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RETAIL IN MOTION

RETAIL AS CO-ACTING CATALYST IN TRANSIT ORIENTED DEVELOPMENT

In accordance with Regulation 4(c) of the General Regulations (G.57) for dissertations and theses, I declare that this dissertation, which I hereby submit for the degree Master of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I further state that no part of my dissertation has already been, or is currently being, submitted for any such degree, diploma or other qualification.

I further declare that this dissertation is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

Marietjie Liebenberg
January 2022

Submitted to fulfil part of the requirements for the degree of Master of Architecture (Professional), Department of Architecture, Faculty of Engineering, Built Environment, and Information Technology (EBIT), University of Pretoria

ABSTRACT

Changes in consumption behaviour and consumption priorities present fertile ground to postulate different, more future-proofed forms of retail architecture. Considering the spectrum of retail interface; from e-commerce (extra convenient/fast) at one end to ‘retailtainment’ (extra experiential/ lasting) at the opposite end; emerging patterns indicate less demand for midway solutions and more demand for the extremes. For the contemporary consumer acquiring basic convenience products must be so integrated into everyday living that it takes no time at all and acquiring specialty products or services must be so entertaining and diverting as to be considered an adventure.
Public transport developments are considered urban catalysts. It should be noted however that the true value of a catalyst is realised through its interrelationship with other surrounding catalytic establishments, and only through the right co-acting arrangement can critical mass be created.
Considering the catalytic potential of both retail and transit developments begs the question - why limit retail integration with the usual office and gym function only to create more non-central nodes and forms of non-equitable inverted public space? To what level could retail be made convenient and part of everyday life if integrated with a daily commute transport terminal, and to what level could retail be made an experience if integrated with heritage, tourism and civic space? Conversely, in what ways can retail as catalyst be optimally used to create critical mass?
This dissertation investigates the following aspects in the context of the Pretoria inner city in South Africa:

Whether an improved integration of truly public space and pseudo-public space can lead to a higher level of social sustainability.

Whether an integration of formal retail, informal trade, and public transit, can lead to a higher level of sustainable consumption.

And whether an integration of infrastructure and retail space can lead to improved adaptability and resilience.

LOCATION

Tshwane Gateway Precinct
Address: 546 Paul Kruger St, Pretoria
GPS Coordinates: -25.7578, 28.1901

RESEARCH FIELD

Regenerative +
Resilient cities

CLIENTS

1. Gautrain Management Agency
2. Bombela Concession Company
3. Passenger Rail Agency of South Africa

PROGRAMME

Transit retail [Railway + Road]

KEYWORDS

Transit retaiL, Transport Oriented Development, Railway terminal, Retail architecture resilience

1 INTRODUCTION

A matter of personal interest

1.1

OVERVIEW

The United Nations (2005) describes sustainable development as the integration of three components: environment, economy, and equity. These components are not merely a list of aspects to attend chronologically but "interdependent and mutually reinforcing pillars" (United Nations 2005). If we fail to address one of these components sustainably, all three will fall short. In this paper a specific type of development will be under scrutiny – retail and commercial development. South Africa is home to more than 24 million m^2 of shopping centre surface area (Prinsloo 2018). That is approximately 2 000 shopping centres (Bell 2020), 46 of which can be found in Tshwane.

Since the first fully enclosed shopping centre in 1969 (Anon. 2020) they have become ingrained in the urban fabric of South Africa, birthing their own urban nodes, and shaping South African's conception of public space in a modernist consumer paradigm. As a contemporary cathedral of consumption (Ritzer 2009) with extensive urban spatial influence it is relevant to ask: Does retail architecture in Tshwane address all three interdependent components of sustainability – environment, economy, and equity?

Figure 1.1
Surface parking areas as green open urban spaces (Author 2021)

1.2

GENERAL ISSUE

Similar to other developed and developing cities in the world inequality and segregation remains a reality in Tshwane (OECD 2018). With high levels of socio-economic disparity, and even more prevalent spatial inequality inherited as part of the residual Apartheid urban fabric (Everatt 2014). The part of South Africa that finds themselves in the more affluent middle economic class category is characterised by increased and a stubbornly linear model of consumption. Modern retail and its most common form, the mall contributes to these aspects of societal fragmentation, environmental resource depletion and waste production.

As in all ongoing processes, pattern adjustments do occur, even if at a slow pace. From a top-down perspective municipalities provide public transport infrastructure and spatial development frameworks (Economic Development and Spatial Planning Department 2018) that encourage transport-oriented development. National departments provide strategies to aid a circular waste economy (Tahulela & Ballard 2017). And from an unplanned global trend perspective digital retail increases due to larger technological accessibility and growing supply chains, intensified by the present Covid 19 pandemic culture, generating consumers in search of more experiential retail over that of traditional. These adjustments constantly seem to misalign, unable to unite for substantial change.

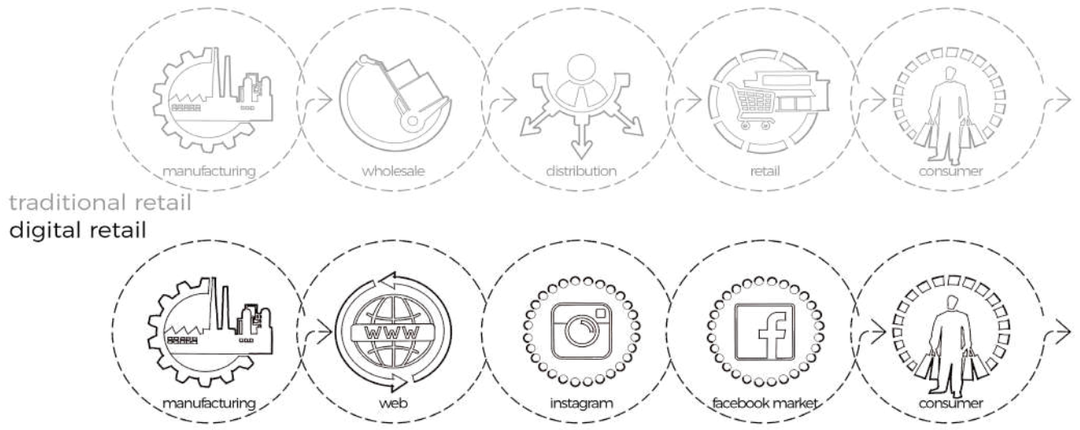


Figure 1.2
Retail pattern changes (Author 2021)

Figure 1.3
a) This dark Palm Beach mall is completely deserted (Greenberg 2020) b) Neighbourgoods (Idsinga 2019)

1.3

URBAN ISSUE

Due to commercial decentralisation and the expansion of residential areas at the peripheries of Tshwane's built area, the urban fabric has progressively become more polycentric "effectively creating separate cities within the municipality" (Everatt 2014:6). This structure has led to the continuing decline of Pretoria's central district urban fabric. Deterioration of urban public space and infrastructure has created an area lacking in socio-economic opportunity and the associated investment and development (Everatt 2014). Karina Landman (2015) provides three terms to describe the trends in South African urban public space as a result of economic and social challenges: deterioration, privatisation, and celebration. A fear of crime along with perceptions of declining inner city spaces has promoted an increase in privatisation of public spaces or pseudo-public spaces (Giddings, Charlton & Horne 2011), with many such transformations taking the form of corporate and shopping plazas (Loukaitou-Sideris 2012). These exclusionary, segregated and consumption focussed spaces that form part of a neoliberal capitalist urbanism "giving a privileged position to the market" (Carmona 2015) now defines the civilian's conception of public space. Along with a very limited number of decently maintained public green spaces to serve as resources for the reduction of environmental injustice (Currie 2017), the importance of public urban space in promoting an equitable environment is neglected.

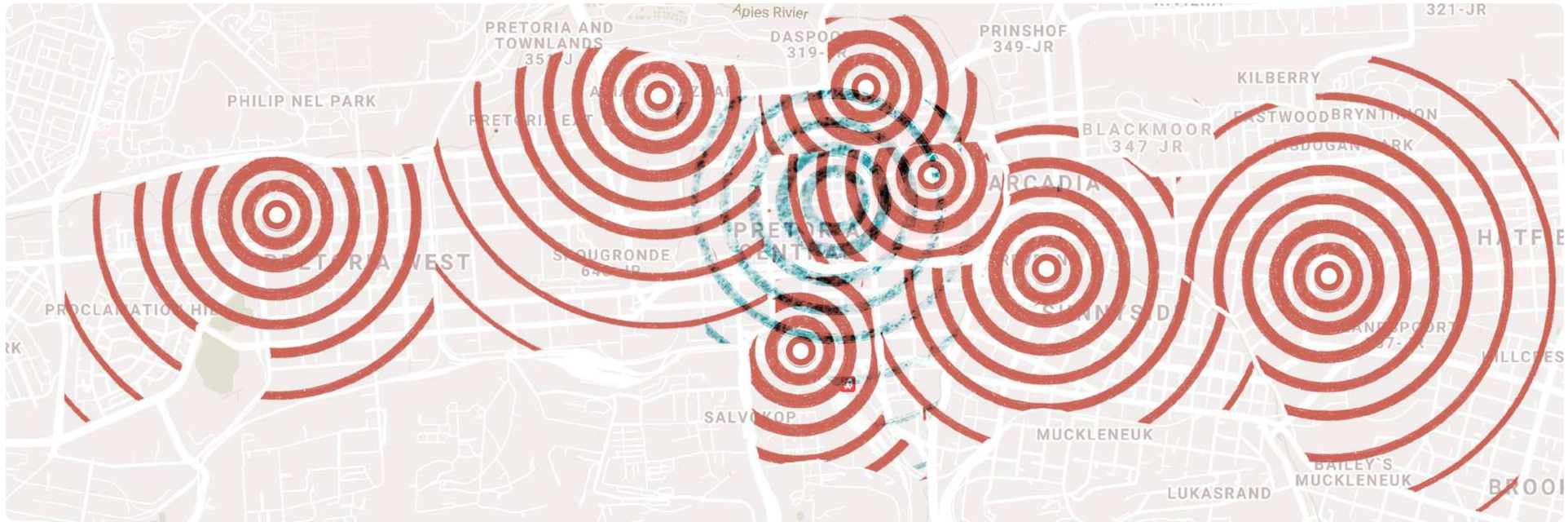


Figure 1.4
Decentralised urban fabric with major retail nodes (Author 2021)

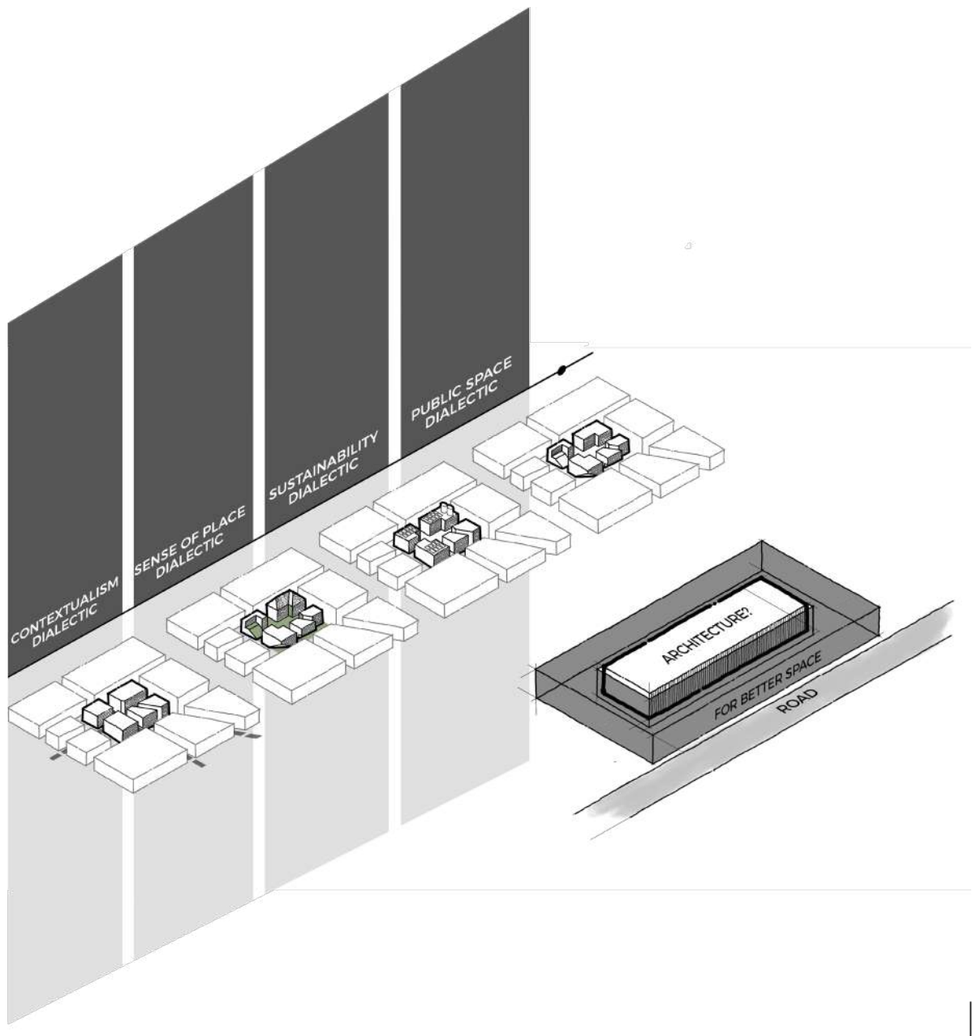


Figure 1.5
Contemporary architecture within the architectural theory continuum (Author 2021)

1.4

ARCHITECTURAL ISSUE

> *"If 'Architecture comes from the making of a room', as stated by Louis I. Kahn, a square or a street 'is a room by agreement. A community room, the walls of which belong to the donors … and whose ceiling is the sky'."* [1]

Many built aspects of Pretoria's inner city contribute to bad urban rooms. Looking at a figure ground image of the inner city demonstrates that except for a few blocks directly surrounding Church Square urban rooms will more accurately be described simply as voids – swaths of voids. "Town planning in South Africa emerged at a time when the modern movement in architecture and planning was at its height" (Parnell & Mabin 1995:55). The principles of the movement are apparent in the city's urban structure with wide vehicle (machine) prioritising streets, large, disconnected city blocks (Natrasony & Alexander 2005) and an overall tendency toward standardisation and categorisation that lent itself well to a caste system or Apartheid configuration (Parnell & Mabin 1995). This irreversible skeletal structure is accompanied by a superfluity of fences, plots and forecourts of surface parking, broken sidewalk surfaces, sparse street lighting, and barren areas of rest or arrival.

Looking at retail, pseudo-public spaces of commercial interest utilize a wealth-reflecting-architecture, "characterized by micro-designed strategies that aim to exclude" (Landman 2015) such as fences, barrier producing parking and public space inversion. Such architecture contributes to the deterioration of an equitably sustainable public space. Buildings that form part of such developments may be environmentally sustainable when measured in a disconnected state but are environmentally unsustainable when considered as part of the urban fabric, not only entrenching voids around it but becoming a void in the Lived space (Lefebvre 1991) of certain segments of society.

1.5

RESEARCH BY DESIGN

The design of a retail complex, as with any development, requires quantitative, objective data to ensure its relative success. Quantitative data collection and analysis must be expanded to include that of transport terminal operation considering the integration of retail and transport terminal toward an extra convenient retail activity.

The design of a retail complex that caters to both the need for convenience but also experience additionally requires qualitative data. Measuring identity and social phenomena is a complex aspect that exceeds the ability of scientific methods (Rehman & Alharthi 2016). Research methodology for this project will therefore not be limited to only a positivist paradigm or a constructivist paradigm but will hybridize "positivist experimental methodologies (and) constructivist interpretation and reflection" (Gray & Malins 2004:21).

Tools for quantitative data, such as GIS and digital data synthesis, along with tools for qualitative data collection, such as observation notation, mapping, photography, and interviews, will form a filter through which appropriate precedents are chosen (Fig 1.6). In design research, as described by Nijhuis (2012), precedents along with applicable theory are analysed both contextually and comparatively (typologically), using tools such as diagrams, concept mapping, and visual narratives. This is followed by experimental design study, applying observed practices within the context of a new intervention, using tools such as visualisation, maquettes, modelling and peer review, which is then made specific using information relevant to the specific site once again.

2.5.1 RESEARCH QUESTIONS

How can a different form of retail architecture accommodate changing retail and transport public patterns within a socially sustainable urban environment?

Supporting questions:

1. In what ways can retail architecture become more adaptable?

2. What form of retail architecture can act as co-acting catalyst in transit-oriented development?

3. What types of spaces are required for e-commerce within transport infrastructure?

4. How can transit-oriented developments contribute toward the identity of Pretoria?

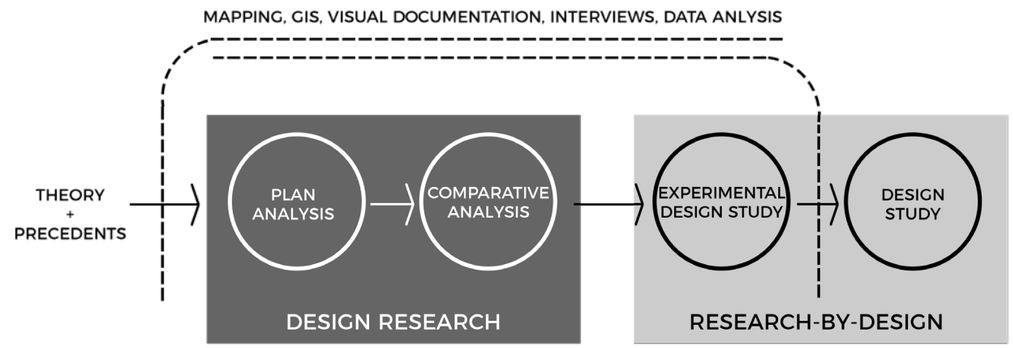


Figure 1.6
Research by design (Author 2021)

1.6

PROJECT SUMMARY

Within this dissertation the following aspects are investigated in the context of the Pretoria inner city in South Africa:

Whether an improved integration of truly public space and pseudo-public space can lead to a higher level of social sustainability.

Whether an integration of formal retail, informal trade, and public transit, can lead to a higher level of sustainable consumption.

And whether an integration of infrastructure and retail space can lead to improved adaptability and resilience.

2.6.1 PROGRAMME

The programme encompasses retail, informal trade, gastronomy, public events and co-working. Parking is also considered a core activity, as a large part of the building will intermittently be used for supporting the railway terminal in this way in the initial part of its lifecycle. This intervention is partnered with a mixed-use secondary structure focussed on the activity of play and entertainment.

2.6.2 PROPOSED CLIENT

The proposed client for this project is the public-private partnership owners of the Gautrain, the Gauteng Provincial Government and the Bombela Concession Company. In the Statement of financial performance for the year ended 31 March, 92% of Gautrain's total revenue was from Government grants (Gautrain Management Agency 2020). It is hypothesized that the Gautrain Management Agency could increase it's exchange transaction revenue by expanding its service offering, especially with programs not limited to peak times.

2.6.3 ASSUMPTIONS

It is assumed that the future Pretoria railway station surrounds will increase in density considering the current office development for the Department of Rural Development in Berea Park and the proposed government precinct development in Salvokop. It is also assumed that in a future with higher numbers of vaccinated civilians and a return to office environments, along with increases in fuel prices, railway commute will once again rise.

2.6.3 LIMITATIONS

Plans researched for the Old Audit building is dated 1950. Without full access to the building it is not possible to definitively know of the alterations it has undergone as a fast food restaurant. As the building forms part of the intervention assumptions are made about its renovations and current structure. structure has led to the continuing decline of Pretoria's central district

2.6.4 DELIMITATIONS

The total site area of the Pretoria station precinct is sizable and due to time constraints, a brief urban design and massing exercise was used to design the total area. The design intervention focus is then dedicated to a section of the site as designated within the urban design vision and as prevalent to the research intentions.

2 THEORETICAL DISCOURSE

Diagamming doctrines + demonstrations

2.1

RETAIL ARCHITECTURE

2.1.1 THE HISTORY OF RETAIL ARCHITECTURE

Exchange of goods have been central to human life since settlements came into existence. Not only central to human life but also urban fabric as marketplaces have been at the centre of new settlements as early as the 15th century in Europe (Benevolo 1980:27) and the 19th century in West Africa (to the extent that evidence could be collected) (Hodder 1965). Towns originated beside or at the intersection of major trade routes taking on the form of perpendicular networks with a market square at its centre (Benevolo 1980). A pattern repeated here in Pretoria with Church Square, or Market Square according to one of its original functions (Potgieter 1953). Markets were places of combined economic, social, civic, and recreational activities. Retail was integral to public space that "integrated members of the local community, strengthened human ties and testified to the towns' historical past" (Zagroba, Szczepanska & Senetra 2020:3). Following the Industrial Revolution supermarkets, or more accurately named convenience stores, gained popularity as part of a fast-paced life with modern problems such as needing a wider variety of products, wishing for a single destination, and desiring zero social interaction (Tron 2016). With post modernism retail reached the ultimate form for overcoming these problems along with a good dose of capitalist manipulation by creating a completely enclosed sunless space filled with a wide variety of goods in a single location at the periphery of a home suburb – an island box of misconstrued utopia floating in surface parking. More contemporary forms of retail have undergone changes. The mini artificial cities have begun to allow for more sun-filled and open-air spaces. Along with mix-uses that include hospitality, health, and residence. Throughout the development of the retail form, it can be noted that even with the desire for convenience, the consumer's desire for an urban street experience never wavered. The growing popularity of open-air markets illustrates that even the desire for a speedy, no social interaction retail experience has changed or that it had never actually supplanted consumers desire to experience community and human connection as more than a side order to the retail occasion. The content of contemporary forms of retail has also changed, dedicating more space to "entertainment and experience-based offerings" (Khan 2021) and falling prey to more and more vacancies in view of increased digital retail, Covid-19 pandemic, and an overall downward trend of several industries for the past years (BusinessTech 2021).The question now is, why are new forms of retail still islands floating on surface parking, why are their layouts and proportions still only conducive to a linear, non-digital process of consumption?

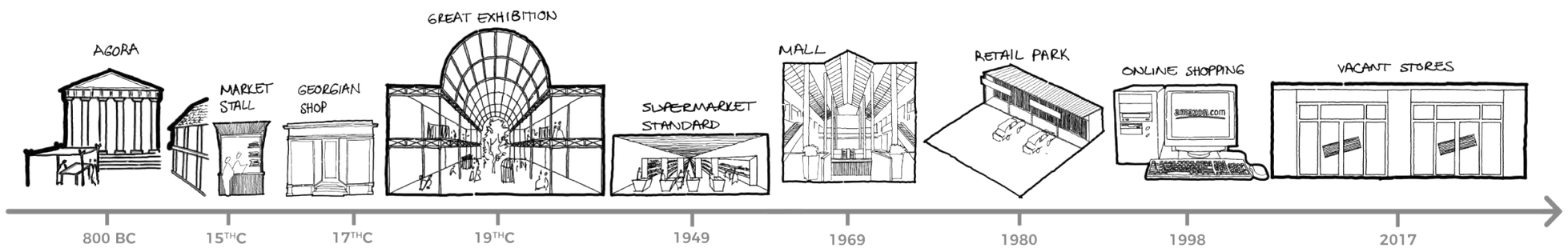


Figure 2.1
A history of retail forms (Author 2021)

2.1.2 THE INTANGIBLES OF RETAIL ARCHITECTURE

Planning – Strategy

The Tshwane Retail Strategy (2007) acknowledges that in the past only the size of the proposed shopping centre was used as criteria for approval and that a "more holistic approach" would improve the quality of retail development in Tshwane. It states that there is no "specific piece of legislation that governs retail development" (City Planning Development and Regional Services Department 2007:100), but conforms to a paradigm of pre-emptive planning and the judgement of decision makers. The strategy focusses on an integrated method that focusses on size, frequency, location, connections, environment, and appearance, as wells as the "social impact of the centre on the immediate environment" (City Planning Development and Regional Services Department 2007:89). The strategy acknowledges the importance of considering informal trading, a significant reality of South Africa's socio-economic condition, when planning for a retail development. Along with the need for public transport provision to establish more equitable accessibility. The principles of the strategy can be summarised in the following way:

- Retail developments must fit in with the Regional Spatial Development Framework and the pace at which new developments occur will be determined by market forces and the free economy.
- The site and wider area, as well as the way in which the retail centre will enhance the general district will determine the feasibility of the retail facility.
- The appraisal of proposed retail developments must consider the local setting and that uniform criteria do not apply to all areas.

Parking and transport

Transit oriented development is a popular approach backed by policy makers and planners in South Africa, but has in some ways failed to recognise the extent to which the general consumer mind-set must be transformed to successfully implement higher utilisation of public transport (Bickford 2013).

Bickford (2013) argues that South Africa's obsession with parking compromises a future of transit-oriented development, a fact evident in the Tshwane Retail Strategy where developers are described to always rather exceed the "standard parking requirement of 6 bays per 100m2 gross floor area" (City Planning Development and Regional Services Department 2007:11). Not only is this an unchecked habit of developers but the strategy promotes the use of this standard even in traditionally black urban area shopping centres where use of public transport is higher but recent data has indicated an increase in vehicle ownership in the areas and a preference for future parking problems to be avoided over further commitment to public transport. Planning frameworks do propose different zones for areas closer to nodes and public transport hubs that allow for less required parking bays. And the Tshwane Retail Strategy does promote the provision of public transport facilities and facilities for taxis. It states, however that such facilities do not have to be on site but can be relegated to a pavement space adjacent to a pedestrian access point.

Developers

Retail and commercial developers take several factors into consideration for the development of new properties:

- Size and composition of population
- Available labour market
- The economic base of the area
- Existing and future competition in the area
- Future growth of the development
- Availability of store site
- Location
- Access and traffic impact
- Topography
- Soil conditions
- Parking
- Environmental impact (City Plan ning Development and Regional Services Department 2007:107)

These factors form part of a feasibility study that determines whether the investment will be lucrative.

Even considering the importance of access to the site developers do not believe that they should be responsible for the provision of public transport infrastructure or facilities, and that any such facilities should be positioned off site (City Planning Development and Regional Sevices Department 2007). Developers are also disinclined to accommodate informal trading on site. Discernibly there are no incentives provided by local authority to entice developers toward more equitable or diverse space provision. There is also no perceived social obligation in ownership as recommended by Gregory Alexander where he cites the German Basic Law “ownership entails obligations. Its use should also serve the public interest.” (Dagan 2007:1257).

Figure 2.2
A contemporary retail form (Author 2021)

2.1.3 THE STATUS OF TRANSIT-ORIENTED DEVELOPMENT

Geoffrey Bickford (2013) laments the failure of transit-oriented development in recent years following substantial investments in public transport infrastructure. He argues that even though considerable development has taken place near Gautrain stations in Rosebank and Sandton these developments are largely “transit adjacent”, consisting of mix-uses and higher density but lacking fundamental aspects required to intrinsically link public transport and developments. The Pretoria station precinct – the chosen site for this research - not only lacks recent developments that link well with public transport systems, but any recent development at all. With no attempts in the foreseeable future at supporting public infrastructure’s goal of creating a more “socially integrated, environmentally friendly and universally affordable spatially patterned” (Bickford 2013) South Africa.

2.1.4 THE FUTURE OF RETAIL ARCHITECTURE

Changes in consumption behaviour and consumption priorities present fertile ground to postulate different, more future-proofed forms of retail architecture. Considering the spectrum of retail interface; from e-commerce (extra convenient/fast) at one end to ‘retailtainment’ (extra experiential/lasting) at the opposite end; emerging patterns indicate less demand for midway solutions and more demand for the extremes. For the contemporary consumer acquiring basic convenience products must be so integrated into everyday living that it takes no time at all and acquiring specialty products or services must be so entertaining and diverting as to be considered an adventure.

Pursuing a form of retail that accommodates the extremes leads to the consideration of retail as even less of a solitary programme than before. The partnership of retail with different programs becomes an important deliberation. Retail can be made vastly sustainable by supporting it with the correct functions and in turn retail can contribute to the transcendence of other programs.

Sternberg (2002) describes catalysts as “facilities – usually buildings – that generate urban development in their immediate surroundings…” (Sternberg 2002:31). Very importantly Sternberg (2002) distinguishes between the concept of catalyst and the concept of critical mass. A solitary catalyst in itself cannot create critical mass. The true value of a catalyst is realised through its interrelationship with other surrounding catalytic establishments, and only through the right co-acting arrangement can critical mass be created.

Considering retail potential in such light one must ask - why limit retail integration with the usual office and gym function only to create more non-central nodes and forms of non-equitable inverted public space? To what level could retail be made convenient and part of everyday life if integrated with a daily commute transport terminal, and to what level could retail be made an experience if integrated with heritage, tourism and civic space? Conversely, in what ways can retail as catalyst be optimally used to create critical mass?

2.2

HYBRIDITY

Hybridisation, as a concept in architecture has a surprisingly large spectrum of application. It is one of the aspects employed by Charles Jencks and Robert Venturi in postmodern discourse - in which architecture is considered a symbolic entity that expresses many heterogenous meanings. For Jencks and Venturi the complexity and contradiction of historic styles in architecture should be used to convey a hybrid system of symbols (Howe 2016).

In post-colonial discourse hybridisation is less symbolically focussed but is used to describe a "complex cultural palimpsest" (Çelik & Akalin 2019), a method whereby the integrity of spatial components are not deteriorated by fusion with the other but becoming something new and specific to place. Çelik & Akalin (2019) categorises this form of hybridisation using the relation between old and new. One of their categorisations is described as front/rear and one of the examples is the Ningbo History Museum in China designed by Wang Shu. By not only using the waste from the traditional buildings demolished on site but also a unique constructions style specific to the region and its history called "wapan", Wang Shu blends historical spirit, memory, and technology to form contemporary facilities.

Very similar to the post-colonial discourse but with a shift in focus to the contemporary side, hybridisation can also be applied when considering cross-breeding of local and international architectural elements.

Ptichnikova (2020) , in her article about hybridisation in architecture pays less consideration to symbolism and culture. She categorises hybridisation in three parts, typological, formalistic, and functional.

When different typological architectural spaces are combined, such as urban housing and rural housing, it is considered typological hybridisation. When familiar functions are housed in non-typical spatial forms it is considered formalistic hybridisation. Examples included housing a museum in a mill, or a bridge that is also a park. And the most well-known form of hybridisation is the integration of different functions, where economic risk is reduced by combining synergistic functions.

Such forms of hybridisation have long been used in architecture and has significantly contributed to the development of cities. The home above a shop is a common example and bridges have been known to become places of dwelling. These two examples lead to another delineation in hybridisation, that of the building scale and the urban scale. On an architectural scale hybridisation may be considered the combination of unrelated functions in a single building. Such an approach contests the notion of architectural typology and whether a building should "look like what it is". It risks the loss of inherent identity but also creates the potential for architectural space better designed for the complex, network-based paradigm of contemporary society.

On an urban scale hybridisation may be considered as the fusion of architecture, landscape, and infrastructure. Once again, designing in such a way must consider a balance. Definitive forms of architecture, landscape and infrastructure is important components for a sense of place. The clarity in their differentiation helps to define a place's identity in the mind of the people that use it. However, there is potential in this approach for an improved public space. Public space previously overlooked within the Modern paradigm of vehicle, and strictly separated function promotion.

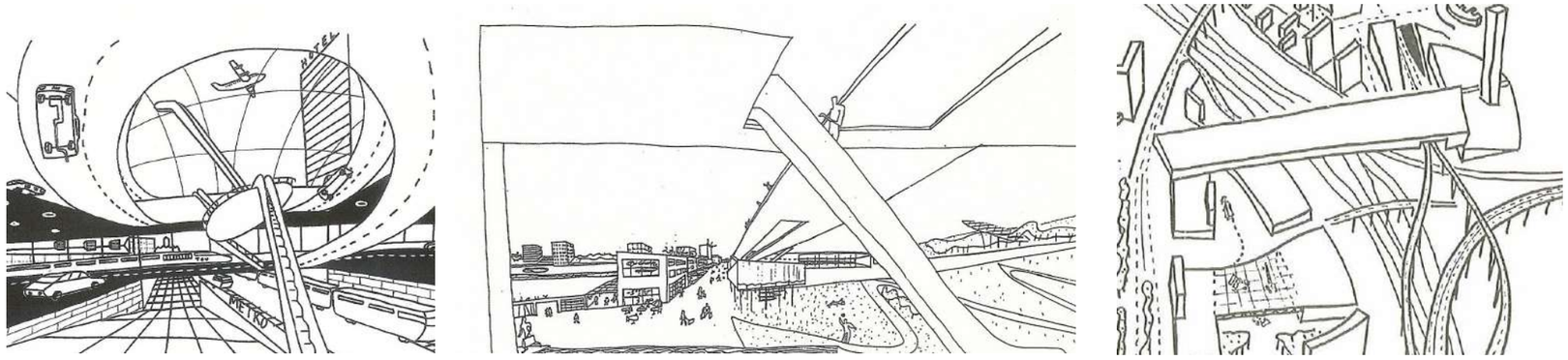


Figure 2.3
In the first figure flight lines, roadways and railways are used as architectural elements to define space. The second figure illustrates the escalator as an extension of the landscape. The third image shows the integration of infrastructure and buildings. (Koolhaas 1994)

2.2.1

PRECEDENT
1111 LINCOLN ROAD

Herzog & de Meuron
Florida

The parkade at South Beach designed by Herzog & de Meuron is a simple but sculptural hybrid of parking, retail and residence. The parking function is not relegated to a far off corner - it cannot do this due to the density of the area. Nor is it relegated to the basement. The simple off-shutter concrete aesthetics of the building is mostly due to the influence of its heavy neo-brutalist neighbour to which the structure is connected with bridges. The parkade serves the neighbouring building but also maintains functions in its own right as retail and event space.
The slabs of the structure are flat with a central ramp so the users of the building can see in all directions. The inclined columns not only acts as columns but continuous struts, enabling thin concrete slabs and unobstructed views of the city skyline. The variable heights of the floor slabs enable the different temporal dependent functions of the building.

Figure 2.4
1111 Lincoln Road elevation (Huffton 2021)

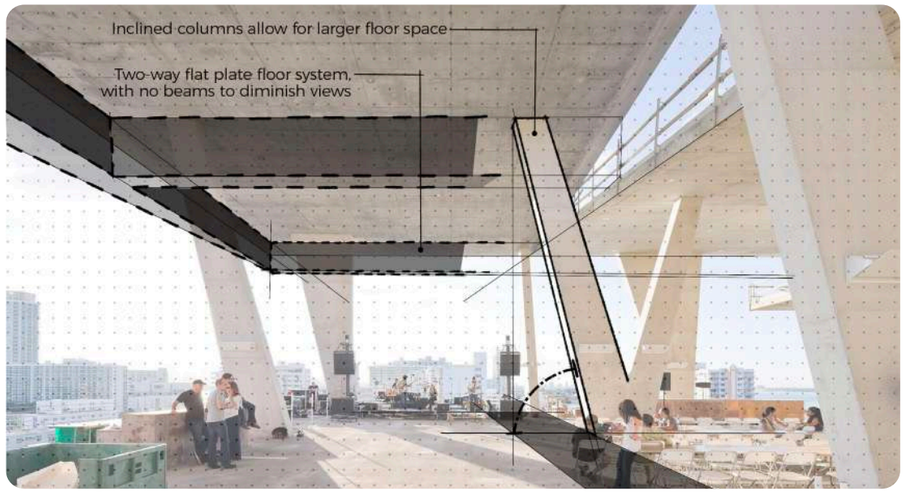


Figure 2.5
1111 Lincoln column and beam structure (Author 2021)

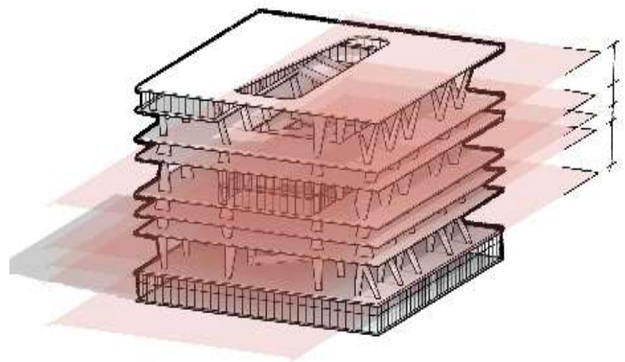


Figure 2.6
1111 Lincoln Road floor slab heights (Author 2021)

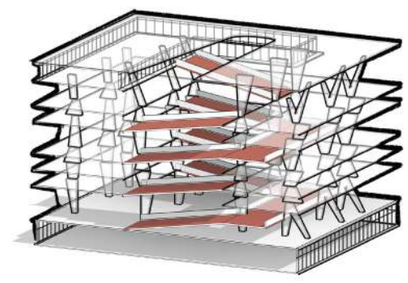


Figure 2.7
1111 Lincoln Road central core and ramp (Author 2021)

2.2.2

PRECEDENT
ENCANTS MARKET

b720 Fermin Vazquez Architectos
Barcelona

This open air market is designed to almost be a continuation of the street. It utilises a single continuous ramp from the one street corner of the site that folds back on itself for a gradual slope and ends at the opposite street corner that has an approximately 9m lower elevation than the other corner. The structure consists of below ground parking, retail spaces at the lower end which is closer to a busy street, a larger central open space and the very wide ramps. The elements that lend shape to the action of exchange is loose tables in the centre space and steel kiosks that line the ramps where vendors can secure their wares. These kiosks are modular and can easily be removed to off-site locations for maintenance or replacement.
The high roof creates a feeling of openness and publicness while keeping users protected from elements. The ceiling material is chosen for its light reflecting effects.

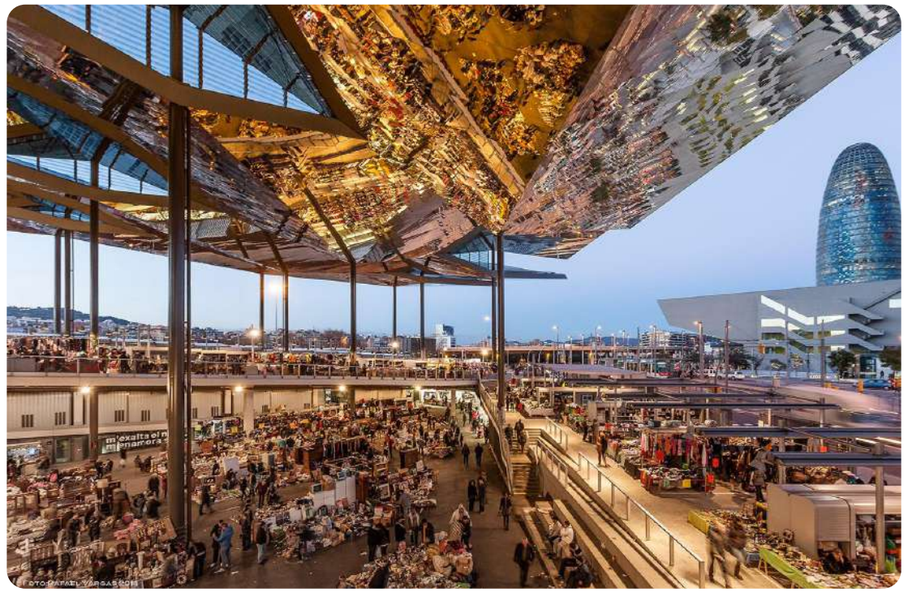


Figure 2.8
"Encants" market - view to interior (Bordas,2018)

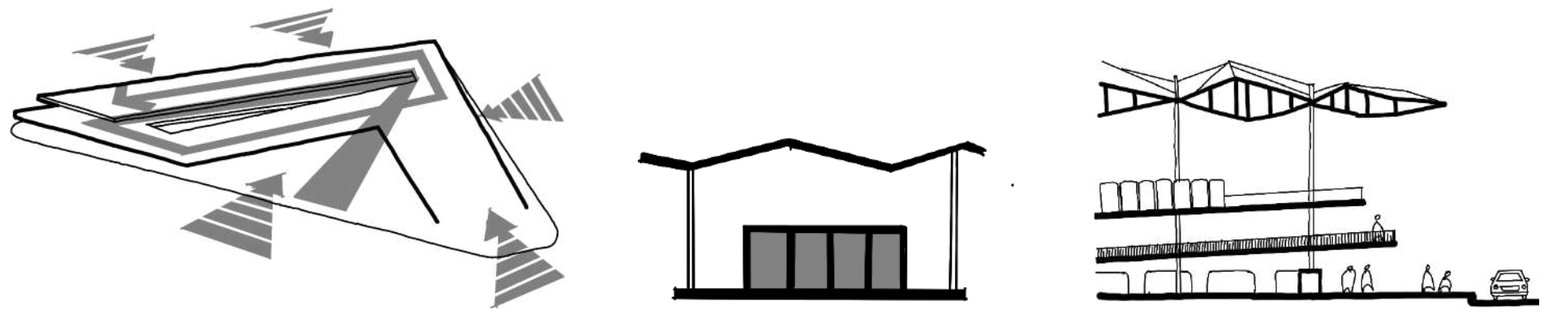


Figure 2.9
Encants market circulation and open structure (Author 2021)

2.3

WAYFINDING

Wayfinding is important in terminals. The architectural historian Koos Bosma (1996) maintains that a terminal should not solely be a machine for efficient people moving but also a place where travellers feel calm as they move through the building or wait for companions or the next form of transport. A large factor that contributes to a calm travel experience is enabling travellers to navigate intuitively rather than rely on signage. If travellers are less reliant on signage they experience less stress (Gordon 2004).
Wayfinding is one of the main aspects to mediate when merging retail with transit. Incorporating retail and food services can sometimes obstruct the transparent design required for easy wayfinding (Hubregtse 2020).

Some spatial and structural considerations from Wayfinding, Consumption, and Air Terminal Design by Menno Hubregtse (2020):
Concourses often have high ceilings so that travellers can always see where they are in the building. A large space with high ceilings helps travellers to be aware of the larger context layout. It would be reasonable to deduct from this that the main circulation design should be provided with vantage point opportunities, where a traveller can elevate their sightline and use the high-ceilinged space to its best advantage. Aspects of this ceiling, such as skylights, are used to indicate directional flow for travellers to instinctively navigate. Light is one of the best ways to aid intuitive wayfinding. It can be employed directionally as well as highlight focus points.
Another way in which architects use buildings as visual cues to push travellers in a certain direction is to align columns or even large beams parallel to major routes.
They also use the different sizes of spaces, larger spaces for important main routes and smaller spaces for less significant or more private destination routes.
Most terminal designs must defer to the infrastructure that it supports; in the case of airport terminals the overall form of the building is mainly determined by the runways. In the case if a railway concourse the largest determinant is the railway direction and layout.
NACO (Netherlands Airport Consultants), a consultancy and engineering firm in the aviation industry employs several strategies toward better wayfinding. One of the strategies is to minimise the number of decision points in a route, and to keep sightlines in the direction of travel unobscured. In Mexico's international airport NACO designed a balcony right after check-in so that travellers can look down at the terminals' central route decision point.
Different path forms are used in terminals when considering retail integration. Most paths maintain a degree of rectilinearity while the pathways employed through duty free shops and other retail are curvilinear and almost meandering.
One of the key elements that Hubregtse explores is how art enables wayfinding in terminals. He writes about the Coda (by Dennis Adams), a sculpture in Schiphol Plaza that contrast starkly with the interior of the plaza and has become a well-known meeting point for travellers meeting at the plaza. The artwork Freedom to Move (by Noel Best) is placed in the centre of an important decision-making point along the main route. The intention of the artwork is to break the traveller's pace and "draw their attention to the approaching intersection" (Hubregtse 2020). Artwork is also installed for the purpose of relaxing travellers. Every Beating Second (by Janet Echelman) consists of soft suspended fabric volumes over the skylights and air ducts of the area immediately after the security screening area. Below the artwork are soft benches and this allows for travellers to calmly put their shoes back on and take a breath after the screening process, with the fabric volumes moving softly overhead due to the airflow and creating a play in the light that enters through the skylights.

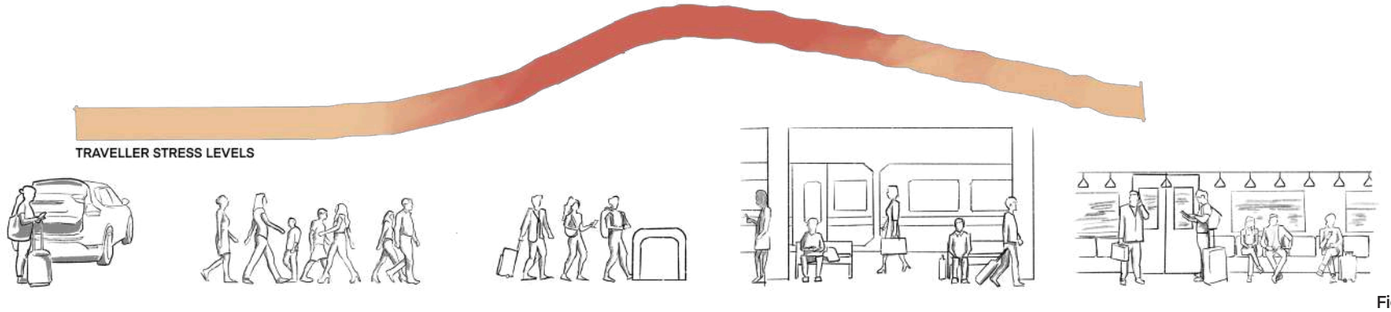


Figure 2.10
Stress in the traveller experience (Author 2021)

2.3.1

CASE STUDY

Schiphol Plaza

Schiphol Plaza consists of a large ground level central area. The building almost functions as one large decision point. It separated from the Jan Dallaertplein with a glass façade, making it an almost seamless interior partner to an exterior square. Travellers arrive at Schiphol Plaza either via bus or taxi, which uses the square as a drop-off, or via the train, which runs beneath the plaza and connects to it via staircases that enter directly into the interior. There are also passageways and stairways that connect the plaza to underground parking. Architects designed Schiphol Plaza with intuitive wayfinding in mind, but they also wanted to optimise the display of directional signage. For this reason, the ceilings are 12m high and the façade glazing is tinted to create darker interior for the electronic signs to contrast well. As part of intuitive wayfinding the designers purposefully deferred complete soundproofing of the railway concourse below the plaza so that travellers could use the sound of the trains as additional navigation aid.
Two strategies for retail integration in terminals are demonstrated in Hubregtse's book, where travellers move past retail to their destination or through retail. Management of Schiphol plaza opted for designing the plaza so that travellers walked through retail space in 2006. The main architect of the project however did not agree with this strategy and opted for prioritising swift travel needs over that of sale revenue.

Terminal 5 London Heathrow Airport

One of the major complexities' airport terminals deal with is when the number of travellers outgrows its capacity. One of the ways in which the designers of Terminal 5 Heathrow airport chose to respond to such a future possibility is to design the interior structure independent from the exterior shell. In this way future changes to the interior layout can be done without affecting the support structure of the roof.

Figure 2.11
Interior view of Schiphol Plaza in Amsterdam (Crouwel 2020)

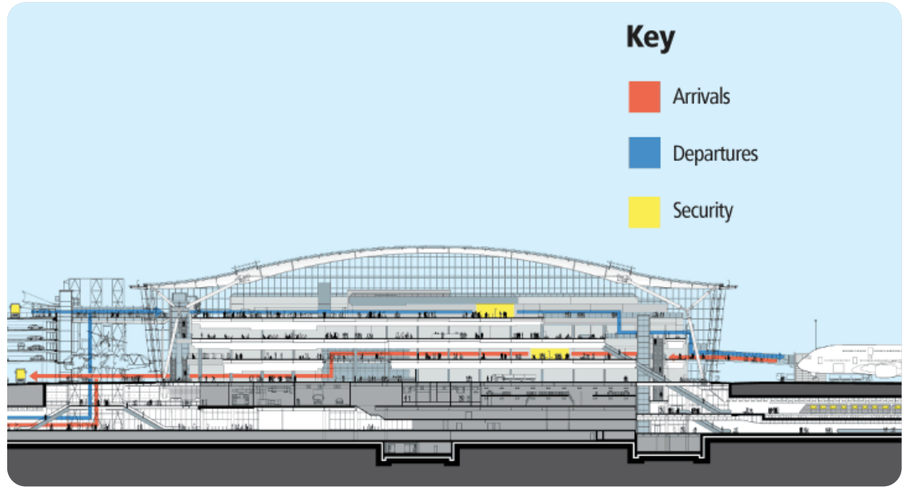


Figure 2.12
9th Avenue Parkade: gently sloping slab winding to top of structure (Author 2021)

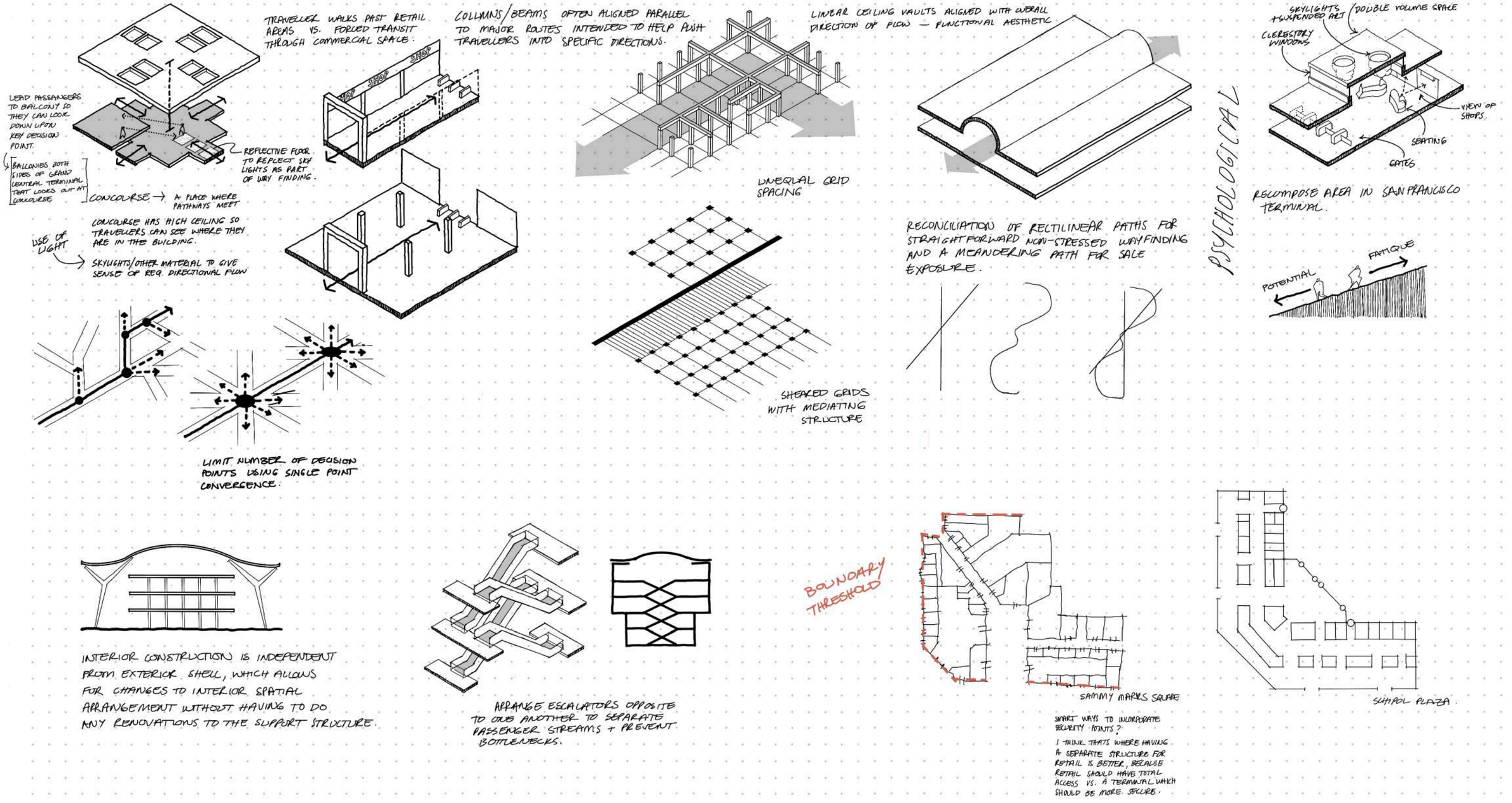


Figure 2.13
Wayfinding analysis digrams (Author 2021)

CONTEXT 3

3.1

THE PRETORIA RAILWAY STATION PRECINCT

Pretoria's inner city expands in all four cardinal directions from its Church square centre in a rigid grid until suddenly halted by the major natural features that surround it. The north and south are delineated by mountain range and hills and east and west bow away in deference to the Apies river and Steenhovenspruit (Jordaan 1989:26). Several roads provide access to the inner city through the natural dips between the southern hill range but only one path contains the railway line as well as the Apies river. This city entrance is named (at least in city planning circles), the Tshwane Gateway.

Instead of directly entering the inner city and conforming to the Cardo-Decumanus grid the railway line veers toward the west, devolving from main pathway to interstitial infrastructure and turning from city entrance to hard edged city separator. Favouring the inner-city side, the Pretoria station precinct is located adjacent to the railway, 1km down from where Apies river, hill range and railway line separates.

The precinct is situated 1.4km from Church Square and several city destinations are within a 5-minute walking radius; Burgers Park, Tshwane City Hall, Ditsong National Museum of Natural History, Salvokop government precinct, and Freedom Park. Considering its purpose and locality the precinct would be considered a major city portal of South Africa. Providing visitors with the first impression of the city and the collective spirit of its citizens. Instead, the area suffers from barrenness and a general indifference. Public spaces have almost no definition, except as afterthought and many aspects are prohibitive and disruptive to the ways which people are using the space. It is within this precinct that a site is chosen for transit-retail architecture experimentation.

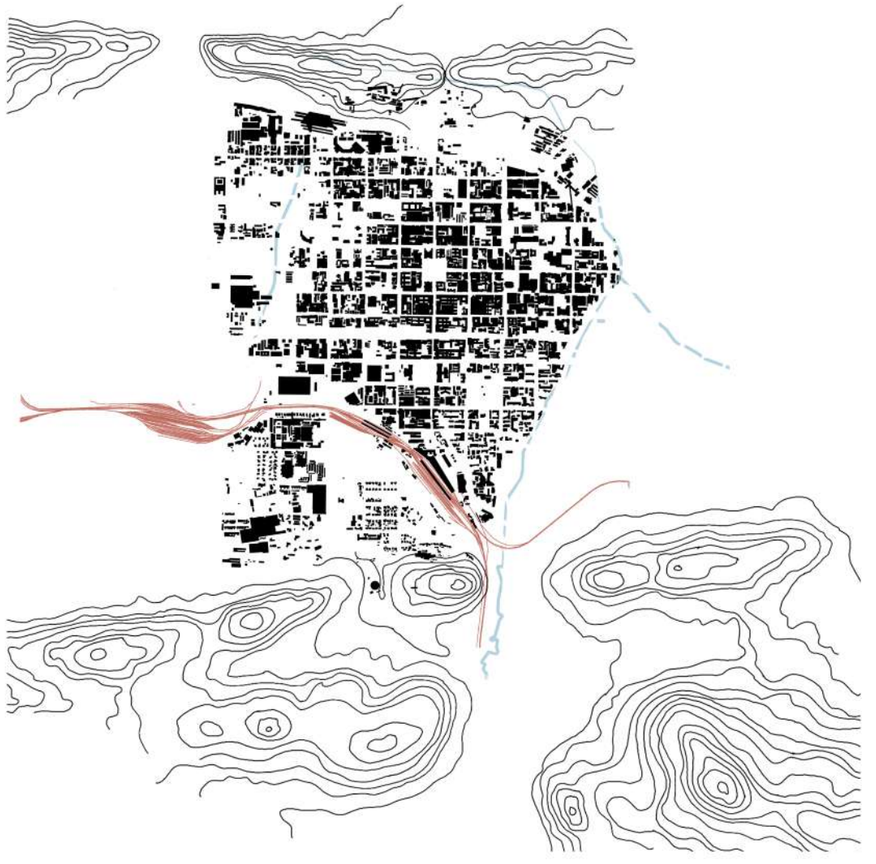


Figure 3.1
Figure ground diagram of Pretoria inner-city situated between Salvokop, the Magalies range and the Apies river (Author 2021)

3.2

MACRO CONTEXT

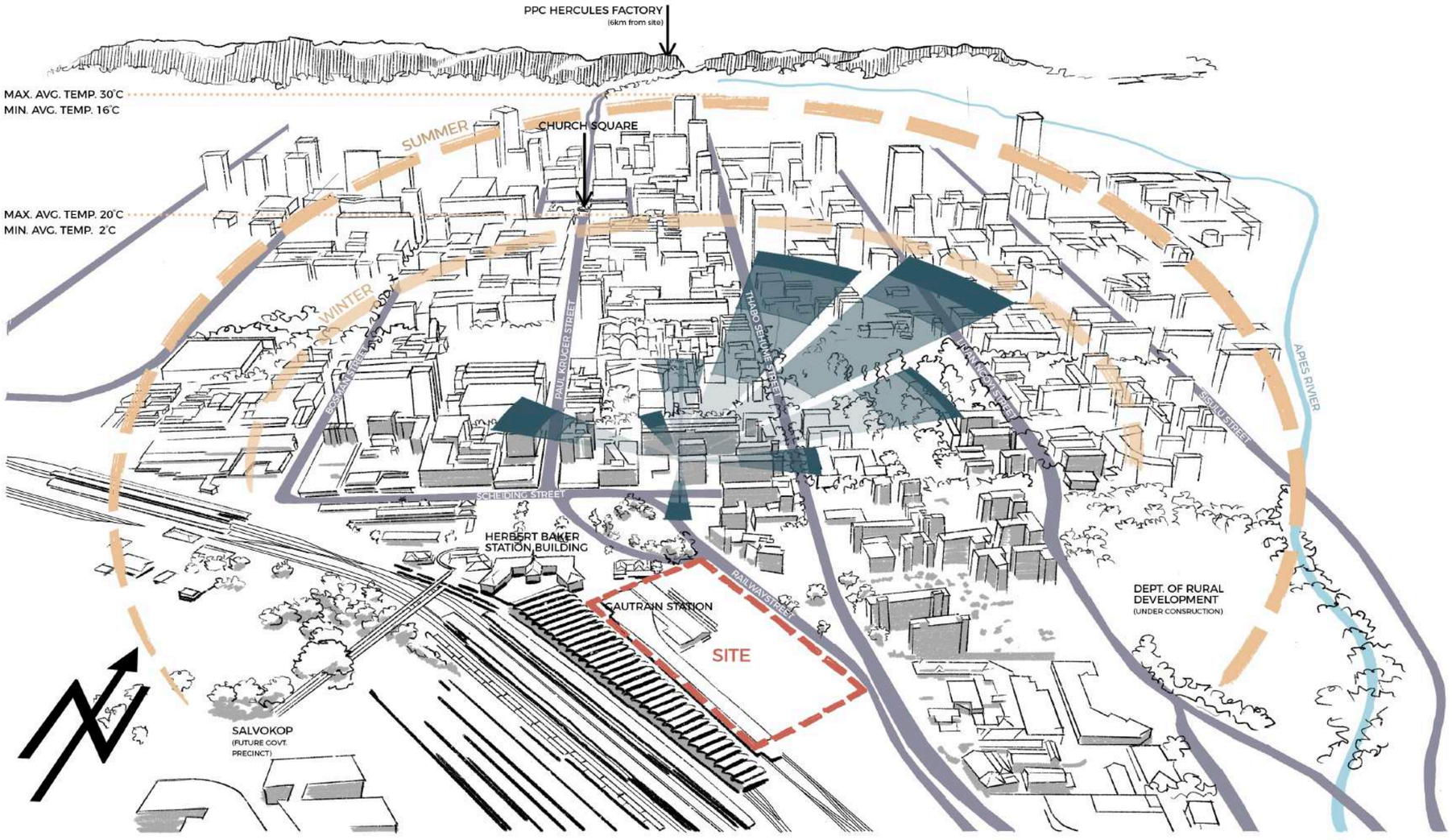


Figure 3.2
Site location relative to Pretoria inner-city and railway (Author 2021)

3.3

SITE CHOICE

The site is directly adjacent to the Gautrain terminal and currently functions as surface parking for Gautrain commuters. Multiple transport interchanges can be identified in and around the site and it is therefore a meaningful site for Transport oriented development toward a sustainable city. The site is also at a nexus of public and private functions making it a well-suited site for socially sustainable space design experimentation.

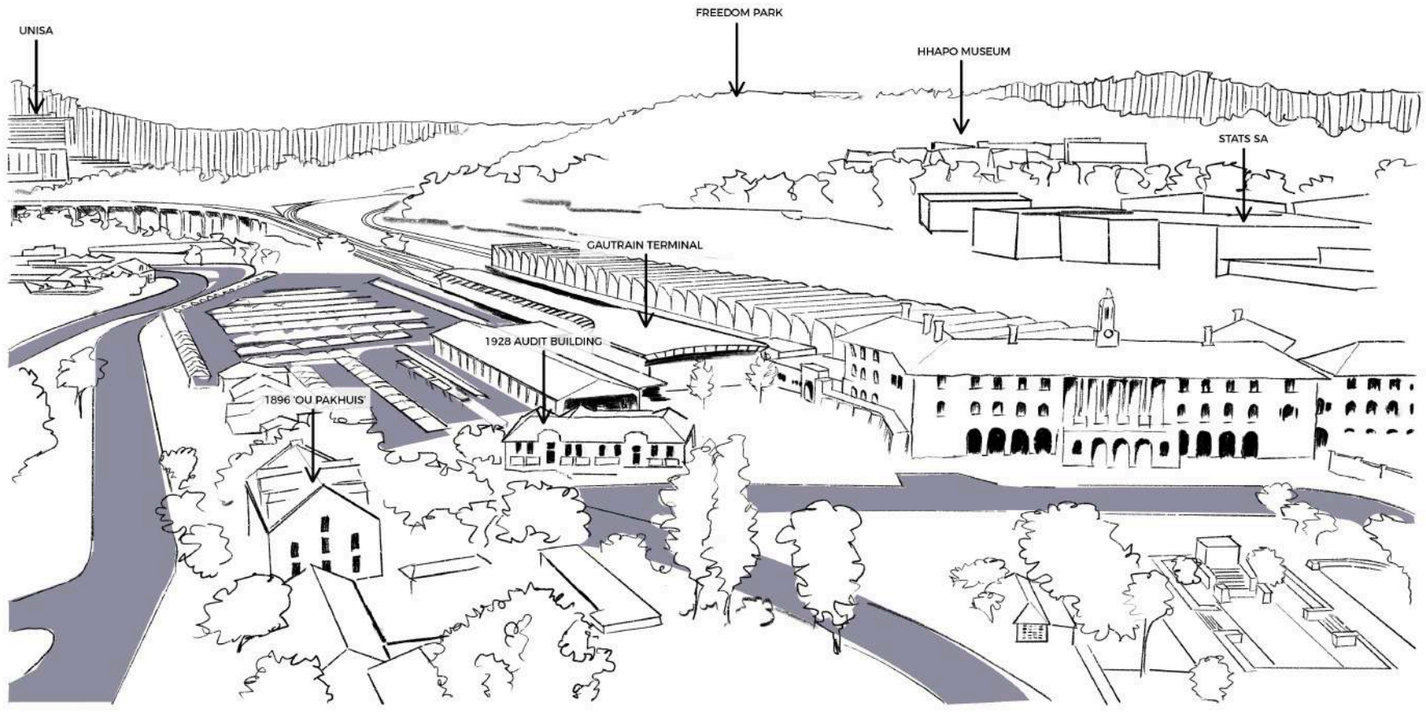


Figure 3.3
Perspective view of site toward the south with Freedom Park and Unisa in the background (Author 2021)

Figure 3.4
Indeterminate leftover space in the urban fabric surrounding Pretoria Station (Author 2021)

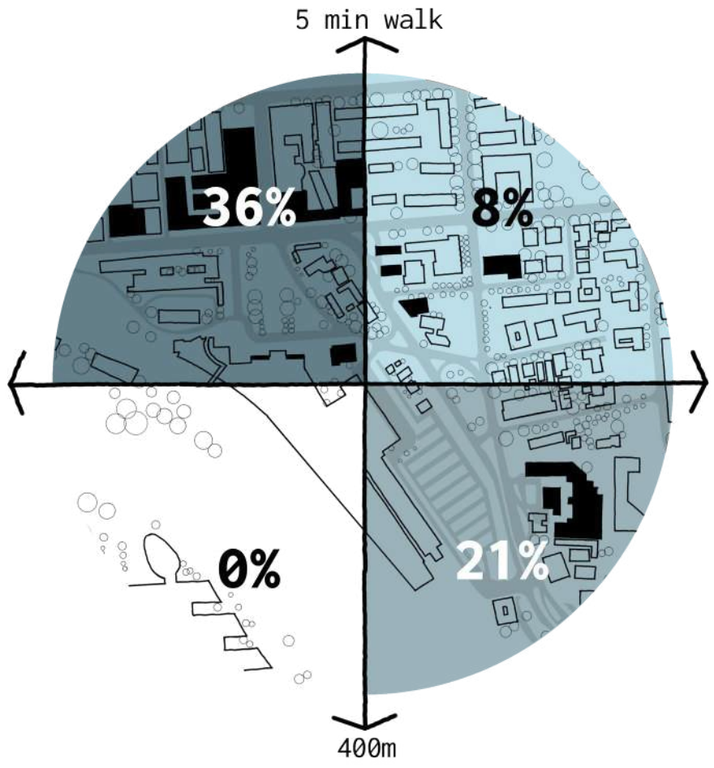


Figure 3.5
Percentage of retail function built fabric within a 5 minute walking radius of the site (Author 2021)

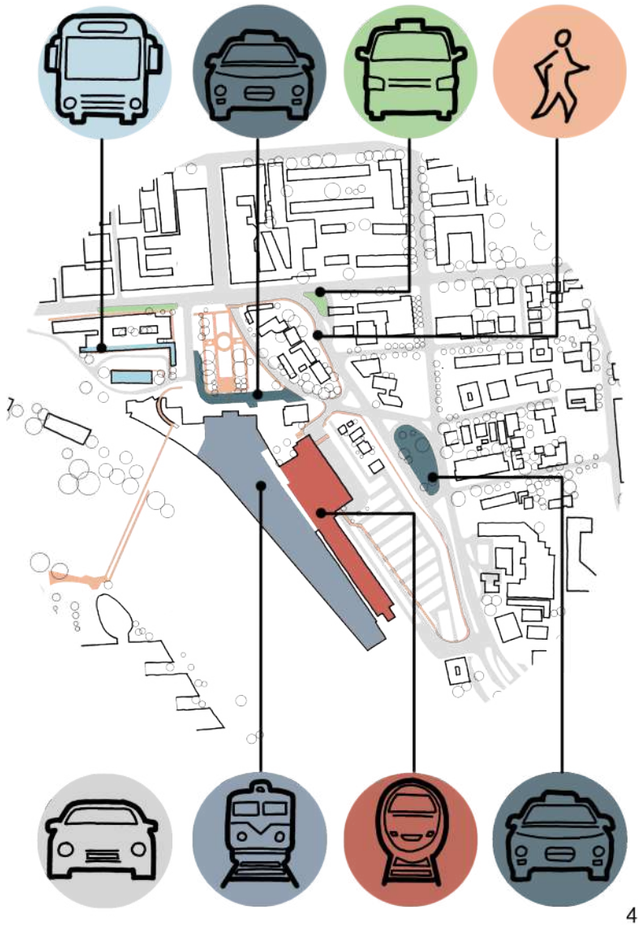


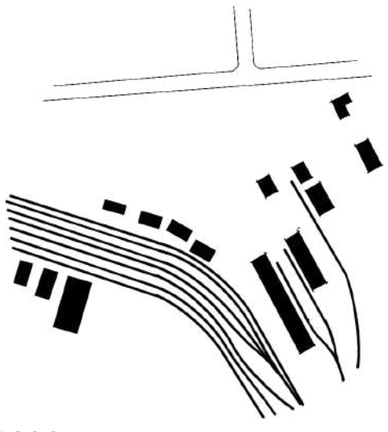
Figure 3.6
Different transport modes focussed around chosen site (Author 2021)

3.4

PRETORIA RAILWAY STATION PRECINCT HISTORY

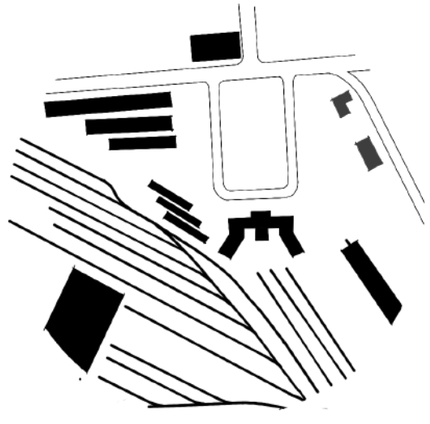
The first railway station of Pretoria came into being as the most western end of the Delgoa Bay railway line in 1892. A railway line commissioned for the purpose of connecting the Rand to the coast after gold had been discovered (Cartwright & Cowan 1978). In 1909 the Transvaal Government decided to replace the essentially functional buildings with a more prominent piece of architecture. A building now known as the Herbert Baker Station building, named for the well-known architect that designed it. In an article written about the decision to construct a new station building in the African Architect the journalist writes, “The site is a happy one, as the building terminates a vista of nearly a mile through Market Street and Church Square to the valley and distant hills on the north”(Anon. 1912).

The layout of the Herbert Baker Station building was heavily influenced by the direction of the railway line approach at 30-degree angle to the Market Street (now Paul Kruger Street) (Greig 1971:167). The main entrance faces the city centre perpendicularly with a view of the northern hills and the wings flank out at 60-degree angles with the eastern wing parallel to the railway line.



1892

In December 1892 the completed Pretoria station received the first train from Elandsfontein Junction (De Jong, van der Waal & Heydenrych 1988).

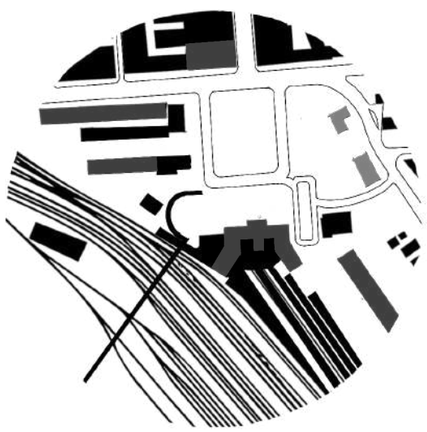


1910

In 1909 the Traansval Government decides to replace the original structure. The second station building, designed by Herbert Baker along with a shed parallel to the rail line is completed in 1912.

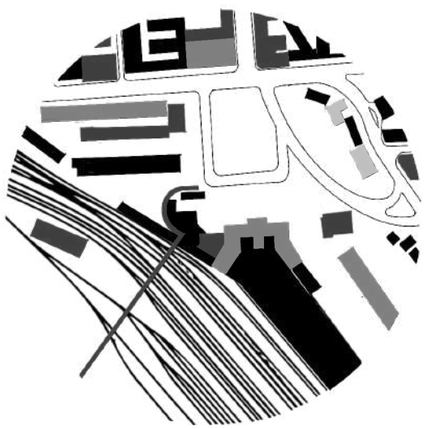
Figure 3.8
Picture postcard showing the Pretoria station complex (Circa 1903) (Hardijzer 2021)

Figure 3.9
Pretoria station complex as designed by Herbert Baker shortly after completion (Circa 1912) (Hardijzer 2021)



1967

A small audit building designed and constructed by Pretice and Mackie is added to the east of the Herbert Baker station building.



2005

Buildings for ticket sales and waiting rooms have been added for the Shosholoza Meyl (west of the Herbert Baker station building), and the Blue Train (south of the 60-degree oriented east wing).

2020

In 2011 the Pretoria Gautrain station operations commence enabling north-south rail commute and a rail commutor connection to OR Tambo International Airport.

Figure 3.7
Figure ground diagrams showing built structure development from 1892 to 2020 (Author 2021)

Figure 3.10
Photo of Old Audit building - elevation toward forecourt (Author 2021)

Figure 3.11
Photo of Shosholoza Meyl Head Office (Author 2021)

Figure 3.12
View of Pretoria Gautrain station main entrance (Bloomberg 2011)

3.5

SITE OVERVIEW AND ANALYSIS

1. Victoria Hotel (1884)
2. Bosman Street Market (Old SAR Sick Fund)
3. TRT Bus Station (Old SAR Drawing& Staff Offices)
4. Clinic
5. Long Distance Bus Terminal
6. Old Pretoria Station Forecourt
7. Offices (PRASA)
8. Autopax Head Office (Old StationMaster's House)
9. Autopax Head Office (Old PriningWorks Building)
10. Thembisa taxi rank
11. BP Garage
12. Belgrave Place Hotel
13. Training College
14. Metered taxi rank
15. Gautrain surface parking
16. Old SAR Housing
17. Gautrain Bus Station
18. Gautrain Drop-off (Old Coach-Washing Shed)
19. Gautrain Terminal
20. Gautrain Forecourt
21. Old Audit Building (1928)
22. Pretoria Herbert Baker station building
23. Blue Train Ticketing & Offices
24. PRASA Platform
25. Station Annex
26. Shosholoza Meyl Head Office
27. Police station
28. Pedestrian bridge to Salvokop
29. Statistics South Africa
30. Salvokop residences (Old NZASM Village)
31. Training centre
32. Warehouse
33. Engen Garage
34. Shopping strip
35. NZASM Workshop and store
36. Car showroom
37. Hotel
38. Department of Rural Development Offices (Old Berea Park Clubhouse)

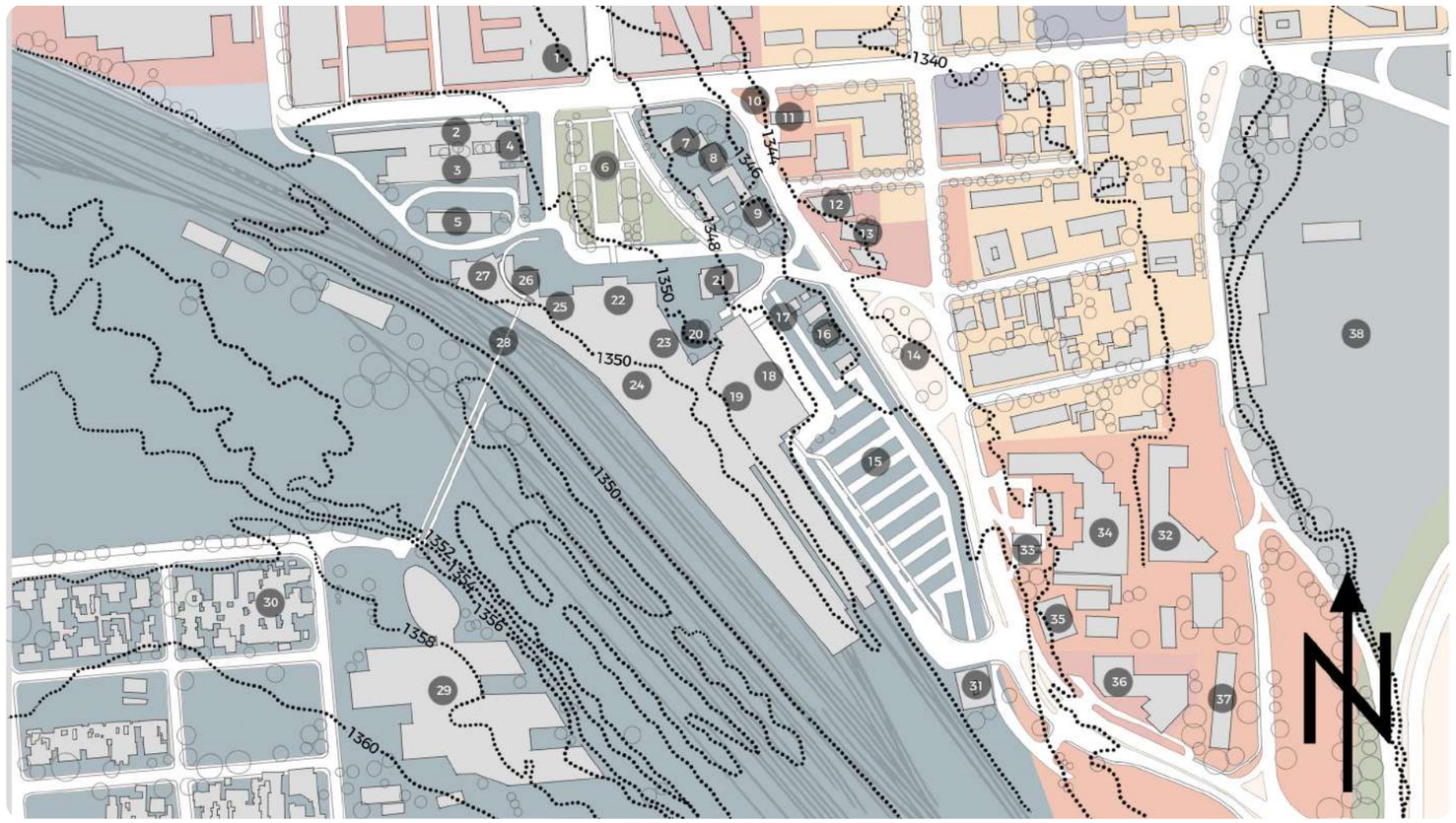
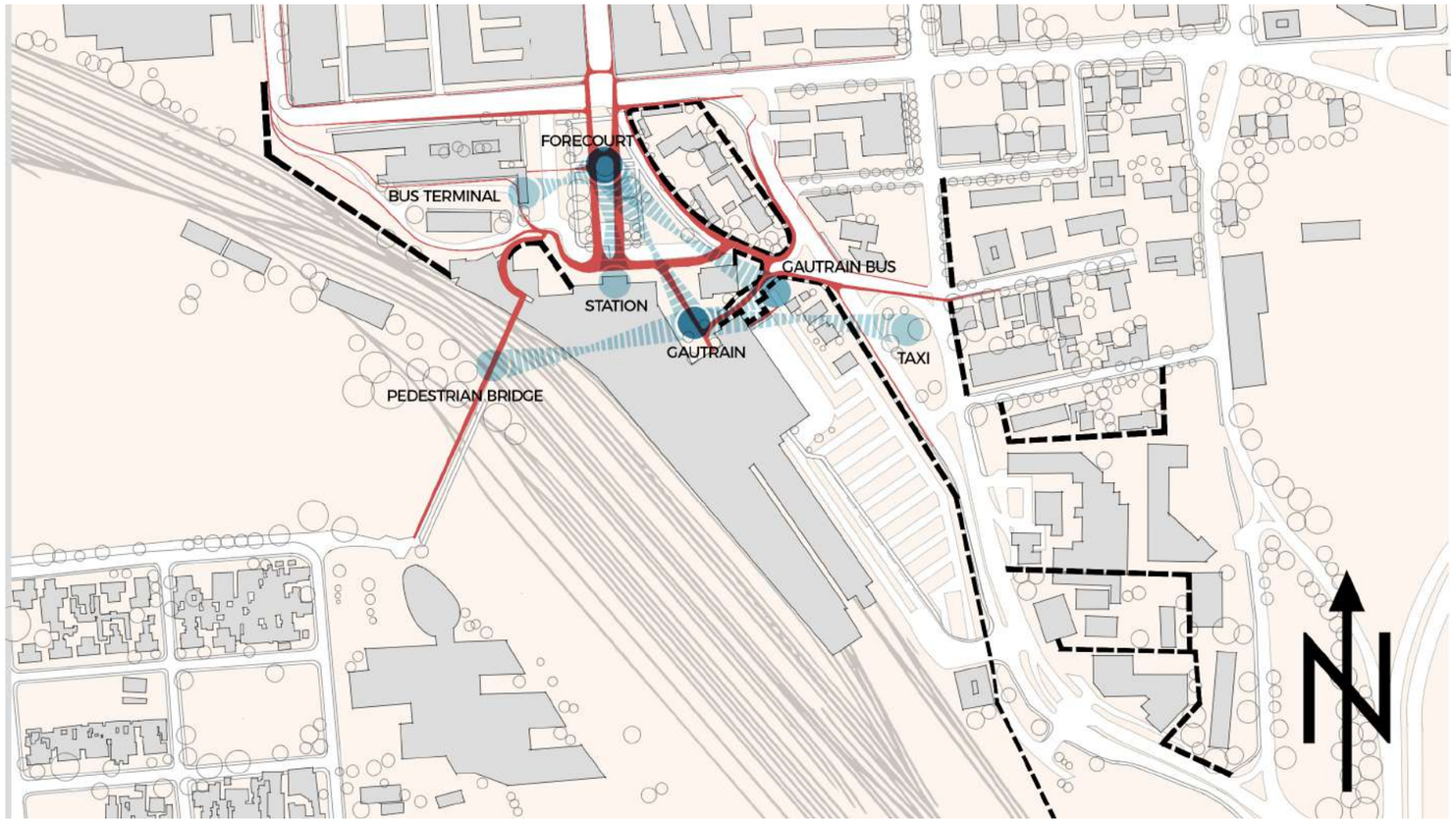


Figure 3.13
Context zoning and notable built structures (Author 2021)



CONTEXT - SIGNIFICANT LINES

Figure 3.14
Context pedestrian flows, sightlines and barriers (Author 2021)

PRECINCT 4

PRECINCT VISION

Recasting the context

4.1

FIGURE GROUND

Considering the focus on a more weighted contemplation of hospitable public open space the first approach explored as part of the design investigation is figure-ground theory (Trancik 1986). Secondly, as replacement to the outdated theory of linkage, connection and circulation is considered at the urban scale using principles from Kevin Lynch and at the architectural scale using principle from Francis D.K. Ching. Thirdly, place theory. These theories enable more practical approaches within the wider dialectics of Contextualism, Place Identity and Public space. The approaches considered for the dissertation investigation is advanced with the addition of sustainable architecture theory.

“Before the distinction there is only void but through the event in which a distinction is constituted there is form, there is meaning”(Arnoldi 2001:4) The urban environment can, as contribution to a comprehensive approach, be abstracted to a two dimensional representation of figure and ground, where figure represents solid mass and ground represents the open voids between masses. This approach is used to transform the urban pattern by “adding to, subtracting from, or changing the physical geometry of the pattern” (Trancik 1986:97).

The concept of architectural design as a way of shaping space and not solely building structure arose from the modernist fascination with Japanese architecture in the late 19th century. Architects such as Ludwig Mies van der Rohe, Walter Gropius and Frank Lloyd Wright experienced an affinity with the philosophical thought of Lao-Tsy: “We fashion wood for a house, but it is the emptiness inside that make it liveable. We work with the substantial, but the emptiness is what we use” (Pluta 2017:88) Thus the term became manifest at the end of the 20th century finding prominence especially in urban design as response to increasing urbanisation and deterioration of natural spaces, making open space a valued commodity worthy of conscience design. (What it is)

Urban voids as a concept can be found in both perceived and conceived space, as determined by Henri Lefebvre (1991). Voids are not only unfilled spaces but also possibly unnoticed spaces – invisible spaces that are not only physical emptiness but also emptiness in the memory of people.

Pluta (2017) differentiates between urban void and urban interior. Open spaces that form part of deliberate planning which are “designed in a conscience way” (Pluta 2017:91) are considered urban interiors or positive voids. It should be added to Pluta’s definition, however, that an urban interior or positive void should not merely be planned but should enable lived space (Lefebvre 1991). A surface parking lot may be planned but that does not make it a positive void that functions as part of a lived space. Trancik (1986) writes that the simplest way of creating positive voids is to conceptually carve the space out of the mass and to achieve form on the exterior “perimeter of spaces and blocks must be well articulated to establish outdoor rooms containing corners, niches, pockets and corridors” (Trancik 1986:100).

The definition of urban void vs. urban interior can be clarified further by the concept of Spatial synergy. Spatial synergy considers the way in which spaces ‘work together’. The way in which space segments are formed through the arrangement of buildings, the way the segments are connected, as well as how far each segment is from another, all contribute to spatial synergy “where locality can be perceived… and a space can be associated with the idea of ‘city’” (Frick 2007:261) or spatial dysergy, non-place and the absence of locality.

Figure 4.1
Urban rooms in the urban fabric surrounding Rotterdam Central Station (Author 2021)

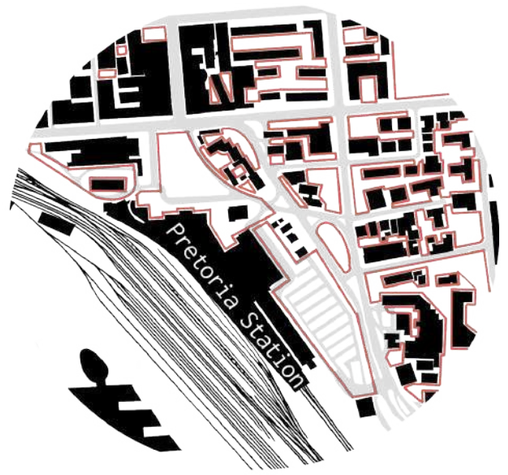


Figure 4.2
Indeterminate leftover space in the urban fabric surrounding Pretoria Station (Author 2021)

4.2

LINKING ANCHORS

The shift of focus from not only the spatial arrangement of solids and voids but also the connections between them introduces the next approach – connection and movement. This approach is applied to all linking elements such as roads, paths and linear open spaces that form a network and aids in ordering spaces. Several principles can aid in design of good circulation on the urban scale as well as the architectural scale.

Considering Kevin Lynch's writing in The image of the city (1960), path lay-out, the extent of interconnection, continuity, and organisation according to scale will impact the movement of people and vehicles. For safety pedestrian and vehicular movement should be segregated and where such segregation is not possible traffic slowing elements should be used to enable pedestrian safety. Sufficient manoeuvring space should be designed for service trucks and separated from public access. Design of the site must encourage public transport with due consideration to pedestrian traffic desire lines and how pedestrian movement through the site can lead to activating outdoor spaces. A vehicular drop-off area should be positioned just off the street closest to the main entrance.

At the scale of the building five elements of circulation are considered; approach, entrance, path configuration, path-space relationship and circulation space form (Ching 1996). Entrance location relative to the space crossed into will impact the arrangement of the path and activities inside the space. The intervention must simultaneously accommodate service space (parking) and commercial space with the aim of transitioning over time into an exclusively commercial space for a future of higher public transport utility and increased urban density. The consideration of mutually beneficial vehicle and pedestrian circulation is therefore significant and due consideration should be provided for its convertibility.

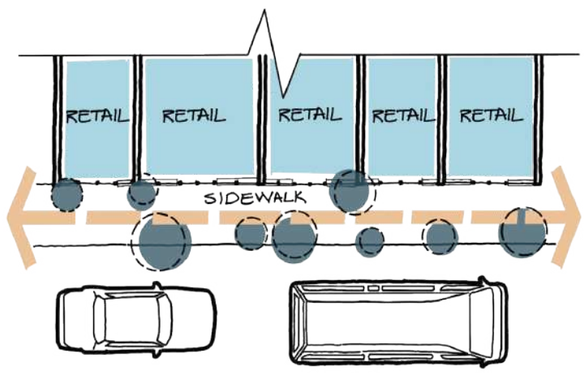


Figure 4.3
Pedestrian movement through typical formal + informal trade space patterns (Author 2021)

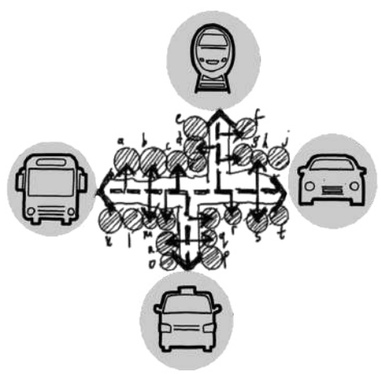


Figure 4.4
Transport points as linking anchors (Author 2021)

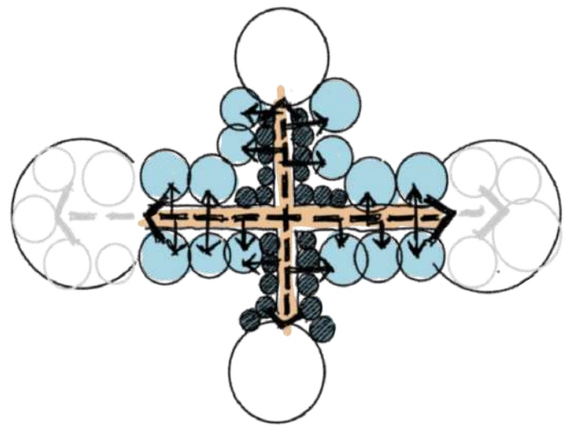


Figure 4.5
Toward an integration of formal + informal trade through linkage (Author 2021)

4.3

OPEN BUILDING

Open Building Co. was founded in 2020 by a group of Dutch architects, engineers, and developers, The group states in its manifesto (2021) that considering the present crucial task of the built industry to lower its ecological and carbon footprint, the concept of Open Building to extend the lifespans of buildings through adaptability, is now more relevant than ever. They combine two prevalent works in the field to realise their main principles and strategy; Supports, an Alternative to Mass Housing (1961), developed by N. John Habraken and How Buildings Learn (1994) by Stewart Brand.

As demonstrated by Stewart Brand the main strategy should be to consider a building as consisting of several different layer elements with different lifecycles, as shown in figure 4.6. Figure 4.7 illustrates Open Building Co.'s principles related to each layer element; site, structure, systems, skin, and space plan.

Open Building Co.'s manifesto expands the relevance of these strategies and principles to three themes of scales; Open Cities, Open Buildings, and Open Systems. "The theme of Open Cities anticipates on designing for a changing investments, new legislation, asset management, tax regime and includes policies and planning tools for a flexible urban development" (Open Building Co. 2021). Within the Open Buildings theme they aim to extend building lifespans to at least 150 years.

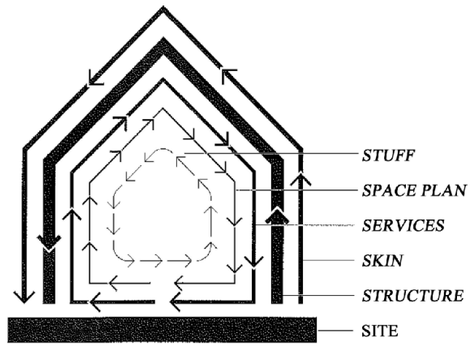


Figure 4.6
Shearing Layers of Change (Brand 1994)

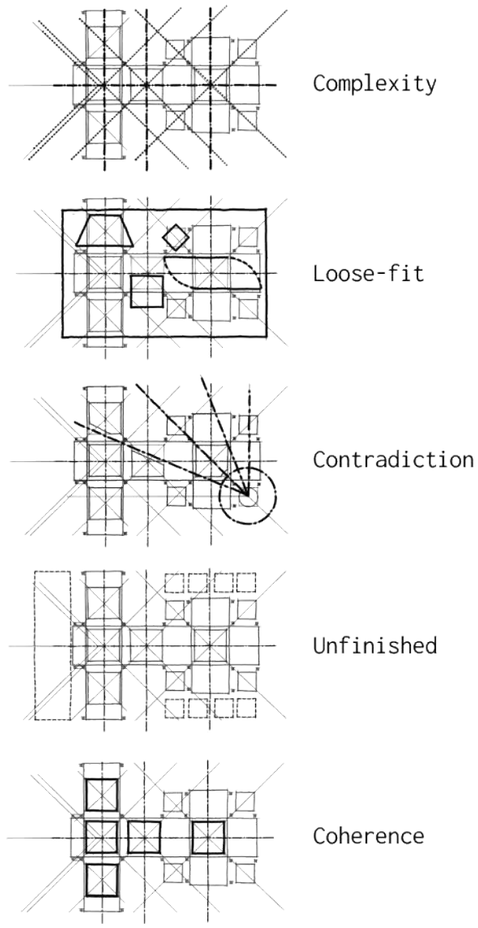


Figure 4.7
Design decisions toward transformable, movable and adaptable architecture (Author 2021)

4.4

POTENTIAL FUTURE DEVELOPMENT

4.4.1 TSHWANE INNER CITY REGENERATION STRATEGY

The Tshwane government views regeneration of the inner city as one of its near future objectives (City of Tshwane Metropolitan Municipality 2015). The intervention strategy is focussed on two boulevards, Government Boulevard (Paul Kruger Street) and Ceremonial Boulevard (WF Nkomo, Helen Joseph, and Stanza Bopape Street). The site of this dissertation falls within the axis of the Government Boulevard. The strategy document states that it is the governments intention to make the Government Boulevard a public space symbolising the status of the government "interspersed with symbolic public squares and landmark buildings" (City of Tshwane Metropolitan Municipality 2015).

Figure 4.8
Pretoria inner-city main boulevard regeneration focus (Author 2021)

4.4.2 TSHWANE GATEWAY, SALVOKOP GOVT. PRECINCT + BEREA GOVT. DEVELOPMENT

Three potential future developments in the near surrounds of the chosen site may have an impact on the urban fabric. The first development, illustrated in figure 4.9, is located directly east of the site. A mixed-use development called the Tshwane Gateway is proposed by Boogertman + Partners (2016), containing offices, residential, heritage and a hotel. 300m further east of the site, the Berea Park cricket and soccer fields are currently under construction by WBHO and will accommodate offices for the Department of Rural Development and Land Reform (Cokayne 2021). West of the site, across the railway line, a major multi-stage development for the future government precinct is underway (Anon. 2019).

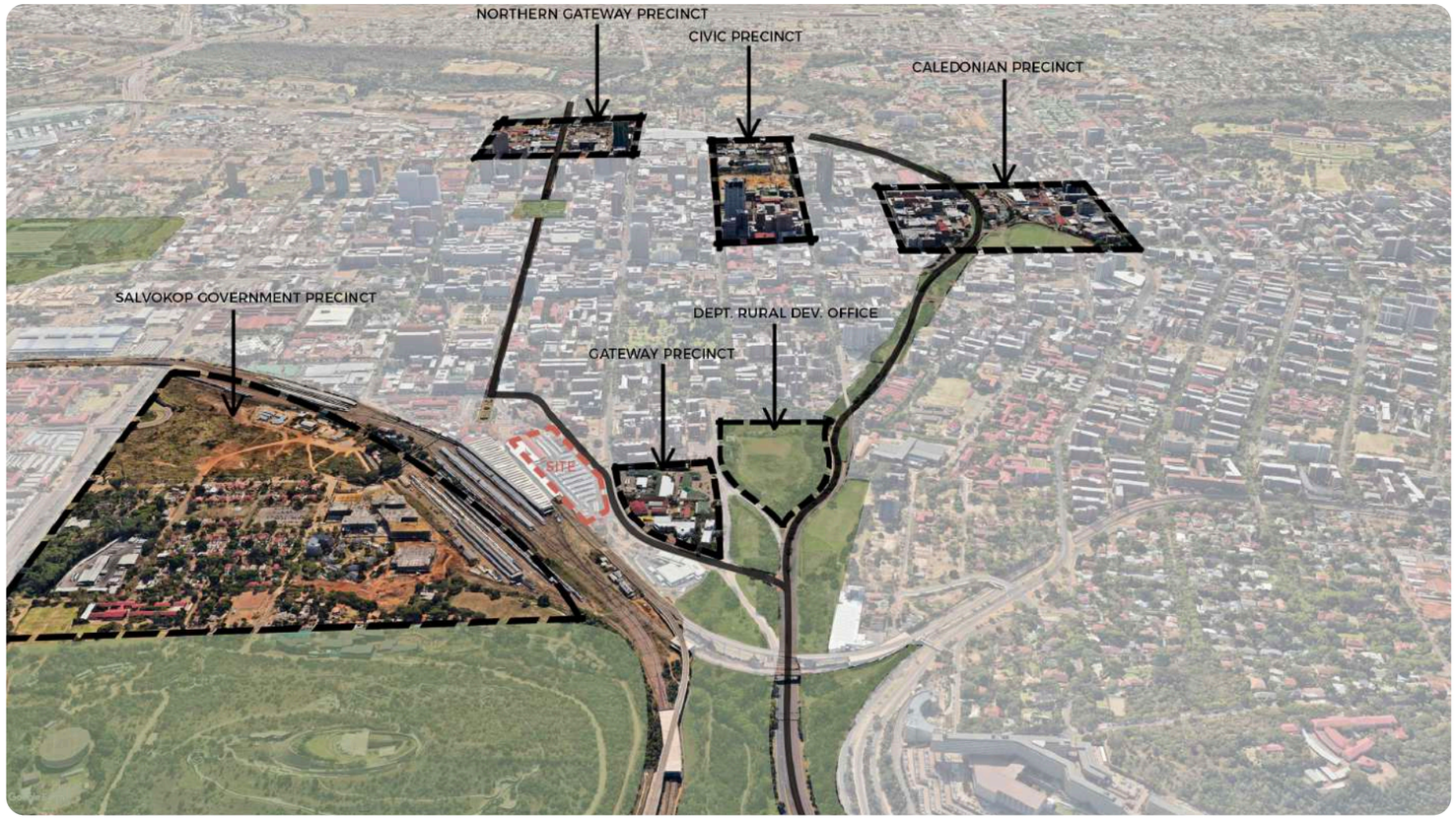


Figure 4.9
Neighbouring precinct developments as part of the inner-city regeneration strategy (Author 2021)

4.4.3 PRASA MASTER PLAN

PRASA states the following high level objectives with its suggested master plan (PRASA Corporate Real Estate Solutions):

- Consolidation and expansion of the existing public transport provision to support the growth of sustainable transportation
- Integration into the transportation environment of both formal and informal retail tuned to the location specific footfall volume and LSM
- Incorporation at the appropriate development stage of a high value commercial anchor component
- Intervention's which support the heritage values
- Creation of a walkable precinct at the centre of an extensive pedestrian city network
- A strategy for social inclusion

The masterplan succeeds at several aspects. The transfer concourse and bridge addition better connect Salvokop to the city and the building provides for future increase in public transport, as well as addressing operational issues such as severe congestion and unplanned perturbated scenarios. The interventions have minimal impact on heritage structures and contains plentiful green roofs.

A few aspects of the suggested plan could be improved however.
Except for green roofs, there is very little green space provision at ground level. The public spaces lack coherent form and are still considered left-over spaces between buildings. The plaza scale in front of the Herbert Baker building can be made more intimate and interesting, and the suggestion completely ignores the heritage of the Pretoria Station forecourt. There is very little attempt to integrate the Gautrain area, plaza area and bus terminals and more street edge activation toward Railway Street and Scheiding Street could be accomplished. There is also a lack of drop-off/pick-up zones and provision for unavoidable vehicle access requirements.

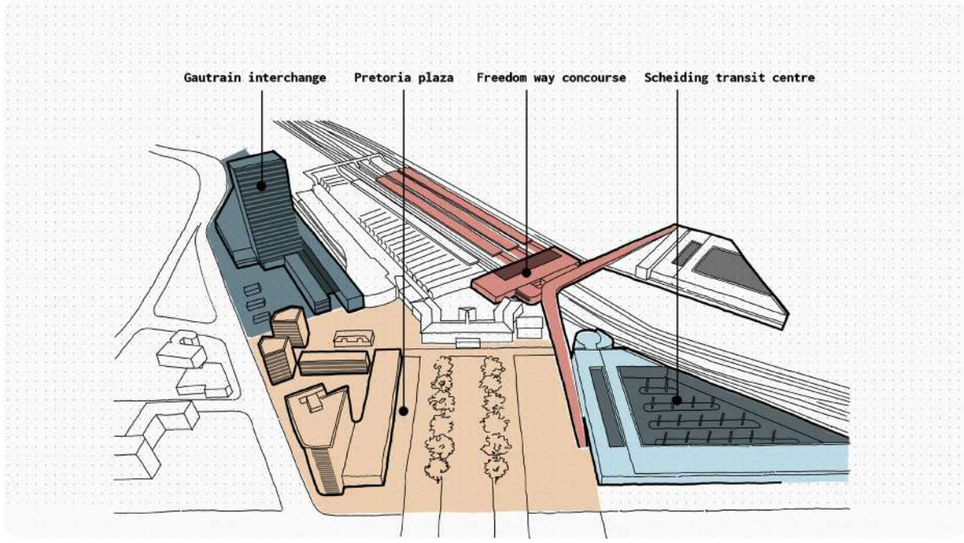
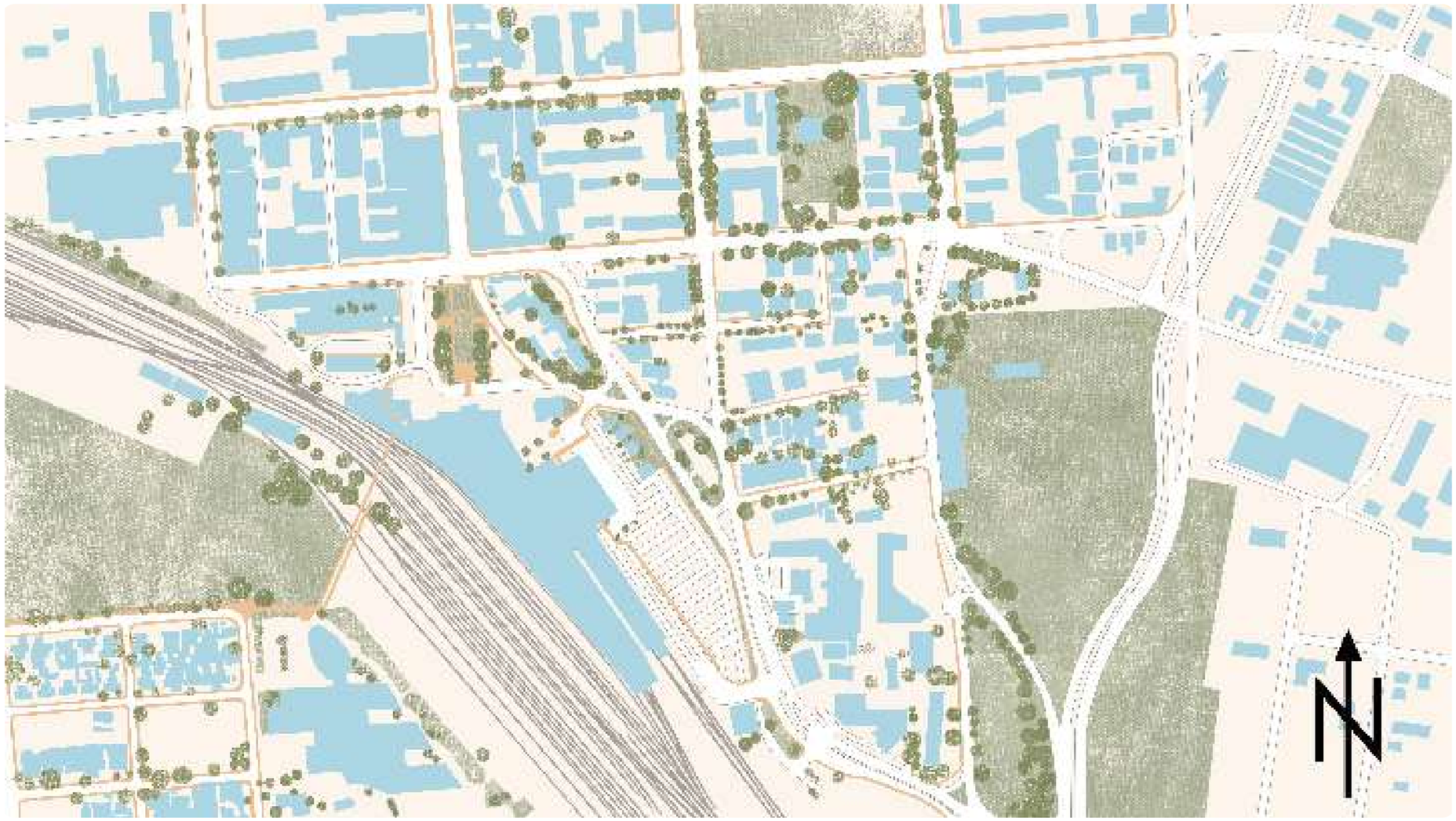


Figure 4.10
Suggested masterplan for site precinct with new PRASA concourse and bridge to Salvokop (Author 2021)

4.5

PRECINCT VISION



PRECINCT - EXISTING

Figure 4.11
Existing precinct - Urban element plan (Author 2021)

The first concept shows a massing addition approach and stronger pedestrian links. The second, with a mindset of “urban rooms” applies a massing subtraction approach. The two are overlayed to identify different benefits to keep for a final iteration. Railway noise, circulation, anchor positioning, defined public space and heritage is considered. The Gautrain bus depot is distanced from the Gautrain station to create linkage space between two anchors. Surrounding context, such as residences, taxi ranks and future developments are used to create open pedestrian pathways that bisect the precinct creating small scale city blocks. Programs range from commercial/co-working space to fitness space to hotel and residential to create a 24 hour cycle of passive surveillance.

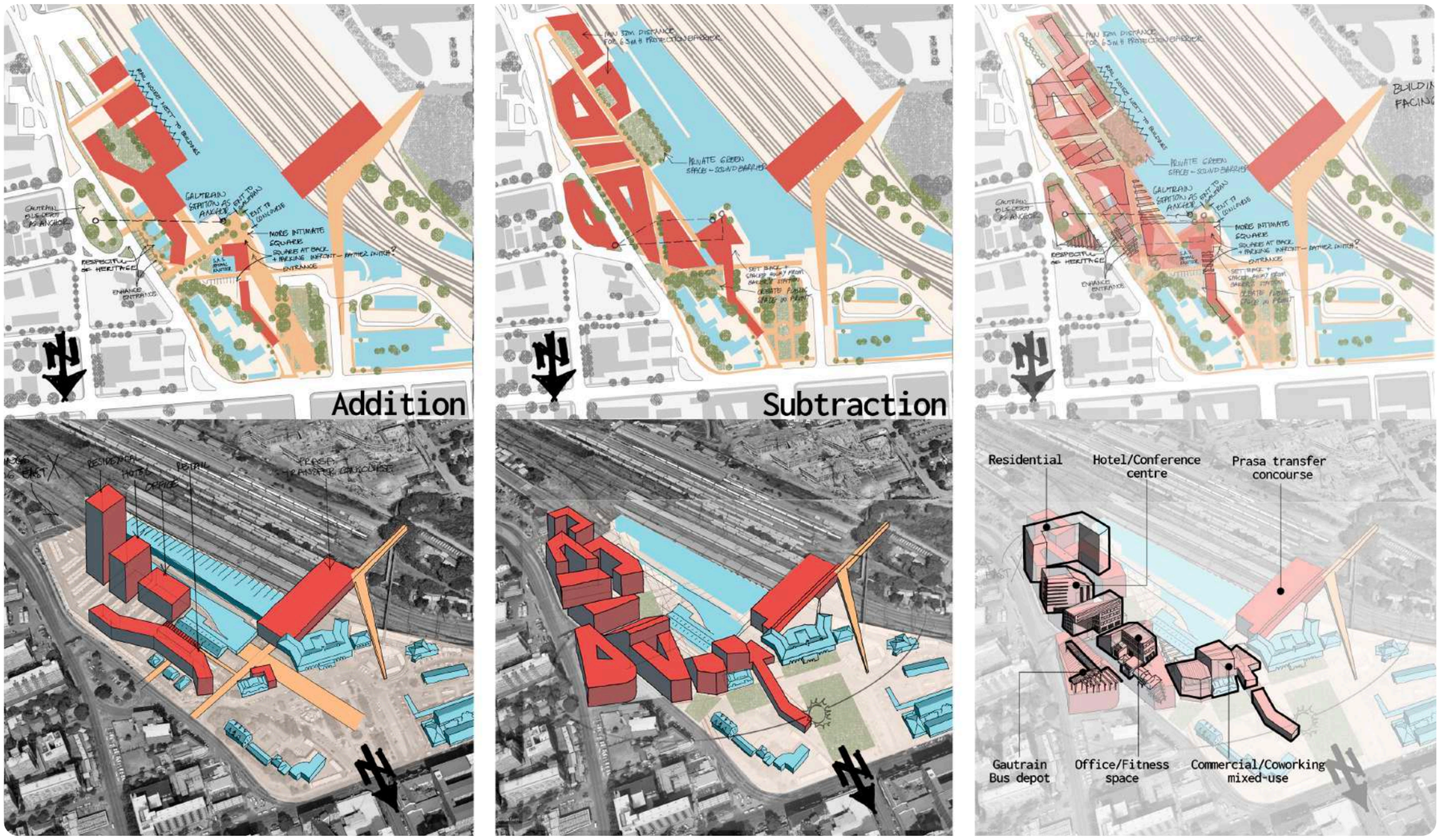


Figure 4.12
Precinct design development - A process of addition and subtraction.(Author 2021)

PROGRAMME 5

5.1

SITE USERS

Site users fall within three important categories in line with the investigations of this dissertation; service provider, consumer, and wanderer (this is the closest positively inclined single word I could find in the English language for a person simply occupying public space – it seems even the English language discriminates against such a concept with most words ranging from loiterer, through idler, wastrel, bum, malingerer, and ending at vagrant.)

Service providers mostly occupy a static state. Traders sit behind counters and wares, ticket sellers inside glass cubicles, taxi drivers wait inside or near their vehicles, and security officers intermittently move between different public thresholds. Consumers occupy a more kinetic state. They are the commuters using train/taxi/bus services, the buyers browsing through shop displays or seeking experiences and at their most stagnant state sitting at cafes or restaurants. And finally, there are wanderers, occupying all the spaces in between. The person waiting, the person eating lunch under a tree, the person taking a break from work and scrolling through social media, and the tourist still deciding or a little lost.

Provider
- The trader
- The rail employee
- The taxi driver
- The security officer

Consumer
- The commuter
- The shopper
- The excursionist
- The patron

Wanderer
- The lounger
- The stroller

5.2

RETAIL TYPES

The programme includes food service and retail but is limited by its compatibility with the railway station and the surrounding area. According to Baraban (2010) food services may be classified according to the main type of food they sell (chicken, French, Steakhouse or the market segment they cater for (Hospital, University, Hotel etc.). But the most effective way to classify them for the purpose of spatial design is to classify them according to service system.
A university or hospital may have multiple service types such as leased à la carte restaurants, quick-service courts, cafeteria or vending machine, and therefore classification according to market segment may provide some information toward the design of the food service space due to its contextual contribution but using service system classification provides more detailed information.
The service system is also ideally used in this design process as it is useful to correlate to another aspect used to define space: relative speed of movement. Flow of travellers along with proximity to the terminals define the assumed speed of travellers and their proclivity to dedicate time to shopping.

The 3 types of retail as used in this project includes:
1. QR Code/Augmented reality shopping
This form of retail is considered the least time consuming and consists of large LED digital displays of products with QR codes where shoppers can scan the code and thereby add it to a digital cart for delivery to their home. This space can be closely integrated with the main travel paths but must use subtle ways of differentiating and provide enough pace that stopping travellers do not hinder passing ones.

2. Retail kiosk
This is defined as a small scale snack or other items shop that stocks the bare basics for a hurried shopper and is considered as an activity of medium time consumption. This is not a space that travellers pass through to get to the terminal but can be situated close to the terminal entrance.

3. Supermarket
This form of shopping is considered the most time consuming with a large retail space and many aisles and a higher chance of pay point queueing. This function can be placed the furthest from the terminal.

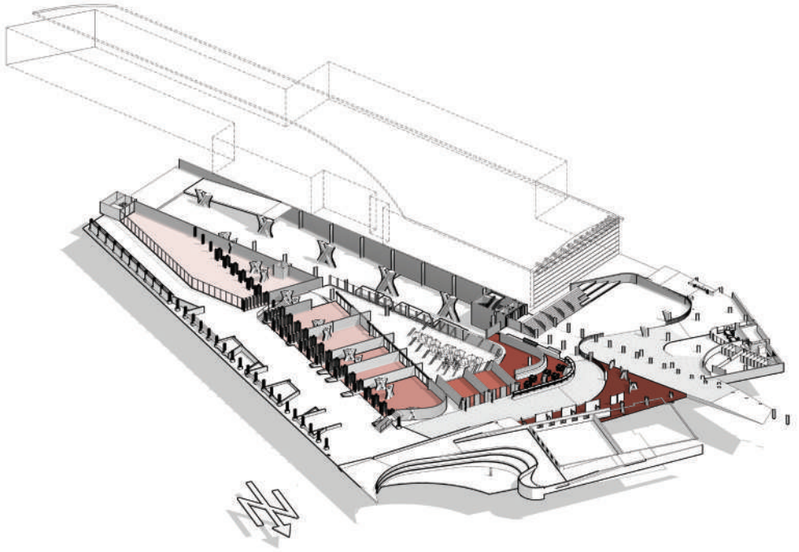
The 4 types of food service as used in this project includes:

1. Snack counter
This food service mainly consists of a point-of-sale counter as threshold where travellers will queue for over-the-counter snacks. This is considered the least time-consuming food service space and is therefore more integrated with travel space.

2. Food bar
This food service space also has a counter as threshold but one for seating with more space for seating behind it. It will fall within Baraban's (2010) service system category of Quick Service, as the customer must still queue at the counter to order.

3. Fast food restaurant
This also falls within the Quick Service category but is larger and has more dedicated food space and has very limited integration with the travel spaces.

4. Restaurant/Bar
This food service is defined as the most time consuming and is considered a leisure activity. It is located further away from the terminal, occupies larger floor area and can easily be passed by for hurried travellers.



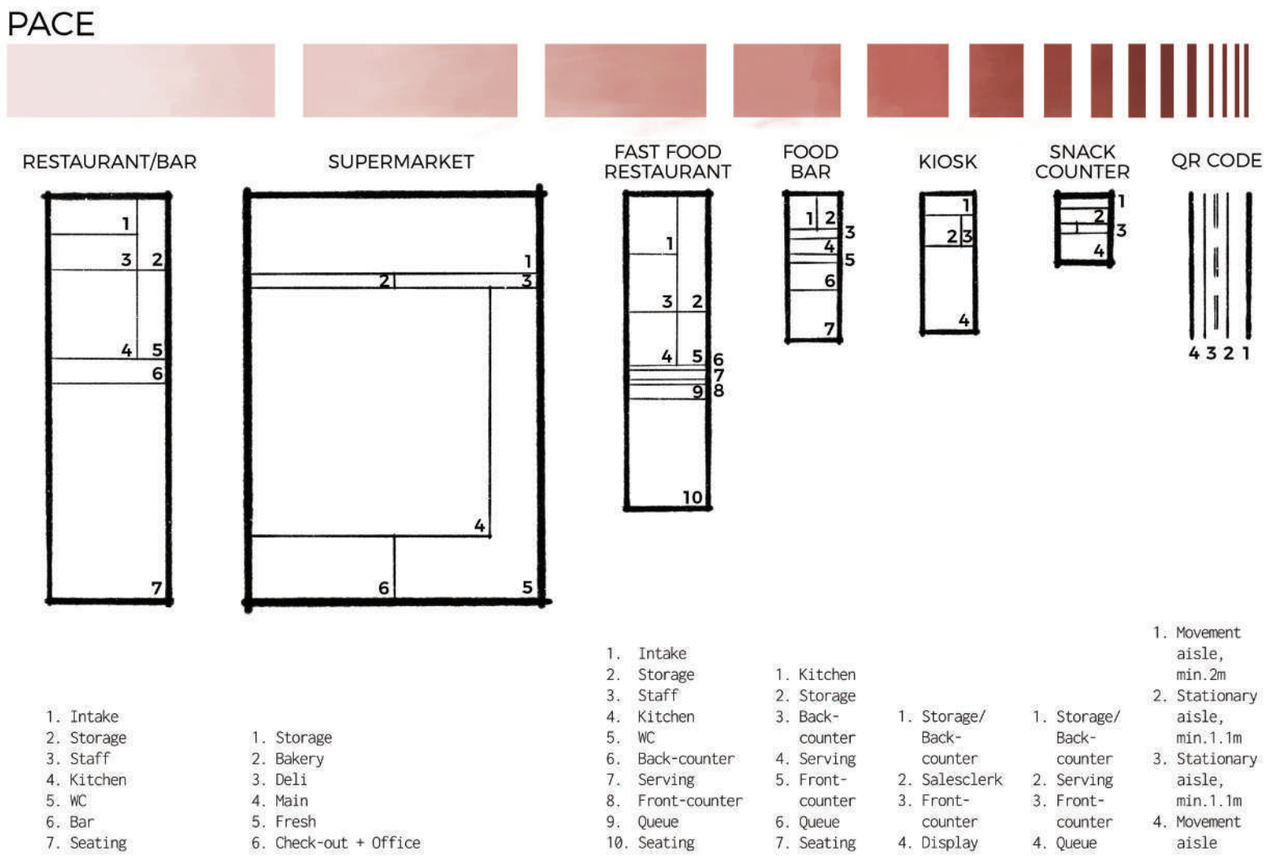


Figure 5.1
Programme proportional to pace (Author 2021)

5.3

PROGRAM OUTLINE

Hybridity as described by Pinto de Freitas (2011) emphasises that it is not just the combination of typologies but more specifically the composite of object, landscape and infrastructure. It is important to realise that hybrid architecture transcends mixed use architecture by not only supporting variable core programmes but by supporting a network of activities both central, supporting and contextual. There is existence and there are activities in between the programmes of live, work and play. Considering this network of activities of both mundane and central is important in the 21st century built environment, not only due to population growth and rapid urbanisation but also environmental protection and city resilience.

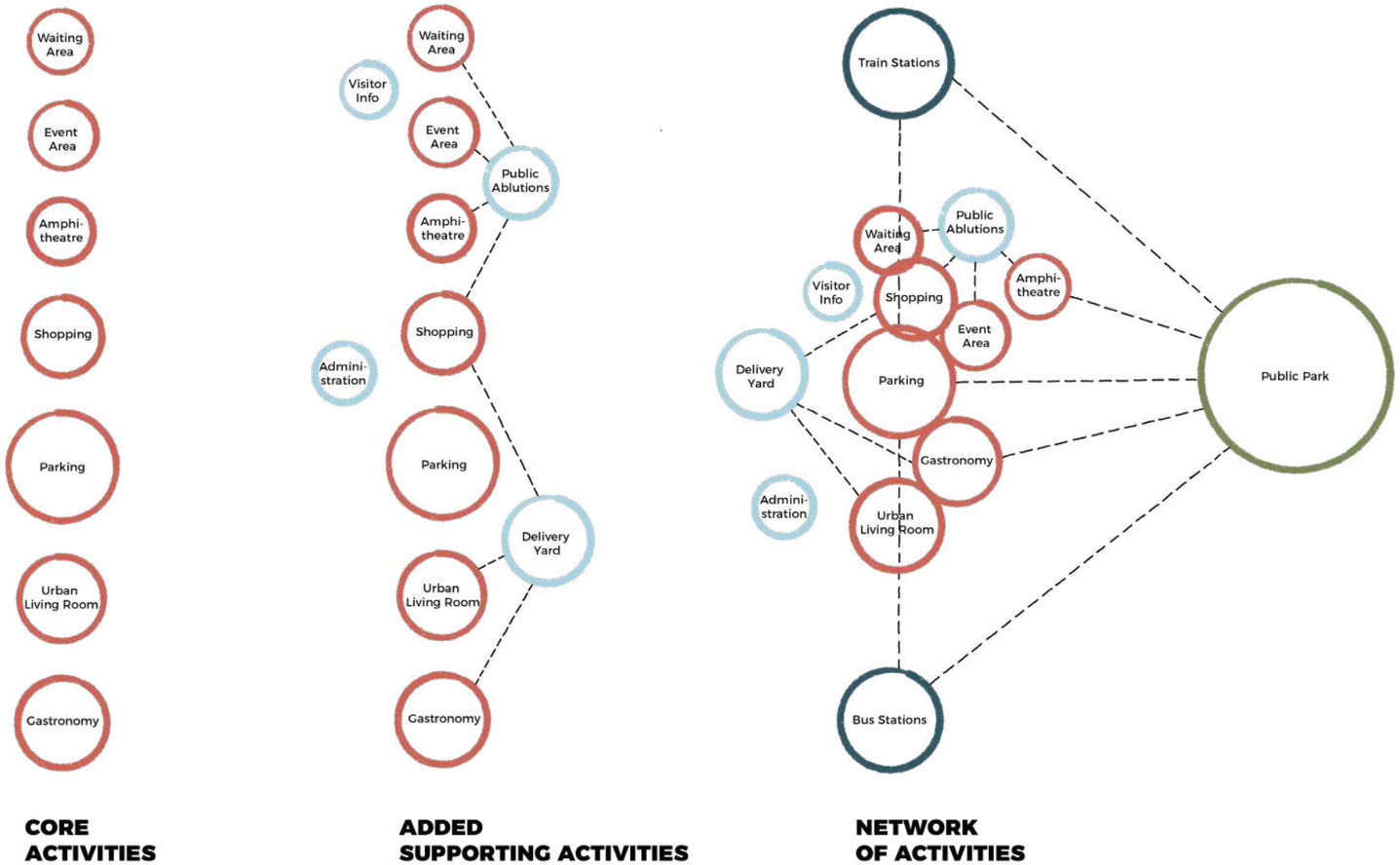


Figure 5.2
Programme network diagram. (Author 2021)

5.4

ACCOMMODATION SCHEDULE

Level	Category	Sub-category	Space description	Unit	Sum of Area
Basement level	Administration	(blank)	Security	m2	16
	Deliveries	(blank)	Service lift	m2	8.8
			Store	m2	300
			Yard	m2	840
	Foyer area	(blank)	Lift lobby	m2	55
	Plant Rooms	(blank)	Electrical Room	m2	9
			LV/DB Room	m2	12
			Standby Generator	m2	17.5
			Transformer	m2	36
	Staff ablutions	(blank)	Female ablutions	m2	22
			Male ablutions	m2	22
			Passages	m2	27
Shed floor	Ablution facilities	(blank)	Cleaning store	m2	5
			Female ablutions	m2	50
			Male ablutions	m2	32
	Administration	(blank)	Office	m2	17.5
			Security	m2	17.5
	Central space	(blank)	Circulation	m2	1150
			Exhibition/Digital shopping	m2	280
			Lift lobby	m2	70
			Open space	m2	360
	Gastronomy	Fast food restaurant	Counter	m2	40
			Entrance	m2	20
			Female ablution	m2	10
			Intake	m2	40
			Kithen	m2	50
			Male ablution	m2	7
			Seating	m2	120
			Staff ablution	m2	10
			Staff room	m2	20
			Storage	m2	55
		Restaurant	Cold room	m2	15
			Disabled	m2	3.5
			Entrance	m2	24
			Female ablutions	m2	2.5
			Kitchen	m2	50
			Male ablutions	m2	2.5
			Office	m2	6
			Seating area	m2	85
			Servery/Counter	m2	16
			Staff ablutions	m2	9
			Store	m2	9
			Waiting area	m2	5
			Wash-up	m2	5
		Snack bar + coffee take-away	Aisle	m2	8
			Coffee station	m2	20
			Counter	m2	8
			Display	m2	8
			Food preparation	m2	60
		Retail kiosk (no cooling)	Aisles	m2	5
			Counter	m2	5
			Display	m2	5
			Queue/Stay area	m2	3
			Shelving	m2	3
	Upper ground	Old Audit building	(blank)	m2	425
	Visitor information	(blank)	Counters	m2	25
			Kitchenette	m2	18
			Reading area	m2	55
First floor	Central space	(blank)	Circulation	m2	200
			Exhibition	m2	420
			Lift lobby	m2	70
	Event space/Parking	(blank)	Kitchenette	m2	15
			Power point	m2	10
			Store	m2	15
			Event space	m2	450
	Parking	(blank)	Circulation	m2	740
			Parking	m2	350
			Ramp	m2	450
	Urban living room	(blank)	Balcony	m2	112
			Co-work/Coffee	m2	230
			Entrance	m2	40
			Fire escape stairs	m2	24
			Lifts	m2	70
			Meeting rooms	m2	100
			Stair	m2	24
Second floor	Parking	(blank)	Circulation	m2	950
			Lift lobby	m2	70
			Parking	m2	1450
			Ramp	m2	450
	Urban living room	(blank)	Fire escape stairs	m2	19
			Lifts	m2	35
			Restrooms	m2	40
			Stairs	m2	35
			Yoga/Group exercise	m2	260
Third floor	Parking	(blank)	Circulation	m2	950
			Lift lobby	m2	70
			Parking	m2	1450
			Ramp	m2	450
	Urban living room	Café/Bar (Rooftop)	Entrance/Reception	m2	40
		(blank)	Ablutions	m2	40
			Bar	m2	40
			Cold room	m2	20
			Dining	m2	200
			Kitchen	m2	95
			Nap pods	m2	260
			Patio seating	m2	60
			Wash-up	m2	20
Fourth floor	Parking	(blank)	Circulation	m2	950
			Lift lobby	m2	70
			Parking	m2	1450
			Ramp	m2	450
Grand Total					17843.8

DESIGN DEVELOPMENT 6

6 DESIGN DEVELOPMENT

Investigative iterations

6.1

FIRST ITERATION

The very initial approach is to let the building be influenced by the public spaces around it. The precinct vision provides its general massing and boundaries, almost making the building 'leftover' space and giving prominence to public space as 'city rooms'. It is also important to consider circulation as one of the most important informants of the overall design. The Gautrain bus drop-off is moved further west in the precinct scheme but it is important to maintain direct access between the drop-off and the Gautrain terminal. This connection is carried through to the transfer concourse as suggested in the PRASA masterplan and retained within the final precinct plan.

The Gautrain terminal, Gautrain bus drop-off, Station forecourt and Precinct courtyard are used as anchors in four different directions. On ground level the "retailtainment" aspects of the program is positioned near the Station forecourt as the main plaza and more active public room. As discussed in chapter 5, the retail types categorised by speed of accommodation is located between anchors, with the most convenient and most digitally integrated placed nearest to main circulation and terminal waiting areas and the more leisure immersive retail programs placed further into the precinct toward the Precinct courtyard.

The Open Building support frame for parking and future density is positioned above ground level accessed via a back entrance in line with the existing drop-off/pick-up driveway.

A secondary plaza to activate Railway street forms part of this iteration. This circular public room is used as pivot point toward reconciling the two grid systems, the cardo and decumanus grid of the inner city and the 30-degree rotated grid parallel with the railway line.

Considering the five architectural strategies proposed by Francoise Bollack (2013) the first iteration takes the 'wrap' approach to the Old Audit Building, encapsulating the back of the structure as an entrance to the new building. The pitched roof shed is extended to the north and so the new addition becomes intersected by a heritage space that matches the inner-city cardo and decumanus grid and a heritage space matching the 30-degree grid.

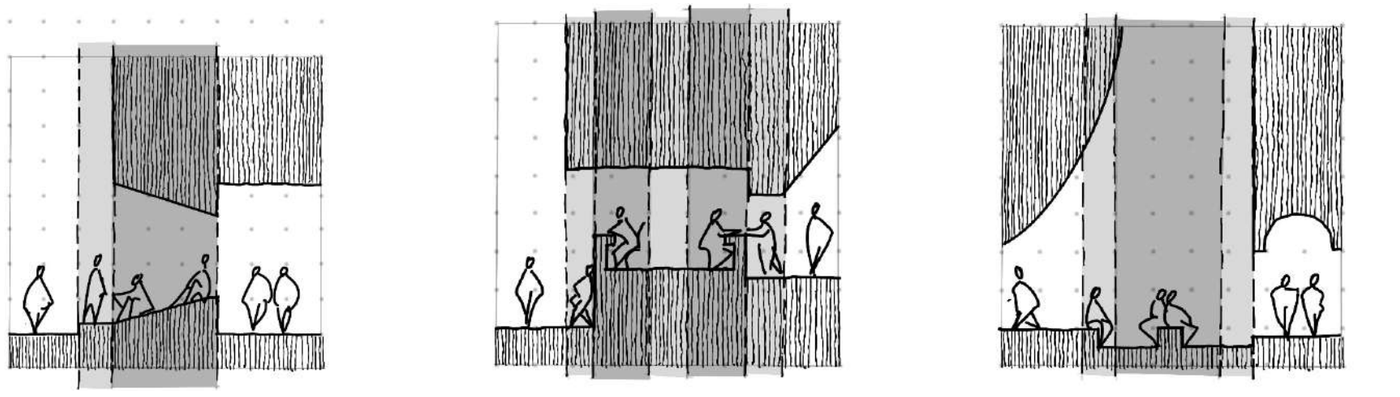


Figure 6.1
Adjacent kinetic and static spaces. (Author 2021)

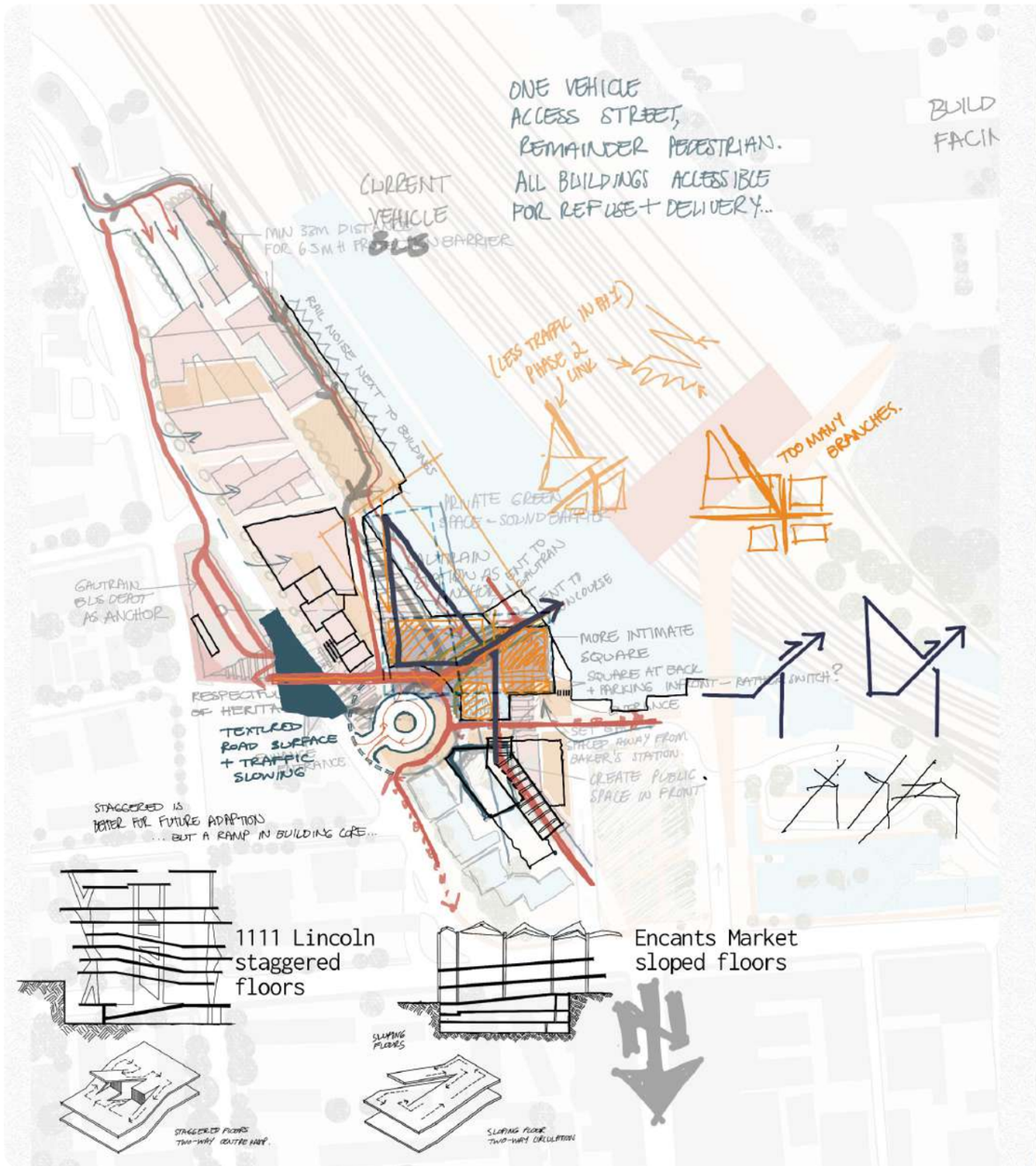
Figure 6.2
a) First iteration diagrams and b) First iteration maquette (Author 2021)

6.2

SECOND ITERATION

In the second iteration a larger amount of the designated space is incorporated in the structure to better accommodate the number of predicted parking bay requirements.
The secondary plaza is integrated with vehicle access to create a more public and street-oriented drop-off/pick-up area.
The building is carved to act as shelter for the circular public room. Although the first iteration does work toward creating more defined public spaces, connectivity and transformation of the heritage fabric it does not sufficiently dissolve the traditional figure-ground. A ramped promenade is placed within the carved space, overlooking the activities of the secondary plaza below and leading as a raised public pathway to the transfer concourse behind the Herbert Baker station building.
Different routes are given more hierarchical definition and a continuous steadily ramped promenade loop, encompassing ground level spaces and upper levels (as alternatively programmed or future market space) is used to spatially configure the second iteration.

Figure 6.3
a) Part 1 of second iteration diagrams and b) Part 1 of second iteration maquette (Author 2021)



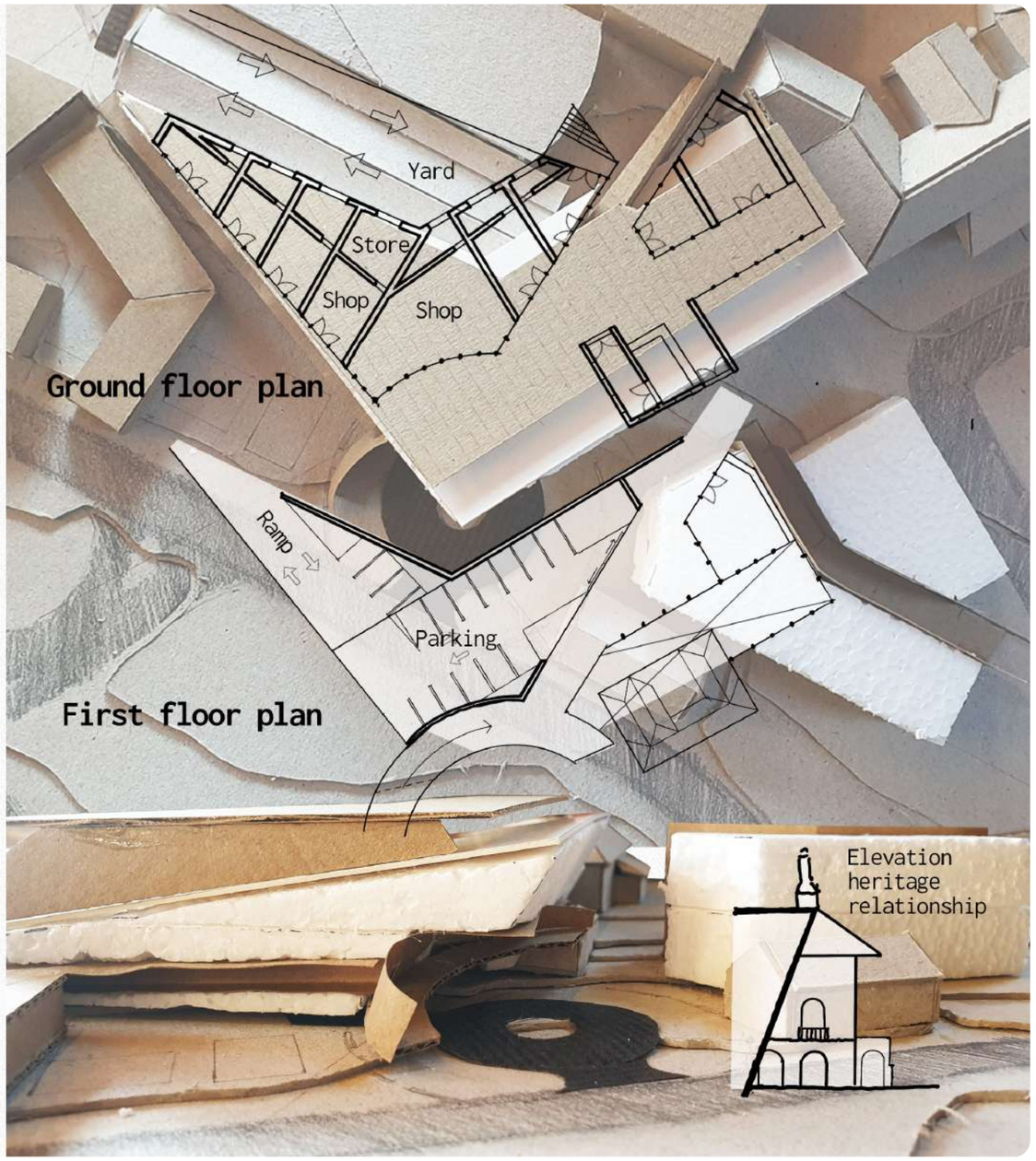


Figure 6.4
a) Part 2 of second iteration diagrams and b) Part 2 of second iteration maquette (Author 2021)

6.4

THIRD ITERATION

Iteration three pulled back on the concept of building as leftover space to some extent to give it more clarity and identity. Feedback from design two placed more focus on the intervention's relationship with its adjacent heritage structures. And my thoughts turned toward the Ningbo Historic Museum in China – where the architect designed the walls to be clad with recycled building materials from traditional Chinese buildings originally situated on the site. The third design considers the shed next to the Gautrain in this light. The entrance to the new intervention is designed in imitation of the shed form and aligned to the original position of the shed, but in a different material, and transposed to intersect the 1928 audit building. This entrance shed is not only of a different material but also takes form as fragmented frame. This makes the new intervention part of the 'wrap' strategy as defined by Bollack (2013) but does not make the structure of the heritage building redundant and rob it of its function. The original shed is pivoted along the new internal street to create a roof structure for trade activity. This solution also serves functionally enabling a service yard for the retail shops at the back of the building, ensuring that the building is not inward looking but maintains its most active face outward to the public.

Figure 6.5
Third iteration maquette (Author 2021)

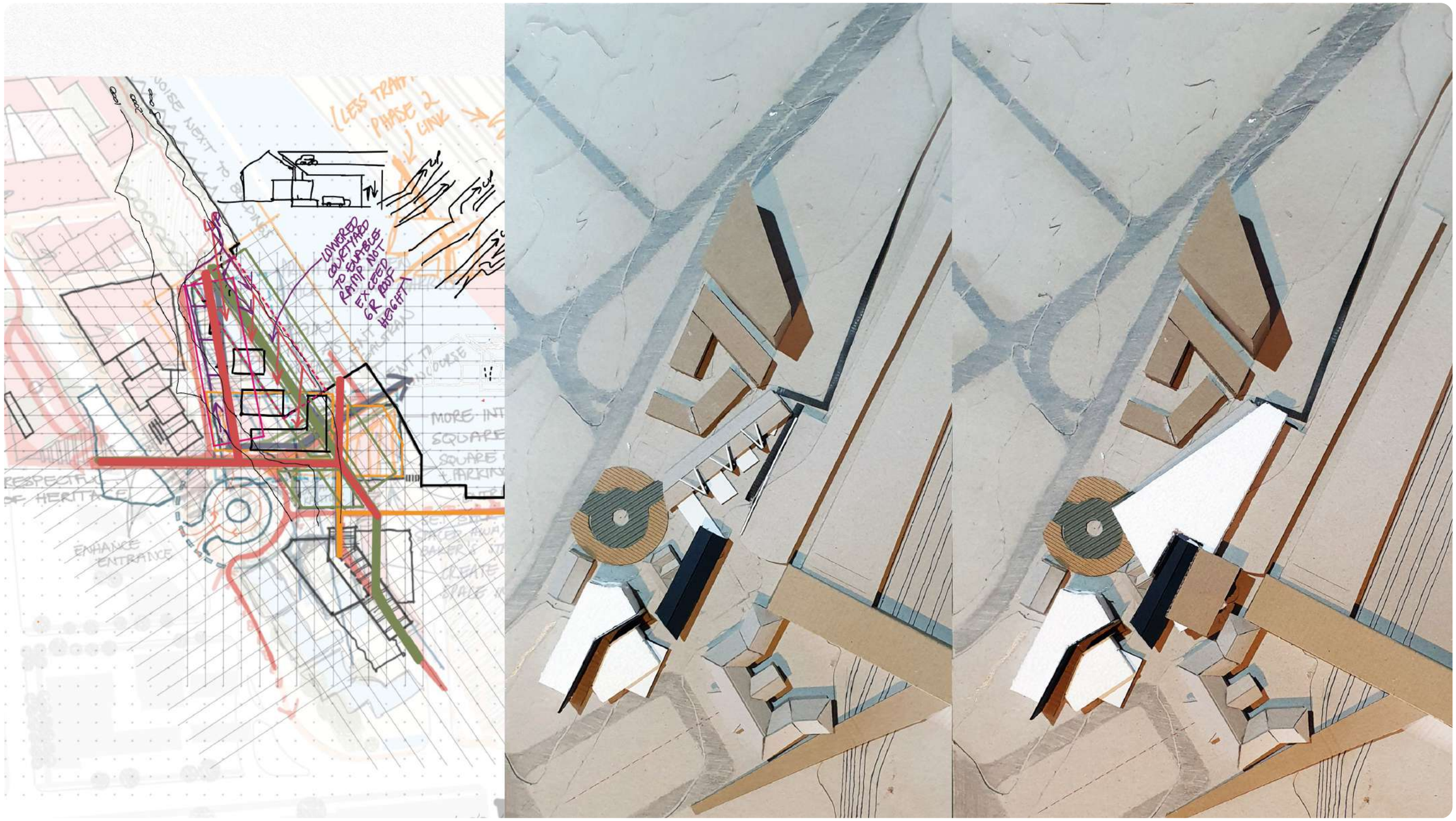


Figure 6.6
a) Third iteration diagrams and b) Third iteration maquette (Author 2021)

DESIGN DEVELOPMENT 6

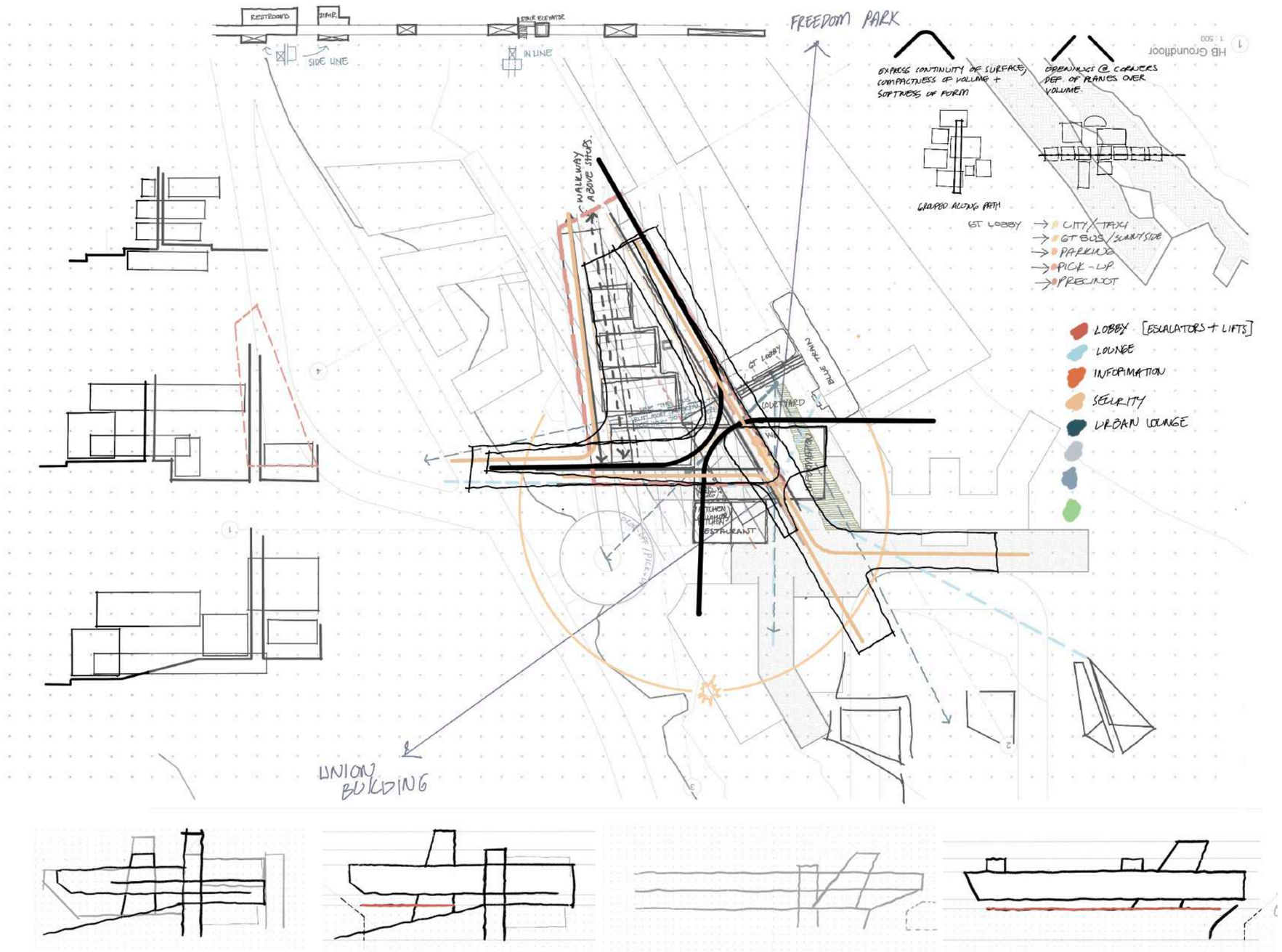


Figure 6.7
Space configuration layering (Author 2021)

7 TECHNICAL DEVELOPMENT

Transect, trasfer + transform

7.1

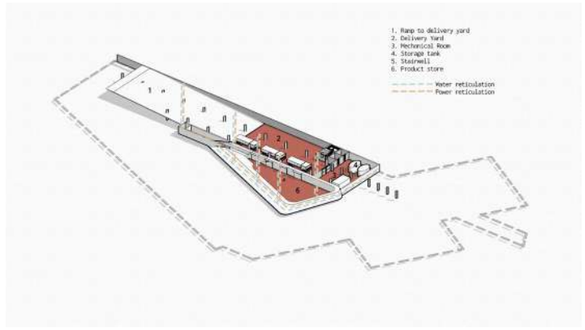
TECHNICAL DEVELOPMENT

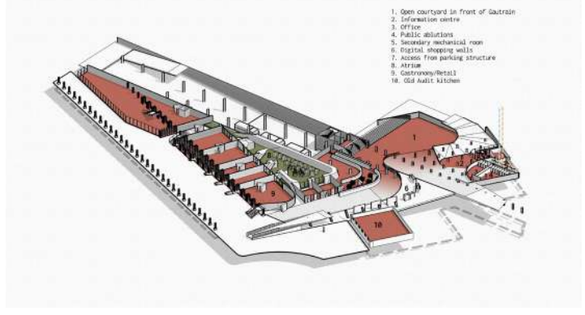
Three key aspects influence structural decisions:

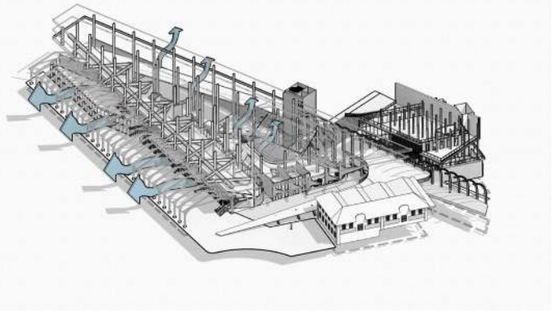
1. The spatial aspects of fast movement spaces merged with slow calm spaces.

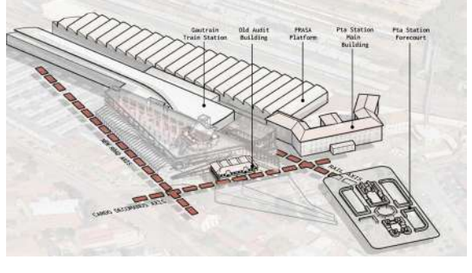
2. Future-proofing the building.

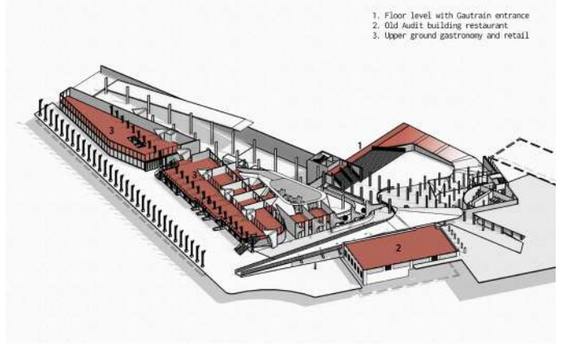
3. The way in which new construction and heritage structures relate to one another.











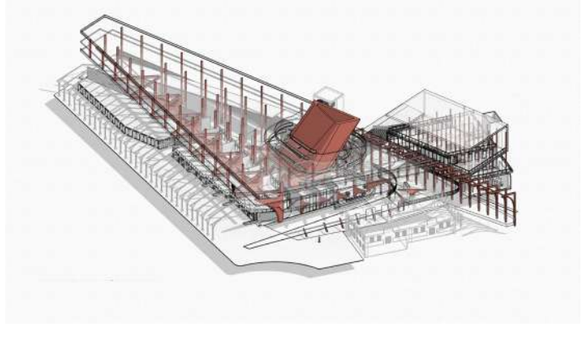


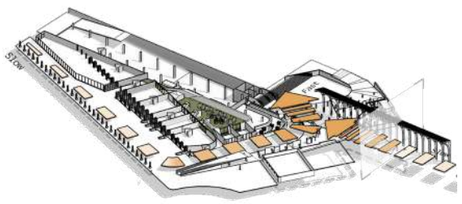
Figure 7.1
Technical development diagrams. (Author 2021)

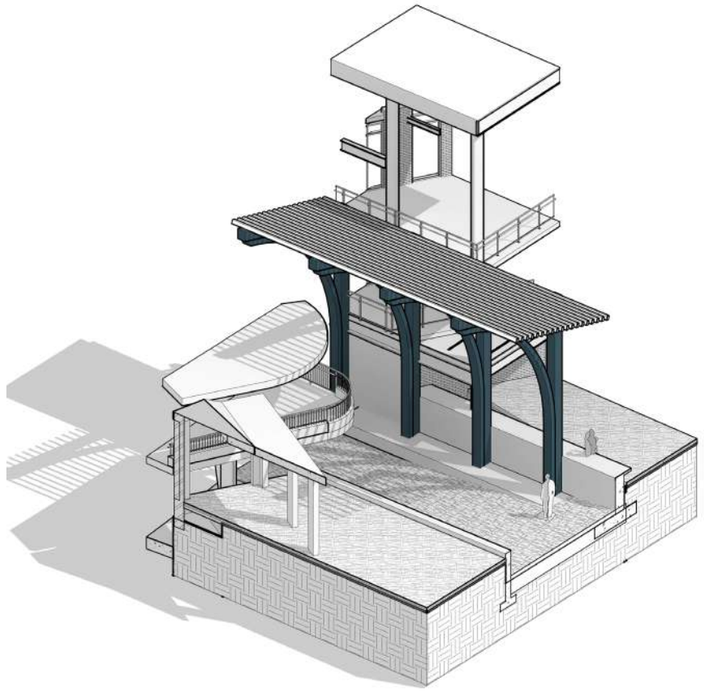
7.2

TECHNICAL TRANSECT

7.1.1 STATIC/KINETIC SPACES

Heights of overhead planes are used to convey different types of movement, with higher planes allowing for more light and freedom and way-finding aspects for fast navigation, and lower planes provide for a calm and leisure pace. Circulation spaces throughout are fully accessible and public and therefore have many different thresholds to private spaces. The surfaces used are durable, safe, unobstructed, and easy to traverse, with careful transitions into more restful spaces. Floor planes have organic forms and reach out into the surrounding landscape creating continuation, flow, and a stronger notion of public accessibility. Descending and ascending floor planes contribute to faster pace toward transport points and a slower pace toward open and leisure spaces.





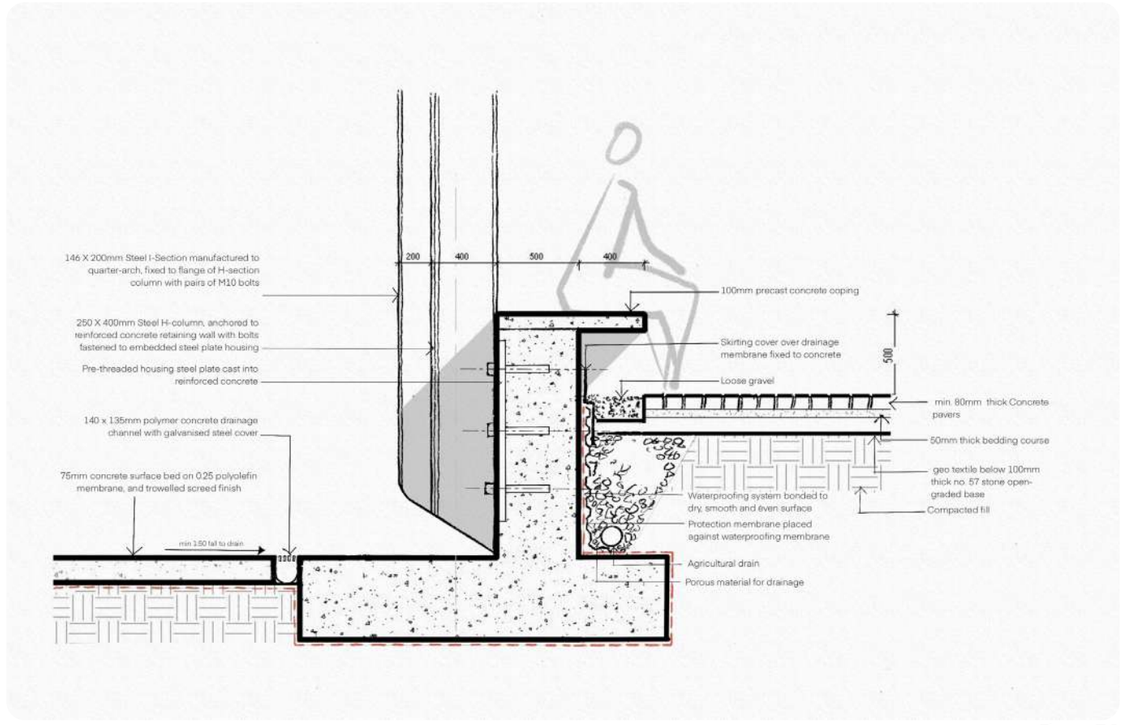


Figure 7.2
Detail - Kinetic and static spaces (Author 2021)

7.2

TECHNICAL TRANSFER

7.2.1 FUTURE-PROOFING THE BUILDING

The parking structure utilises increased and variable floor to floor height for different programs in the present and future repurpose to residences or offices. Flat plate, two-way spanning reinforced concrete construction is used for the parking structure not sloped, and ramps are constructed out of steel with a design-for-disassembly strategy. The flat plate concrete slabs are thicker and contain more reinforcement for the greater weight of future people and furniture. Thickened column supports are omitted for easier future renovation. Less beams and joists enable more flexibility in the layout of mechanical, plumbing, and electrical systems. Diagonal knee braces at corner columns are used to support the floating and distinct aesthetic. The parking structure footprint is narrower, better enabling future retrofitting with higher window to floor ratios than a typical parking structure.

7.2.2 ADAPTABLE RE-USE PARKING STRUCTURE

A parkade at its final stage of completion is but a bare and mostly unadorned skeletal structure as well as a building with a typical lifespan of more than 60 years (International Parking Institute, Fernandez & Yoka 2018). Considering its potential for reuse in reducing costs of future projects if situated on a valuable land area, as well as reducing its environmental footprint, building parking structures in the present according to adaptable and reuse principles can support a more sustainable future.

A complete shift away from privately owned vehicles is still some way down the road, especially in cities and suburbs built on modern principles such as Pretoria. Developers cannot deny the fact that the success of new developments is still linked to the amount of available parking. However, societal changes such as environmental awareness, and new technologies such as Uber have already impacted use of privately owned vehicles. And these changes are only relevant to less than 35% of Tshwane's population as 65% of its residents already rely on public transport (Morolo, Kisuule, Koch & Ramorapeli 2021). And these changes are only relevant to less than 35% of Tshwane's population as 65% of its residents already rely on public transport (Morolo, Kisuule, Koch & Ramorapeli 2021). Considering the evident changes and the importance of encouraging and improving public transport for the majority users, any new parking structures should be designed today to be adapted in the future.
A parking garage might just be a bare skeletal structure but its potential to become something else is inhibited by several factors (International Parking Institute et al. 2018):

1. Floor-to-floor heights are too low
2. Floor loading capacity is too low
3. Too few drop-off and pick-up zones
4. Sloped ramp floors
5. Sloped finish for drainage
6. Size, number and layout of circulation cores
7. Inadequate HVAC and fire protection
8. No exterior enclosure

The following precedent: 9th Avenue Parkade in Calgary, designed by Kasian Architecture, is a multistorey car park designed for future adaptation and addresses the above shortcoming and more.

Figure 7.3
Platform innovation centre + parkade on 9th Avenue, Calgary (Calgary Municipal Land Corporation 2020)

7.2.2 9TH AVENUE PARKADE

Calgary Municipality's aim with 9th Avenue Parkade was to build a parking structure that does not want to be a parking structure, a structure that should not look like a parking structure and should be fully integrated into the urban fabric (Platform Galgary 2020). This aim required cross disciplinary collaboration and innovative strategies to accomplish an amalgamated facility to service the Calgary's East village with an innovation centre on the first two floors and five levels of parking above, that is primed for future conversion into commercial functions. With addition of new parking structures to the city waning in the face of "expanded public transit and a growing cycling culture" (Kasian Architecture 2020), this approach was crucial to not creating a structure that would become redundant too soon.

The 9th Avenue Parkade is designed with a floor-to-floor height ranging between 3.8 and 4.2 m (Malysheva & Generalova 2020), providing clear heights of 3.6m for small commercial/retail use on ground level and 2.7m clear heights for office or residential use. The parkade strictly has 2 ramps, one from ground to first level is designed with steel to be dismantled easily and the second ramp is integrated into the structure of the parkade as a "gently sloped slab winding all the way to the top of the structure"(Kasian Architecture 2020). Each floor can be levelled separately as needed in the future as "segmented terraces" (Malysheva & MDGeneralova 2020:3).

The slab is also designed to withstand heavier occupancy loads and winds around a void so as to provide natural light to the interior (Kasian Architecture 2020). The parkade has two vertical circulation cores at the furthest ends, approximately 90 meters apart. The void may also be used for additional circulation cores in the future (International Parking Institute et al. 2018).

The building's façade, consisting of thousands of metal tubes, aims to be futuristic and reference the adjacent National Music Centre with its wave-like form, but most importantly function as a more aesthetically pleasant cover for the mundane concrete parkade (White 2021).

Concrete beams contain a line of multiple sleeves for future service reticulation, with some reticulation already installed, such as fire protection. Sanitary and sewer reticulation is installed for the first two floors occupied as Innovation centre in a design that can easily be replicated on other floors.

The centre part of the building ground floor is open and publicly accessible. This is in part because the structure is built over an existing tunnel and must in essence act as a bridge with no foundation support at its centre. This public area contains sports facilities such as a basketball court and parking for 100 bicycles. The street edge is lined with wide footpaths and planters that double as seating.

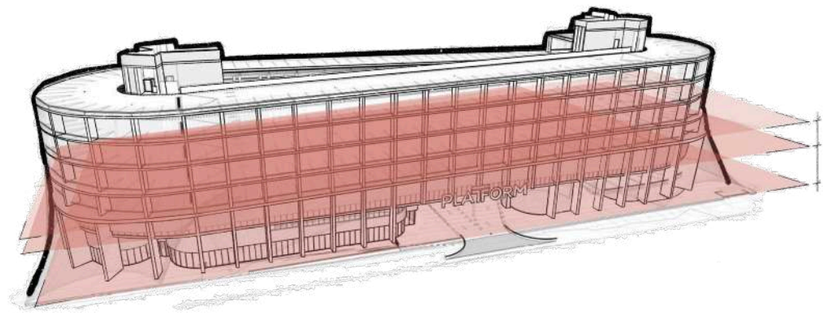


Figure 7.4
9th Avenue Parkade: floor-to-floor height ranging between 3.8 and 4.2m (Author 2021)

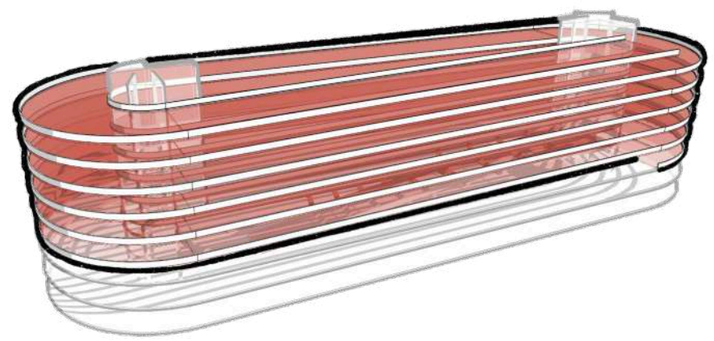


Figure 7.5
9th Avenue Parkade: gently sloping slab winding to top of structure (Author 2021)

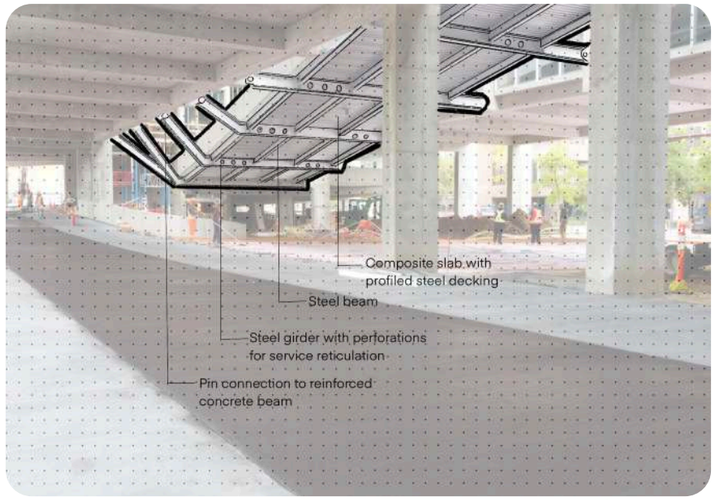


Figure 7.10
9th Avenue Parkade: centre composite slab ramp hanging from structure (ALSA Team 2021)

Figure 7.11
9th Avenue Parkade: sidewalk planters + seating (ALSA Team 2021)

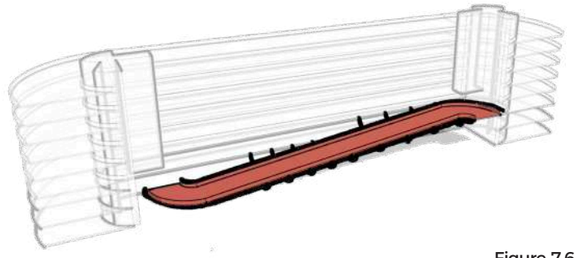


Figure 7.6
9th Avenue Parkade: design for disassembly centre ramp (Author 2021)

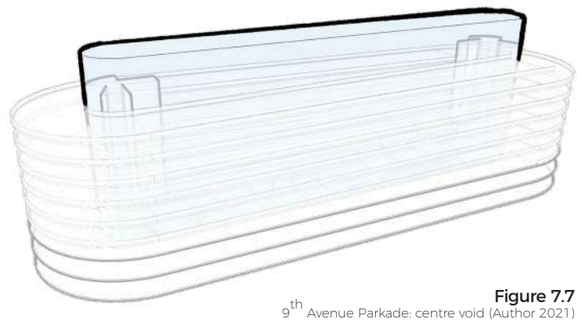


Figure 7.7
9th Avenue Parkade: centre void (Author 2021)

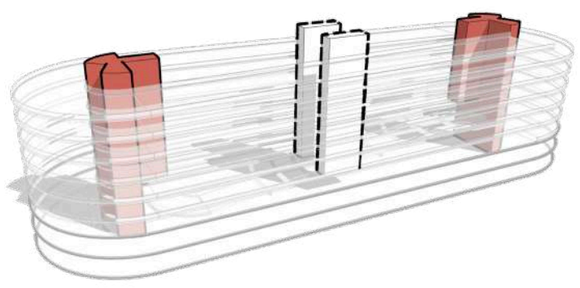


Figure 7.8
9th Avenue Parkade: vertical circulation core existing + future (Author 2021)

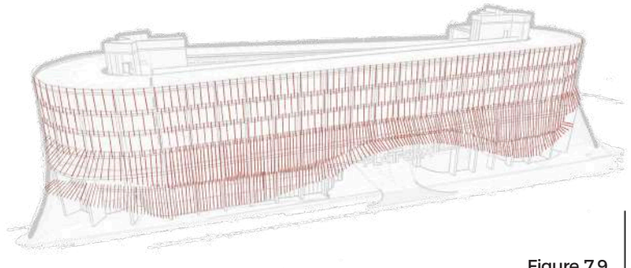


Figure 7.9
9th Avenue Parkade: metal tube facade (Author 2021)

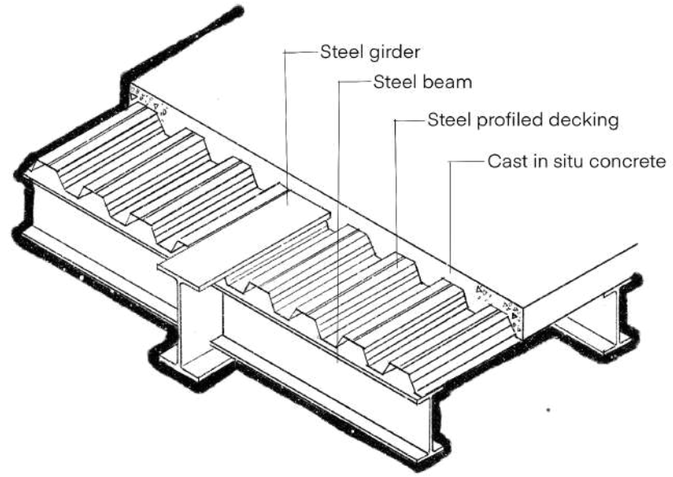


Figure 7.12
Typical composite slab structure (Author 2021)

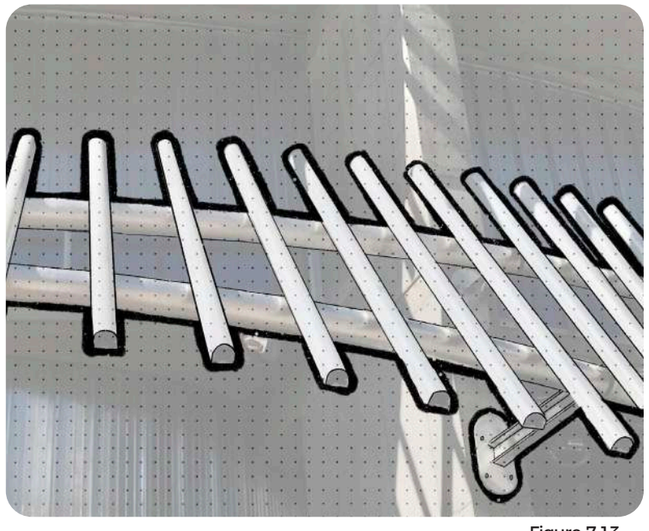


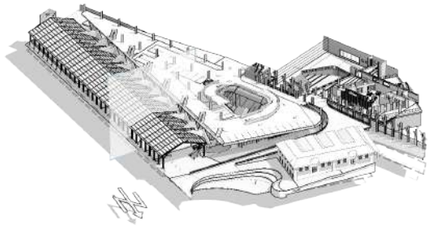
Figure 7.13
9th Avenue Parkade: tube facade structure connection (White 2021)

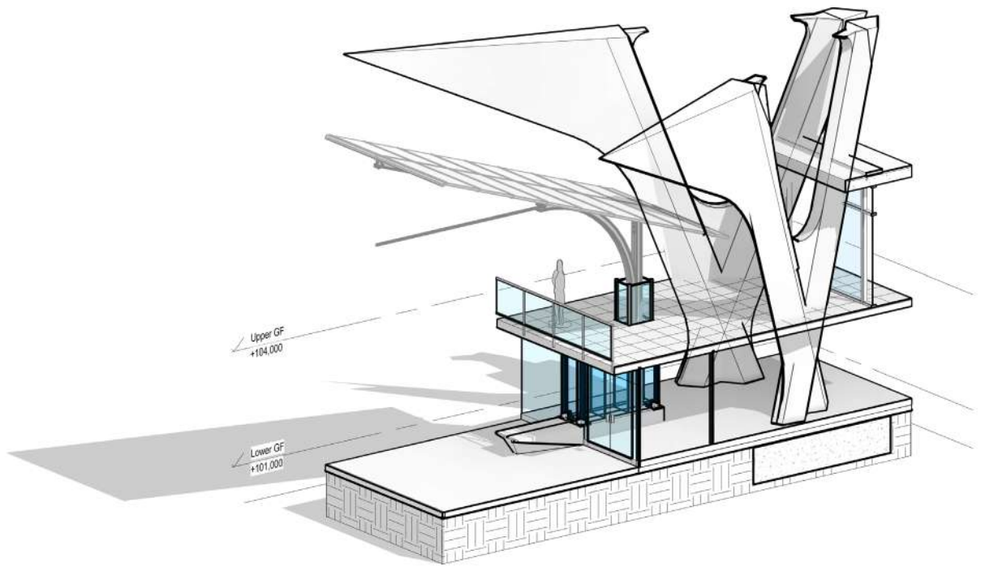
7.3

TECHNICAL TRANSFORMATION

7.3.1 THE WAY IN WHICH NEW CONSTRUCTION AND HERITAGE STRUCTURES RELATE TO ONE ANOTHER

Steel structures reflect and celebrate the utility and industrious look of the heritage shed in line with the intention and history of railways and their contribution to building the economy. Cantilevered steel and cantilevered reinforced concrete enable considerate and distinct relationships with heritage structures on site. Tectonic steel cantilevered structure interacts and contrasts with the stereotomic stone structure of heritage buildings and stereotomic concrete cantilevered structure interacts and contrast with the tectonic steel heritage shed structure. The reinforced concrete core supports the cantilevered structures. A large foundation is utilised to resist overturning moment. Inclined column members or struts are used for misaligned concentrated loads and beams are added to act in horizontal support.





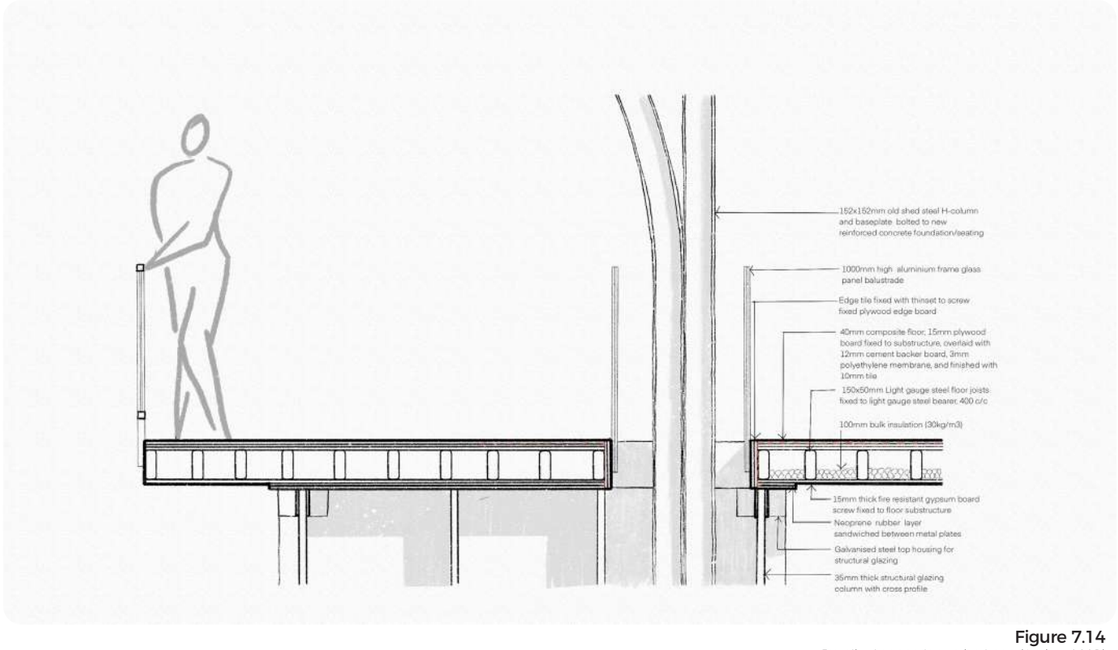


Figure 7.14
Detail - Connection to heritage (Author 2021)

7.4

VENTILATION

The parkade atrium consist of a solar chimney. The stack effect caused by the chimney greatly aids natural ventilation, especially in a structure where there is a high level of carbon emissions from cars. The stack effect “is based on the buoyancy driven force” (Moosavi, Mahyuddin, Ab Ghafar & Ismail 2013) which takes place due to different outside and inside temperatures. As described by Moosavi et al. (2013) there are three factors required to accomplish buoyancy driven ventilation; the building must have a high placed outlet, lower placed opening to let in air, as well as a heat source to maintain the outside/inside temperature difference. The solar chimney provides the high place opening to let out air, and if designed with a Trombe wall at its back it absorbs and stores heat at a high elevation within the chimney, supplying the heat source needed to maintain air flow.

7.4.1 Rob and Cheryl McEwen Graduate Study & Research Building

The Rob and Cheryl McEwen Graduate Study & Research Building, designed by Baird Sampson Neeuert architects, has a 28m tall solar chimney above its main atrium. The design utilises a multi-modal environmental control system to switch between passive ventilation and hybrid ventilation. A building automation system checks the inside temperature and adjusts the system of operable skylights and dampers on the chimney to control the direction of the air flow. This enables the building to close the atrium then allow in air and direct it through and Air Handling Unit with heating coils when the weather is cold. Which is then distributed through the vent. And when the weather is warm the system can switch to complete passive ventilation by opening the skylight between the atrium and solar chimney along with the lower placed openings.

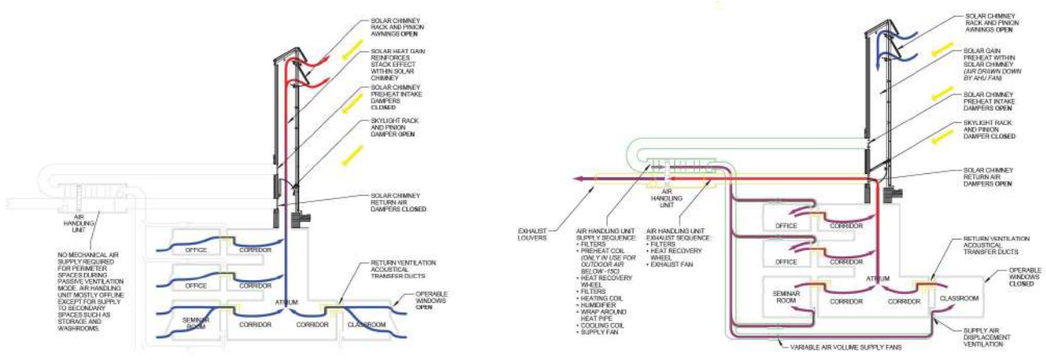
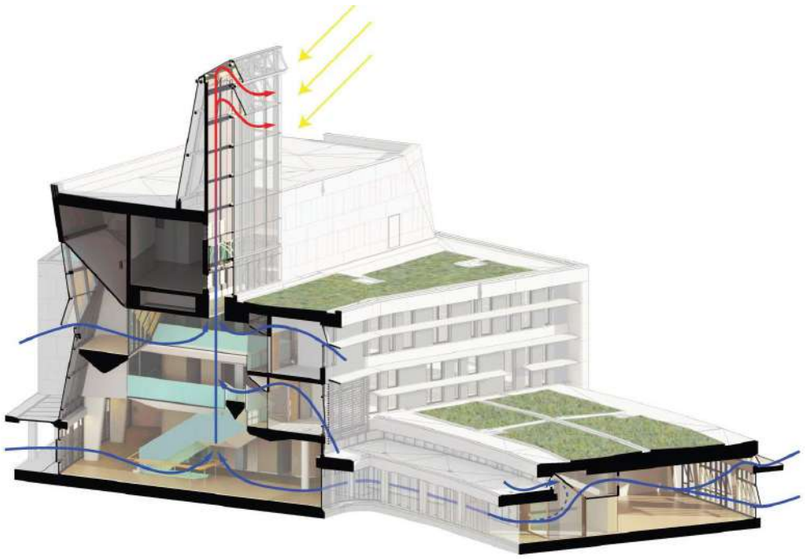


Figure 7.15
Rob and Cheryl McEwen Graduate Study & Research Building solar chimney hybrid ventilation diagram (Moosavi 2013)



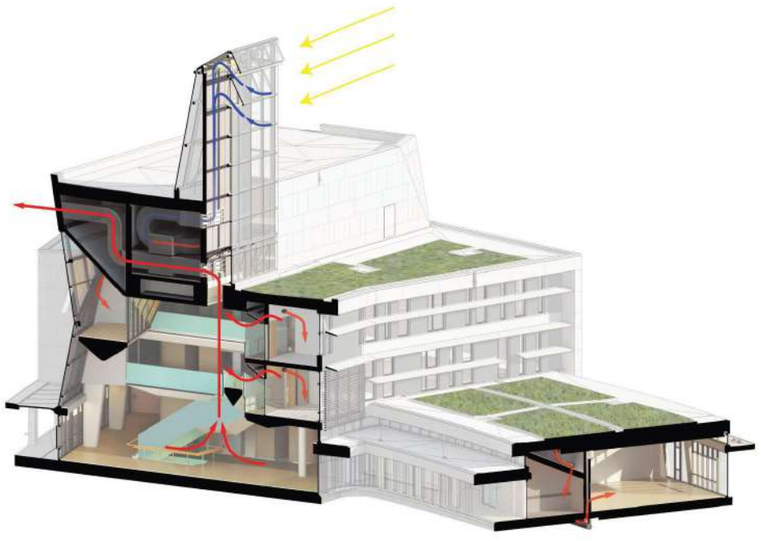


Figure 7.16
Rob and Cheryl McEwen Graduate Study & Research Building 3D solar chimney hybrid ventilation diagram (Moosavi 2013)

7.5

DAYLIGHTING

The function of the intervention required a sizeable mass. This requirement along with the chosen response to heritage buildings and the aim to create generous ground floor public space lead to the intervention creating a substantial solid canopy effect over the site. It was therefore important to analyse whether sufficient natural light reached the deep interior of the intervention.
Due to the intervention being informed strongly by the urban space plan as well as the city and railway grid the intervention faces north but its longest elevation faces east. This elevation is not at risk on the ground floor due to the deeply recessed threshold beneath the transposed Old Coach-washing Shed, but all levels from the first floor is directly exposed to the morning sun. The months in which interior are most susceptible to discomfort due to high temperatures range from September 22nd to March 21st. During this period direct light hits the east elevation until 11 am in the morning.

To ensure that floor levels receive sufficient natural light but are not over-exposed, Sefeira software was utilised to simulate the daylight factor as well as the underlit and overlit areas in the intervention. Daylight factor is known as the ratio of indoor illuminance to outdoor illuminance (Poudel 2020). The GBCSA (Green Building Certification of South Africa) can award a commercial building up to three points depending on its Daylight Factor performance. Similar to LEED the Daylight Factor must exceed 2%. If the Daylight Factor of 2% is applicable to 90% of the usable floor area the design can attain all three points.
Within the Overlit/Underlit analysis two values are used sDA (spatial Daylight Autonomy) and ASE (Annual Sun Exposure). The aim is to acquire high sDA values. This parameter indicates how much of the interior space receives a minimum 30 footcandles daylight for minimum 50% of a 24 hour cycle. The LEED credit score is higher for higher sDA percentages, with 3 credits for the highest at 90%.
ASE must preferably be low. This parameter indicates how much of the interior spaces receives too much (more than 1000 lux) direct natural light for “more than 250 occupied hours annually” (Trimble 2017).

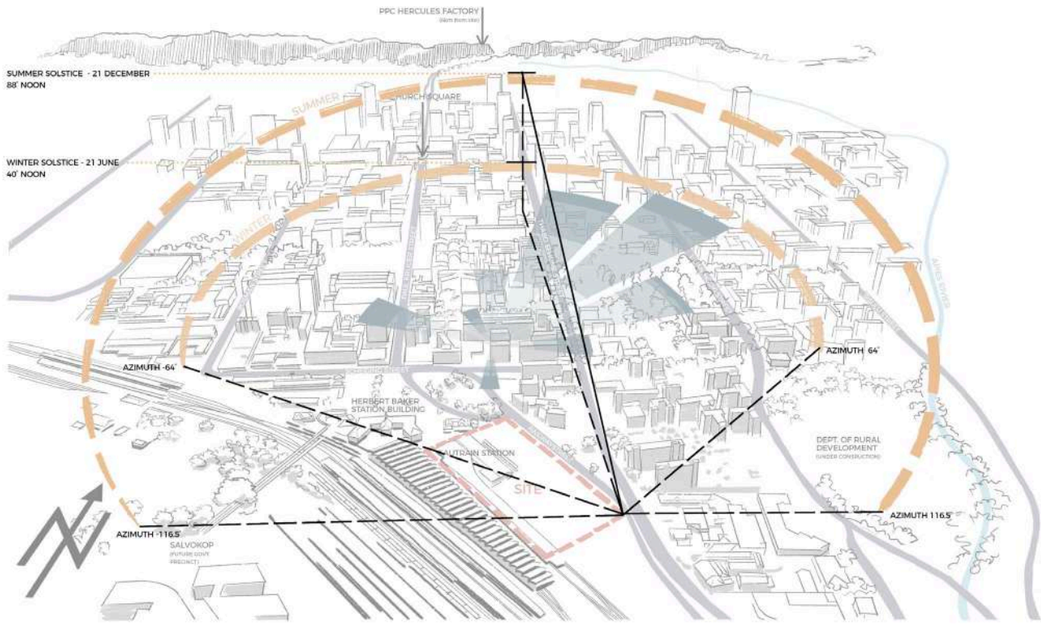
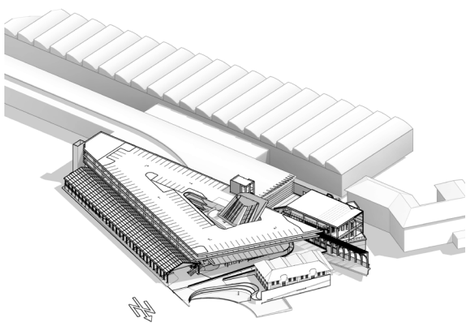
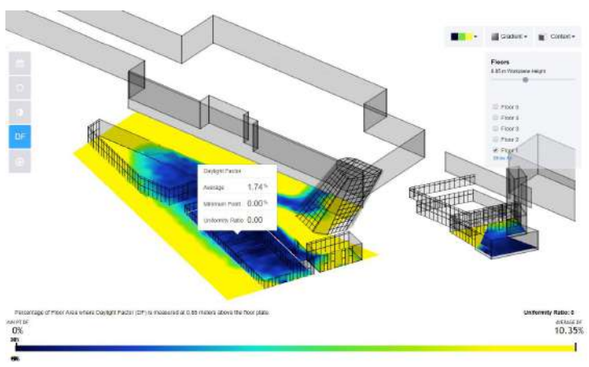


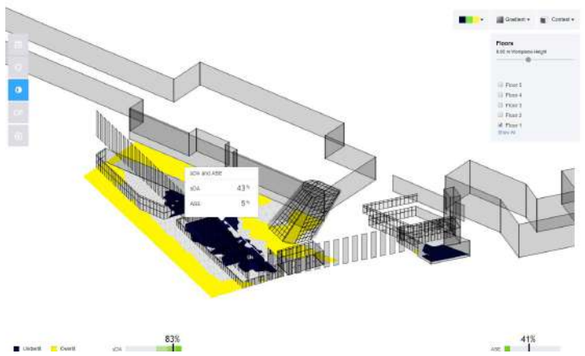
Figure 7.17
Sun angle diagram - Pretoria (Author 2021)

7.5

BASE CASE

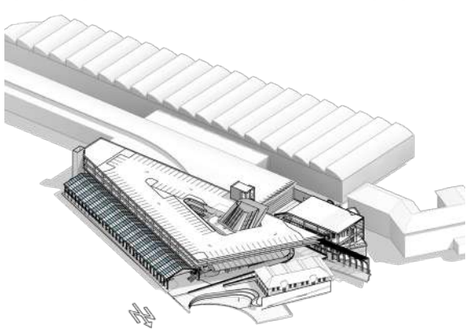


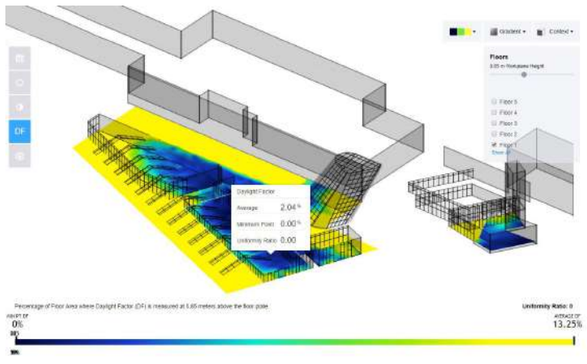


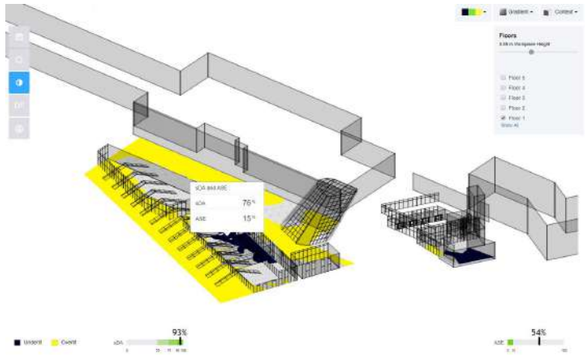


The modelled base case has a daylight factor less than 2%. sDA for the Lower Ground floor is less than 55%. ASE is very low, with little risk of glare and increasing cooling load.

GROUND LEVEL ANALYSIS

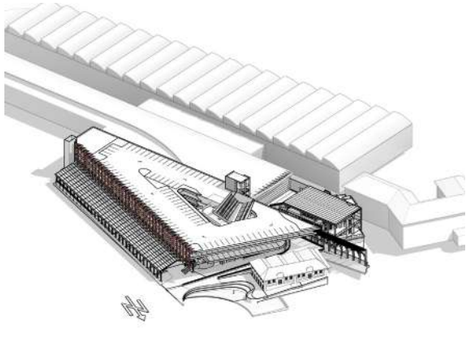


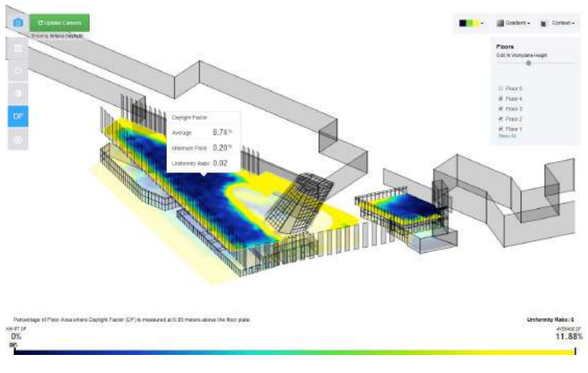




The addition of skylights to the Old Coach-washing Shedmodelled case has a daylight factor less than 2.04% on ground floor level. sDA for the Lower Ground floor is improved to 76%. ASE is very increases with this change, but is still very low.
The addition of vertical louvres to the east and west elevation model case has a daylight factor decrease to 8.7%. sDA for the second floor is improved to 94%. ASE is very increased to 31% with this change.

UPPER LEVEL ANALYSIS





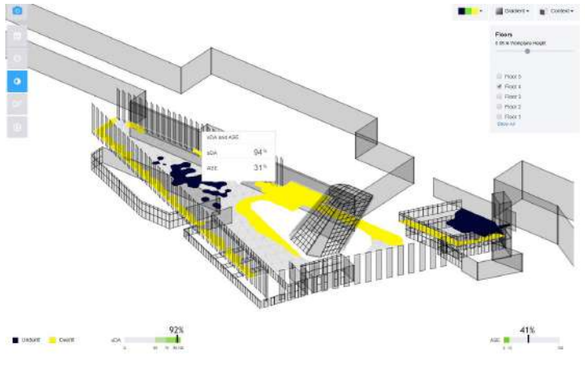
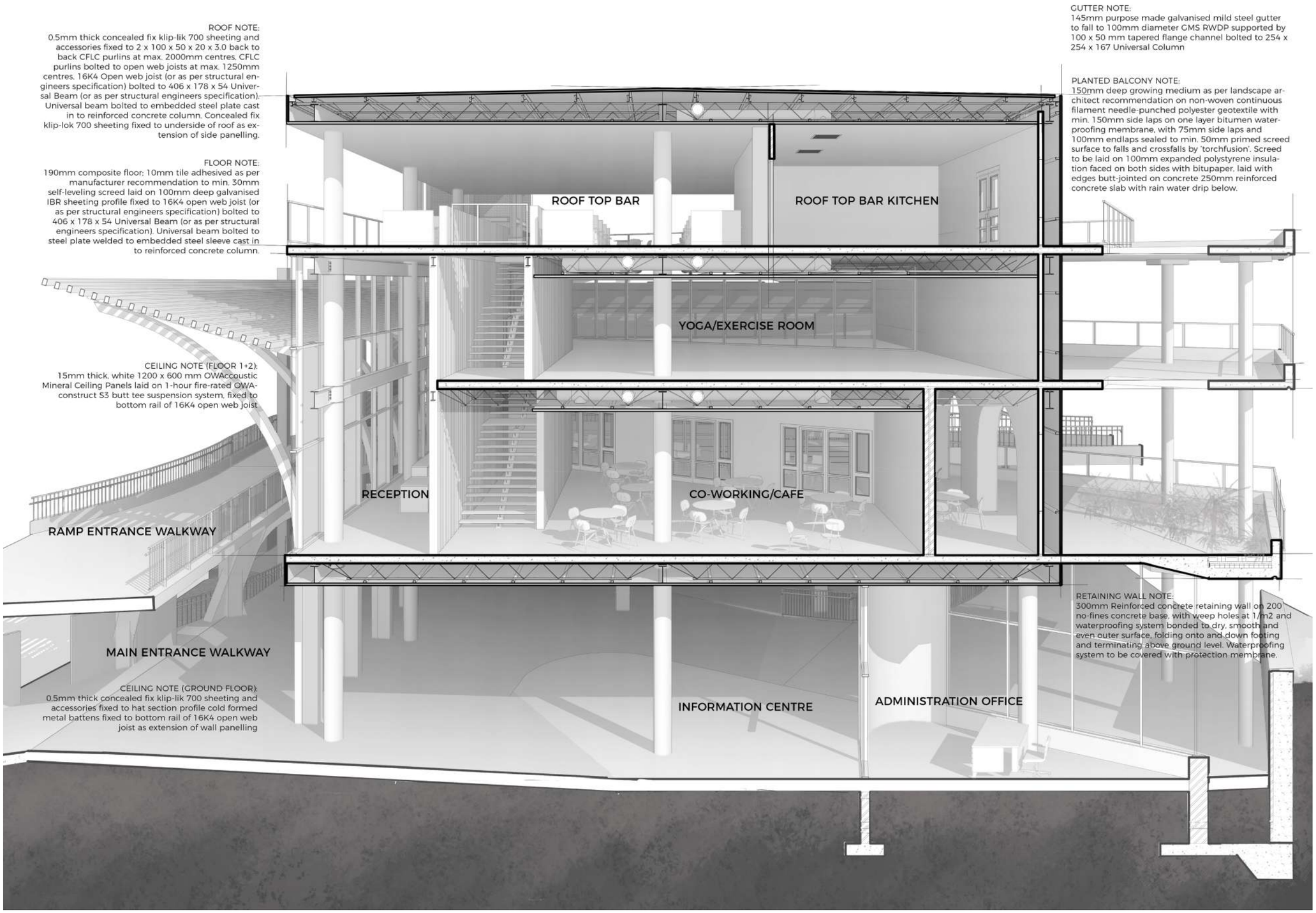


Figure 7.18
Daylighting study diagrams (Author 2021)

TECHNICAL EXPLORATION 7



CONCLUSION 8

8.1

REFLECTING

Supported by relevant literature studies the author maintains that the archetypical form of retail architecture in Pretoria contributes to poor place-making and a disconnected urban fabric. With this dissertation the author aims to challenge the archetypical form of retail architecture in Pretoria. Not only in respect to its configuration but its potential as co-acting catalyst when hybridised with transport infrastructure.

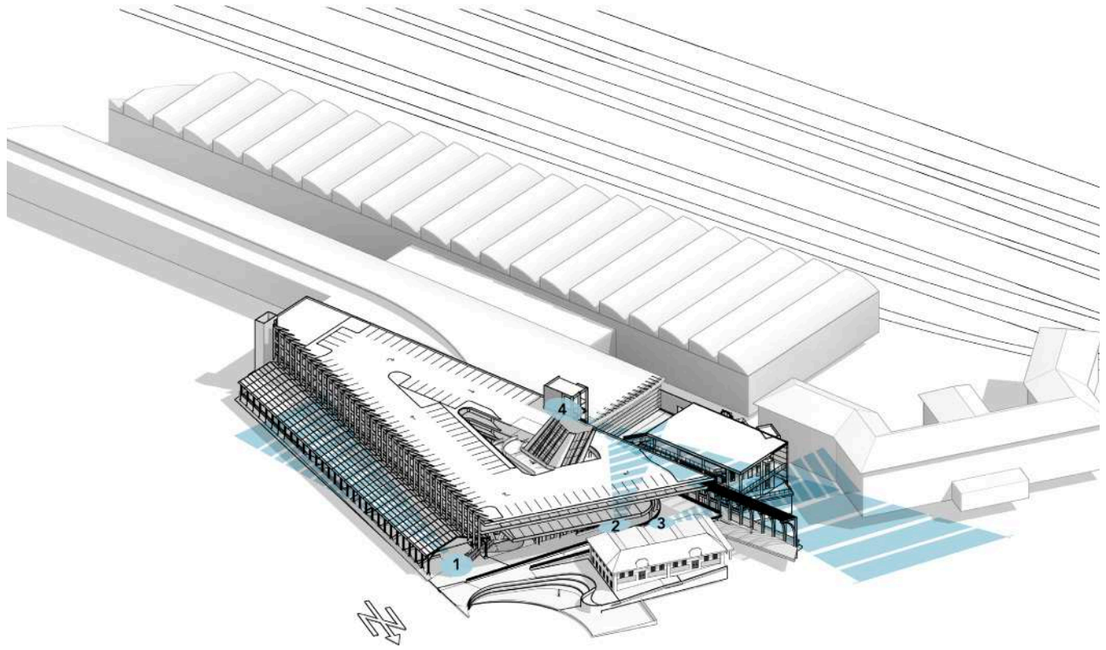
The intention of the dissertation research was to explore the ways in which retail and rail station architecture may be optimally combined in a South African context, with a significant consideration of public space-making in lieu of pseudo-public schemes and resilience of transport infrastructure.

As a city that experienced most of its growth within a modernist and segregated paradigm, it is paramount to explore alternative methods of continuing Pretoria's growth in a more compact and socio-economically sustainable way, that caters for all members of society and decreases the consumption of irreplaceable natural resources. Utilising design principles to create architecture that will retain its relevance and lend itself easily to adaptability will contribute to less obsolescence and a more resilient city. And considering different types of retail, public space and travelling relevant to the South African context will provide the dynamism required for a more resilient South African city.

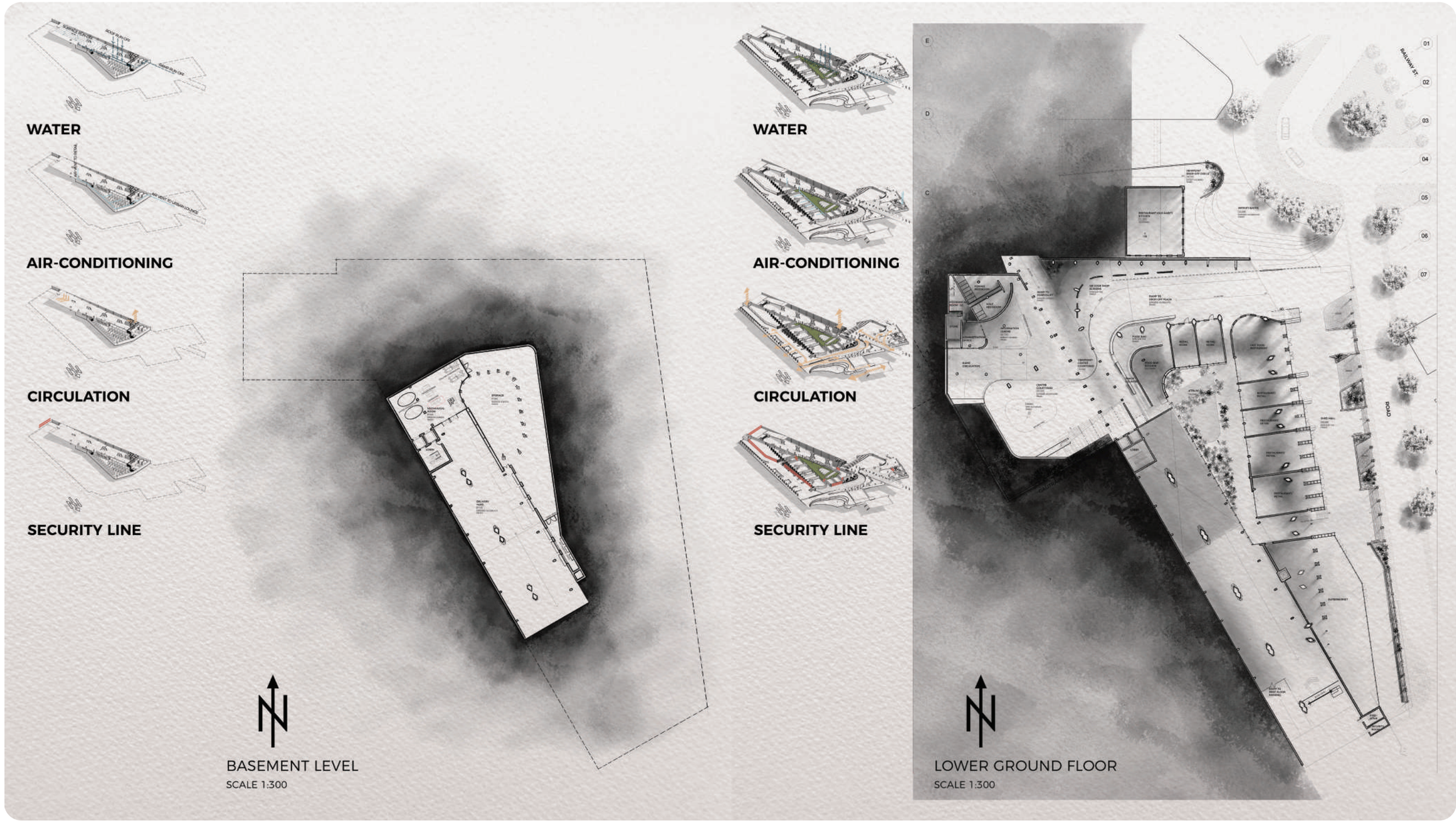
Two very different modes of spatial interaction were analysed to guide the design investigation: the leisurely mode of shopper and trader, and the rapid mode of the commuter. The examination of the two juxtaposing patterns were used to guide an approach to spatial organisation, hierarchy, and scale, when mediating the architecture of retail and transport infrastructure.

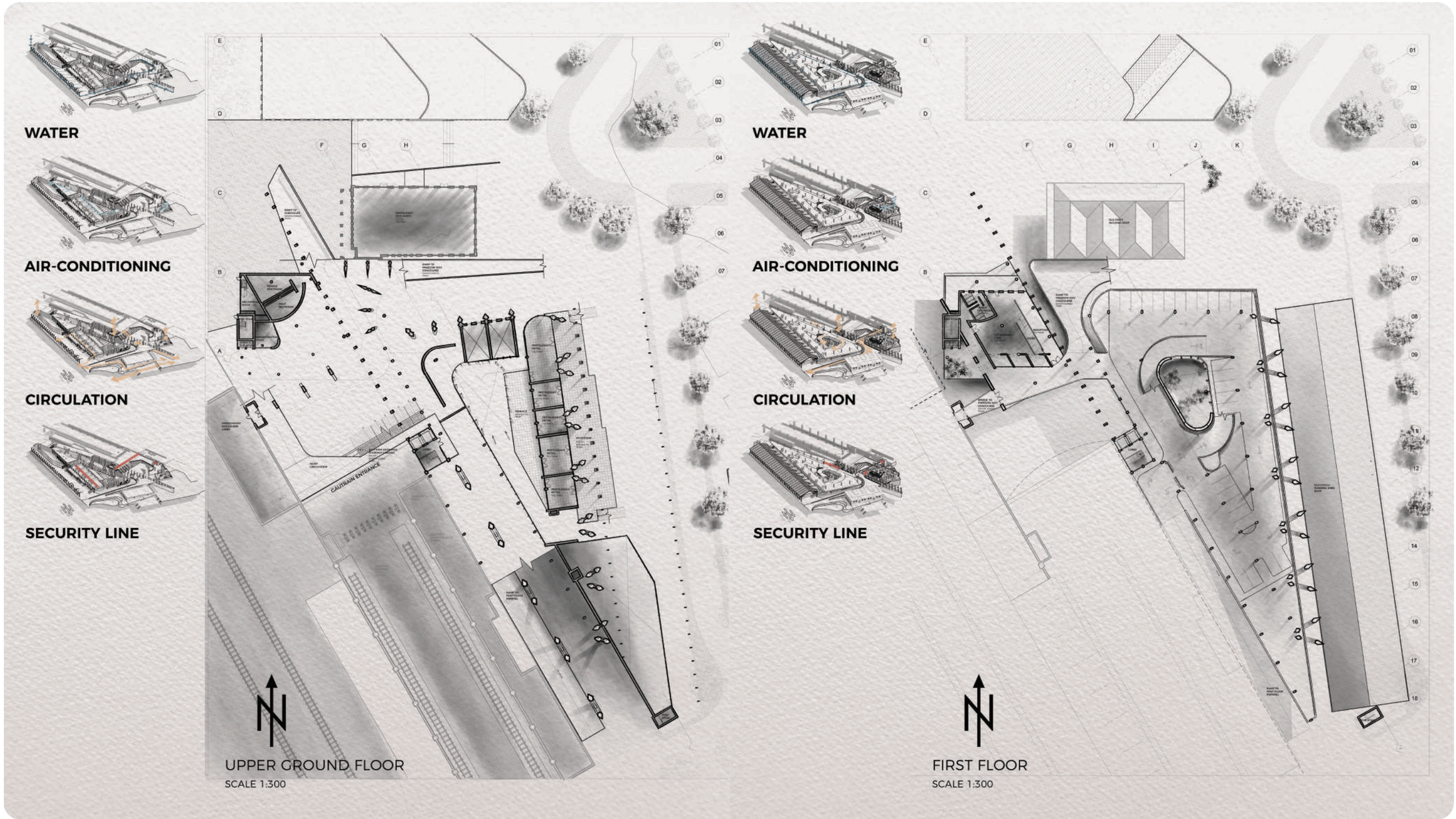
In the dissertation the author focussed on spatial and technological aspects broadly categorised under the themes of Transect, Transfer, and Transform. These themes guided the design in three critical mediation aspects: static vs. kinetic spaces, present vs. future spaces, and new vs. heritage spaces.

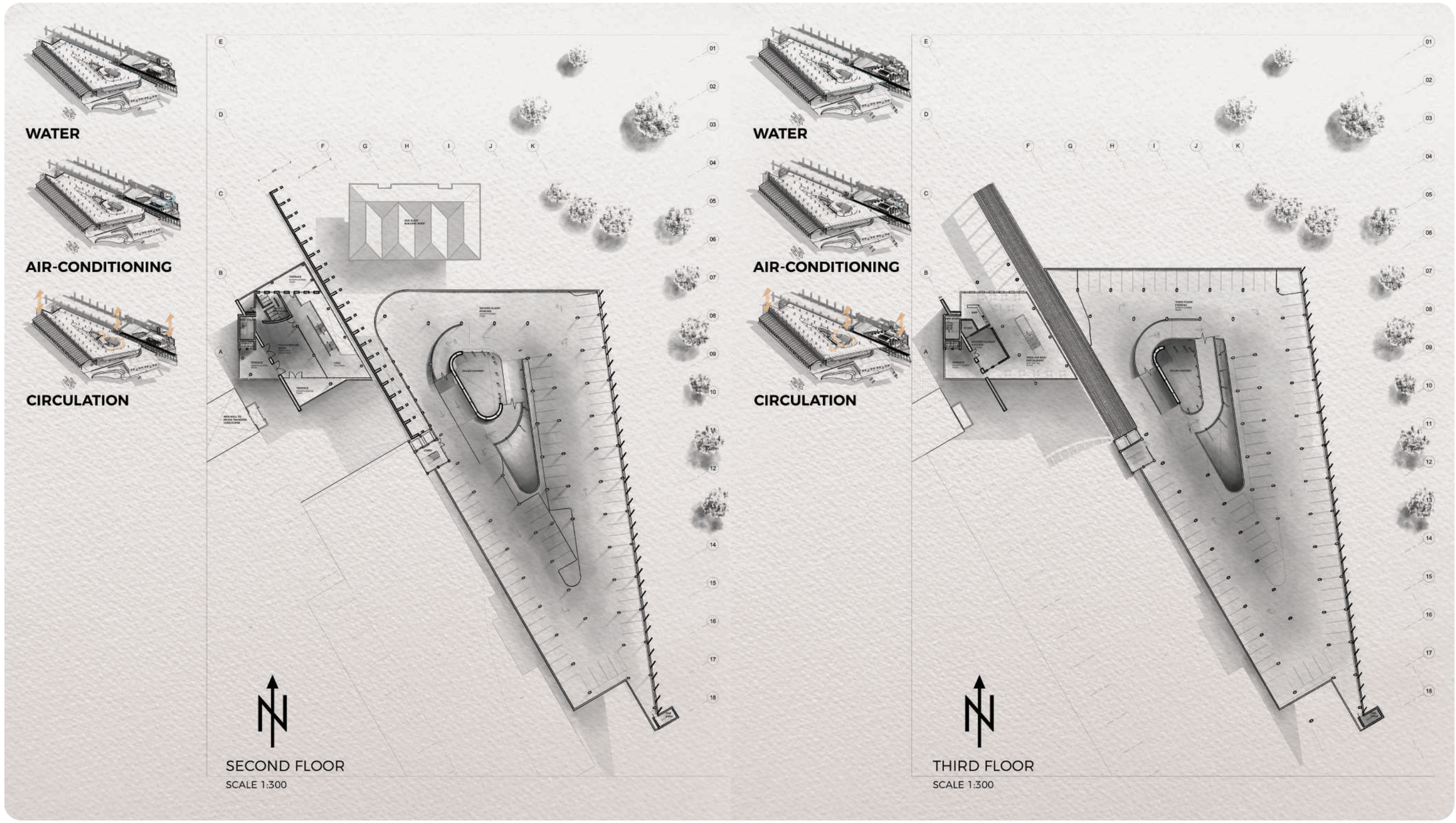
Large unbounded, formless public space focussed on private vehicle transport and isolated inward-looking retail space does not conform to the triad notion of sustainability: environment, economy, and equity. Although the urban future postulated in this dissertation may be judged as idealistic is the hope of the author that the aspects explored in this dissertation may form part of a continuum of improving retail architecture in South Africa geared toward resilience and integrity.



CONCLUSION 8

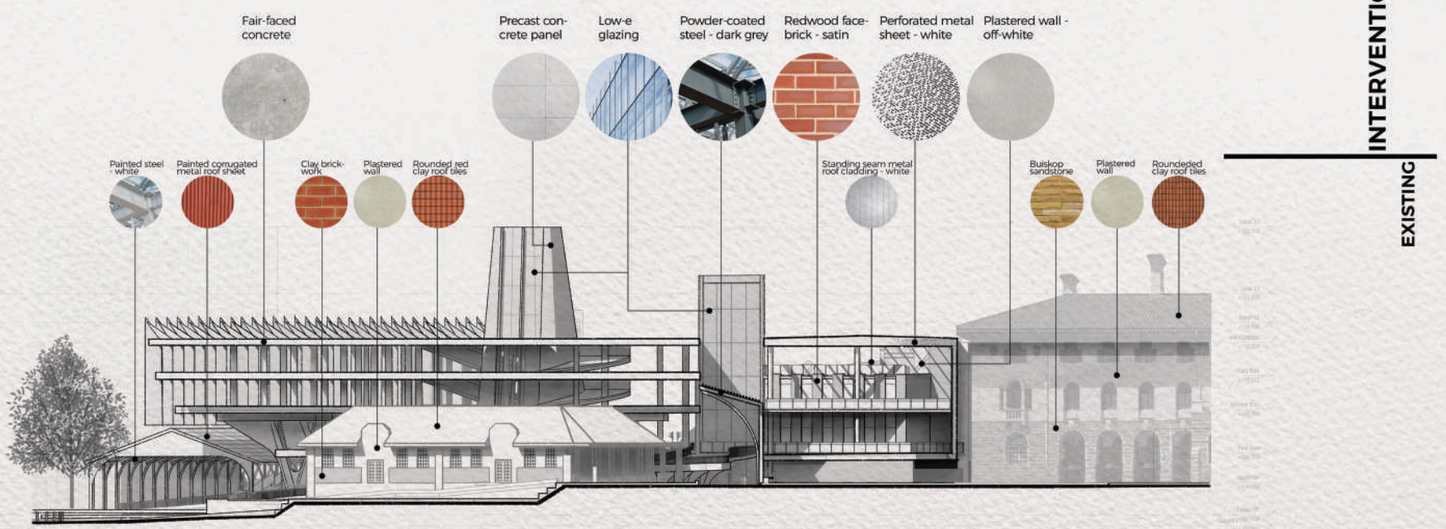




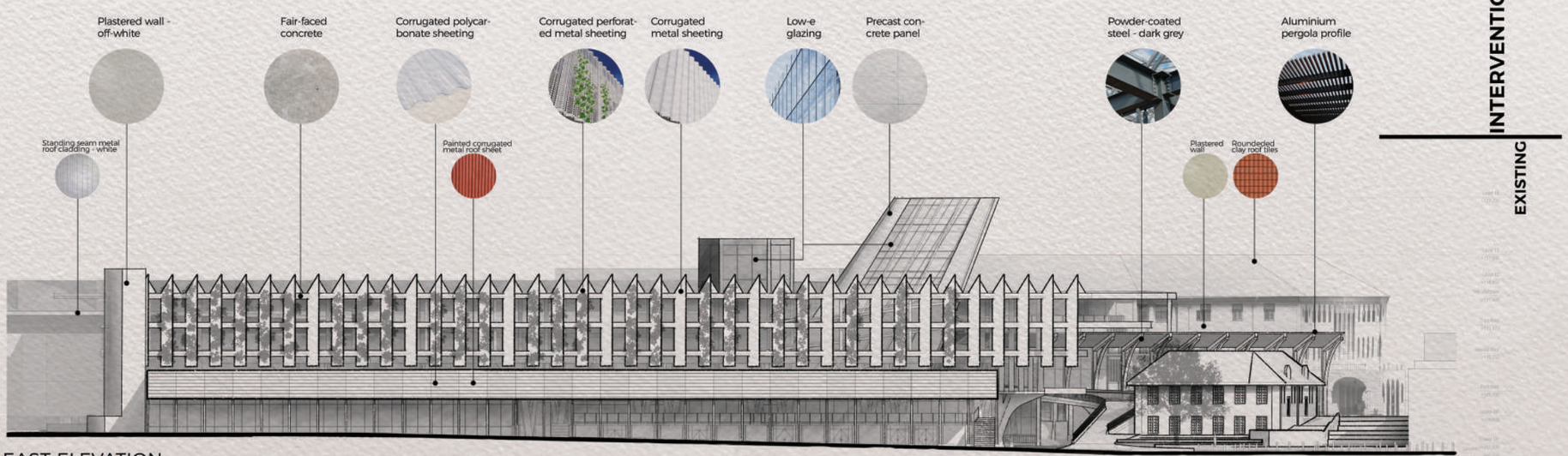


MATERIAL MATTERS

Material considerations for the intervention rely on the surrounding built context. Corrugated metal sheeting plays a prominent role as an extended concept of the Old Coach Washing Shed, but in a white colour supporting the white metal clad roof of the Gautrain.
Fair-faced concrete finish and off-white plastered walls form part of the structural back-drop as a supporting finish to highlight the more prominent materials.
Satin Redwood facebrick walls imitate the rhythm of the Old Audit Building openings as well as the existing facebrick, but with flush white mortar joints to compliment the white cladding.
The main entrance canopy contrasts the cumulative material palette colour with a dark grey finish.



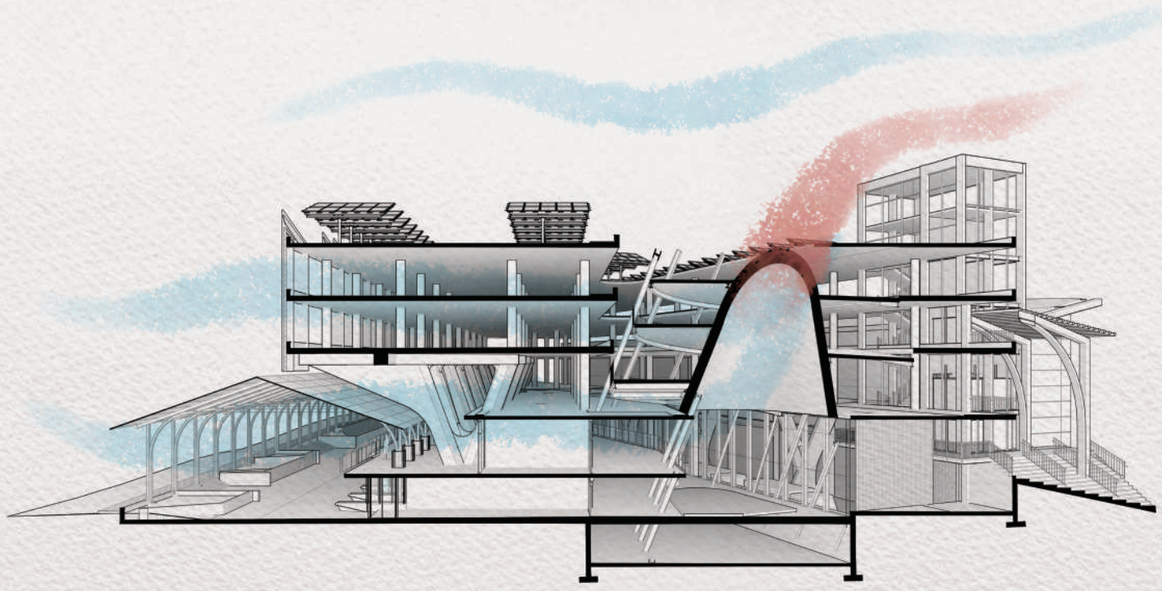
NORTH ELEVATION
SCALE 1:200

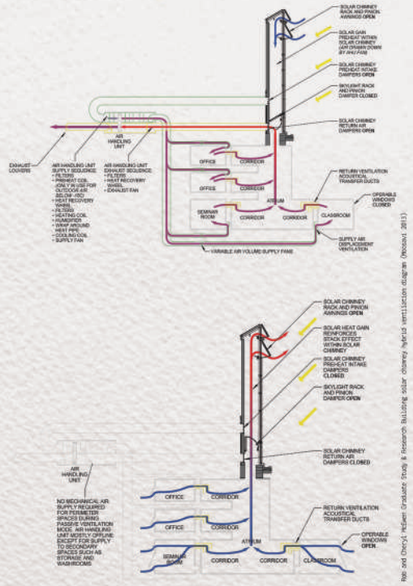


EAST ELEVATION
SCALE 1:200

VENTILATION

The parkade atrium consist of a solar chimney. The stack effect caused by the chimney greatly aids natural ventilation, especially in a structure where there is a high level of carbon emissions from cars. The stack effect "is based on the buoyancy driven force" (Moosavi, Mahyuddin, Ab Ghafar & Ismail 2013) which takes place due to different outside and inside temperatures.
As described by Moosavi et al. (2013) there are three factors required to accomplish buoyancy driven ventilation; the building must have a high placed outlet, lower placed opening to let in air, as well as a heat source to maintain the outside/inside temperature difference. The solar chimney provides the high place opening to let out air, and if designed with a Trombe wall at its back it absorbs and stores heat at a high elevation within the chimney, supplying the heat source needed to maintain air flow.





VENTILATION + DAYLIGHT

DAYLIGHTING

The modelled base case has a daylight factor less than 2%. sDA for the Lower Ground floor is less than 55%. ASE is very low, with little risk of glare and increasing cooling load.

The addition of skylights to the Old Coach-washing Shed modelled case has a daylight factor less than 2.04% on ground floor level. sDA for the Lower Ground floor is improved to 76%. ASE is very increases with this change, but is still very low.

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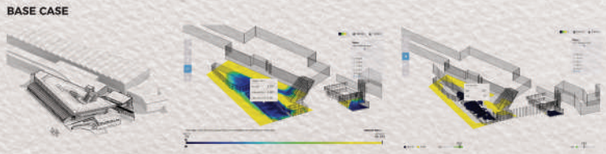
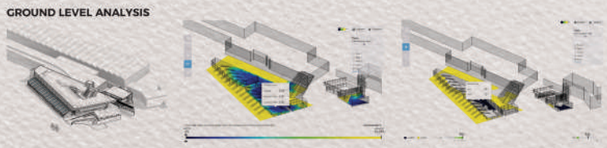
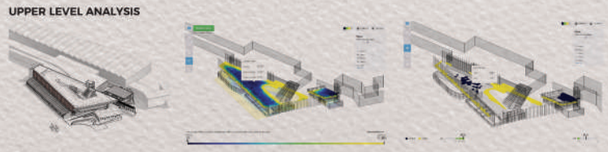
BASE CASE

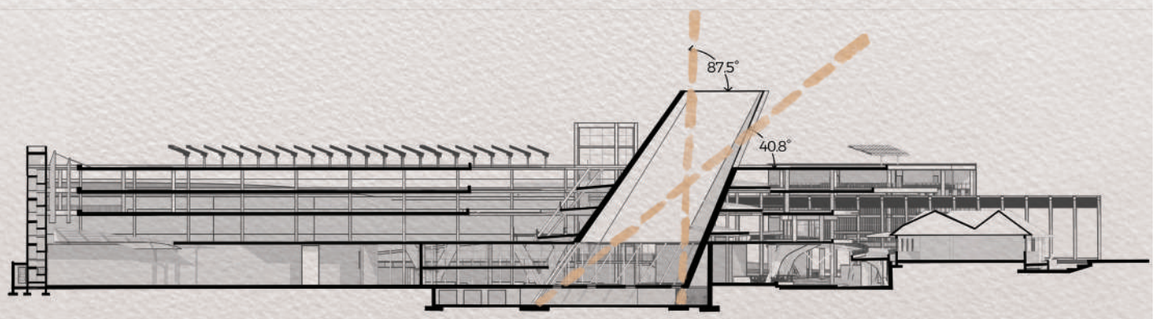


GROUND LEVEL ANALYSIS



UPPER LEVEL ANALYSIS





8.2

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