ONE ADDERLEY PLAZA

CONSTRUCTING AN URBAN RESPONSIVE SKYSCRAPER IN CAPE TOWN'S CITY BOWL

DESIGN RESEARCH PROJECT (APG 5058S)

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE MASTER OF ARCHITECTURE (PROFESSIONAL)

BY

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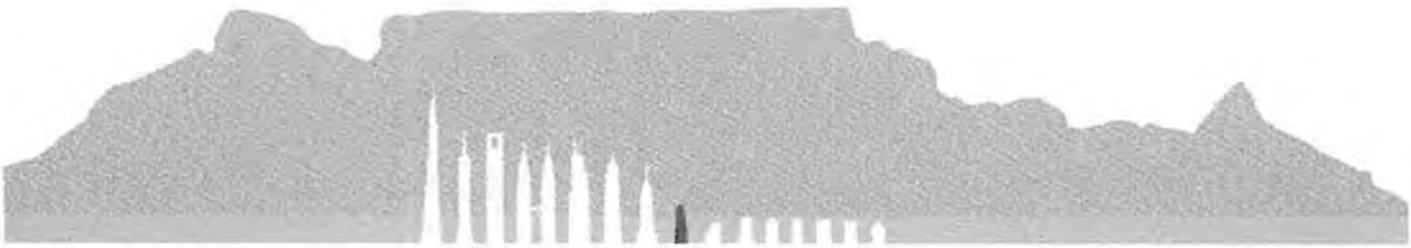
OCTOBER 2012

University of Cape Town



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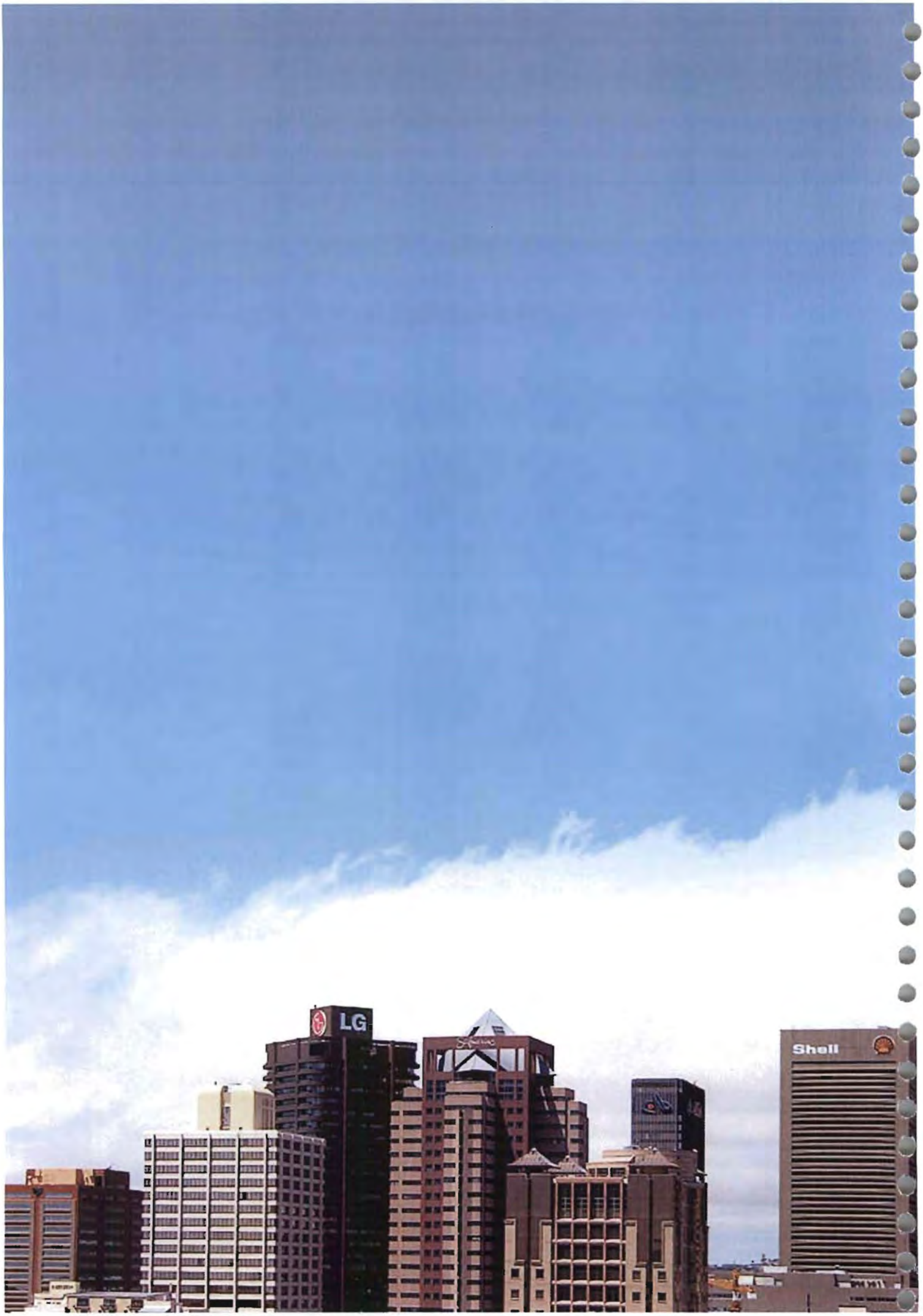
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Preface

The grandiosity of skyscrapers has always captivated me. Their colossal scale and the beauty of their form creates a sense of pride and identity for a city. This passion for high-rises and the belief in their relevance has led me to this undertaking.

Travelling through different parts of the world, one thing keeps me at the edge of my seat; the visit to the high-rise district. The life that well designed skyscrapers create is second to none in the context of a dense city. The activity that takes place at the grounding and the movement through the tower are two things that have always fascinated me, the former being more significant.

Skyscrapers are one of the most debated typologies in history. Till today there are still factions that believe the world should be void of high-rise buildings. However, due to the increase in urban sprawl over the past three decades, I believe that skyscrapers are exactly what most cities need to keep them densified hence fostering sustainable environments. Well-designed skyscrapers that take into account the impact of the form, function and grounding on the urban context tend to give positive responses.

Figure 2

Figure 3

Figure 4

Figure 5

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Introduction

The objective of this M.Arch design project is to design an iconic, yet urban responsive skyscraper in Cape Town's city bowl. 'Urban Responsive Skyscrapers' are high-rise buildings that are governed by the constraints and opportunities offered to them by their urban context. The essence of their being is embedded in the context in which they are designed and they would almost seem out of place anywhere else. Cape Town is one of the most scenic cities in the world with the backdrop of the iconic Table Mountain. A large part of the design consideration was the building's relationship to the mountain, the sea and the existing urban fabric. It also investigates ways in which it could deal with the infamous 'Cape Doctor'; Cape Town's 40km/h South Easterly prevailing winds.

This design project focuses on the significant aspects of skyscraper design; the building morphology, relevant programme, core design and most significantly, the urban grounding and the spaces it creates for the city. This particular building seeks to set a precedent for the future of high-rise urbanity in Cape Town and shed light on the positive aspects of skyscrapers in a city centre. It aims to achieve this by using urban principles and ideals to inform most of the decisions carried out in the entire design process.

This document will be structured with a narrative similar to the design process that was carried out through the course of the year. It will commence with an account of the local urban realities of existing skyscrapers in the city and then outline ways in which skyscrapers could be a positive influence to a city. Through the design process, it will demonstrate strategies and scenarios that create an appropriate setting for an improved urban environment.

> "*Urban responsive* skyscrapers are high-rise buildings that are governed by the constraints and opportunities offered to them by their urban context."

2. Pic taken en-route to the Empire State Building (2010)
3. Pic taken from a highway in Dubai showing the Burj Dubai under construction (2007)
4. Pic take from the entrance plaza of the Petronas Towers (2008)
5. Pic taken from London Bridge showing the Shard under construction (2011)
7. Panoramic pic taken of skyscraper tops with the mountain serving as a backdrop (2012)
8. Promotional photo showing the city bowl with Table Mountain in the background

Background

Skyscrapers in South Africa

The first skyscraper in South Africa was Cape Town's Mutual Heights Building. It was constructed in 1939 and would stand as the tallest building in the country for 25 years. High-Rise development would boom in the 70's and 80's but would come to a halt in the early 90's with only three high-rises built since 1994.

Johannesburg is the most developed with the tallest towers and has the most iconic built skyline; with high-rises like the Ponte City Tower and the Hillbrow Tower creating a dynamic silhouette. Cape Town however, is dominated by Table Mountain which is prominent in the skyline and is an iconic symbol for the city. Cape Town's towers sit on the edge of the city, in the 'bowl' between the mountain and the sea.

Skyscrapers throughout the country serve as iconic objects as opposed to sensitive urban hubs. In Cape Town, very few high-rise buildings create spaces to enhance urban life, however, the Portside Building which is currently under construction promises to display a degree of urban responsibility.

Figure 10

Figure 11

Figure 12

9. Carlton Centre, Johannesburg, designed by SOM in 1973
10. Mutual Heights, Cape Town, designed in 1939
11. Portside Tower in Cape Town, by dtrk, to be completed in 2014
12. Alice Lane Towers designed by Paragon

The Urban Significance of Skyscrapers

The high-rise typology is becoming more prevalent in modern day cities and a new urban model seems to be taking shape; one that expresses an urban sensibility of tall buildings and forges relationships between towers and urbanism. Contrary to common belief, high-rise buildings play a very significant role in the urban environment. Its spire adds to the city skyline, its base can act as a major urban node and social condenser and its height and form create a landmark in the city. A skyscraper has the ability to capture the public's imagination. Dr Mir Ali argues that "skyscrapers impact the balance of an urban environment and represent one of the most important public mediums drawing public attention and epitomizing the citizens' pride in their cities". (Ali, 2005)

In my view, high-rises can be places of immense urban life. They can activate certain areas of the city for 24hrs through the addition of different programmes and the strategic spatial articulation of urban functions. This project aims to demonstrate how public spaces at the grounding thresholds of high-rise buildings can engage their environment and create spaces of immense public activity. These spaces should not simply be demarcated commercial areas, but rather, connected urban networks that inject public programmes into building functions and link them to the urban life of the city.

Figure 13

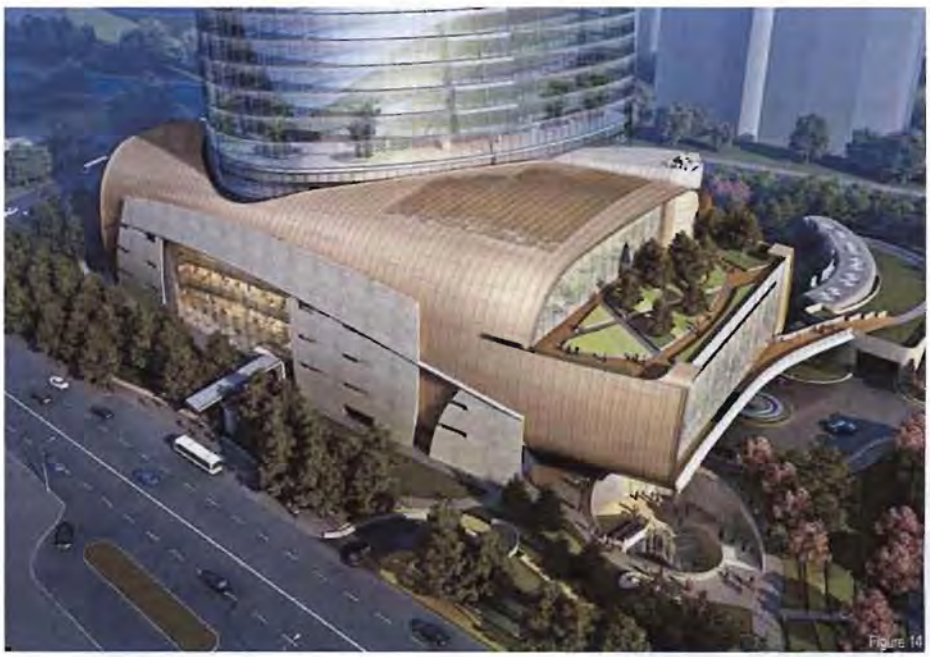
Figure 14

13. High-rises provide strong visual links to major landmarks in the city as seen from the Bank of America tower.
14. Shanghai Tower incorporates a interactive public filled base with a city park.

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High-Rise Urbanity

Urban Impacts of Skyscrapers

The impact of skyscrapers on an urban environment is multi-faceted. There are four main urban impacts that can be instantly identified in an urban context. These are; the building function and how its influences the activities in the area. The form the build takes and the image it gives the skyline. The way a building touches the sky and how it grounds and creates urban spaces at street level. These would be briefly outlined in this section.

For an urban environment to be sustainable it needs to be activated for most of the day and it needs people to live and work at close proximities. In Cape Town, the majority of workers commute from suburbs into the city and back out at the end of the day. New skyscrapers in the city need to have a residential component to allow the building to stay activated 24hrs a day. Most of the high-rise buildings in the city are a single-functioned and this does not allow for city activation after hours. The Shard London Bridge is a quintessential example; comprising of office spaces, a hotel, apartments, restaurants, conference rooms, exhibition spaces, viewing decks, retail spaces and a station concourse. Buildings of this nature promise to be incredibly dynamic, introducing a very diverse culture to the area and promoting wider infrastructural development.

> "New high-rises in the city need to have a significant residential component that allow the city to stay activated for 24hrs"

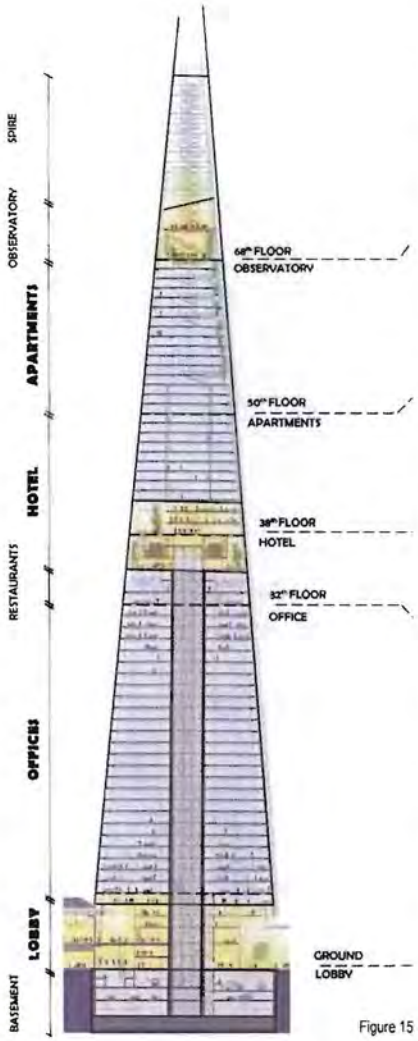
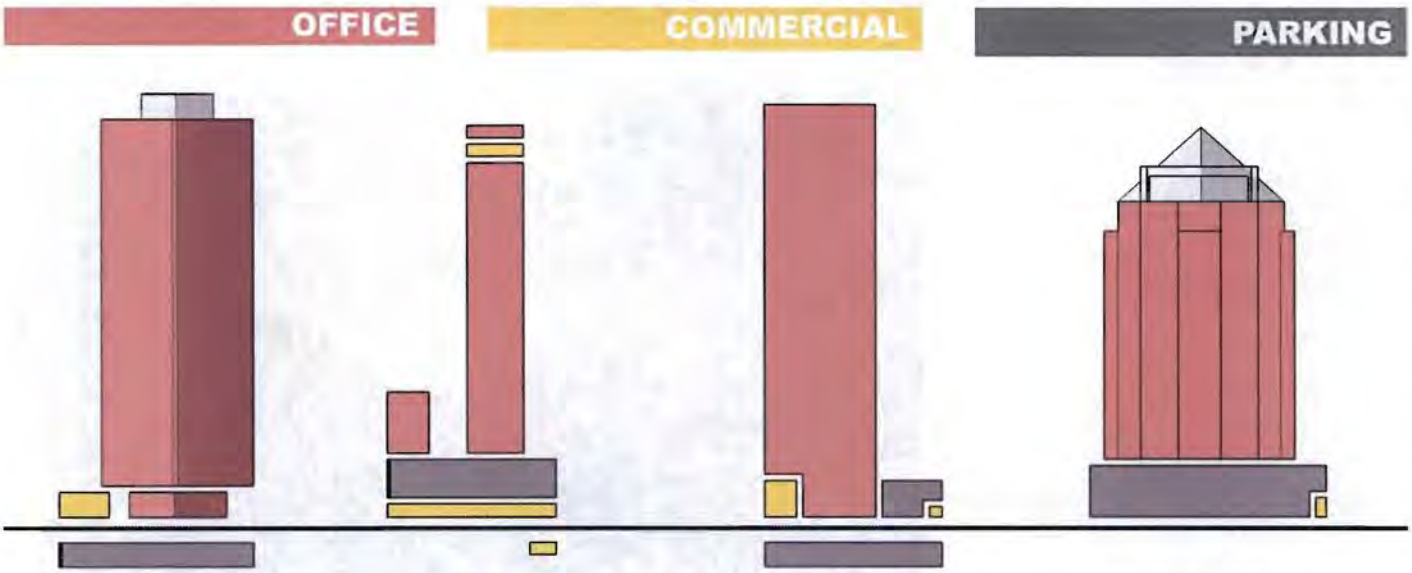


Figure 15



1 Thibault Square
Full office building
Comercial banks and other minor functions in adjacent block

ABSA Centre
Full office building
Commercial ground floor
Three level parking above
31st floor night club

Atterbury House
Full office building
Parking at rear of building
Commercial strip along perimeter

Triangle House
Full office building
Three level parking base
Minimal public space in the building

Figure 16

'Imageability' is the extent in which a building contributes to the general impression a city, district or neighbourhood. They often serve as landmarks and reference points to a city. (Ali, 2005) Skyscrapers need to be captivating and inspiring. Their forms should come from the feeling of the place and they should in turn give off a feeling of the place to the world.

Responsible skyscrapers articulate their form in respect to their urban context and this helps to improve or preserve certain aspects about their environment. An interesting case of this is the Leadenhall Tower in London which tapers inwards to preserve the views of St. Paul's Cathedral from the City of London business district. Recently skyscrapers are being morphed by the wind action around them. These new forms have proved to be sustainable and create new opportunities for energy efficient buildings.

15. The Shard London Bridge - Mixed use high-rise with three anchor functions and public functions at different heights through the tower
16. Study of high-rise functions in Cape Town
17. Jin Mao tower in Shanghai is a symbol of the city embodying vernacular metaphors in its expression
18. The Leadenhall building in London preserves historical vistas
19. The New York skyline is synonymous with large city. The city is immediately recognized due to its iconic skyscrapers

The Grounding Threshold

This section is concerned with the immediate urban realm and the impact high-rise buildings have on them. The most significant aspect is how the building meets the ground, the spaces it creates and the opportunities it provides for people in the area. Most skyscrapers of the past were created simply as monuments that were disconnected from their immediate contexts, creating hostile streetscapes all across the city. Today it is very important to draw a strong connection from the ground right into the tower making this threshold is the most important space in the building.

Figure 20

Figure 21

Tall buildings have the opportunity to create social spaces at their bases; such spaces can act as hubs for human interaction and create urban nodes in the city. The Atterbury House and 1 Thibault Square both in Cape Town are the only buildings that create an urban plaza and give their ground floors back to the public to a certain degree. The Golden Acre Tower creates a major public concourse at its base, however the base and the tower seems disconnected. The Golden Acre Building and the Atterbury House have the right attitude towards the grounding of a tower. The former, however seems to have a much more activated environment, this might be due to the programme of the concourse.

Figure 23

"Towers should ground in imaginative ways, with ground levels that cater to public activities and not private parking."

High-rises in Cape Town should be more ambitious with their grounding articulation and find ways to harness the everyday activities of the area it locates itself in. Retail seems to be the most sustainable function of tower bases as it keeps them buzzing with life most of the day. In a context like Cape Town, ideas of combining formal and informal retail would be interesting. New ideas of high-rises catering to informal traders would strike a good balance and create an interesting relationship between the executive businessman working in the building and the informal trader at the ground level.

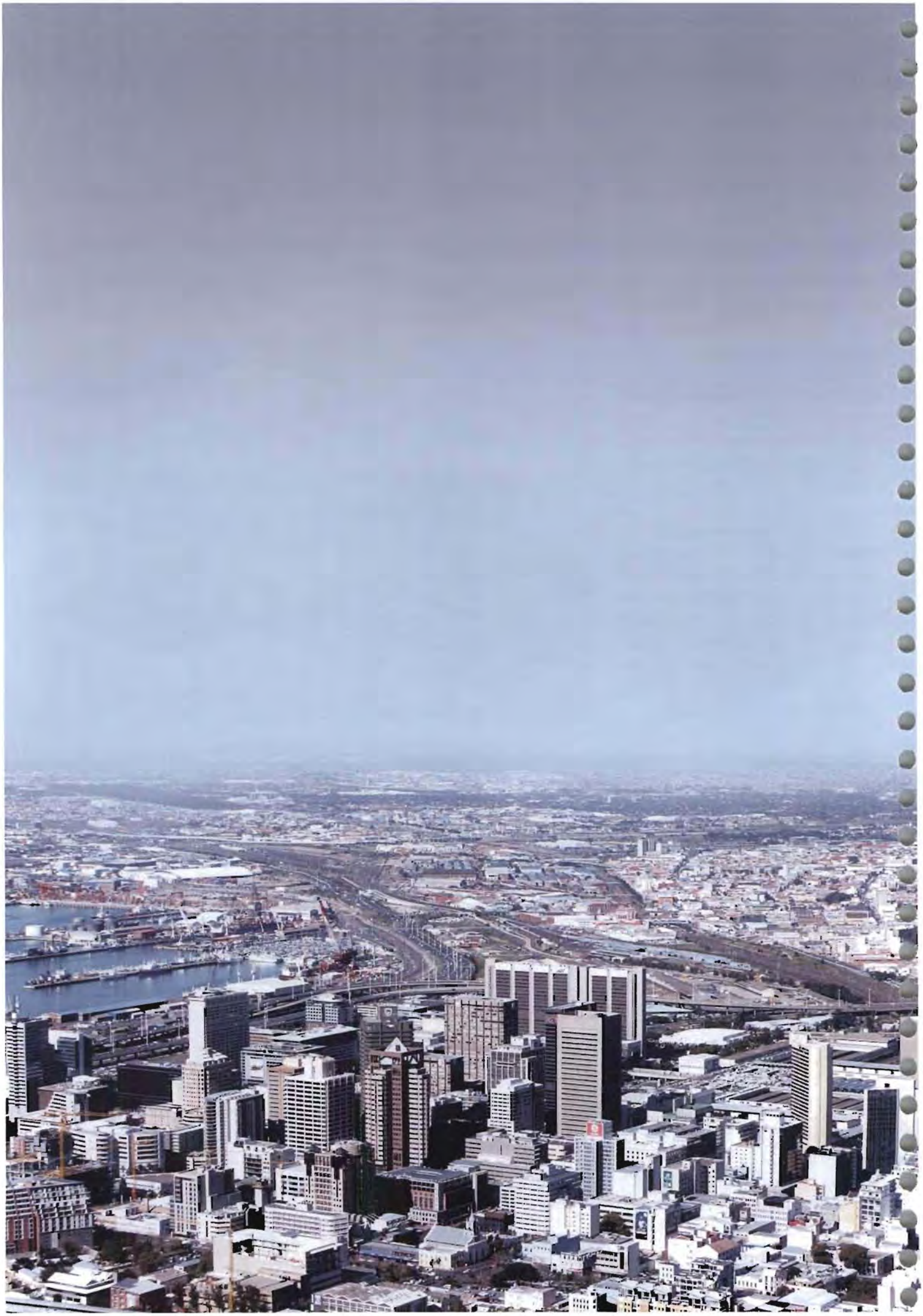
With Cape Town's proposed strategies of sinking the railway lines, an interesting design response would be to incorporate the station concourse into the ground lobbies of high-rise buildings. This is the case in Hong Kong's ICC which incorporates Kowloon Station concourse into its main lobby. This new paradigm is known as a Transit-Integrated High-Rise. (Malott, 2010)

Figure 24

In Cape Town the grounding of high-rise buildings is done very poorly, the constraints of things like parking are given priority over the well-being of the occupants. Most of the high-rises are sitting on reclaimed land and this makes the construction very expensive, hence most of the ground space is taken up by parking, leaving little foyer spaces for people to access the building.

One has to be very strategic with the use of the site and the positioning of parking. Towers should ground in imaginative ways, with ground levels that cater to public activities and not private parking. They should be multi-leveled dynamic spaces that allow for a vast array of different activites. A good example of this the forecourt of the Swiss Re Building in London which transforms into a mini-piazza everyday to facilitate the midday lunch break.

20 The John Hancock Building's retail amphitheatre creates a significant urban pause point in the city
21. Bank of America's urban garden is a public node that creates a space that gives back to the city
22. Golden Acre and its base used as a retail arcade. The arcade is a major urban node in Cape Town
23 The Atterbury House provides a forecourt on its northern end on Riebeek Street
24. The Hong Kong ICC, one of the pioneers of the 'Transit Integrated Towers'. Its base act as one of the Kowloon Station concourses
25. The Marina Bay Sands Towers in Singapore creates a massive entrance foyer that is open to the public
26 30 St Mary Axe Tower's entrance forecourt transforms into a classic style piazza to cater for lunch daily



Urban Reality of High-Rises in Cape Town

27 View of Cape Town's city bowl from Signal Hill
28 Aerial view of the city centre showing the four analysed buildings and urban networks
29 ABSA Centre (tower-base)
30 Allerbury House (tower-plaza)
31 1 Thibault Square (tower-plaza)
32 Triangle House (tower-base)

Cape Town currently has nine high-rise buildings; all built at different times and with different design philosophies. The main concern of this chapter is analysing the nature in which these tall buildings hit the ground and the spaces they create around their bases. My point of view is that the enthusiasm for high-rise development is very low because the current high-rises do not give much back the city and are very inaccessible. The analysis of four buildings in Cape Town will assist in understanding the reality of the urban grounding trends in the city.

The four buildings being analysed are all somewhat connected to an urban network in the centre of the city bowl.

This network consists of pedestrian links such as St. George's Mall and Waterkant Street. It is intersected by Riebeek Street which is a pseudo high-rise axis in the city; in that, most of the major high-rises in the city have a direct connection to it. This creates an interesting spatial connection which should be expanded and linked with any new major high-rise building in the city.

Three major squares are linked to this network, these are;

Thibault Square at the heart of the network, Station Square across Adderley Street and Green Market Square further south. The four towers all have distinct appearances and special urban qualities. This section will take a critical look at the urban nature of all four towers; the spaces they create to enhance urban life and their key urban components.

ABSA Centre
Height: 120m | Floors: 34 | Built: 1970 | Function: Office

The ABSA Centre is bounded by St. George's Mall to its north, Adderley Street to the south and Riebeek Street on its western façade; making it a prime location in the city.

The tower shaft is offset from the base of the building and rises to a height of approximately 120m. The exterior of the building is blank as most of it has been boarded up with signage.

The building borrows its design ideas from the Seagram Building (appearance) and the Lever House (grounding) both on Park Avenue in New York City. However, it doesn't live up to either one; the Seagram Building sets itself back and creates a large open plaza and the Lever House creates a massive base that surrounds a public art courtyard. The ABSA centre; draped in the 'Seagram' skin, creates a 'Lever House' base but fills it with parking spaces. In doing so, it achieves a hybrid appearance of both but the urban qualities of neither.

The base, which covers the full extent of the site, is a large three storey parking garage which provides no connection between the ground and the tower and almost goes as far as disconnecting the two completely

Figure 33

Figure 34

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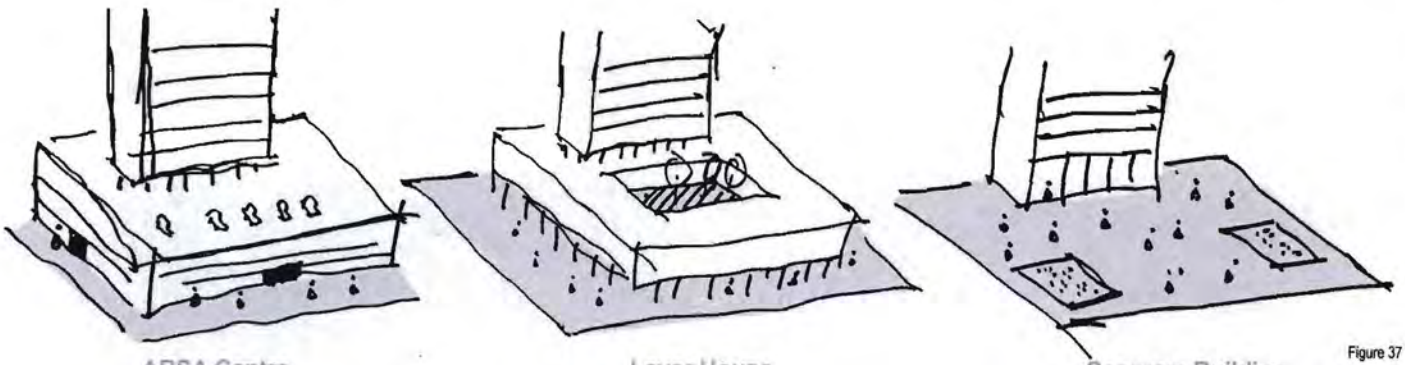

ABSA Centre
Base is used for parking
No connection between ground and tower
Limited street interaction; blank facades with point entrances and narrow sidewalks

Lever House
Base used as public art gallery
Elevated over open walkways and surrounds public art plaza that serves as a major urban node
Building opens up to plaza

Seagram Building
Large open public plaza leading to entrance lobby
Building spills out onto plaza connecting the occupants with pedestrians
Facilitates city gatherings and public events

Figure 37

The Retail Arcade

The tower functions as an office with a few retail spaces at the bottom and a night club on the 31st floor, allowing the public to travel up through the tower to a pseudo public place that is famously one of the most breath-taking spaces in the city. However, it is the articulation of the retail spaces on the ground floor that is the key urban component of the tower.

The retail arcade cuts through the north end of the tower and connects people directly from Adderley Street to Thibault Square. It cuts right past the building's core making pedestrians feel like they get right into the heart of the building and out again into another world.

The ABSA Centre arcade single-handedly keeps the building relevant and a part of the urban life in the city. This however is a minimal attempt to inject urban character into the building. It also has the opportunity to do more with its ground level. It was conceived with a similar idea to the Lever House; to keep the ground floor open, so it should open up its corner faces and relate directly to the street.

The parking lot was badly positioned which creates a one dimensional space and prevents the building from adapting to the changing urban environment. The St. George's street façade has potential to be a vibrant node if the building opens up to it.

Figure 41

33. The Lever House (SOM)
34. Seagram Building (Mies van der Rohe)
35. The Lever House's free ground floor is open for public access
36. ABSA Centre's base occupied by a commercial bank
37. Comparative analysis of grounding strategies
38. Arcade interior
39. Arcade interior
40. ABSA Centre
41. Analytic 3D study of building programme

Atterbury House (FNB)
Height: 130m | Floors: 28 | Built: 1976 | Function: Office

Situated on the corner of Riebeek Street and Lower Burg Street, It is bounded by buildings on the south end and opens to the street on the north.

Atterbury House sets itself back from its two street edges in an attempt to create pedestrian friendly walkways.

It places its parking lot at the rear (south) end of the site and allows the shaft to hit the ground on the north end. The building is surrounded by pedestrian activity on three sides. Lower Burg to the west, Waterkant to the south and St. Georges to the east. This creates a lively environment all around the tower. It plays a big role in this by setting itself back to create a forecourt to its north end. This end of the building houses a restaurant which spills onto the forecourt.

The south end of the building is dominated by the parking lot, but it cleverly slots in retails shops on the ground level that feed into the Waterkant Street network. This axis is full of informal traders in the middle and fast food restaurants on the building edges; forging a dialogue that stays active for most of the day.

The traffic flows freely around this building and although the main building interior is inaccessible to the public, the forecourts make interacting with the building free and welcoming.

Figure 42

Figure 43

Figure 44

The Urban Forecourt

The main forecourt of the tower is on the north end, adjacent to Riebeek Street. It opens up a mini plaza which served as an outdoor eatery for a major restaurant in the city.

The forecourt changes character at different times of the day creating a vibrant setting which can also be used for performances and other city exhibitions. It is a flexible space that brings life to the building allowing pedestrians to come right up to it, giving one a sense of its scale and size. The forecourt works well in the urban network but its interior counterpart is rather disconnected from the building and could have been more linked to the main lobby. The surrounding retail is a good response to the pedestrian axes but also seem like a neighbouring building to the tower.

Like the ABSA Centre, this buildings grounding threshold is one dimensional; in that, there was opportunity for dynamic volumes, yet the buildings simply gives off a side room to some form of commercial activity, which is rather disappointing. The urban response to the pedestrian network on the south end of the building however, is commendable.

Figure 45

Figure 46

42. The building's monolithic shaft stand out amidst the city's buildings
43. The ground level supports the public transport system in the inner city
44. Public activity on Lower Burg street
45. Large planters situated all around the building
46. Diagrammatic 3D analyse
47. Sketch plan of the ground level spaces
48. The restaurant utilizing the forecourt on the north end of the building

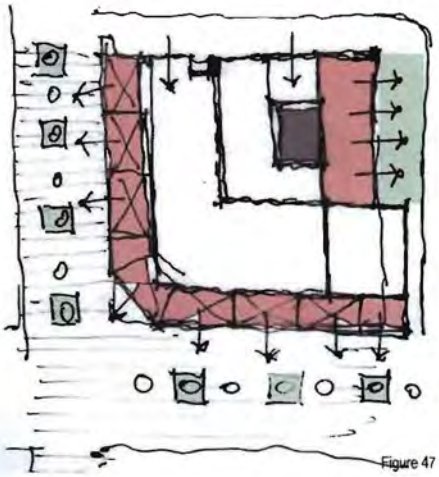
Figure 47

1 Thibault Square (Standard Bank)
Height: 135m | Floors: 32 | Built: 1972 | Function: Office

The Standard Bank building is situated at the corner of Long Street and Hans Strijdom Avenue and opens up to Thibault square on its south-east façade. The building sits off the city grid to orientate its self to the north. In doing so it creates dynamic pocket spaces around it.

The building's mass is elevated and sits on a glazed transparent base. The glazed entrance is set back allowing for movement all across and around the building's ground level.

The façade also allows for a visual connection; which acts as surveillance for the surrounding environment and allows for views right into the core of the building. There is no retail component at the base; it acts simply as an entrance lobby to the office spaces above. However there is an adjacent wing that houses some commercial functions and parking.

A bridge connects the adjacent block to the main tower. The recessed base allows people to take shelter under its elevated mass and walk right up to the glass; feeling safe, welcome and connected to the building occupants.

The urban character of the building has been well thought about. Taking advantage of the uneven terrain, the building appears raised; this podium acts as a threshold interface. There are a series of little green public pocket spaces on the north side and an open plaza on the south side which is one of the main components of the pedestrian network that runs through the city.

Due to the building's 45 degree orientation, all side are equally important; capturing the best north light and streamlines south-easterly winds most efficiently.
The connection with the plaza creates opportunity for informal trade and other local urban activities. There is a feeling of approachability that draws a lot of people towards the building daily while some enter for business and others lounge on its plaza.

Figure 49

Figure 50

Figure 51

The City Square

Thibault square functions as a city square, but also acts as a plaza for the Standard Bank Building. It serves as the metaphoric public component of the tower. During lunch breaks and rush hours, the plaza is one of the busiest places in the city. The tower speaks directly to the plaza and acts as the destination for all that use it, while providing the human activity that gives life to it. In this way it functions for the plaza and the plaza functions for it. The existence of the plaza allows the building to have a very minimalist ground floor lobby.

The main access into the building is on the south end facing directly into the plaza. This grounding strategy works much better than the tower-base grounding strategy as it affords an opportunity to reconnect with the urban life in the city. It places a major parking garage below the plaza allowing pedestrians to dominate the urban environment.

The building would have been even more successful if it created some way of linking a public function into the interior of its base; perhaps a mezzanine level containing a café, overlooking the plaza. This building's grounding strategy evokes happy thoughts in anyone that passes it and lures people towards it every day. If the Atterbury House displays 'urban responsibility' then this building displays 'urban consideration'.

Figure 52

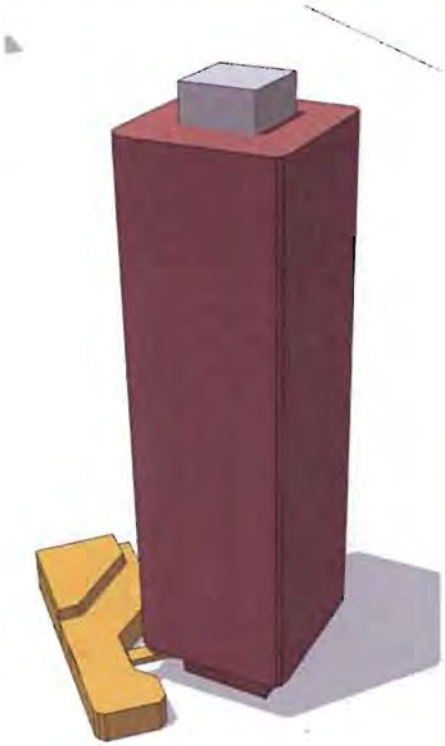
Figure 54

Figure 55

49. The building's exterior skin
50. Thibault Square
51. Interior lobby of the building
52. Steps toward the main lobby
53. The plaza is a main urban anchor in the city
54. Diagrammatic analysis
55. The main entrance area

Triangle House
Height: 115m | Floors: 26 | Built: 1993 | Function: Office

Located on the corner of Riebeek Street and Loop Street, it covers a full city block with its main entrance of the south façade.

The building takes on a variegated look in true post-modernist fashion, crowned by a pyramid and decadently clad in different coloured granite stones. The base has a three level parking garage with a grand entrance on the south end facing Riebeek Street. The Triangle House does not provide much to its urban surrounding and its priority lies in its appearance over its environment.

The building creates three dead faces all around it, with only the entrance façade interacting with the street. However this façade is dominated by a grand stairway at the entrance; which might have been conceived as a public node, but seems to give off an air of robust monumentality. This feels a bit intimidating. On approaching the building, one gets a feeling of intrusion and trespassing as there is no function in the vicinity that caters to anyone besides the tower occupants.

This is one of the arguments made against the postmodern high-rise typology, which believed in the tower-base strategy. However, this particular base has a feature that can be perceived as a last minute plug-on addition to fulfil some type of urban requirement. This feature is possibly the only urban gesture the building expresses; the colonnade.

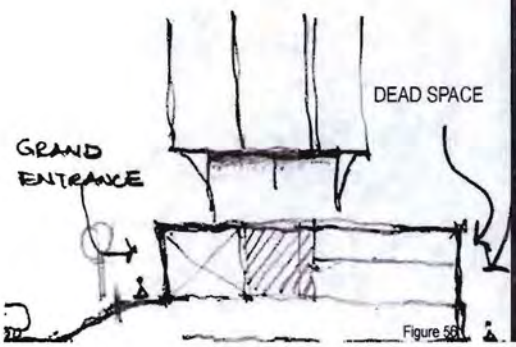

Figure 56

Figure 57

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The Grand Colonnade

The building creates a colonnaded walkway in an attempt to protect pedestrians from harsh weather conditions. This feature is interesting as it creates beautiful filtered light. However, due to the blank wall on the side, it merely serves a covered city sidewalk, which creates no real threshold between the inside and outside of the tower.

People tend to walk on the narrow outside lane because of its neutral atmosphere.
The north facing wall is totally blank and has created a dead alleyway in the city. Sadly, this building is the most recent high-rise building in the city and it displays the least urban responsibility supporting my argument against tower-base buildings. This is a good example of what new high-rise buildings should stay away from.

Figure 59

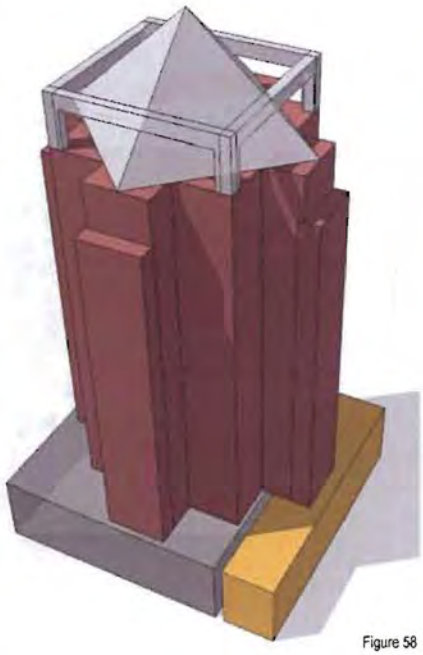


Figure 58

56. Sketch of urban situation showing dead space created on the north facade
57. View of the Triangle House with signal hill in the background.
58. Diagrammatic 3D
59. The colonnaded side walks around the building
60. The main monumental entrance foyer is robust and intimidating

Synopsis

New high-rises in Cape Town should be urban-conscious and accessible. The ground floor spaces in existing high-rise buildings make a dismal attempt to create public spaces. They create grand office lobbies that remain dead for most of the day, while demarcating little side rooms for retail functions. I believe in the opposite; whereby the building's ground level is totally dedicated to public activities with a small private entrance for people simply travelling up the tower.

The ground floor level should be celebrated and should be spread over many levels and not be one dimensional like many of the buildings in the city. This will create a dynamic ground lobby full of cascading floors with immaculate views of its surrounding environment. The buildings should make an effort to allow the public to move through it; either strengthening desire lines or creating new urban connections.

In my opinion, the tower-plaza is a more successful strategy and will be much more conducive in Cape Town. High-rises should spill out of their towers and into spaces that are directly related to the urban context and not contained in a private zones away from it.

Figure 61

Figure 62

Figure 63

61. Heron Tower, transparency into retail concourse
62. Lever House, public art courtyard
63. Hakoo Tower, dynamic entrance foyer
64. Three First National Plaza, multi-levelled entrance that opens up to forecourt
65. Leadenhall tower, public plaza below building

Figure 64

An imaginative version of the ABSA Centre arcade has the potential to be a significant urban node that blurs the line between interior and exterior spaces in and around the tower. This being said, retail should not be the only space created; cultural exhibition spaces dedicated to local arts and crafts are major attractions for a tourist city like Cape Town. Examples like the Lever House's 'public art courtyard' can inspire such spaces.

Finally, tower-plaza interactions are pivotal to the urban life of any context. The activation of plazas are a source of life for any city in the world and this ideal should be upheld by high-rises which are high dense building typologies that have the ability to spill out and fill up public spaces instantly.

Figure 65

"Grounding thresholds in Cape Town should be a series of dynamic floors that contain a variety of public functions and make strong connections to exterior public spaces, creating major urban nodes that activate the city"

N

Setting an Urban Precedent

Adderley Urban Strategy

The selection of Adderley has historical significance; as Adderley was the first main street in Cape Town. It still has pieces of the historical fabric intact which gives an opportunity for a connection between the old and the new.

Figure 66

Stitching Land and Sea

The main urban strategy is this idea of a link between the mountain and the sea. From Company Gardens, down the spine of Adderley to a new dockland precinct that takes on a similar mixed-use character, edged by a promenade. This link would have several pause points along it such as parks and plazas.

Figure 67

Distinct Urban Districts

This axis will facilitate the creation of districts around the city centre which would group similar activities in an area and place them all at a close proximity to each other. This would create a sustainable urban environment where people can live and work within walking distance, reducing the issue of congestion due to vehicular travel and parking inside the city centre.

Figure 68

Reconnecting the City

The proposed urban axis would act as a line of symmetry that would incentivize the mirroring of the city grid from the west side of the city onto the east side. This would stretch all the way to the Culemborg precinct, reconnecting the city centre with surrounding suburbs and allowing it to expand toward the rest of the inland urban fabric.

Mixed-use High-Rise Corridor

The Adderley urban axis will be edged by high-rise buildings, creating a corridor in the inner city that is full of life and energy. The result is a series of high-rises that all spill out into the urban network, allowing for an uninterrupted urban connection. The notion of public spaces will be redefined as the grounding thresholds of high-rise towers would act as social condensers in the city.

Figure 70

Figure 71

University of Cape

Precinct Studies & Analyses

The first step taken in choosing a site was understanding the immediate context. The entire Adderley strip was mapped and analysed in order to understand certain characteristics it possessed. The most significant was the location of public spaces and nodes along the strip. An interesting find, was the large number of parking bays provided in the area. This finding would support decision to provide minimal parking and promote sustainable utilization of public transport.

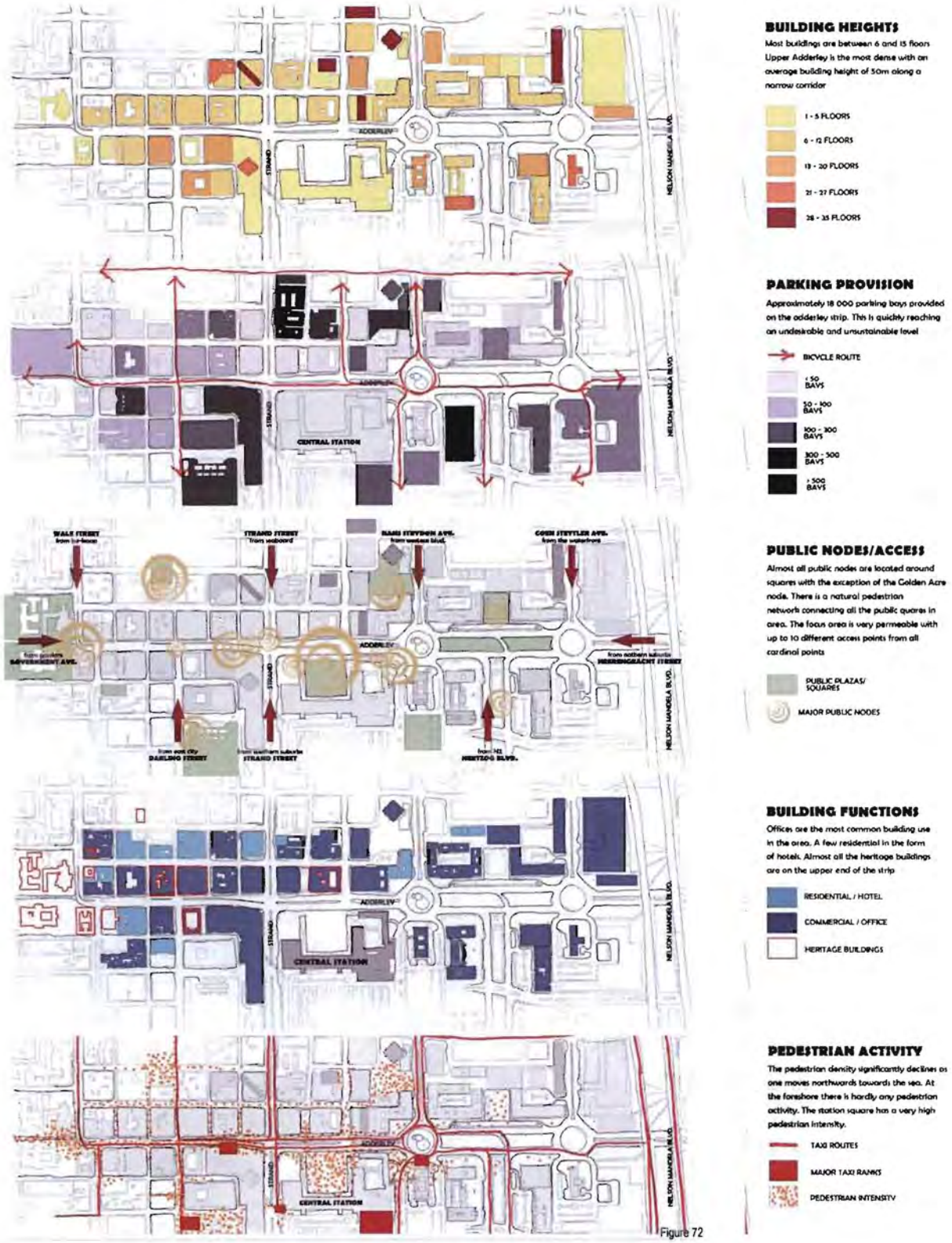


Figure 72

Historical Time Line Study

Before exploring directions for the city's future it was pivotal that there was an understanding the city's past. This is an analytical historical study of the city high-rise growth from 1960 till today and beyond.

This exercise uncovered certain things about the city. In some way it allows the city to speak for itself and say where it wants to go. The analysis shows the city grows gradually from its edges and peaks around Riebeek street which is where the city currently experiences a pseudo high-rise district. This area also contains many of the city's main pedestrian thoroughfares.

This study was satisfying as it displays a correlation between high-rise development and dense urban activity. An intuitive extrapolation was done to show the what a possible future skyline might look like.

Figure 73

Figure 74

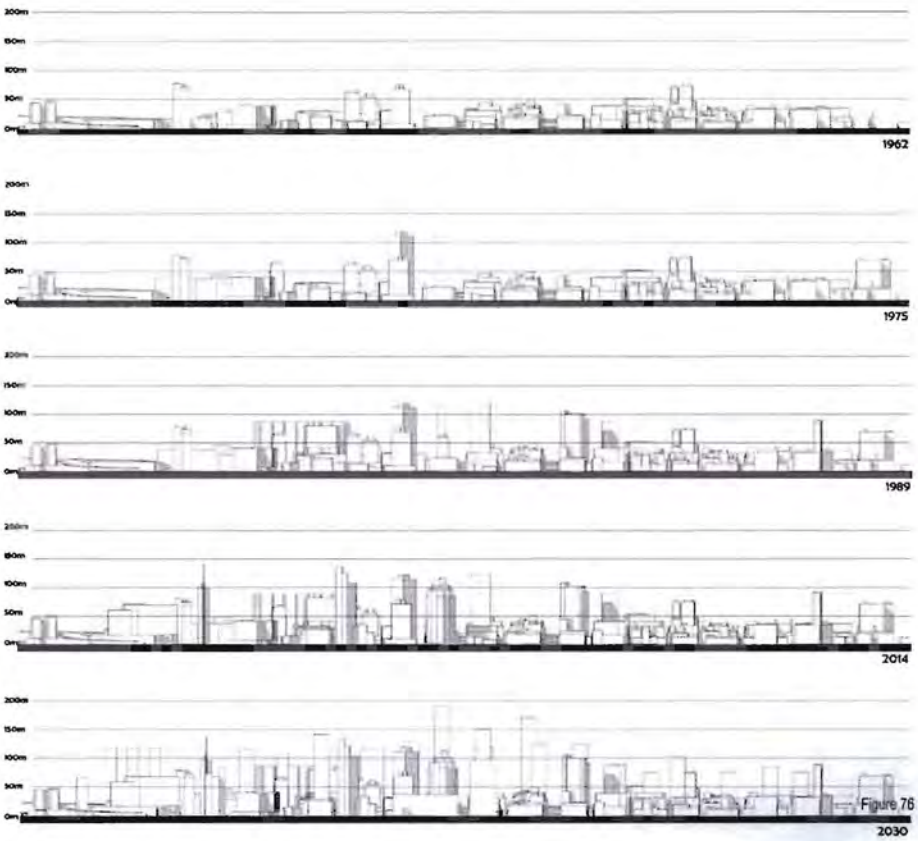


Figure 76

A study of a three major coastal cities in the world and how they compare with the two major coastal cities in South Africa. Of all the cities Cape Town has the lowest number of high-rises and hence the lowest city density. Durban boast a much more impressive built skyline while Cape Town relies on the Mountain as a natural skyline

No. of Skyscrapers*	1226
Average Height*	275m
Tallest Skyscraper	484m (ICC)
First Skyscraper*	1966 (Kiu Kwan Mansion)
Lastest Skyscraper	2012 (Azura)
City Area	1105km²
City Population	7, 200, 000
Density	6480/km²
Tallest (country)	497m (Shanghai)

No. of Skyscrapers*	567
Average Height*	268m
Tallest Skyscraper	541m (Freedom Tower)
First Skyscraper*	1902 (Flatiron Building)
Lastest Skyscraper	2012 (Freedom Tower)
City Area	1220km²
City Population	8, 500, 000
Density	10, 430/km²
Tallest (country)	541m (New York)

No. of Skyscrapers*	101
Average Height*	170m
Tallest Skyscraper	243m (Citigroup Centre)
First Skyscraper*	1968 (CRA Building)
Lastest Skyscraper	2011 (1 Bligh Street)
City Area	1300km²
City Population	4, 000, 000
Density	3058/km²
Tallest (country)	343m (Gold Coast)

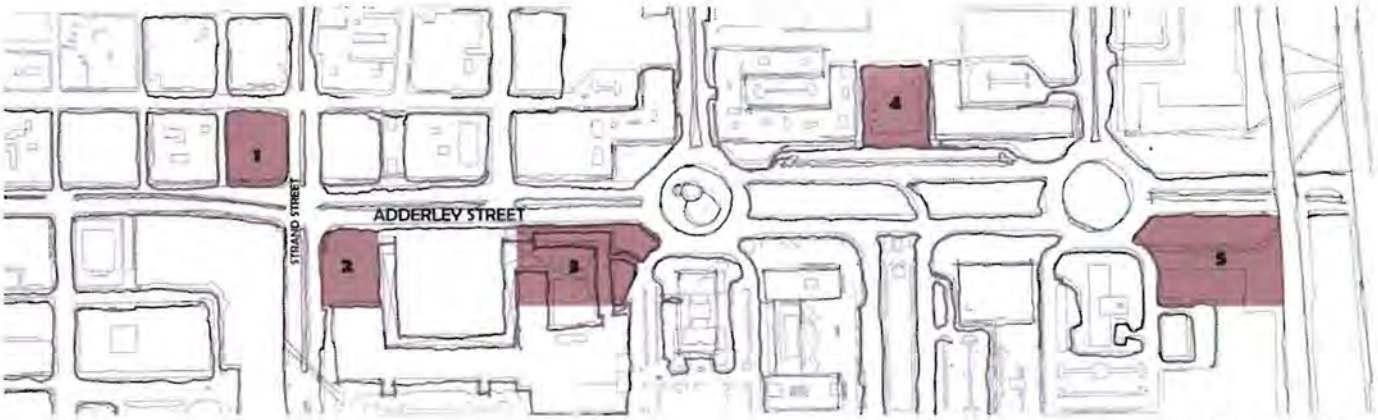
No. of Skyscrapers*	23
Average Height*	122m
Tallest Skyscraper	155m (Pearl Dawn)
First Skyscraper*	1973 (Transnet Tower)
Lastest Skyscraper	2010 (Pearl Dawn)
City Area	228.5km²
City Population	540, 600
Density	2500/km²
Tallest (country)	225m (Johannesburg)

No. of Skyscrapers*	8
Average Height*	104m
Tallest Skyscraper	148m (MetLife Building)
First Skyscraper*	1970 (ABSA Building)
Lastest Skyscraper	1993 (Triangle House)
City Area	496.7km²
City Population	870, 000
Density	1700/km²
Tallest (country)	225m (Johannesburg)

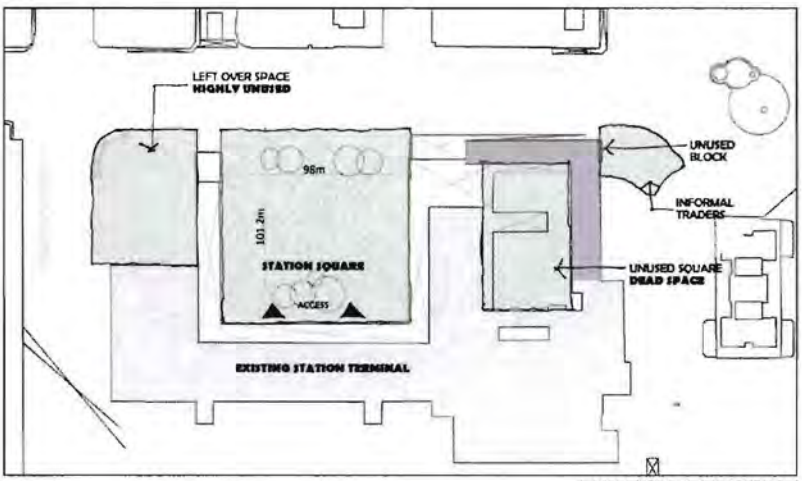
Figure 77

Site & Urban Scenarios

Five sites were selected based on the their proximity to certain amenities in the city. Of these sites ;option 3 was selected based on its relationship with Cape Town's Central Station. The site was then examined and appropriated for a this type of development. The initiative was to develop a high-rise typology that would integrate aspects of itself to a major transport hub.



POTENIAL SITES

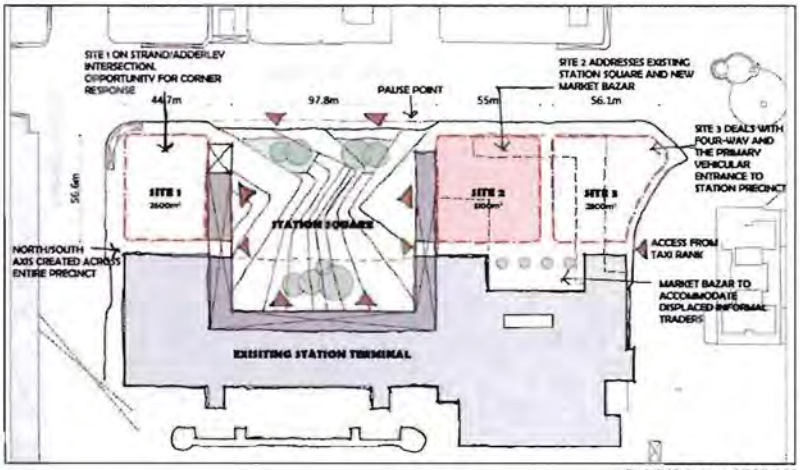


EXISTING PRECINCT

The existing station square sits in the centre of a precinct that unimaginatively positioned. Most of the spaces around the original scheme were left unattended and unoccuppied.
The main square is the greeting point for most of the city's commuters to the city.

The secondary semi-enclosed square is dead space and is beeing used to park idle taxis.

The informal traders that used to give life to the site have been displaced and pushed to the corner of the precinct



NEW PRECINCT

The first intervention is the removal of the L-shaped wing that encloses the secondary square. All the towers at the boundary of the square would be directly oriented towards the square.

The creation of a market bazar caters to the displaced informal traders and allows them to have a setting within an urban scheme.

The adderley street edge was pushed in allowing for a pause point at the mouth of the square

Figure 78

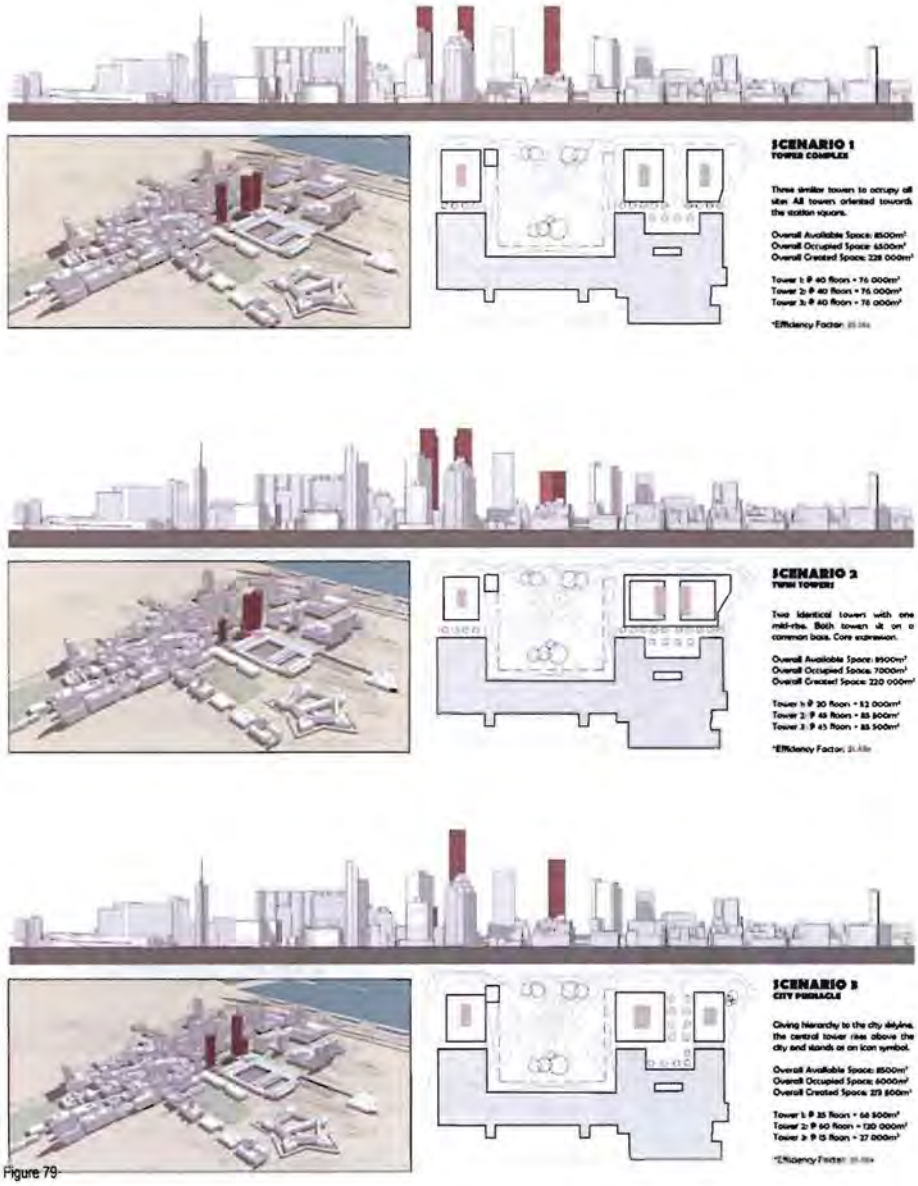


Figure 79

Urban Scenario (left)

In a search for the appropriate high-rise intervention a few urban scenarios were explored. The three scenarios took into account bulk factor and gross floor area that could be achieved in an attempt to create the largest amount of space on the site. The third option was favourable. It strategically made provision for the chance of an iconic architectural addition to the city skyline.

Scale Register (right)

To understand the magnitude of the site, a scale test was done using six recently built skyscrapers. The respective buildings were drawn up to scale and put on the site to see how they would fit. Most of the building go beyond the constraints of the site. This would immediately mean that the building would have a slender shaft; narrower than the shafts of the studied buildings.

Local Authority

Dealing with areas in the city, considerations were made for regulations like setbacks and departures. These considerations were taken up with the Cape Town City Council.

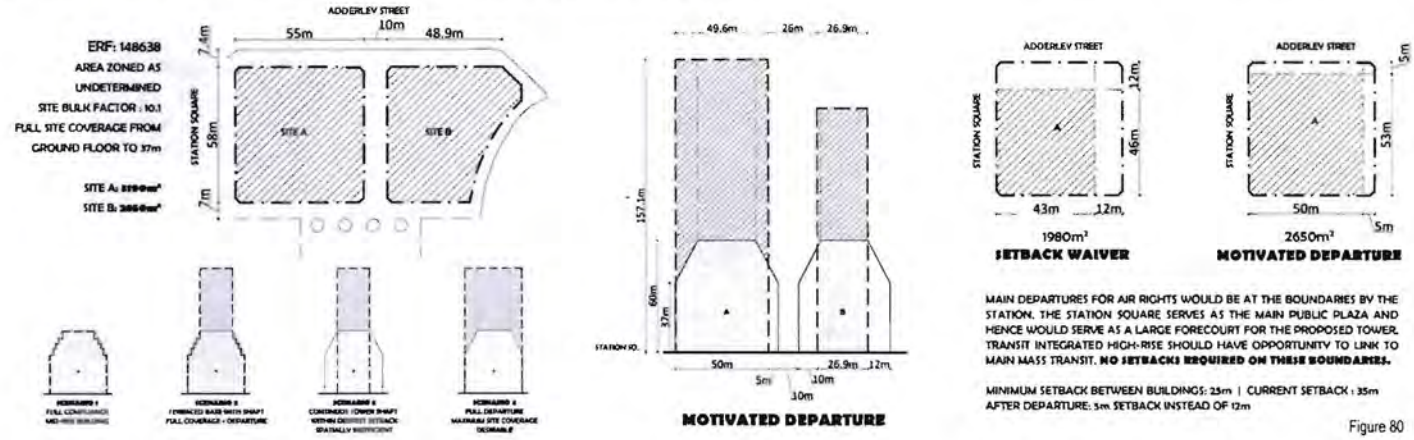


Figure 80

SCALE TEST	ANALYSIS	TYPICAL FLOOR PLAN	SECTION	
LEADENHALL TOWER 45.7m, 11.2m, 56.1m	**RICHARD ROGERS** GROSS FLOOR AREA: 3240m² NET FLOOR AREA: 2520m² FLOOR AREA RATIO: 78% FLOOR COUNT: 48 BUILDING HEIGHT: 225m AVE. FLOOR DEPTH: 40m REF. FLOOR PLAN: 22 FUNCTION: OFFICE			
FREEDOM TOWER (1 WTC) 55.5m, 55.3m, 10.6m, 34.2m	**SOM** GROSS FLOOR AREA: 2840m² NET FLOOR AREA: 1780m² FLOOR AREA RATIO: 65% FLOOR COUNT: 104 BUILDING HEIGHT: 541m AVE. FLOOR DEPTH: 11m REF. FLOOR PLAN: 32 FUNCTION: OFFICE			
NEW YORK TIMES 28.6m, 15.1m, 47.9m, 59.3m	**RENZO PIANO B.W** GROSS FLOOR AREA: 2650m² NET FLOOR AREA: 2012m² FLOOR AREA RATIO: 75% FLOOR COUNT: 52 BUILDING HEIGHT: 319m AVE. FLOOR DEPTH: 12m REF. FLOOR PLAN: 25 FUNCTION: OFFICE			
30 ST. MARY AXE 29.3m, 63.7m, 17.3m	**FOSTER & PARTNERS** GROSS FLOOR AREA: 3345m² NET FLOOR AREA: 2465m² FLOOR AREA RATIO: 76% FLOOR COUNT: 40 BUILDING HEIGHT: 180m AVE. FLOOR DEPTH: 17m REF. FLOOR PLAN: 15 FUNCTION: OFFICE			
LONDON BRIDGE TOWER 25.8m, 54.7m, 53.6m	**RENZO PIANO B.W** GROSS FLOOR AREA: 2900m² NET FLOOR AREA: 2100m² FLOOR AREA RATIO: 78% FLOOR COUNT: 60 BUILDING HEIGHT: 300m AVE. FLOOR DEPTH: 14m REF. FLOOR PLAN: 28 FUNCTION: MIXED USE			
THE HERON TOWER 31.9m, 58.6m, 13.4m	**KPF** GROSS FLOOR AREA: 2040m² NET FLOOR AREA: 1500m² FLOOR AREA RATIO: 74% FLOOR COUNT: 46 BUILDING HEIGHT: 230m AVE. FLOOR DEPTH: 30m REF. FLOOR PLAN: 20 FUNCTION: OFFICE			

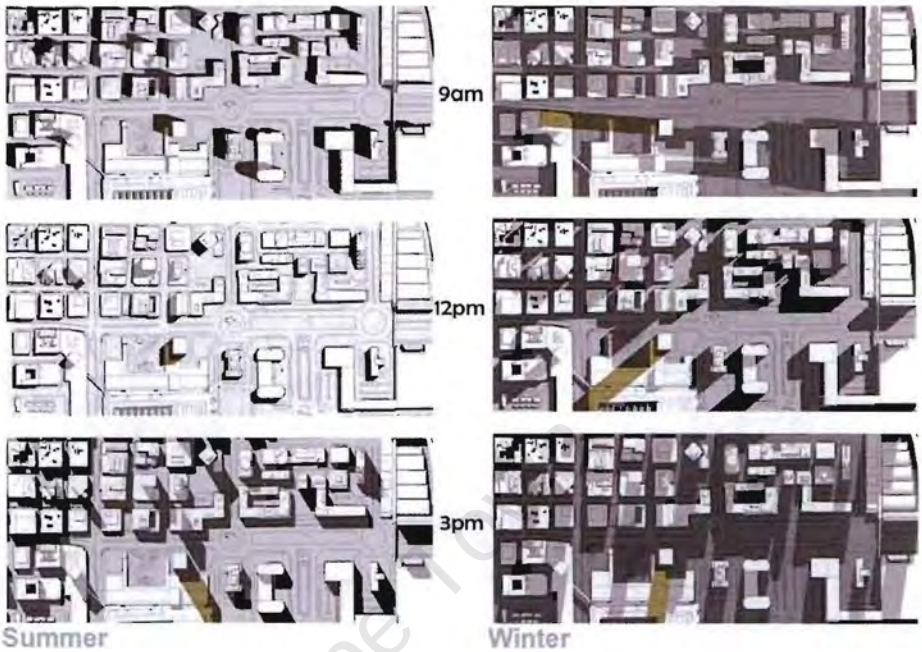
Figure 81

Climatic Analysis

The climatic study of the immediate area was done with two main objectives.

1. A shadow study was carried out to determine the type of shadows a tall building would cast on the station square. The results show that the position of the sun forces the building to cast large shadows on the plaza. This would influence the selection of a slender tower option as opposed to a wide one.

2. A wind study was done on Ecotect to understand the action of the wind on the existing buildings. The prevalent wind in Cape Town is the South Easterly. It also records one of the highest wind speeds in the world. This would become a primary concern for the project.



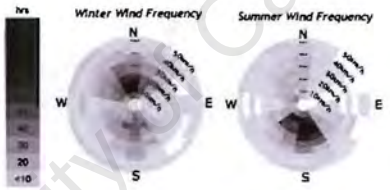


Figure 52

Figure 53

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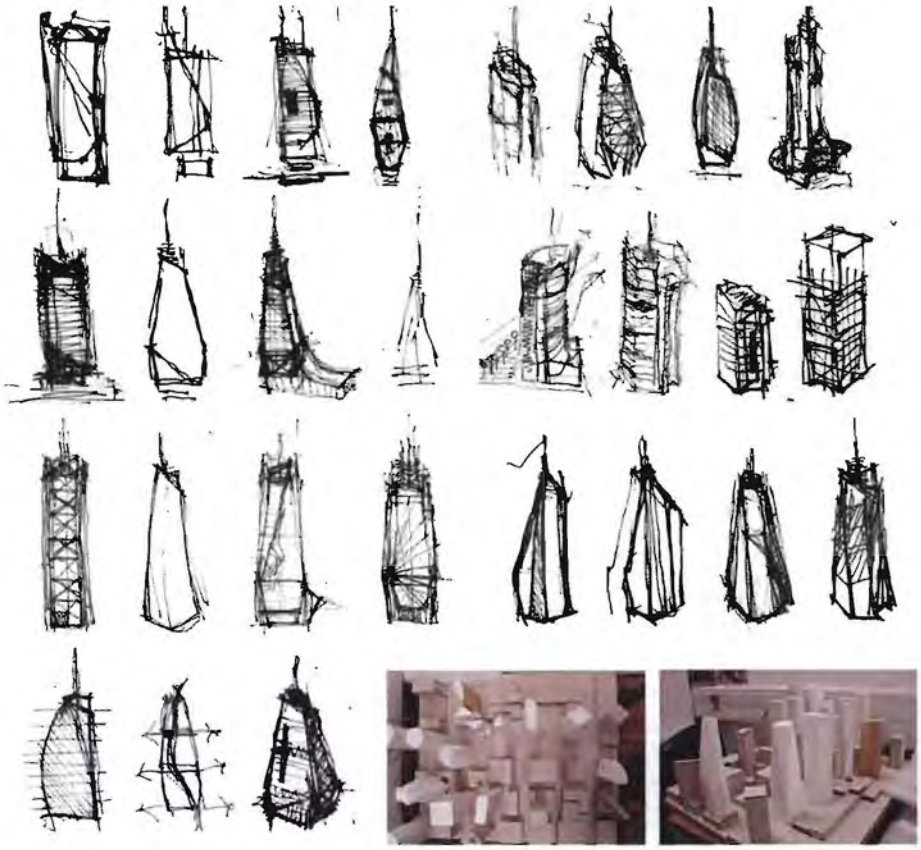
A Facet with a Cause

Form Exploration & Wind Tunnel Testing

In designing the form of the building, many conceptual ideas were drawn but none of them seemed right. They all seemed predetermined and no fitting the vision of an urban responsive skyscraper. After several models and sketches all the ideas were discarded. Being true to the idea of an urban response, the form of the building must be influenced by something that embodies the essence of Cape Town.

The point of entry was the wind response of the form. In order to do this thoroughly models were built and physically wind tunnel tested to get results as accurate as possible. These results were tabulated and were also represented in diagram form displaying all their wind qualities.



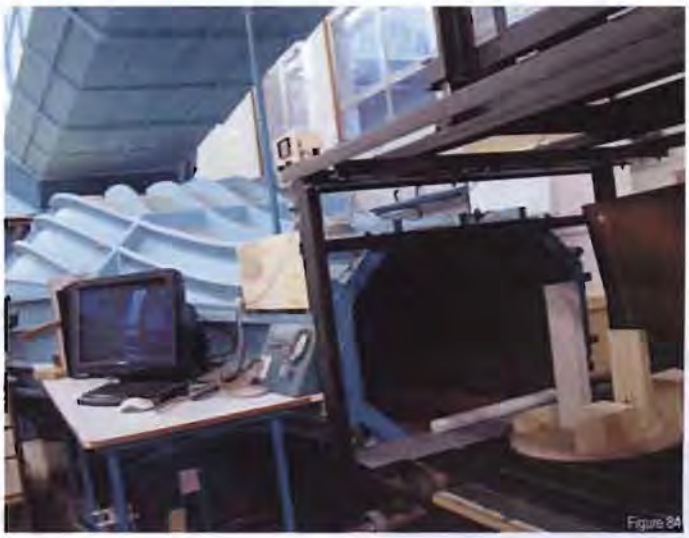
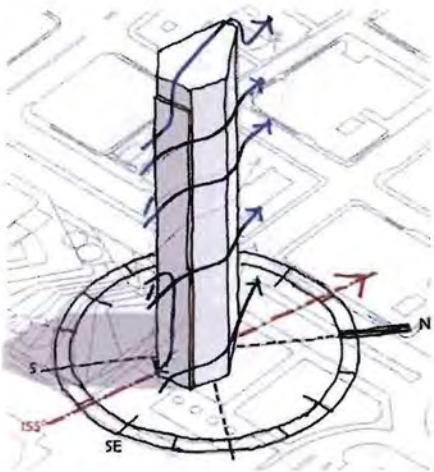
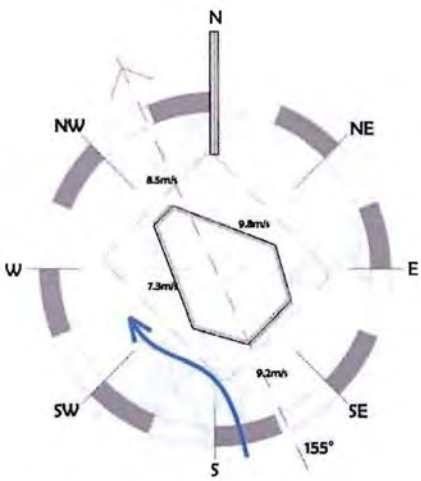


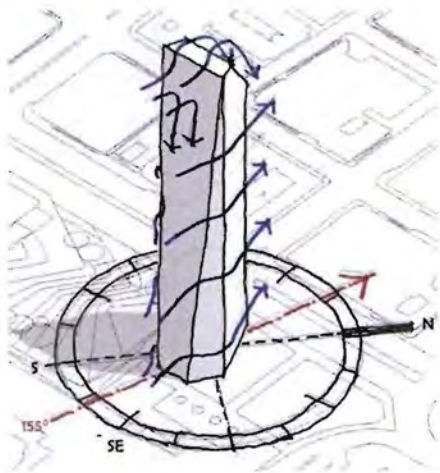
Figure 84

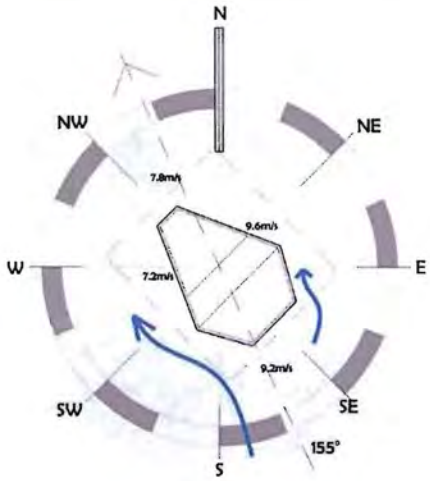
OPTION 3



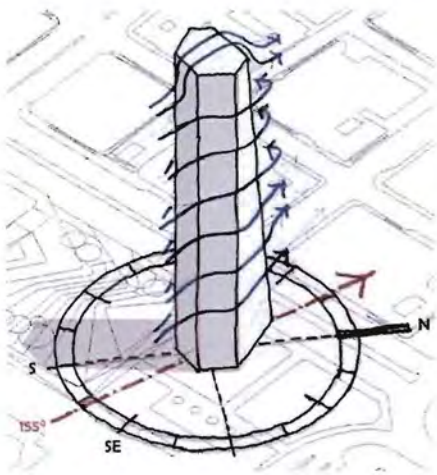


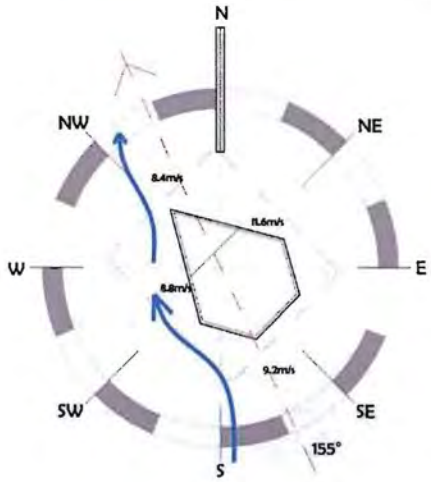
OPTION 2

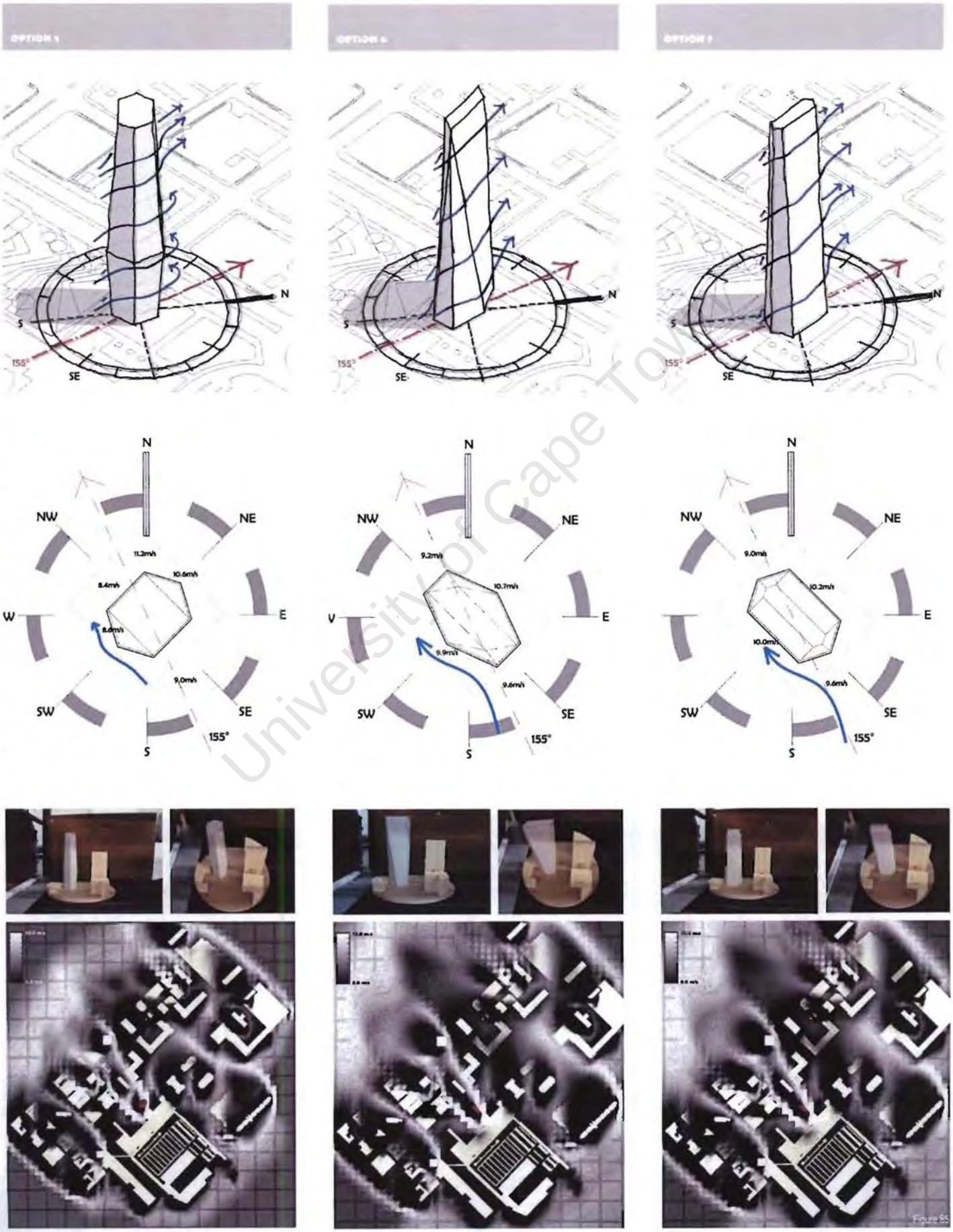




OPTION 4







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Morphology

Option 3 would come out as the most successful option from the experiment. This was based on the wind speed test results, the action on the neighbouring buildings and the architectural potential the form had to develop.

The form would then go through two avenues of refinement. Both of these design influences would shape the building into its final form. The diagrams on the right give a quick summary of a few steps in the refinement of the form. These steps however are purely formal as the building was being moulded under various criteria.

1. The form that was wind tunnel tested; the action of the wind on the faceted edges proved to be highly favourable. The sloped face minimizes the down force of the wind. The chamfered leeward side minimizes the negative pressure.

2. With functional considerations the building centred its mass to allow for an efficient circulation strategy. The main faceted slope only goes half way to allow for better floor efficiency ratios.

3. The building tapers inwards to reduce the lateral forces on the structure. It also reduced likelihood of oscillation due to vortex shedding.

4. The building edges are faceted to further reduce wind speeds around the building but more importantly to create more faces on the building hence more vantage points to view the city.

5. Narrowing the building any further would cause spatial inefficiencies.

6. The building then poetically crafts itself into an elegant form that is impacted by its surroundings, predominantly governed by its responses to the wind and its visual links around the scenic city

WIND TUNNEL SPEED TEST ON 155° AXIS (m/s)

	SOUTH EAST				SOUTH WEST				NORTH EAST				NORTH WEST			
OPTION 1	9.4	9.6	9.8	9.6	7.3	7.4	7.3	7.4	11.2	11.1	10.9	11.2	9.8	9.8	9.8	8.1
OPTION 2	8.9	9.1	9.4	9.2	7.4	7.5	7.1	7.3	9.8	10.0	9.8	9.8	8.5	8.6	8.5	8.5
OPTION 3	8.9	9.0	9.2	9.2	7.3	7.4	7.3	7.2	9.6	9.8	9.4	9.6	7.9	7.5	8.0	7.8
OPTION 4	9.0	9.1	9.4	9.2	8.6	8.8	9.0	8.8	11.2	10.9	11.0	11.2	9.0	8.8	8.8	8.9
OPTION 5	8.9	9.1	9.0	9.0	8.8	8.6	8.6	8.6	10.5	10.6	10.4	10.6	8.6	8.6	8.6	8.4
OPTION 6	9.7	9.5	9.4	9.6	10.2	9.9	9.6	9.9	10.6	10.8	10.9	10.7	8.8	9.0	9.4	9.2
OPTION 7	8.9	9.1	9.4	9.6	9.9	9.9	10.2	10.0	9.9	10.2	10.6	10.2	8.6	9.4	9.0	9.0

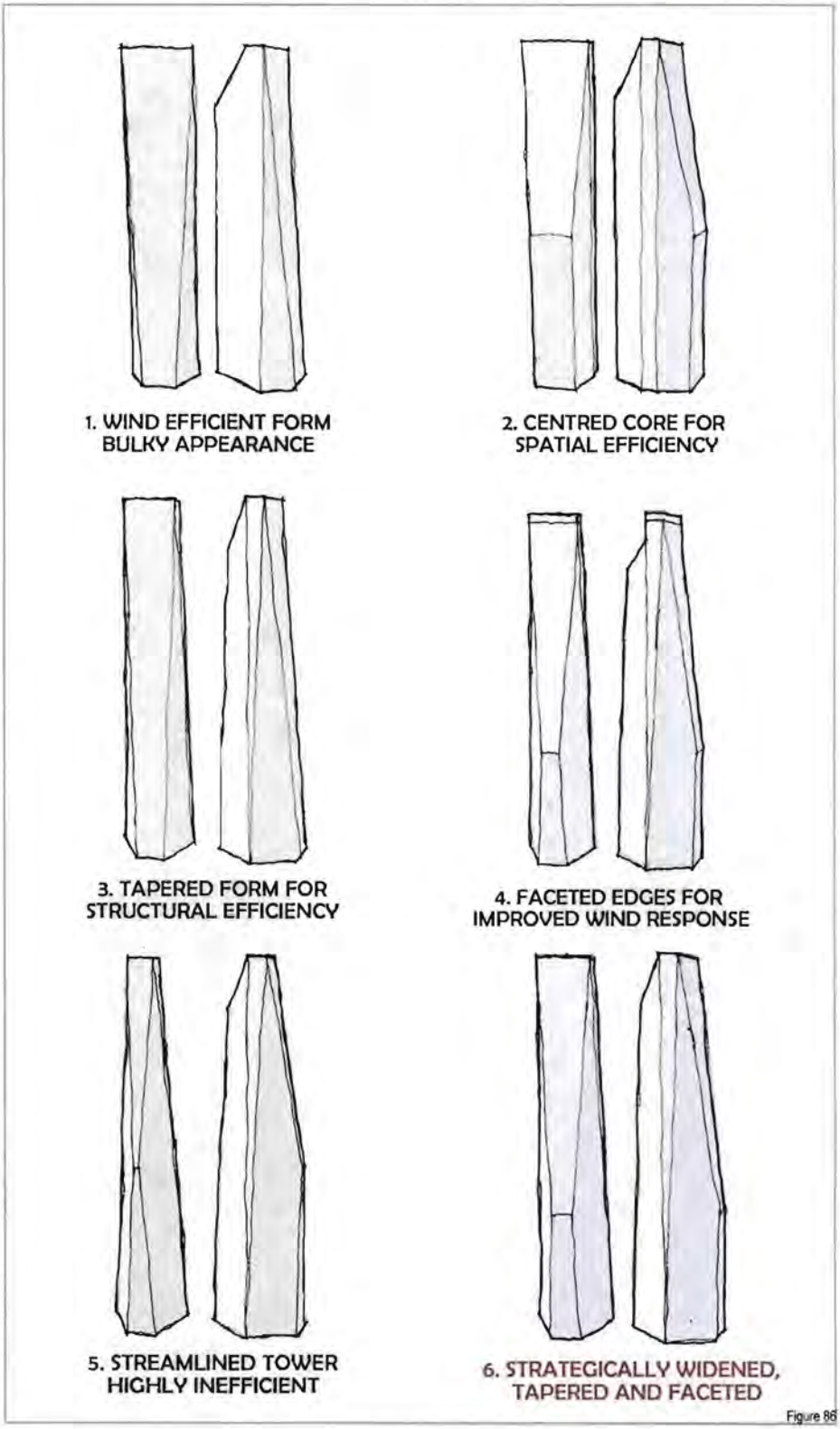


Figure 86

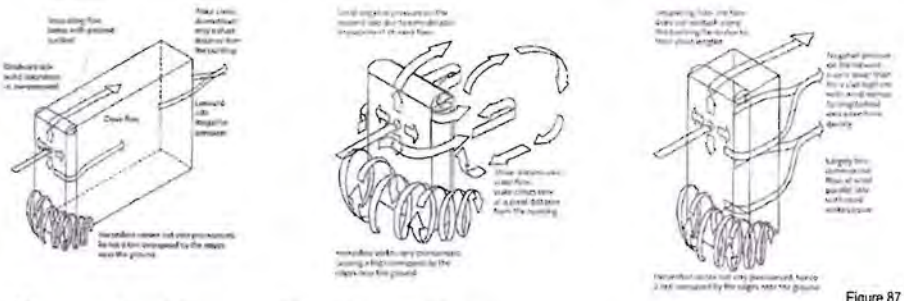
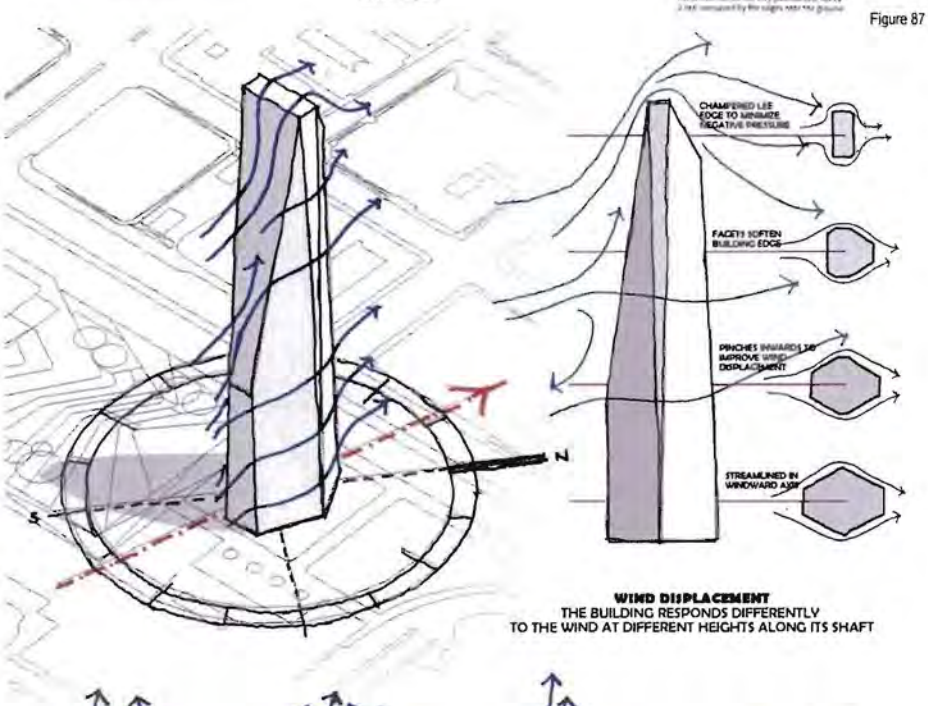


Figure 87



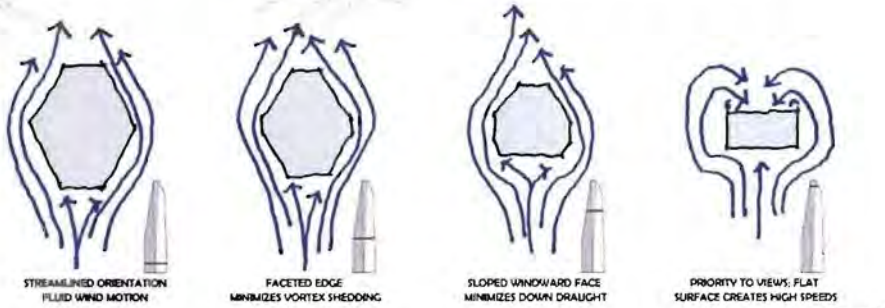


Figure 88

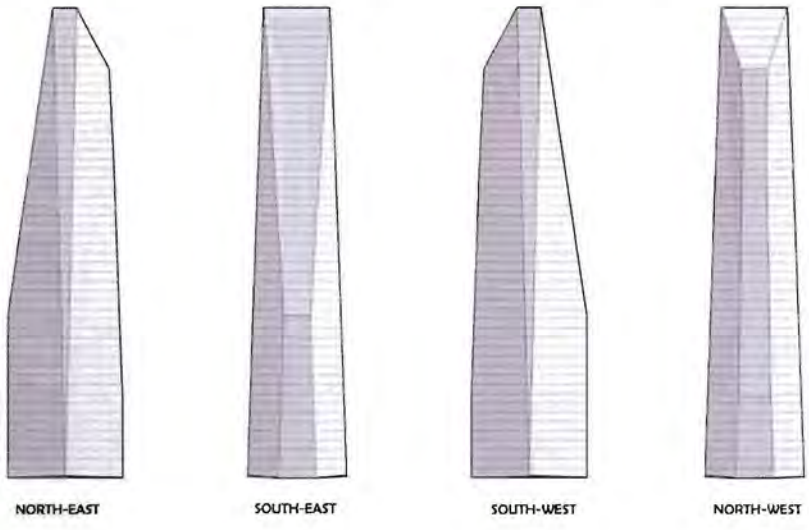


Figure 89

Wind displacement theories are very important. These theories were studied in depth in order to make informed design decisions on how the building would respond to the wind.

The building's response to the 'cape doctor is extremely significant in embedding it in the context of Cape Town. It streamlines its form to allow winds to pass undisturbed at certain points and it spreads its mass to slow the wind down at others. Faceted edges of buildings minimize the wind speed around them.

The main facet catches winds at the top and releases it slowly towards the ground. The secondary facet on the leeward side reduces the swift downfall that produces negative pressure. The building changes shape all along its shaft. This creates different wind displacements along the tower. These differences were noted and considered for further strategies such as harvesting the wind to passively cool the building.

"The building's faceted form is in concert with the '*cape doctor*'. It pays homage to Table Mountain, strengthens urban links to the city's landmarks and creates an array of framed views around the scenic city."

The building's form is characterized by its facets. Each facet existing for a distinct reason. The building is triangulated; All the facets are triangular, increasing the structural integrity of the form which would benefit the structural resolution of the building. The facets also create eight elevations instead of four which creates more dynamic spaces in the building and allow for greater visual connections with more sides of the city.

More significantly, the building pays respect to certain aspects of the city.
It uses its major facet to frame an interior view of Devil's Peak.

The form pinches and contorts at certain places to get a direct link with existing landmarks in the city.

The main facet in the building cuts back the building mass and in doing this it not just preserves views from Adderley Street to Table Mountain, but it creates optical illusions and dynamic angles that cut across the mountain creating a visual stimulus for city's inhabitants.

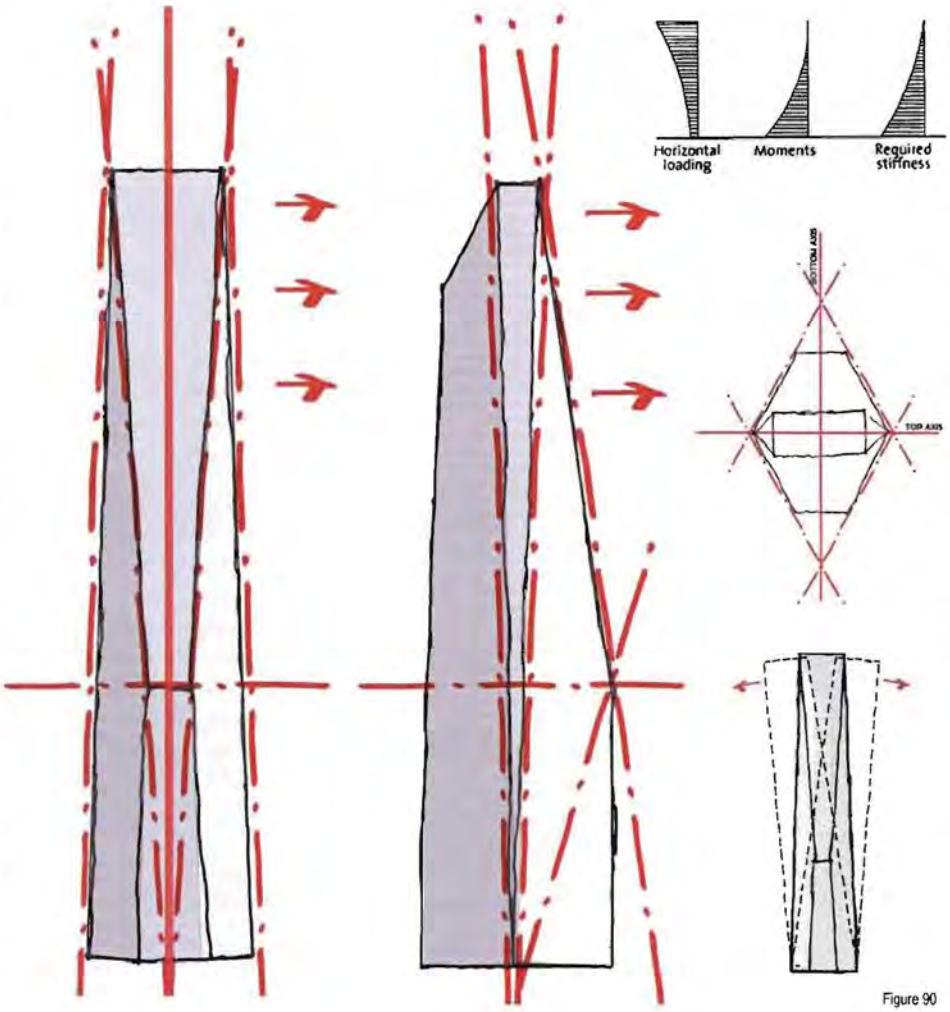


Figure 90

PRESERVE URBAN VISTAS
THE BUILDING PRESERVES VIEWS TO THE MOUNTAIN BACKDROP BY CREATING DYNAMIC CUTS ACROSS IT

Figure 91

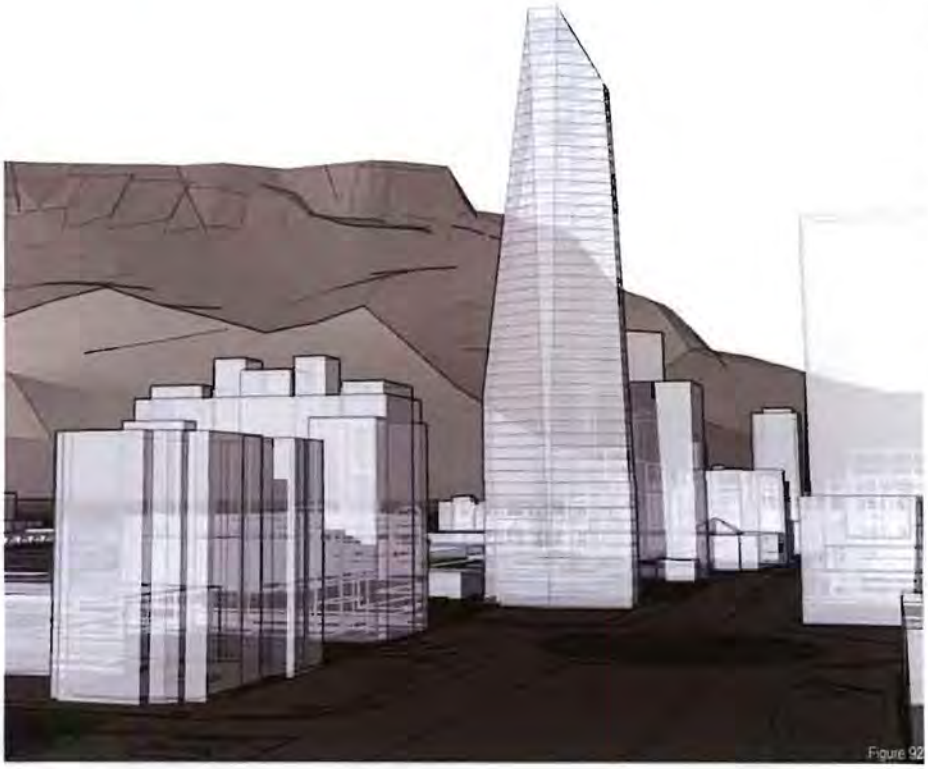
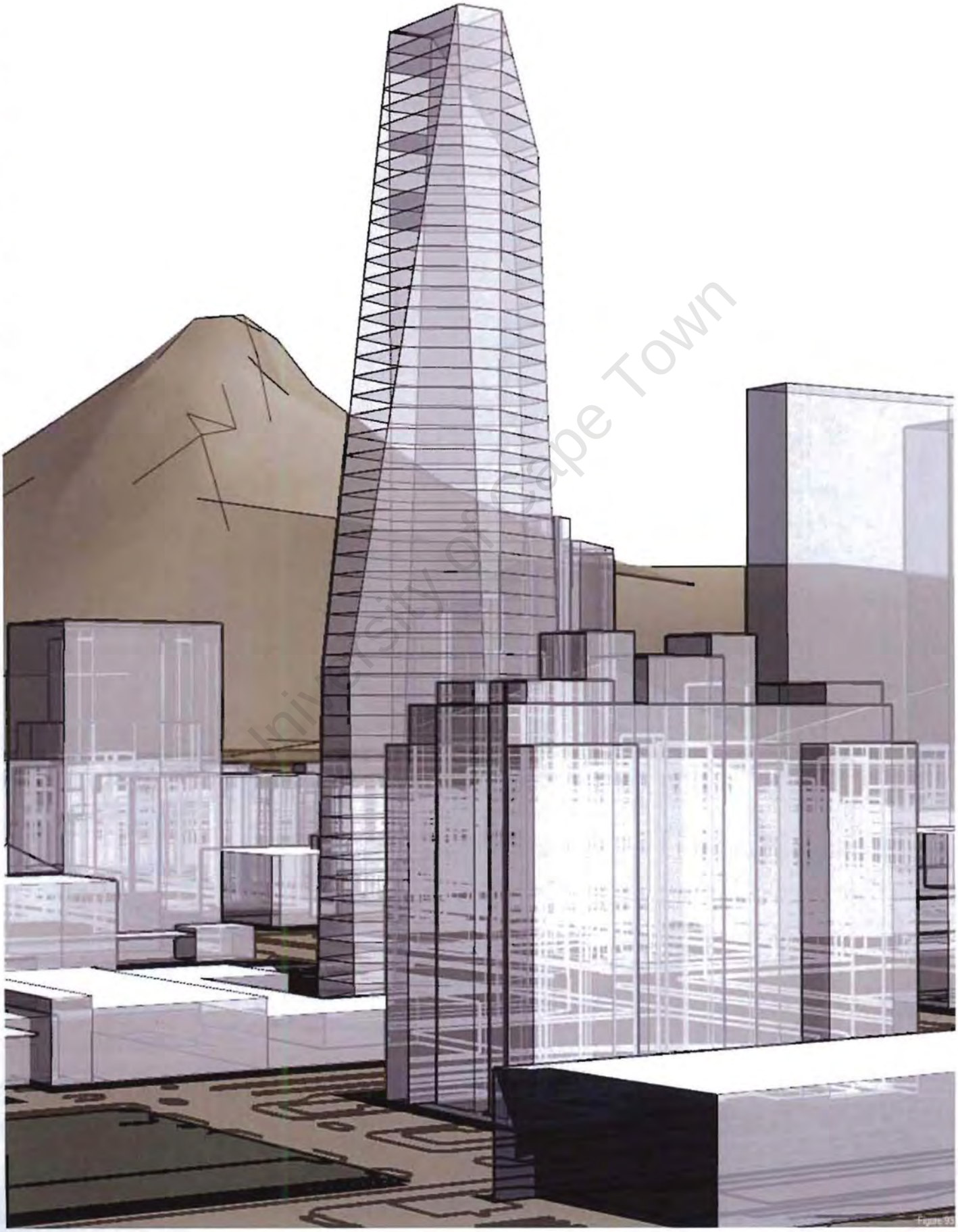


Figure 92



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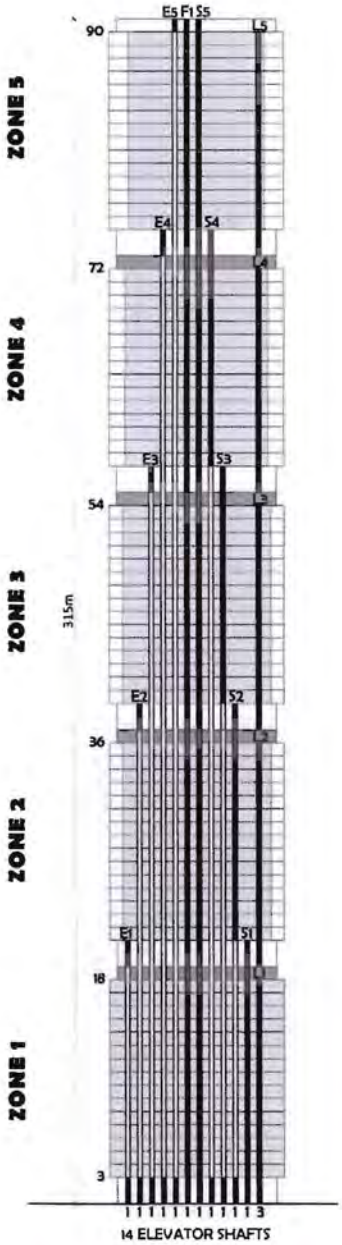
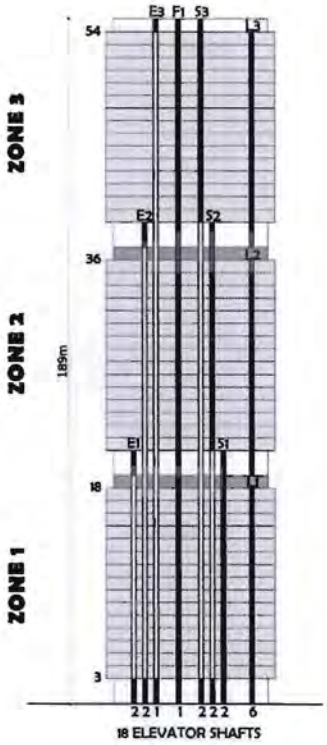
Programme

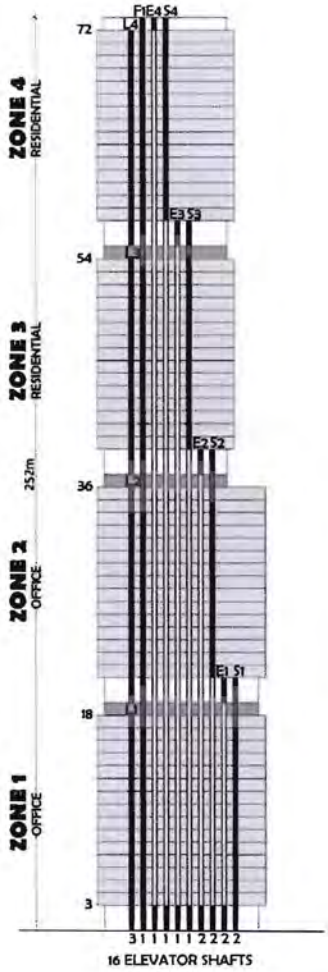
The programme for the building is also embedded in the concern for its urban context. As mentioned earlier (p.3), the city suffers from a lack of residential components. With a 3200m² site, the next step was a functional planning exercise to determine what could fit on the site and how high it could get. This was done with the Floor Area Ratio (F.A.R) being the most significant factor. Three typologies were examined using elevator requirements to determine the core sizes and then trying to achieve a F.A.R of above 65% to render the building commercially viable. The objective was to achieve a mixed-use building with a significant residential component.



60 FLOORS, 5 MECHS, 5 LOBBIES = **90 FLOORS | 315m**
TOTAL NFA = 84 435m² | AV. FAR = 75.4% | 1060 UNITS



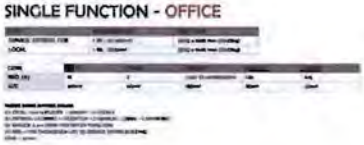
48 FLOORS, 3 MECHS, 3 LOBBIES = **54 FLOORS | 189m**
TOTAL NFA = 41 770m² | AV. FAR = 69%



63 FLOORS, 4 MECHS, 4 LOBBIES = **75 FLOORS | 252m**
TOTAL NFA = 55 800m² | AV. FAR = 71.5% | 360 UNITS

SINGLE FUNCTION - RESIDENTIAL

SINGLE FUNCTION - OFFICE



MIXED-USE FUNCTION - OFFICE | RESIDENTIAL

Figure 94

Single Function Residential
Due to a very low elevator requirement floor efficiencies stay high and the building can get very tall with a economic floor ratio.

Single Function Office
With congested vertical circulation traffic this type requires a very large core so the floors quickly become inefficient the taller the building gets.

Mixed Function Office-Residential
The mixed-use strategy merges the upper residential zones with the lower office zones. Seemingly compromising between the two heights.

Functional Planning

The mixed-use option was selected and taken further.

Method:

The bottom two zones (least efficient) of the office model were used as they have the highest core requirements. These zones would set the footprint of the core. To achieve the mixed use, the top two zones (most efficient) of the residential model were used. An efficiency gap was created which would be remedied by adjusting the number of floors in certain zones.

The two centre zones were reduced in size, with zone 2 remaining an office zone and zone 3 becoming a hotel zone. This would add a dynamic quality to the space usage in and around the building taking the urban impact into consideration. The hotel zone has different requirements so the model was adjusted accordingly.

Taking the resolved form into consideration, the model pushes the narrower upper zones to one extreme end. This is to facilitate the major facet in the building form.

High floor area ratios mean more leasable space but it also means deeper floors. This will have energy efficiency draw backs. Taking that fact into account the building slims down to the bare minimum. All floor ratios moved to 70%, which is well in the economic efficiency range. However this action allows the building to narrow floors yet keep its 70% floor ratio.

The average floor depth is 8m; meaning all the spaces in the building would get daylight right up to the core. This would dramatically reduce the energy cost of the building, making a leap towards energy efficiency.

MIXED-USE FUNCTION - OFFICE | HOTEL | APARTMENTS

LIFTS	REQUIREMENTS	SHAFT SIZE
SERVICE, EXPRESS, FIRE	1 lift / 24 600m²	2032 x 1448 mm (1360kg)
LOCAL	1 lift / 3250m²	2032 x 1448 mm (1360kg)

(L) LOCAL: 1 per 15 FLOORS = 3 LOCALS
(E) EXPRESS: 2 LOBBIES + 2 (E) / LOCAL = 4 EXPRESSES + 2 (HOT)
(S) SERVICE: 2 per ZONE FOR OFFICE FUNCTION
(F) FIRE: 1 FIRE EMERGENCY LIFT TO SERVICE ENTIRE BUILDING
CORE = 300m²

LIFTS	REQUIREMENTS	SHAFT SIZE
SERVICE, EXPRESS, FIRE	1 lift / 150 units (50m²)	2032 x 1448 mm (1360kg)
LOCAL	1 lift / 75 units (50m²)	2032 x 1295 mm (1140kg)

(L) LOCAL: 1 per 15 FLOORS = 2 LOCALS
(E) EXPRESS: 1 LOBBY = 1 EXPRESS + 1 (RES)
(S) SERVICE: 1 per ZONE FOR RESIDENTIAL FUNCTION
(F) FIRE: 1 FIRE EMERGENCY LIFT TO SERVICE ENTIRE BUILDING
CORE = 250m²

LIFTS	REQUIREMENTS	SHAFT SIZE
SERVICE, EXPRESS, FIRE	1 lift / 300 units (70m²)	2032 x 1448 mm (1360kg)
LOCAL	1 lift / 75 units (70m²)	1727 x 1295 mm (900kg)

(L) LOCAL: 1 per 15 FLOORS = 2 LOCALS
(E) EXPRESS: 1 LOBBY + 1 ROOFTOP = 1 EXPRESS
(S) SERVICE: 1 per ZONE FOR RESIDENTIAL FUNCTION
(F) FIRE: 1 FIRE EMERGENCY LIFT TO SERVICE ENTIRE BUILDING
CORE = 250m²

CORE (OFF)	LIFTS	STAIRS	TOILETS	SERVICE	ROVER
REQ. (#)	14	2	1 per 75 workstations	n/a	n/a
SIZE	140m²	60m²	150m²	30m²	60m²

CORE (RES-HOT)	LIFTS	STAIRS	TOILETS	SERVICE	ROVER
REQ. (#)	7	2	-	n/a	n/a
SIZE	70m²	60m²	-	30m²	60m²

FOUR ZONE OFFICE - HOTEL - APARTMENT STACK
TWO OFFICE | ONE HOTEL | ONE APARTMENT

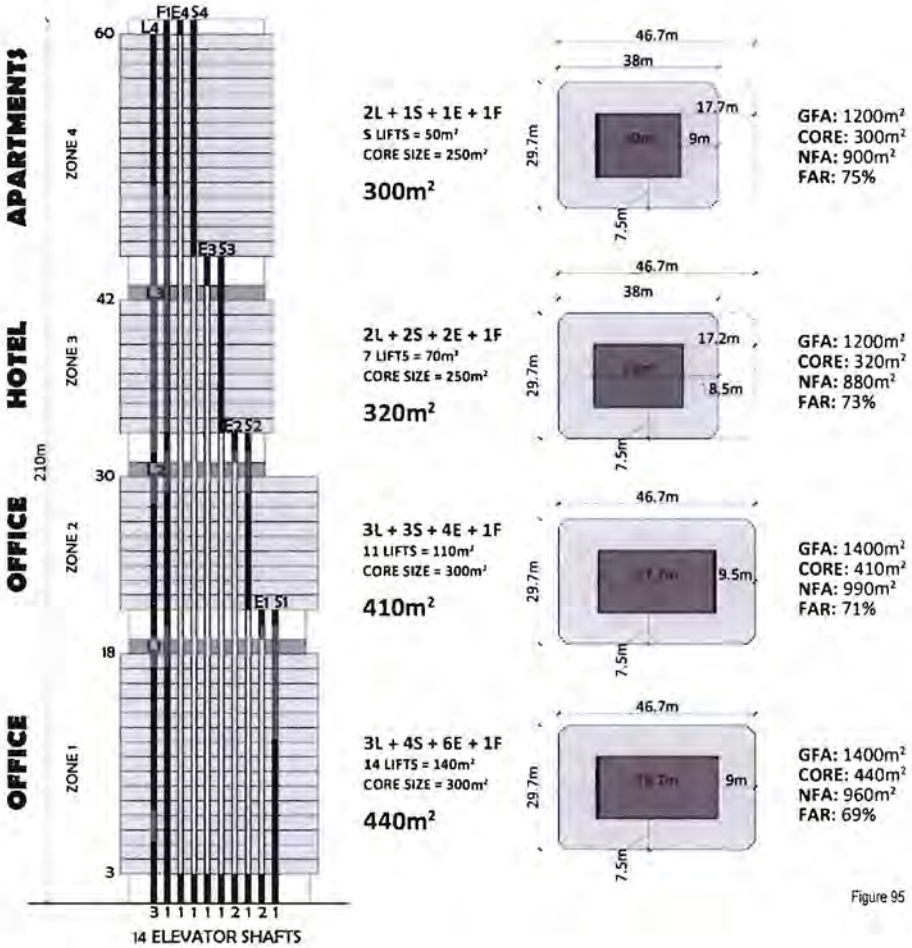


Figure 95

53 FLOORS, 3 MECHS, 4 LOBBIES = **60 FLOORS | 210m**
TOTAL NFA = 44 750m² | AV. FAR = 72% | ROOMS: 158 (H), 194 (A)

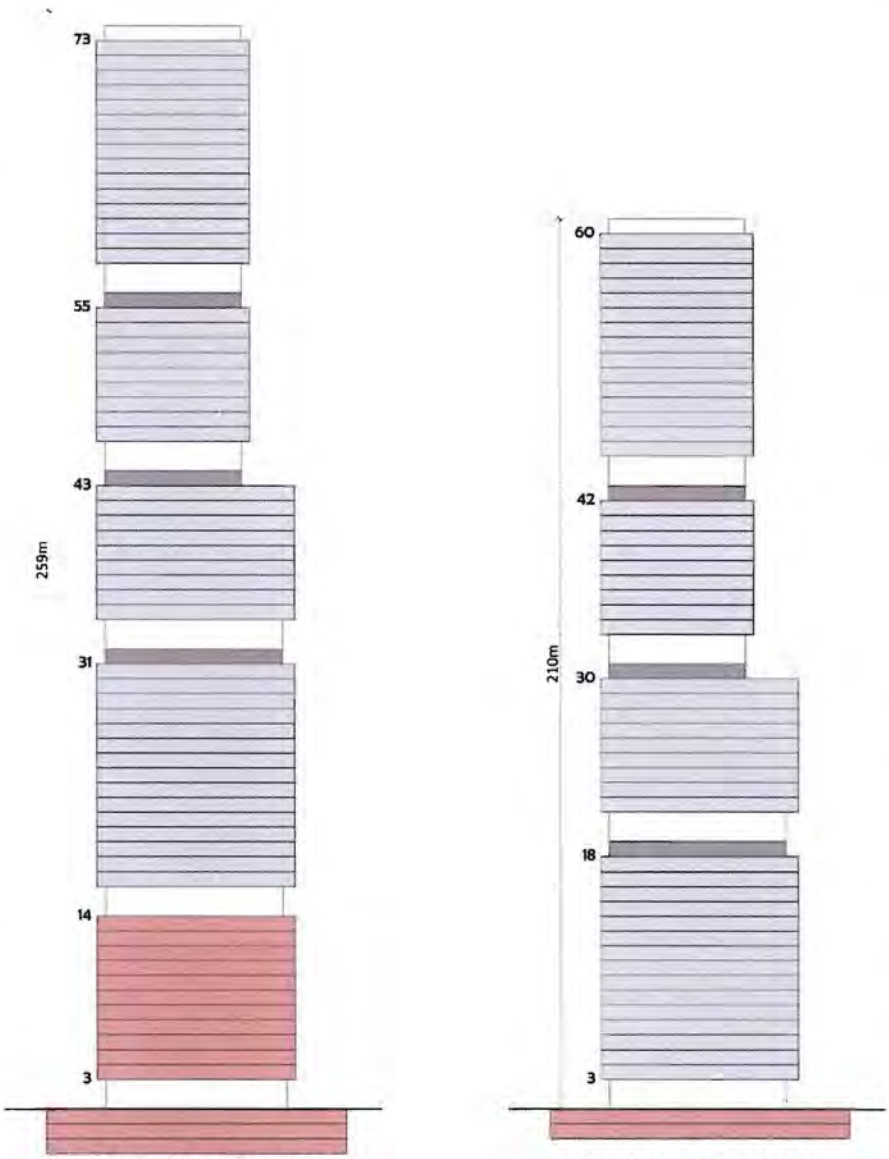
Parking Provision

The parking space that the building provides is the kept at a minimum. This decision was motivated by urban realities of the site.
The building is located adjacent to the largest public transport hub in the city. It aims to integrate its urban strategy with the functions of the public transport terminal in some way.

The city's regulations stipulate that buildings should provide 4 bays per 100m². This is a very unsustainable regulation. The new Portside tower has provided only 2.7 bays per 100m² (dhk, 2012) in an effort to reduce vehicular congestion in the city bowl.

The ABSA Centre which sits across the street from the station suffers from vacant parking bays in its parking lot. This is because most people that utilize the building commute to and from the city by public transport.

The aforementioned facts motivated the significant reduction in parking spaces provided for the building. The sections show the two options that were calculated for the building. The two parking levels shown for option 2 will sit above the water table preventing expensive tanking procedures for the basement.



PARKING OPTION 1
20m²/bay @ 4 bays/100m²
1 bays/apartment

PARKING OPTION 2
20m²/bay @ 0.5 bays/100m²
0.5 bays/apartment

Figure 98

	REQUIREMENT	FLOORS	TOTAL
OFFICE	980m² / floor	24	23 500m²
HOTEL	18 units / floor	9	162 units
APARTMENT	12 apts / floor	15	180 apartments

Based on total required units:

	# PARKING
OFFICE	940 bays
HOTEL	160 bays
APARTMENT	180 bays

Total number of bays: **1280**

Parking Floor Area: 25600m²
Total Net Floor Area: 80 120m²
Parking Ratio: 32%

14 floors + 3 basment levels

Based on total required units:

	# PARKING
OFFICE	120 bays
HOTEL	20 bays
APARTMENT	90 bays

Total number of bays: **230**

Parking Floor Area: 4600m²
Total Net Floor Area: 50 470m²
Parking Ratio: 9%

2 basment levels

The Portside parking basement and core under construction (2012)

Spatial Programme

In an effort to counter the prevalent high-rise programming in the city, the building distributes public spaces all through the tower. The entire ground floor is designed as a massive urban arcade and a public node in the city. There are four other public zones in the building. Two minor lobbies are situated between functional zones and two major public spaces; an arts and culture space half way up and an observatory and sky park at the top.

The public spaces are designed to allow people to come up and experience Cape Town from different heights. All the public spaces have different primary orientations which are experienced as soon as one exits the core of the building. This way the building is embedded in its context from the inside out and vice versa, responding to the its urban environment right from the core shaft.

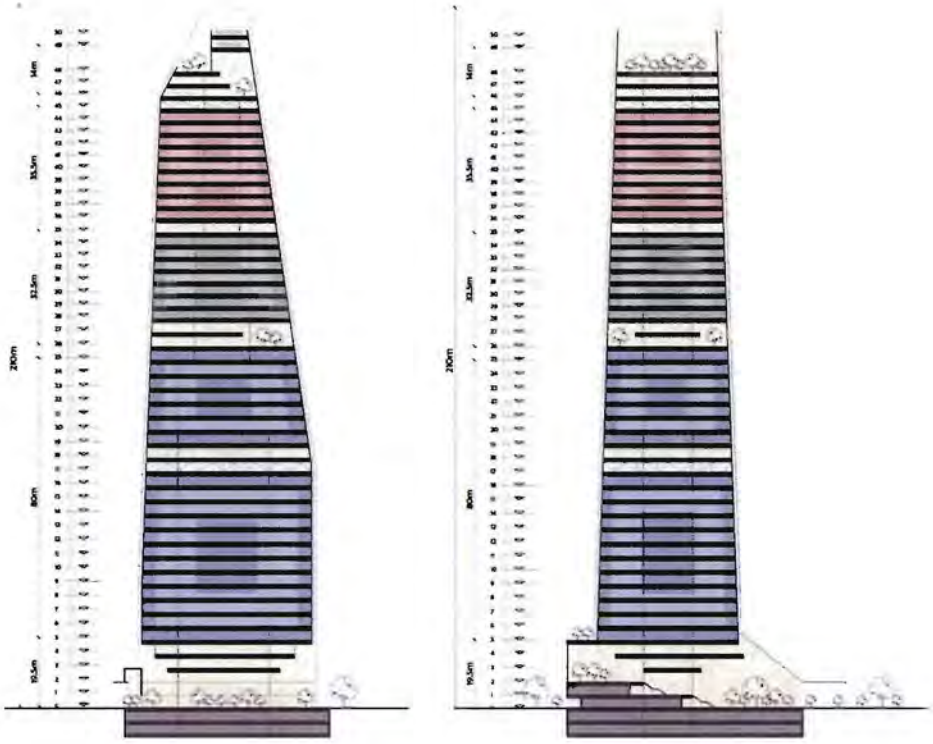
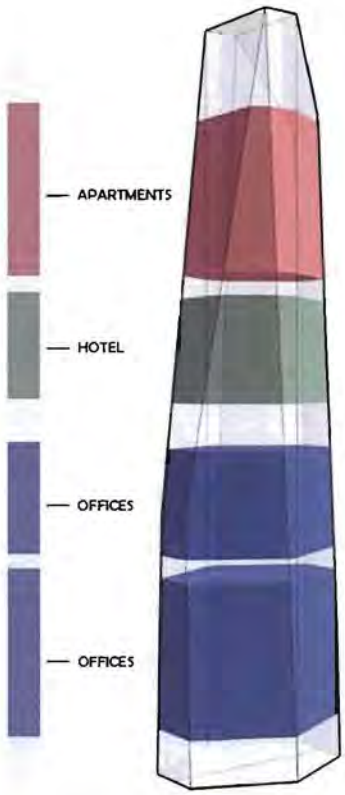
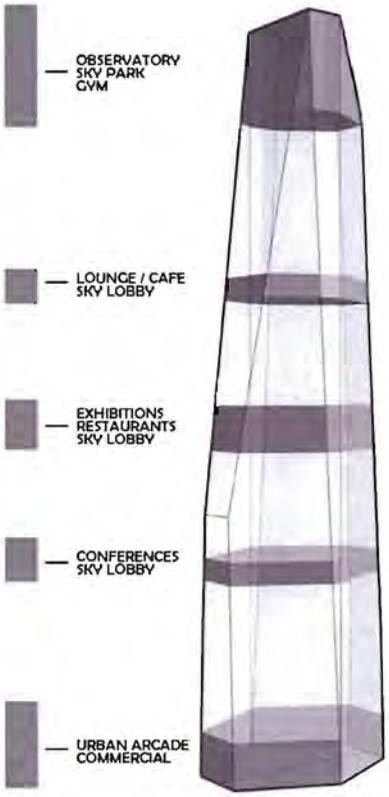


Figure 96



PRIMARY FUNCTION



PUBLIC FUNCTION

CORE DISTRIBUTION

Figure 97

Core Design

The design of the core is one of the most complicated processes in the entire design process. The cores have very specific functions and requirements. It is a complex Rubik's cube that needs to be matched. The main function of the core is to transport people vertically, so it is crucial that one understand the requirement of each zone in the building in order to put the puzzle together.

The main concern for the building was the relationship between the building envelope and the core. A study was done of several towers highlighting their cores to understand the types of spaces that were provided between the core and the facade.

This building would employ a central, stepped core due to its faceted form. The diagram below explains the main aspects of the vertical transportation requirements for this building. The analyses on the right show the relationship between the core size and the building programme. Mixed-use building have larger cores due to the fact that there are more functions to cater to in the building.

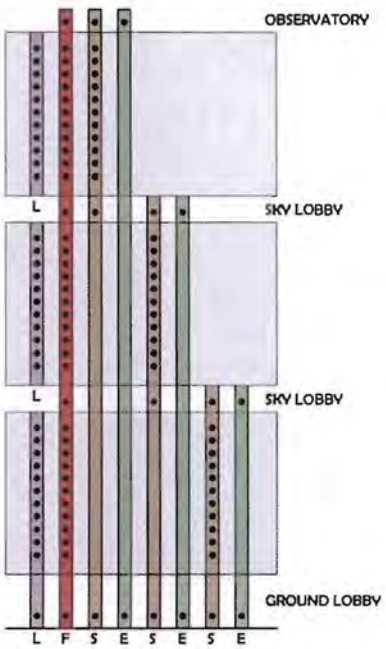


Figure 100

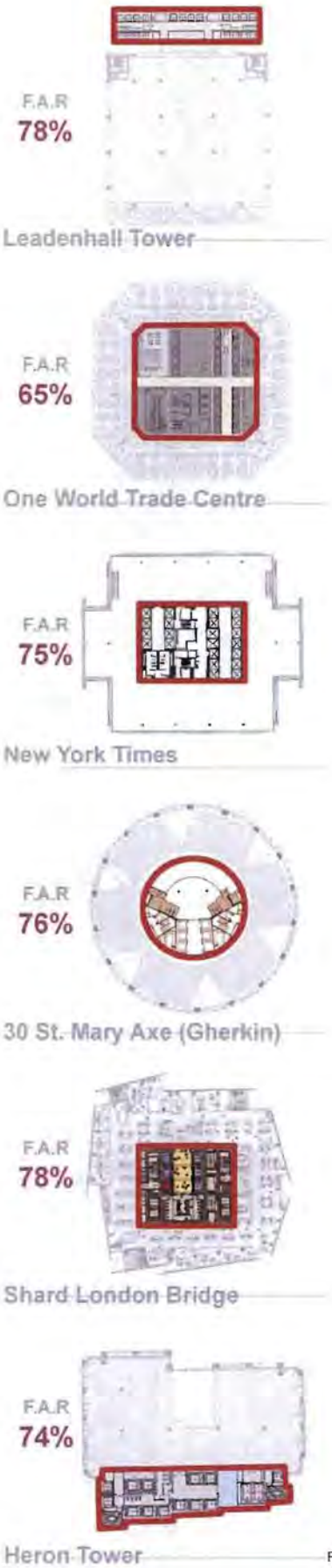
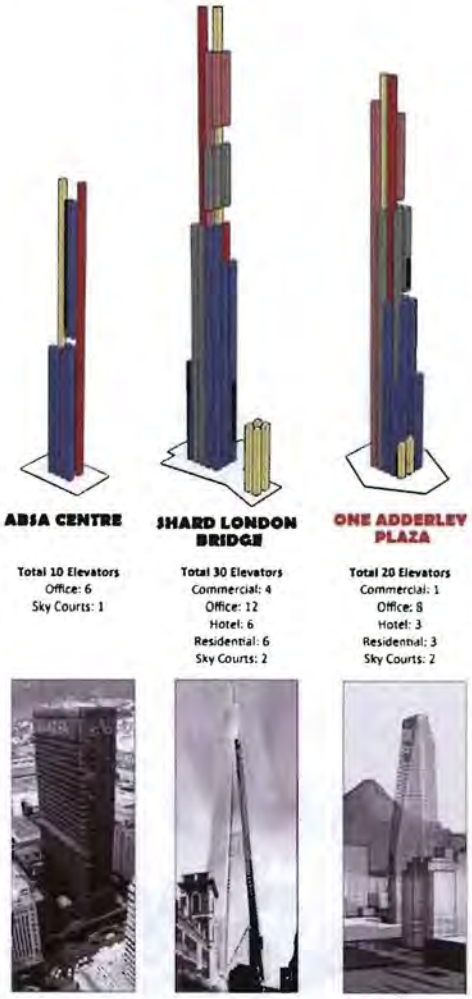
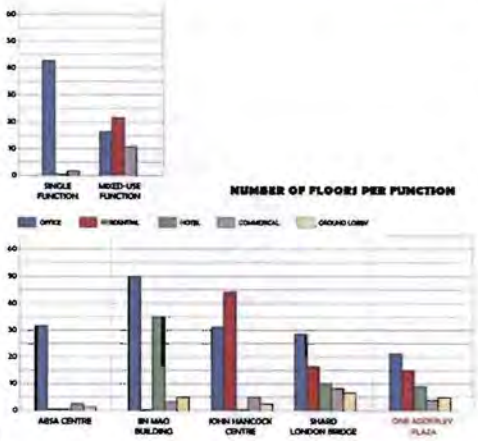


Figure 101

Core Analysis

Several cores were studied and modelled to get an understanding of how they function. The cores of this building, the ABSA Centre and the Shard have been selected to illustrate the difference in core requirements for single function and mixed-use buildings. The Shard London Bridge was a major influence on the vertical transportation strategy of this building.





The relationship between the core and the building envelope was explored. There were three options considered. The selected option was the diamond core even though it did not produce the best efficiency results. This was due to the regular spaces it provided and the shallow depth of its floor while keeping a good floor area ratio.

SQUARE CENTRAL CORE

Highest space efficiency
Deep floor plates
Irregular spaces

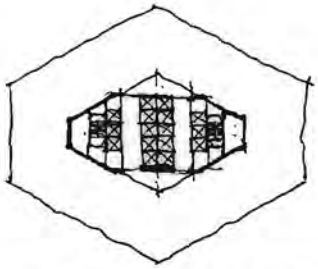
RECTANGLULAR CORE

Lowest space efficiency
Deepest floor plates
High structural integrity

DIAMOND CORE

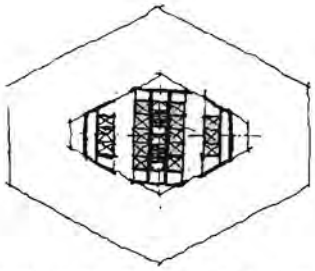
Favourable space efficiency
Regular spaces around core
Shallow floor plate

Figure 103



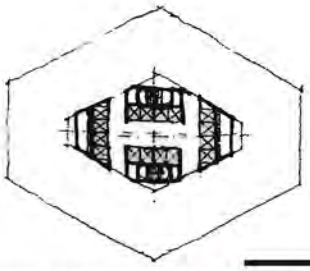
TWIN AISLES - SIDE STAIRS

The concept for the core was a layered system of aisles that would fall away as the core got higher. The stairs were initially on the sides of the core but proved futile as the edges of the core would fall away and stairs are required to run the full length of the core.



TWIN AISLES - CENTRAL STAIRS

The stairs were then pushed to the centre of the core allowing then to remain intact but this brought up spatial problems as it occupied valuable space in the centre of the core reducing the number of lifts that could be accommodated .



TWIN AISLES - CENTRAL LOBBY

Figure 104

Finally, a design with a central lobby allowing occupants to stay in the core as they change lifts. This created a lot of freedom to shuffle the lifts around. The stairs were placed on the edges of the long side and would remain intact the full height of the tower.

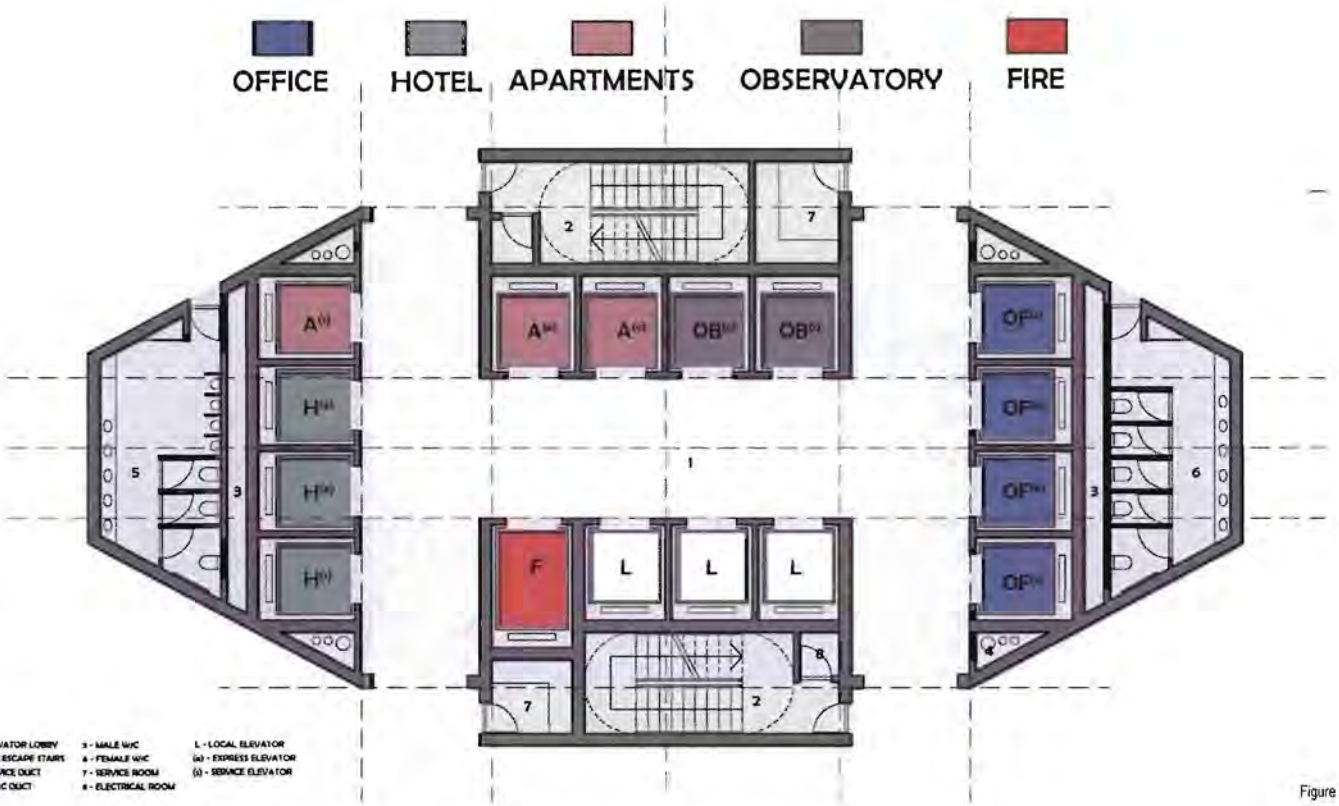


Figure 108

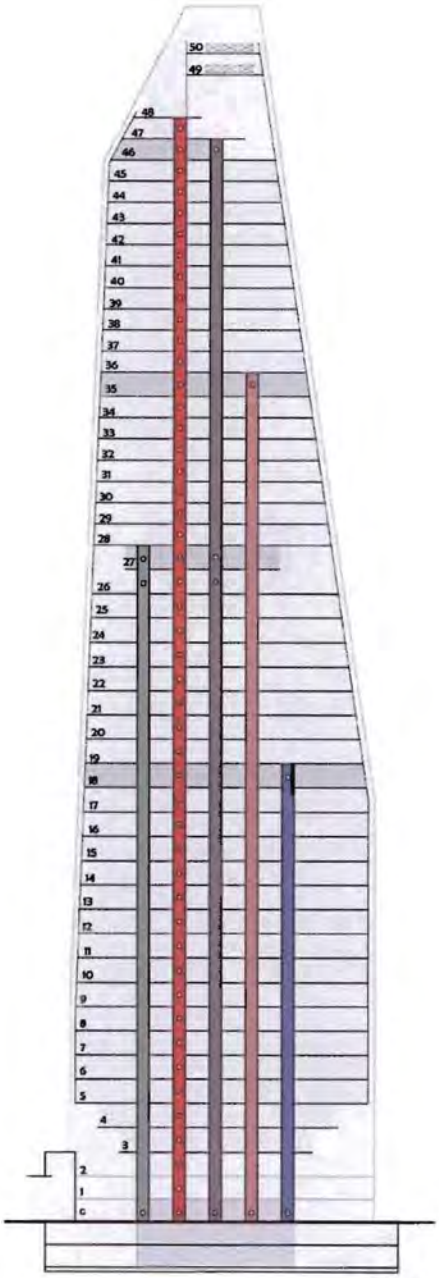


Figure 106

The section above illustrates the lift distribution through the tower. It also clearly indicates where the core would fall out and reduce in size. It was strategically designed so the centre of the narrowest end of the core would line up with the widest end of the facets at the top of the tower and similarly the widest end of the core would line up with the building envelope at the bottom. To achieve this the core was divided in to four segments; a central spine (local lifts) and two wings (express lifts). The wings fall away as the expresses reach their respective floors while the locals run the entire height of the building.

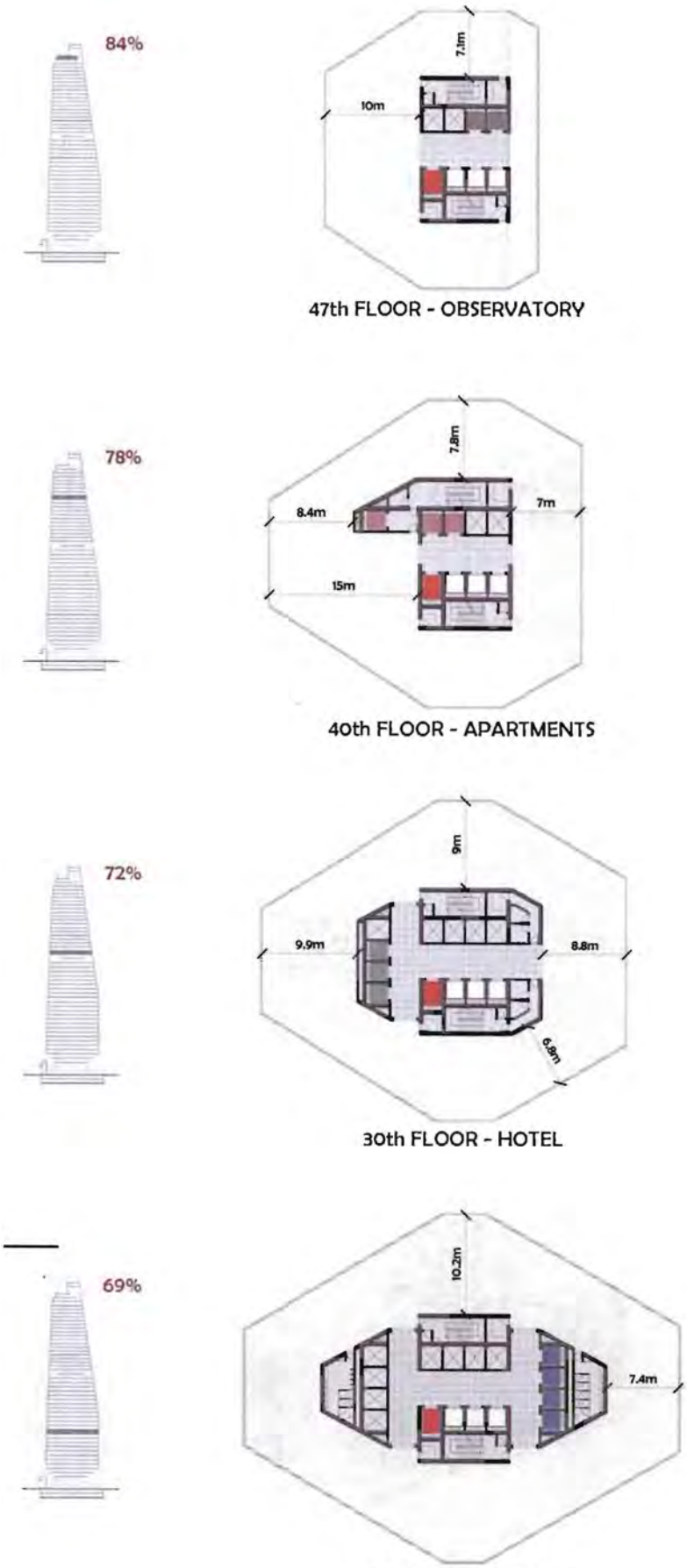


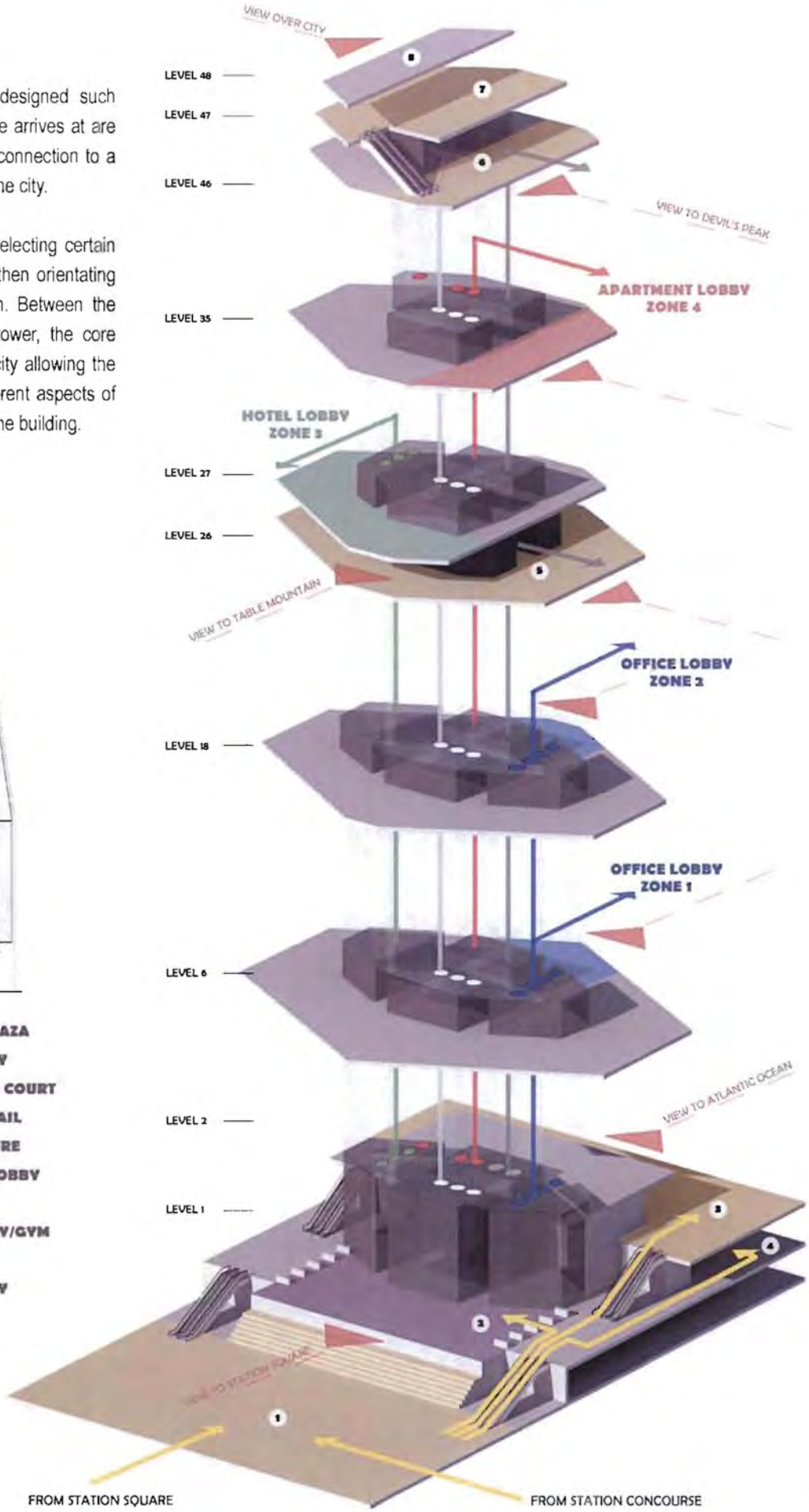
Figure 107

Core Relationship

The core was strategically designed such that the lobby spaces that one arrives at are orientated to create a visual connection to a certain landmark or scene in the city.

This was done by carefully selecting certain urban vistas around the city then orientating the core exit in that direction. Between the ground and the top of the tower, the core opens up to all sides of the city allowing the occupants to experience different aspects of the city as the travel through the building.

1 - ENTRANCE PLAZA
2 - TOWER LOBBY
3 - PUBLIC FOOD COURT
4 - ANCHOR RETAIL
5 - ARTS & CULTURE EXHIBITION LOBBY RESTAURANT
6 - OBSERVATORY/GYM LOUNGE
7 - OBSERVATORY
8 - SKY PARK



Exploring Tectonics

Cape Town's Tectonic Expression

In Cape Town, most of the buildings are heavy set monolithic shafts. Prime examples are the Golden Acre tower and the Atterbury House, which resemble each other.

The Standard Bank Building takes on a similar concrete form and structure except it expresses its heavy structure sitting atop a light glass box as if it was floating. The building also makes use of mega concrete columns to complement the concrete core system.

The Triangle House expresses a similar structure but has been clad in a decorative manner in line with postmodernist principles.

The exception to this is the ABSA Centre which was the first, all glass building in the city. This building uses a rigid frame structure unlike the concrete core system which is ubiquitous in the city. Cape Town's high-rises seem to be 'scared' of getting blown over by its winds. The buildings seem to go out of their way to be heavy and bulky, expressing their weight in structure and in skin.

Most skyscrapers in the city seem to be vertical concrete 'loaves' that were finely sliced to allow a little light to get into the building. The city lacks a high-rise that expresses a skin that protects as well as reveals the building. None of the buildings take advantage of the scenic environment. They are all tower blocks that could exist anywhere in the world.

ABSA Centre Figure 108

Standard Bank Building Figure 109

Triangle House Figure 110

Atterbury House Figure 111

Figure 112

University of Cape Town

Tectonic Considerations

Post & Beam System

The post & beam system was considered because it is the prevalent construction method and tectonic in Cape Town. It was explored to see what expression it would produce. This tectonic allows the building to blend in with the existing built fabric. The concrete technology is also prevalent in Cape Town. However, due to the fact that the building is faceted on all sides, the concrete construction will be extremely expensive.

Framed Tube System

The framed tube system is an exoskeleton structure that expresses its structure on the exterior. This structural system was explored because it is the most wind resistant structure. It would be expressed in an industrial steel tectonic reminiscent of the John Hancock building in Chicago. This system, though wind efficient, is very robust. The structure determines the expression of the building. It is a steel structure.

Core-Outrigger System

The core outrigger system is the most versatile of the three. It is structurally resistant to wind due to its outriggers positioned to stiffen it from deflection. Coupled with mega columns, this system allows for free expressive facades. This allows for elaborate skins and brise soleils to be explored without disturbing the facets created while developing the form.

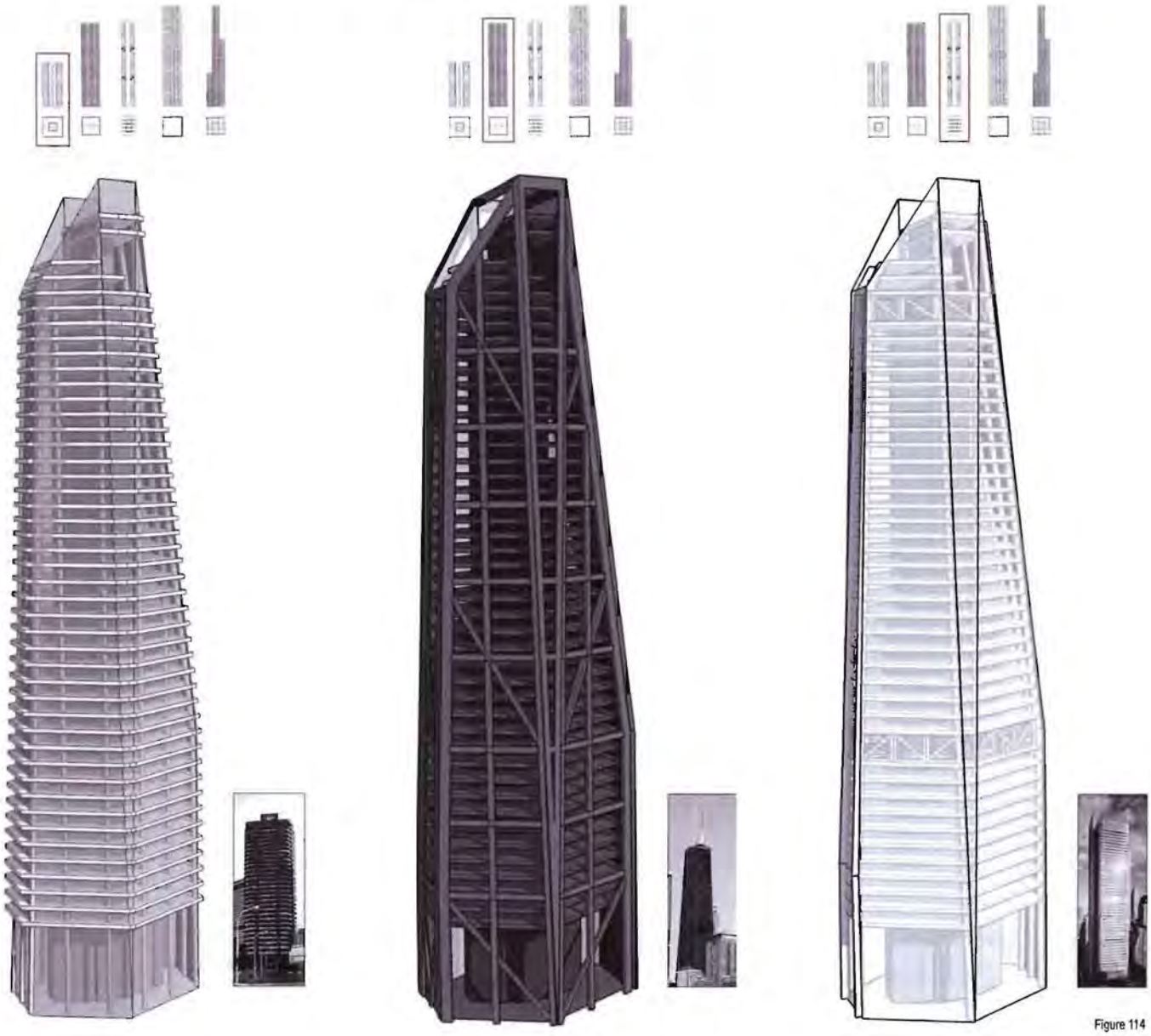


Figure 114

Structural Resolution

Three tectonics were explored and their respective structures were considered. Of the three, the most suitable one for this building was the core-outrigger structural system. This system allows for a free facade with a seemingly ethereal appearance while simultaneously possessing the structural characteristics that are highly resistant to lateral forces (wind loads).

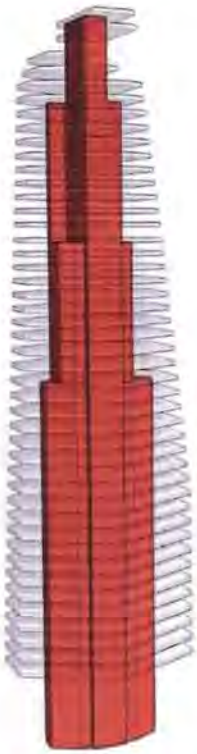
This system relies on the core and a steel system called outriggers to stabilize it. In this case the system has employed mega columns that will sit at the facade of the building. The outriggers attach the core to the mega columns and with a belt truss wrapping around the perimeter, they tie the whole structure together. These outrigger systems occur at two points in the building and share the same space as the mechanical floors.

These floors were carefully positioned when the form was being moulded and triangulated. Both outrigger systems also act as ties that counter the building's horizontal forces. The average floor to ceiling height is 3m. The floors are a composite of steel and precast concrete, they are 800mm deep with beams that span between the mega columns.

The mega columns consist of two systems. The first is a Y-Frame mega column that is 1400x1400mm which sits on the inside of the building facade an edges the terraces that cut through the central facet of the building. The second system consists 2000x700mm rectangular columns that sit on the outside of the building envelope on the east and west facade. These columns are intentionally designed and positioned in this way as they create act as vertical brise soleils that protect the building from the harsh east/west sunlight. This strategy allows the structure to play a role in the urban setting and energy efficiency of the building.

FLOOR PLATES Figure 115

MEGA COLUMNS Figure 116



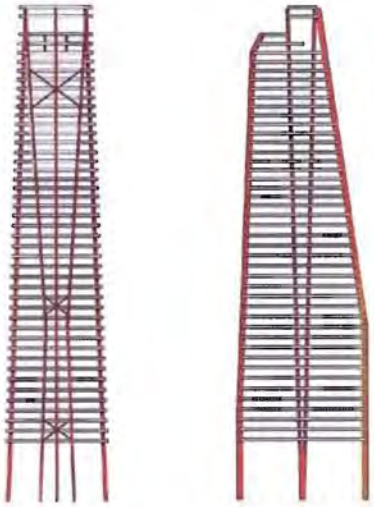
CONCRETE CORE Figure 117

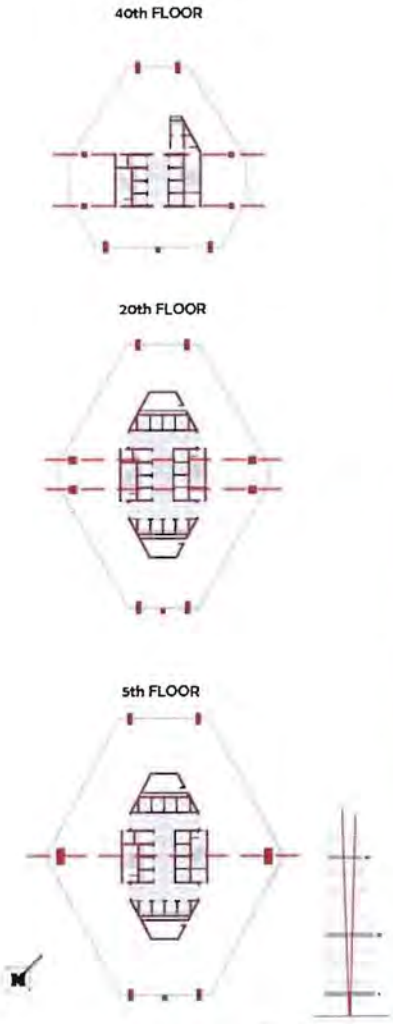
OUTRIGGERS Figure 118

University of Cape Town

Due to the shallow floor depth, the floor plate structure only spans about 7-9m away from the core. This allows for the main loads to be distributed between the core and the mega columns. In achieving this, the building uses half the number of columns it would have used in a regular post and beam system.

The outriggers then act as arms that bundle the columns together, forming a very rigid and stable structural system. Mega-braces on the east and west facade were considered to further reduced chances of oscillation as a result of vortex shedding due to the south easterly winds.





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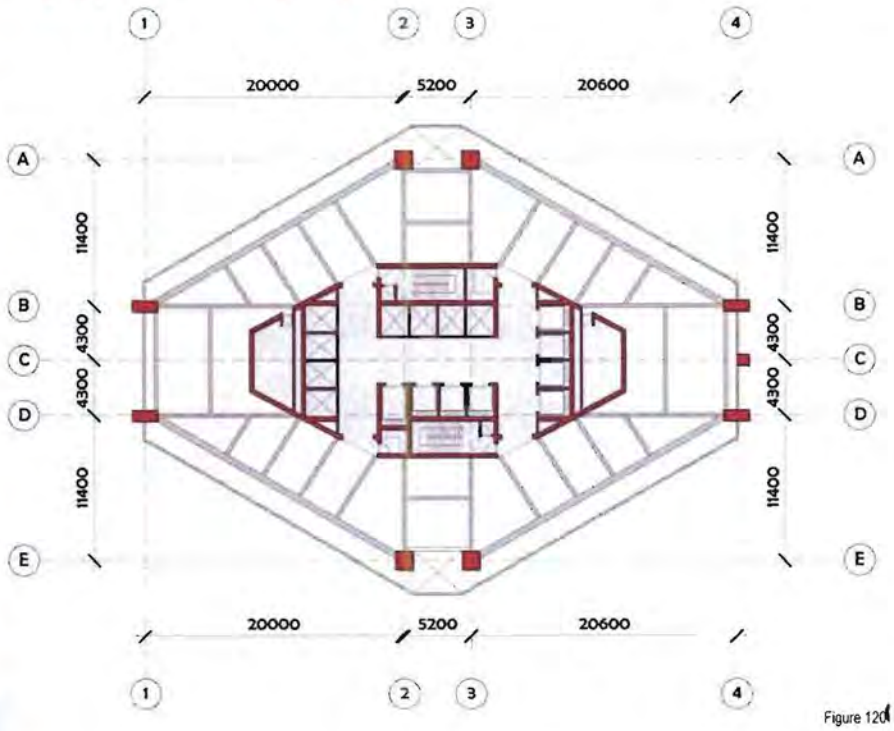

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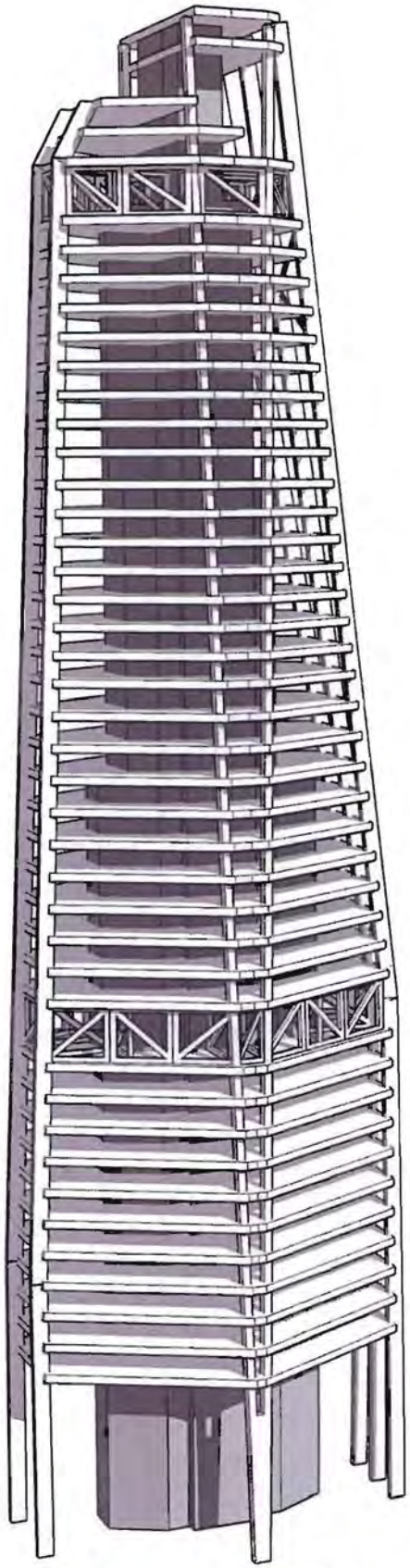
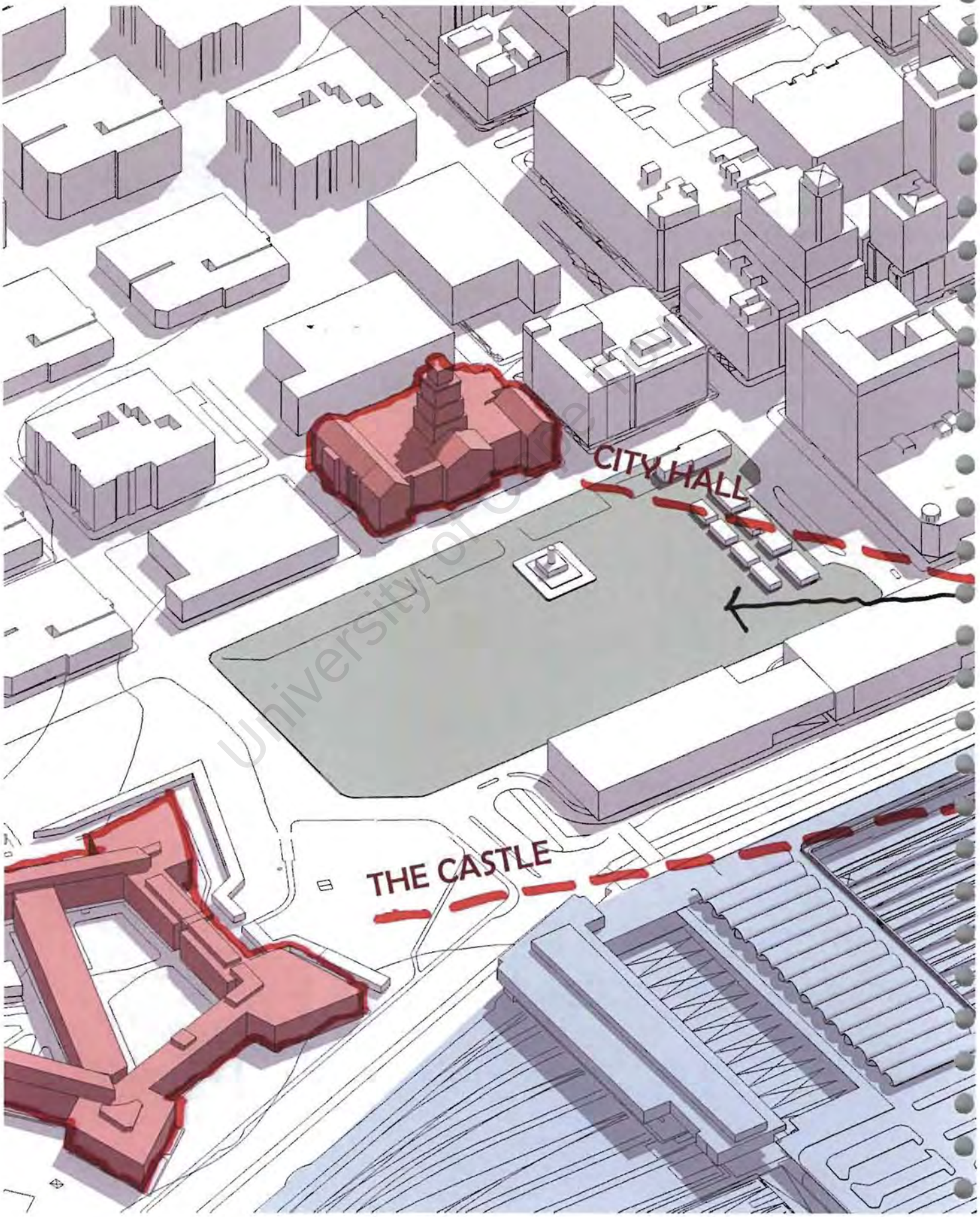


Core Outrigger - Mega Column Structural System

Figure 121



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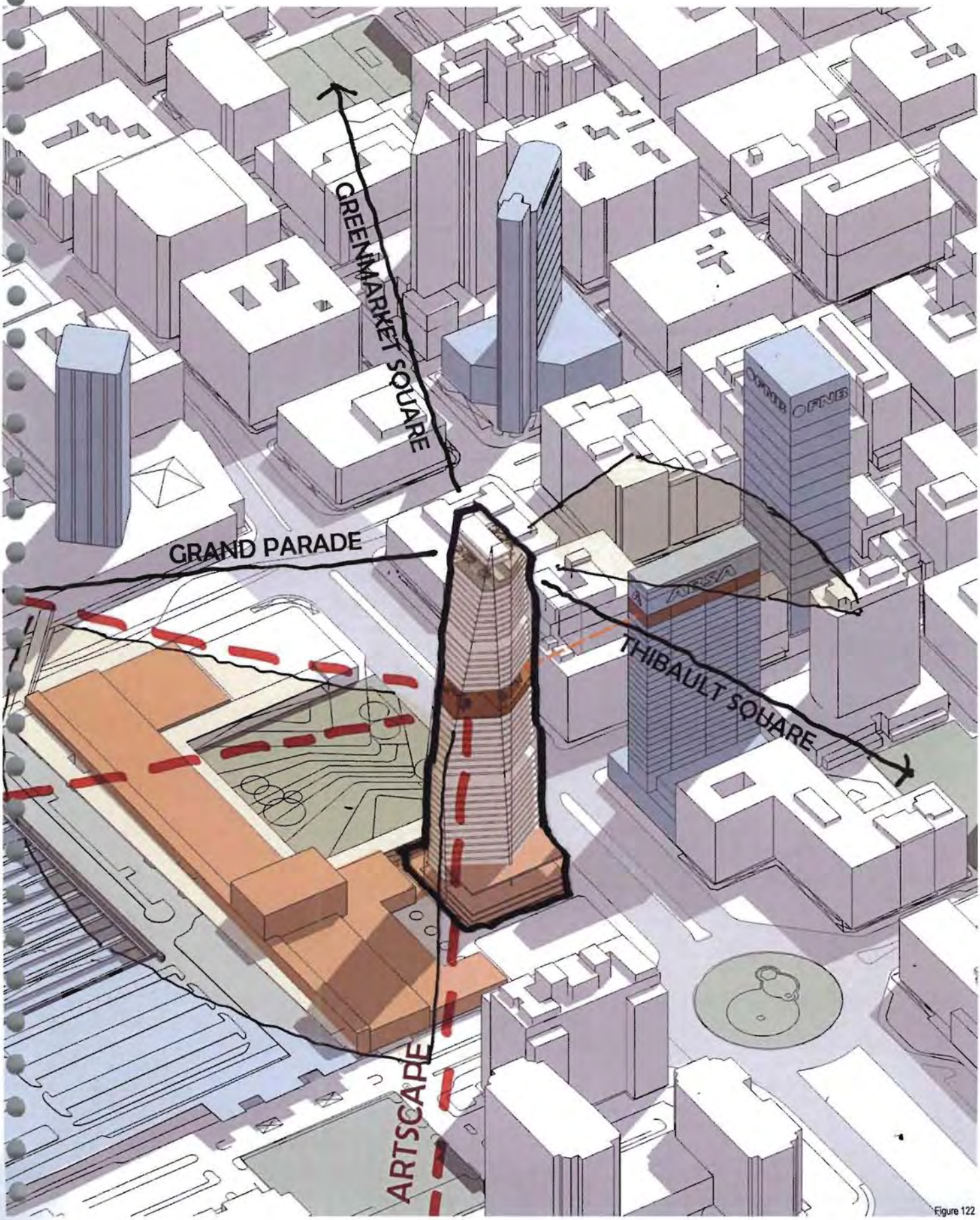

GREENMARKET SQUARE
GRAND PARADE
THIBAULT SQUARE
ARTSCAPE
ABSA

Figure 122

The Urban Setting

Urban Links

The urban setting is the most significant part of the building. It is the intangible aspect of the architecture that gives the building a place in the city. The tower relates to the city and the mountain through its formal expression.

From the framed views to the faceted illusion, the building pays homage to the mountain at different scales. The mountain is a major part of the architecture of the building. The images below show the dialogue between the mountain and the building from the city scale to the human scale.

The building also has major urban links to major nodes around the city. The skycourts right at the top and around the building create a new vantage point for the city. These skycourts relate directly to the different public plazas in the vicinity. The facets give a direct visual line towards the respective public spaces. The images on the right illustrate the relationship between the building, Greenmarket Square, Company Gardens and the Grand Parade. The public spaces in the tower are purposefully designed with over scaled volumes to create a dynamic space in the building and simultaneously allow the spaces to be legible from the ground level in the city.

In an attempt to be successfully 'transit integrated' the building creates a strong connection to the station terminal. The grounding strategy of the building, designed as public arcade will ground the building firmly in the city through its accessible and dynamic spaces.

Figure 123

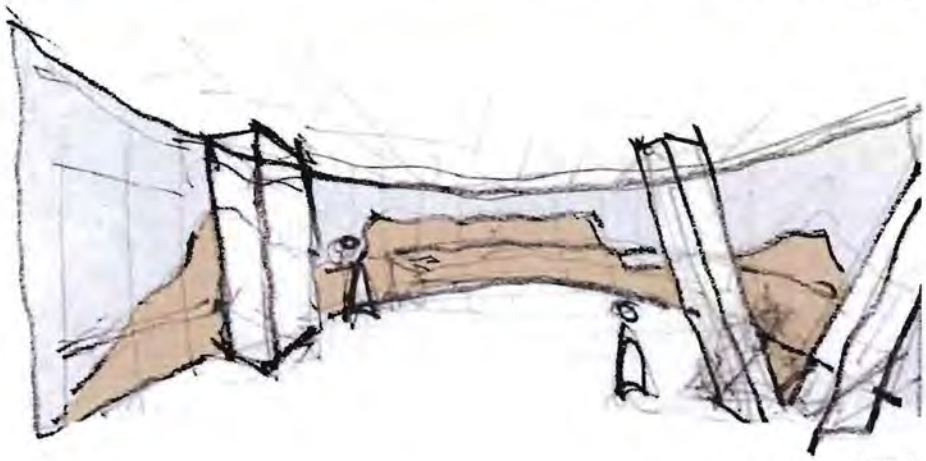
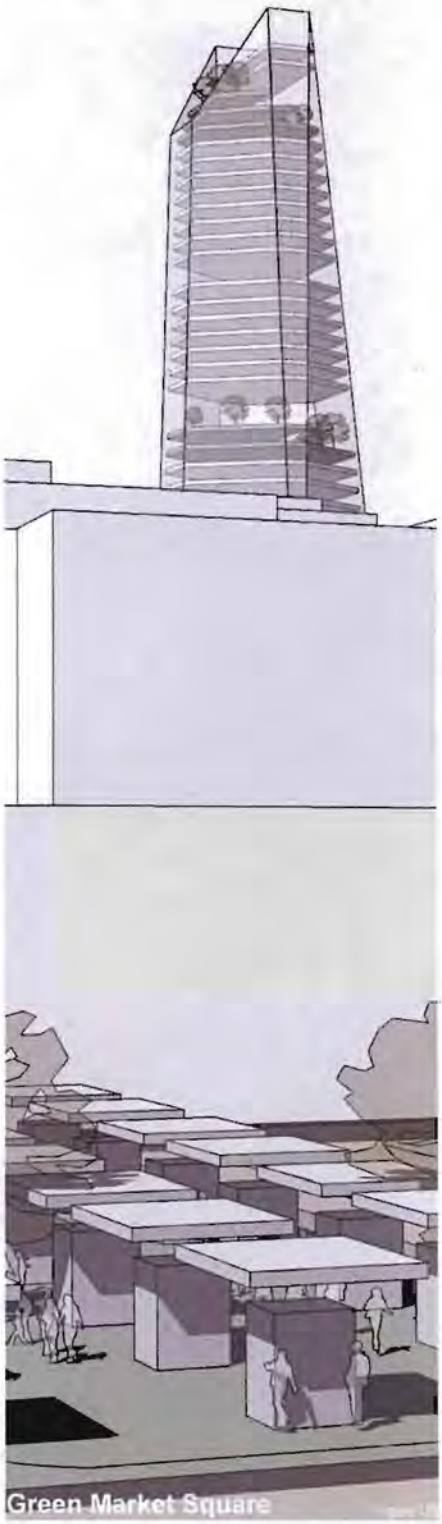


Figure 124

Figure 125



The Grand Parade

Figure 127

Company Gardens

Figure 128

Sustainability Strategies

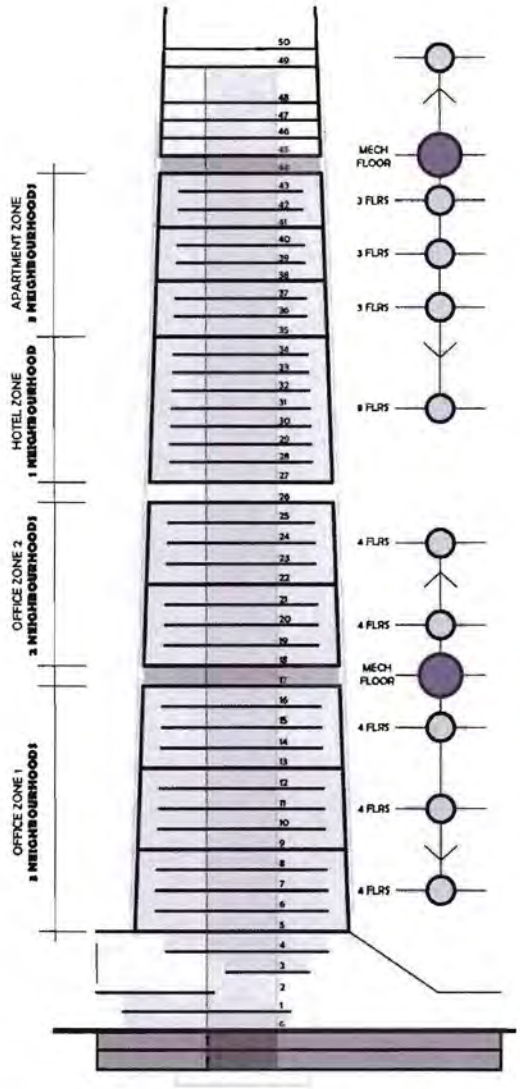


Figure 129

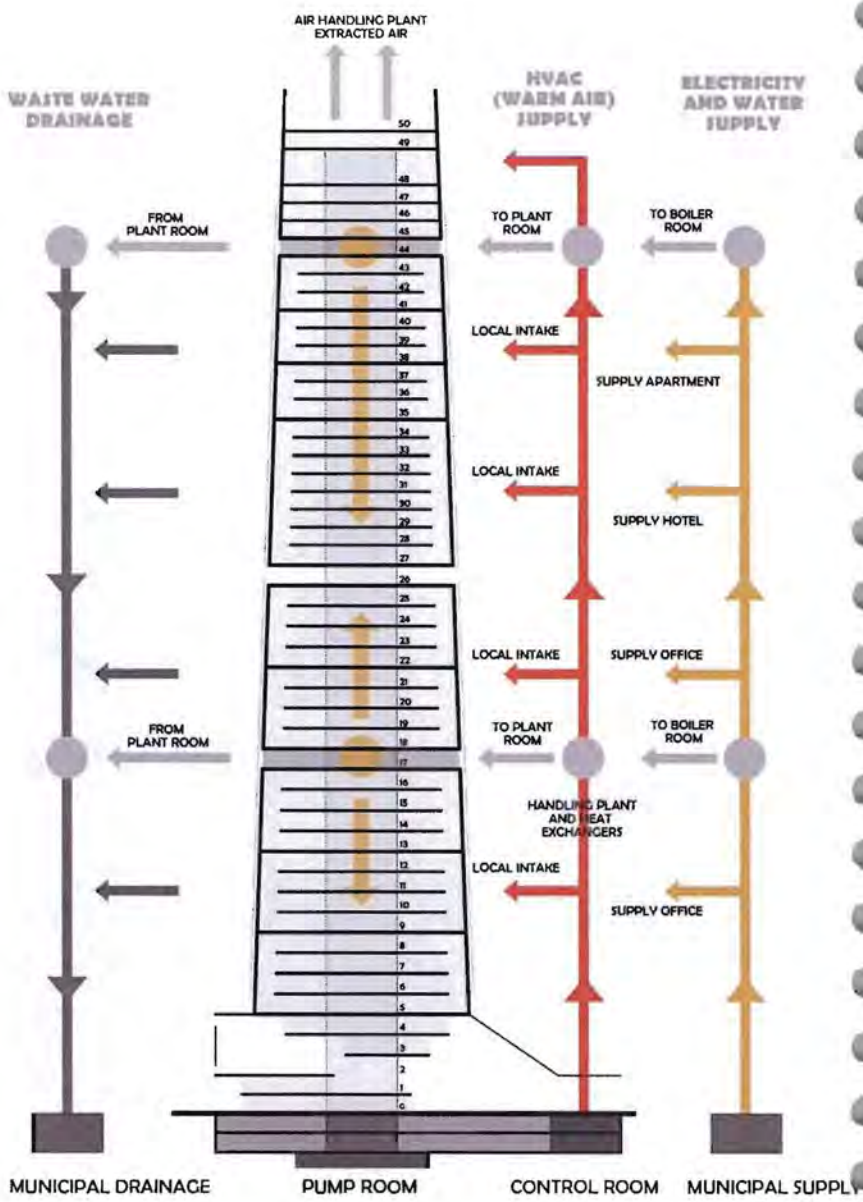


Figure 130

Vertical Neighbourhoods

The building is split into self sustained vertical neighbourhoods. This allows it to become more efficient in its energy usage and passive strategies. These neighbourhoods also split the building services up and all have exclusive relationships with the mechanical plants. The neighbourhoods are highlighted by terraces that run down one of the facets and help with passive ventilation.

Building Services

The building has two mechanical floors. These floor contain the storage tanks and plant rooms which receive the municipal supply and distribute it to different neighbourhoods throughout the tower. The first plant room services both office zones while the second one services the hotel and apartment floors.

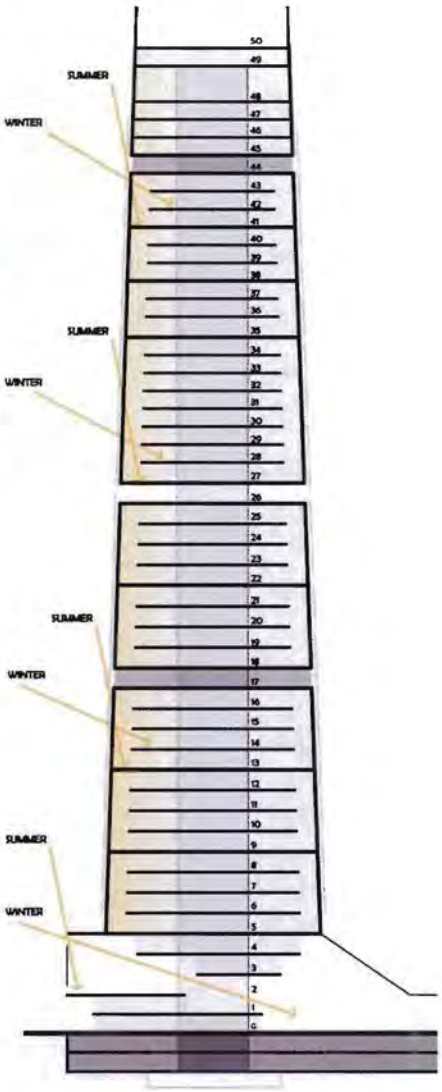


Figure 131

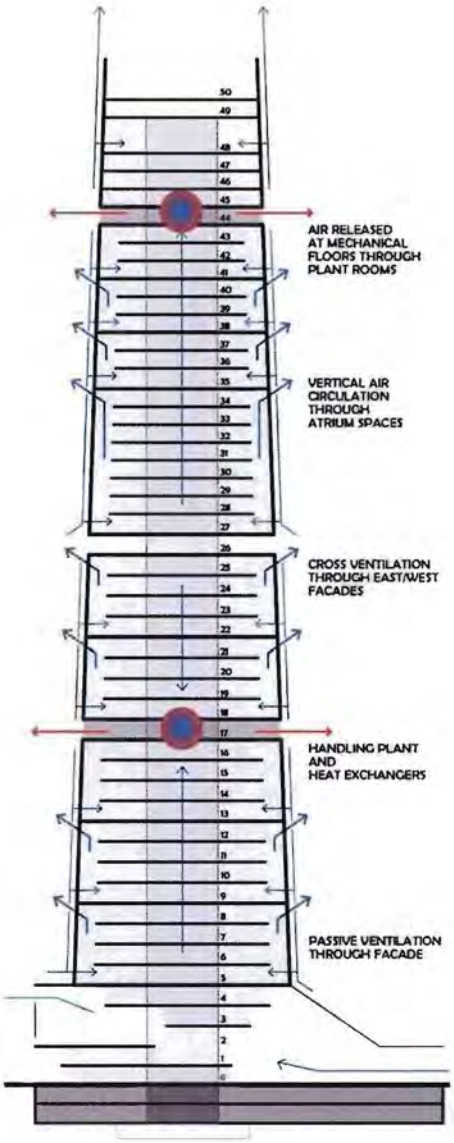


Figure 132

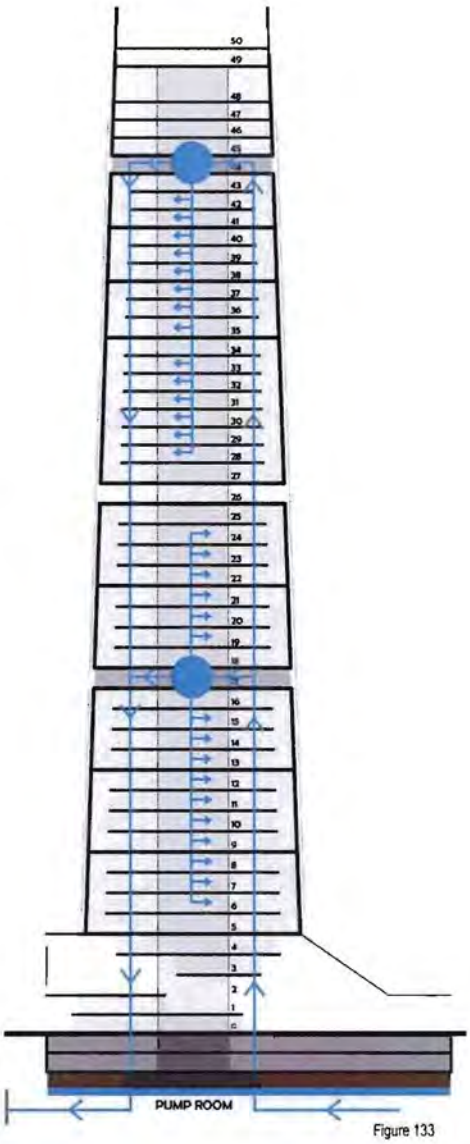


Figure 133

Daylighting

The terraces that cut through the building floor plates allow natural light to penetrate deep into the spaces. The shallow floor plates coupled with the terrace volumes allows the building to be naturally lit during the entire duration of daylight hours.

Passive Ventilation

The building was designed to harvest the south easterly and allow for cross ventilation through the south east and north west ends of the spaces. The terraces allow for vertical ventilation in each neighbourhood. Exhaust air is extracted and expelled through the mechanical floors.

Camissa Water Supply

One of the special qualities of the immediate context is that it has the Camissa water stream running below the precinct. This water will supplement the municipal water supply. By tapping into the Camissa water supply, the building responds to the local Cape context in its servicing strategy.

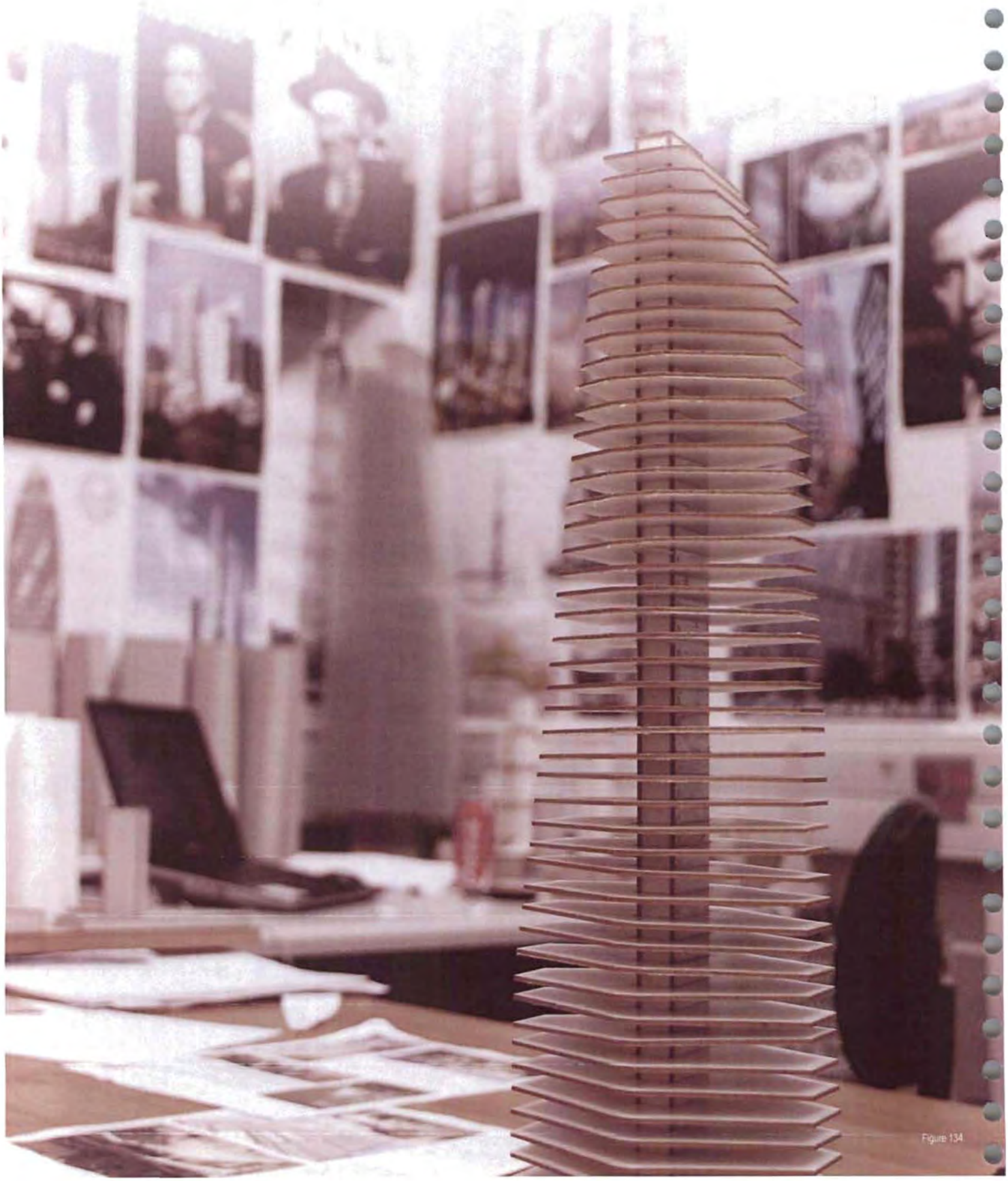


Figure 134

Conclusion

The project set out to design an urban responsive skyscraper in Cape Town. Through understanding the city and its characteristics, a set of constraints and opportunities were identified. The resultant building responds to the characteristics of the city. It interacts with the city at many different levels and sets a precedent for new buildings of this nature to take shape, not only in Cape Town but in cities all over the world.

Every aspect of the building is embedded in the context of Cape Town;
Its's shape is moulded by the 'cape doctor'. Its mass contorts to pay homage to Table Mountain, while its orientation is in ovation of Devil's Peak. The programme addresses the issues of residential occupancy in the city bowl. Its spaces are orientated in response to existing city landmarks and vistas.

It meets the ground elegantly, creating urban spaces for the city that will cater to the day to day realities of the everyday Capetonian. Simultaneously it uplifts the notion of public transport which will create an incentive for a more sustainable method of commuting to and from the city.

Simply put, the building is in concert with the city of Cape Town. It is an 'urban responsive' skyscraper which sets an example that future high-rises can follow and hopefully encourage the development of more skyscrapers in the city.

Figure 135

Bibliography

Abel, Chris. 2006. High-Rise and Genius Loci. Council for Tall Buildings and Urban Habitat (CTBUH)

Ali, Mir. 2005. The Skyscraper: Epitome of Human Aspiration. CTBUH

Ali, Mir. 2008. Toward a Better Urban Life: Integration of Cities and Tall Buildings. CTBUH

Ang & Prins, 2003. Strategies for Tall Buildings in the Netherlands. CTBUH

Boraine, Andrew. 2008. Cape Town Central City. Cape Town Partnership

Collins, M. 2004. Restoring Urban Sensibility: Returning Soul to Seoul. CTBUH

Eisele & Kloft. 1999. High Rise Manual. Birkhauser

Howeler, Eric. 2003. Skyscraper; Designs of the Recent Past and for the Near Future. Thames and Hudson

Jencks, Charles. 1980. Skyscrapers – Skycities. Rizzoli International Publishers

Krummeck, Stefan. 2010. A New Urbanity: The Relationship between Towers and Urbanism. CTBUH

Lindner, Christopher. 2006. Urban Space and Cityscapes. Routledge

Malott, David. 2010. Case Study: Hong Kong International Commerce Centre. KPF. CTBUH

Pedersen, William. 2004. Strategies for Tall Urban Buildings. KPF. CTBUH

Rees, Wayne. 2008. London: World City in a Sustainable Location. CTBUH

Shiyan,Huang. 2004. Urbanization Characteristics of the Skyscraper. CTBUH

Strelitz, Ziona. 2005. Tall Buildings; A strategic Design Guide. RIBA Publishing & British Council for Offices

Terranova, Antonino. 2008. New Urban Giants; the Ultimate Skyscrapers. White Star Publishers

Urban Design Branch. 2009. Central City Development Strategy. City of Cape Town. Government Publications

Urban Design Branch. 2012. Draft Urban Design Guidelines for Tall Buildings. City of Cape Town Department of Spatial Planning and Urban Design

Urban Design Branch. 2012. Draft Tall Building Policy. City of Cape Town Department of Spatial Planning and Urban Design

Wells, Matthew. 2005. Skyscrapers; Structure and Design. Lawrence King Publishing

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