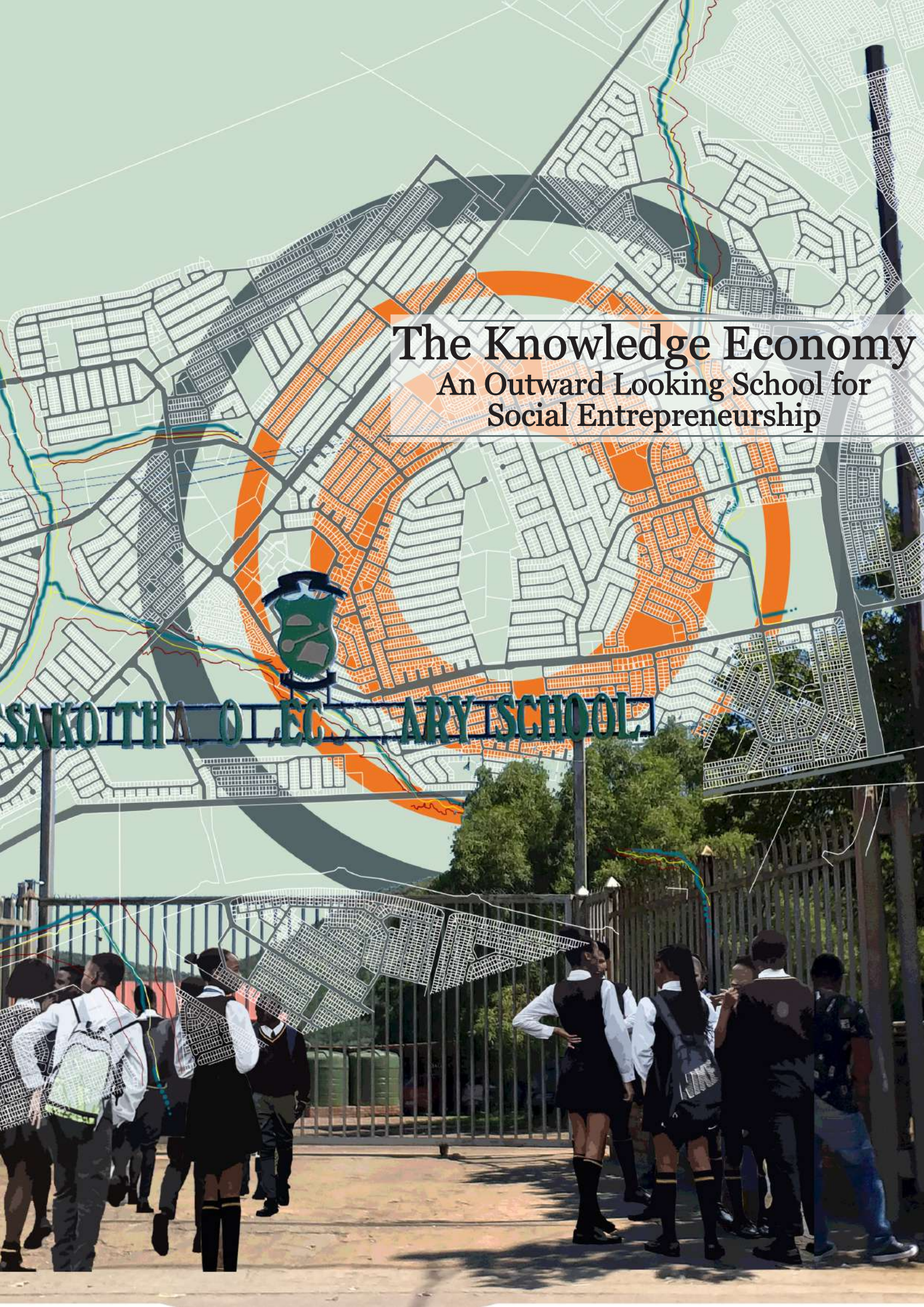


The Knowledge Economy

An Outward Looking School for Social Entrepreneurship

DECLARATION

In accordance with regulation 4[e] of the general regulations [G.57] for dissertations and theses, I declare that this dissertation, which I hereby submit for the degree of Masters of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution. I further state that no part of my dissertation has already been, or is currently being, submitted for any such degree, diploma or other qualification.

Simoni Veldsman

Thank You

This book would not have been possible without the endless support that I have received this year. I hope that my journey reflected in this book inspires you as it has done for me.

To all my family and friends, I am so grateful for the support, motivation, and guidance you have given me this year. My Mom, Dad, and Arrie, for always pushing me, believing in me and jumping in when needed.

Dr. Combrink, for guiding me this year, teaching me of what architecture can become and taking me on this adventure in Mamelodi with the Hons Studio of 2019.

Prof Arthur Barker, for always going out of your way for every student. You are an inspiring teacher.

Abre Crafford for always making time to see me, teaching and reminding me of the small things that makes architecture so meaningful.

Karlien van Niekerk, I am truly blessed to have endured this journey with a beautiful soul like you. Your constant inspiration and love carried me through this year.

My fellow friends and students, thank you for taking this journey with me. The Im(Prof) team Twane, Chante and Dirk, being the spirit and soul of this journey. Karlien, Khulani, Reginald, Charnay, Rinus, Larissa, and all the many others that contributed (you know who you are) for all the assistance from motivation to model building- thank you!.

Karla, my twin sister, I do not know where to start. This has been above all our journey and walking these past few years beside you has been our adventure. Thank you for always being my support, my dreamer and constant motivator to become better.

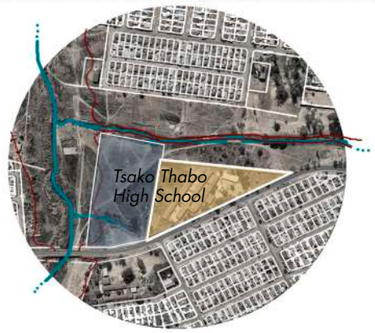
Map Indicating Mamelodi, the Study Area and Site
(Author 2019)

The Knowledge Economy

An Outward-Looking School for Social Entrepreneurship

The Knowledge Economy
Submitted by: Simoni Veldsman
Student Number: 14207266

Programme:
Further Education and Training for Social Entrepreneurs



Site Location:
Tsako Thabo Secondary School, Tsomo Street, Mamelodi East

GPS Coordinates:
-25.709488, 28.371560

The Client:
Tsako Thabo Secondary School, the Department of Higher Education in association with the Entrepreneurship Development in Higher Education (EDHE).

Study Field: Human Settlements and Urbanism

Study Leader: Dr Carin Combrinck

Course Coordinator: Prof Arthur Barker

Submitted in partial fulfilment of the requirements for the degree of Masters in Architecture (Professional) in the Faculty of Engineering. The Built Environment and Information Technology at the University of Pretoria, 2019.

Edited by Desre Stead

Abstract

Within this dissertation, the Knowledge Economy is explored as an educational pathway for youth in Mamelodi, investigating how the surrounding entrepreneurial activity and economy can impact the design of a school in the creation of an Entrepreneurial Education Ecosystem (EEE). It is therefore important to investigate and improve the outdated and seemingly unsuccessful spatial relationships that currently exist between educational buildings, the surrounding environment and the community it serves. It explores an alternative spatial response to education as being both didactic and economically enabling.

This dissertation investigates the potential of alternative education as a social catalyst that allows for increased diversity of educational service and socio-economic collaboration that informs the way we teach and learn. Current public service systems, such as education in South Africa, are under constant pressure to meet the demand for quality service. Research generated in Mamelodi will set out principles to follow and determine the development of architectural design proposals in remaking these typologies to adopt a new approach that recognises the power of society, local knowledge, culture as well as the high amount of entrepreneurial activity embedded in the surrounding context.

Key Words:
Knowledge-Economy, Entrepreneurship, Education, Entrepreneurial Education Ecosystems, Social entrepreneurship, Human Capital

01
Introduction

1.1 Introduction

Within the Knowledge Economy, higher education is regarded as a knowledge industry that produces a knowledge foundation and employees by reinforcing the capacity to learn and develop competent employees within the workforce (Jimenez 2018:22,23). In South Africa, there currently exists a failure to foster these skills and a culture of learning which in turn leaves learners vulnerable, manifesting in the "South African Skill Paradox" (Weeks 2012:1). Unemployment is an evident consequence of the high dropout levels of pupils in the South African Education System, the inability to find employment and lack of work opportunities (CDE 2014:4).

Mamelodi, a South African township to the Northeast of Pretoria, is one such instance where, despite the number of schools in the area, a high level of unemployment has been recorded (StatSA 2018). Typically, schools in this township were constructed as part of state-provided infrastructure both under the apartheid regime as well as in the post-democratic era. Schools were used to implement divisions within society and to propagate beliefs in apartheid education (Maloka n.d.). Schools were divided into four racial groups to implement segregation, evidence of actions taken pre-1994 is recognised in the Bantu Education Act 47 of 1953 and the educational legislation of the 1960s (de Wet & Wolhuter 2009:365). The state was assigned the responsibility for organising school education with education departments allocated to administer and regulate curriculum development, infrastructure and protocols for each ethnic and racial group separately.

Currently, the South African education system is governed by two national departments, namely the Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET). Each of the nine provinces in South Africa has its own education departments that are responsible for implementing the policies of the national department, as well as dealing with local issues (South African Yearbook 2017/2018:2).

Tsako Thabo High School is situated next to the Pienaar River that divides Mamelodi into east and west. Tsomo Street provides access to the school on the South-eastern end. The site is surrounded by zoned public open space, government-owned land, on the northern and western sides. The architectural typology found at Tsako Thabo Secondary School subscribes to the idea of the 'Modern Classroom' suggested by Dudek (2000:10) and is reminiscent of a school typology investigated in this study (see Chapter 3) and applied across the country, that affects the development of schools.

Literature studies reviewing factors impacting schools and learning environment suggests that the physical environment contributes to the ability of students to learn (Higgins et al 2005:7). This suggests that some of the problems associated with the current culture of learning and eventual employment or entrepreneurial success may be related to the spatial typology inherited from the legacy of apartheid which has been extended throughout the Mamelodi context.

In this study, the research aims to offer a perspective on how architecture may either contribute positively to a culture of learning or negatively undermine the ability of learners to acquire the skills necessary for employment or entrepreneurial education.

The study will then identify the barriers perceived and experienced by learners by using Tsako Thabo Secondary School as a case study to reflect issues apparent in the schools located within the study area of Mamelodi east.

1.2 Project Statement

Spatial conditions inherent to school typologies in South Africa play a role in students' inability to complete their educational pathways (Jimenez 2018:24). The learning landscapes' physical environment contributes to the role of disjunction and spatial legacy occurring in higher education institutions as well as in social problems within the community. Numerous South African schools reflect multifaceted socio-educational problems due to this spatial dysfunction that exists that in turn affected their culture of teaching and learning (Week 2012:4). The schooling context is shaped by social and spatial patterns that affect the way learners relate to the school and their education, and the values they learn from the world they experience around them (Hammett & Staeheli 2013:318). When disparity is characterised within society, individuals and communities are marginalised (Ebersohn 2016:2).

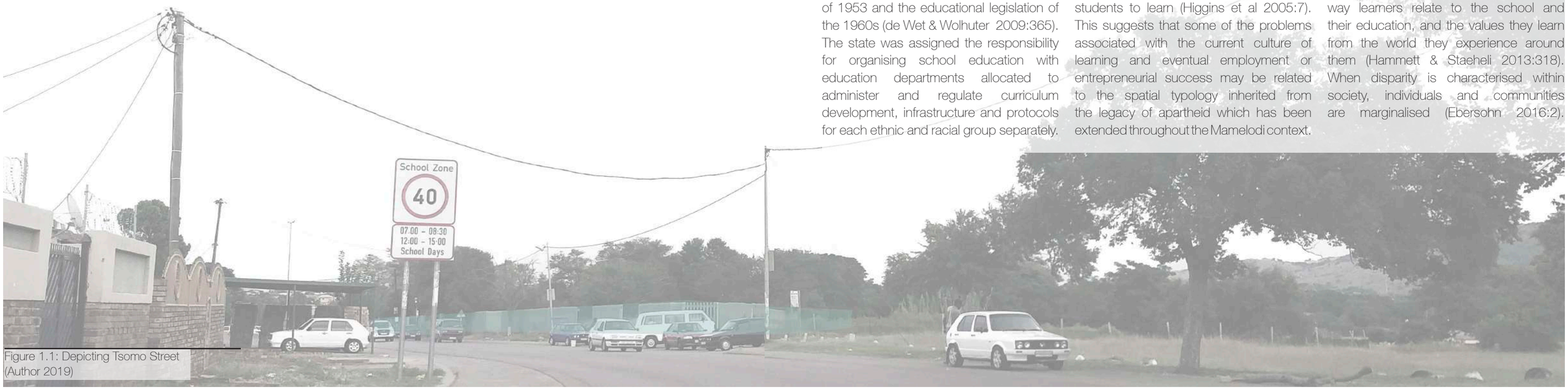


Figure 1.1: Depicting Tsomo Street (Author 2019)

1.3 Terminology:

a. Knowledge-Economy
The use of knowledge to create services and goods, in particular, referring to skilled workers and the idea that most employment opportunities require specialized skills.

b. Entrepreneurial Education
Entrepreneurial Education provides students with the skills, knowledge, and motivation to encourage entrepreneurial success in various settings.

c. Entrepreneurial Education Ecosystems
A structured framework to explore education environments that support entrepreneurial learning.

d. Human Capital
The knowledge, skills, and experience possessed by an individual, group or population.

e. Outward-looking
Considering the entrepreneurial activity in its context and the systematic nature of interaction beyond the boundary.

f. Social Entrepreneurship
Social entrepreneurship is an approach used by start-up entrepreneurs or companies, vary in size, aims, and beliefs, where they fund, develop, and implement solutions to issues varying from social to environmental.

(Definitions adapted from Oxford Dictionary to explain the term)

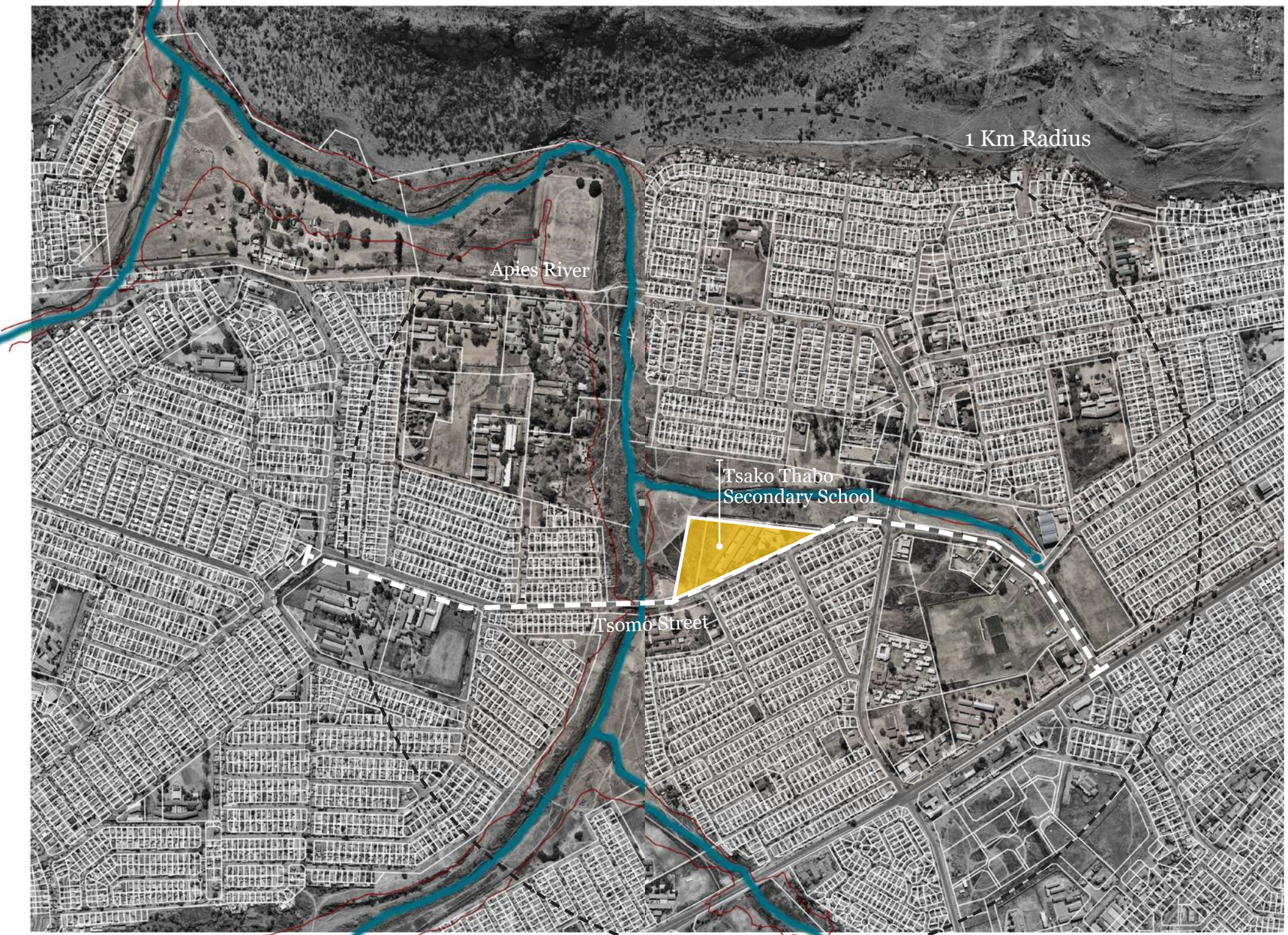


Figure 1.2: Locality of Tsako Thabo Secondary School (Author 2019)

1.4 Site Selection

Tsako Thabo Secondary School has been chosen as the site for an architectural intervention. It forms part of the learning collaborative of the University of Pretoria's Architectural Department in Mamelodi, investigating "Education in township communities" and creating "strategies for ensuring the long-term success of learners in township settings" (Mamelodi Collaborative: 2017).

Within this collaborative, the Tsako Thabo Secondary school has a relationship with the University of Pretoria's Mamelodi Campus making this school accessible and valuable to investigate the importance of education within a community such as Mamelodi-east. Secondly, the Department of Architecture Honours group (4th-year students) of 2019 was involved with the school in collaborative mapping in and around Tsako Thabo High School.

1.4.1 History of Tsako Thabo Secondary School

Tsako Thabo Secondary School was originally known as Junior Secondary 3, and part of Mamelodi Junior Secondary School in Mamelodi West. It moved to its current location in 1979. It was known for its excellence in music and sports. Prior to 1994, Woodwork, Sewing and Home Economics were the main subjects taught. The Deputy Principal, also a former student explained that schools back then were built to train and not to educate and attributes the barracks-like feel of the school to apartheid. It was originally open (not fenced off), but over time, due to fear of crime, it gradually fortified itself further. However, this has not solved the security problem (Achi & Venter 2019).

1.5 Users

Figure 1.3: School Learners of Tsako Thabo Secondary School.
Photo by Morne du Bois (edited by Author 2019)

1.6 Research Question

How can the entrepreneurial Knowledge Economy contribute to space and place-making within a high school in Mamelodi-east?

1.7 Research Intentions

The intention of this dissertation is to push the boundaries of a school design; To investigate the potential architecture has to become a device or instrument of knowledge, collaboration and skill transfer. Discovering ways of architectural placemaking in a rapidly changing world will be proposed.

1.8 Delimitations

This dissertation identifies opportunities in the educational system and will explore the role architecture has in the facilitation of education and economic integration in the scheme.

In the development of an architectural solution, the construction methods used at Tsako Thabo Secondary School will be assumed as standard building methods. The school was built in 1979. The school consists of 230mm brick walls, finished with exposed brickwork, painted or plastered and painted in cases. Roofs are mostly mono-pitched and in some cases pitched, with plaster board ceilings with no insulation. Roofs are constructed with I-beams or in other cases timber trusses.

Due to no formal documentation found on the Pienaars river in this region, the assumed flood line for the Pienaars River is 40m at the mainstream running from North to South and 20m at the sub-stream running West to East (Department of Water and Sanitation 2004).

1.9 Limitations

While the entire site will be included in the development of a design solution, a phased approach is suggested further in this study and the design focus will be on phase 3, in the re-imagining of Tsako Thabo Secondary to illustrate the best response to the research problem.

1.7 Methodology

To develop an appropriate architectural solution, the following methods will be utilised in order to address the issues and intentions set out in this dissertation.

Case Study Research
This research strategy is implemented to specifically focuses on Tsako Thabo Secondary School within its context. An in-depth investigation is initiated to explore the causes of underlying principles and give an understanding of the importance of theory development in the research design phase. Education facility design is not a new concept, therefore precedent analysis of both local and international examples are conducted to compare and discussed in this study. This will be achieved through site visits and desktop studies.

Context analysis
The proposed site will be explored and analysed through mapping, observation, visual interpretation and unstructured discussions to provide a well-informed architectural solution. Collaboration in research will be conducted with the Department of Architecture fourth year Mamelodi Studio of 2019 working in the same area. Desktop and fieldwork studies will be conducted to rigorously explore the education and economic realms of the existing context and networks.

Desktop Study
Supporting the research question, theoretical premises of the site and surroundings are to be investigated to form a basis to provide a design solution. Both quantitative and qualitative forms of research are undertaken to allow for the assessment of existing data in relation to selected theories, research objectives, the context, and hypothesis. These methods allow the researcher's interpretation of the collected data.

02
The Educational Context

2.1 Background

2.1.1 Unemployment

South Africa faces a huge unemployment problem (Weeks 2012:2) which currently poses as the most pressing socio-economic crisis (Altbeker & Bernstein 2017:i). Yet businesses and industry are confronted with significant skills shortages where people have an abundance of knowledge, experience, and skills finding themselves in a 'skills paradox', with no opportunity to find employment with those skills.

The age group between 15–24 years is the most vulnerable in the South African labour market as their unemployment rate was 55,2% in the first quarter of 2019 (Stat SA, 2019), resulting in the inability to produce the required growth or employment within South Africa's economic strategy (Altbeker & Bernstein 2017:i). Furthermore, nearly 40% of young people (aged between 15 and 34 years) are not participating in further education, employment, or training (Altbeker & Bernstein 2017:1). Figure 2.1 illustrates how the unemployment rate among youth is still high regardless of the education level (Stat SA, Q1 2019).

2.1.2 The South African Education System

Figure 2.2 illustrates the South African education system. The education system is governed by two national departments, namely the Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET). The DBE is responsible for primary basic education and the DHET for tertiary education and training (GCIS, 2017/18:2). In the 1996 Bill of Rights of the Constitution of the Republic of South Africa, point 29 declares basic education as an inalienable basic human right for all South Africans from grade R to grade 9 (GCIS 2017/2018:2). The educational pathway for higher education from grade 9 onwards becomes limited, optional and restricted.

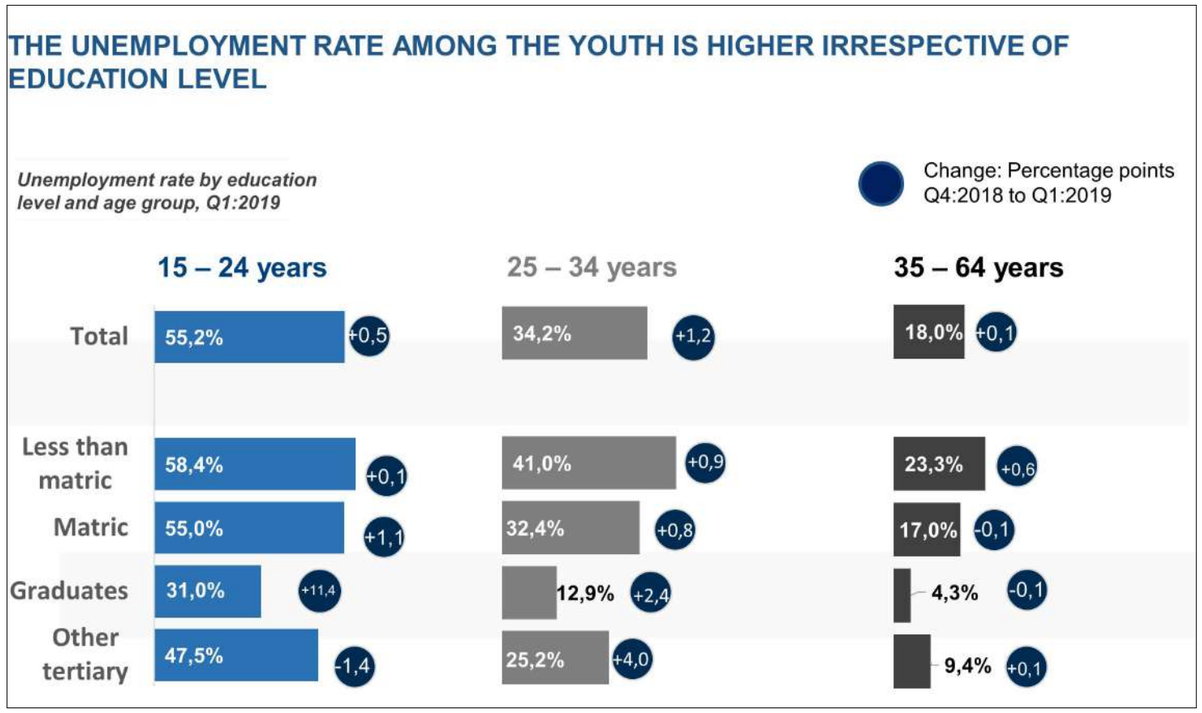


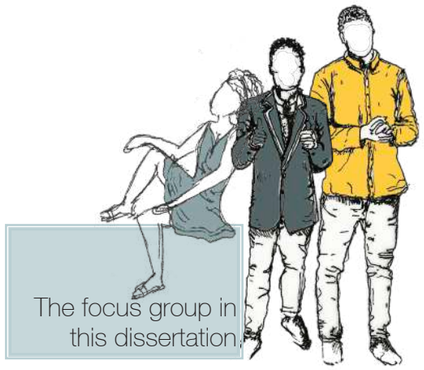
Figure 2.1: The unemployment rate among youth in relation to the education level (Sats SA 2019).

2.1.3 The Focus Group

The learners of higher education institutions will be the focus group in this study due to the role knowledge plays in employment and learners being equipped for employment. From 'grade 9' learners are provided with various options to continue their studies from secondary school to higher education. These options are varied from continuing with schooling until matric, leaving school or going back into schooling at universities, technical and vocational education and training colleges, artisan training colleges, or community education and training colleges.

2.1.4 Financing the DHET

A further investigation reveals how tertiary education in South Africa is financially driven. According to the latest financial data from Statistics South Africa's higher education institutions report (Stat SA,2016), higher education institutions depend mostly on government grants to be able to function, secondly on tuition fees, finally on the third stream of income through donations and investments. This makes the dependence on Governmental input clear.



The Learner/ The Student/ The Entrepreneur

Figure 2.3: Study Focus Group
(images adapted from Mamelodi Urban Vision Group Mapping (Gerber & Veldsman 2019))

Higher Education Financial statistics
Source of Income

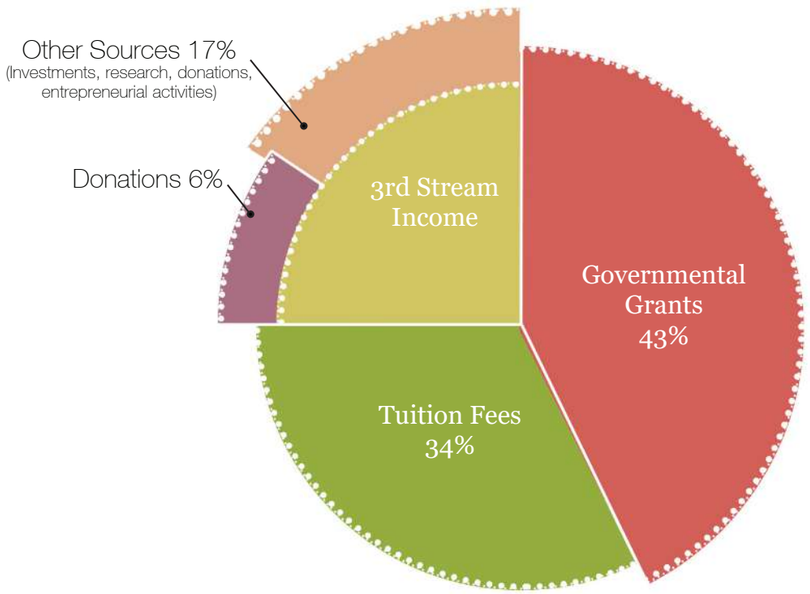
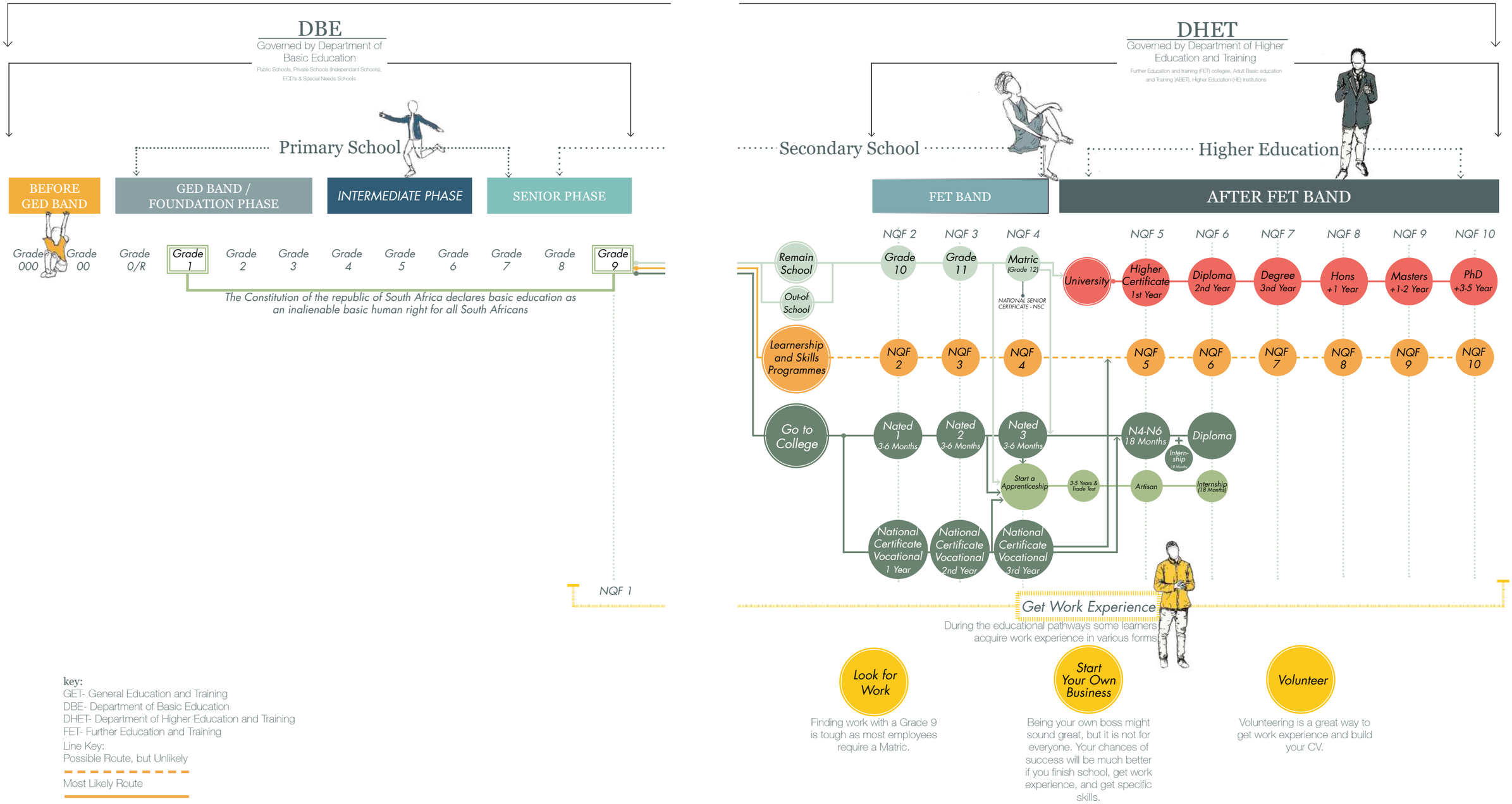


Figure 2.4: Source of Income of DHET
(adapted from Sats SA 2016)

The South African Education System



key:
GET- General Education and Training
DBE- Department of Basic Education
DHET- Department of Higher Education and Training
FET- Further Education and Training
Line Key:
Possible Route, but Unlikely

Most Likely Route

Figure 2.2: Visual illustration of the South African Education System.
(Adapted from Altbeker et al 2017; GCIS 2017/18 2017; wikipedia.org 2017)

2.1.5 Education Paradox

Obtaining a higher education qualification is among the most reliable paths to employment in South Africa (Altbeker & Bernstein 2017:22). Higher education branches, such as universities, further education, and training, as well as adult education and training, are the primary engine for the production of higher-level skills and talent for economic growth, technological innovation, societal leadership and the 'in-between' phase for work preparation (Jansen 2018:1). There is a perception that most who enter the system prefer a university degree to a technical and vocational qualification (Jansen 2018:4).

2.1.6 The Knowledge Economy: Skills, Employment and Entrepreneurship

Wit and Orvis (2010:6) suggest that learners require new skills for tertiary education and careers to keep up with the rapid changes that occur in a Knowledge Economy. Employment generation has been identified as one of the highest priorities within South African society (CDE 2017:1).

The Knowledge Economy relies and recognises intellectual assets (human capital) as a key factor in economic growth (Powell & Snellman 2004:199; Weeks 2012:2) and with inadequate skills makes it difficult for the economy to function effectively (Weeks 2012:2).

The reality is that the majority of people who are potentially economically active in South Africa generate their own employment, entrepreneurial business or activity, usually in the form of 'informal sector' activity (CSIR 2005:10). Being entrepreneurial has been a catalyst in the growth and development of strong economies (Greyling 2007:14). This contributes in terms of job creation, employment and income that can be accredited to entrepreneurial businesses (Belle et al 2004:1).

The DHET established the 'Entrepreneurship Development in Higher Education' (EDHE) within the University branch of higher education, which is an intervention to make entrepreneurial education and training accessible for students, equipping them to successfully participate in the economy upon graduation, regardless of whether they are employed or not (EDHE 2019).

Despite the mentioned initiative in higher education, entrepreneurial learning is excluded from all other higher education branches and models previously illustrated in figure 2.2 such as training centers and colleges where facilities, learners, and economic growth can benefit from entrepreneurial learning within their own communities. It creates a limitation in the economic processes for higher education models to produce relevant skills for careers and what is required in the economy of South Africa.

2.1.7 General Issues

There exists an overall systemic disjointedness between education and economic processes that leaves educational systems unresponsive or unsupportive of the relationship with the economic systems apparent in the South African Community. Unemployment is an evident consequence of this disjointedness between system and process.

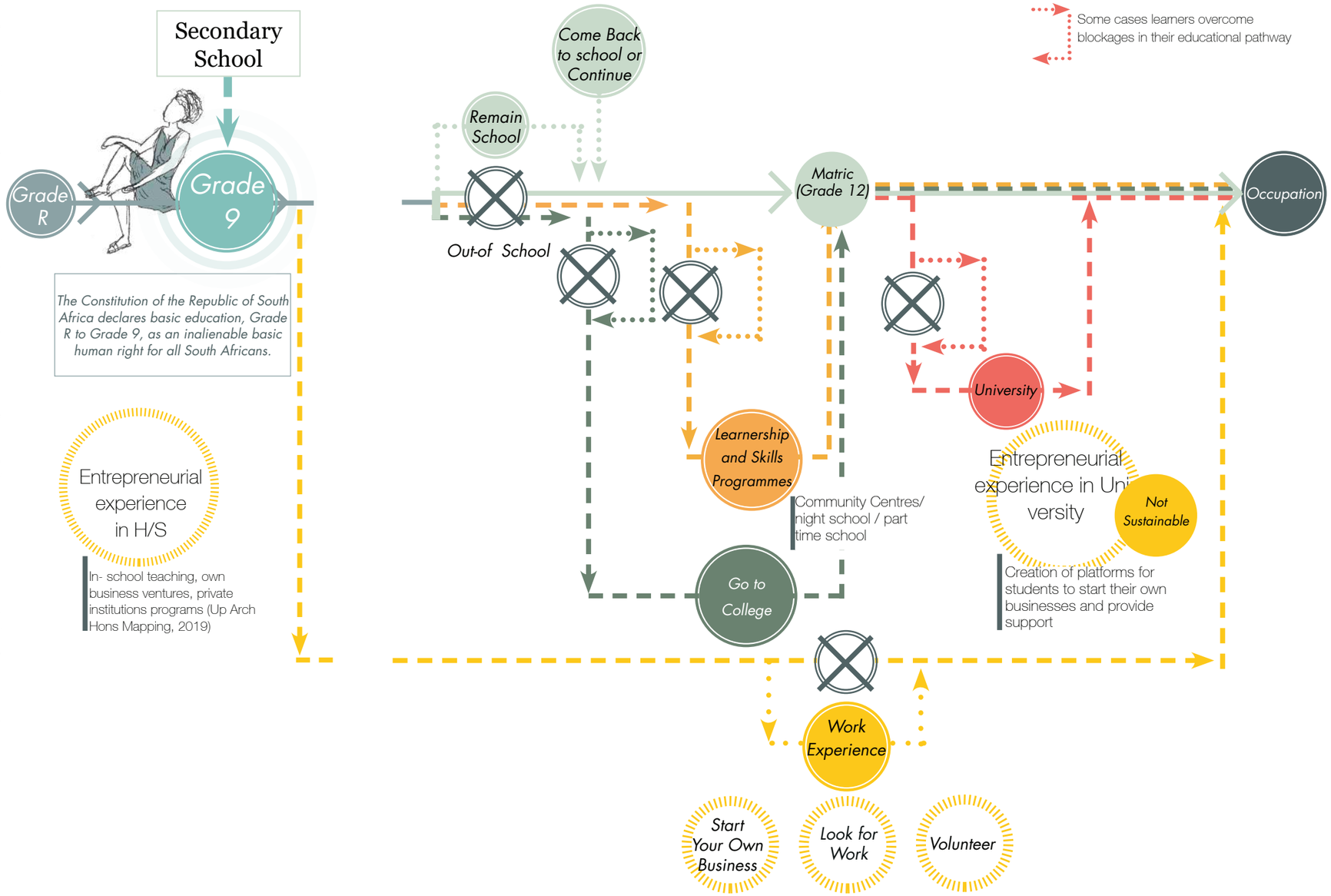


Figure 2.5: Blockages restricting Educational Pathways
(Author 2019)

2.1.8 Barriers to Education

Barriers effecting and preventing education:

Apart from limitations in creating platforms to enhance the entrepreneurial activity, the education system in South Africa is challenged by many social issues. Emerging economies are regularly exposed to crime and conflict and aggravated by an at-risk social context and social origins (Ebersohn 2016:2). Many students withdraw from schooling (Muller and Toutain, 2015:7). Factors impacting this withdrawal from the educational pathways range from domestic factors such as substance abuse to systemic factors such as school capacities (CDE 2017:2; Ebersohn, 2016:2; Hammett & Staeheli 2013:323; Weeks 2012:3). Figure 2.5 illustrates the effect such barriers of education have on educational pathways.

Social barriers affecting educational blockages:

Ebersohn (2016:2) provides a risk lens in education research depicting that inadequate opportunity is associated with socially-generated risk factors that impact educational pathways. Figure 2.6 represents a 'deficit policy lense on rural education, opportunity, and inequality' demonstrating risk factors as barriers in educational pathways.

Given the above study, issues persist in educational systems that cause these barriers in education, the ability for students to complete their education or come back into learning and the limited entrepreneurial provision made by the DHET.

Risk factors as barriers to education — **Opportunity Low**

Social origin of risk:

In the school-community:
- exposure to conflict, insecurity, crime
- lack of, distance to, and barriers to access limited services (health, welfare, transport)
- lack of school-community participation
- high poverty neighbourhood / village

In the kinship system:
- low levels of parental education
- low household income generating based on parental occupation
- high intergenerational poverty

Individual level (student, teacher, family of origin):
- higher risk for females
- orphanhood as risk
- higher risk of individual with a disability
- negative affect (emotions)
- negative temperament
- low individual self-esteem

Inequality High

Figure 2.6: 'deficit policy lense: rural education, opportunity and inequality' (Ebersohn 2016;2)

2.1.9 Entrepreneurial Education: an outward-looking school

The value of incorporating entrepreneurial education into higher education models can assist in developing skills and knowledge to equip people with skills to start-up, organisation and manage their own enterprises (Paltasingh 2012:233). Entrepreneurship Education (EE) is considered as one of the fastest-growing fields of education globally; it is an indication of the importance of entrepreneurship for the economy of any society (Muller and Toutain 2015:6; Sirelkhatim & Gangi 2015). The possibility exists within the higher education system to develop the necessary knowledge, experience, and skills needed to address the challenges of unemployment to create employment opportunities for people to manufacture, trade and provide services (CSIR 2015: 10). Entrepreneurship Education also invites a wide spectrum of actors from within and outside schools to build entrepreneurship as well as broadening perspectives on finding creative and new ways of teaching and learning (European Commission 2010; Muller and Toutain 2015:6).

The intention is, therefore, to promote entrepreneurial learning by suggesting a systemic alteration in the educational system to create an educational platform that promotes entrepreneurial learning and attaches itself to a Higher Education branch, building on the term of being an "outward-looking" school/ facility and the creation of an Entrepreneurial Education Ecosystem.

Muller and Toutain (2015:6) set out two key issues to design and implement entrepreneurial learning for an educational environment to being "outward". The first is to understand the entrepreneurial activity in its context and the second is to understand the systemic nature of interaction beyond the boundary.

In this study, the focus is established to investigate how such a model can be applied to a school, Tsako Thabo Secondary School, located in Mamelodi-east spatially through architectural design and processes. Tsako Thabo Secondary school, located in Mamelodi east, similarly to other formal settlements around South Africa, it is characterised by high levels of unemployment and poverty (Maphall n.d:4).

Wolff (2007:26), a well known South African Architect involved in school design, states that the education system is undergoing a fundamental transformation. One of these suggestions is to transform secondary schools to Further Education and Training (FET) Schools and rethinking education facilities being built. FET schools will then be more focused on skills and entrepreneurial training to equip learners to generate their own income during and when they leave school.

Two such examples occur in South Africa where attempts are made to incorporate entrepreneurial learning in Secondary Schools: Usasazo Secondary School and Jakes Gerwel Entrepreneurial School.

01 Usasazo Secondary School

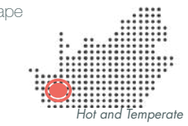
Jo Neoro Architects
Khayelitsha, Western Cape
2004

This school is a conventional high school commissioned by the Department of Education of the Western Cape. The design seeks to challenge conventions associated with schools located in townships.

One of the primary issues identified in this project was to create a connection with the street due to the required compact form of the school. The one facade responds to the street edge in scale, proportions, and exchange to reflect existing entrepreneurial businesses that occurs in informal buildings in the street. Hatches open to the street from the classrooms along the edge to allow for trade to occur between the school and community.

02 Jakes Gerwel Entrepreneurial School

Department of Education & Community
Bonnievale, Western Cape
2017-2018



Jakes Gerwel Entrepreneurial School is located in Bonnievale in the Western Cape. The community is very poor and has a high demand for workers on surrounding farms. Children did not attend school due to the inadequate provision of school facilities and limited resources available in their township. Through community collaboration on donated land, equipment, and resources, Jakes Gerwel Entrepreneurial School was established to resolve issues in the community (Friedman 2017; YehBaby Digital Creatives 2018).

The school is technically driven and acts as two schools in one. Firstly, a mainstream school with technical subjects, and secondly, a skill and training section that is vocationally focused. The school thus creates the opportunity for learners to develop early entrepreneurial skills in their secondary education (Landbou.com:2019; Jakes Gerwel Entrepreneurial School .co.za, 2018).

More importantly, the focus is directed on the architectural response to the schools. Literature studies on factors impacting schools suggests that the physical environment contributes to the ability of students to learn (Higgins et al,2005:7), therefore suggesting that some of the problems associated with the current culture of learning, restrictive educational pathways and eventual employment or entrepreneurial success may be related to the spatial typology of education facilities.

The question then arises as to how architecture affects students' capability to finish their education and secondly, how can architectural design facilitate entrepreneurial education to address unemployment and resolve inherent spatial conditions restricting learners to complete their educational pathways by incorporating an economic system into a school.

Figure 2.7: Precedents of entrepreneurial Learning Incorporated into secondary schools
01. Courtyard in Usasazo Secondary School (Wolff Architects 2004)
02.Traders Edge in Usasazo Secondary School (Wolff Architects 2004)
03. School under construction (Jgt.co.za 2018)
04. Image depicting first phase of school complete (Esbou.co.za 2018)

2.2 Contextualizing Education

2.2.1 Educational Landscape of Mamelodi

A second layer of literature studies are initiated to investigate how the current schooling model in terms of the built environment is affected and play out within this study in Mamelodi-east.

2.2.2 The Urban Condition

Mamelodi is located in the City of Tshwane, under the 1950s Group Areas Act, Mamelodi was classified as a township (Van der Waal 2000:1). Townships originated as residential developments segregated according to race and income with the intention of removing black people from white proclaimed areas illustrated in figure 2.8 (Dewar 2000:5; Smith 2003:23; Walker et al. 1991:11). Township planning and design pre-1994 were intended for the perpetuation of segregation on various levels (Smith 2003:23; Walker et al.1991:11) with education being one of the tools used to enforce segregation.

After the fall of Apartheid in 1994, the new government inherited economic, physical and social imbalances from the past in the provision of public services and housing (Maloka n.d). The first form of public infrastructure in Mamelodi was the Vlakfontein Industrial School (set up in 1947/8) and in 1953 the first black school, Mamelodi Model School, opened (Porter 2018).

1953-1967

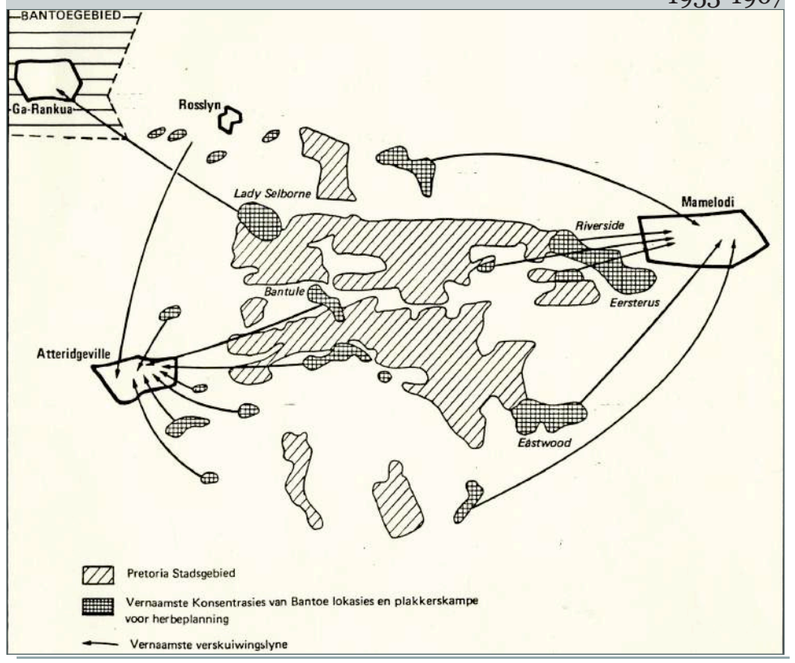


Figure 2.8: Forced Removals in Pretoria 153-1967
(Van der Waal Collection 2016)

1961

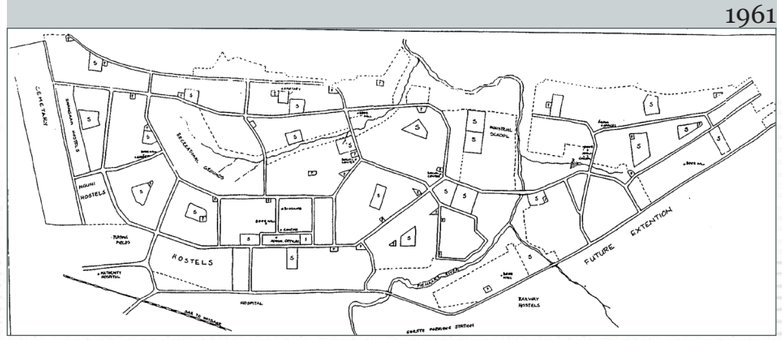


Figure 2.9: Distribution of educational facilities across the Mamelodi Landscape
(Van der Waal Collection 2016)

Since then, social infrastructure is distributed across the Mamelodi landscape, figure 2.9 illustrates the distribution of educational facilities.

Teriman, Yigitcanlar & Severine (2011:173) argue that social infrastructure is crucial to create healthy communities and sustainable environments. Although the democratic government has made significant progress in meeting service delivery challenges in under-serviced areas since 1994, there are still many issues that persist in the spatial legacy left in South African educational landscapes (Hammett and Staeheli 2013:323).

As observed in mapping and engagement, public infrastructure in the built environment has not become integrated with the Mamelodi context. Infrastructure, such as for learning, worship, exchange, markets, and universities, are highly valued by society and serve as key structural elements or landmarks within communities due to its locality in urban environments and accessibility (CSIR 2005:10).

Dewar (2000:4) raises the issue that South Africa's settlement-making is dominated by the programmatic approach; shelter being the primary priority and being quantitatively

1965

Figure 2.10: Forced Removals in Pretoria 153-1967
(Van der Waal Collection 2016)

1988

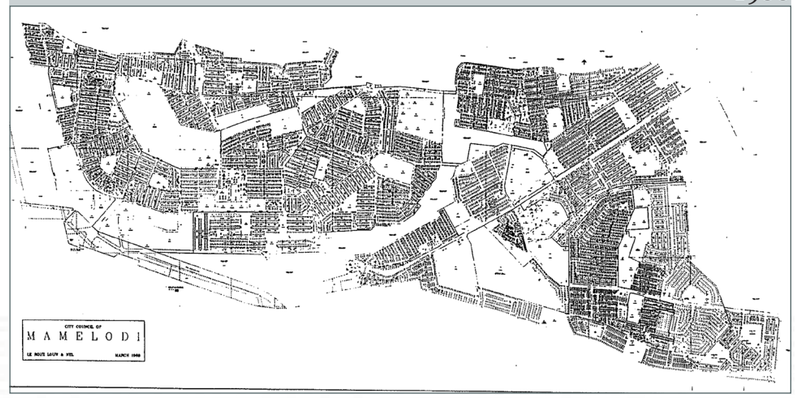
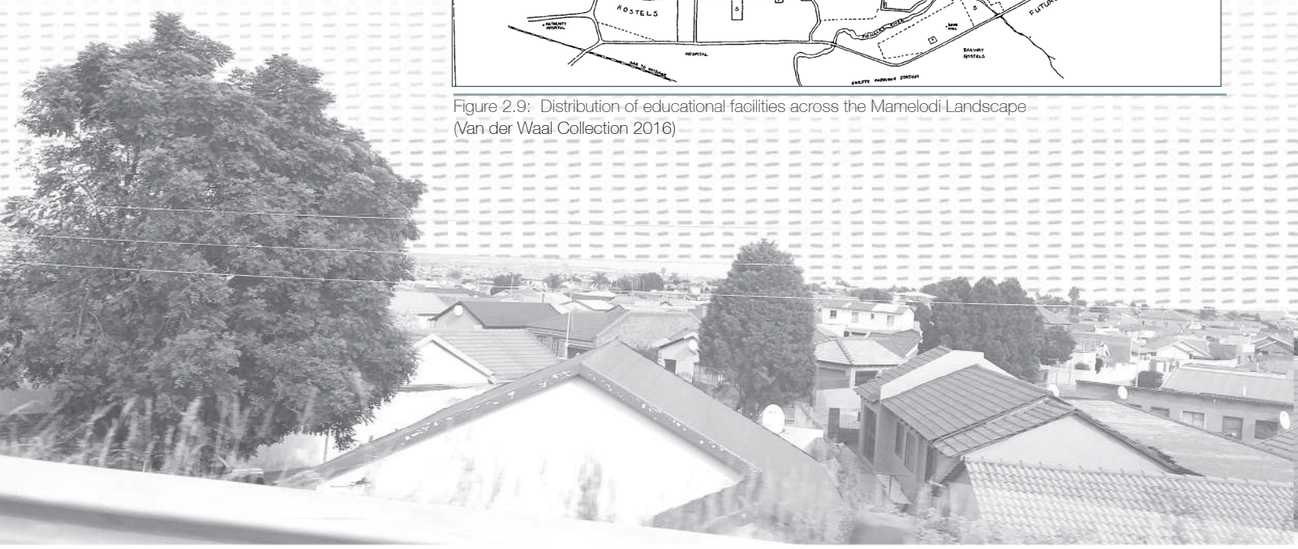
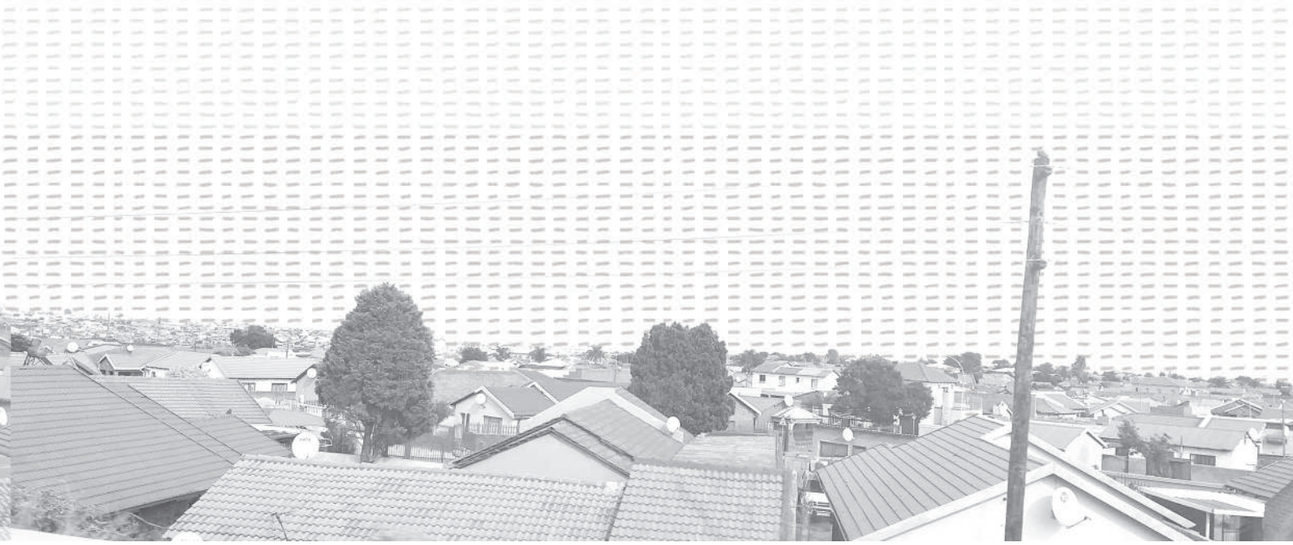


Figure 2.11: Distribution of educational facilities across the Mamelodi Landscape in 1988
(Van der Waal Collection 2016)





(for A amount of money= B amount of houses). Secondly, programmes provided are directed towards assisting individual households resulting in an X 'amount' of residential units generating facilities such as firstly primary schools, secondary schools and commercial spaces (Dewar, 2000:4). In this approach, spatial requirements compete to create a balance between planning and design.

This issue has impacted the typological outcome of these public services provided, with problems associated inherent to the previous legacy of apartheid and uncritically continued in the Mamelodi context.

2.2.3 The 'free-standing unit'

The urban condition of public Infrastructure has the inevitable outcome of sterility, spatial and social injustice and the creation of the concept: the 'free-standing unit' (Dewar 2000:7) a mono-functional typological issue. Many schools located in disadvantaged communities had inherited a legacy of dysfunction (Weeks 2012:2). Modernist ideas further shaped the urban form in planning and architecture; free-standing buildings were set back from the street edge to float, separate and alone (Dewar 2000: 4; GCRO 2018:5).

Throughout the landscape institutional buildings stand isolated in communities, damaged or limited in resources due to the high demand. This typological phenomenon is a pervasive occurrence in the South African education landscape in both primary and secondary schools and is an architectural typological issue that is played out in scale, as illustrated in xx it s not only in Mamelodi, but Khayelitsha and Soweto as well; all the schools in these areas have the same 'free-standing' typological model.

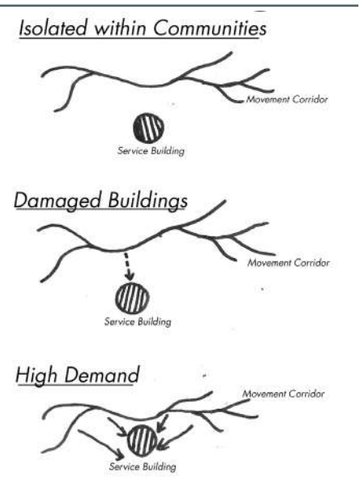


Figure 2.12: Image adapted from Pattern Language of the condition of social infrastructure within a context (Alexander et al 1977)

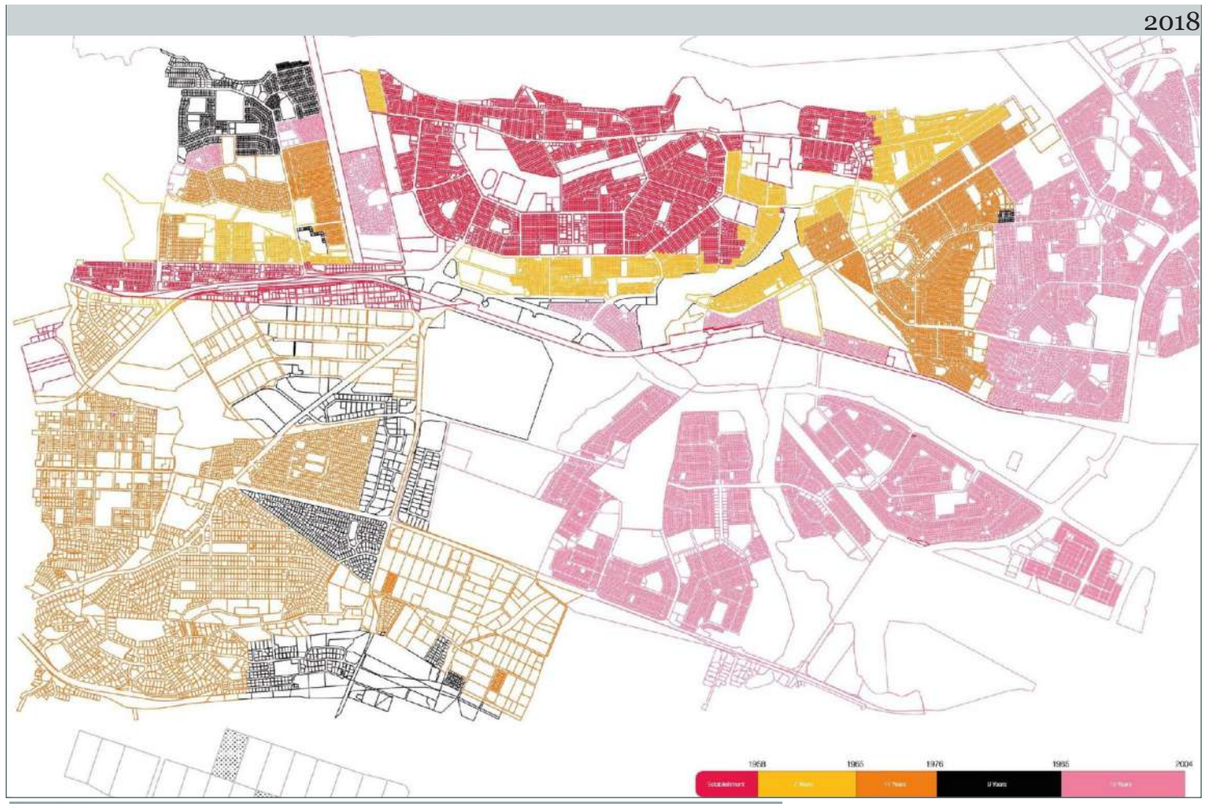


Figure 2.13: Visual representation of the Mamelodi expansion.
(Up Arch Hons History Mapping 2018)

2.2.4 The Current Condition of Public Services

To gain a deeper understanding of the Institutional challenges Mamelodi faces with regard to public services, an investigation was initiated by the 2019 Mamelodi Masters group investigating public social infrastructure through mapping.

The mapping is divided into two layers. The first is on a macro scale of the urban condition of Mamelodi and the second, specific questions were identified to determine relationships.

Layer 01

The intention of this mapping illustrated below in figure xx is to identify community energy, namely, 'Synergy nodes' that are formed where points of activity and social infrastructure overlap. This is an indication of places where there are high levels of pedestrian movement and community interaction on various scales.

Mapping explored the locality of: Education facilities; Community-oriented centers; education in relation to well-being centers; Main transport nodes in relation to density, community centers, well-being; Main transport nodes in relation to education, community centers, well-being; Informal trade that occurs along the main movement corridors in relation to density, community centers, well-being and Synergy nodes.

In summary, discoveries led to where there is concentrated social infrastructure (such as educational facilities or well-being centers) and where high levels of pedestrian activity occur. This result in entrepreneurial businesses and their direct relationship with public facilities along movement corridors. Consequently, due to the increased activity, passive surveillance results which have led to these spaces being safer and creating a sense of security where the community prefers to linger, gather and socialize. These form the synergy nodes of our investigation.

Soweto

Khayelitsha

Mamelodi

Figure 2.14: "Free standing" Concept
(Author 2019)

Green Spaces

Map indicating green, open and recreational spaces in Mamelodi

Figure 2.15: Mamelodi Urban Vision Group Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

Community Centres & Well-being Facilities

Map indicating community centres and well-being facilities in Mamelodi

Well Being Facilities

1. Second chance recovery centre
2. Mamelodi Hospital - maternity ward
3. Mamelodi Hospital
4. holani clinic
5. Stanza 1 clinic tea room
6. mens clinic intermatinal
7. phelang hospital
8. bophelong community hospice
9. mamelodi day hospital
10. stanza bopape health and community development centre
11. phameng clinic
12. stanza 1 clinic

Community Centres

1. mamelodi community learning centre
2. reniwe community learning centre
3. rethabile sports grounds
4. stanza bopape community hall
5. ikageng community centre
6. stanza bopape sport complex

Figure 2.16: Mamelodi Urban Vision Group Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

Educational Facilities

Map indicating educational facilities in Mamelodi

Figure 2.17: Mamelodi Urban Vision Group Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

Informal Trade & Transport Nodes

Map indicating informal trade that occur along main movement corridors and main transport nodes in Mamelodi (Hons research group, 2018)

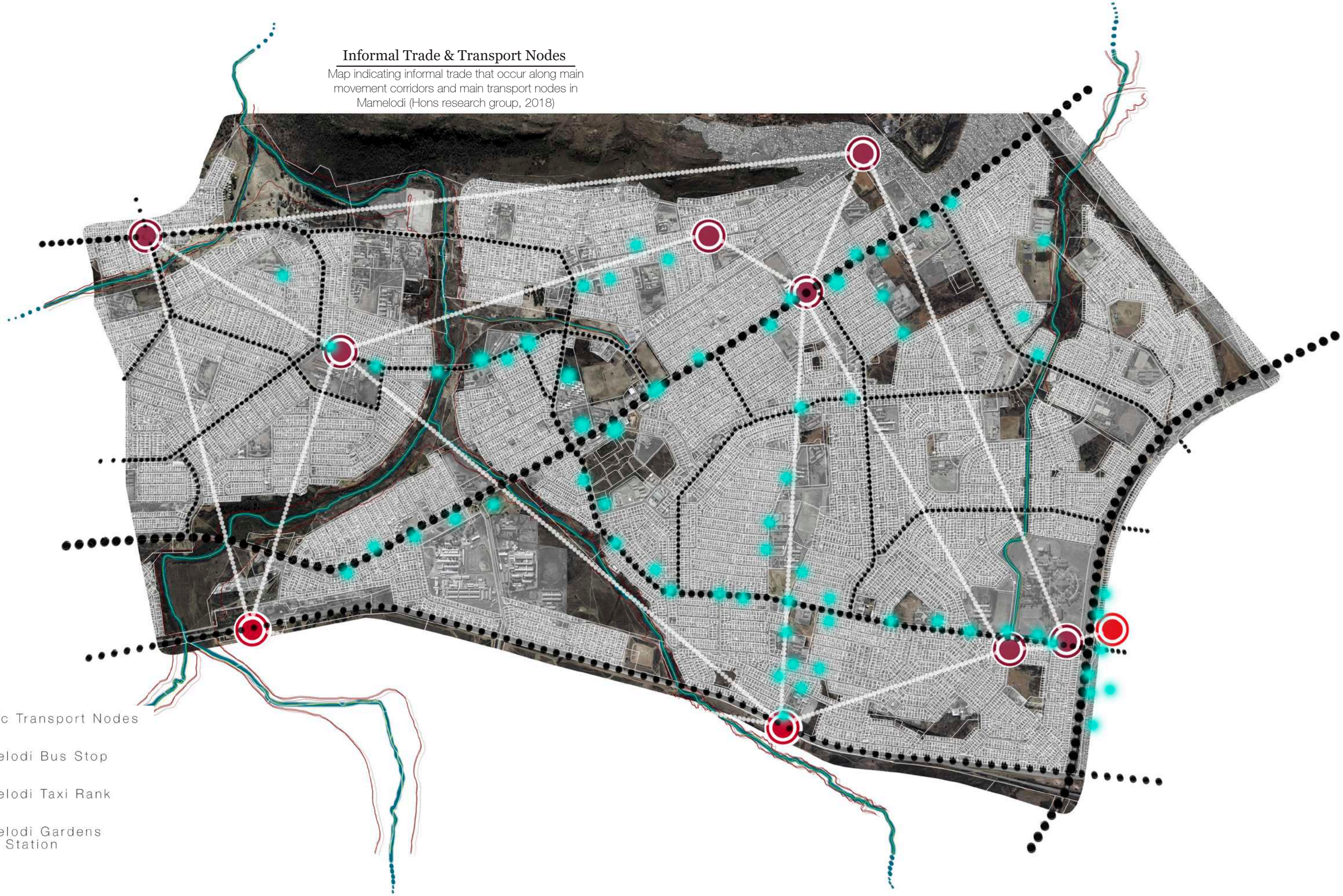


Figure 2.18: Mamelodi Urban Vision Group Mapping (Author 2019, adapted from Gerber & Veldsman 2019)

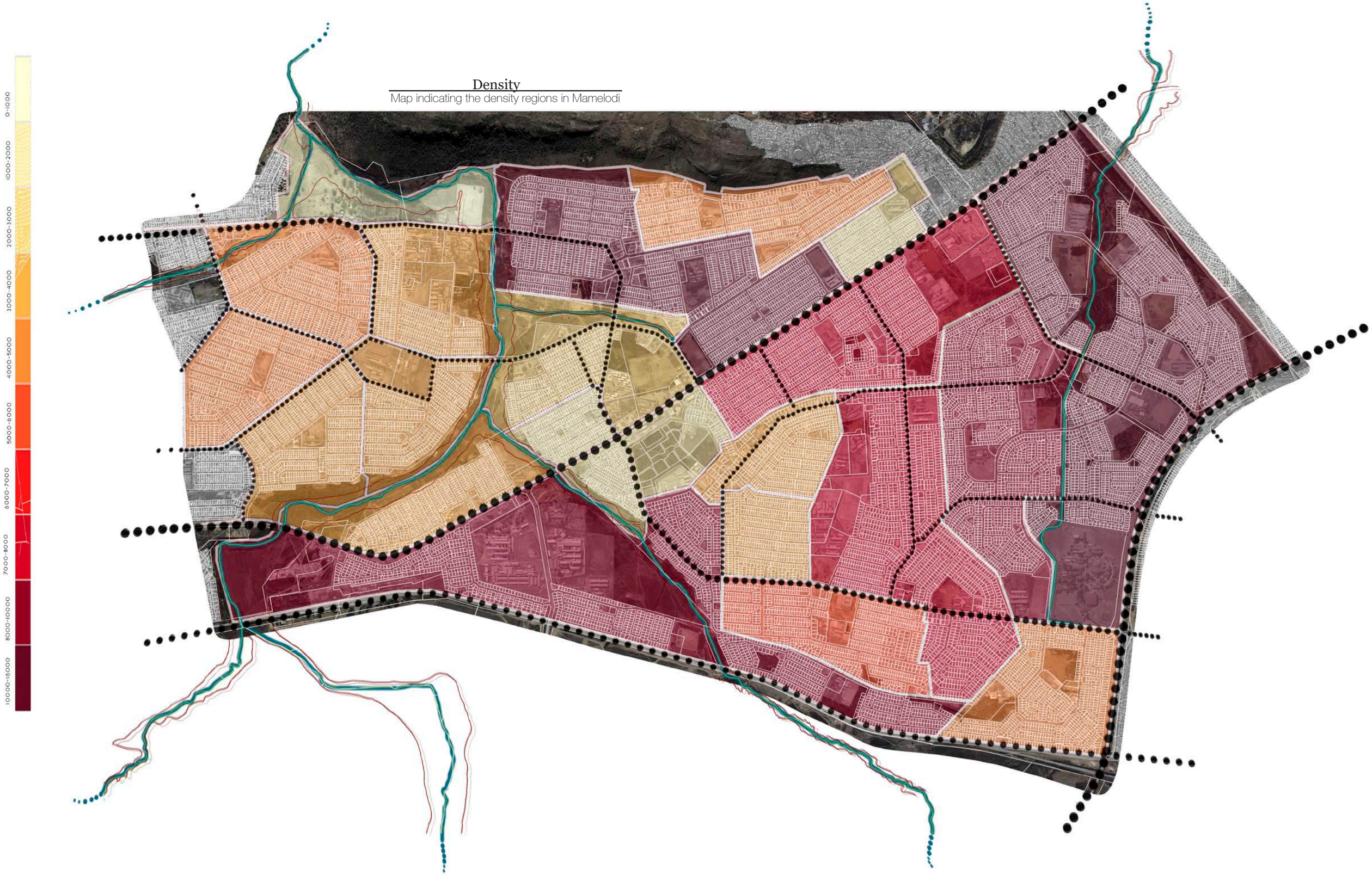


Figure 2.19: Mamelodi Urban Vision Group Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

Social Infrastructure

Map indicating the all findings

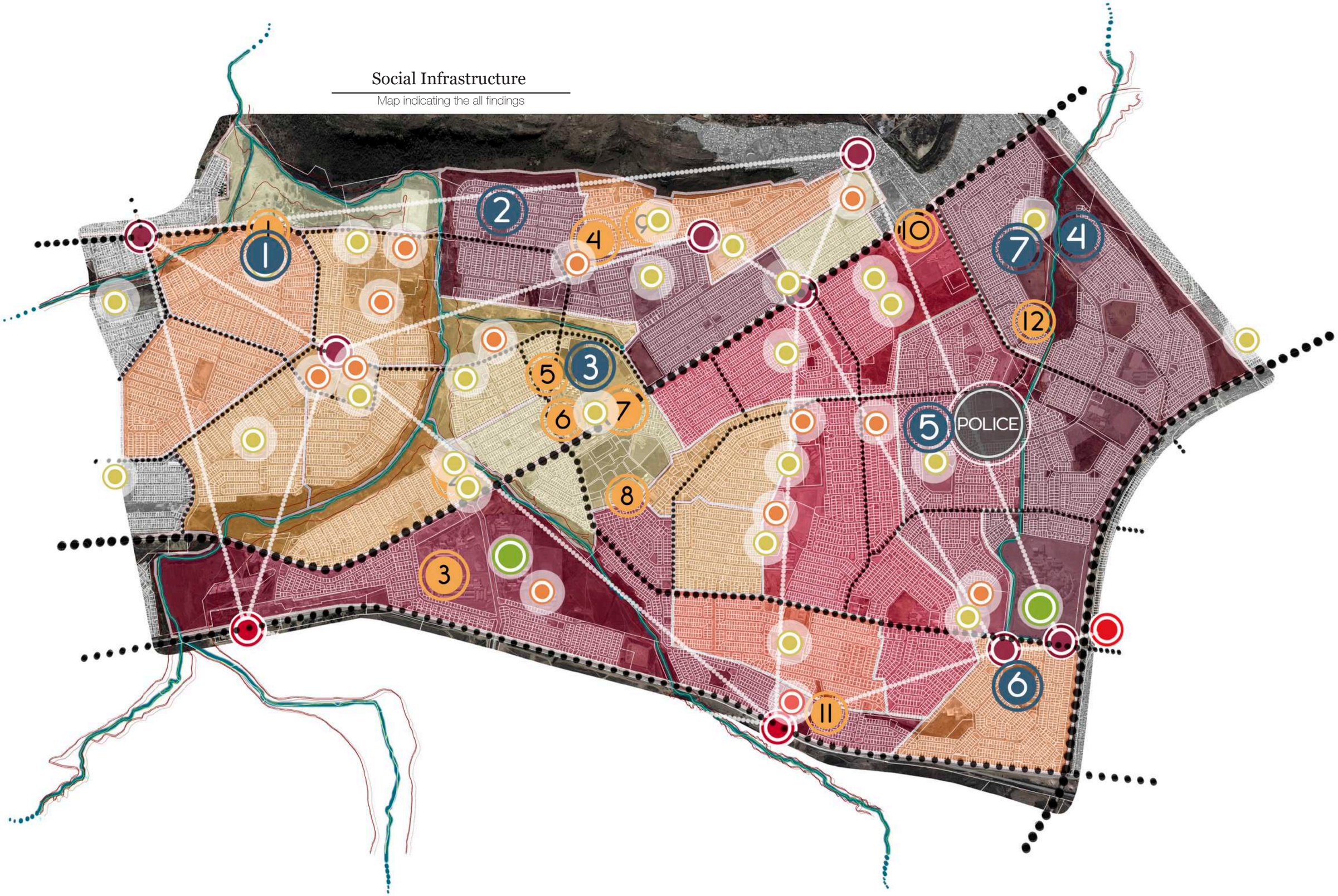


Figure 2.20: Mamelodi Urban Vision Group Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

Synergy Nodes

Synergy nodes are formed where points of activity and social infrastructure overlap. This is an indication of places where there is high levels of pedestrian movement and community interaction on various scales

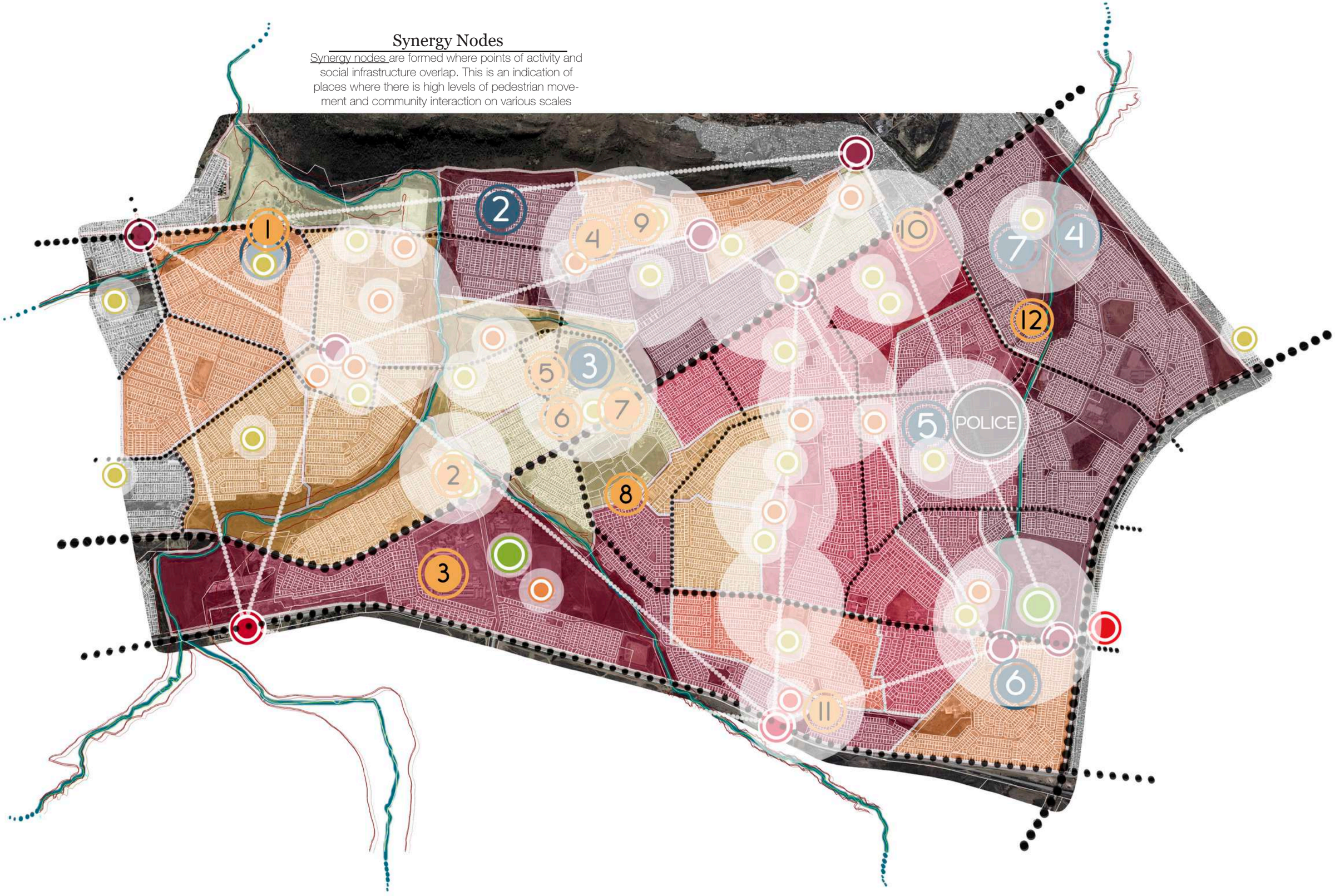


Figure 2.21: Mamelodi Urban Vision Group Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

Layer 02

The second layer of mapping was undertaken to determine specific relationships in the urban condition and to further understand occurrences within the synergy nodes. This mapping aimed to investigate specific factors deemed important identified by the urban vision mapping group and formulate investigation questions.

Factors investigated such as entrepreneurial activity, the spatial importance of the edge, the value of variety in density and affordability, how education facilities play out spatially and patterns within the educational context are aspects identified within this mapping (Gerber & Veldsman, 2019).

Therefore, the following questions were asked,:

A. What is the relationship between movement corridors, transport, and education facilities?

B. What is the relationship between residential typology and density? Why do people want to live in specific areas?

B. What is the relationship that educational facilities entrances have with the street?

C. What is the relationship between educational buildings and their environment?

A. Movement Synergy

A. The relationship between movement corridors, transport and education facilities?

The findings in the mapping of layer 1 revealed that entrepreneurial businesses have a direct relationship with public facilities along movement corridors. This mapping visually illustrates how the intangible movement and energy produced from entrepreneurial businesses can take form along main movement routes.

Findings:
Movement corridors are the main thoroughfare to trade as well as feed users to public facilities. Informal trade becomes an indication of synergy nodes that occur along main movement corridors and near social infrastructure and is deemed as important to the context. It is also seen that social infrastructure becomes the result and runs tangent to the movement corridors.

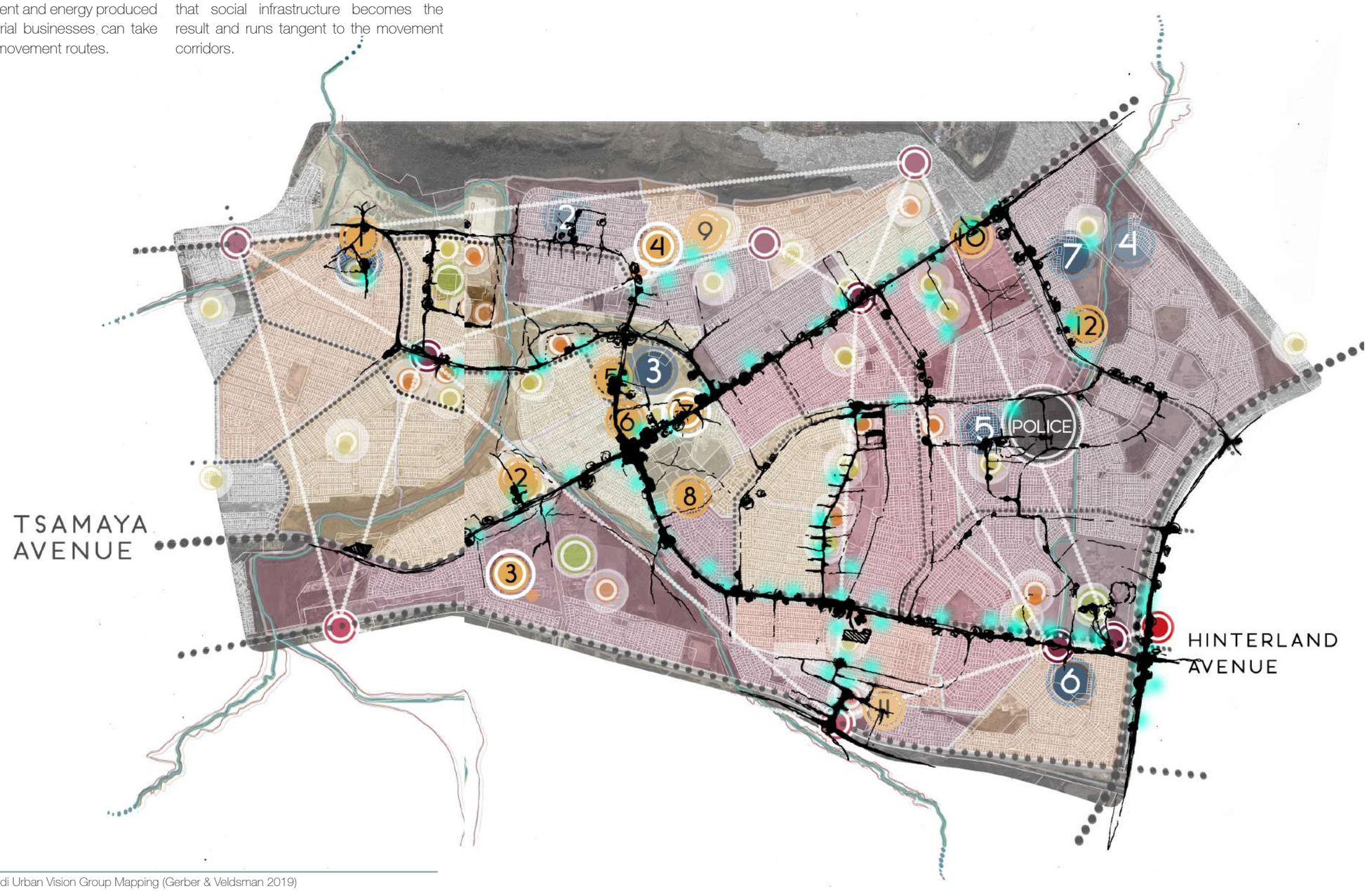


Figure 2.22: Mamelodi Urban Vision Group Mapping (Gerber & Veldsman 2019)

B. Density

B. What is the relationship that educational facilities entrances have with the street?

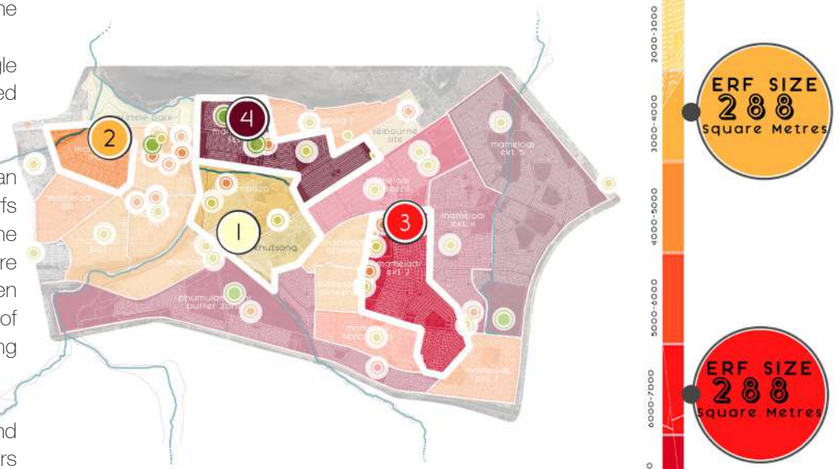
Observed in layer 01 there is a variety of density occurring throughout the landscape. Four study groups were taken from different density groups to determine why people live in specific areas and how it plays out typologically. Homes were classified into three groups: government homes (NE/51), homes that have undergone additions and alterations. A section was then taken through the landscape to see how it plays out spatially.

Interpretive Findings observed in the landscape:
-The lower density resulted in single structure buildings and the site is populated to its full capacity.

-The highest density consists of more than one housing structure on an erf. These erfs are also larger in square meters than the other studied areas. The structures are tightly arranged with passageways between the structures. This could be evidence of sub-letting, allowing for lower-cost housing and affordable housing options to occur.

-Most sidewalk surfaces are untreated and in poor condition, and as a result, users have to occupy the street and are unable to walk on the walkways.

-Wider sidewalks allow for informal traders to occupy the sidewalks spontaneously and users to pass. As observed more users use these wider sidewalks due to activity and self appropriation/ treatment of sidewalks by entrepreneurial activity.



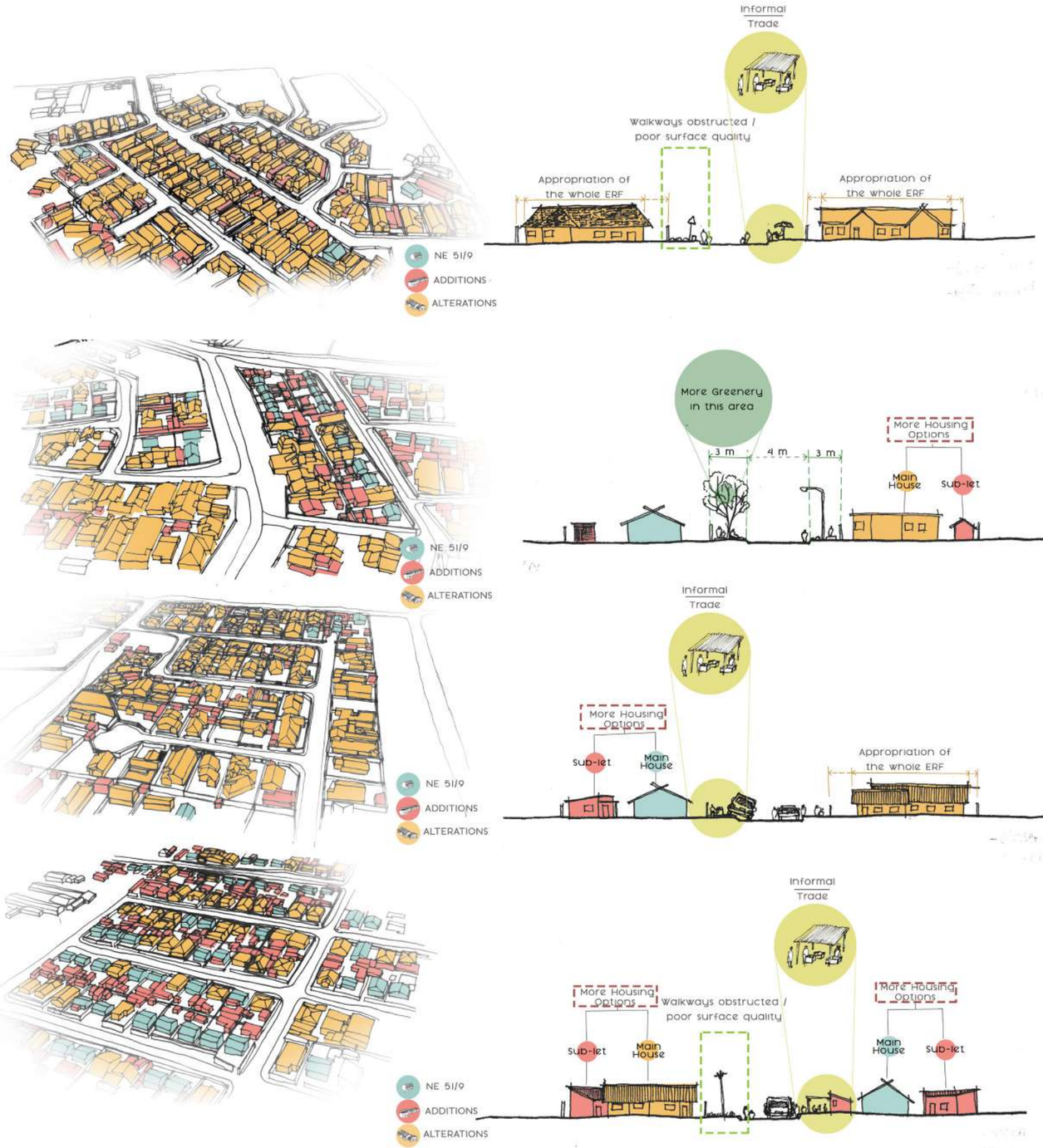


Figure 2.23: Mamelodi Urban Vision Group Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

C. Schools in their context

1.What is the relationship educational buildings have in their environment?

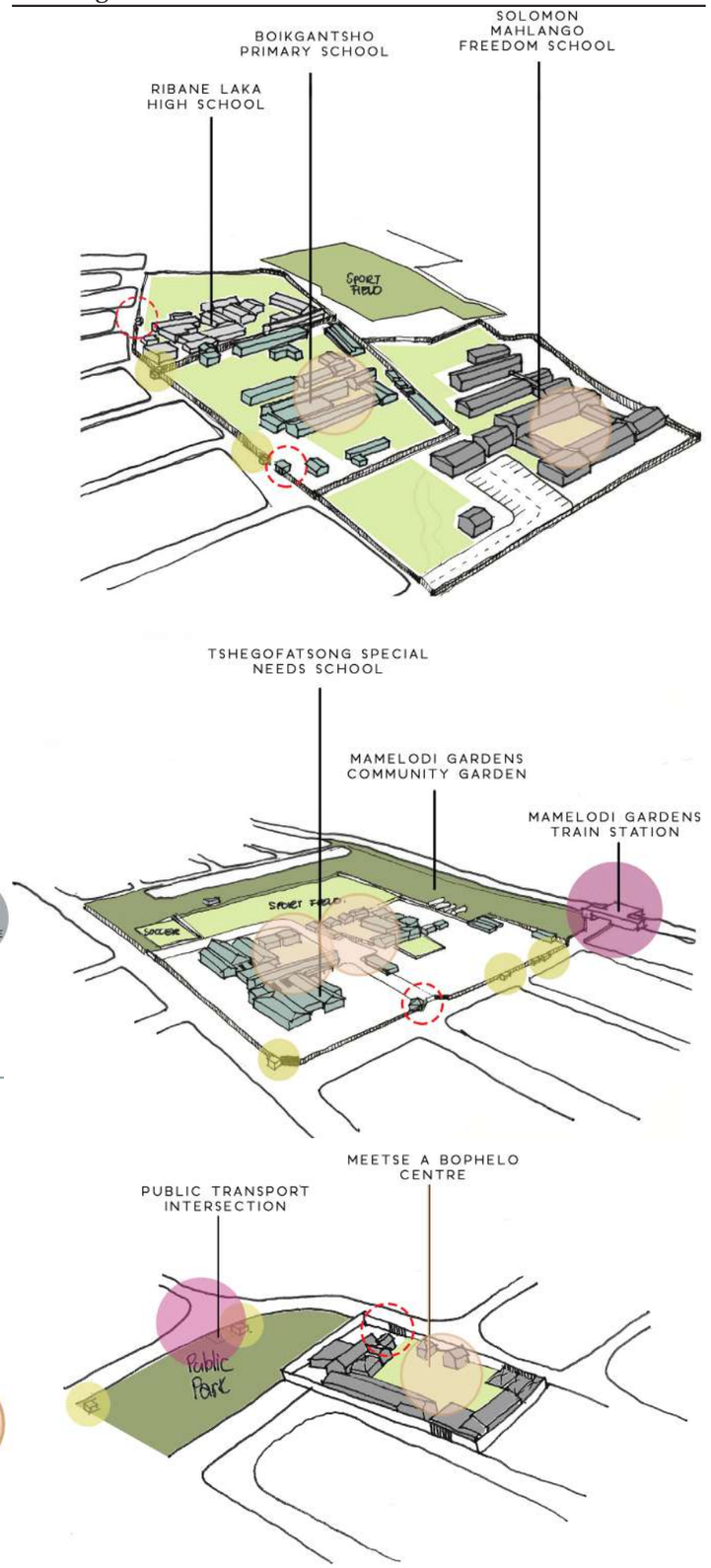
2.What is the relationship that educational facilities entrances have with the street?

Findings:
Informal trade becomes an important factor that runs in line with movement corridors and near social infrastructure. The relationship that exists between entrepreneurial business and these facilities, therefore, becomes important to entrance thresholds, as it provides passive surveillance as illustrated in the figure below. In all these examples the notion of 'safety' is highlighted through security at the entrances and boundaries.

School Entrance - Socio-economic model

Figure 2.24: Mamelodi Urban Vision Group Mapping (Author 2019, adapted from Gerber & Veldsman 2019)

Relationships Between Service Buildings And The Urban Fabric



Investigating The Entrance Threshold To The Educational Facility

Figure 2.25: Mamelodi Urban Vision Group Mapping (Author 2019, adapted from Gerber & Veldsman 2019)

D. Investigating The Urban Footpath / Verge

What is the relationship of entrepreneurial activity in their context?

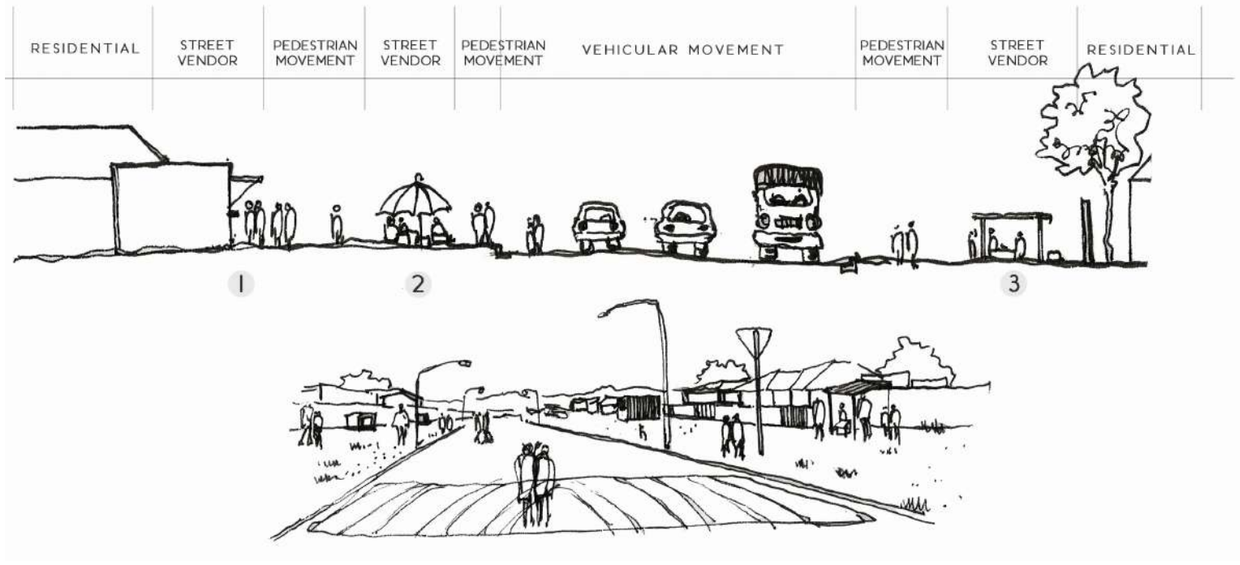


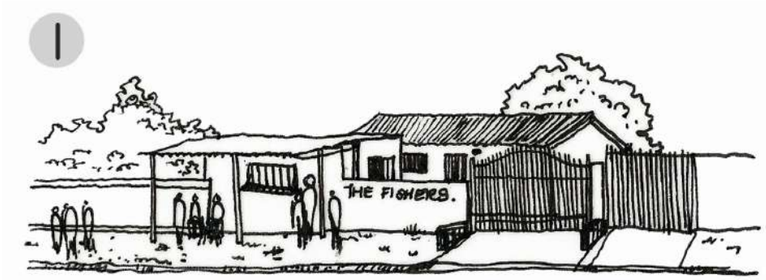
Figure 2.26: Urban Vision Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

Key Elements Identified from Mapping

- [x] Movement- The importance of streets
- [ ] Density
- [ ] Institutional disjunction
- [x] Relationship between education and entrepreneurship
- [ ] The importance of the edge
- [x] Safety
- [ ] Boundaries
- [ ] Value in Entrepreneurial Businesses

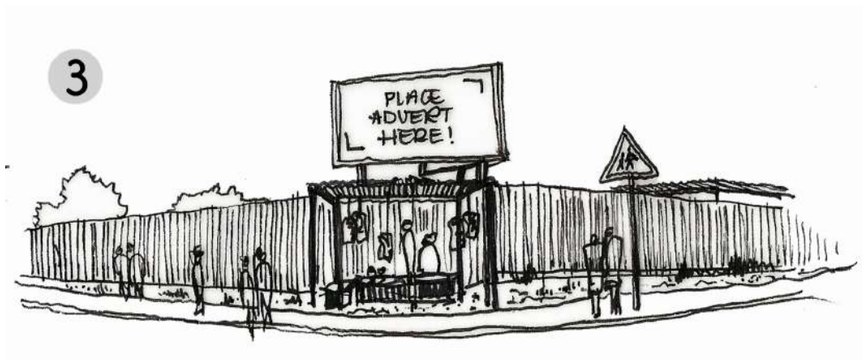
Impact on the built environment

3 Informal Trade Conditions Were Identified



Structure additions to residential properties to form informal trading on the street

Nomadic street vendors near the street edge along broad pavements



Expandable/ recycled material structures on busy street corners against school fences

Figure 2.27: Urban Vision Mapping
(Author 2019, adapted from Gerber & Veldsman 2019)

2.2.5 The Importance of Streets

Discoveries in Mamelodi, through the mapping exercises of Layer 01 and 02 and findings in the (GCRO 2018:41)led to the importance of the use of the street. Therefore, the concept of Edge City arose for the project. Edge City symbolizes the programmatic implementation of the project intervention.

Streets are public and have a multi-functional role of social, exchange, economic driver dynamic and contribute spatially to the creation of social spaces, community, and identity in Mamelodi.

Cities are made up of a continuum of public and private spaces that shape place (GCRO 2018:41). Streets have the ability to become self-reinforced social spaces that contribute to a sense of community and act as platforms for social interaction (Human & Puren 2016:11).

Streets are social spaces with their own particular formulated characters, social organisation, and forms (Barker 2009:115). Yet, in Mamelodi, the streets are designed with inadequate regard for their users and the function they serve. Investigation was conducted to determine the relationship education facilities and entrepreneurial businesses have with the streets.

"Edge City" aims to build on two key elements, firstly the functional differentiation of the township from the city which is foreclosed on the local economy. Secondly, it relies on the logic of control that characterizes Mamelodi in its design and ongoing functionality that is interwoven with the urban fabric (Human and Puren 2016:11). Further in this study how Social Entrepreneurship becomes a driver for this project intervention will be explored.

2.2.6 Urban Issue

There is an anomaly between the fine-grain scale of informality and the institutional scale of educational facilities, causing a breakdown on the urban edge, the urban experience and the disconnection from its surroundings. Figure 29 and 30 illustrates this effect.

"Edge City"

Figure 2.28: Edge City (Author 2019)

Fine grain of Informality

Entrepreneurial businesses in Mamelodi consist of a fine grain interwoven into the urban fabric. Multi-use, malleable, adaptable and informal structures are constructed spontaneously on the urban edge. Each stall adapts or applies a level of differentiation to stand out in the urban fabric.

Figure 2.29: Entrepreneurial Businesse in Mamelodi East (Author 2019)

Institutional Scale

Public buildings, such as schools, are fenced off, creating isolated institutions that do not contribute to the surrounding context. These high fences cause erosion of the urban edge condition resulting in unmaintained, unsafe, devalued barriers within these neighbourhoods.

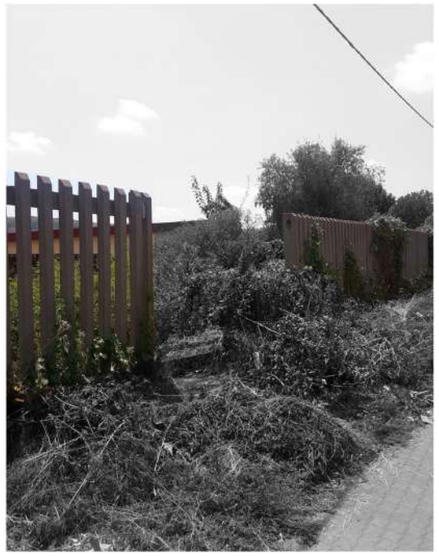


Figure 2.30:
Images of the of Educational Facility boundaries in Mamelodi-east
(Author 2019)

2.2.7 Urban Vision

As identified in the mapping and the concept of Edge City, Mamelodi currently consists of high entrepreneurial activity that occupies the streets in the context and the institutional disjunction inherent to institutional typologies causing the erosion of the urban edge Thus, the aim is to address this disparity and the effect it has on the street, in scale, program and integration. Thus, the following approach for the urban vision was taken.

The intent is to re-imagine and transform 'the edge', by re-evaluating edge-conditions of Public Service buildings (such as education and health care), street interface and public land and their relationship with the community. The adoption of an extroverted approach – motivating permeability between facilities and its community, integrating boundaries and creating a mixed approach between teachers, students, school and community extending facilities into the context.

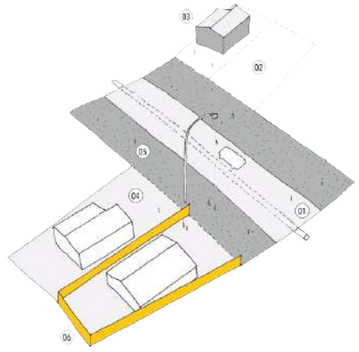
Therefore, the implementation of Transit-Oriented Developments (TODs) in Mamelodi is proposed.

TODs emphasise walkability, public transport and liveability within cities (Harber 2018:15). It is essentially a series of pedestrian pockets strung along a public transit route, establishing functionality through diversification and intensification. Development of TODs supports density, mixed-use functionality, walkability and connected communities (Jacobson & Forsyth 2008:52). The TODs will motivate pocket development around public facilities in Mamelodi, supporting transport and economical links.

The success of a TOD node not only relies on transport investment but on a broader range of policy instruments. Attention needs to be paid to the creation of vibrant street life, which requires the orientation of streets towards their users – particular to the users and transit-dependent users (Harber 2018:15).

a. First fix

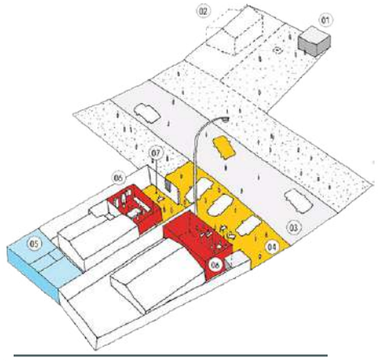
The accompanying diagram illustrates the original infrastructure that informed the properties along Eveline street.



Standard state housing is placed in the middle of the plot, streets are set back (±5,0m) and homes have privately constructed boundary walls (UrbanWorks & Sustainable Livelihoods Foundation 2017: 23).

b. Early Transformations

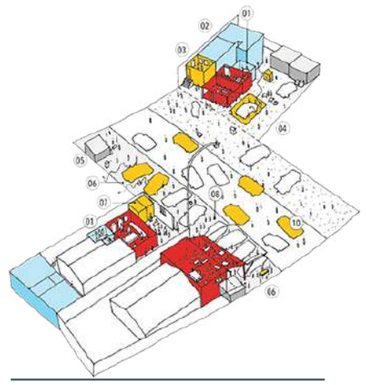
Early responses to the original infrastructure sought to optimise and appropriate wherever possible.



Original state housing is adapted/ demolished to make way for new structures or make-shift structures. Sidewalks are appropriated through the use of surface treatments, encroachments, and objects. Backyards are optimised with new structures for residential accommodation and additions are added in front of the original structures. Observed in Eveline street, leisure businesses were the first to utilise these property extensions. Semi-permeable front yards are made between the new structure and sidewalk (UrbanWorks & Sustainable Livelihoods Foundation 2017: 23).

c. Transformed Streets

Over time, these small incremental changes result in a dramatic change to the street creating a diversity of uses.



Small residential accommodation is provided in immediate proximity to businesses. The absence of boundary walls assist in the formation of inter-dependent business relations. Incremental development allowed business owners to replace original houses to better suit the economic interests and have a direct relationship to the street and are small in scale (UrbanWorks & Sustainable Livelihoods Foundation 2017: 23).

With this occurrence opportunity arise smaller businesses such as car washing, car repairs and small food vendors stimulate and accommodate along the sidewalk. Further allowing the sidewalk is highly appropriated to allow for circulation, socialisation, business, and entertainment (UrbanWorks & Sustainable Livelihoods Foundation 2017: 23).

Figure 2.31: Transformation of Eveline Street
(UrbanWorks & Sustainable Livelihoods Foundation 2017: 23).

Precedent:
Eveline Street, Windhoek

One such example where TODs were implemented was in Namibia: Eveline Street in Windhoek, aiming to create a vibrant and well-used street that supports the informality and recognises business corridors illustrated in figure 2.31 (UrbanWorks & Sustainable Livelihoods Foundation 2017:23).

Strategy Implemented:
"Sustainable building alterations (vertical and horizontal), infrastructure adaptations, provision of shaded parking, surface treatment (paving). Public lighting and the establishment of satellite enterprise." (UrbanWorks & Sustainable Livelihoods Foundation 2017: 23).

Urban Vision Strategy:

The aim of the Urban Vision is to incorporate entrepreneurial businesses into public buildings such as education, health, a variety of employment opportunities adjacent to public transport interchanges to promote social transformation and to transfigure the street with both spatial and economic benefits.

Firstly, principles are set out for a urban strategy, further previous mapping in layer 01 and 02 set-out design principles. Lastly, the street edge is re-imagined by creating a urban vision.

01

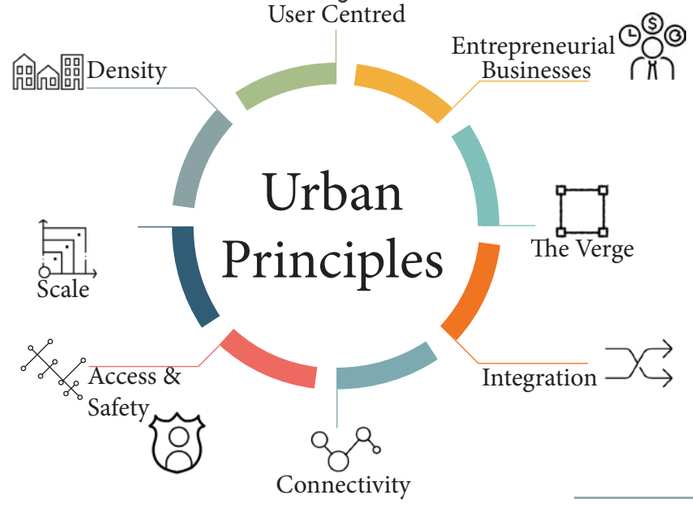


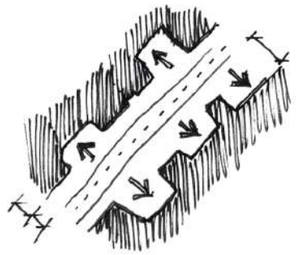
Figure 2.32: Urban Principles (Author 2019)

Establishing Design Principles

based on the site analysis and findings

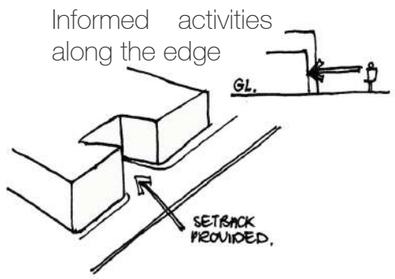
activity, breaking or permeating the street edge

Widen Pedestrian Corridors



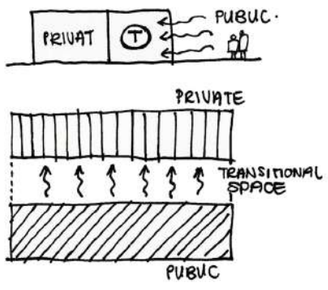
Wide pavements to allow for pedestrian movement and street vendor activity

Informed activities along the edge



Recess built edge to create spaces for activity and interaction

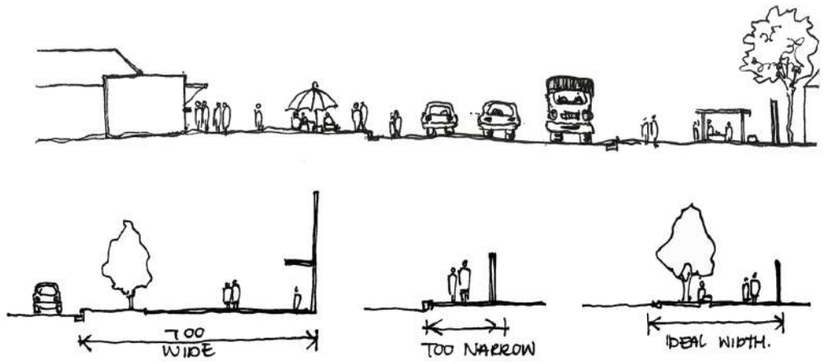
The setback from the street edge for entrances to public buildings create inviting and more comfortable thresholds



Within the transitional space the public life of buildings show their face to the street

Figure 2.33: Mamelodi Urban Vision Group (Author 2019, adapted from Gerber & Veldsman 2019)

Successful Footpath / Verge



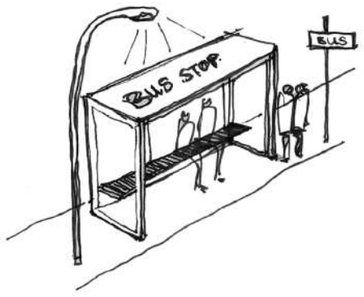
Public Space at Edge of Street

This is the center of pedestrian activity and the interface between the public and private realm. As this space is the 'in-between' space which links all things in the street. Its width is important to accommodate movement and community interaction

Informal Trade

Wide pavements to allow for pedestrian movement and street vendor activity

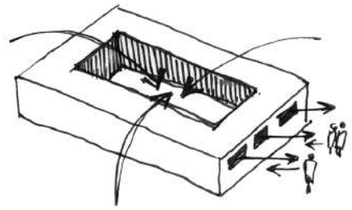
Public Transport



Formalised public transport nodes which offer street furniture and social gathering spaces which will allow for informal businesses to succeed in these spaces

Create safe environments for community interaction

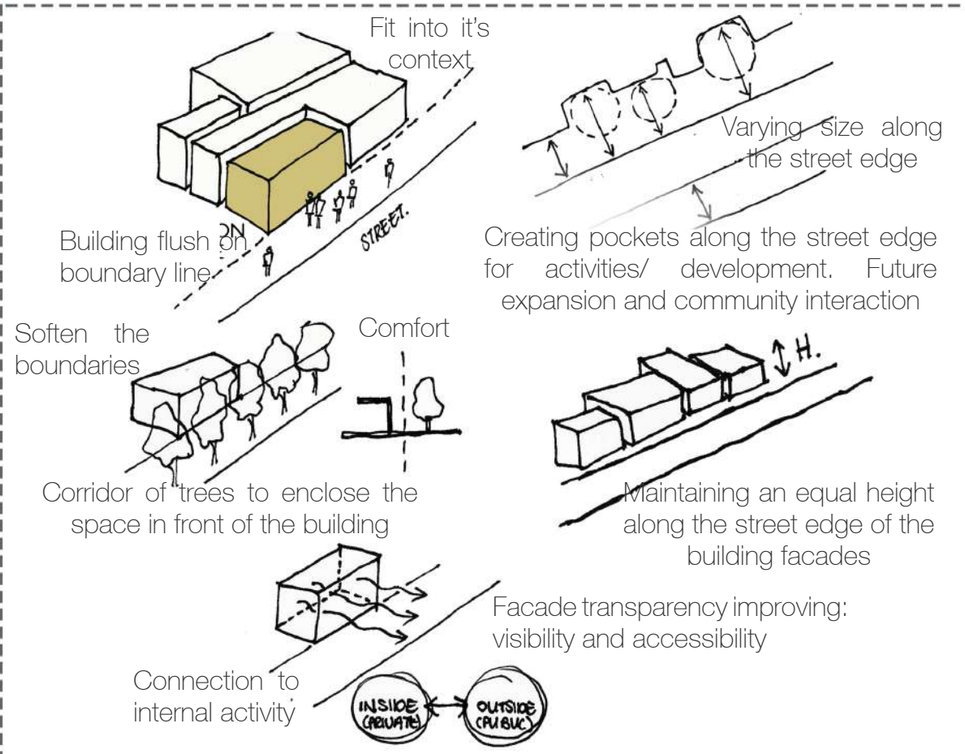
Accessible Public Face to the Street and The Community



Social infrastructure pushed up against the public boundary to allow for community accessibility in terms of visibility. Yet internalised design approaches are adopted to create safe and secure spaces within the facilities.

Open Public Spaces

Green open spaces to allow for community gathering and interaction within the natural environment



Urban Vision

Transit Oriented Development (TODs)

Social infrastructure such as a school or well-being facility

Open Public Spaces

Rubbish bins to promote cleaner streets

Bicyle leane to encourage safe and 'sustainable' means of transportation

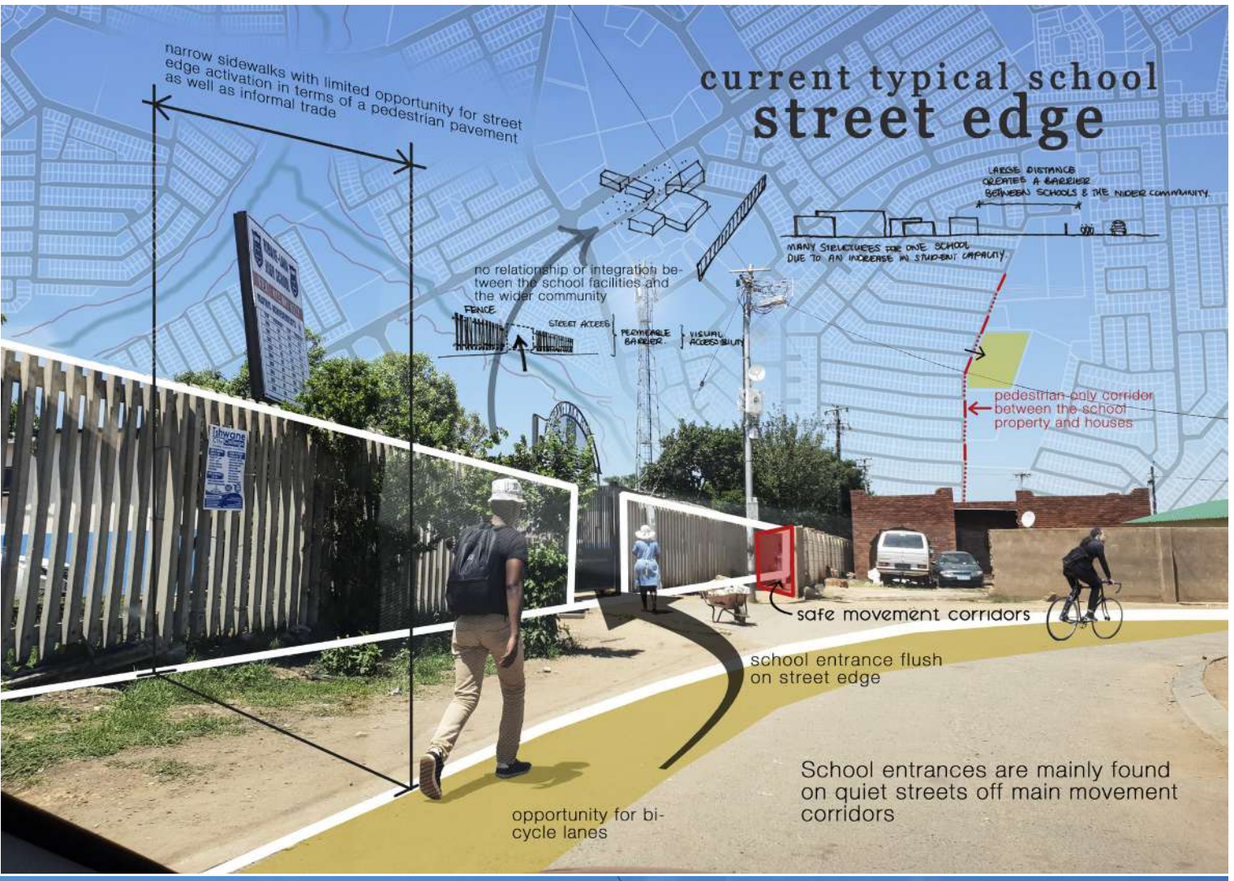
Wide pavements for street gatherings and activities to occur

Pedestrian bridge across busy vehicular roads

Pavements which allows for street vendors to operate

Adopting an extroverted approach improving the permeability between schools /public facilities and the community with the aim of establishing and strengthening a sense of community within Mamelodi.

Figure 2.34: Mamelodi Urban Vision Group illustrations by Gerber (2019);
(Edited by Author 2019 from Mamelodi Urban Vision Group (Gerber & Veldsman 2019))



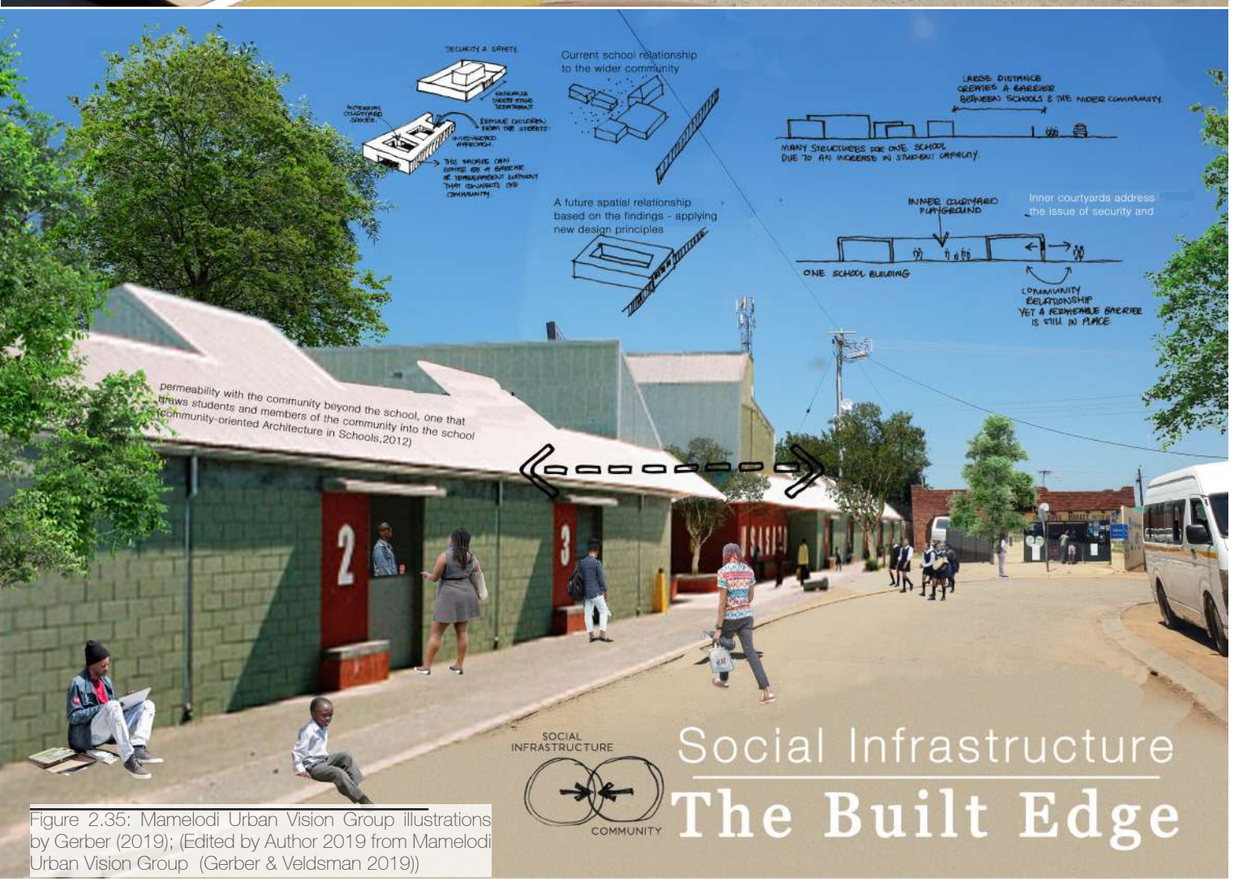


Figure 2.35: Mamelodi Urban Vision Group illustrations by Gerber (2019); (Edited by Author 2019 from Mamelodi Urban Vision Group (Gerber & Veldsman 2019))

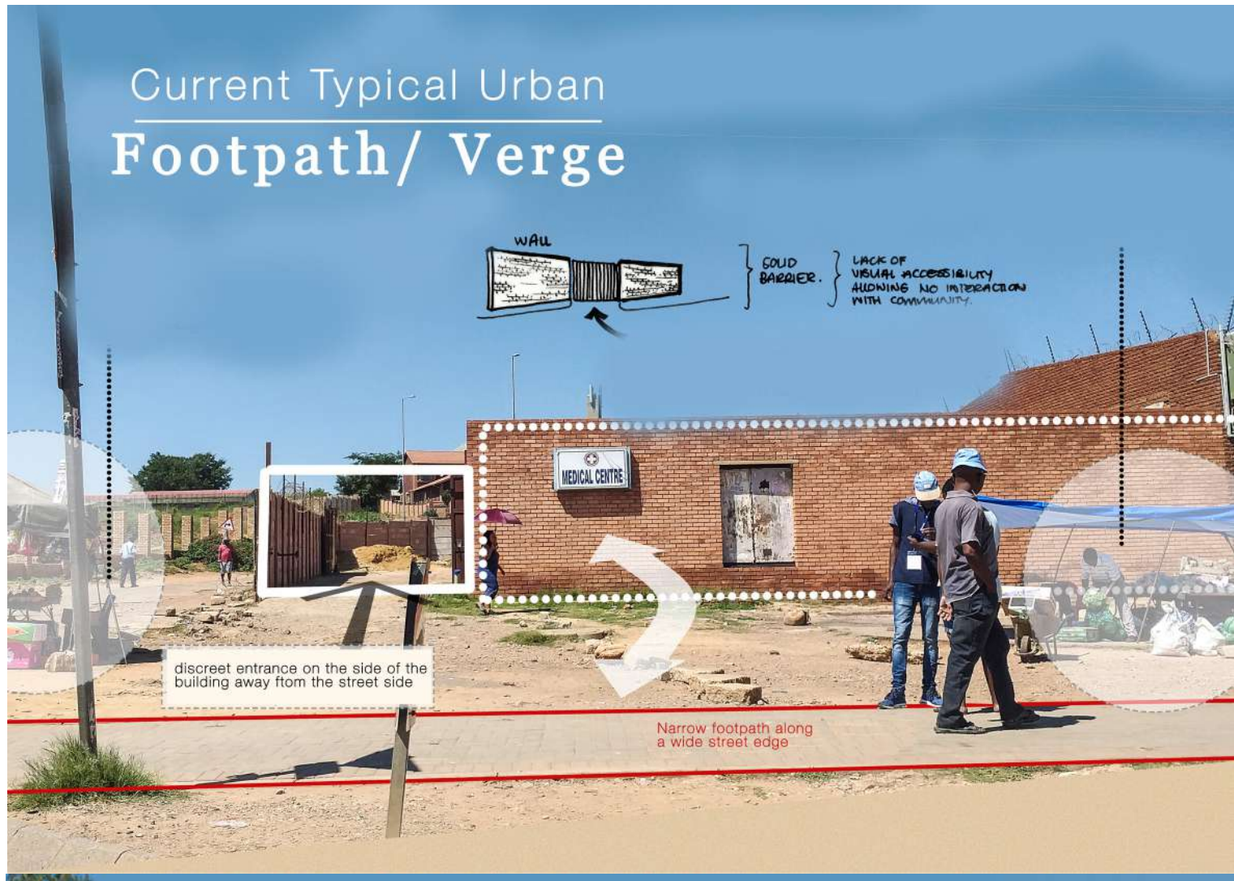


Figure 2.36: Mamelodi Urban Vision Group illustrations by Gerber (2019); (Edited by Author 2019 from Mamelodi Urban Vision Group (Gerber & Veldsman 2019))

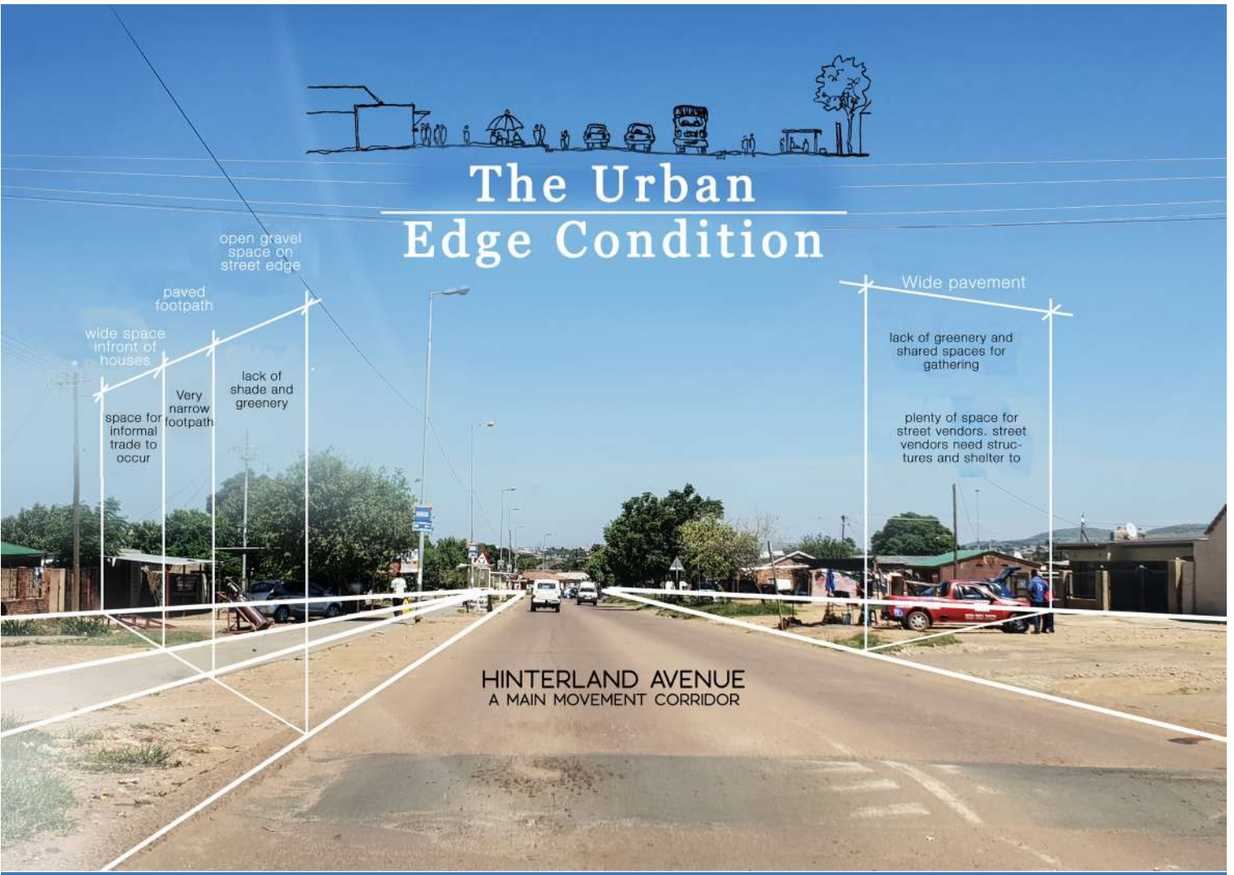


Figure 2.37: Mamelodi Urban Vision Group illustrations by Gerber (2019); (Edited by Author 2019 from Mamelodi Urban Vision Group (Gerber & Veldsman 2019))

The Current Situation Investigated the use of Large Open Spaces

unutilised spaces with little activity became dumping spaces for rubbish

pathways developed through large open spaces/fields to create shortcuts accross urban blocks.

Findings: very little activity occurs in these open spaces where there is little or no shade provided by trees and there is no social infrastructure or services here, therefore less pedestrian activity within these spaces. These spaces go unused and become dumping grounds.

Figure 2.38: Mamelodi Urban Vision Group illustrations by Gerber (2019); (Edited by Author 2019 from Mamelodi Urban Vision Group (Gerber & Veldsman 2019))

2.3 Programme Intention

The intention of the programme is to introduce a new perspective to reuse and repurpose existing education facilities. The aim is to investigate how the architectural design and processes can assist an existing secondary school to become entrepreneurial and "outward" through placemaking.

The programme mediates between education and entrepreneurial processes to create an engaged higher education model that promotes social entrepreneurship. Figure 2.40 illustrates the conceptual intention of the programme. The programme proposes to create educational pathways for youth in Mamelodi by providing a multi-function platform of shared resources, skills and learning to support the surrounding entrepreneurial activity, school, and community.

The programme intends to inform the architectural response to re-imagining the boundaries and extending learning spaces through creative use of open space and forging partnerships, fostering an economic environment within Mamelodi-east. In turn, employment projects can grow and impact the consequential role of microeconomics in our cities.

2.3.1. Context Influencing Programme

The surrounding context is investigated and used as an informant to improve the outdated and seemingly unsuccessful spatial relationships that currently exist between educational buildings, the environment and the community it serves.

2.4 Study Area

The study area aimed to be investigated sets out a 1km radius from Tsako Thabo Secondary School of macro influences impacting this site.

Figure 2.39: Conceptual illustration of Programmatic Intention (Author 2019)

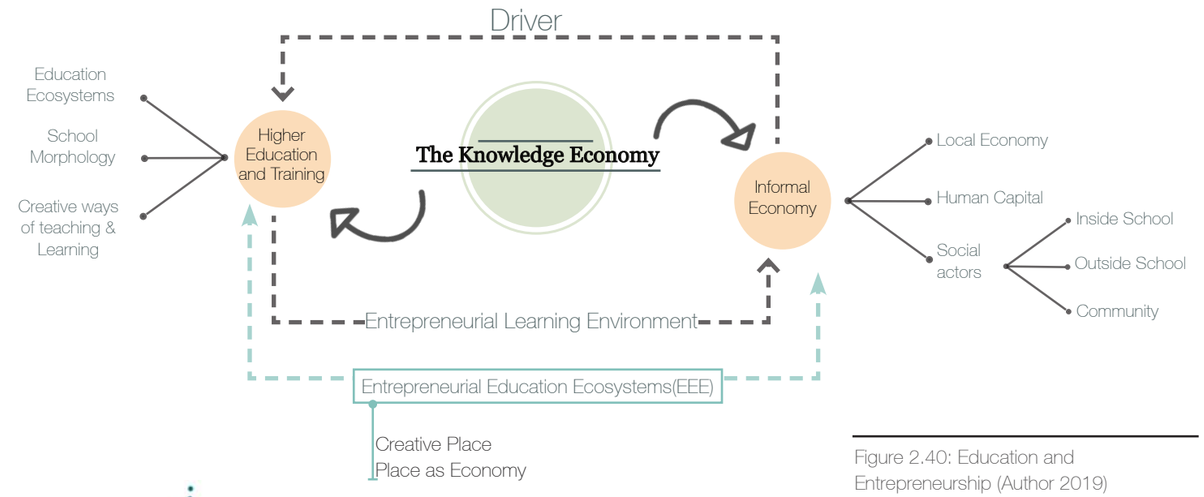


Figure 2.40: Education and Entrepreneurship (Author 2019)

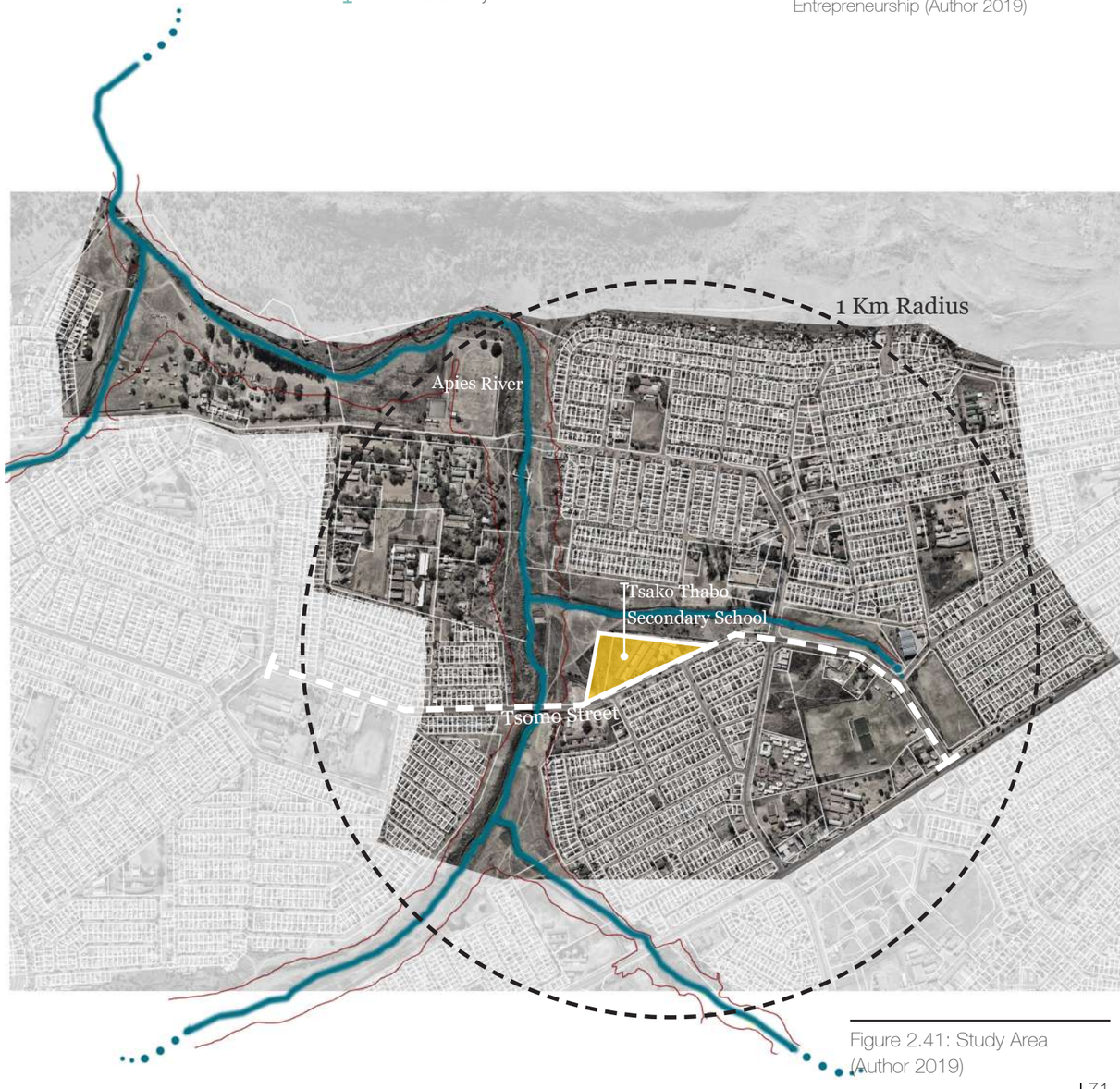


Figure 2.41: Study Area (Author 2019)

2.5 Context

Natural Context

Tshako Thabo High School is located next to the Pienaar River that divides Mamelodi into east and west. The natural ridge is an important factor in the context, its setting suggests the expansion of Mamelodi from the West to the East. The ridge allows for pedestrian routes, access to other educational complexes, recreational provisions and as a natural context.

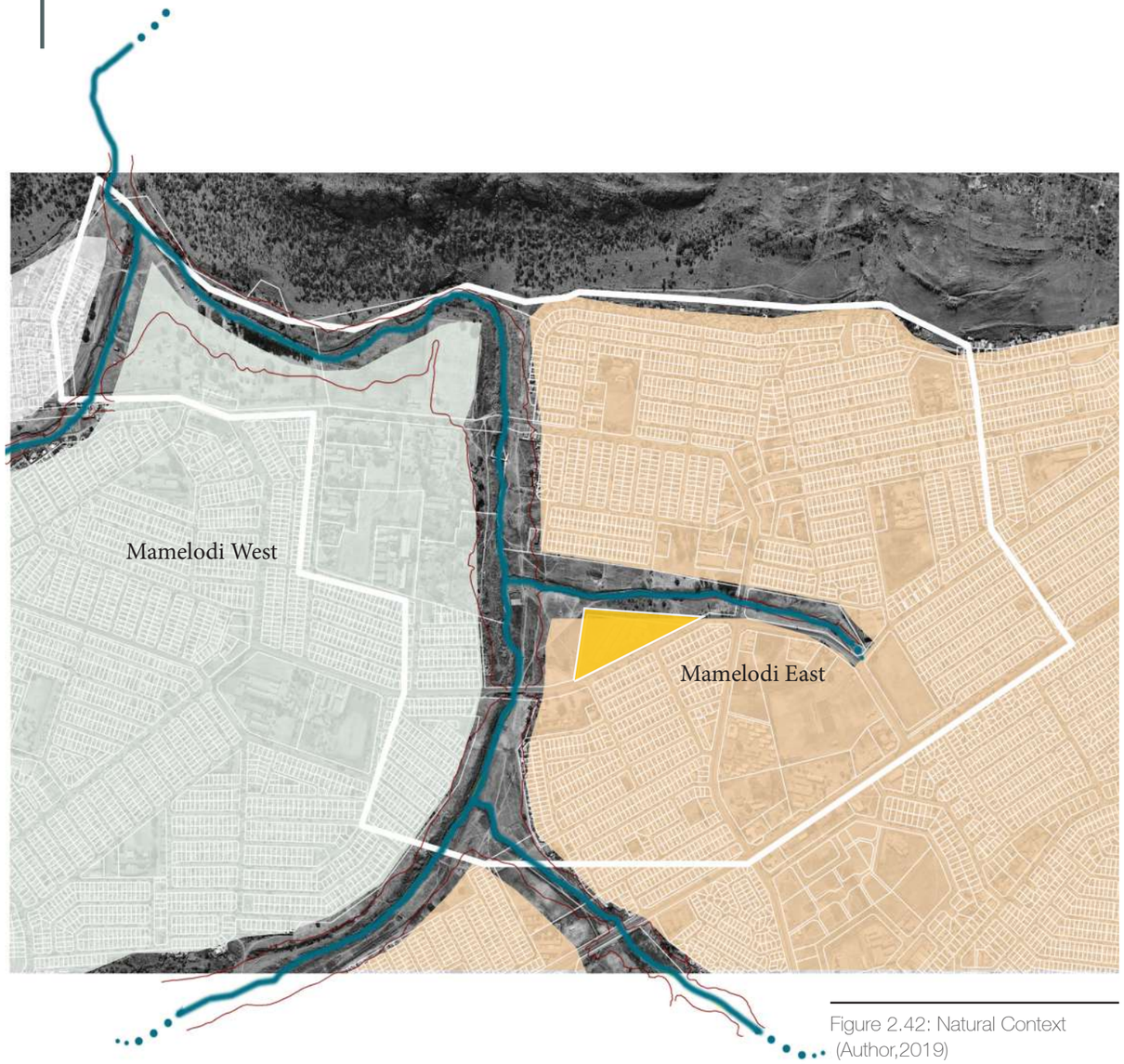


Figure 2.42: Natural Context (Author,2019)

Education Facilities

This figure illustrates learning facilities located within this study area, there are 7 Primary schools, 6 Secondary Schools and 4 Higher Education Facilities. There exist a high concentration of education facilities in this area.

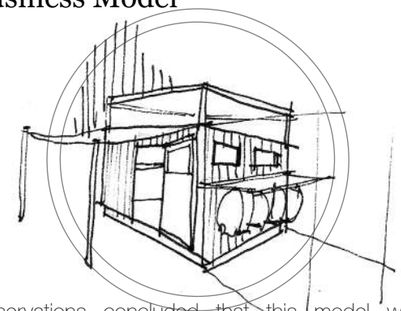
Figure2.43: Education facilities in study area (Author,2019)

Entrepreneurial Businesses

This figure illustrates entrepreneurial activity located and observed within the study area. They are classified into 6 groups (adapted from van der Hoven, Konstantinou, Mlabo Nolwazi. Hons 2019 Nested Systems Mapping of Mamelodi). McGraffin (2015:6) identifies these type of models as household survival strategies. These business owners consider the provision of suitable spaces less important than access to finance and customers" (McGraffin, 2015:7)

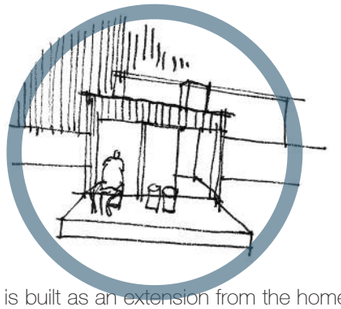
Figure 2.44: Adapted from van der Hoven, Konstantinou,Mlabo Nolwazi.
Up Arch Hons 2019 Nested Systems Mapping (Author 2019)

01
The Innovative Business Model



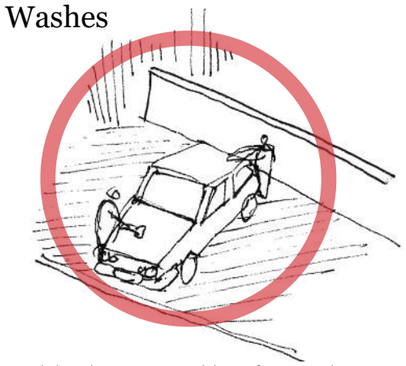
Observations concluded that this model was established as a result of the creation of a innovative product. These include: assistance in domestic chores, fast food or backyard rental.

02
Hair Salons/ Barber/Hair Dresser



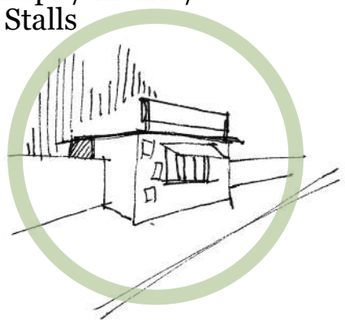
This model is built as an extension from the home/ yard, a source of secondary income and activates the street edge.

03
Car Washes



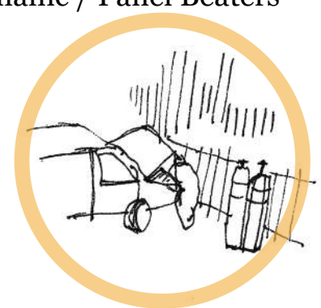
This model takes ownership of an edge or extends from a household. In many cases it is observed how this model formalise the street edge and influence the edge, by cleaning up public space, co-exist programmes and forming recreational areas.

04
Spaza Shops / kiosks / Vendor Stalls



Common business model that is extended from the home/ yard. Business model occurs where there is high pedestrian activity and provides passive surveillance to its context. This model is a additional source of income or full time employment.

05
Mechanic / Panel Beaters



Generation of income, apprenticeship and skill transfer. This model co-exist with other models, such as car wash to parts.

06
Taverns/ Night Clubs

This model is an extension of households and caters for a more privatised network. This model has a relationship with the street edge and is located near high pedestrian activity.

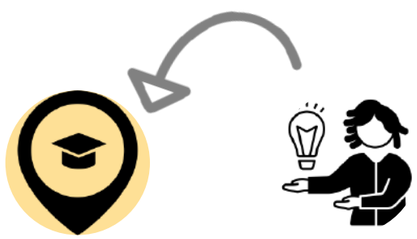
Figure 2.45: Adapted from van der Hoven, Konstantinou,Mlabo Nolwazi.
Hons 2019 Nested Systems Mapping (Author 2019)

Entrepreneurial Activity in Tsako Thabo Secondary School

Investigation is initiated of the entrepreneurial activity in Tsako Thabo Secondary School is observed in 4 ways (Up Arch Hons Studio 2019):

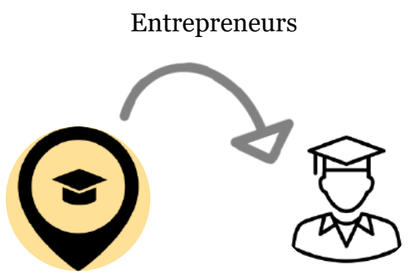
A. Entrepreneurial Actors coming in

As there is no formal tuck shop on the school premises, women from the community are allowed to enter the school premises and sell their goods to the students during their break time.

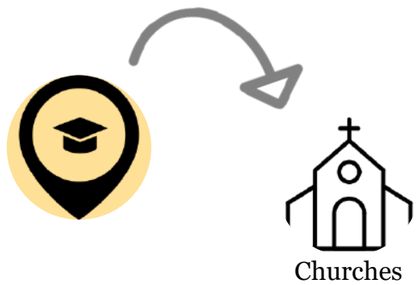


B. In-School stimulation

The students are offered entrepreneurial classes in the school to encourage them to pursue their own businesses.



C. School is hired out to about 16 churches on Sundays



D. Social Actors in Tsako Thabo Secondary School

Internally students sell good to their piers on the school grounds, such as sweets and cookies.

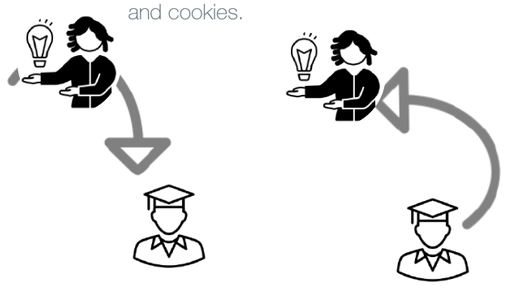


Figure 2.46: Entrepreneurial Activity in Tsako Thabo Secondary. Adapted from van der Hoven, Konstantinou,Mlabo Nolwazi. Up Arch Hons 2019 Nested Systems Mapping (Author 2019)

Entrepreneurial Activity on the edge of Tsako Thabo Secondary School

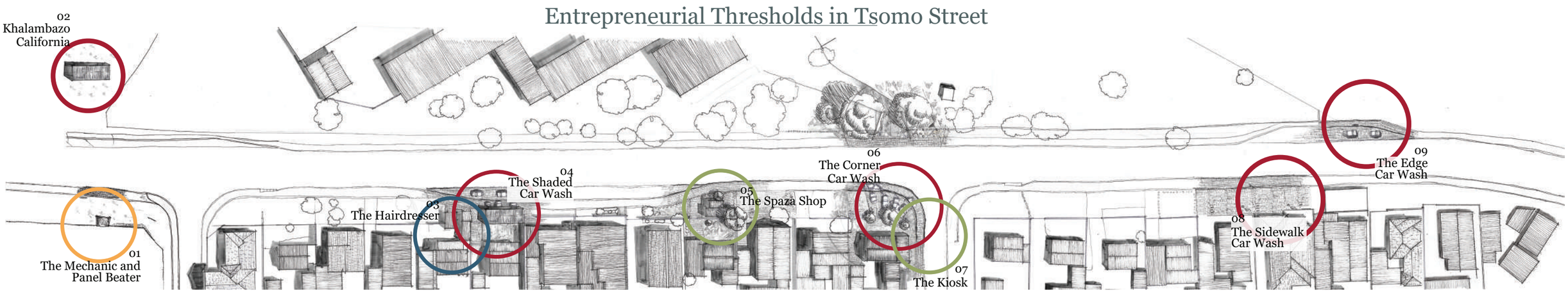


Figure 2.46: Entrepreneurial Activity in Tsomo Street (Author 2019)

The Context of Tsako Thabo Secondary School

Tsako Thabo Secondary School is located on Tsomo Street. The site slopes to the Nort-west with a clear view to the Magaliesberg Mountain Range to the north of the site.

The school is in close range to various other schools. The site has formal access only on Tsomo Street, with entrepreneurial activity in the street, other edges are fenced off.

The site consists of various desire lines of pedestrian traffic, with two car washes that are present on the site. A Main movement desire-line forms long the fenced off edges.

Figure 2.47: The Context
(Author 2019)

2.6 Programme and Client

2.6.1 Stakeholders and Client

The proposed stakeholders are Tsako Thabo secondary Schools in association with the Department of Higher Education and Training, the community secondary schools and higher education models in this region and the and Entrepreneurship Development in Higher Education. The focus is on providing skills and learning to the entrepreneurial businesses in the area.

In the creation of a social entrepreneurial school, the community and parents become the secondary stakeholder. The network of schools and higher education models strengthen and the Business School of the University of Pretoria Mamelodi Campus form part of the secondary stakeholder group.

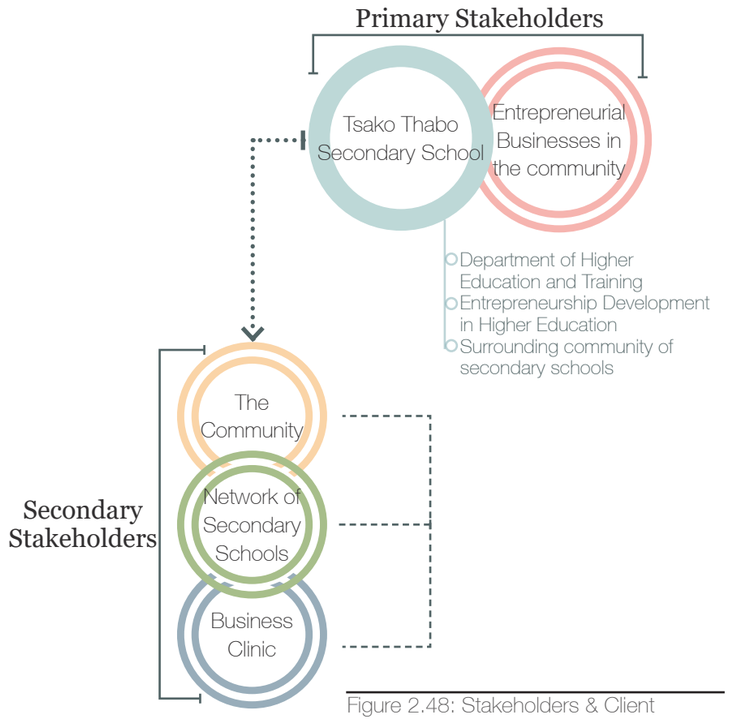


Figure 2.48: Stakeholders & Client (Author 2019)

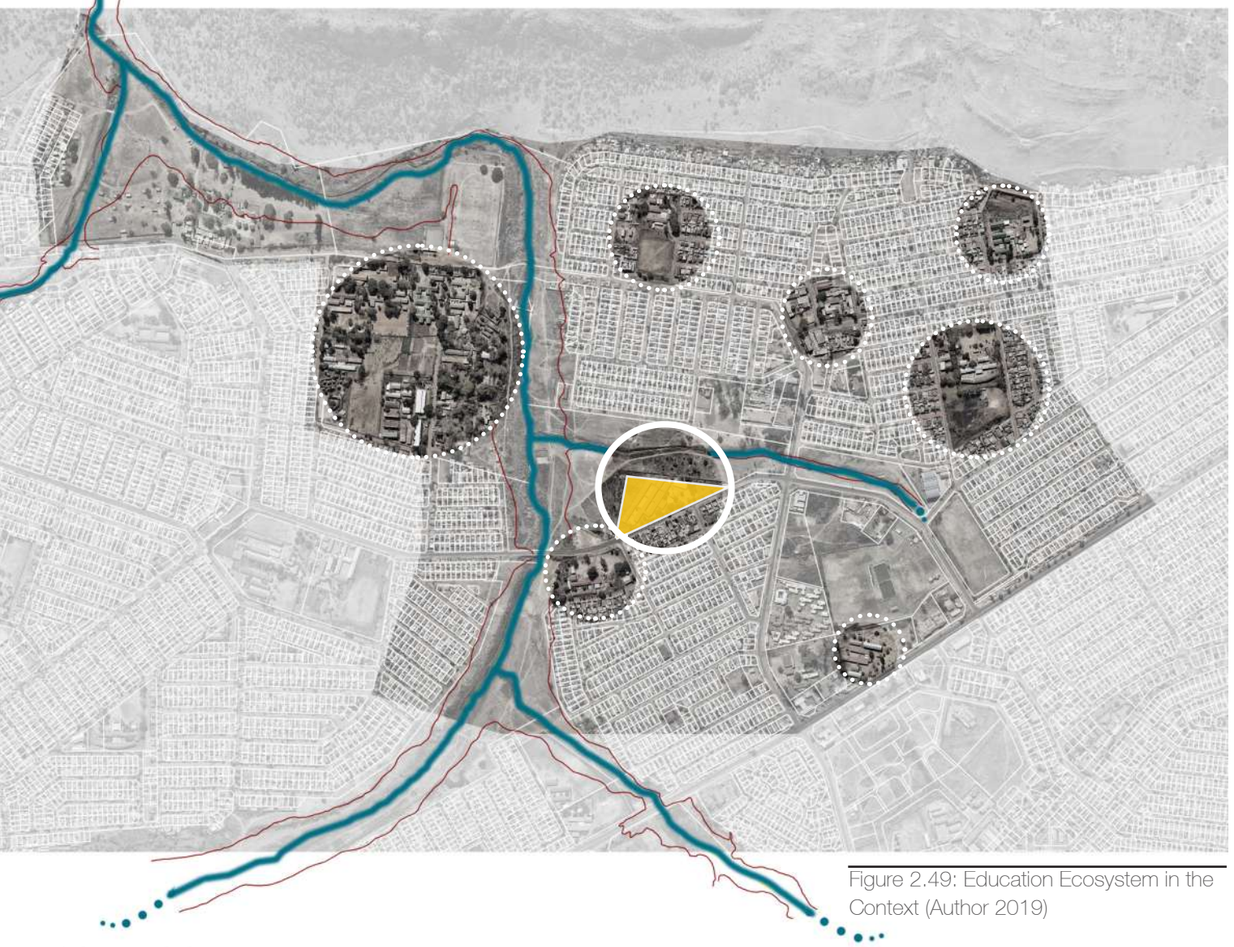


Figure 2.49: Education Ecosystem in the Context (Author 2019)

2.6.2 Programme Structure

Tsako Thabo Secondary School will be the starting point of this intervention establishing the connection between the community, education, and entrepreneurship.

Primary Programme

The primary engine and core of this programme is Tsako Thabo Secondary School re imagined to respond to new programmes inserted into the site.

Secondary Programme

The primary engine of this programme is Tsako Thabo Secondary School re imagined to respond to new programmes inserted into the site.

Tertiary Programme

Tertiary programmes aim to address the edge by incorporating existing entrepreneurial businesses into the edge.

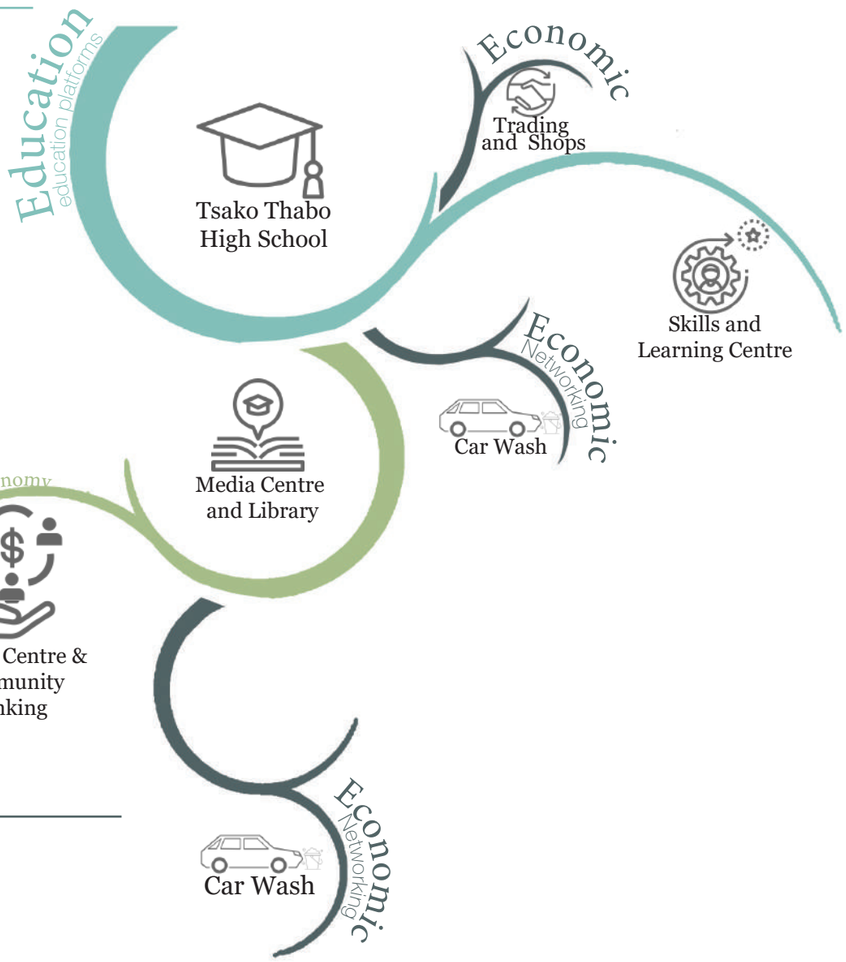


Figure 2.50: Programme Illustration (Author 2019)

2.6.3 Programatic Requirements

With Tsako Thabo Secondary School being primary focus of this study. The programatic requirements are explored based on the Department of education annexture A (2013:14-16).

Together with programatic requirements users are characterised to assist the design process in placement of programmes.

Secondary School - Admin

(Department of Education,2013:14-16 Annexure A)

Function	Functional Quantity	Users	Requirements	Unit size m^2
1. Principals Office	1			15-20
2. Storage	1			12-15
3. Offices	3			12-15
4. Printing Room	0-1			10-15
5. Sick Room and Supporting Services	2			10-15
6.Staff Room	1			48-60

Secondary School - Core

(Department of Education,2013:14-16 Annexure A)

Function	Functional Quantity	Users	Requirements	Unit size m^2
1. Classroom	25			48-60
2. Technological Teaching	2-3			60-120
3.Amblutions (ladies ans gents)				14-16 WC 4-5 Urinals 11 Basin
4. Library	1			60-80 computer lab 100 (50 Students)
5. Creative Teaching [E.g. Agricultural studies, Design room, Visual Arts...]	-			100-120

Key

Natural Daylighting
Natural ventilation
Safety
Prevent Glare
Multipurpose spaces
Promotion of Innovative Design

Key:
- Learners/ Staff
- Entrepreneurs
- Community
- Up Mamelodi/ TVET/AET
- Parents

Figure 2.51: Programmatic Requirements (Author 2019)

Secondary School - Supporting Spaces

(Department of Education,2013:14-16 Annexure A)

Function	Functional Quantity	Users	Requirements	Unit size m^2
1.Food Garden	1			15-20
2. Tuck Shop	-			12-15
3.Kitchen	1			15-20
4. Food Storage	1			12-15
6.Parking	17-27			100-120
7. Hall	-			120-180
8. Sports Fields	-			Soccer/ rugby field 60 x 80-60x100 Netball 18x31
9. Training Room (shared learning)	-			

03
The Architectural Context Argument

3.1 The Context of learning

Learning environments are an integral part of the student learning experience and contribute to the creation of a 'culture of learning' in schools (Jimenez 2018:24). The school environment is the next resource in line to be tapped in terms of providing constructive and supportive environments after home environments (Mampane and Bouwer 2011:114). The physical learning environment serves as a link between design and behavior as where you learn impacts your learning (Jimenez 2018:21,23; Weeks 2012:1). Teaching and learning in these educational contexts have been recognised as important when creating learning environments (Muller 2015:1).

The built pedagogy is influenced by the way in which a designed space shapes the learning that happens and imposes on how space should be used; depending on the design, the designed space invites students to appropriate the space according to their perceived needs (Jimenez 2018:24). Weeks (2012:4) explains that limited research has been conducted to determine what constitutes a culture of learning in schools in South Africa; the current accent in generated literature rather relates to the understanding of the difficulties encountered in schools, such as violence and poverty, rather than the blockages that are caused by the built environment of educational facilities.

The physical environment of learning landscapes contributes to the role of disjunction and spatial legacy occurring in higher education institutions as well as in social problems within the community (Jimenez 2018:21,23; Weeks 2012:1). This disjunction occurring within the built environment impacts on the ability of learners to complete their educational pathways. Therefore, the study aims to investigate how the culture of learning is impacted by the built form and how social problems in Tsako Thabo Secondary School are in line with barriers preventing educational pathways.

3.2 The Continuum of learning environments

Learning environments and the creation of a culture of learning play an integral part in the student learning experience. An investigation is made into the continuum of architectural thinking in school design from the 20th century to the present. Examples are used to set out a visual summary illustrated in figure 3.1 to represent the educational shifts that occurred and have impacted on learning environments and culture of learning at the time.

The study is illustrated in three parts. The first illustrates key moments from the 20th century that shaped education and how learning environments are structured. The second conveys an educational shift made by architects such as Hertzberger, van Eyck and Scharoun that went against the systematic model of educational spaces, and gives attention to the reimagined educational environments which focus on the social role and relationship architecture has with its participants (Dudek 2000:38). The third investigates international and South African examples of how learning environments are constructed within their context.

Further investigation is initiated into education facilities in South Africa by way of a matrix. Two comparison research groups were used: schools that complied with the South African Schools Act: Minimum uniform norms and standards for public school infrastructure from 2009 and 2013 (Department of Education 2013). The intention was to discover the impact that six schools from different provinces in South Africa have on the design of schools and to consider the shift that occurred from 2009 to 2013.

Wood (2018) argues that by revisiting the creation of space, a broader vision of education is created. Dyer (2018b) discusses that limited attention is given to where students learn in schools. These spatial limitations affect learning spaces, the physical space as well as the learning outcome. The following findings were uncovered from this illustrative study which challenges the educational space and so fosters a new culture of learning.

Findings:

Trends impacting learning environments internationally:

Schools abroad are affected by conditions that have a substantial impact on learning spaces in the built environment which in turn affect and create unsuitable learning spaces. The first set of factors impacting learning relates to the physical learning space and includes limited learning spaces within schools, unsuitable learning spaces beyond the classroom, and spatial design implications affecting learning (e.g. noise, interruptions, and privacy) (Dyer 2018a).

The second range of factors involving space relates to the interior of learning space and how space affects learning, such as the arrangement of classrooms, the curriculum requirements within a space, the required policy in a learning space and pedagogical decisions (Dyer 2018a; Dyer 2018b).

Educational shift:
As observed in this study more recent learning environments are created to respond to contextual influences such as climate, culture, and material available in their specific setting (educational facilities designed by Kere (2015), Neoro (2004) and Wolff (2017)).

The built environment of a school creates gathering spaces across the school that promotes socio-spatial relationships to occur with the built environment. Interaction is promoted by the creation of seating, gathering pockets within the walkways of learning spaces, water-points, landscaping and materials used.

An example that stood out in this study was the local precedents illustrated, where both architectural firms, Kere Architects (2015) and Haworth Tompkins (2012), worked within an existing school and suggested alterations to address issues in the school to improve learning environments and learning experiences illustrated in figure 3.1 part 3.

Trends impacting learning environments in South Africa:

Judging from the matrix, a shift occurred from 2009 to 2013 with the implementation of the South African Schools Act: Minimum uniform norms and standards for public school infrastructure (Department of Education 2013). It is evident that the South African Higher Education Department's goal is to improve the context of learning environments of education facilities, with a set of universal principles, set out for the design of school buildings (GCIS 2017/18).

Many problems occurring in public government schools are socially generated, with difficulties encountered varying from violence to poverty and lack of resources as discussed in chapter 2, figures 2.5 and 2.6 (Ebersohn 2016:2).

Thus, the ability for existing schools in townships to reach these goals set out by the Norms and Standards of 2013 to address issues in school may only be in a few years due to schools relying on government funding and resources. This leaves many schools with the same issues and unable to achieve the norms and standards without an alternative strategy (third stream income or private funding, refer to figure 2.4).

Part 1

Illustrates key moments from the 20th century that shaped education and how learning environments are structured

The Formal Classroom 1908

The focus of schools were on the built form and not external spaces. Each room was allocated a specific function (Dudek,2000: 6).

Figure:
Geography Lesson at Alma School.

Industrial Era Teaching

Learning environments were designed for mass education and needs due to the large pupil numbers of expanding in cities. Classrooms where to be, factory floor like as functional space. The first schools provided large schoolrooms in which hundreds of children could assemble for instruction (Dudek, 2000:15).

Figure:
Example is Robotson's ideal of Early classroom layout with dividing curtain.

Open Air Classroom 1911

Open air schools are the result of a paradigm shift against the industrial era (Crocker, 2017:39). Open air schools responded to the poor conditions that occurred in learning spaces during the industrial era. The educational focus was to the spiritual well-being and hygiene of underprivileged children in new industrialized cities, placing learning environments in their naturalistic setting (Dudek, 2000:8)

Figure:
An example of such a school is the Whiteley Woods open air schools

1932

Figure:
Open-air school in Suresnes France built by Eugène Beaudouin & Marcel Lods with Jean Prouve

The Modern Classroom 1940's-1950's

Contemporary school design where rooms and spaces are intended to meet precise functional needs (Dudek,2000:10). The form is prefabricated, difficult to refurbish and does not consider environmental standards.

Figure:
Photograph bu Dudek

Proposed Site: Tsako Thabo Secondary School 1978

Figure:
Tsako Thabo High School

'The Idea of Learning Space'

Adapted from the architectural firm 'ProjectWorks', in designing Sol Plaaitjie university in South Africa (2018).

Organization

Spatial Section

Part 2

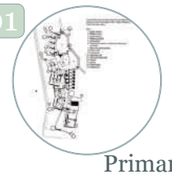
This part conveys the educational shift that gives attention to educational environments which focus on the social role and relationship architecture has with its participants.

1950's

Historical development of Schools in the 20th Century was impacted by the Structuralist architects such as Hans Scharoun, Aldo van Eyck and Herman Hertzberger, in Holland and Germany respectively. Their response critiqued schools conditions in the Modern Movement and the lack of consideration that reflected in school buildings. Conflicting need to design humane environments for learning (Dudek,2000: 38).

Structuralist Examples

01



Primary School Darmstadt

Hans Scharoun
Darmstadt, Germany
1951

'Humane' Approach + Social Role

Scharoun (post war), provided a humane approach in designing a school. It was not only about the functional requirements but the social role, where pupils are seen as the primary importance within the built form.

02

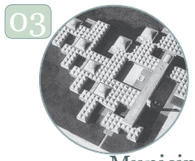
Montessori School

Herman Hertzenberger
Delft, Netherlands
1960

Social Approach

Herman Hertzberger illustrated new ways in enhancing the social relationship between users and the built form through a social approach, where learners use the wider environment freely, through organization and suggestive detailing within the built form.
Hertzberger view: "a thing made exclusively for one purpose, suppresses the individual because it tells him exactly how it is to be used"

03



Municipal Orphanage

Aldo van Eyck
Amsterdam, Netherlands
1960

The "In Between"

Aldo van Eyck, with his harmonious spatial ideas in motion adds to the theory of schools by focussing on the spaces "in between".

Connects to part 3

Figure 3.1: Continuum of architectural thinking of educational spaces (Author,2019)

2000's

Educational facility design has been moving into a shared learning approch. Building on principles of Hertzberger, van Eyck and Schraudon

Two key ideas were identified in studies about the designing of schools in international examples. The first, is by inserting new architecture into existing schools to address limitations in the educational condition.

The second is by creating an educational campus that includes the community, contex and climate. Each part is designed to respod directly to the age groups needs.

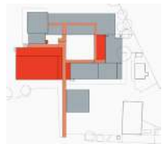
Connects to part 2

International Examples

01 Birmingham School

Haworth Tompkins
England
2012

The buildings were in poor condition and suffered from overcrowded corridors. A new circulation spine has been inserted into the existing courtyard to merge new additions to the existing school. Interior walkways have been re-configured to aid modern teaching techniques with new services coordinated throughout.



02 Education Campus for Mama Sarah Obama Foundation

Francis Kéré
KENYA
2015

The project is intended to promote a sustainable approach to strengthening the community and education. Each school is designed for its specific age group and act as a educational campus. The project is to be developed in phases and to rehabilitating existing schools on the property.

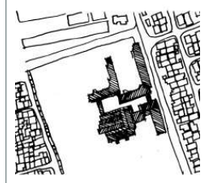
The 'in between' (movement corridors) is considered as critical, as it impacts the rest of the spatial quality structure

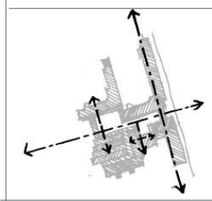
The building shape Social Spaces for students to interact/ observe

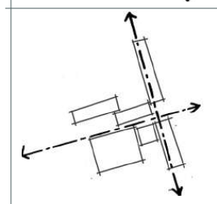
Local Examples

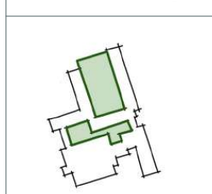
01 Usasazo High School

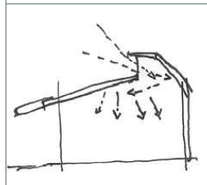
Jo Neoro Architects
Khayelitsha, Western Cape
2004











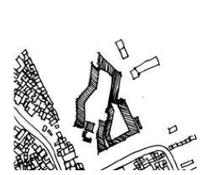
Principles of Universal Design of South African Public Schools

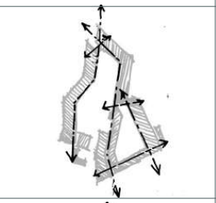
Department of education (2013)

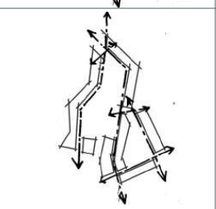
Figure 3.1: Continuum of architectural thinking of educational spaces (Author 2019)

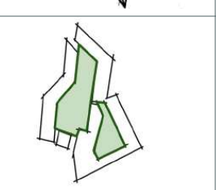
02 Inkwenkwezi Secondary School

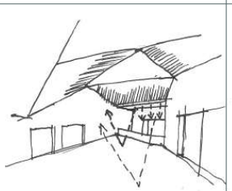
Neoro Wolff Architects
Khayelitsha, Western Cape
2007





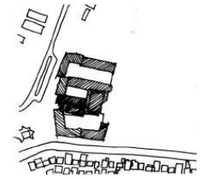


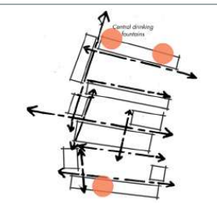


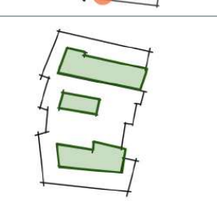


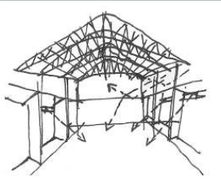
03 Louwville High School

2AD Space Architects Inc
Vredenburg, Western Cape
2017



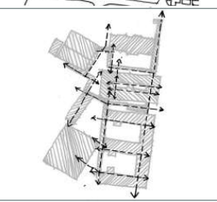


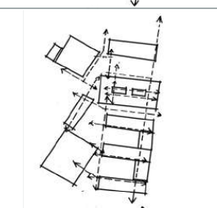


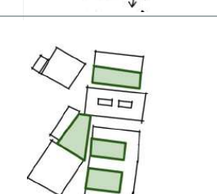


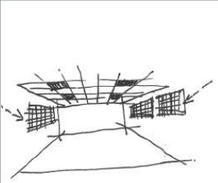
04 Olivenhoutbosch Secondary School

Unknown
Centurion, Gauteng
2017/2018



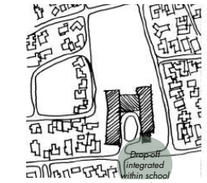


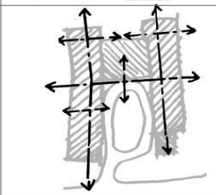


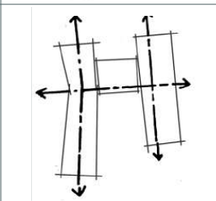


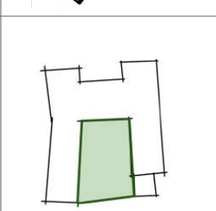
05 Cheré Botha LSEN School

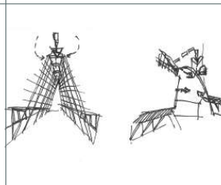
Wolff Architects
Oakglen, Western Cape
2017





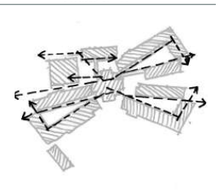


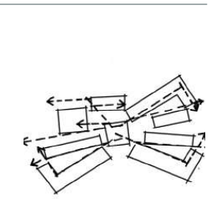


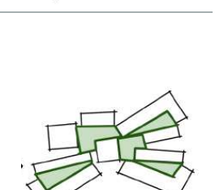


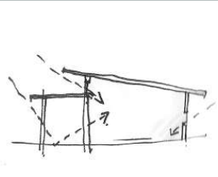
06 Meetse A Bophelo Primary School

Humphris Jooste Architects
Alaska, Gauteng
2011









Educational Norms a

s and Standards 2009

Educational Norms and Standards 2013

Figure 3.2: One of the classrooms at Tsako Thabo Secondary School (Up Arch Hons Mamelodi Group 2019)

3.3 The Context of learning in Tsako Thabo Secondary School

Typological Study:

The built environment contributes to socially generated issues impacting the learning environment. This study is a descriptive Case Study reporting on how issues manifest themselves within Tsako Thabo Secondary School and how they play out spatially. The purpose of the analysis is to provide an impact analysis of the context of a culture of learning and to identify barriers as perceived by learners through an architectural lens.

The scope of the research includes Tsako Thabo Secondary School's pupils and teachers, community interviews and comparative analysis in the demarcated study area in Mamelodi East. It is important to note that research collaboration occurred with the findings of this case study with the University of Pretoria's Department of Architecture Honours Mamelodi Studio 2019. Research will be analysed and interpreted within this dissertation. .

3.4 The Classroom

Tsako Thabo Secondary School is inserted in figure 3.1 to determine where it is placed in the continuum of educational spaces and what impacted the current culture of learning at the school. As the literature suggests, Tsako Thabo Secondary School's typology and other schools in the study area are influenced by the idea of the 'modern classroom' as suggested by Dudek (2000:10). Thereafter the intention is to unpack how this typology is played out in scale in the study area of Mamelodi East and how it then contributes to socially generated issues in the school.

The 'modern classroom' was first introduced by Joseph Lancaster, a Systems Architect, who discussed the idea in 1811 in his book: Hints and Direction for Building, Fitting Up and Arranging Rooms. This publication was a turning point influencing the building of schools today and was the inspiration for the idea of a 'modern school building' for that time (Wood 2018b). The book illustrates the system overall, not only in constructing this type but offers a 'set of rules' in arrangement and necessary organisation of this system. Ultimately, it suggests a systematic thinking which can be applied to the way schools are designed. The aim of the system was mass education and incorporation of a holistic system towards control, in other words, the incorporation of architecture, pedagogy, control, decisions of age and gender, theories of learning and hygiene (Wood 2018b).

In 1815, de Lasteyrie (in Wood 2018b) explained that this school system needs different parts to exist. There are three 'components' to this system: firstly there is the design of the instruction room itself, secondly organising these spaces into an 'articulation' of different spaces, and thirdly the idea of a monitorial system applied across the country and imposed on the development of schools (Dudek 2000:10; Wood 2018b). At that time, in this new idea of school design, the role of the architect was sidelined, to minimise design adaptations through standardised specifications and drawings applied to a wide variety of schools (Dyer 2018).

Seconday and Tertiary Schools:

1. Lompec Education Centre

Secondary Schools:

2. Modiri Technical School

3. Mamelodi Technical High School

4. Vlakfontein Secondary School

5. Tsako Thabo Secondary School

6. Mi Msezane Middle School

Higher Education:

7. Mamelodi Community Learning Centre

8. Reneilwe Community Learning Centre

Figure 3.3: Adapted from Achi & Venter. Hons Mamelodi Group 2019 (Author 2019)

3.5 Schools in the Study Area

This same system has played out in the Mamelodi context. Figure 3.3 illustrates the comparison of Tsako Thabo Secondary School to other secondary schools in the study area. Here, it is evident that the schools in this area are similar in planning, design, and issues affecting school design. Figure 3.3 illustrates how it is played out in scale. These issues are further investigated, illustrated and unpacked in Tsako Thabo Secondary School.

3.6 Tsako Thabo Secondary School

Tsako Thabo Secondary School is arranged slightly to the angle of North-east to South-west, aligned with the contours. There is a strict spatial organisation with an articulated access route, with classrooms opening onto corridors. Internal courtyards are formed between the linear buildings (refer to figure 3.4).

The classrooms are arranged with the instructor in front of the pupils arranged in rows. Hertzberger (2008:24) argues that this model of teaching in the rectangular classroom accommodates instruction with unidirectional transfer of knowledge that forms the basis of teaching. Each classroom has high steel frame clerestory windows on the side of the walkway and towards the entrance of the classroom. The other side has large steel frame windows. This model of classroom design is repeated throughout the whole school. The arrangement and orientation of the classrooms in relation to the walkways are inconsistent and leave classrooms cold and under-lit. Some classroom entrances are at the South-east end and some in the North-west (refer to figure 3.5).

Figure 3.6 illustrates the perceived safe zones identified by the students (Achi & Venter 2019:31); figure 3.7 identifies the perceived unsafe zones; and, figure 3.8 demonstrates the recreational areas in the school. These figures are analysed, together with figure 3.3, and spatial conclusions are drawn which are illustrated in figure 3.9.

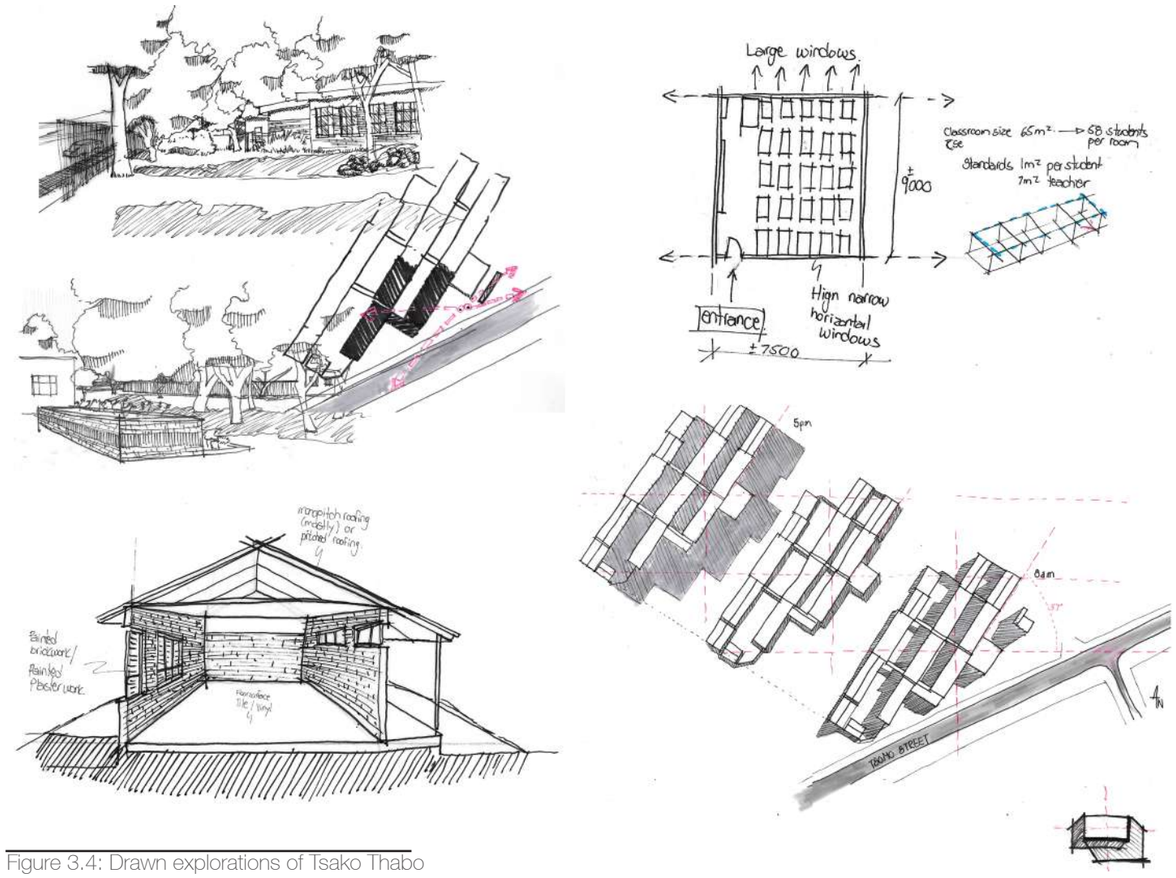


Figure 3.4: Drawn explorations of Tsako Thabo Secondary School (Author 2019)

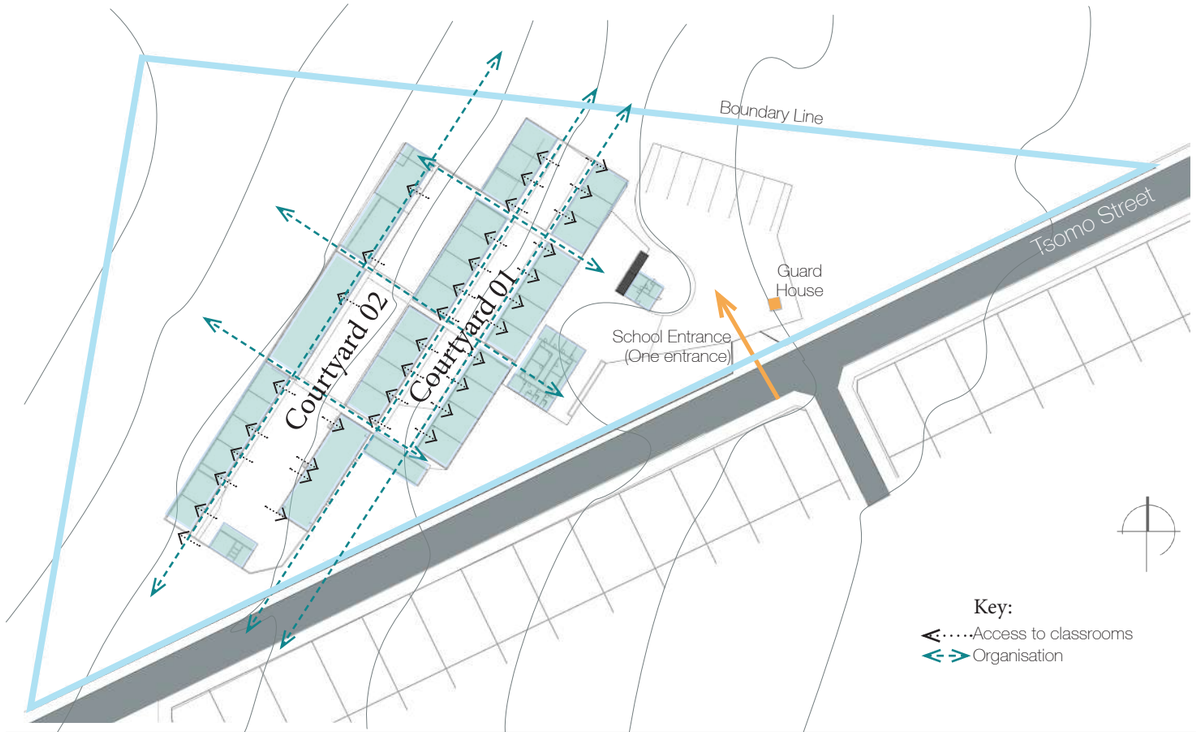


Figure 3.5: Arrangement of Tsako Thabo Secondary School (Author 2019)

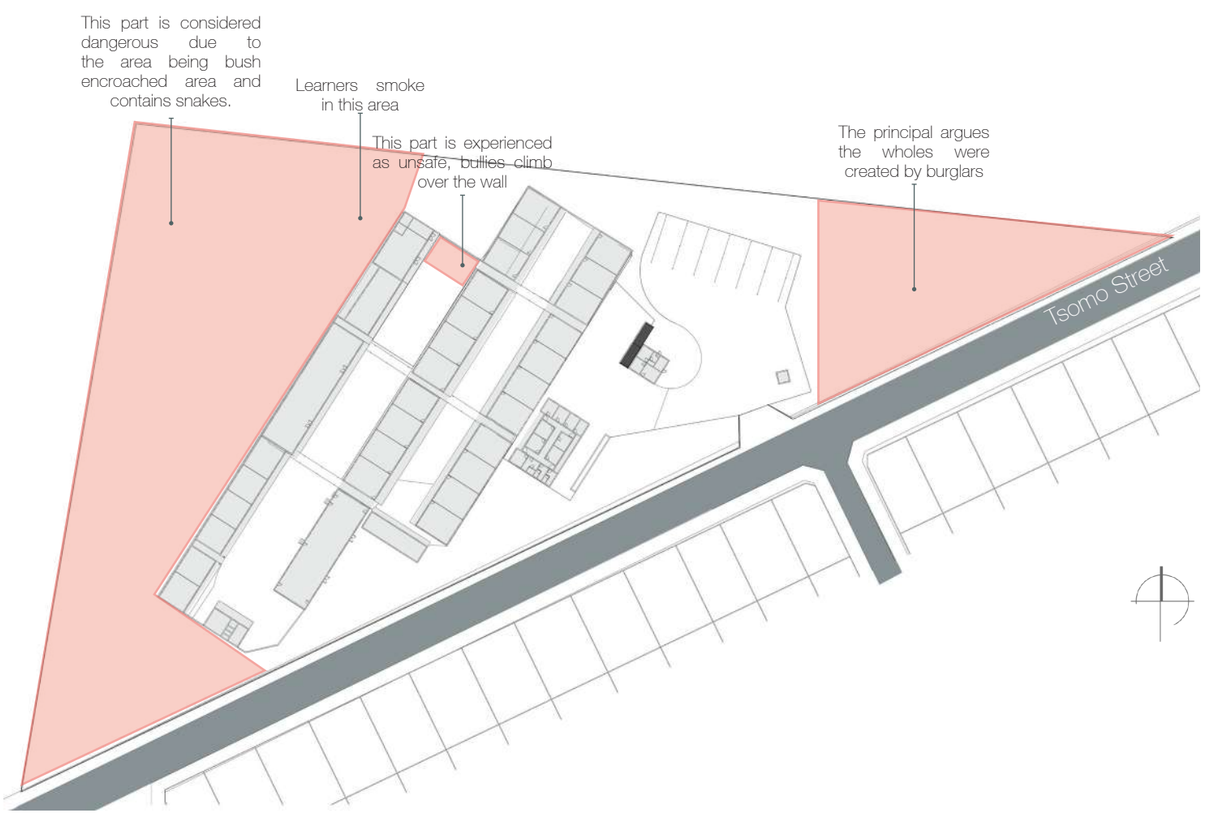


Figure 3.6:Identified unsafe zones in Tsako Thabo secondary School (Adapted from Achi & Venter 2019:28)

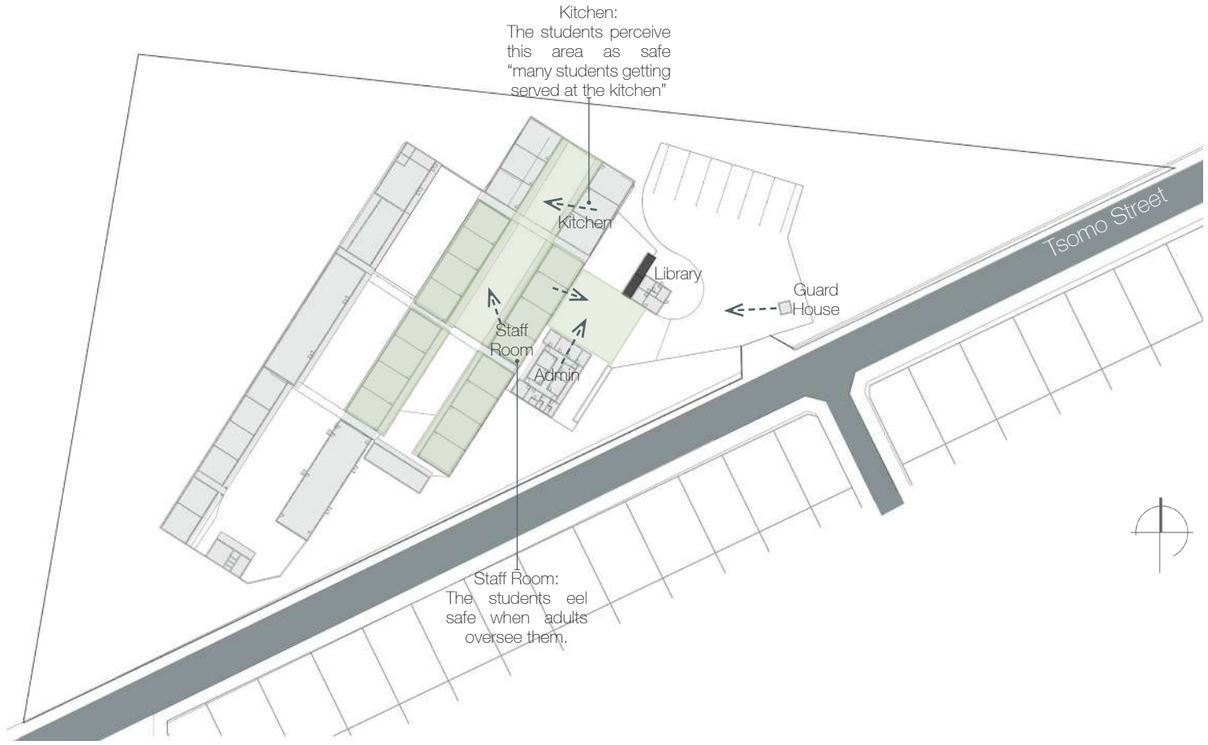


Figure 3.7: Identified safe zones in Tsako Thabo secondary School (Adapted from Achi & Venter 2019:28)

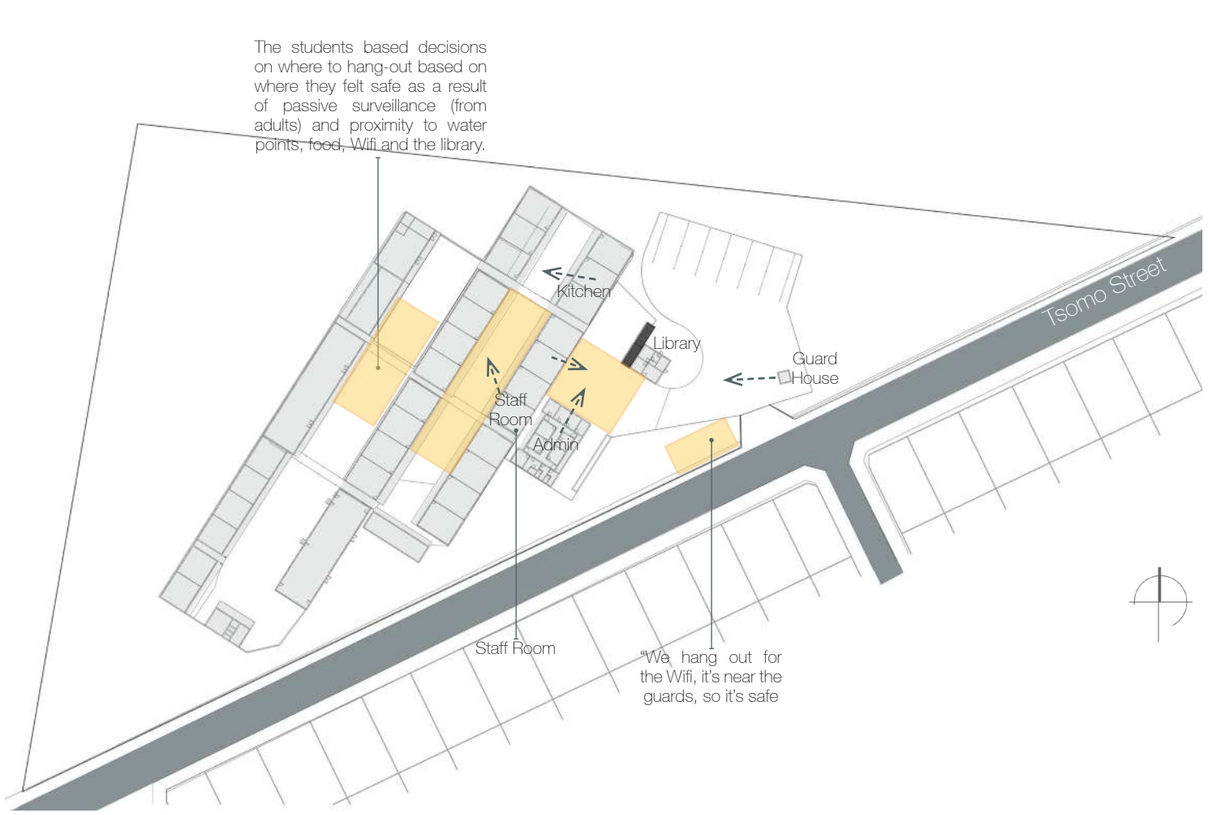
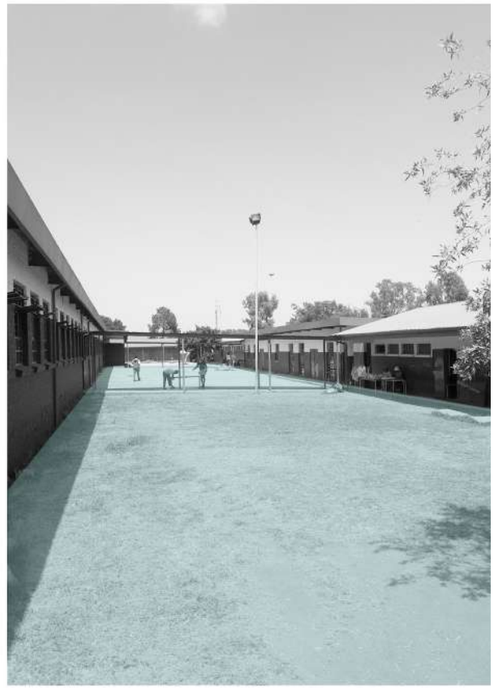


Figure 3.8: Identified recreational zones in Tsako Thabo secondary School (Adapted from Achi & Venter 2019:28)

Courtyard 01

Courtyard 02



Social Spaces

Edge Conditions

Learning Spaces

Figure 3.8 (b): Condition of Tsako Thabo secondary School (Venter 2019)

3.6.1 Spatial Conclusion:

These findings look at the school complex as a whole. Spatial organisation of buildings is arranged linearly, creating a uniform language of the built environment applied to each site. Buildings allow for the creation of internal spaces between buildings (courtyards). The built form has no other spatial contribution to its contexts such as the street or community. The school tends to become isolated and stands alone on its site.

It is observed that schools tend to have an inward nature; learners prefer courtyards between buildings due to passive surveillance from pupils and teachers. Leftover space around schools is perceived as unsafe (Achi & Venter 2019:34).

Left-over space surrounding school property is unused and in most cases perceived as unsafe; these spaces are accessed by bullies, external pupils from other schools and children not attending school who enter the school causing social issues. Fences of schools are damaged and tend to become unsafe barriers (Achi & Venter 2019:34).

There are no public spaces connecting schools to the public realm or community such as public transport, waiting areas, allowance for informal trading and for commuters. Due to the negative connotation of leftover space, the relationship with the street becomes difficult. The school's urban edge is eroded and it becomes difficult for learners or members of the public to engage (Achi & Venter 2019:34).

Reflection:
The issues illustrated in figures 3.3 to 3.8 are further investigated and the spatial issues become apparent in the built environment of Tsako Thabo Secondary. Through the observations in this study, it is seen that the built environment contributes to socially generated issues suggested by the CDE (2017:2), Ebersohn (2016:2), Hammett & Staeheli, (2013:323) and Weeks (2012:3) in Chapter 2.

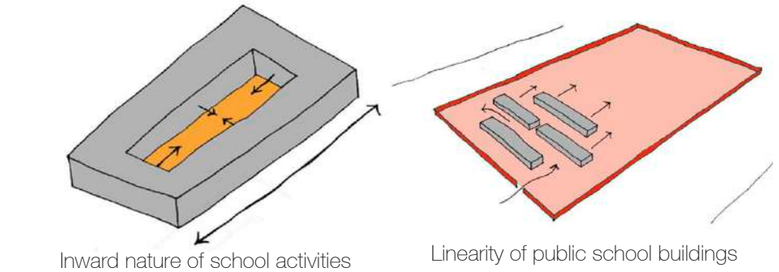
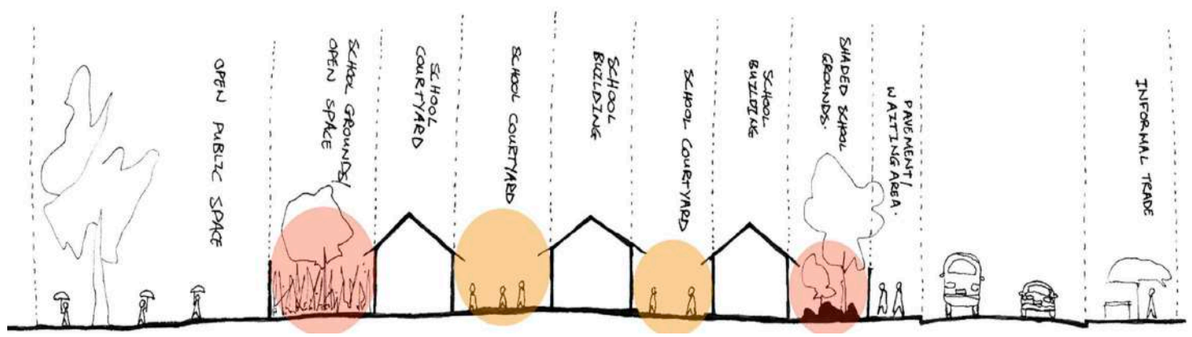


Figure 3.9: Spatial Conclusions
(Achi & Venter 2019:34)

Figure 3.10: Spatial Issues adapted from Ras (2019.2 Q2 Mapping)
(Author 2019)



3.7 Architectural Issue

The foremost architectural problem is to address the limitations and shortcomings apparent in educational facilities. The education facilities that are supposed to be servicing this society are struggling with high levels of unemployment and are actually sitting in the landscape as islands of institutional disjunction instead of serving and supporting their community.

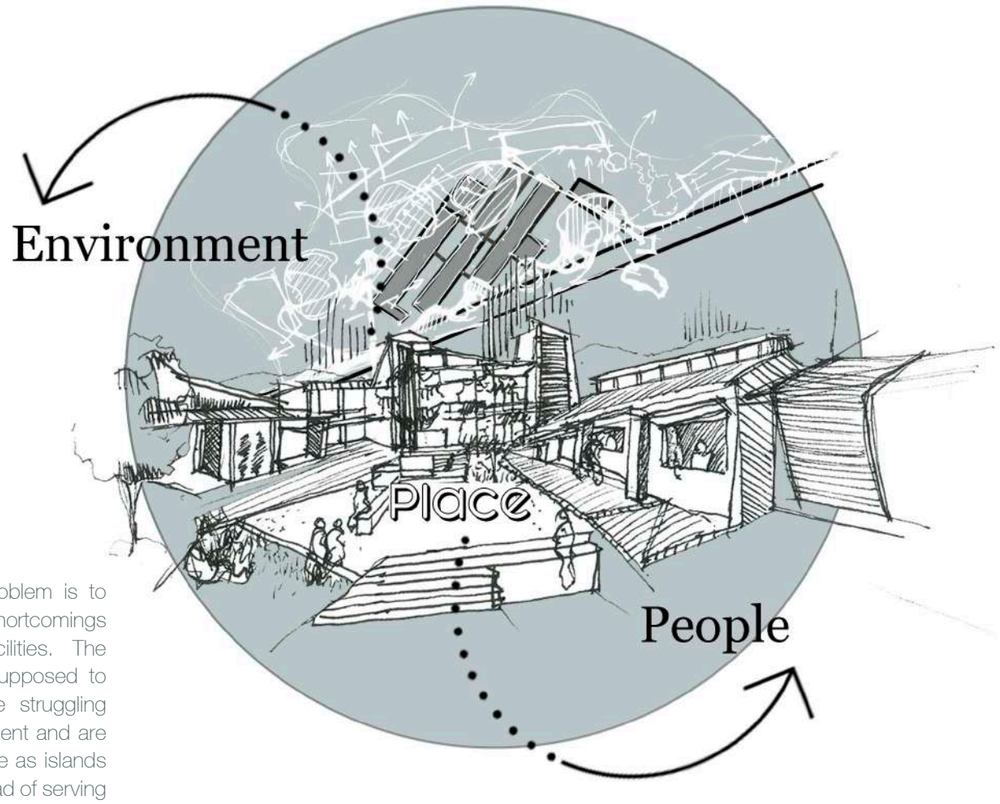
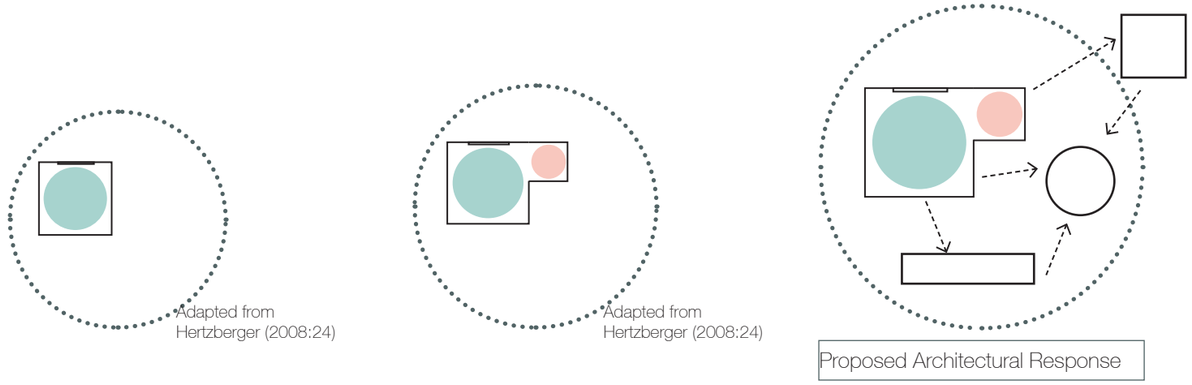


Figure 3.11: Architectural Issue
(Author 2019)



The Classroom

The Articulated Classroom

'Being Outward / 'Shared Learning'
Learning in more than one space

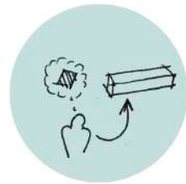
Figure 3.12: Shift in Learning environments, adapted from Hertzberger(2008:24) to authors interpretation (Author,2019)

3.8 The Classroom re-imagined

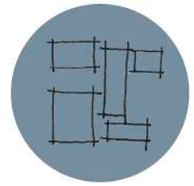
As identified in this chapter, design impacts the learning experience occurring in that space. Design, therefore, aims to investigate how space and place-making within Tsako Thabo Secondary School can assist in activating the knowledge economy through improved learning spaces.

In the investigation of figure 3.1, the continuum of architectural thinking of educational spaces, Hertzberger (2008:24) suggests a new spatial approach to the idea of the classroom to shift to an articulated classroom. This model creates the opportunity for various models of learning, such as co-learning or shared learning, to manifest alongside the traditional model of learning. This model suggested by Hertzberger (2008:24) is then developed to respond to the Mamelodi context to suggest learning in more than one space, incorporate entrepreneurial learning into a school and address the current spatial condition that is not supportive of the entrepreneurial environment.

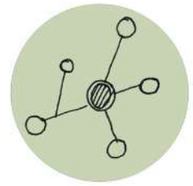
Thus, the following issues and opportunities are identified in this study to generate an appropriate architectural response illustrated in figure 3.13



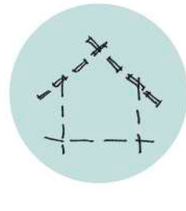
Limited learning space unsuitable to the needs of the learner.



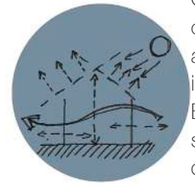
Arrangement of the classroom.



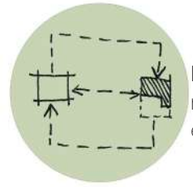
The co-exist/ shared resources.



The need to overcome spatial restrictions in the learning space.



Opportunity in design principles set out by the Minimum uniform norms and standards for public school infrastructure 2013 (Department of Education, 2013) as well as contextual solutions suggested by schools designed Kere (2015), Noero (2004) and Wolff(2017).



Incorporation of socio-spatial relationships to occur with the built environment.

Working within an existing school to address issues to improve learning environments and learning experiences.

Figure 3.13: Issues / opportunities identified in the learning context of Tsako Thabo Secondary School (Author 2019)

04 Design Development

4.1 Preface

In this section, the development of an architectural response to an educational framework for social entrepreneurs that was set out in the previous chapters will be documented. The architectural response aims to mediate between the objectives of the educational, entrepreneurial and architectural context to respond to site-specific solutions.

The design will, therefore, aim to:
1. Connect to the street (Urban Vision)
2. Utilisation of space (Contextual Condition)
3. Respond to the context (Context)
4. Adopt a new educational legislative approach (Theory or Programme)
5. Multi-purpose (Programme)
6. Innovative building methods (Technology)

4.2 Conceptual Intentions

In the creation of an outward-looking school for social entrepreneurs, the conceptual intention is to work within an existing school (Tsako Thabo Secondary School), incorporating entrepreneurial learning into the school and address spatial issues apparent in the school.

Thus, the objective is to create an architectural language that responds to the fine grain of informality of entrepreneurial businesses that fracture and differentiate the urban condition in Mamelodi East. As identified in the previous chapters, the existing institutional scale and concept of the 'free-standing' unit restricts learning and does not allow for this type of informality to occur due to scale, material, spatial restrictions, and architectural response.

The intention is to morph the school typology and incorporate an entrepreneurial typology into an existing school. Morphology also refers to changing learning spaces in order to address the shortcomings visible in the current condition.

The existing and entrepreneurial context is the main informant to an architectural response providing contextual, typological and architectural solutions for this site.

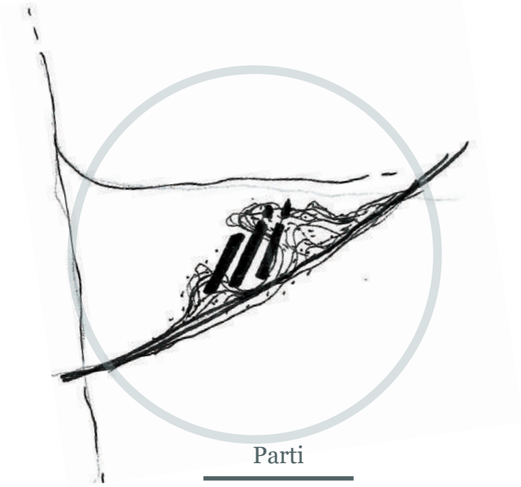


Figure 4.1:Parti diagram of scheme
(Author 2019)

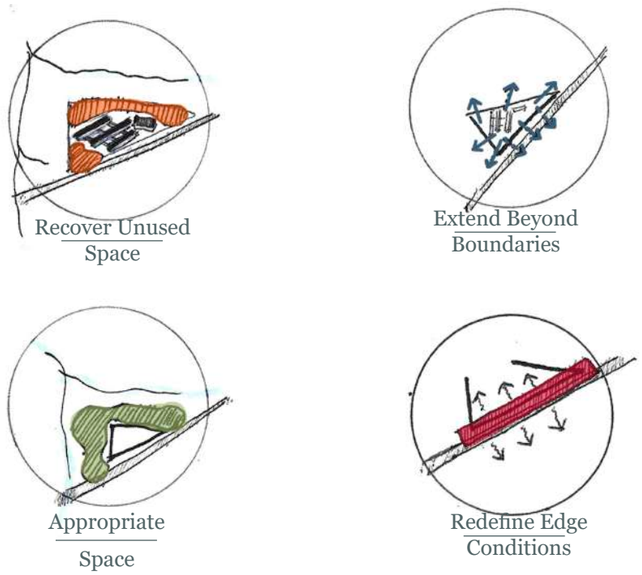


Figure 4.2: Site Intentions
(Author 2019)

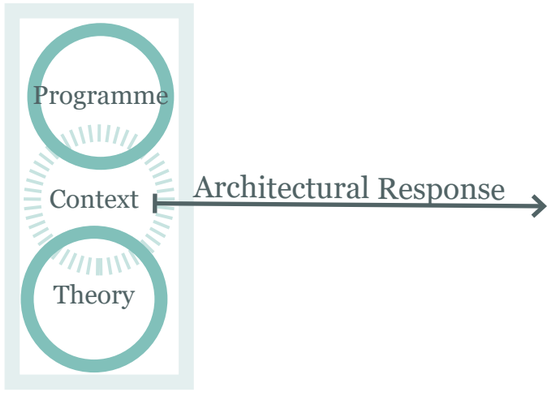


Figure 4.3: Site Intentions
(Author 2019)

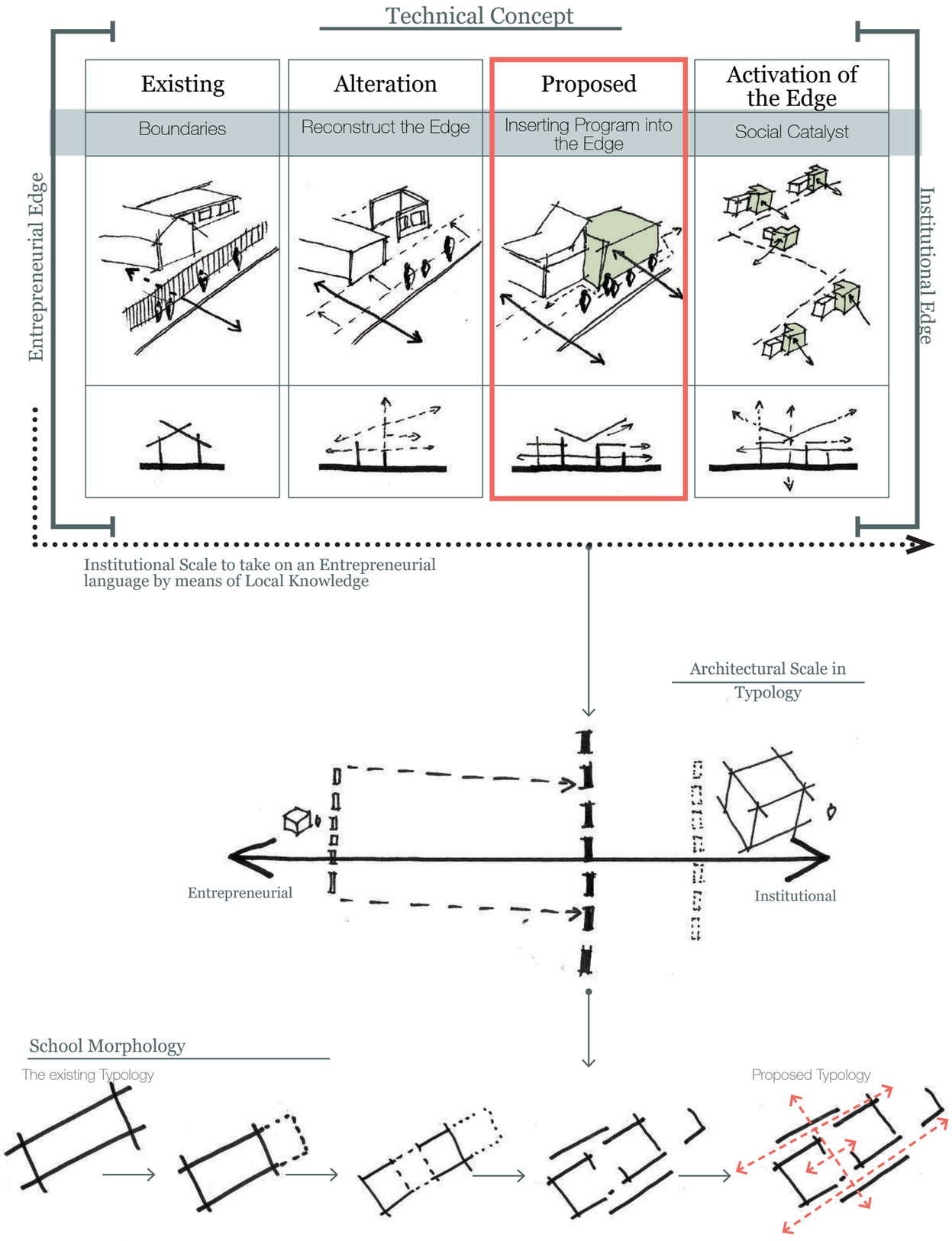


Figure 4.4: Conceptual Intention
(Author 2019)

4.3 Concept Expression

The conceptual intention is illustrated and expressed through an exploration of three parts: relationship, threshold, and local knowledge illustrated in figure 4.5. These parts are set out to guide the architectural thinking.

4.4 Architectural Informants

The architectural response is further understood in the categories of informants. These informants draw from the previously discussed chapters – programmatic, contextual and theoretical – in order to develop an appropriate response to a specific community and place.

These informants take form as:

a. The Existing Condition

This refers to the existing school on-site, Tsako Thabo Secondary School, that is intended to be re-used and refurbished to allow for a school morphology to occur. The re-use of the school requires a response that acknowledges the fine grain and scale of the existing typology and surrounding entrepreneurial businesses to fracture the built environment of the school and address social issues.

b. The new condition:

This refers to the new typology that considers, introduces and responds to density, scale, material, and typology of the 'existing condition' mentioned above.

c. Site, Topography and Context

The site or context is the main informant to the design response, by means of developing spatial principles from entrepreneurial activity in Tsomo Street, the existing slope grading the site and using context as a driver (explored further in this chapter). The slope of the site moves down to the North-West and informs the response to become contextual. The site informs the spatial placement of the building to step down as levels with the site and inform space-making and how the structural tectonics manifest as it moves with the slope of the site to create an architectural response. The massing is influenced by the existing trees on-site, guiding form-making to take shape and offers opportunities to create courtyards, gathering places, and opens up visual corridors to the surrounding context (physical and natural).

d. Programme

Architectural intended programme and programmatic requirements inform the way architecture is planned, created and facilitated (Department of Education 2013). It also informs the programmatic implementation of 'Edge City' to re-imagine the importance that edge conditions of education facilities have with the community and space-making in the architectural response.

e. Technology

Refers to how architectural design responds in terms of structure, material, and systems to site-specific solutions.

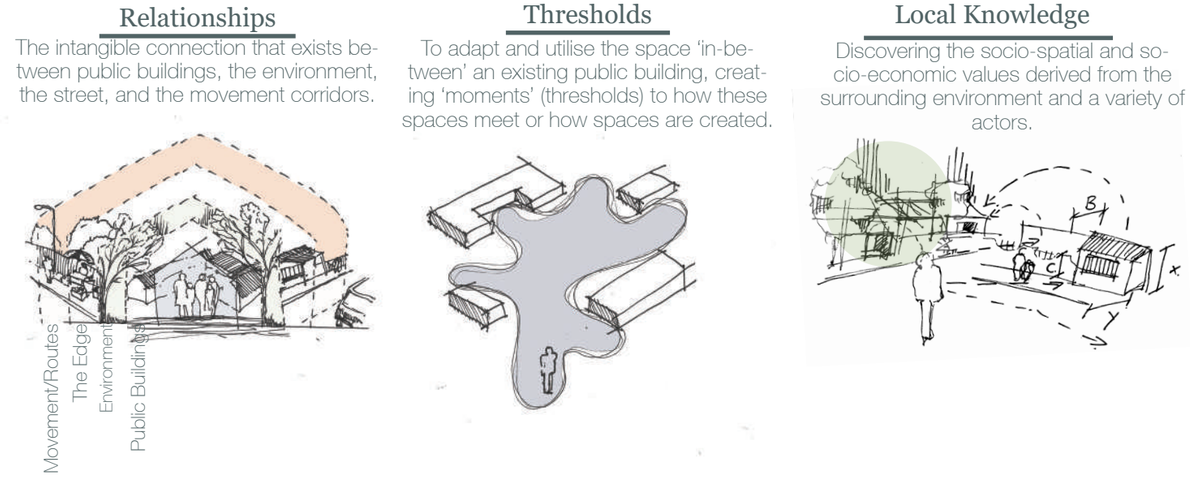
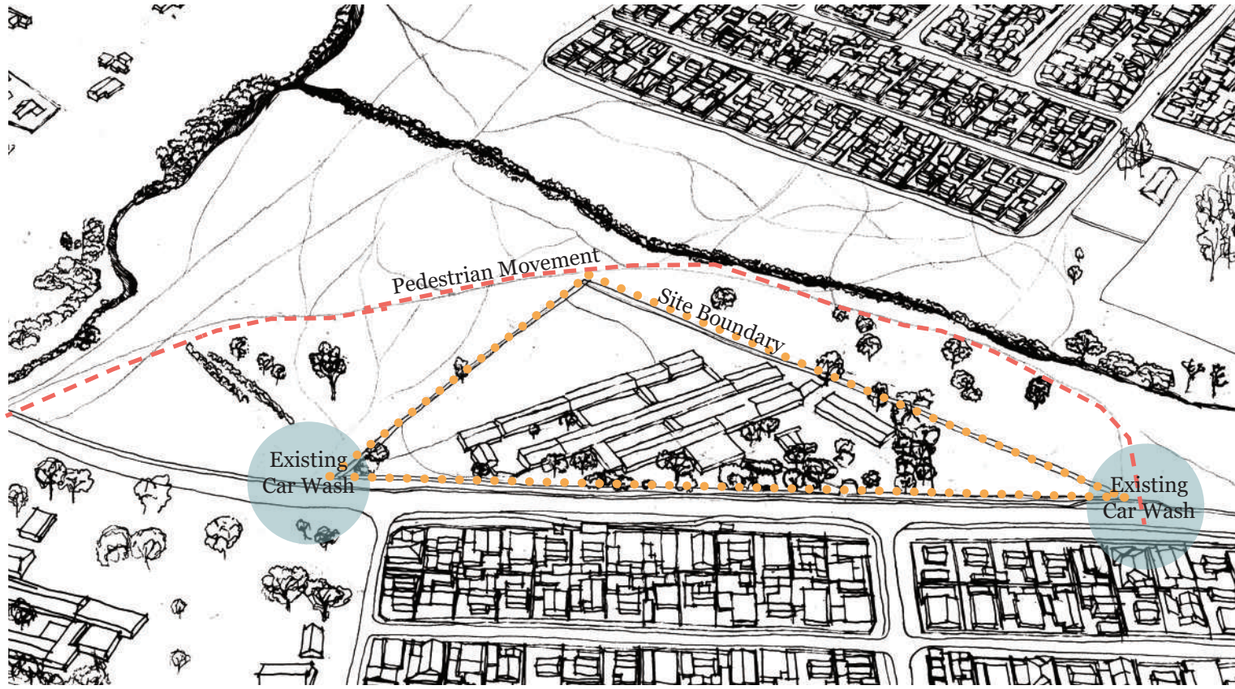
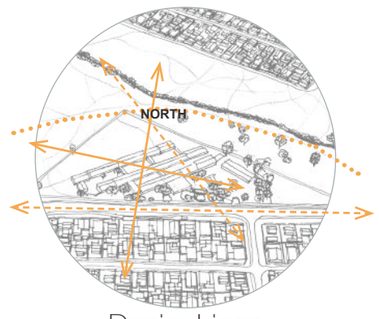


Figure 4.5: Expression
(Author 2019)




The Existing Condition


Topography



Desire Lines

Figure 4.6: Informants
(Author 2019)

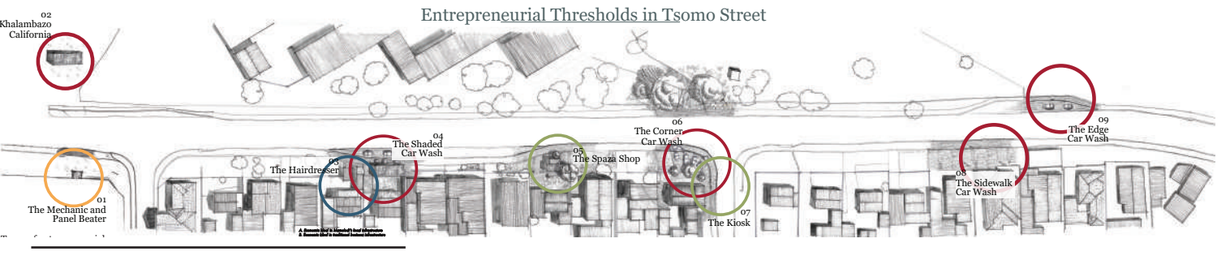


Figure 4.7: The Edge of Tsako Thabo Secondary school (Author 2019)

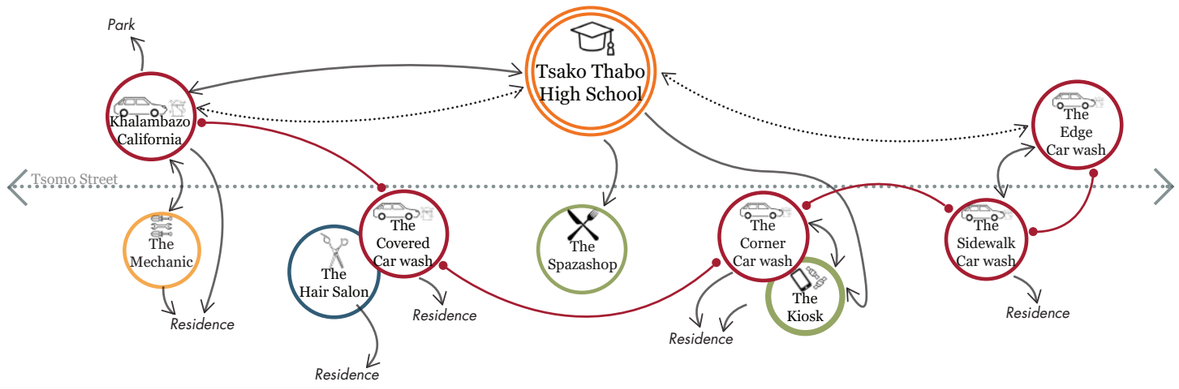


Figure 4.8: Relationships between nodes (Author 2019)

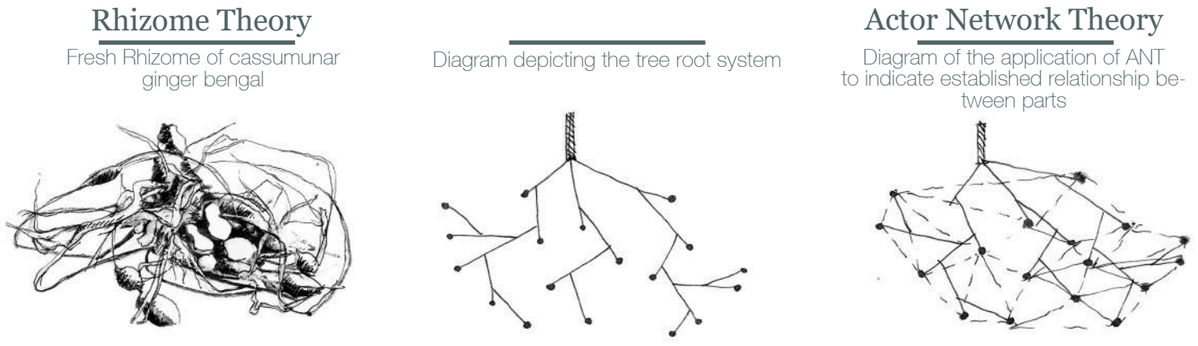


Figure 4.9: Visual representation of Rhizome and ANT Theory (Pringle & Landi 2017:118) (Author 2019)

4.5 Design Response

4.5.1 Context as a Design Driver

From the synthesis of the preceding chapters, the incorporation of social entrepreneurship, high levels of entrepreneurial activity in the context and school, the supporting theory suggests the value of incorporating entrepreneurial learning into school models and the relationship between parts.

The opportunity arose to investigate the surrounding context of Tsako Thabo Secondary School to set out spatial principles. These principles are established from entrepreneurial activity in Tsomo Street to inform space- and place-making in the creation of architecture.

The school edge in Tsomo Street is investigated to determine the entrepreneurial activity illustrated in figure 4.7. According to information derived from research conducted in Chapter 2, it is clear that Mamelodi consists of many layers, actors and parts that are complex in nature. Figure 4.8 illustrates the relationships and possible relationships the entrepreneurial nodes have with each other. These relationships or connections fall within the constructs of what is known as the Rhizome theory and Actor-Network theory (ANT)(Pringle & Landi 2017:118; Seijo 2005:185).

Rhizome theory
The Rhizome theory is used in a botanical sense: “plant stem that sends out roots and shoots from its nodes” and can be linked to a model tree (Pringle & Landi 2017:118). Ideas have a distinct beginning, branch out in chronological order and the ends to form knowledge points (Pringle & Landi 2017:118). They are critical notions of independent identities that are always in the process of becoming.

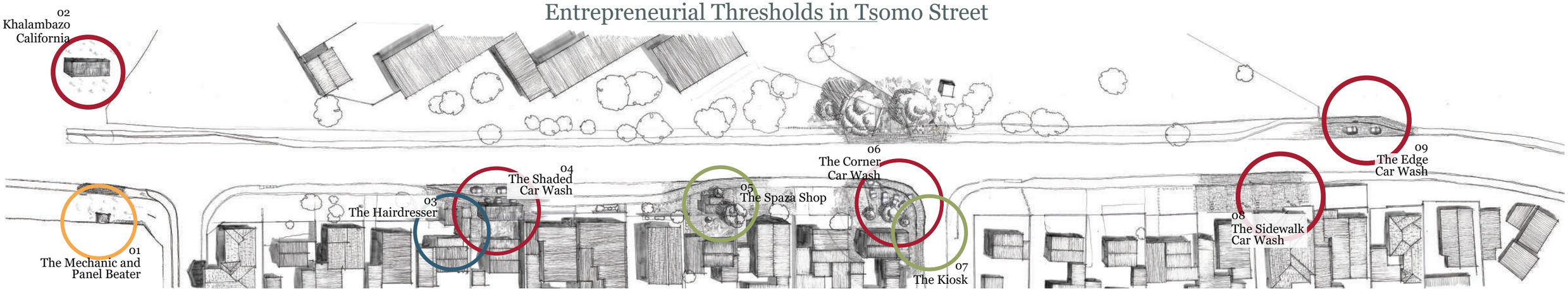
Metaphorically the theory is described to define research that does not have a distinct beginning, end or hierarchy but encourages the connections between its parts (Seijo 2005:185). This thinking forged alliances between seemingly diverse ideas, elements, and concepts.

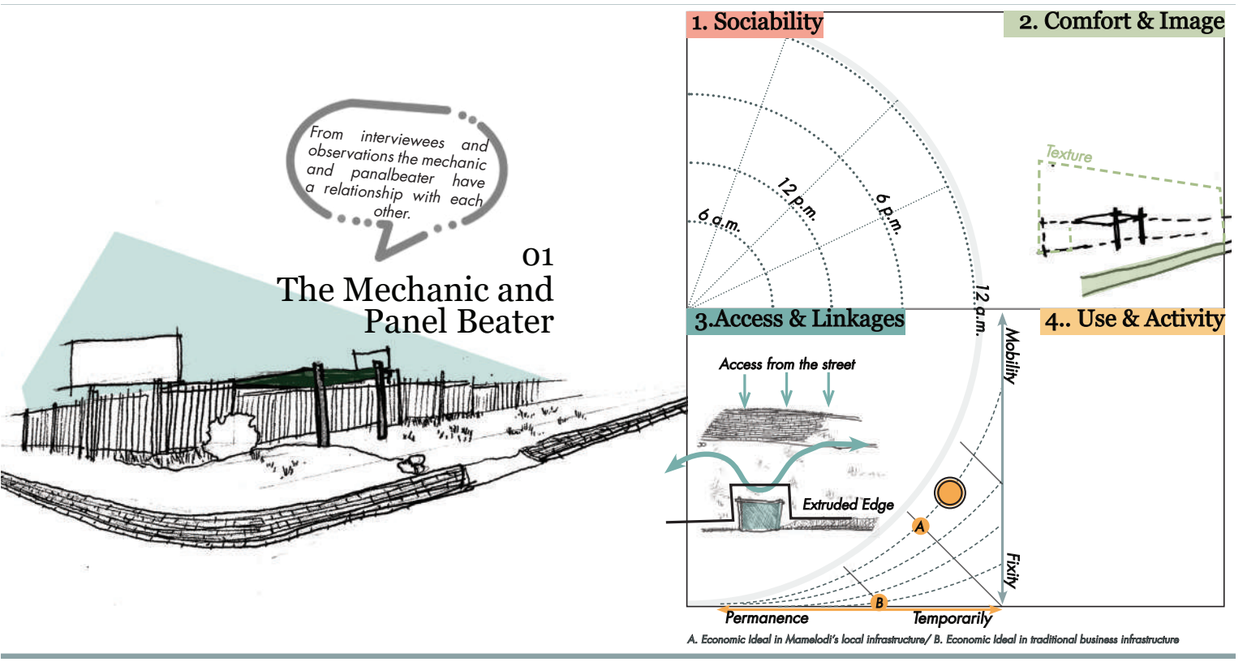
The second theory, ANT, is used to further explain the relationship and connections between parts derived from Rhizome theory. This theory is a methodological approach to social theory. Everything in the natural and social worlds exists in constantly shifting networks of relationships. All the factors involved in a social situation are on the same level, and thus there are no external social forces beyond what and how the network participants interact at present (Seijo 2005:192). Thus, objects, ideas, processes and any other relevant factors are seen as just as important. Therefore, the relationship between these parts or elements is considered important.

From left: figure 4.9 a. Fresh Rhizome of Cassumunar Ginger Bengal, b. Diagram depicting the tree root system, c. Diagram of the application of ANT to indicate the established relationship between parts (visual representation of Rhizome and ANT theories (Pringle & Landi 2017:118).

A deeper investigation is initiated into these identified entrepreneurial nodes in Tsomo Street illustrated in figure 4.10. This investigation was to determine the entrepreneurial typology at each node. From these nodes, spatial principles are derived and illustrated in figure 4.11 to inform design decisions in space- and place-making.

Entrepreneurial Thresholds in Tsomo Street





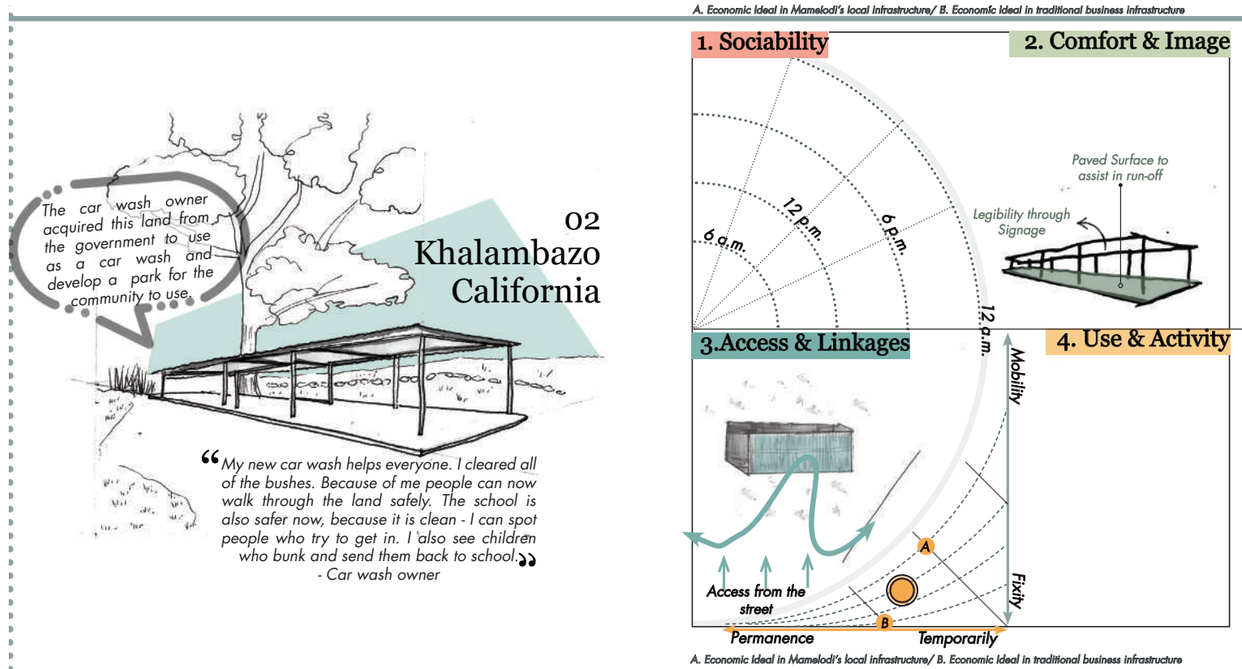
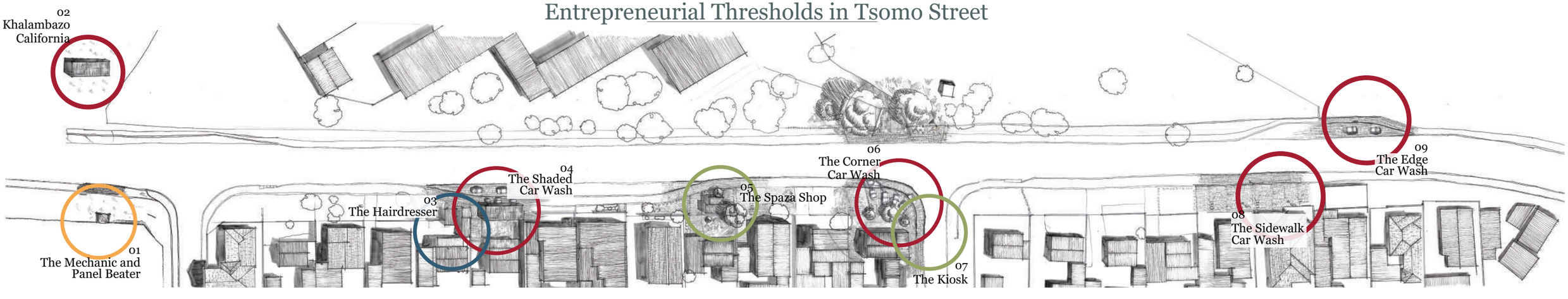
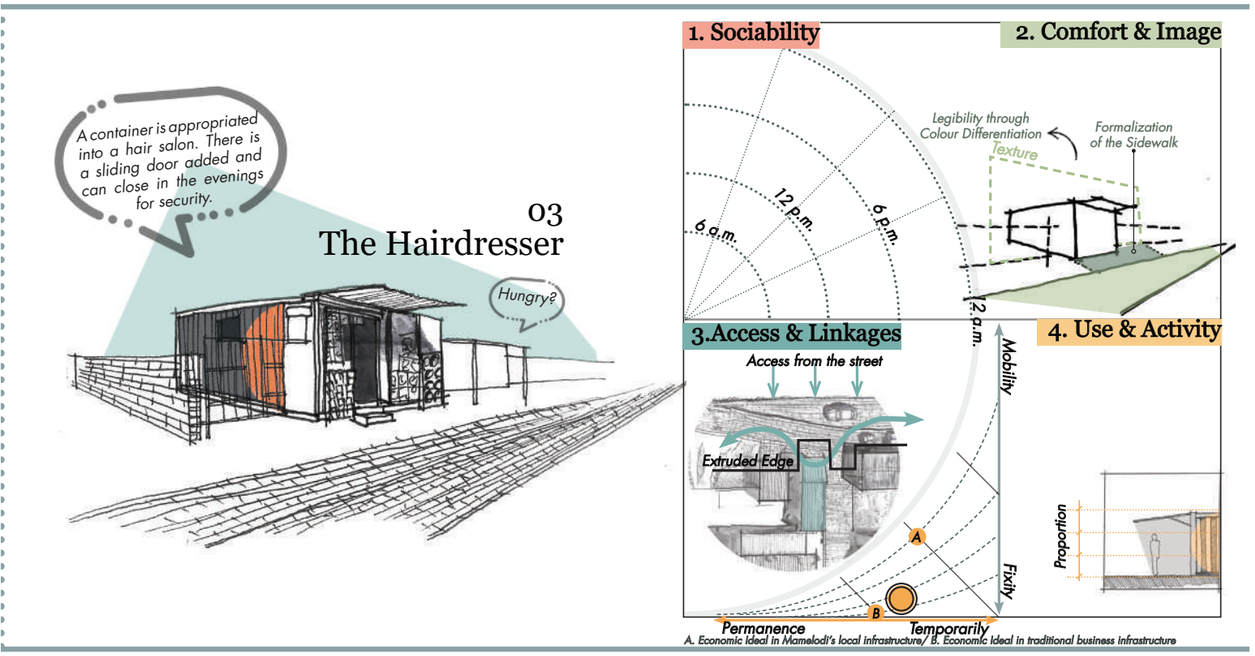


Figure 4.10: Entrepreneurial study in Tsomo Street (Author,2019)

Entrepreneurial Thresholds in Tsomo Street





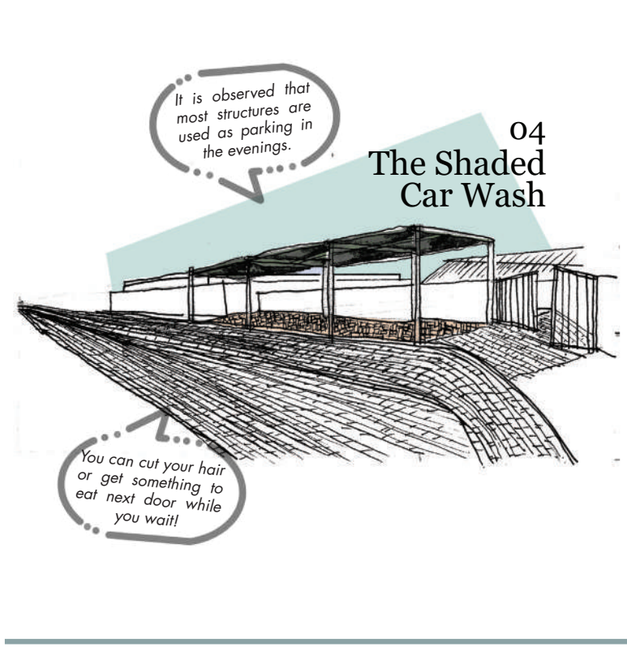
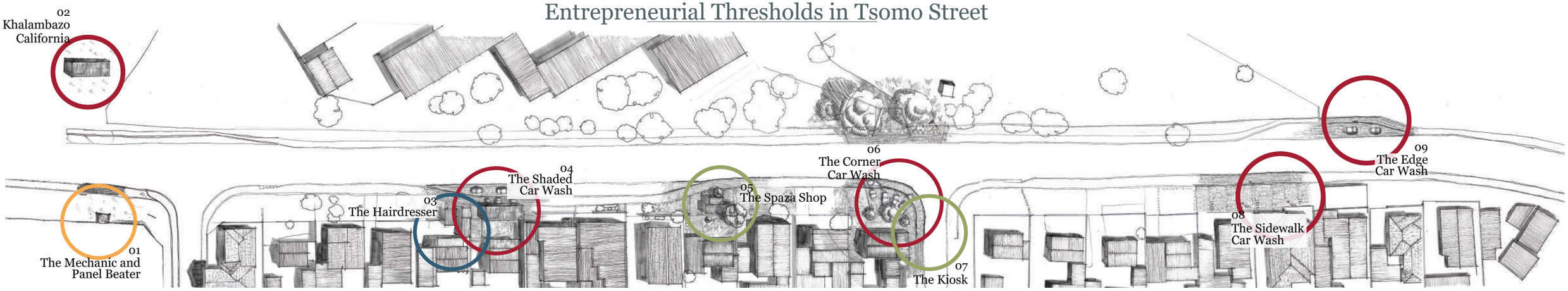
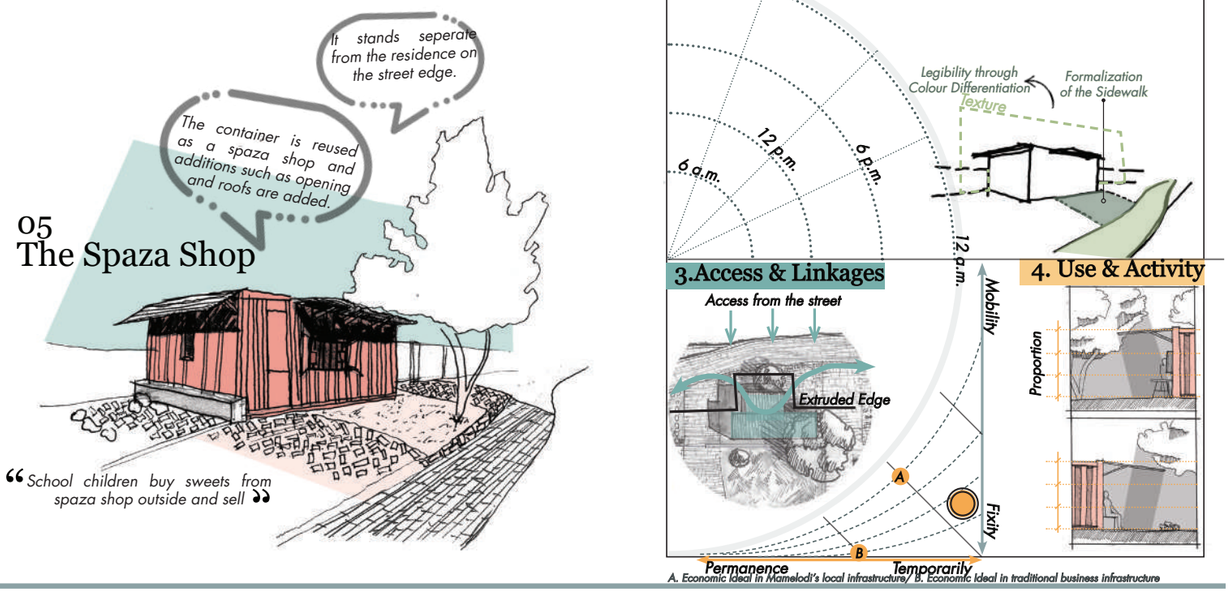


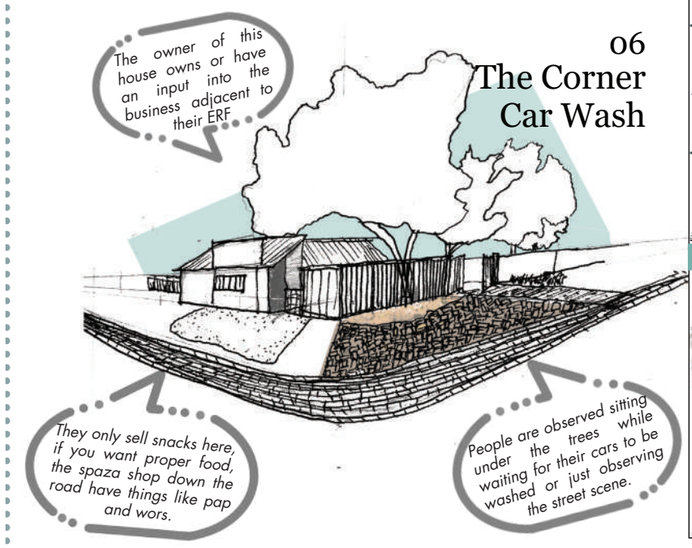
Figure 4.10: Entrepreneurial study in Tsomo Street (Author,2019)

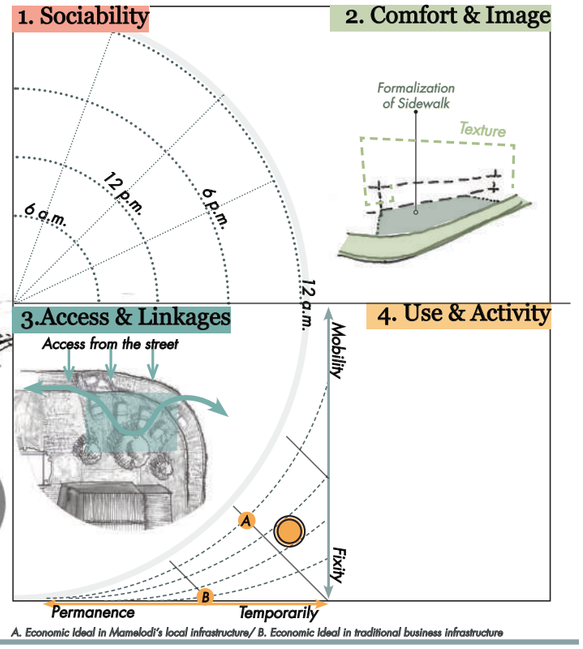
Entrepreneurial Thresholds in Tsomo Street





A. Economic Ideal in Mamelodi's local infrastructure/ B. Economic Ideal in traditional business infrastructure

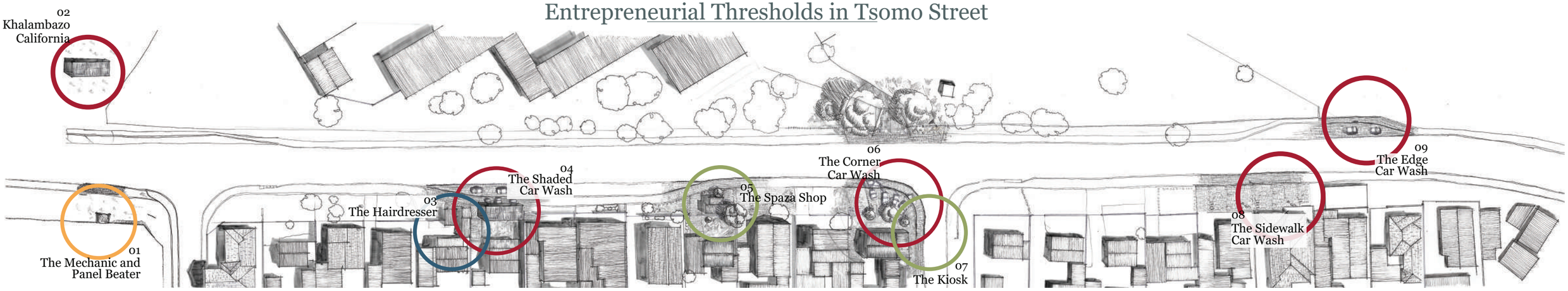


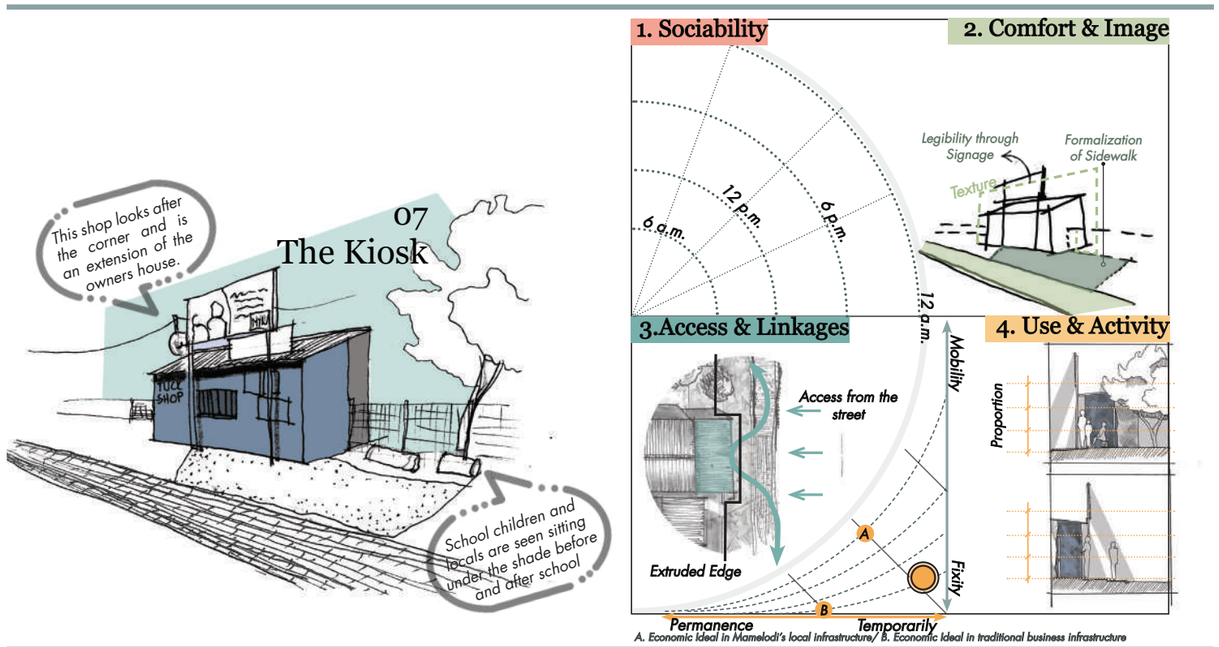


A. Economic Ideal in Mamelodi's local infrastructure/ B. Economic Ideal in traditional business infrastructure

Figure 4.10: Entrepreneurial study in Tsomo Street (Author,2019)

Entrepreneurial Thresholds in Tsomo Street





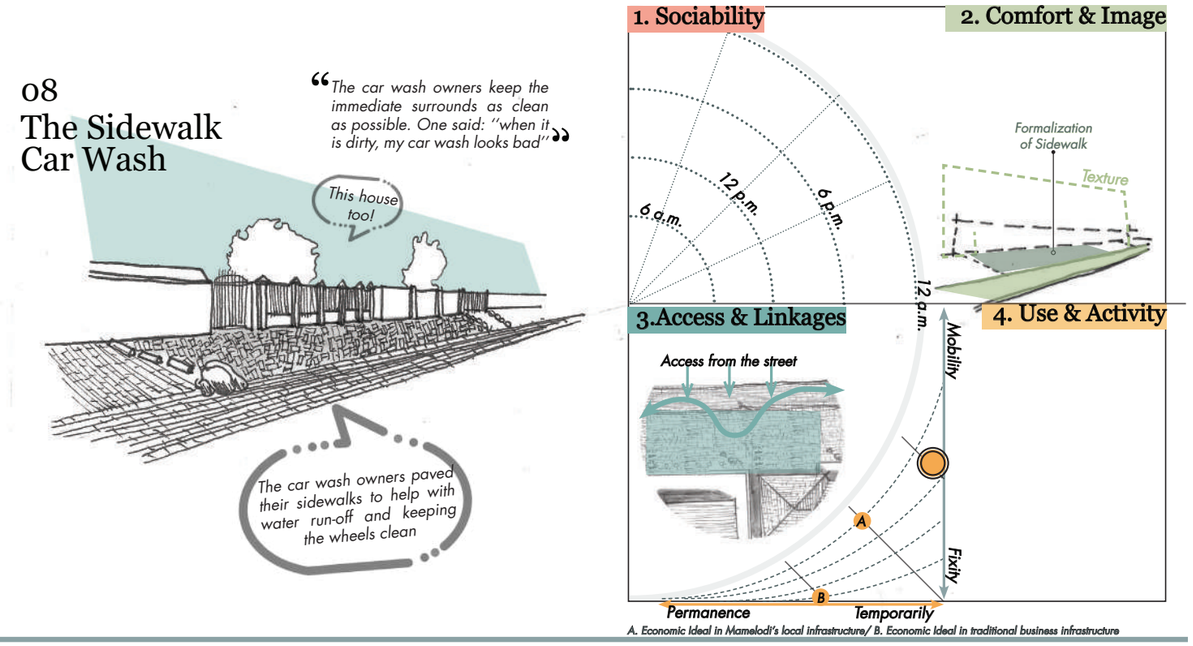
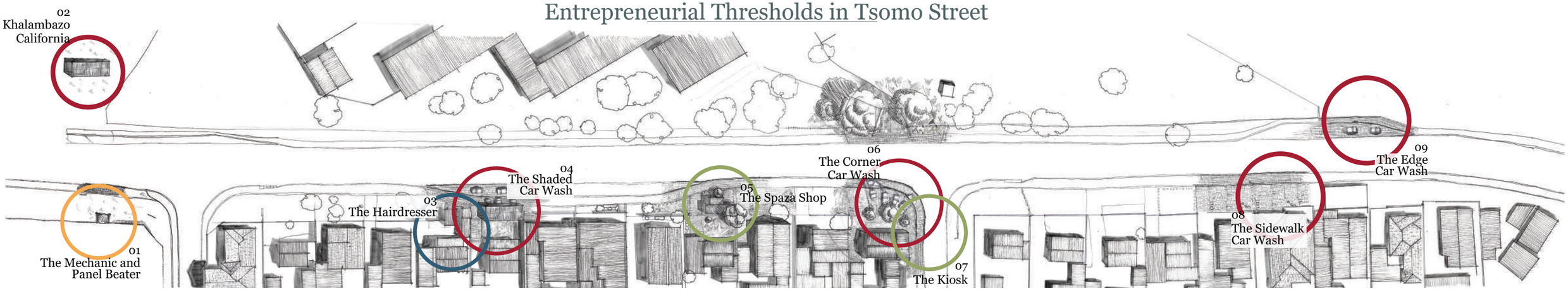


Figure 4.10: Entrepreneurial study in Tsomo Street (Author,2019)

Entrepreneurial Thresholds in Tsomo Street



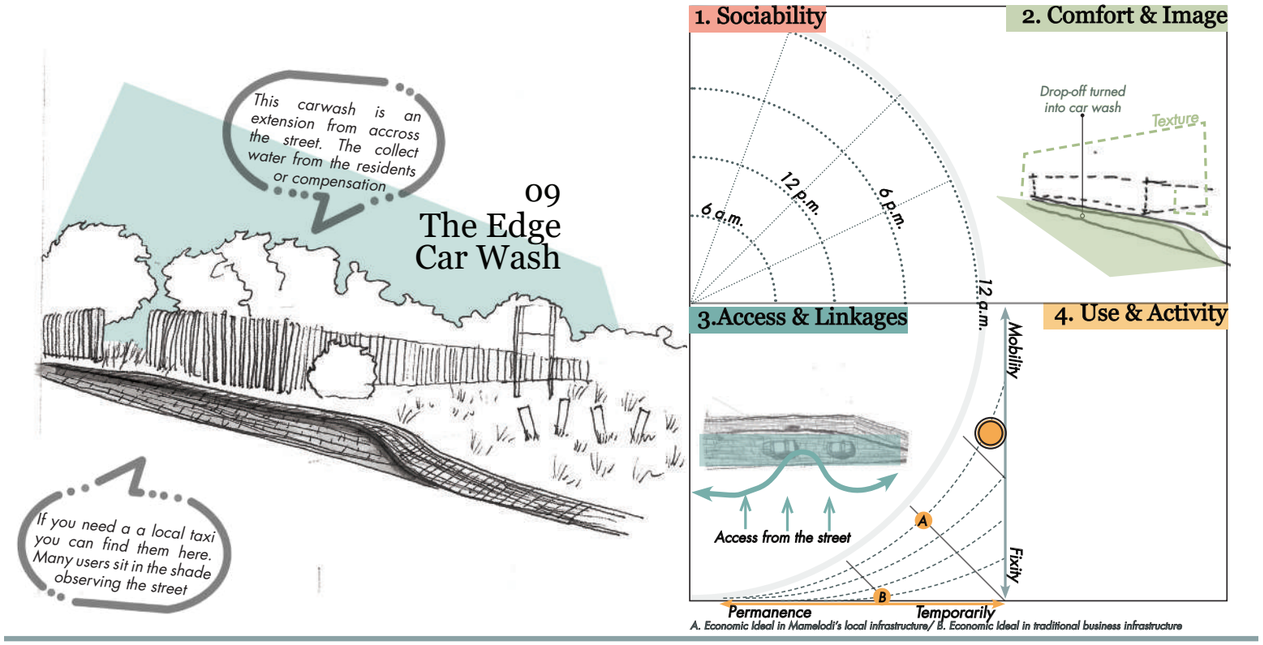
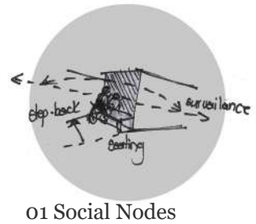
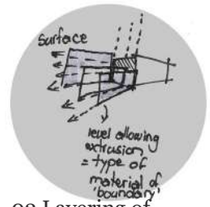


Figure 4.10: Entrepreneurial study in Tsomo Street (Author,2019)

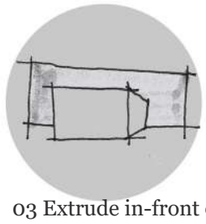
4.5.2 Entrepreneurial Spatial Principles



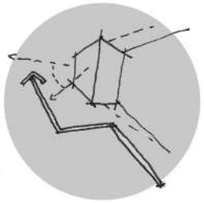
01 Social Nodes



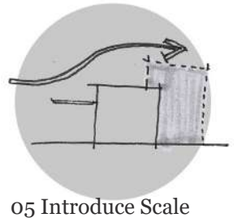
02 Layering of Surfaces



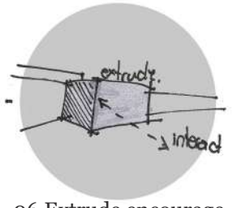
03 Extrude in-front of Surface- Solid Texture



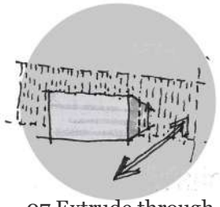
04 Stepped Surfaces



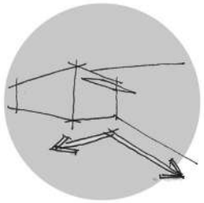
05 Introduce Scale



06 Extrude encourage interaction

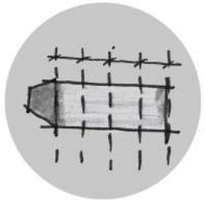


07 Extrude through surface- transparent texture



08 Stepped back Surface

09 Proportion in Height



10 proportion in Width

Figure 4.11: Spatial Principles (author, 2019)

4.6 Design Development

A series of design iterations are explored to develop an appropriate architectural response in Mamelodi East to incorporate entrepreneurial learning into Tsako Thabo Secondary School. It is therefore important to set out the strategy of how to intervene with the existing and how such a programmatic intervention will be feasible in the community of Mamelodi.

4.6.1 Mediation of the existing condition:

In response to the analysis in previous chapters, and in order to address the creation of supportive learning environments (Mampane & Bouwer 2011:14), Tsako Thabo Secondary Schools built environment is analysed and opportunities are identified on how to intervene with the existing condition.

Some buildings are demolished due to the spatial conditions created by impacting socio-spatial problems in the school identified in Chapter 3. Buildings are also identified to be demolished due to spatial opportunities which will be discussed later in this chapter. Figure 4.13 illustrates the unpacking of the buildings that are maintained by Tsako Thabo Secondary School.

4.6.2 Programme implementation as a Business Strategy

The proposed programme aims to provide and support the shortcomings of financing a Higher Education Model illustrated in figure 2.4 (Chapter 2). Currently, schools depend on Governmental grants and the intention is, therefore, to provide a business strategy for the school to become entrepreneurial. This strategy will rely on third stream income (Stats SA 2016) and allow the school to develop as funding becomes available. The school can be developed in a sustainable manner while addressing the urban issue.

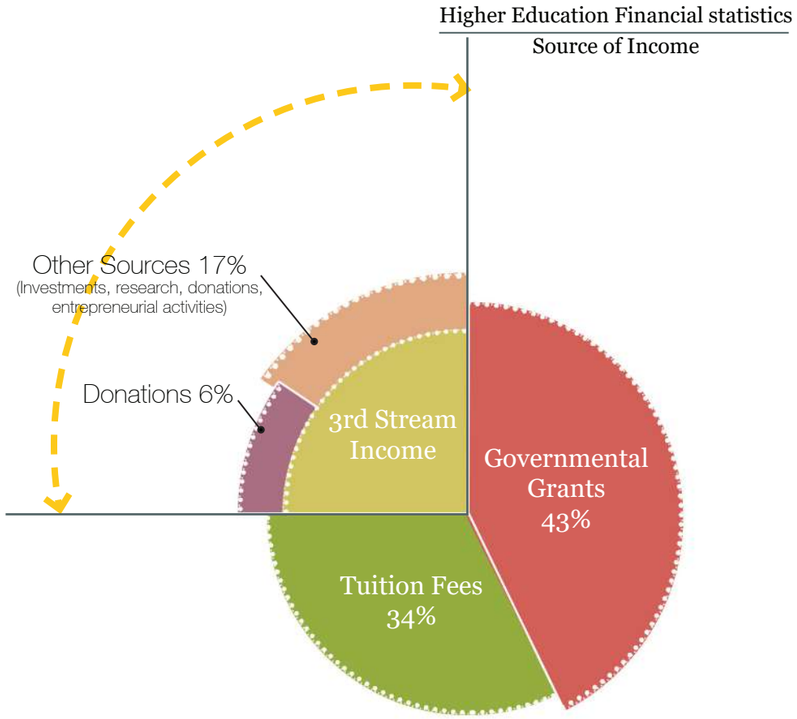


Figure 4.12: Source of income proposed for adopting a business strategy (STATS SA, 2016)

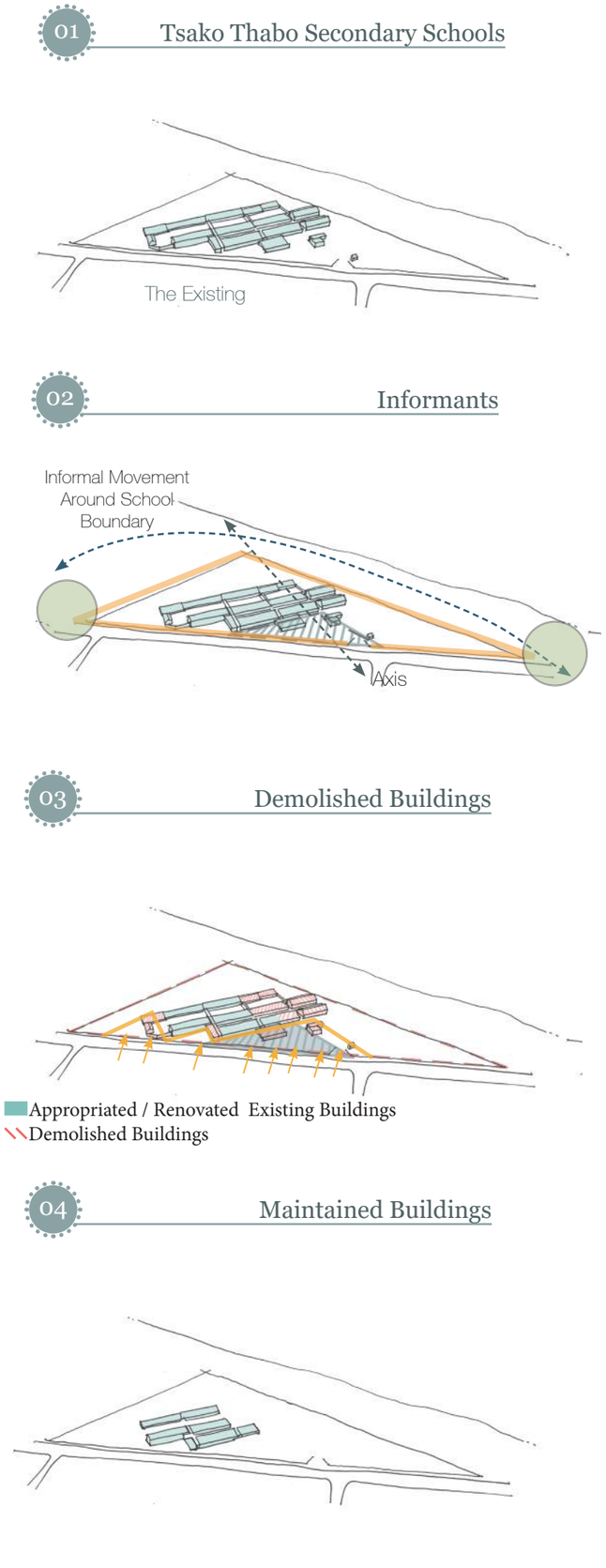


Figure 4.13: Unpacking of the buildings that are maintained (Author 2019)

Programme implementation as a Business Strategy

1. Phase One –
Re-imagine Tsako Thabo Secondary School

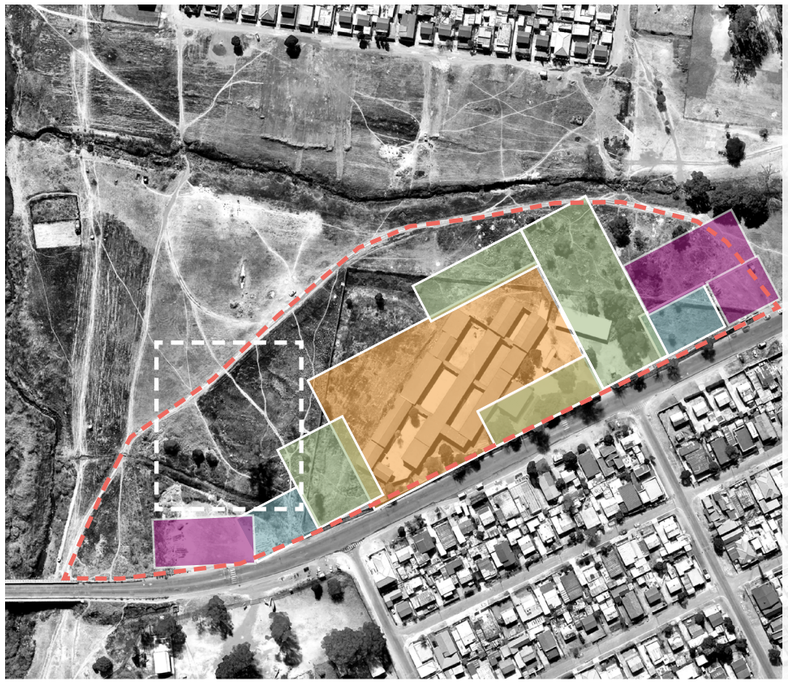
This phase proposes to address spatial issues apparent in the existing Tsako Thabo Secondary School. This phase intends to re imagine space making to allow for a new culture of learning to manifest within the existing, by starting to address required design principles of the Norms and Standards(2013) (sports field) of school design and establish an entrepreneurial connection with the street by establishing the two car washes on either sides of the schools.

2. Phase Two –
Extend Tsako Thabo Secondary School & Community Connection

This phase is aimed to utilize the unused landscape surrounding the school on the North, East and western parts of the school and strengthening the edge to Tsomo Street. Extending the school and the community to merge boundaries in the form of services to aid social entrepreneurship.

3. Phase Three –
Tsako Thabo Entrepreneurial School

This phase intends to use the energy produced in phase two and direct it back into phase 1 to reshape the existing school into the final stage (phase three). Reimagining Tsako Thabo secondary School to connect the new intervention with the existing school.



4. Phase Four –
Future Development

As a result of the development in the previous phases, this phase is aimed at strengthening community networks with the school towards the greater community

Figure 4.14: Proposed business strategy (Author 2019)

4.7 Design Exploration

The exploration of an architectural response. All models and sketches are the authors materials.

Exploration 01

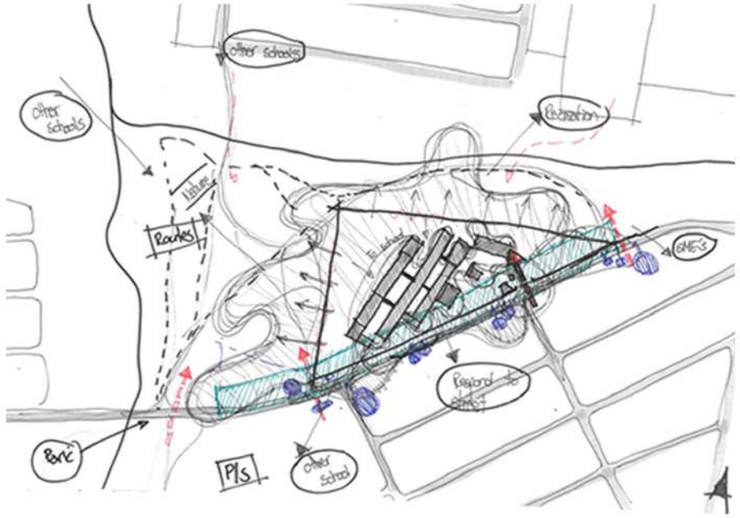
Emotive Model

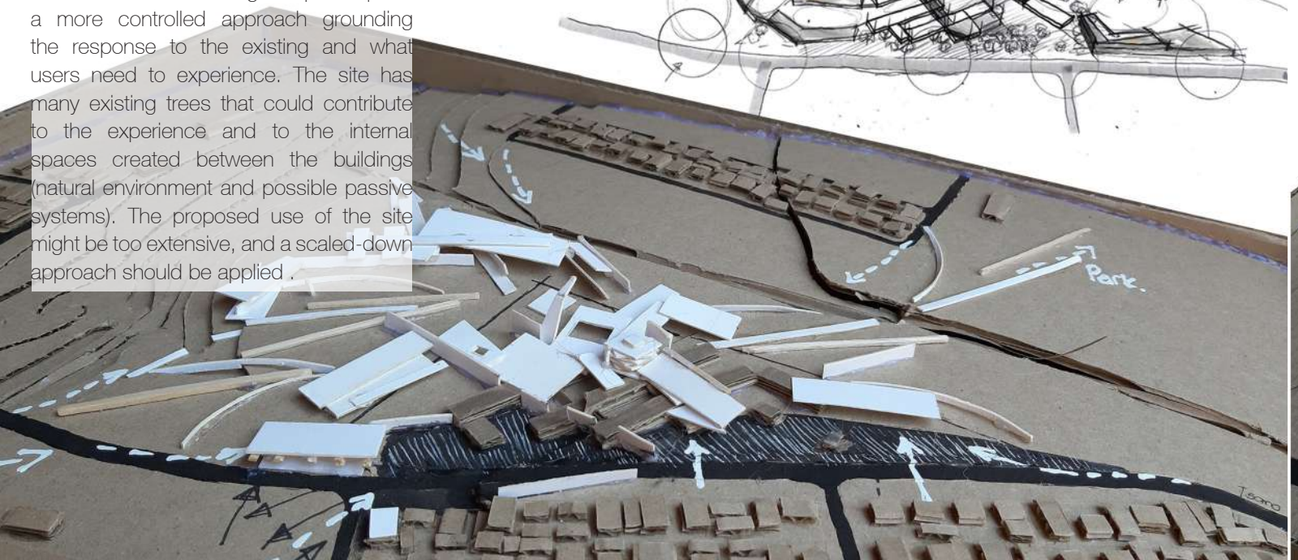
This primary exploration was conducted as a simple emotive spatial model exploration. This model is a massing and conceptual exercise to determine the opportunity on the site without looking at programme or requirements but relying on intuition and opportunities on-site. The model investigates the relationship between the preliminary placement of the new building in response to the existing school. The model investigates how the new response can overcome with the existing school to reshape the current conditions that are not contributing to learning environments (Jimenez 2018:21,23; Weeks 2012:1).

Through a sketch exercise, potential form and massing were derived from the exploration model. The massing also intends to reconfigure the existing boundaries of the school moving away from the free-standing unit (Dewar 2007:4,7) and reusing unused property in the school, along the boundary and around the school. The building form creates courtyards to motivate the use of internal interactive space between buildings and guide users through these spaces.

Reflection:

The model revealed the potential interaction with the school edge of Tsomo Street, introducing various scales of interaction. The building shape requires a more controlled approach grounding the response to the existing and what users need to experience. The site has many existing trees that could contribute to the experience and to the internal spaces created between the buildings (natural environment and possible passive systems). The proposed use of the site might be too extensive, and a scaled-down approach should be applied .



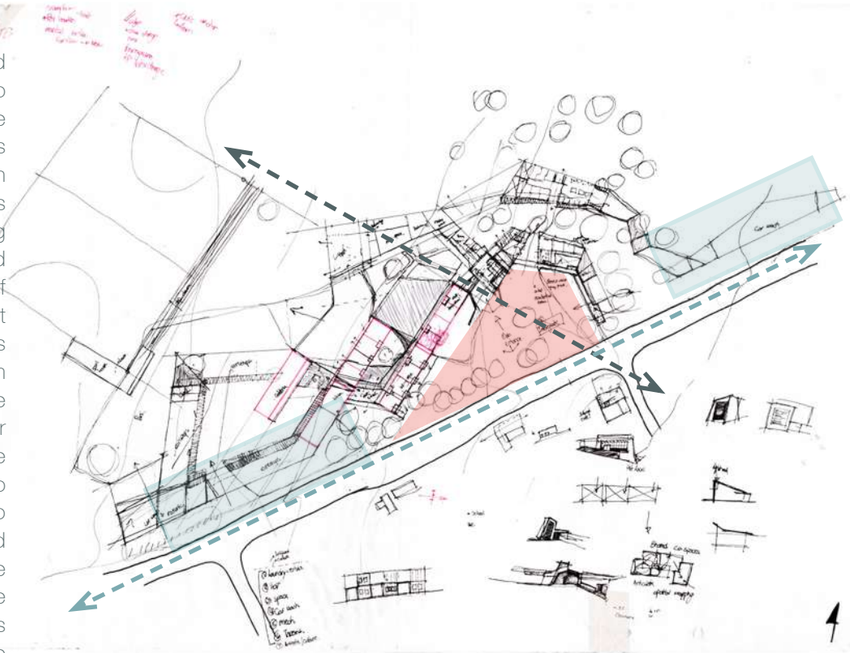


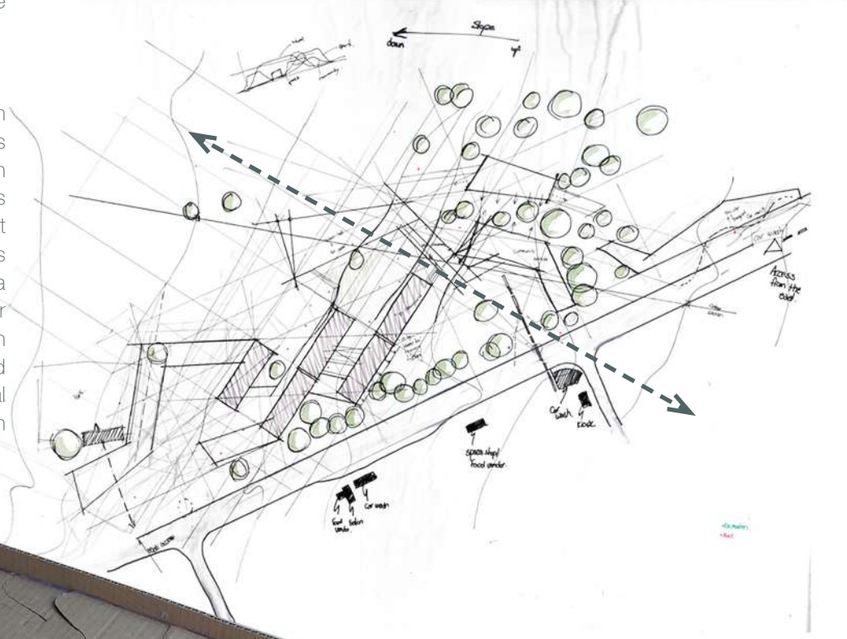
Exploration 02

Developing on the first exploration, aimed at refining the previous exploration into controlled form. The placement of the forms on-site reconsidered the effect it has on internal spaces (courtyards) between the new and existing buildings. Buildings are placed between existing trees allowing the architectural response to be informed by the site condition and in consideration of spatial contribution the natural environment can make. The new proposed edge is moved back to allow for a continuum of public and private spaces to shape the edge (GCRO 2018:41). Existing car wash entrepreneurial businesses are formalised on both edges of the site to recognise the business corridor in Tsomo Street promoting vibrant and well-used streetscape (UrbanWorks & Sustainable Livelihoods Foundation 2017:23). The programmatic placement on-site moves from public interface to specific use of the school activities.

Reflection & Opportunity:

The potential form and massing still seem random and not grounded. Courtyards seem uncomfortable and require design consideration. The massing of buildings is creating uncomfortable corners that create future problems. A spatial link forms movement through the site, creating a public space on the one edge to filter interaction from public to private and then guide movement into the school and implement various layers of entrepreneurial activity to attract various users (Urban Vision).



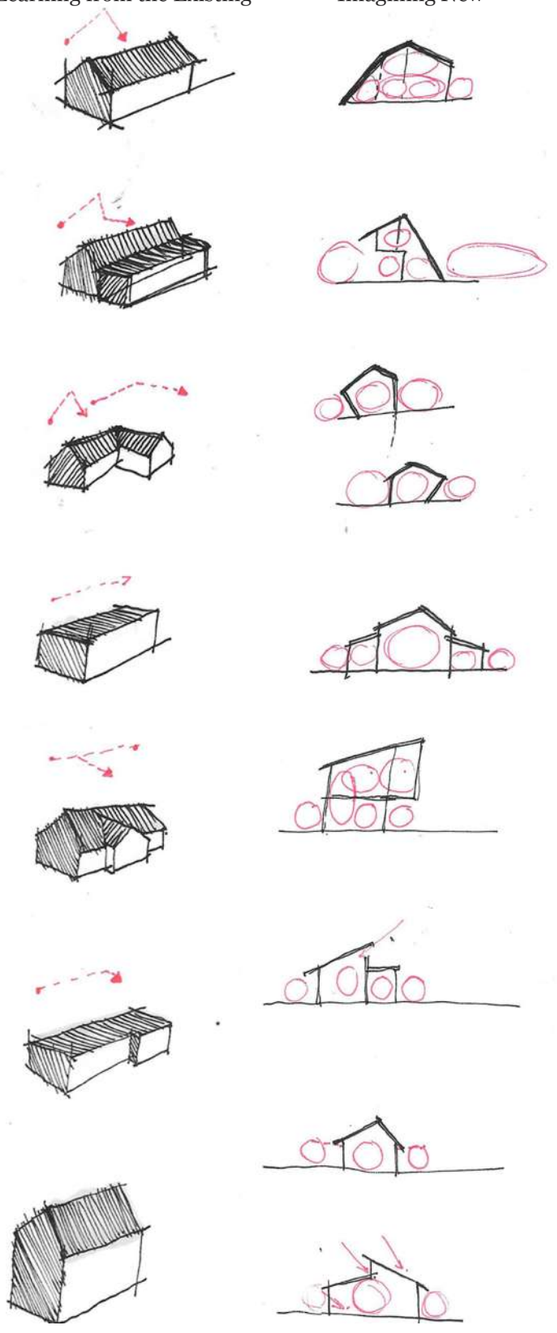


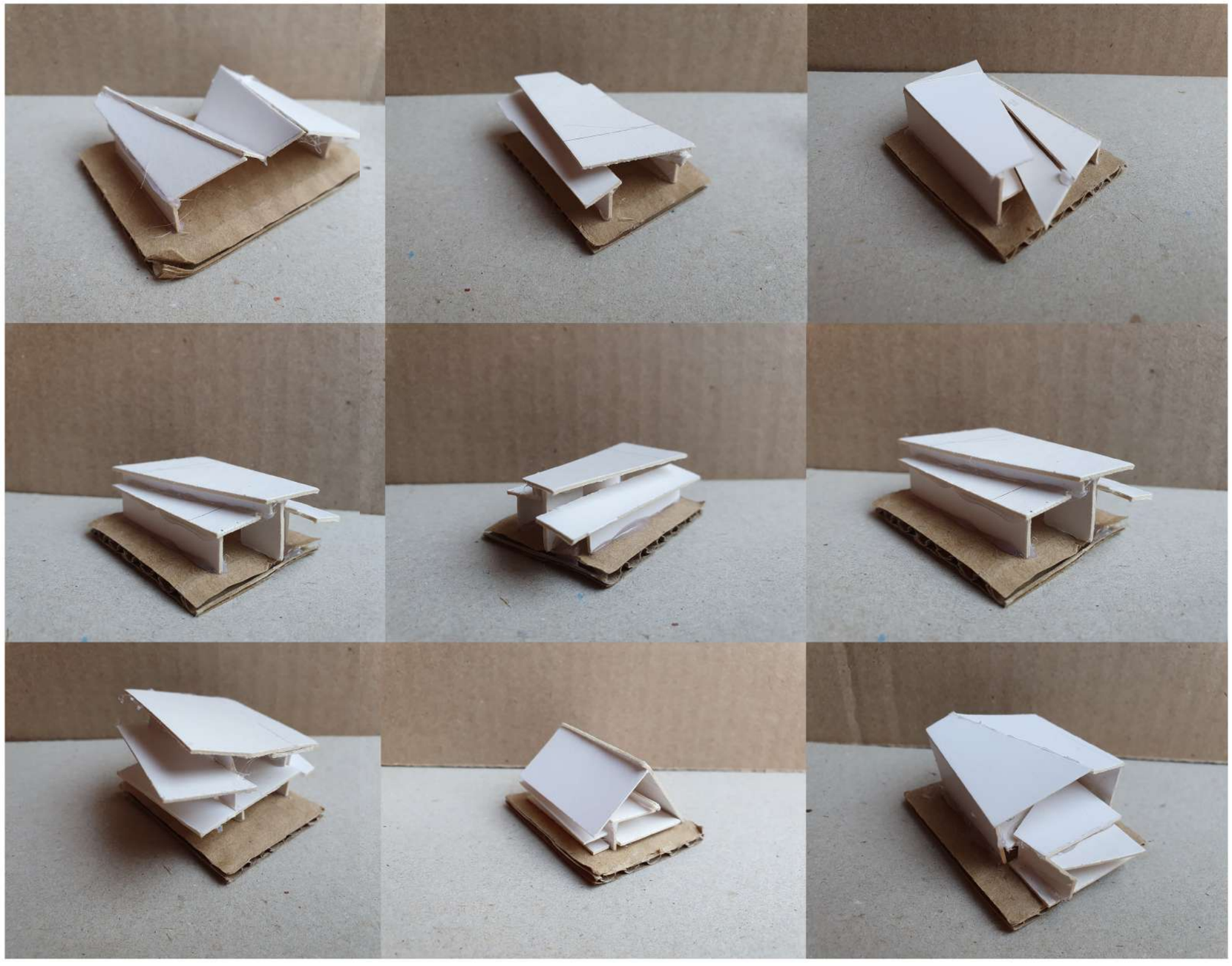
Exploration of Roof Scapes

The design intention of the roof is to configure the learning experience and the culture of learning in schools (Jimenez 2018:24, Muller 2015:1). As discussed in Chapter 3 the existing classrooms create many spatial restrictions and the opportunity arises to address these limitations. The roof becomes an extension of the existing building and this idea is further explored throughout the design development.

Learning from the Existing

Imagining New

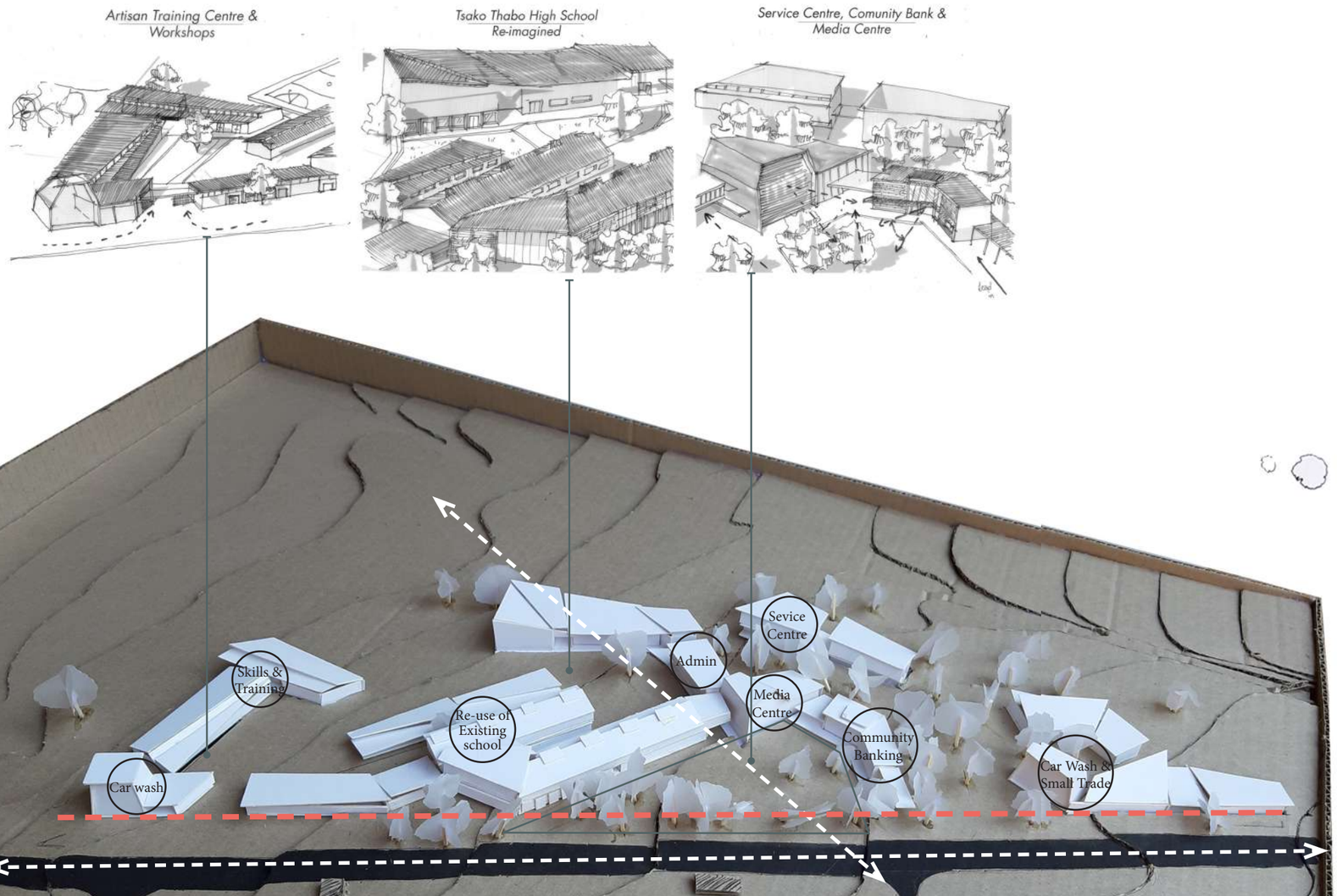


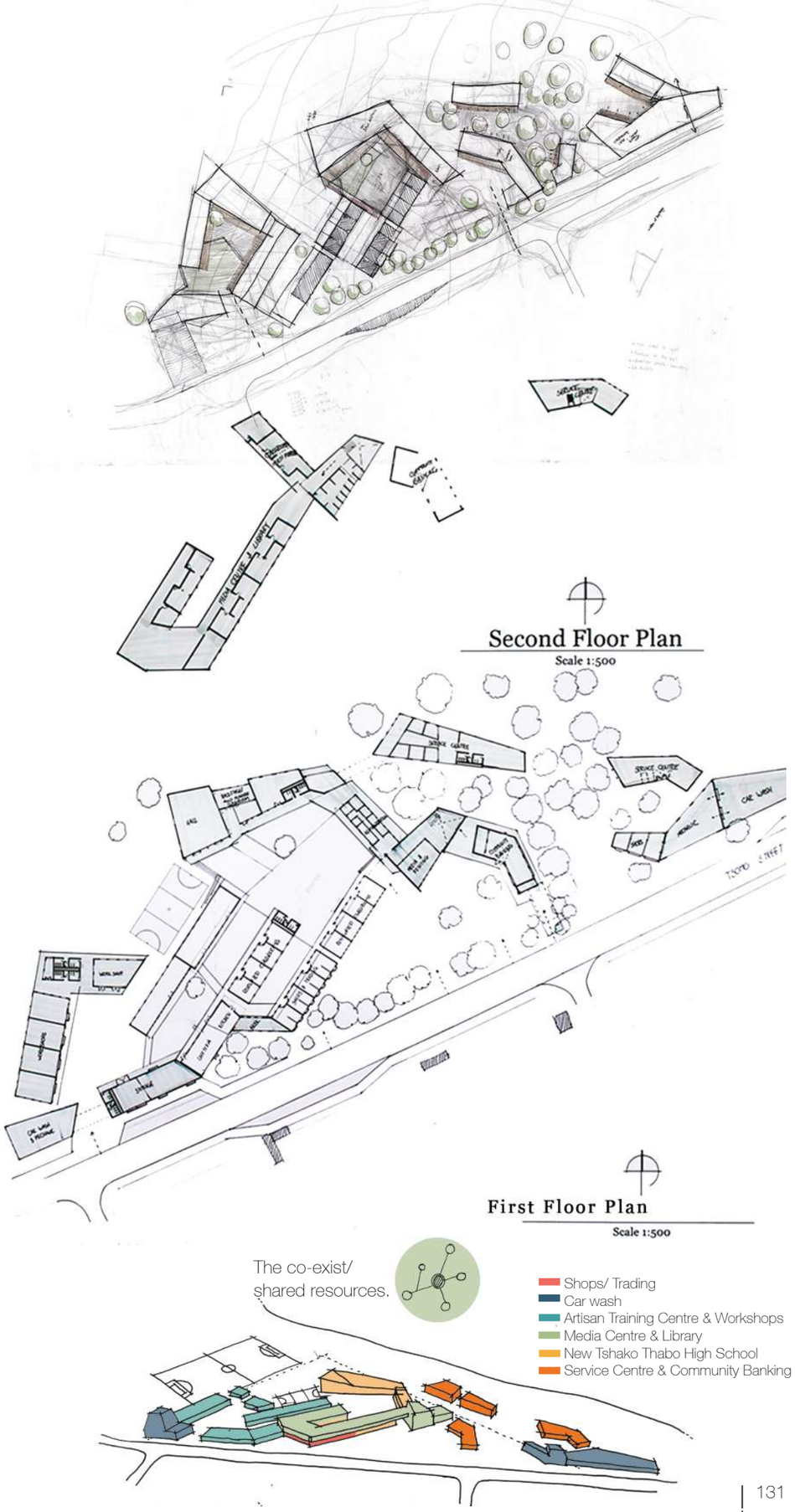


Exploration 03

In this iteration, the design set out to explore the programmatic requirements and zoning to investigate how they can contribute to one another (refer to Chapter 3 conclusion). Programmatic placement is explored to filter user interaction from public to private. Buildings are set back from Tsomo Street, creating wider pavements to enable pedestrian movement, interaction and street vendor activity on the street edge (findings in layer 02 mapping). The building form is further developed to become more grounded and intentional, to guide users through the space. Courtyard spaces encourage movement from the main spatial link and create internal streets allowing the creation of social spaces (Barker 2009:115). These spaces act as platforms for social interaction (Human & Puren 2016:11).

Critique:
The public connection needs to be more intentional between the school and community and an architectural intervention needs to motivate this interaction. The site requires further exploration in terms of the edges, possible connections to encourage entrepreneurial incorporation into the school. Building forms still seem 'random' and need to be grounded more deliberately to desired lines such as the street and angle Tsako Thabo Secondary is aligned at. Courtyard spaces need refinement and need to be designed to inform social interaction to happen in that space: Currently, the courtyards seem uncomfortable. The building angle requires environmental strategies to assist with the western sun that can affect and impact the learning environments (refer to mapping in Chapter 3). The programme and building need to intervene more with Tsomo Street and its various users. Access, and safety should be considered and controlled through design decisions.



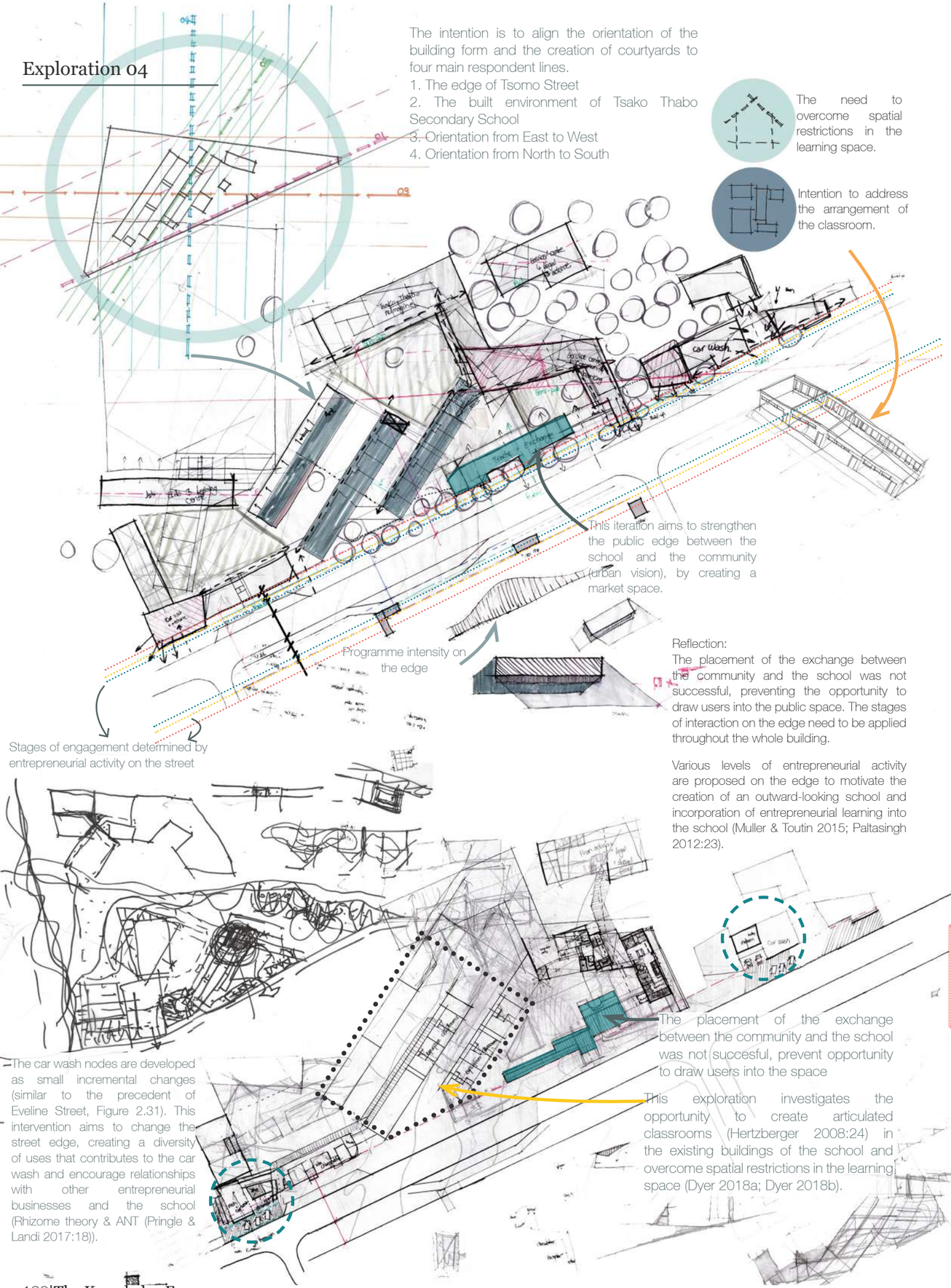


Exploration 04

The intention is to align the orientation of the building form and the creation of courtyards to four main respondent lines.
1. The edge of Tsomo Street
2. The built environment of Tsako Thabo Secondary School
3. Orientation from East to West
4. Orientation from North to South

The need to overcome spatial restrictions in the learning space.

Intention to address the arrangement of the classroom.



This iteration aims to strengthen the public edge between the school and the community (urban vision), by creating a market space.

Programme intensity on the edge

Stages of engagement determined by entrepreneurial activity on the street

Reflection:
The placement of the exchange between the community and the school was not successful, preventing the opportunity to draw users into the public space. The stages of interaction on the edge need to be applied throughout the whole building.

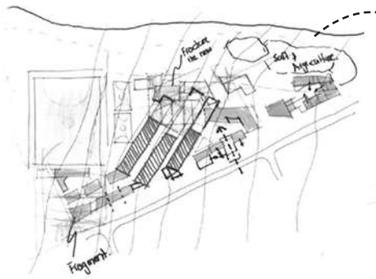
Various levels of entrepreneurial activity are proposed on the edge to motivate the creation of an outward-looking school and incorporation of entrepreneurial learning into the school (Muller & Toutin 2015; Paltasingh 2012:23).

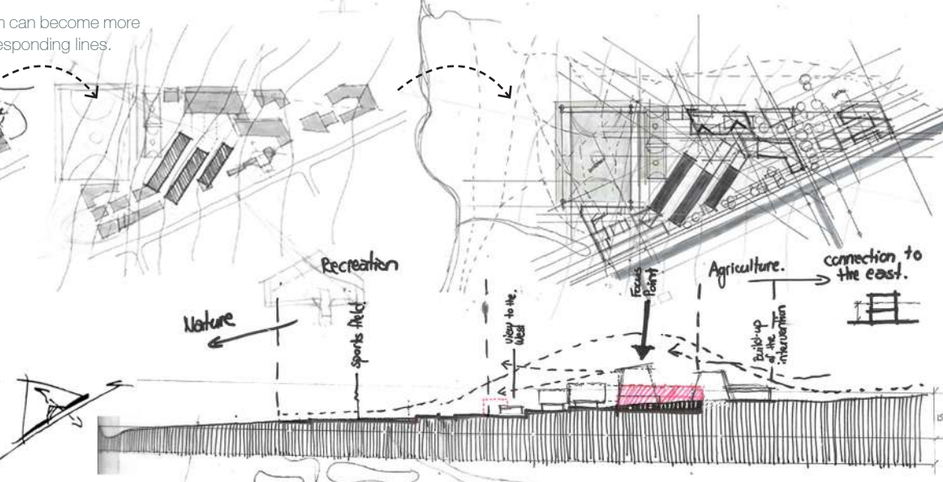
The car wash nodes are developed as small incremental changes (similar to the precedent of Eveline Street, Figure 2.31). This intervention aims to change the street edge, creating a diversity of uses that contributes to the car wash and encourage relationships with other entrepreneurial businesses and the school (Rhizome theory & ANT (Pringle & Landi 2017:18)).

The placement of the exchange between the community and the school was not succesful, prevent opportunity to draw users into the space

This exploration investigates the opportunity to create articulated classrooms (Hertzberger 2008:24) in the existing buildings of the school and overcome spatial restrictions in the learning space (Dyer 2018a; Dyer 2018b).

Massing exploration of how the built form can become more controlled and structured with the responding lines.

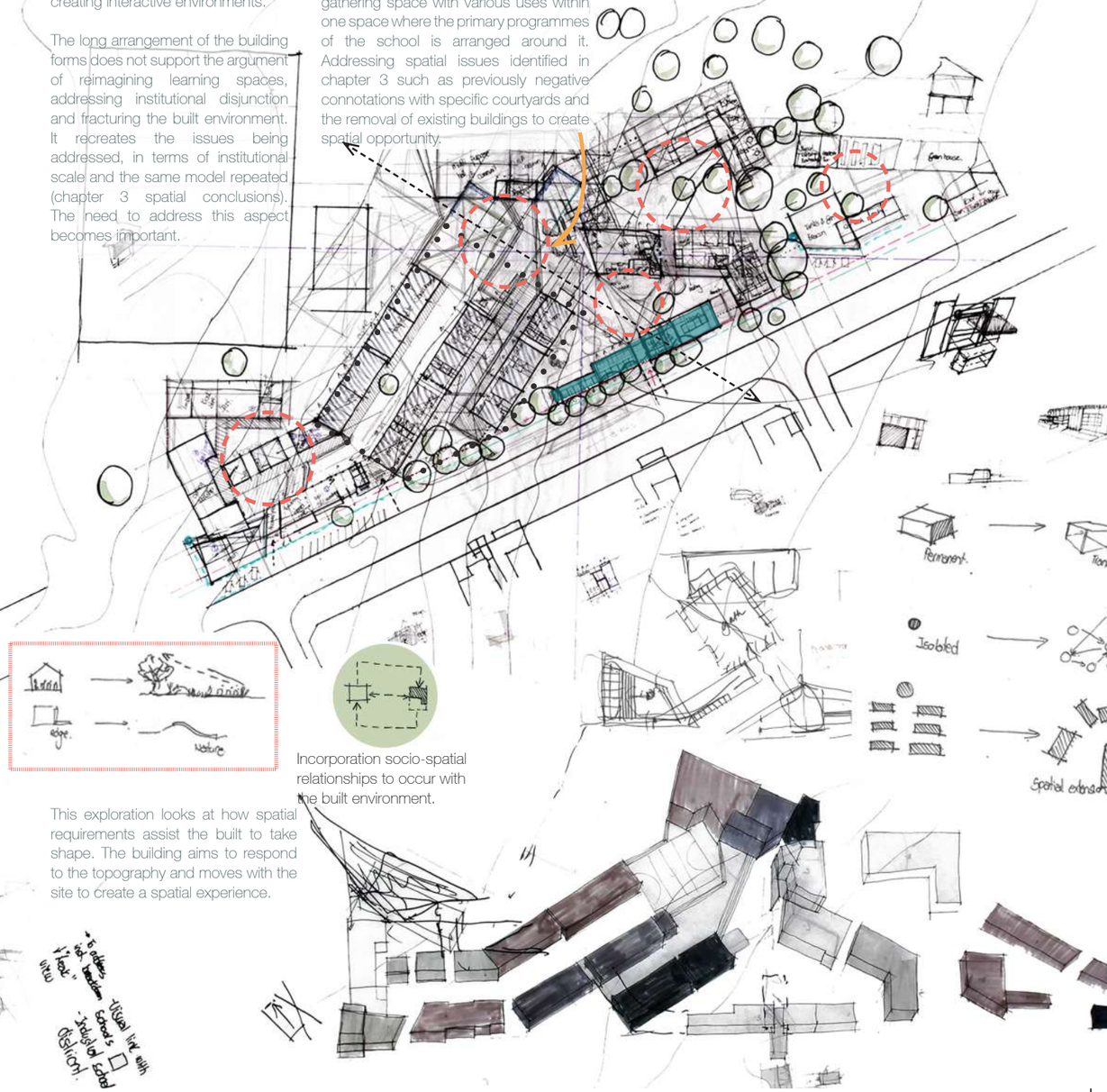




Reflection:
Opportunity arises for the programme and building form to use the slope of the site and guide users through the spaces. This assists the design to give attention to the social role architecture had with its participants (Dudek 2000:38), focusing on the in-between (van Eyck date?) and creating interactive environments.

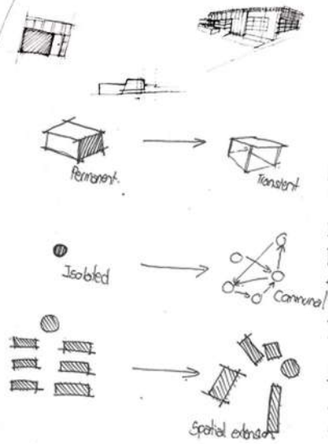
The long arrangement of the building forms does not support the argument of reimagining learning spaces, addressing institutional disjunction and fracturing the built environment. It recreates the issues being addressed, in terms of institutional scale and the same model repeated (chapter 3 spatial conclusions). The need to address this aspect becomes important.

The spatial link spills into a courtyard, the design intention is to create a larger gathering space with various uses within one space where the primary programmes of the school is arranged around it. Addressing spatial issues identified in chapter 3 such as previously negative connotations with specific courtyards and the removal of existing buildings to create spatial opportunity.



Incorporation socio-spatial relationships to occur with the built environment.

This exploration looks at how spatial requirements assist the built to take shape. The building aims to respond to the topography and moves with the site to create a spatial experience.



Exploration 05

This iteration develops ideas generated in the previous explorations. The site boundary is investigated as another edge, incorporating the movement of the community across the open field to the North into the design intervention.

Recreation, in terms of sport facilities (Department of Education 2013) is placed on this part of the site to share these facilities with the primary school, other schools in the area and the community.

Learning spaces of Tsako Thabo Secondary School are further developed to break up the long arrangement of the building, fragmenting the school and allowing school morphology to occur.

Agriculture:
Vegetable garden for proposed production and kitchens within entrepreneurial school.

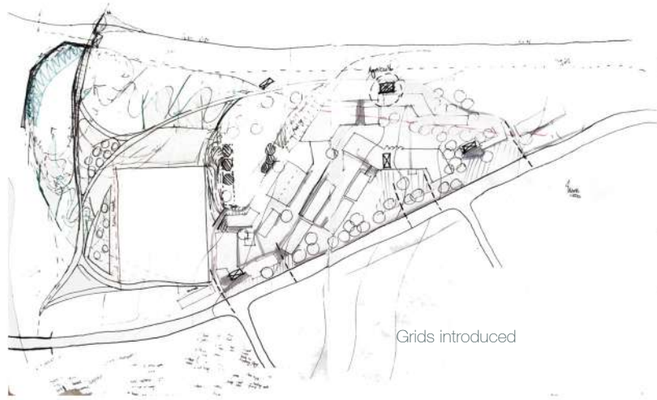
Entrepreneurial connection with the public is considered important, as identified in mapping layer 02 and urban vision. The connection suggested with the public explores to align with Tsako Thabo Secondary and is considered as the approach to be taken as it assists in guiding users into the public space.

Recreational:
Sport Facilities proposed to be shared with Primary School across the road.

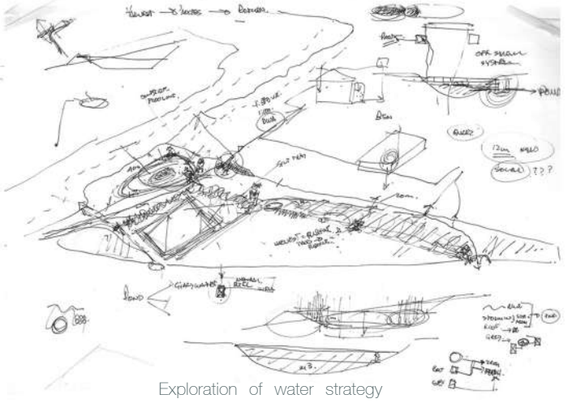
Classroom type 1

Classroom type 2

Classroom type 3



Grids introduced



Exploration of water strategy and opportunity to incorporate into the design.

Interpreting the findings, Classroom blocks are conceptualised to be broken up into parts, to change learning occurring in these spaces and create social interaction on one edge where a classroom will be taken away. The reason is due to the long linear arrangement of classrooms impacting social issues identified in chapter 3. By breaking up classrooms it also encourages various models of learning to occur and the creation of social spaces encouraging relationships with the built environment by removing one classroom.

Reflection:
Entrepreneurial spatial principles (figure 4.11) are set out to be applied to the building to step edges, informing users of entrances and interaction opportunities. Currently building facades are not encouraging these ideas.

Various Learning Models

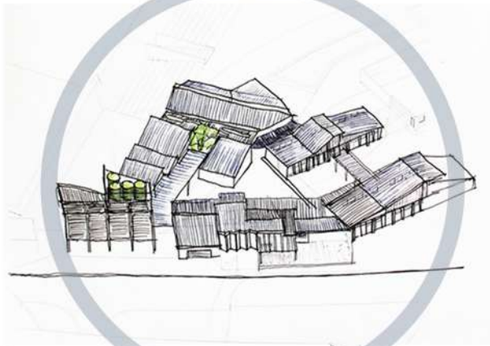
Shared Learning

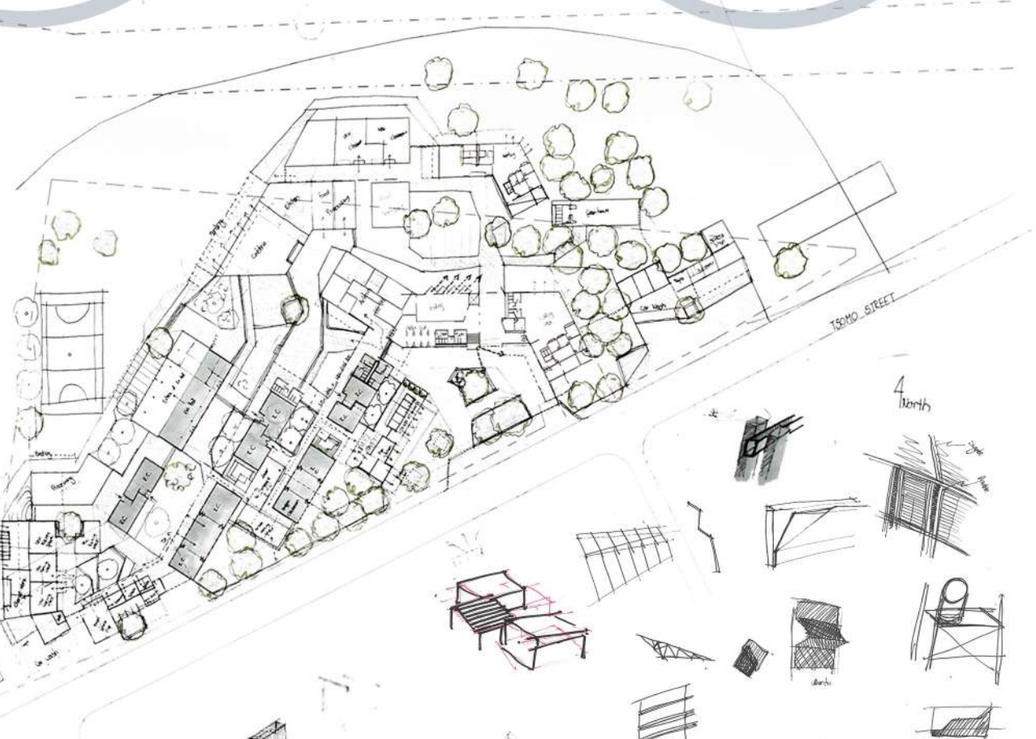
Various Learning Models

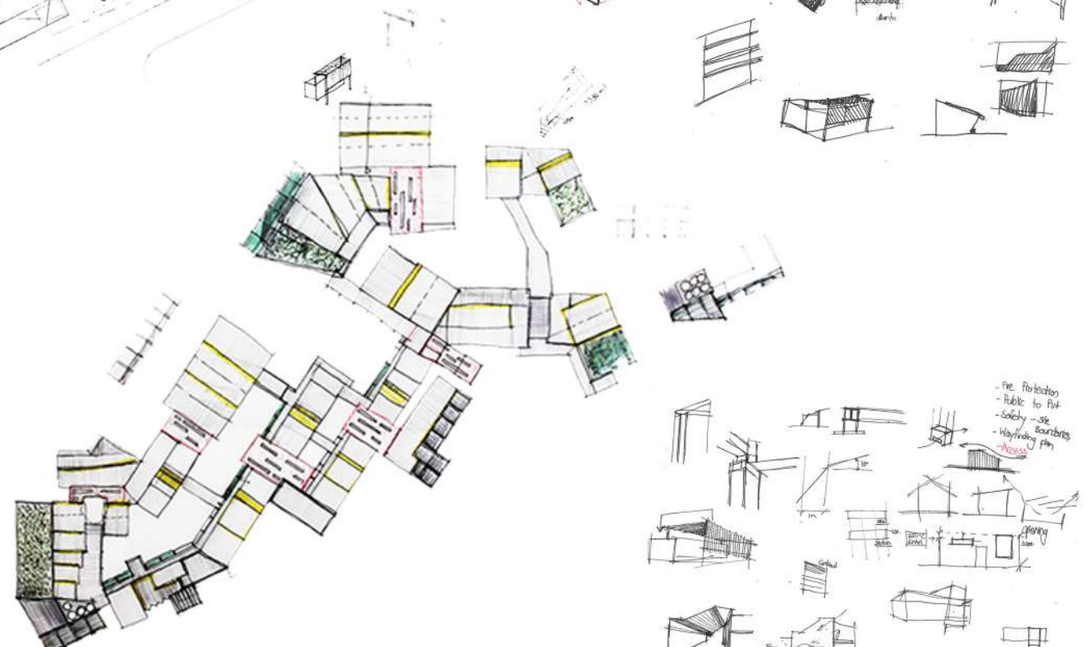
Shared Learning

Reflection:
Learning environments are categorized into three types to promote entrepreneurial learning by creating various learning environments to suit possible spatial needs: such as shared learning, entrepreneurial exchange and adaptive learning environments to contribute to this culture of learning in this school (Jiminez 2018:24; Muller 2015:1; Weeks 2012:9).

Classroom type 2 is adaptable workshop spaces and is placed to the public edge for community accessibility in terms of visibility (urban vision principles) and 'public' association of programme in these spaces such as the identified nature of entrepreneurial trade on streets.







Exploration 06

This iteration develops ideas created in the previous explorations. The intention in this iteration was to develop the building to a stage to understand how programme requirements, building form and the "in between" impacts one another. The school buildings are then taken further to develop the new proposed architectural response to the existing. This approach is considered important to the dissertation study as it is suggested as a possibility for other schools as well.

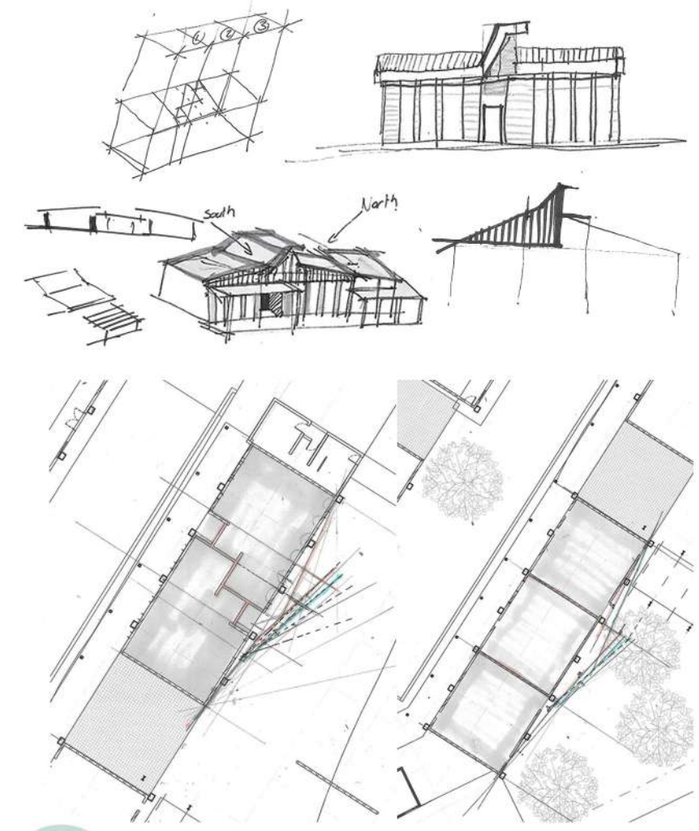
The intention is to explore the opportunity of the school buildings have (phase 3 business plan) to interpret what needed to happen in phase 1 and 2 to produce phase 3 of the business strategy.

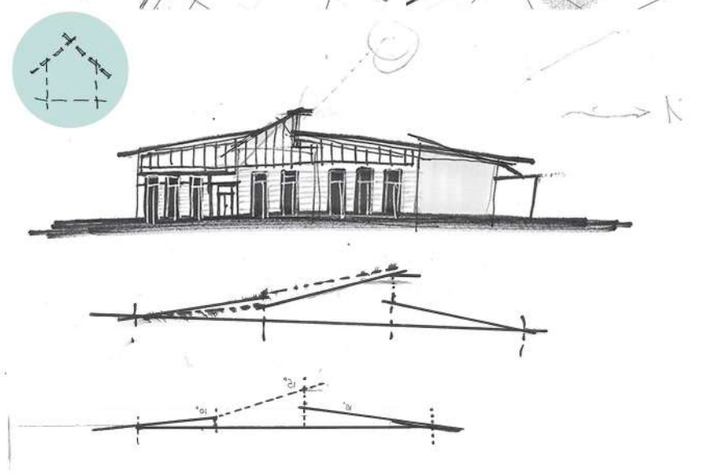
This iteration explores the boundary of the site, incorporating the movement and access from movement edge into the boundary of the school, promoting aspects such as passive surveillance and edge conditions (urban vision, mapping layer 02 and entrepreneurial spatial principles.

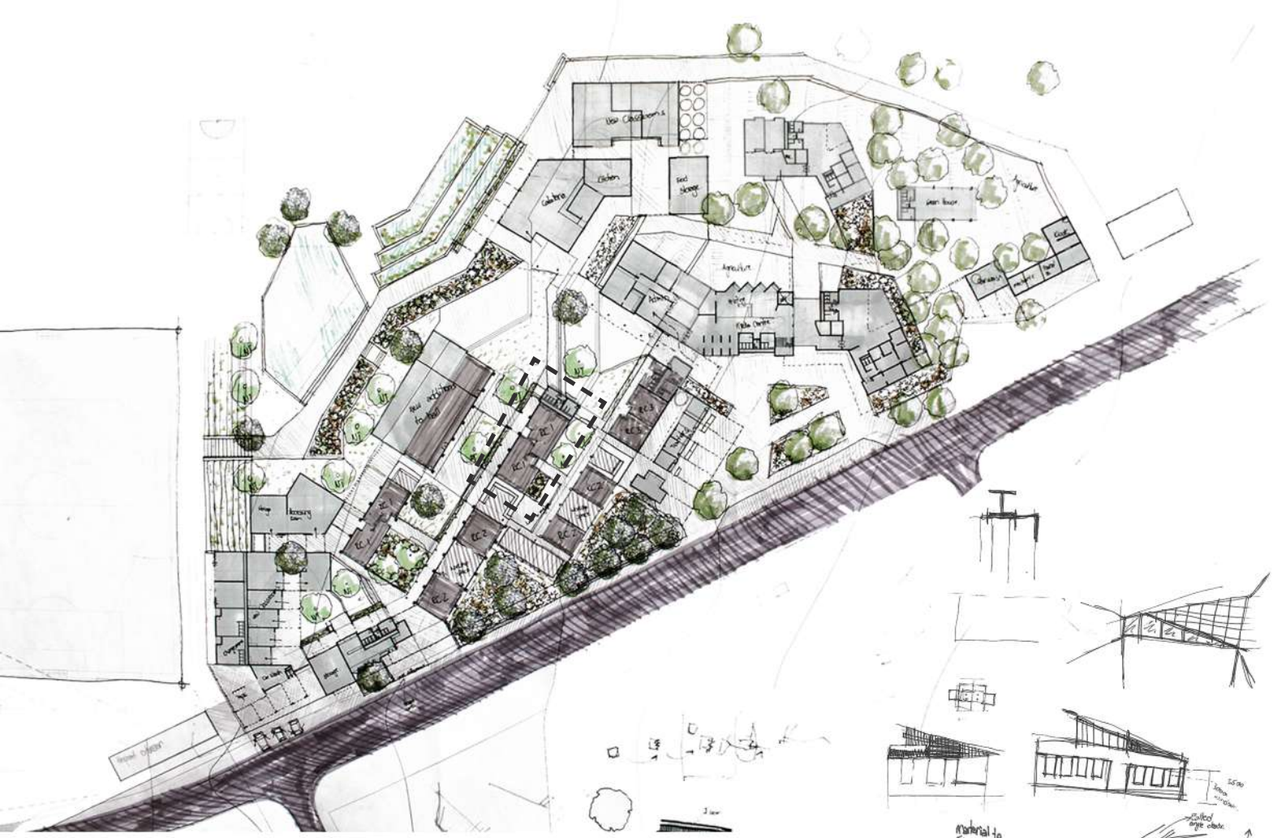
The concept of the roof is explored in this iteration to provide focus on the centre of each classroom block suggested in iteration 5. The roof explores here to wrap as parts over the building.

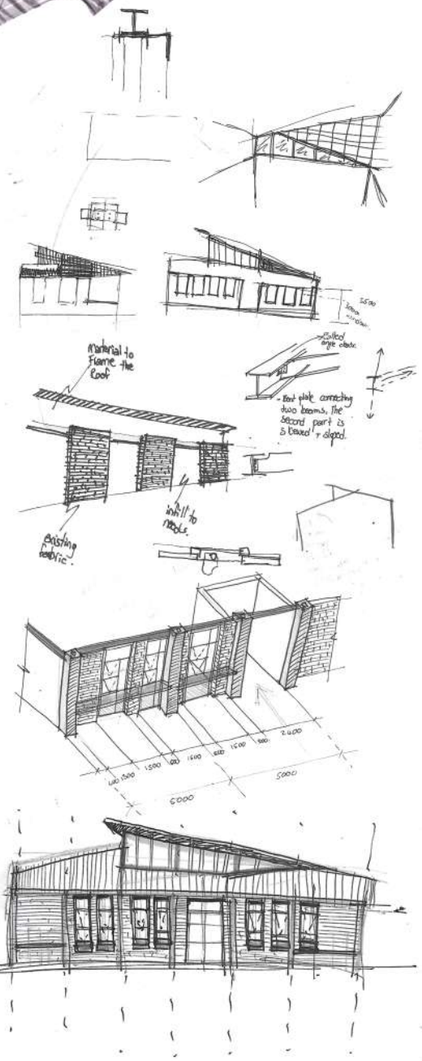
The iteration explores with boundaries to the edge facade transparency improving: visibility, accessibility and including the public into the school.

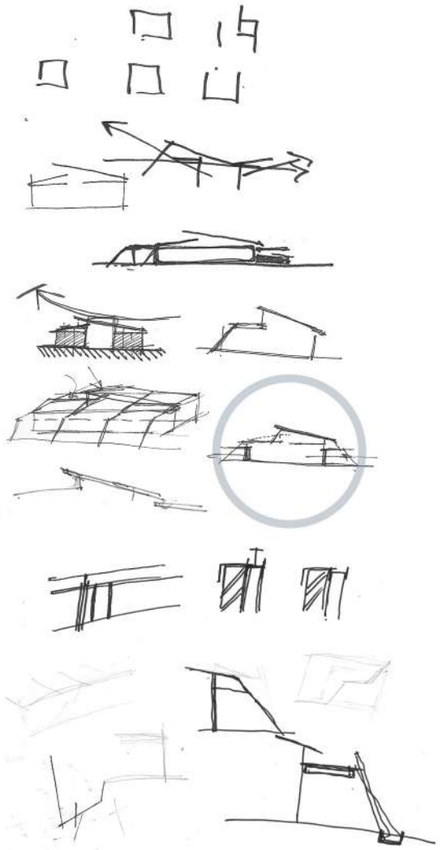
Reflection & Opportunity
The roof creates uncomfortable endings in terms of design observed in model exploration, material and assembly. It creates future problems with rainwater, how materials meet at the ends. The direction of the roof explored will be expensive due to the many connections suggested and doesn't provide economical solutions. The window also creates too much exposure to the Nort-western facade that will make classrooms to hot and uncomfortable. The roof is also not consistent in creating an architectural language, it seems "safe" and does not reflect the spatial exploration created on plan.











Exploration 07

In this exploration design ideas are refined and developed. Entrepreneurial spatial principles (figure 4.11) are applied to the building to inform users program and interaction. The natural environment is deliberately incorporated to improve spatial experience, soften boundaries with landscaping, used as informants to walkways, contribute to social spaces and protect the buildings from the western sun.

Boundaries and safety is considered as issues impacting educational environments (Layer 02 mapping and Urban Vision). The design intends to address boundaries by incorporating the schools built edge with Tsomo Street, boundary walls are not placed deliberate, rather than design elements informing space suggested in the floor plan and to motivate visibility. Programmatic development on the edge is developed so that the relationship they have with one another (Rhizome and ANT theory) contributes to activating the edge (Edge City).

Learning environments within the existing buildings of the school are further developed. The facade of the school is explored to determine design opportunity to remove windows and insert new openings to address changes made within the space to improve learning environments.

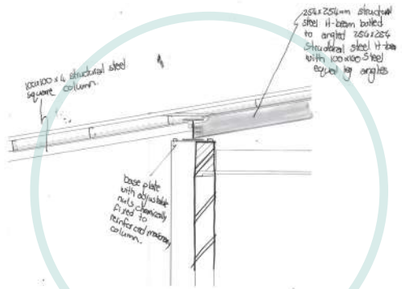
The roof is developed as a device that acts as more than one device, roof, shading, column and solar chimney illustrated in the model exploration.

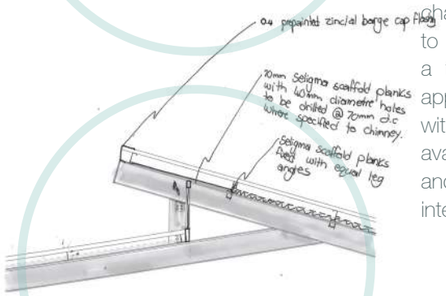
Exploration 08

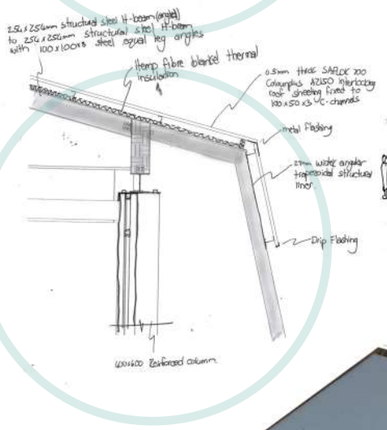
This exploration developed a critical reflection and synthesis of the previous explorations investigated, ensuring the design principles, architectural intentions, refinement of 'Edge City' and morphing of the school typology is applied.

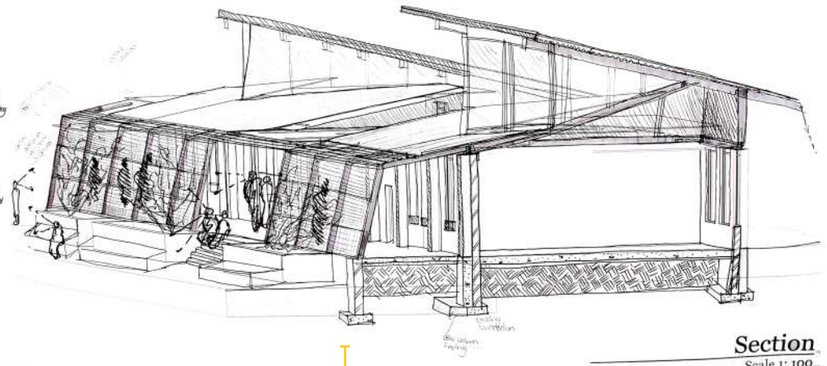
In order to be able to afford such a project, as suggested earlier in this chapter a business strategy is proposed to be adopted. Secondly, in developing a technical solution, a more sensitive approach is required when intervening within the existing school. Due to availability of materials from the context and 'costing' available (field research). The intention therefore is directed to resolve a more considerate approach to use the existing more. In this case the existing roof is constructed from steel beams, the design will intend to explore an approach to reuse these beams and improve the learning environments (Jimenez 2018:24, Muller 2015:1) within this framework.

Design strategies will need to be explored in conceptualising and designing this roof (Department of education 2013, standards). This architectural response will be refined within the technical exploration in chapter 5 to extend resolution to improve learning environments and the culture of learning in Tsako Thabo Secondary School.









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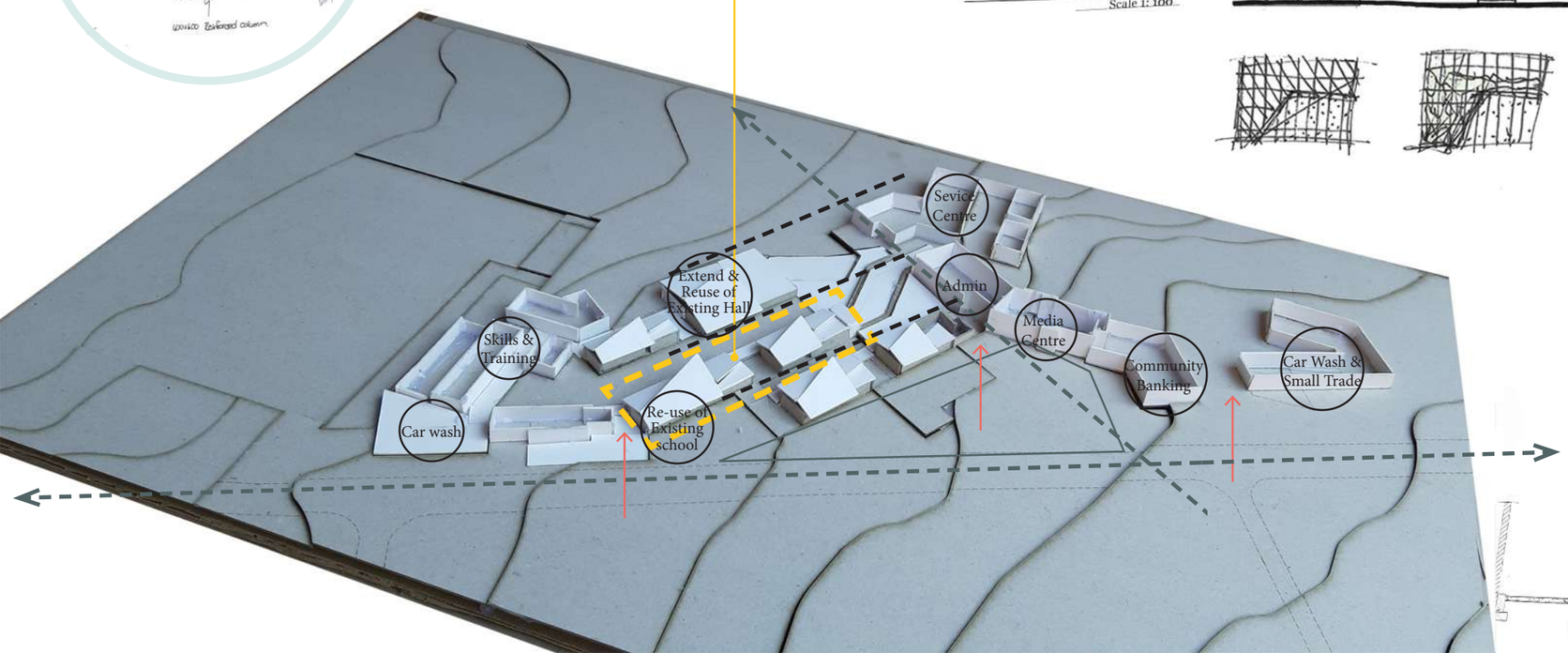

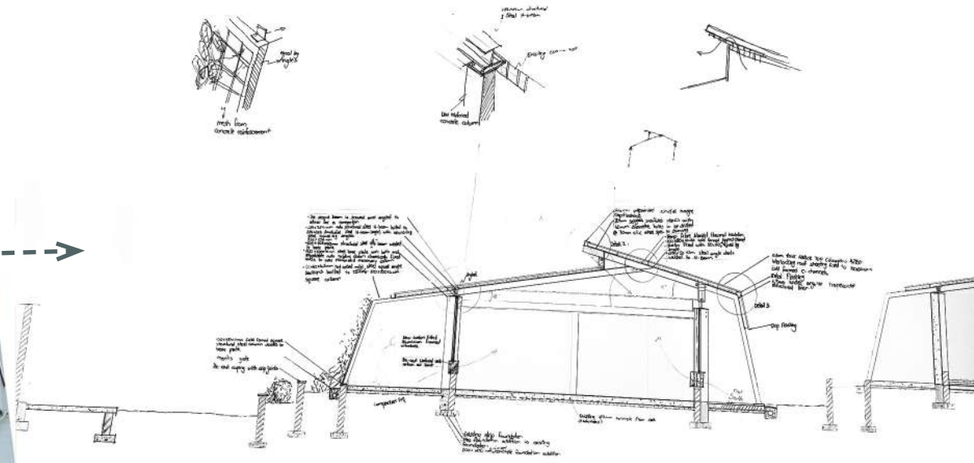

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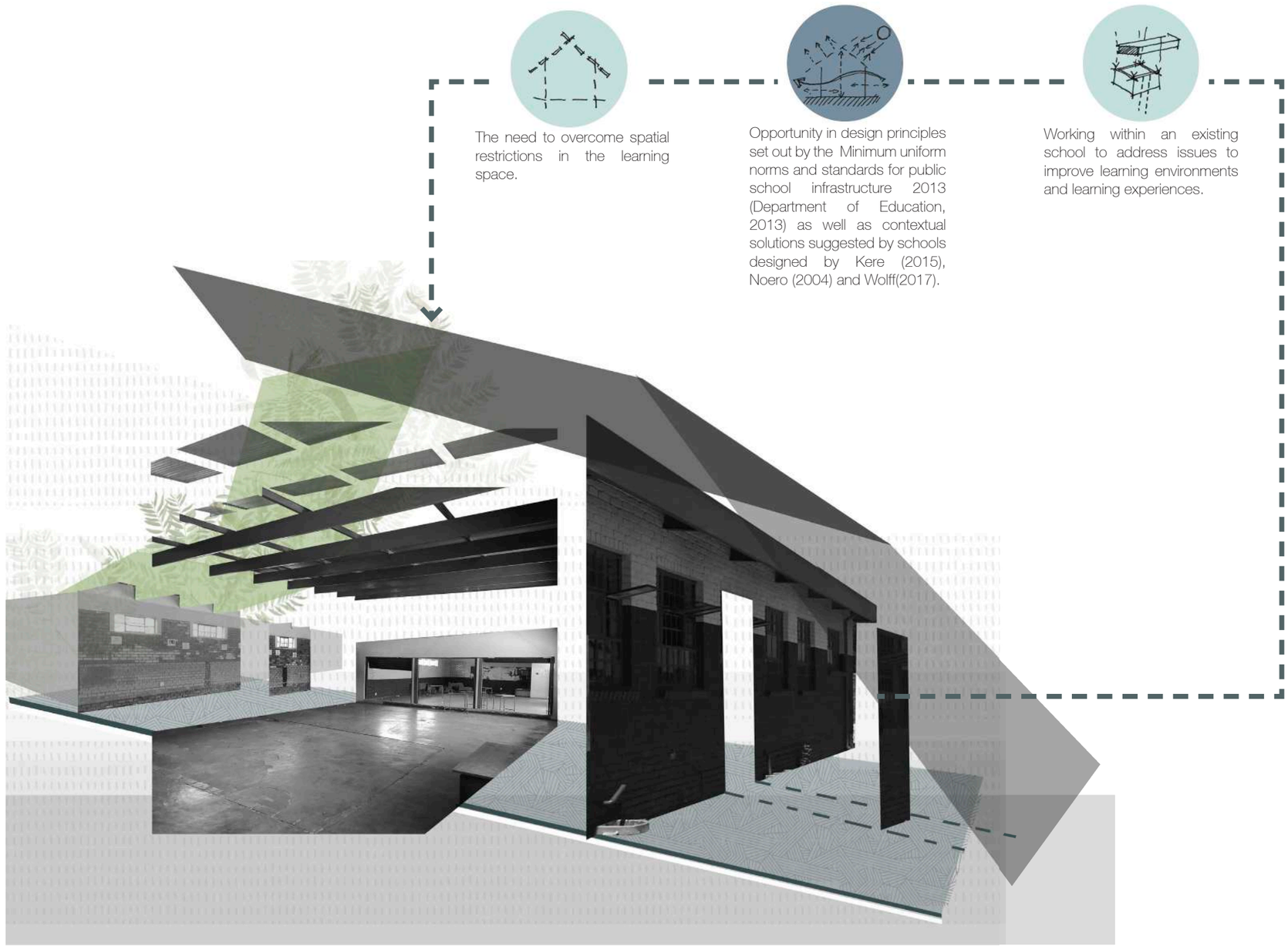


Figure 5.1: Technical Concept
(Author 2019)

5.1 Overview

This chapter explores the technical investigation of the final design synthesis in terms of material, technology, services, environmental strategies, and construction. The technical concept expresses the design decisions which are based on theoretical and programmatic requirements and will be approached as an extension of the design response to the site and landscape.

5.1.1 Technical Intention

The intention is to reimagine educational facilities into a stimulating, supportive and inviting environment, addressing shortcomings apparent in the current learning environments of Tsako Thabo Secondary School. The theoretical exploration draws from the theoretical premise and the value of space- and place-making that can contribute through the built environment to improved and versatile learning environments.

5.1.2 Contextual Condition

As uncovered in the previous chapter, spatial conditions inherent in school typologies play a role in a student's inability to complete their educational pathways (Higgens et al. 2005:7; Jimenez 2018:24). As uncovered in Chapter 3, the arrangement and orientation of the classrooms in relation to the walkways are inconsistent and leave classrooms cold and under-lit due to some of the classroom entrances being located on the South-East end and other the North-West (refer to Figure 3.5).

Secondly, the conceptual intention of morphing the school typology into incorporating an entrepreneurial typology expand to the technical investigation.

51.3 Technical Concept

The architectural design is informed by the theoretical premise, set out in the educational learning environments, and socio-economic connections to investigate the impact architecture has on learning environments and the opportunity technology and systems have on shaping learning environments.

The concept is to reuse the existing school buildings to address these spatial limitations apparent in the learning environment discussed in Chapter 3 and in doing so improve the students' learning experiences (Jimenez 2018:24; Weeks 2012:4).

The tectonic concept further explores the concept of architecture becoming instructive through integrating interaction and participation with the built environment through design, materiality, light, construction, detailing, layering the environment and systems. Architecture and space inform the behavioural, physical, emotional, cognitive and social aspects of teaching and awakens creative thought (Bjørnholt 2014:117). The architectural tectonic exploration aims to enhance a platform and experience through space- and place-making in creating a school for social entrepreneurs.

5.2 Response strategies

The aim is for the building tectonics to respond to contextual, environmental and climatic attributes. The investigation explores this idea of response to the site, location, the existing spatial restriction, and landscape.

The arrangement and orientation of the classrooms in relation to the walkways are inconsistent and leave classrooms cold and under-lit. Some classroom entrances are at the South-East end and some in the North-West (refer to Figure 3.5).

5.3 Responding to Materiality

5.3.1 Material and Assembly

The building assembly, technology, and construction rely on a hands-on approach and the encouragement of local knowledge. This allows for the craftsmanship and method of assembly to be derived from the context and the 'ability to recognise the demands of context' (SACAP 2010:8) and visible in the completed buildings to include economic aspects.

This idea further builds on identified entrepreneurial spatial principles as seen in Figure 4.11. Observations in field research and study of entrepreneurial activity indicated in Chapter 4, that the context is used as a design driver and the relationship between parts is important (Pringle & Landi 2017:118), is further translated into the material and assembly. Contextual familiarity is used to derive materials and these materials were selected on the grounds of the contribution they can make to the existing site. This also promotes local craftsmanship and incorporates the building into the community.

In the creation of learning environments, materiality plays an important role in the facilitation of sensory experiences. Materials and assembly are aimed at introducing complexity and layering onto the new architecture (entrepreneurial spatial principles). Investigation is initiated into the existing context to identify local skills for assembly available in Mamelodi East illustrated in figure 5.2.

The existing condition of Tsako Thabo Secondary School is illustrated in Figure 5.3 and further illustrates the exploration of possible materials used based on the investigation into the context, introducing complexity and layering with the new.

Material and Assembly Principles

- Local sourced products
- Easily understood assembly
- Materials and assembly derived from the existing context
- Introduce complexity into materiality & assembly

Figure 5.2: Observed Local labour Skills
(Author 2018 & 2019)

Existing Material of Tsako Thabo Secondary School

Horizontal Plane

The existing roof structures consist of mono-pitch corrugated roof sheeting and on some parts pitched roofing.

Vertical Plane

Various types of wall finishes were observed within the context. In most cases, smooth face brick was used and was painted in yellow and brown. In other observed cases plastered face brick was used, also painted and exposed smooth brown-colored face brick.

Ground Plane

The floor finish for interior spaces vary from vinyl and tile work. All walkways are done in concrete and finished on edges with brickwork. Courtyard surfaces vary from brickwork, lawn and in-situ concrete.

Infill

All openings between buildings are barricaded and fenced off either in brickwork or steelwork.

Natural Environment

The school is located within an identified important ridge to the community, it has little to no acknowledgment of the environment and vice versa.

Proposed Material Palette:

Figure 5.3: Existing and proposed material palette (Author 2019)

5.3.2 Structure

Three interdependent substructures:

The primary structure consists of the existing stereotonic structure of the existing school fabric.

The secondary structure consists of the new additions to the extension of the roof and panels wrapping down on the North-western and South-eastern facades. Steel portal frames will be used to extend and integrate with the mono-pitch existing steel beam roof.

The tertiary structure transitions between the existing primary structure and secondary steel frame structure, as 'infill' and the wrapping of material. These elements consist of the skin, new walls, screens and shading devices. This structure explores the technical concept of didactic architecture to contribute to the user's experience in the treatment of light, material, comfort and natural environment.

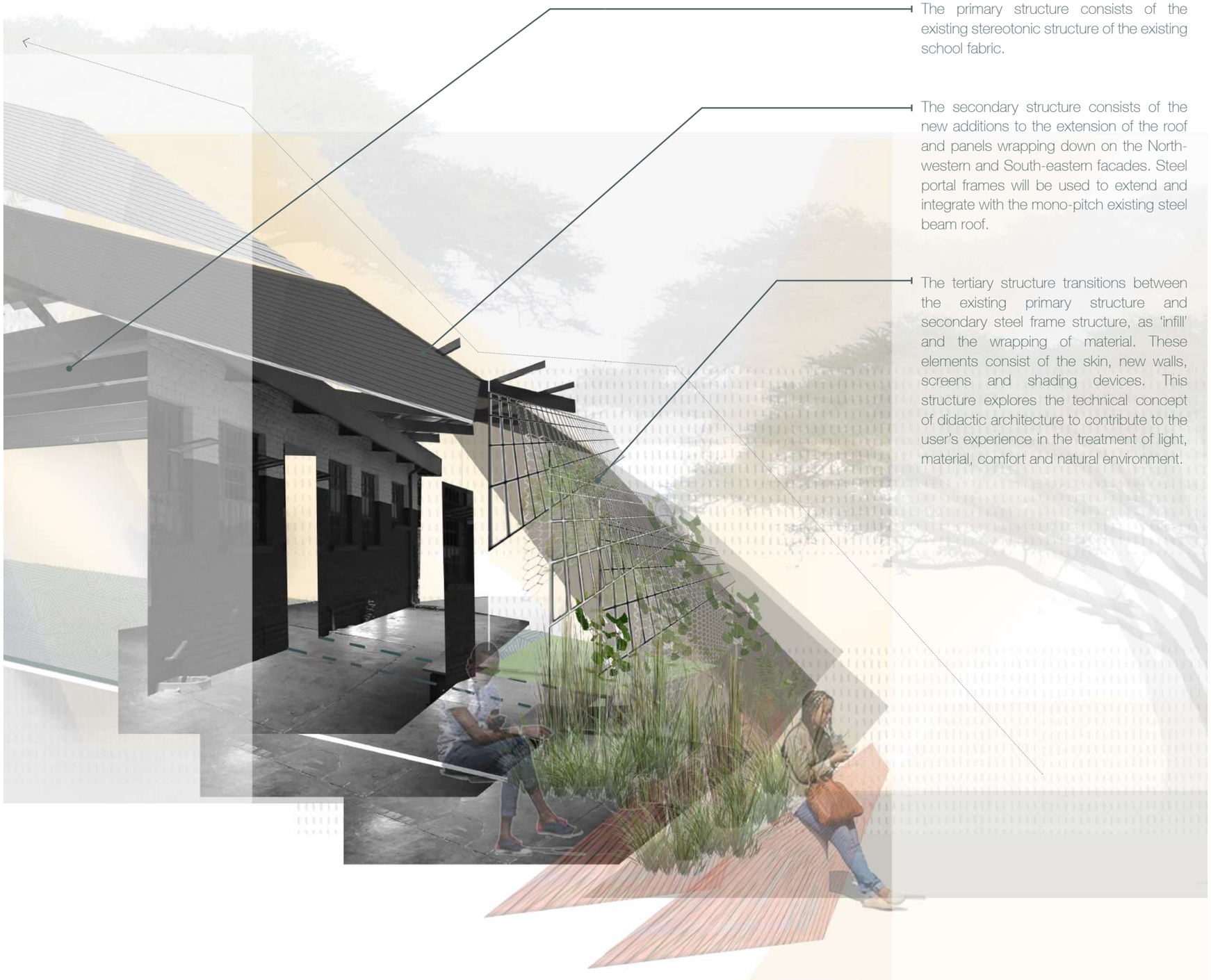


Figure 5.4: Structural Concept
(Author 2019)

5.3.3 Structural Exploration and Implementation

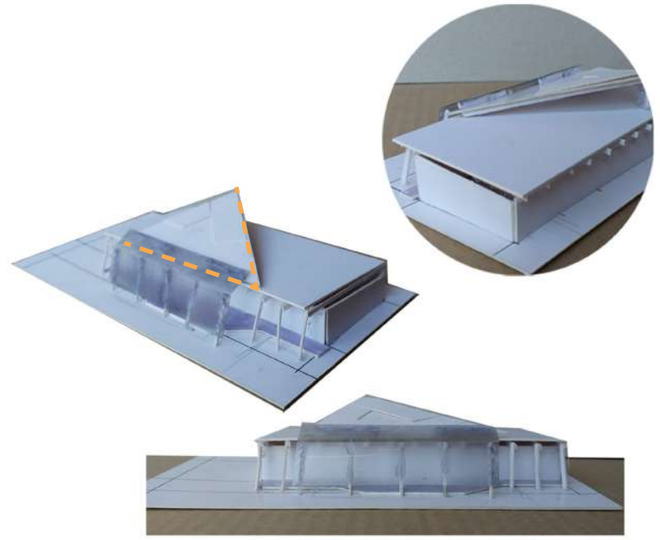
In developing this idea for the classroom to become instructive and morphing, explorations are initiated to develop the idea to re-imagine the classroom to address the shortcomings apparent.

Figure 5.5 firstly illustrates model explorations of this idea of re-using the classroom.

Figure 5.6 demonstrates how this morphology takes shape within the design intervention.

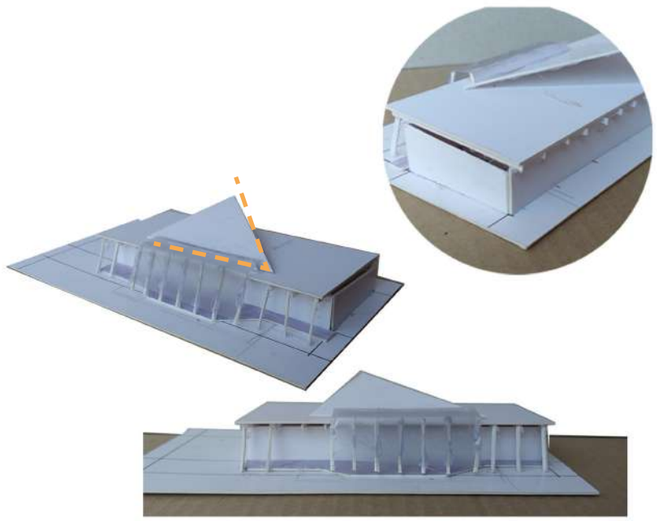
The Existing

The intention is to reuse the existing steel beam of the school buildings.



Roof Exploration 01

The intention is to attach a new roof construction to the existing roof. Extending the existing roof from.



Roof Exploration 02

Figure 5.5: Technical Exploration
(Author 2019)

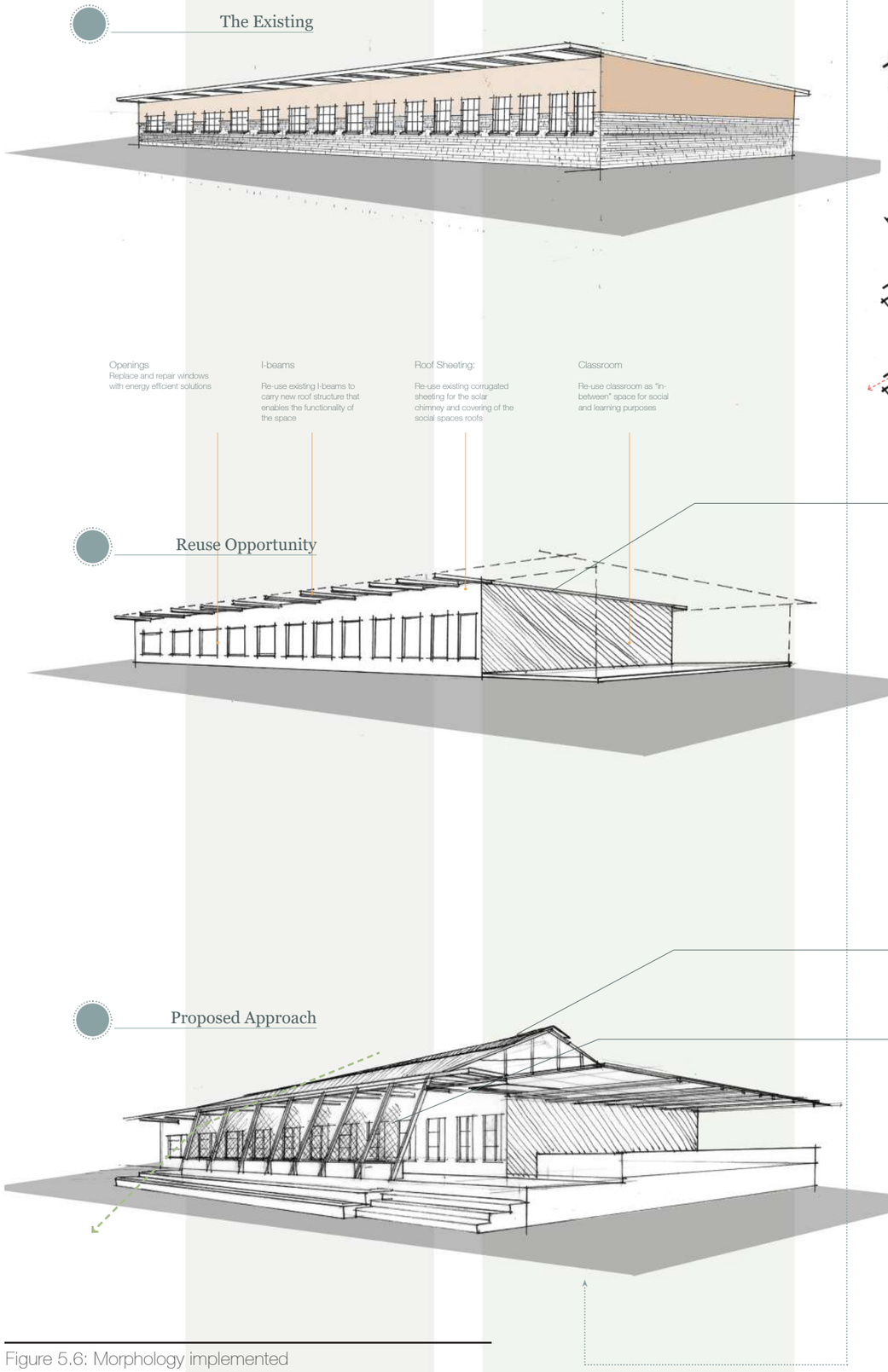


Figure 5.6: Morphology implemented
(Author 2019)

5.4 Technical Precedents

Structural Precedent

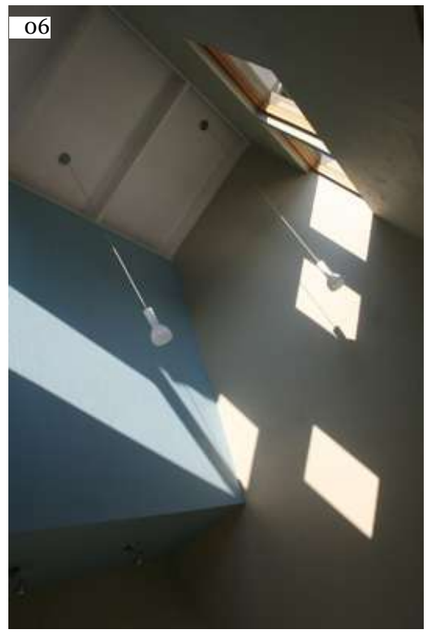
Parkhurst Shops

Kate Otten Architects
Parkhurst, Johannesburg
2010

This project is chosen due to its response to the existing, urban dynamics, materiality, place-making and clever design. This project transforms homes on 4th Avenue in Parkhurst into businesses. Many of these converted houses are still perceived as having a closed-off relationship with the high street through their existing boundary walls and set-backs from the road (kateottenarchitects.co.za, 2010).

The project intends to create a vibrant edge by linking two suburban houses on a busy street into retail shops and encouraging a direct and open relationship with the street. The existing facades of the two converted homes have been maintained, the boundary wall was removed and a new covered walkway is introduced to create a new urban feeling to the street (kateottenarchitects.co.za, 2010).

In this project, the re-use of the existing timber trusses of the original residence in the construction of the new roof is incorporated. The roof is designed in a manner to consider the spatial experience, designing with light and responding to the existing condition.



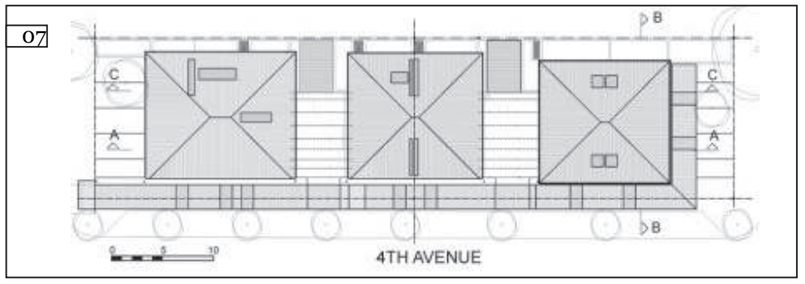


Figure 5.7: Technical Precedents of the reuse of existing roof truss
01. Reuse of existing truss (kateottenarchitects.co.za, 2010)
02.Section through project (kateottenarchitects.co.za, 2010)
03. Entrance of shops (kateottenarchitects.co.za, 2010)
04. Covered walkway (kateottenarchitects.co.za, 2010)
05. New space created in existing roof (kateottenarchitects.co.za, 2010)
06. New space created in existing roof (kateottenarchitects.co.za, 2010)
07. Plan of project (kateottenarchitects.co.za, 2010)

Systematic Precedent

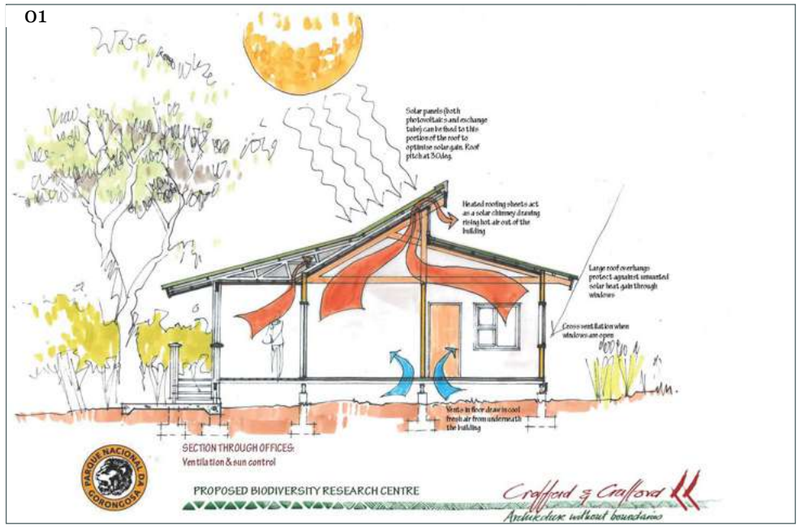
Proposed Biodiversity Research Centre

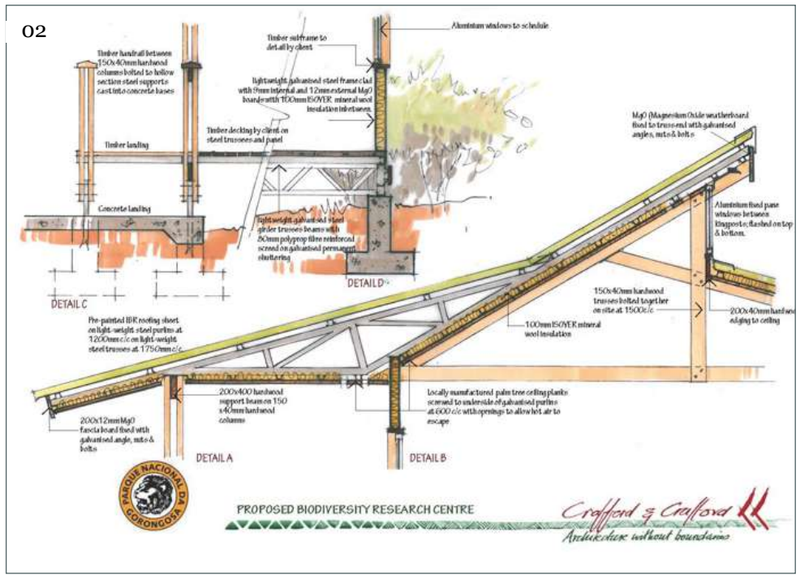
Crafford & Crafford Architects
Gorongosa, Mozambique
2014

This project is chosen due to its responsiveness to its climatic condition, materials used and how it contributes to the spatial experience.

Gorongosa climatic conditions are hot and humid. In summer, the temperature seldom drops below 20 degrees Celsius at nighttime; often daytime temperatures soar above 40 degrees C. One of the biggest challenges in this project was keeping the air temperature within spaces comfortable and the only natural way of cooling down air temperature is through wind movement. The buildings were all designed to maximize natural airflow using cross ventilation and solar stack ventilation. Roof sheets are designed in such a way that they act as solar chimneys, assisting the rising hot air in escaping from the building and draws in cool air from underneath the building (Architecture without Boundaries, 2014).

Materials used within this project was chosen to be brought onto site and easily assembled between the rainy seasons (Architecture without Boundaries, 2014).





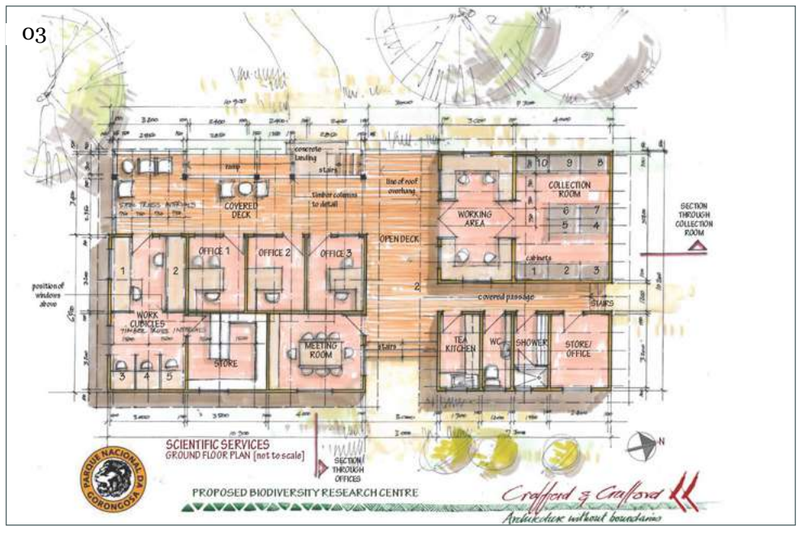


Figure 5.8: Systematic Precedent of using a solar chimney
01.Section through offices- sun and ventilation control (Architecture without Boundaries, 2014)
02. Detailed construction section through offices (Architecture without Boundaries, 2014)
03. Floor Plan (Architecture without Boundaries, 2014)

5.5 Environmental Response strategies:

The intention is for the building tectonics to respond to environmental strategies such as climatic attributes, natural ventilation and daylighting (Department of Education, 2013).

The investigation further explores how contextual influences such as site, climate and locality can assist in developing site-specific solutions to improve learning environments in Tsako Thabo secondary School (Jimenez 2018:21,23; Mampane and Bouwer 2011:114; Weeks 2012:1).

5.5.1 Climatic Condition

The climatic condition of Mamelodi east informs the design response in reducing energy consumption, enhancing human comfort and providing passive design strategies that are responsive to the climatic conditions.

Mamelodi is located in zone 2 and consists of a temperate interior according to the climatic zones stipulated in the SANS 204, this region experiences hot summers with rainfall and cold to very cold dry winters (Muller et al. 2013: 140-105). The average annual temperature in the region is 18°C. The hottest months are from December to February with an average maximum temperature of 25°C. The coldest months with an average minimum temperature of 11°C are June and July (SA Places 2019).

Wind
This region experiences reigning winds in the summer: East-North-Easterly to East-South-Easterly with 41% of days breezy and in the winter: South-Westerly with some North-Easterly and 60% breezy days (AAL 2016).

Conclusion:
Natural ventilation is considered as one of the most fundamental low cost passive cooling strategies (Saadatjoo et al. 2016). The importance of creating responsive design contributes spatial comfort and experience in a space (Muller 2013:104). Therefore, the technical exploration examines strategies to be applied. Due to the climatic nature of Pretoria passive strategies are not considered in isolation but in assisting one another.

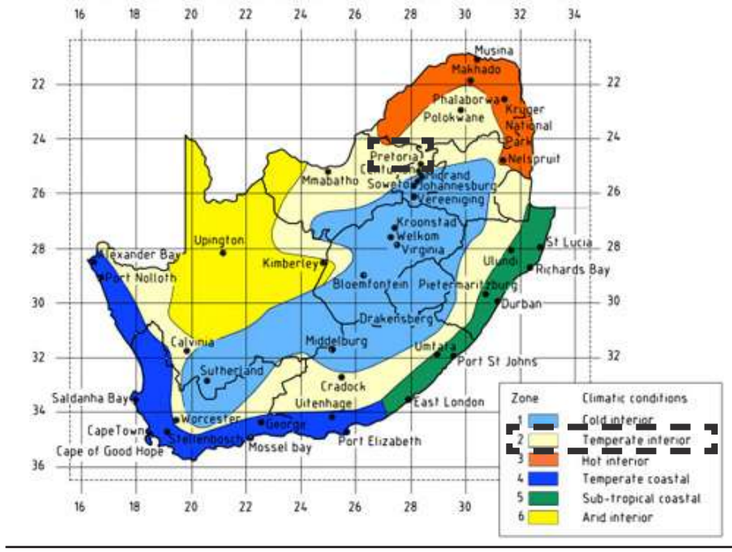


Figure 5.9: Climatic zone map
(SANS 204-2, 2008)

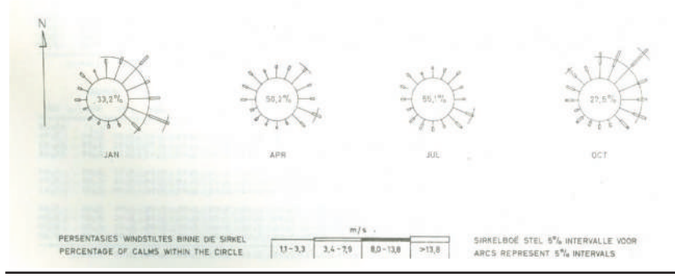


Figure 5.10: Wind Direction
(AAL,2016)

Passive Strategies for designing in this climatic condition:
Muller (2013) suggests passive strategies and principles beneficial for a temperate interior:
a. The use of Passive solar principles;

b. The use adjustable shading elements;

c. Maximise the north facing walls and glazing for solar access in living areas;

d. Minimise the glazing on both eastern and western facades;
e. Minimise external wall area

f. Use Cross-ventilation and passive cooling strategies for summer

g. Use convective ventilation and heat circulation

h. Refective insulation to keep out summer heat

i. New buildings for solar access, cooling winds and protection from cool winds.

5.5.2 Daylighting

The advantages of using daylight are highlighted in numerous studies that can be summarised as: Economic and ecological, due to reduced energy consumption; Psychological, as daylight effectively stimulates the human visual and circadian systems; Well-being, as it enables occupants to fulfill two very basic human requirements namely to be able to focus on tasks and to perceive the space well, as well as experience some environmental stimulation. (Kunkel and Kontonasiou 2015:1262)

According to Boubekri (2008), in order to use daylighting successfully, the designer should maximize daylight levels inside the building but optimize the quality of the luminous environment for occupants. However, daylighting is not only about maximizing light levels as excessive amounts of light can make the interior spaces uncomfortable for its occupants. Therefore, there should be a controlled aspect to it regarding its direction and distribution of light (Boubekri 2008).

The strategy used is to soften courtyards as principles set out in figure 5.12 to improve the conditions set out in chapter 3 and soften the courtyards. By incorporating vegetation as explored through iterations, it will assist in reducing direct glare and interior luminance (lux) on the horizontal surface and into the classroom (required Daylight factor (DF) percentage is between 2% and 5% (Hugo 2018))

Furthurmore, to reduce the potential for glare and thermal stress, the ASE values should be lowered (Van Den Wymelenberg & Mahic n.d.). The Annual Sunlight Exposure (ASE) measures the presence of sunlight using annual luminance grids. The ASE should be less than 10%. With higher levels of daylight sufficiency comes the potential for glare and solar heat gain.

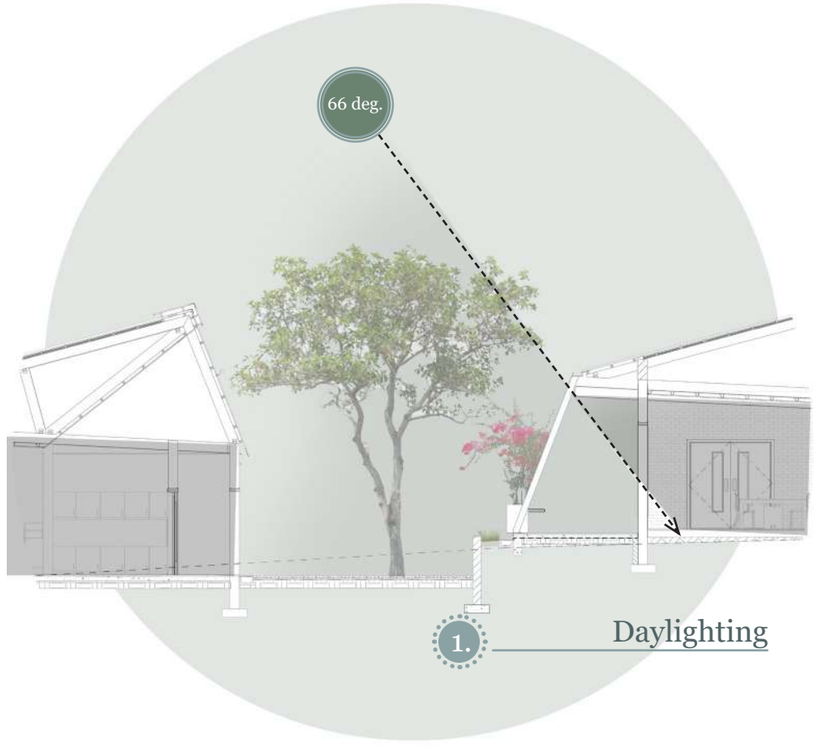


Figure 5.11: Implementing Daylight Principles
(Author 2019)

What is Daylighting:
Daylighting utilizes the distribution of natural diffused daylight throughout a building's interior to ensure acceptable levels of illumination while reducing the need of artificial lighting (Muller 2013:109).

Daylighting Principles

-Glare at a minimum (required Lux)

-Keep heat gain at acceptable limits

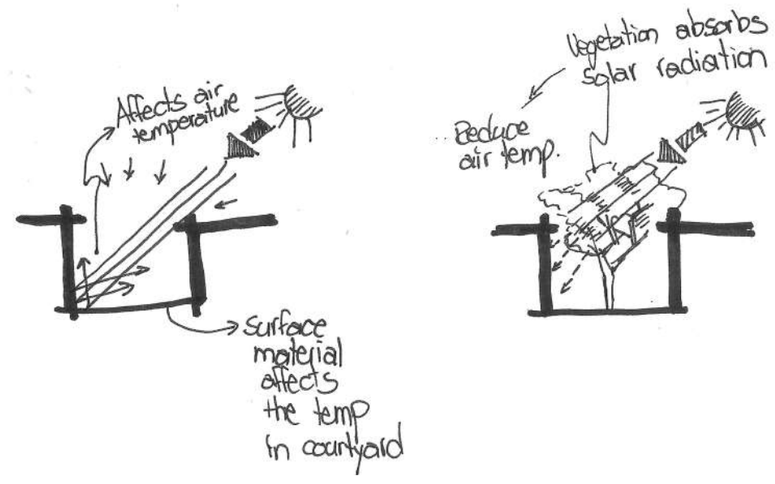


Figure 5.12: Factors Affecting Courtyards
(adapted from Muller 2013:111)

5.5.3 Natural Ventilation

Two systems are used to drive one another. Natural ventilation is promoted by the courtyards, they help circulate air through the structure. (Systems adapted and derived (AAL,2016:8; Dwidart al. 2017:7-9)

How does wind pressure works:
Wind pressure, the phenomenon of hot air rising and replaced /replenished by colder air usually at a lower level than the hot air outlet Muller 2013:108).

Requirements: Well naturally ventilated spaces.

System 1

System 1 is paired with cross ventilation

Natural Ventilations System Principles

Accelerates to activate a ventilation system:

-The chimney/stack or venturi effect – hot air rises and its speed can be accelerated by narrowing the duct, and/or heating the air even further

-Wind catchers or multi-directional wind scoops placed at a height and orientation that will ensure maximal funneling of any available wind pressure into the desired spaces

Heating the air in enclosed spaces:

-Source of energy

-The sun directly heating objects in a space

Cooling the air in enclosed spaces requires:
(Since chilled air is denser, it will tend to move downwards in space)

-A source of cooler air

-System by which the ambient temperature of air inside an enclosed space can be reduced.

Figure 5.13: Natural Ventilations System Principles
(Icons adapted from thenounproject.com)

Cross Ventilation

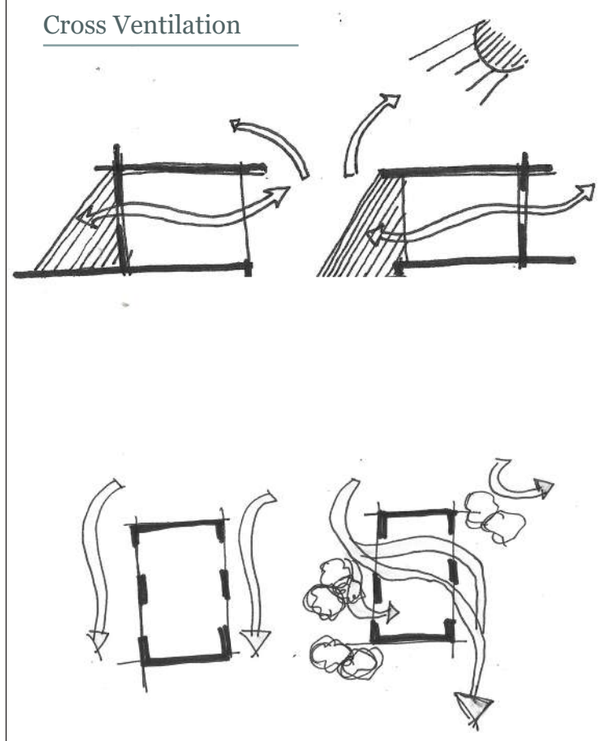
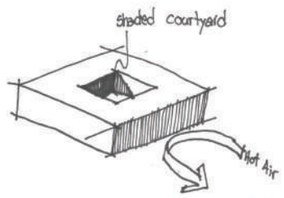


Figure 5.14: Cross ventilation
(adapted from Muller 2013:111)

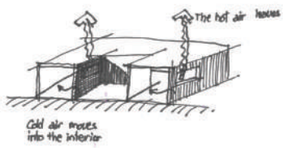
System 2

Alternative heating and cooling systems

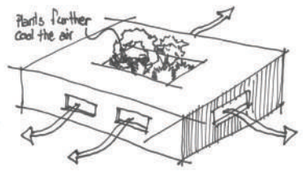
Courtyards as passive cooling strategies

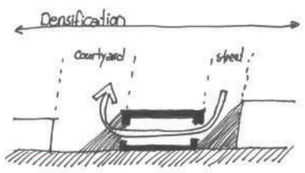


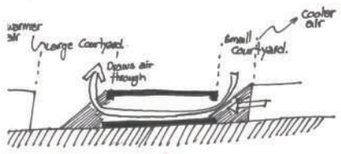
Shaded courtyards extract heat out of a structure



Vegetation



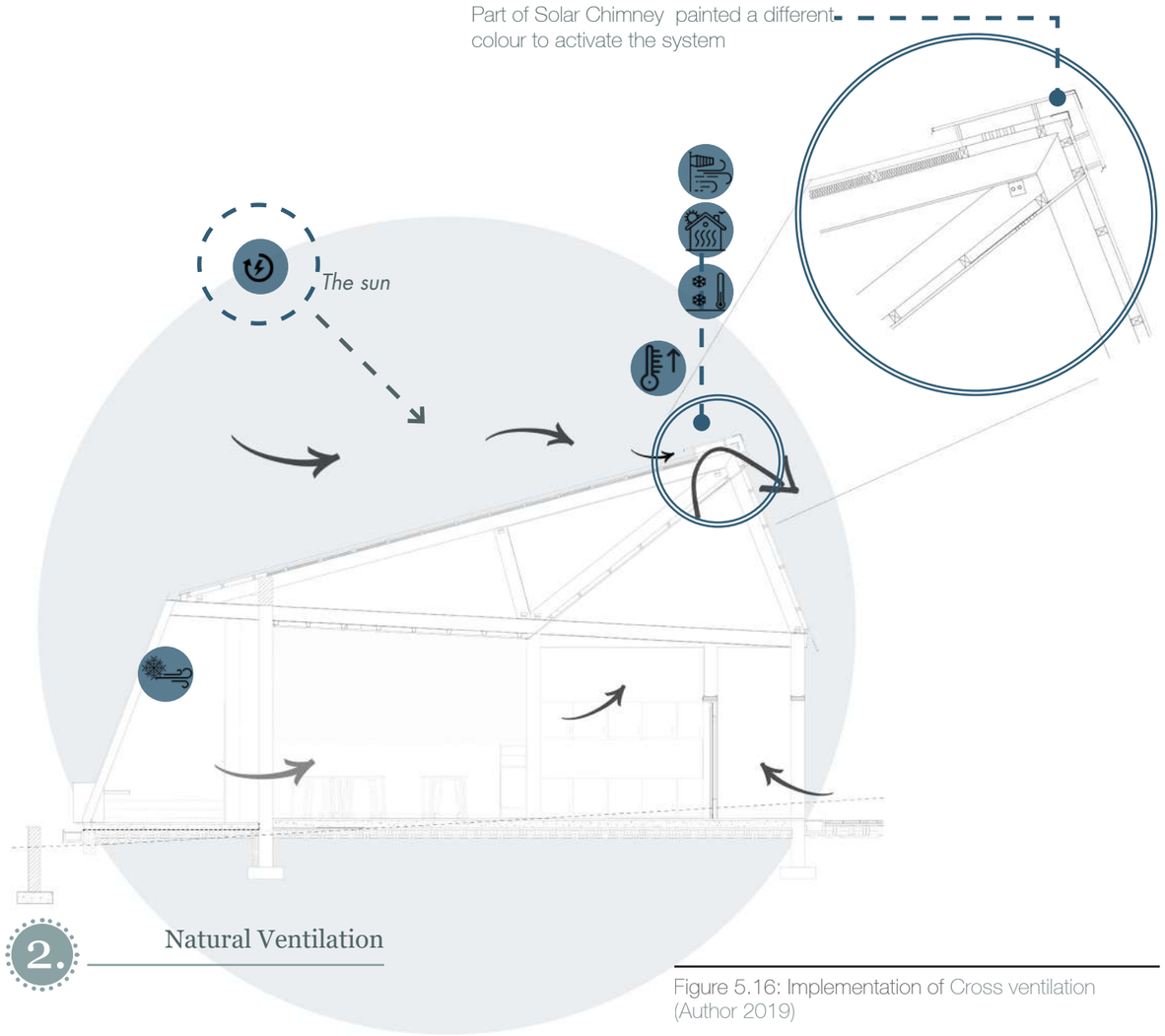




Using "warm and cool" courtyards to activate cross ventilation within spaces.

Cool courtyards is achieved through planting and the usage of water

Figure 5.15: Courtyards as passive cooling strategies
(Adapted from Dwidar at al. 2017:7-9)



2. Natural Ventilation

Figure 5.16: Implementation of Cross ventilation (Author 2019)

Objective: determine a ventilation strategy in accordance to principles set out.

d. Develop of the identified system/ requirements of a section to achieve the right air change per hour rate.

This will be achieved through a simulation tool: Energy2D is an interactive, visual multi physics simulation program that models all three modes of heat transfer conduction, convection, and radiation, and their coupling with particle dynamics.

Note:
This programme only provides a simulation to derive conclusions.

Charles Xie, Interactive Heat Transfer Simulations for Everyone, The Physics Teacher, Volume 50, Issue 4, pp. 237-240, 2012.

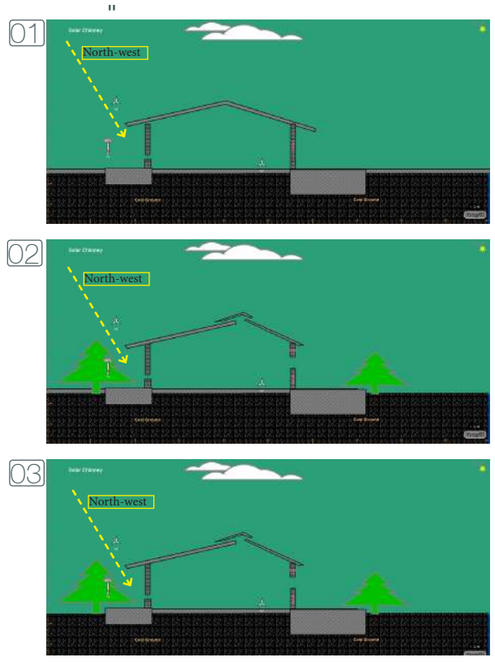


Figure 5.17: Natural Ventilation Simulation in Energy2d (Xie 2012)

a. The required air change per hour within this space (CSIR; Nice,2015)

Required ACH (Per classroom) → classroom 5-8 l/s per person [8] as study

$$ACH = \frac{\text{ventilation rate (l/s)} \times 3600\ (s/hr)}{\text{Room Volume } (m^3)}$$

$$= \frac{8 \times 3600}{193}$$

$$= 149.2$$

c. 2.3 How does it relate to the required fenestration? (SANS)

∴ Windows exceed required fenestration (existing) conditions, thus alternative ventilation methods is needed. Window openings are enlarged to improve interior experience and therefore strategies are required.

→ Replace existing windows with energy effecient windows
⇒ Use material that improve indoor quality without causing over exposure of glare.

b. Determine the required square meters for the smallest window opening for cross ventilation and air change to take place (WHO, 2009)

$$ACH = \frac{0{,}65 \times \text{Wind speed (m/s)}\ (\text{Assume 1 m/s}) \times \text{Smallest opening area } (m^2) \times 3600\ (s/h)}{\text{Room Volume}}$$

$$149.2 = \frac{2340 \times \text{Sog}\ (m^2)}{193}$$

Sog = 12,35 m².

∴ Windows exceed required fenestration (existing) conditions, thus alternative ventilation methods is needed. Window openings are enlarged to improve interior experience and therefore strategies are required.

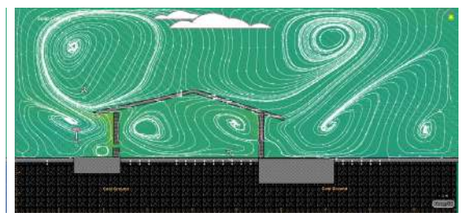
→ Replace existing windows with energy effecient windows
⇒ Use material that improve indoor quality without causing over exposure of glare.

Fenestration area in accordance with SANS 10400-XA: 2001

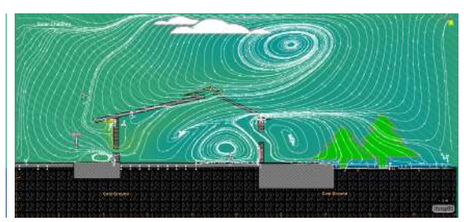
Nett Floor area per classroom: 64 m² (study segment)

Allowable fenestration: 15% x 15% = 9.6 m²

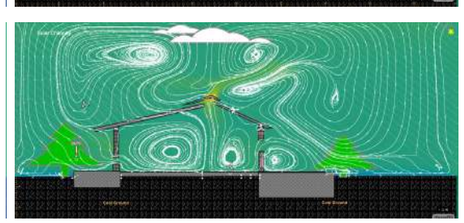
Total fenestration of a classroom: [8 x 1.82] + [1 x 3] = 16.38 + 3 = 19.38

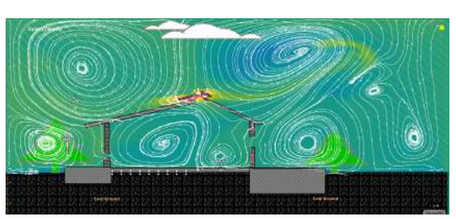


Test 1 / The Existing
Alteration: Modeling the existing roof condition
Conclusions:
Problem: Circulation within the structure traps the air and the North-western facade indicates a temperature increase, this will affect the temperature of the air moving into the structure. Temperature increase within the structure will create discomfort.
Opportunity: The streamlines indicates wind pressure on the North-western facade and opportunity to develop a strategy that responds accordingly.



Test 2 / The Solar chimney
Alteration: Modeling first attempt of Roof Type
Conclusions:
Problem: The Northwestern facade still indicates a temperature increase affecting the temperature of the air moving into the structure.
Opportunity: The streamlines indicates an increase of wind pressure and air change within the structure. Strategy can be strengthened on the north-western facade.





Test 3 / The Solar chimney
Alteration: Modeling first attempt of Roof Type and the addition of vegetation,landscaping and a heat source in the solar chimney on the North-western facade.
Conclusions:
Problem: Air change per hour may be to much, strategies required to control it by design development of the solar chimney.
Opportunity:
The addition of vegetation proved to enhance cooling the air within the space.

5.5.4 The Landscape as Material

The surrounding context of Tsako Thabo Secondary School is considered in creating a design strategy suggested earlier in chapter4 . The natural topography of the site allows for a landscape intervention to lighten the current landscape.

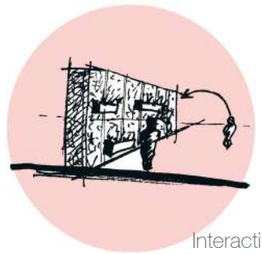
The natural environment has the ability to contribute to stimulating, well-being and educational environments and therefore the intention is to use the landscape as a material to become didactic and promote a softer learning environment.

The design and use of a landscape across the precinct will act as a system that responds to environmental issues on the site and assists in implementing passive ventilation strategies in the buildings explored in figure 5.12 and 5.13.

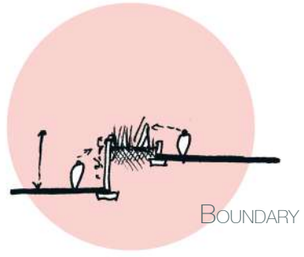
One of the prime strategies that will be implemented on the site will be the use of minimal artificial irrigation and the re-use of recycled storm-water/greywater set out in the water harvesting strategy.

Objective: How natural environment is used as:
Cooling strategy in courtyards
Protection from the Western Sun
Improve spatial experience in teh outdoors
Being educational

Intentions:


Interaction

Visual link


BOUNDARY

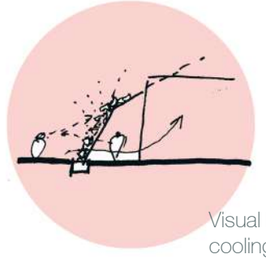

Visual Link and cooling the air

Figure 5.18: Natural Environment as Informant (Author 2019)

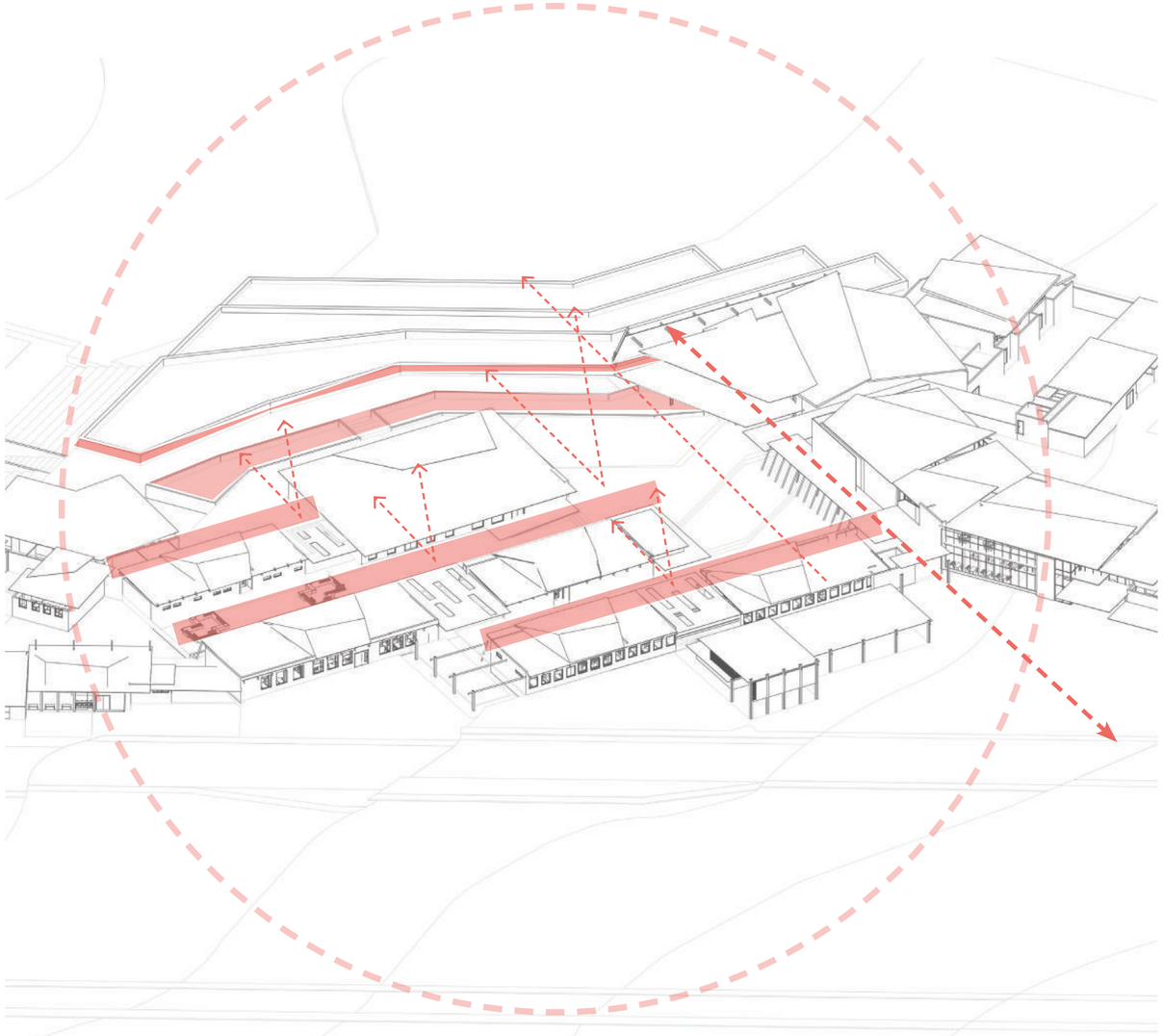


Figure 5.19: Natural Environment as Informant Implemented (Author 2019)

Nature
Proposed Planting

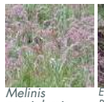
Grassland Biome Species:


Gladiolus crassifolius


Hyparrhenia Hirta


Themeda Triandra


Aristida Junciformis


Melinis nerviglumis


Eragrostis Racemosa


Eragrostis Gummiflua


Aristida

Tree Species:


Celtis africana


Searsia lancea (Karee)


Dombeya rotundifolia Hochst


Euclea crispa


Aloe barberae


Combretum erythrophyllum

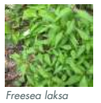

Combretum kraussii

Shade species


Chlorophytum bowkeri


Dietes iridioides


Carissa bispinosa


Freesea laksa

Ground Cover Species:


Chlorophytum krokuanum


Eucomis autumnalis


Scabiosa columbaria

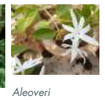

Aleoveri kunda

Figure 5.20: Planting Pallet (Images sourced from SANBI.org)

5.5.5 Water Strategy

The site has a steep topography causing a high amount of site run-off during rainstorms and the site is located near the Pienaars River, therefore, an environmental strategy is implemented to develop a design solution for stormwater management.

Rainwater is collected from the roofs, stormwater, site run-off and greywater. Water is treated respectively to requirements as illustrated in figure XX and stored. Water is then used for irrigation purposes of the landscape, grey water or treated by UV purification for supplying the precinct portable water. The water strategy allows for reducing the amount of water needed from the local municipal supply.

Given:
1.stormwater
2.site run-off
3.Grey water

Needs:
1.agriculture
2.reinvest into the context
3.re-use

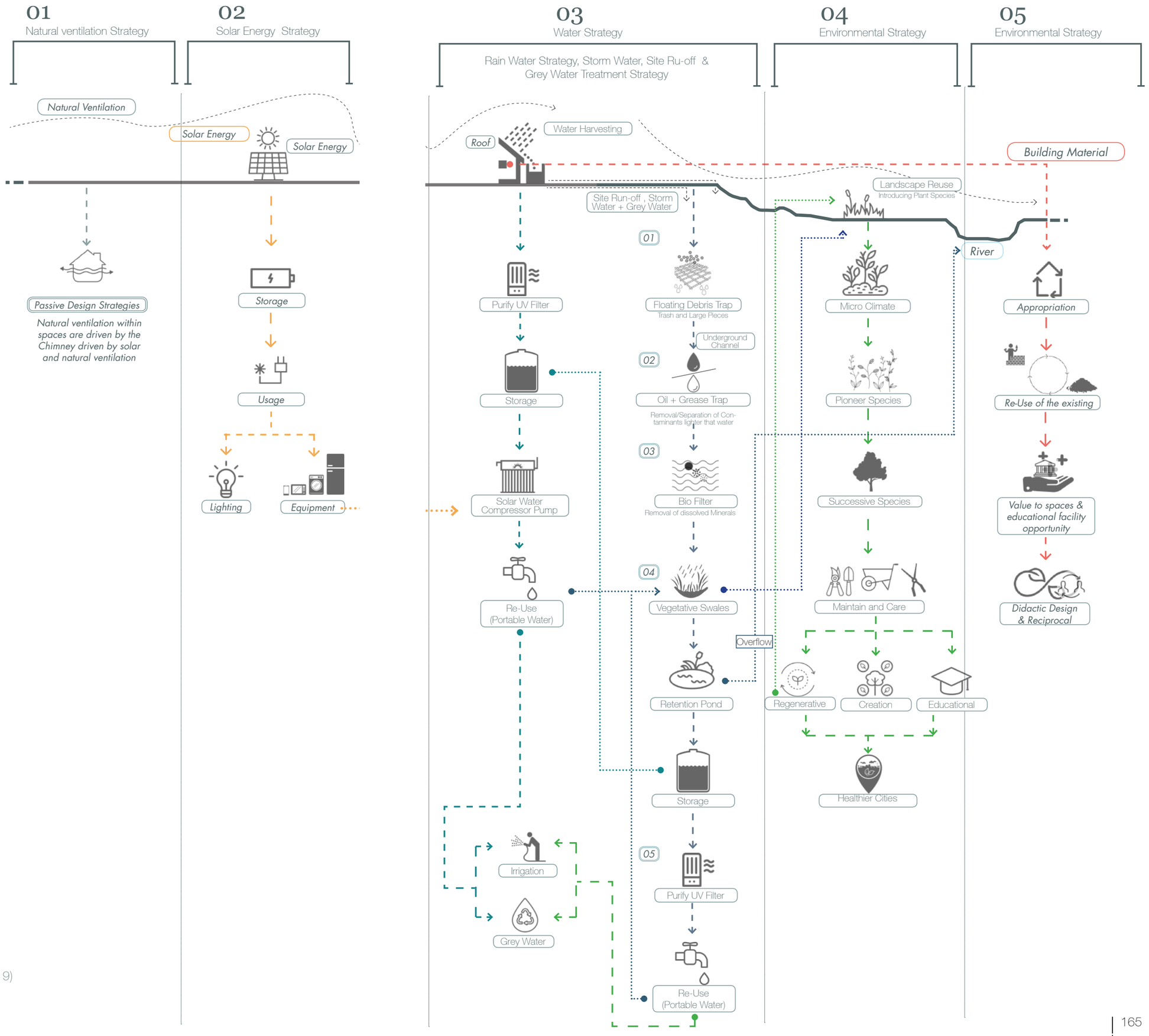


Figure 5.21: Water Strategy (Author 2018 & 2019; Energy.gov 2019) Icons adapted from Thenounproject.com

4. Water Strategy

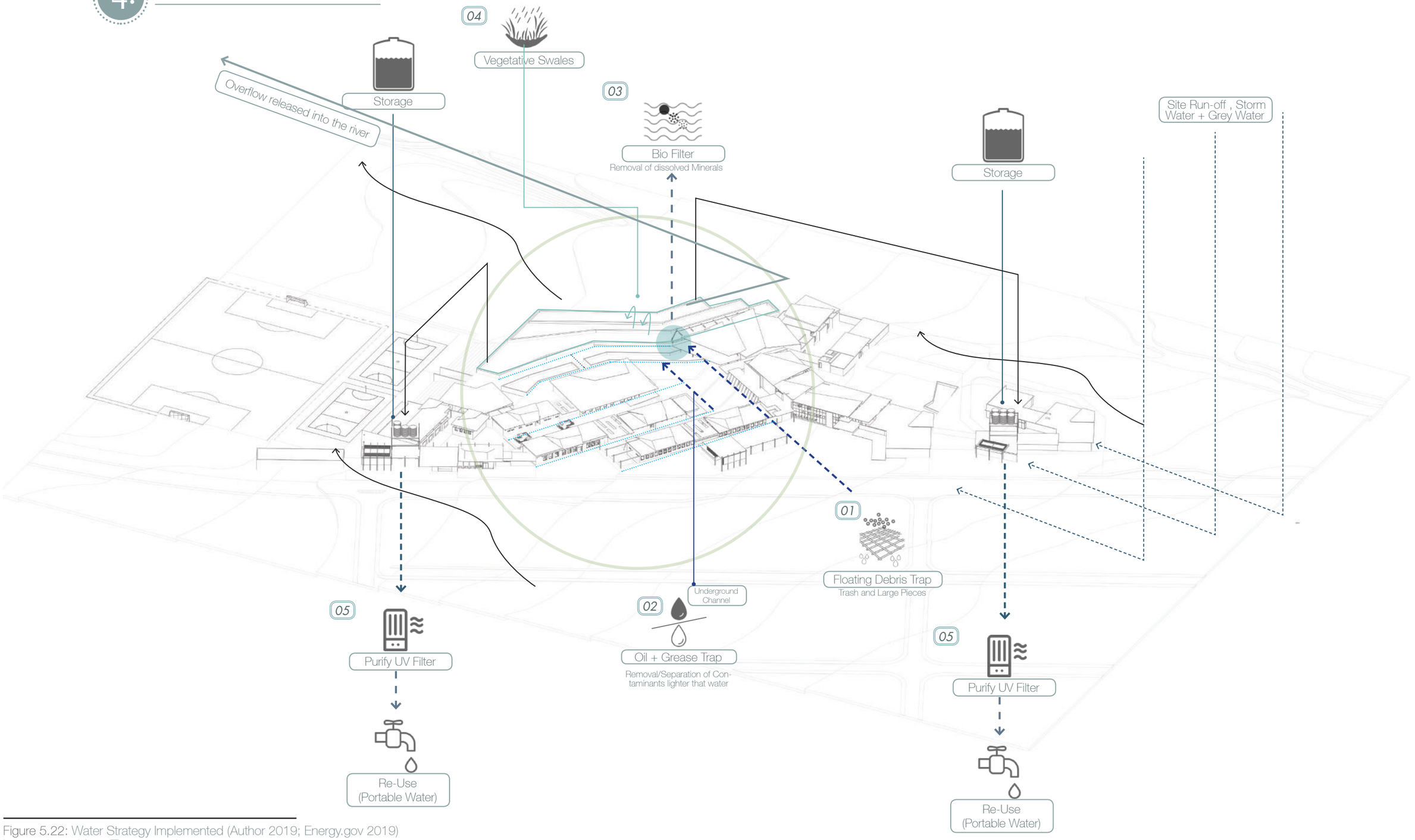


Figure 5.22: Water Strategy Implemented (Author 2019; Energy.gov 2019)
Icons adapted from Thenounproject.com

5.6 Iterative Process

Detail Exploration and Development of a classroom. Investigating how it plays out spatial considering material, assembly and systematic attributes.

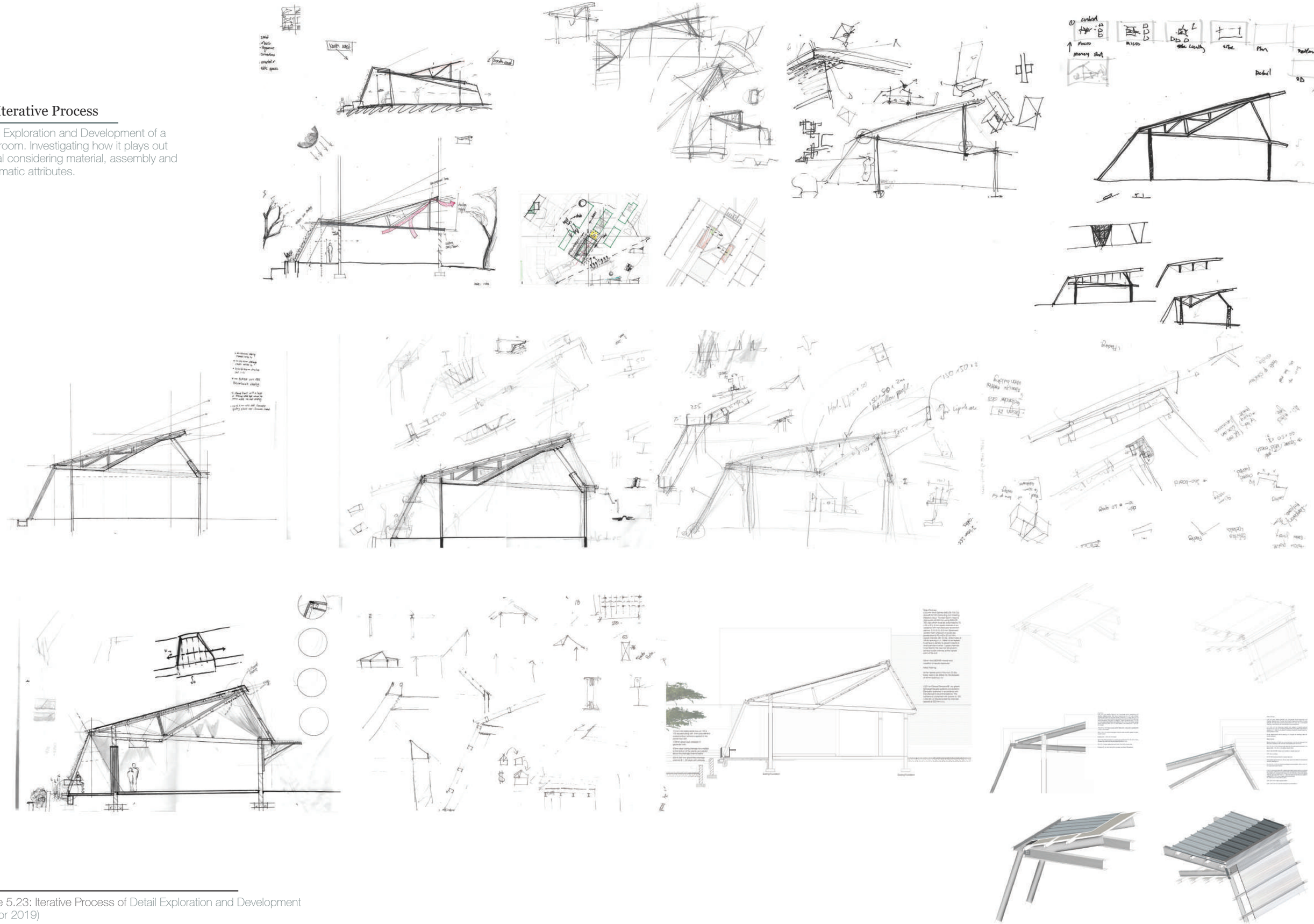


Figure 5.23: Iterative Process of Detail Exploration and Development (Author 2019)

5.7 SBAT Rating

Before Intervention

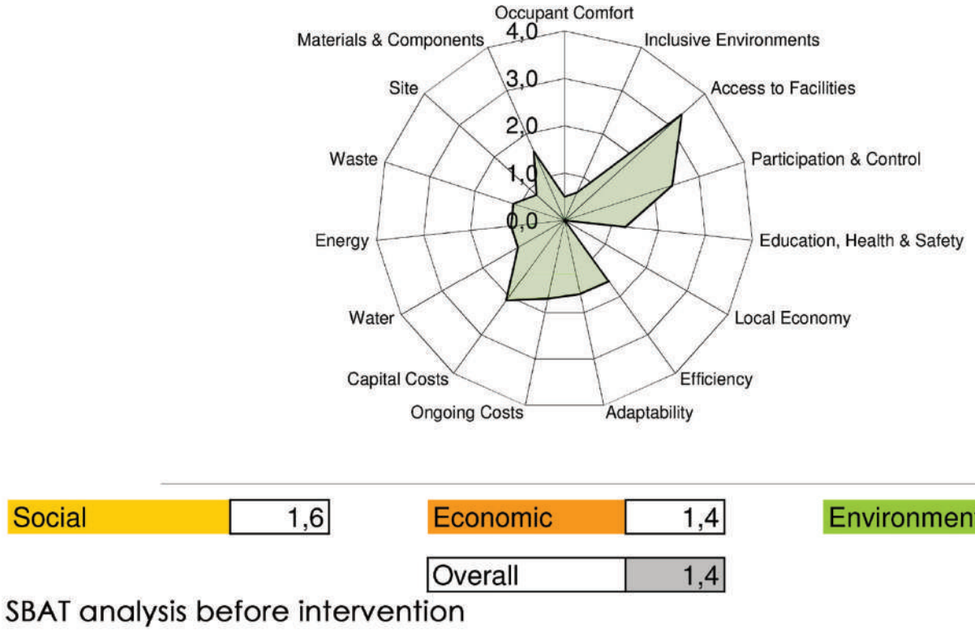
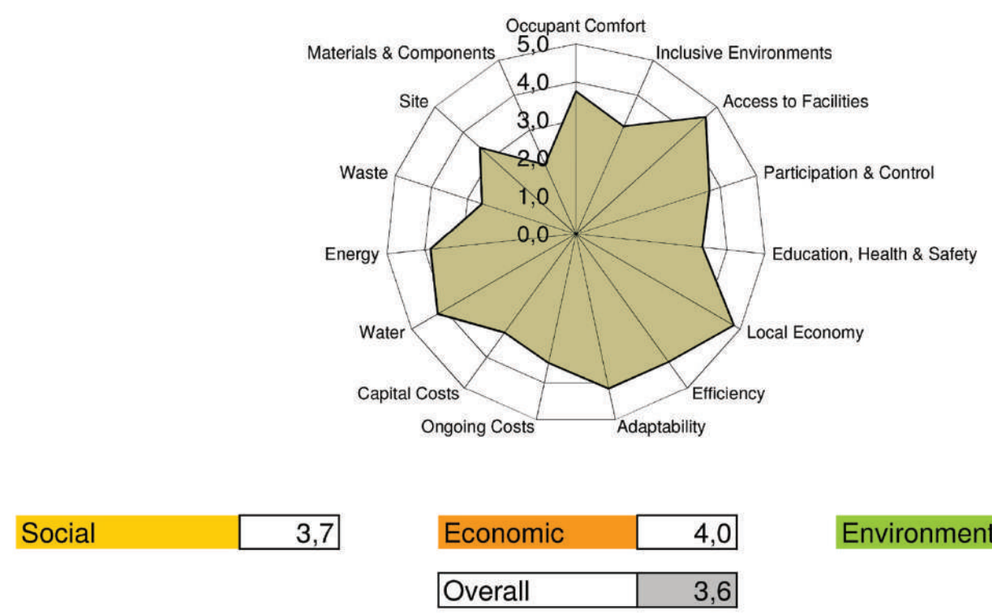


Figure 5.24: SBAT Rating
(Author 2019)

Before Intervention



06
Conclusion

Conclusion

This dissertation, establishes itself within the educational and economic context, in the creation of educational pathways for the youth of Mamelodi. Unemployment is an evident consequence of the high dropout levels of pupils in the South African Education System, the inability to find employment and lack of work opportunities. Employment generation has been identified as one of the highest priorities within South African Societies. The reality is that the majority of people who are potentially economically active generate their own employment, entrepreneurial activity, usually in the form of 'informal sector' activity.

Entrepreneurial learning is excluded from most higher education models. Therefore the opportunity to create an architectural response for architecture in this dissertation to facilitate entrepreneurial education to produce relevant skills for careers and the economy of Tsako Thabo Secondary school arise.

In the creation of such a model within a secondary school, Tsako Thabo Secondary School, the current urban condition of schools need to be considered. Thus, a descriptive case study reflects the issues Tsako Thabo Secondary School face and similar schools in the community, reporting on issues apparent and educational shifts that need to be considered in order for a school to become entrepreneurial.

Many schools in Mamelodi face social and physical barriers creating blockages and affecting educational pathways of learners . Spatial conditions inherent to school typologies play a role in students' inability to complete their educational pathways. This study aimed at addressing these spatial restrictions by identifying design opportunity and reimagining educational facilities into a stimulating, supportive and inviting environment. Architectural solutions intended to address the shortcomings apparent in the current learning environments of Tsako Thabo Secondary School by incorporating an entrepreneurial language.

The power of our spatial environments, and their impact on people, is evident in the research and theories discussed in this dissertation. It can therefore be said that the architecture has an impact on the creation of learning environment in the built form. Therefore, architectura also has the ability to improve learning environments and assist in overcoming educational blockages.

Answering the research question of this dissertation, yes it is possible for the knowledge economy to contribute to space and place making within a school in Mamelodi-east. The architectural response creates the opportunity to recreate and reuse existing schools to suit the community's needs, responding to both educational, economic and architectural processes.

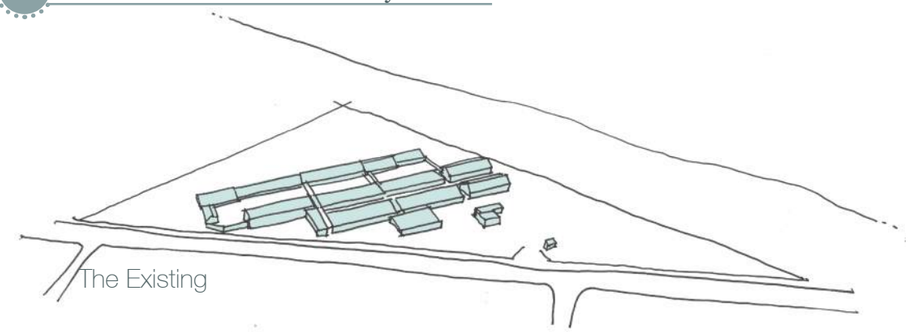
Figure 6.1: Tsako Thabo Secondary School
(adapted from Up Arch Hons Mamelodi Studio 2019, Sacred Space)

07 Reflection

Site Plan

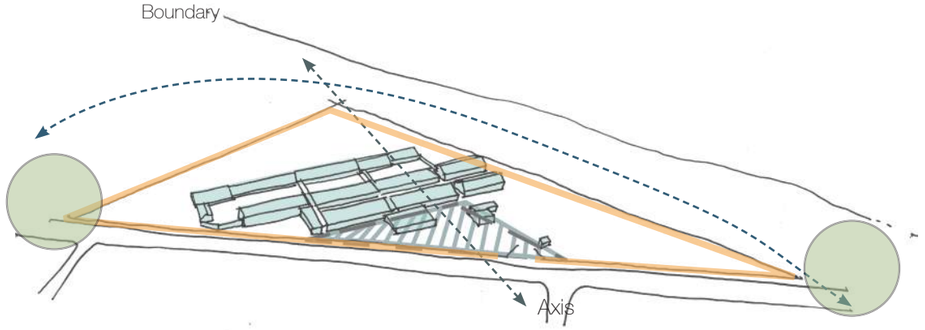
Not To Scale

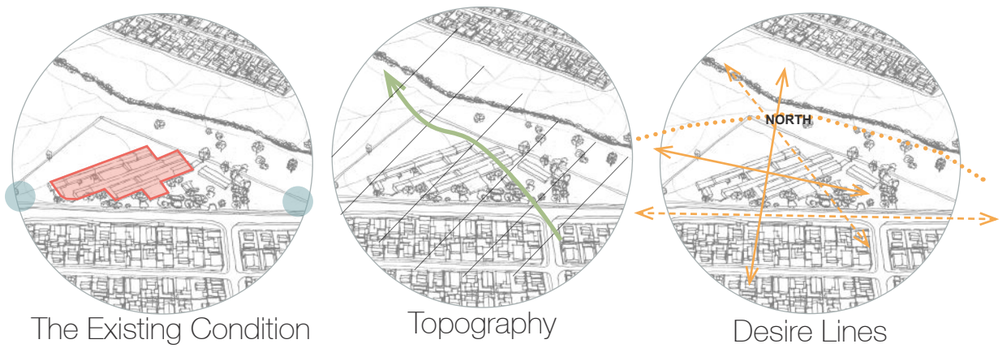
01 Tsako Thabo Secondary Schools



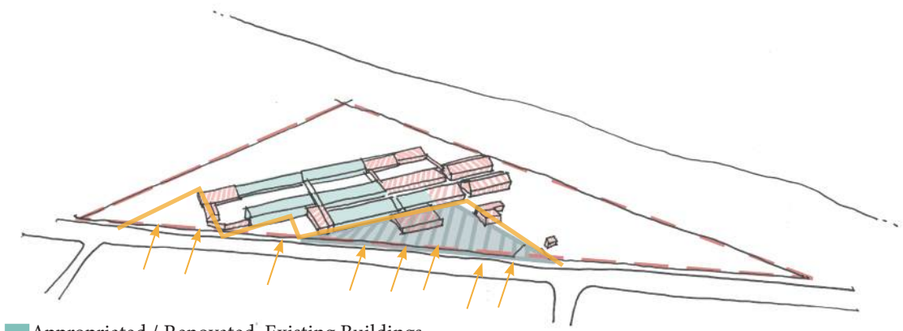
02 Informants

Informal Movement Around School





03 Demolished Buildings



04 Reuse Opportunity

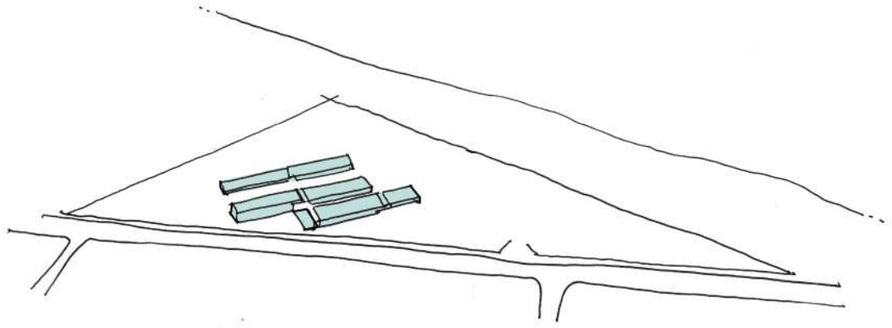


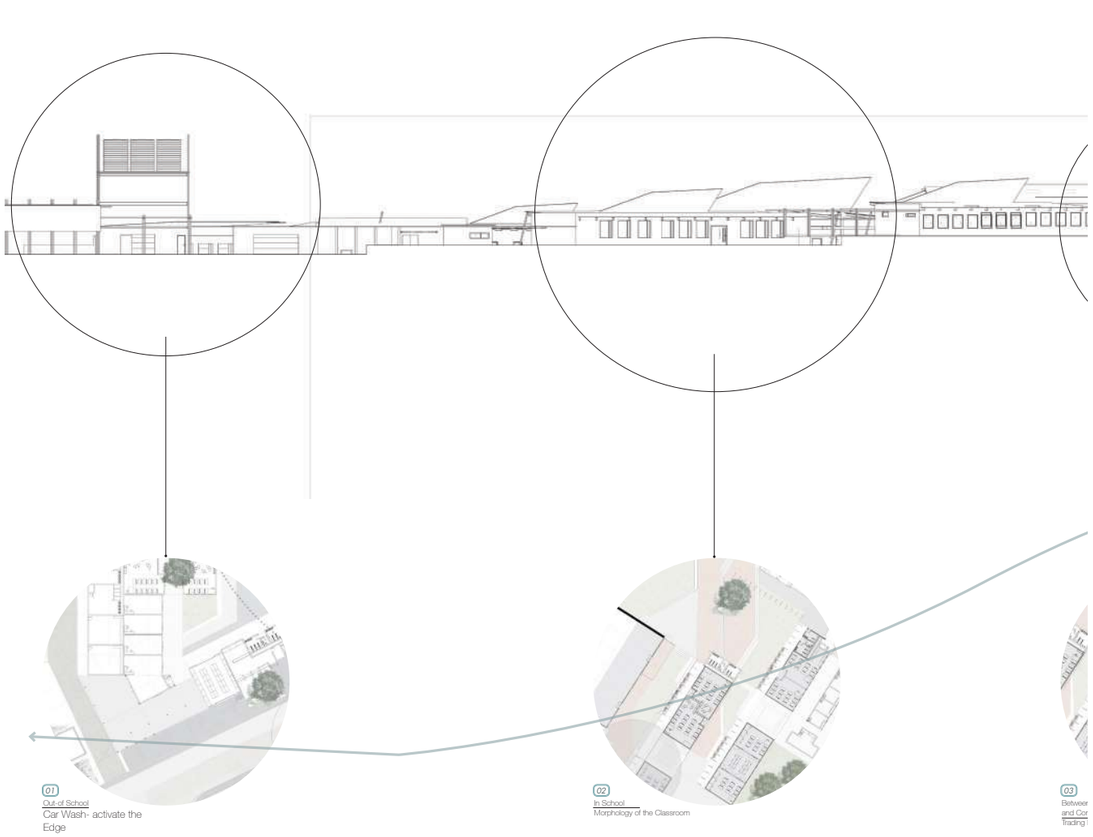
Figure 7.2: Unpacking the existing
(Author 2019)

Figure 7.3: Final Floor Plan
(Author 2019)

Ground Floor Plan
Not To Scale

South-East Elevation

Not To Scale

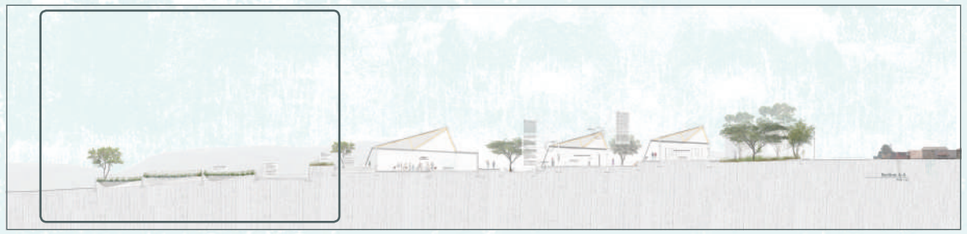


Programmes

Access

Boundaries

Figure 7.4: Elevation, Entrepreneurial Implementation, Programme, Access and Boundaries (Author 2019)



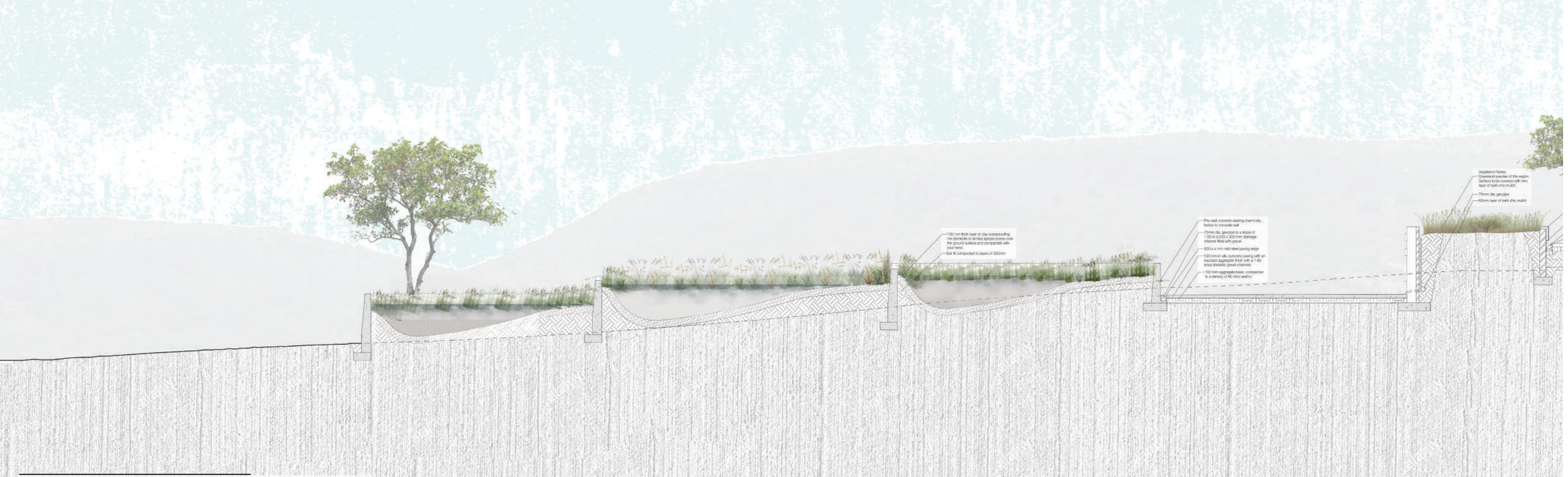
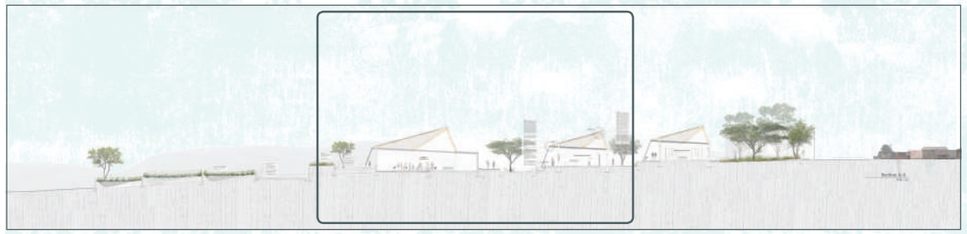


Figure 7.5: Final Section
(Author 2019)



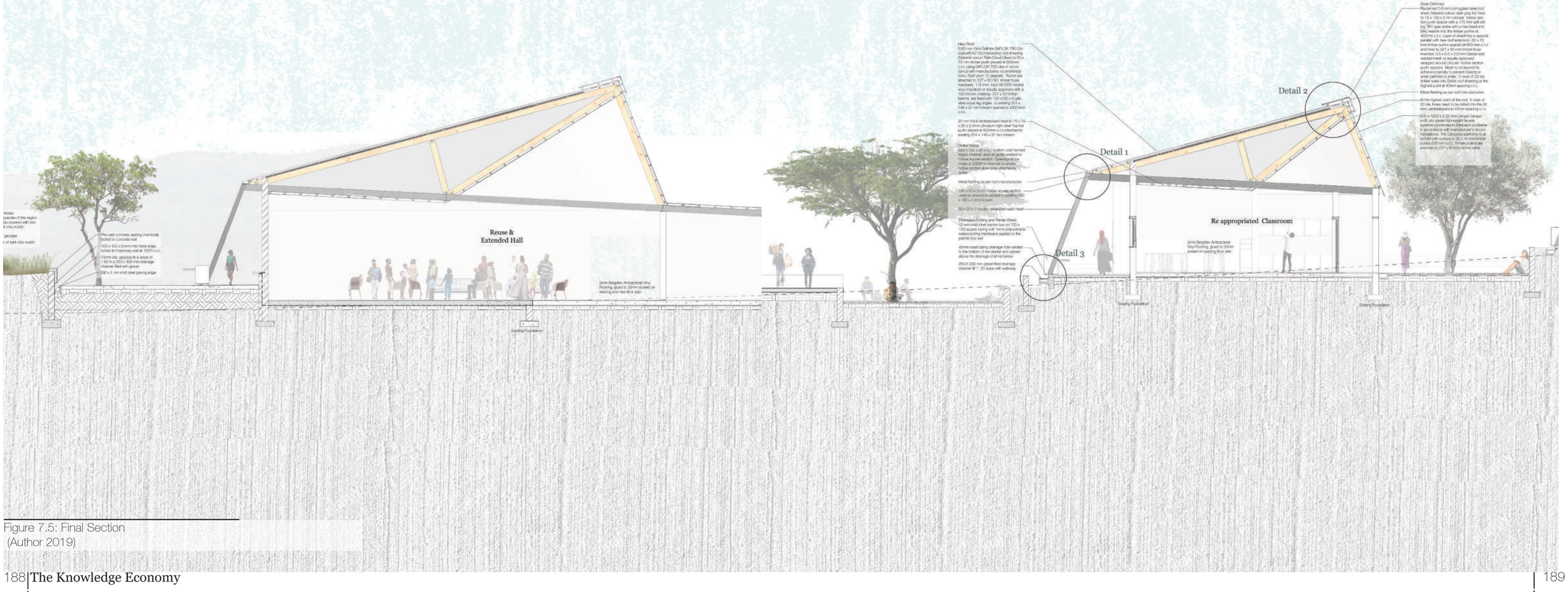
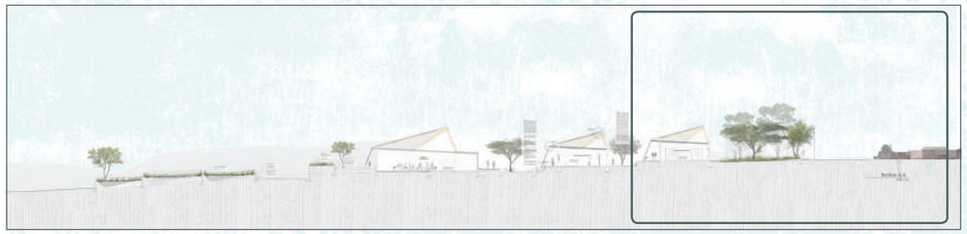
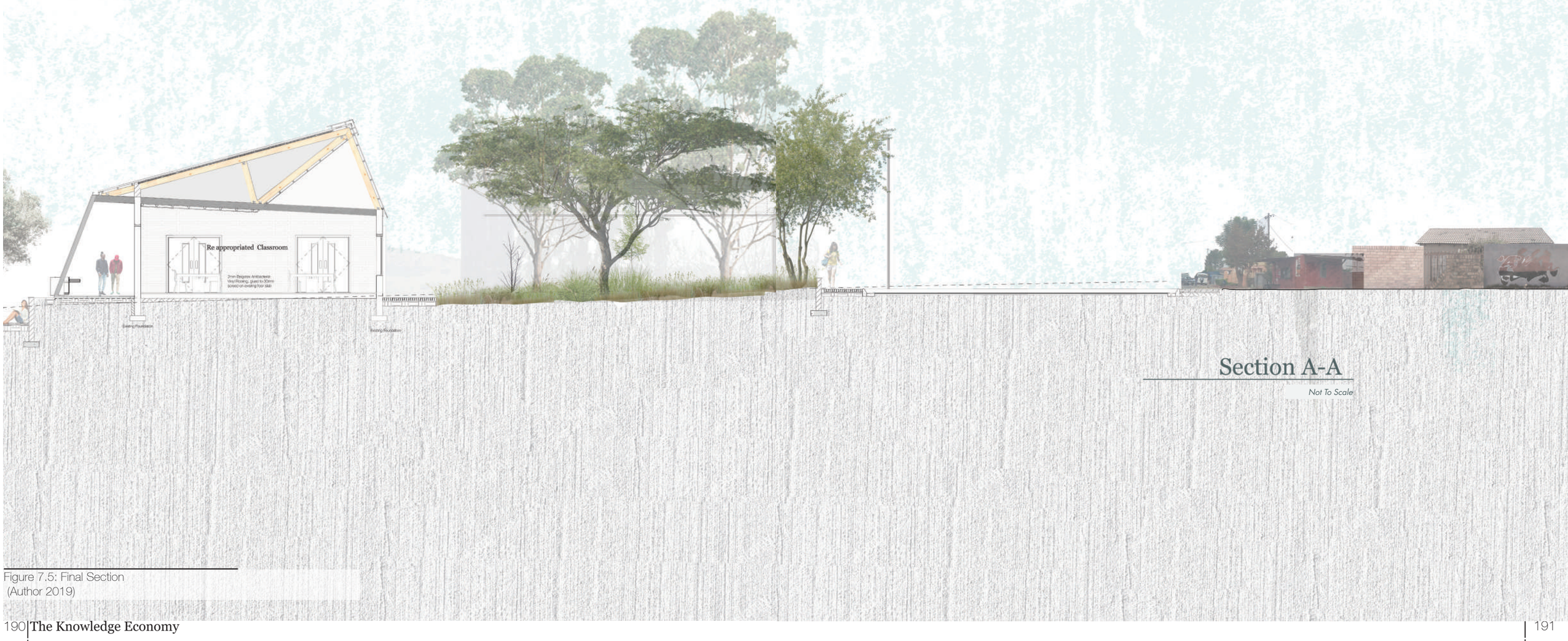


Figure 7.5: Final Section
(Author 2019)





Section A-A

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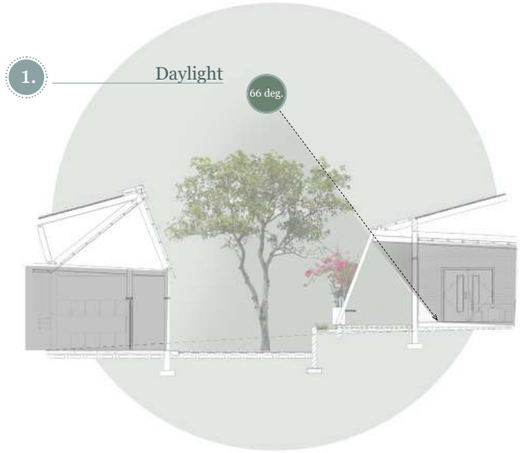
Figure 7.5: Final Section
(Author 2019)

Responsive Strategies

1. Daylight



Benchmarks

What is Daylighting:
Daylighting utilizes the distribution of natural diffused daylight throughout a buildings interior to ensure acceptable levels of illumination while reducing the need of artificial lighting (Muller 2013:109).

Daylighting Principles

- Glare at a minimum (required Lux)
- Keep heat gain at acceptable limits

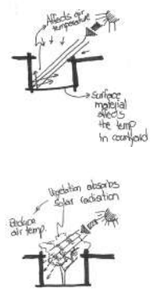
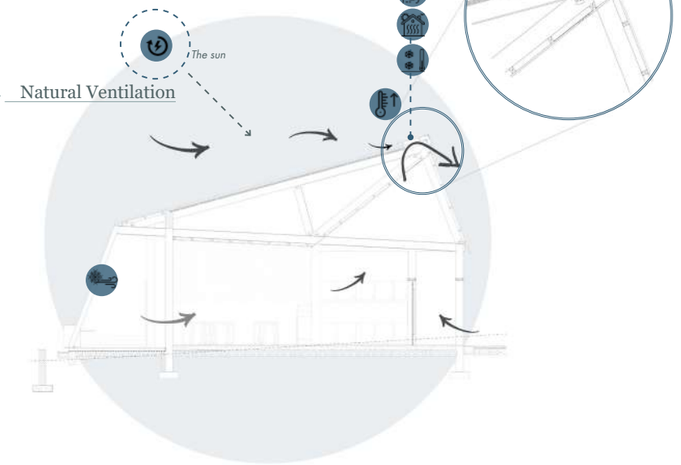


Figure: Factors Affecting Courtyards (adapted from Muller 2013:111)

1. Natural Ventilation



Part of Solar Chimney painted a different colour to activate the system

Objective: determine a ventilation strategy in accordance to principles set out.

Benchmarks

How does wind pressure works:
Wind pressure, the phenomenon of hot air rising and replaced /replenished by colder air usually at a lower level than the hot air outlet Muller 2013:108).

Requirements: Well naturally ventilated spaces.

Natural Ventilation

Two systems are used to drive one another. Natural ventilation is promoted by the courtyards, they help circulate air through the structure. (Systems adapted and derived (AAL,2016:8; Dwidarl al. 2017:7-9)

System 1

System 1 is paired with cross ventilation

Natural Ventilations System Principles

Accelerates to activate a ventilation system:

- The chimney/stack or venturi effect – hot air rises and its speed can be accelerated by narrowing the duct, and/or heating the air even further
- Wind catchers or multi-directional wind scoops placed at a height and orientation that will ensure maximal tunnelling of any available wind pressure into the desired spaces

Heating the air in enclosed spaces:

- Source of energy
- The sun directly heating objects in a space

Cooling the air in enclosed spaces requires:
(Since chilled air is denser, it will tend to move downwards in space)

- A source of cooler air
- System by which the ambient temperature of air inside an enclosed space can be reduced.

Figure: Natural Ventilations System Principles (Icons adapted from thenounproject.com)

Cross Ventilation

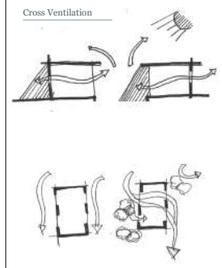
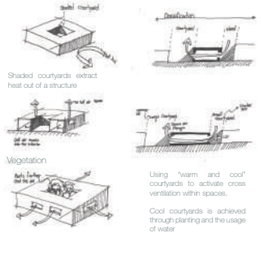


Figure: Cross ventilation (adapted from Muller 2013:111)

System 2

Alternative heating and cooling systems

Courtyards as passive cooling strategies



Shaded courtyards extract heat out of a structure

Vegetation

Using 'warm and cool' courtyards to activate cross ventilation within spaces.

Cool courtyards is achieved through planting and the usage of water

Figure: Courtyards as passive cooling strategies (Adapted from Dwidar et al. 2017:7-9)

Environmental response strategies:

Climatic Condition

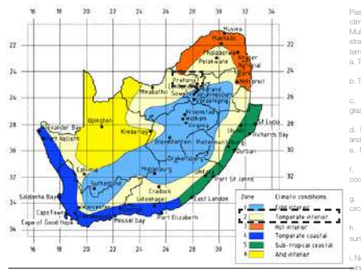


Figure 5.7: Climatic zone map (SANS 204-2, 2008)

Passive Strategies for designing in this climatic condition:
Muller (2013) suggests passive strategies and principles beneficial for a temperate interior:

a. The use of Passive solar principles;

b. The use adjustable shading elements;

c. Maximise the north facing walls and glazing for solar access in living areas;

d. Minimise the glazing on both eastern and western facades;

e. Minimise external wall area

f. Use Cross-ventilation and passive cooling strategies for summer

g. Use convective ventilation and heat circulation

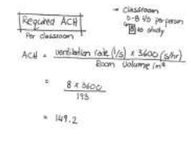
h. Refective insulation to keep out summer heat

i. New buildings for solar access, cooling winds and protection from cool winds.

Figure 5.8: Wind Direction (AAL,2016)

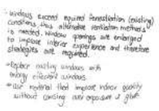
1.1 2.3 Required fenestration per classroom? (SANS)

2.1 The required air change per hour within this space (CSIR; Nico,2015)



2.2 Determine the required square meters for the smallest window opening for cross ventilation and air change to take place (WHO, 2009)

2.3 2.3 How does it relate to the required fenestration? (SANS)



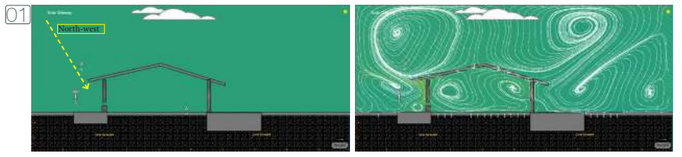
2.1 Develop of the identified system/ requirements of a section to achieve the right air change per hour rate.

This will be achieved through a simulation tool:
Energy2D is an interactive, visual multi physics simulation program that models all three modes of heat transfer conduction, convection, and radiation, and their coupling with particle dynamics.

Note:
This programme only provides a simulation to derive conclusions.

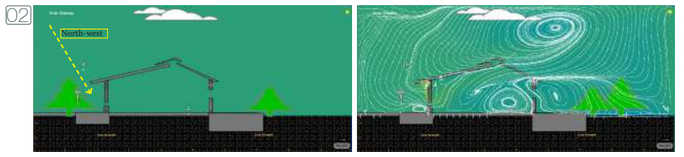
Charles Xie, Interactive Heat Transfer Simulations for Everyone, The Physics Teacher, Volume 50, Issue 4, pp. 237-240, 2012.

01



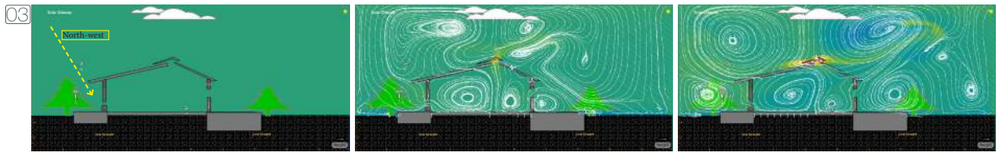
Test 1 / The Existing
Alteration: Modeling the existing roof condition
Conclusions:
Problem: Circulation within the structure traps the air and the North-western facade indicates a temperature increase, this will affect the temperature of the air moving into the structure. Temperature increase within the structure will create discomfort.
Opportunity: The streamlines indicates wind pressure on the North-western facade and opportunity to develop a strategy that responds accordingly.

02



Test 2 / The Solar chimney
Alteration: Modeling first attempt of Roof Type
Conclusions:
Problem: The Northwestern facade still indicates a temperature increase affecting the temperature of the air moving into the structure.
Opportunity: The streamlines indicates an increase of wind pressure and air change within the structure. Strategy can be strengthened on the north-western facade.

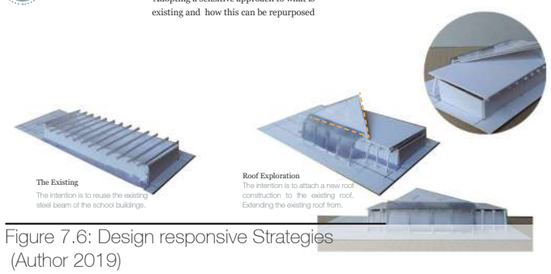
03



Test 3 / The Solar chimney
Alteration: Modeling first attempt of Roof Type and the addition of vegetation,landscaping and a heat source in the solar chimney on the North-western facade.
Conclusions:
Problem: Air change per hour may be to much, strategies required to control it by design development of the solar chimney.
Opportunity:
The addition of vegetation proved to enhance cooling the air within the space.

Iterative Process of the Roof

Adopting a sensitive approach to what is existing and how this can be repurposed



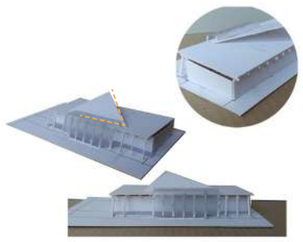
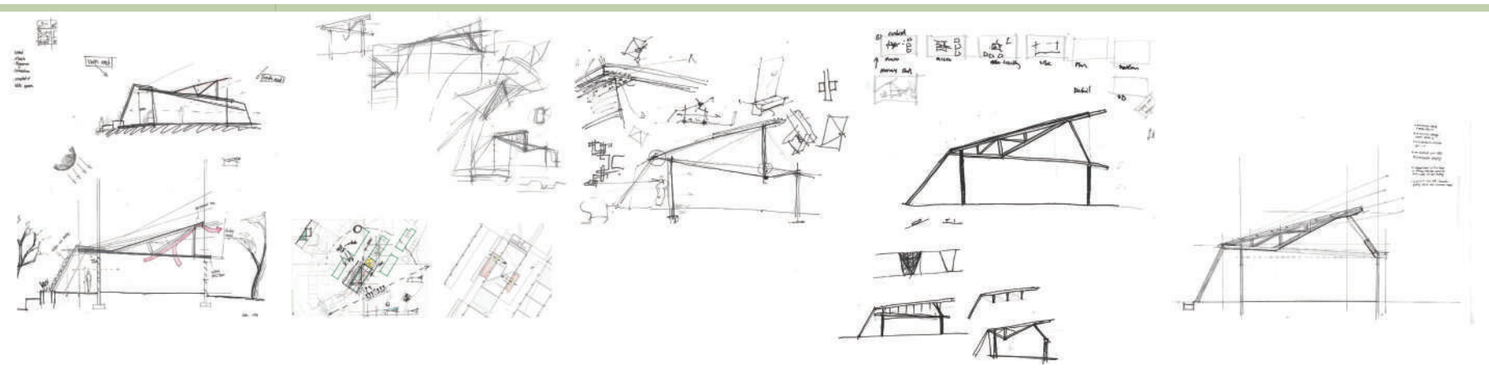
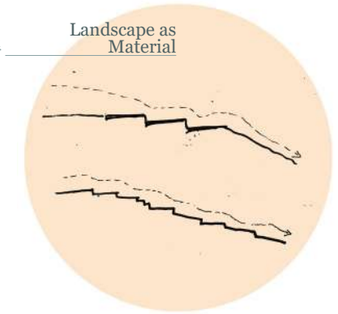


Figure 7.6: Design responsive Strategies (Author 2019)



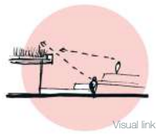
Responsive Strategies

3. Landscape as Material



Intentions:

Interaction



Visual link

Boundary

Visual Link and cooling the air

The surrounding context of Tsako Thabo Secondary School is considered in creating a design strategy suggested earlier in chapter4 . The natural topography of the site allows for a landscape intervention to lighten the current landscape.

The natural environment has the ability to contribute to stimulating, well-being and educational environments and therefore the intention is to use the landscape as a material to become didactic and promote a softer learning environment.

The design and use of a landscape across the precinct will act as a system that responds to environmental issues on the site and assists in implementing passive ventilation strategies in the buildings explored in figure 5.12 and 5.13.

One of the prime strategies that will be implemented on the site will be the use of minimal artificial irrigation and the re-use of recycled storm-water/greywater set out in the water harvesting strategy.

Objective: How natural environment is used as:
Cooling strategy in courtyards
Protection from the Western Sun
Improve spatial experience in teh outdoors
Being educational

Nature
Proposed Planting

Grassland Biome Species:

Gladiolus crassifolius

Hyparrhenia Hirta

Themeda Triandra

Aristida Junciformis

Melinis nerviglumis

Eragrostis Racemosa

Eragrostis Gummiflua

Aristida

Ground Cover Species:

Chlorophytum krokanum

Eucomis autumnalis

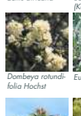
Scabiosa columbaria

Aloeveri kunda

Tree Species:

Celtis africana

Searsia lancea (Karee)



Dombeya rotundifolia Hochst

Euclea crispa

Aloe barberae

Combretum erythrophyllum

Combretum kraussii

Shade species

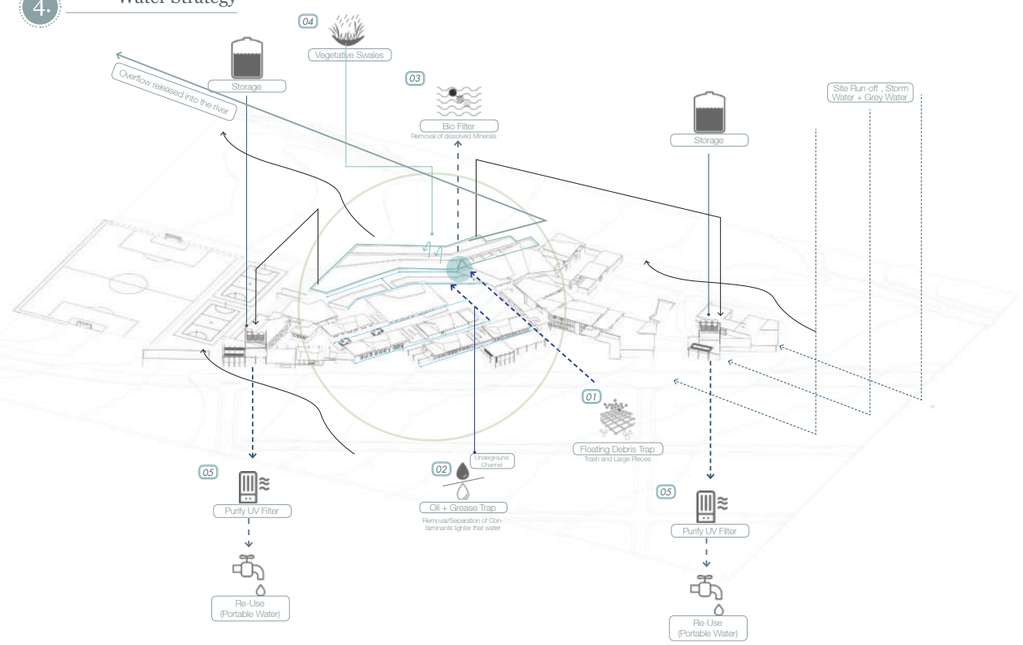
Chlorophytum bowkeri

Dietes iridioides

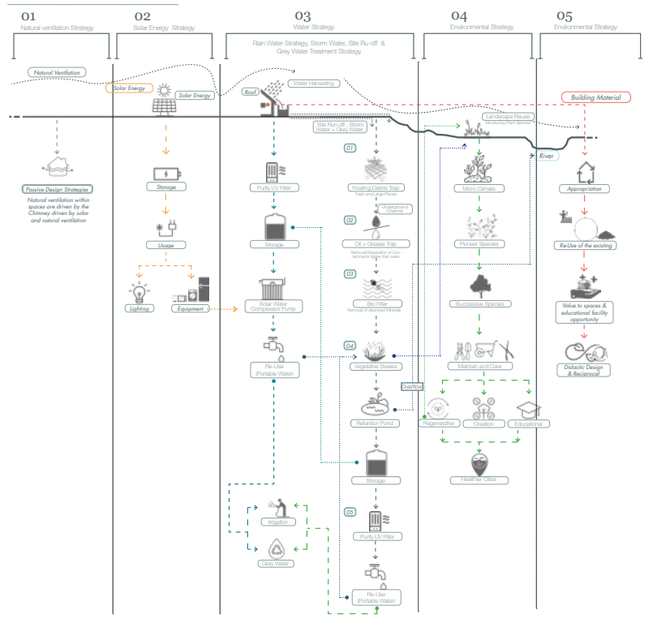
Carissa bispinosa

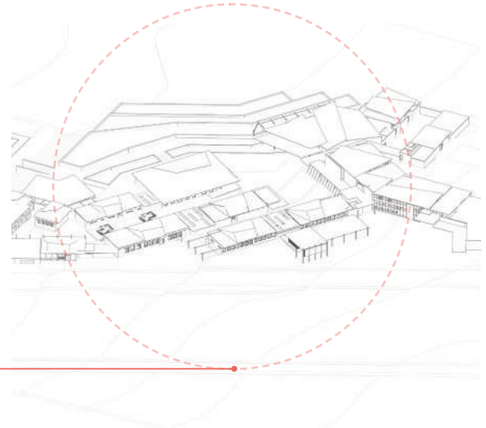
Freesea laksa

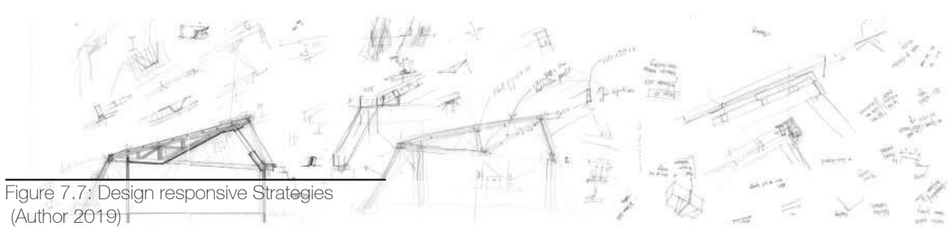
4. Water Strategy



Proposed Systems







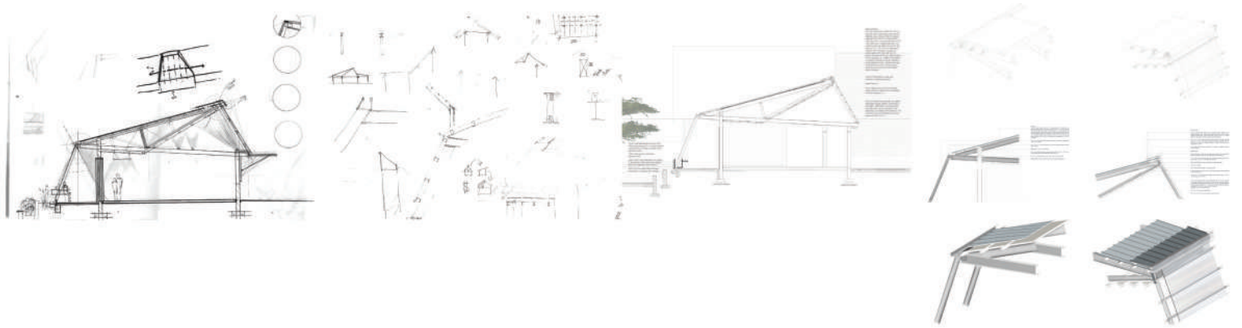
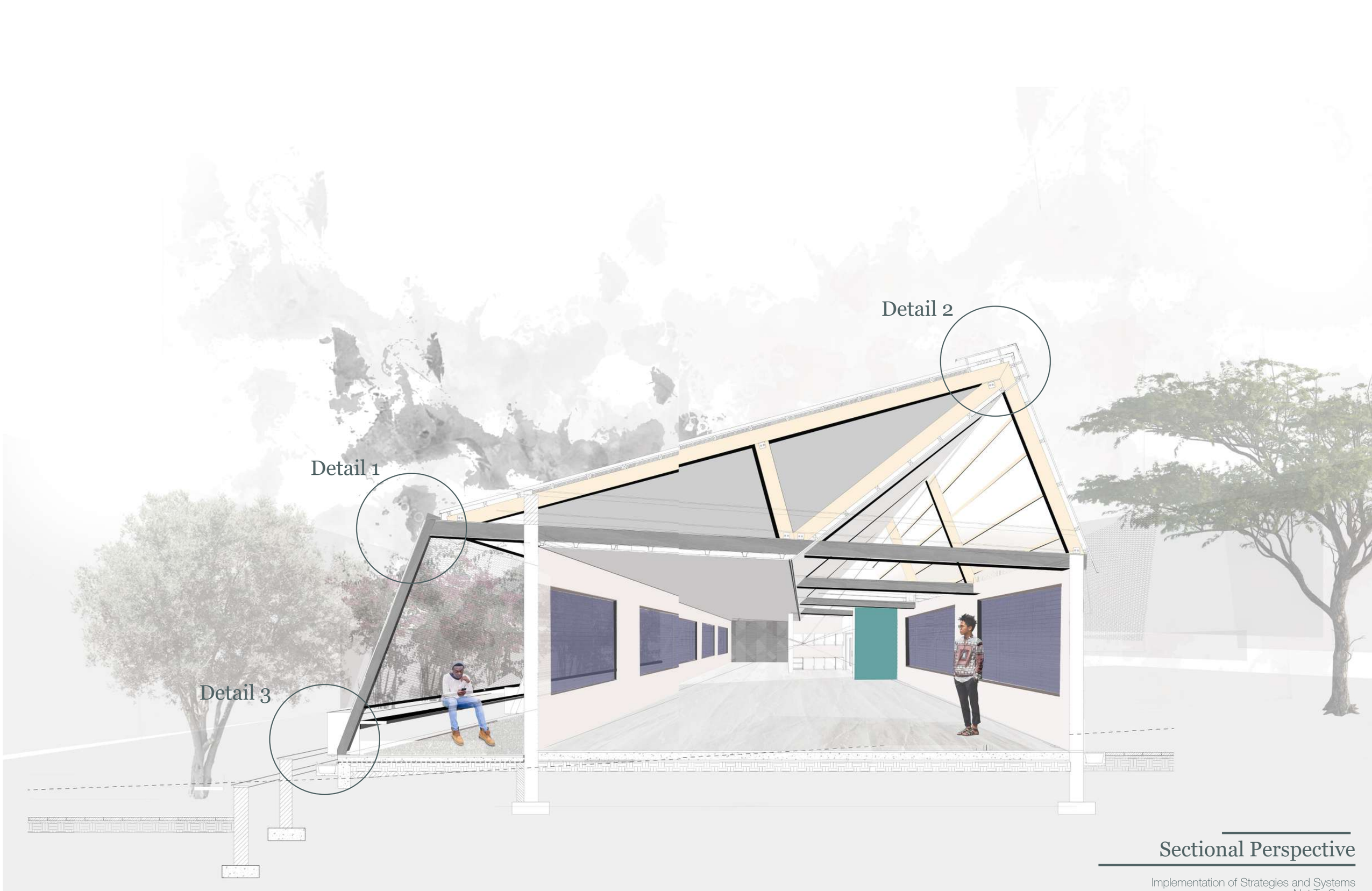


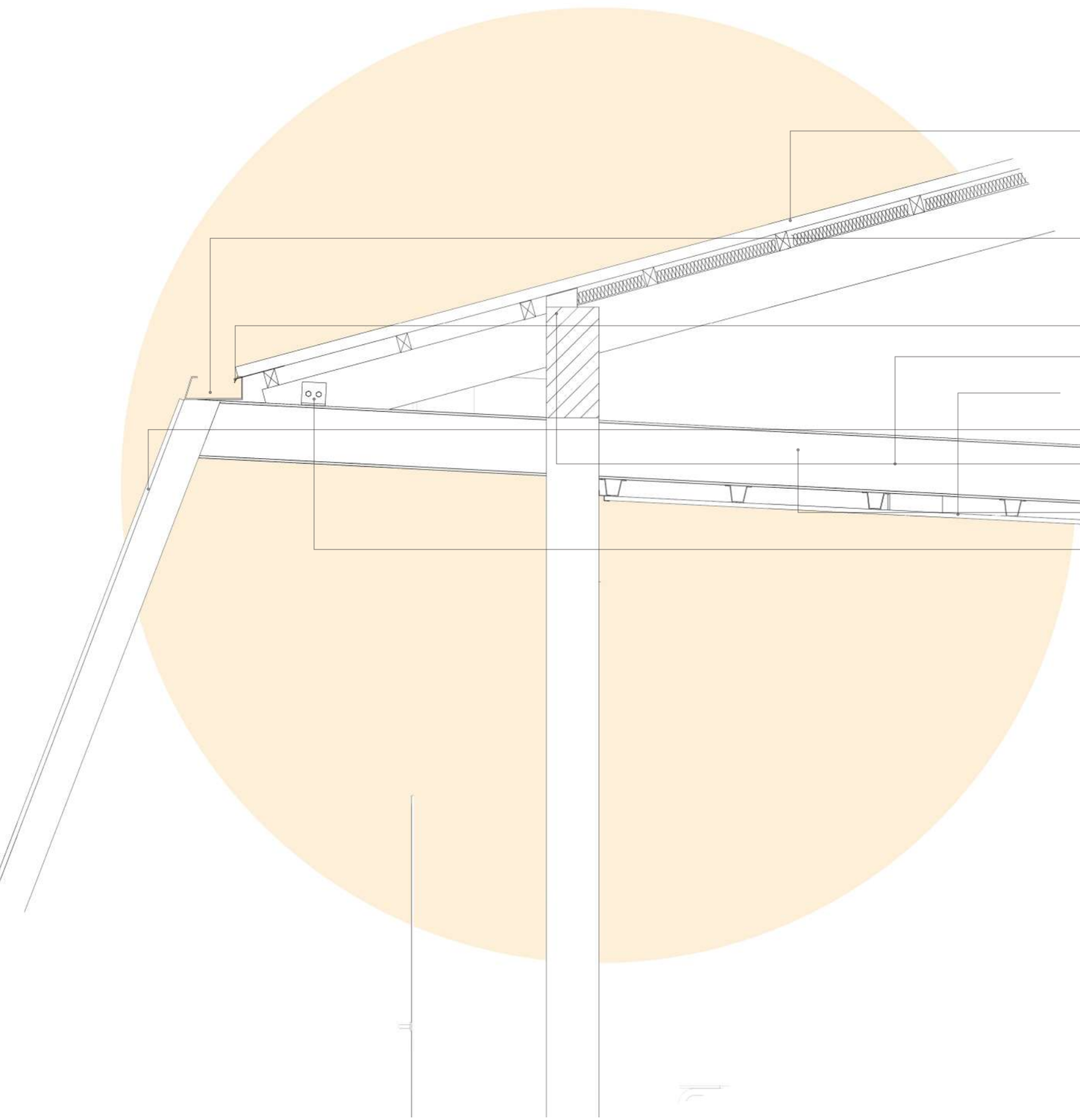
Figure 7.7: Design responsive Strategies (Author 2019)



Sectional Perspective

Implementation of Strategies and Systems
Not To Scale

Figure 7.8: Sectional Perspective
(Author 2019)



0,50 mm thick Safintra SAFLOK 700 Colorplus® AZ150 interlocking roof sheeting (Material colour: Rain Cloud) fixed to 50 x 75 mm SA Pine purlins at 600 c.t.c. using SAFLOK 700 clips which must be screw fixed to new purlins in accordance with manufacturers recommendations. Roof pitch 15 degrees. Purlins are fixed to 227 x 50 timber member.

225 x 100 x 20 x 3,0 custom cold-formed lipped channel used as gutter welded to 150 x 50 x 3 mm galvanised hollow square section used as downpipes. Openings to be made at 2000mm intervals to where hollow section downpipe attaches to gutter.

Metal flashing as per roof manufacturer

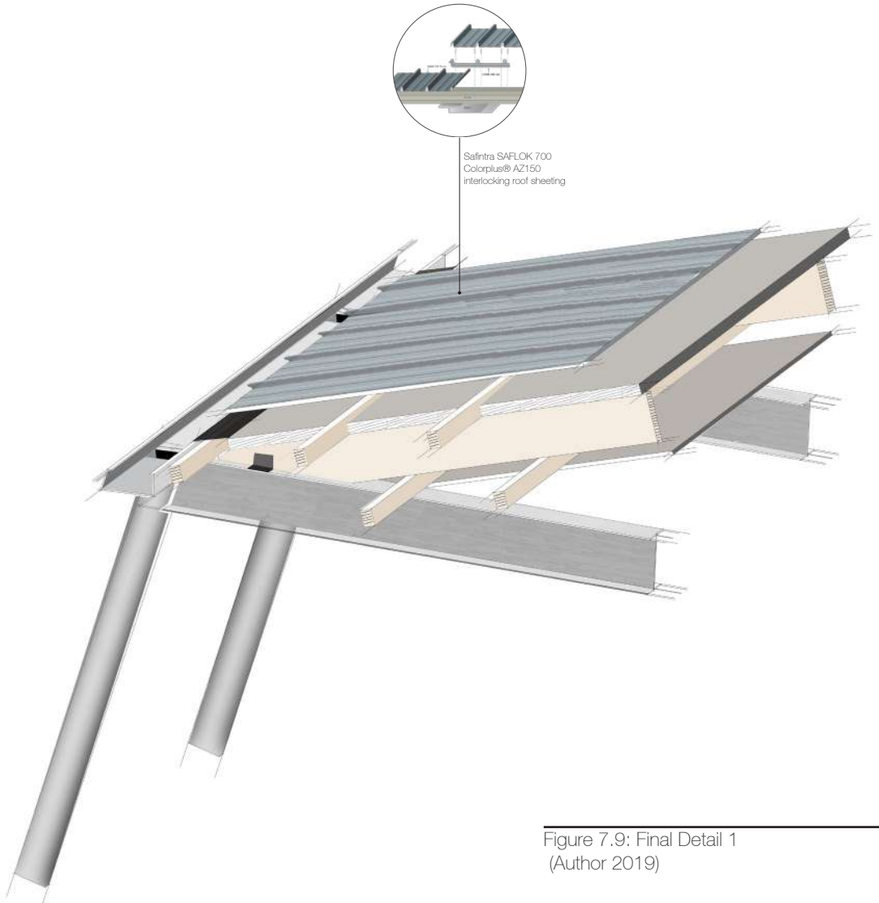
Existing 254 x 146 x 37 mm I-beam

20 mm thick Lamdaboard placed or equally approved fixed to 75 x 75 x 20 x 2.0mm Zincalum light steel Top hat purlin placed at 600mm c.t.c fixed to existing I-beam.

50 x 50 x 3 square galvanized weld mesh fixed with a 50 x 50 x 3 mm galv. steel equal leg angles to 150 x 50 x 3 mm hollow square section down pipe.

Existing 230 mm brick wall built to top beam and beam filling placed

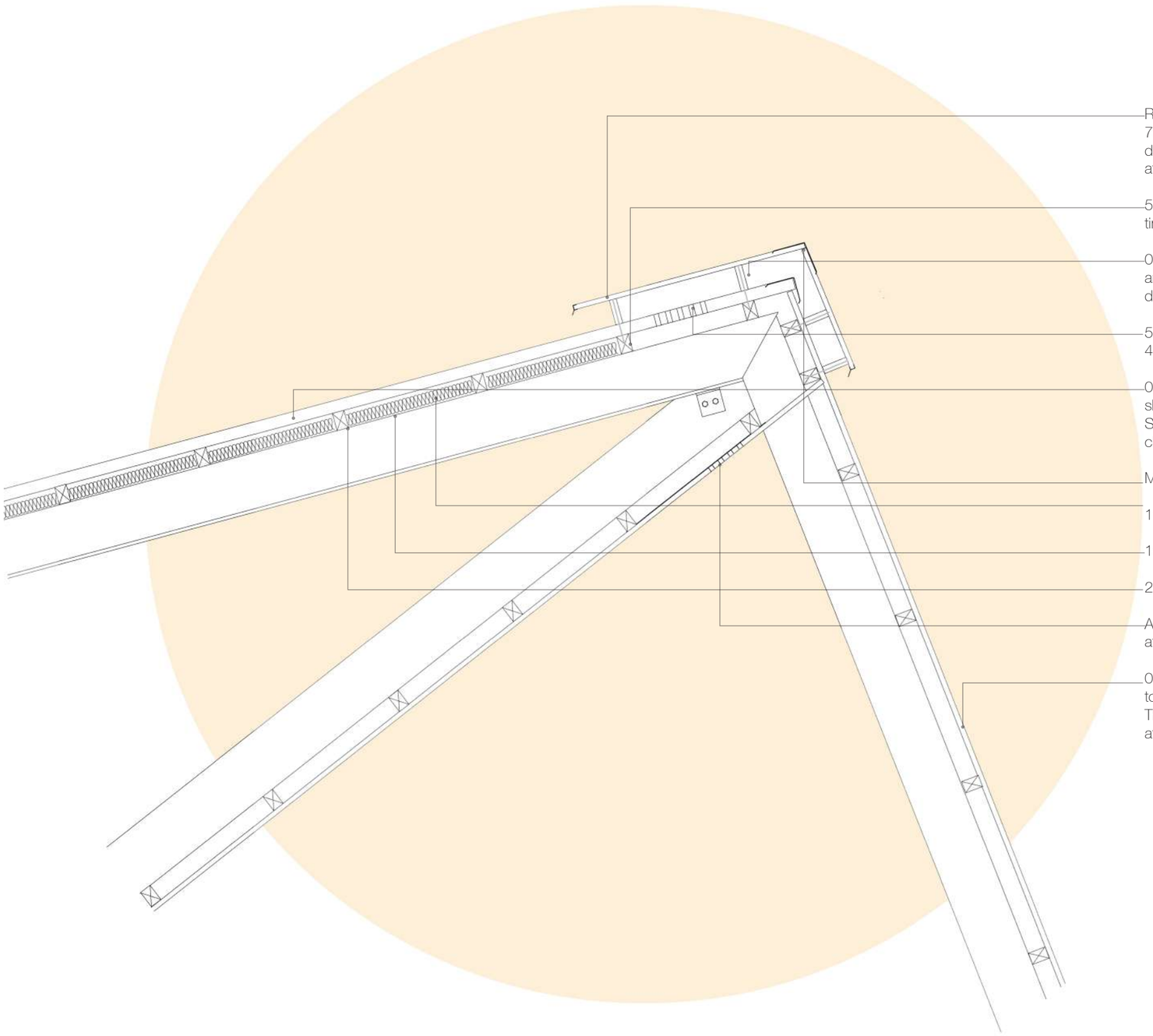
227 x 50 mm timber member are bolted to a 100 x 100 xx 8 mm galv. steel equal leg angles which are welded to the existing 250 x 100 x 4 mm I-beam.



Detail 1 Beam Connection & Gutter Detail

Scale 1: 10

Figure 7.9: Final Detail 1
(Author 2019)



Reclaimed 0.6 mm corrugated steel roof sheet (Darrk Material colour) fixed to 75 x 100 x 3 mm circular hollow section purlin spacer with a 175 mm self drilling TEK type screw with a hex head and BAZ washer into the timber purlins at 400mm c.t.c. Layer of sheathing is spaced parallel with new roof extension.

50 x 75 mm timber purlins spaced at 600 mm c.t.c and fixed to 227 x 50 mm timber truss member.

0.5 x 0.5 x 0.9 mm Galvanized welded mesh or equally approved wrapped around circular hollow section purlin spacers. Mesh to be layered to achieve a density to prevent insects or small particles to enter.

5 rows of 20 dia. drilled holes into Saflok roof sheeting at the highest point at 40mm spacing c.t.c.

0,50 mm thick Safintra SAFLOK 700 Colorplus® AZ150 interlocking roof sheeting (Material colour: Thunder Storm) fixed to steel purlins at 600 mm using SAFLOK 700 clips which must be screw fixed to 75 x 50 x 20 x 2 mm lipped channels in accordance with manufacturers recommendations

Metal flashing as per roof manufacturers

115 mm flexible mineral/ rock-wool or equally approved

150-micron underlay

20 mm thick lambdaboard or equally approved attached to 75 x 50 mm purlins

At the highest point of the roof, 20 dia. holes need to be drilled into the Isoboard at 40mm spacing c.t.c

0.22 mm Danpal Dampalon® dry glazed lightweight facade systems connected to Dampalon subframe in accordance with manufacturer's recommendations. The subframe is connected with screws to 228 x 50 mm truss member spaced at 600 mm c.t.c.

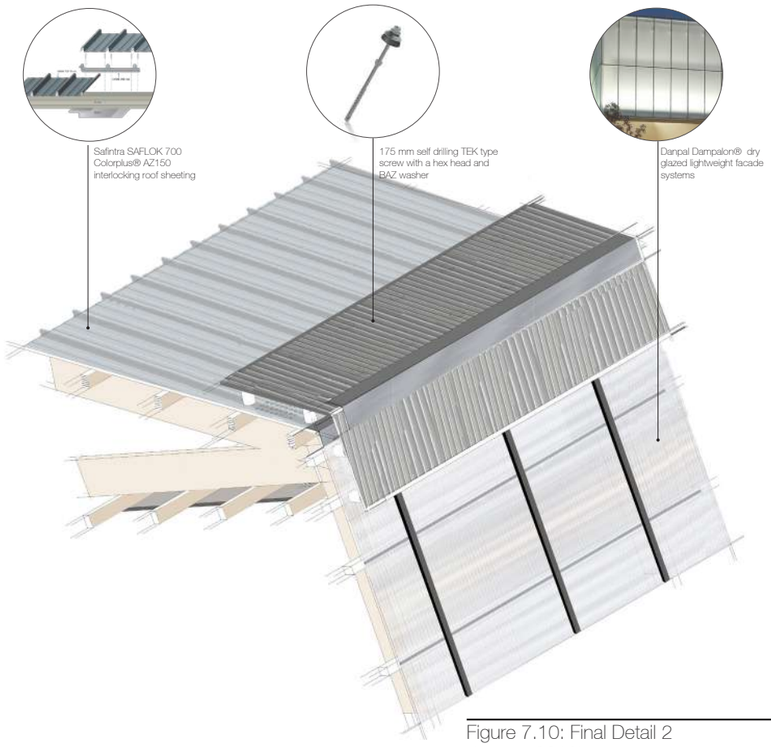
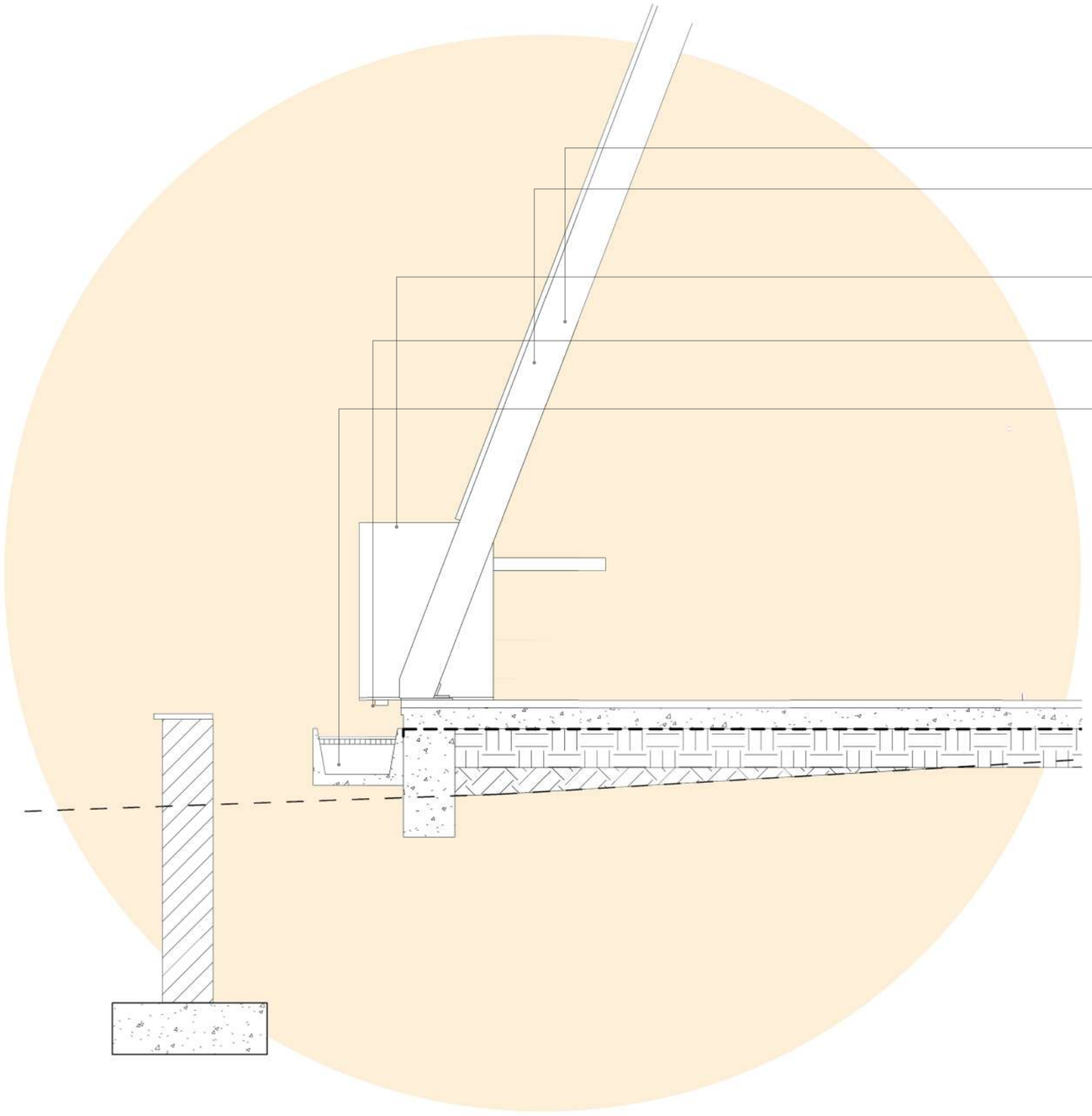


Figure 7.10: Final Detail 2
(Author 2019)

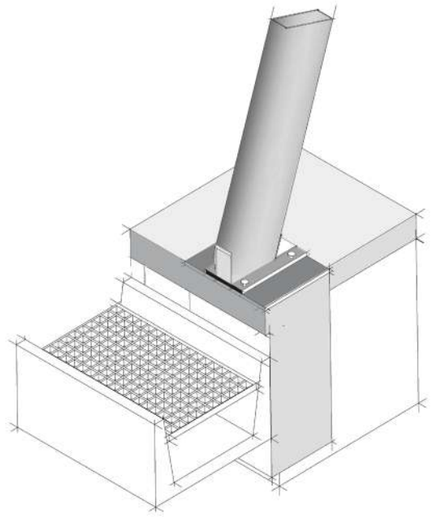
Detail 2 Solar Chimney Detail

Scale 1: 10



Detail 3 Downpipes Detail

Scale 1: 10



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Entrepreneurial Connection with the Community

Established Entrepreneurial Activity on the Edge

Figure 7.12: Final Entrepreneurial Connection with the Community (Author 2019)

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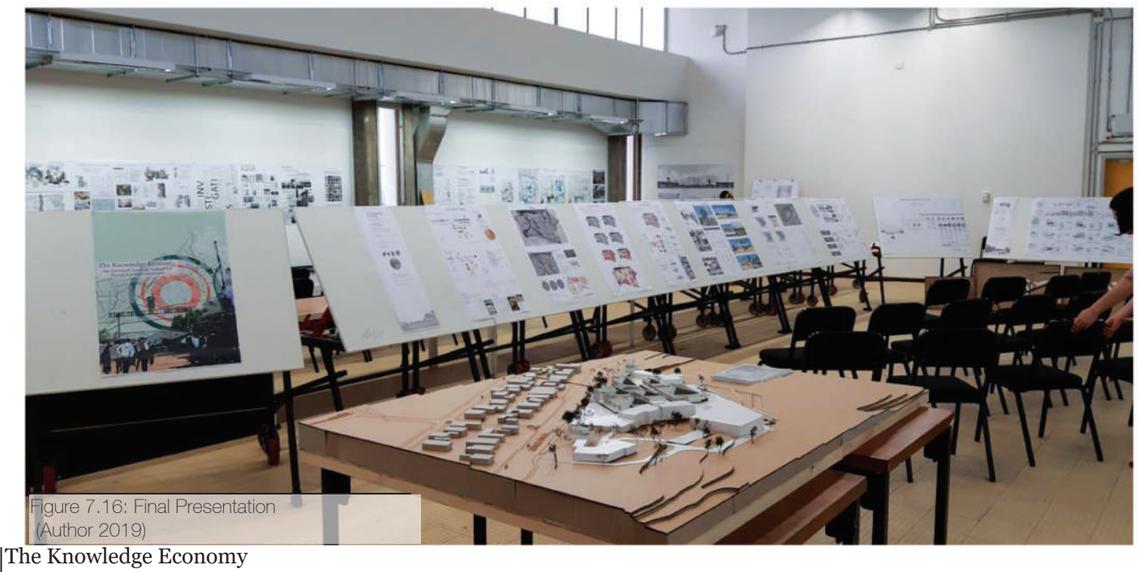

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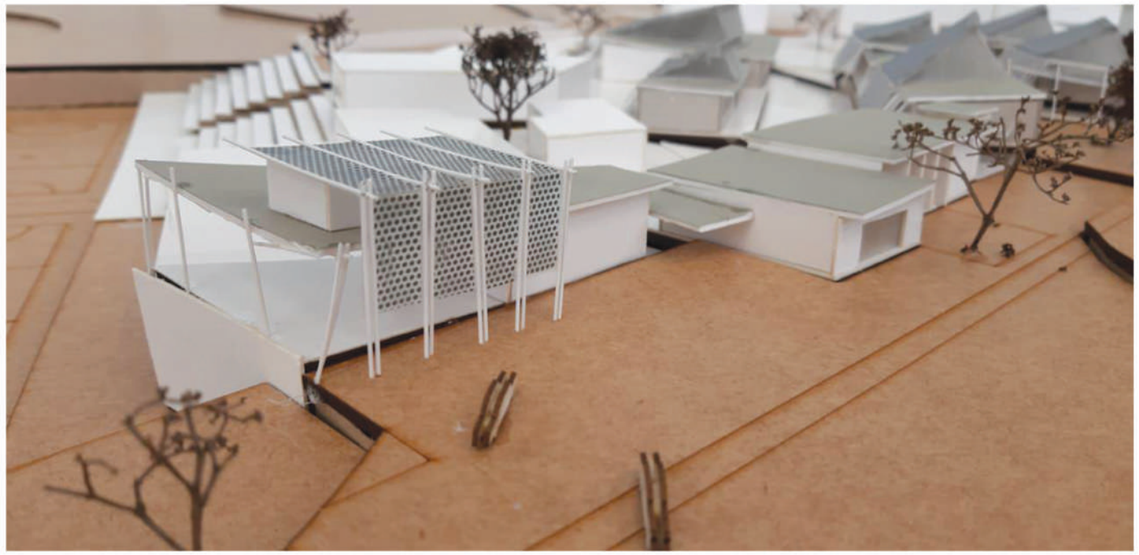

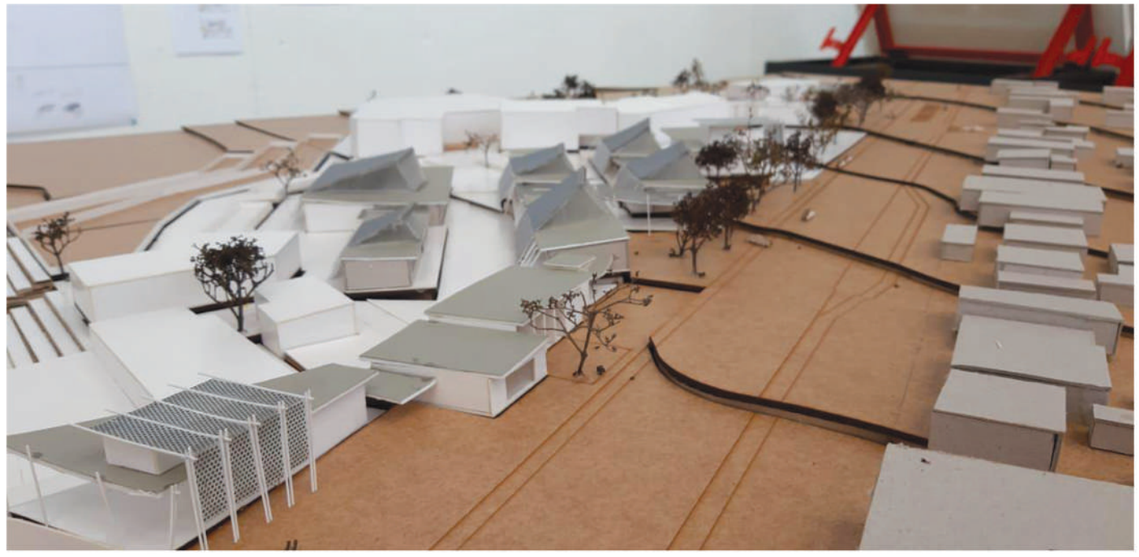

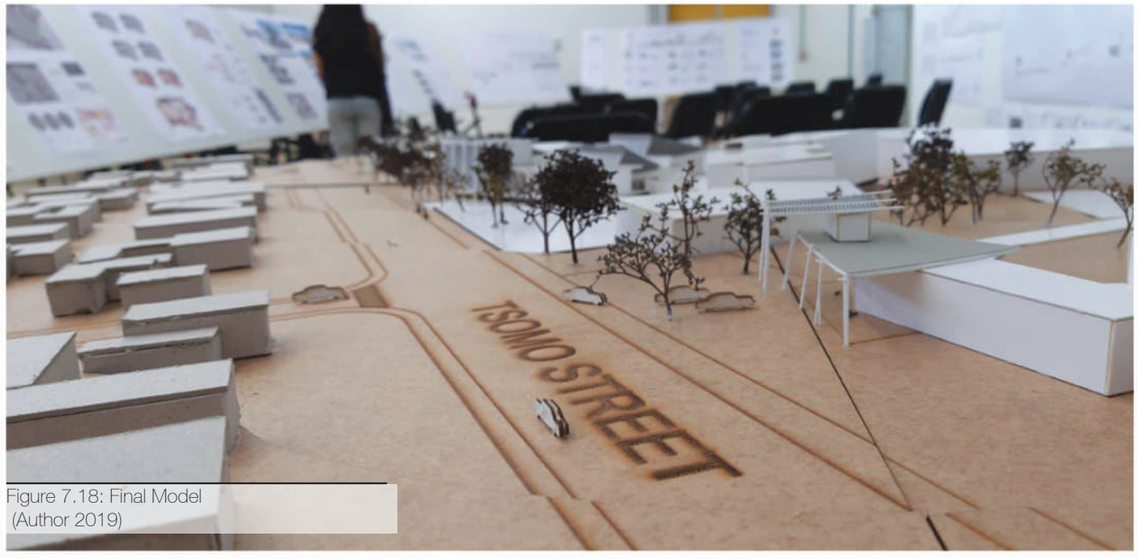

Figure 7.18: Final Model
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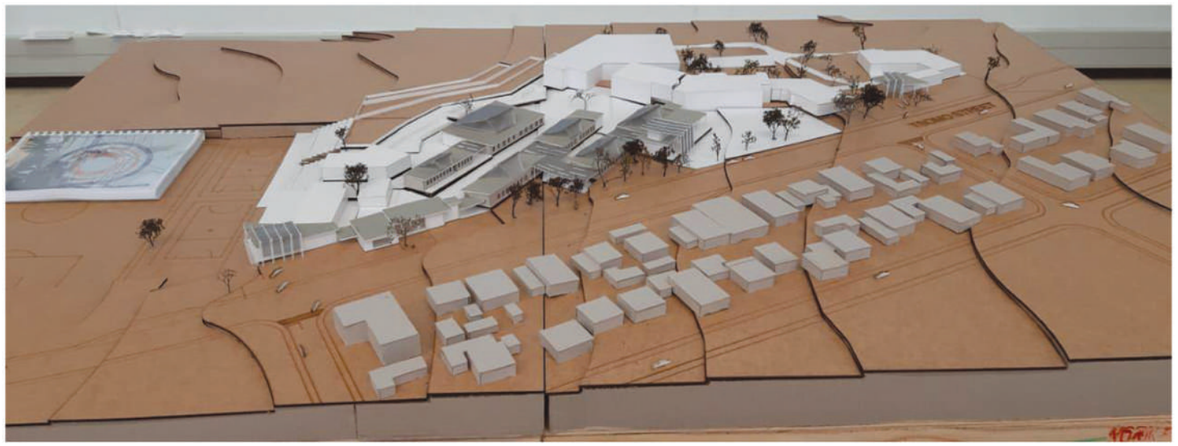

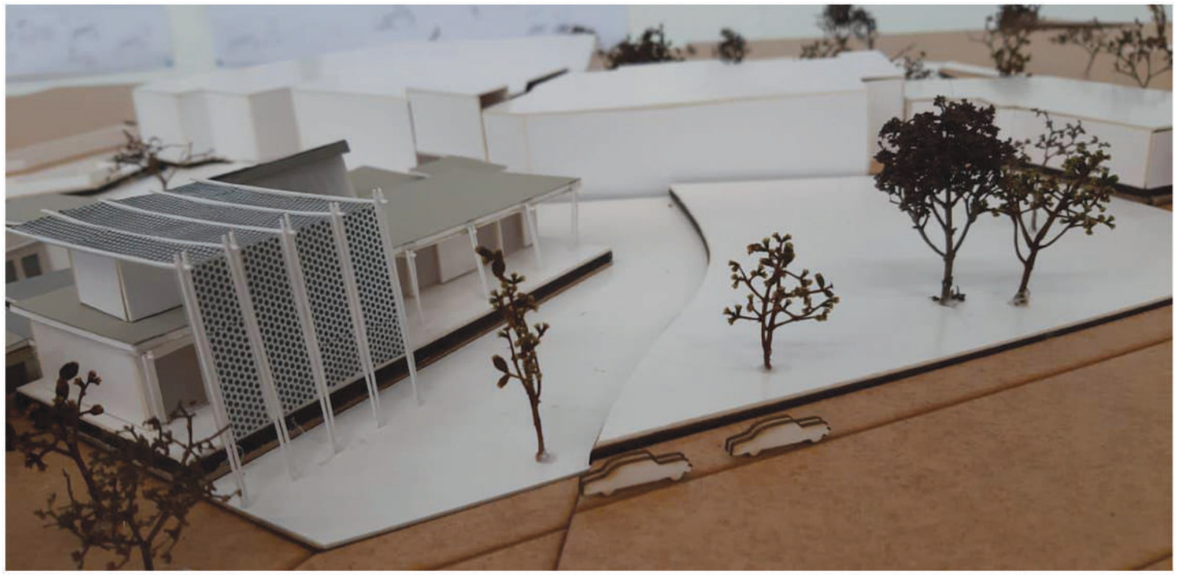

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Appendices

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

Reference number: EBIT/E11/2019 25 April 2019

Prof A Barker, Mr JN Prinsloo & Ms C Karusseit
Department Architecture
University of Pretoria
Pretoria
0028

Dear All

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Research Ethics Committee refers.

Approval is granted for the application with reference number that appears above.

1. This means that the research project entitled "*Masters professional dissertation in architecture, landscape architecture and interior architecture*" has been approved as submitted. It is important to note what approval implies. This is expanded on in the points that follow.
2. 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 Research Ethics Committee.
3. If action is taken beyond the approved application, approval is withdrawn automatically.
4. 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.
5. The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

Prof JJ Hanekom
Chair: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

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

2 May 2019

TO WHOM IT MAY CONCERN

I hereby provide Simoni Veldsman (Student No 14207266), student of the Department of Architecture under the supervision of Dr C Combrinck, permission to include UP personnel and/ students as participants in the study: the Knowledge Economy.

I also give consent that the student can partake in the fieldwork component of this research.

I understand that participation will we voluntary and consent will be obtained from all participants and potential interviewees. Participants and interviews will remain anonymous but their words might be quoted in academic or practice related publications.

Yours sincerely

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Kgoro ya Boentšenere bja Mohlagase, Elektroniki le Khomphutha

Simoni Veldsman

The Knowledge Economy

How can the entrepreneurial Knowledge Economy contribute to space and place-making within a high school in Mamelodi-east.

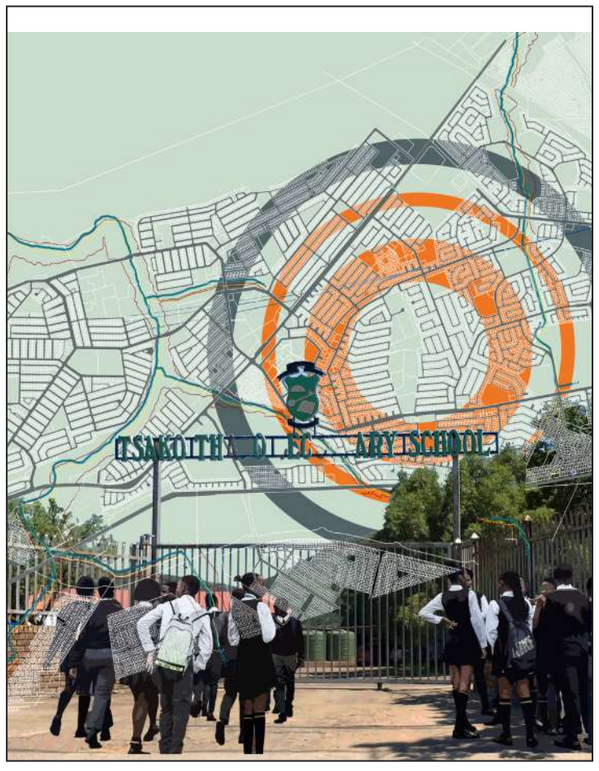


Fig. 01. Above; The Knowledge economy (Author 2019)

Introduction

Within the Knowledge Economy, higher education is regarded as a knowledge industry that produces a knowledge foundation and employees by reinforcing the capacity to learn and develop competent employees within the workforce (Jimenez 2018:22,23). In South Africa, there currently exists a failure to foster these skills and a culture of learning which in turn leaves learners vulnerable, manifesting in the ''South African Skill Paradox'' (Weeks 2012:1). Unemployment is an evident consequence of the high dropout levels of pupils in the South African Education System, the inability to find employment and lack of work opportunities (CDE, 2014:4).

Mamelodi, a South African township to the Northeast of Pretoria, is one such instance where, despite the number of schools in the area, a high level of unemployment has been recorded (StatSA, 2018). Typically, schools in this township were constructed as part of state-provided infrastructure both under the apartheid regime as well as in the post-democratic era. Schools were used to implement divisions within society and to propagate beliefs in apartheid education (SA History Online). Schools were divided into four racial groups to implement segregation, evidence of actions taken pre-1994 is recognised in the Bantu Education Act 47 of 1953 and the educational legislation of the 1960s (de Wet & Wolhuter 2009:365). The state was assigned the responsibility for organising school education with education departments allocated to administer and regulate curriculum development, infrastructure and protocols for each ethnic and racial group separately.

Currently, the South African education system is governed by two national departments, namely the Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET). Each of the nine provinces in South Africa has its own education departments that are responsible for implementing the policies of the national department, as well as dealing with local issues (South African Yearbook 2017/2018:2).

Tsako Thabo High School is situated next to the Pienaar River that divides Mamelodi into east and west. Tsomo Street provides access to the school on the South-eastern end. The site is surrounded by zoned public open space, government-owned land, on the northern and western sides. The architectural typology found at Tsako Thabo Secondary School subscribes to the idea of the 'Modern Classroom' suggested by Dudek (2000:10) and is reminiscent of a school typology investigated in this study (see Chapter ?) and applied across the country, that affects the development of schools.

Literature studies reviewing factors impacting schools and learning environment suggests that the physical environment contributes to the ability of students to learn (Higgins et al, 2005:7). This suggests that some of the problems associated with the current culture of learning and eventual employment or entrepreneurial success may be related to the spatial typology inherited from the legacy of apartheid which has been extended throughout the Mamelodi context.

In this study, the research aims to offer a perspective on how architecture may either contribute positively to a culture of learning or negatively undermine the ability of learners to acquire the skills necessary for employment or entrepreneurial education.

The study will then identify the barriers perceived and experienced by learners by using Tsako Thabo Secondary School as a case study to reflect issues apparent in the schools located within the study area of Mamelodi east.

Statement

Spatial conditions inherent to school typologies in South Africa play a role in students' inability to complete their educational pathways (Jimenez 2018:24). The learning landscapes' physical environment contributes to the role of disjunction and spatial legacy occurring in higher education institutions as well as in social problems within the community. Numerous South African schools reflect multifaceted socio-educational problems due to this spatial dysfunction that exists that in turn affected their culture of teaching and learning (Week, 2012:4). The schooling context is shaped by social and spatial patterns that affect the way learners relate to the school and their education, and the values they learn from the world they experience around them (Hammett & Staeheli, 2013:318). When disparity is characterised within society, individuals and communities are marginalised (Ebersohn, 2016:2).

Site Selection

Tsako Thabo Secondary School has been chosen as the site for an architectural intervention. It forms part of the learning collaborative of the University of Pretoria's Architectural Department in Mamelodi, investigating "Education in township communities" and creating "strategies for ensuring the long-term success of learners in township settings" (Mamelodi Collaborative: 2017).

Within this collaborative, the Tsako Thabo Secondary school has a relationship with the University of Pretoria's Mamelodi Campus making this school accessible and valuable to investigate the importance of education within a community such as Mamelodi-east. Secondly, the Department of Architecture Honours group (4th-year students) of 2019 was involved with the school in collaborative mapping in and around Tsako Thabo High School.

History of Tsako Thabo Secondary School

Tsako Thabo Secondary School was originally known as Junior Secondary 3, and part of Mamelodi Junior Secondary School in Mamelodi West. It moved to its current location in 1979. It was known for its excellence in music and sports. Prior to 1994, Woodwork, Sewing and Home Economics were the main subjects taught. The Deputy Principal, also a former student explained that schools back then were built to train and not to educate and attributes the barracks-like feel of the school to apartheid. It was originally open (not fenced off), but over time, due to fear of crime, it gradually fortified itself further. However, this has not solved the security problem (Venter & Achi 2019).

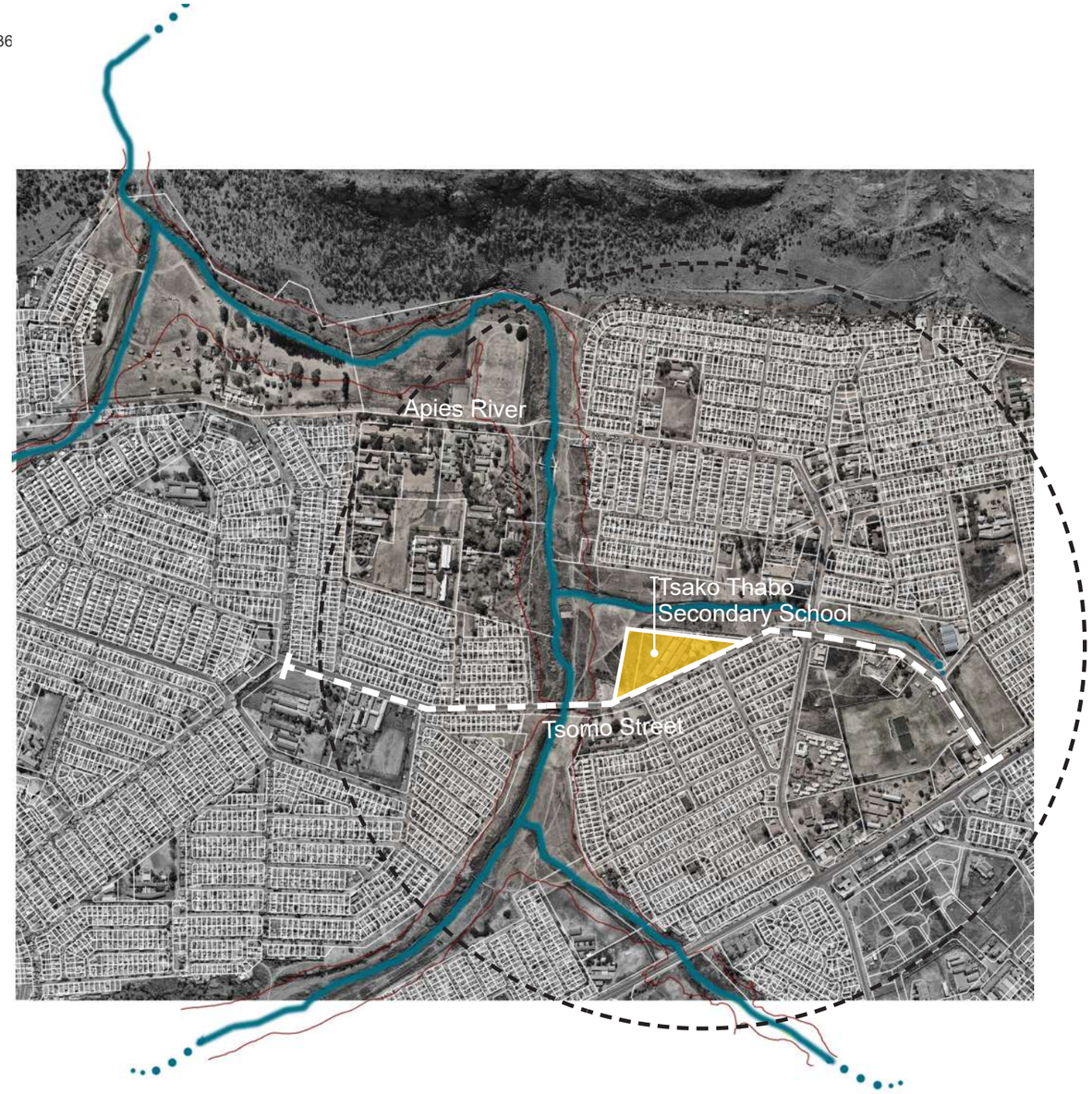
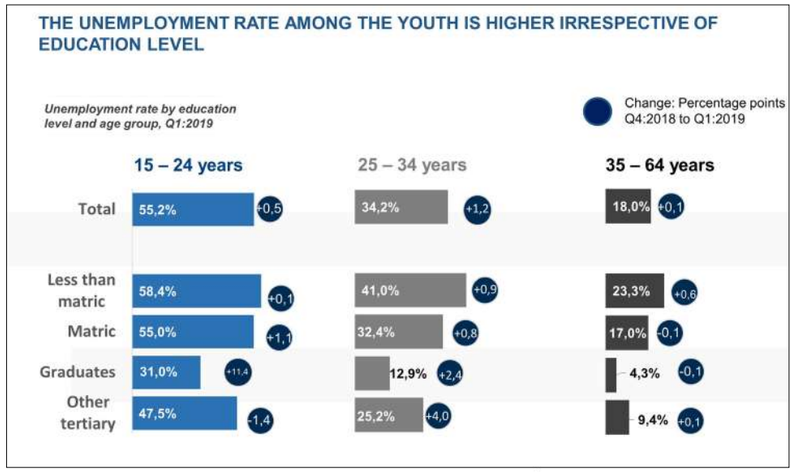
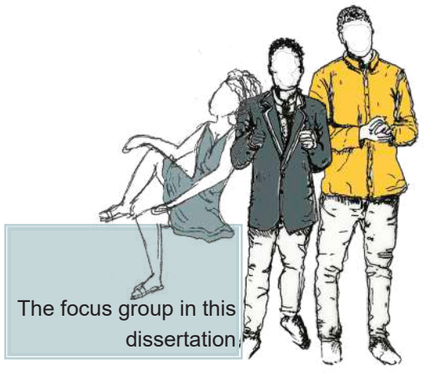
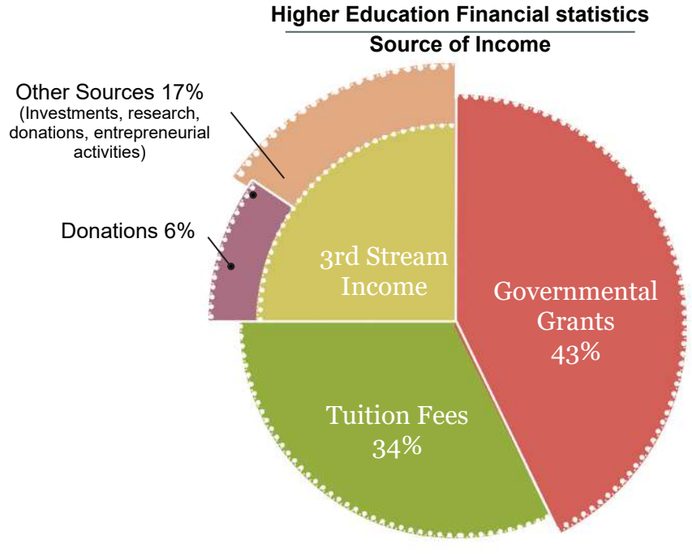


Fig. 02. Left; Locality of Tsako Thabo Secondary School (Author 2019)
Fig. 03. Top Right; Image name or title (Author, 2019)
Fig. 04. Middle Right; Study Focus Group (Stats SA 2016)
Fig. 05. Bottom Right; Source of Income of DHET (adapted from Sats SA 2016)





The Learner/ The Student/ The Entrepreneur



Unemployment

South Africa faces a huge unemployment problem (Weeks 2012:2) which currently poses as the most pressing socio-economic crisis (Altbeker & Bernstein 2017:i). Yet businesses and industry are confronted with significant skills shortages where people have an abundance of knowledge, experience, and skills finding themselves in a 'skills paradox', with no opportunity to find employment with those skills.

The age group between 15–24 years is the most vulnerable in the South African labour market as their unemployment rate was 55,2% in the first quarter of 2019 (Stat SA, 2019), resulting in the inability to produce the required growth or employment within South Africa's economic strategy (Altbeker & Bernstein 2017:i). Furthermore, nearly 40% of young people (aged between 15 and 34 years) are not participating in further education, employment, or training (Altbeker & Bernstein 2017:1). Figure 04 illustrates how the unemployment rate among youth is still high regardless of the education level (Stat SA, Q1 2019).

The South African Education System

Figure 06 illustrates the South African education system. The education system is governed by two national departments, namely the Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET). The DBE is responsible for primary basic education and the DHET for tertiary education and training (GCIS 2017/18:2). In the 1996 Bill of Rights of the Constitution of the Republic of South Africa, point 29 declares basic education as an inalienable basic human

right for all South Africans from grade R to grade 9 (South African Yearbook 2017/2018:2). The educational pathway for higher education from grade 9 onwards becomes limited, optional and restricted.

Focus Group:
The learners of higher education institutions will be the focus group in this study due to the role knowledge plays in employment and learners being equipped for employment. From 'grade 9' learners are provided with various options to continue their studies from secondary school to higher education. These options are varied from continuing with schooling until matric, leaving school or going back into schooling at universities, technical and vocational education and training colleges, artisan training colleges, or community education and training colleges.

Funding the DHET
A further investigation reveals how tertiary education in South Africa is financially driven. According to the latest financial data from Statistics South Africa's higher education institutions report (Stat SA,2016), higher education institutions depend mostly on government grants to be able to function, secondly on tuition fees, finally on the third stream of income through donations and investments. This makes the dependence on Governmental input clear.

Education Paradox
Obtaining a higher education qualification is among the most reliable paths to employment in South Africa (Altbeker & Bernstein 2017:22). Higher education branches, such as universities, further education, and training, as well as adult education and training, are the primary engine for the production of higher-level skills and talent for economic growth, technological innovation, societal leadership and the 'in-between' phase for work preparation (Jansen 2018:1). There is a perception that most who enter the system prefer a university degree to a technical and vocational qualification (Jansen 2018:4).

The Knowledge Economy: Skills, Employment and Entrepreneurship Wit and Orvis (2010:6) suggest that

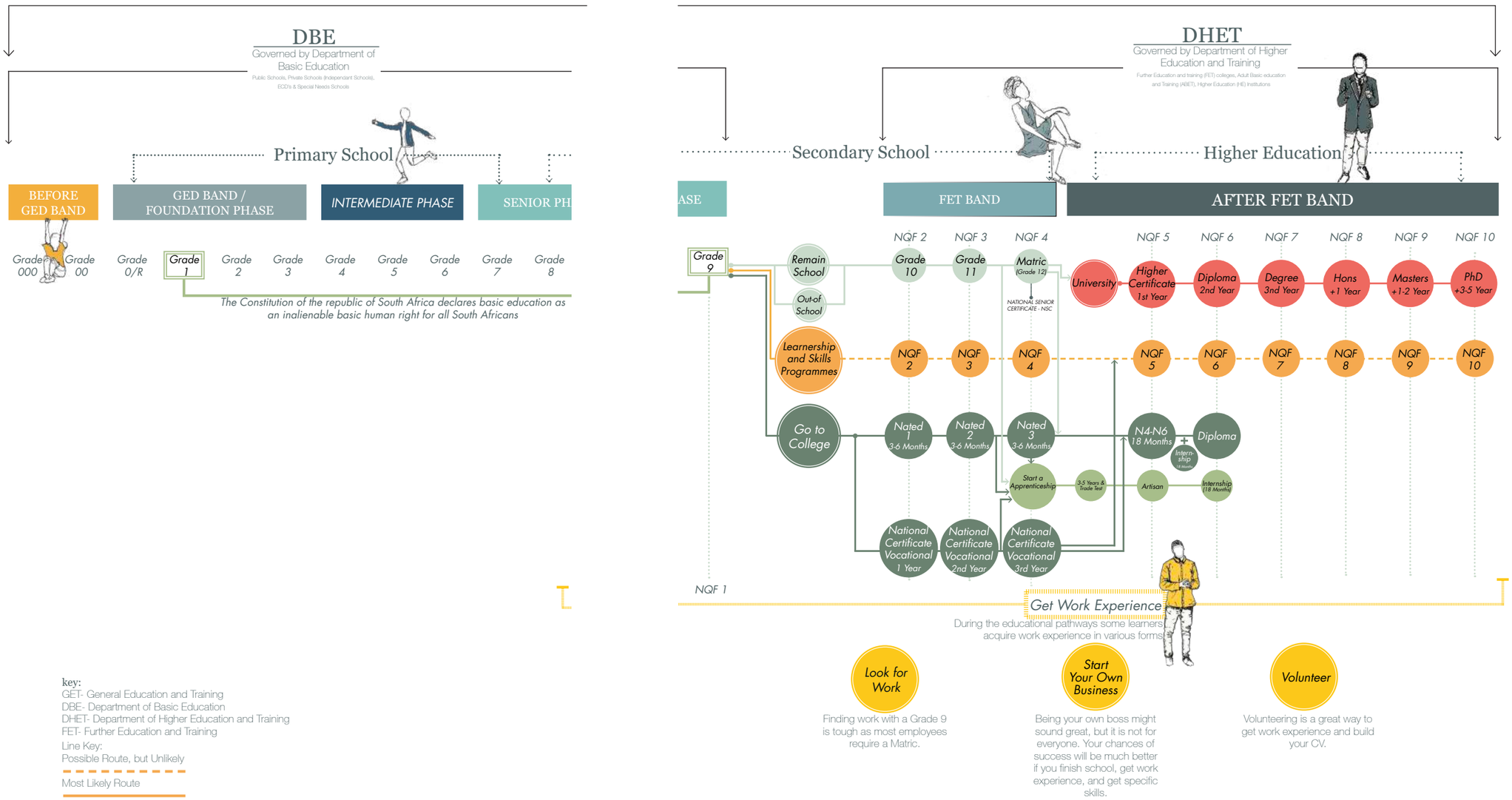


Fig. 06. Above; Visual illustration of the South African Education System (Adapted from Altbeker et al 2017, GCIS 2017/18 2017, wikipedia.org 2017)

learners require new skills for tertiary education and careers to keep up with the rapid changes that occur in a Knowledge Economy. Employment generation has been identified as one of the highest priorities within South African society (CDE 2017:1).

The Knowledge Economy relies and recognises intellectual assets (human capital) as a key factor in economic growth (Powell & Snellman 2004:199; Weeks 2012:2) and with inadequate skills makes it difficult for the economy to function effectively (Weeks 2012:2).

The reality is that the majority of people who are potentially economically active in South Africa generate their own employment, entrepreneurial business or activity, usually in the form of 'informal sector' activity (CSIR 2005:10). Being entrepreneurial has been a catalyst in the growth and development of strong economies (Greyling 2007:14). This contributes in terms of job creation, employment and income that can be accredited to entrepreneurial businesses (Belle et al 2004:1).

The DHET established the 'Entrepreneurship Development in Higher Education' (EDHE) within the University branch of higher education, which is an intervention to make entrepreneurial education and training accessible for students, equipping them to successfully participate in the economy upon graduation, regardless of whether they are employed or not (EDHE 2019).

Despite the mentioned initiative in higher education, entrepreneurial learning is excluded from all other higher education branches and models previously illustrated in figure 07 such as training centers and colleges where facilities, learners, and economic growth can benefit from entrepreneurial learning within their own communities. It creates a limitation in the economic processes for higher education models to produce relevant skills for careers and what is required in the economy of South Africa.

General Issue

There exists an overall systemic disjointedness between education and economic processes that leaves educational systems unresponsive or unsupportive of the relationship with the economic systems apparent in South African society. Unemployment is an evident consequence of this disjointedness between system and process.

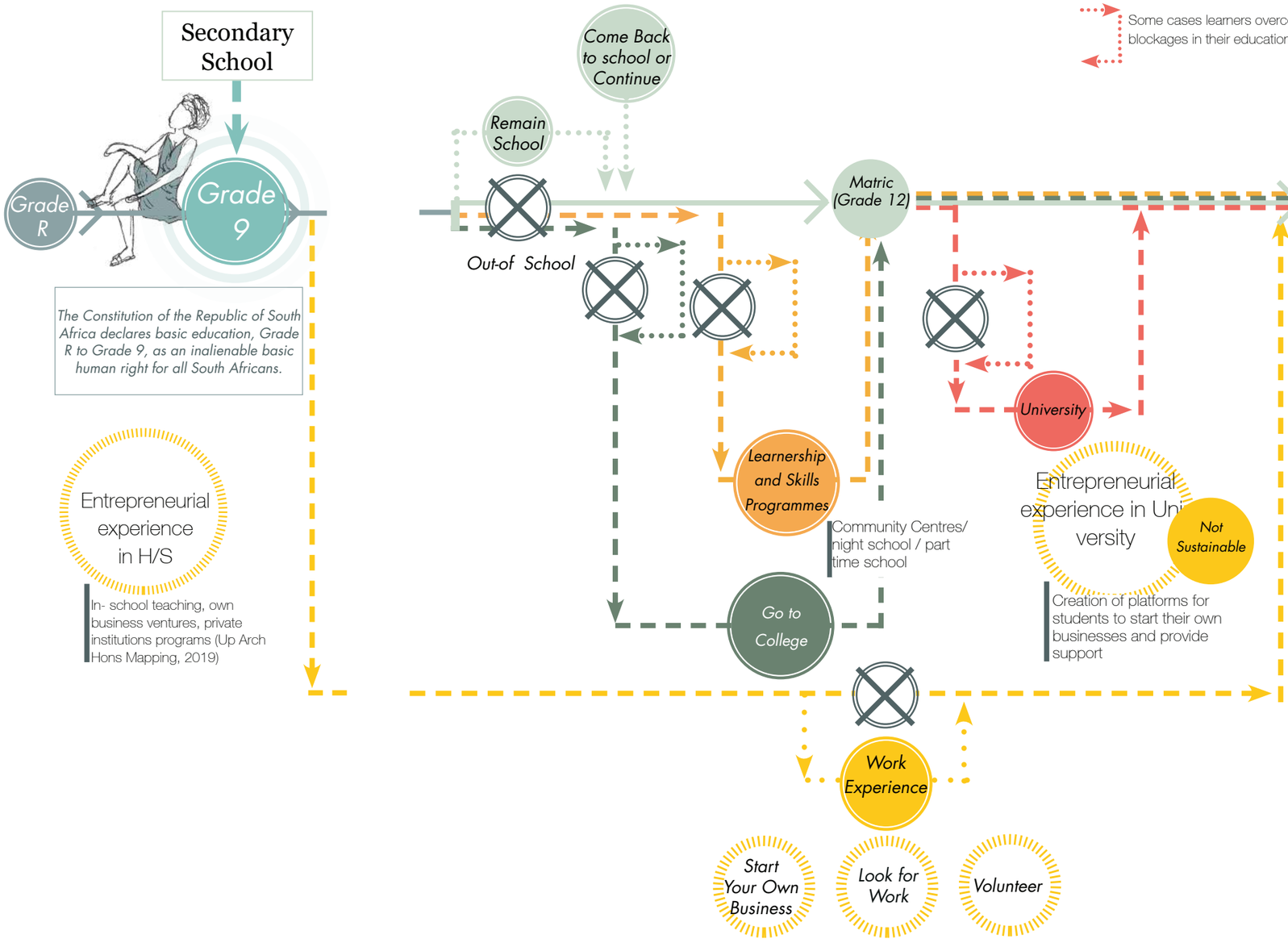


Fig. 07. Above; Blockages restricting Educational Pathways (Author 2019)

Risk factors as barriers to education — **Opportunity Low**

Social origin of risk:

In the school-community:

- exposure to conflict, insecurity, crime
- lack of, distance to, and barriers to access limited services (health, welfare, transport)
- lack of school-community participation
- high poverty neighbourhood / village

In the kinship system:

- low levels of parental education
- low household income generating based on parental occupation
- high intergenerational poverty

Individual level (student, teacher, family of origin):

- higher risk for females
- orphanhood as risk
- higher risk of individual with a disability
- negative affect (emotions)
- negative temperament
- low individual self-esteem

Inequality High

Fig. 08. Left; 'deficit policy lense: rural education, opportunity and inequality' (Ebersohn, 2016;2)

Barriers to Education

Barriers affecting and preventing education:
Apart from limitations in creating platforms to enhance the entrepreneurial activity, the education system in South Africa is challenged by many social issues. Emerging economies are regularly exposed to crime and conflict and aggravated by an at-risk social context and social origins (Ebersohn 2016:2). Many students withdraw from schooling (Muller and Toutain, 2015). Factors impacting this withdrawal from the educational pathways range from domestic factors such as substance abuse to systemic factors such as school capacities (CDE 2017:2; Ebersohn, 2016:2; Hammett & Staeheli 2013:323; Weeks 2012:3). Figure 07 illustrates the effect such barriers of education have on educational pathways.

Social barriers affecting
educational blockages
Ebersohn (2016:2) provides a risk lens in education research depicting that inadequate opportunity is associated with socially-generated risk factors that impact educational pathways. Figure 08 represents a 'deficit policy lense on rural education, opportunity, and inequality' demonstrating risk factors as barriers in educational pathways.
(Ebersohn, 2016: 2)

Given the above study, issues persist in educational systems that cause these barriers in education, the ability for students to complete their education or come back into learning and the limited entrepreneurial provision made by the DHET.

Entrepreneurial Education-an outward-looking school

The value of incorporating entrepreneurial education into higher education models can assist in developing skills and knowledge to equip people with skills to start-up, organisation and manage their own enterprises (Paltasingh 2012:233). Entrepreneurship Education (EE) is considered as one of the fastest-growing fields of education globally; it is an indication of the importance of entrepreneurship for the economy of any society (Muller and Toutain 2015:6; Sirelkhatim & Gangi 2015). The possibility exists within the higher education system to develop the necessary knowledge, experience, and skills needed to address the challenges of unemployment to create employment opportunities for people to manufacture, trade and provide services (CSIR 2015: 10). Entrepreneurship Education also invites a wide spectrum of actors from within and outside schools to build entrepreneurship as well as broadening perspectives on finding creative and new ways of teaching and learning (European Commission 2010; Muller and Toutain 2015).

The intention is, therefore, to promote entrepreneurial learning by suggesting a systemic alteration in the educational system to create an educational platform that promotes entrepreneurial learning and attaches itself to a Higher Education branch, building on the term of being an ''outward-looking'' school/ facility and the creation of an Entrepreneurial Education Ecosystem.

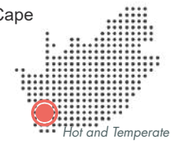
Muller and Toutain (2015:6) set out two key issues to design and implement entrepreneurial learning for an educational environment to being ''outward''. The first is to understand the entrepreneurial activity in its context and the second is to understand the systemic nature of interaction beyond the boundary.

In this study, the focus is established to investigate how such a model can be applied to a school, Tsako Thabo Secondary School, located in Mamelodi-east spatially through architectural design and processes. Tsako Thabo Secondary school, located in Mamelodi east, similarly to other formal settlements around South Africa, it is characterised by high levels of unemployment and poverty (Maphall n:4).

Wolff (2007:26), a well known South African Architect involved in school design, states that the education system is undergoing a fundamental transformation. One of these suggestions is to transform secondary schools to Further Education and Training (FET) Schools and rethinking education facilities being built. FET schools will then be more focused on skills and entrepreneurial training to equip learners to generate their own income during and when they leave school.

Two such examples occur in South Africa where attempts are made to incorporate entrepreneurial learning in Secondary Schools: Usasazo Secondary School and Jakes Gerwel Entrepreneurial School.

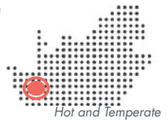
01
Usasazo
Secondary School
Jo Neoro Architects
Khayelitsha, Western Cape
2004



This school is a conventional high school commissioned by the Department of Education of the Western Cape. The design seeks to challenge conventions associated with schools located in townships.

One of the primary issues identified in this project was to create a connection with the street due to the required compact form of the school. The one facade responds to the street edge in scale, proportions, and exchange to reflect existing entrepreneurial businesses that occurs in informal buildings in the street. Hatches open to the street from the classrooms along the edge to allow for trade to occur between the school and community.

02
Jakes Gerwel
Entrepreneurial School
Department of Education & Community
Bonnievale, Western Cape
2017-2018



Jakes Gerwel Entrepreneurial School is located in Bonnievale in the Western Cape. The community is very poor and has a high demand for workers on surrounding farms. Children did not attend school due to the inadequate provision of school facilities and limited resources available in their township. Through community collaboration on donated land, equipment, and resources, Jakes Gerwel Entrepreneurial School was established to resolve issues in the community (Friedman 2017; YehBaby Digital Creatives 2018).

The school is technically driven and acts as two schools in one. Firstly, a mainstream school with technical subjects, and secondly, a skill and training section that is vocationally focused. The school thus creates the opportunity for learners to develop early entrepreneurial skills in their secondary education (Landbou.com:2019; Jakes Gerwel Entrepreneurial School .co.za, 2018).

More importantly, the focus is directed on the architectural response to the schools. Literature studies on factors impacting schools suggests that the physical environment contributes to the ability of students to learn (Higgins et al,2005:7), therefore suggesting that some of the problems associated with the current culture of learning, restrictive educational pathways and eventual employment or entrepreneurial success may be related to the spatial typology of education facilities.

The question then arises as to how architecture affects students' capability to finish their education and secondly, how can architectural design facilitate entrepreneurial education to address unemployment and resolve inherent spatial conditions restricting learners to complete their educational pathways by incorporating an economic system into a school.

Fig. 09. Top Left; Courtyard in Usasazo Secondary School (Wolff Architects 2004)
Fig. 10. Bottom Left; Courtyard in Usasazo Secondary School (Wolff Architects 2004)
Fig. 11. Middel;Traders Edge in Usasazo Secondary School (Wolff Architects 2004)
Fig. 12. Top Right; School under construction (Jgt.co.za 2018)
Fig. 13. Bottom Right; Image depicting first phase of school complete (Esbou.co.za 2018)

Contextualising Education

Educational Landscape of Mamelodi

The second layer of literature studies is initiated to investigate how the current schooling plays out in terms of the built environment and how this is manifested in Mamelodi East.

The Urban Condition

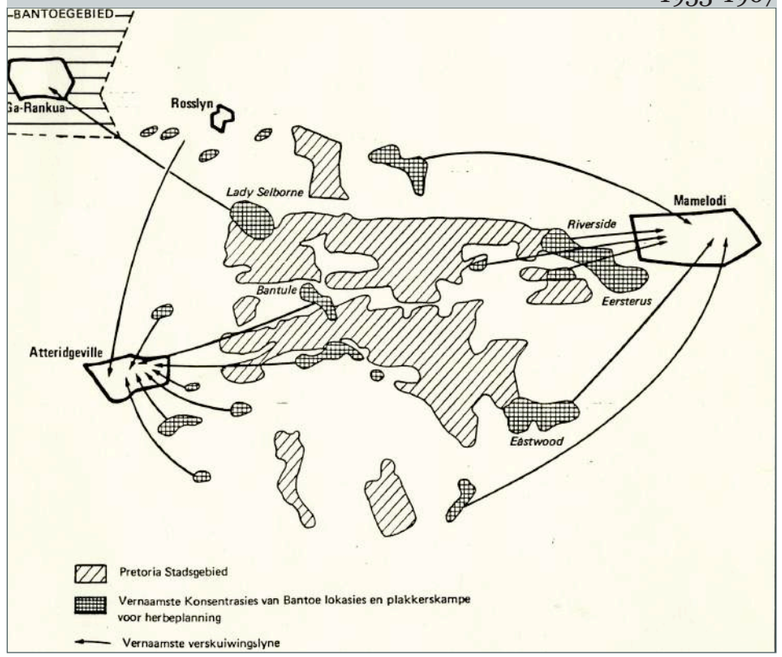
Mamelodi is located in the City of Tshwane, under the 1950s Group Areas Act, Mamelodi was classified as a township (Van der Waal, 2000:1). Townships originated as residential developments segregated according to race and income with the intention of removing black people from white proclaimed areas illustrated in figure 14 (Dewar, 2000:5; Smith, 2003:23; Walker et al. 1991:11). Township planning and design pre-1994 were intended for the perpetuation of segregation on various levels (Smith, 2003:23; Walker et al.,1991:11) with education being one of the tools used to enforce segregation.

After the fall of Apartheid in 1994, the new government inherited economic, physical and social imbalances from the past in the provision of public services and housing (Maloka, n.d). The first form of public infrastructure in Mamelodi was the Vlakfontein Industrial School (set up in 1947/8) and in 1953 the first black school, Mamelodi Model School, opened (Porter, 2018). Since then, social infrastructure is distributed across the Mamelodi landscape, figure 15 illustrates the distribution of educational facilities.

Teriman, Yigitcanlar & Severine (2011:173) argue that social infrastructure is crucial to create healthy communities and sustainable environments. Although the democratic government has made significant progress in meeting service delivery challenges in under-serviced areas since 1994, there are still many issues that persist in the spatial legacy left in South African educational landscapes (Hammett and Staeheli, 2013:323).

As observed in mapping and engagement, public infrastructure in the built environment has not become

1953-1967



1961

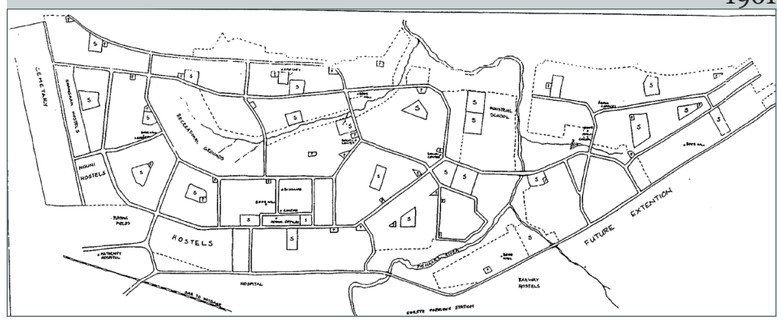


Fig. 14. Top Left; Figure 2.9: Distribution of educational facilities accross the Mamelodi Landscape (Van der Waal Collection 2016)
Fig. 15. Bottom Left; Figure 2.9: Distribution of educational facilities accross the Mamelodi Landscape (Van der Waal Collection 2016)
Fig. 16. Opposite Top Right; Forced Removals in Pretoria 153-1967 (Van der Waal Collection 2016)
Fig. 17. Opposite Bottom Right; Distribution of educational facilities accross the Mamelodi Landscape in 1988 (Van der Waal Collection 2016)

integrated with the Mamelodi context. Infrastructure, such as for learning, worship, exchange, markets, and universities, are highly valued by society and serve as key structural elements or landmarks within communities due to its locality in urban environments and accessibility (CSIR,2005:10).

Dewar (2000:4) raises the issue that South Africa's settlement-making is dominated by the programmatic approach; shelter being the primary priority and being quantitatively driven (for A amount of money= B amount of houses). Secondly, programmes provided are directed towards assisting individual households resulting in an X 'amount' of residential units generating facilities such as firstly primary schools, secondary schools and commercial spaces (Dewar, 2000:4). In this approach, spatial requirements compete to create a balance between planning and design.

This issue has impacted the typological outcome of these public services provided, with problems associated inherent to the previous legacy of apartheid and uncritically continued in the Mamelodi context.

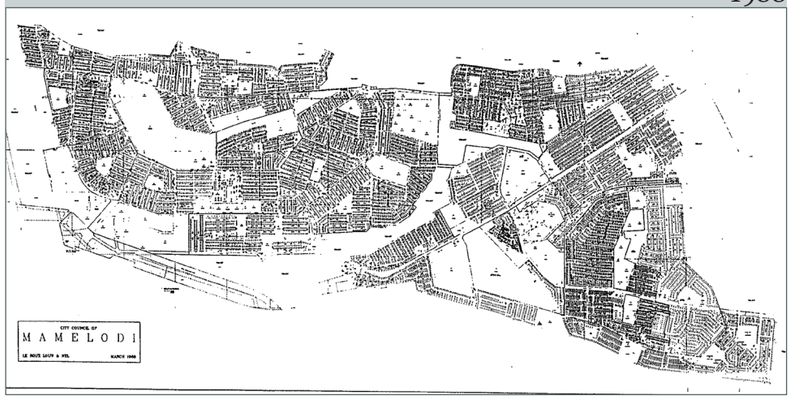
The 'free-standing unit'

The urban condition of public Infrastructure has the inevitable outcome of sterility, spatial and social injustice and the creation of the concept: the 'free-standing unit' (Dewar, 2000:7) a mono-functional typological issue. Many schools located in disadvantaged communities had inherited a legacy of dysfunction (Weeks, 2012:2). Modernist ideas further shaped the urban form in planning and architecture; free-standing buildings were set back from the street edge to float, separate and alone (Dewar, 2000: 4; GCRO, 2018:5).

Throughout the landscape institutional buildings stand isolated in communities, damaged or limited in resources due to the high demand. This typological phenomenon is a pervasive occurrence in the South African education landscape in both primary and secondary schools and is an architectural typological issue that is played out in scale, it is not only in Mamelodi, but Khayelitsha

1965

1988



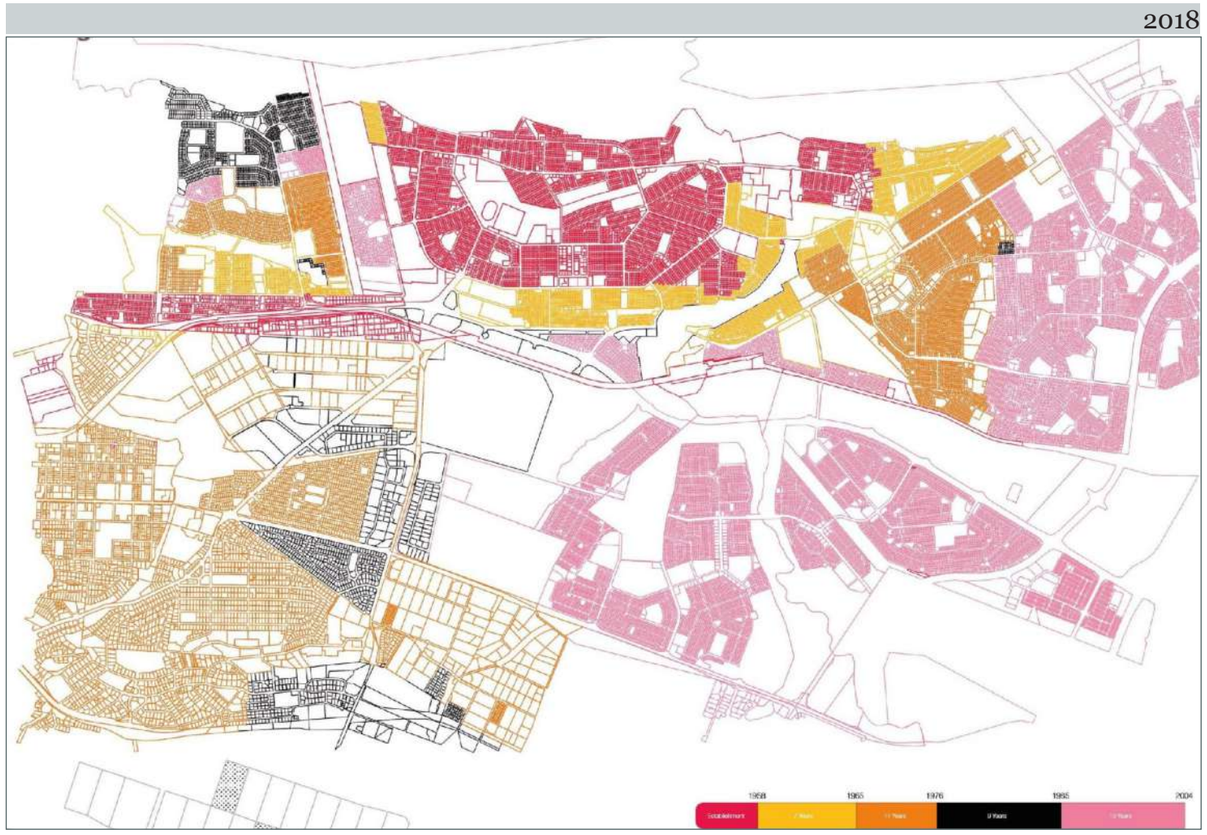


Fig. 18. Top Left; Visual representation of the Mamelodi expansion (Hons History Mapping 2018)

and Soweto as well; all the schools in these areas have the same 'free-standing' typological model.

Methodology:

Scope of research:
The scope of the research includes Tsako Thabo Secondary School's pupils and teachers and community interviews and comparative analysis in the demarcated study area in Mamelodi-east. It is important to note that research collaboration occurred with findings with the University of Pretoria's Architecture fourth year Mamelodi studio 2019 Q1 to interoperate within the authors' study.

Purpose of the research:
The purpose of the research is to provide an impact analysis of the context to identify barriers as perceived by learners through an architectural lens.

Methodological approach:

The type of research conducted in this study is qualitative research. To collect data, textual, visual, mapping, field studies, evaluation research, and case studies. Casell and Symon (2004:11) argue that the goal of a qualitative research interview is, therefore, to see the research topic from the interviewee's perspective and to understand how and why they come to have this particular perspective.

The context of learning:

Learning environments are an integral part of the student learning experience and contribute to the creation of a 'culture of learning' in schools (Jimenez 2018:24). The school environment is the next resource in line to be tapped in terms of providing constructive and supportive environments after home environments (Mampane and Bouwer 2011:114). The physical learning environment serves as a link between design and behavior as where you learn impacts your learning (Jimenez 2018:21,23; Weeks 2012:1). Teaching and learning in these educational contexts have been recognised as important when creating learning environments (Muller 2015:1).

The built pedagogy is influenced by the way in which a designed space shapes the learning that happens and imposes on how space should be used; depending on the design, the designed space invites students to appropriate the space according to their perceived needs (Jimenez 2018:24). Weeks (2012:4) explains that limited research has been conducted to determine what constitutes a culture of learning in schools in South Africa; the current accent in generated literature rather relates to the understanding of the difficulties encountered in schools, such as violence and poverty, rather than the blockages that are caused by the built environment of educational facilities.

The physical environment of learning landscapes contributes to the role of disjunction and spatial legacy occurring in higher education institutions as well as in social problems within the community (Jimenez 2018:21,23; Weeks 2012:1). This disjunction occurring within the built environment impacts on the ability of learners to complete their educational pathways. Therefore, the study aims to investigate how the culture of learning is impacted by the built form and how social problems in Tsako Thabo Secondary School are in line with barriers preventing educational pathways.

The continuum of learning environments

Learning environments and the creation of a culture of learning play an integral part in the student learning experience. An investigation is made into the continuum of architectural thinking in school design from the 20th century to the present. Examples are used to set out a visual summary illustrated in figure 19 to represent the educational shifts that occurred and have impacted on learning environments and culture of learning at the time.

The study is illustrated in three parts. The first illustrates key moments from the 20th century that shaped education and how learning environments are structured. The second conveys an educational shift made by architects such as Hertzberger, van Eyck and Scharoun that went against the systematic model of educational spaces, and gives attention to the reimagined educational environments which focus on the social role and relationship architecture has with its participants (Dudek 2000:38). The third investigates international and South African examples of how learning environments are constructed within their context.

Further investigation is initiated into education facilities in South Africa by way of a matrix. Two comparison research groups were used: schools that complied with the South African Schools Act: Minimum uniform norms and standards for public school infrastructure from 2009 and 2013 (Department of Education 2013). The intention was to discover the impact that six schools from different provinces in South Africa have on the design of schools and to consider the shift that occurred from 2009 to 2013.

Wood (2018) argues that by revisiting the creation of space, a broader vision of education is created. Dyer (2018b) discusses that limited attention is given to where students learn in schools. These spatial limitations affect learning spaces, the physical space as well as the learning outcome. The following findings were uncovered from this illustrative study which challenges the educational space and so fosters a new culture of learning.

Findings:

Trends impacting learning environments internationally:

Schools abroad are affected by conditions that have a substantial impact on learning spaces in the built environment which in turn affect and create unsuitable learning spaces. The first set of factors impacting learning relates to the physical learning space and includes limited learning spaces within schools, unsuitable learning spaces beyond the classroom, and spatial design implications affecting learning (e.g. noise, interruptions, and privacy) (Dyer 2018a).

The second range of factors involving space relates to the interior of learning space and how space affects learning, such as the arrangement of classrooms, the curriculum requirements within a space, the required policy in a learning space and pedagogical decisions (Dyer 2018a; Dyer 2018b).

Educational shift:
As observed in this study more recent learning environments are created to respond to contextual influences such as climate, culture, and material available in their specific setting (educational facilities designed by Kere (2015), Neoro (2004) and Wolff (2017)).

The built environment of a school creates gathering spaces across the school that promotes socio-spatial relationships to occur with the built environment. Interaction is promoted by the creation of seating, gathering pockets within the walkways of learning spaces, water-points, landscaping and materials used.

An example that stood out in this study was the local precedents illustrated, where both architectural firms, Kere Architects (2015) and Haworth Tompkins (2012), worked within an existing school and suggested alterations to address issues in the school to improve learning environments and learning experiences illustrated in figure 19 part 3.

Trends impacting learning environments in South Africa:

Judging from the matrix, a shift occurred from 2009 to 2013 with the implementation of the South African Schools Act: Minimum uniform norms and standards for public school infrastructure (Department of Education 2013). It is evident that the South African Higher Education Department's goal is to improve the context of learning environments of education facilities, with a set of universal principles, set out for the design of school buildings (GCIS 2017/18).

Many problems occurring in public government schools are socially generated, with difficulties encountered varying from violence to poverty and lack of resources as discussed, figures 07 and 08 (Ebersohn 2016:2).

Thus, the ability for existing schools in townships to reach these goals set out by the Norms and Standards of 2013 to address issues in school may only be in a few years due to schools relying on government funding and resources. This leaves many schools with the same issues and unable to achieve the norms and standards without an alternative strategy (third stream income or private funding, refer to figure 05).

Part 1

Illustrates key moments from the 20th century that shaped education and how learning environments are structured

The Formal Classroom
1908

The focus of schools were on the built form and not external spaces. Each room was allocated a specific function (Dudek,2000: 6).

Figure:
Geography Lesson at Alma School.

Industrial Era Teaching

Learning environments were designed for mass education and needs due to the large pupil numbers of expanding in cities. Classrooms where to be, factory floor like as functional space. The first schools provided large schoolrooms in which hundreds of children could assemble for instruction (Dudek, 2000:15).

Figure:
Example is Robotson's ideal of Early classroom layout with dividing curtain.

Open Air Classroom
1911

Open air schools are the result of a paradigm shift against the industrial era (Crocker, 2017:39). Open air schools responded to the poor conditions that occurred in learning spaces during the industrial era. The educational focus was to the spiritual well-being and hygiene of underprivileged children in new industrialized cities, placing learning environments in their naturalistic setting (Dudek, 2000:8)

Figure:
An example of such a school is the Whiteley Woods open air schools

1932

Figure:
Open-air school in Suresnes France built by Eugène Beaudouin & Marcel Lods with Jean Prouve

The Modern Classroom
1940's-1950's

Contemporary school design where rooms and spaces are intended to meet precise functional needs (Dudek,2000:10). The form is prefabricated, difficult to refurbish and does not consider environmental standards.

Figure:
Photograph bu Dudek

Proposed Site: Tsako Thabo Secondary School 1978

Figure:
Tsako Thabo High School

Organization

Spatial Section

'The Idea of Learning Space'

Adapted from the architectural firm 'ProjectWorks', in designing Sol Plaaitjie university in South Africa (2018).

Part 2

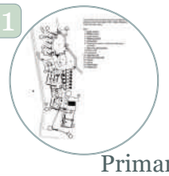
This part conveys the educational shift that gives attention to educational environments which focus on the social role and relationship architecture has with its participants.

1950's

Historical development of Schools in the 20th Century was impacted by the Structuralist architects such as Hans Scharoun, Aldo van Eyck and Herman Hertzberger, in Holland and Germany respectively. Their response critiqued schools conditions in the Modern Movement and the lack of consideration that reflected in school buildings. Conflicting need to design humane environments for learning (Dudek,2000: 38).

Structuralist Examples

01



Primary School Darmstadt

Hans Scharoun
Darmstadt, Germany
1951

'Humane' Approach + Social Role

Scharoun (post war), provided a humane approach in designing a school. It was not only about the functional requirements but the social role, where pupils are seen as the primary importance within the built form.

02

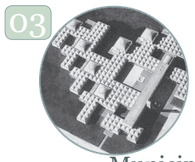
Montessori School

Herman Hertzenberger
Delft, Netherlands
1960

Social Approach

Herman Hertzberger illustrated new ways in enhancing the social relationship between users and the built form through a social approach, where learners use the wider environment freely, through organization and suggestive detailing within the built form.
Hertzberger view: "a thing made exclusively for one purpose, suppresses the individual because it tells him exactly how it is to be used"

03



Municipal Orphanage

Aldo van Eyck
Amsterdam, Netherlands
1960

The "In Between"

Aldo van Eyck, with his harmonious spatial ideas in motion adds to the theory of schools by focussing on the spaces "in between".

Connects to part 3

Fig. 19. Above; Continuum of architectural thinking of educational spaces (Author,2019)

2000's

Educational facility design has been moving into a shared learning approch. Building on principles of Hertzberger, van Eyck and Schraudon

Two key ideas were identified in studies about the designing of schools in international examples. The first, is by inserting new architecture into existing schools to address limitations in the educational condition.

The second is by creating an educational campus that includes the community, contex and climate. Each part is designed to respod directly to the age groups needs.

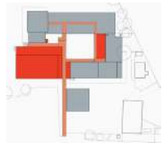
Connects to part 2

International Examples

01 Birmingham School

Haworth Tompkins
England
2012

The buildings were in poor condition and suffered from overcrowded corridors. A new circulation spine has been inserted into the existing courtyard to merge new additions to the existing school. Interior walkways have been re-configured to aid modern teaching techniques with new services coordinated throughout.



The 'in between' (movement corridors) is considered as critical, as it impacts the rest of the spatial quality structure

The building shape Social Spaces for students to interact/ observe

02 Education Campus for Mama Sarah Obama Foundation

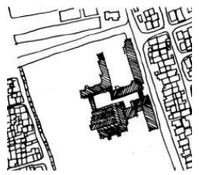
Francis Kéré
KENYA
2015

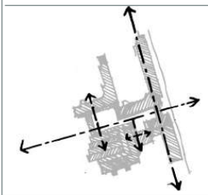
The project is intended to promote a sustainable approach to strengthening the community and education. Each school is designed for its specific age group and act as a educational campus. The project is to be developed in phases and to rehabilitating existing schools on the property.

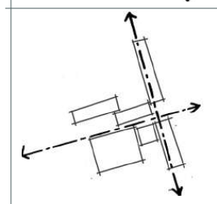
Local Examples

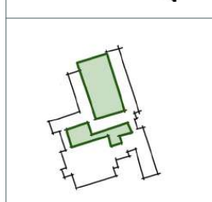
01 Usasazo High School

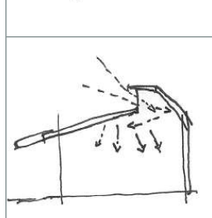
Jo Neoro Architects
Khayelitsha, Western Cape
2004





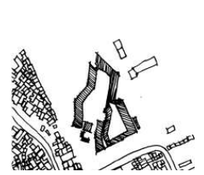


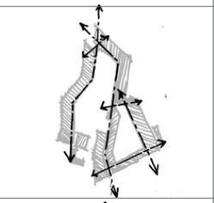


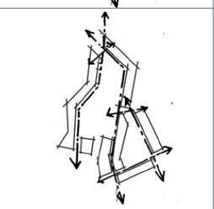


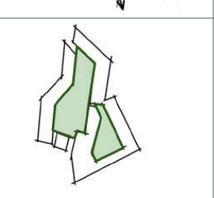
02 Inkwenkwezi Secondary School

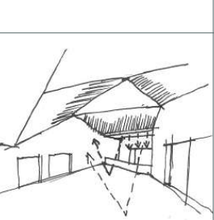
Neoro Wolff Architects
Khayelitsha, Western Cape
2007





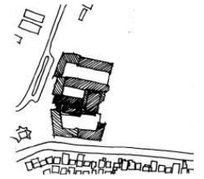


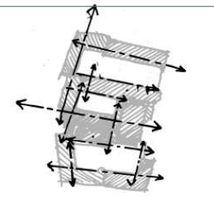


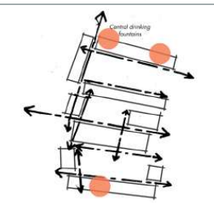


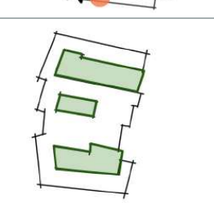
03 Louwville High School

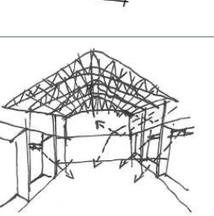
2AD Space Architects Inc
Vredenburg, Western Cape
2017





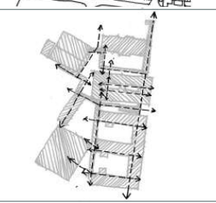


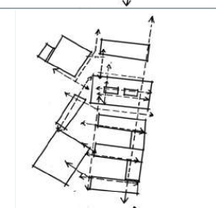


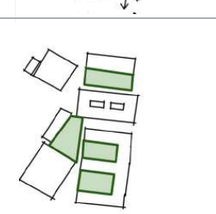


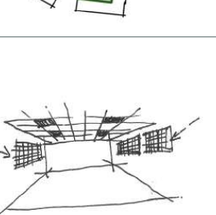
04 Olivenhoutbosch Secondary School

Unknown
Centurion, Gauteng
2017/2018



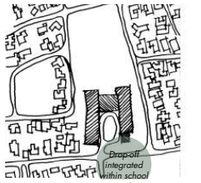


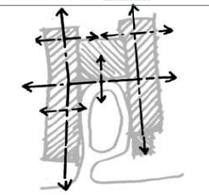


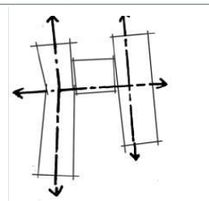


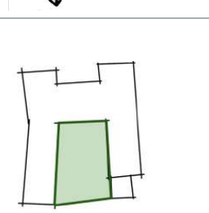
05 Cheré Botha LSEN School

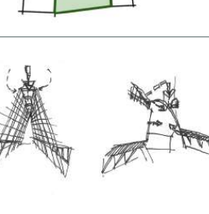
Wolff Architects
Oakglen, Western Cape
2017





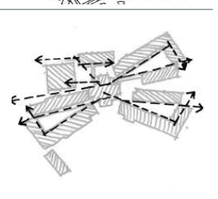


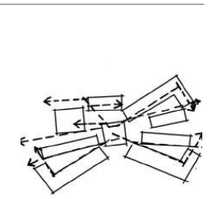


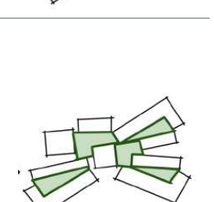


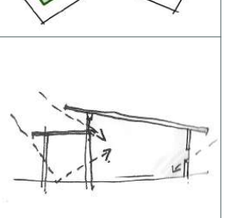
06 Meetse A Bophelo Primary School

Humphris Jooste Architects
Alaska, Gauteng
2011









Principles of Universal Design of South African Public Schools

Department of education (2013)

Educational Norms a

s and Standards 2009

Educational Norms and Standards 2013

Fig. 20. Top Left; One of the classrooms at Tsako Thabo Secondary School (Up Arch Hons Mamelodi Group 2019)
Fig. 21. Opposite Top Right; Typology Study, Adapted from Achi & Venter. Hons Mamelodi Group 2019 (Author 2019)

The Context of learning in Tsako Thabo Secondary Schoo;

Typological Study

The built environment contributes to socially generated issues impacting the learning environment. This study is a descriptive Case Study reporting on how issues manifest themselves within Tsako Thabo Secondary School and how they play out spatially. The purpose of the analysis is to provide an impact analysis of the context of a culture of learning and to identify barriers as perceived by learners through an architectural lens.

The scope of the research includes Tsako Thabo Secondary School's pupils and teachers, community interviews and comparative analysis in the demarcated study area in Mamelodi East. It is important to note that research collaboration occurred with the findings of this case study with the University of Pretoria's Department of Architecture Honours Mamelodi Studio 2019. Research will be analysed and interpreted within this dissertation.

The Classroom

Tsako Thabo Secondary School is inserted in figure 3.1 to determine where it is placed in the continuum of educational spaces and what impacted the current culture of learning at the school. As the literature suggests, Tsako Thabo Secondary School's typology and other schools in the study area are influenced by the idea of the 'modern classroom' as suggested by Dudek (2000:10). Thereafter the intention is to unpack how this typology is played out in scale in the study area of Mamelodi East and how it then contributes to socially generated issues in the school.

The 'modern classroom' was first introduced by Joseph Lancaster, a Systems Architect, who discussed the idea in 1811 in his book: Hints and Direction for Building, Fitting Up and Arranging Rooms. This publication was a turning point influencing the building of schools today and was the inspiration for the idea of a 'modern school building' for that time (Wood 2018b). The book illustrates the system overall, not only in constructing this type but offers a 'set of rules' in arrangement and necessary organisation of this system. Ultimately, it suggests a systematic thinking which can be applied to the way schools are designed. The aim of the system was mass education and incorporation of a holistic system towards control, in other words, the incorporation of architecture, pedagogy, control, decisions of age and gender, theories of learning and hygiene (Wood 2018b).

In 1815, de Lasteyrie (in Wood 2018b) explained that this school system needs different parts to exist. There are three 'components' to this system: firstly there is the design of the instruction room itself, secondly organising these spaces into an 'articulation' of different spaces, and thirdly the idea of a monitorial system applied across the country and imposed on the development of schools (Dudek 2000:10; Wood 2018b). At that time, in this new idea of school design, the role of the architect was sidelined, to minimise design adaptations through standardised specifications and drawings applied to a wide variety of schools (Dyer 2018).

Schools in the Study Area

This same system has played out in the Mamelodi context. Figure 21 illustrates the comparison of Tsako Thabo Secondary School to other secondary schools in the study area. Here, it is evident that the schools in this area are similar in planning, design, and issues affecting school design. Figure 3.3 illustrates how it is played out in scale. These issues are further investigated, illustrated and unpacked in Tsako Thabo Secondary School.

Tsako Thabo Secondary School

Tsako Thabo Secondary School are arranged slightly to the angle of North-east to South-west, aligned with the contours. There is a strict spatial

Seconday and Tertiary Schools:

1. Lompec Education Centre

Secondary Schools:

2. Modiri Technical School

3. Mamelodi Technical High School

4. Vlakfontein Secondary School

5. Tsako Thabo Secondary School

6. Mi Msezane Middle School

Higher Education:

7. Mamelodi Community Learning Centre

8. Reneilwe Community Learning Centre

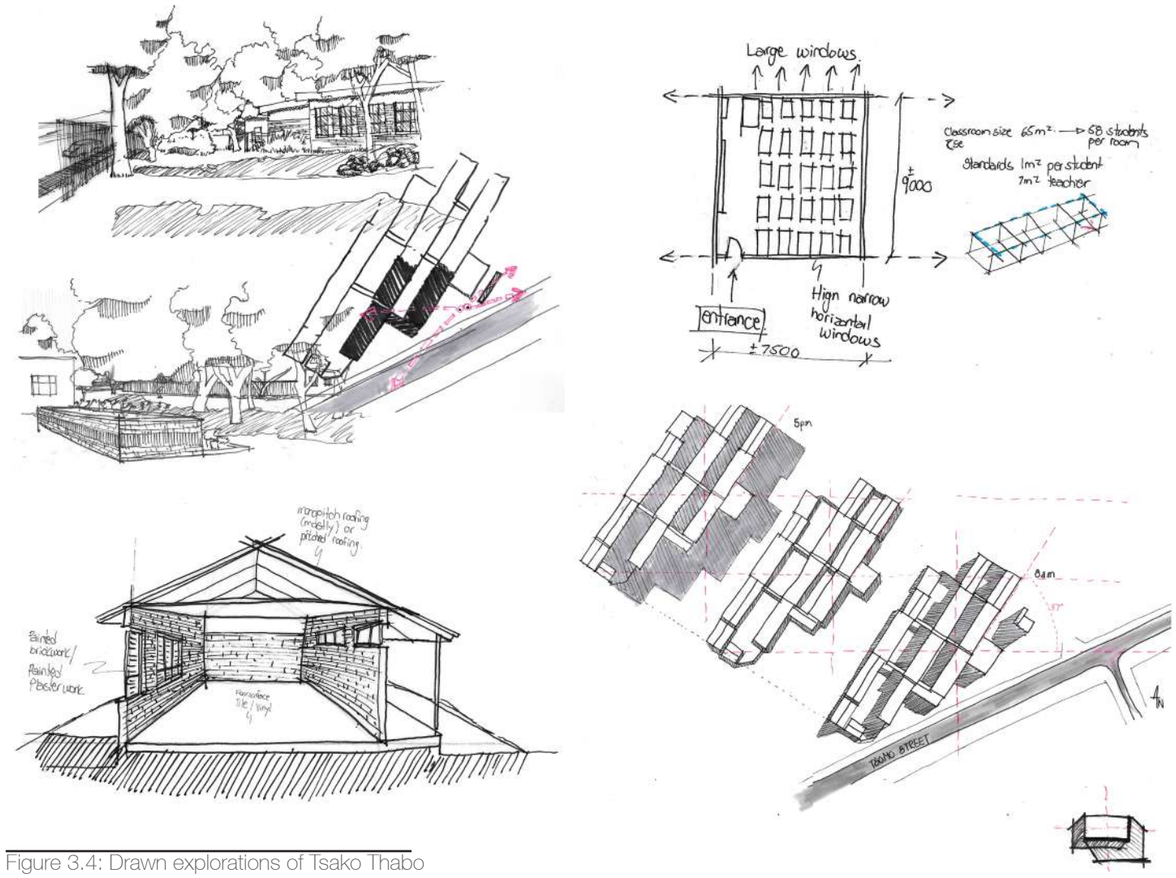


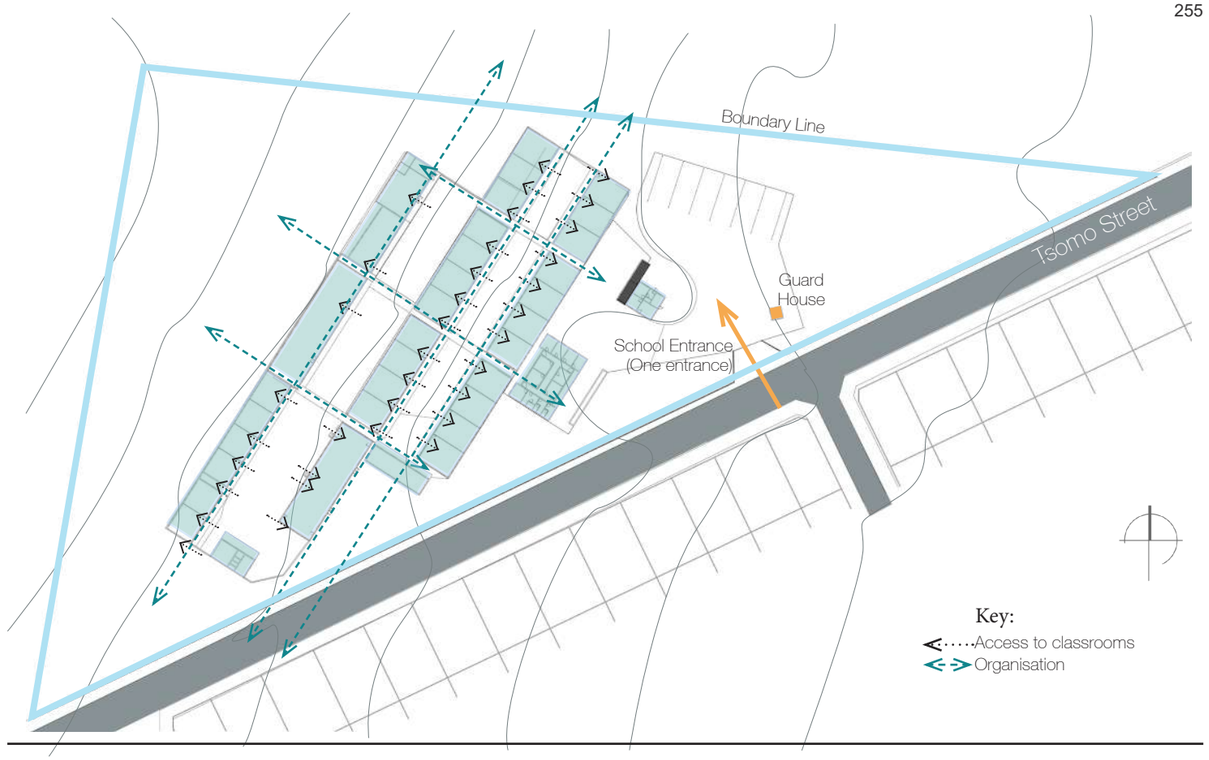
Figure 3.4: Drawn explorations of Tsako Thabo Secondary School (Author 2019)

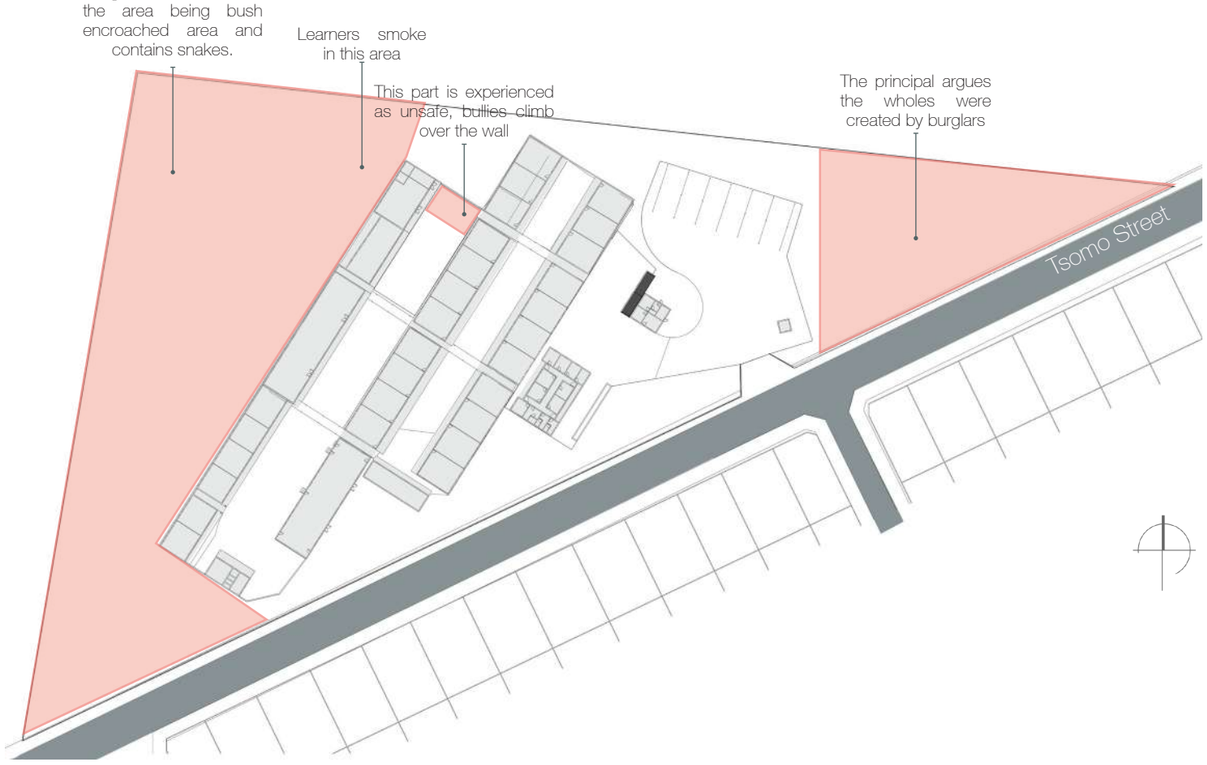
organisation with an articulated access route, with classrooms opening onto corridors. Internal courtyards are formed between the linear buildings (refer to figure 23).

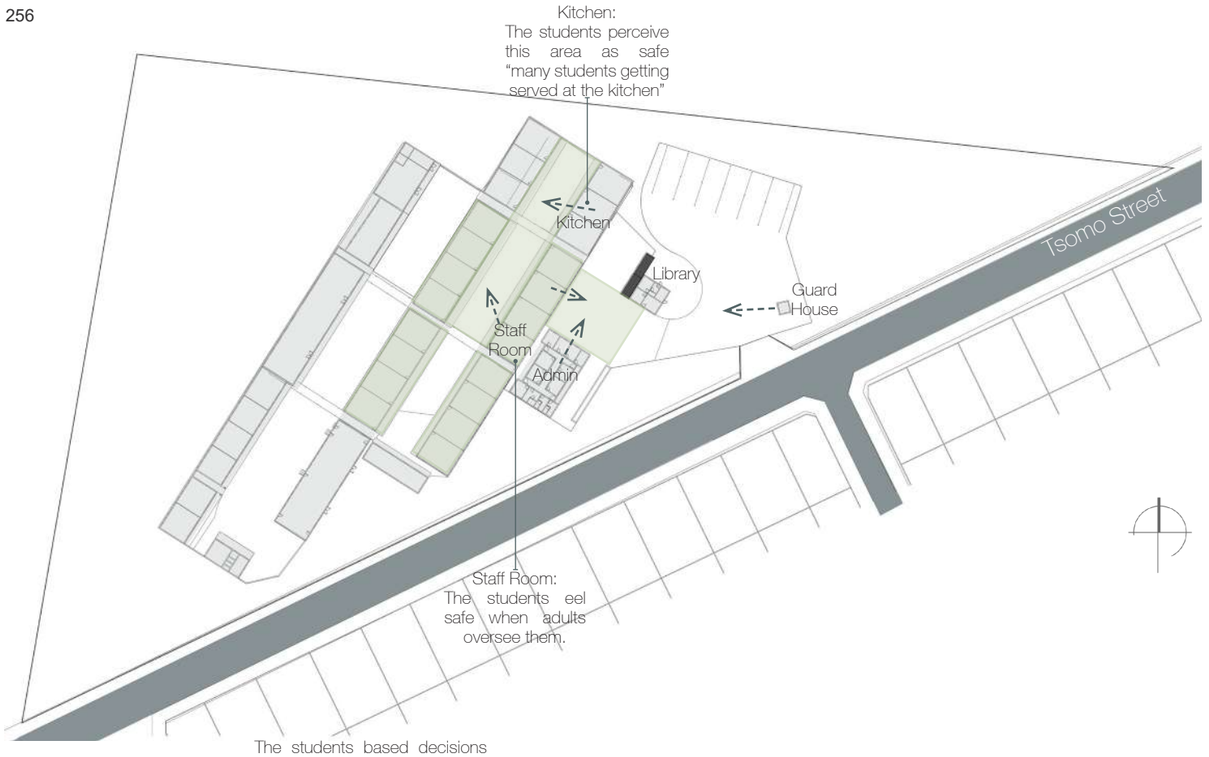
The classrooms are arranged with the instructor in front of the pupils arranged in rows. Hertzberger (2008:24) argues that this model of teaching in the rectangular classroom accommodates instruction with unidirectional transfer of knowledge that forms the basis of teaching. Each classroom has high steel frame clerestory windows on the side of the walkway and towards the entrance of the classroom. The other side has large steel frame windows. This model of classroom design is repeated throughout the whole school. The arrangement and orientation of the classrooms in relation to the walkways are inconsistent and leave classrooms cold and under-lit. Some classroom entrances are at the South-east end and some in the North-west (refer to figure 23).

Figure 25 illustrates the perceived safe zones identified by the students (Achi & Venter 2019:31); figure 24 identifies the perceived unsafe zones; and, figure 3.8 demonstrates the recreational areas in the school. These figures are analysed, together with figure 26, and spatial conclusions are drawn which are illustrated in figure 27.

Fig. 22. Top Left; Drawn explorations of Tsako Thabo Secondary School (Author 2019)
Fig. 23. Opposite Top Right; Arrangement of Tsako Thabo Secondary School (Author 2019)
Fig. 24. Opposite Bottom Right; Identified unsafe zones in Tsako Thabo secondary School (Adapted from Achi & Venter 2019:28)







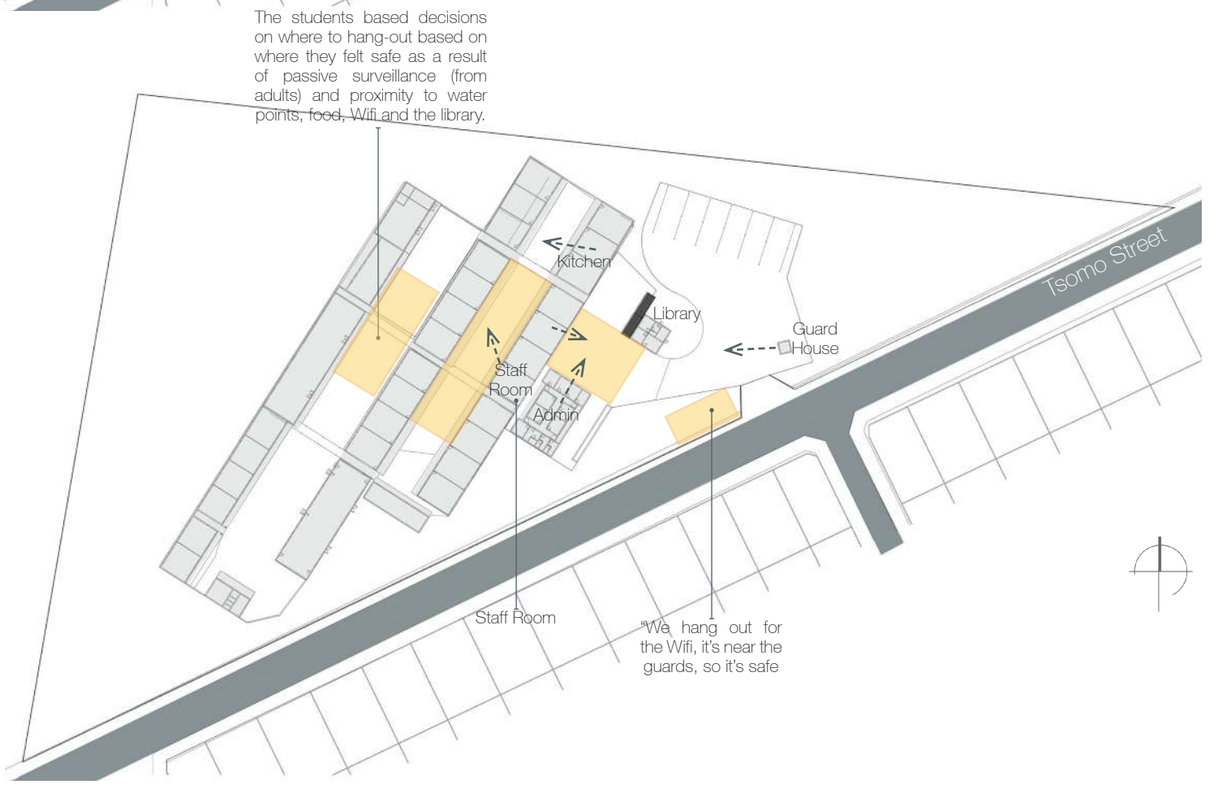


Fig. 25. Top Left; Identified safe zones in Tsako Thabo secondary School (Adapted from Achi & Venter 2019:28)
Fig. 26. Bottom Left; Identified recreational zones in Tsako Thabo secondary School (Adapted from Achi & Venter 2019:28)
Fig. 27. Opposite Bottom Right; Spatial Conclusions (Achi & Venter 2019:34)

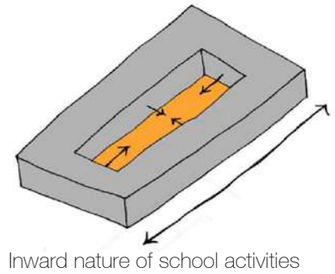
Spatial Conclusion:
These findings look at the school complex as a whole. Spatial organisation of buildings is arranged linearly, creating a uniform language of the built environment applied to each site. Buildings allow for the creation of internal spaces between buildings (courtyards). The built form has no other spatial contribution to its contexts such as the street or community. The school tends to become isolated and stands alone on its site.

It is observed that schools tend to have an inward nature; learners prefer courtyards between buildings due to passive surveillance from pupils and teachers. Leftover space around schools is perceived as unsafe (Achi & Venter, 2019:34).

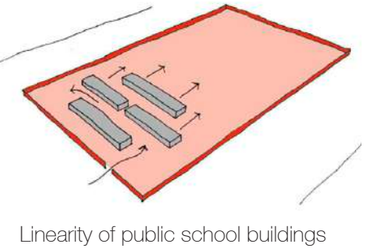
Left-over space surrounding school property is unused and in most cases perceived as unsafe; these spaces are accessed by bullies, external pupils from other schools and children not attending school who enter the school causing social issues. Fences of schools are damaged and tend to become unsafe barriers (Achi & Venter, 2019:34).

There are no public spaces connecting schools to the public realm or community such as public transport, waiting areas, allowance for informal trading and for commuters. Due to the negative connotation of leftover space, the relationship with the street becomes difficult. The school's urban edge is eroded and it becomes difficult for learners or members of the public to engage (Achi & Venter, 2019:34).

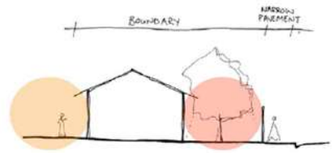
Spatial Issues:
The issues illustrated in figures 3.3 to 3.8 are further investigated and the spatial issues become apparent in the built environment of Tsako Thabo Secondary. Through the observations in this study, it is seen that the built environment contributes to socially generated issues suggested by the CDE (2017:2), Ebersohn (2016:2), Hammett & Staeheli, (2013:323) and Weeks (2012:3).

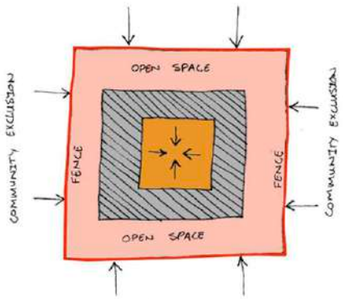


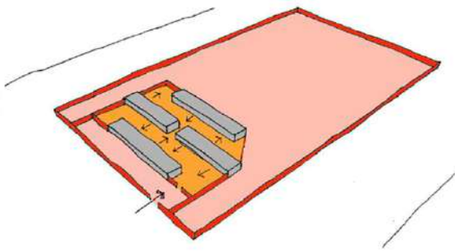
Inward nature of school activities



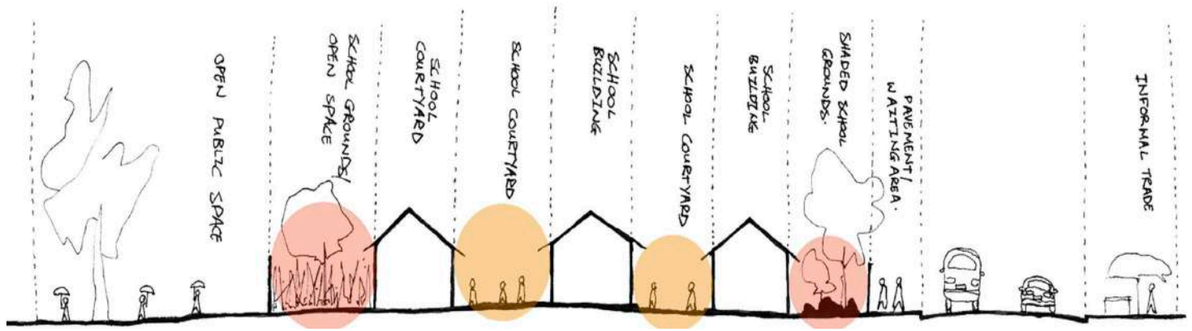
Linearity of public school buildings







Inward nature of the recreational areas and unused open spaces within the school boundary



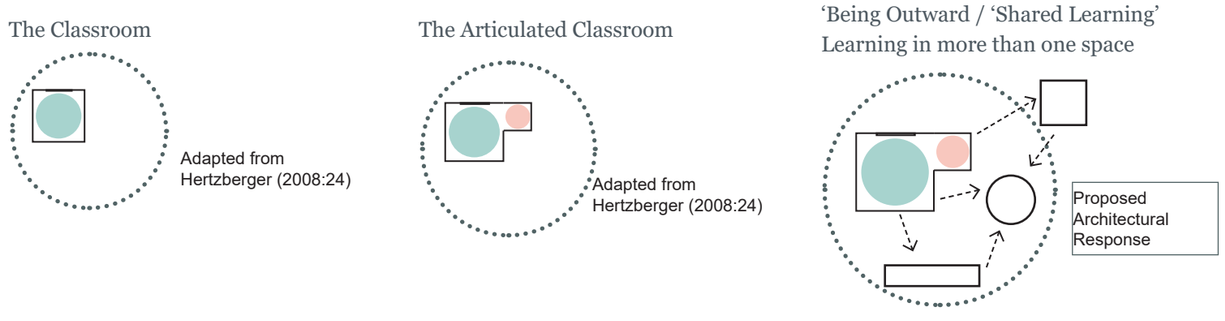
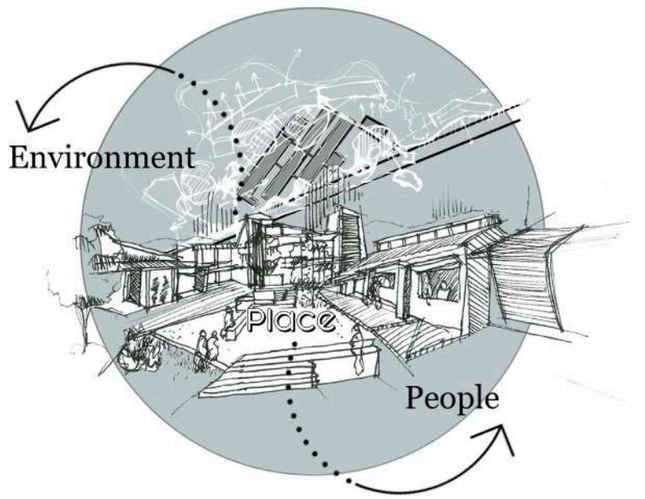


Fig. 28. Opposite Top Left; Spatial Issues adapted from Ras (2019.2 Q2 Mapping) (Author 2019)
Fig. 29. Bottom Left; Shift in Learning environments, adapted from Hertzberger (2008:24) to authors interpretation (Author 2019)
Fig. 30. Top Right; Architectural Issue (Author 2019)



Architectural issue

The foremost architectural problem is to address the limitations and shortcomings apparent in educational facilities. The education facilities that are supposed to be servicing this society are struggling with high levels of unemployment and are actually sitting in the landscape as islands of institutional disjunction instead of serving and supporting.

The Classroom Re-imagined

As identified in this chapter, design impacts the learning experience occurring in that space. Design, therefore, aims to investigate how space and place-making within Tsako Thabo Secondary School can assist in activating the knowledge economy through improved learning spaces.

In the investigation of figure 29, the continuum of architectural thinking of educational spaces, Hertzberger (2008:24) suggests a new spatial approach to the idea of the classroom to shift to an articulated classroom. This model creates the opportunity for various models of learning, such as co-learning or shared learning, to manifest alongside the traditional model of learning. This model suggested by Hertzberger (2008:24) is then developed to respond to the Mamelodi context to suggest learning in more than one space, incorporate entrepreneurial learning into a school and address the current spatial condition that is not supportive of the entrepreneurial environment.

Thus, the following issues and opportunities are identified in this study to generate an appropriate architectural response:

-Limited learning space unsuitable to the needs of the learner.
-Arrangement of the classroom.
-The co-exist/ shared resources.
-The need to overcome spatial restrictions in the learning space.
-The opportunity to design principles set out by the South African Schools Act: Minimum uniform norms and standards for public school infrastructure (Department of Education, 2013).
-contextual solutions suggested by schools designed by Kere (2015), Neoro (2004) and Wolff (2017).
-Incorporation of the socio-spatial relationships which occur in the built environment.
-Working within an existing school to address issues to improve learning environments and learning experiences.

Conclusion:

This dissertation, establishes itself within the educational and economic context, in the creation of educational pathways for the youth of Mamelodi. Unemployment is an evident consequence of the high dropout levels of pupils in the South African Education System, the inability to find employment and lack of work opportunities. Employment generation has been identified as one of the highest priorities within South African Societies. The reality is that the majority of people who are potentially economically active generate their own employment, entrepreneurial activity, usually in the form of 'informal sector' activity.

Entrepreneurial learning is excluded from most higher education models. Therefore the opportunity to create an architectural response for architecture in this dissertation to facilitate entrepreneurial education to produce relevant skills for careers and the economy of Tsako Thabo Secondary school arise.

In the creation of such a model within a secondary school, Tsako Thabo Secondary School, the current urban condition of schools need to be considered. Thus, a descriptive case study reflects the issues Tsako Thabo Secondary School face and similar schools in the community, reporting on issues apparent and educational shifts that need to be considered in order for a school to become entrepreneurial. Many schools in Mamelodi face social and physical barriers creating blockages and affecting educational pathways of learners .

Spatial conditions inherent to school typologies play a role in students' inability to complete their educational pathways. This study aimed at addressing these spatial restrictions by identifying design opportunity and reimagining educational facilities into a stimulating, supportive and inviting environment. Architectural solutions intended to address the shortcomings apparent in the current learning environments of Tsako Thabo Secondary School by incorporating an entrepreneurial language.

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