GOING CIRCULAR

Uncovering the Spatial Potential of Circular Economic Theories Inspired by Urban Vernacular Environments

Professional Masters of Architecture Dissertation

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Going Circular: Uncovering the spatial potential of Circular Economic Theories inspired by Urban Vernacular Environments

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DECLARATION

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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.

Signature  **Date:** 15/ 12/ 2021

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Project Summary

Dissertation Title

Going Circular:
Uncovering the spatial potential of circular economic theories inspired by urban vernacular environments

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Moreleta Park
25°49'30.1"S ; 28°18'35.7"E

Research field

Urban Citizenship &
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Study leaders

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Programme

Transport Interchange Hub

Primary:

Gautrain Station

Secondary

Taxi Rank
Informal Market Spaces

Tertiary:

Formal Commerce and Offices

Client

City of Tshwane Public Transport Department
Gautrain Management Agency
SA Cares (NPO)

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This is for all the campus cats out there.

Definition of Terms

Circular Economy: Whereas the traditional linear economy is based on a 'take, make, dispose' model of production, the circular economy is a regenerative approach, aiming at minimising resource input, waste, emission, water and energy leakage (Hans 2019).

Knowledge-Economy: Production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advances. A greater reliance on intellectual capabilities than on physical inputs or natural resources (Powell and Snellman 2004).

Resilience: A term indicative of the ability to survive and bounce back from adversity in any form (Hamdi 2010: 54).

Tacit knowledge: Tacit knowledge or implicit knowledge (as opposed to formal, codified or explicit knowledge) is the kind of knowledge that is difficult to transfer to another person by means of writing it down or verbalising it (Vathanophas 2011).

Urban Resilience: Urban resilience can be described as the capacity of a city to adapt to change, brought about by slow pressures or rapid-pulse disturbances (du Plessis 2013: 35).

Vulnerability: Defenselessness and exposure to risks, shocks and stress. Vulnerability is a recurrent concern of people living in poverty that professional definitions of poverty overlook (Hamdi 2010: 92).

Vernacular: Relates to indigenous, domestic and non-foreign, it is commonly understood to derive its form from building and architecture of local life, style, materials and geography (Oliver 1969).

Abstract

Kate Raworth (2019) argues in Doughnut Economics the importance of global communities living within their social and ecological boundaries, otherwise known as 'living in the doughnut.' Living within these boundaries supports the social priorities of the UN Sustainable Development Goals (SDG). It helps preserve the Earth's critical life-supporting systems that humanity depends on for survival (Steffen et al. 2015). Living within the planetary limits and providing a socially just space for all humanity is not only possible to achieve, but crucial to pursue to ensure the wellbeing of Earth and its inhabitants. Currently, society is overshooting at least four ecological boundaries (including climate change), and we now live with billions of people unable to meet their basic needs (Raworth 2019: 45). This condition is not simply unsustainable; it is unacceptable.

Globally, cities account for 60% of the world's total energy use and 70% of greenhouse gas emissions that negatively contributes to global warming and the impact of climate change (C40 2019). Without significant changes to the consumption of resources in our cities, the Earth's demand for material resources is estimated at 90 billion tonnes by 2050, compared to only 40 billion tons in 2010. This unsustainable and wasteful consumption of raw materials in our cities is a model of linear economic thinking (Raworth 2019).

Urban environments must challenge this status quo of linear economic thinking and strive for a more resilient framework explored as the Circular Economy (CE). CE aims to close inefficient resource loops and lead us towards living within our ecological boundaries (MacArthur 2013: 5). Theories from Transit Orientated developments (TOD) and Third Places are explored in this dissertation to complement CE. Their incorporation may reveal the spatial potential in living within our ecological boundaries in a socially just manner.

The global north does offer clues on spatially achieving a CE within built environments. This dissertation, however, looks at those systems already in place within informal settlements. Urban vernacular environments such as Plastic View where resources and waste are already being used most economically in a contextually relevant setting.

01 Introduction

Cities of the global south still operate in a ‘take, make, dispose’ linear economic system, which has detrimental effects on a country’s urbanisation processes (MacArthur 2013: 5). The CE paradigm directly responds to the linear economic paradigm found within many of our cities’ spatial and cultural-economic practices. CE aims to shift society from a ‘take, make, dispose ’ mode of production to a regenerative strategy that minimises resource input and waste production (MacArthur 2013: 5). CE helps preserve and optimise natural capital utilised in the built environment by keeping them in cyclic loops and ensuring their highest possible intrinsic value (Arup 2016: 10). Cities in the global north have positively taken to the CE philosophy. Cities such as Amsterdam have benefited from increased energy and material efficiency, job creation, and lower pollution (C40 2019: 3).

However, current research shows that CE still has limited evidence of successful implementation in third-world countries, such as South African cities, where many practical implications remain theoretical and conceptual (Dokter et al. 2021:692). For example, in South Africa, where potentially 90% of Construction & Demolition Waste (CDW) is recyclable, only 20% is reserved from becoming waste (Aboginije et al. 2010: 2430).

Overcoming the lack of evidence of CE in South African built environments may be possible by factoring in scale and local context. For example, investigations by the Moreleta Park Integration Project (2020) from the University of Pretoria revealed CE practices within urban vernacular environments, particularly informal communities such as Plastic View located in Moreleta Park. This dissertation explores these CE practices from the urban vernacular as lessons for implementing CE at a grander scale in the South African built environment.

1.1 General Global Issue

Antonio Guterres, Secretary-General of the United Nations, issued a “Red Alert for the World” and challenged humanity to “Narrow the gaps. Bridge the divides. Rebuild trust and bring people together around common goals” by the year 2030 or face irreversible changes (United Nations 2021). Unless we confront the linear economic model that functions globally as the status quo in modern built environments, cities like those in South Africa will be subject to resource scarcities and waste management issues.

Figure 1.1: The unsustainable gaps between resources, products and waste in our built environment (Author 2021).

1.2 Local Urban Issue

Currently, South African cities share similarities with other African cities such as Lagos, characterised by an overburdened institutional capacity and a rapid growth in urbanisation (Lehne, Preston, Wellesley 2019). In response, the City of Tshwane's 2055 vision (2013: 173) aims to "...close the loop in the cycle of waste resources." This framework, however, has not been interrogated to determine how spatial conditions may hinder or promote this circular strategy. For example, in Moreleta Park, the growing number of gated communities, the increasing privatisation of public spaces, and limited public transport access have contributed to spatial injustice, hardest felt by informal settlements in the area. How this fragmented urban fabric influences, the Circular Economic lifestyle of existing communities is yet to be determined.

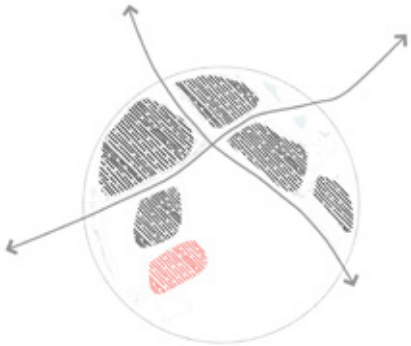


Figure 1.2: Disconnected systems and contested communities living in a fragmented urban context (Author 2021).

Unless we confront the linear economic model that functions globally as the status quo in modern built environments, cities like those in South Africa will be subject to resource scarcities and waste management issues.

1.3 The South African Built Environment

With most of the world's cities still operating in the linear 'take-make-dispose' mode of production, South Africa is no exception. The current state of the South African built environment is a significant consumer of resources, consuming 40% of virgin materials and producing 20-30% of total Greenhouse gas emissions per year in the country (Macozoma 2002). Not only is this inefficient consumption of resources exacerbating social, environmental and economic issues in the country, but it also occurs even when viable alternatives and counteractions are possible. For example, in South Africa, 90% of construction and demolished waste is recyclable, but 80% of it still ends up in landfills (Aboginije et al. 2010: 2429). Following along this trend will bring South Africa closer to irreversible environmental degradation and future resource scarcity, as seen in figure 1.3.

Fig. 1.3: Typical South African landfill dealing with environmental protection issues and holding capacity (DTE 2019).

In response to impending resource scarcities in Tshwane, the 2055 vision for the City of Tshwane aims to achieve spatial resilience they define as '...building the capacity to withstand vulnerability to environmental degradation, resource scarcity and climatic shocks...' (City of Tshwane 2013: 87). Underpinning many of CoT's aspirations in achieving spatial resilience are principles from new urbanism theory and cradle-to-cradle thinking. The CoT 2055 vision does not explicitly mention CE, but the principles and strategies outlined can help facilitate circular systems in cities and help 'close the gaps in the built environment (Braungart et al. 2012).

1.4 The Circular Economy

Sustainable design and development approaches such as cradle-to-cradle, biomimicry and green design represent a shift from object-centric thinking to systems thinking in design approaches (Gaziulusoy and Brezet 2015). CE theory forms part of a systems thinking mindset. What makes it unique is its emphasis on restorative approaches focused on keeping products and their associated materials at their highest value and utility for as long as possible (Dokter 2021: 693). Design considerations are often emphasised on the typical 'R' hierarchies (reduce, recycle, reuse, refurbish, remanufacture, repurpose and recover) in achieving resource value retention (Reike et al. 2018).

Using CE and looking for holistic solutions is a possible counteraction to the inefficiencies of a linear economic model, both spatially and in resource distribution. However, we may make more intelligent and responsible moves within existing systems before creating new ones. We need to look at those systems already in place in the built environment and ask; where are resources already being used most economically, where is linearity at work, how do we transition linearity into circularity and where does scarcity drive innovation? Thus, this dissertation explored these questions to uncover their spatial potential in the production of buildings whilst fostering community resilience in the act of creating CE environments.

1.5 Urban Vernacular Environments

According to Goel (2010:2), urban vernacular environments such as Plastic View represent an unconscious response to any building by non-professionals. These environments are home to inhabitants who daily face sanitation challenges, lack of infrastructure or social services and other resource scarcities. Plastic View, however, has managed to produce a productive environment under these conditions despite the recurring scarcity issues. Learning how to achieve resource efficiency from this 'vernacular laboratory' is the foundational goal of this mini-dissertation.

Plastic View as a resource-conscious environment represents a unified system between architecture and context, with sustainable closed-loop processes at play. Figure 1.4 highlights the diverse responses in the built form to issues surrounding waste, livelihood and economy. These resource-conscious systems must increasingly become adaptive against increasing social, economic and environmental pressures in achieving resiliency. Achieving this resiliency calls for designers to identify systemic contextual vulnerabilities to provide opportunities for a site's latent potentials (du Plessis 2013: 38).

Figure 1.4: A resource conscience and context-dependent selection of materials resulting in various buildings within Plastic View (MPIP edited by Author 2021).

The South African urban poor, who often reside in informal settlements, is argued by Neha Goel (2010: 5) to be the understudied urban vernacular that has been largely ignored as a source of learning material. Through prior investigations performed by the MPIP group, Plastic View revealed evidence for spatial lessons relevant to the CE discourse and informed the design proposal.

1.6 Third Places & Transit Orientated Development (TOD)

In his book The Great Good Place, Ray Oldenburg (1999) elaborates on the concept of a 'Third Place' that serves as a leisurely place where people come together and interact. The lack of these spaces in Moreleta Park encourages the dissonance between the residents of the gated communities and Plastic View. This barrier to social cohesion is also exacerbated by the proposed Gautrain extension passing through Plastic View, threatening community severance. As seen in both the Gautrain stations in Hatfield and Marlborough, there was a failure in bringing communities together and creating an inclusive environment. Transport infrastructure can thus inadvertently be a social and mobility barrier that separates people and potentially leads to a fragmented urban framework.

The analysis of this condition and more on TOD and Third Places will be analysed in the fourth chapter of this mini-dissertation.Understanding the relationship between Transit Orientated Developments and 'Third Places' in the public realm will be crucial in examining how circularity is affected by spatial planning and design. This interface between the threats to Plastic View, current Gautrain Station typologies and the urban requirements will provide innovative architectural possibilities for facilitating circularity.

1.7 Research Intentions

This dissertation explores how architectural practices can support the transition towards a circular built environment, whereby raw material resources and sustainable waste management are used as foundational design strategies to unlock multiple systemic values and benefits. These systemic values and benefits can be found in the dormant potential of 'closed-loop economies' found in informal urban rituals and practices. This exploration is guided by the following sub-questions:

1. What are the applicable spatial principles of Circular Economic theory in the context of underdeveloped/ informal urban areas of South Africa?
2. At what scale do these principles have potential in alleviating Tshwane's pressures of formal and informal urbanization in regards to resource utilization?
3. How do we scale these principles into relevance for a 21st-century architectural vernacular, that addresses resource scarcity and waste in Plastic View and by extension, the greater urban area of Moreleta Park?

1.8 Research Delimitations & Assumptions

In the dialogue between CE and the changing role of the designer as a facilitator and connector (Manzini 2009), the architectural design solution does not aim to overcome the socio-economic and political challenges associated with informal urbanisation.
Instead, this mini-dissertation makes an educated assumption on the positive contribution the urban vernacular may possess for informing architectural practices in transitioning towards a circular built environment.

1.9 Methodological Approach

For the discourse of CE to take a foothold in the South African built environment, new and contextually relevant knowledge is needed. For example, the CE model in Hamburg, Germany, discourages wet construction methods due to its high waste potential (Arup 2016:79). This tenet, however, is not equally as relevant in Tshwane, where informal settlements like Plastic View actively de mortar bricks and reuse them. Thus, this mini-dissertation adopted a mixed methodology framework used to understand the contextual issues surrounding resource efficiency holistically and to elicit multiple design informants.

1.10 Data Collection

1. **Urban mapping** involved using GIS software such as ArcGIS and Google Earth to build upon the existing mapping performed by the Honours group of 2020 (MPIP 2020). This mapping ensures an understanding of the historical patterns, topographical and environmental conditions of the study area.
2. **Media** from photographic documentation, drone footage and videography contributes towards defining the gestalt of the urban context. Sketches and general site observations complement this as well.
3. **Interviews,** both structured and unstructured, are methods of gaining a comprehensive insight into people's lives located in and around Plastic View (Groat &Wang 2002).
4. **Desktop studies** of relevant literature and precedents are studied to complement the insights obtained from the primary data obtained.

1.11 Data Coding

In analysing or coding the voluminous and extensive data captured in this proposal, Zina O'Leary (2017) offers below a qualitative and iterative analysis applied towards the data captured. As seen in figure 1.5, this method was the procedure used in the development of patterns, explaining the highlighted themes, and evaluating the findings.

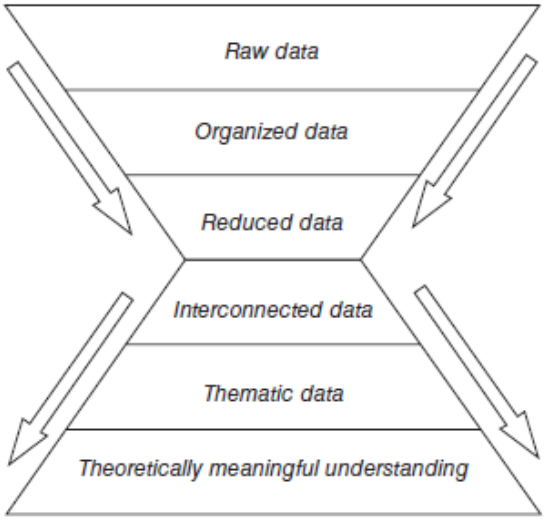


Figure 1.5: Diagram depicting sequence followed in qualitative data analysis (O'Leary 2017).

02 Site Analysis

This chapter aims to introduce the reader to the site-contextual lens of this investigation. Several theories and analyses highlighted the various scales at which CE may or may not operate within the South African Built Environment. This contextual study from the macro towards the micro assisted the author in elucidating patterns and strategies in defining a CE framework for architectural production.

Figure 2.1: Map contextualising the Tshwane region and its spatial planning (MPIP edited by Author 2020).

2.1 Macro Analysis - Pretoria

As stated, this investigation looks at urban vernacular environments for clues towards their hypothesised CE practices. This macro analysis aims to understand how these environments came to be and how informal urbanisation became the main form of urbanisation in South Africa. This analysis is to understand better how the resulting spatial injustices affect these communities. During South Africa's governing under the National Party, the incumbent Apartheid government-enforced spatial reform policies such as the Land Acts of 1913 and 1936 (L 2000). The segregated layout of these policies disfavoured non-Europeans by forcing them to the city outskirts that we often not suitable for human habitation (Morris & Hindson 1991:76).

These policies had socio-spatial implications felt today as this restricted black people to 13% of the total land surface in Pretoria, as seen in fig. X (L 2000). The implications are communities disconnected from job opportunities in city centres, often removed from infrastructural networks and exercise agency towards their housing. The city of Tshwane's goal for 2030 aims to address these past reforms with a spatial, economic and ecological mindset (Makgata 2018:28).

2.2 Meso Analysis - Moreleta Park

The study area is located in Moreleta Park in Pretoria East. The site itself is bounded by Garsfrontein and De Villebois Mareuil Drive, with the informal settlement in question, Plastic View, well hidden from both these streets. As seen in figure 1.7, Moreleta Park is characterised by gated communities, with commercial and medical facilities that mainly cater to the affluent neighbourhoods. Where nodes of activity occur, such as surrounding Woodlands Boulevard, informal settlements such as Cemetary View or Plastic View were likely to emerge to capitalise on the economic opportunities. Here we see the spatial injustices from Apartheid legislation that has inadvertently promoted spontaneous urban settlements near economic nodes.

Fig. 2.2: Map showing the disconnect of Plastic View from transport services (MPIP edited by Author 2020).

Public Transport

The map shows Plastic View and Cemetery view on the very edge of Tshwane's bus support. Although a future Pretoria East Gautrain Station is earmarked for the site, spatial injustice still ensues and limits city centres' access to jobs and opportunities.

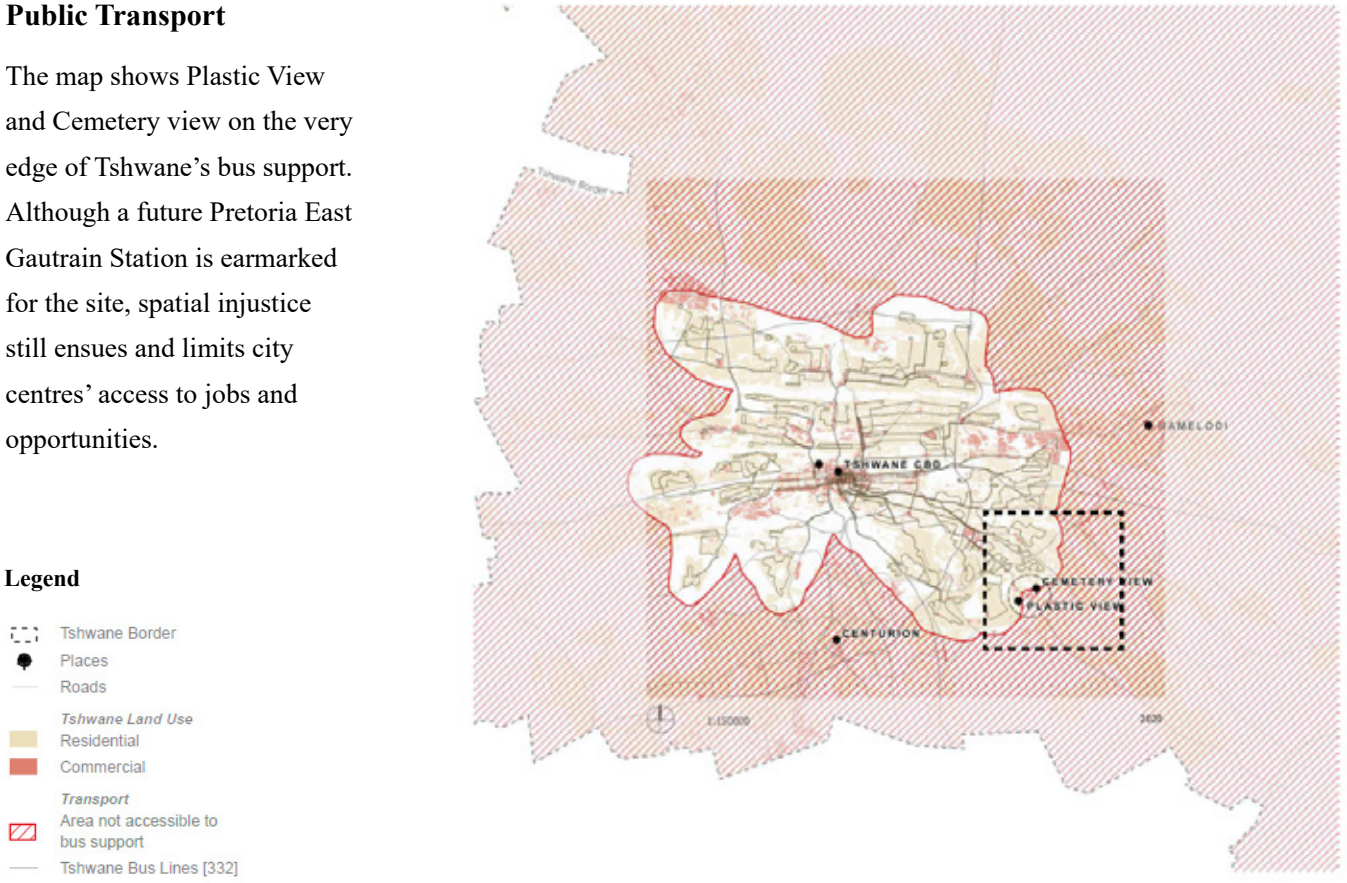


Figure 2.3: Map showing the disconnect of Plastic View from transport services (MPIP edited by Author 2020).

Physical Barriers

Hard barriers characterized by fences of non-transparent walls are a substantial part of Moreleta Park's identity. As part of the spatial fragmentation problem, these gated communities limit mobility and force marginalized citizens to form communities in urban 'pockets'.

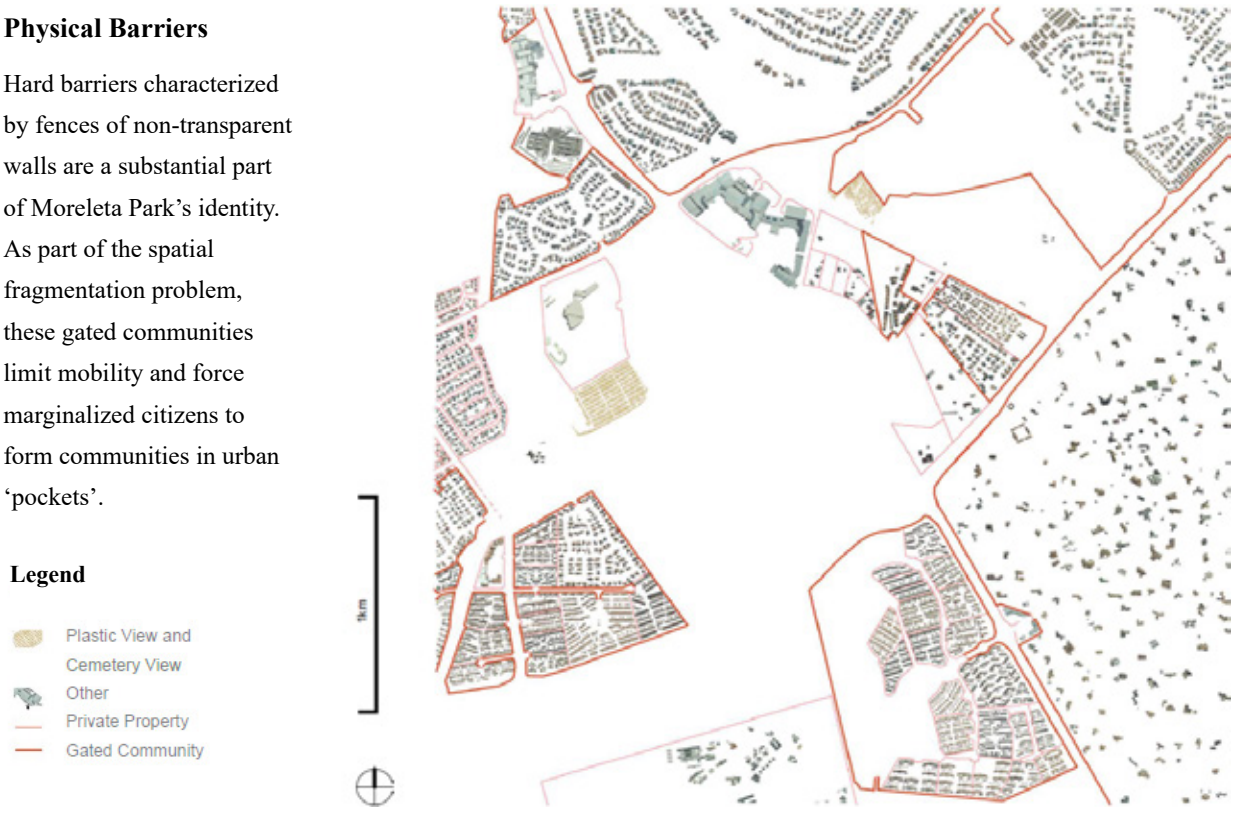


Figure 2.4: Map showing the disconnect of Plastic View from transport services (MPIP edited by Author 2020).

Accessibility

The nolli map visualizes the interplay between public and private spaces. The privatization of public spaces is an increasing concern in this context as Plastic View residents rely on the quality and accessibility of public spaces for increased economic opportunities.

Figure 2.5: Map showing physical barriers in Moreleta Park (MPIP edited by Author 2020).

Nodes & Corridors

The location of the study area finds itself connected to a variety of land uses. The site itself is demarcated as mixed-use and provides an opportunity for a diverse urban framework to achieve circularity.

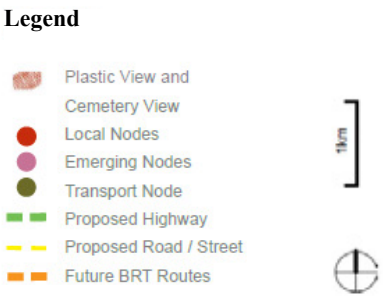


Figure 2.6: Map showing physical barriers in Moreleta Park (MPIP edited by Author 2020).

2.3 Micro Analysis - Plastic View

Plastic View has slowly developed over the years adjacent to the Moreleta Park Church. Since its formalisation in 2009, this community has densified dramatically over the years, as seen in fig. As of 2020, the population estimate after a survey performed by the MPIP is at 8000- 9000 residents (MPIP 2020). Informal communities like Plastic View live in these urban peripheries with little to no access to affordable public transport, limiting economic opportunities affordable to members of this community. The site itself, first occupied by early Plastic View residents in 2001, was chosen due to its proximity to economic opportunity and vegetation to hide the settlement from possible eviction (MPIP 2020).

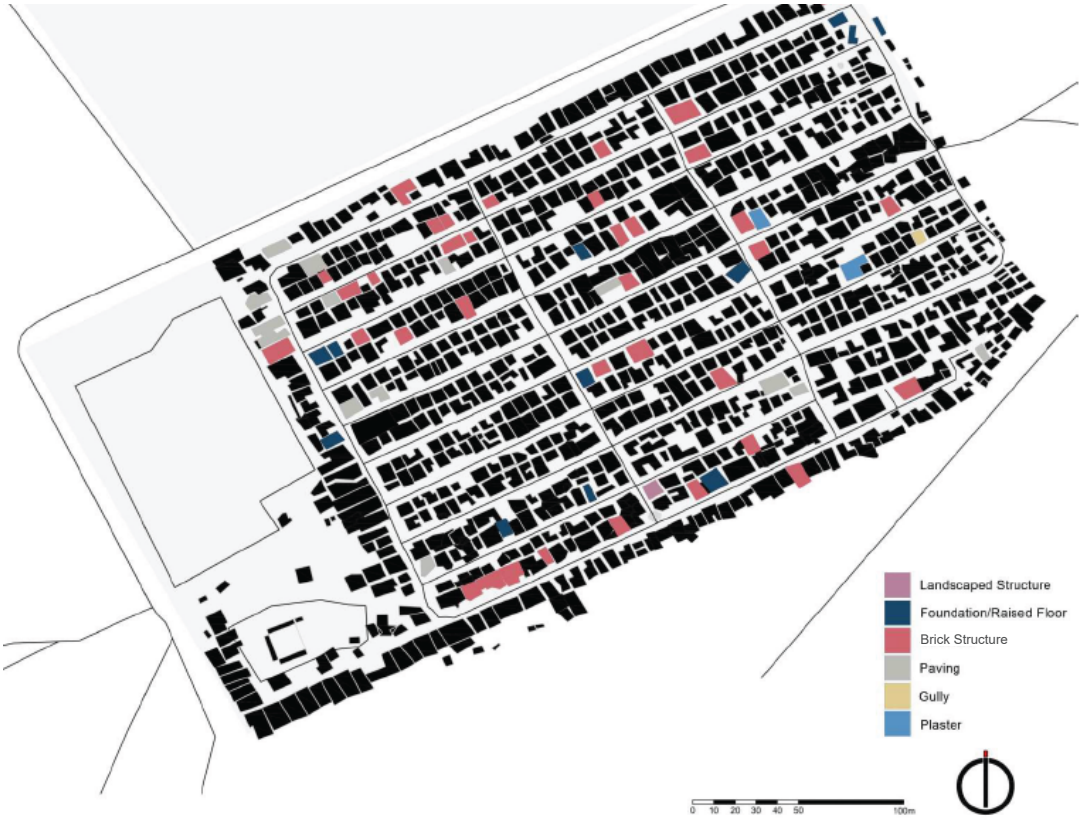


Figure 2.7: Map showing the various building technologies found within Plastic View (Honours MPIP 2021).

In *Niche Tactics* by O' Donnell (2015:244), the author describes the vernacular environments as being in an iterative process, contextually responsive to available materials, technologies and systems. This sentiment is evident in figure 1.12 that reveals the emerging building technologies found within Plastic View. This condition is revealed with technologies available and the amount of skilled labour harnessed within the community. This brought another lens of insight into the context of CE by examining the extent to which the knowledge economy of Plastic View has increased the resiliency of the urban vernacular settlement.

By examining the three focus areas of systems, built form and waste, as seen in figure 1.13, this mini-dissertation was drawn closer towards the applicable spatial principles of circularity that could be scaled into a programme as discussed in the next chapter.

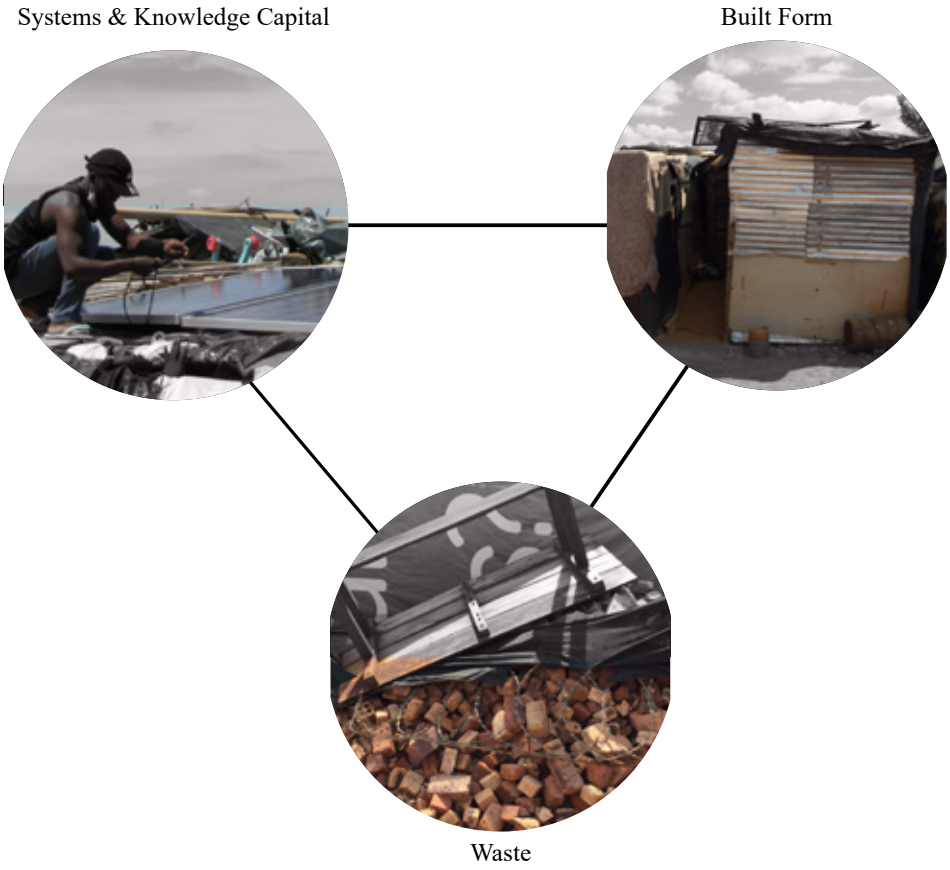


Figure 2.8: Focus areas of investigating the CE within Plastic View (Author 2021).

2.4 Conclusion

The preliminary observations of the context revealed an urban vernacular settlement that has established itself and thrived despite social, environmental and economic challenges. These challenges in the context of CE provided hints towards a circular lifestyle that manifested into a spatial design. These insights informed a spatial design that responded to the main issues highlighted regarding transportation, public space and economic participation—responding to these concerns through the lens of a circularity framework aimed to ensure a contextually appropriate design response with CE principles at its core. Such a response is the first step in allowing the public to engage with what a Circular Built Environment (CBE) may look like in South Africa.

03 A Spatial Argument for Circularity

3.0 Introduction

This section of the mini-dissertation discusses and unpacks the several informants and arguments used to generate an architectural design. This design response mediates the urban issues, context, and architectural issues further outlined in the following chapters. The exploration for design informants was spurred by the question:

What are the parameters within which a Circular Built Environment (CBE) can be learnt from the urban vernacular and generated through the design and construction of public buildings?

3.1 The Linear Built Environment

The linear economy that characterises many Africa cities, like South Africa, sees a process where materials are extracted, utilised and inevitably discarded as waste (Arup 2016: 9). Following this trend is both an economic and environmental concern, contributing to carbon emissions, ecosystem pollution, and increasing pressure on landfill capacities or water availability (Macozoma 2002: 10). As seen in figure 3.1, the typical flow of natural resources from steps one through 5 inevitably becomes waste in the South African built environment.

However, this linear flow becomes circular from step four to six in informal communities like Plastic View. Plastic View's incentive to utilise the built environment's waste as a resource is one of contextual necessity. This condition contrasts with the South African built environment, which lacks sufficient incentive from suppliers and consumers to adopt CE principles (Mativenga 2017:285).

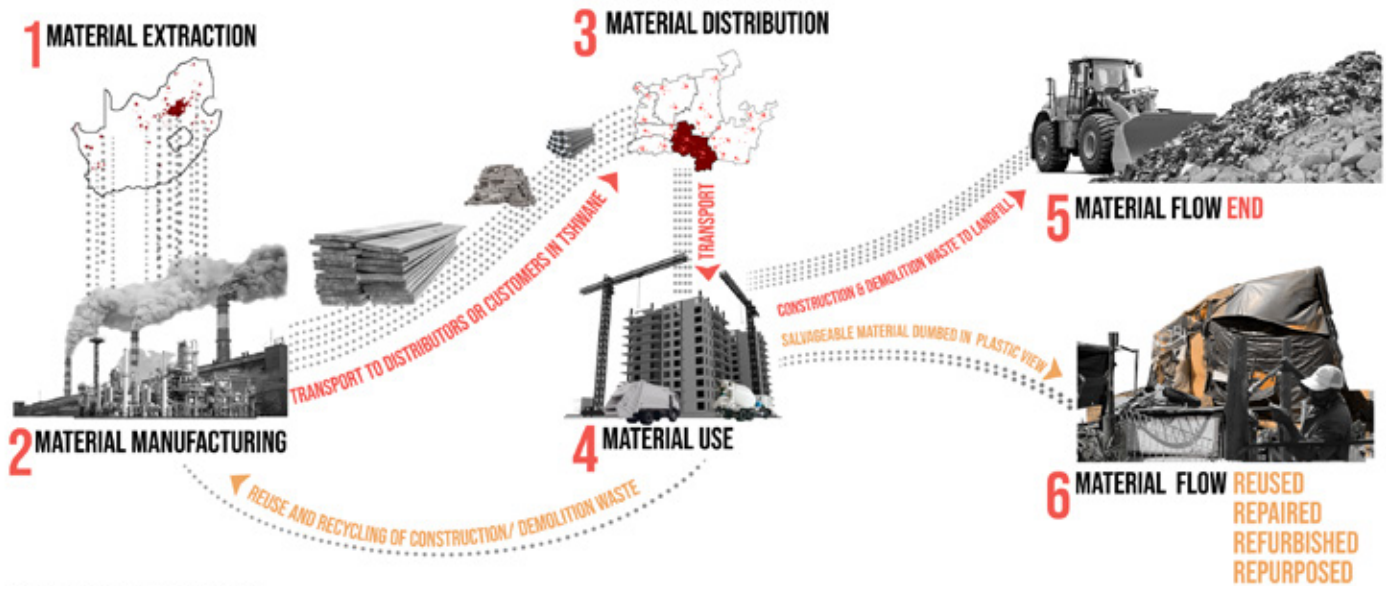


Figure 3.1: Typical flow of resources in the Linear Built Environment (Author 2021).

For example, in this map of the clay brick lifecycle, we see that most of the resources are deposited at landfills and are taken out of the loop despite little recycling efforts. The continued operating of this linear economic process is, as discussed, unsustainable. However, community members in Plastic View are known to de-mortar bricks obtained through illegal dumping and are upscaled once again in home construction.

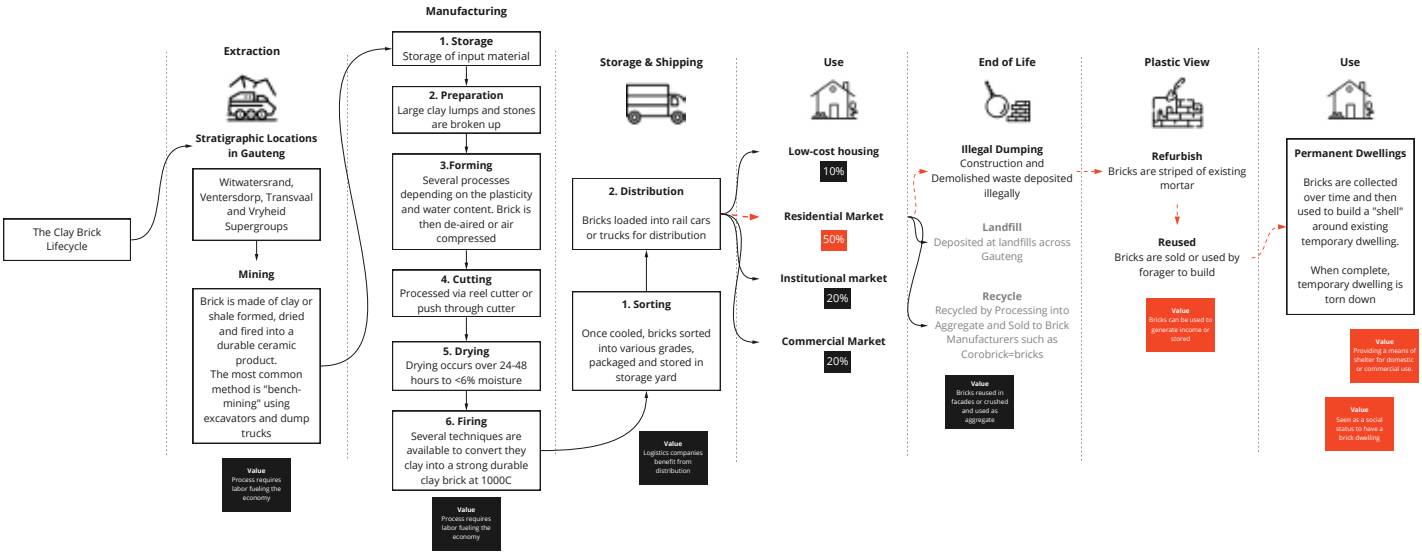


Fig 3.2: Diagram depicting typical lifecycle of the clay brick in the South African built environment (Author 2021).

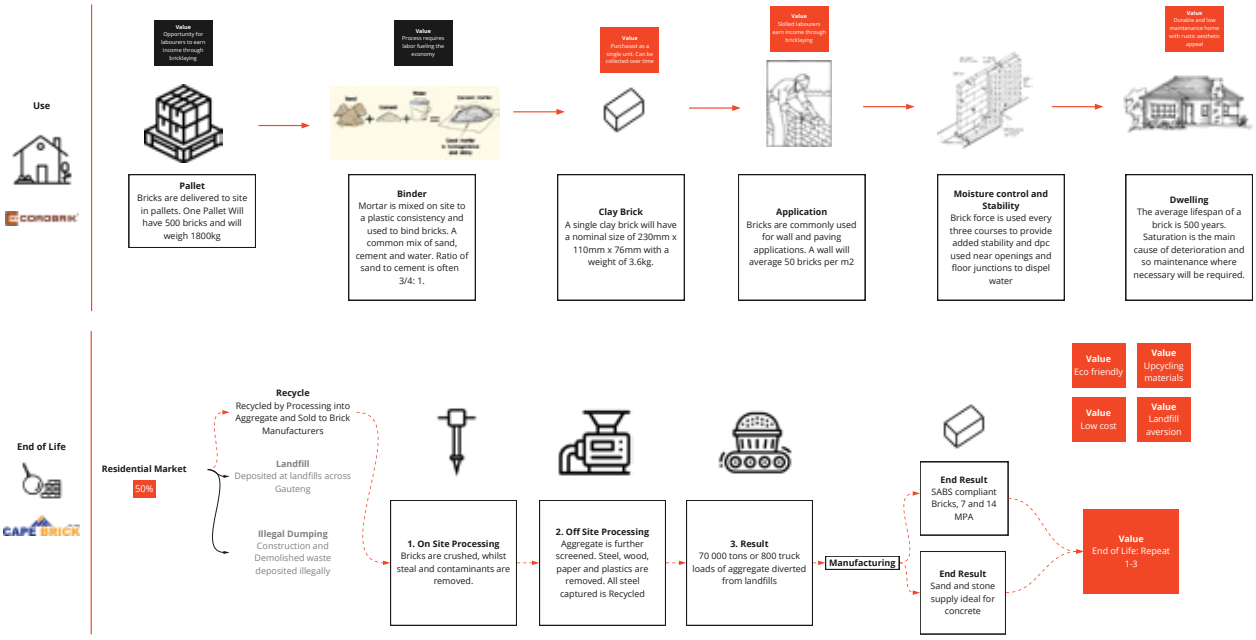


Fig 3.3: Material flow diagram illustrating waste management of clay brick manufacturers (Author 2021).

As of 2008, Cape Brick was the only local manufacturer of environmentally friendly clay bricks in South Africa. Their bricks hold the country's lowest embodied energy of all brick manufacturers (Cape Brick 2019). By taking cues from urban vernacular environments, just as what Cape Brick has done, this dissertation scaled locally inspired circular practices into an architectural spatial response.

3.2 'Vernacular Laboratories'

This dissertation situates itself at heart in the architectural discourse on the relationship between man and nature. Man's relationship to nature is both being in it and using it for its utility. In *An Essay on Architecture*, Marc-Antoine Laugier (1753:48) argues that architecture must look towards nature for inspiration and architectural principles that erode the boundary between man and nature. This philosophy is not only evident in Plastic View's dependency on timber sourced from the immediate context, but its organic occupation of the site over time, as seen in figure 3.4. Similarly, Plastic View is a community existing as a visual reminder for the importance of resource consciousness, waste mindfulness and the connection between production and consumption. This is a community where homeowners are participants in the building process of their homes, homes are open-ended in nature, and socio-cultural factors instead of climate are the primary factors that shape the dwelling. According to Goel (2010: 10), these attributes deem Plastic View as a vernacular environment located within an urban context.

These vernacular environments' basic 'green' architectural principles are visible reminders of humans' physiological and psychological necessities, the personal need to connect with the environment. In the case of Plastic View, this connection was not a conscious one as opposed to the residents of the surrounding gated communities. According to Rapoport (1990), only 2 per cent of buildings in the world have an involved architect, and thus, vernacular environments are the norm today. Vernacular environments, according to Asquith & Vellinga (2005:181), are unparalleled 'laboratories' that provide:

"... vast range of human responses to an equally vast range of problems; cultural, technological, or resources (including materials), site, climate, ways of making a living and so on."

Fig 3.4 Material flow diagram illustrating waste management (MPIP 2021).

Learning how to achieve resource efficiency from these 'vernacular laboratories' is the foundational goal of this mini-dissertation. These resource-conscious environments represent a unified system between architecture and context, with sustainable closed-loop processes at play. These very same resource-conscious systems must be resilient. This calls for designers to identify systemic contextual vulnerabilities to provide opportunities for a site's latent potentials (du Plessis 2013: 38). Thus, the urban poor who often reside in informal settlements is argued by Neha Goel (2010: 5) to be the understudied urban vernacular that has been largely ignored as a source of learning material.

3.3 The Changing Role of the Designer

According to Pedersen and Clausen (2019), achieving a resilient Circular Built Environment (CBE) requires the design of relationships and networks amongst collaborators, going beyond the traditional role of an architect associated with physical objects. As seen in the career of Hamdi described in Small Change (2004), the role of participatory design focused on the benefactor instead of the designed output. The challenge for spatial designers is especially pronounced in addressing the cultural and societal barriers that impede the adoption of circular practices (Kirchherr et al. 2018).

For example, the precarious and often hostile relationship between Plastic View and the surrounding communities are a condition that can serve to exacerbate the severance between these two groups. This community severance limits the potential benefits that the residents can share in Moreleta Park's built environment. This limitation is because CE is inherently based on extensive collaboration with stakeholders and experts in all stages of the design proposal (Dokter 2020:692). In a lecture given by Hamdi (2014) on *The Art of Practice in Development Planning*, he stresses the importance of broadening the purpose of architecture whilst being 'strategic.' Hamdi views the architect as an enabler in complex environments and to scale up solutions to maximize efficiency and increase the potential of systemic change (Hamdi 2010: 67). Adopting this philosophy as a designer promoted the CE through an architectural intervention and simultaneously promoted community cohesion.

Developing solutions in these complex environments of urban settlements is what Horst, Rittek & Webber (1973:155) would deem a 'wicked problem'; a social or cultural problem that is often either difficult or impossible to solve. An example would be the housing crisis that shapes South African cities and culminates in informal settlements such as Plastic View. Roggema (2016: 01) argues that design-led research is a suitable approach for addressing 'wicked problems' due to creating new knowledge within wickedness. The design-led research approach, undertaken through the Reality Studio, investigated CE by actively practising as a means of gaining new knowledge (Roggema 2016: 2). Thus, the potential of a spatial designer as an enabler of CE in complex environments was explored, notably how different roles were occupied in bringing forth systemic change.

3.4 The Reality Studio

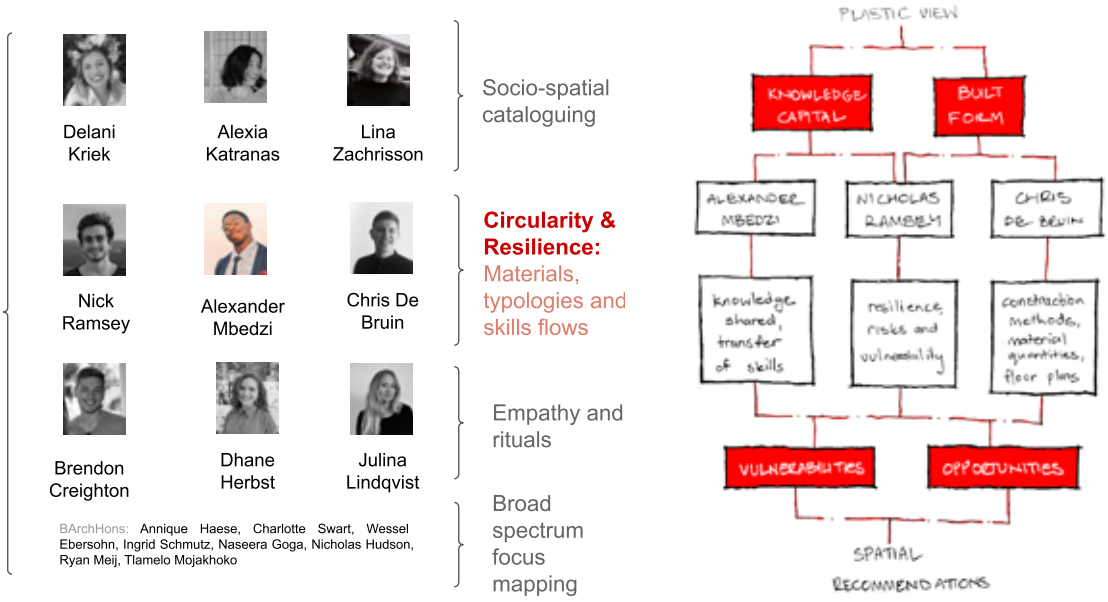


Fig.3.5 The Reality Studio (MPIP 2021).

The design-led research investigations occurred as part of the Urban Citizenship & Reality Studio. The authors focus group with Nick Ramsey and Chris de bruin looked at Plastic View with the lenses of Circularity & Resilience and followed the procedure as seen below in figure 3.6. The active translation of theoretical knowledge to practical insight through prototyping was performed to inspire the residents of Plastic View to adopt new typologies and methods towards home construction. Fundamental circularity principles employed in the prototype were using bio-renewable resources such as timber and building the prototype in a design for disassembly (dfd) fashion. These principles and others are further elaborated upon in chapter 04.

Figure 3.6: Design-led research methodology undertaken by the Reality Studio in 2021 (Author 2021).

Key lessons taken from this experience were how knowledgeable the community was regarding timber and how crucial the material was in the functioning of this urban vernacular environment. Directly participating with residents allowed the author to engage with stakeholders directly and play an active role in forming networks and collaborations between the Moreleta Park Church, residents and the students in Sweden from the Chalmers University of Technology. Alongside the loops detailed in the following section, the experience of prototyping was invaluable in bringing CE from a theoretical concept into one with socio-spatial implications examined in real-life.

Figure 3.7: Completed prototype (left) and author drilling (right) (Zorn 2021).

3.5 Loops

In developing a circularity framework for the site in question, four loops have been identified that will aim to leverage the existing assets of the site and the surrounding communities. These Lenses framed the mapping that took place in Plastic View to generate design principles as informants. Tackling these lenses and aiming to achieve regenerative loops coincide with higher-order frameworks from the City of Tshwane's 2055 vision and the National Development Plan (NDP), further outlined in chapter 04, section 4.2.

3.5.1 Material Loop

The repurposing and rethinking of a product into a new product with a different function helps to optimise the assets of the Built environment. According to Dokter, Thuvander & Rahe (2021), increasing the usage efficiency of existing buildings will help 'close the loop'. As seen in Figure 3.8, timber plays a significant role in the functioning of Plastic Views circular lifestyle. Timber, if sustainably sourced, is a bio-renewable resource that acts as a carbon sink and helps preserve the natural assets of the built environment (Arup 2016:24).

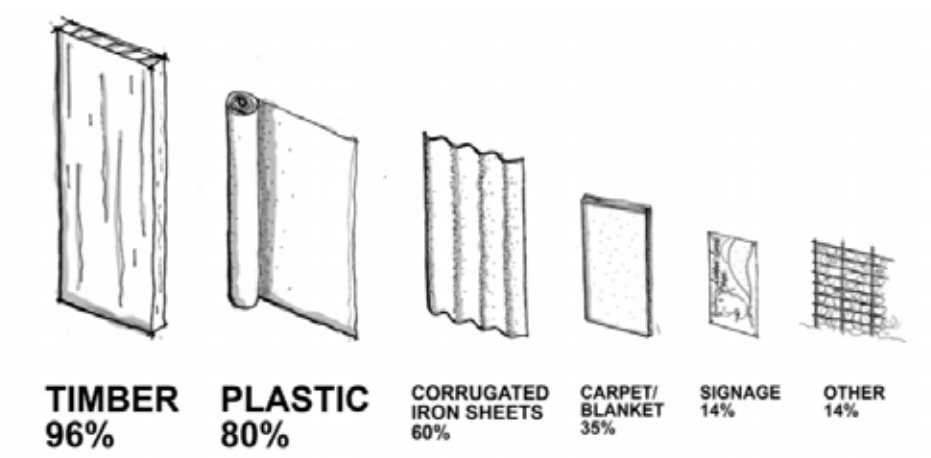


Figure 3.8: Material Composition of Plastic View (MPIP 2020).

Thus, using timber as a sustainable material is supported by the CoT 2055 vision. The vision has identified managing the impending challenge of resource scarcity as a significant milestone in achieving spatial resilience (CoT 2013:87).

3.5.2 Knowledge Loop

The measure to which an informal settlement becomes an agent of change for its residents depends on the intellectual assets located within the community. As seen in figure 2.6, the investigation into building skills revealed a community with capable and proficient intellectual assets to have an active hand in their built environment. Creating knowledge loops would involve a skills development framework that can up-skill labourers, create quality jobs and manifest in an Eco-friendly built environment. This loop will be imperative in changing behaviours regarding CE by fostering skilled workers and workmanship that can give greater credibility to circular practices.

Figure 3.9: Residents of Plastic View utilizing their knowledge to shape their environment (MPIP 2021).

3.5.3 Community Loop

The Tshwane 2055 vision (2013:40) anticipates a significant increase in Tshwane's population by the year 2055 and has produced a densification and compaction strategy to address this (CoT 2013:199). Densification will be explored in its potential to foster community loops. Increasing the density of programmes, closing the gap between product and consumer and revealing the proximity between the invisible and visible can provide an opportunity for the CoT to lower resource consumption and mitigate urban sprawl (CoT 2013:199). Increasing densities also allows more opportunities to create collaborative links that foster community adhesion (Hamdi 2010:48). Fostering the collaborative links and sense of community as discussed furthers the goal of achieving a CE lifestyle.

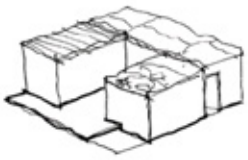
Figure 3.10: Community gardens (left) and the sharing of waste amongst residents (right) (MPIP 2021).

3.5.4 Regenerative Loop

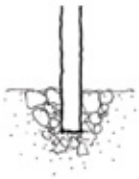
Architecture can play a positive role in the restoration and resilience of natural ecosystems (Arup 2016). In achieving regenerative loops, net-zero strategies, biomimicry and other regenerative design opportunities were explored to protect and promote the regeneration of natural capital (Ellen MacArthur Foundation 2013). As seen in figure 3.11, these principles influenced a set of spatial recommendations applicable to the residents of Plastic View. This goal was to promote ecosystem services whilst accommodating human habitation as a foundational strategy for climate change resilience (CoT 2013:124). This regenerative loop also represents a two-way knowledge stream of information that contributes to both the knowledge of the designer and the community.

Roof pitch: From site observations, certain dwellings were identified as having a small slope to their roof angle. Increasing this will aid in draining away water from the dwelling. People also use their roofs as storage space.

Planted (green) wall: In a similar sense to the green roof, a green wall would improve fire-resistance and insulation of dwellings. It also creates an innovation response to small-scale agriculture by freeing up ground space and having the vegetable on a vertical plane.



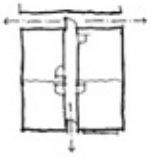
Courtyard typology: Numerous dwellings exist in a courtyard typology. How this came to be requires further research. The typology however provides greater air movement for natural ventilation and increased safety.



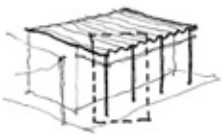
Gum poles: There was a knowledge gap evident in the construction methods of gum poles. With proper treatment between the poles and earth and correct drainage methods, the poles can last longer without rotting and other damage.

Stormwater catchment: The site showed a distinct lack in catchment systems like gutters and downpipes of any sort. Implementing such systems can assist in flooding prevention as well as aiding against water scarcity, as stormwater, whilst limited, has reusable qualities.

Material/stock storage system: There are existing networks formed through the collection and storage of materials coming into the site, however it is limited by spatial and financial restrictions. An organised system could expand the existing activity to benefit more residents.



Escape routes: Having more than one entry depending on the occupancy and size of the dwelling should be taken into account. This strategy does have safety concerns but it does aid in escape in the case of fire (Arup 2018).



Wood sealant: Exposed structural members typically used in the porches could be benefit from wood sealant. They can be affordable if the cost is shared amongst a number of people.

Figure 3.11: Spatial recommendations for Plastic View to leverage existing assets (MPIP 2021).

3.6 Key Spatial Principles

The following key principles were identified as the characteristics of urban informality that supports Plastic Views circular lifestyle. Alongside the identified loops, these principles were complemented by other systems theories such as regenerative design, biophilic design, and cradle to cradle strategies in developing a circularity framework.

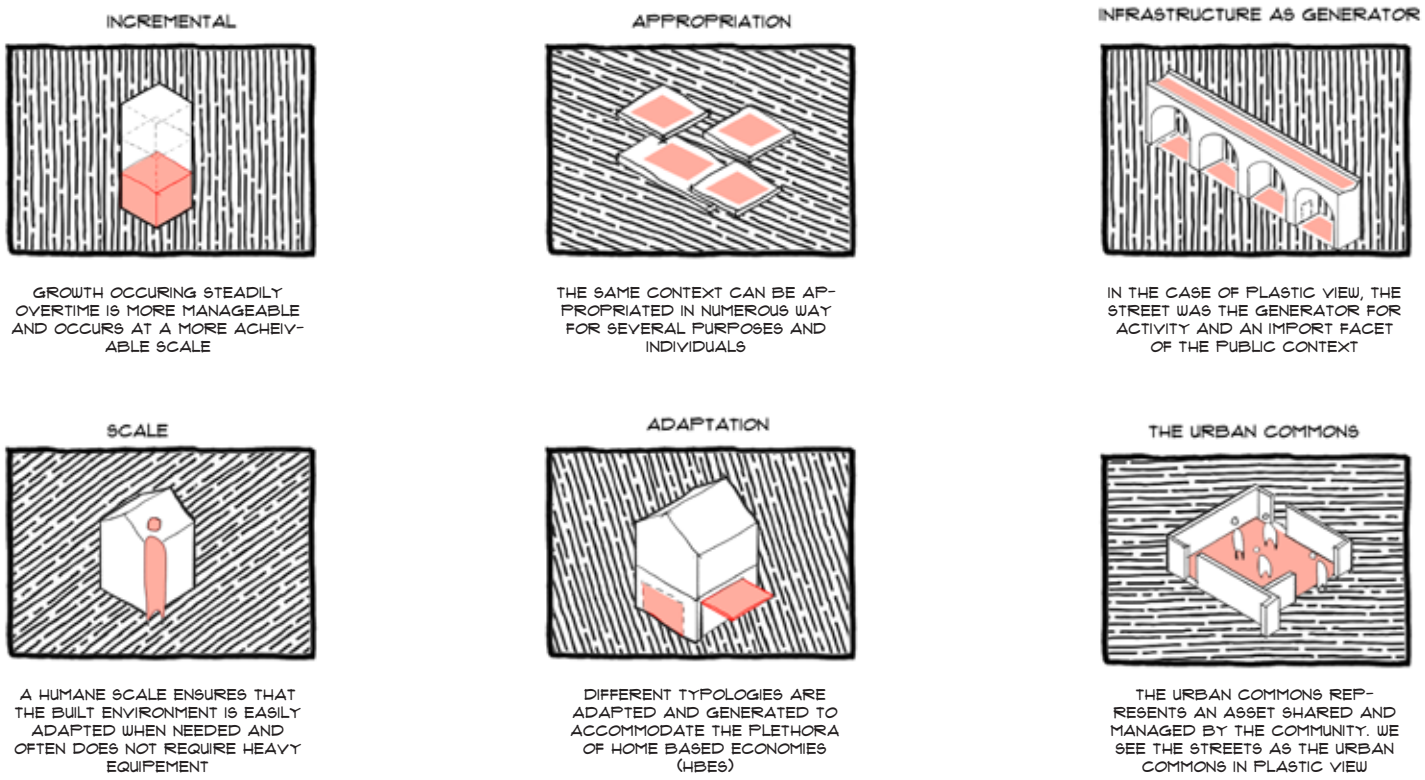


Figure 3.12: Spatial recommendations for Plastic View to leverage existing assets (Author 2021).

3.7 Plastic View, A Circular Organ

The current state of the built environment shows a disconnect between the opportunities available through Circular Economic (CE) and the inefficient resource loops that exist. Looking for global solutions is a possible answer. Before that, this dissertation looked at those systems already in place in the built environment. Where resources are already being used most economically, as shown in Plastic View, scarcity rules and the community has learnt to adapt to those circumstances.

The research revealed a compelling case for Plastic View as a circular organ in Moreleta Park's built environment. Like how the liver functions as an organ in the body, metabolizing waste within the blood before being pumped to vital areas, Plastic View also makes productive work of Moreleta Park's waste. This action inherently plays a role in reducing the load placed upon landfills and limits natural resource extraction thus, upkeeping South Africa's environmental assets. This dissertation, taking into cognizance the limited literature around Circular Built Environments (CBE), would define a circular organ as a community that utilizes circular practices by actively reducing the demand for natural resources and managing the waste of the built environment through urbanization.

Plastic View's circular lifestyle is shown through the community's culture to inherently use R practices (reduce, recycle, reuse, refurbish, remanufacture, repurpose and recover). These practices extend towards using Construction and Demolition Waste (CDW) to build their community and homes. This process prevents CDW from reaching landfills and maintains the value of these materials in economic use, which benefits both the environment and its inhabitants.

Therefore, this dissertation argues that Plastic View's role as a circular organ should be acknowledged for its role in regulating the built environment's waste. There are limits to an architectural designer's influence in improving the livelihood of the residents. However, there is an opportunity in addressing the threats to Plastic View's functioning as a circular organ.

Figure 3.13: Conceptual collage of Plastic View as the Circular Organ of its local built environment (Author 2021).

3.8 Architectural Issue

The architectural issues thus pertain to the external pressures placed upon Plastic View that threaten the community's functioning as a circular organ in Moreleta Park. These pressures include the surrounding gated communities calling for the relocation of Plastic View and the proposed Gautrain expansion cutting through the site. The architectural intention of this dissertation is to address these issues highlighted and contribute to the architectural discourse by better understanding the link between CE and the spatial qualities of the built environment. Fostering the closed-loop lifestyle already inherent in Plastic View and addressing the threats to its functioning is argued to provide the learning material to scale circular practices into contemporary architectural practice.

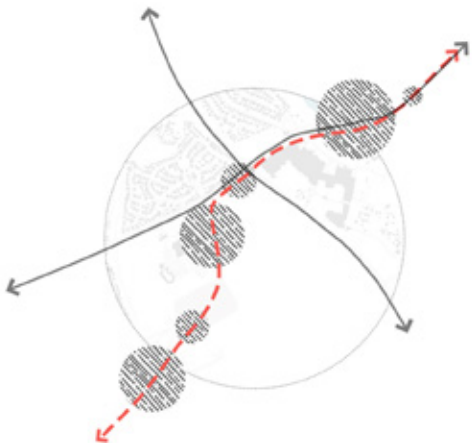


Figure 3.14: Parti diagram of architectural issues in Moreleta Park (Author 2021).

3.9 Conclusion

This chapter aimed to walk the reader through the several informants used to inform the circularity framework in the following chapter. The chapter also elucidated the themes, principles and strategies used in achieving a circular lifestyle by examining Plastic View as an urban vernacular environment. Live-prototyping was used to explore circularity in a South African context and offered practical insights into creating collaborative networks and partnerships in promoting the CE.

04 The Circularity Framework

4.0 Introduction

The following chapter looks at the architectural issues in context and how a circularity framework can be used as a criterion in addressing these issues. The design development will be explored as a culmination of the several informants outlined in this chapter and will aim to:

1. Open debate through a visual connection with the invisible Circular Strategies (CE) occurring in Moreleta Park (Urban Vision).
2. Discuss why the Gautrain development is an opportunity to improve the livelihoods of Plastic View and Moreleta Park residents. (Urban Vision - Programme).
3. Explore the future development of Plastic View as a circular organ (Contextual Condition).
4. Develop the uncovered circular parameters from Plastic View into an architectural design (Architectural Vision).

4.1 Analytical Mapping

The issues outlined at the urban level are to be addressed by urban intentions and spatial principles. These are largely inspired by the existing COT 2055 framework, lessons from Plastic View and selected theories from TOD and Third Places. The analytical mapping was performed to delve deeper into the socio-economic influences on space within Moreleta park, as seen in figures 4.1 and 4.2. Findings suggest that the site opposite the Moreleta Park church is highly valuable in its size, visibility and potential to become an interface where the community interacts.

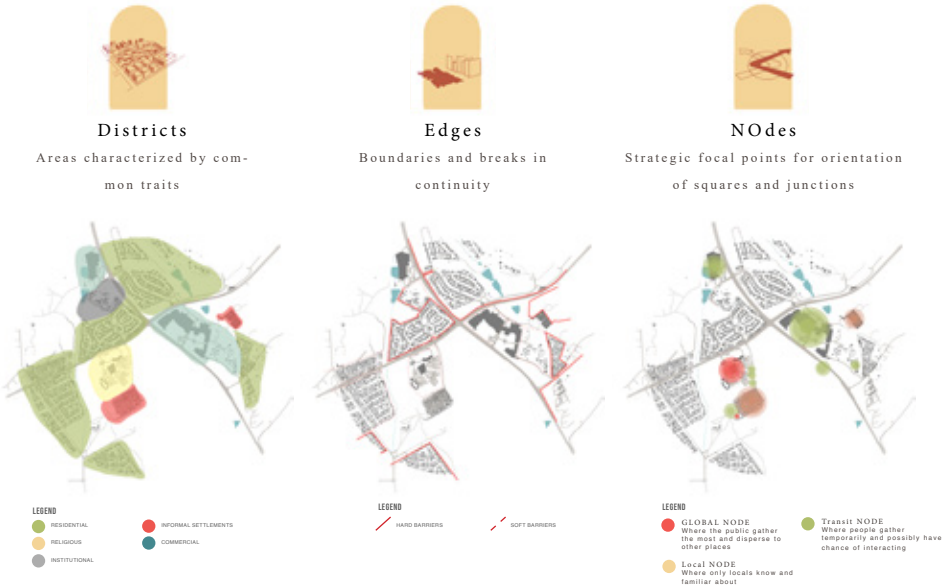


Fig. 4.1: Analytical mapping according to Kevin Lynch's way-finding principles (Author 2021).

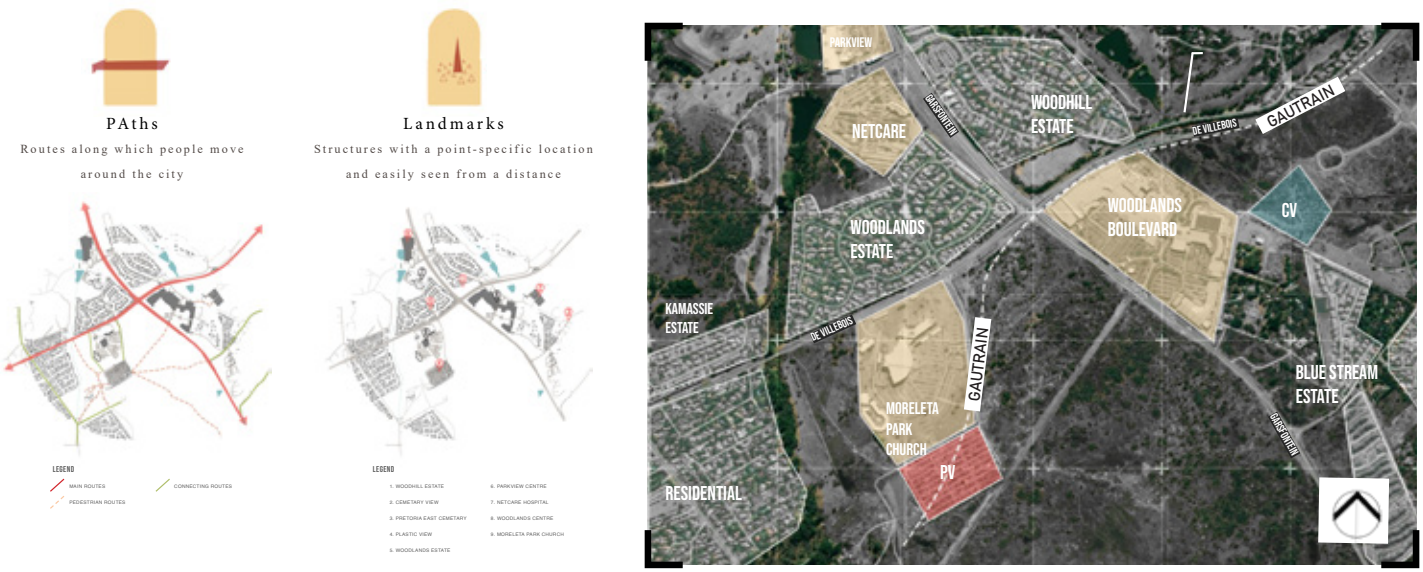


Fig. 4.2: Analytical mapping according to Kevin Lynch's way-finding principles and contextual Map (Author 2021).

4.2 Programme

Informed mainly by the Gautrain expansion passing through the site and Plastic View, the programme proposed is a Transit hub located on the corner of Garsfontein and De Villebois Drive. This transit hub offers the opportunity to create a destination where hundreds of people pass through every day may have a visual and spatial connection to the role of circularity in the built environment. By interweaving different programmes centred around the Gautrain station, the transit hub can be more than just a place for people to pass through, but also a cross-collaborative platform of engagement amongst diverse stakeholders.

It offers the opportunity to create neutral public spaces where the surrounding gated communities and Plastic View may interact. This is with the intention of de-escalating the high tensions between these two communities and begin to foster a greater sense of community cohesion. The tension coming from the mapping perfomed that revealed that majority of the gated community residents would have Plastic View relocated (MPIP 2021). The transit hub is envisioned as a platform where Circular Economy no longer remains a theory, but now magnifies invisible processes occurring in vernacular environments into a spatial response. The programmes undertaken are as follows:

1. The primary programme is the proposed Gautrain Tshwane East Station. It is envisioned as the mediator between the public and private spaces as a semi-public space. This extends to integrating the existing public transport infrastructure, such as the Bus Rapid Transit system and the taxi network.
2. The secondary programmes inhabit the public sphere and include informal markets, open-air thrifting spaces, farmer's markets and exhibition spaces. Restaurants and retailers open to the public will be complemented by 'third spaces' as recreational green spaces. These spaces will ensure that different income groups can participate in the same spaces despite their economic backgrounds.
3. Lastly, tertiary programmes are the most private and include offices, cafeterias, clinics and training centres. The training centres and clinics are in direct response to the needs of Plastic View

community members who seek to participate economically and socially in Moreleta Park. This is whilst having access to basic medical services from local NGO's such as SA Cares.

4.3 Transit Orientated Development (TOD)

The justification for opting to use the Gautrain as the primary programme to explore circularity has to do with the problem of severance. According to Handy (2003), severance is the converse condition to the goal of connectivity (concerning street networks) and the converse to creating community cohesion. As seen in figure 4.4, there were missed opportunities by the Gautrain stations in both Hatfield and Marlborough in bringing communities together and creating an inclusive environment. Analysed in the particular case of Marlborough Gautrain Station was how the development contributed towards physical, psychological and social severance. Transport infrastructure can thus inadvertently be a social and mobility barrier that separates people and potentially leads to a fragmented urban framework. This fragmentation would undermine the design response rooted in the CE principle of stakeholder and community collaboration without addressing this at the architectural level.

In response to the threat of community severance by transport infrastructure, Transit Orientated Development (TOD) combines city revitalization, suburban renewal, regional planning, and walkable neighbourhood theories (Calthorpe 2004). These theories support stimulating a healthy, cohesive and active public life that has close synergies with the Third Places concept. TOD is directly targeted towards the spatial injustices characteristic of Moreleta Park and aims to create socially inclusive environments through vehicle-orientated developments (Bertolini 2009). The Following elements will serve as informants for the design.

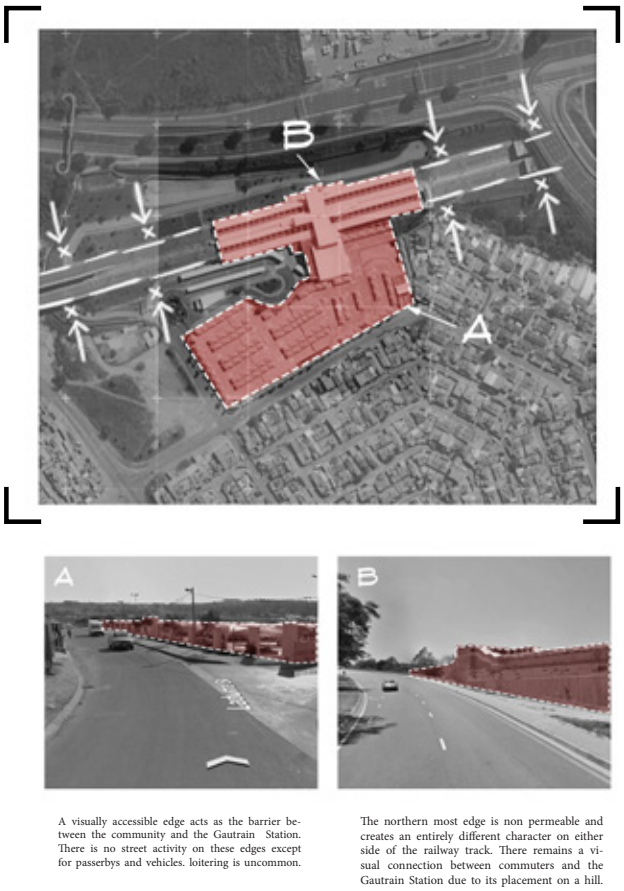


Fig. 4.3: Severance analysis of the Marlborough Gautrain Station (Author 2021).

TOD is a response to a broader movement of a decline in public spaces that have resulted in the absence of public engagement and interaction amongst people of different social classes, regions and gender (Hamdi 2010:89). According to Lynch (1960), public spaces contribute to the socio-cultural character of an area and have the potential to create a shared, local identity. This new socio-cultural identity can be centred around circularity, to which the challenge of severance aims to destabilize. In tackling these concerns, principles from Transit Orientated Development and the concept of Third Places will aim to prevent severance and create spaces that promote a culture of a circular lifestyle.

4.4 The Third Place

As discussed in the previous chapter, there is a need in Moreleta Park for neutral public spaces that accommodate for different communities to interact, gather and socialize. In his book The Great Good Place, Ray Oldenburg (1999) elaborates on the concept of a 'Third place' that serves as a leisurely place where people come together and interact. In this concept, the home is imagined as 'the first place' and a place of work as the 'second place.' Once again, taking cues from the urban vernacular, we may observe the importance of the streetscape in Plastic View. As seen in figure 4.5, the street becomes the 'home away from home' where people engage and mostly spend their time leisurely. The street was also where we were most likely to find participants for interviews and have discussions during our research.

Fig. 4.4: The Third Place in Plastic View as the streetscape (MPIP 2021).

By using the qualities of a third place found within the urban vernacular into architecture, the applicable principles and qualities can promote community cohesion, like the Glass Chapel seen in chapter 05.
The identified healthy qualities of a third place in Plastic View extend themselves to predominantly four facets, namely:

1. Encourage psychological well-being.
2. Able to freely move through space with no obligation.
3. Promote activities with abundant opportunities for interaction.
1. Being non-discriminant spaces.

Public space becomes a commodity managed and controlled by its members by giving ownership of the third spaces to the community members. These very same participants become the infrastructure for the urban commons' resilience and sustainability. Doing so will promote the development of a new cultural identity in Moreleta Park centred around CE.

> *What suburbia cries for are the means for people to gather easily, inexpensively, regularly and pleasurably. A 'Place on the corner.'* (Oldenburg 1999)

4.5 The City of Tshwane's 2055 Vision

In response to the challenges of vulnerability and resource scarcity, principles from new urbanism and cradle-to-cradle are integrated into the framework to address future concerns of scarcity (CoT 2013:110). Although CE is not named in the CoT 2055 vision, Cradle-to-cradle principles can help facilitate Circular systems and help 'close the gaps' (Braungart & McDonough 2012).

4.6 Urban Framework

The first phase (Insertion: Phase 01) of the framework development uses the proposed Gautrain development as the first catalytic node for fostering stakeholder engagement, participatory action and bringing visibility to the role of circularity in the built environment. This Transport node serves as physical infrastructure by connecting communities and has non-physical infrastructure potential in expanding flow networks of social capital and intellectual capital through architectural design.

0 1

Proposed Gautrain Development [2023]

The current framework is built around the proposed Tshwane East Gautrain extension to occur through the site (GMA 2019:66). The biggest motivators for this expansion are the R84 billion Mooikloof Mega-city development and the R44 billion Hazeldean development (Moatshe 2021, un. 2020). The current extension is planned through Hazeldean and end in Mamelodi.

0 2

Plastic View Relocation [2025]

In light of the forthcoming Gautrain development and the discussions over the years regarding Plastic View's relocation, this appears to be a most likely outcome for the settlement. Involved parties in this relocation will include Tshwane Metro Police Department, Home Affairs, Human Settlements, CoT and Home Affairs (Venter 2020).

Fig. 4.5: Steps 1 & 2 of the Urban Framework (Author 2021).

The second phase (Growth: Phase 02) sees the development of Plastic View after its relocation and the simultaneous development of the other catalytic programmes centred around the Gautrain development.

This Development Node intends further to expand the flow networks between the different programmes and bring about functional coherence to achieve the urban circularity goals. Programmes will include an affordable housing scheme, a technology research park in collaboration with the University of Pretoria, a skills training centre, and a Forestry and Agricultural Biotechnology Institute (FABI) headquarters.

Fig. 4.6: Steps 3 of the Urban Framework (Author 2021).

The third and final phase (Activate: Phase 03) truly sees Plastic View as an asset and generator for the site's potential. The carefully curated site and programmatic development are intended to support the residents of Plastic View by enabling their socio-economic participation in Moreleta Park as a circular organ. A trade node integrated with a green network will provide public spaces for a host of temporal activities in Moreleta Park. These spaces will be vital in promoting reuse and waste-to-value processes via a visual connection.

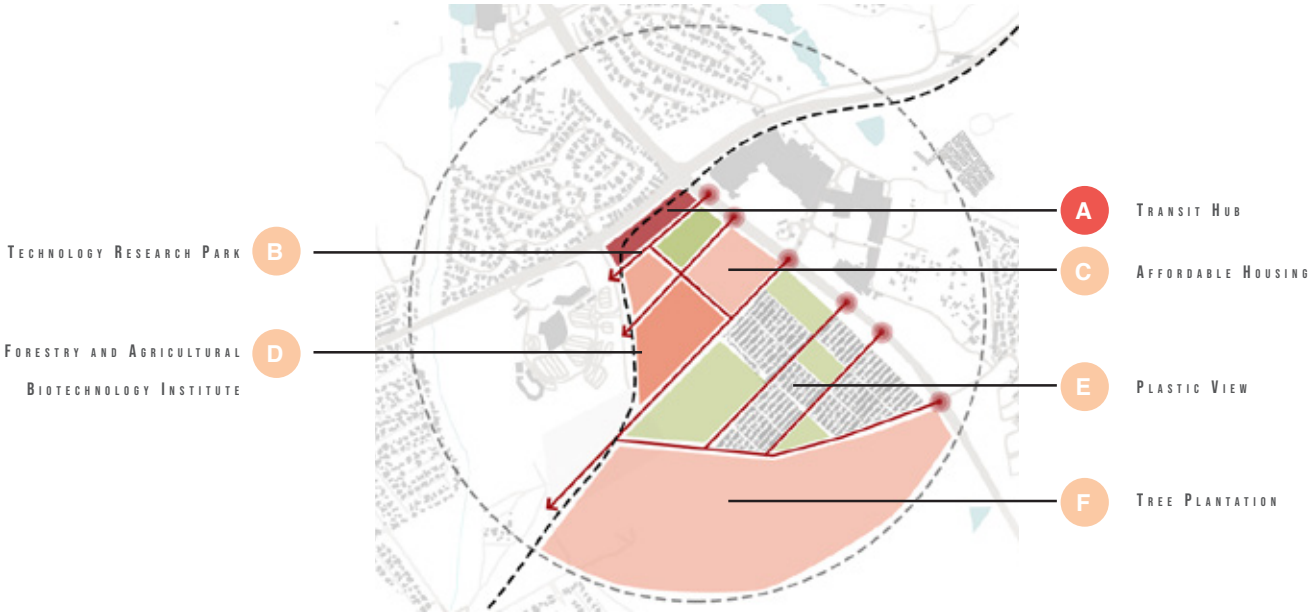


Fig. 4.7: Final proposed Urban Framework (Author 2021).

4.8 The Circularity Framework

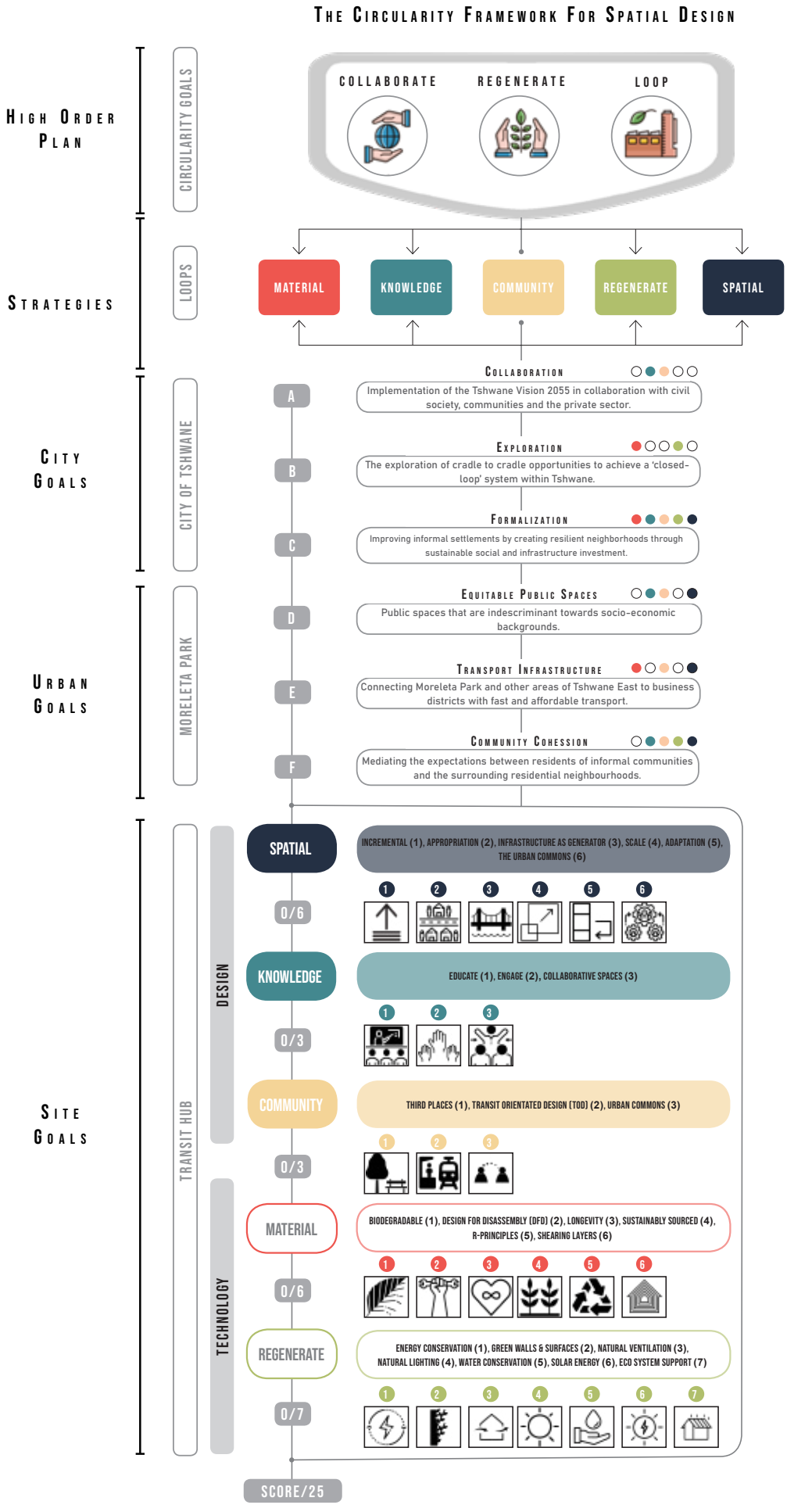


Fig. 4.8: The Circularity Framework (Author 2021).

The Circularity Framework

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YUNIBESITHI YA PRETORIA

1 CE GOALS

CIRCULARITY GOALS

COLLABORATE | REGENERATE | LOOP

LOOPS

MATERIAL | KNOWLEDGE | COMMUNITY | REGENERATE | SPATIAL

2 CITY GOALS

CITY OF TSHWANE

A — Collaboration
Implementation of the Tshwane Vision 2055 in collaboration with civil society, communities and the private sector.

B — Exploration
The exploration of cradle to cradle opportunities to achieve a 'closed-loop' system within Tshwane.

C — Formalization
Improving informal settlements by creating resilient neighborhoods through sustainable social and infrastructure investment.

3 URBAN GOALS

MORELETA PARK

D — Equitable Public Spaces
Public spaces that are indescriminant towards socio-economic backgrounds.

E — Transport Infrastructure
Connecting Moreleta Park and other areas of Tshwane East to business districts with fast and affordable transport.

F — Community Cohession
Mediating the expectations between residents of informal communities and the surrounding residential neighborhoods.

4 SITE GOALS

TRANSIT HUB

DESIGN

SPATIAL — INCREMENTAL (1), APPROPRIATION (2), INFRASTRUCTURE AS GENERATOR (3), SCALE (4), ADAPTATION (5), THE URBAN COMMONS (6)

0/6

KNOWLEDGE — EDUCATE (1), ENGAGE (2), COLLABORATIVE SPACES (3)

0/3

COMMUNITY — THIRD PLACES (1), TRANSIT ORIENTATED DESIGN (TOD) (2), URBAN COMMONS (3)

0/3

TECHNOLOGY

MATERIAL — BIODEGRADABLE (1), DESIGN FOR DISASSEMBLY (DFD) (2), LONGEVITY (3), SUSTAINABLY SOURCED (4), R-PRINCIPLES (5), SHEARING LAYERS (6)

0/6

REGENERATE — ENERGY CONSERVATION (1), GREEN WALLS & SURFACES (2), NATURAL VENTILATION (3), NATURAL LIGHTING (4), WATER CONSERVATION (5), SOLAR ENERGY (6), ECO SYSTEM SUPPORT (7)

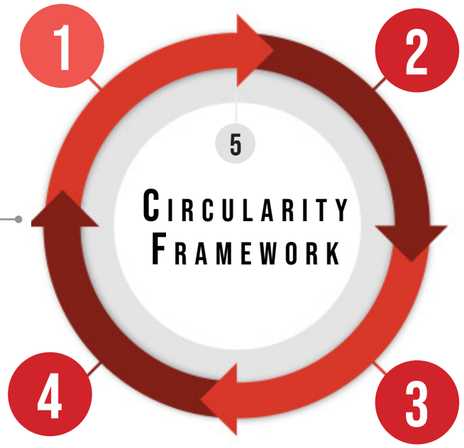
0/7

SCORE/25

5 THEORY

THEORETICAL CONCEPTS

- THIRD PLACES
- TRANSIT ORIENTATED DEV
- CRADLE-TO-CRADLE



As seen in figure 4.9, the investigations have culminated in a circularity framework that incorporates the informants used to generate a circular design. From the higher-order plan to the urban goals, key targets were selected that best emphasize the CE within South Africa's built environment. These key targets are measured against the loops discovered from the urban vernacular. They aim to highlight during the design process where the emphasis is placed on achieving a circular design. The Site Goals are detailed further in the following chapter 05 and demonstrate how the point-based system is used as a metric for circularity. Although the circularity framework is highly contextualized towards the urban and architectural issues highlighted in Moreleta Park, this was deliberate in revealing how the framework may be used. The framework itself has been designed to be iterated upon and be adapted to different contexts.

4.9 Conclusion

eveloping a circularity framework was to provide a pathway to which there was none of how design practitioners could interpret and implement CE concepts within the South African built environment. This is not to say there have not been circular designs in the field of architecture. This dissertation uncovered the inherent qualities of circularity hidden in our built environment and documented the process to which it was formally translated into architecture. The strategies and principles employed from the circularity framework were simultaneously inspired and responded to the urban morphology, programmatic requirements, history, contextual assets and climatic condition. Implementing the developed conceptual framework in the case of the transit hub is intended to be experimental and serve as a prototype for future developments.

05 Design Development

5.0 Introduction

The following chapter takes a closer look at the range of informants used to influence the design exploration. This begins with precedent investigations used to inform the programmatic, spatial, technical and contextual explorations. The lessons from this investigation are discussed in light of the circularity framework and influenced the site selection and conceptual intention. By setting this context, the viewer will be ready to be through the design development section.

5.1 Precedent Studies

5.1.1 Spatial-Programmatic Precedent: Baragwanath Taxi Rank

The taxi rank's general design and the accommodated public spaces reflect broader considerations regarding mediating informal processes and architecture. The arcade stretching across the site accommodates many functions from transit to street trade and provides supportive amenities such as ablutions and storage facilities. A commuter can stay sheltered underneath the arcade as they access all terminals available along the spine. Along this spine, the double volume arcade is perforated with market activities that invite passerby with concrete public furniture and pause spaces.

The spine concept used to guide the design and stimulate movement around the taxi rank is adapted into the proposed transit hub. Movement and pause spaces are augmented with local artworks that promptly situates the taxi rank as a Sowetan landmark and focal point of attraction. Providing spaces and surfaces for expression ties into the knowledge and community loop by providing spaces to inform the public on contemporary cultural topics of debate.

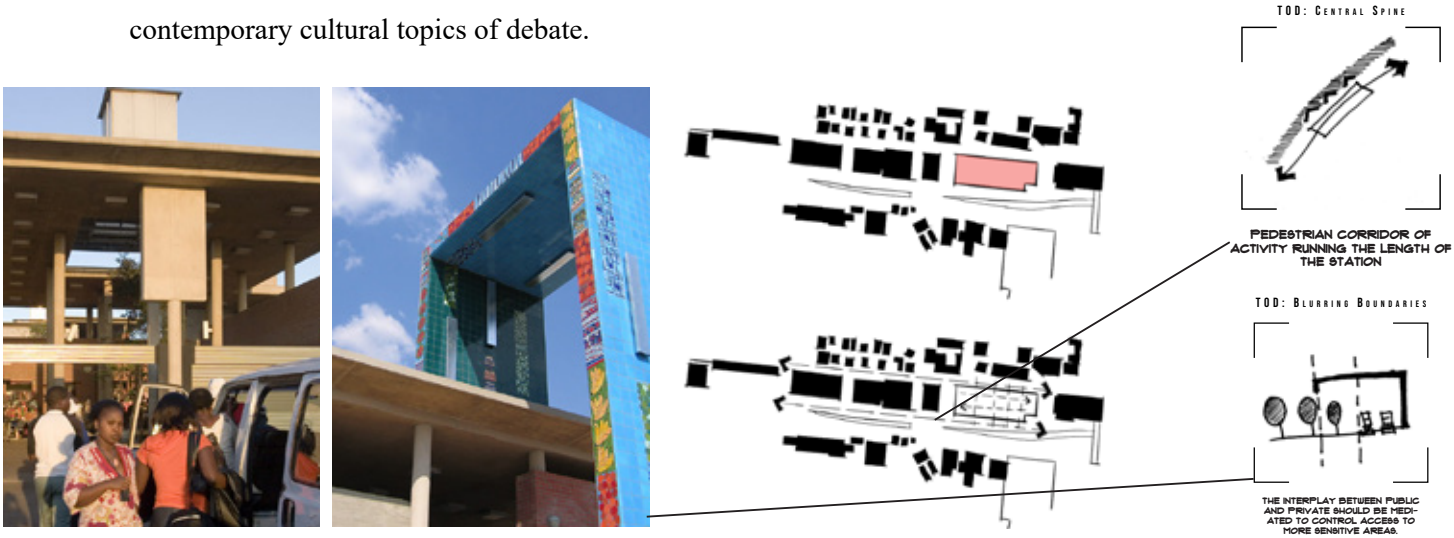


Fig. 5.1: Baragwanath Taxi Rank on the left (Ludwighansen 2008) and figure-ground analysis (Author 2021).

5.1.2 Spatial: The Oculus

The Oculus is the centrepiece to the Transportation Center, a celebration to the commuter and a revolt to the surrounding glass and steel tower buildings. The effect is a well-illuminated train station and shopping centre located beneath the landmark. Free from columns, this elegant dome rests above the lobby below, allowing light to penetrate on all levels. The effect at night makes it a point of destination as the light glowing through the glass creates a 'lantern' effect reflected off the surrounding glass and steel buildings. Scale plays a significant effect in achieving conceptual intentions. The structure's scale behaves as an intermediary between the surrounding skyscrapers and against one's scale. The scale thus humanizes the area by this attention to bodily scale.

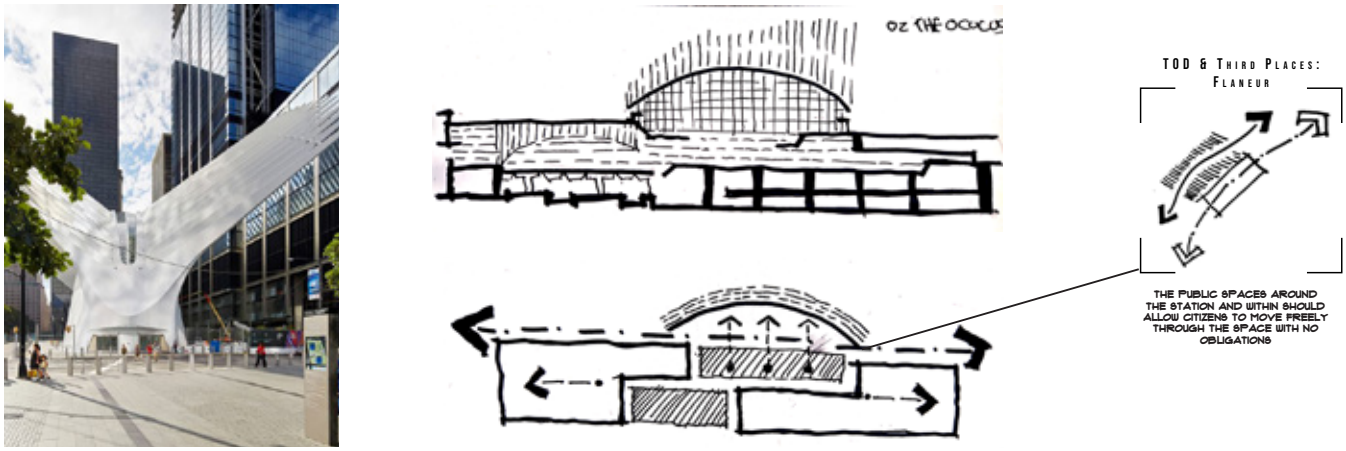


Figure 5.2: The Oculus on the left (Calatrava 2017) and diagrammatic analysis on the right (Author 2021).

The spatial arrangement and lantern effect invite commuters to explore the space creating a thriving third place. The space welcomes flaneurs, people passing through the space solely to experience it. The design creates a landmark celebrating commuters and non-commuters alike, a third place.

5.1.3 Technical Precedent: Gugu S'thebe

The theatre's name is derived from a Xhosa Idiom, "Guga S'thebeKudala Usophulela", which means to honour an old serving platter for its service. The value of this precedent in the CE discourse is how craft is used to generate a cultural and practical architecture. Multiple stakeholders, including international universities, residents, designers, and professionals, created this performance cultural "village." Affordable and eco-friendly approaches are used by utilizing recycled and waste materials with earth constructions (Baerlecken et al. 2016:2).

Figure 5.3: Gugu S'thebe on the left (CSStudio n.d) and Plan analysis (Author 2021).

The result is building prototypes that are easily replicated by inexperienced or unskilled labourers, facilitating knowledge transfer in construction. Here we see how agency is facilitated by carefully using materials and available resources in up-skilling labourers. Another contextual response in the CE dialogue is the up-cycling of discarded shipping containers found locally due to the proximity of the site to the harbour (Baerlecken et al. 2016:3). This precedent shows high reciprocity with the knowledge and material loops from the circularity framework. At the same time, materials and technologies during construction are used to educate and inform.

5.1.4 Contextual-Technical Precedent: The Glass Chapel

This transportation stop was built in collaboration with community members and led by 5th-year architecture students in the Rural Studio from Auburn University. The stop, located in the rural area of Mason's Bend, also functions as a community gathering space, food distribution space and a chapel for the local choir group. What makes the structure unique is the use of salvaged materials to form the shell of the structure. Car windows salvaged from a local scrap yard provided the roofing material on the northern facade, resting atop rammed earth walls. The timber structure with the car window panels creates a seemingly light and warm space with relatively controlled exposure to the elements.

The scale, proportions and rhythm of the structural elements lend themselves to design that is both contextual and aesthetic in its appeal. The use of waste from unconventional sources in defining a new vernacular in the area will serve as an informant for the architectural solution of this dissertation. Furthermore, using rammed earth with modern construction techniques represents a mediation between the old and new when considering the principled agency of materials. Regarding the circularity framework, using locally sourced waste as a resource and bio-based materials are foundational strategies relevant to the technical design exploration of the design proposal.

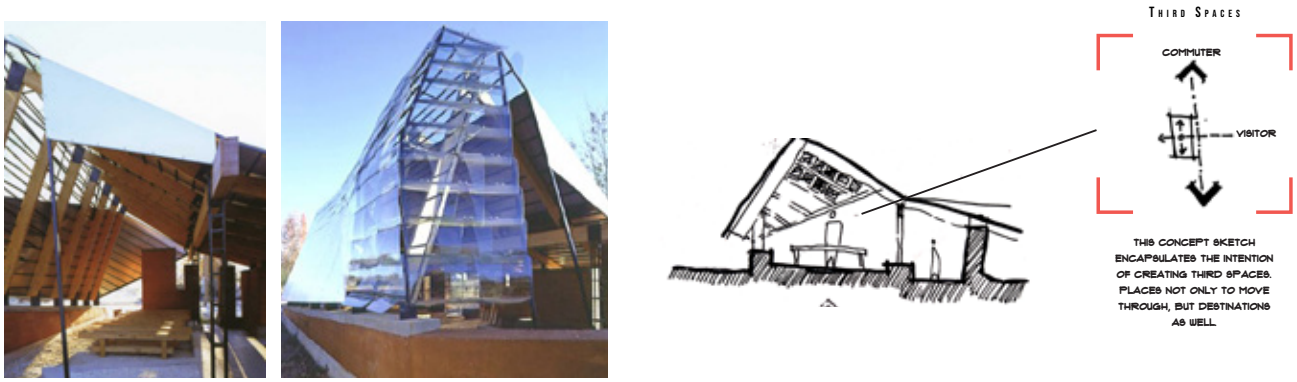


Figure 5.4: Glass Chapel on the left (Rural Studio 2008) and section on the right (Author 2021).

5.1.5 Spatial-Technical Precedent: Southern Cross Station

The Southern Cross Station by Grimshaw architects was chosen due to its fundamental strategy to mediate two urban conditions. This mediation was done by facilitating the public nature of the station. With an emphasis on a simplistic and understandable design, a diverse group of users are attracted to the station. These activities, including the station's functional requirements, are housed under a larger unifying canopy that serves as the defining architectural feature of the station. The roof shape directly responds to the external climate, particularly the prevailing north-west and southwest winds used to assist in expelling diesel fumes and other air contaminants through natural ventilation.

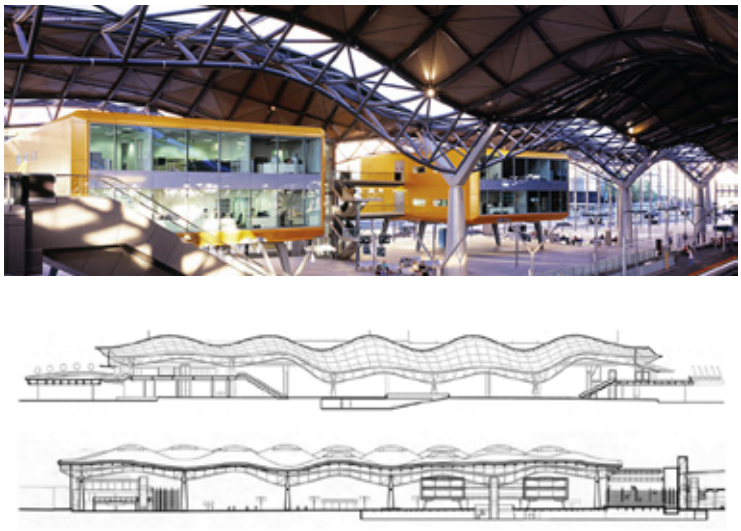


Figure 5.5: Southern Cross Station (Detail 2018).

The transparent facades and large volumes help frame the entrances to the station. According to Edwards (2011), these invites a diverse group of users beyond just commuters and promotes a cross-city flow through the station. Apart from creating a landmark in the urban context, the roof design floating above the platforms helps define the major circulation zones to assist in wayfinding. This layering of various programmes underneath a unifying roof was used to provide coherence across the site's length. Colour is also used to break up the monotony of steel, glass and concrete, to which the use of exposed timber may counter this effect with the perceived warmth it lends to spaces.

5.2 Site Selection

In affecting circularity in the given context, responding to the site's characteristics will leverage the contextual assets found. Informed mainly by the Gautrain expansion route cutting across the context, the site was chosen along the proposed route. This route was modified from passing through Plastic View to being tunnelled underneath the Moreleta Park church and surfacing on the westernmost edge of the site. As seen in figure 5.7, this change in path achieved two main things along with the identified site assets. Firstly it improved the curve radius of the Gautrain and allowed for an easier deceleration of the train by not relying so much on the brakes (Gautrain Construction: 2009:9). Secondly, it allowed the proposed transit hub full access to the length of the site.

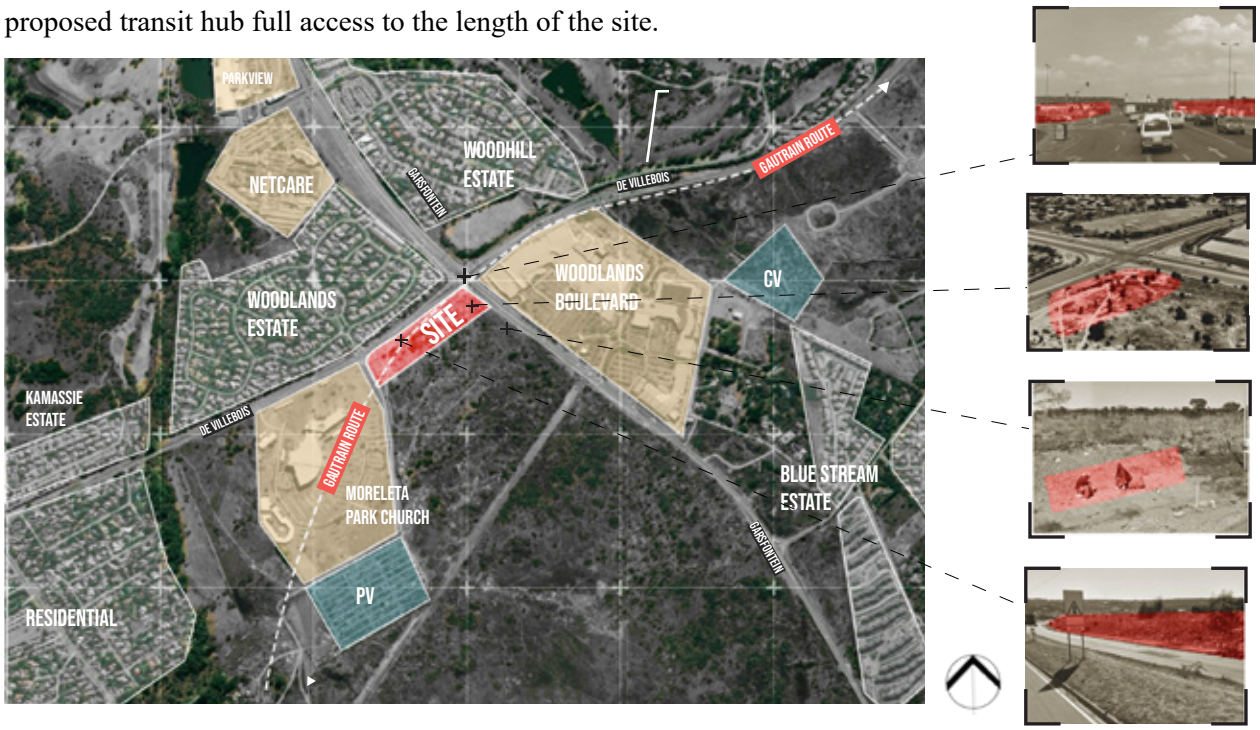


Figure 5.6: Contextual map of site (Author 2021).

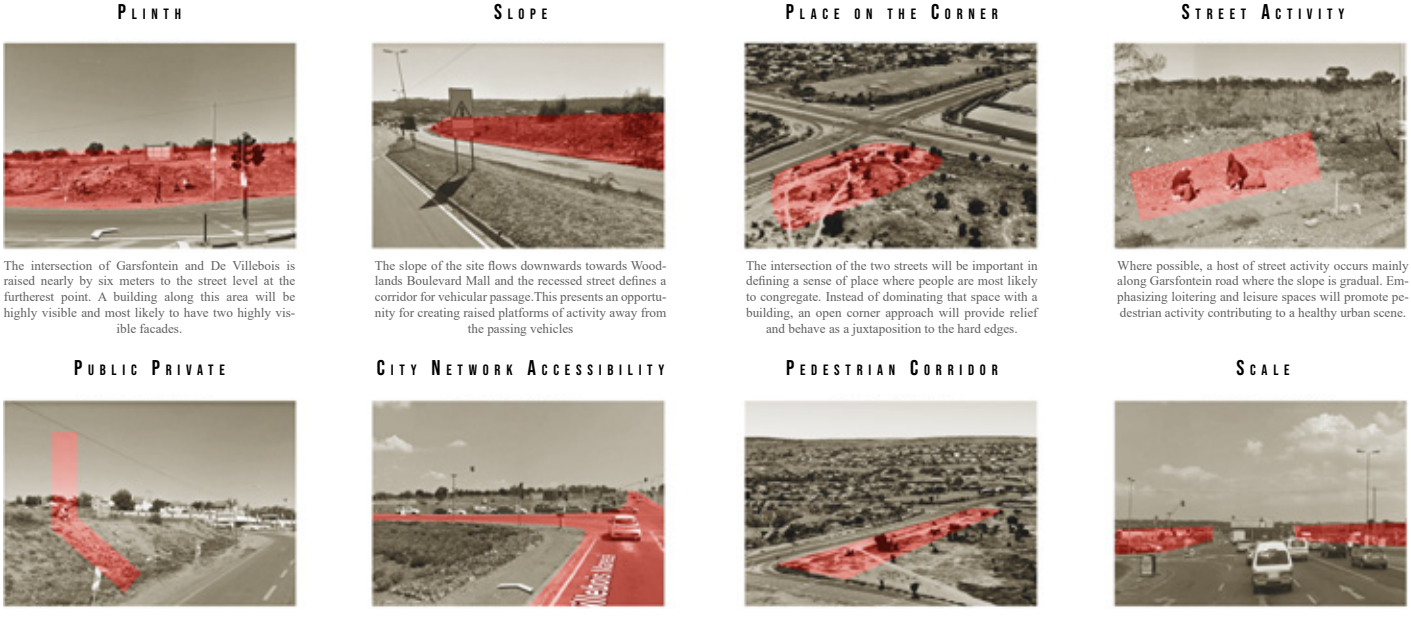


Figure 5.7:Analysis of site characteristics (Author 2021).

5.4 Concept

The site's community mapping, theoretical arguments, resource loop mapping, and venacularity led to a set of design principles that reinforced the CE. These principles aimed to achieve an architectural intervention that is circular by design. The concept generated responded to the circularity framework by focusing the identified loops into specific areas of the design in the act of placemaking. The core conceptual elements are split up into three elements, namely:

- **Image element:** This is an architectural element, namely the facade and roof, responding to the opportunity of creating a visual connection between the built form and the community. It responds to the essential functional and technical requirements of the Transit hub. It can be described as being 'private' and is influenced by Kevin Lynch's (1961) Image of the City that stresses the need for people to recognise and pattern their surrounding context.
- **Form Element:** This is envisioned as a semi-public space with a robust dialogue in the interior and exterior spaces. It also responds to critical functional and technical requirements but lends itself towards non-programmatic spaces.
- **Activity Element:** This element holds the highest narrative potential towards achieving third spaces and serves as the mediator between semi-public and public spaces. It aims to spur pedestrian activity as, according to Gehl et al. (2006), this activity contributes towards healthy public spaces and the sustainability of a city.

If done well, TOD's are places to be, not "places to pass through."(Bertolini 1999).

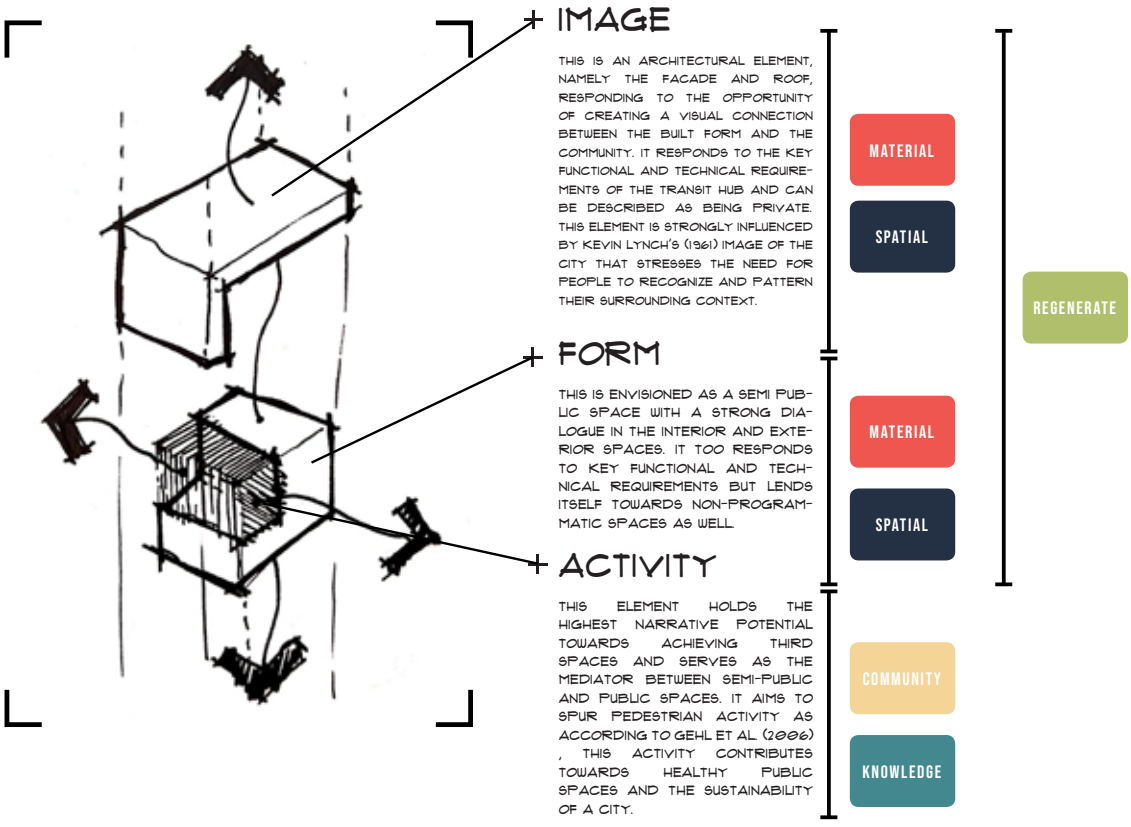


Fig. 5.8: Conceptual diagram indicating the three main elements (Author 2021).

5.5 Design Development

5.4.1 Iteration 01

The first Iteration performed was an intuitive spatial response to all aspects of the context considered. This massing exercise had a vague sense of the proportions needed for the transit hub. It aimed to investigate the possibility of linking Woodlands Boulevard to the transit hub via a sky bridge. The roof forms were inspired by existing Gautrain stations that utilize waves as a concept in the roofing design. Strong cues were taken from the Oculus and Baragwanath precedents in utilizing the roof to celebrate the commuter.

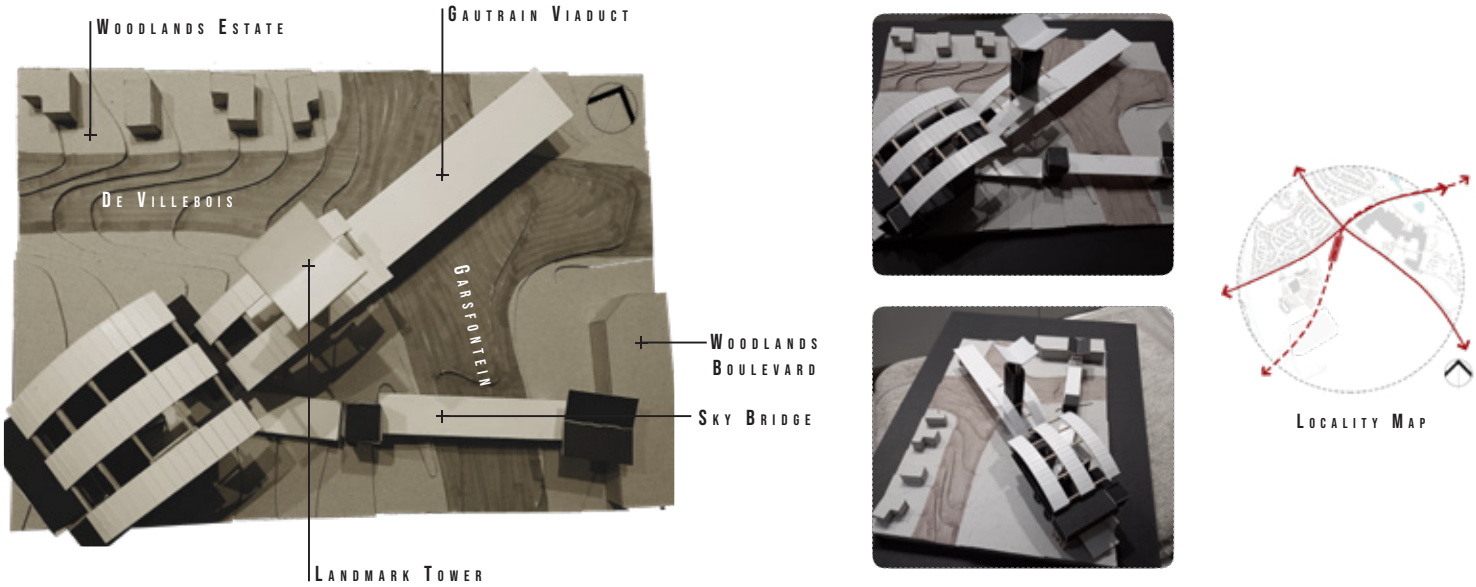


Figure 5.9: First conceptual and intuitive iteration (Author 2021).

This iteration had yet to capitilize on the site goals of the circularity framework. With taxi's and Gautrain busses integrated, an intuitive flow of movement around the hub was lacking. The infrastructure as generator principle was not condusive to attractive public spaces around the current form. There was a need for well defined edges and the current form hinted towards possible severance between De Villebois and garsfontein Drive.

5.4.2 Iteration 02

Developing upon the first iteration, this exploration had greater control on the proportions required in terms of scale with the context. The focus was on the conceptual element of form and the interfaces between both sides of the railway track. Creating a link on either side was crucial in discouraging community severance. The conceptual exploration of the activity element was still in its infancy but is indicated by the rhythmic pergola structures subconsciously indicating the third places upon evaluation. These were rightfully placed towards the edges as the mediator between public and semi-public spaces. Creating links to outdoor public spaces with varying sizes, connected by some form of pedestrian network, is an opportunity for exploration in another iteration.

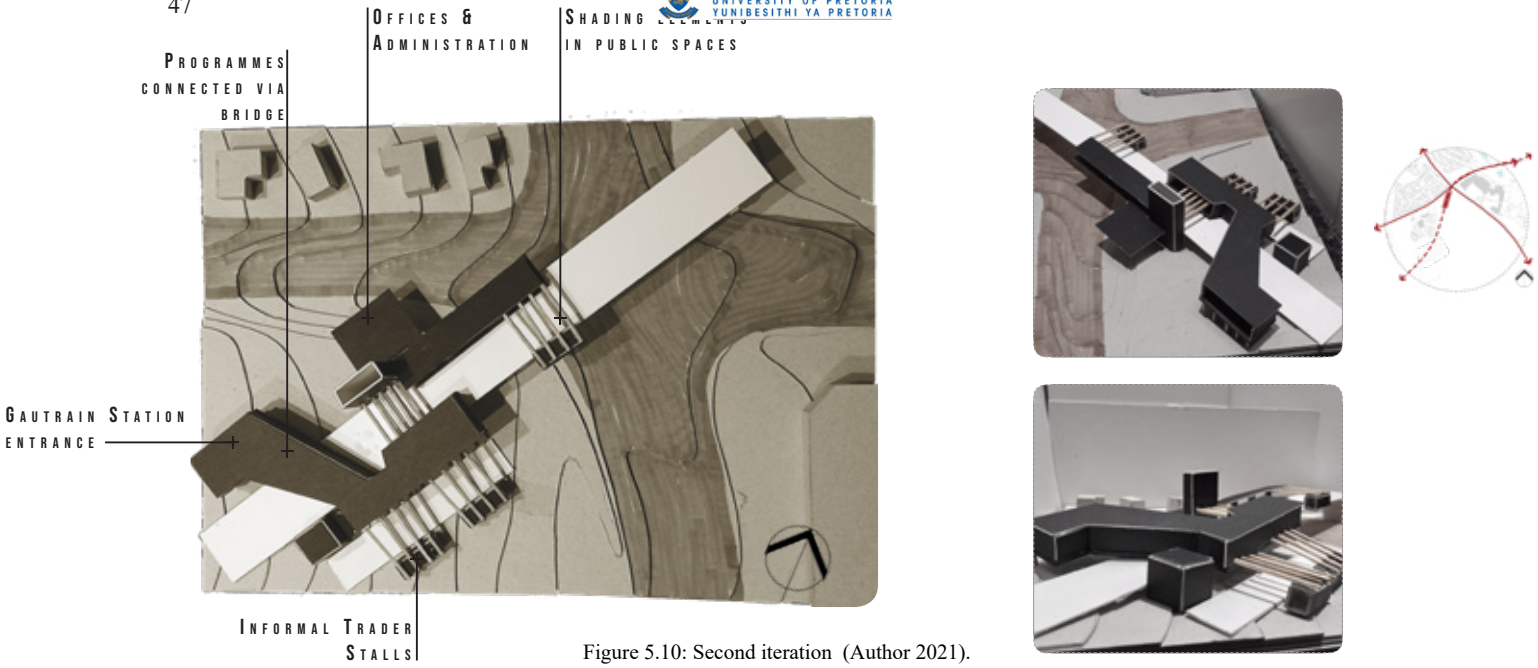


Figure 5.10: Second iteration (Author 2021).

5.4.4 Iteration 03

The movement of the railway track along the street presented several opportunities. Moving back from the edge had more significant potential for creating a defined corridor of activity that promotes vibrancy through pedestrian activity. The conceptual element of activity was envisioned as a corridor of movement hosting the flow of commuters and non-commuters. This flow was connected via various platforms of public spaces on either side of the Gautrain viaduct. The conceptual form element gives spatial form to these public spaces by creating pockets and voids that create diverse public space arrangements. Creating this corridor of activity along the edge gave greater potential to provide visual stimulation and contribute to a sense of place by creating a new highly visual landmark in the area.

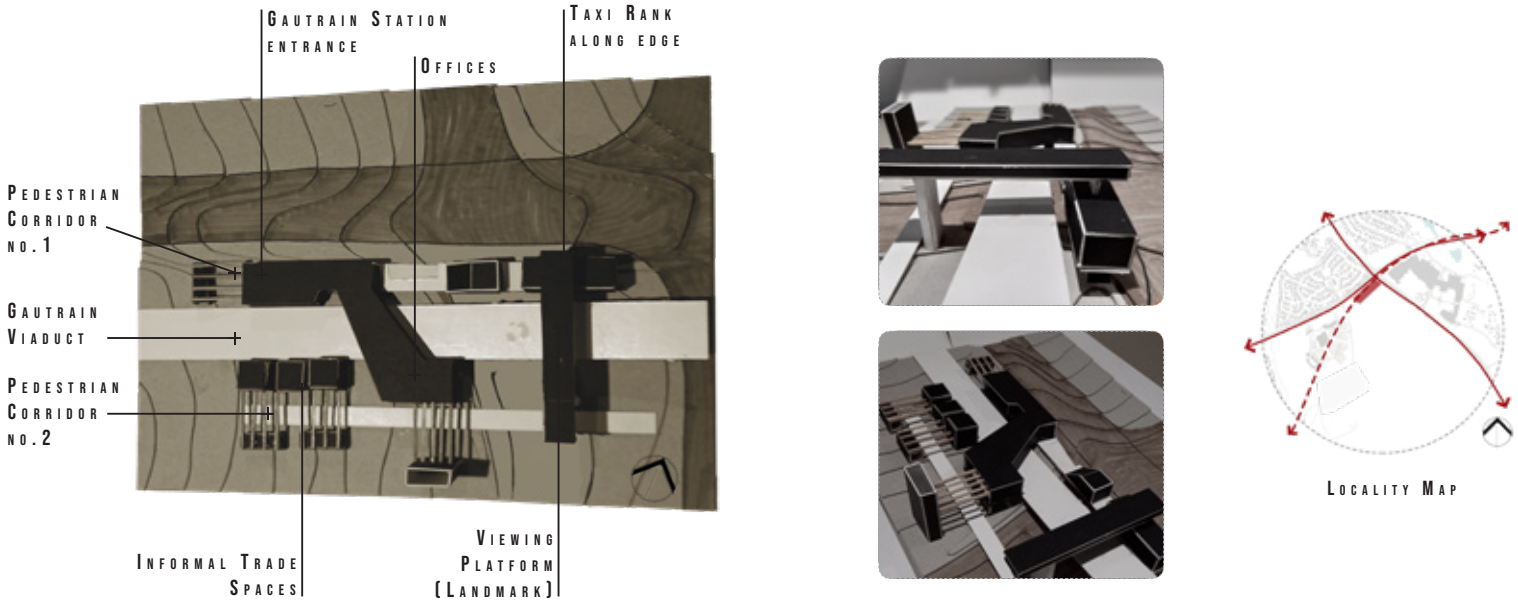


Figure 5.11: Third iteration responding to the new Railtrack placement (Author 2021).

The conceptual form element here is broken up into hubs that create visually and physically permeable blocks. This act would aid in wayfinding and give the user an intuitive sense of direction throughout the site. Parking and drop off zones had been delegated to the west of the site.

South of the Railway track sought more public activities on the ground level and more private activities on the floors above. The ground floor edge condition was identified as being imperative in creating activity as it is the closest edge to Plastic View and has a planned road that directly connects Plastic View with the transit hub.

5.4.5 Final Iteration

This final exploration developed through critical reflections on prior iterations, the context and design principles. As seen in the Baragwanath Taxi Rank, a central spine was developed with different activity nodes surrounding it. From this spine, a vital link was made towards the community of Plastic View through a pedestrian street, as the second street is designated for vehicular access for public and private transport next to the taxi rank. Linking either side of the railway will be crucial in facilitating the spatial circularity principles and discouraging community severance.

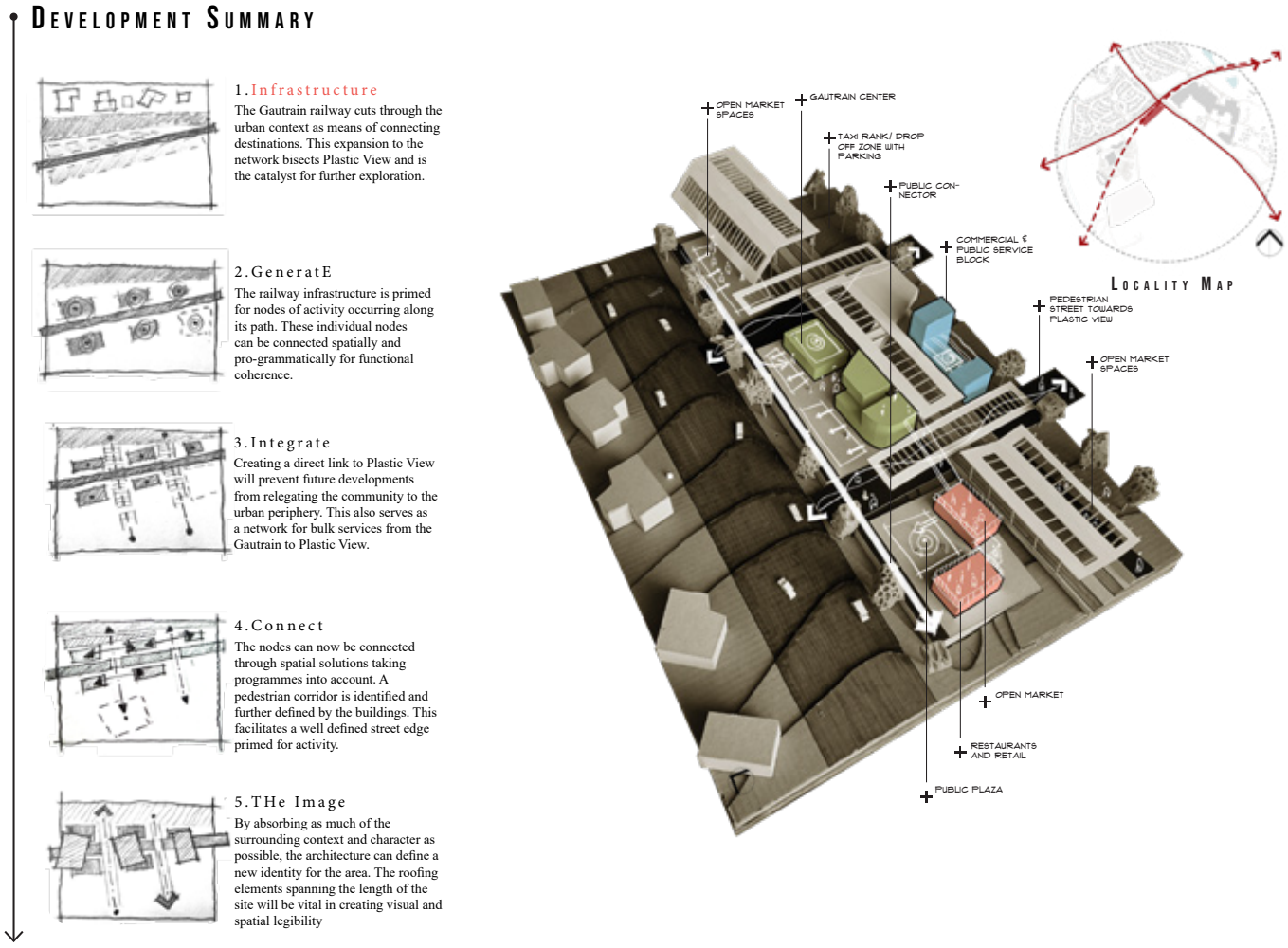


Figure 5.12: Final iteration with development sequence (Author 2021).

Roof typologies were explored to lend themselves to functions in the public domain, such as in the open market spaces and possibly the taxi rank area. Informed by the ‘Image’ concept, a roofing system is intended to provide more than just shade but also define a pattern of language in defining a strong sense of place.

5.5 Conclusion

The iterative and spatial development of the design was continuously tested against the circularity framework in achieving a circular spatial response. Centred around the Gautrain, the transit hub was developed along the central spine parallel to the street, creating a well-defined edge of activity and movement in line with the spatial loop of the circularity framework, informed by the urban vernacular. As seen below, the spatial, knowledge and community were mediated with the preceding city and urban goals to generate an architecture informed by its theoretical, programmatic and contextual informants. In the following third essay, the technological development will be tested against the material and regenerate loops. However, this is not a linear process, as the technological exploration would necessitate further spatial changes to embody the CE philosophy better.

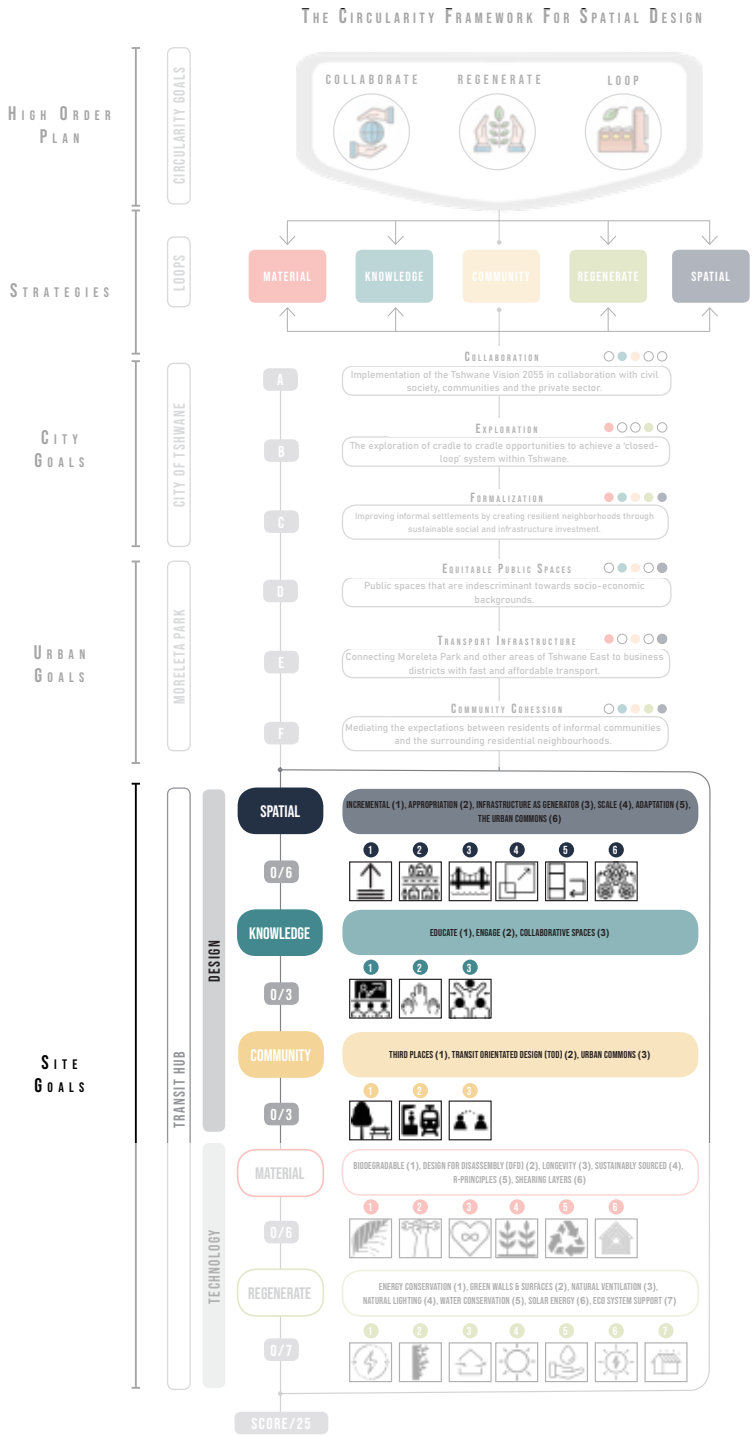


Fig. 5.13: The Circularity Framework (Author 2021).

06 Towards a Technical Circular Framework

6.0 Introduction

This chapter explores the tectonic solutions needed to produce an architecture that responds to the overall intentions and investigations. These aims will be explored in terms of structure, materials, services, systems and environmental strategies that define the circularity framework. Much of the intentions and strategies employed are directly influenced by the ongoing exploration of what a Circular Economy (CE) looks like in South African cities? From the perspective of a Circular Built Environment (CBE), this line of questioning will see this chapter explore cradle-to-cradle approaches and regenerative strategies in achieving aesthetic and functional technological responses. Mediating the needs of the context, providing aesthetic spaces to draw people and exploring new innovative building technologies was crucial in breaking away from the status quo of building construction and beginning a new dialogue between designers, suppliers and users.

6.1 Technical Intention

The technical intention is to promote the core maxims of CE, resource efficiency and waste optimization to illicit awareness regarding waste in the built environment. The exploration takes its first cue from the urban vernacular investigations of Plastic View, which was revealed to be living a Circular lifestyle. Bringing to scale this immediate example of a CBE in Moreleta Park aimed to create an urban visual reminder on the relevant technical lessons learnt from the urban vernacular: resource consciousness, waste mindfulness, utilizing sustainable materials and using old ideas and practices with modern technologies.

6.2 Technical Concept

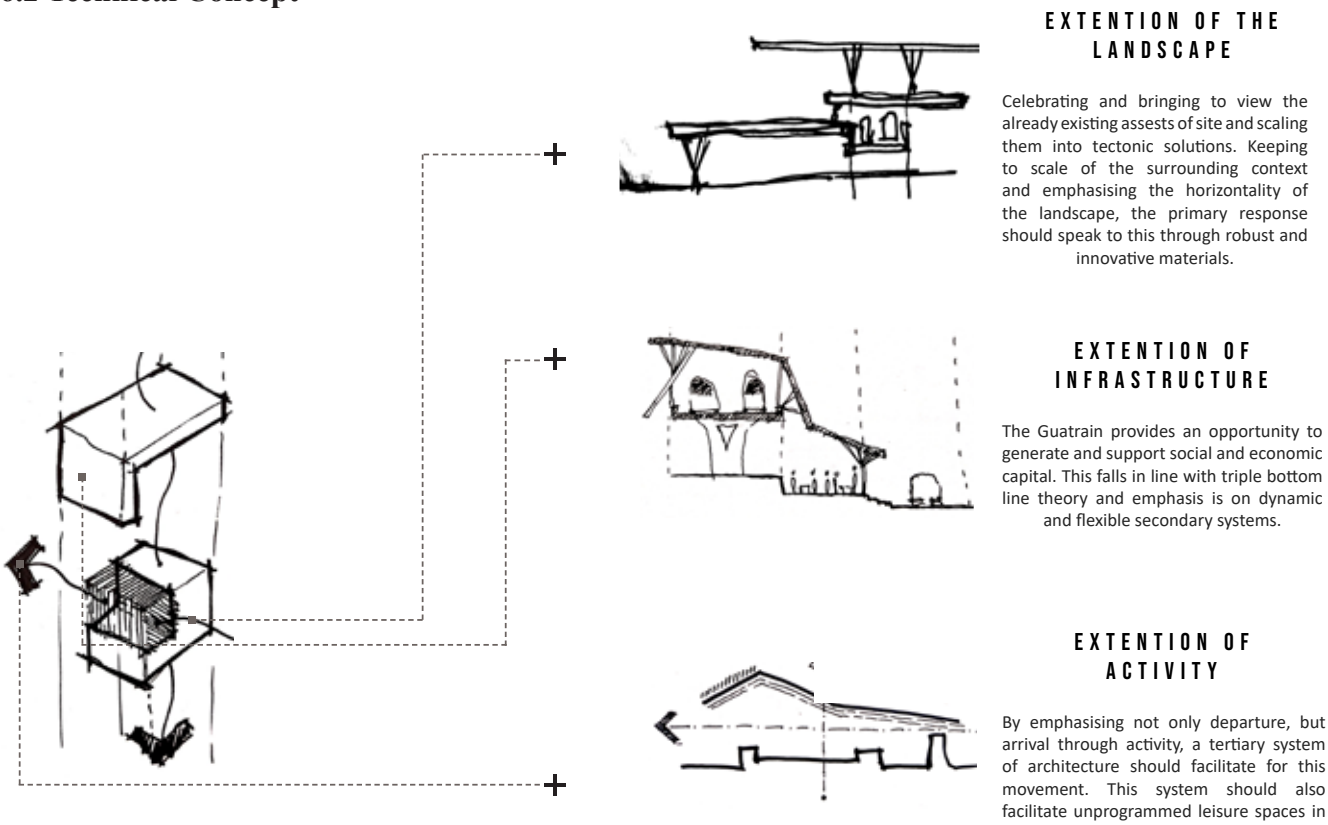


Figure 6.1: Technical concept as the celebration of three focal interfaces (Author 2021).

The technical concept is derived from the conceptual design intentions, informed by the theoretical premise of this dissertation and the circularity framework. It is a celebration of the hidden spatial qualities found within the urban vernacular and the various intersections between the uncovered circular principles and architecture. Thus, the technical concept is the extension or celebration of architecture and the three focal assets: landscape, infrastructure and activity. Celebrating these interfaces between the vernacular and modern construction methods is imperative to creating an immersive spatial experience.

6.3 Technical Informants

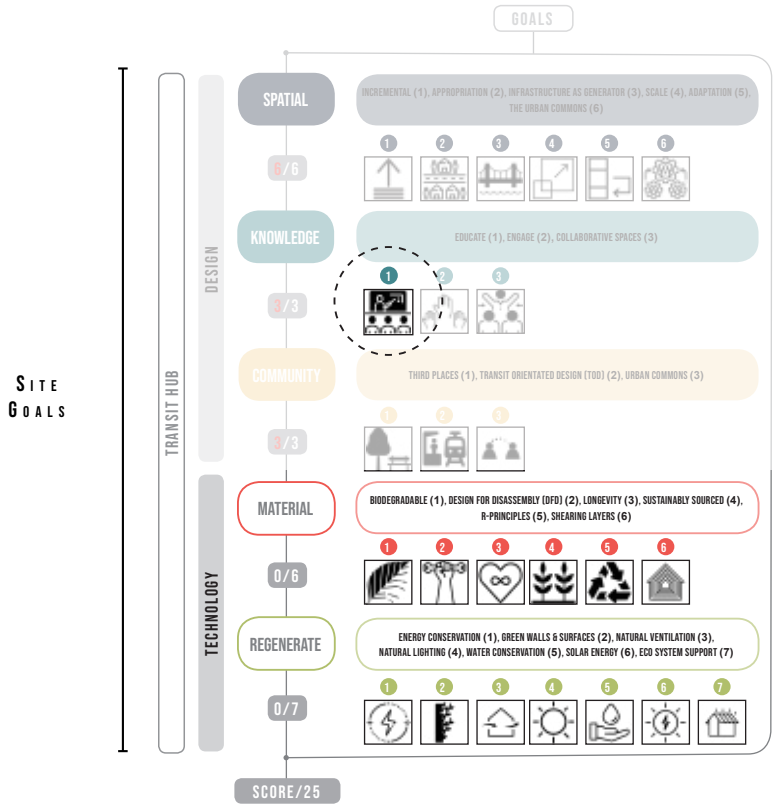


Figure 6.2: Technical framework adapted from the circularity framework (Author 2021).

As seen in figure 6.2, the technical informants are distilled from the circularity framework and were used to guide the technical investigations. The following technical development section will unpack the decisions and changes made to the design and how they were informed by the circularity framework, programme, site and climate. Emphasis on the following chapter had been placed on the material and regenerate loops, becoming the lenses and criterion measured against the design.

6.4 Technical Development

6.4.1 Concept into Structure

The approach emphasises the transitional nature of the design by taking a palimpsest outlook and layering innovations in construction technology with traditional building materials. This strategy aimed to change perceptions towards waste and resources by celebrating the lessons learnt from the hidden urban vernacular. Each strategy and principle used to inform the concept is grounded in educating the public through a visual connection to circularity, as seen in figure 6.3.

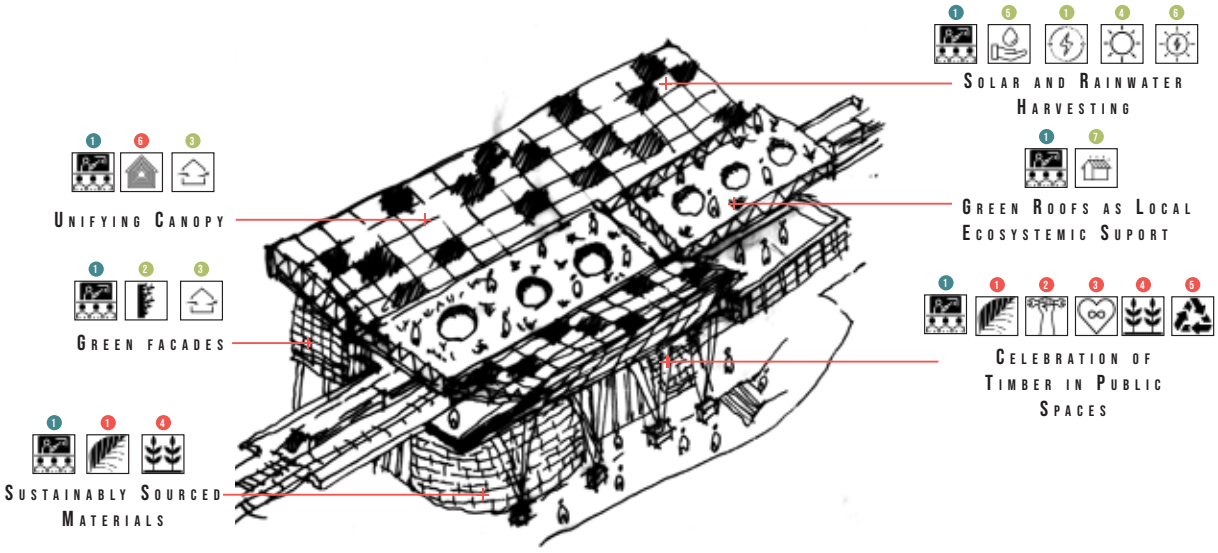


Figure 6.3: Conceptual sketch of technical intentions (Author 2021).

The translation of the concept to a tectonic solution envisions a large canopy over the transit hub and houses various waiting areas, services, retail outlets, terminals and car parks. The wood and steel roof is the defining feature of the building and extends well beyond the building's footprint on all sides. This civic role performed by the roof covers the exterior public spaces, creating appealing and shaded waiting areas. The other facades facilitate continuity between the interior and exterior public spaces through the floor-to-ceiling height glass facades.

6.4.2 Structural Hierarchy

The transit hub comprises a hierarchical structure of three elements: the primary, secondary, and tertiary structure. The primary structure is a structural timber portal frame extending from a corresponding concrete column grid running from the basement floor. Laminated Veneer Lumber (LVL) columns will span between 9 and 12 meters with a height of 11 metres and are connected via stainless steel pin connections. Exposing the columns and celebrating the high volumes beneath the roof can be done through slender timber profiles that emphasize the verticality. Using timber and concrete in the primary structure is the initial layering step toward transitioning to the new from old construction technology. This post and beam system allows for independence of the structural system from the building envelope, and the concrete service core's walls provide shear support for the CLT floors.

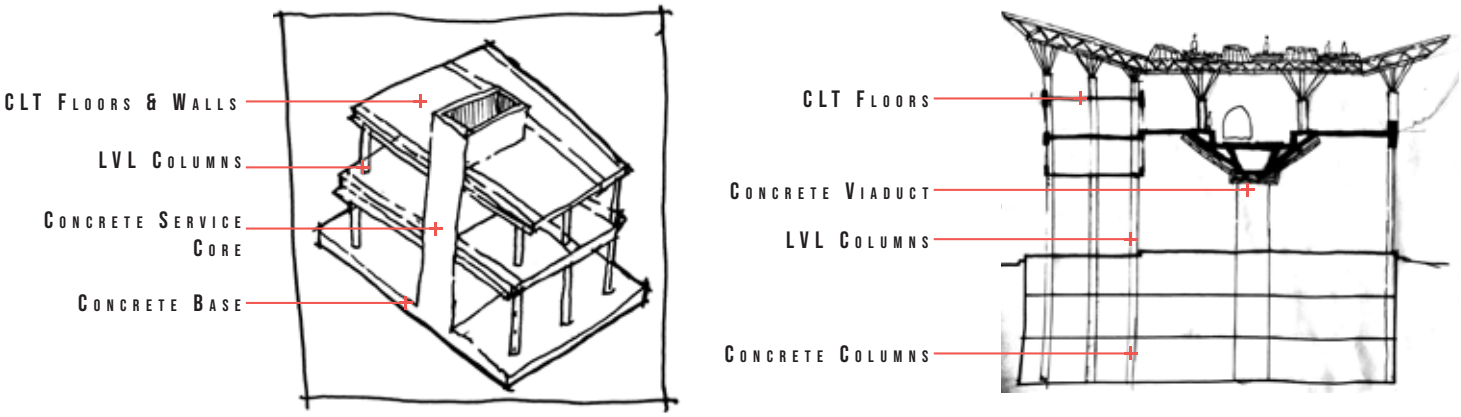


Figure 6.4: Hybrid multi-storey timber construction with concrete base and service cores (Author 2021).

A secondary lightweight construction that is adaptable and flexible accommodates for future programming changes and be innovative. Inspired by Le Corbusier's Maison Domino, the exterior walls separated from the primary structure allow the secondary skin system to maximise the potential of disassembly, reuse, and use of new building technologies. A lightweight stainless steel system forms a double skin on the north and south facades for aesthetic and fire safety precautions. A steel super truss frame roof canopies over the building with a cross frame truss network. A structural gutter to steel cross-bracing and V-shaped steel struts will connect the two canopies into one.

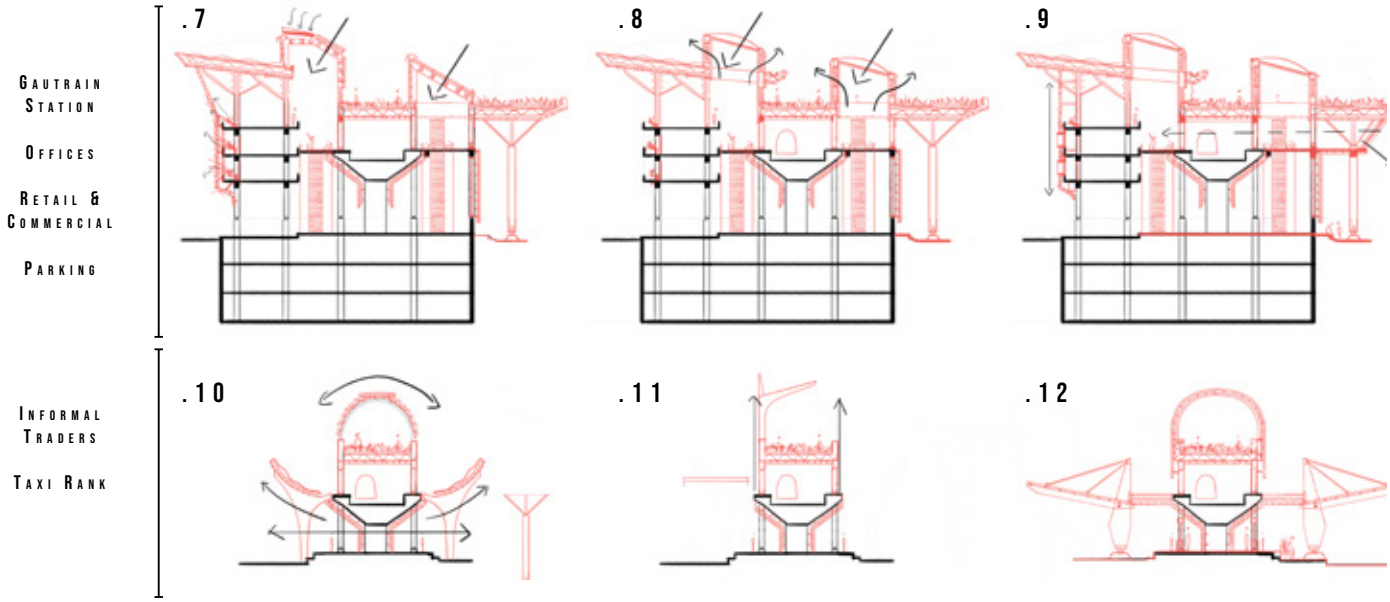


Figure 6.5: Iterations (7-12) of secondary & tertiary structural system (Author 2021).

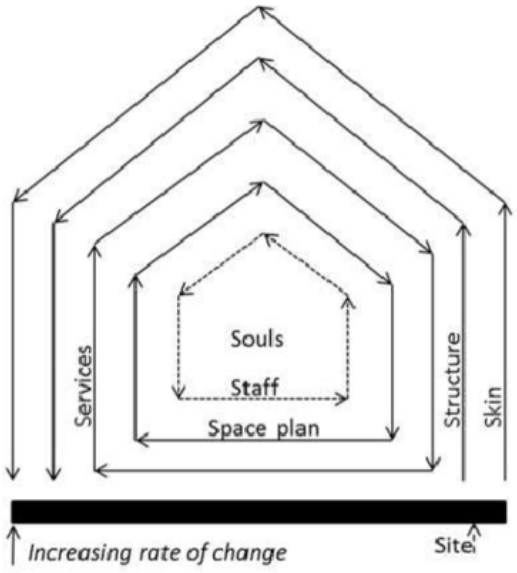
The tertiary structure will be most visible in the cladding used on the double skin system. Various cladding materials inspired by Plastic View include reclaimed bricks, glass, plywood and steel materials supported by the secondary structure. Segments of the roof are clad by ETFE and perforated stainless steel panels to increase the daylighting quality where applicable. The soffit is made of modular plywood panels that are either flat or formed into a gentle curve and fixed to a frame of steel channels. Services in line with dfd principles as part of the tertiary system will be largely exposed for ease of access and adaptation.

6.4.4 Assembly

As designers, we must contemplate how to reuse valuable materials to bring them back to the loop. In this sense, the architecture is understood as a material bank, and the materiality chosen is influenced mainly by considering the beginning and ending life cycles. In his *How Buildings Learn*, Stewart Brand introduces design for disassembly (dfd) as a design criterion that envisions the building as layers with different lifecycles (Brand 1995). Differentiating these layers optimizes the recycling potential of a building and should subscribe to the following dfd principles:

1. Use fewer parts.
2. Optimize the use of fasteners.
3. Minimize different kinds of materials (easier to sort).

4. Materials used should be commonly recycled and clearly labelled.
5. Plastics: avoid paints, coatings or adhesives that can contaminate the material.
6. Avoid downcycling: the best recycling allows materials to come back into use with the same value.



Shearing layers	Description	Typical lifespan/activity
Site	Location and context	Permanent
Structure	Bones	30-300 years
Skin	Envelope	20+ years
Services	Lifeblood	7-20 years
Space plan	Interior layout	3 years
Stuff	Furniture and equipment	Under 3 years
Souls	People	Daily

Figure 6.6: Stewart Brand's shearing layers concept (Brand 1994).

It is imperative to recognize a material's different life-cycle stages and ensure it is not the same as the building's life-cycle. Separating the two is a significant step towards a Circular Built Environment (CBE), moreover, it determines whether a building could generate little to no waste throughout its entire lifetime. The following strategies are adopted to help achieve this:

- Avoid wet building methods (Pouring concrete or wet sealants).
- Expose services (Easy to access, update and maintain).
- Build like Lego (Can be reused and reassembled).
- Bio-based materials (Construction materials obtained from plants or animals).

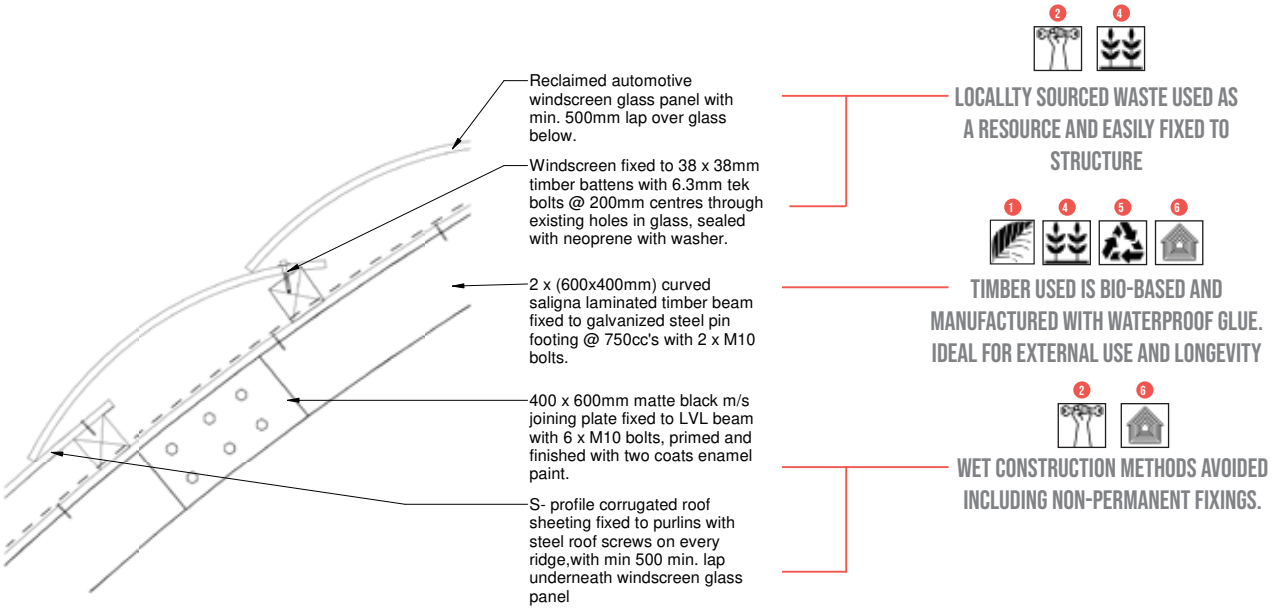


Figure 6.7: Detail of tube canopy over Gautrain platform (Author 2021).

6.4.3 Materiality

The material palette has been chosen with the effect of contrasting one another to reflect the merging of the two urban conditions in the area. The first urban condition comes from the communities living in the surrounding gated communities, and the second is the urban vernacular environments found within the 'urban' pockets. The diversity of materials in Plastic View will be celebrated through modern construction methods as found in the surrounding gated communities. The duality and contrast between the two urban environments will provoke the transit hub's evocative 'inside out' character. For example, timber in Plastic View is often hidden; it shall now be celebrated on the exterior. The same goes for steel cladding generally on the exterior, now to be used in the interior of Gautrain station as exterior cladding.

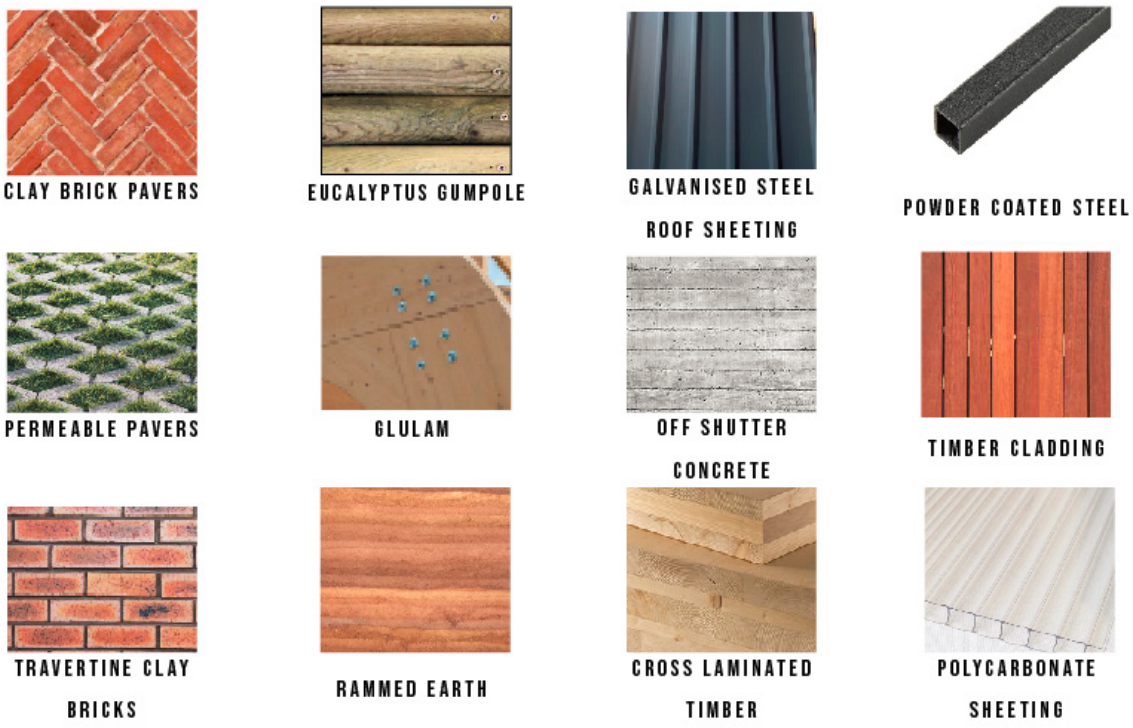


Figure 6.8: Proposed materiality palette (Author 2021).

Concrete is a material known for its strength in compressions, and so is a robust material, ideal for future superstructure expansion to meet unexpected needs. The grid structure with pad foundations aids in this extension in line with available building principles. Basement floors, retaining walls, and the service core is reinforced concrete for better fire safety and structural reinforcement for the timber elements above ground level. The four-storey building is designed with a non-combustible concrete base on the ground floor to compensate for the extensive use of timber. This concrete base limits the flammable surface to three storeys and reduces the risk of arson. The use of concrete here is an extension of the concrete used in the Gautrain viaduct, which promotes a simultaneity between architecture and infrastructure.

Figure 6.9: The liberal use of timber elements used for structural and cladding purposes (MPIP 2021).

Timber as a building material is used as the primary load-bearing superstructure above ground. The benefits of using this bio-based material are due to it being one of the few genuinely renewable building materials found throughout South Africa (The Wood Foundation 2006: 7). Wood has the lowest carbon footprint of all building materials, can be sourced from carbon-neutral plantations and can be re-used for other projects (The Wood Foundation 2006:7). This material can last just as long as a traditional brick and mortar building and so is a highly appropriate building material to be used in the construction of the transit hub. The timber floors above ground level are made of a simple cross-wall style, which remains the same on all storeys. This allows for economical construction and is dissolved by rows of columns throughout the building.

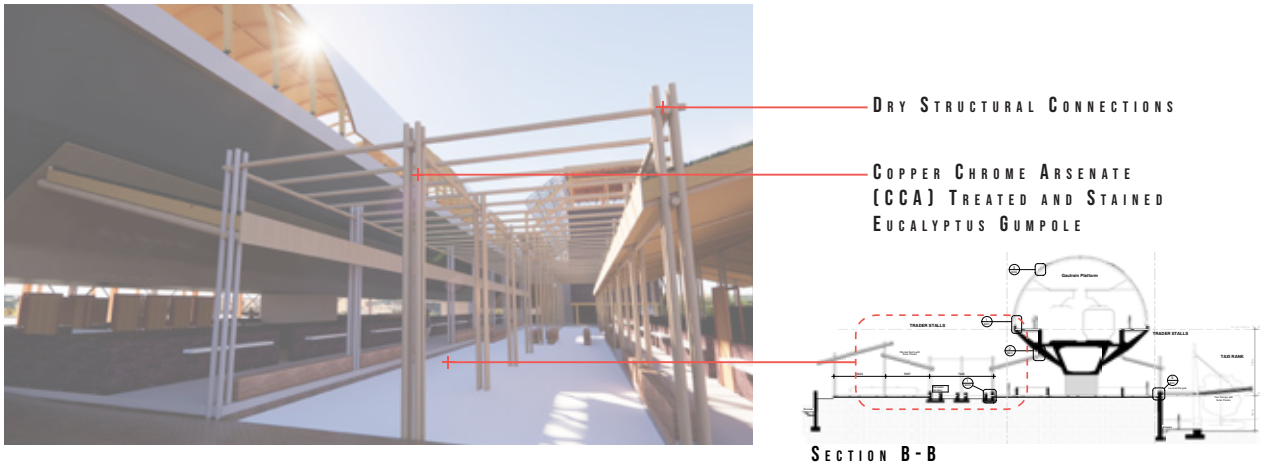


Figure 6.10: Process perspective of informal market spaces (Author 2021).

With dry structural connection details such as bolts, a dismantling process is possible whilst limiting waste if required. Using timber as the primary structure alludes to the hidden primary structure common in informal settlements, now to be celebrated on a larger, visual scale and will affirm vernacular practices. Exposing the timber stimulates feelings of warmth and welcome in direct contrast to existing Gautrain typologies. This humanizes the space with a personal feel that encourages loitering. Dry fixing connections with the aid of Computerized Numerical Control (CNC) technology are explored to understand the potential of timber connections without steel bolts. Other notable materials include polycarbonate panels that are 100% recyclable and lighter than glass.

Mycelium insulation from fungi is a bio-based material known for its good insulative properties. It has a thermal conductivity of 10c (W/mK): 0.039 and treated bamboo is used as cladding on the northern and southern facades (Xing, Brewer, El-Gharabawy, Griffith, Jones 2018:22).

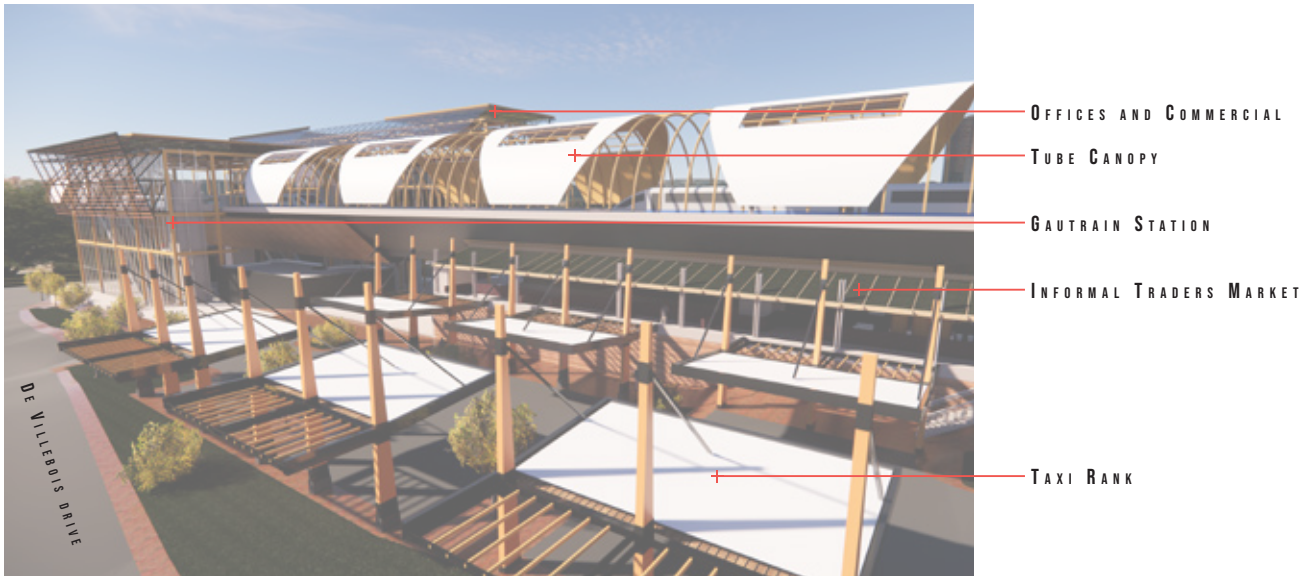


Figure 6.11: Process perspective of the transit hub (Moreleta Station) (Author 2021).

6.5 Environmental Strategies

6.5.1 Climatic Condition

Despite the encroaching effects of climate change, according to Conradie (2018: 52), Pretoria has of the best climates in the world. The city in Climatic Zone two is characterized by dry winters and hot, rainy summers that promote an outward living city. The climatic condition is highly conducive towards solar energy generation and passive design methodologies that influence the transit hub's design. The region does not receive a significant amount of wind to warrant wind-power generation. Due to the scale of the site, solar protection should be considered at the architectural and urban levels. Shading devices at the building scale should exclude the sun during overheated periods and allow penetration during cooling periods. Whilst at the urban scale, landscaping and urban vegetation can cool both surface and air temperatures whilst simultaneously providing a positive psychological effect on pedestrians (Conradie 2018:18).

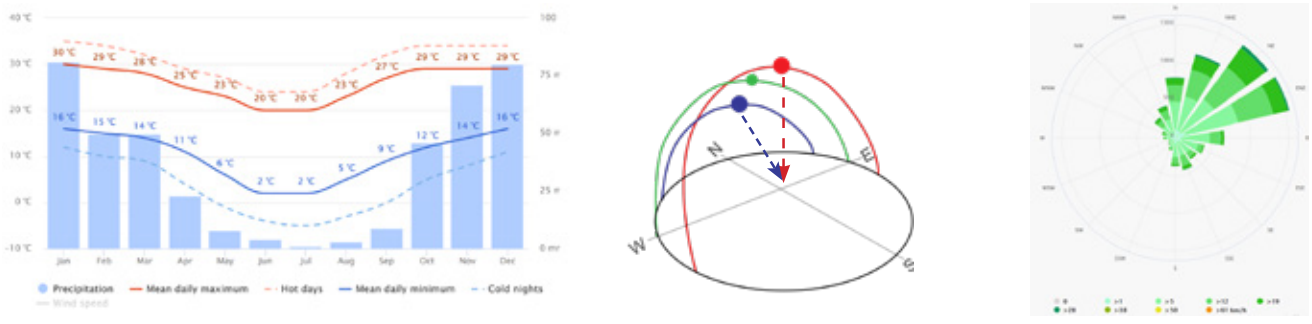


Figure 6.12: Tshwane's climatic informants (Meteoblue 2021).

6.5.2 Natural Ventilation

Gautrain and transit typologies are largely open systems by design, and harnessing the predominant NE wind, provides more comfortable spaces and reduces the dependency on AC systems. A double facade on the north and south provides buffer zones for ventilation and acoustic purposes. The evaporation from vegetation growing on the southern facade skin assists in natural cooling during summer periods. Large atrium spaces running through the building is naturally ventilated by the chimney stack effect, complemented by the pressure differentials created by the incoming and departing trains.

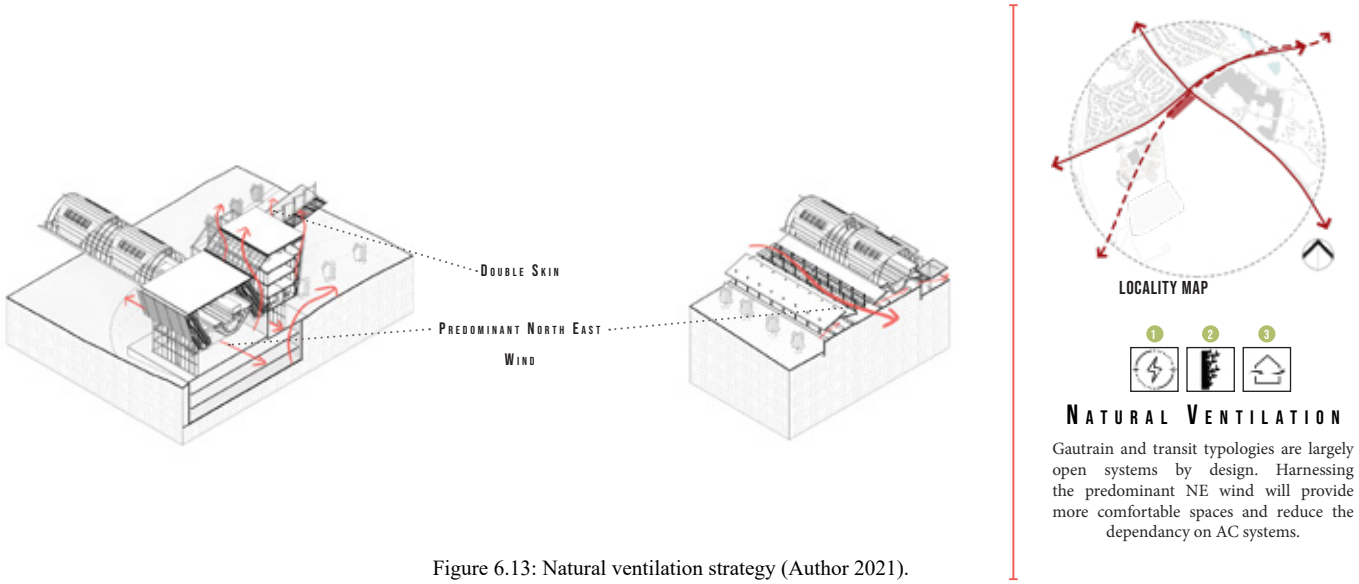


Figure 6.13: Natural ventilation strategy (Author 2021).

6.5.3 Water and Solar Systems

Due to the high demand for non-portable water for irrigation and washing of taxis, rainwater is collected from surface run-off, roofs and greywater. Water captured on site is directed towards the site's lowest point through the aid of stormwater gardens, gutters bioswales, and permeable paving for water treatment. The water treatment is a three-phase strategy to produce water ideal for irrigation, toilet flushing, taxi cleaning and floor cleaning.

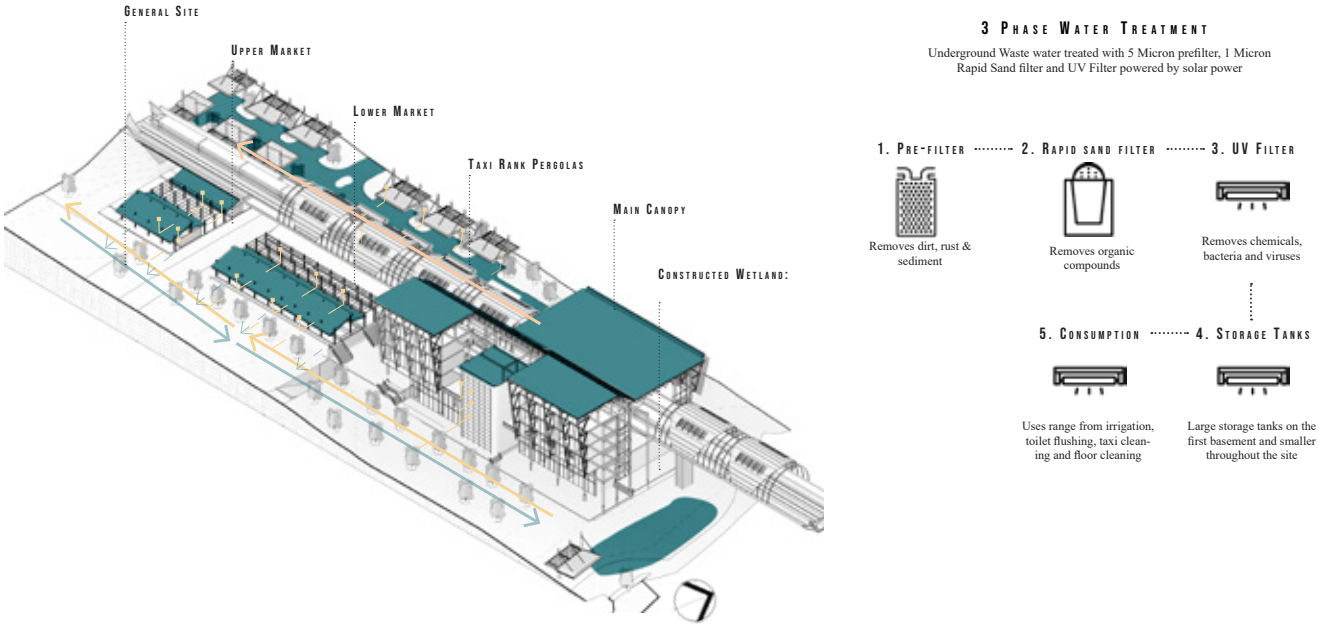


Figure 6.14: Site axonometric of water harvesting surfaces (Author 2021).

In terms of solar, utilizing the average of 5.5hrs solar exposure in Pretoria satisfies the circular criteria of harnessing renewable energy. An on-grid solar system that requires no battery storage has been selected and functions through photovoltaic panels and inverters.

The building classification is not listed in SANS 10400-XA and so a maximum consumption of 240/ kWh/m2 has been assumed for the purposes of the calculations. With the target of meeting at least an 30% load offset from the municipal grid, the calculations determined the number of panels and surface area that is required.

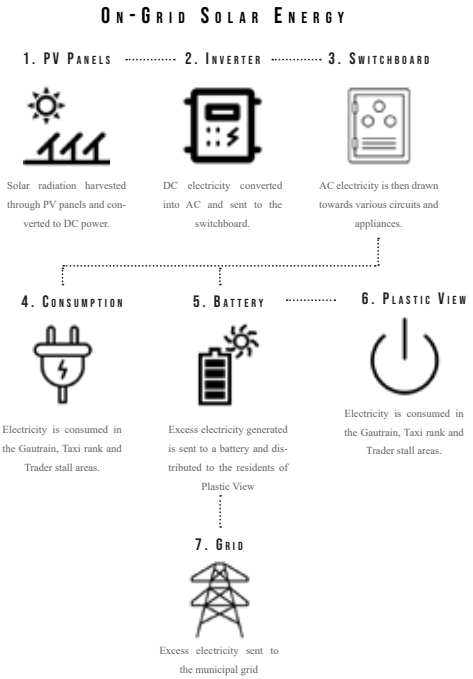


Figure 6.14: Water harvesting and solar strategy (Author 2021).

6.5.4 Green Systems

The generous application of green landscaping and trees increases the rate of CO2 sequestration, and this process is a step towards achieving a net-positive carbon footprint. This application, along with timber, creates an architectural landscape across the site that functions as a carbon sink at varying scales and quantities. The increasing use of trees and vegetation throughout the site increases the water demand. Various elements are employed to facilitate this, as discussed earlier in the water harvesting strategy. Using green roofs to replace the ground lost in the construction process is a method to support the local flora and fauna that may have been affected. This tactic is directly inspired by Plastic View, where living roofs are used for agricultural purposes, insulation, and protection of the material underneath.

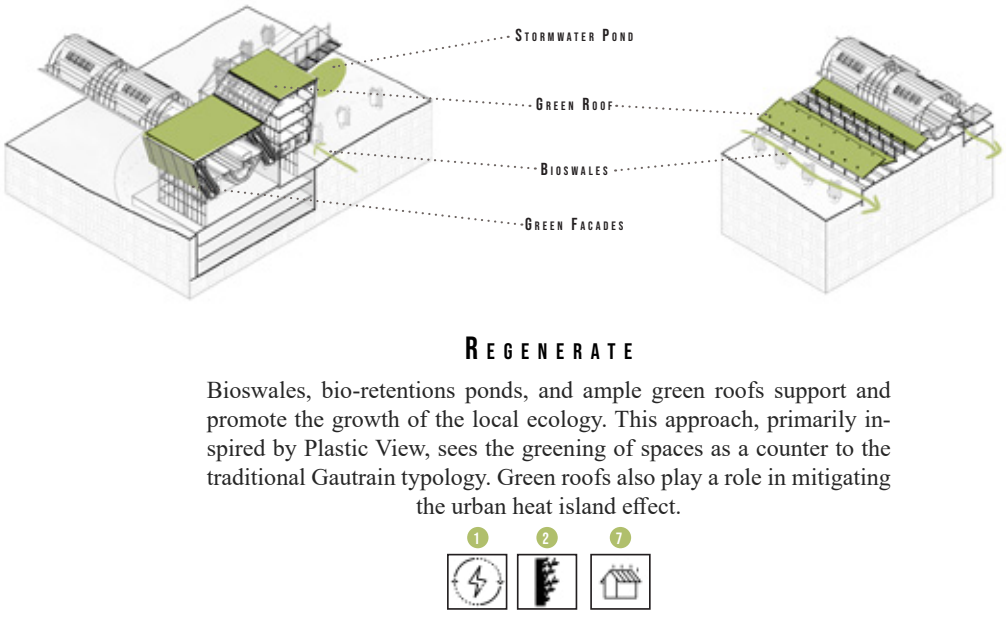


Figure 6.15: Various green systems employed on-site (Author 2021).

6.5.5 Daylighting

The current model's illuminance (without shading devices) is between 75% and 100% occupied hours with 28-foot candles/ 300 lux adequate in these spaces. Glare and heat gain must be reacted with non-reflective surfaces and a low emissivity glazing system or appropriate shading on the northern facades. The majority of the floor surfaces in these instances overlit with over 100 lux of direct light. The Spatial Daylight Autonomy (sDA) reflects this by being near 100%, instead of the acceptable range of 60 - 80%. The ASE (natural light) should be as low as possible yet is also at 97%.

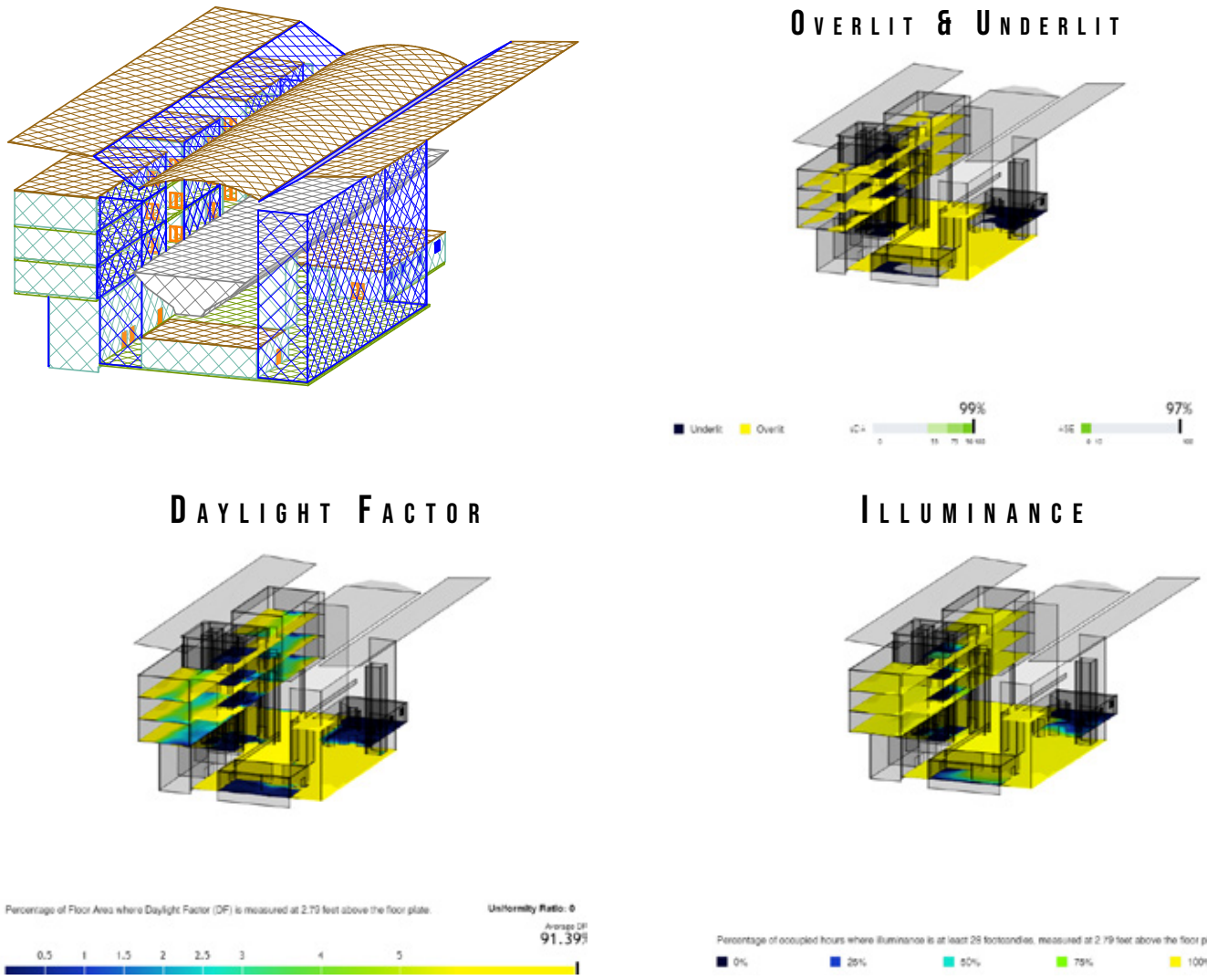


Figure 6.16: Daylight Analysis before intervention (Author 2021).

The masses south of the railway receive more light than expected, and the Northern glazing system needs to be addressed. This condition presents an opportunity for exploring a 'green' second skin to the building that will improve the light quality and introduce vegetation to the Gautrain Station.

6.6 SBAT & The Circularity Framework

An SBAT rating of 4.4 was achieved during the technical development and presents opportunities for improvement in aceess and education to improve the score. The transit hub expectedly scored a 13/13 for the technical criterion of the circularity framework, by fulfilling the set outcomes . In order to reconcile the two criteria, further development of the circularity framework alongside the SBAT rating is needed. The circularity framework did prove itself to be most helpful in the quickening and guiding of the technical explorations. For example, selecting the material palette was directly informed by the material loop and measured against the city, urban and local goals.

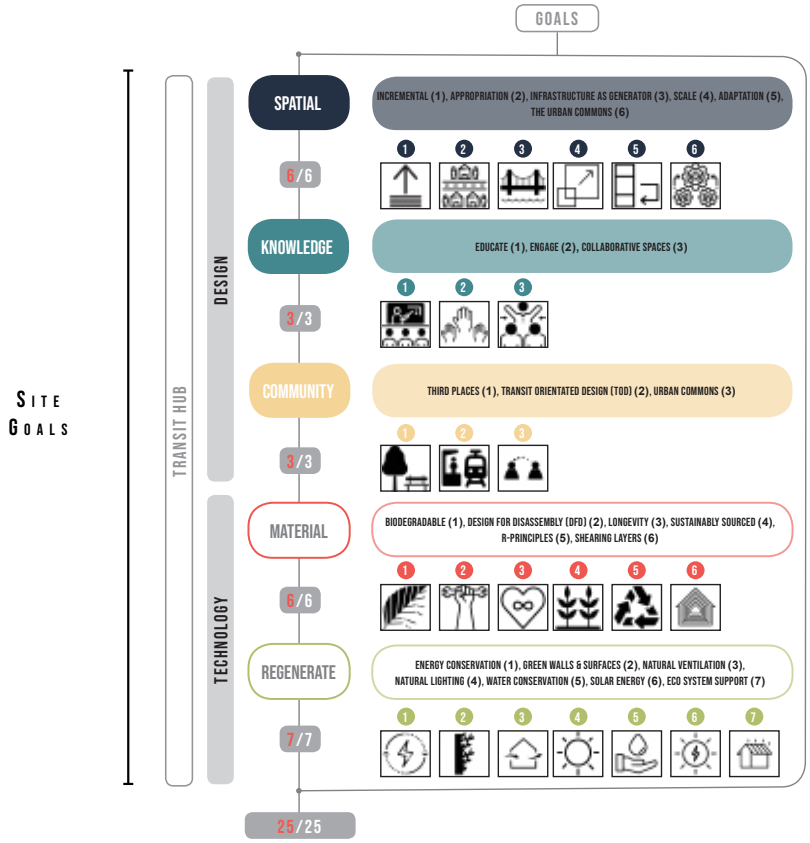


Figure 6.17: Technical framework adapted from the circularity framework (Author 2021).

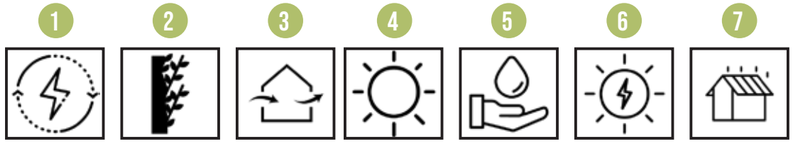
6.7 Conclusion

The technical investigations and development allude to a high level of circularity per the proposed circularity framework. The design and technological explorations walked the viewer through the spatial characteristics of a circular architecture and how the various principles and strategies were responded to via the design proposal.

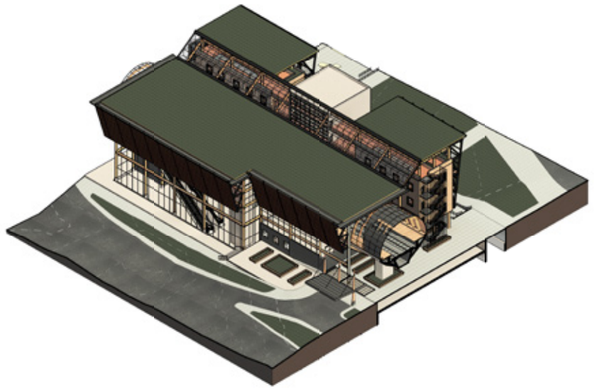
Passive Strategy

Circular Systems

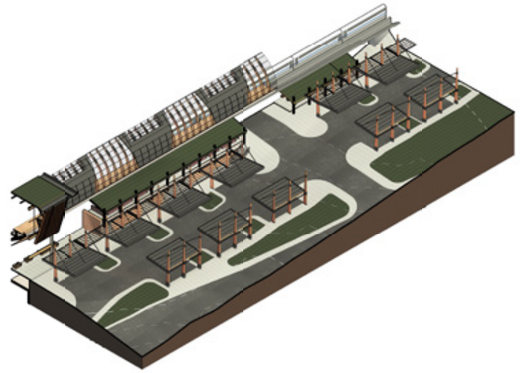
ENERGY CONSERVATION (1), GREEN WALLS & SURFACES (2), NATURAL VENTILATION (3), NATURAL LIGHTING (4), WATER CONSERVATION (5), SOLAR ENERGY (6), ECO SYSTEM SUPPORT (7)



Gautrain Station

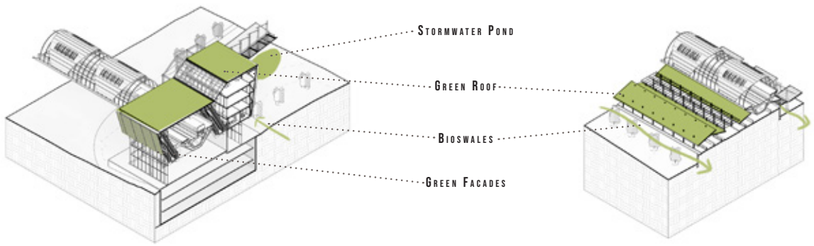


Taxi Rank

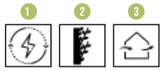


Ecosystems

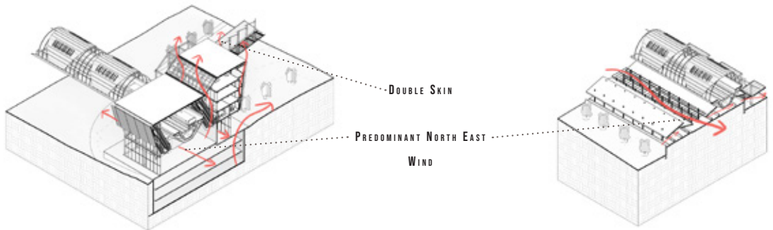
Bioswales, bio-retentions ponds, and ample green roofs support and promote the growth of the local ecology. This approach, primarily inspired by Plastic View, sees the greening of spaces as a counter to the traditional Gautrain typology. Green roofs also play a role in mitigating the urban heat island effect.



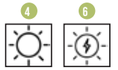
Natural Ventilation



The design takes advantage of the predominant NE wind and this reduces the dependency on AC systems. A double facade on the north and south provides buffer zones for ventilation and acoustic purposes. The evaporation from vegetation growing on the southern facade skin assists in cooling and the atrium space is ventilated by the chimney stack effect.



Daylighting



The daylight studies helped reveal the inneficiencies of the design and prompted changes that inproved natural lighting, reduced glare and roof slopes were adjusted to account for solar angles.

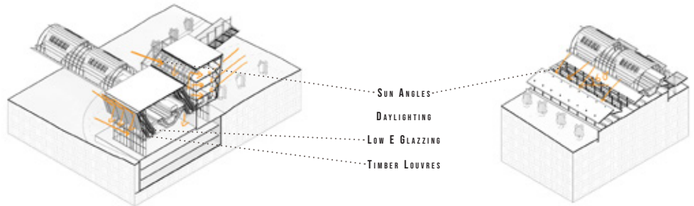


Figure 6.18: Passive Strategies in reference to the circularity framework (Author 2021).

07 Critical Reflection

7.1 Towards a Circular South African Built Environment

The agency and involvement of Plastic View's residents in providing shelter for themselves revealed a subconscious awareness of resource scarcity, which consciously manifested as vernacular building construction. Unfortunately, this cultural tenet that links resources and shelter becomes less apparent as one progresses into higher socio-income groups. Low-income groups are inherently predisposed towards a 'make more with less' culture that limits waste. This culture based on utility inspires the use of R principles (reuse, recycle, repair and refurbish) to keep dwellings in their highest value and is correspondingly financially sustainable. Higher-income groups are typically disconnected from the value or destination of their waste. More value is typically placed in the use phase of the building's lifecycle than the end-of-life stages.

This culture questions the role of education and awareness in promoting an urban vernacular culture towards building construction, getting the maximum out of the minimum. The severity of the current environmental and global crises is not properly reflected by the rate at which the built environment innovates and educates. This condition informed the progressive technological explorations in the proposal to encourage industrial innovation conceptually. Innovation coupled with more circular buildings in our built environment can promote the reevaluation of traditional construction value-chains and realise the potential of a new systemic value chain across many sectors.

This new value chain aims to instil a culture of awareness that prompts built environment professionals to consider the long term implications of their input. This system involves considering all phases of a building's lifecycle by mapping and tracking all the resources involved. This high level of information exchange across multiple collaborators and stakeholders will promote a systemic integration of energy, water, material and waste management aided by modern mapping and digitisation tools. The greater control and management we have on built environment resources can only be economically beneficial whilst preserving our environmental assets.

7.2 The Designers Role in CE

The dissertation, at its core, sought to conceptualize an architecture rooted in CE principles by learning from the urban vernacular, a neglected source of learning potential. Conversely, the very act of designing a new proposal is the least favourable option in achieving a Circular Built Environment (CBE). Renovating and upgrading existing buildings remains the foremost circular strategy in limiting waste, preserving materials, energy and limiting greenhouse gas emissions.

This presents opportunities for interior architects and designers to maximize upon existing buildings, with social, economic and environmental benefits to be capitalized on in urban renewal projects. Designers in this field should make ample provisions to maximize building construction resources and upkeep their value at the highest level attainable.

South Africa, however, finds itself in contrast to the global north's built environment by having large amounts of land available favourable for greenfield projects. Particularly in Pretoria's urban condition expanding southeasterly, the proposal aimed to reflect the most plausible case study of future possible circular projects to be developed in Pretoria East. To enable the successful renovation and renewal of buildings, architects will need to facilitate this first by designing flexible and easily adaptable buildings. Buildings that are retrofit and upgrade ready will provide incentives for industry manufacturers to create interchangeable components.

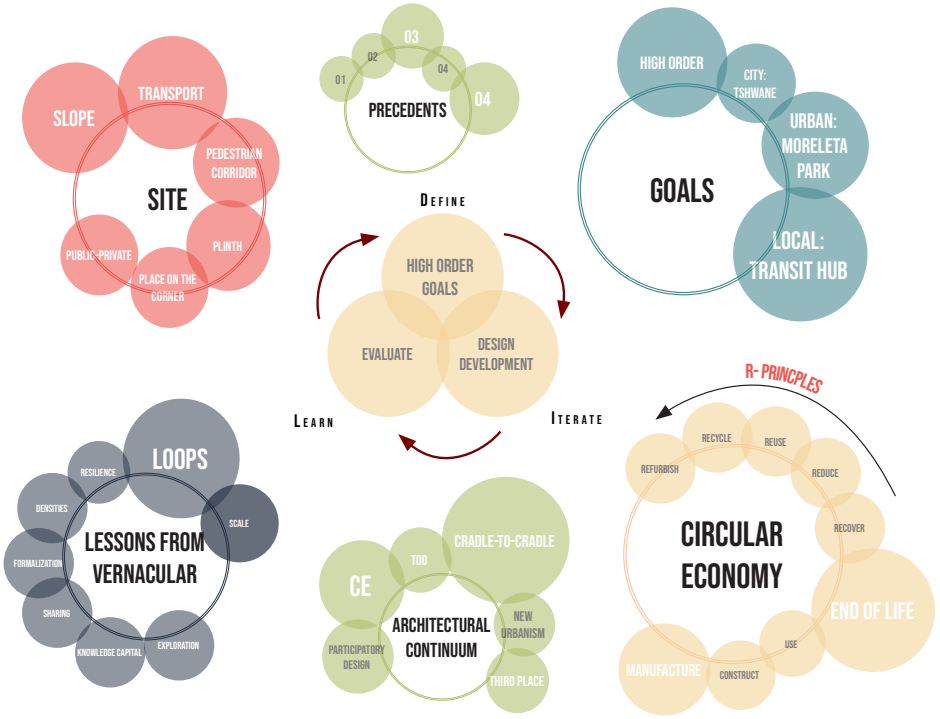


Figure 7.1: Summary of the Circular Framework (Author 2021).

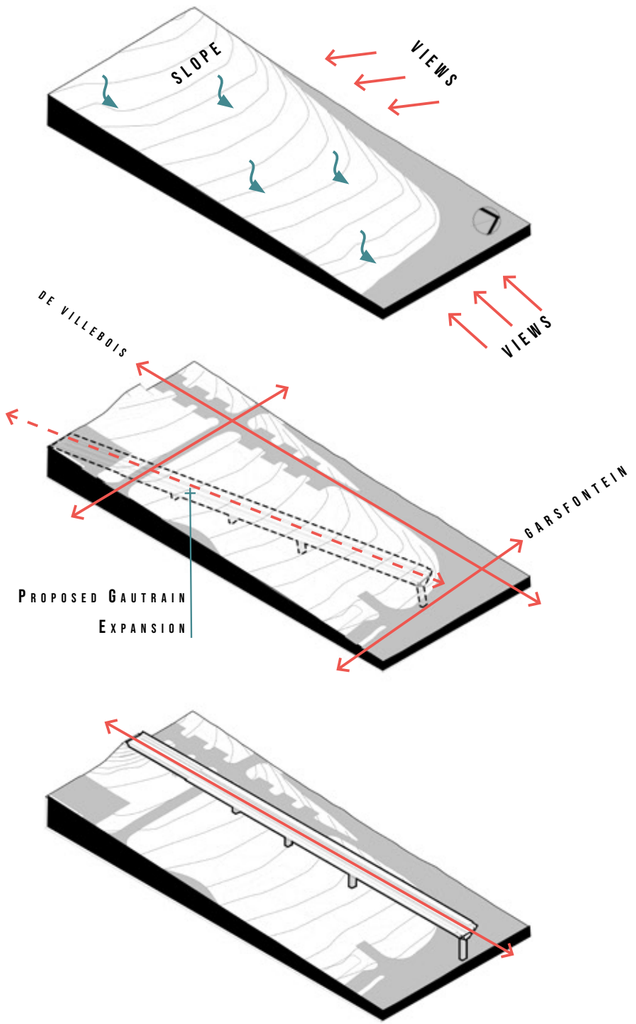
7.3 Finale: The Design Proposal

The architectural solution as a transit hub is proposed as a catalyst for exploring the interfaces between different connections. Whether architectural or as systems, these connections become the starting point of an enriched dialogue between supplier, client, and the designers extended involvement in the product's life-cycle. The scale to which the public infrastructure proposal is conceptualised maximises the potential of user engagement with the role of circularity in the built environment. The proposal forms a threshold into Moreleta Park with didactic qualities at varying scales, encouraging the union of a fragmented community within the provided servile public spaces. Achieving these aims was guided by the circularity framework, as summarised in figure 7.1, showing the body of influences used to guide the design and technical explorations.

The exploration of fluidity between public and private spaces in transit architecture resulted in a woven fabric of spaces along defined corridors of activity. The layering of programmatic functions from the Gautrain viaduct introduces complexity towards the various interfaces between site and infrastructure to be realised as architecture. These interfaces as architecture occur at different scales and frame the informal commercial areas, the corridors of activities, communal spaces and the Gautrain Station.

Design Development

Summary of Intention



A Place on the Corner

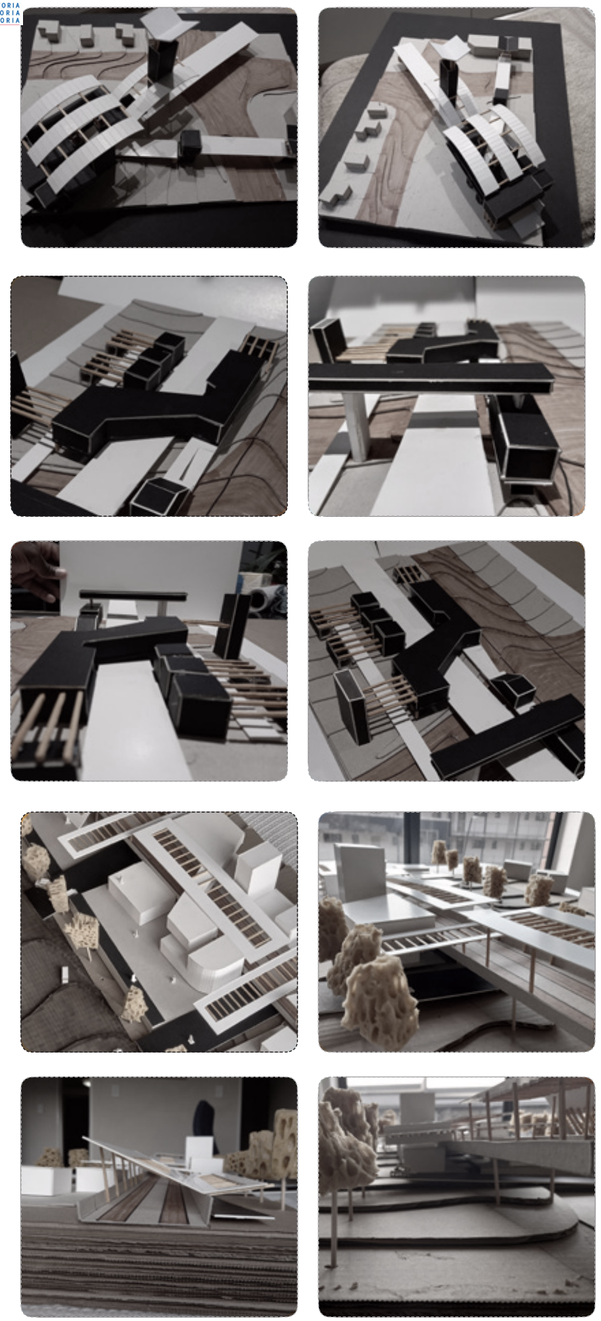
At the intersection of Garsfontein and De Villebois, the Moreleta Station at this point will be highly visible and be at a position to take maximum advantage of street activity

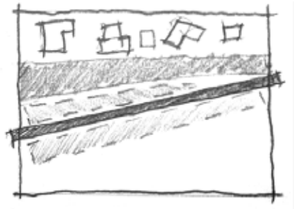
Vehicular Circulation

Vehicular circulation around and through the side was carefully considered whilst still placing first consideration upon the pedestrian. Long sight-lines and visible turns are employed for safety and movement is largely kept to the perimeter

Proposed Gautrain Expansion

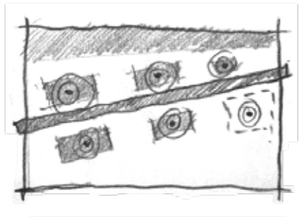
The proposed Tshwane East expansion was initially proposed to run through Plastic View and past Woodlands onto De Villebois drive. The author maneuvered the path to be as parallel as possible to De Villebois drive coming out from underneath Moreleta Park Church and onto the viaduct





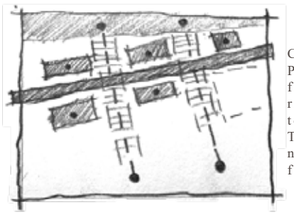
1.SEVERANCE

The Gautrain railway cuts through the urban context as means of connecting destinations. This expansion to the network bisects Plastic View and is the catalyst for further exploration.



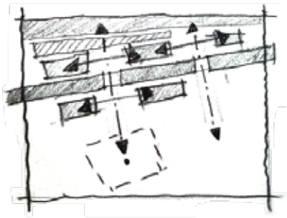
2.GENERATE

The railway infrastructure is primed for nodes of activity occurring along its path. These individual nodes can be connected spatially and pro-grammatically for functional coherence.



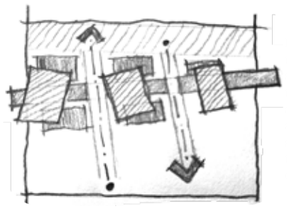
3.INTEGRATE

Creating a direct link to Plastic View will prevent future developments from relegating the community to the urban periphery. This also serves as a network for bulk services from the Gautrain to Plastic View.



4.CONNECT

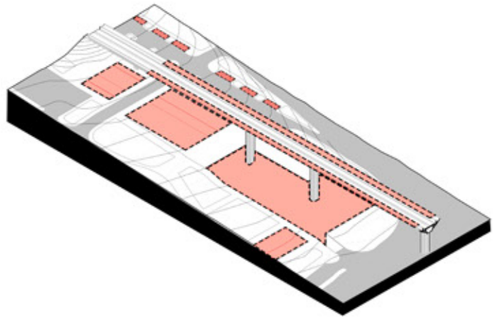
The nodes can now be connected through spatial solutions taking programmes into account. A pedestrian corridor is identified and further defined by the buildings. This facilitates a well defined street edge primed for activity.



5.THE IMAGE

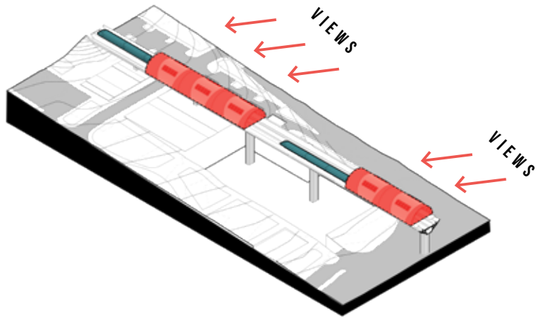
By absorbing as much of the surrounding context and character as possible, the architecture can define a new identity for the area. The roofing elements spanning the length of the site will be vital in creating visual and spatial legibility

Design Iterations & Developments



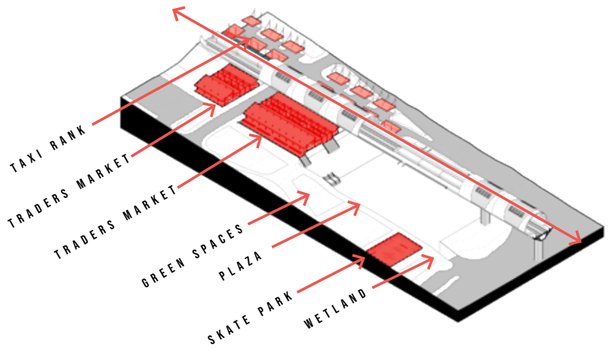
Platforms of Engagement

The size of the site brings the advantage of creating a diversity of programmes across it. These nodes vary in function and decrease in scale closer to the street edge as possible. These are envisioned as platforms for the Third Place conceptual intention.



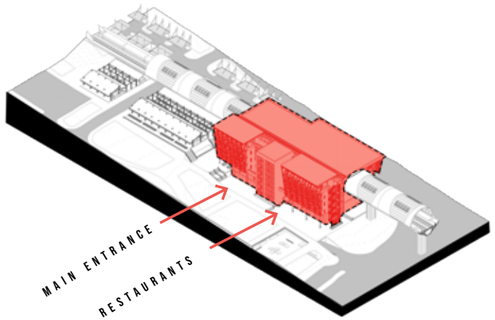
Gautrain Canopy

Traditional Gautrain canopies over platforms are inspired by a tree concept replicated through various sites. Intentionally breaking away from this whilst keeping to scale is with the intention of making the station more memorable and conceptually distancing itself from the 'sterile' and 'cold' qualities at Gautrain Stations.



Third Places

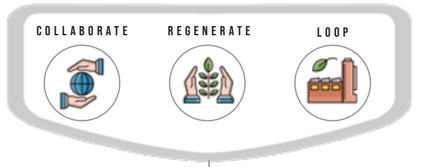
The taxi rank, traders market, skate park and green spaces are located mainly along a single axis parallel to De Villebois Drive. This eases the connection and fluidity between the various programmes across the site. These programmes are mediated between their public and semi-public qualities to promote lingering.

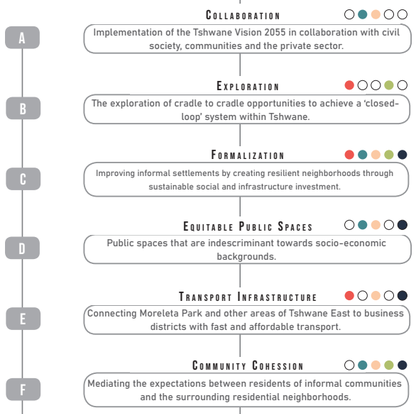


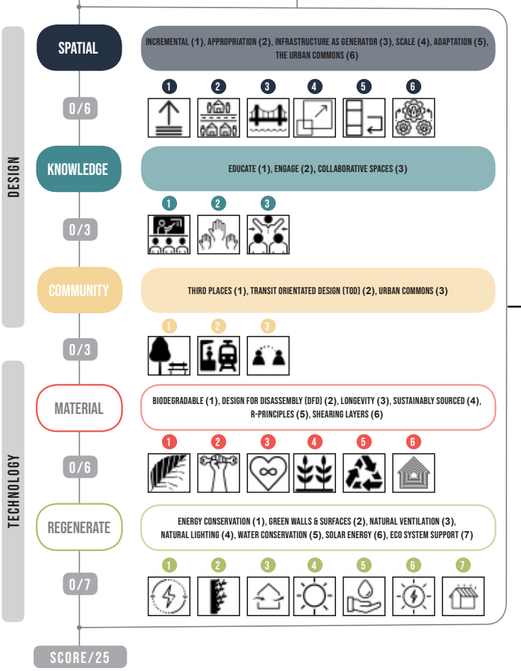
The Station

The site and its programmes are intended to be functional and have aesthetic qualities that promote the principles of circularity. The Gautrain station in particular is meant not only to celebrate departure, but arrival as well.

High Order Plan → Strategies → City Goals → Urban Goals → Site Goals







The Circularity Framework

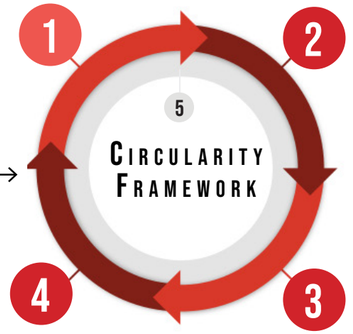
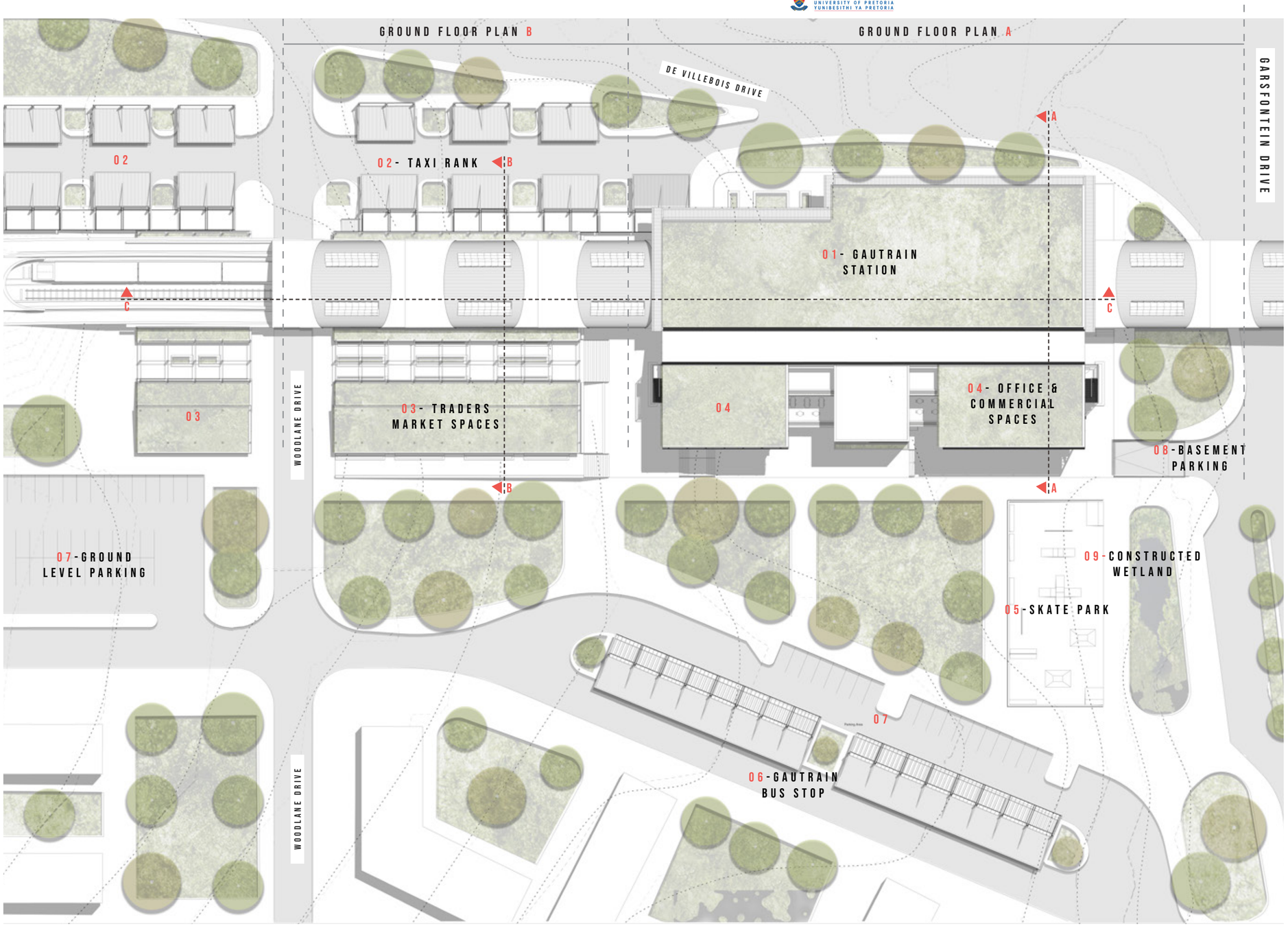


Fig 1.2 Diagram



Key

01 Gautrain Station
02 Taxi Rank
03 Traders Market Spaces
04 Office & Commercial
05 Skate Park
06 Gautrain Bus STop
07 Ground Level Parking
08 Basement Parking
09 Constructed Wetland

SITE PLAN

1:200 (A0)

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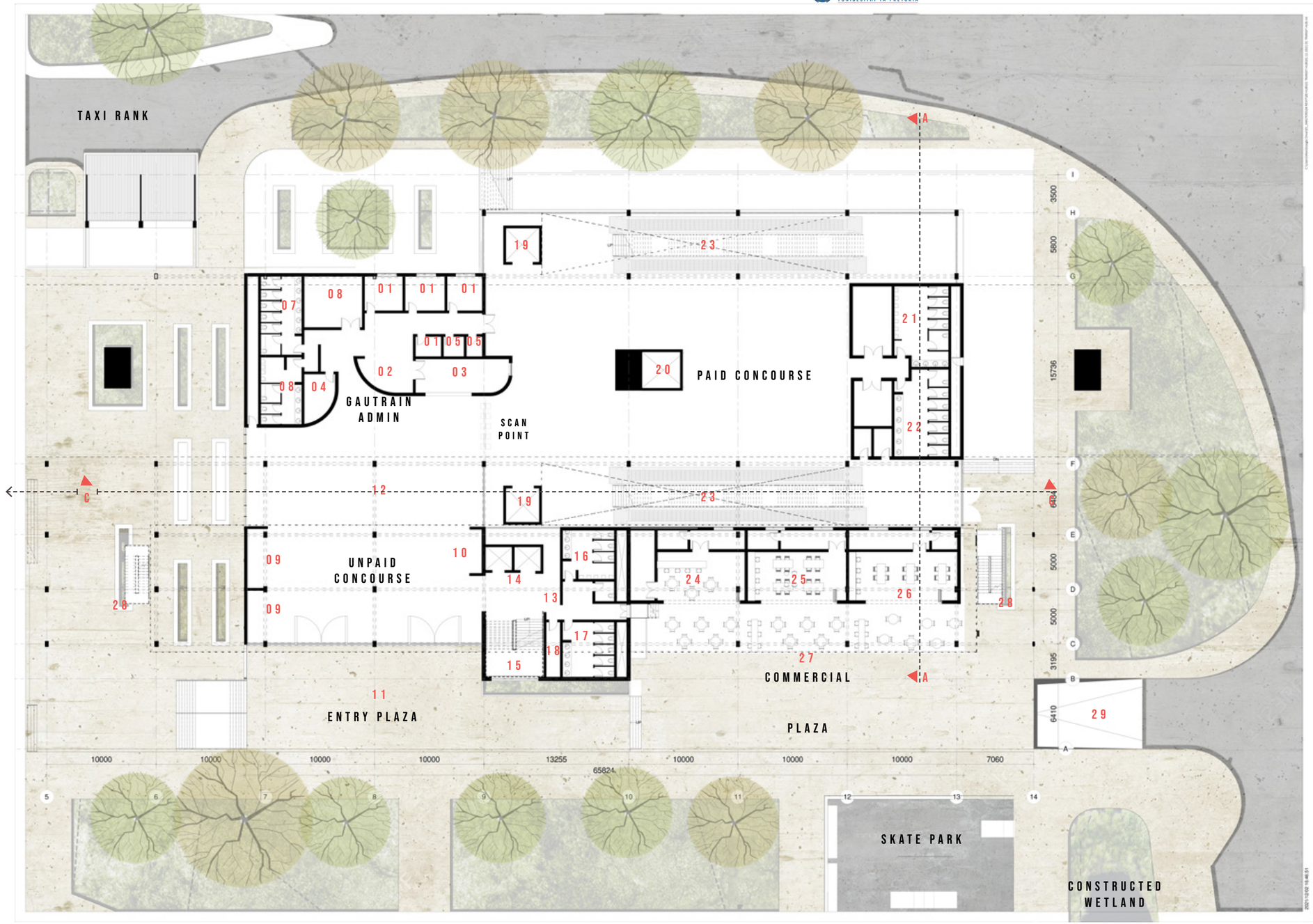


Key

Gautrain Administration

- 01 office
- 02 staff lounge
- 03 ticket office
- 04 kitchen
- 05 storage
- 06 male bathroom
- 07 female bathroom
- 08 boardroom

Unpaid Concourse

- 09 tickets
- 10 atm
- 11 entry plaza
- 12 lounge
- 13 circulation/service core
- 14 lifts
- 15 stairs
- 16 male bathroom
- 17 female bathroom
- 18 storage

Paid Concourse

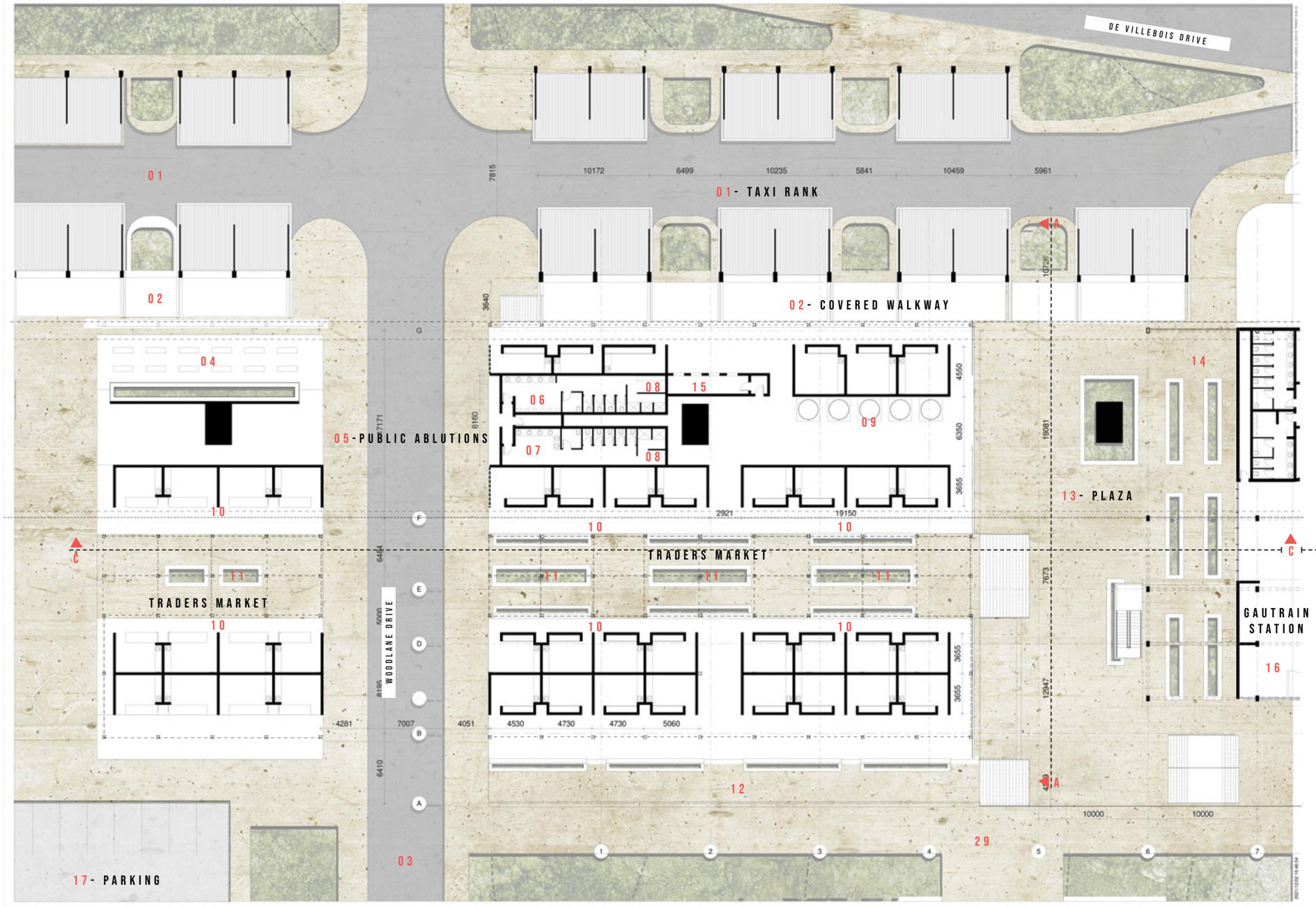
- 19 lift
- 20 hvac services
- 21 male bathroom
- 22 female bathroom
- 23 escalators & stairs

Commercial

- 24 lucky bread
- 25 krispy kreme
- 26 seattle coffee
- 27 outdoor seating
- 28 fire escape
- 29 basement parking

GROUNDFLOOR PLAN - A

1:100 (A0)



Key

Taxi Rank

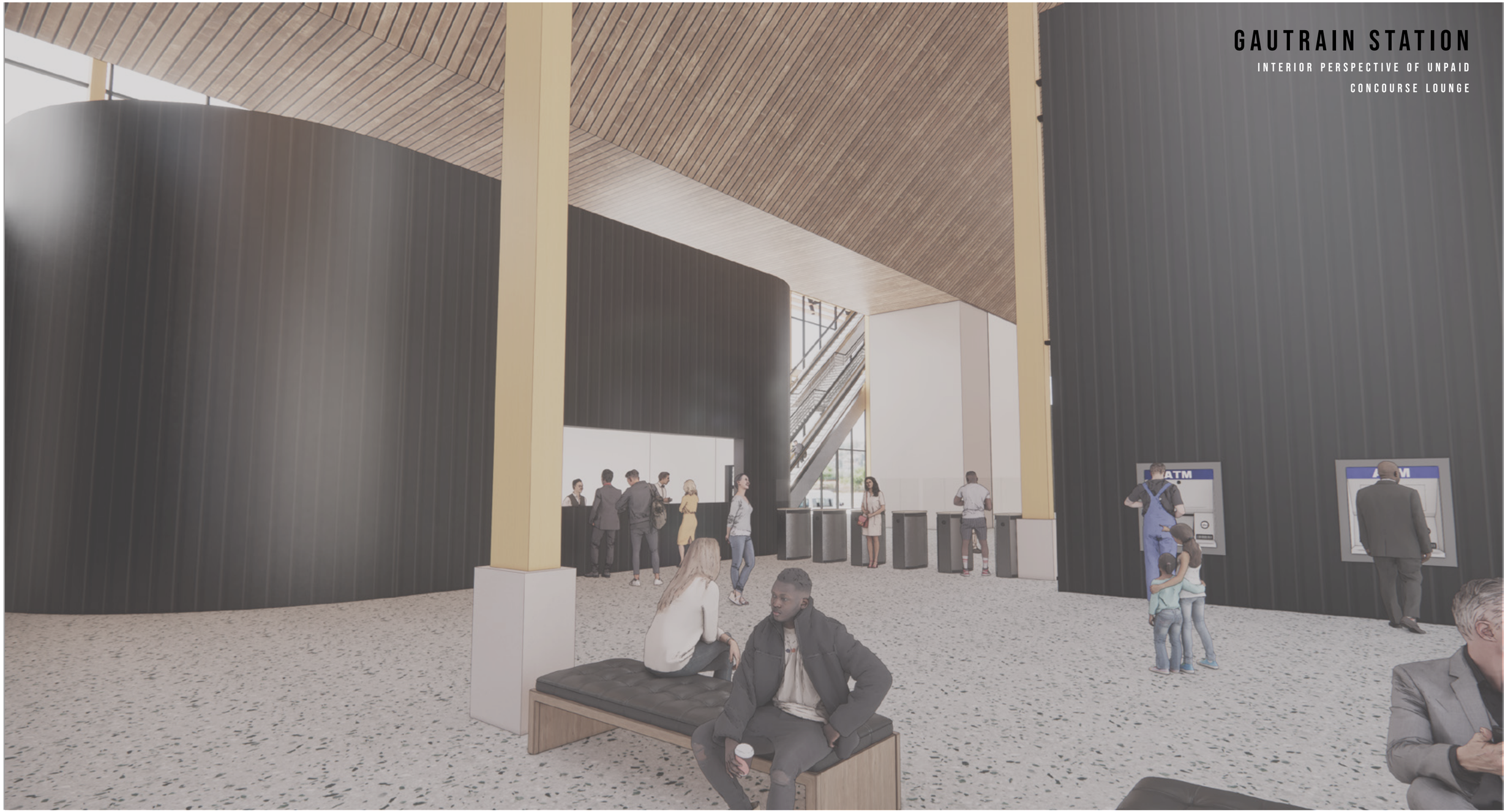
- 01 taxi rank
- 02 covered walkway
- 03 proposed woodlane drive
- 04 seated waiting area
- 05 ablutions
- 06 male
- 07 female
- 08 showers
- 09 water tanks

Traders Market Spaces

- 10 semi formal stalls
- 11 rain gardens
- 12 open walkway
- 13 plaza
- 14 seated waiting spaces
- 15 atm machines
- 16 gautrain station
- 17 Parking

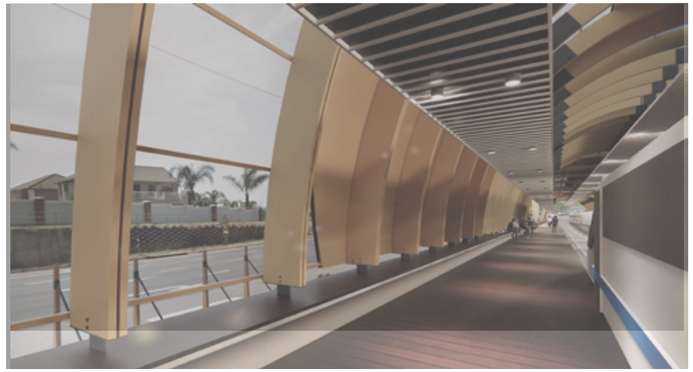
GROUNDFLOOR PLAN - B

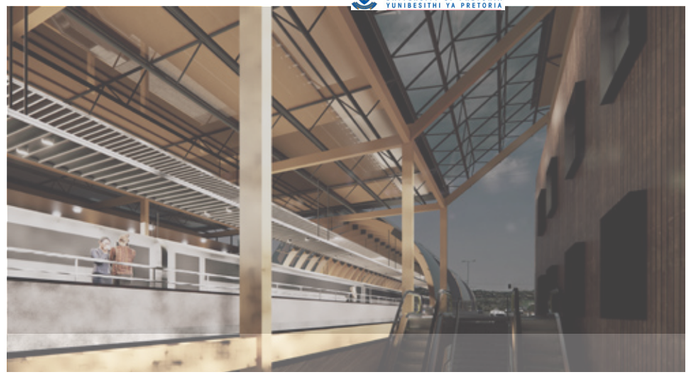
1:100 (A0)

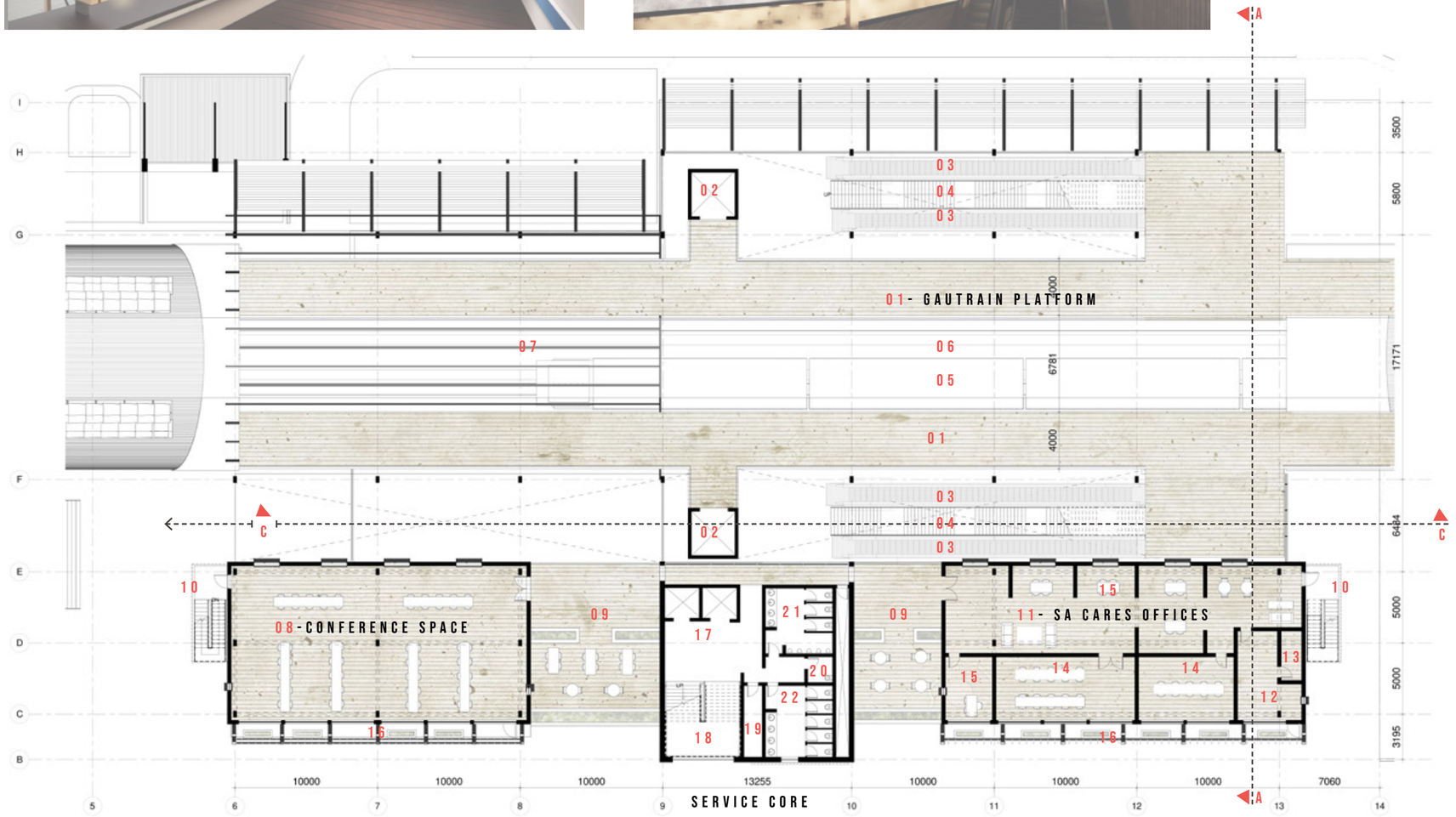


GAUTRAIN STATION

INTERIOR PERSPECTIVE OF UNPAID CONCOURSE LOUNGE







Key

Gautrain Platform

01 gautrain platform
02 elevator
03 escalator
04 stairs
05 gautrain
06 rail track
07 tube canopy above platform

Office Block

08 conference space
09 veranda
10 fire-escape
11 sa cares offices
12 kitchen
13 storage
14 meeting rooms
15 consultation/office
16 planted service walkway

Concrete Service Core

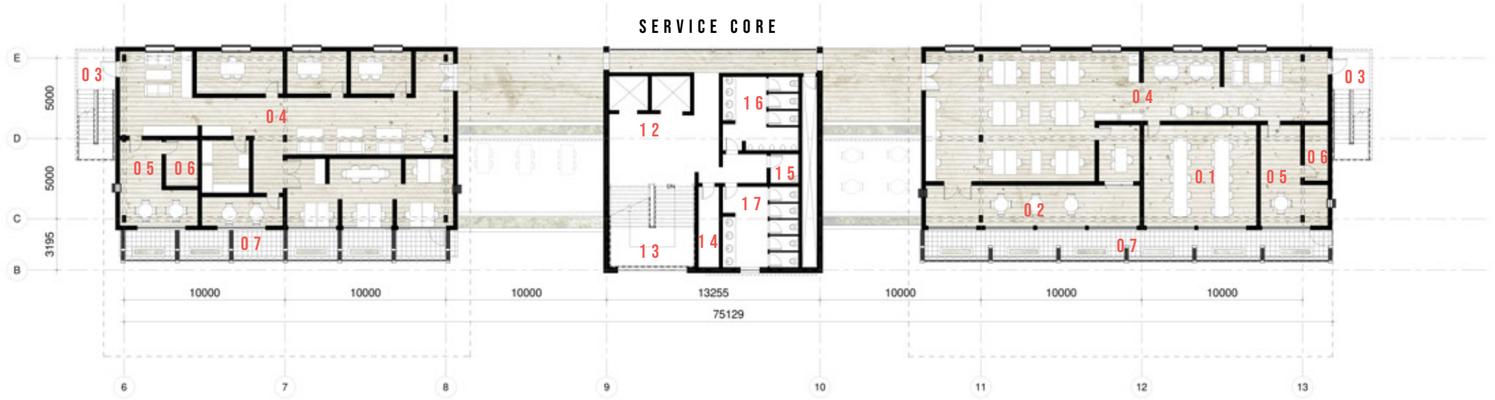
17 elevators
18 stairway
19 storage
20 disabled ablution
21 male ablutions
22 female ablutions

FIRST FLOOR PLAN

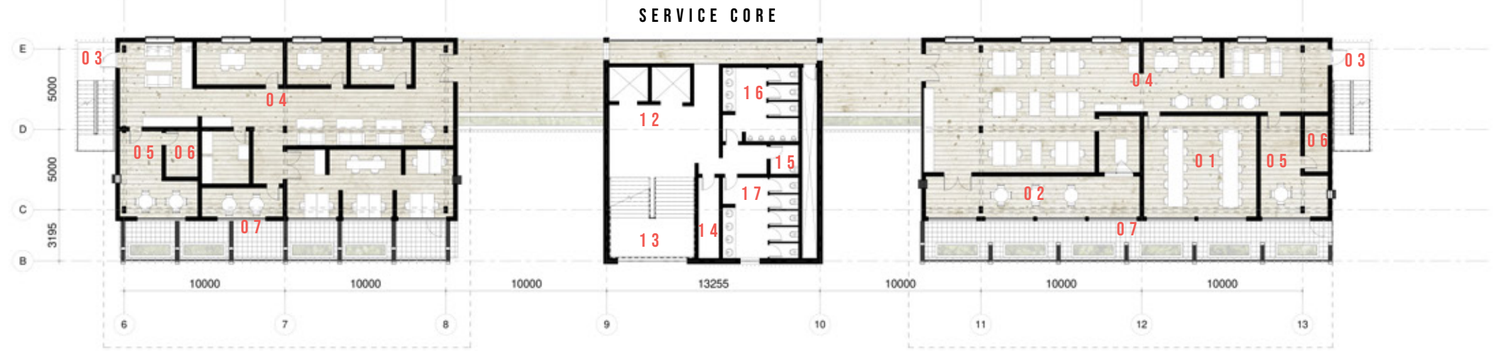
1:100 (A0)

SA CARES OFFICES

INTERIOR PERSPECTIVE OF TYPICAL OFFICE SPACE



1 02 SECOND FLOOR
1 : 100



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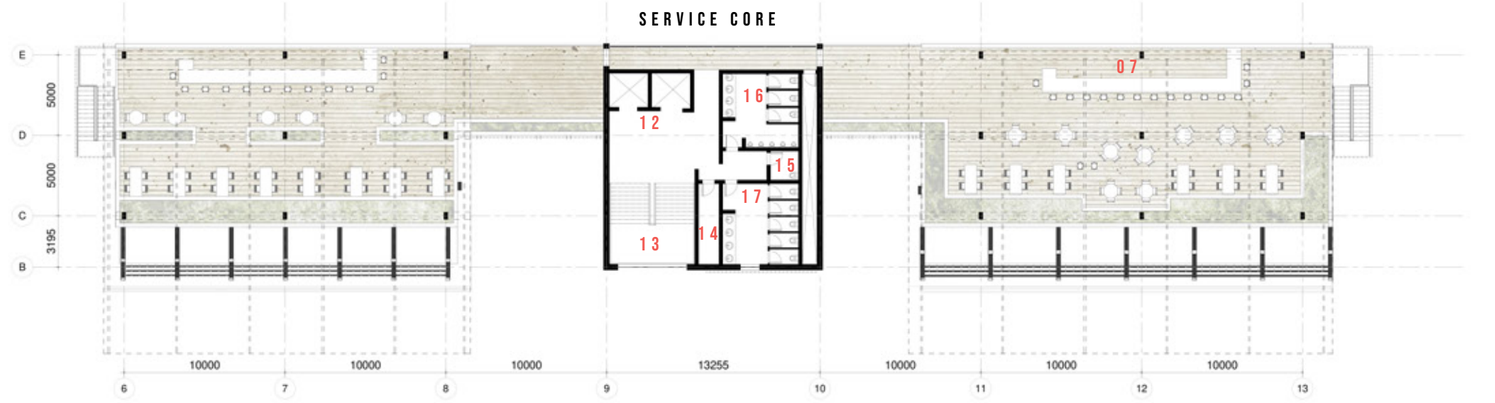
1 : 100



3 04 ROOFTOP
1 : 100

Key

Office Block

01 conference space
02 veranda
03 fire-escape
04 office/admin spaces
05 kitchen
06 storage
07 planted service walkway

Rooftop Skybar

08 rooftop Skybar
09 bar area
10 planters
11 seating area

Concrete Service Core

12 elevators
13 stairway
14 storage
15 disabled ablution
16 male ablutions
17 female ablutions

UPPER FLOOR PLANS

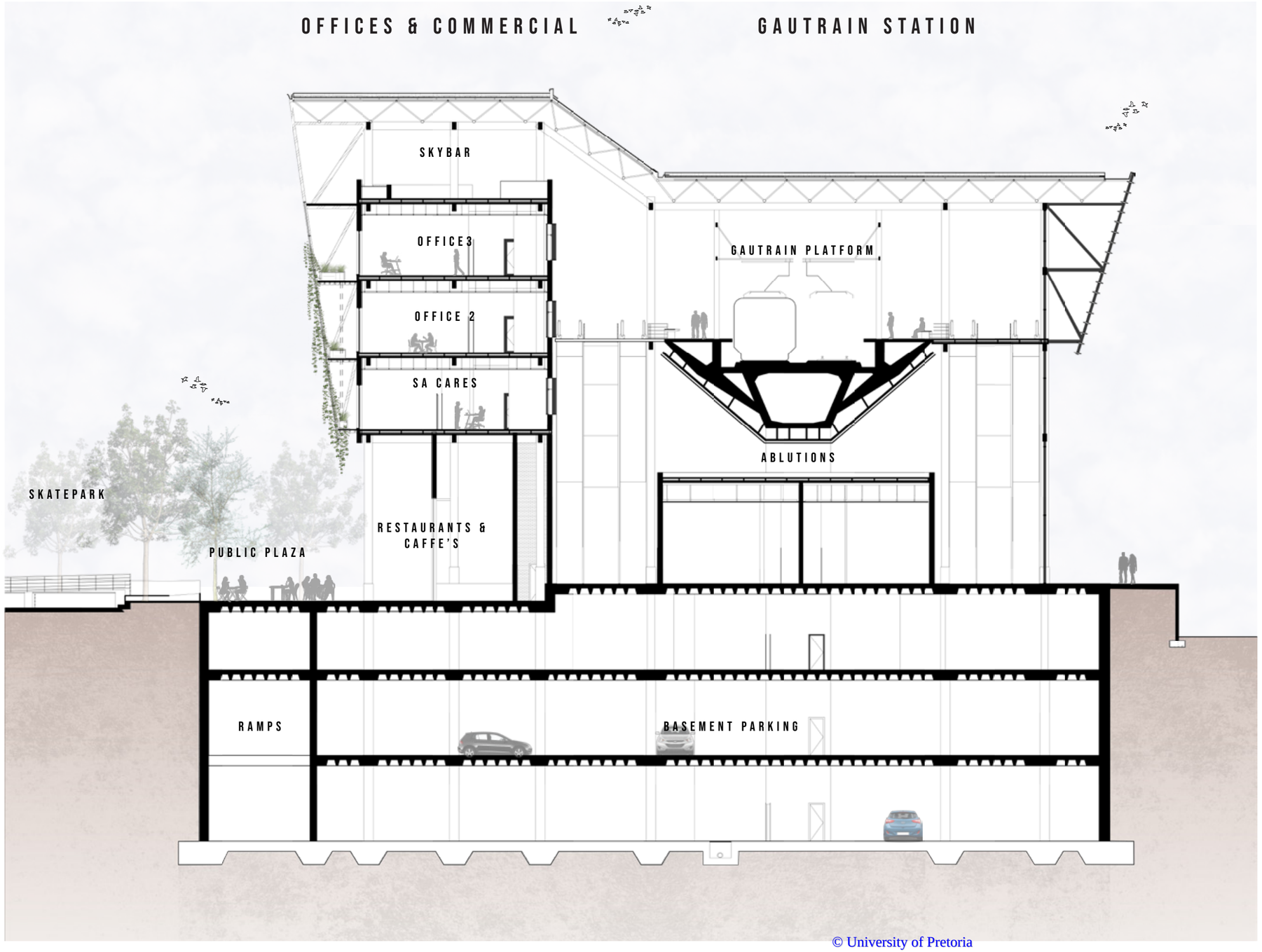
1:100 (A0)

ROOFTOP SKYBAR

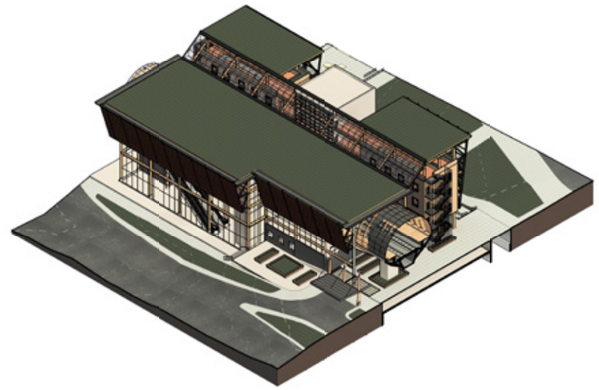
PERSPECTIVE FROM ROOFTOP

OFFICES & COMMERCIAL

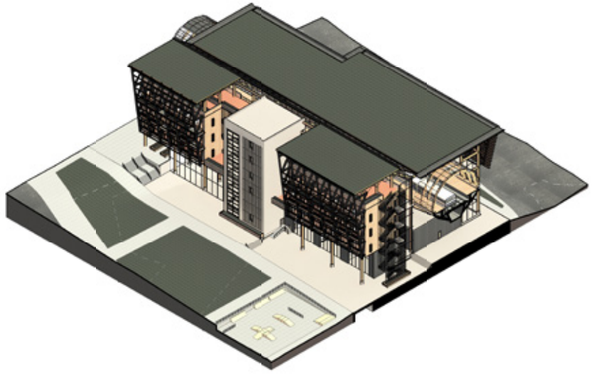
GAUTRAIN STATION

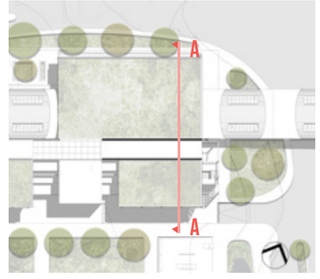


Gautrain Station, North Facade



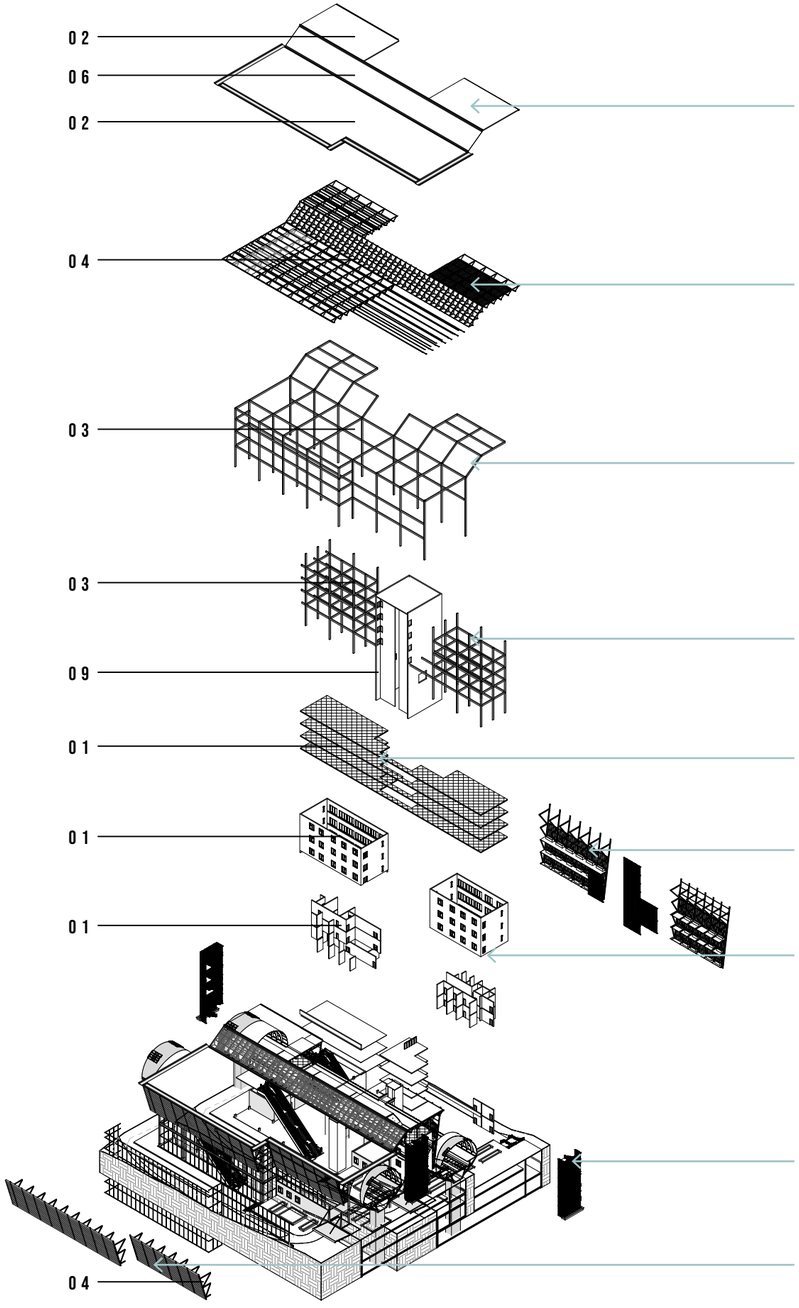
Gautrain Station, South Facade





Section A-A

1:50 [A0]



SECONDARY:
POLYCARBONATE & GREEN COMPOSITE ROOF

SECONDARY:
LIGHTWEIGHT STEEL SPACE FRAME ROOF STRUCTURE

PRIMARY:
GLULAM & LAMINATED VENEER LUMBER(LVL) SKELETAL STRUCTURE

PRIMARY:
COMPOSITE GLULAM, LVL & CONCRETE STRUCTURE

CROSS LAMINATED TIMBER FLOOR PANELS

TERTIARY:
RHS STEEL MEMBER GREEN FACADE

SECONDARY:
LOAD BEARING EXTERNAL CLT PANELS
CROSS LAMINATED TIMBER WALL PANELS

TERTIARY:
STEEL FIRE ESCAPE STAIRS

TERTIARY:
RHS STEEL MEMBER LOUVRED FACADE

GAUTRAIN STATION AXONOMETRIC

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

VERNACULAR RESPONSE

MATERIAL LOOP

REGENERATE LOOP

CLT WALLS & FLOORS

GREEN ROOFS

GLULAM & LVL

STEEL MEMBERS

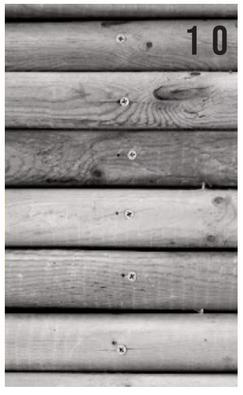
STEEL ROOF SHEETS

POLYCARBONATE

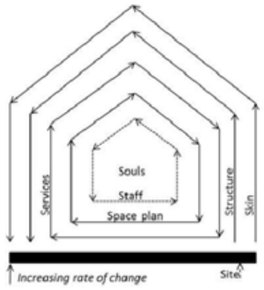
RAMMED EARTH

RECLAIMED BRICKS

CONCRETE

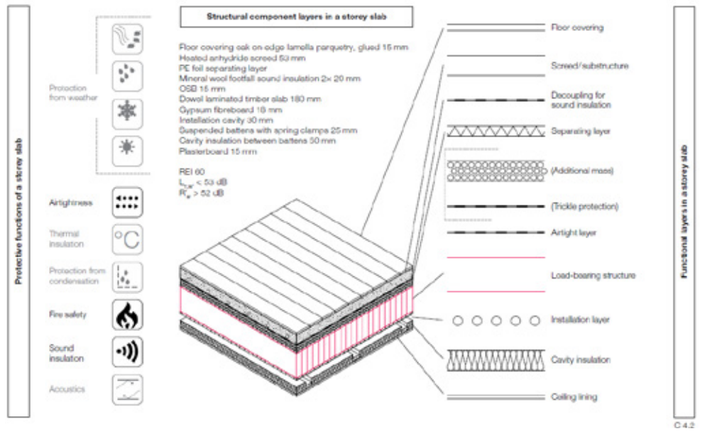


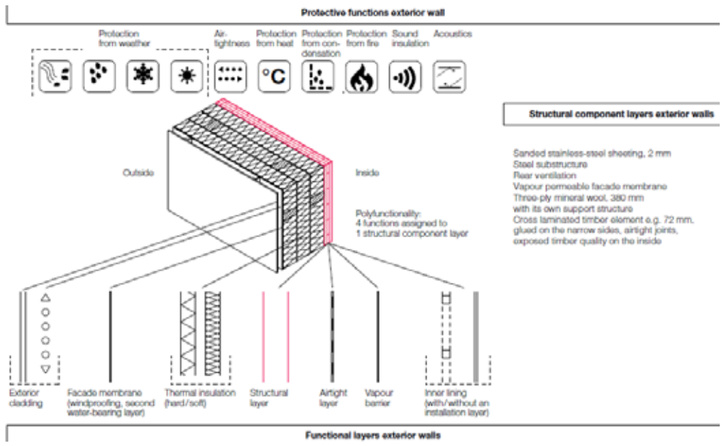
GUMPOLES



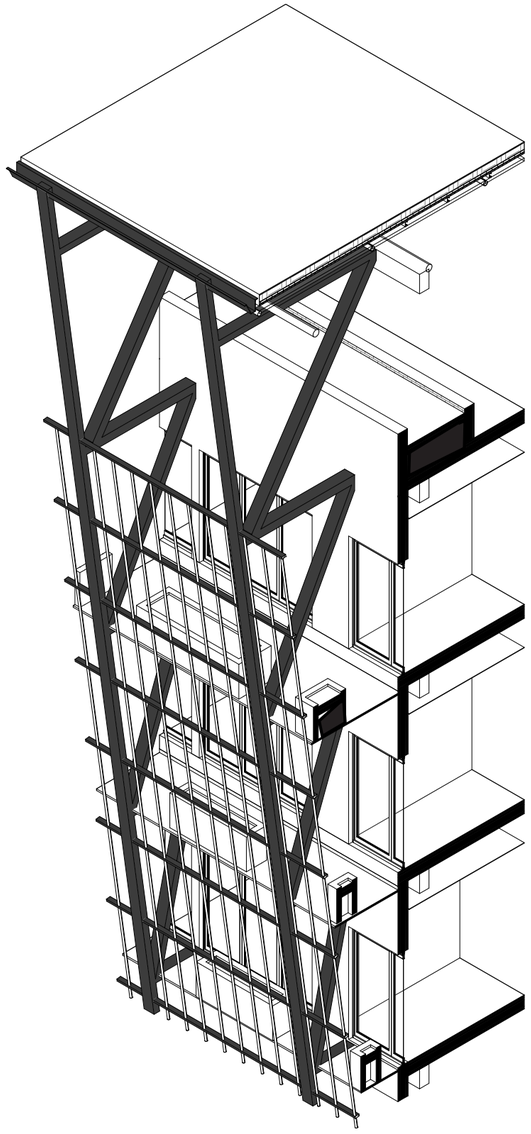
Shearing layers	Description	Typical lifespan/activity
Site	Location and context	Permanent
Structure	Bones	30-300 years
Skin	Envelope	20+ years
Services	Lifeblood	7-20 years
Space plan	Interior layout	3 years
Stuff	Furniture and equipment	Under 3 years
Souls	People	Daily

SHEARING LAYERS (BRAND 1994)



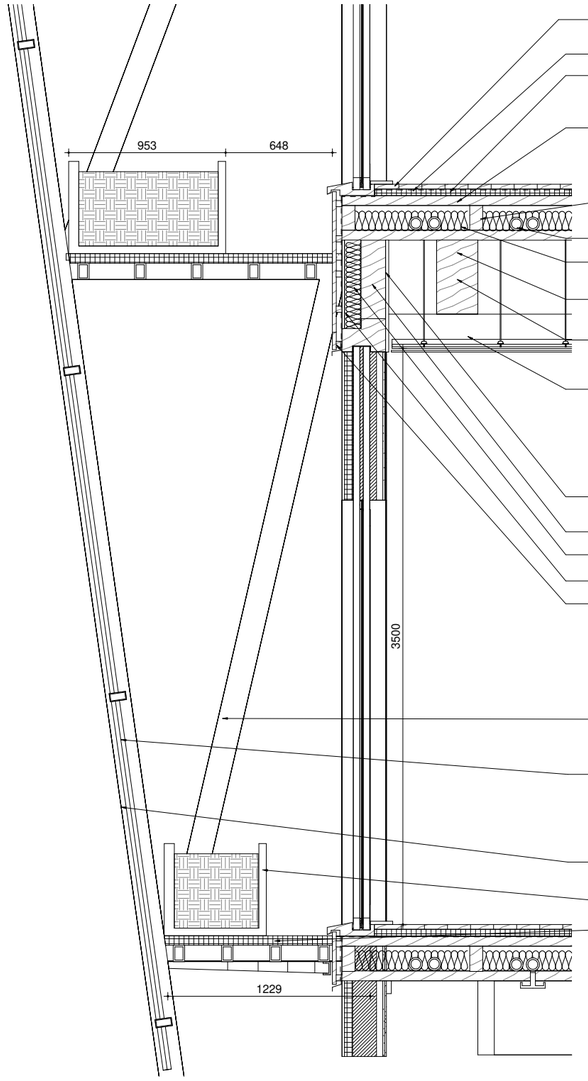


TYPICAL CLT SYSTEMS (KAUFFMAN 2018)



DETAIL 01 AXO

DETAIL 01



FLOOR ASSEMBLY

- 14mm Baltic Pine tongue and grove Hearteco reclaimed timber flooring
- 40mm 3M™ Sound Impact sound insulation
- 170 microns USB green 3 layer damp proof membrane with min 150mm overlaps
- 2 x (2100 x 2900 x 60mm) Novatop CLT floor panel system fixed to 2 (150 x 60mm) CLT ribs @ max 1200cc with 6mm Rothoblaas tek screws.
- CLT ribs @ max 1200cc with 6mm Rothoblaas tek screws.
- Services laid within cavity
- 120mm hempcrete insulation layed within cavity
- 20 x 20mm Meranti slats fixed with countersunk 6mm tek screws to soffit
- CLT flooring system resting on 325 x 225mm Saligna LVL beams fixed to glulam posts according to detail
- White 1220 x 2438mm mineral fibre OWA Acoustic ceiling panels suspended from CLT soffit with T-section and wire hangers to manuf. spec.

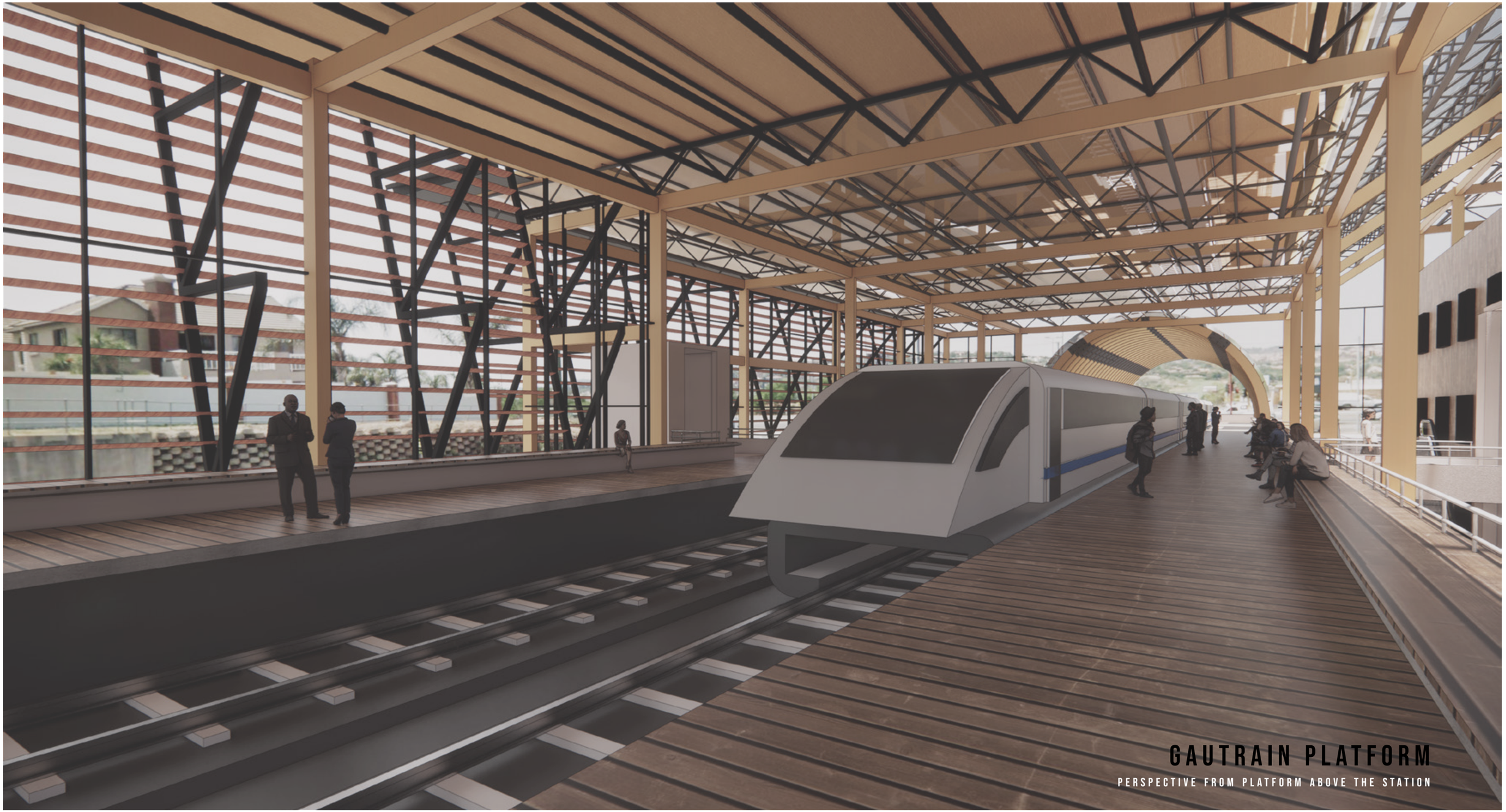
EXTERIOR WALL ASSEMBLY

- 9mm Nutek tongue and groove internal cladding panel
- 145mm CLT load bearing wall panel
- 90mm hempcrete insulation
- 12mm Gyprock Firestop Rhinoboard
- 22mm Baltic Pine tongue and grove Heart Eco reclaimed timber cladding fixed to 38 x 38mm timber spacers with 4mm tek screws

GREEN FACADE

- Matte black 150 x 100 x 5mm m/s RHS, primed and finished with two coats enamel paint @ 1200 c/c
- White plastic coated 8mm dia. galvanised steel tensile cable threaded through 100 x 50 x 5mm m/s RHS sections and fixed to ends according to manuf. specification
- Jasminum (Jasmin) creeper plant growing on tensile cable
- Planter Box
- 6 x 1200mm m/s checker plate flooring fixed to RHS structure

SOUTH FACADE CONSTRUCTION

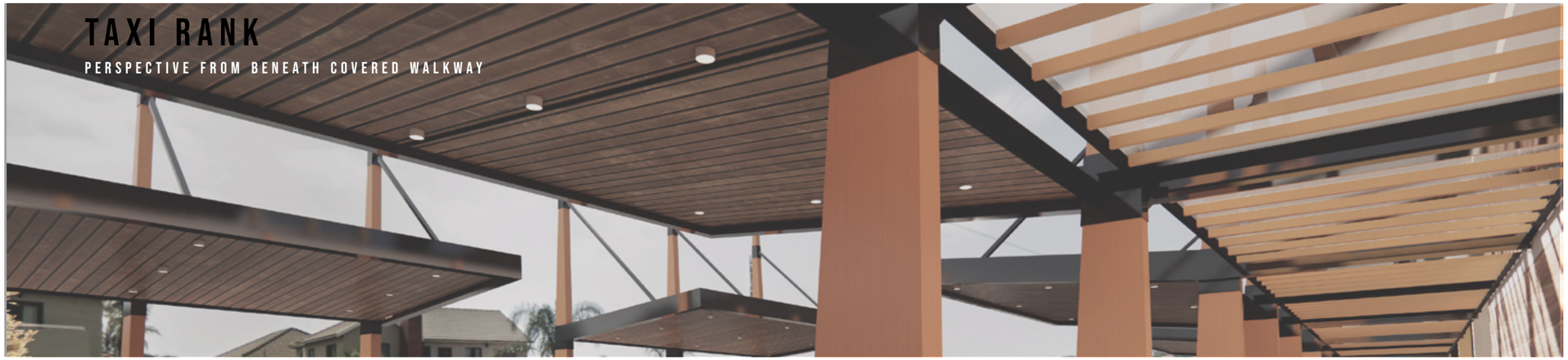


GAUTRAIN PLATFORM

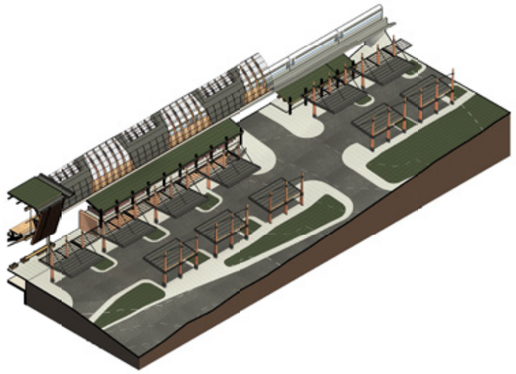
PERSPECTIVE FROM PLATFORM ABOVE THE STATION

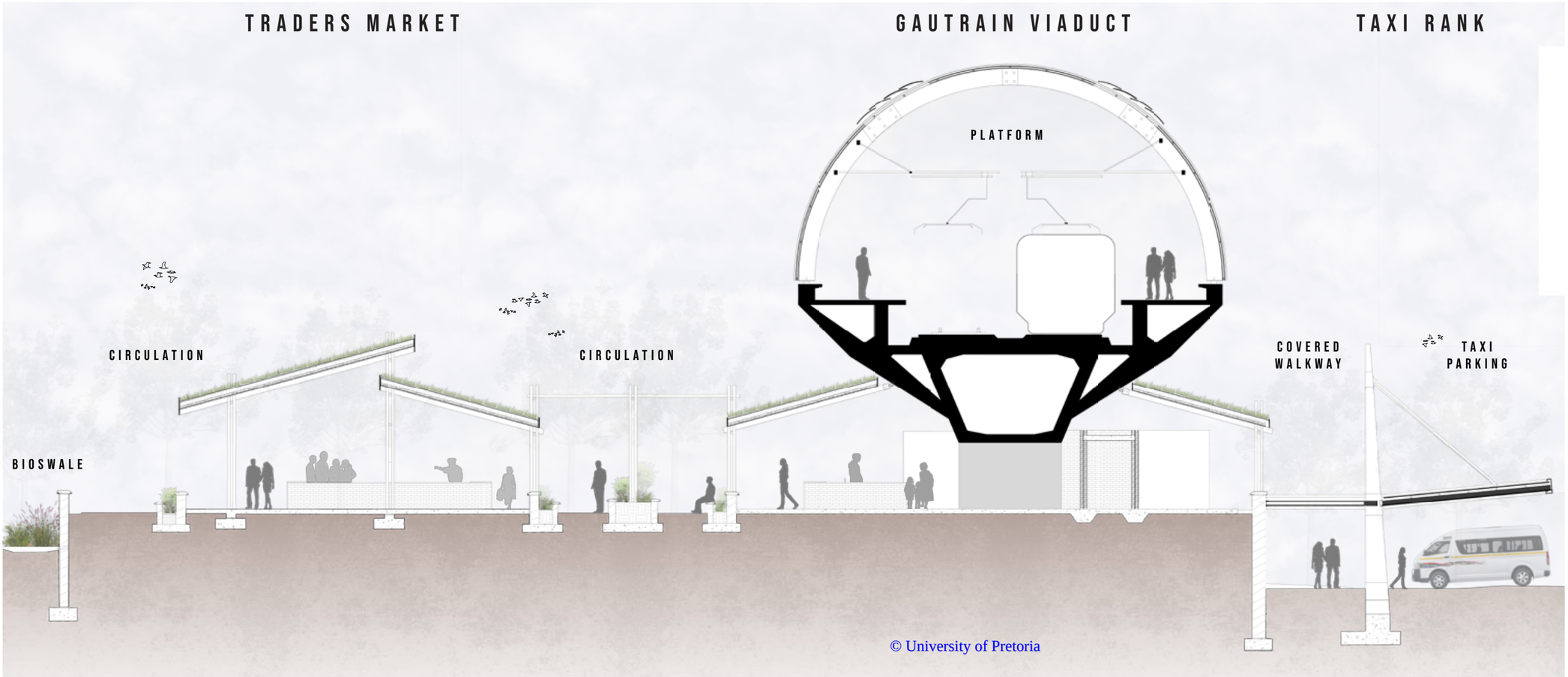
TAXI RANK

PERSPECTIVE FROM BENEATH COVERED WALKWAY

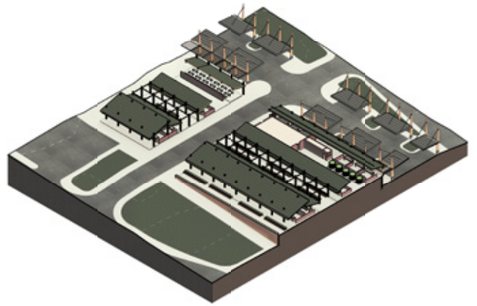


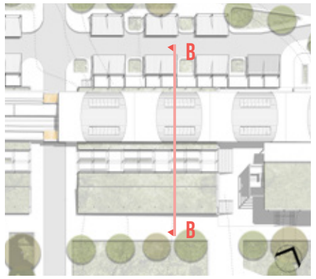
Axo-Taxi Rank





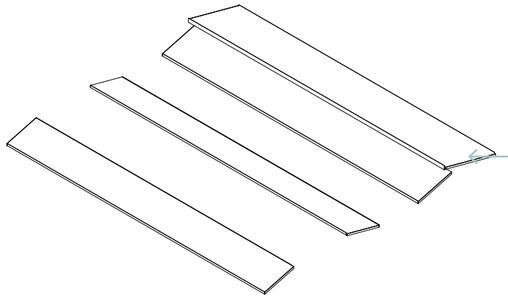
Traders Market



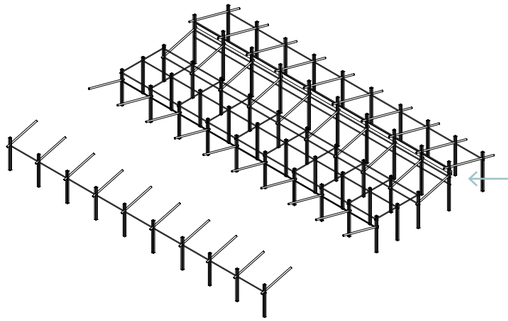


Section B-B

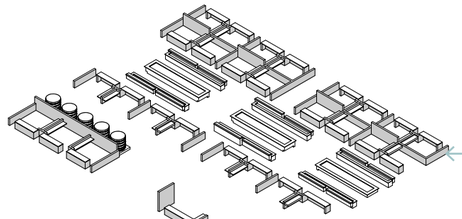
1:50 (A0)



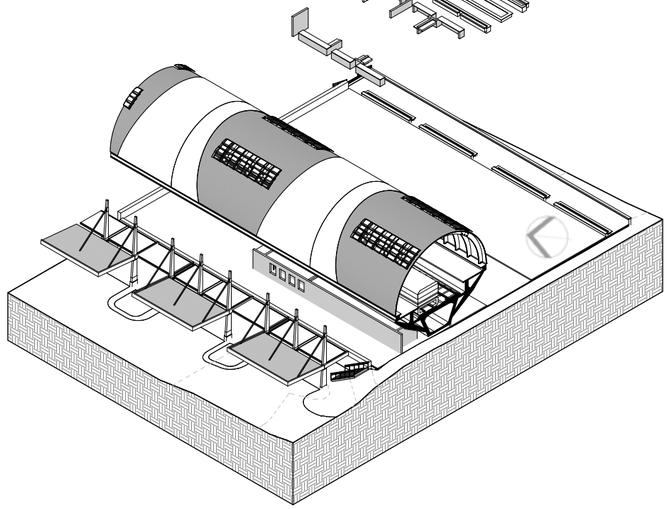
COMPOSITE GREEN ROOF STRUCTURE



PRIMARY:
CCA TREATED GUMPOLE STRUCTURE



RECLAIMED BRICK AND RAMMED EARTH WALLS



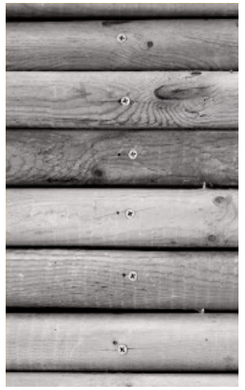
VERNACULAR RESPONSE

MATERIAL LOOP

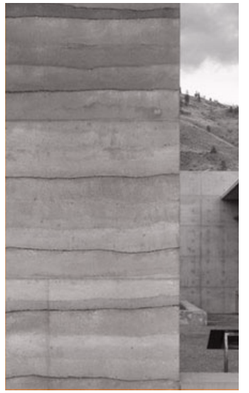
REGENERATE LOOP

CLT WALLS & FLOORS

GREEN ROOFS



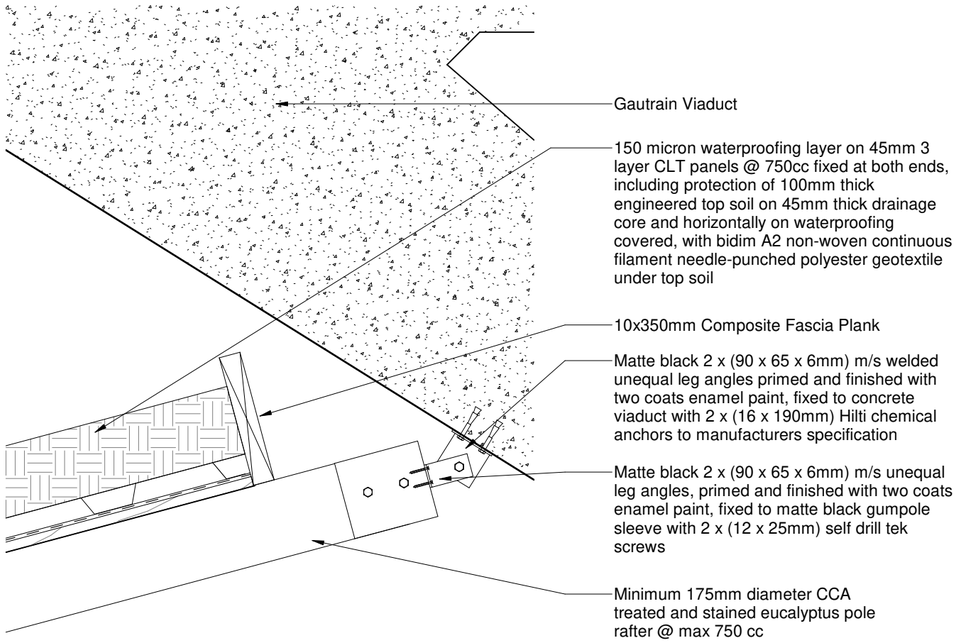
GUMPOLES



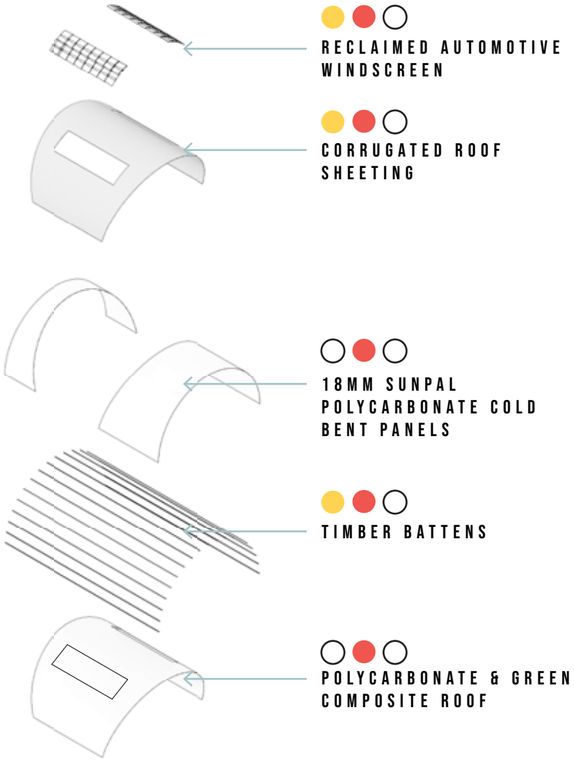
RAMMED EARTH

RECLAIMED BRICKS

Detail 04



Gumpole Roof to Gautrain Viaduct



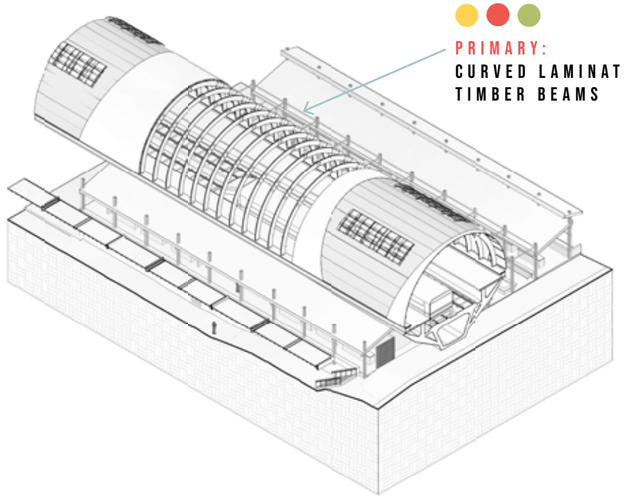
RECLAIMED AUTOMOTIVE WINDSCREEN

CORRUGATED ROOF SHEETING

18MM SUNPAL POLYCARBONATE COLD BENT PANELS

TIMBER BATTENS

POLYCARBONATE & GREEN COMPOSITE ROOF



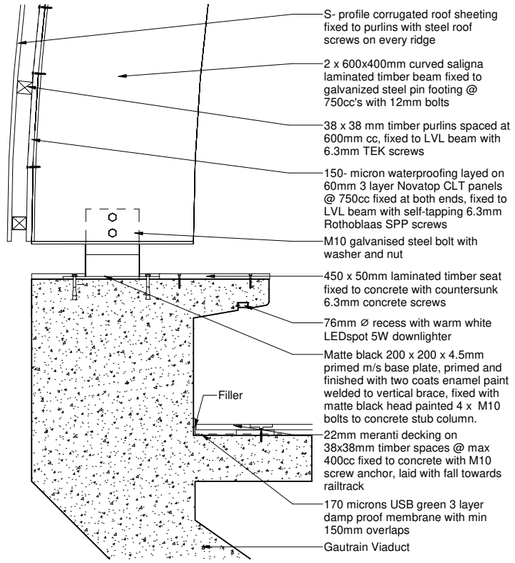
PRIMARY:
CURVED LAMINATED TIMBER BEAMS

VERNACULAR RESPONSE

MATERIAL LOOP

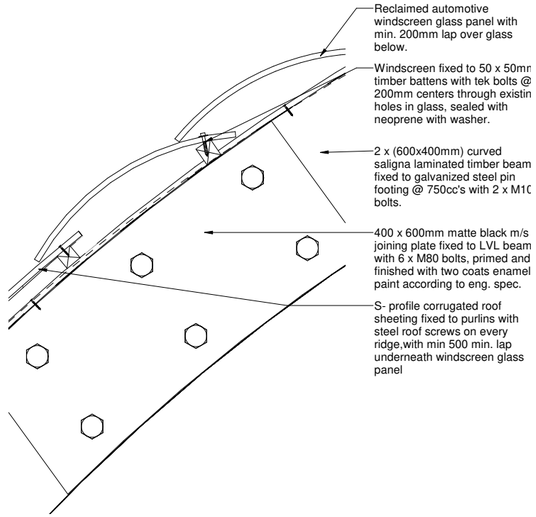
REGENERATE LOOP

DETAIL 06

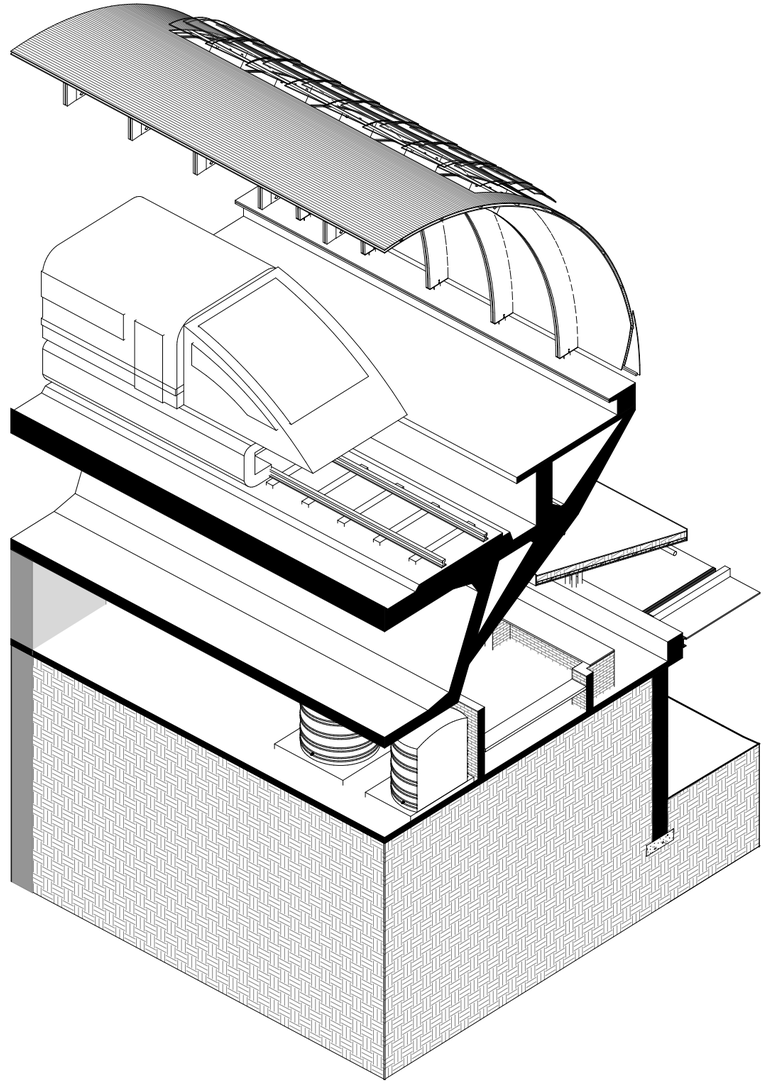


TUBE CANOPY BASE

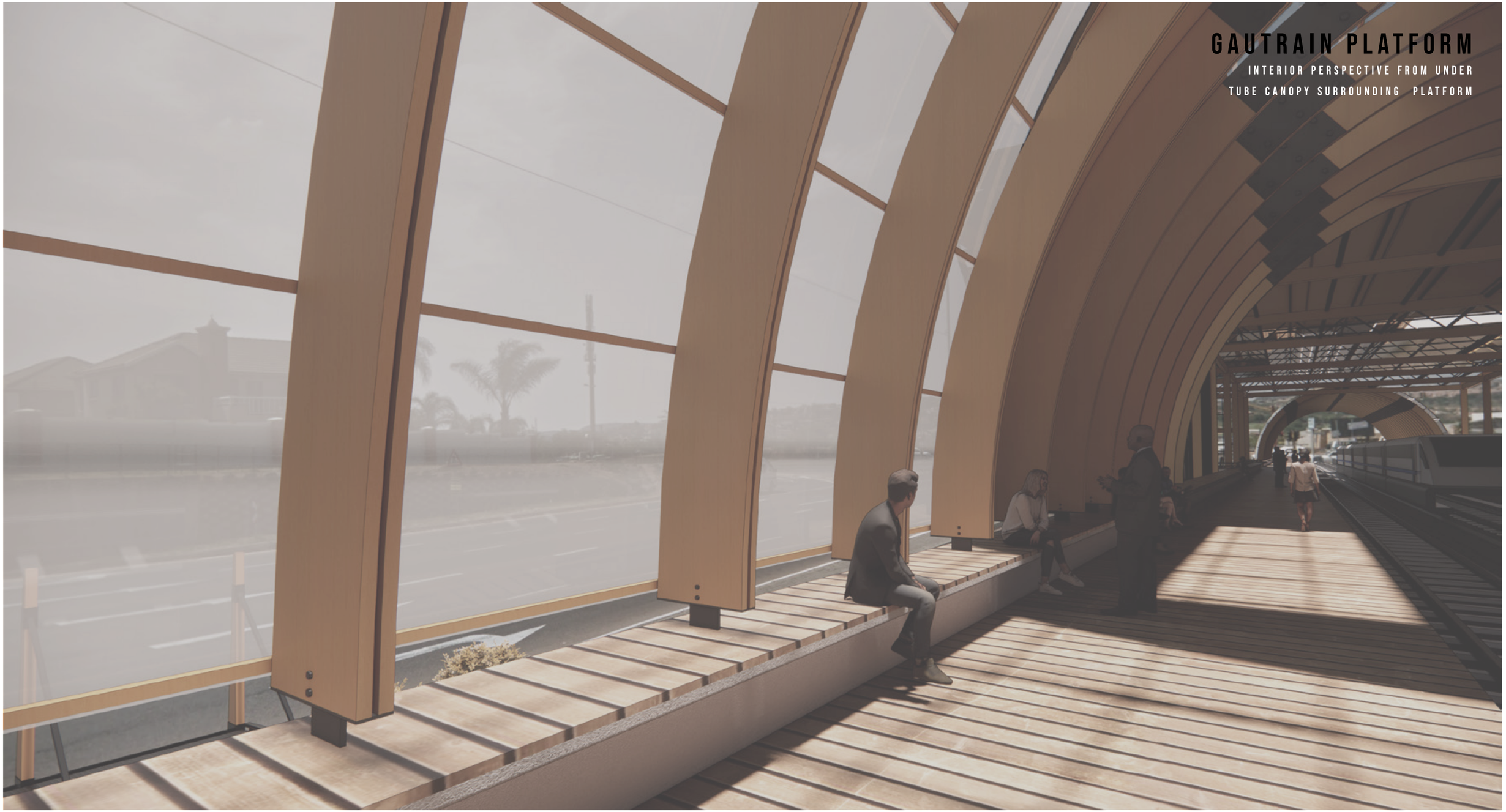
DETAIL 07



TUBE CANOPY RECLAIMED WINDSCREEN SKYLIGHT

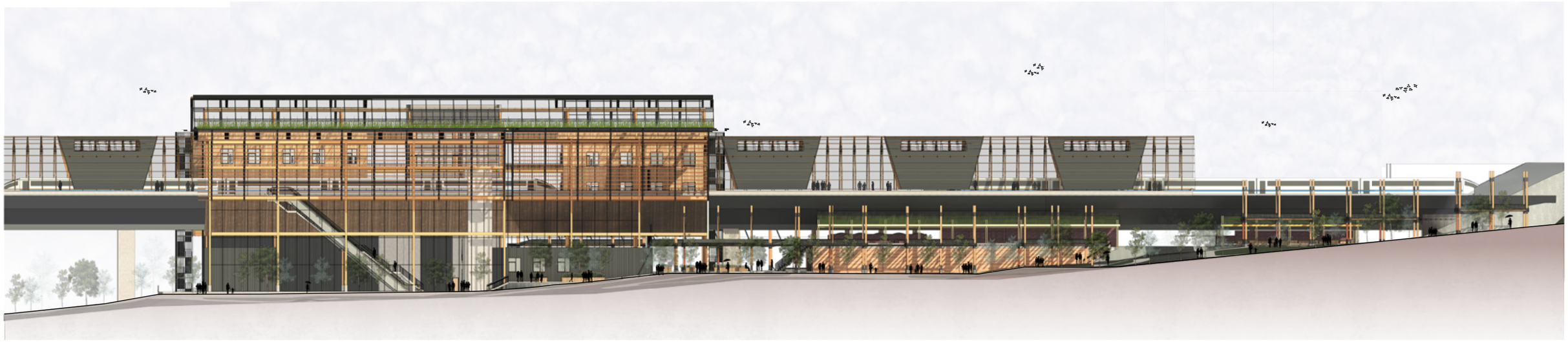


AXO - TUBE CANOPY



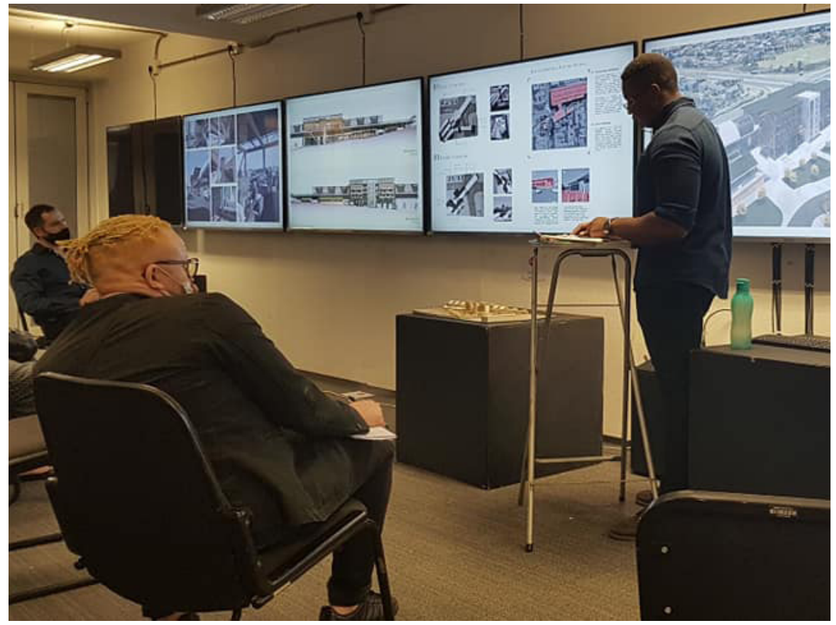
GAUTRAIN PLATFORM

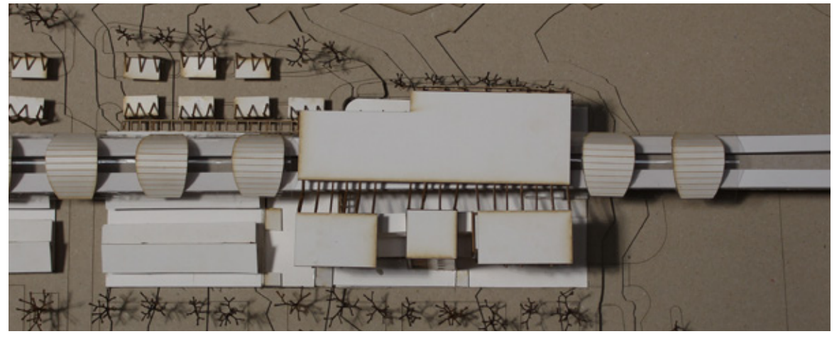
INTERIOR PERSPECTIVE FROM UNDER
TUBE CANOPY SURROUNDING PLATFORM



North Elevation
1:200 (A0)

South Elevation
1:200 (A0)





CONCLUSION

The architectural solution as a transit hub is proposed as a catalyst for exploring the interfaces between different connections. Whether architectural or as systems, these connections become the starting point of an enriched dialogue between supplier, client, and the designers extended involvement in the product's life-cycle. The scale to which the public infrastructure proposal is conceptualised maximises the potential of user engagement with the role of circularity in the built environment. The proposal forms a threshold into Moreleta Park with didactic qualities at varying scales, encouraging the union of a fragmented community within the provided servile public spaces. Achieving these aims was guided by the circularity framework.

The different scales of intervention respond to the diversity of stakeholders and users involved within the project. The interactions and activities between these diverse groups are envisioned as social, economic, and environmental capital generators. How this capital is cultivated spatially has been the designer's role in facilitating new collaborative links by magnifying the site's hidden potential.

7.4 Conclusion

Many parties are needed for a transition towards a circular economy. The uncovered role of the designer in this dialogue is facilitating the cooperation of different sectors and stakeholders to redesign architecture based on circular value chain models. Part of the problem in achieving this is the lack of interest in achieving circularity, primarily due to broader society not fully grasping its relevance or knowing how to achieve circularity. The circularity framework developed is preliminary in addressing this lack of education surrounding CE. The circularity framework for spatial designers is intended to begin a shift towards circularity within African cities. This shift, encouraged by this dissertation, is a necessary step for our species survival. A shift that demands in the following nine years, we follow bold, innovative and decisive action by industry and design professionals.

Figure 7.2: Process perspectives of the transit hub (Moreleta Station) (Author 2021).

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8.2 List of Figures

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8.3 Annexure

Water Calculations

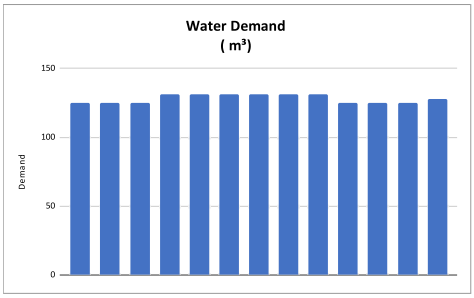
(01) Catchment Area	
Surface Area	**Area size (m²)**
Gautrain Station main roof	2830
Bus Stop	254
Taxi Rank Ports	978
Trader Stalls	812
External Floor	6935
Bio-retention basin	557
Permeable Paving	4280
Total Possible Catchment Area	16646
Runoff coefficient	0.9
Effective catchment area	**14981.4**

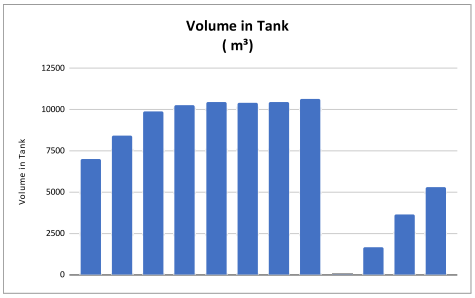
(02) Rainwater Yield		
Month	**Ave. rainfall, P(m)**	**Yield (m³) (Yield = PxAxC)**
January	0.12	1797.77
February	0.106	1588.03
March	0.091	1363.31
April	0.033	494.39
May	0.022	329.59
June	0.006	89.89
July	0.01	149.81
August	0.021	314.61
September	0.07	1048.7
October	0.12	1797.77
November	0.14	2097.39
December	0.12	1797.768
Annual Ave.	**0.072**	**1078.6608**

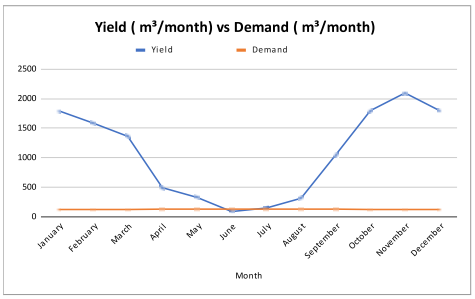
(03) Total Yield	
Month	**Yield (m³) (Yield = PxAxC)**
January	1797.77
February	1588.03
March	1363.31
April	494.39
May	329.59
June	89.89
July	149.81
August	314.61
September	1048.7
October	1797.77
November	2097.39
December	1797.768
Annual Total	**12869.028**

(05) Building & Site Water Consumption						
Fixture	**Quantity**	**Usage (litre)**	**Times used per day (per fixture)**	**Total Daily (Litres)**	**Daily 1000 Litres (m³)**	**Monthly (30.5 days) 1000 Litres (m³)**
Toilet	59	7.5	5	2212.5	2.21	67.41
Handwash basins	50	1	3	150	0.15	4.57
Minibus Washing	35	100	0.15	525	0.53	16.17
Showers	6	40	2	480	0.48	14.4
			Subtotal	3367.5	3.37	102.55

(05) Irrigation Consumption				
Season	**Area**	**Coefficient**		**Monthly (30.5 days) 1000 Litres (m³)**
Summer	5834	0.125	30.5	22.24
Winter	5834	0.16	30.5	28.47
			Subtotal	50.71





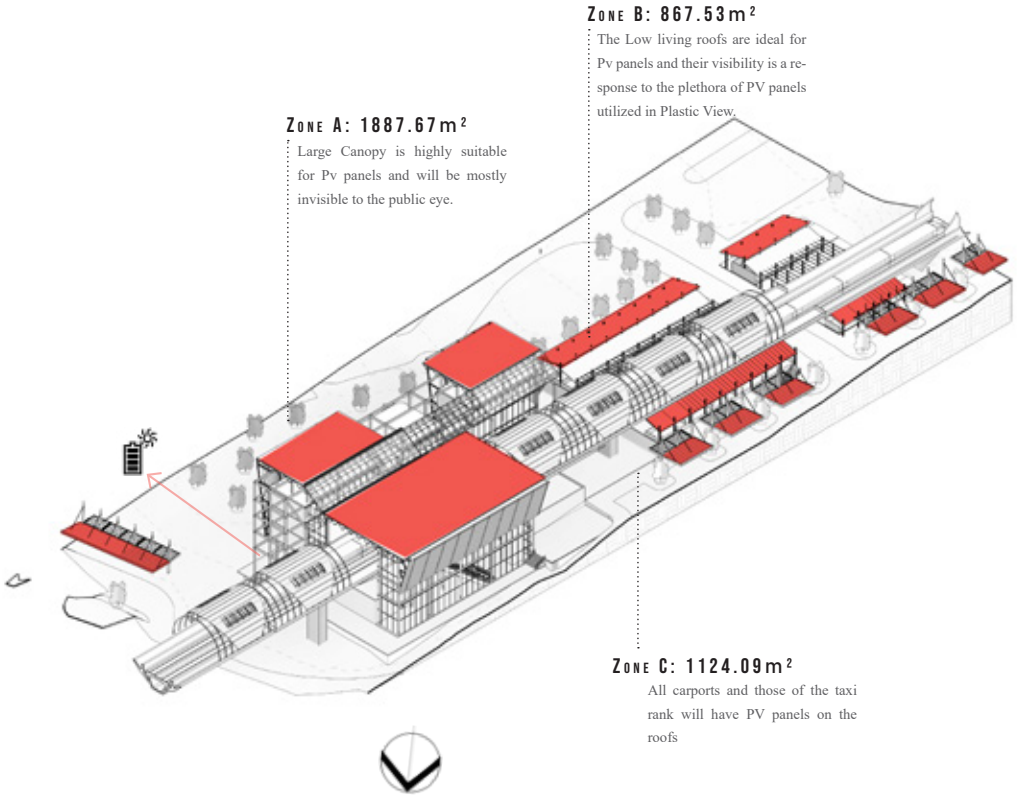


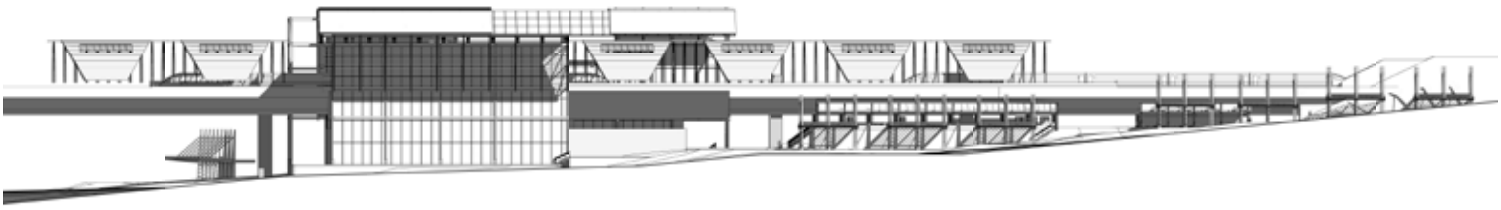
(06) Water Budget (Accumulative)				
Month	**Yield (m³/month)**	**Demand (m³/month)**	**Monthly Balance (m³)**	**Volume in Tank (m³)**
January	1797.77	1247.79	550.0	2499.6
February	1588.03	1247.79	340.2	2839.8
March	1363.31	1247.79	115.5	2955.3
April	494.39	131.02	363.4	3318.7
May	329.59	131.02	198.6	3517.3
June	89.89	131.02	-41.1	3476.2
July	149.81	131.02	18.8	3495
August	314.61	131.02	183.6	3678.6
September	1048.7	131.02	917.7	0
October	1797.77	1247.79	550.0	550.0
November	2097.39	1247.79	849.6	1399.6
December	1797.768	1247.79	550.0	1949.6
Annual Average	1072.419	689.405	383.014	

Solar Harvesting Calculations

(01) Solar System Calculations							
Zone	**Roof Area size (m²)**	**Monthly Energy Usage (kWh/ m²)**	**Sun hours for PTA (hrs)**	**Solar Panel Capacity (kWh)**	**Daily Capacity (kWh/30) / 5.5**	**Quantity of Panels Req.**	**Invertor needed (kW)**
Zone A: Gautrain Station	1887.67	131 808	5.5	335.0	798	6234	800
Zone B: Market Spaces	867.53	23 944	5.5	335.0	145	1132	150
Zone C: Taxi Rank & Bus Stop	1124.09	13 488	5.5	335.0	82	640	85
					Subtotal	**8006**	

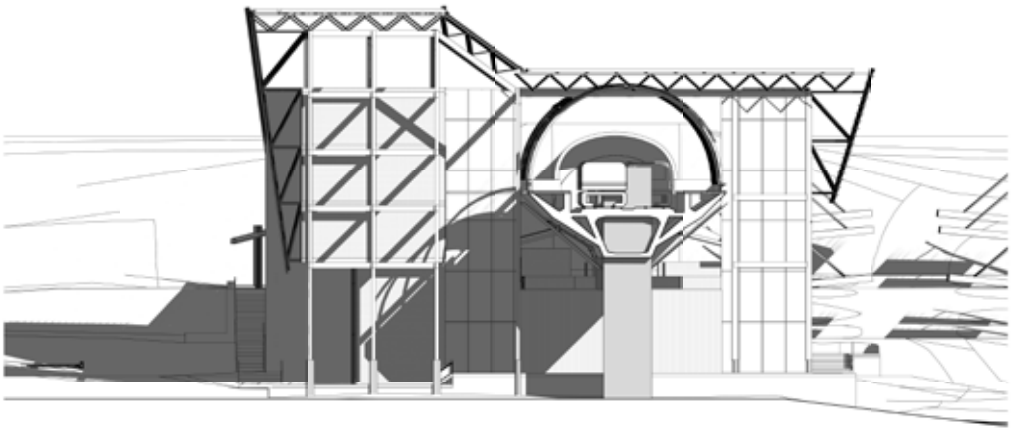
(02) Estimated Energy demand			
Zone	**Floor Area size (m²)**	**Benchmark Energy Usage (kWh/ m²)**	**Monthly Usage (kWh)**
Zone A: Gautrain Station	5492	240.00	131 808
Zone B: Market Spaces	1260	190	23 944
Zone C:Taxi Rank & Bus Stop	1124	120.00	13 488
		Subtotal	**169 240**



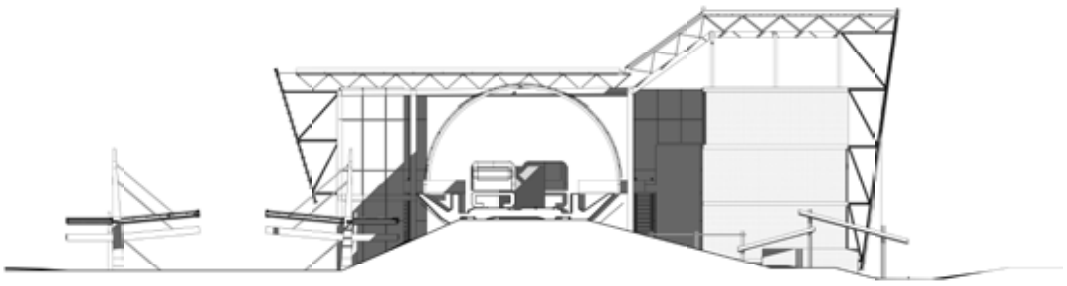


1 | **North**
1 : 500

2 | **South**
1 : 500

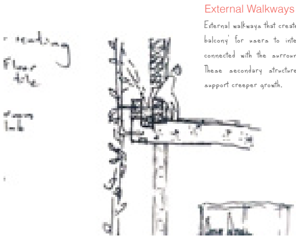


1 | **East**
1 : 200



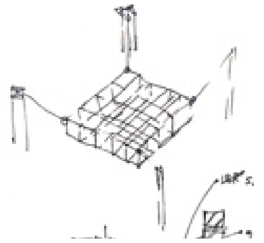
2 | **West**
1 : 200

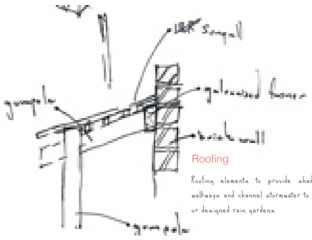
ELEVATIONS (NTS)



External Walkways

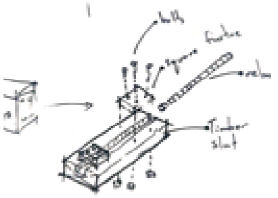
External walkways that create a 'communal balcony' for users to interact and be connected with the surrounding context. These secondary structures can then support creeper growth.

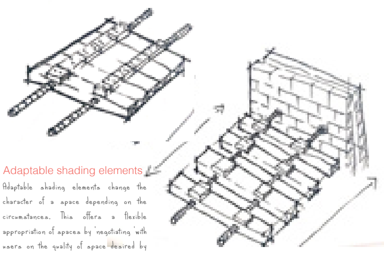




Roofing

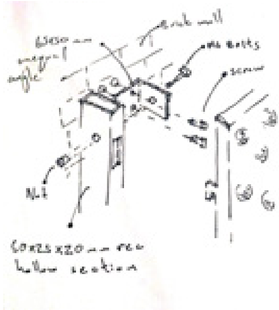
Roofing elements to provide shading of walkways and channel stormwater to gutters or designed rain gardens

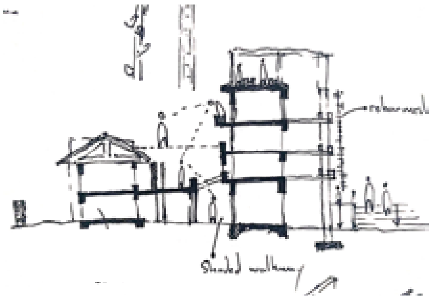


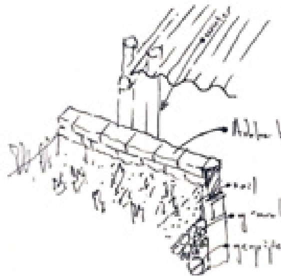


Adaptable shading elements

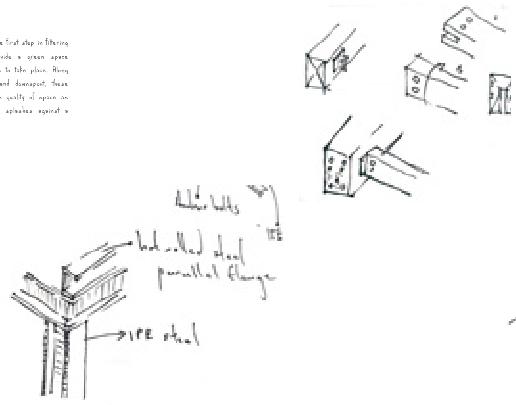
Adaptable shading elements change the character of a space depending on the circumstances. This offers a flexible appropriation of spaces by 'negotiating 'with users on the quality of space desired by the inhabitants.

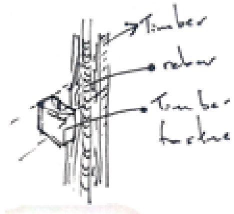


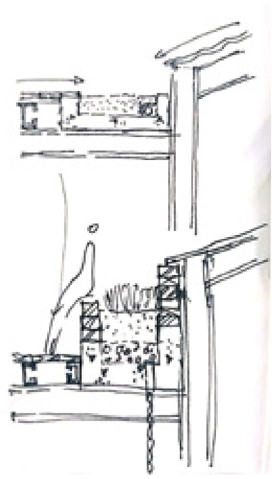


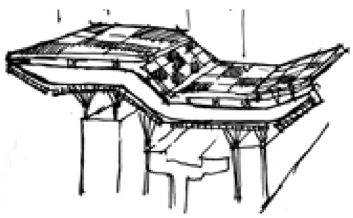


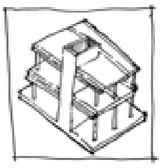
Rain gardens offer the first step in filtering stormwater and provide a green space for urban agriculture to take place. Along with a rain chain and downspout, these can contribute to the quality of space as rainwater drips and splashes against a gravel splash layer.

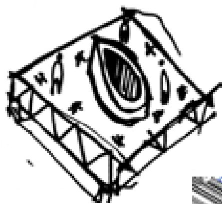


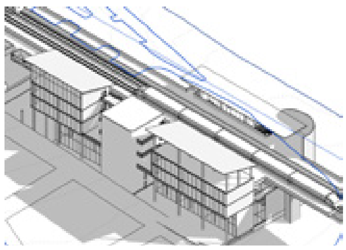


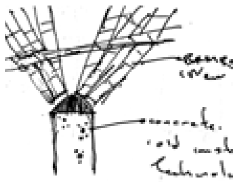


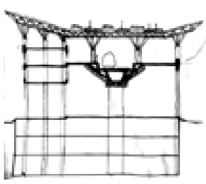


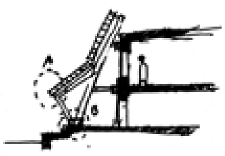


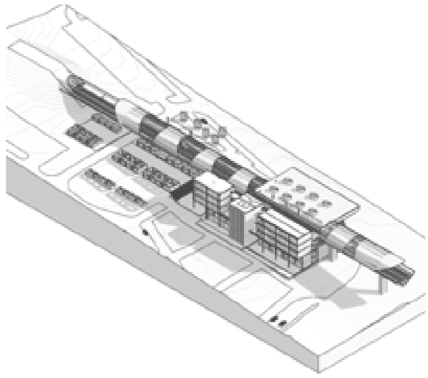












DETAIL EXPLORATIONS (NTS)

Conditional Ethics Approval

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

9 June 2021

Reference number: EBIT/79/2021

Ms A van Aswegen
Department: Architecture
University of Pretoria
Pretoria
0083

Dear Ms A van Aswegen

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Research Ethics Committee refers.

Conditional approval is granted.

This means that the research project entitled "Masters Professional Mini-Dissertation in Architecture, Landscape Architecture and Interior Architecture (Group / Blanket)" is approved under the strict conditions indicated below. If these conditions are not met, approval is withdrawn automatically.

Conditions for approval
This application is approved based on the summaries provided.
Applications from each student (including application forms and all necessary supporting documents such as questionnaire/interview questions, permission letters, informed consent form, etc) will need to be checked internally by the course coordinator/ supervisor. A checklist will need to be signed off after the checking.
All of the above will need to be archived in the department and at the end of the course a flash disc / CD clearly marked with the course code and the protocol number of this application will be required to be provided to EBIT REC administrator.
No data to be collected without first obtaining permission letters. The permission letter from the organisation(s) must be signed by an authorized person and the name of the organisation(s) cannot be disclosed without consent.
Where students want to collect demographic the necessary motivation is in place.

This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Code of Ethics for Scholarly Activities of the University of Pretoria, or the Policy and Procedures for Responsible Research of the University of Pretoria. These documents are available on the website of the EBIT Ethics Committee.

If action is taken beyond the approved application, approval is withdrawn automatically.

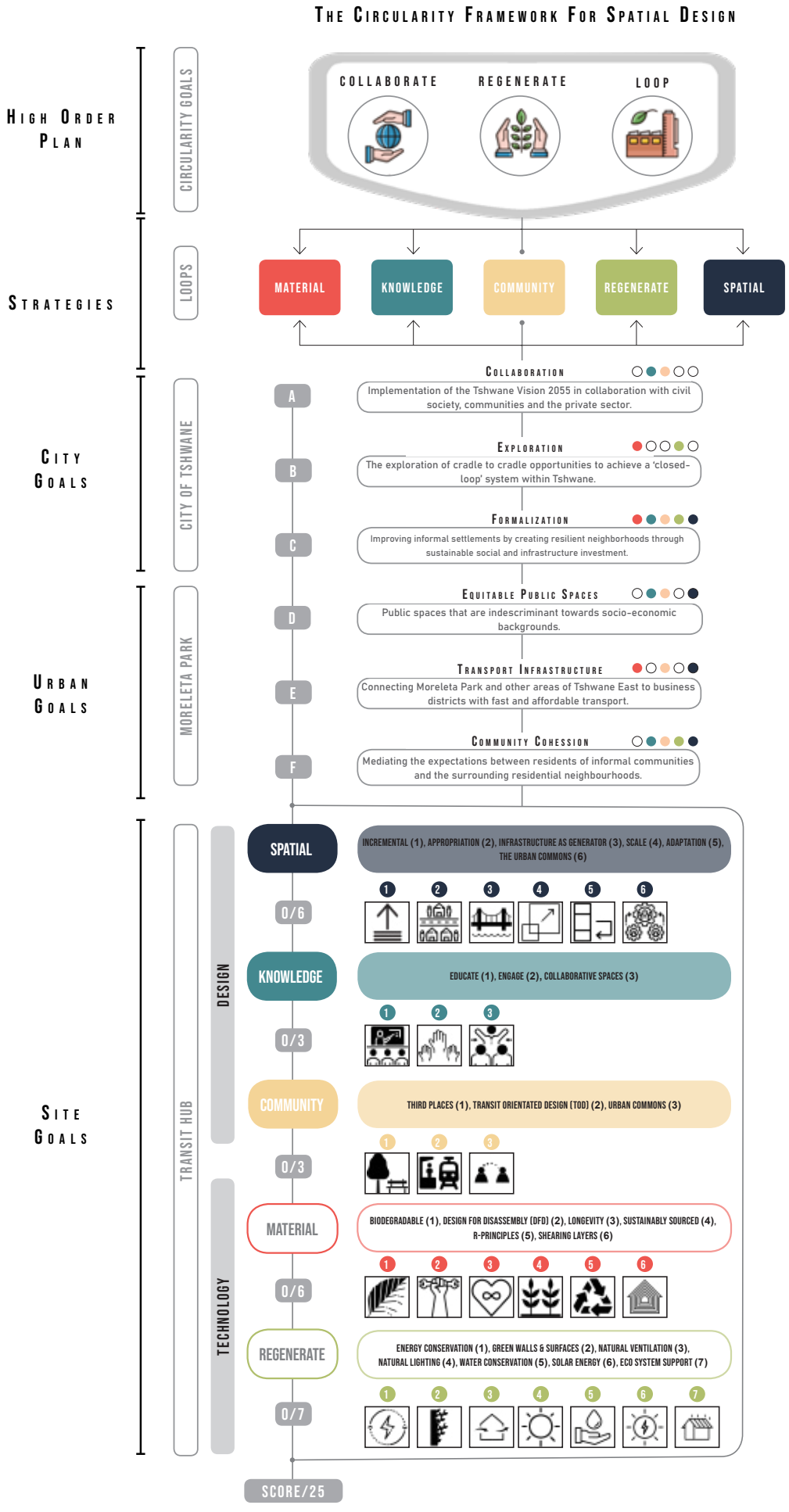
According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of the EBIT Research Ethics Office.

The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

Prof K.-Y. Chan
Chair: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

The Circularity Framework for Spatial Designers



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SBAT Report

SB SBAT REPORT	Achieved 4,4

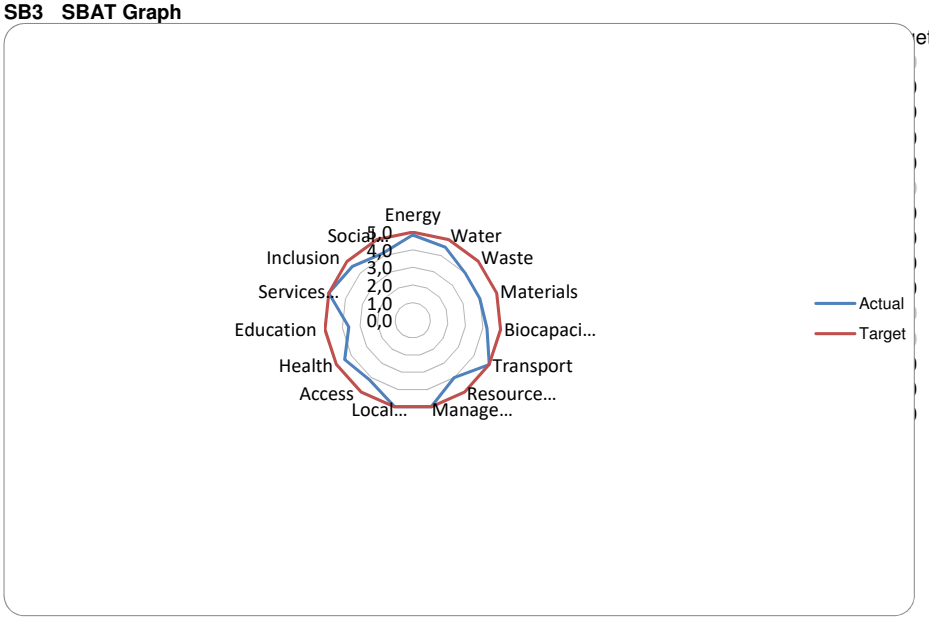
SB1 Project

0

SB2 Address

0

SB3 SBAT Graph



SB4 Environmental, Social and Economic Performance	Score
Environmental	4,3
Economic	4,6
Social	4,4
SBAT Rating	4,4

SB5 EF and HDI Factors	Score
EF Factor	4,4
HDI Factor	4,4

SB6 Targets	Percentage
Environmental	86
Economic	93
Social	87

SB7 Self Assessment: Information supplied and and confirmed by

Name	Date
Signature	

SB8 Validation: Documentation validated by

Name	Date
Signature	

SB9 Validation Report Version

IVR

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Ethics Application: Questions

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ETHICS APPLICATION: DEPARTMENT OF ARCHITECTURE
URBAN CITIZEN STUDIOS
PUBLIC INTEREST DESIGN IN SOUTH AFRICA
APPENDIX A

SECTION A: URBAN CITIZEN STUDIOS

Observation and physical mapping:

1. Social networks & nodal points of energy
2. Building fabric density and typology
3. Position, size and impact of Institutions of learning, churches, health facilities
4. Prevalence and reach of NGO's
5. Street, sidewalks and public accessibility
6. Security: Tangible and intangible systems
7. Retail stratification: Informal trade, SSME's, franchises, large retail outlets, central markets, food distribution networks
8. Densification, infill and anchoring strategies to redefine, revitalise and support distressed and isolated urban neighbourhoods
9. Intersection of formal and informal sectors as it relates to shelter, health, commerce and cultural activities
10. Opportunities for the production and processing of food (Food sovereignty)
11. Access to potable water, sanitation, electricity
12. Condition and functionality of soft and hard infrastructure
13. The role of green infrastructure in shaping environments: biodiversity, water management and harvesting, climatic conditions

Open interview/ focus group questions in support of observations and mapping:

1. Spatial perception questions:
    a. Do you visit this part of the city regularly?
    b. What are reasons for you to come to this area?
    c. How do you feel about the city of Tshwane in general? Please elaborate
    d. What activities do you typically enjoy to partake in general? Why?
    e. Please describe the quality of the amenities you use; School, church, sport, shopping, clinic: eg. Well maintained, poor condition, easy to use, safe, scary?
    f. What are your impressions of this space?
    g. Have you noticed changes to this space over time? Please explain

department of architecture
ARCHITECTURE • INTERIOR ARCHITECTURE • LANDSCAPE ARCHITECTURE

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ETHICS APPLICATION: DEPARTMENT OF ARCHITECTURE
URBAN CITIZEN STUDIOS
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APPENDIX A

h. On a scale of 1 to 10 how will you rate these spaces? Please explain why you say so
i. Which qualities of the space do you find pleasant? Why?
j. Which qualities do you not enjoy/ would you like to change? Why?
k. Do these spaces remind you of anything specific? Please elaborate
l. Which features stand out for you? Please describe them
m. Do you feel safe in this space? Explain
n. Do you enjoy this space? Explain

2. Transport related questions:
   a. Please describe the route between your home and amenities: School, church, sport, shopping, clinic
   b. Please describe the route you travel between home and work.
   c. Please describe the type of transport you use: How far (how many hours) do you walk every day/ bicycle/ car/ bus/ train?
3. Social network-related questions:
   a. Please describe the groups you are connected to and how often you meet, such as: family; school (friends and parents); sport clubs; church; savings groups; support groups; residents' committees; NGO's or NPO's; arts & crafts groups; any other?
   b. Please explain your use of the internet: Do you use your cellphone or computer? How many hours a day are you connected? How do you acquire data?
   c. Where do you prefer to do your shopping for food/ clothes/ furniture/ electronics? Please explain why you choose these places?
4. Expenditure related questions:
   a. How do you manage your monthly income? What are the things that you spend your money on and what do you do when you run short?
   b. Do you own your home/ pay rent/ informal dweller?
5. In the case of home-run businesses:
   a. Do you conduct any type of business from your home? How did you decide to choose this type of business?

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Application For Approval of Research Project

For office use only	
Assigned EBIT tracking number	EBIT/ /
Date received	

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FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

(EBIT Ethics Committee)

APPLICATION FOR APPROVAL OF A RESEARCH PROJECT

This application form must be read with the relevant UP regulations, as documented in the Code of Ethics for Scholarly Activities, and the Policy and Procedures for Responsible Research. By completing and submitting this form, you declare that you have read these two documents and understand the regulations.

Important: Each item must be completed.

Complete the form in your word processor. Forms completed in handwriting are not accepted.

Where applicable, underline the correct answer (e.g. Yes or No).

1. RESEARCHER DETAILS: (Please include your Supervisor details in this section if you are a student)

Applicant details:		**University of Pretoria supervisor details:**	
Initials and surname:	C Combrinck	Initials and surname:	C Combrinck
Title:	Dr	Title:	Dr
Email:	Carin.Combrinck@up.ac.za	Email:	Carin.Combrinck@up.ac.za
Phone:	012 420 6536	Phone:	012 420 6536
Employee/student number:	05075718	Employee number:	05075718
Department:	Architecture	Department:	Architecture
Are you a student (yes or no):	No		No

2. RESEARCH PROJECT TITLE (use a descriptive title)

Urban Citizen Studios: Public Interest Design in South Africa

3. RESEARCH PROJECT DETAILS

3.1 Provide a complete but concise description (no more than 5000 characters, including spaces) of the study objectives and study design, so that the relevant ethical aspects can be identified.

- From this, please identify the aspects clearly that you believe require ethics clearance.
- Please note: do NOT submit a complete research proposal. The Ethics Committee will not consider this, but will only consider the documents required for submission of an application.

The Urban Citizen Studios are situated in the Honours (NQF Level 8) and Masters (NQF level 9) level of the UP Department of Architecture. A requirement of these studios is for the students to engage with specific networks of communities that have an established relationship with the department that has existed for more than five years in the Mamelodi East area as well as Moreleta Park as part of their introduction into the field of Public Interest Design. Following on the successful conclusion of the NRF/STINT project *"Stitching the City: From Micro data to Macro views"*, a methodological framework was developed for the collection, management and sharing of data that may continue to inform work done in these studios. This methodology is reliant on face-to-face and on-line engagement with a variety of stakeholders, that includes the following research instruments: Unstructured interviews; Workshops; Transect Walks; Surveys; Visual Journals; Observation. Data is then captured on platforms such as: Maptionnaire; Kobo Toolbox; Aerial or drone imagery; GIS and archives.

From this data, students are expected to develop Community Action Plans in collaboration with the stakeholders, followed by CoDesign processes that may include the physical implementation of prototypes. In support of these studios, students will also participate in the project documenting Public Interest Design in South Africa. The project proposes the cinematic documentation of selected architectural interventions in South Africa since 1994 that represent a paradigm shift towards Public Interest Design. In reference to Kim's (2018) Conceptual Taxonomy, nine episodes are proposed, in which the following themes will be used to categorise the work:

- Design as Political Activism
- Open-source Design
- Advocacy Design
- Social Construction
- Collective Capability
- Participatory Action Research and Practice
- Grassroots Design Practice
- Pro Bono Design Services
- Architect-Facilitator

Interviews with the architects and project team members, clients and affected communities are proposed, with specific attention to the processes that governed the inception, implementation and consequence of the interventions. Documentation of the contextual circumstances and tangible quality of these interventions will be undertaken by students enrolled for their professional Honours and Masters degrees in Architecture, Landscape and Interior Architecture, in collaboration with a professional team of documentary film-makers. Interviews with architects that have undertaken significant projects in other parts of Africa will be included to contextualise progress in the discourse on a continental level.

Why is this important? Despite the radical political transformation promised in the democratic elections of 1994, the people of South Africa remain adversely affected by the socio-spatial legacies of a segregated urban landscape. The contributions by architects to address these challenges go largely unnoticed and remain marginalised, even within the mainstream profession. The purpose of this project is to bring to the fore the significant and important work that has been done in this space, which may be seen as establishing a basis for the promotion of Public Interest Design as a legitimate and potentially mainstream pursuit of the architectural profession in this country.

The objective is to document projects that have been implemented in South Africa since 1994, to foreground the value of an emphasis on Public Interest Design, thereby establishing a sound platform for including this in mainstream architectural education and praxis. The series of documentary films will explore and illustrate how these projects were undertaken and how they have impacted on their communities over time.

3.2 Will a research questionnaire/survey be used? • If Yes, please answer the next question. If No, ignore the next question.	**Yes**	**No**

• Please submit your questionnaire, survey questions or interview questions with your application. This will be a separate file that should be submitted as a pdf file, using this filename format: Questionnaire.pdf or Survey.pdf		
3.2.1 Does your questionnaire/survey include any personal questions? (including ANY of the following: name, address, email address, any other information by which a respondent can be identified, gender, age, race, income, medical status)?	**Yes**	**No**
3.3 Are employees of a firm, organisation or institution questioned as informant in this study? • If Yes, please submit letter(s) of permission from this entity to carry out this study. It should be clear that the person giving permission is authorised to do so and should be on a company letterhead and should include the date and that person's signature. • Where required, your application cannot be considered without this permission. • This letter should be submitted as a pdf file, using this filename format: CompanyPermissionLetter.pdf	**Yes**	**No**
3.4 Will you be surveying or questioning UP students or UP personnel in this study? • If Yes, you need to submit a letter or email from the Dean that provides permission for you to include UP personnel or students as participants in your study. • Where this is required, your application cannot be considered without this permission letter. • This letter should be submitted as a pdf file, using this filename format: DeanPermissionLetter.pdf	**Yes**	**No**

4. RESEARCH PARTICIPANTS

Does the project involve people as participants, either individually or in groups? If Yes, please answer questions 4.1 to 4.7. If No, continue to section 5.	**Yes**	**No**
4.1 Does the study involve people as informants, or does it involve people as research subjects? ***Informants*** are people of whom you require an opinion, e.g. people that are interviewed or that take part in a survey. ***Research subjects*** are people that actively take part in research, e.g. where biological measurements are made (e.g. heart rate) or where people take part in behavioural tasks (e.g. listening tasks)	**Informants**	**Subjects**

4.2 Describe possible safety and health implications that participation in the project may pose.

None foreseen

4.3 What is the expected duration of participation of people in the project?

People will participate intermittently on a voluntary basis. The duration of the studios extends over the academic year.

4.4 Describe the manner in which confidential information will be handled and in which confidentiality will be assured.

No geographic or personal references (name, address, ID, occupation, age, income etc) that may accidentally imply the identity of the interviewees will be included in the interview/ survey/ focus group discussion. Interviewees or survey participants will be asked to give consent to be surveyed, interviewed, recorded or quoted. If they request that certain parts of the interview cannot be made known, it will be deleted and not used in the study.

4.5 Please explain how and where data will be stored. It should be clear that data will be appropriately protected (e.g. password protected in encrypted files).

Data will be stored on a password secured electronic devices.

4.6 Is remuneration offered to subjects for participation? If yes, please expand.

No

4.7 INFORMED CONSENT/ASSENT

Informed consent is a requirement for *all* studies. All participants need to provide individual informed consent, which the researcher should keep on record. An example for an informed consent form appears on the website, but this should be adapted to be very specific about your study and what you will require of participants.

Please submit your informed consent form (an example of the form that you will use) with your application.
This should be submitted as a pdf file, using this filename format: InformedConsent.pdf

4.7.1. Please describe what you will do to obtain informed consent/assent from your participants (or their caregivers in the case of underage participants).

We will explain the research project to the interviewee and ask their permission to be surveyed, interviewed, recorded and/or quoted. If they request that certain parts of the interview cannot be made public or published, it will be deleted and not used in the study. We will explain that they will remain anonymous, that the data will be securely stored and that some information might be used for publication purposes. All discussions will include translation to ensure that communication is clear.

4.7.2 Detail the measures you will take to ensure that participation is voluntary.

We will explain to the interviewees/ survey participants that they may refrain from participation or stop the interview/ survey if they do not feel comfortable at any stage. All discussions will include translation to ensure that communication is clear.

5. ENVIRONMENTAL IMPACT and HAZARDOUS MATERIALS

5.1 Does the project have a potentially detrimental environmental impact, or are hazardous materials used in the project?	**Yes**	**No**

- If Yes, you will need to submit a letter of approval from the Department of Facilities and services, Occupational Health and Safety division, before the Ethics Committee can consider your application.
- If section 5 (this section) is the only aspect of your project for which you require clearance from the Ethics Committee (i.e. no people or animals are included in your study), you should not apply to the Ethics Committee, but should apply for clearance directly to the Occupational Health and Safety division.
- If No, continue to section 6.

6. DISSEMINATION OF DATA

6.1 How and where will your results be published and/or applied?

Through architectural filmmaking, it is proposed that the dynamic field of Public Interest Design may be conveyed not only to those within the architectural profession but also to the public at large. In addition, through the publication of a printed and e-book, the academic rigour supporting the documentary film may become widely available and recognised as an educational and practice resource.

7. DECLARATION (Tick the relevant boxes)

x	I accept and will adhere to all stipulations pertaining to ethically sound research as locally, nationally and internationally established.
x	I will conduct the study as specified in the application and will be principally responsible for all matters related to the research.
x	I shall communicate all changes to the application or any other document before any such is executed in my research, to obtain the necessary permissions from the Ethics Committee.
x	I will not exceed the terms of reference of the research application or any other documents submitted to the Ethics Committee.
x	I confirm that I'm not seeking ethics clearance for research that has already been carried out.
x	I affirm that all relevant information has been provided and that all statements made are correct.
x	I have familiarised myself with the University of Pretoria's policy regarding plagiarism http://www.aibrary.up.ac.za/plagiarism/index.htm. Plagiarism is regarded as a serious violation and may lead to suspension from the University.

Please submit the completed Declaration By The Researcher form with your application.
Please submit this as a pdf file with this filename format: Declaration.pdf

8. SUBMISSION CHECKLIST

Each item to be submitted should be submitted as a separate pdf file, using the naming convention given earlier in this document or below.

8.1 Have you submitted confirmation that the research proposal has been approved? Please submit as a pdf file with this filename format: Confirmation.pdf	**Yes**	**No**	

8.2 Have you submitted your application form (this form)? Please submit as a pdf file with this filename format: ApplicationForm.pdf	**Yes**	**No**	
8.3 Have you submitted your survey questions, questionnaire or interview questions (where applicable)? Please submit as a pdf file with this filename format: Questionnaire.pdf	**Yes**	**No**	**N/A**
8.4 Have you submitted the *Declaration by the researcher* form? Please submit as a pdf file with this filename format: Declaration.pdf	**Yes**	**No**	
8.5 Have you submitted the *Informed consent form*? Please submit as a pdf file with this filename format: InformedConsent.pdf	**Yes**	**No**	
8.6 Have you submitted permission letters from firms, institutions or organisations where required? Please submit as a pdf file with this filename format: CompanyPermission.pdf	**Yes**	**No**	**N/A**
8.7 Have you submitted a permission letter from the Dean where required? Please submit as a pdf file with this filename format: DeanPermission.pdf	**Yes**	**No**	**N/A**

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