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

HENRY ABOSI

OCTOBER 2012
The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.
PLAGIARISM DECLARATION

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.
2. I have used the Harvard convention for citation and referencing. Each contribution to and quotation in, this essay/report/project/paper.............. from the work(s) of other people has been attributed, and has been cited and referenced.
3. This essay/report/project/paper.............. is my own work.
4. I have not allowed, and will not allow, anyone to copy my work.

Signature

Date: 17/10/2012
Contents

Preface iii
Introduction iv

Background 1
Skyscrapers in South Africa
The Urban Significance of Skyscrapers

High-Rise Urbanity 3
Urban Impacts of Skyscrapers
Urban Reality of High-Rises in Cape Town
Synopsis

Setting an Urban Precedent 19
Adderley Urban Strategy
Precinct Studies & Analyses
Site and Urban Scenarios

A Facet with a Cause 27
Form Exploration & Wind Tunnel Testing
Morphology
Programme
Core Design

Exploring Tectonics 43
Cape Town’s Tectonic Expression
Tectonic Considerations
Structural Resolution

Urban Setting 47
Urban Links
Sustainability Strategies

Conclusion 54
Bibliography 55
Picture Credits 56
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.
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."
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.
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.
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"
'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.

\[\text{Figure 10}\]

- The Shard, London Bridge: Mapped with three anchor functions and public functions at different heights through the tower.
- Study of high-rises functions in Cape Town.
- Jin Mao Tower in Shanghai is a symbol of the city embodying versatile interactions.
- The Leadenhall building in London preserves architectural space.
- The New York skyline is synonymous with large cities. The city is immediately recognizable 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.

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.

“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)

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 activities. A good example of this is the forecourt of the Swiss Re Building in London which transforms into a mini-plaza everyday to facilitate the midday lunch break.
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 34**

- **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
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 breathtaking 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.
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.
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.
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 itself 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.
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'.
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.
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.
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.
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.

"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"
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.

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.

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.

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.
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.
Historical Time Line Study

Before exploring directions for the city’s future, it was pivotal that there was an understanding of 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.
A study of 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 boasts a much more impressive built skyline while Cape Town relies on the Mountain as a natural skyline.
Site & Urban Scenarios

Five sites were selected based on 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 this type of development. The initiative was to develop a high-rise typology that would integrate aspects of itself to a major transport hub.
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.

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 buildings 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.
LEADENHALL TOWER
CROSS FLOOR AREA: 3340m²
NET FLOOR AREA: 2820m²
FLOOR AREA RATIO: 78%
FLOOR COUNT: 48
BUILDING HEIGHT: 225m
AVE. FLOOR DEPTH: 40m
REF. FLOOR PLAN: 22
FUNCTION: OFFICE

RICHARD ROGERS
GROSS FLOOR AREA: 3340m²
NET FLOOR AREA: 2820m²
FLOOR AREA RATIO: 78%
FLOOR COUNT: 48
BUILDING HEIGHT: 225m
AVE. FLOOR DEPTH: 40m
REF. FLOOR PLAN: 22
FUNCTION: OFFICE

FREEDOM TOWER (1 WTC)
CROSS FLOOR AREA: 2840m²
NET FLOOR AREA: 1980m²
FLOOR AREA RATIO: 69%
FLOOR COUNT: 104
BUILDING HEIGHT: 541m
AVE. FLOOR DEPTH: 12m
REF. FLOOR PLAN: 32
FUNCTION: OFFICE

NEW YORK TIMES
CROSS FLOOR AREA: 2650m²
NET FLOOR AREA: 2010m²
FLOOR AREA RATIO: 75%
FLOOR COUNT: 52
BUILDING HEIGHT: 319m
AVE. FLOOR DEPTH: 12m
REF. FLOOR PLAN: 25
FUNCTION: OFFICE

SO ST. MARY AXE
CROSS FLOOR AREA: 3345m²
NET FLOOR AREA: 2465m²
FLOOR AREA RATIO: 75%
FLOOR COUNT: 40
BUILDING HEIGHT: 220m
AVE. FLOOR DEPTH: 17m
REF. FLOOR PLAN: 15
FUNCTION: OFFICE

LONDON BRIDGE TOWER
CROSS FLOOR AREA: 2900m²
NET FLOOR AREA: 2100m²
FLOOR AREA RATIO: 76%
FLOOR COUNT: 60
BUILDING HEIGHT: 300m
AVE. FLOOR DEPTH: 14m
REF. FLOOR PLAN: 28
FUNCTION: OFFICE

THE HERON TOWER
CROSS FLOOR AREA: 1040m²
NET FLOOR AREA: 800m²
FLOOR AREA RATIO: 76%
FLOOR COUNT: 46
BUILDING HEIGHT: 280m
AVE. FLOOR DEPTH: 20m
REF. FLOOR PLAN: 20
FUNCTION: OFFICE

FUNCTION: OFFICE

GROSS FLOOR AREA: 2650m²
NET FLOOR AREA: 2010m²
FLOOR AREA RATIO: 75%
FLOOR COUNT: 52
BUILDING HEIGHT: 319m
AVE. FLOOR DEPTH: 12m
REF. FLOOR PLAN: 25
FUNCTION: OFFICE

FORSTER & PARTNERS
GROSS FLOOR AREA: 3345m²
NET FLOOR AREA: 2465m²
FLOOR AREA RATIO: 75%
FLOOR COUNT: 40
BUILDING HEIGHT: 220m
AVE. FLOOR DEPTH: 17m
REF. FLOOR PLAN: 15
FUNCTION: OFFICE

RENZO PIANO B.W
GROSS FLOOR AREA: 2900m²
NET FLOOR AREA: 2100m²
FLOOR AREA RATIO: 76%
FLOOR COUNT: 60
BUILDING HEIGHT: 300m
AVE. FLOOR DEPTH: 14m
REF. FLOOR PLAN: 28
FUNCTION: OFFICE

FUNCTION: MIXED USE

KPF
GROSS FLOOR AREA: 3040m²
NET FLOOR AREA: 2400m²
FLOOR AREA RATIO: 77%
FLOOR COUNT: 46
BUILDING HEIGHT: 320m
AVE. FLOOR DEPTH: 20m
REF. FLOOR PLAN: 20
FUNCTION: OFFICE

SCALE TEST | ANALYSIS | TYPICAL FLOOR PLAN | SECTION

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.
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.
**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 the 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 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.
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.
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.
Parking Provision

The parking space that the building provides is 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 100m$^2$. This is a very unsustainable regulation. The new Portside tower has provided only 2.7 bays per 100m$^2$ (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.

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 its urban environment right from the core shaft.
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.

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.

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.

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.
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 into 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.
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 they travel through the building.
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.
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.
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 and 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.
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 reduce chances of oscillation as a result of vortex shedding due to the south easterly winds.
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 overscaled 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.
Sustainability Strategies

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 floors 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.
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.
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 shape is moulded by the 'cape doctor'. Its mass contours 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.
Bibliography

Boraine, Andrew. 2008. Cape Town Central City. Cape Town Partnership
Howeler, Eric. 2003. Skyscraper; Designs of the Recent Past and for the Near Future. Thames and Hudson
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
Rees, Wayne. 2008. London: World City in a Sustainable Location. CTBUH
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
Picture Credits

All pictures, diagrams, drawings and images in this document were taken/produced by the author unless stated otherwise.

- Figure 1. Cape Town city bowl - Google Images
- Figure 8. Cape Town city bowl - CTICC Brouchure
- Figure 9. Carlton Centre - Google Images
- Figure 10. Mutual Heights - Google Images
- Figure 11. Portside Tower - dhk Architects
- Figure 12. Alice Lane Towers - Google Images
- Figure 13. Bank of America Tower - Arch Daily
- Figure 14. Shanghai Tower - CTBUH
- Figure 17. The Jin Mao Building - Google images
- Figure 18. The Ledenhall Building - Google image
- Figure 19. The New York City Skyline - CTBUH
- Figure 21. The John Hancock Centre - CTBUH
- Figure 22. The Hong Kong ICC - CTBUH
- Figure 23. The Marina Bay Sands Tower - CTBUH
- Figure 24. 30 St Mary Axe Tower's - Google image
- Figure 25. Mahanakhon Tower - Arch Daily
- Figure 26. The Bank of America Tower - CTBUH
- Figure 33. The Lever House - Google image
- Figure 34. The Seagram Building - Google image
- Figure 35. The Lever House - Google image
- Figure 61. The Heron Tower - (Zacknic, 1998)
- Figure 62. The Lever House - Google image
- Figure 63. The Harkou Tower - Arch Daily
- Figure 64. Three First National Plaza - (Zacknic, 1998)
- Figure 65. The Leadenhall - (Zacknic, 1998)
- Figure 66. Strand/Adderley Street intersection - Flickr
- Figure 68. New CTICC - www.futurecapetown.com
- Figure 69. Connect Cape Town - www.futurecapetown.co.za
- Figure 70. Mixed use high rise on Adderley Street - Louis Karol Architects
- Figure 71. Shenzhen Corridor - Google images
- Figure 75. ABSA Building 1969 - Flickr
- Figure 76. Adderley Street - Flickr
- Figure 87. Wind Displacement Diagram - Eisele & Kloft, 1999