

A breath of fresh air

Dismantling toxicity in a post-industrial landscape in Durban, South Africa

Ural Chetty

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Durban, South Africa

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This document is submitted in fulfilment for the degree: Master of Architecture (Professional) at the University of the Witwatersrand, Johannesburg, South Africa,
2022

Declaration

I Ural Chetty (1325100) am a registered M(Arch) Prof. student in the year 2021 at the University of the Witwatersrand. I hereby declare the following: I am aware that plagiarism (i.e. the use of someone else's work without permission and or without acknowledgement of the original sources) is wrong. I confirm that the work submitted for assessment for the above course is my own unaided work except where I have explicitly stated otherwise. I have followed the required conventions in referencing thoughts, ideas and visual materials of others. I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my unaided work or that I have failed to acknowledge the source of the ideas or words in my own work.



Ural Chetty
23 February 2022

Acknowledgement

I would like to express my deepest appreciation to my supervisor Prof. Hilton Judin who has consistently been the voice of reason and motivation during the entirety of the year.

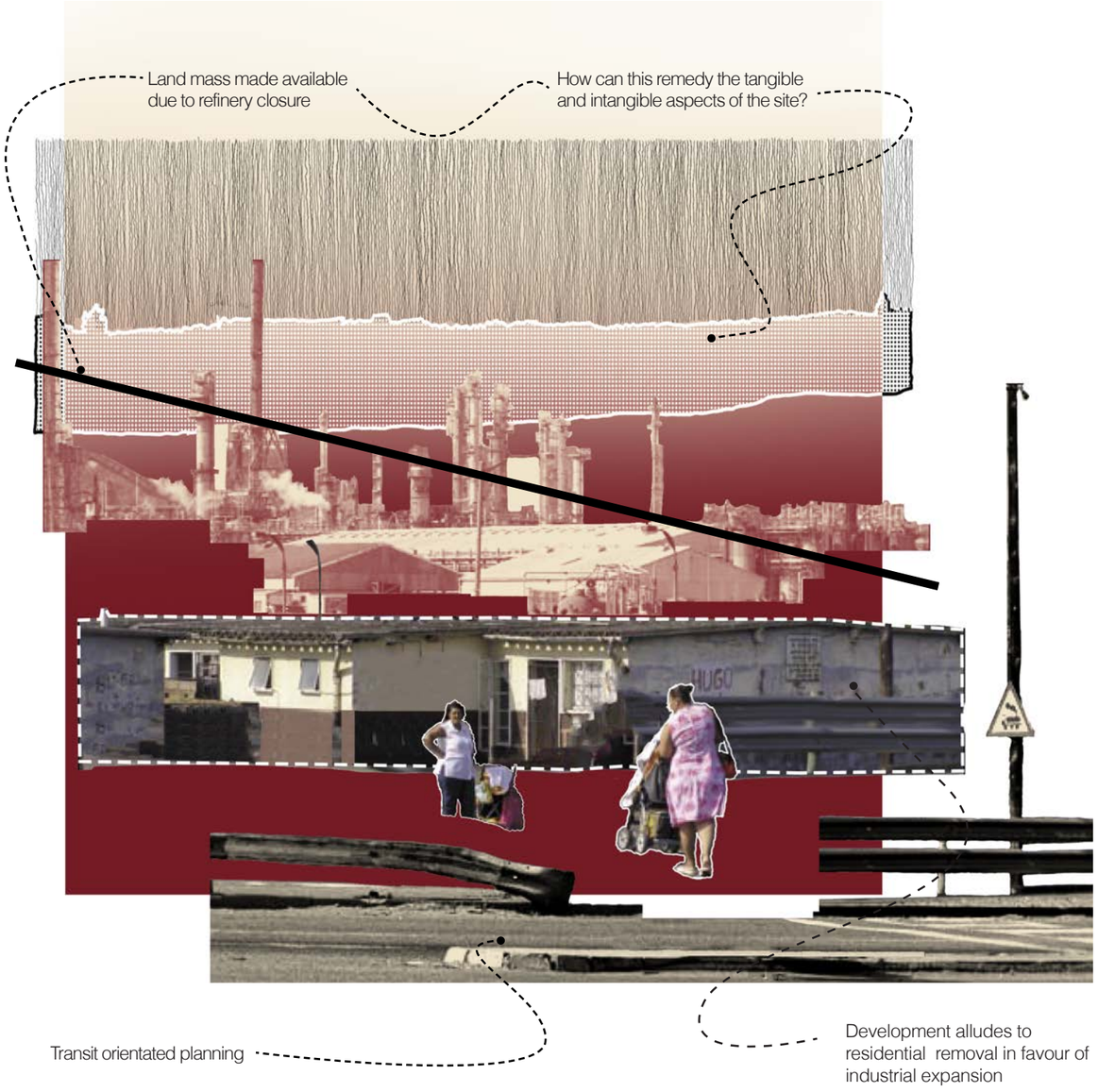
A very special thanks goes to the lecturers at the School of Architecture and Planning, the late Gerald Chungu, Sechaba Maape, Kirsten Doermann, Solam Mkhabela and Hannah Le Roux whose knowledge and mentoring throughout my academic career has helped shape my interpretation of the built environment. A personal thanks to Ashvira Sanjith, Lencho Brynard, Atish Harrylal, Angelique Probert, Hemal Ambaram and Charvana Diar for their constant support throughout this year and to my grandparents for their insights without whom, this project would not be possible.

Finally, to my parents to whom I owe everything. I thank you for the years of sacrifice you had to endure to ensure that I could realize my dreams of becoming an architect. Thank you for always making me see the potential of hard work and perseverance through those endless study sessions at the dining room table. This accomplishment would not have been possible without you.

Abstract

Modernization and turbulent power dynamics formed part of the ethos of the 20th century and as a result, saw the eventual boom of various forms of infrastructure and the rise of toxic landscapes. However, early in the 21st century, these infrastructural marvels have become obsolete and extremely dependent on the extraction of natural resources all to the detriment of any living inhabitants that surround these sites. Dealing with a central theme of toxicity, this research report aims to build an understanding of how toxic political structures have brought about the rise of hazardous industrial landscapes to fuel apartheid modernisation in the South Durban basin. While the remanence of residential apartheid is still very present in the urban landscape today, a historical analysis of apartheid urbanism was done to document the origins of this spatial practice in order to clinically subvert the effects of apartheid modernism. At the intersection of toxic, politically driven, urbanism and industrialization is where the study area for this project is sited.
As is the case with many neighbourhoods established during the group areas act, the people placed in these areas are often left powerless to the powers that dictate their settlements. Therefore, as an act of urban and social rehabilitation, power needs to be given back to people who have been previously marginalized. This then alludes to a diverse reshaping of the communities that their ancestors were forcefully placed in. Accordingly the architectural response seeks to programmatically facilitate the spaces for participatory, design-led change while addressing physical and abstract forms of toxic contamination.

Right: Fig 1.2: Conceptual collage outlining research (Author, 2021) adapted from (groundworks report, 2021)



Personal Philosophy

When tasked with putting together a research report for the culmination of my academic career I began thinking about where the eventual design intervention would be sited and how effective the response would be to the context in which it is placed. I was drawn to my hometown of Merebank because of the vast array of issues that could be resolved through specific architectural interventions. Having been raised in the area I was aware of the current urban conditions that have been dictated by the presence of the oil refinery industry.
After much deliberation at the beginning of the year, I set out a list of guiding principles that would inform the research, writing and design of the final architectural intervention that would take place within an oil refinery site reportedly due for closure.

These include the following:

- It needs to be geared toward cleaning various forms of toxicity to enhance the ecological conditions of the contaminated site and surrounding context.

- It needs to provide spaces for diverse rehabilitation of the urban landscape which had been setup through toxic political structures.

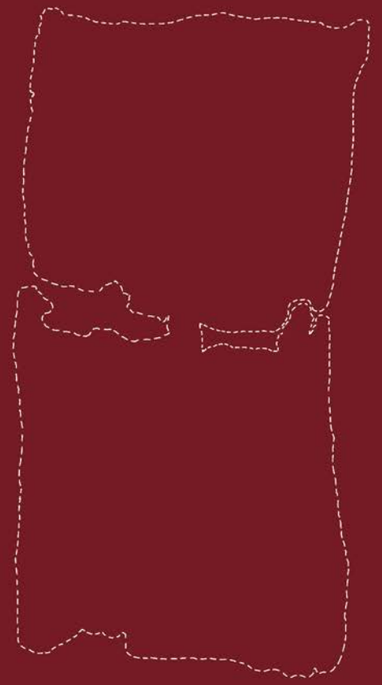
- It must have a sculptural quality that is sensitive to the site but placed as a reminder of the toxic environment.



Fig 1.3: Image of my grandparents house (Author, 2021)
adapted from :(Google, 2021)



Fig 1.4: Image of my father and I circa 1999 (Author,2021)



layering toxicity to understand its formation

Contents

Part 1_ Remember

1 Introduction 01

2 Histories 06

3 Contaminated modernist urbanism 17

Part 2_ Interpret

4 Identity place and territory 25

5 Reprogramming toxic heterotopias 39

6 The politics of Post industrialism 44

7 Toxic rehabilitation 50

Part 3_ Make

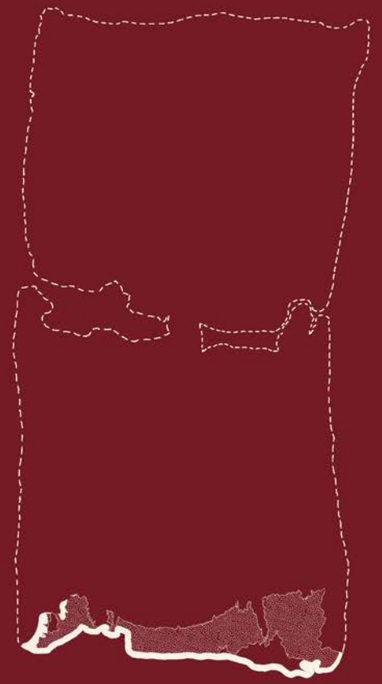
8 Locality 53

9 Design Development 75

10 Concept design 90

11 Final Intervention 120

12 Bibliography and Appendices 121



1. Introduction

- Background
- Problem statement
- Research Methodology

Background

South Africa's turbulent past has had a lasting effect on the current urban fabric. Its colonial history along with the modernist driven apartheid regime has created immense social, political, and environmental challenges all of which require careful attention and response.

The South Durban basin is a direct testament to the effects of colonial rule and post-colonial oppression. The area which consists of a highly industrialized makeup is one of the most important contributors to the formation of the country because during the 1950's in a period of mass modernization, the South Durban basin housed the creation of one of the first large scale industrial complexes that served the oil and fuel needs of the rapidly expanding infrastructural development at the time. However, its existence on the contemporary paradigm has fueled the formation of toxicity in various forms. The likes of which have had serious consequences on the area.
Toxicity in literal terms is the degree to which one substance has a particularly damaging effect on another.[1] In a metaphorical sense it is used to describe the formation of the industrialized landscape and its effects on the community that it surrounds. For the purposes of this exploration, a thorough review on the historic development of the landscape will be conducted to understand the genius loci of the site. Using relevant literature and findings, the exploration aims to build a theoretical stance on the matter at hand that will further inform the architectural intervention to come.



Fig 1.3: Locality map of The South Durban Basin (Author, 2018)

Problem Statement

When looking at the role of architecture generally, one can argue that it is a product of its time and the context in which it is built and therefore extends itself into the shaping of identities, cultures and spatial qualities of the people who occupy it. In the past 20 years architecture has been orientated around a drastic inclination towards environmental rehabilitation to clinically address the effects of climate change.

The problem lies in the fact that while architects may advocate for environmental sustainability, outdated, large-scale industrial facilities often overshadow these attempts at remediation. An example of this is the emergence of the oil industry in South Africa. A product of Apartheid urbanism in the 1950's, the oil industry in Durban, South Africa has been established alongside racially segregated urban landscapes. For nearly 70 years this has been the norm for many non-white areas that have been built near these industrial facilities. Over the years, people living in these areas shaped their surroundings in response to the conditions that were imposed onto them. Having spent my childhood in Merebank, an area previously established for Indian occupancy, I experienced the architecture of response and adaptability first-hand in a post-democratic setting. However, it was not until I started studying architecture that I began to question the morality and sustainability of the urban conditions that led to the current industrial-residential typology that has been formed. Recently, the emergence of renewable energies as well as updated regulations regarding emission standards has forced oil refinery industries into closure or adaptability into other business forms thus leaving large areas of toxic land open. This poses the question of what response would be appropriate in such instances where toxic landscapes now exist in a post-industrial architectural context.

"We should not leave this place to fall victim to the perils that overwhelm it. We should claim it; claim it for peace, for harmony, for order, for cleanliness and for all the other desirable features that could go with the maturing of the new South Africa" Denis Becket (The Star 1994 as cited in Bedderson, S.A.B., 1995.)



Fig 1.5: Looking towards the refinery from Austerville (adapted from Verasamy,2003)

Research Methodology

The departure point of this research began with the question of, "How can an imposing toxic landscape become a site for community revival while purifying the surroundings it once polluted?" This introduced a central theme of understanding toxic establishments and how to further dismantle them. After multiple failed attempts at organizing a site visit to the closed oil refinery, I had to rely on an intrinsic knowledge of the area while drawing on the insights of family members who are residents in the area.
Given that the outcome of this research would be about urban rehabilitation I began an intensive desk study on the histories, geographies and people of the area to understand the region's formation holistically.

The next step in the research process involved a site analysis of the area bordering the refinery to understand the context in which the eventual design would take place. The last phase of this research project involved using the findings from the aforementioned research to inform the development and design of an architectural response that is fully responsive to the conditions of the site as well as other informants. Through various sketching, modelling and charette design exercises, I developed a conceptual basis upon which the final intervention would be designed. Aspects of the conceptual sketch design was then taken further through the research of various building systems appropriate to the design at hand.

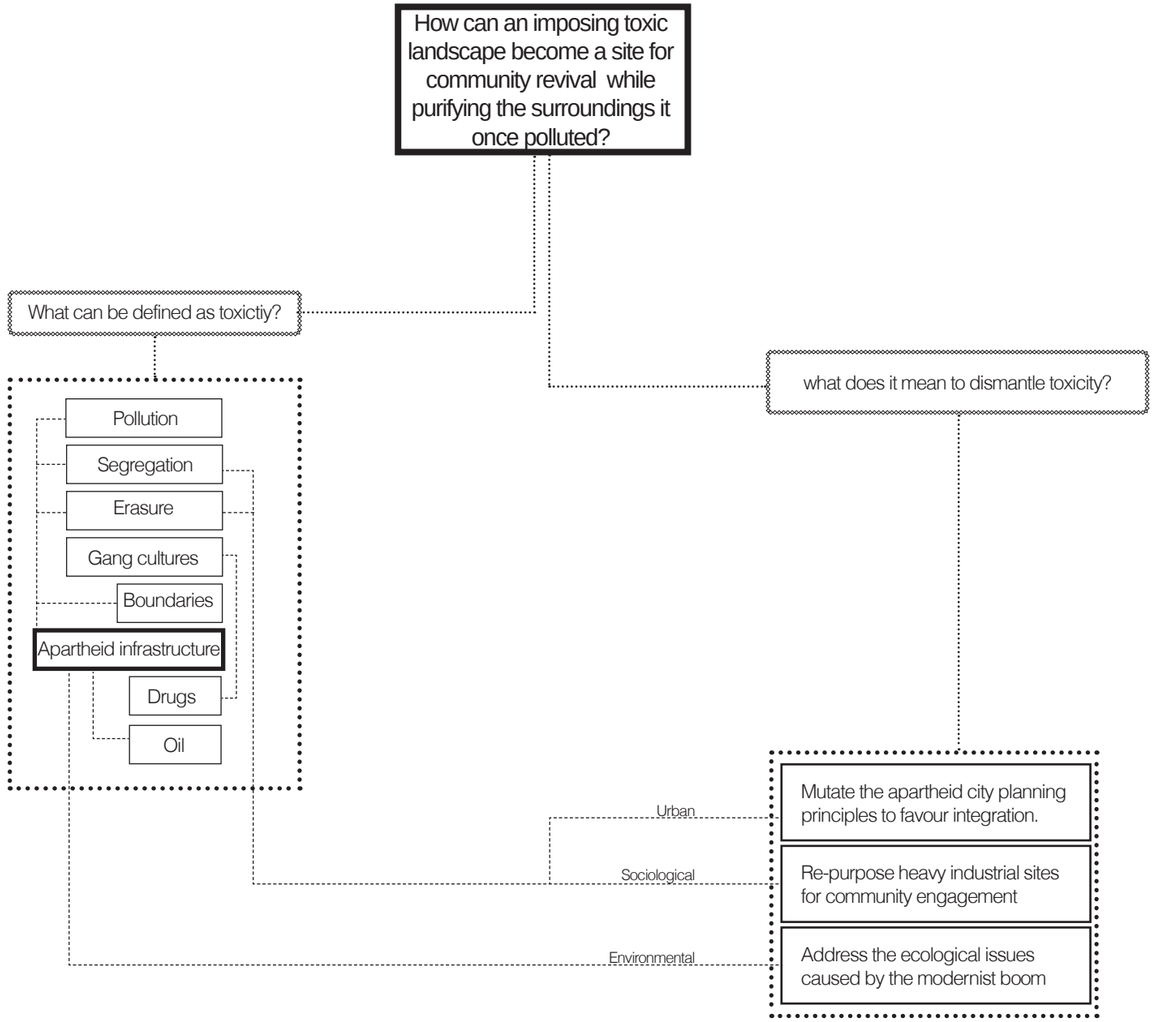
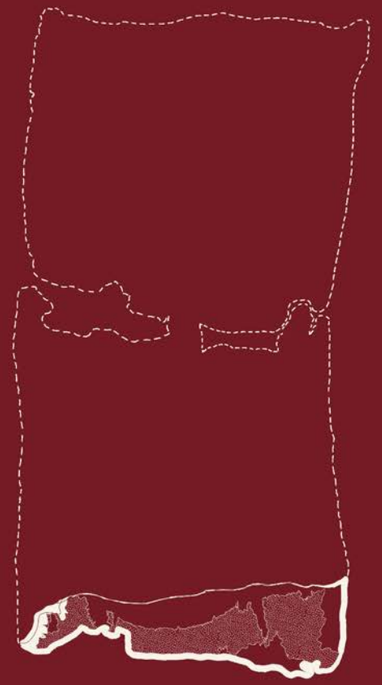


Fig 1.6: A breakdown of research processes (Author,2021)



Fig 1.7: Woman traversing along industrial pipeline in Durban (African Climate Reality Project, 2021)



2. Histories

- Timeline
- Establishing the toxic landscape
- The origins of apartheid in context

Timeline

The following timeline aims to shape an understanding of the genius loci of the area through documenting events that took place during the five sequential epochs in the history of it's formation. These events locate the origins of the people and cultures both in time and within the ever-contested landscape of the South Durban basin.

For the most part the story of Durban is often associated with the arrival of Vasco de Gama, the emergence of the Zulu kingdom and the arrival of Indians as indentured labourers. However, in attempting to understand the site through its histories, it allows for one to structure a holistic view of cultural formations in specific regard to race, migrations, settlements, economies, territories and the intersectional relationship between these themes.

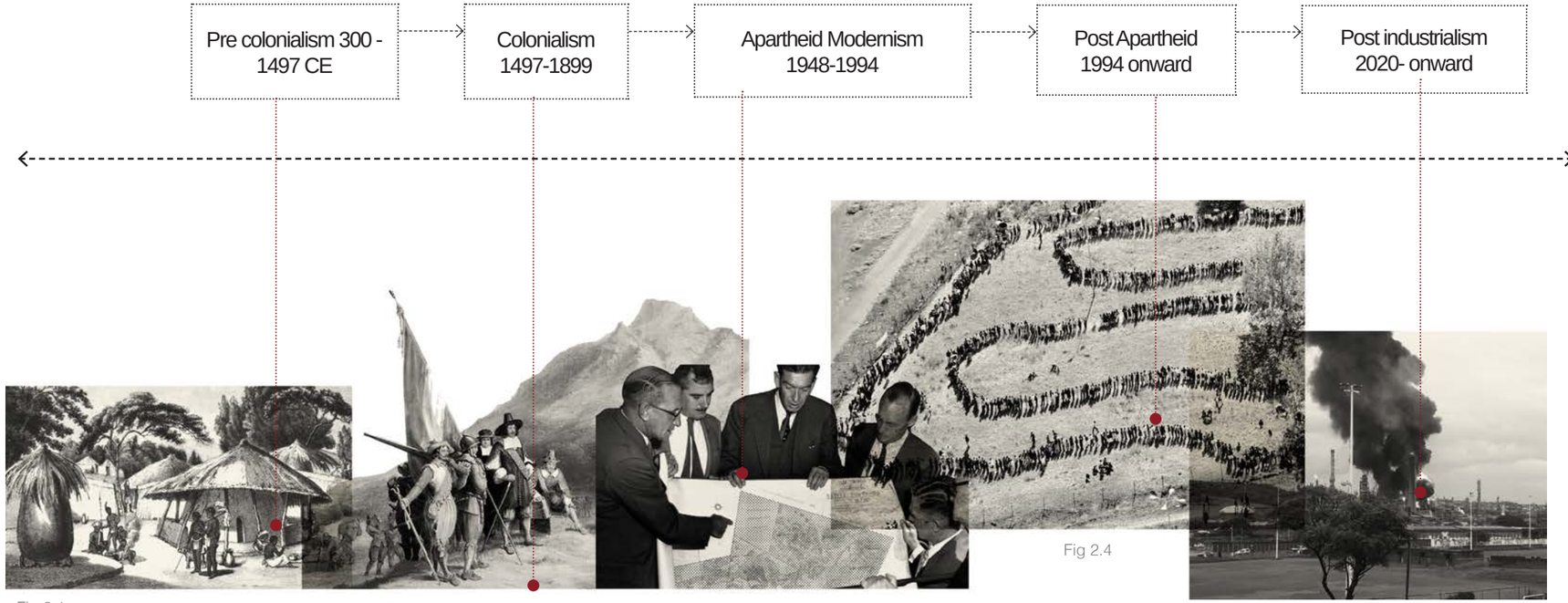


Fig 2.1 Fig 2.2 Fig 2.3 Fig 2.4 Fig 2.5

Fig 2.1: Illustration of a scene from Dithakong (Samuel, 1801)
Fig 2.2: Jan van Riebeeck and the Dutch arrival in the Cape (Roodepoort Record, n.d.)
Fig 2.3: Officials examine Johannesburg 'Native Townships' plan (adapted from Apartheid Museum, n.d.)
Fig 2.4: Residents in Soweto vote in first democratic elections circa 1994 (Farell, 1994)
Fig 2.5: Explosion at Engen refinery (Naidoo, 2020)



Fig 2.6

300 - 900 CE

Kwazulu natal becomes a site for human settlement during the early iron age period. Sustenance farming begins using the surrounding wild plant and animal resources available. The settlers begin producing a specific style of pottery (SAHO, n.d.).

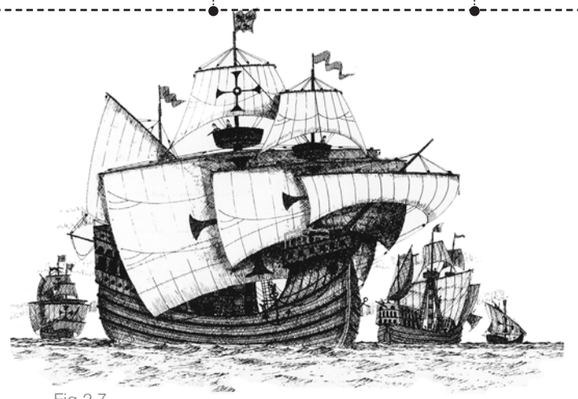


Fig 2.7

1497

Under the command of Vasco De gama, three Portuguese ships moor overnight in what is now known as Bluff on the 24th of December. The name 'Natal' meaning Christmas in Portuguese, was chosen due to the date of arrival of the sailors (SAHO, n.d.).

1652

The Dutch arrive at the Cape of Good Hope and set up a small colony which serves as a refreshment station for the Dutch East India Company. (SAHO, 2018)

In the historical context of this exploration this event is important because it marks the beginning of the Afrikaner identity.

late 1700s

Through the process of political consolidation, groups of predominantly pastoral zulu societies that had emerged through the Nguni migrations, transformed into a more organized version of a statehood (SAHO, n.d.).

1800s

The 1800s in South Africa proved to be a turbulent time in its history with the fight for power, land and political dominance waging on between the indigenous and foreign communities in southern Africa. One of the most significant events that shaped the political and physical landscape was the European colonization of Natal in the late 1800's



Fig 2.9

1815-1840

The Mfecane which translated to 'the crushing' was caused by a series of events that led to severe conflict amongst the established Nguni tribes. It occurred because of three main factors having to do with maize, water availability and ivory trade. In the early 1800s after chiefdoms began growing maize, it was realized that the crop resulted in high yields which increased the population to unsustainable levels. This caused a shortage in water in Southern Africa and subsequently led to mass conflict over mineral availability. Some tribes were scattered, others completely destroyed and new groups formed (SAHO, n.d.).

Mfecane begins



Fig 2.8

1818

Shaka kaSenzangakhona becomes king of the Zulu kingdom and quickly establishes a strong military capability (SAHO, n.d.).

Fig 2.6: Major lines of Bantu migrations (University of California press, n.d.)
Fig 2.7: Vasco Da Gama voyage from Portugal (Abe books, n.d.)
Fig 2.8: Illustration of King Shaka Zulu (King, 1824)
Fig 2.9: Painting of the first migration of the Fengu tribe affected by Mfecane (New York Public Library, n.d.)

1835
Following tensions between the descendants of the Dutch colonists (known as the Boers) and the British who had now taken control of the Cape, the Boers trekked inland from the southern colony and ventured eastward in order to live beyond the reach of British colonial administration (Readers, Digest, 1988).

1838
The great trek led a group of Afrikaners towards KwaZulu Natal. This became one of the first meetings between the Afrikaaners and the Zulus. Conflict ensued along the banks of the Ncome River and this became known as “The Battle of Blood River” (Opperman, 1982).

1839
A victory by the Afrikaaners over the Zulus at led to the establishment of The Natalia Republic (Readers, Digest, 1988).

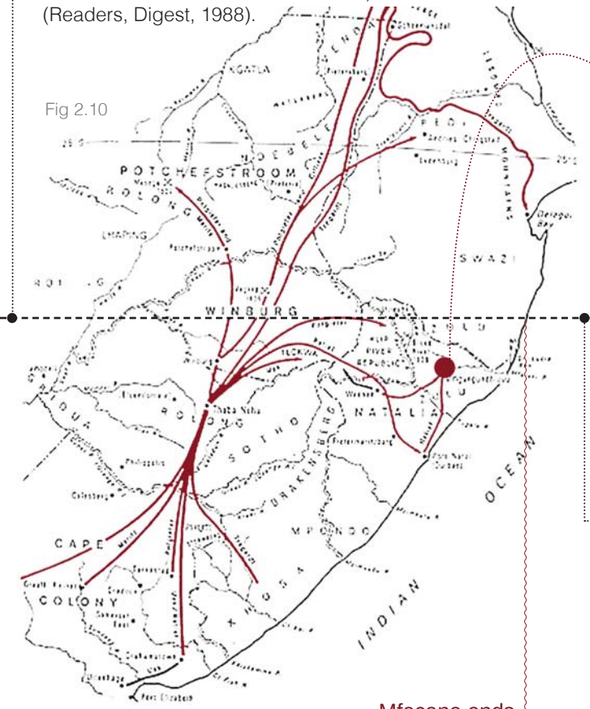


Fig 2.10



Fig 2.11



Fig 2.12

1880
The first Anglo-Boer war takes place between the British and the Afrikaners of the The war ended in 1881 and resulted in a Boer victory and eventual independence of the South African Republic (Raugh,2004).

1882
Paul Kruger is elected president of Transvaal. (Kruger National Park, n.d.)

1886
Gold mining begins in the Transvaal and Johannesburg is founded as a mining town (South African Government, 2021)

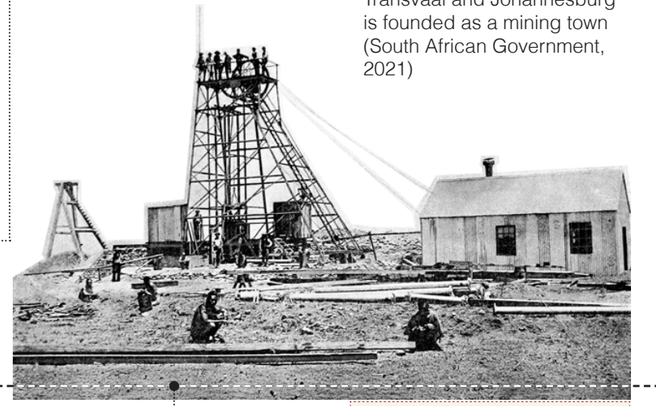


Fig 2.14

1843
The short-lived Boer republic is annexed by the British and forms part of the The Colony of Natal (SAHO, n.d.).

Mfecane ends

1856
The Natal Charter of 1856 is proclaimed and Natal is formally separated from the Cape Colony with functions under limited self-governance.

1859
As a result of a joint effort between the Natal Government and the British Secretary of state for the colonies, the Natal ‘Coolie’ Law 14 of 1859 is passed. This law allowed for immigration of Indians as indentured labourers from the Indian Colony. The law also allows for the immigrants to renew their indenture for up to 5 years and be entitled to full citizenship rights and a gift of crown land (SAHO, n.d.).

1860
The first group of 342 Indentured Indian labourers arrives in Natal on board the Truro and later another group of labourers arrive on board the Belvedere (SAHO, n.d.).



Fig 2.13

1899
The presiding government realizes that mines would be a crucial source of income in the event of a war and reintroducing the Gold Law (Law 15 of 1898).
It stated that once martial law was declared, the government could order mines to reopen if they had been closed and in the event of non compliance, the government could take over the mine and use the gold mined for their own benefit (Cammack, 1990).
This laid the financial backing for the eventual war that was to become known as the Second Anglo-Boer War

Fig 2.10: Illustration of the routes taken during the Great trek adapted from: (South Africa Tours and travels, n.d.)
Fig 2.11: Illustration of the map of the Natalia republic (Our Civilisations, n.d.)
Fig 2.12: Illustration of the first Anglo Boer war (The Illustrated London News, n.d.)
Fig 2.13: The arrival of Indian indentured labourers in South Africa (South African History Online, n.d.)
Fig 2.14: The Langlaagte gold mine (British Library, n.d.)

Fig 2.15



1899

The second Anglo-Boer War, takes place between the British and a joint effort between the South African Republic (Republic of Transvaal) and the Orange Free State, over the British Imperial influence in South Africa (SAHO, n.d.).

Fig 2.16



Fig 2.17



1900

Upon occupying the Free State capital, Bloemfontein, Frederick Roberts who was the chief commancer of the British Army, issued a proclamation inviting the Afrikaners to sign an oath of neutrality and return to their place of residence with no further participation in the war. With the capture of both state capitals, the Boers still fighting in the war adopted guerrilla warfare and as a result, the British ordered the destruction of agricultural land and the homes of civilians to cripple the supply of food and supplies to the guerrilla army through the scorched earth policy.Roberts, with an obligation to protect those who signed an oath of neutrality placed the civilians in refugee camps. The first two camps establishted were in Bloemfontein and Pretoria in September 1900 (Wessels, 2012).

1901

Merebank concentration camp was established in September 1901 as an overflow facility that supported the Transvaal camps which at the time were experiencing high mortality rates (Wohlberg, 2000).

Fig 2.18



1902

Jacobs Siding camp was established as an overflow facility that supported the Merebank camp. The camp was located on the Bluff railway line, about 0.8 km from Merebank. Plans for the camp were drawn up in November 1901. Wentworth camp was the third of the three Durban camps to be constructed. The poor conditions at these camps forced the authorities to work on adequate housing and establishing good sanitation infrastructure. The “Peace treaty of Vereeniging” was also signed marking the end of the Anglo Boer war (Wohlberg, 2000).

Fig 2.19



1910

South Africa becomes a Union eight years after making peace with the British and becomes a self-determinate nation (SAHO, n.d.).



Fig 2.20

1913

With the white Minority government now in control, the Land Act (No: 27) was passed. This act was the first of many to come that had a negative effect on the non-white population. It became the foundation onto which other oppressive forms of legislature was formed (SAHO, n.d.).

1921

Clairwood Park Racecourse is built and is officially open on Tuesday May 24, 1921. The racecourse becomes one of the most famous in the country and becomes a hotspot for social activity amidst the ensuing racial tension (Sporting Post, 2014).



Fig 2.21

1922

The Durban Land Alienation Ordinance, No 14 of 1922 is passed and this allows the council to ban Indian property ownership or occupation in white areas (SAHO, n.d.).

1925-1927

A series of laws are passed that ultimately functions to cripple the economic capabilities of non white citizens.

The Transvaal Dealers (Control) Ordinance No 11 of 1925 is passed and this complicates the allocation of trade licenses for Indians ultimately aiming restrict Indian trade.

The “Areas Reservation and Immigration and Registration (Further Provision) Bill of 1925” secured the commercial and residential segregation of Indians and facilitated repatriation.

In 1927 The “Women’s Franchise Bill” prevented Indian women from voting while the “Riotous Assembly Act of 1927” ensured that any Indians who were considered dangerous agitators could be subject to deportation.

The Old Age Pension Act of 1927 saw that pension provisions were made for Indians (SAHO n.d.).

Fig 2.15: Boer soldiers in a trench. (Imperial War Museum, n.d.)
Fig 2.16: Illustration of the siege at Ladysmith(Encyclopaedia Britannica, n.d.)
Fig 2.17: Jacobs siding concentration camp(Teper, circa.1901)
Fig 2.18: Merebank concentration camp(Teper, circa. 1901)
Fig 2.19: Stamp that marked the union of South Africa and it's ex- colonies(Walden, n.d.)
Fig 2.20: Warning signage erected because of the land act, (Chan, n.d.)
Fig 2.21: Clairwood park racecourse (Sporting Post, n.d.)

1946
the Asiatic Land Tenure Act of 1946 is passed and places restriction on the acquisition and occupation of land by Asiatic people (UKZN, n.d.).

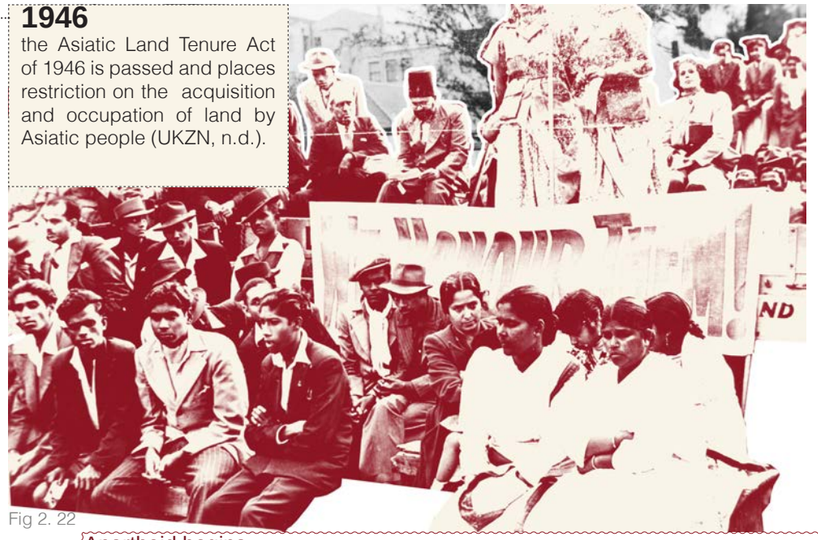


Fig 2. 22

Apartheid begins

1948
After the general election, the presiding government commenced the apartheid policy that sought to segregate people according to racial groups.

1950
The Group Areas Act is passed and racially divides the cities and towns of South Africa . The act becomes the foundation upon which spatial apartheid is formed and leaves a lasting legacy on the geographies of the country.

1951
Durban International Airport (formerly Louis Botha Airport) opened as the international airport of Durban.

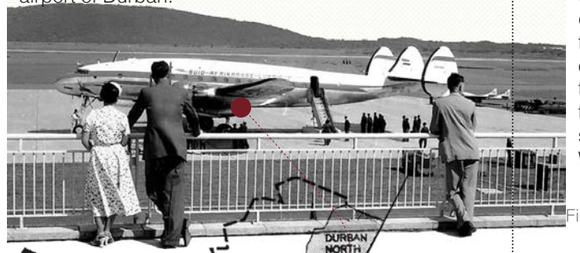


Fig 2. 23

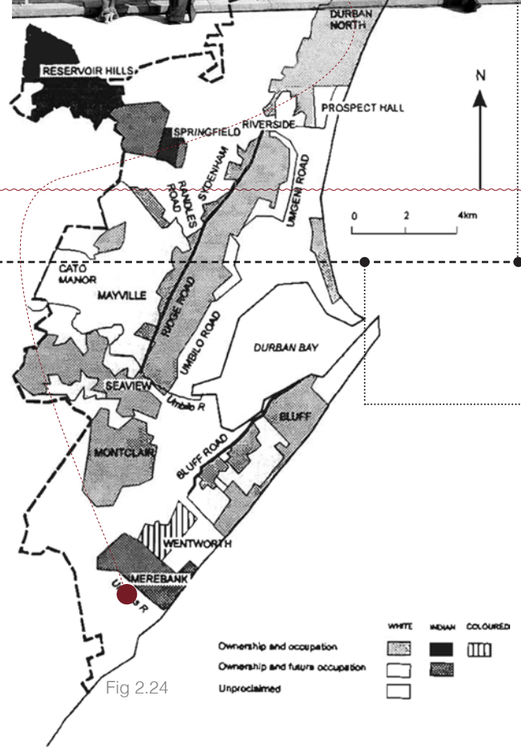


Fig 2.24

1954
The first crude oil refinery in the country is constructed and occupied by Mobil (now Engen Petroleum) in Durban. Up until this point the country's fuel demands were met by imported products (South African Petroleum Industry Association, 2015).

1960
While large scale infrastructure establishment takes place in Merebank, the excavations for storm water drains and cutting of roads for housing scheme reveals exposed shells and pottery that was believed to be from the early Iron age Nguni settlers (Schoute-Vanneck, & Walsh, 1960).

1963
BP Southern Africa and Shell SA Refining commissioned the construciton of SAPREF, the second crude oil refinery just south of Merebank (South African Petroleum Industry Association, 2015).

1965
Petronet (now Transnet Pipelines) commissions a pipeline between Durban and Johannesburg with the sole purpose of carrying refined products to Johannesburg to meet high demands of the inland region (South African Petroleum Industry Association, 2015).

1969
Following the success of the Durban- Johannesburg pipeline a subsequent oil pipeline was laid to move imported crude oil to inland regions (South African Petroleum Industry Association, 2015).

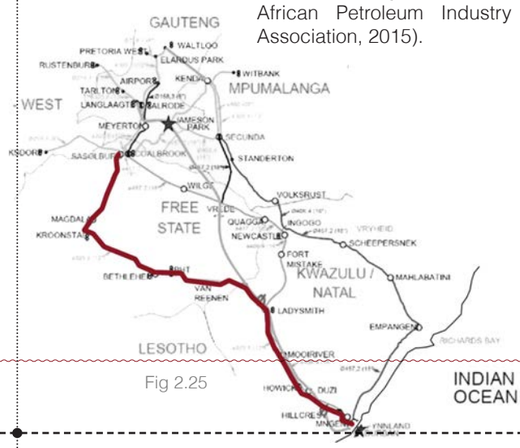


Fig 2.25

1969
Mondi paper mill is commissioned in Merebank. The move to construct the mill in the area further establishes the industrial footprint in the area (Mondi,2015).

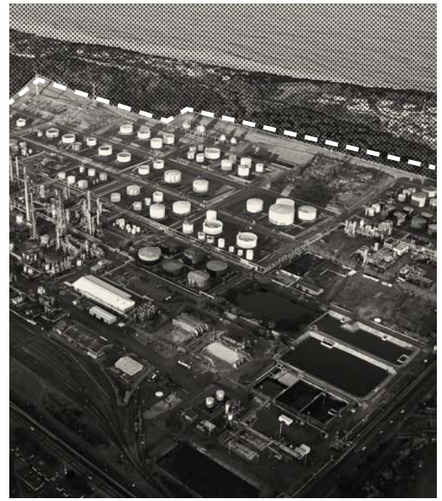


Fig 2.26

Fig 2.22: Suriakala Patel leads the singing of the anthem (SS Singh Collection, 1946)

Fig 2.23: Louis Botha International Airport(adapted from Transnet Heritage Foundation, n.d.)
Fig 2.24: Map of the Group Areas proclamation in Durban. (Scott, 1994)
Fig 2.25: Map locating the path of the first crude oil pipeline (Africa PORTS & SHIPS maritime news, n.d.)
Fig 2.26: Aerial view of the Engen refinery (adapted from: Engen, n.d.)

1984

The African National Congress claim responsibility for an RPG attack on the Mobil Oil Refinery(now Engen Petroleum). In an ensuing shoot-out at the refinery, four insurgents and three bystanders were killed (Cowell, 1984).



Rebels Attack South African Refinery and Are Slain After a Chase

By ALAN COWELL

Special to The New York Times

JOHANNESBURG, May 14 — Guerrillas made a rocket attack on an oil refinery in the port of Durban Sunday night that led to a series of gunfights and a car chase, the police said today. Seven people were killed, four of them suspected guerrillas.

The African National Congress, the most prominent of South Africa's outlawed opposition groups, took responsibility for the attack on the refinery, which is owned by the South African subsidiary of the Mobil Oil Corporation. The attack was followed by car chases, grenade throwing and the exchange of gunfire. The opposition group said it was carrying out its pledge of "the program for the intensification of the armed struggle" against white minority rule.

It was the first claim of responsibility by the group for an attack inside South Africa since the signing of a nonaggression treaty on March 18 between South Africa and Mozambique. That treaty committed that black-ruled country to curbing the military activities of members of the opposition group in exchange for a pledge that it killed three people in Durban, but no one took responsibility for that attack.

Most Serious in a Year

It was also the most serious and spectacular act of urban violence in South Africa since a car-bomb attack on a military headquarters in Pretoria last May 20 in which 19 people were killed.

The police said the attack on the refinery — one of only two in South Africa — was a response to the decision by Mozambique to expel some of the guerrilla group. There was an immediate comment from the South African authorities tonight on whether the attack Sunday was viewed as an indication that the treaty remained in force with Mozambique. It remained unclear whether they would skirt the challenge to the treaty by saying they believed the attackers were based in South Africa, not in Mozambique, an avowedly [illegible] group, the African National Congress's most important rear base.

Four South African policemen were injured in the fighting, one by a hand grenade thrown at a roadblock and the others by shots fired from the attackers' car.

How Battle Started

Police officials said the attack on the oil refinery began at 10:30 P.M. Sunday night with several grenades fired from a Soviet-made RPG-7, a shoulder-held rocket-propelled-grenade launcher designed for antitank warfare.

The police said the refinery's managing director, Colin Murdoch, said the attack had caused damage but that it would not slow the refinery's operations.

The refinery, which has a capacity of 69,000 barrels a day, is owed by the Mobil Refining Company of Southern Africa. That company is owned by the Mobil Petroleum Company, which is owned by the Mobil Oil Corporation, according to a spokesman for the corporation in New York City. Both Mobil Refining and Mobil Petroleum are wholly owned subsidiaries of Mobil Oil.

In New York, a statement by Mobil Oil Corporation said that the refinery was not damaged, and a water line was ruptured, and a small fire was started. This was extinguished by refinery personnel. There were no injuries to Mobil staff or contractors, and the damage is estimated at less than $25,000. The refinery was operating normally today.

The Attackers Flee

The attackers sped from their firing position in a yellow Peugeot sedan, according to the police account, and the police chased it. A police officer was wounded in the head by shots fired from the fleeing guerrillas, a police spokesman said.

The attackers abandoned their car and fled to a construction site, throwing grenades and [illegible] fire with the policemen who surrounded them, the police said. The shooting started a fire in a paint depot, which burned down, the police said, and the four attackers were also dead. The battle ended at 1:30 A.M. The police identified the assailants as three black men and one man of mixed race.

In a statement made public in Lusaka, Zambia, the headquarters of the African National Congress and one of the organization's military wing, Spear of the Nation, carried out the oil refinery attack and an attack earlier this month on Government offices in Durban that caused some damage but no casualties.

Must Backer to Last

The attacks "are part of the program for the intensification of the armed struggle which we are embarking [illegible]," the statement said.

The statement was made by the leader of the opposition group, Oliver Tambo, after the bombing in Pretoria last year, but it was not followed by any publicized increase in insurgent attacks. The group's attacks have usually been on economic and strategic installations rather than on military personnel or civilians.

Since then, however, the group has killed civilians, supporter in black-ruled Africa because of the agreement between Mozambique and South Africa, which obliges each side to withhold support for the other's internal foes.

In its compliance with the agreement, Mozambique has moved many members of the African National Congress to other black-ruled African nations. But both sides have stressed that the accord itself will not be enough to prevent insurgents attacks.

The agreement has been billed in South Africa as a major achievement for the country's President, F.W. de Klerk, who is trying to persuade the white-minority Government that South Africa's ability to exact reprisals for the refinery attack, Western officials said, is limited by an evident desire to prevent the nonaggression pact from collapsing.

Swift Retribution in the Past

In the past, South Africa's retribution has been swift. South Africa has declared [illegible] and air strikes [illegible], in response to earlier attacks. The most recent such strike came after the [illegible]

One purpose of the reprisals has been to underscore what Pretoria regards as threats to South Africa's security from forces of separatism, called apartheid, are being contained.

Western diplomats said the attack on the oil refinery was apparently intended to show whites and blacks in South Africa that the African National Congress is still a force in the land. As such, the diplomats said, it is likely to be welcomed by the black majority of the country, but to alarm the white minority and show it as the threat of black nationalism has always been.

According to South Africa's officially controlled television tonight, many white residents of Durban made their way to an assembly point near the refinery under a civil-defense plan, indicating the depth to which the authorities have prepared plans for attacks on installations like oil refineries.

Fig 2.27

Abolishment of Apartheid

1994

After winning the first democratic general election in the country, The African National Congress is elected into power and immediately abolishes the apartheid regime.

1995

The South Durban environmental alliance is founded as a Non-governmental organization and actively advocates for environmental justice and renewal in the South Durban Basin (About the SDCEA, n.d.).

2011

Clairwood racecourse which served as a node for social activity in the community is sold by Gold Circle for R430 million to Capital Property Fund. After demolition, Plans are initiated to turn the old racecourse into a commercial facility that services the growing logistics industry and strengthen the industrial corridor that leads to Durban Harbour (Sporting Post, 2014).

2012

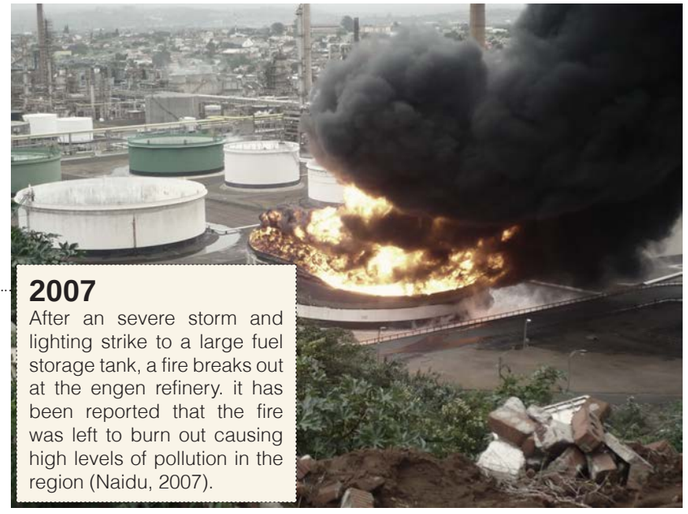
Transnet buys the land that previously houses the Durban international airport and intends to creat a digout port that is an extension of the existing Durban Harbour. The move is highly contested by environmentalist groups bcuase of the trade corridor that will be created through residentail areas and put off until 2030 to see if upgrades to the existing harbour's facilites and capacity can be done until then (Manda, 2021).



Fig 2.29

2021

With maintenance costs becoming infeasible as well as a sharp decline in fuel demands as a result of the Covid-19 pandemic, Engen makes the move to convert the refinery into a fuel storage terminal (Ward, 2021).



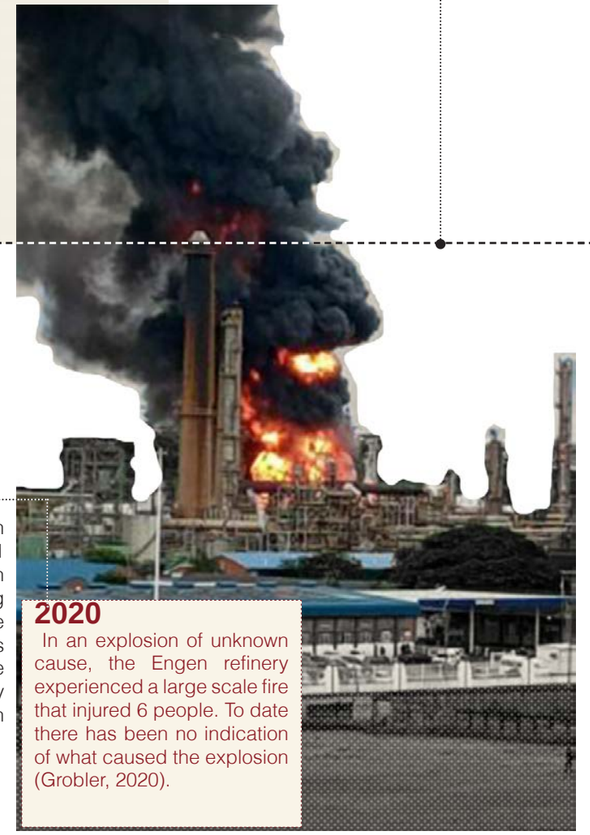
2007

After an severe storm and lighting strike to a large fuel storage tank, a fire breaks out at the engen refinery. it has been reported that the fire was left to burn out causing high levels of pollution in the region (Naidu, 2007).

Fig 2.28

2020

The President of South Africa, announces a 21 day coronavirus lockdown that limits trade, travelling and social interaction in the country. This led to business adopting a work from home culture while drastically reducing the dependency on fuel for travelling.



2020

In an explosion of unknown cause, the Engen refinery experienced a large scale fire that injured 6 people. To date there has been no indication of what caused the explosion (Grobler, 2020).

Fig 2.30

Fig 2.27: Excerpt from NY times (Cowell, 1984)
Fig 2.28: Fuel storage tank on fire (Corcoran, 2008)
Fig 2.29: Map showing the trade corridor between the Louis Botha airport and Harbour (Author, 2021)
Fig 2.30: Fire at the Engen refinery view from Wentworth (Southlands SUN, 2020)

Establishing the toxic landscape

The formation of South Africa is infamous for segregationist spatial practice. From the beginning of colonial urbanism to the implementation of the group areas legislature, such practices have had a major influence on the formation of cultures, identities and spatial rituals that begin to construct an understanding of the current urban fabric (Maharaj, 2003).

In their research into racial group distribution in Durban, geographers, Brookfield and Tatham(1957) state that, “Durban, which celebrated its centenary as a municipality in 1954, was founded in the 1820’s but remained a small trading post at Zulu sufferance until the establishment of Boer hegemony in 1838. Then Durban became the port for the limited overseas contacts of the Boer Republic of Natalia and, after the British annexation in 1844, of the Colony of Natal.” Prior to its existence as an Industrial Hub, The South Durban Basin was the stage for an expression of colonial power in the form of concentration camps set up during the latter years of the Anglo Boer war. The camps were initially created by the British to house citizens of the two Boer republics namely the South African Republic and the Orange Free State. These camps became home to the Boer citizens who had signed an oath of neutrality during the war (van Heyningen, n.d.)[1]. The site for intervention borders three of these camps that eventually became one of the many designated areas for nonwhite occupancy during the implementation of the group areas act. These include the Merebank, Wentworth and Jacobs Siding camps.

Merebank camp was based closer to the southern portion of the Natal coast line, now known as the South Durban Basin, the climatic conditions of the region were starkly different to that of Transvaal region to which the Boers were accustomed to at the time. The humid and windy conditions all contributed to feelings of discomfort and hardship. It also happened to be built on low-lying, swampy grounds which contributed to the discomfort factor. Jacobs Siding camp was subsequently created to service the Merebank camp as an overflow facility for families coming from the Transvaal in 1902. Roughly one kilometer away from the Merebank camp, it was primally located along the Bluff railway line. The Wentworth camp was the last of the three camps to be established in the area. It was located opposite the Jacobs Siding camp and also along the Bluff railway (van Heyningen, n.d.)[2].



Fig 2.31: Aerial view of Merebank Concentration camp, circa 1902(Teper,n.d.)

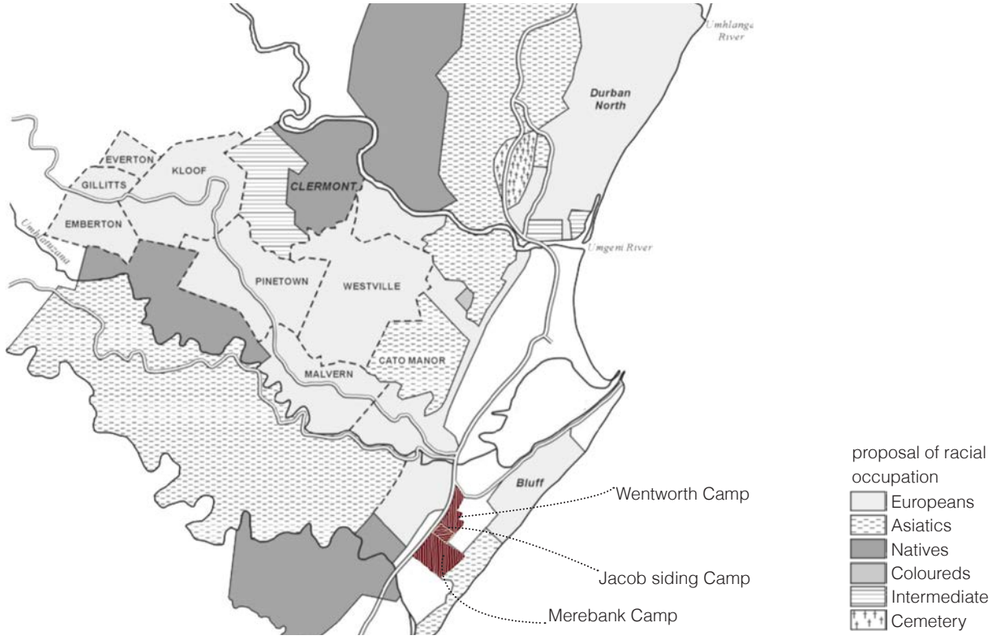


Fig 2. 32: Location of the Concentration camps of the Anglo Boer war in relation to the Racial Zoning Plan proposed by the Durban city council in 1944 adapted from (Scott,2003)

The origins of Apartheid in context

As a means of unpacking the formation of this version of the apartheid city, it is important to understand its origins and underlying principles that governed its creation. Created in the 1940's to appease the concerns of the white minority population as well as to amplify the interests of the National Party government, the system of apartheid was founded on past policies of racial segregation and spatial governance. All of which were established during and after the colonial era (Hindson, 1996).

The Apartheid city as an urban design model relied heavily on legislative backing to see its eventual creation. In his work on the colonial origins of apartheid, historical geographer A.J. Christopher (1983) argues that the apartheid city through its formation in South Africa is one of the more widely distributed variants of the colonial city and that it shares spatial and legislative characteristics to that of a typical English colonial city. To understand the characteristics of a colonial city, I will look at the work of sociologist, Patrick Le Galès. In a lecture on the features of a colonial city, Le Galès (n.d.) outlines the principles that govern the creation and function of the city model. He states that colonial cities are planned to place the political control of the colonizers at the center of all development and a fundamental aspect of their success is either the extraction of resources and/or economic development. This also includes the robust infrastructure for commerce, transport, and trade exchange.
He also states that one of the main concerns when creating a colonial city is the protection of the colonizers against a rebellion to the imposed system. The colonial city therefore can be understood as a urban scale manifestation of the theories pertaining to the Panopticon model proposed by English philosopher and theorist Jeremy Bentham in the 18th century. The panopticon is represented as a circular building designed with a central control tower. The idea behind the building is to impose a system of control and surveillance. This directly places the power in the hands of those in the central control tower by allowing complete surveillance of the surrounding prisoners. When translated into colonial urbanism, it meant that all aspects of colonial power needed to be centralized so as to maintain a hold on all that its power could reach.

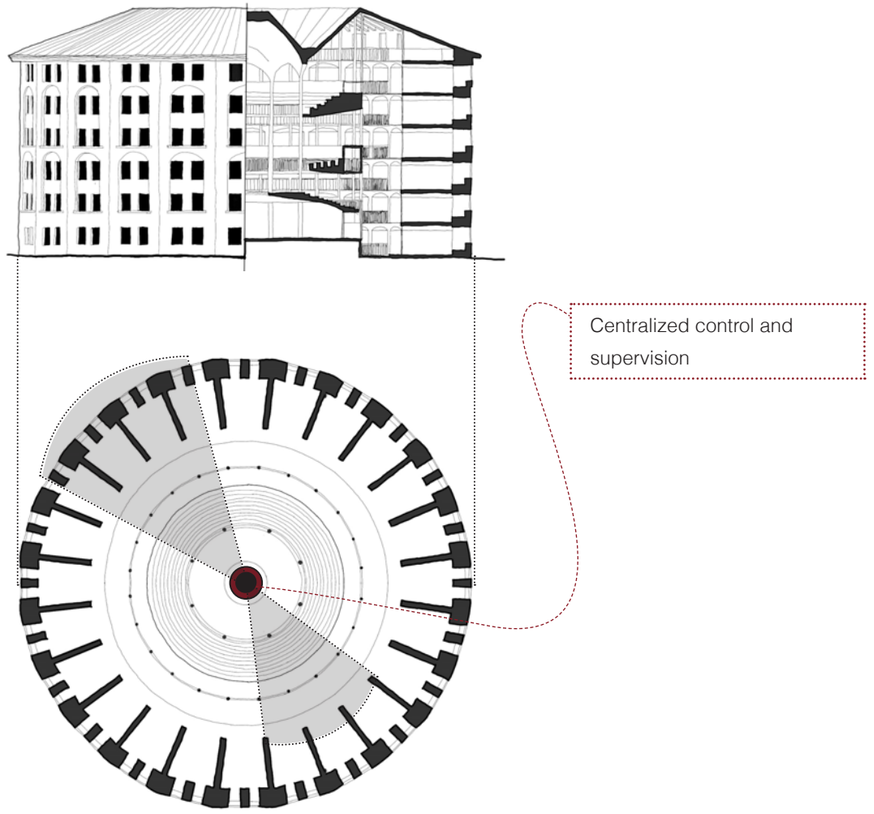


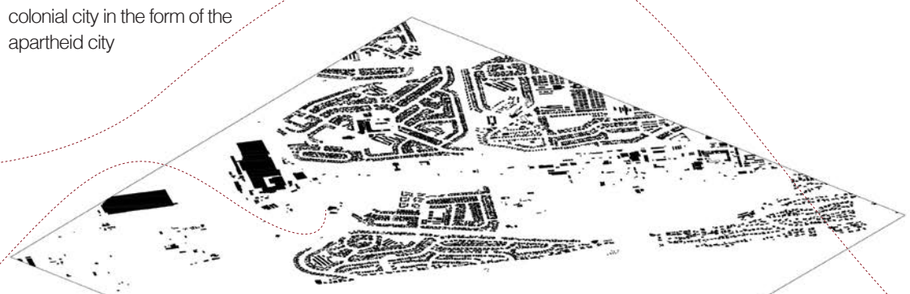
Fig 2.33: Illustration of Benthams Panoticon design sectional elevation and plan (Author, 2021) adapted from :(Wiley Reveley, 1791)

While all colonial cities around the world may vary in terms of culture, landscape and urban conditions, Le Galès also argues that there are common tools used to create the colonial city. The first being erasure in the form of imposed institutionalization of health, religious and educational infrastructures. The second being the imposition of an administrative institution for the purposes of tax collection that could mobilize the colony for any future wars. The last tool used is isolated human settlements. Initially done as a precaution against indigenous diseases thought to harm and cause death to the elitists, it later became a common spatial practice used to control the population and somewhat prevent the rise of a rebellion. Looking back at the work of Christopher, it is clear to see that since their rise to power, apartheid politicians have systemically refined aspects of the colonial city model that was inherited to further secure the establishment of the apartheid city.



Fig 2.34

Refined versions of the colonial city in the form of the apartheid city



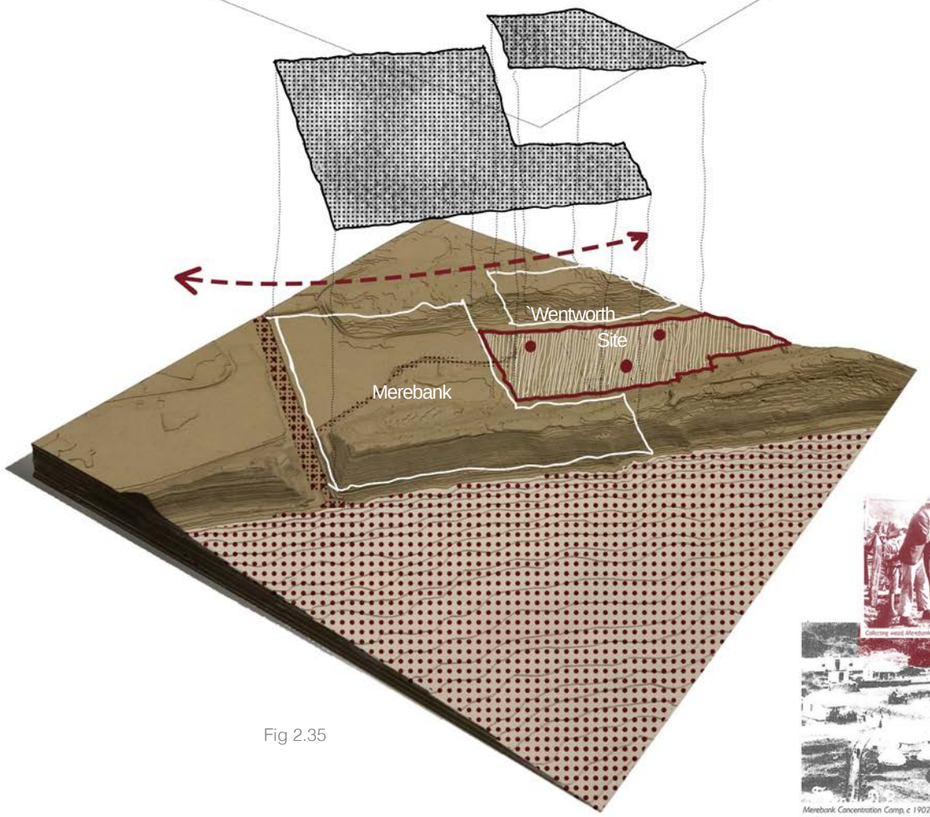


Fig 2.35



Fig 2.36

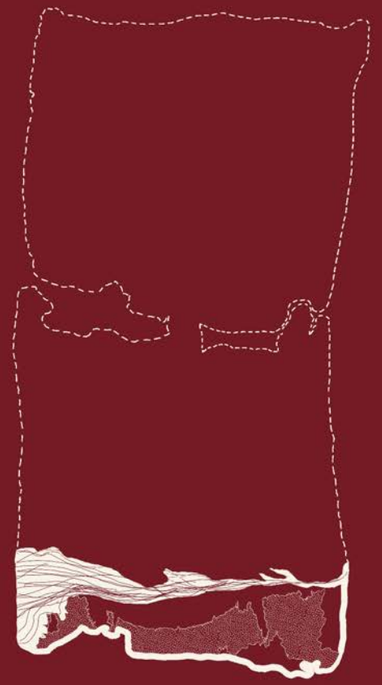
Isolated human settlement

Impositions of administrative institutions



Fig 2.37

Fig 2.34 Officials examine Johannesburg 'Native Townships' plan (adapted from Apartheid Museum, n.d.)
Fig 2.35 collage representing the adaptations of the colonial city(Author 2021)
fig 2.36: Location of the Concentration camps of the Anglo Boer war in relation to the Racial Zoning Plan proposed by the Durban city council in 1944 adapted from (Scott,2003)
Fig 2.37: Conditions in the Merebank Camp(Merebank concentration camp information website, 2021)



3. Contaminated Modernist Urbanism

- Contaminated precursors
- Toxic formation
- Tainted Geographies
- The rise of Industrial landscapes

Contaminated Precursors

Apartheid urbanism was not only drawing on the principles of the colonial system, but it was also influenced by modernist urban planning and design. To understand how the modernist movement was adapted in the formation of the current urban condition, an exploration into the geographies of the area will be explored through the work of social scientist Dianne Scott and her research and analysis of the South Durban basin. As well as the work of geographer, David Smith whose work helps build an understanding of urbanization and social conditions that shaped the apartheid urban model in context. Designed with a strong influence of modernist spatial design principles, the reality is that the apartheid city would not turn out to be a sustainable scheme because of its decentralizing ideals regarding race, resources, and opportunities.

Smith (1992) states that, “since the doctrine of apartheid as legislated racial separation was introduced, it has been inextricably bound up with urbanization.” That need for urbanization was done at the expense of the masses as well as the environment. Fuelling this process happened at a large scale that did not consider the long-term effects it would have. Advocates for apartheid might have argued that it was a utopian creation when it was in fact the very antithesis of it. Globally, industrialization formed a major part of early modernist discourse and design. The immense urban disorder in Europe required serious intervention and came in the form of the Industrial Revolution. It was not too long before the resulting utopian ideas of spatial ordering and control spread across the world in colonial and post-colonial contexts. Ildefons Cerda, the Spanish urban planner and engineer responsible for the layout of Barcelona used the term “urbanism” to define the spatial organization of a city (Caves, 2005). With urbanism on the rise early in the twentieth century, it became closely associated with the rise of modernist ideals such as centralized manufacturing to enhance efficiency, controlled spatial ordering, mixed-use neighbourhoods, and what has been described by social scientists Talja Blokland and Mike Savage (2008) as “the convergence between political, social and economic citizenship”.

“The apartheid city exhibits many of the physical and legal characteristics of the English colonial city as it evolved through several hundred years of imperial expansion”

- A.J. Christopher, From: From Flint to Soweto: Reflections on the Colonial Origins of the Apartheid City, 1983)

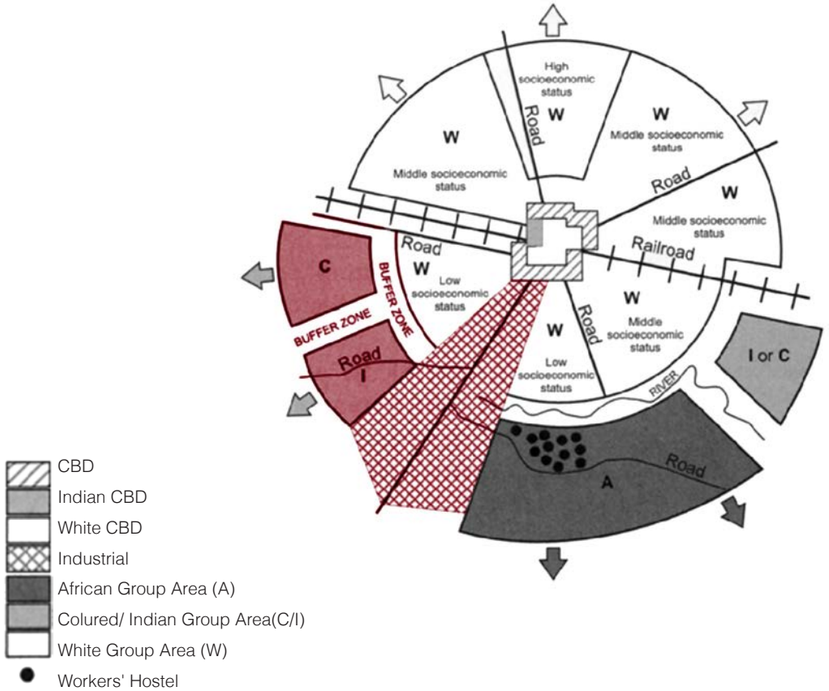


Fig 3.1: Spatial planning diagram of the apartheid city (Author, 2021) adapted from (Scott,2003)

Referring to the work of Scott (2003), it is evident that the nationalist government sought to consolidate political power through industrial development and autocratic control based on the ideas of modern architects and planners. This meant that to maintain control, the government had to see to the creation of urban landscapes that favoured industrial efficiency while still attending to mass scale housing needs.

This became a joint effort between the Durban city council, port authorities and various key role players of industry. With the legislative backing already in place, it became a three-stage process to securing the industrial vision of the stake holders. The first stage involved institutionalizing relevant planning legislation while the second stage involved drawing up the relevant plans and maps that would then inform the last stage which was the submission of a racial zoning plan to the government. While industrial efficiency and housing does fall in line with the common goals of modernism, the morality of it in this context has always been contested.

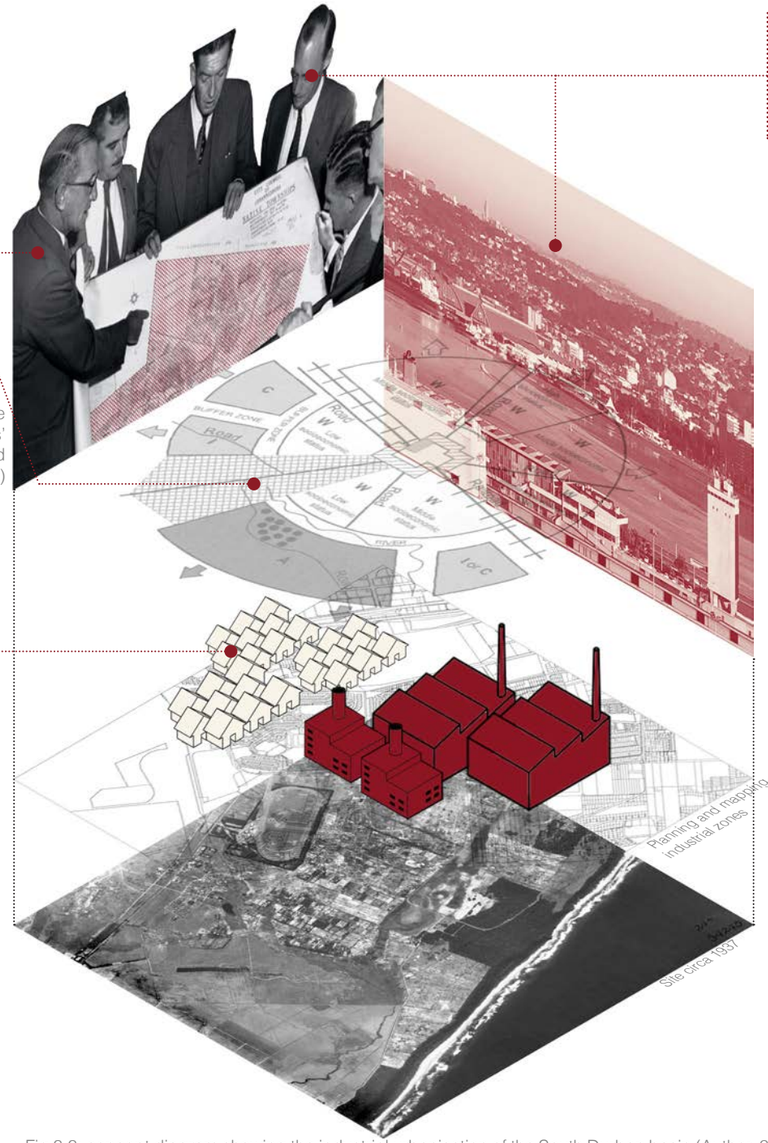


Fig 3.2: Officials examine Johannesburg 'Native Townships' plan (adapted from Apartheid Museum, n.d.)

fig 3.4 View of Durban Harbour from Berea ridge(Hunter, n.d.)

Fig 3.3: concept diagram showing the industrial urbanisation of the South Durban basin (Author, 2021)

Toxic Formation

From the early 1920's and well into the years leading up to apartheid, scattered development emerged in the form of residential settlements in and around the Merebank and Wentworth area. It can be argued that the colonial occupation of these sites informed the planning of the aforementioned areas as nonwhite places when planning racial segregation. When commenting on urban segregation, Historian Paul Maylam, (1995) argues that, it would serve the economic interests of the white constituency to allocate prime land for business activity. In context, the hilly terrain across Durban was not ideal for industrial/ commercial activity.

Therefore, this placed a high value on the flat land located in the south of the city and entailed large scale property expropriation in the area for industrial use. Dianne Scott (2001) outlines these changes in her paper that discusses Clairwood, another closely located area affected by apartheid urbanism. Her research explains that to facilitate the industrial formation of the site, a series of large-scale engineering works was commissioned in the South Durban basin in 1930. Notable projects included the upgrading and extending of the existing road network, the construction of a water borne sewerage and storm water drainage system as well as the canalizing of rivers that ran through the areas designated for industrial expansion. One of the more notable works included site works for future housing schemes in the area. With a culture of social and racial inequality already well established, the beginning of the twentieth century saw the foundations being laid for legislative segregationism. The period between 1940-1950 saw the formalization of institutional segregation that eventually resulted in urban spatial planning with inbuilt inequalities base on race (Haarhoff, 2011). The rise of rapid industrialization and urbanization during this period was the result of an economic boom that followed the discovery of mineral wealth in South Africa in the 19th century.



Fig 3.5: Aerial view of the South Durban Basin circa 1953 showing large scale industrial works (Author, 2021) adapted from: (Department of Rural Development and Land Reform, 1953)

This meant that there was a high demand for labour at the expense of nonwhite citizens ultimately leading to the rise of rural to urban migrations towards growing industrial centers and the creation of racial territories. State-owned areas near the Durban Bay region became desirable locations for intensive market gardening as well as residential use for poorer nonwhite constituents because of the fertile nature of the land. (Scott, 2003) With no formal provision for housing, slum conditions then became a regular occurrence in cities. This brought about the introduction of nationwide urbanism. When looking at the spatial impact of the group areas act in Durban, geographer, Brij Maharaj (2003) argues that the ideology of apartheid, was reinforced using group areas legislation as a foundational element in the oppressive state and thus had considerable spatial implications for the residential restructuring of the country. The area of study is a direct testament to this argument.



Fig 3.6: A market gardener and her assistant clearing land adjoining Louis Botha Airport (Rajgopaul, 1983)

Tainted Geographies

Geographically, the present-day urban condition is still confined to these well-established territories. The use of space in southern Durban represents just one of the many other instances of state intervention in urban space. Other examples of places that have been destroyed in the implementation of a segregated city include District 6 in Cape Town, and Sophiatown in Johannesburg. However, in the case of the South Durban basin, land industrialization required a replacement of non-productive uses with uses that would have a large-scale contribution to capital accumulation in the industrial sector. While political power was consolidated through oppressive legislature, the economic implications of sustaining the model revealed the flaws in the system that would ultimately have detrimental environmental and ecological implications. These effects can be seen from the creation of black homelands or 'Bantustans' as they were formerly known. Black homelands in South Africa were a product of white ethnographers. They were areas designated for black occupancy and established based on ethnic and linguistic characteristics. Their creation was enforced and upheld through several Land Acts passed between 1913 and 1936, which allocated remote areas as "native reserves" for black South Africans. The conditions in these areas were rural, lacked infrastructural development and was almost entirely reliant on substandard government funding.

While conducting research on the environmental impact of apartheid at the Worldwatch Institute during the nineties, Alan Durning (1990) states that, "Environmental deterioration in the homelands has four interlocking causes, and all of them trace their roots to apartheid: poor land, politically enforced overpopulation, labour shortages, and poverty." The environmental damage was not only caused by the homeland establishment but also by the carbon footprint of the white minority.

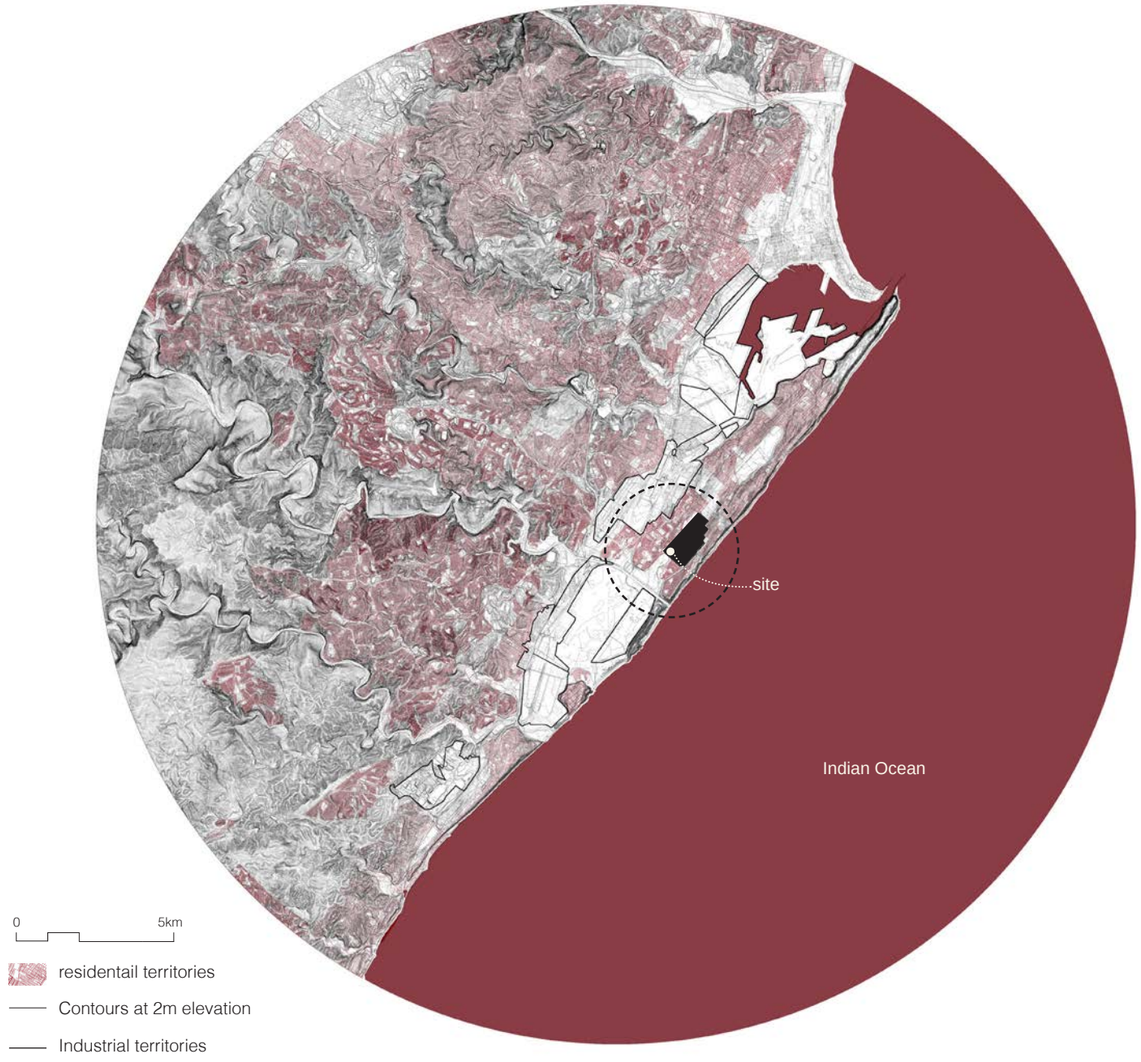


Fig 3.7: The coexistence of residentail and industrial space. (Author, 2021)

According to Durning's research, in a 1987 study on worldwide emissions, the white minority population in South Africa were responsible for 9 times more than the global average carbon emissions per ton capita and he argues that the pattern of emissions mirror the income pattern of the time in which the white minority held 65% of the national income.

Durning's work also touches on the global impact of apartheid's carbon dioxide emissions. While the number is unquantifiable, he argues that it can include the emissions of other countries who acquired under priced coal from South Africa. Another major contributing factor to environmental degradation was an indispensable reliance on diesel fuel. With homelands housing most of the population, massive fleets of buses and other forms of transport such as taxis were required to transport the masses of black urban workers from these far-off reserves to their places of work in city centers.

The decentralizing nature of this urban model, led to a serious overconsumption of fuel and a sharp increase in air pollution that has remained ever present in the urban makeup of the country today. Secondly, the law enforcement agencies deployed to control the masses such as the military and police exerted their power through a show of force and specialized equipment. Enforcing these strict policies meant that officials would need to travel vast distances as well as transport equipment and/or prisoners. (Durning, 1990) This subsequently led to an expansion of the existing refinery industry in the country with detrimental effects on the landscape and the people of the South Durban Basin.

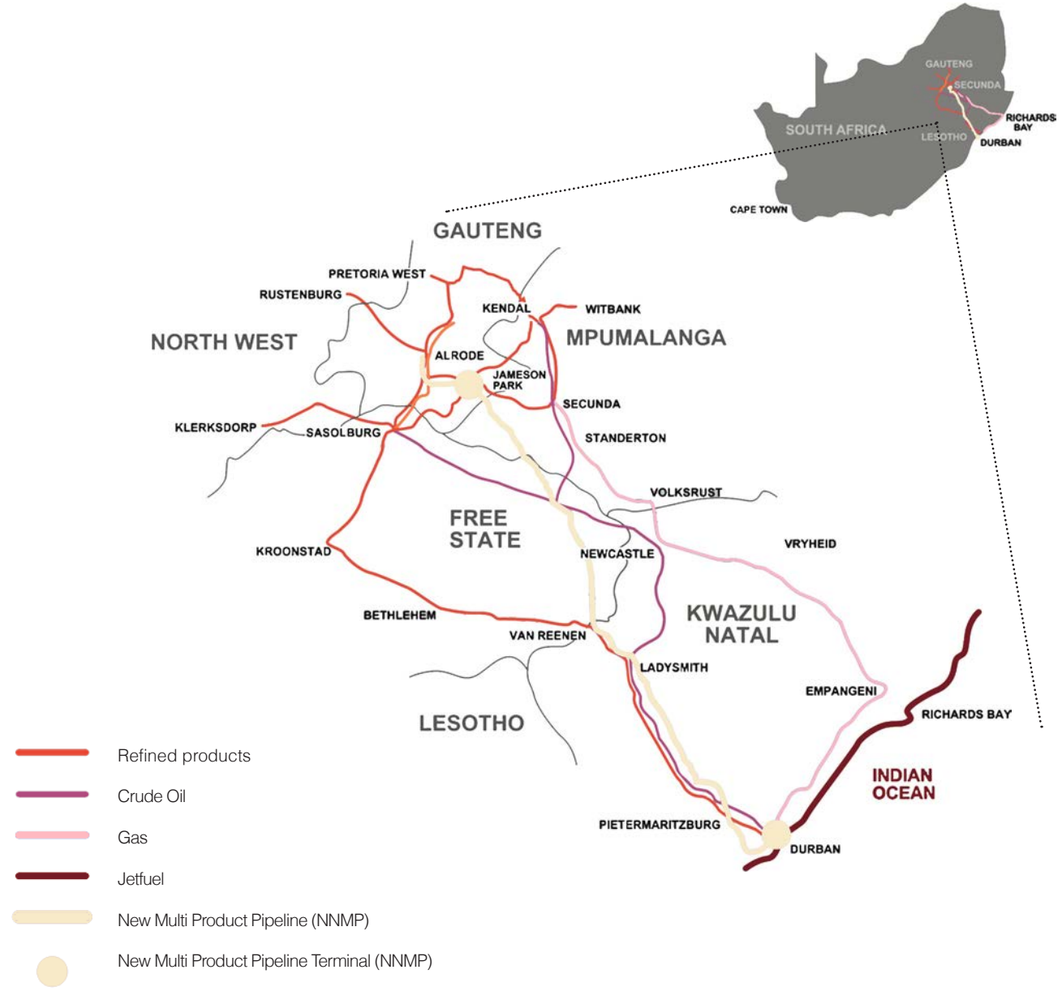


Fig 3.8: Diagram showing the current 3800 kilometre industrial pipe network that operates in relation to the oil refineries in Durban (Author, 2021) adapted from (Transnet, n.d.)

The South Durban Basin becomes a node upon which the entire country is reliant on to supply rising fuel needs.

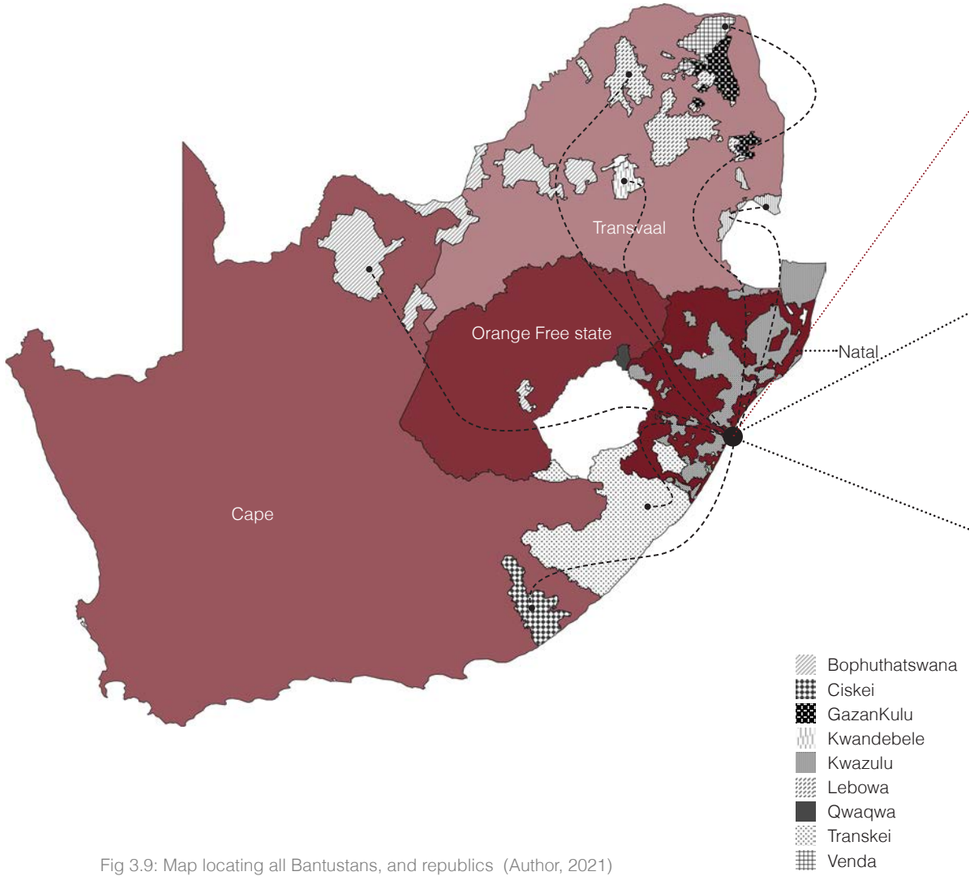


Fig 3.9: Map locating all Bantustans, and republics (Author, 2021)

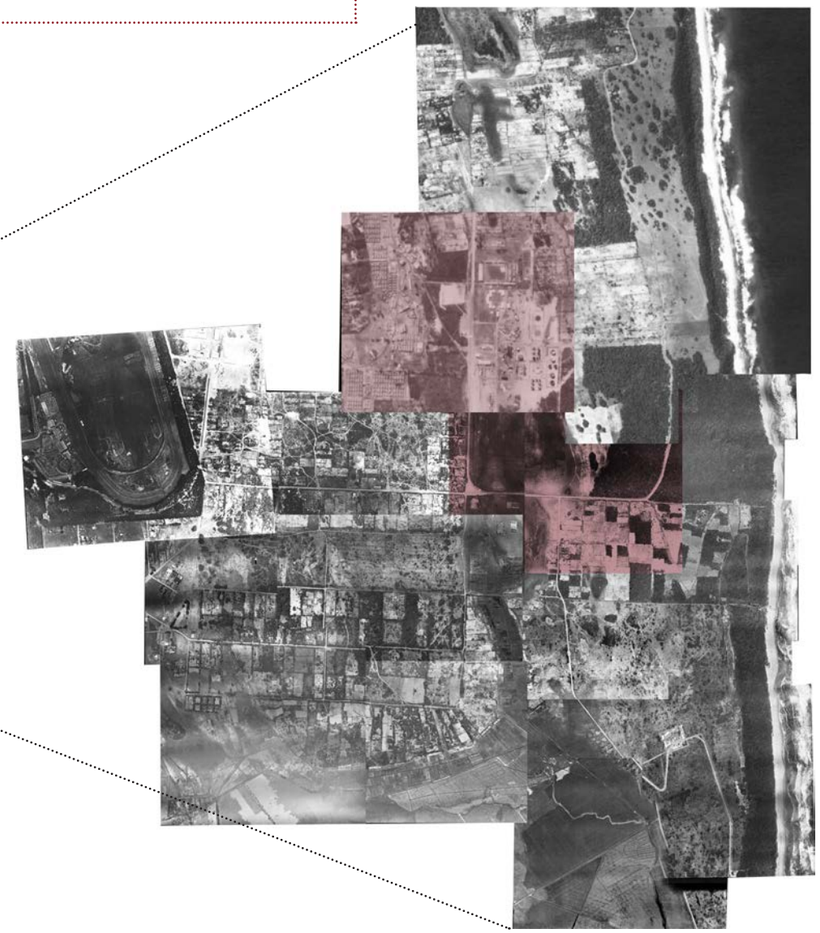


Fig 3.10: Aerial collage of Merebank and Wentworth, during the 1930's-1950's (Author, 2021) adapted from: (Department of Rural Development and Land Reform, 1953)

The rise of the industrial landscape

In the years preceding 1954, before developing an adequate refining capacity, South Africa relied entirely on importing refined petroleum products. However, in 1954, Mobil (now Engen Petroleum) commissioned the first crude oil refinery in the country. A joint venture between Shell SA and BP Southern Africa led to the commission of the SAPREF refinery in 1963 which lies further south. This meant that the residential zones planned for the area would firstly be located within the most unsuitable terrain and secondly lie within a heavy industrial zone.

These infrastructural interventions as displays of economic power by the government informed movement patterns and established corridors of industry, trade and commerce that maneuvered through the predetermined residential zones in the south and all the way up north east to the harbour. A natural ridge covered by thick bush in addition to the oil refinery separated the dense Coloured communities in Wentworth from the White seaside neighbourhood of the Bluff while the Indian and Coloured communities are separated by a single road which is one of the main routes leading to the freeway.

The steady rise of industry in the area continued throughout the 60's and 70's with a further expansion of the SAPREF facility in 1967 and the construction of Mondi paper mill in 1969. During 1972, further expansions took place that eliminated the need for importing base oils for lubricant production thus setting up a major contributor to the economy of the country[4] (South African Petroleum Industry Association, 2014).

One of the major contributors to the territorializing of space was the construction of Louis Botha international Airport in 1951. Functioning as the international airport for KZN promoted the South Durban Basin as a highly industrialized zone with a subsidiary residential function. The presence of a heavy industrial footprint profoundly overshadowed the lives of all residents in the area which subsequently saw the rise of environmental activism in the latter years of Apartheid.

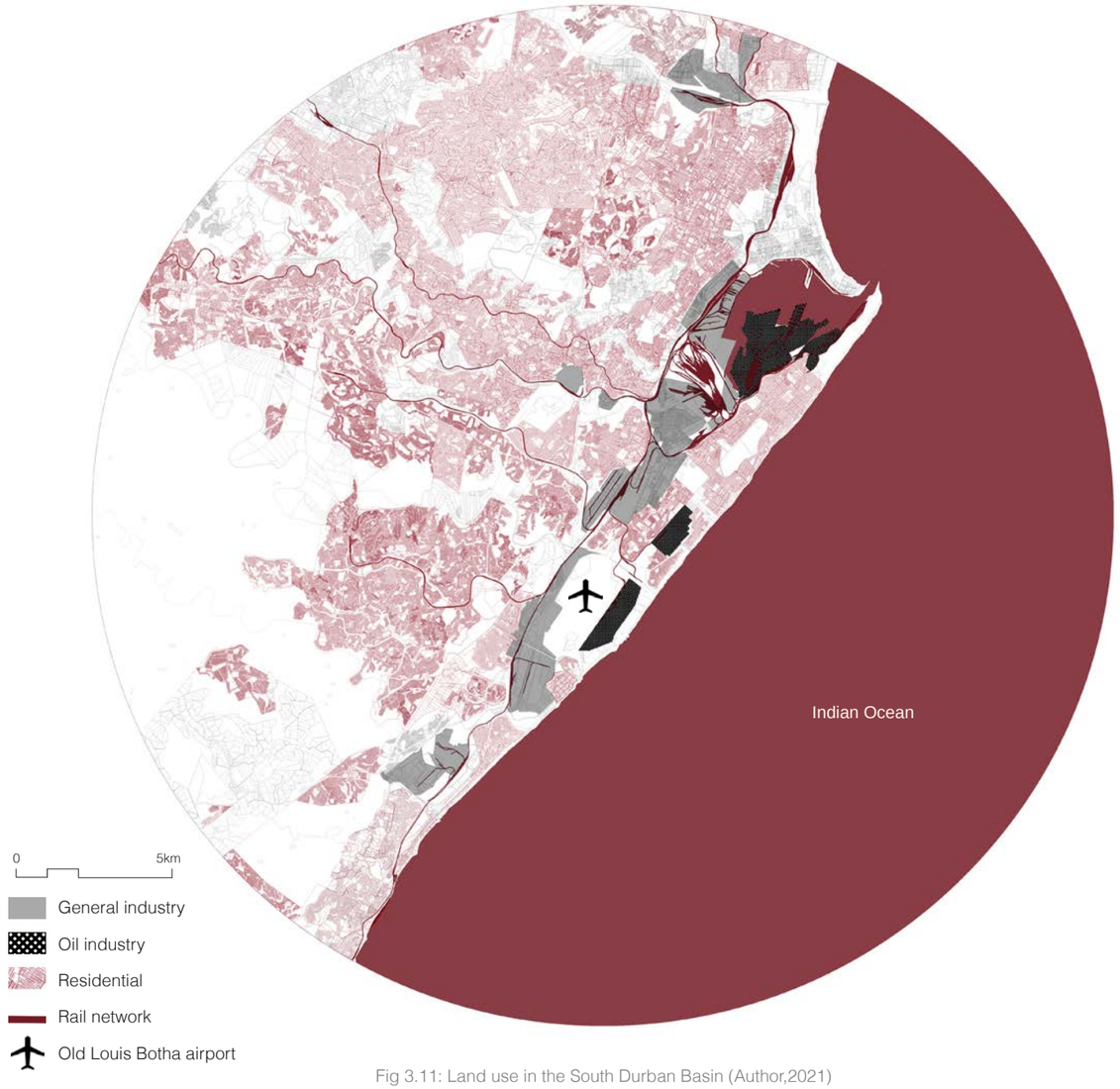
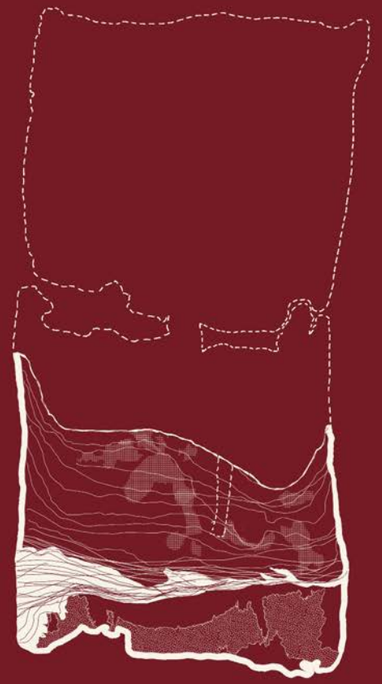


Fig 3.11: Land use in the South Durban Basin (Author,2021)



4. Identity, Place and territory

- Territories of race and space
- Suburban archetypes
- Ad hoc place making
- Post apartheid rehabilitation

Territories of race and space

Historically the blend of industrial and residential typologies was never a good form of hybridization, but in this case, it brought about new paradigms of identity, race, cultures and spatial rituals. Toxic urban design and political structures have not only determined the spatial inequities of the past but have also had a major impact on the forging of identities and the idea of place and culture, both of which are interlinked and often become a complex topic in academic discourse.
Historian, Mohamed Adhikari (2006), argues that, in the case of South Africa, this discourse is often centered around the battle between black and white with Coloured and Indian identities and narratives interspersed in the grey area or given peripheral attention. This could be attributed to the fact that the black and white demographics make up most of the national population. However, The South Durban Basin is home to more than 50% of the provincial population of Indians and Coloureds. The space around the refinery allowed for the emergence of a strong Coloured and Indian identity to be formed involuntarily because of the racialized zoning imposed onto the landscape as previously discussed. (link to referenced dot diagram showing the population density) Generally, oppressive areas breed toxic social structures that tend to have a strong influence on place and as with the many other towns established because of this, both Merebank and Wentworth became colloquially identified as dangerous, dirty, and toxic. The separation between Coloureds and Indians created non-physical boundaries that are still present today. These boundaries prevented Indians and Coloureds from integrating with one another and bred feelings of hate and disdain setting up a narrative of “us vs them”. One of the biggest physical separators is the Engen oil refinery. Its shear scale forced the creation of two opposing residential territories between the Indian and coloured communities.

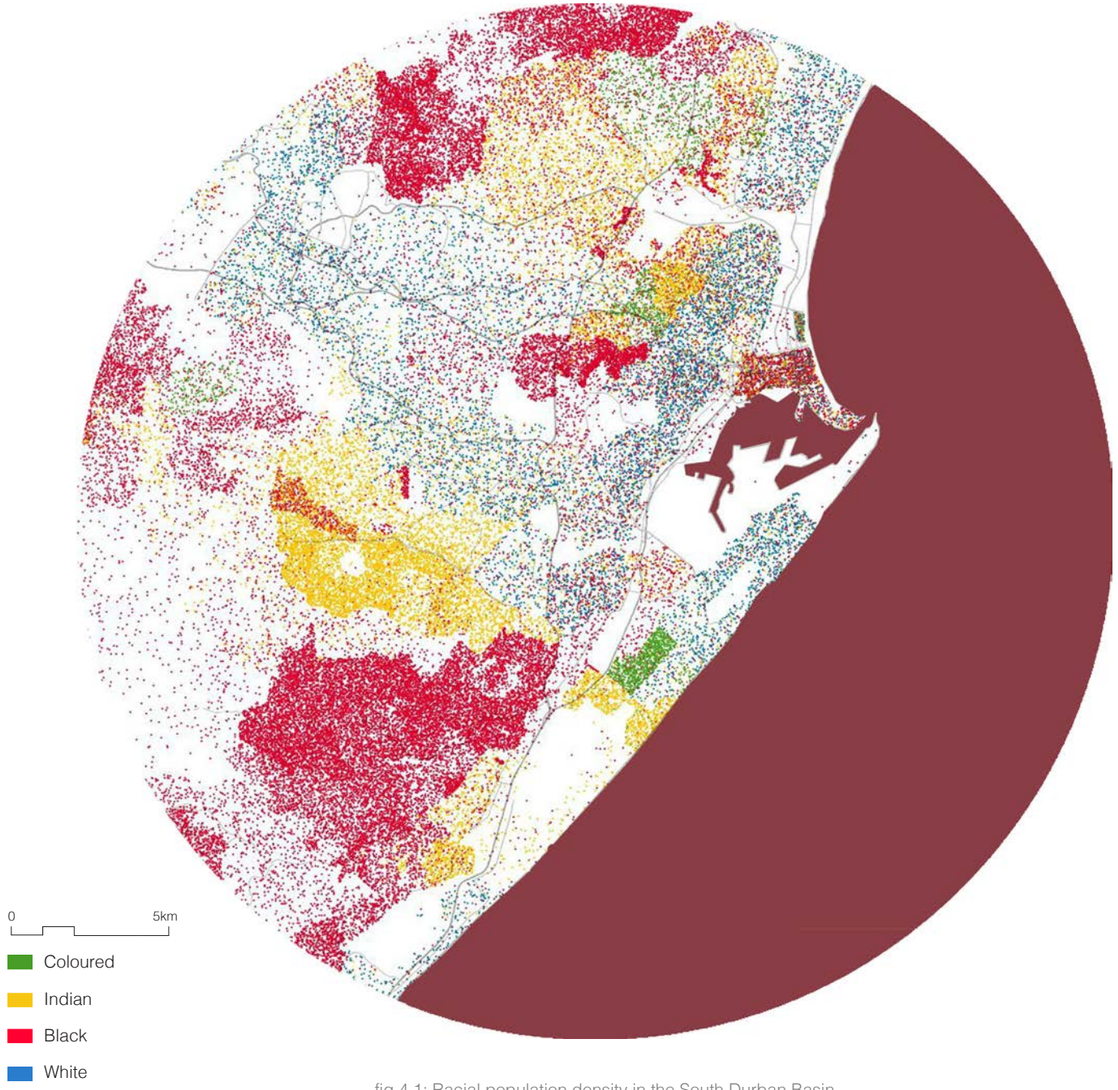


fig 4.1: Racial population density in the South Durban Basin
(Author,2021) adapted from: (Datalens, 2012)



Fig 4.2 : Photographic collage (Author,2021)adapted from: (Du toit and Gordon, 2016)

Photographers, Marijke Du Toit and Jenny Gordon (2009) who were drawn to the strong history of environmental activism in the community aimed to build up a composite portrait of the industrial-residential geographies in Merebank, Wentworth and neighboring Lamontville.

Through interviewing various residents and taking photographs with their permission, Du toit and Gordon(2009) found that “There exists a multitude of quieter, more intimate and often hidden spaces that exist within the domestic interiors which creates a contrast between power and fragility.”

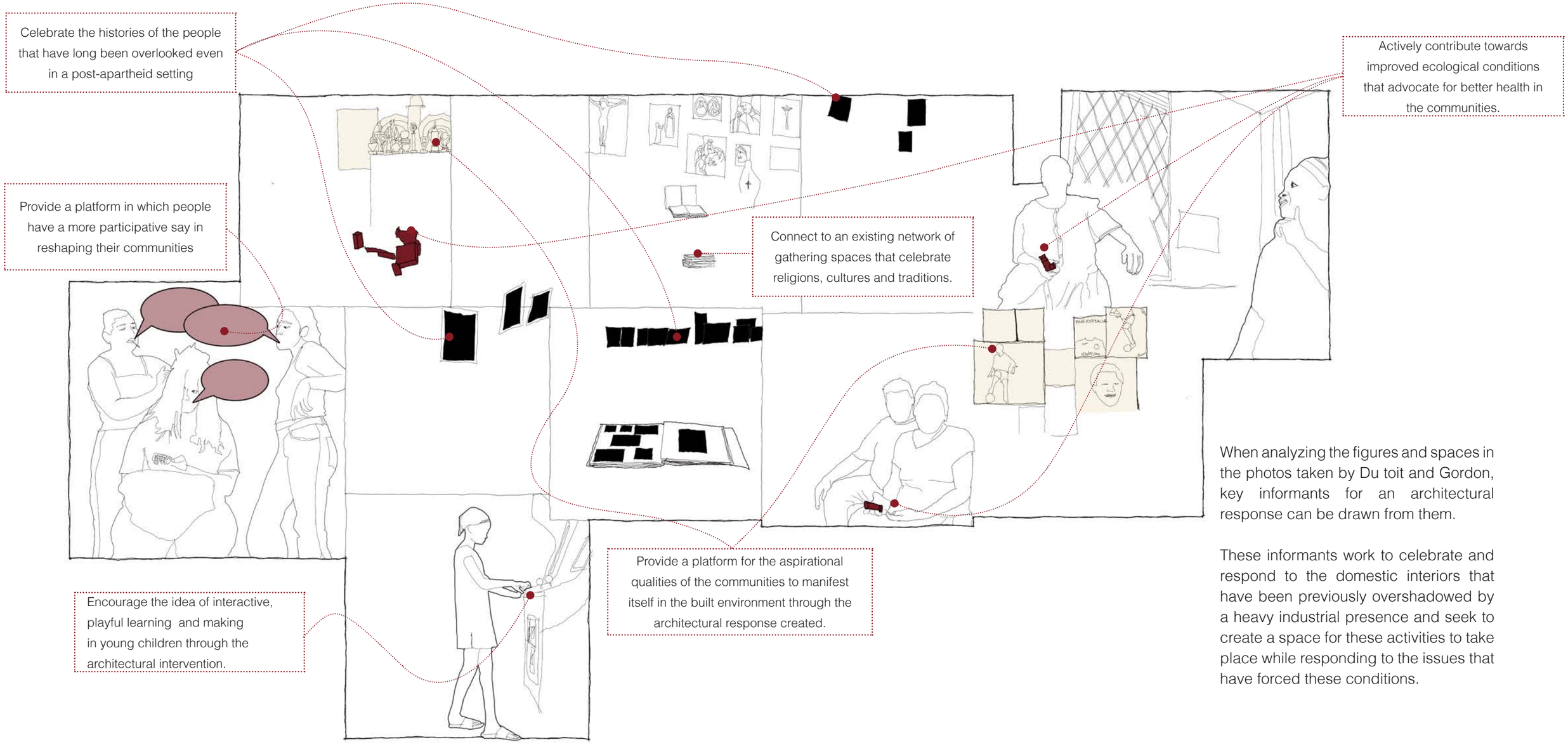


Fig 4.3 : Analysis of collage (Author,2021)

When analyzing the figures and spaces in the photos taken by Du toit and Gordon, key informants for an architectural response can be drawn from them.

These informants work to celebrate and respond to the domestic interiors that have been previously overshadowed by a heavy industrial presence and seek to create a space for these activities to take place while responding to the issues that have forced these conditions.

Suburban archetypes

A key component that further divided the communities were the provision of economic and sub-economic housing. The planning and construction of these houses were done in accordance with the implementation of the group areas act. The housing archetypes were used in a suburban setting and rolled out at a mass scale to accommodate for non-white occupancy. While racial boundaries had an overarching influence on the demographic makeup of the communities, common urban design principles were followed in planning the suburban layout to extend the oppressive architecture of apartheid into private everyday spaces.

The first being that civil and retail institutions were used as nodes and surrounded by residential areas all within walking distance to alleviate the need for movement into white areas. Secondly, yard sizes were reduced to cater for denser communities and lastly, the design of houses with outside toilets. Sociologist Paul Edwards (2017) argues that, “the naked toilet stood as a symbol of ongoing inequality and incomplete infrastructure”. First used as a design mechanism to separate the black workers from white residents in well off areas, the use of these toilets was incorporated into the homes of the Indian and Coloured communities in Durban. Both the Coloured and Indian communities can be understood as forms of low-cost urbanism. However, within the neighbourhoods, hierarchies of wealth and social statuses were formed based on where one lived or attended school. This was further intensified with the construction of flats towards the late 70’s.

For example, people who lived in the double storey semi-detached houses were perceived to be of a wealthier demographic because of their immediate access to a private outdoor space, place to park a vehicle and the general sense of owning more space to those who resided in the single-storey flats who were of a poorer demographic. In a 2007 documentary titled “what kind…?” (colloquial slang for what’s up?) Peter Mckenzie and Sylvie Peyre document the realistic nostalgia of Wentworth and the conditions at the time of filming. In an excerpt discussing his family’s forced placement in Wentworth, McKenzie paints a vivid picture of the houses provided and the settings they were placed in.



Fig 4.4 : Church in the foreground with refinery in background (Mbele, 2021)



Fig4.5 : Children play football outside their homes (Ward, 2018)



fig 4.6: View down Dinapur road (Harper,2014)

“I was born in the East Coast city of Durban in 1955 to deeply charismatic Christian parents. The sheltered middle-class family environment done little to prepare me for the ordeal of moving to the township of Wentworth...my mother wept when she first saw our sub economic air brick asbestos roofed house which looked as if it had been manufactured elsewhere and dumped onto a sand dune like in a Monopoly game which it was. My father’s morning prayers were interrupted by screaming passenger jets making their descent to the nearby Durban International Airport. Jeopardizing the requested blessings for the day. Surrounding industries meant that you awoke to the sour stink of…The rotten egg smell of sulphur dioxide or industrial paint fumes depending on the way the wind blew. Any vestiges of culture were diluted in this hopeless landscape as lifestyles adapted dramatically to deal with newfound realities. Consequently, these disparate communities from areas in and around Durban stuck together more closely. Vicious gangs were formed and deadly turf wars fought effectively confining communities to ghettos within a ghetto”

– an excerpt from the documentary titled “What kind…?” by Peter Mckenzie and Sylive

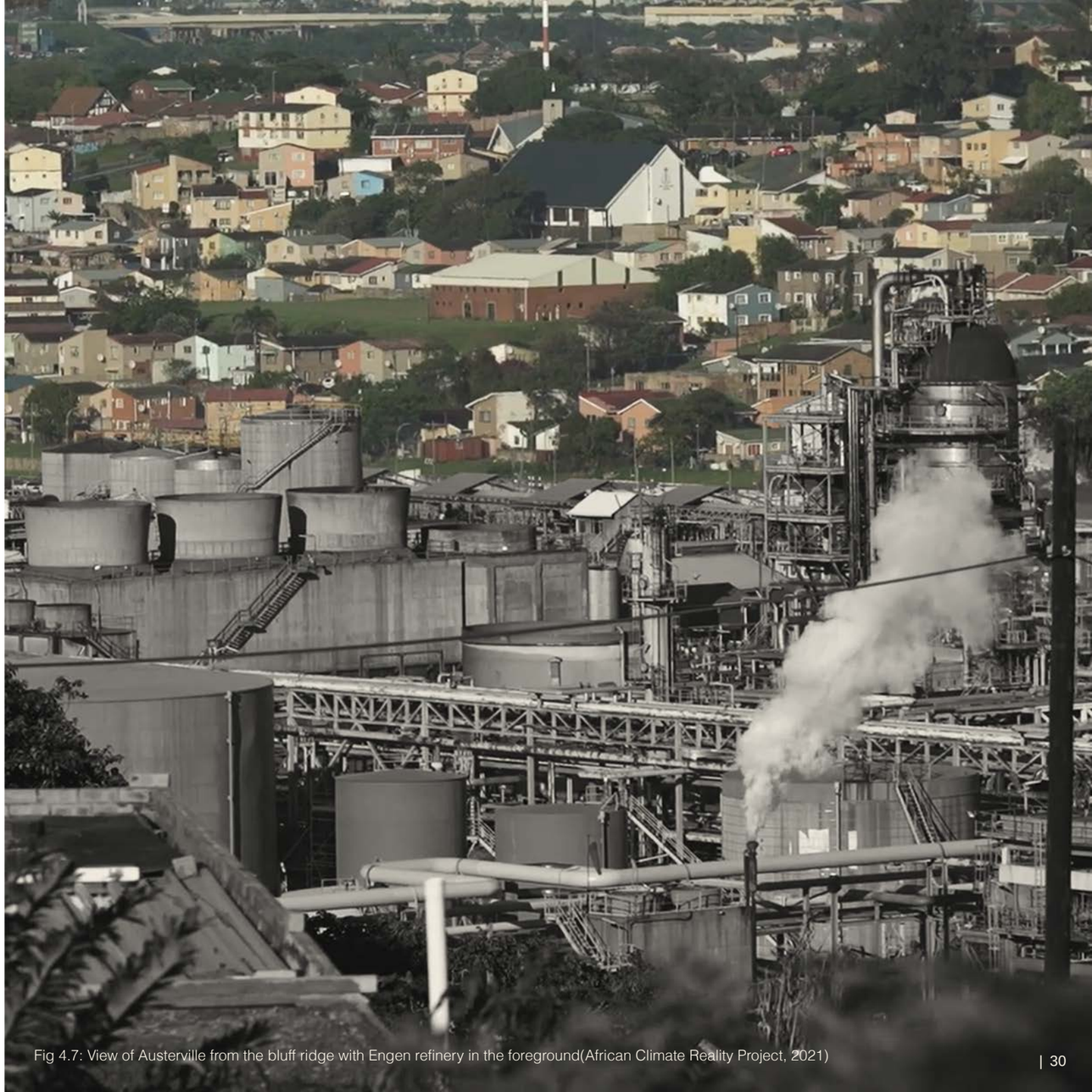


Fig 4.7: View of Austerville from the bluff ridge with Engen refinery in the foreground(African Climate Reality Project, 2021)

The first archetype used mostly in the coloured community was the double storey semi detached house. Across all uses of this archetype a common design principle was to place the toilet on the outside and have the bathroom in an awkward setting. In some cases the bathroom door would open up into the kitchen. Designed for fast and cheap construction Concrete masonry units were used in addition to standard fittings and Asbestos roofing. Auxiliary finishes such as ceilings and plaster were omitted

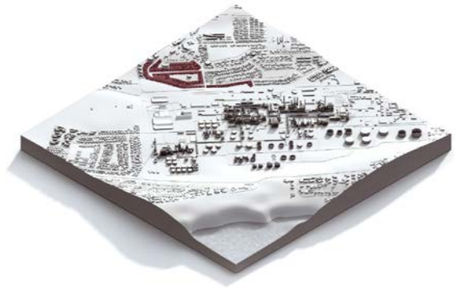


fig 4.9: Key diagram locating archetype (Author, 2021)

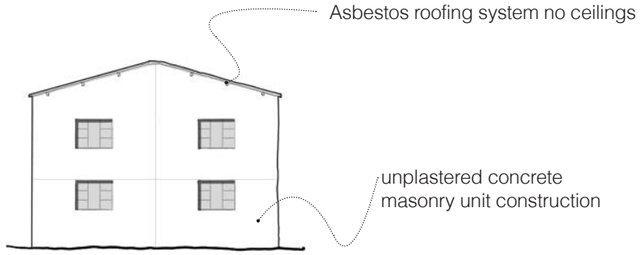


fig 4.8: Elevation of double storey semi detached housing archetype used in Wentworth (Author, 2021)

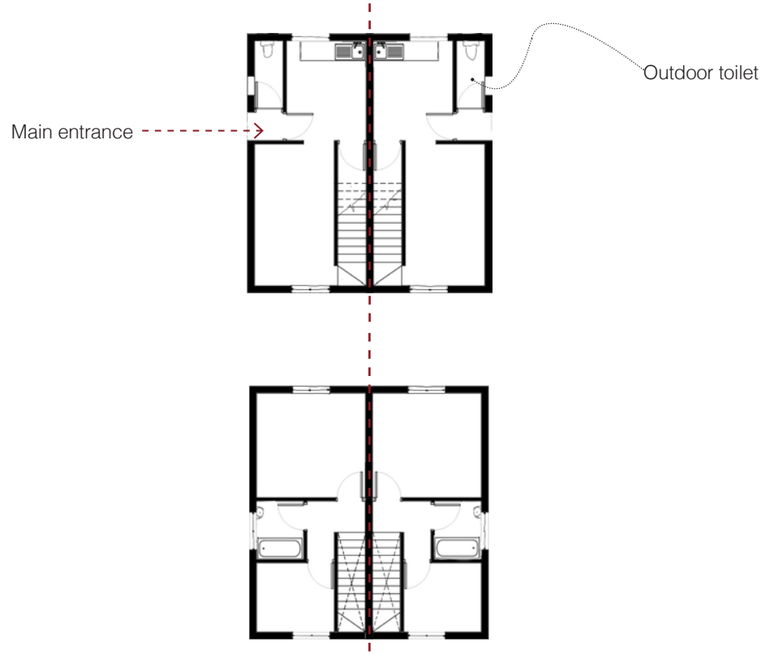


fig 4.10: Plan of double storey semi detached housing archetype used in Wentworth (Author, 2021)



fig 4.11: Wedding in Wentworth during the construction of the oil refinery circa 1956 (Author, 2021)

The second archetype was built as a single room, single storey, semi-detached unit with a kitchen and toilet. unlike the double storey unit, there was no covered access to the toilet/ washroom instead one had to walk outside before entering the toilet. In most cases, residents in these units eventually bought the units after renting for a period of 5 years and made additions and alterations as they saw fit.



fig 4.12: Elevation of single storey semi-detached housing archetype (Author, 2021)

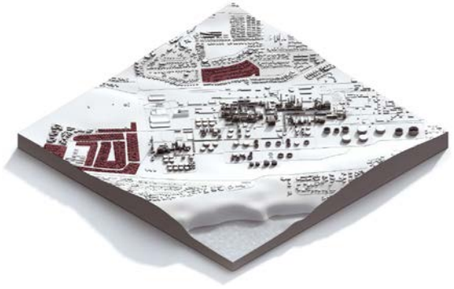


fig 4.13: Key diagram locating archetype (Author, 2021)

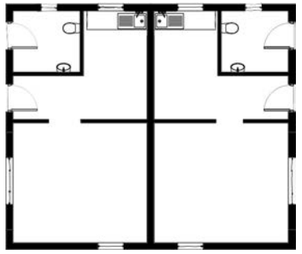


fig 4.14: Plan of single storey semi-detached housing archetype (Author, 2021)

Another variation of the single storey semi-detached unit was one that include an indoor bathroom as well as a centrally located circulation path that was accessed from all rooms in the house. While still a relatively small residential unit, in principle this housing archetype displays good spatial coherence established through a rigid ordering of space.



fig 4.16: Elevation of single storey semi-detached housing archetype 2 (Author, 2021)



fig 4.15: Key diagram locating archetype (Author, 2021)

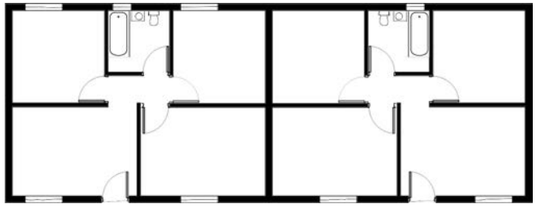


fig 4.17: Plan of single storey semi-detached housing archetype 2 (Author, 2021)

Initially built as a temporary residence to house people arriving from Cato manor. The makeshift row housing or "mini town flats" as they colloquially became known, became a permanent housing scheme for the poorer demographic. Consisting of only two rooms and a kitchen, residents had to make use of communal toilet with open air drainage as well as communal troughs for bathing and washing. It was only until the latter years of Apartheid that this archetype was either demolished or in the case of Austerville, upgraded with the provision of private toilets.

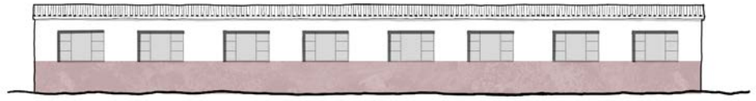


fig 4.18: Elevation of single storey temporary housing archetype (Author, 2021)

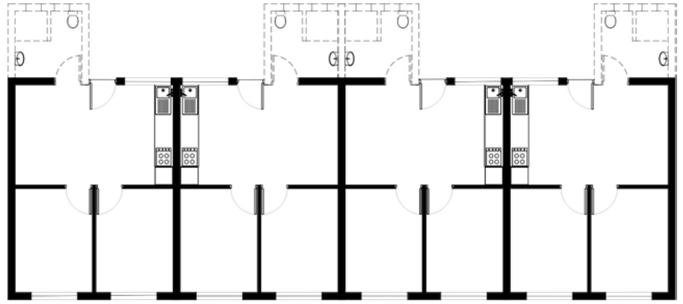


fig 4.20: Plan of single storey temporary housing archetype (Author, 2021)



fig 4.19: Key diagram locating archetype (Author, 2021)

Following the poor conditions of the single storey row housing scheme, many sites housing the archetype had to be demolished and a double storey variation was introduced in Austerville as well as Merebank. This new variation did away with the communal toilets through the inclusion of private bathrooms designed for each unit. The main entrance into the apartments led into the kitchen, from which the two rooms and bathrooms were accessible. Within each row, there was a single unit that consisted of two bedrooms as well as a lounge. However, this unit was only incorporated into the design of the scheme when the site boundaries permitted the inclusion of a larger building footprint.

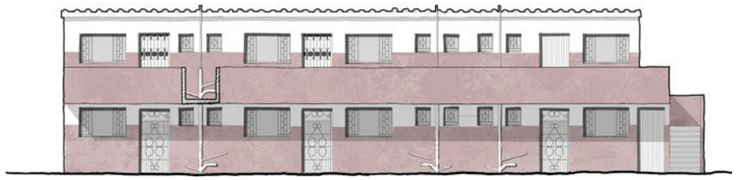


fig 4.22: Elevation of Double storey apartment archetype (Author, 2021)

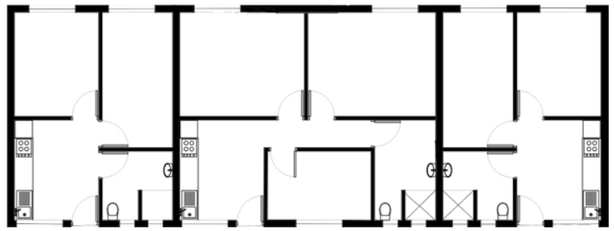


fig 4.23: Plan of Double storey apartment archetype (Author, 2021)



fig4.21: Key diagram locating archetype (Author, 2021)

Along with the design and construction of the double storey units, triple storey apartment blocks were also introduced. The first archetype consisted of 6 apartments that shared a centrally located stairwell. The design of each unit was based on the single storey semi-detached unit previously introduced in the group areas act. Entrance into each unit came from the central circulation core and opened into the living room space. This variation of the triple storey block was used mostly in Austerville on larger sites. that could accommodate at least 3- 4 blocks placed near to each other.

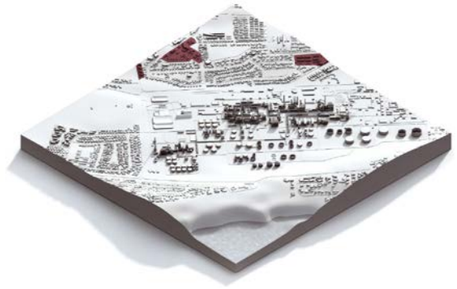


fig 4.26: Key diagram locating archetype (Author, 2021)

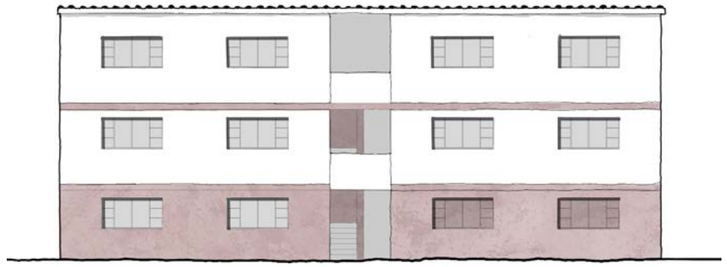


fig 4.25: Elevation of triple storey temporary housing archetype 1 (Author, 2021)

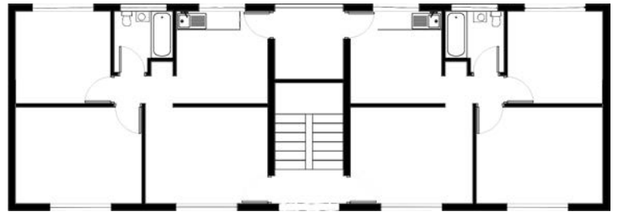


fig 4.27: Plan of triple storey temporary housing archetype 1 (Author, 2021)

The last variation of the triple storey units was introduced in Merebank. With all six units essentially designed as semi-detached housing, they shared an externally located stairwell. The overall footprint of the apartment block was smaller than the overall footprint of the previously discussed archetype, however, this meant that the sizes of internal spaces could be better articulated, and an additional room could be included. Unfortunately, this meant that 2 of the 3 bedrooms as well as the bathroom opened directly into the kitchen while the third opened up into the lounge. Spatially, the design of this unit was flawed even though it has the resemblance of a modern-day apartment.



fig 4.28: Key diagram locating archetype (Author, 2021)

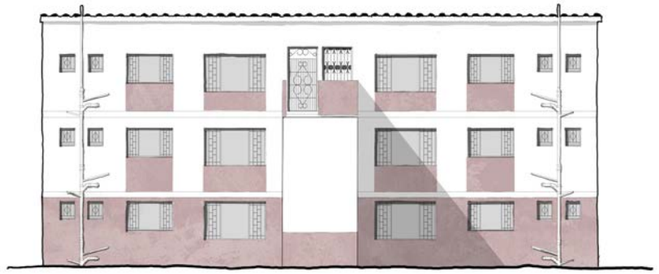


fig 4.29: Elevation of triple storey apartment archetype 2 (Author, 2021)

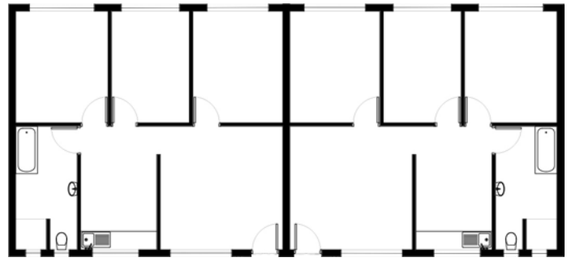


fig 4.30: Plan of triple storey apartment archetype 2 (Author, 2021)

The sketch below shows how people have adapted the residential typology of the group areas act to favour social interactions and integrate the activity of the street edge into the domestic interiors of their homes.

Rigid typology is softened through place making

Boundaries are active spaces

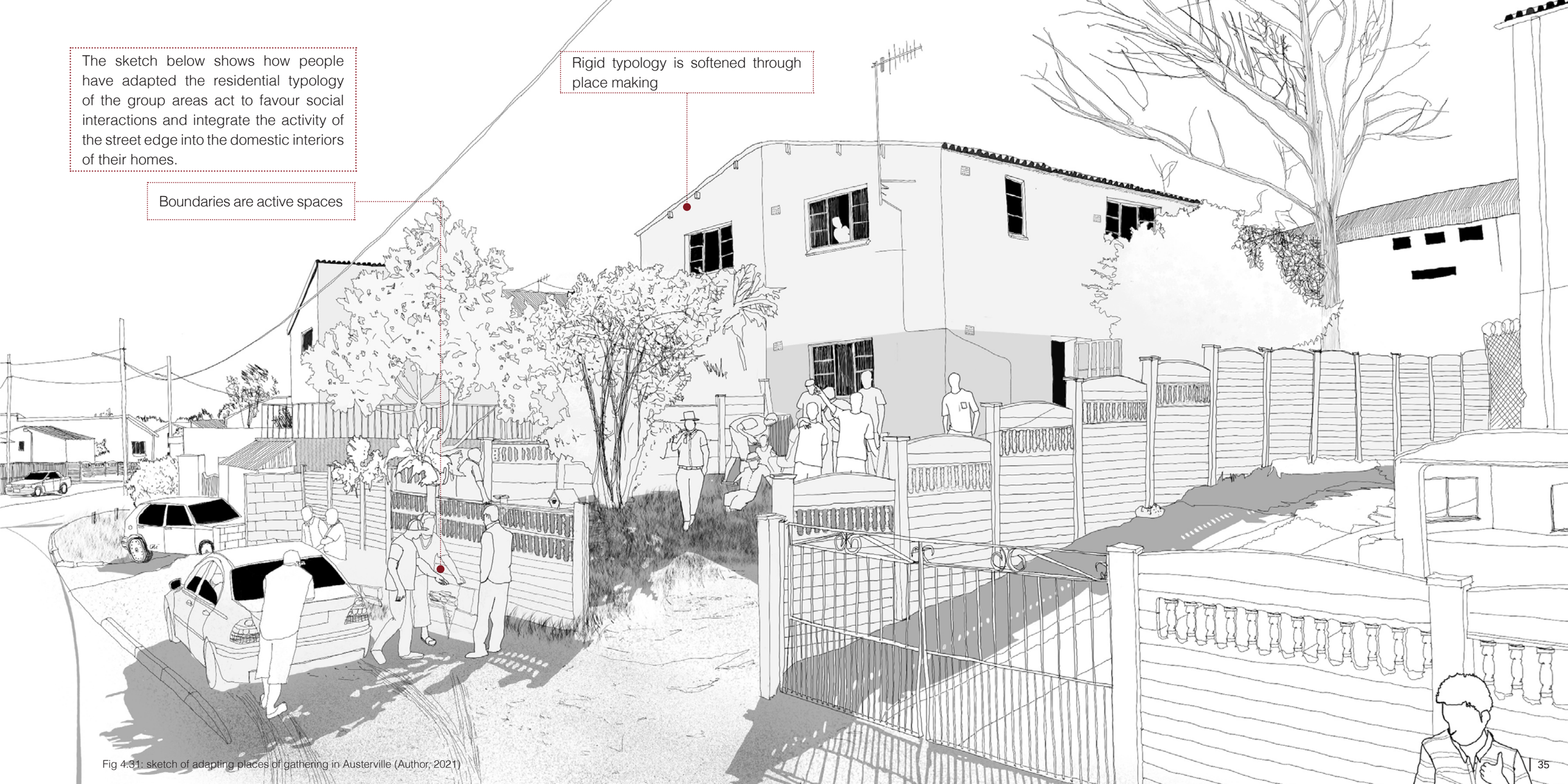


Fig 4.31: sketch of adapting places of gathering in Austerville (Author, 2021)

Ad hoc place making

Over the years people living in these units eventually gained ownership and brought about a new existence to these homes. With the flatter part of the landscape currently housing industrial functions, people in the residential areas took advantage of the hilly landscapes to extend their houses across varying levels in very interesting ways. One the most prominent features that occurred during this time is the construction of outbuildings and tuckshops which is still common practice to date.

These buildings had no set design principles because it was based on the requirements of the owners as well as their financial capabilities, but it saw the creation of new economies that were somewhat reminiscent of the market gardeners who had been previously displaced. Boundary walls became places to meet and socialize. Washing lines were shared between the families in the main house and the renters in the outbuilding which enticed more social interaction, and this became the start of microeconomies and subsidiary nodes within the residential territories thereby dissolving the predetermined urban conditions set out by in the original planning of these neighbourhoods.

The problem, however, lies in the fact that while all this occurred, these changes to the suburban condition was still separated by race.

In conversation with a former resident of Merebank, it was found that this led to the emergence of gang cultures which found its way into schools and other aspects of daily life as well. The factions weren't merely fighting for territorial control but for superiority over the neighbouring ethnic group as well. Social gatherings between Indian and Coloured communities became very tense events that harboured immense hostility and almost always erupted in fights. Arguably this had a profound effect on the perceived boundaries between the communities

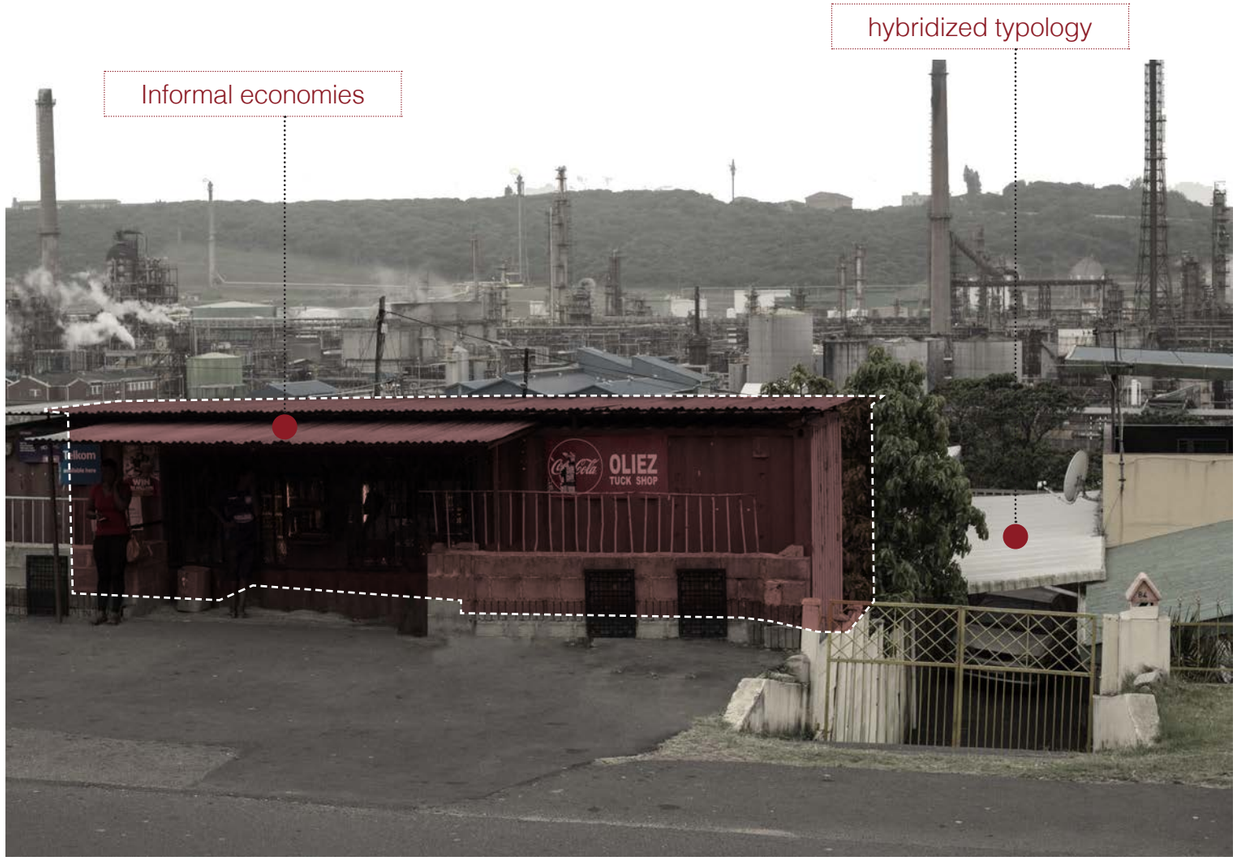


Fig 4.32: Tuckshop in Merewent with refinery in Background (Author, 2021) adapted from (Ward, 2020)



Fig 4.31: sketch of Merebank Shopping centre showing the commercial archetype
(Author, 2021)

Post Apartheid rehabilitation

One of the most prominent events that took place after the end of apartheid was the removal flats that neighbour the oil refinery. Initially built as temporary residential units during the 50's to house people removed from Cato Manor, the rainbow flats as it colloquially became known because of its similarities to a battery chicken farm, eventually became the permanent residence for many Coloured people up until 2013. After years of neglect and almost no maintenance, residents were forced to relocate to another site with government subsidized apartments which lie directly opposite the freeway. Even though the move was for the better well-being and living conditions of the residents, it tore them away from the very community that their cultures and identities had been shaped around and provided little to no access to any of the public facilities that they previously had access to.

The new housing scheme that they occupied was poorly built and resembled strong similarities of the previous housing schemes provided with no direct access to any public recreational facilities or any other form of betterment. Currently, with tensions less apparent but still existing between the communities, the well-established racial zones of the past have created territories that make one feel as if they do not belong in the residential area of the other race. This alludes to perceived boundaries within the two communities. The 2011 census shows this urban condition to be true. One of the positives that came from the end of apartheid meant that movement of non-whites in and out of the Bluff and other white areas around Durban was not prohibited anymore. Places like beaches, shopping malls, casinos, parks and nature reserves became neutral zones in which all boundaries of race were dissolved. The problem however is that even though these conditions provided for new ways of racial integration, once a person goes home after a day out, the residential zones in the South Durban basin and Durban at large still exist as a bitter reminder of the segregationist urban model setup all those years back. Another strong unification factor in the area is the strong sense of environmental activism.

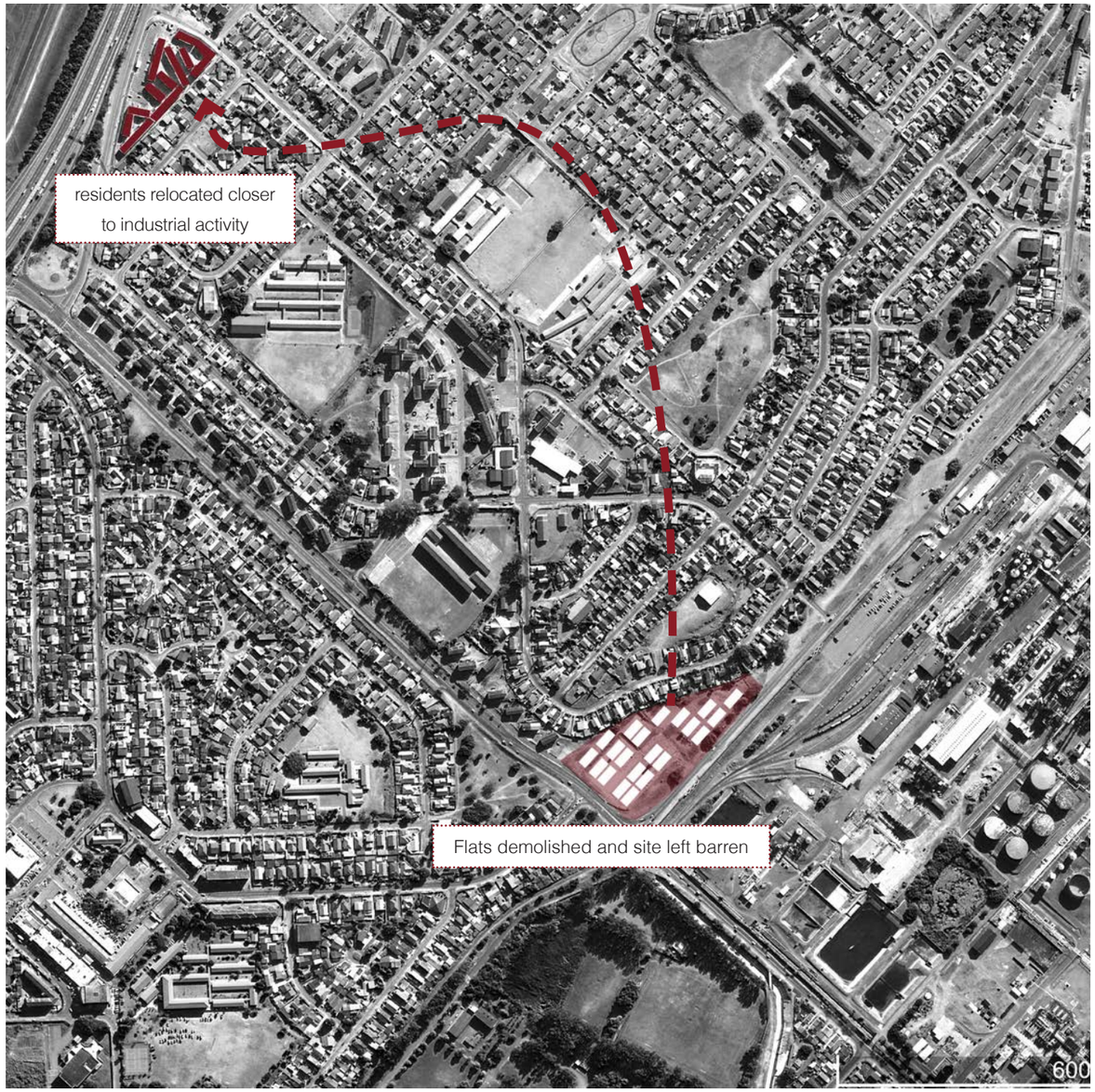
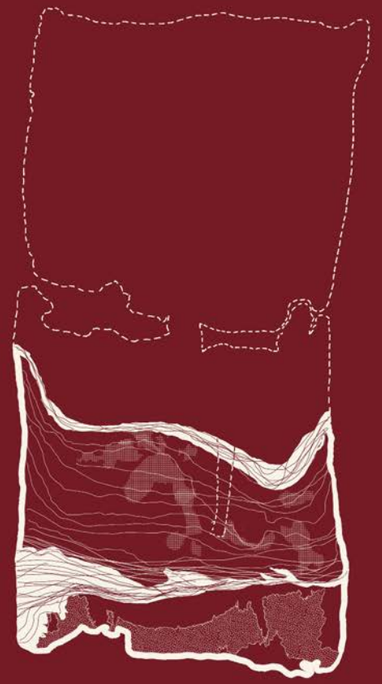


Fig 4.31: Aerial view of the site showing relocation of residents in Austerville (Author, 2021)adapted from (Google Earth ,2021)



5. Reprogramming toxic heterotopias

- Dismantling homogeneous spaces in toxic heterotopias.
- Case study: the wedding Marquee

Dismantling homogeneous spaces in toxic heterotopias.

Having been a resident in the Wentworth since its inception, Photographer Peter McKenzie portrays a vivid story through his work in documenting his life in the Wentworth Community. In the exhibition titled “Vying Posie” which translates to going home, He tells the story of the community in a post-apartheid context who felt that they were being marginalized again. This sums up the current dilemma of the South Durban Basin. The people, having inherited these geographies, cultures, territories, and thresholds have an overarching feeling that they have been overlooked by the wave of optimism and change that accompanied democracy in 1994. While the previous generation were forced to adopt a culture of cohabitation with people of the same race but from different areas with different cultures and values, the current generation of residents have had to forge new identities from the fragmented histories of their predecessors.

This poses the question of what spatial rehabilitations would implicate sustainable change in the area? One such approach to this is to rethink the status quo of urban regeneration and municipal development programs that seek to pacify the cries of the residents. Instead solutions that are mindful of the current urban conditions across all layers need to be proposed. Architectural programming can be defined as the function of space based of the research and decisions undertaken in the design process. In the context of the site, with the refinery being an emplacement established over time, it can be argued that the surrounding areas as well as the refinery exist as a form of a heterotopia.

Consisting of a juxtaposition of varying spaces, functions, people, and beliefs. Michel Foucault(1997) first explored the idea of heterotopias as cultural, institutional and discursive spaces that form ‘other’ spaces. In his essay, ‘Of other spaces Utopias and Heterotopias, he argues that the space in which we occupy, is heterogeneous. He goes further to state that. “The guarantee of freedom is freedom itself and that architectural form alone, does not possess the ability to address such questions, however, it could have positive outcomes when ‘the real practice of people in the exercise of their freedom’ is juxtaposed with liberating intentions of an architect”. This goes beyond the idea of collaborative design but instead suggests a shift in power to the people who occupy space in defining what their idea of place can be.



fig 5.1: residents gather outside Austerville flats on a Saturday afternoon(Houston, 2009)



fig 5.2: Residents gather outside Wentworth flats on a Saturday afternoon(Houston, 2009)

In his book, Becoming Places, architecture critic Kim Dovey (2010) comments on the practices and politics of place and identity formation. He argues that throughout western philosophy, empiricism has repressed the idea of place to become an abstract 'location' within spatial coordinates, i.e. to exist on a site. This can be clearly seen with the establishment of racial territories driven by a political agenda and thus has created the site/s for place making to occur. For the purposes of this exploration and the proposed design, a clear differentiation between space and place needs to be established. Space can be considered the medium in which place manifests itself. While space has a physical dimension to it, place creates the essence of what a space can be through the emergence of territories, thresholds, and in-between spaces. All of which coalesce to create the urban condition. Placemaking is entirely dependent on a social catalyst. Therefore, to gain a deeper understanding of place, a conceptual breakdown of social constructs is required. Referring back to the work of Maylam,(1995) he argues that academic research to date, has placed much focus on well-developed metropolitan areas while areas of a lesser density or smaller towns were left poorly documented and marginalized. While this is true especially in the case of the study area, it did not stop the people living there to forge their own cultures and identities. One way in which cultures were formed is the use of a temporary architectural typology in the form of a marquee and the subsequent spatial rituals that followed.



fig 5.3: Residents in Austerville (Grossman, 2018)



fig 5.4: Urban Context in Wentworth overlooking the refinery (Du toit and Gordon, 2004)

CASE STUDY: The wedding Marquee

When event venues were not a feasible option, families opted to erect a marquee for weddings and other events like religious gatherings, birthdays or family reunions. Weddings are interesting because the marquee structure is constructed and remains for at least four days to cater for the event and even though it is essentially a tent, a range of contrasting activities occur there. Thereby creating a micro- heterotopic space. The marquee will be transported to the wedding house and erected on a Thursday morning.

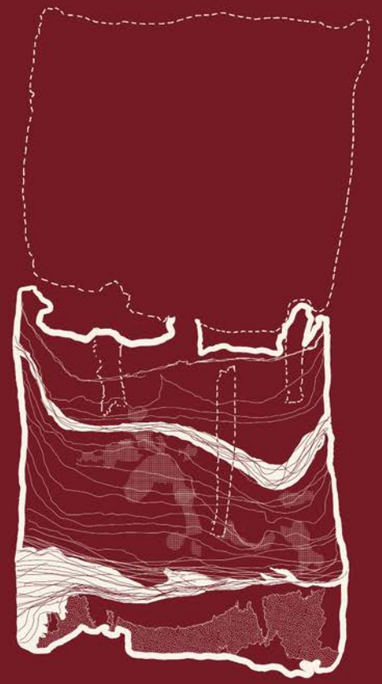
The entire day it will be filled with family members prepping food and other assortments for the wedding. Men can be seen drinking and playing cards, and children playing catch by throwing a tennis ball onto the roof of the marquee while their mothers chat and cut vegetables around a trestle table. Towards the end of the day, the interior space will be transformed from a flexible work space into a social space with chairs and a stage for the next day. Friday would see the interior space become a space for pre-marital rituals (depending on the religious denominations of the families) in the morning and a party in the evening as well as a make-shift dining area for wedding guests. The wedding then occurs on Saturday as a formal event and culminates in another party that celebrates the union of two families. On Sunday it becomes a passive social space where visiting family members and other wedding guests gather in small numbers, catch up while the marquee company arrives to dismantle the structure.

The wedding marquee therefore becomes an interesting example of vernacular programming in a space with predetermined boundaries which are both racial and physical. The spatial programming all has outputs that culminate in the eventual ritual of a wedding. This notion of using the space to create a new sense of place is a design concept that will be carried out in the preliminary stages of the design intervention for the future design of non-rigid programming.



fig 5.5: My grandparents celebrating their wedding inside the marquee (Author, 2021)

fig 5.6: Axonometric of the wedding house (Author, 2021)



6. The Politics of Post-industrialism

- The Post-industrial society
- Peak oil and its effects on the global market
- The case of the Obsolete Engen refinery

The Post industrial Society

Post industrialism is a term used to describe the socioeconomic shift from heavy industry to a more service orientated economy. In 1973, sociologist Daniel Bell, published a book titled, The Coming of Post-Industrial Society, which outlined a society in which service orientated businesses based on technology and information would be at the forefront of the post-industrial age. While his predictions were correct, given the reality we live in today, the architectural interpretation of post industrialism deals with the tangible aspects of a site, landscape or geographies that previously was used for heavy industrial purposes but currently lays dormant.

At the time of Bell's publication, the socio-economic changes had started taking place however, the architectural interpretation of a post-industrial society had not. This only began taking shape in recent years after global efforts to curb the effects of climate change. (Manahan, 2015). With the oil industry being one of the major contributors to all forms of pollution, the reliance on traditional fuel sources became unsustainable practice and subsequently led to explorations in alternative fuels. While this occurred, it meant that the oil industry while still very active, would see the beginning of it's decline. At the cusp of this is the closure of production facilities such as small-scale oil refineries that have lost their influence on the global market. With crude oil being a finite resource, at some point the production of refined oils will cease to exist and this deeply influences the emergence of post-industrial facilities through the concept of Peak oil



fig 6.1: Children watch a football match in a park opposite the refinery in Wentworth (Mbele, 2021)

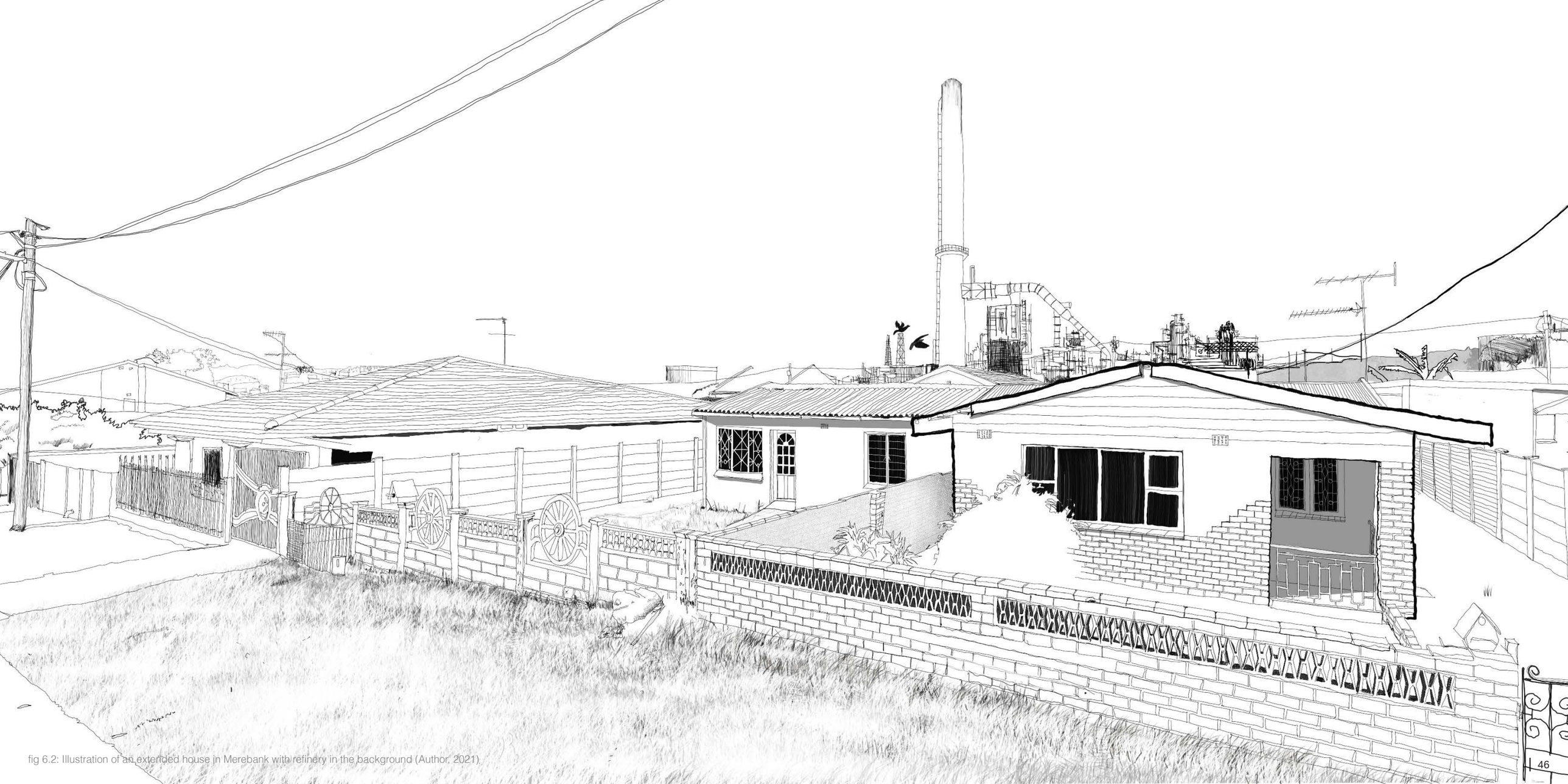


fig 6.2: Illustration of an extended house in Merebank with refinery in the background (Author, 2021)

Peak Oil and its effects across scales

Peak oil is a term used to express the point at which crude oil production reaches a plateau point after which the rate of extraction of the finite resource slows down thus making petroleum products scarcer and more expensive to produce. It was introduced by Marion King Hubbert in 1956. When graphed, he proposed that a bell-shaped curve representing oil production would be formed. He also predicted that oil production would reach its peak in America around the 1970's and that there would be a global peak towards the beginning of the 21st century. While his predictions for the United States were correct, the lack of researched data led to the global prediction being incorrect (Bardi, 2018).

Towards the end of the 1980's there was a dramatic collapse in global oil prices, and this subsequently placed little importance on Hubbert's theories pertaining to peak oil. However, in 2018, Ugo Bardi analyzed the works of Hubbert and two petroleum engineers, Colin J. Campbell and Jean H. Laherrère, who did further studies on peak oil during 1998 using the concepts and data set out by Hubbert.[5] Upon reviewing their findings and statistics pertaining to oil production, Bardi argues that while symmetry cannot be guaranteed in the bell shape curve, it still is a common feature when graphing the production process. This can be attributed to new growth cycles in oil production leading to a slower decline in production as opposed to a slower growth. He also found that Campbell's predictions regarding the date of a global peak was incorrect. He predicted that peak oil would be achieved around 2010 at about 82 million barrels a day, while other data sources[6] indicate that global production went up 97 million barrels per day (Bardi, 2018).

Although Hubbert's theory on peak oil coupled with the work from Campbell and Laherrère are inaccurately established because of volatile external factors, their partially correct predictions comment on the level of strain that will inevitably arrive with the depletion of oil reserves. This therefore regards the bell-shaped curve as an indication of the general theory relating to mineral depletion (Bardi, 2018).

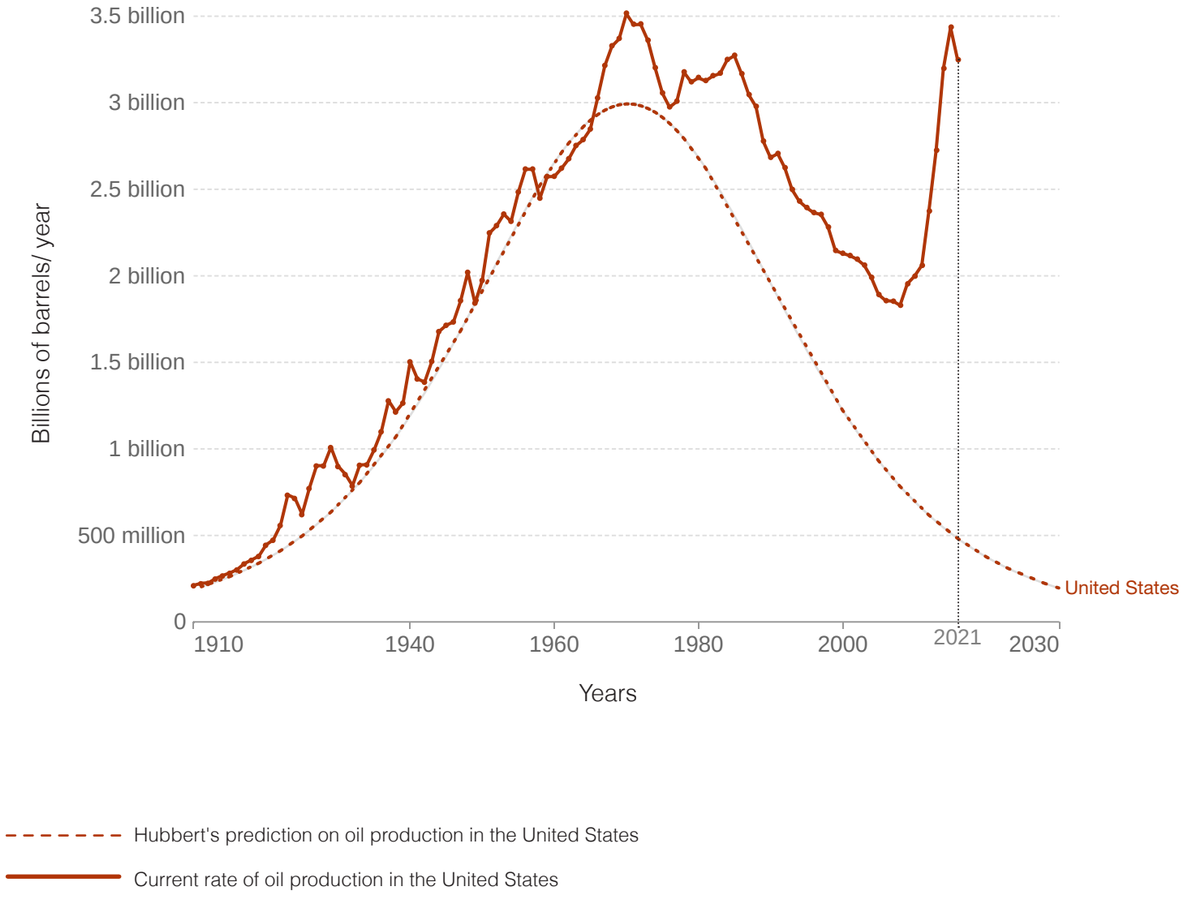


fig 6.3: Hubbert's peak prediction vs. actual oil production in the United States (Our world data, n.d.)

The case of the Obsolete refinery

With the scares presented by peak oil coupled with the emergence of renewable fuel that have gained traction in a global market, many refineries all over the world have sought to find ways of either reinventing their business models or completely transforming existing facilities into fuel storage terminals (Sundria and Chakraborty, 2021). The Covid-19 pandemic followed by a subsequent national lockdown in South Africa saw to the temporary shutdown of all major refineries in the country.

After 67 years of production and incurring annual losses for the past decade, the Engen refinery will reportedly be converted into a fuel storage terminal. This has become a norm with refineries around the world. Older refineries with smaller capacities designed for domestic consumption are finding it difficult to compete with bigger and more agile plants that export fuel. The fundamental function of a refinery is to process crude oil for a variety of different uses. Therefore, the success of a refinery is determined by the number of barrels of oil produced per day. Engen during its period of operation produced roughly 120 000 barrels a day. This fares in comparison to contemporary refineries that produce up to 400 000 barrels per day. According to Engen CEO Yusa Hassan, refitting the Durban plant to meet contemporary emission regulations will require an investment of around 40 billion rand ($2.8 billion). A task that seems completely futile when considering the financial implications this upgrade would cause. The Engen refinery's logistics have been complicated ever since U.S. sanctions on Iran cut crude supplies.

Designed to run on oil from the Persian Gulf nation, the plant was forced to use a blend of other crude grades. "Importing fuels instead makes more sense since it takes about half the time," Hassan said.
The conversion will also reduce South Africa's overall emissions. The refinery, located within a residential area, has also drawn opposition due to health and environmental concerns over pollution. It will seek to preserve jobs and may turn part of the site into an fuel storage terminal," the CEO said. The volume of fuels imported into the converted Durban unit will depend on the expansion of Engen's retail business, Hassan said. The company runs more than 1,000 service stations in South Africa and about 230 more in sub-Saharan Africa (Burkhardt, 2021).



fig 6.4: Oil spill in Umbilo river being cleaned by workers (Majola, 2020)

CASE STUDY: IBA Emscher landscape park network

The Emscher park System is one of the largest post-industrial interventions that advocate for adaptive reuse. It stretches roughly 64 kilometres and was once home to Germany's core industrial steel foundries and coal mines. With technological advancements on the rise, most of the industrial functions began leaving the area thereby leaving large sites abandoned by the late 1980's. This forced the local government to partner with local and international agencies to prevent the physical decay of the highly industrialized sites as well as the deterioration of the surrounding neighbourhoods and landscapes. The main goal was to create an enhanced natural landscape that would be sustainably developed and kept. This would set the stage for industrial remediation and renovation and allow for a reinstitution of vernacular cultures and spatial rituals. This was done through 7 set design principles.



fig 6.5



fig 6.6



fig 6.7

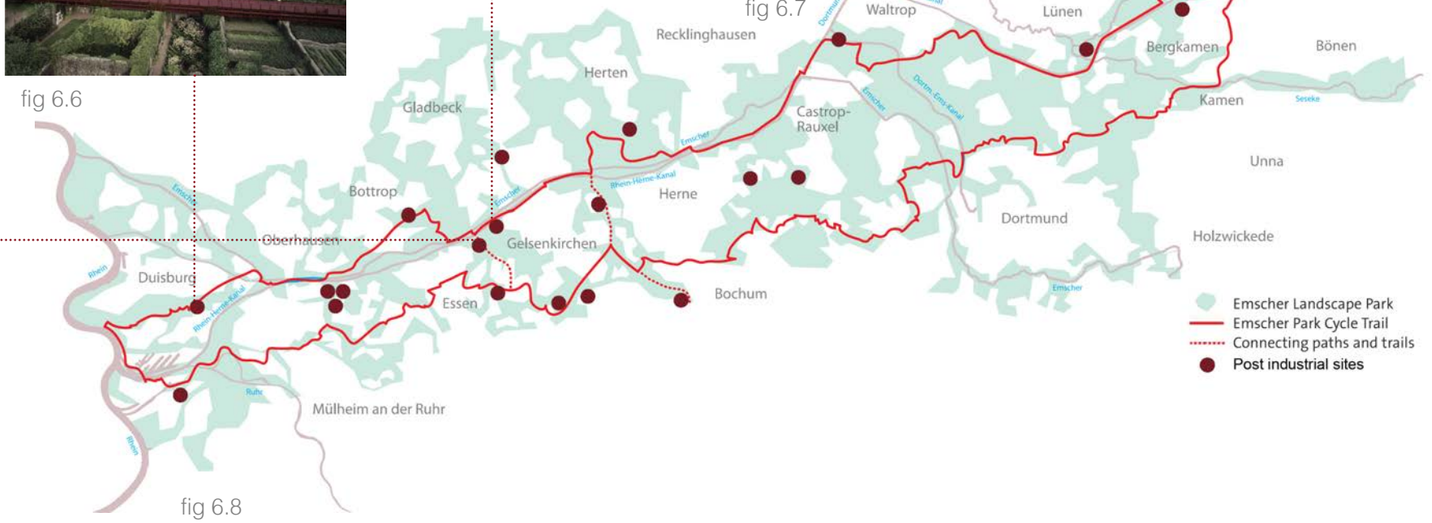


fig 6.8

fig 6.5: Gelsenkirchen park (Emscher landscape park visitors guide, 2021)
fig 6.6 Duisenburg park (Emscher landscape park visitors guide, 2021)
fig 6.7 Gelsenkirchen park (Emscher landscape park visitors guide, 2021)
fig 6.8 Map of the Emscher park network (Emscher landscape park visitors guide, 2021)

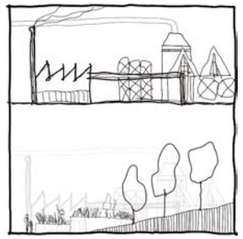


fig 6.8 Reconstruction of the landscape(Author,2021)

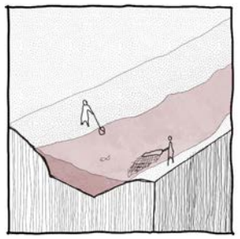


fig 6.9 Ecological river restoration(Author,2021)

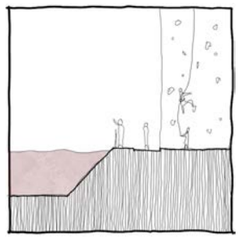


fig 6.10 Ecological river restoration(Author,2021)

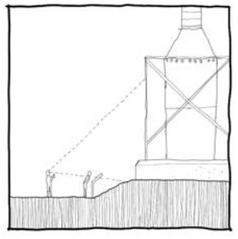


fig 6.11 Industrial heritage as national treasure (Author,2021)



fig 6.12 mixed use development in the park (Author,2021)



fig 6.13 New forms of housing(Author,2021)

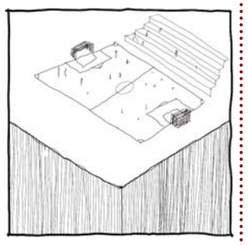
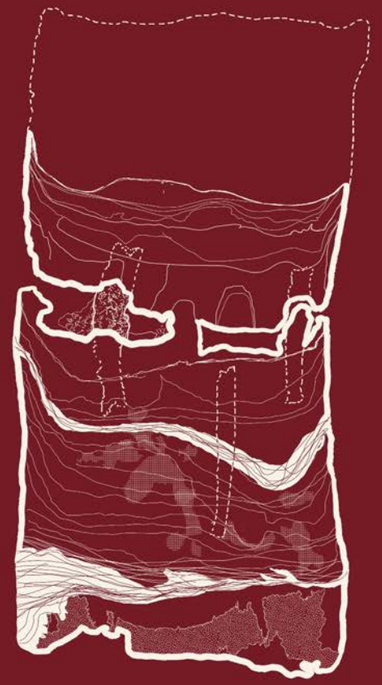


fig 6.13 New options for social, sport and culture activites(Author,2021)



7. Toxic Rehabilitation

- The rise of environmental activism
- Co- produce. Not consult
- Case Study: Multiprogram Ship

The rise of environmental activism

All residents, irrespective of race share a common belief that there is an immense need for environmental remediation in the post-apartheid, post-industrial landscape. The problem with environmental activism in the case of the South Durban basin is that all means of research and findings are highly inaccessible to the general populace. Essentially, while it is possible to retrieve this data from various information outlets, it cannot be interpreted simply to encourage change in the area without input from experts in the field of research. This is where the South Durban Community environmental alliance (SDCEA) is vitally important to this theoretical argument. To strengthen their position in challenging industrial corporations, they have appointed specialists to monitor and publish reports on ambient air quality in the region as well as to conduct environmental impact assessments on industrial facilities keen on expansion. While this is an ongoing process, the NGO has lobbied for environmental remediation through ways that also involve the communities directly affected by the presence of the industrial facilities. This has been done through communal meetings, legal representations and what is termed as “Toxic tours”. These tours are hosted by the SDCEA on request from local and global participants including universities and NPOs from America and Europe. Between 2018 and 2020, there has been 31 Toxic tours conducted in the South of Durban (SDCEA, 2020). These tours are important because it brings awareness to the challenges faced in the area and draws on the social responsibility of all the stakeholders to contribute to some form of change.



fig 7.1: Durban South residents protest at the Engen Refinery Gates on Tara Road circa 2020. (Gilili, 2020)

Co- produce. Not Consult

Through no fault of their own, marginalized communities have been located near industrial zones because of apartheid city planning. This begs the question of what would be an appropriate response to the complex racial and industrial issues that have been compounding since the inception of this urban condition? Sociologist Richard Sennett (2018) argues in favour of the process of “co-production. Not consultation” In the consultation process, when infrastructural or general building work is planned in a community by professionals, engagement between the community and the professionals is limited to public consultation.

This process involves the professionals presenting the proposed works to the community through endlessly long PowerPoint presentations filled with highly confusing infographics and selective images that all substantiate the need for the proposed works. Sennet argues that this process is done to dematerialize the essence of the project to prevent the public from engaging on how the proposed works would feel physically or be experienced throughout its life cycle. He goes further to state that the spatial organization of the consultation process is also important because in most cases, professionals present on a raised platform or stage while the community sit below almost as if done to transform the public into spectators to the thereby limiting interactions

Co- production in stark contrast to consultation puts the engagement of both parties at the forefront of all development. It draws on the technical experience of the professional and the lived experiences of the community. (Sennett, 2018) To often there is a disconnect in what is proposed by the professional and what is perceived by the user. Co-production aims to bridge the gap between the two through meaningful engagement. The forms of engagement may vary depending on the professional involved. The architects for example, will be involved in facilitating drawing workshops, walk abouts with the community on a site and assist in creating a conceptual modelling environment. Architecture schools, as argued by Sennett(2018) advocate for the construction of physical 3D models to help students and their lecturers understand complex 2D drawings and diagrams.

This provides a more intimate relationship with the eventual spaces created because it becomes tangible. This process can be adopted into the co-production method of urban regeneration as it allows the community to interact with the spaces they will one day occupy in a more visceral and tangible way. The process of making is important because it allows one to comprehend and build up a realist image of what a space, object or event might feel like. Facilitating a space for co-production therefore becomes the resultant for the premise of this thesis. The design intervention created will exist as a heterotopic space that has positive outcomes when deciding on the rehabilitation of the industrial landscape.

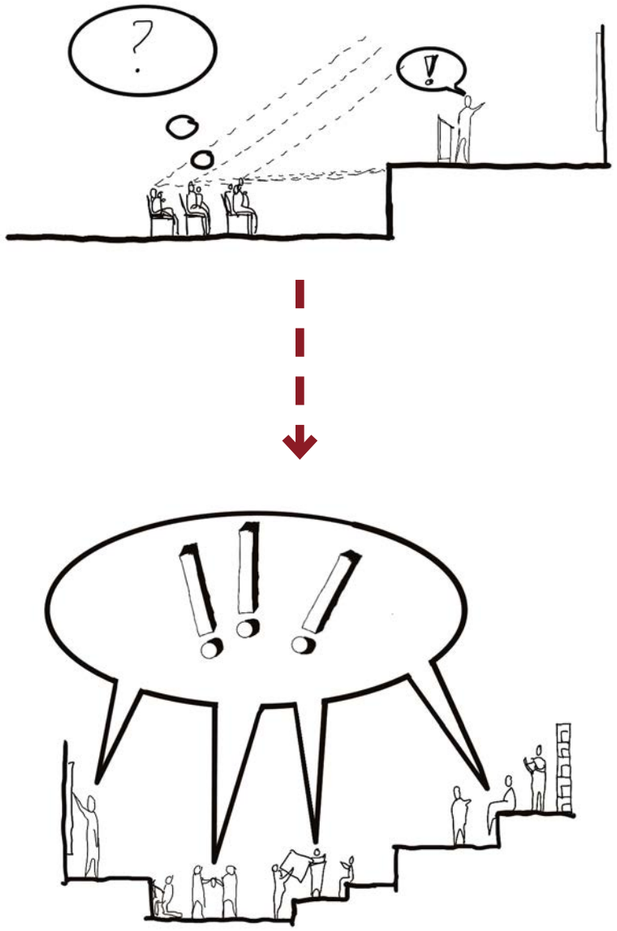
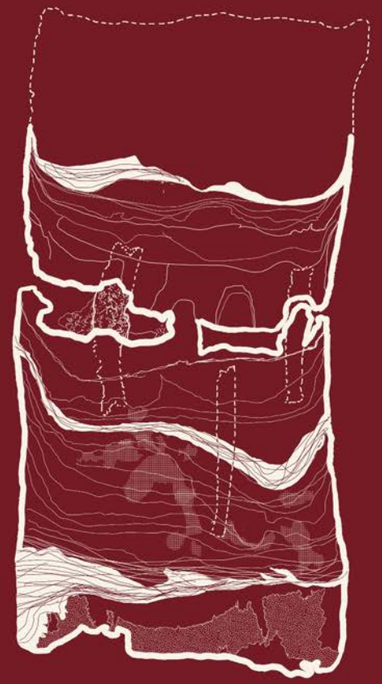


fig 7.2: transition in the site that houses participatory design (Author, 2021)



8. Locality

- Understanding the landscape
- Industrial residential coexistence
- Confined territories
- Movement and transport infrastructure
- Nodes
- Greenscapes
- Site analysis

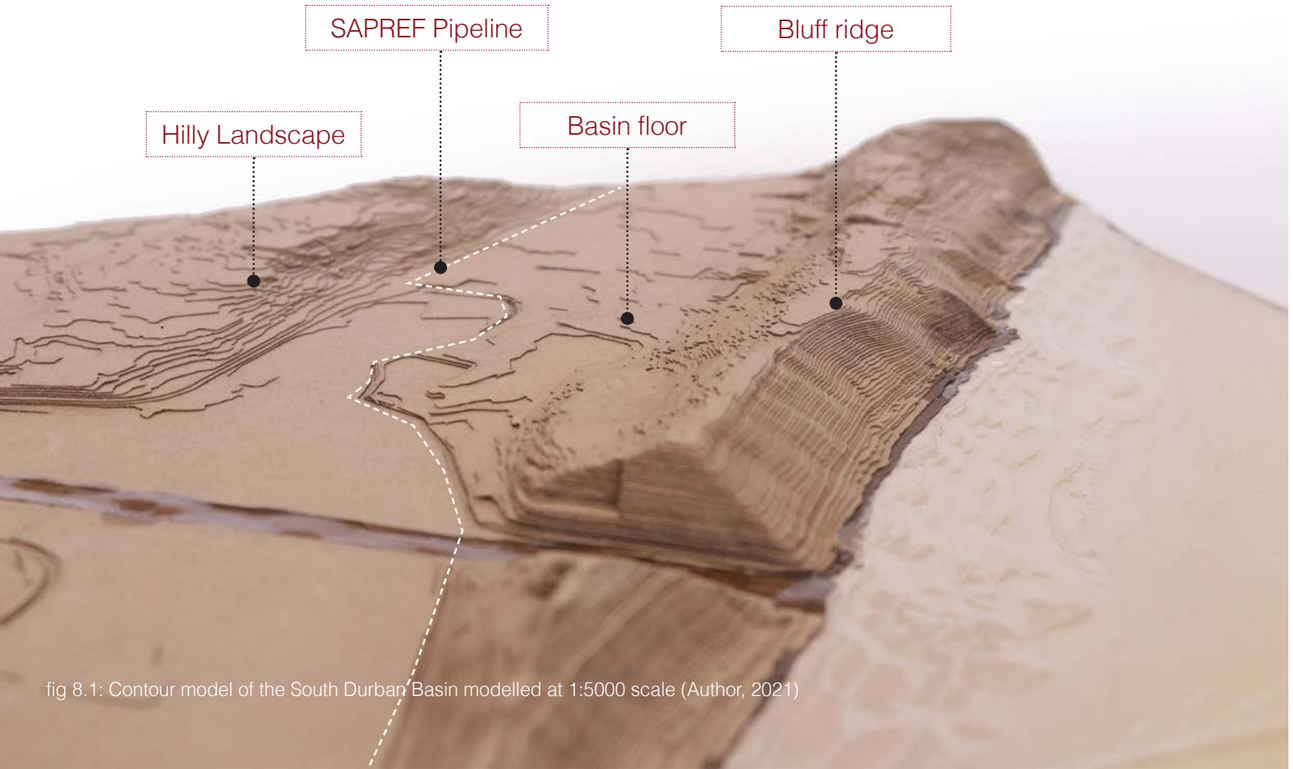


fig 8.1: Contour model of the South Durban Basin modelled at 1:5000 scale (Author, 2021)

Understanding the landscape

Geographically the South Durban basin owes its name to the natural formation of the landscape. A geological basin is a large scale depression in a landscape caused by certain natural forces such as erosions and earthquakes. The South Durban basin is formed by the Bluff ridge that runs the along the east coast and a steady rise in the landscape towards the north west. The soil conditions of the basin floor consist of a loose sandy top soil layer with a clayey subsoil layer. According to the council for geosciences (2015), this is due to the fact that the region in which the refinery is sited, consists of a very shallow water table. This means that the geological conditions dictate that the top of the permanently saturated zone occurs close to the ground surface making the area easily prone to contamination by industrial leaks or incorrect site developments.

In a publication by Milieudefensie, a Dutch environmental organisation, Bart Plantenga, Myrthe Verweij and Pascal Messer outline the events that had occurred on the 7th of July 2001 when a SAPREF pipelines spillage of 1000 tons (one million liters) of petrol was detected. According to the publication, the leak which was located near the Bluff Nature Reserve was caused by external rusting of the pipelines due to moisture exposure. This later became known as the largest oil spill in the history of the country (Verweij et al, 2003). Subsequently, the refined oil leaking into natural and residential areas caused large scale contamination of the soil in the region. With the site located along said pipelines, the opportunity for site remediations on a large scale presented itself in the form of Bioremediation. This will be discussed further when elaborating on the technical systems involved in chapter 10.



fig 8.2: Key locating photo view of model (Author, 2021)

Solar study

The 2D sun path diagram superimposed over the site shows that the area receives most of its natural daylight from the north. The shaded yellow band represents the suns movement throughout the year with the top of the band showing the suns positions during the winter months and the bottom band during the summer months. When looking at the two extremes, we see that during the summer months overhangs will be vital to prevent unwanted heat but during the winter months, the sun's altitude will allow for sunlight and heat to reach into the building.

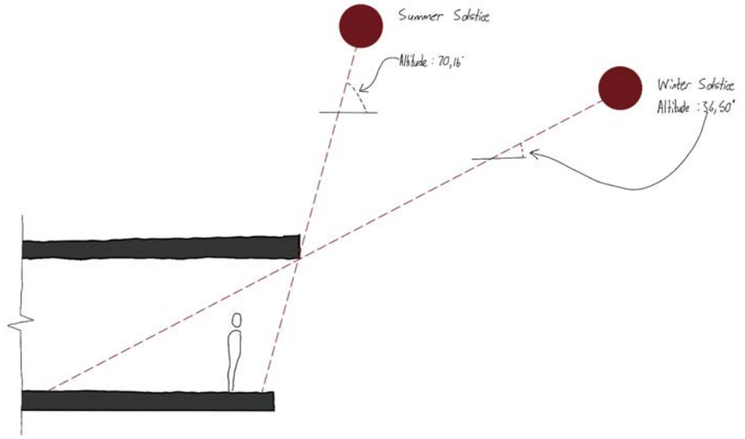
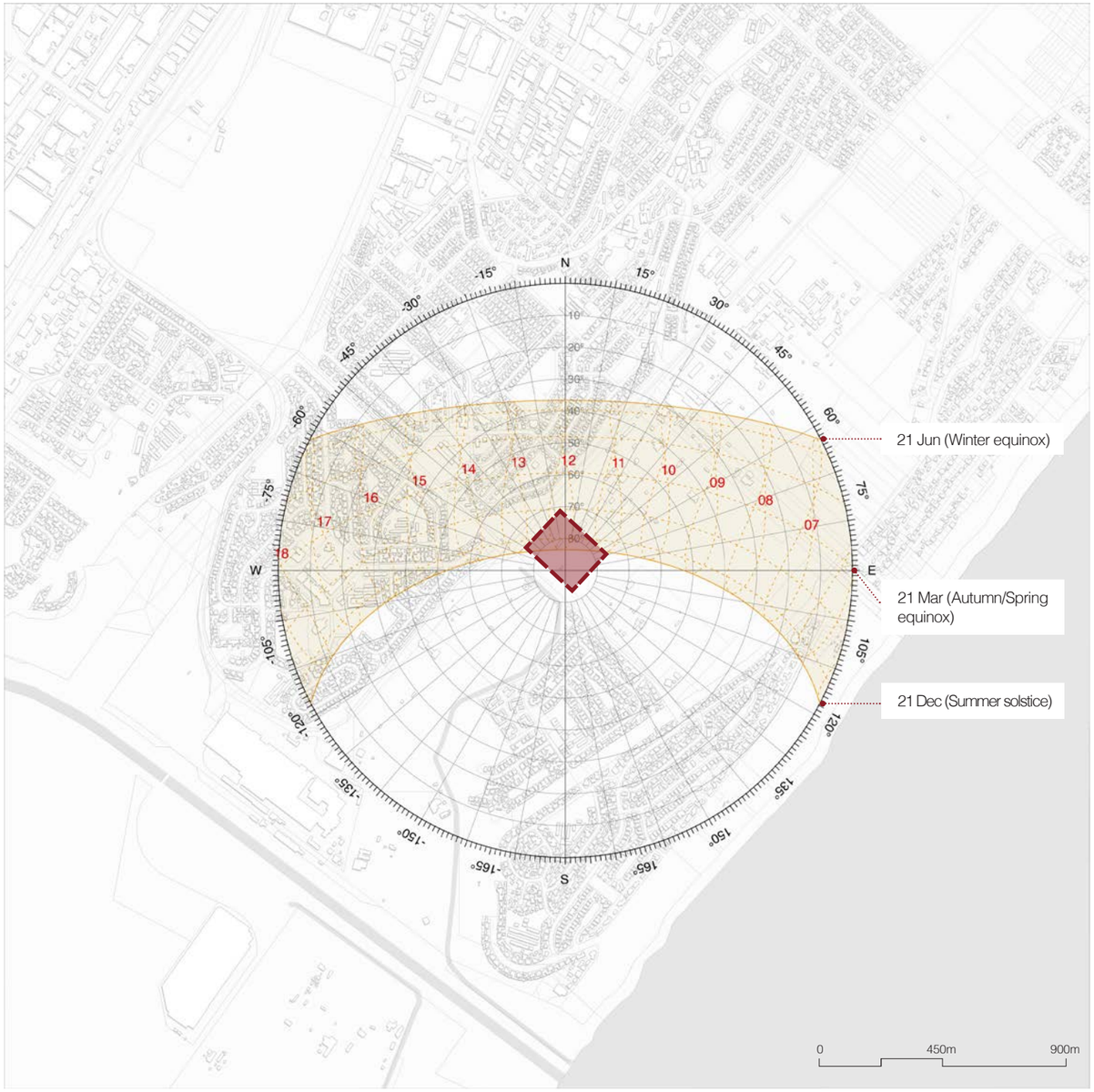


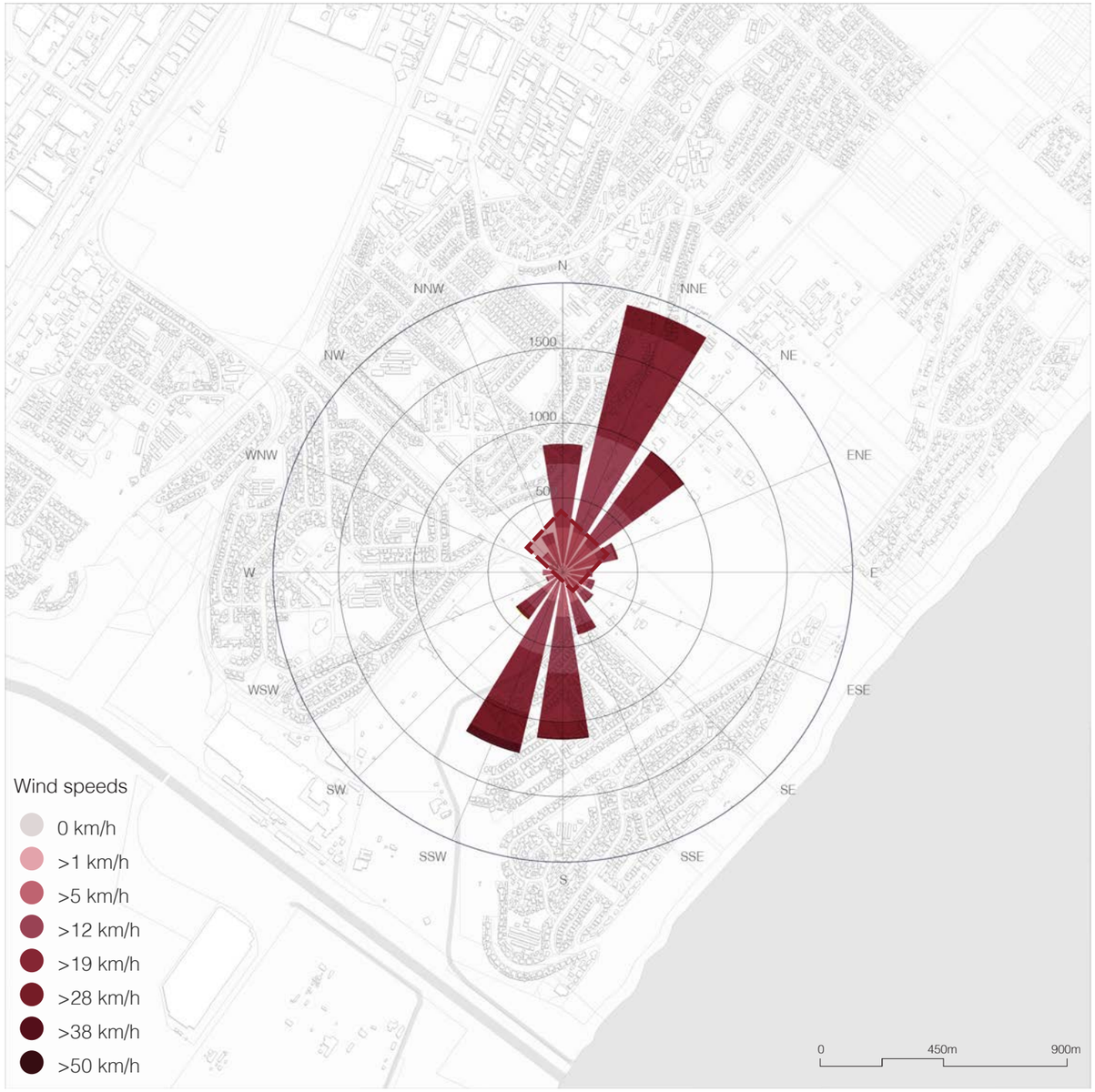
fig 8.4: Sectional view of the sun angles interacting with a building at 12pm on the Summer and Winter solstice days. (Author, 2021)



Site

N

fig 8.3: Sunpath diagram superimposed on map of site (Author, 2021)



Wind studies

The wind rose diagram imposed over the contextual map of the area shows how many hours per year the wind blows from the indicated direction. Using archived weather data, It was found that the site experiences a prevailing north easterly wind. This can be attributed to the bluff ridge forcing north to south wind directions.

Therefore in order to respond to the hot and humid conditions of the area, openings should be placed along the north-south axis to maximise cross ventilation opportunities. it is also imperative that these openings are properly screened or have adequate overhangs due to the sun exposure that will be experienced on the northern façades.





fig 8.5: Windrose superimposed on map of site (Author, 2021)



Confined Territories

The adjacent map shows how the chosen site is located at the intersection of residential and industrial footprints. While most of the area consists of strictly defined zones of activity, the proposal will act as the mediator between industry and community.

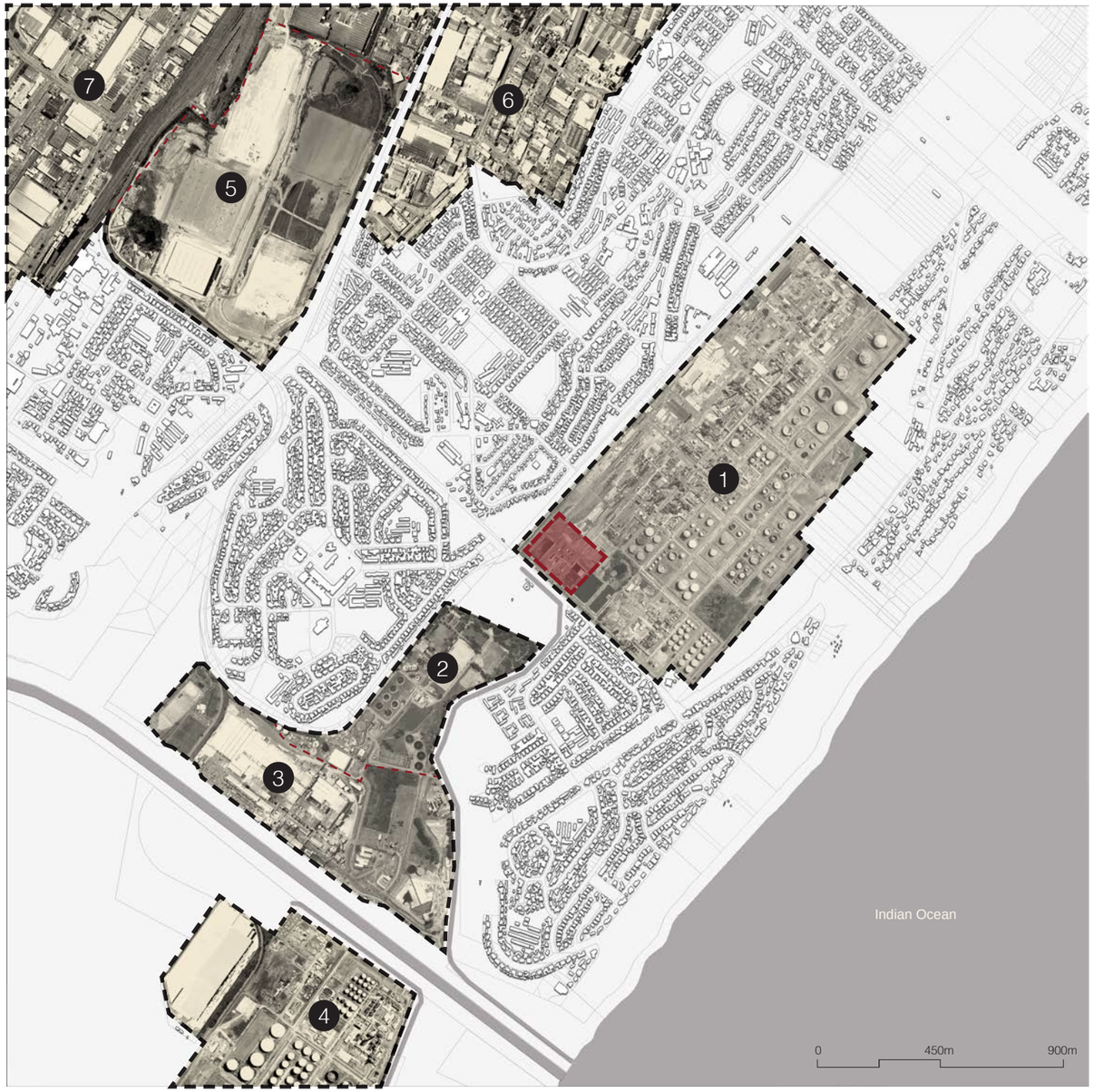
Industrial zones

Residential zones

Site

N

fig 8.6: Map showing the shared boundaries between industrial facilites and residential zones (Author, 2021)



Industrial/ residential coexistance

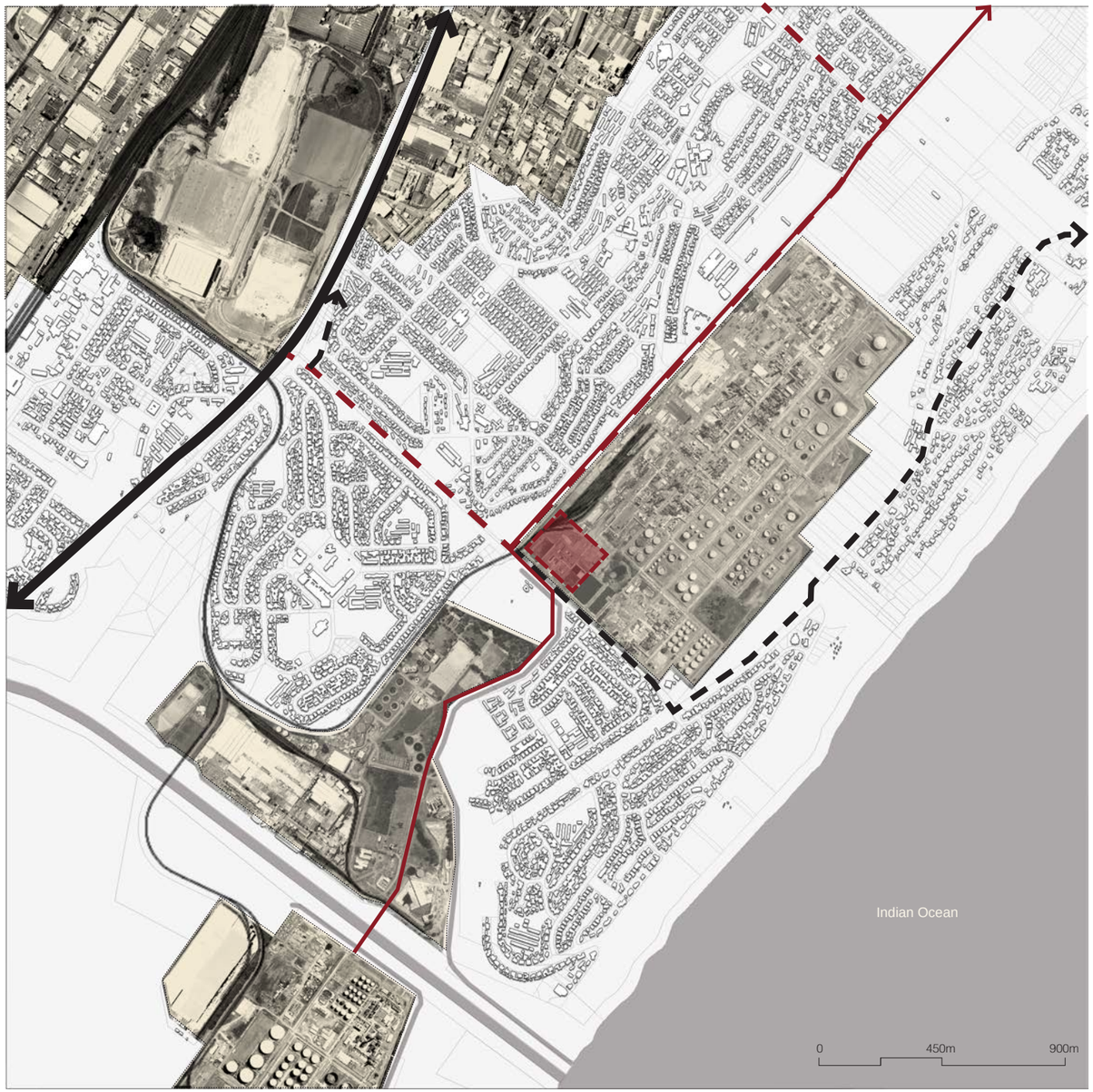
The current urban conditions show the long-term effects of apartheid modernism in the context of the site. The adjacent map shows the extent of the industrial sprawl and how the urban landscape has remained restricted to the previously imposed boundaries under the apartheid regime. Over the years following the construction of the refinery other forms of industrial sites emerged giving rise to other forms of toxic waste that spilled into the area.

1. Engen refinery
2. Waste water treatment plant
3. Mondi Paper Mill
4. SAPREF refinery
5. Clairwood logistics park (former race course)
6. Jacobs manufacturing area
7. Mobeni munfacturing and commercial zone

Site

N

fig 8.7: Map showing the location of industrial zones in the Basin area (Author, 2021)



Movement and transport infrastructure

With the imposing industrial landscape, transportation routes become an important element in the urban structure of the area. As a means of optimization, the road network is designed to connect the industrial facility to the M4 freeway as efficiently as possible. General public roads leading into residential areas are extremely compact to favour the busier industrial road network.

The underground pipe network that runs from Sapref refinery towards Durban Harbour also played a major role in dictating the design of residential zones in favour of industrial efficiency.

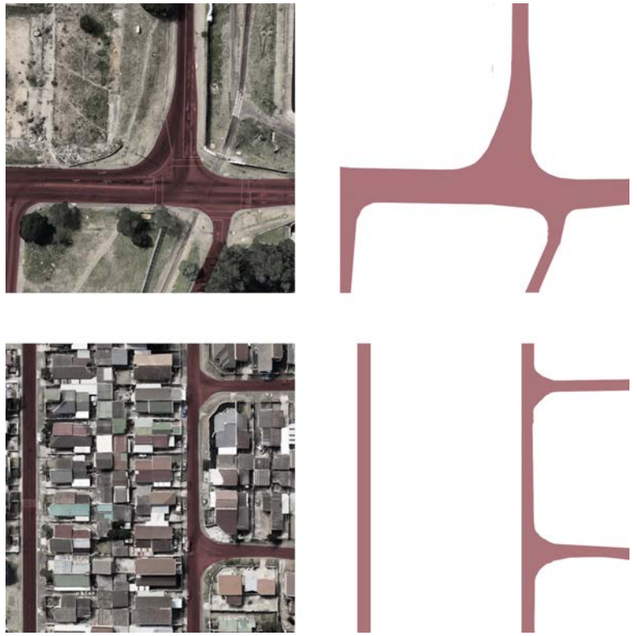


fig 8.9: aerial view analysis of hierarchy in road network (Author, 2021) adapted from: (Google 2021)

Rail network

Sapref pipeline going towards harbour via Tara road

M4 freeway

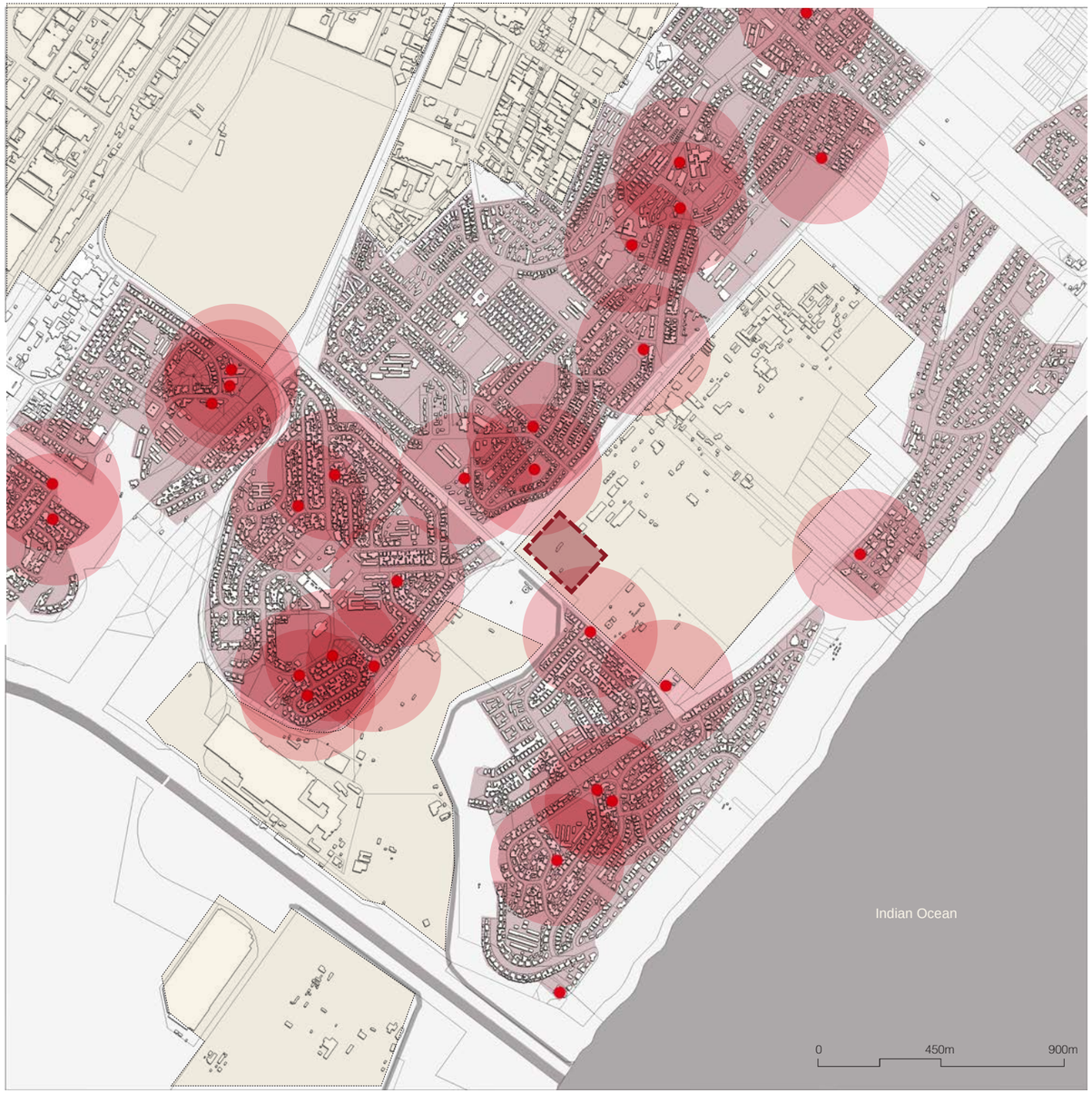
main trucking route and vehicular route

Main public transport route

Site

N

fig 8.8: Map showing the industrial movement networks in the Basin area (Author, 2021)



Religious gathering nodes

The adjacent maps shows the location of sites that host religious programme. Often places of gatherings for ritual practice, these facilities often house multi-purpose gatherings for activities associated with the religious denomination of the site or other community based activities enticing interactions from the surrounding residential areas.

Given the nature of these spaces, they are found to be interspersed within the respective residential areas. An important element to take away is that while these sites exist, there also exist a multitude of non-denominational gathering spaces that are often used for religious gatherings such as sports grounds, schools during weekends and homes capable of holding large crowds

500m radius

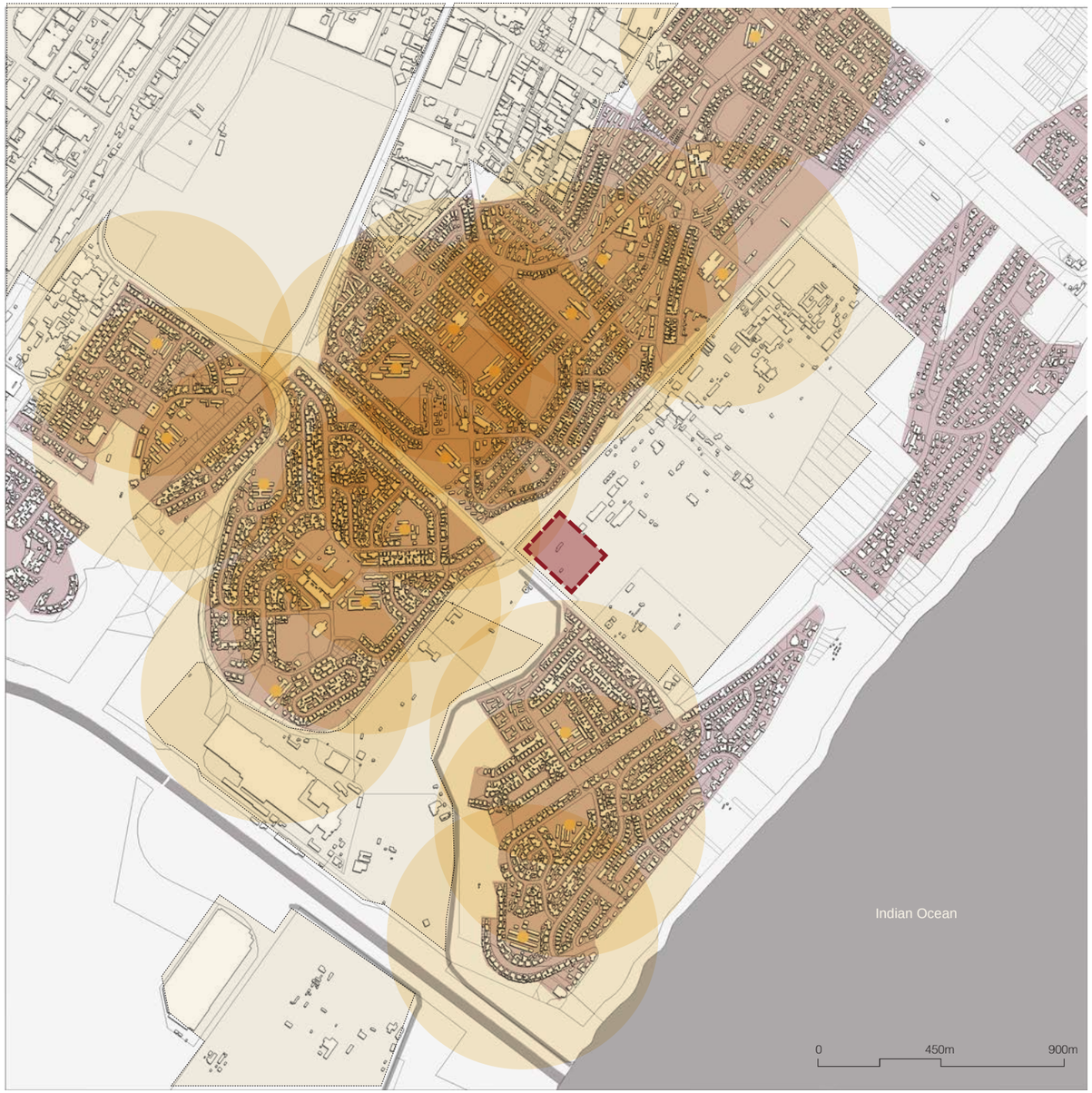
religions node



Site



fig 8.10 :Map showing sites housing religious nodes of activity and their proximity to residential areas. (Author, 2021)



Educational gathering nodes

As with many other public schools established during the apartheid era, the schools in the area consist of a rigid typology of rows of classrooms with dedicated sports fields. The adjacent map shows that the amount of schools present, service the area so that every home has access to a school within a 1km radius. This presents an opportunity to design for a better outdoor pedestrian experience for daily commutes.

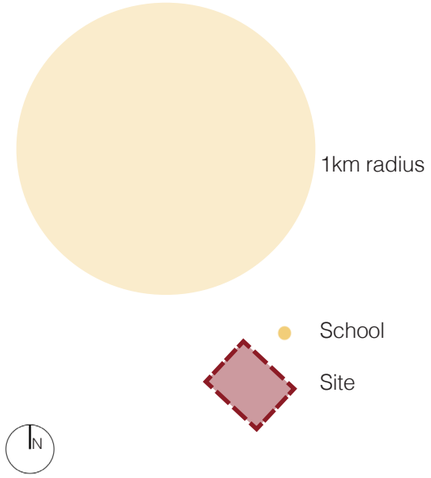


fig 8.11: Map showing the location of schools their proximity to residential areas. (Author, 2021)

Formal economic nodes

Although there exists a much more intricate network of informal economies that line the street edge of the residential areas, the formal economies which consists of general retail programmes also exist as nodes of gathering spaces. in some instances they provide the infrastructure for informal economies such as the Merebank shopping centre which exists as a mixed use complex.



fig 8.12: Street view showing Merebank shopping centre (Google, 2021)

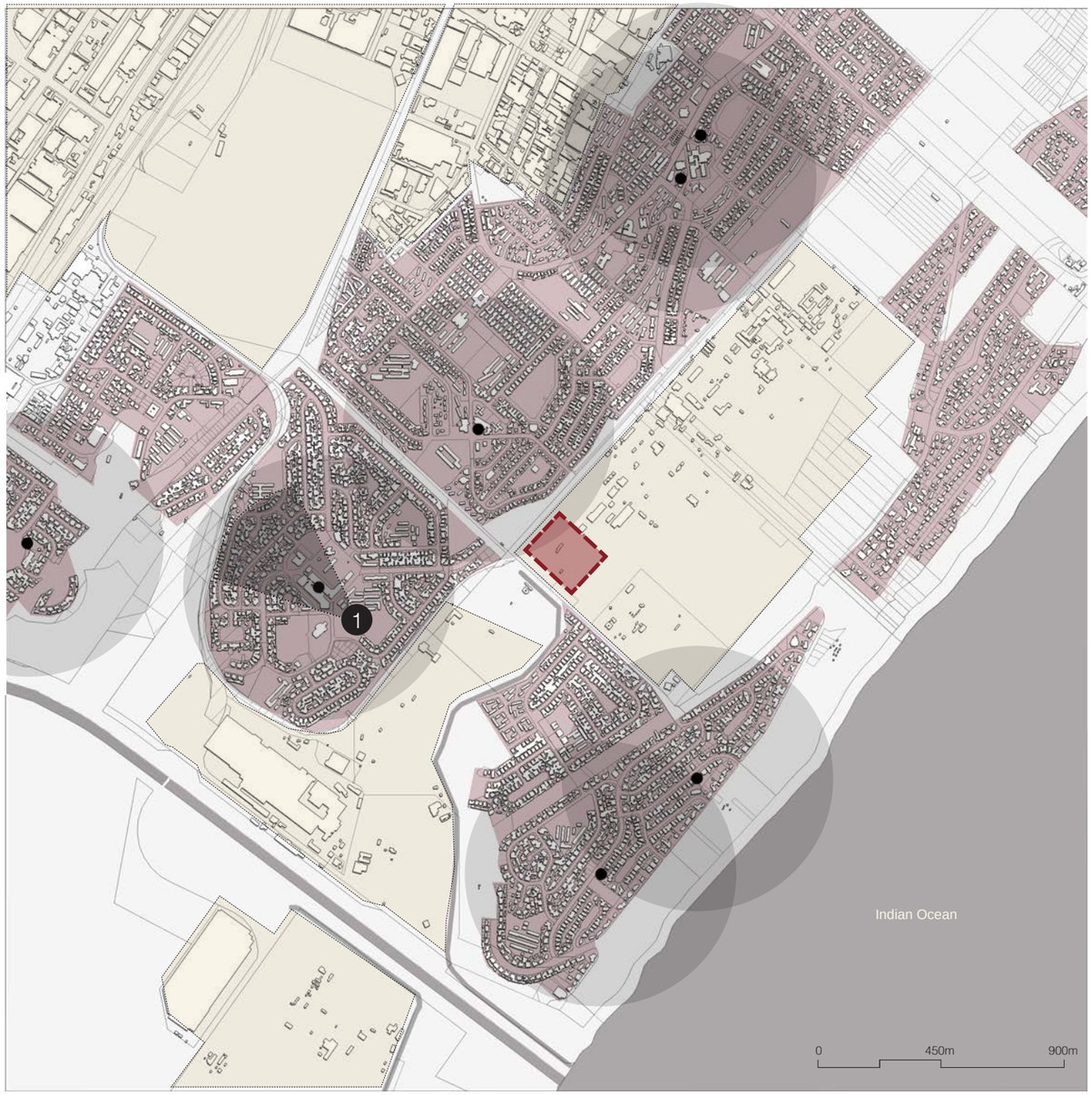


fig 8.13: Map showing sites housing retail programmes and their proximity to residential areas. (Author, 2021)



Greenscapes

There exist 3 main types of greenscapes as represented in the adjacent map. Structured greenscapes often are large portions of land used for sporting events or general social use while protected areas serve the ecological needs of the area. in instaces like that in figure 8.15 these portected zones become bufferzones between residential areas and industrial activity. The areas left as undeveloped swampy areas have been historically left alone due to their poor conditions for development. This provides an excellent opportunity to intergrate such areas into the larger park networks hoped to be achieved.

Undeveloped swampy area

Protected areas/Buffer zone

Structured greenscape/school grounds

Site

N

fig 8.17: Map showing greenscapes in the Basin area (Author, 2021)



fig 8.14: Street view Bluff Nature reserve (Google, 2021)



fig 8.15 : Street view showing green bufferzone (Google, 2021)



fig 8.16 : Street view showing a park in Austerville (Google, 2021)



fig 8.18: Site plan indicating key movement routes and site boundaries (Author, 2021)

The Site in context

Using the findings from the mapping and research, an appropriate site was chosen based on the desired outputs of the project. At the corner of Badulla And Tara road, the site previously used as the main access point for the rail network currently houses pools of water that formed part of the refinery systems. With the production facility closed, these pools became obsolete and now form part of the future precinct plan that will be proposed later in this chapter.

The site was chosen because it lies at the intersection of perceived racial boundaries as well as a physical boundary between the refinery and the communities. Therefore it provides the perfect opportunity for reintegration between the predominant Indian and coloured communities while addressing various forms of industrial toxicity.

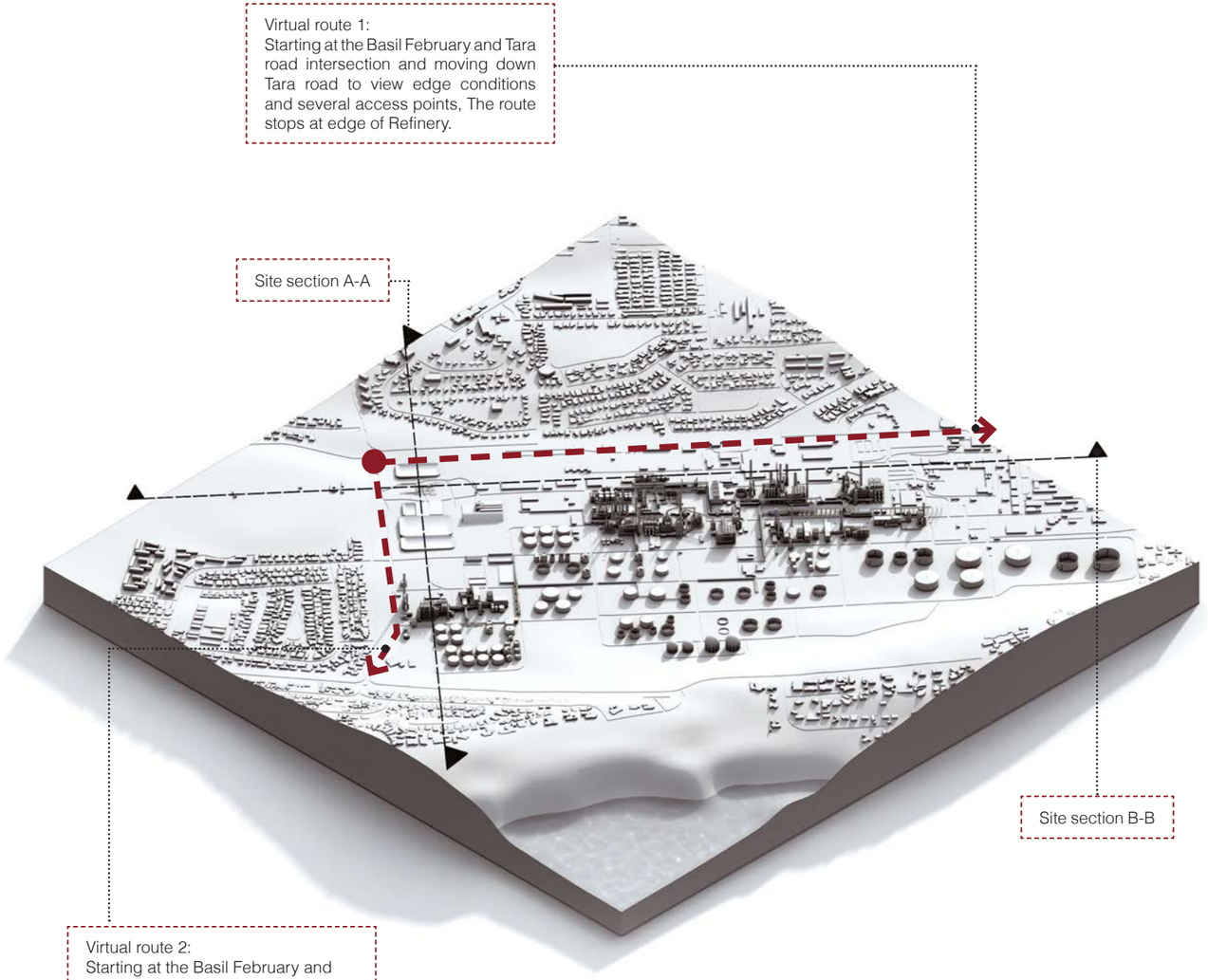


fig 8.19: Axonometric model of site (Author, 2021)

Understanding boundaries and thresholds.

With an understanding that development favoured industrial activity throughout the years, one can see the glaring presence of the refinery amidst the existing residential neighbourhoods. A further investigation into the context of the site shows the transitions of space, scale relationships, territories, and boundaries as they are experienced at human scale. This will be analysed further in three ways.

The first investigation is an analysis of the site in relation to its topography through detailed site sections. This investigates the relationship between the natural landscape and the industrial functions.

The second step involves interpreting detailed sections of the refinery's boundary conditions that have interesting relationships with the surrounding context. This allows for an understanding of the threshold spaces that currently exist and how they can be developed further.

The last investigation draws on the work of Guy Debord(1967) and his theories on psychogeography and the derive. Working in a time of revolutionary anti-establishment upheaval in 1960s Paris, Debord and the situationists critiqued the status-quo of a consumerist driven society through creating situations that allowed one to come across new people, places and experiences as opposed to the rigidity of a modernist planned suburb.

The derive becomes an aimless wander across spaces to entice new connections to landscapes and people. Using two routes that were explored virtually through Google street views to experience the industrial presence first hand, a virtual tour of the boundaries of the refinery was conducted to reveal opportunities for the development of spaces that encourage the notion of wandering. This becomes the premise for the design of a large park network.

Investigation 1- Site sections

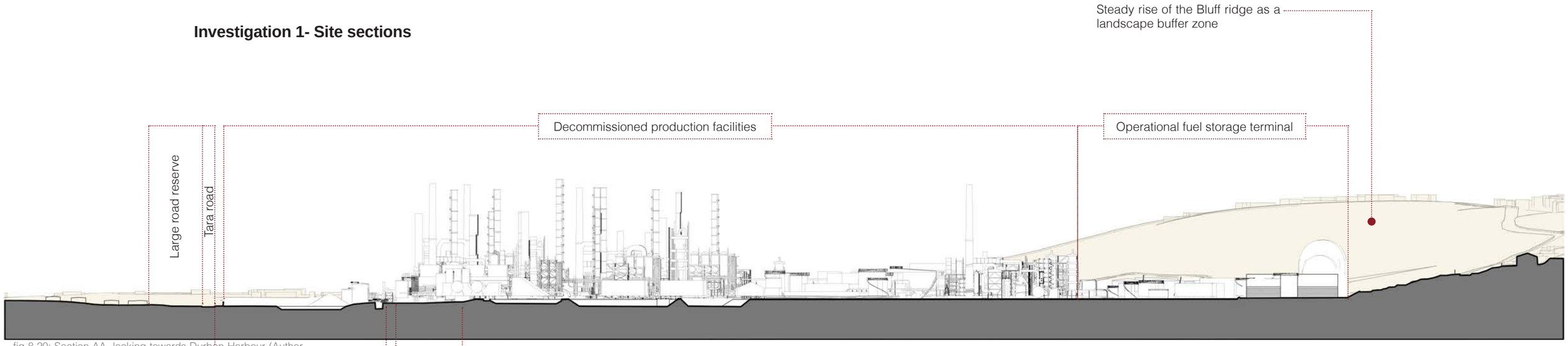


fig 8.20: Section AA looking towards Durban Harbour (Author, 2021)

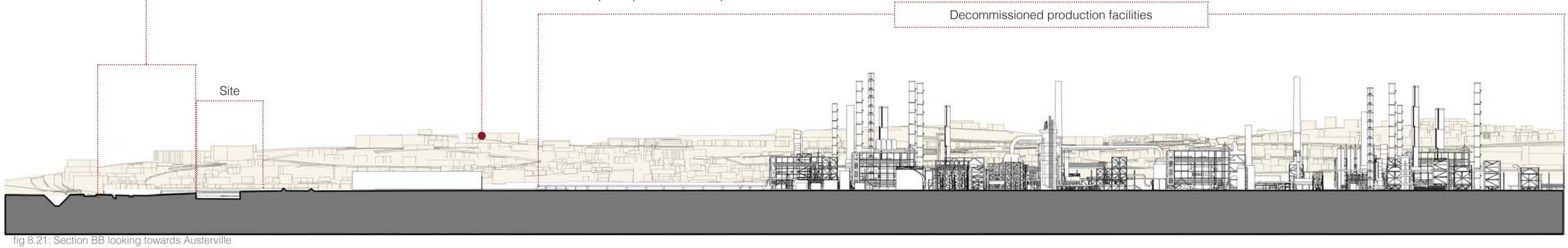


fig 8.21: Section BB looking towards Austerville (Author, 2021)

Investigation 2- interpreting boundary conditions



fig 8.22: Key plan locating section (Author, 2021)

With the production facilities no longer operational, the large scale industrial machines, can sit as palimpsest sculptures while an attempt to mediate the scale between industry and community, various forms of landscape design along the street edge will take place.

The large road reserves that border the refinery on Tara road and Badulla road provide ample opportunity to connect the communities to the site via a park network that forms part of a larger on-going master plan for the area.

fig 8.23: Section showing scale relationships across Badulla road (Author, 2021)

Investigation 2- interpreting boundary conditions



fig 8.24: Key plan locating section (Author, 2021)

simple boundary dissolution means that the greenfield site opposite Tara road can connect via suggested desired paths and create an interesting social threshold leading up to the future building

Large road reserve made available

The pool closest to Tara road will be drained and demolished. However, the landscape will sculpted to emulate the sunken depth that the pool once occupied. Once again touching on the scale relationship between industry and community.

The site that previously housed the derelict flats that were removed as part of a post-apartheid rehabilitation attempt now sits as a vacant greenfield and presents an excellent attempt at social remediation between the surrounding communities and the refinery.

fig 8.25: Section showing existing boundary conditions across Tara road (Author, 2021)

Investigation 2- interpreting boundary conditions



fig 8.26: Key plan locating section (Author, 2021)

An upgrade to the industrial works set up during the 1950's can be done over a longer period of time to allow for future inhabitance and connection of the canal infrastructure into the proposed park network.

Decommissioned production facilities

The second of the 4 pools will be drained, refurbished and filled again as a water body that ties into the park network. Conceptually it will also form part of the palimpsest sculptural landscape as it once functioned as a storage facility for steam driven processes at the refinery.

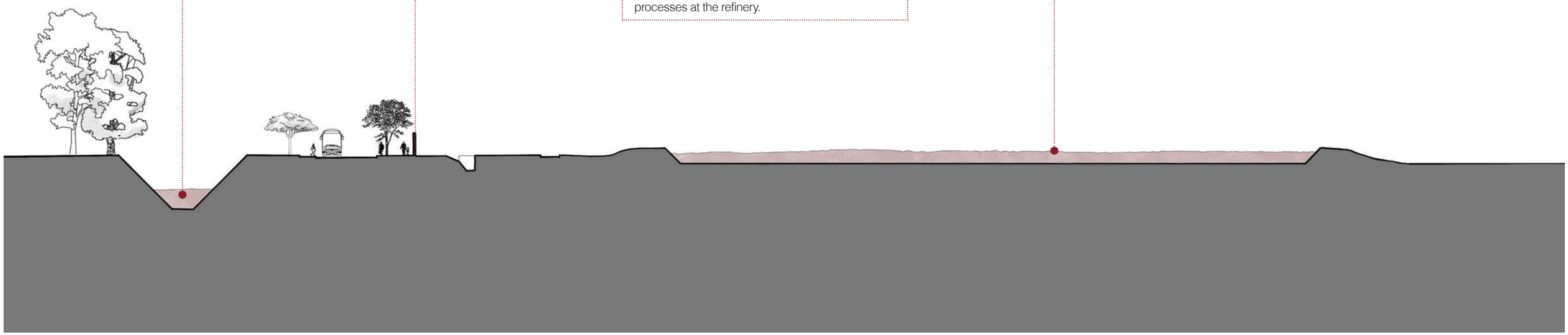


fig 8.27: Section showing existing boundary conditions across Badulla road (Author, 2021)

Investigation 2- interpreting boundary conditions



fig 8.28: Key plan locating section (Author, 2021)

Operational fuel storage terminal

Fortunately, The houses bordering the area designated for the future fuel storage terminal is protected by a large green buffer zone that actively hides the industrial facilities when traversing the boundaries at street level. With reduced emissions as a result of the decommissioned production lines the conditions are naturally mediated

Current site boundary to remain

fig 8.29: Section showing existing boundary conditions across Marine Drive and remaining fuel storage terminal (Author, 2021)

Investigation 3- Finding opportunities for derive networks



fig 8.30: Key plan locating derives (Author, 2021)



Fig 8.31. Corner intersection



Fig 8.32. Major Movement route



Fig 8.33. Park network to link community and industry



Fig 8.34. Stark difference between street edges



Fig 8.35. current main access point to refinery



Fig 8.36. Refinery Edge conditions restrict any form of interaction



Fig 8.37. Outdoor sporting facilities act as buffer zone



Fig 8.38. Cellular infrastructure becomes present



Fig 8.39. Edge of refinery dissolved by sponsored sporting facilities

fig 8.31- fig 8.39: Street views sourced from (Google Earth, 2021)

Investigation 3- Finding opportunities for derive networks



fig 8.40: Key plan locating derives (Author, 2021)



Fig 8. 41. Busy intersection



Fig 8. 42. Industry movement is prioritized



Fig 8. 43. Dead zone created when entering residential area



Fig 8. 44. Canal infrastructure seen weaving through residential zone



Fig 8. 45. Refinery creates dead street façades in dense urban fabric



Fig 8. 46. Dinapur road entrance to refinery and major taxi/ uber pick up spot



Fig 8. 47. Road reserves houses informal economies



Fig 8. 48. Imbalanced scale relationships



Fig 8. 49. Edge of the refinery shares boundary with Mosque.

Park network plan

Given the large site open for development, the area would need to be rehabilitated in stages. The figures on the right demonstrate how this process will take place. By linking the decommissioned production facility to a series of connected parks that have been designed from existing road reserves, the rigid boundaries therefore fall away and space for interesting social interactions take place. Due to the dangerous nature of the refinery, the inclusion of interpretation paths will limit physical interactions with certain unsafe areas within the decommissioned site.



fig 8.50: Sketch plans of proposed park network (Author, 2021)

Site strategies

1. Designed project within large scale precinct (masterplan)

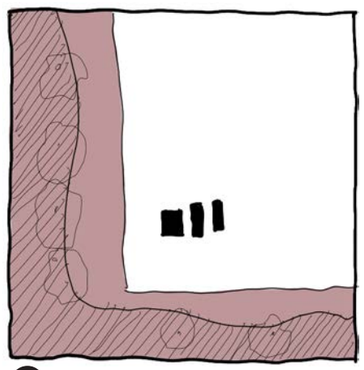
2. Establish a park network for the community to build on

3. Clean up toxic site. from various points in the site determined by professionals.

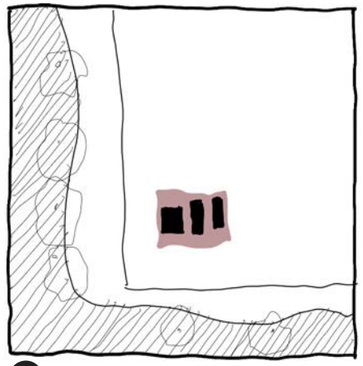
4. Improve edge conditions within precinct plan

5. Interpretation path within masterplan to remember the toxic object.

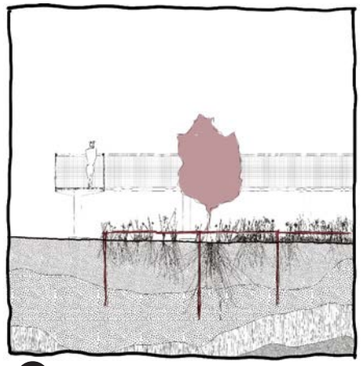
6. Celebrate the local community through multiple gathering spaces



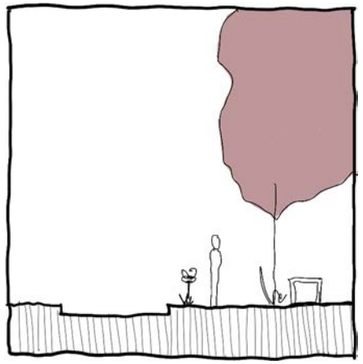
1 fig 8.51: Site strategy diagram (Author, 2021)



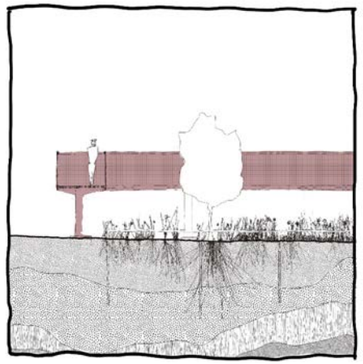
2 fig 8.52: Site strategy diagram (Author, 2021)



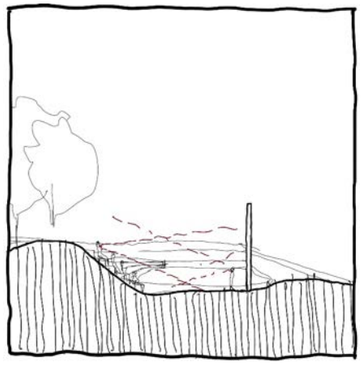
3 fig 8.53: Site strategy diagram (Author, 2021)



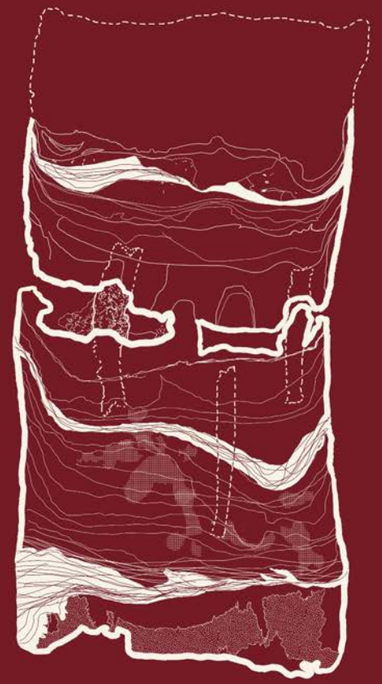
4 fig 8.54: Site strategy diagram (Author, 2021)



5 fig 8.55: Site strategy diagram (Author, 2021)



6 fig 8.56: Site strategy diagram (Author, 2021)



9. Design development

- Design processes
- Design brief
- Programme
- Case study: Greek agora

Design processes

In navigating the design of an architectural intervention certain design processes were done from the beginning of the year and throughout. The following stages aim to outline the development of the design throughout the course of the year as it was worked and reworked alongside research, critical analysis of the context as well as in-depth explorations into the technical systems involved in the project. In order to understand the design of the building at all stages the design processes often overlapped and informed each stage as the project progressed. It has led to the culmination of a project brief, an introduction to the proposed programme as well as a preliminary design.

Sketch booking:

The first step involved setting up an initial idea of what the building would be based on the preliminary stages of the research framework. Through extensive sketching and writing I set up a conceptual base upon which the design progressed

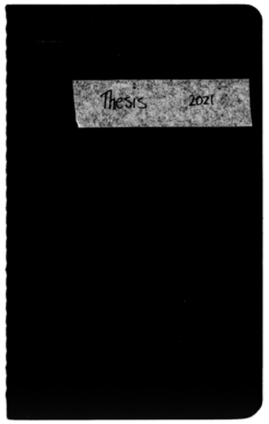


fig 9.1

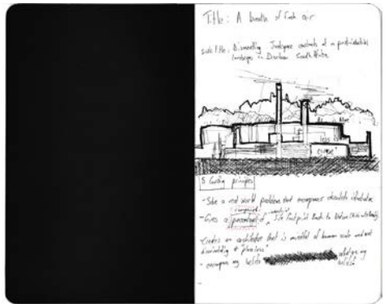


fig 9.2

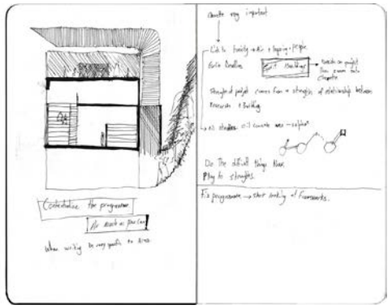


fig 9.3

fig 9.1- fig 9.3: Scanned sketchbook illustrations (Author, 2021)

Parti work:
The initial approach to the design was to use a large footprint to accommodate a multi-purpose centre that served the needs of the community while incorporating air purification systems that actively cleaned the air of the region. The lack of informing context on the refinery site proved to be a challenge especially when dealing with the large footprint offered up for development.



fig 9.4 initial project plan diagram (Author, 2021)

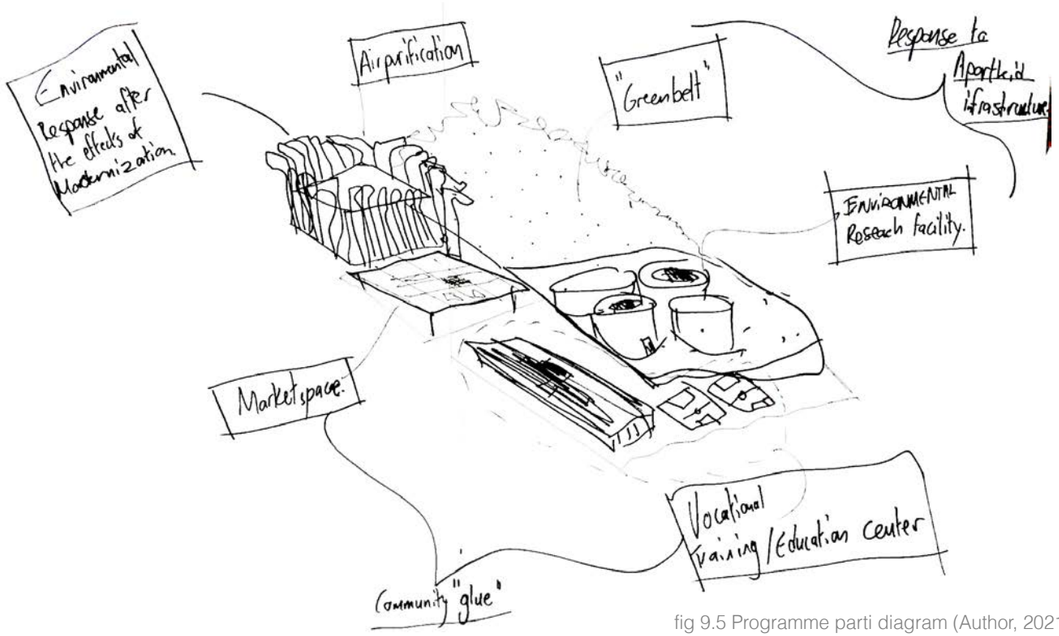


fig 9.5 Programme parti diagram (Author, 2021)

Charette studies:

The next step of the design process involved multiple charette studies that aimed to work on an abstract understanding of toxicity through the creation of toxic objects derived from the production processes of petroleum refineries. These involved working with paraffin wax candles and epoxy resin in addition to soil and twigs as an abstract representation of earth. The Charette study will be explored further in the chapter 10 which deals with conceptual design.



fig 9.6 Charette design model 1 (Author, 2021)



fig 9.7 Charette design model 2 (Author, 2021)

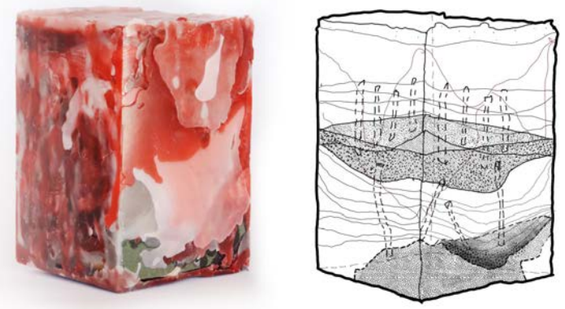


fig 9.8 Charette design model 3 (Author, 2021)



fig 9.10 Charette design model 4 (Author, 2021)

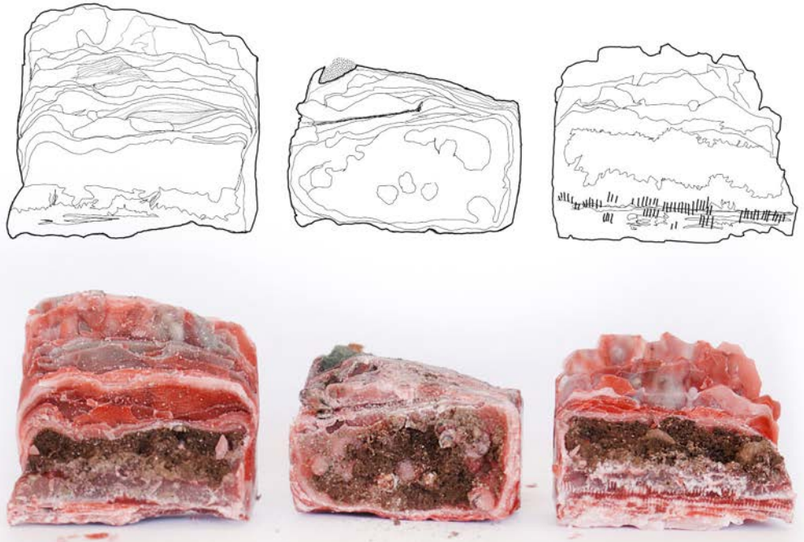


fig 9.10 illustration of charette design model 3 after cutting (Author, 2021)

Design iteration 1

To respond to the imposing scale of the refinery, the proposal was transformed to include a temporary architectural expo that would sit in the post-industrial context as a financial contributor towards future redevelopment of the landscape. The project would then be phased accordingly:

Phase 1:

1.1 Determining the boundary of the fuel storage terminal.

1.2 Decommissioning the production equipment.

Phase 2:

2.1 Construction of the interpretation centre, library and labs

2.2 Clean up and preparation of the rest of the site for future expo

Phase 3:

3.1 Development of expo

3.2 Regular construction intervals during winter months of temporary architectural pavilion

Phase 4:

Incremental development of community driven urban development on a project-by-project basis.

After much deliberation and consideration to the local context, key ideas were drawn from the new design but due to the nature of architectural expo's alluding to vanity as opposed to the very premise of this research, the expo was excluded.

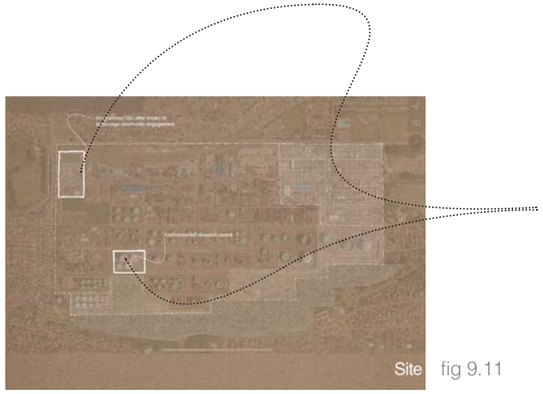


fig 9.11



fig 9.12



fig 9.14

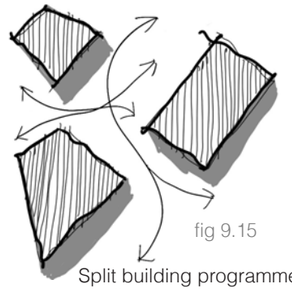


fig 9.15

Split building programme to readjust imposing scale

Adaptive reuse

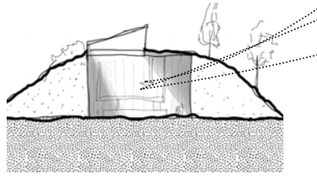


fig 9.16



fig 9.17

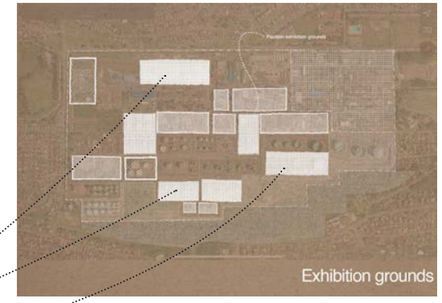


fig 9.18



fig 9.19

fig 9.11- fig 9.19 represents a collection of sketches done during the first design iteration(Author, 2021)

Design iteration 2

Using the idea of rehabilitating the landscape the design was altered to include an interpretation centre as the central statement building of the precinct design. By using the existing water pools on site, the idea was to use the pools as interactive spaces that formed the outdoor elements of the interpretation centre while site remediations took place. The problem was that the project still existed as a monument with very little community engagement.

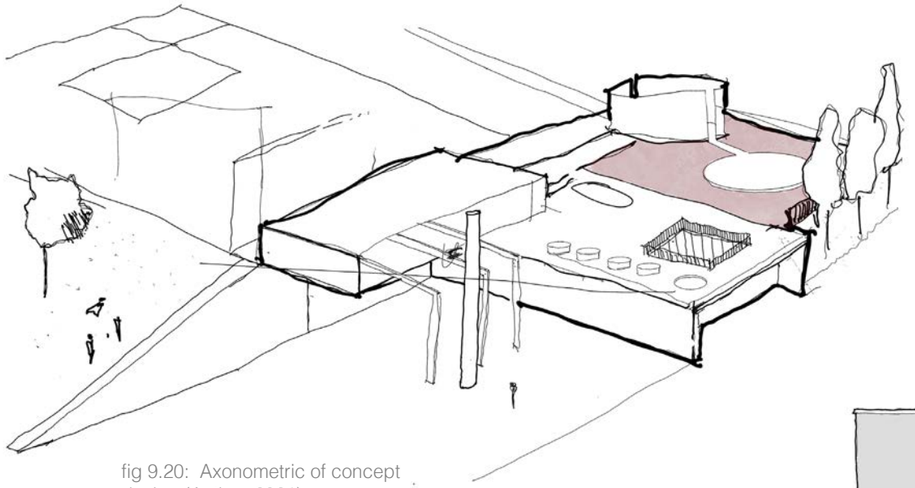


fig 9.20: Axonometric of concept design (Author, 2021)



fig 9.21: perspective of concept design (Author, 2021)

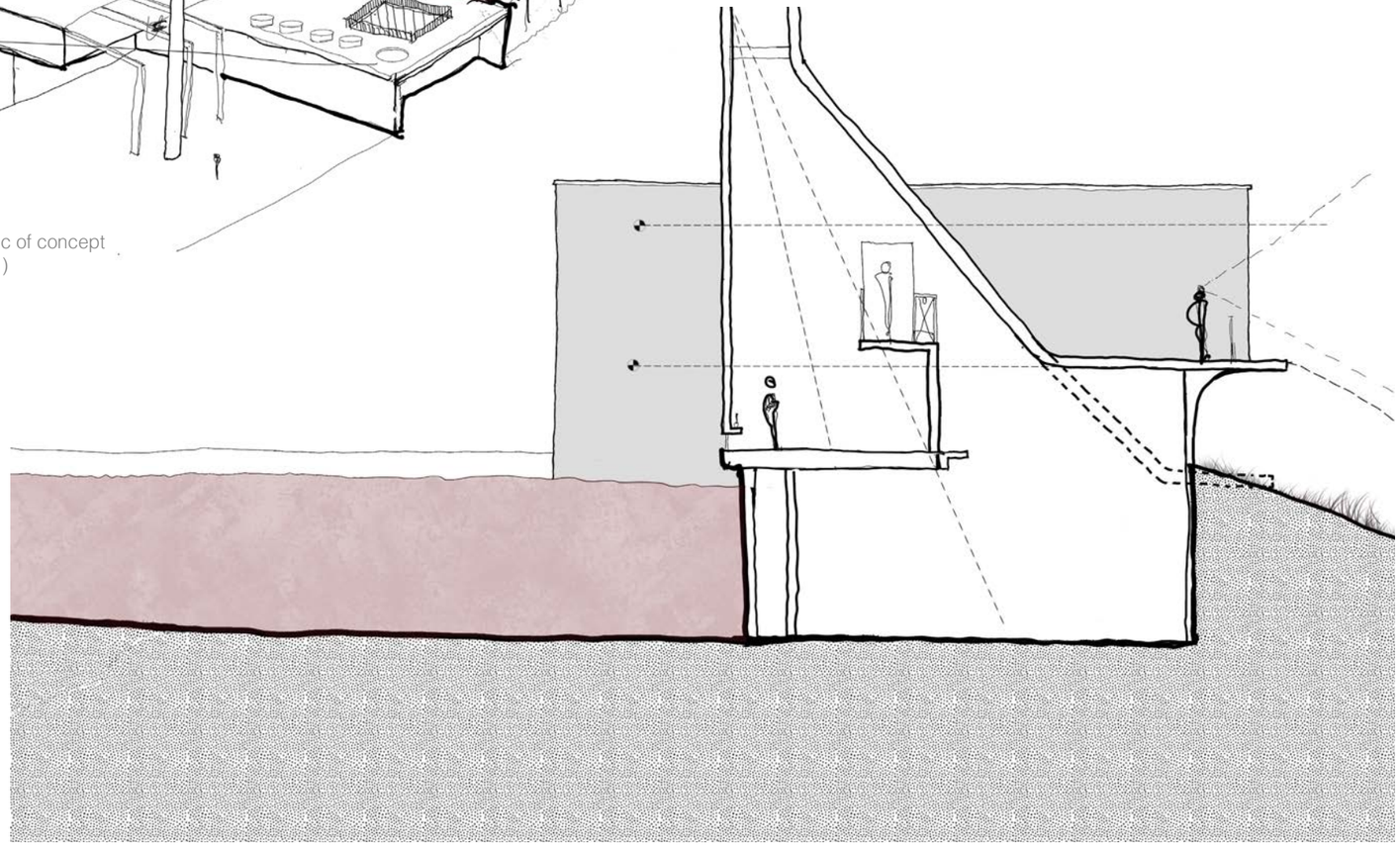


fig 9.22: Conceptual building section that use the water in the design (Author, 2021)



fig 9.23: Aerial view of the water pools on site (Google, 2021)

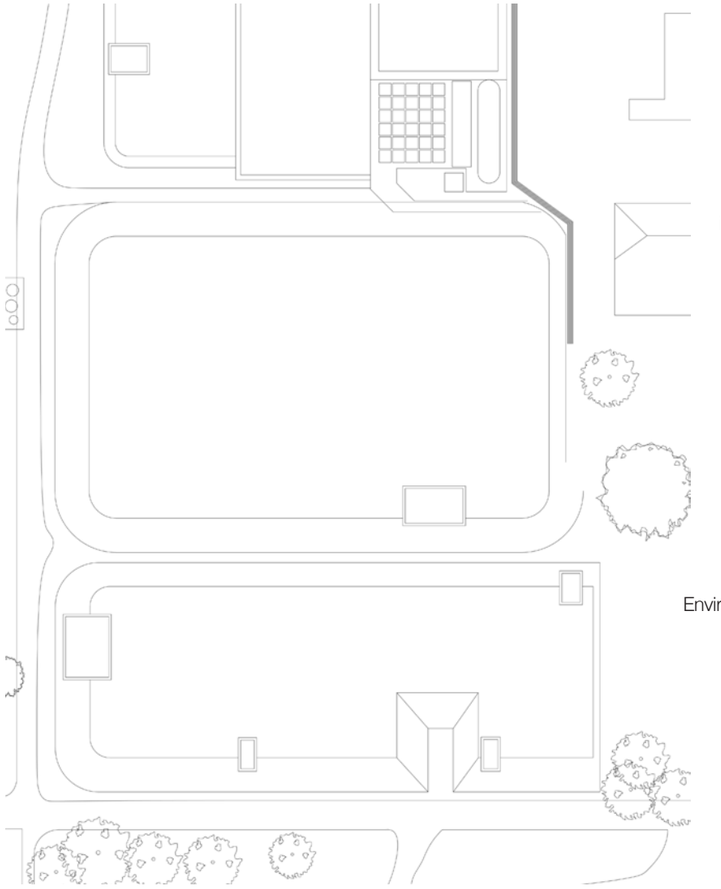


fig 9.24: Sketch of the water pools on site (Author, 2021)

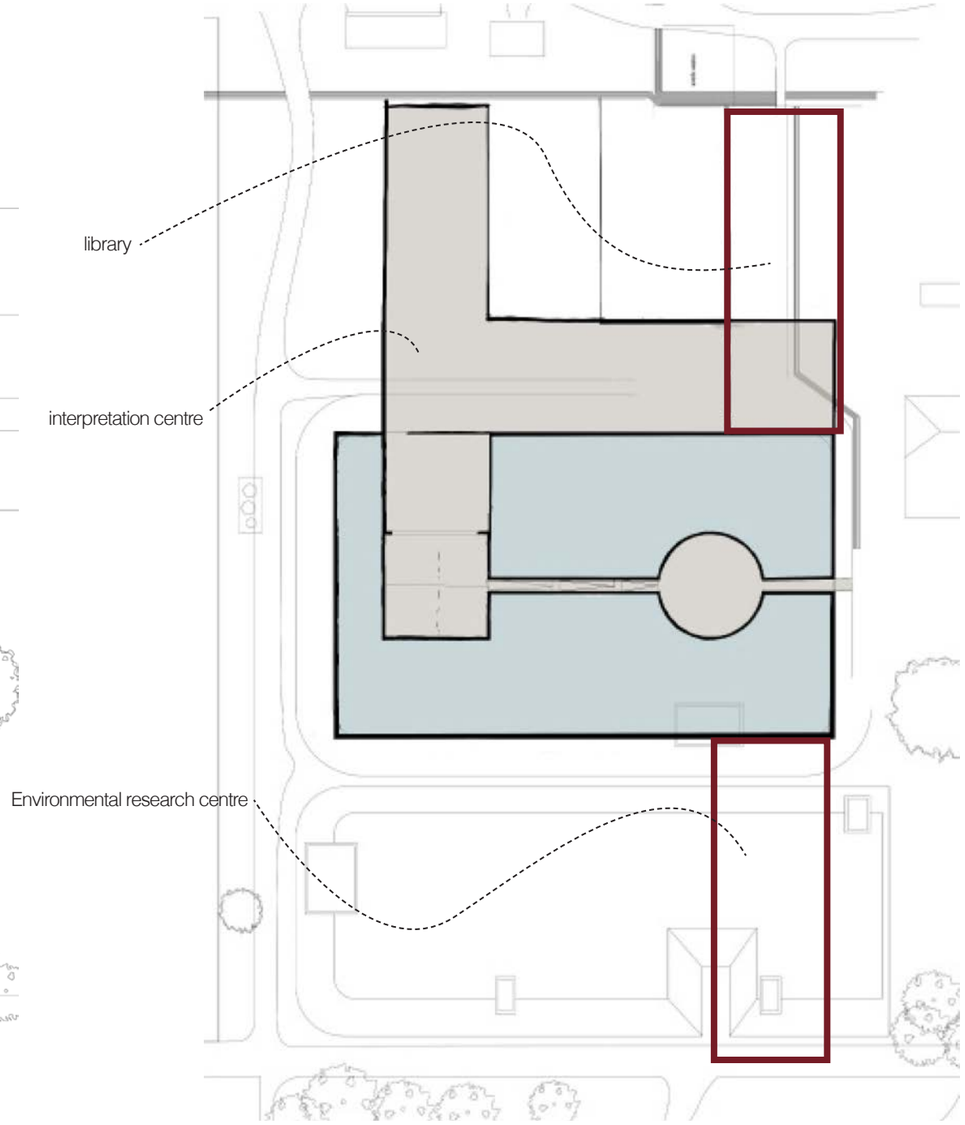


fig 9.25: Design of spaces using the water pools on site (Author, 2021)

Design iteration 3

With the previous iteration discarded I began working on creating an architecture that is more responsive to the researched issues. The refinery has a very imposing presence on the communities therefore, the design of the building was altered to have a more disruptive quality across the rectilinear language of the industrial complex.

By using the prominent street edge to splay the boundaries inwards the design drew activity from the street while locating programme along two structural spines.

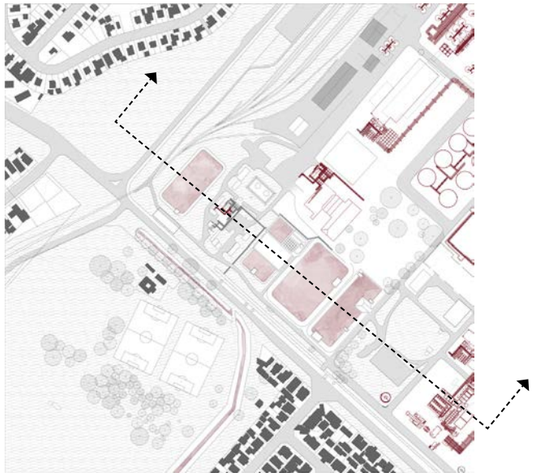


fig 9.26: Key plan locating preliminary site section (Author, 2021)

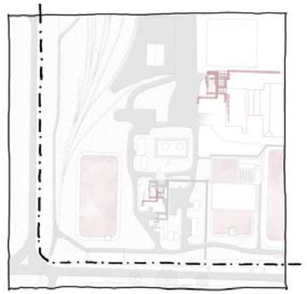


fig 9.27: Existing Boundaries

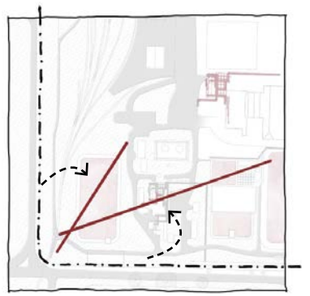


fig 9.28: Shifted rectilinear boundaries inwards

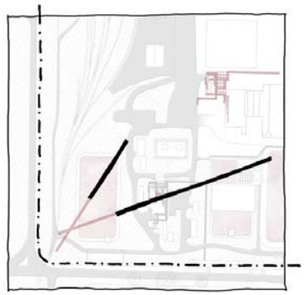


fig 9.29: New lines inform structural and service spine of the building

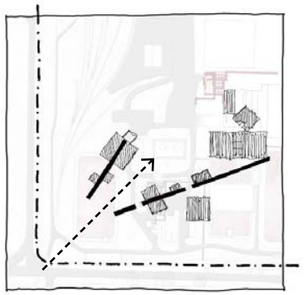


fig 9.30 Programme distributed along spine based on a hierarchy of public to private functions

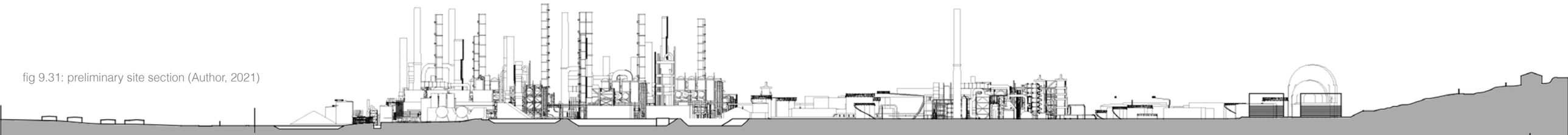


fig 9.31: preliminary site section (Author, 2021)

This created vast garden/ park like spaces however, it did not capture the toxic essence of the site in order to have the theme of toxicity as a reminder amidst the urban rehabilitation processes. In an attempt at using environmentally friendly materials, the material palette chosen was found to be an inappropriate response to climatic conditions of the region.

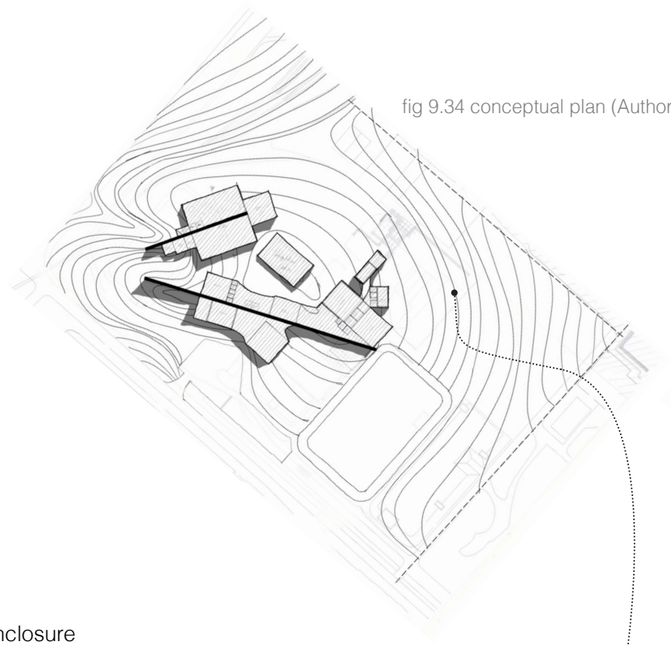


fig 9.34 conceptual plan (Author, 2021)



fig 9.35 conceptual programming (Author, 2021)

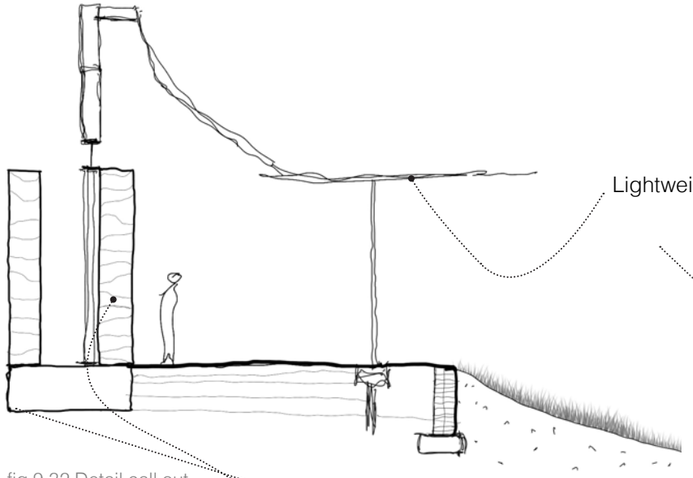


fig 9.32 Detail call out of conceptual section (Author, 2021)

Lightweight steel and glass enclosure

Restructured park that is reminiscent of the natural hilly landscape in surrounding areas

Outdoor gathering facilities linking in door and outdoor spaces

Rammed earth structural spine

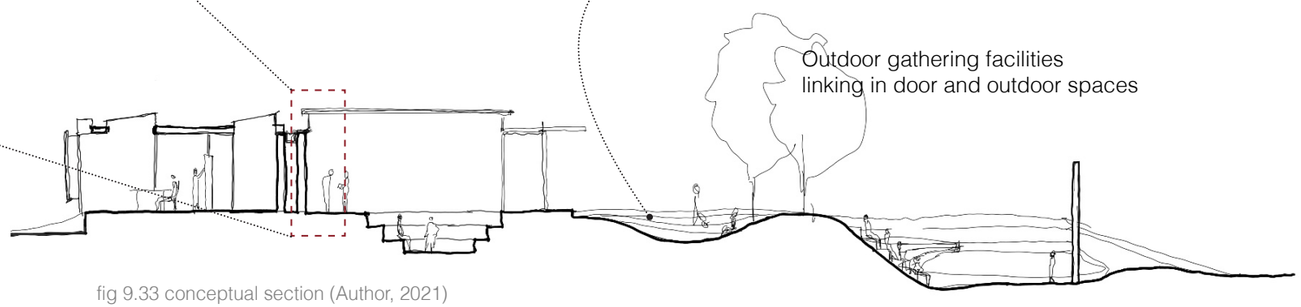


fig 9.33 conceptual section (Author, 2021)

- Re-interpretation space
- Environmental research facilities
- Service spaces
- library and maker space

Design iteration 4

The final sketch design was completed while drawing on key findings from the previous 3 iterations. By locating the programme on top of existing structures, the project now allows for larger scale site remediations. This also means that the post-industrial state of the refinery can be experienced first hand as a reminder of the previously toxic site. This is done through interpretive walkways that sprawl across the site instead of an interpretation centre which would have little to no benefit to the community.

Using a spatial hierarchy that places community engagement at the forefront of the design, three groups of programme will be chosen to occupy the site. All responding to the range of problems outlined in the previous chapters of this research report.

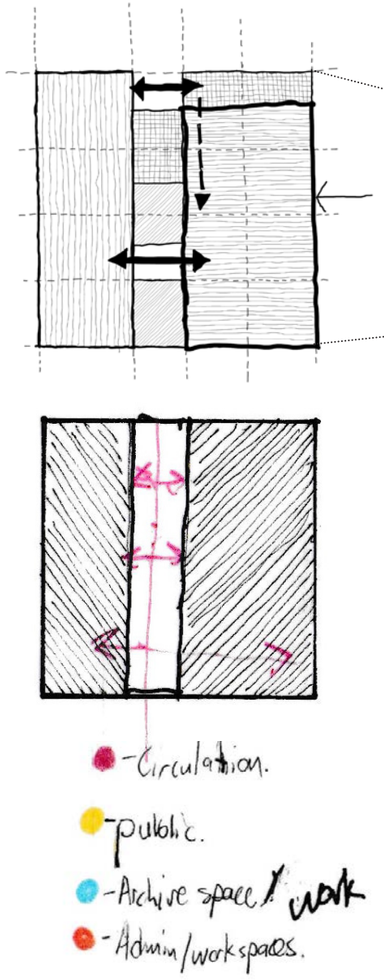


fig 9.36 plan development of Library (Author, 2021)

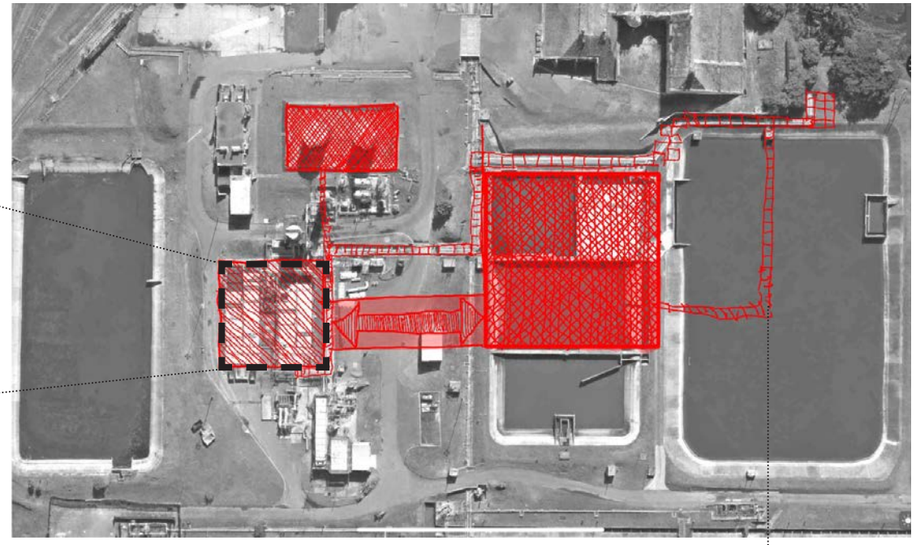


fig 9.37 Preliminary sketch plan of final design interation(Author, 2021)

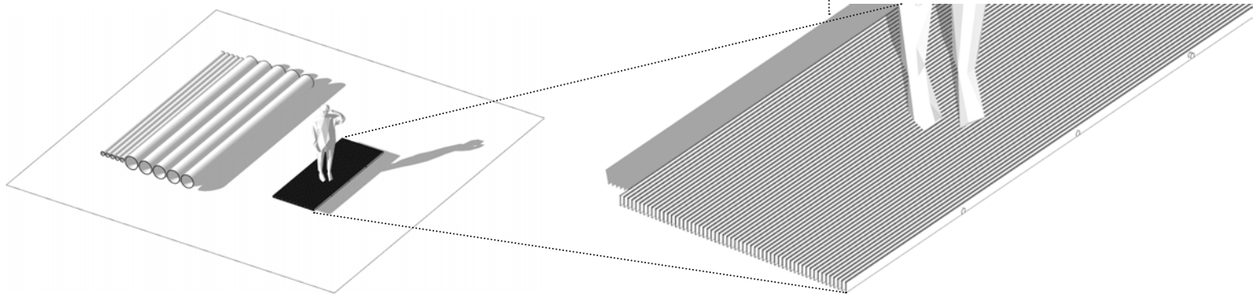


fig 9.37 conceptual illustration of walkways to be placed on site (Author, 2021)

By establishing a grid using existing trenches on the site, the design of the public library began to take shape. The grid informed the layout of spaces as well as key circulation routes of the interior spaces.

The function of the library is meant to serve as workspace for the community in collaboration with professionals therefore a sculptural element in the form of a floating nest was proposed as the dedicated workspace. The relevance of the nest proved to be conceptually weak therefore through the process of resolving the design for the final submission, the interior spaces of the library will be further articulated

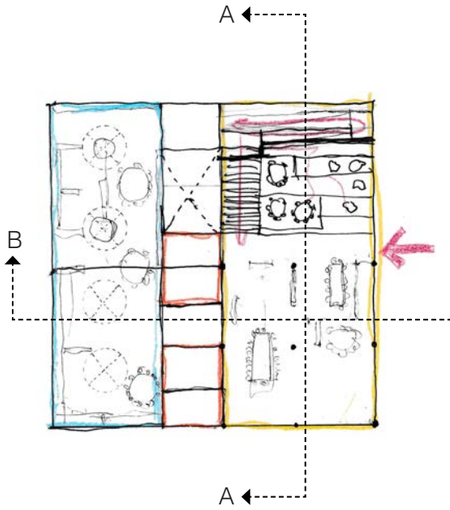


fig 9.38 Lower ground floor plan developement (Author, 2021)

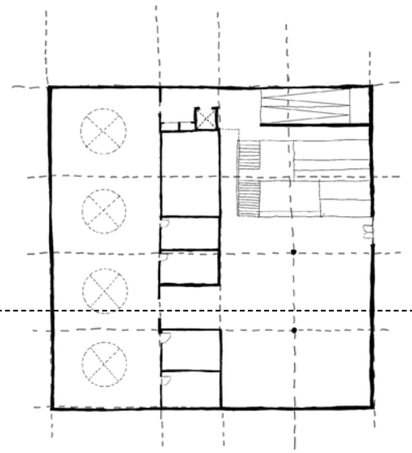


fig 9.39 Ground floor plan developement (Author, 2021)

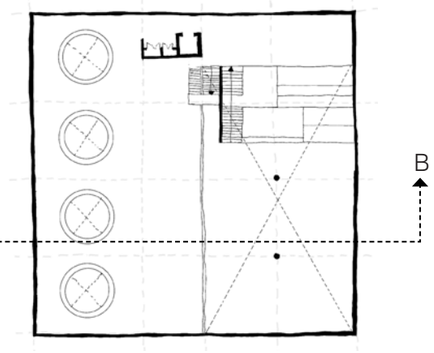


fig 9.40 First floor plan developement (Author, 2021)

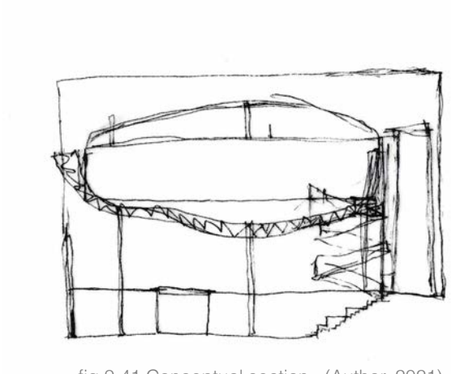


fig 9.41 Conceptual section (Author, 2021)

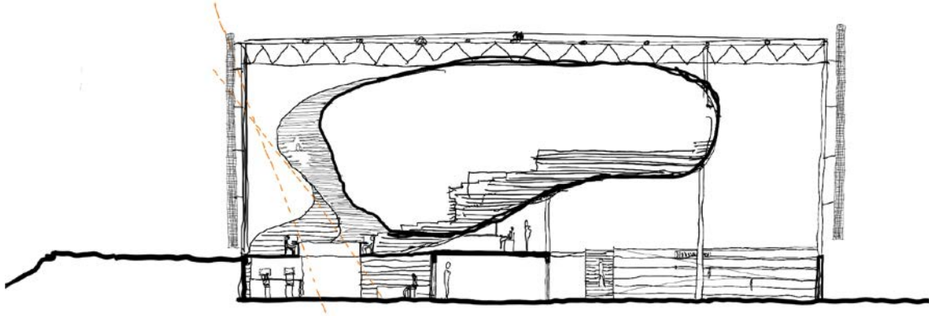


fig 9.42 Conceptual section (Author, 2021)



fig 9.43 Conceptual section model (Author, 2021)

The design of the research laboratories began with choosing a site for the facilities to be housed in. Given that the primary function of the laboratory is to experiment on bioremediation techniques to be rolled out across the site, a portion of the total site area would need to be given for controlled experimentation. To do this, the labs were located near one of the disused water storage pools. At this stage of the design process, I was able to work on certain programmatic decisions which will be discussed further in the following subchapter

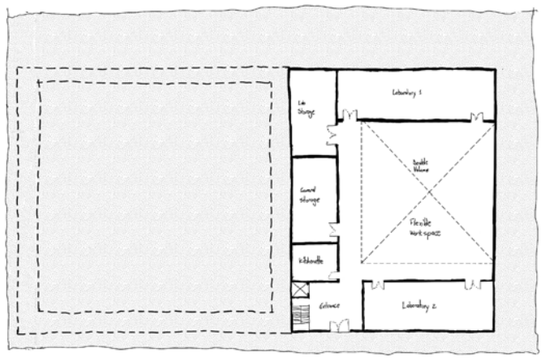


fig 9.44 Lower ground floor plan developement of laboratories (Author, 2021)

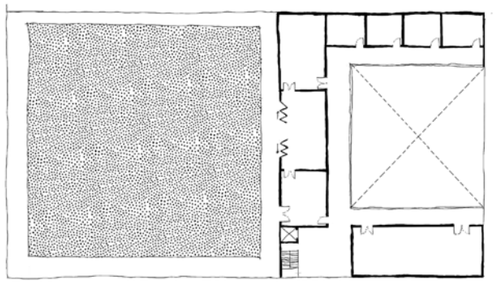


fig 9.45 Ground floor plan developement of laboratories (Author, 2021)

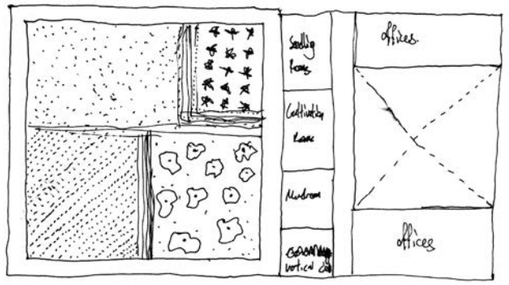


fig 9.46 conceptual sketch plan of laboratories (Author, 2021)

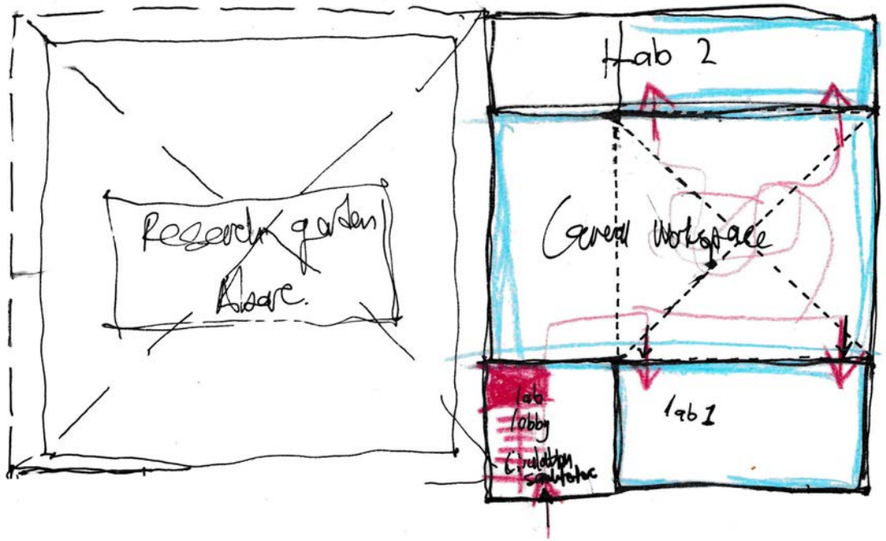


fig 9.47 conceptual sketch plan of laboratories (Author, 2021)

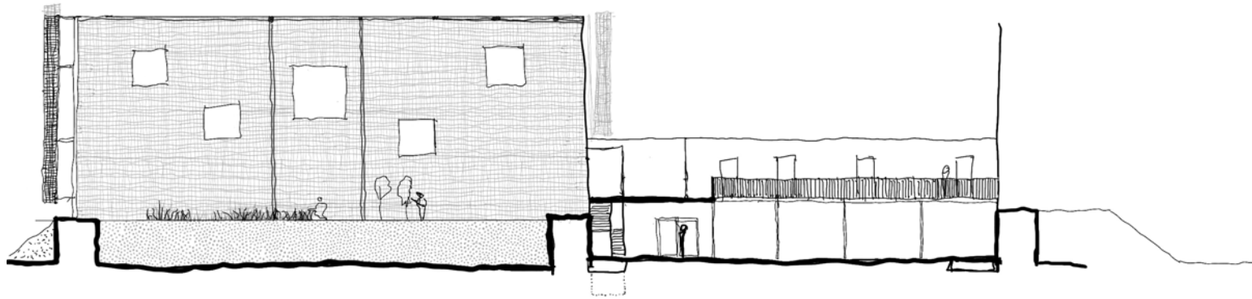


fig 9.48 conceptual section of laboratories (Author, 2021)

Design Brief and informants

Drawing on the informants from the research and analysis conducted throughout the course of the year, the design brief is structured to inform the final project in a way that mediates the relationship between industry and community. At this stage it is important to note that while the production facilities of the refinery may be out of commission, the large area currently housing the fuel storage tanks will still be operational. Fortunately, this means that the area will see a sustained decrease in emissions.

in order to switch the narrative from industrial driven development to community driven development, a list of key points outlined in figure 9.49 show the approach that will be taken.

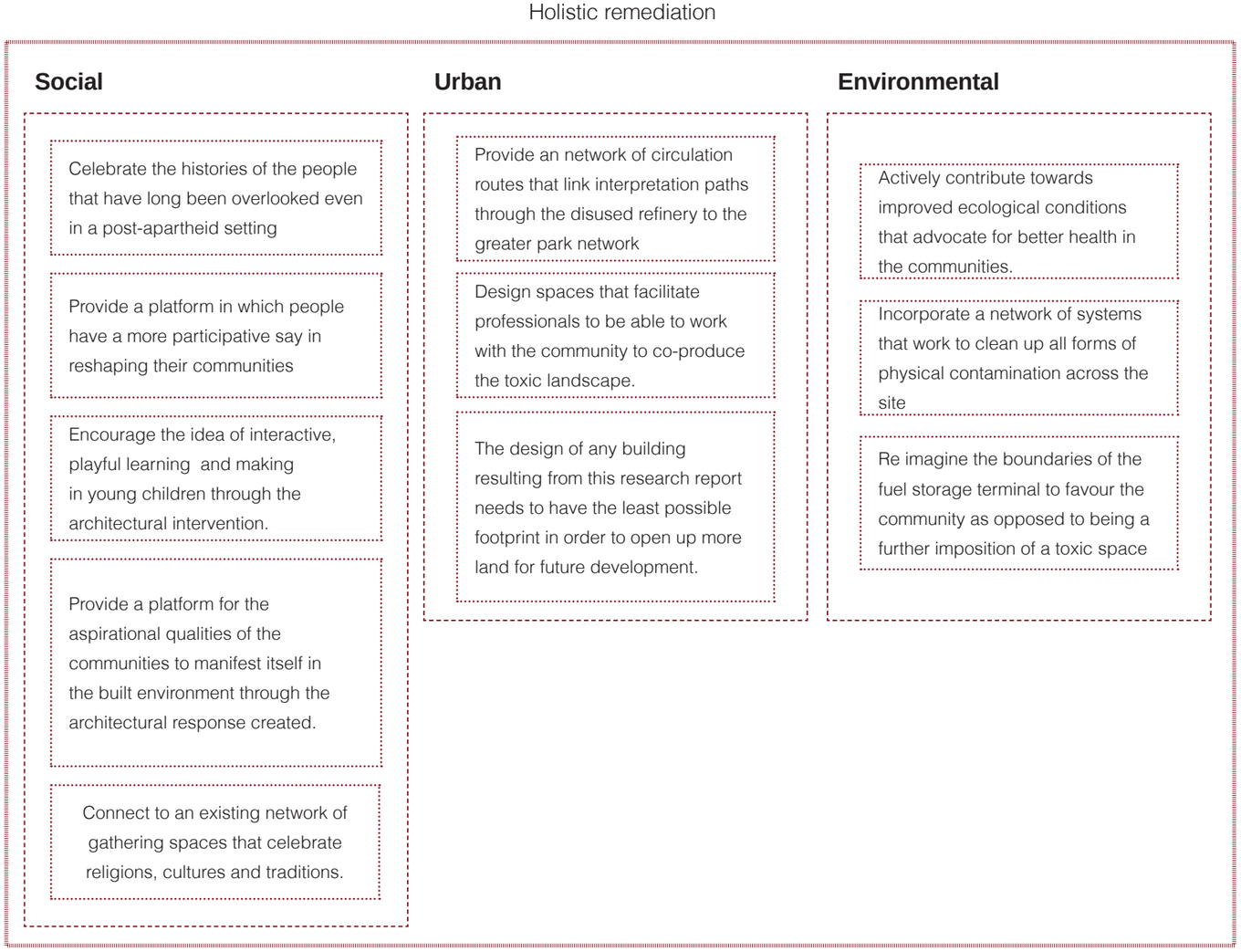


fig 9.49 Diagram of key findings translated into architectural responses (Author, 2021)

Programme

Overall the project needs to be aimed towards reshaping the landscape so this needs to be reflected in the programme of the spaces created. The programmatic outputs of the eventual design will be geared towards the key components that need a response as outlined in the design brief. To cater for community driven development. Three main overarching programmes will be designed within a greater park network. The park network will begin as large areas dedicated for landscaping but in the long run it will provide certain areas up for development similar to that seen in the Emscher park network. As a means of understanding the spatial implications of the programmatic outputs through virtual modelling and data handling in Rhino and Grasshopper, the areas of each space are reflected in the radius of each circle. When placed over each other, one can see that the building footprint occupies very little space in the greater park network. However it will have a greater influence over the area designated for development

Public engagement and community empowerment: In order to empower the community to engage with the site and proposed functions of the building a library will be designed in addition to a large makerspace that can be occupied by people of varied ages to favour skills development through the process of learning new technical skills. The library will act as an active archive that becomes a vital tool towards informed urban development.

Informed ecological remediation: In order to allow for a technical understanding of the contaminated landscape, laboratories will be included to test ideas, theories and practical applications of site remediation systems. Due to the technical nature of the programme, access to these areas will need to be strictly controlled to prevent public access into specialized spaces. However, it is important that there is a visual connection to these spaces so as to make the outputs of the laboratories more accessible to the general public.

Public to institution mediator: In order to mediate the transition from public(library) to private(laboratory) programme, A semiprivate element of the library will be the design of an SDCEA workspace. Access to these areas will be controlled due to sensitive and specialized work that would need to occur in these spaces. The function of this space is to help facilitate communication of findings from the research facilities to the general public.

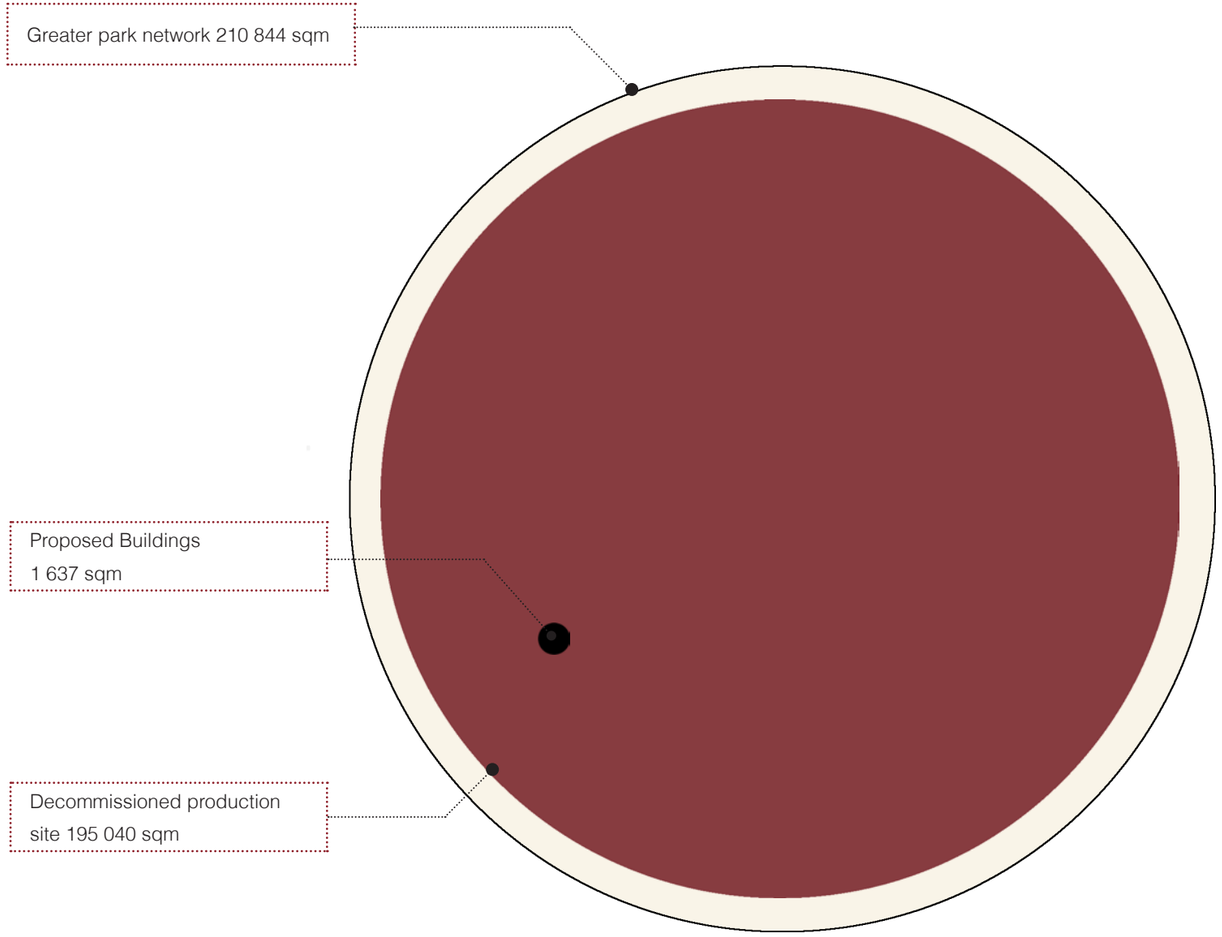


fig 9.50 Building programme diagram (Author, 2021)

Library programme

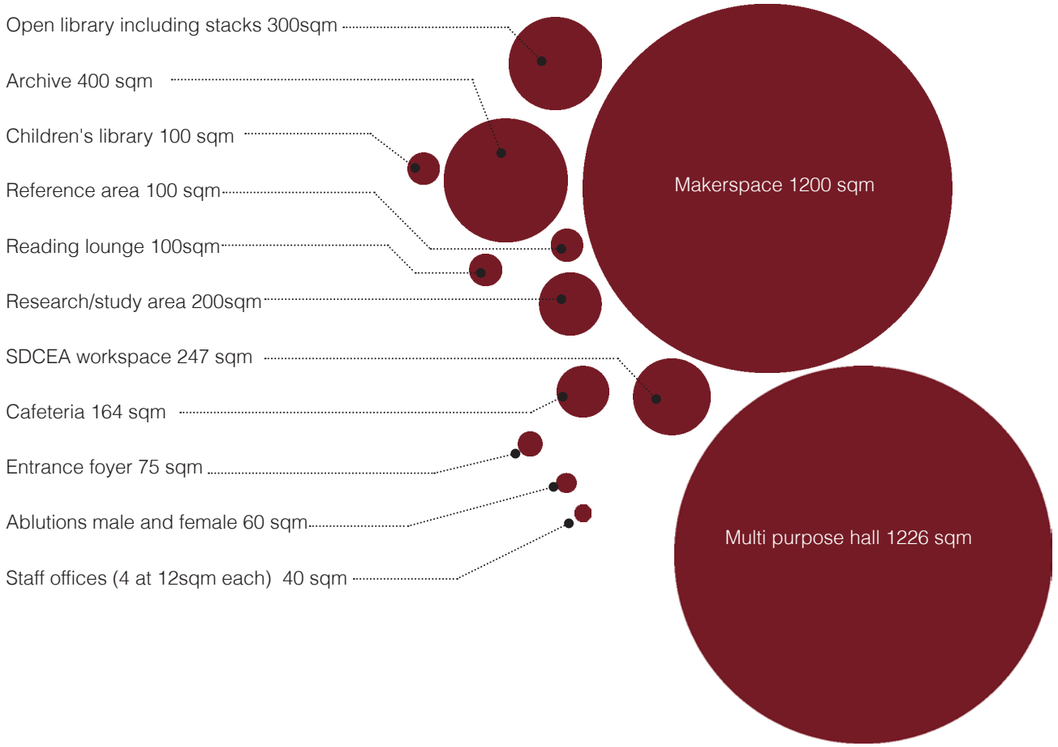


fig 9.51 Library programme diagram (Author, 2021)

Research centre programme

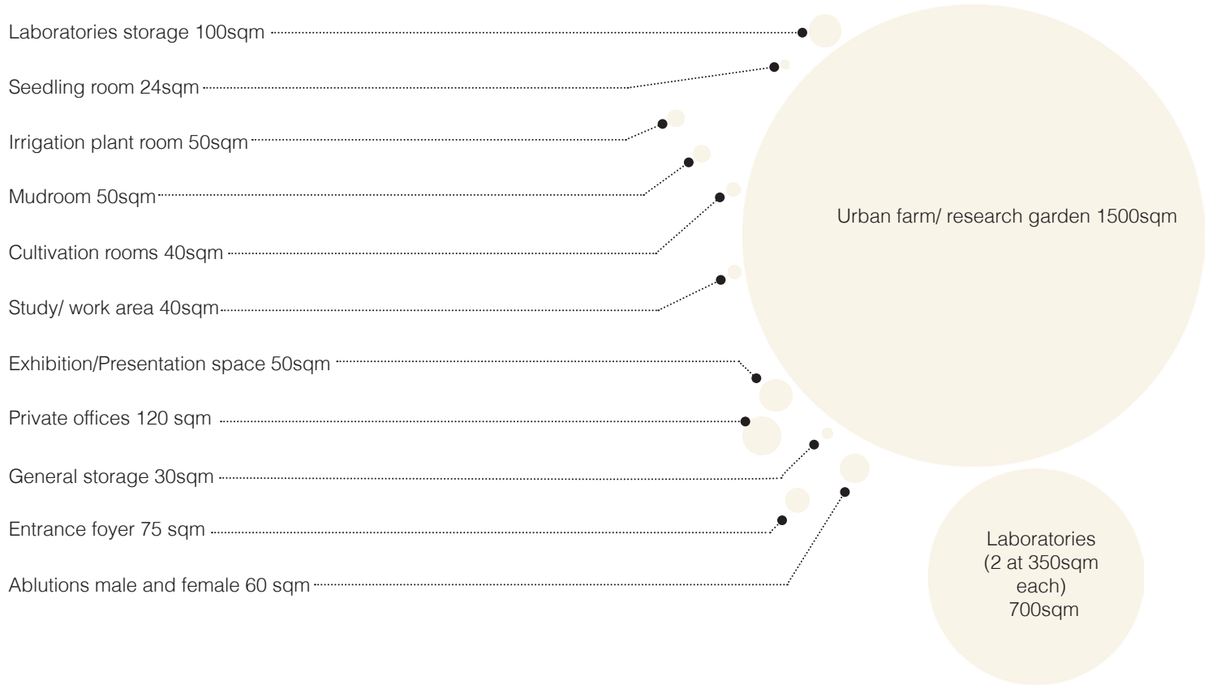


fig 9.52: Research facilities programme diagram (Author, 2021)

CASE STUDY: Ancient Agora of Athens

The agora of Athens was located below the Acropolis. “Agora” which is Greek for “open place for assembly” is a famous site which housed the creation of democracy through political discussions and arguments. The Agora as a public space was an important form of community congregation because it allowed people to inform themselves and partake in the events of the day. Specifically referring to that of politics, religion, philosophy, and legal matters. Spatially this space was cultivated to entice interactions between the people using trees and gardens with colonnaded buildings and statues interspersed in the space.

It’s relevance in the modern world is important because it is one of the first forms of co- production in a community through the use of a physical heterotopia. It also entices interactions at various scales. For example, one might have enjoyed the views of the Acropolis while engaging in conversations over tax laws with a fellow market goer. Architects and Historians may not know the entirety of the events that may have taken place in the Agora however, it is evident that a gathering space to share one’s input on the surroundings in which one occupies can be successful when carefully planned and constructed.

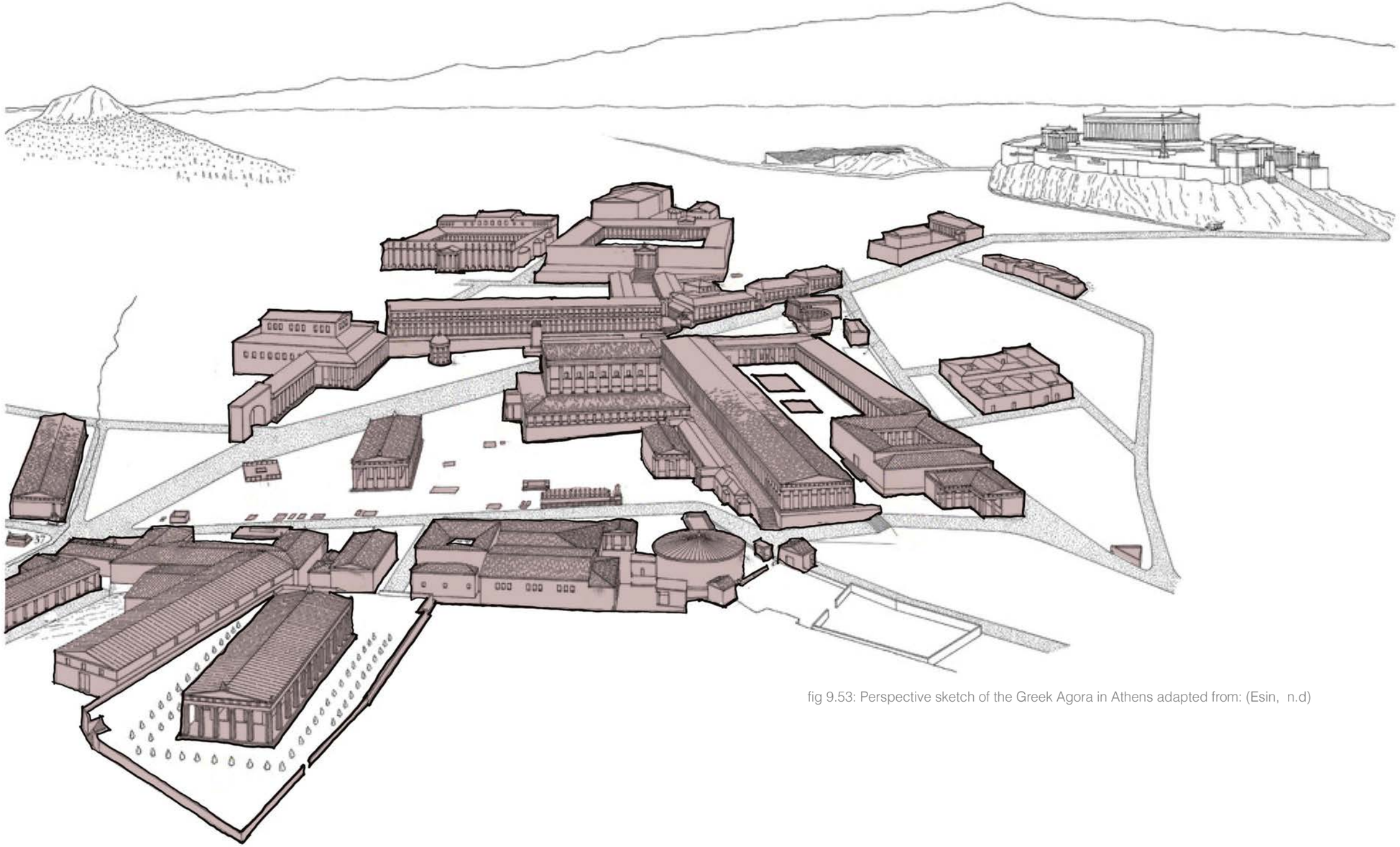
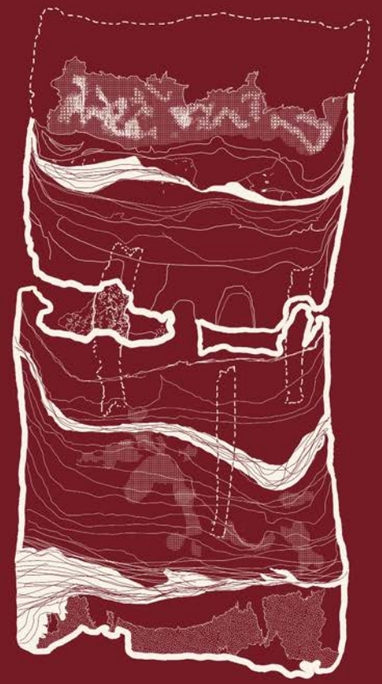


fig 9.53: Perspective sketch of the Greek Agora in Athens adapted from: (Esin, n.d)



10. Concept design

- Charette studies
- Precedent studies
- Preliminary design
- Tectonics
- Bioremediation systems
- Case study: Phytoremediation austraila thingymajig

Charette studies

The charette studies discussed in this chapter, consisted of an exploration of concepts relating to the corrosion of purity of site. This was interpreted in many ways to help understand toxic formations of political structures, community cultures and toxic spaces.
The objects created alluded to an understanding of how I would navigate an architectural intervention that responds to the geology of the landscape. Using materials that exist as by-products of refinery functions, I began assembling several objects for the exploration. This charette helped direct me towards establishing the design brief for the project as well begin a conceptual understanding of the problems outlined in the research

The first exploration involved a basic understanding of how paraffin wax interacted with string. By burning a candle and dropping the wax onto a string formation, I was able to assemble a toxic object. I then proceeded to burn it to resemble the dismantling of a toxic object.

The second exploration entailed layering variations of wax over compacted soil with holes made in them to cast a wax figure. this helped understand the nature of contaminants in a landscape.

The third exploration was very similar to the second however, instead of the sand as a mould, I used oasis floral foam to see the nature of the contaminants in man-made objects.

The last exploration proved to be the most useful object when conducting the charette studies because it set a conceptual basis upon which the design progressed. Layers of wax, sand, twigs and oasis floral foam was compacted in a mould and then cut to view the conditions inside the object.



fig 10.1 image of charette object 1 (Author, 2021)



fig 10. 2 image of charette object 2 (Author, 2021)

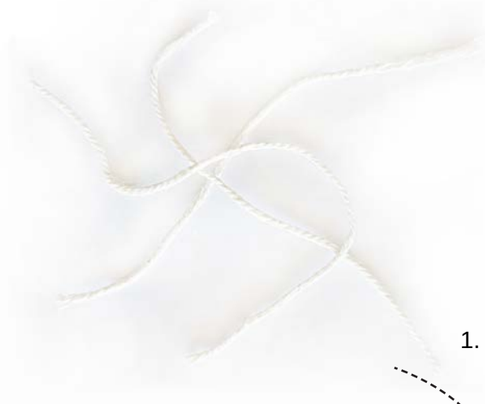


fig 10. 3 image of charette object 3 (Author, 2021)



fig 10. 3 image of charette object 4 (Author, 2021)

Exploration 1



1. Structure

fig 10. 4 string laid down to represent urban structure



2. Assembling toxicity

fig 10. 5 Melted Wax is poured over the string to represent toxic formation

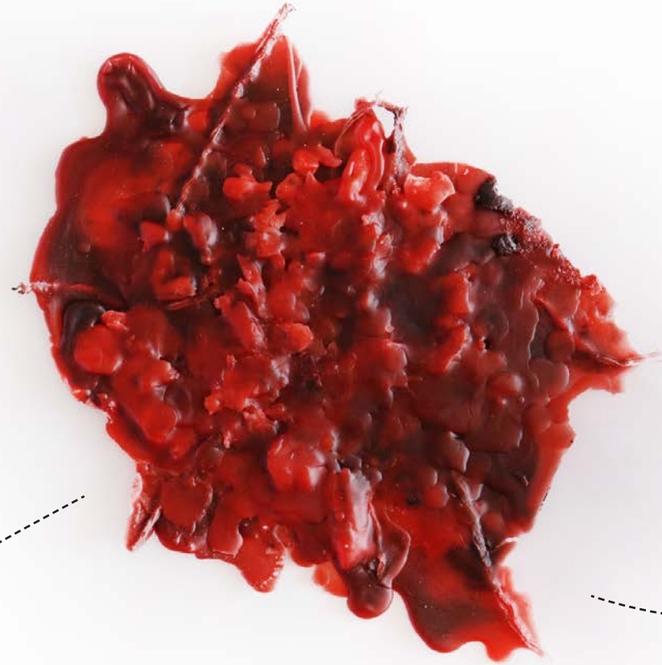


fig 10. 6 Once the toxic object is formed the process of dismantling it becomes the challenge.

3. Toxic assemblage



4. Dismantled toxicity

fig 10. 7 after burning each of the wicks showing on the edges till it burnt out, the toxic object still remained relatively intact.

Figure 10.4 to 10.7 shows how the resulting form became one with little structural integrity and thus made the wax element malleable while the structural component(wicks) became brittle after burning.

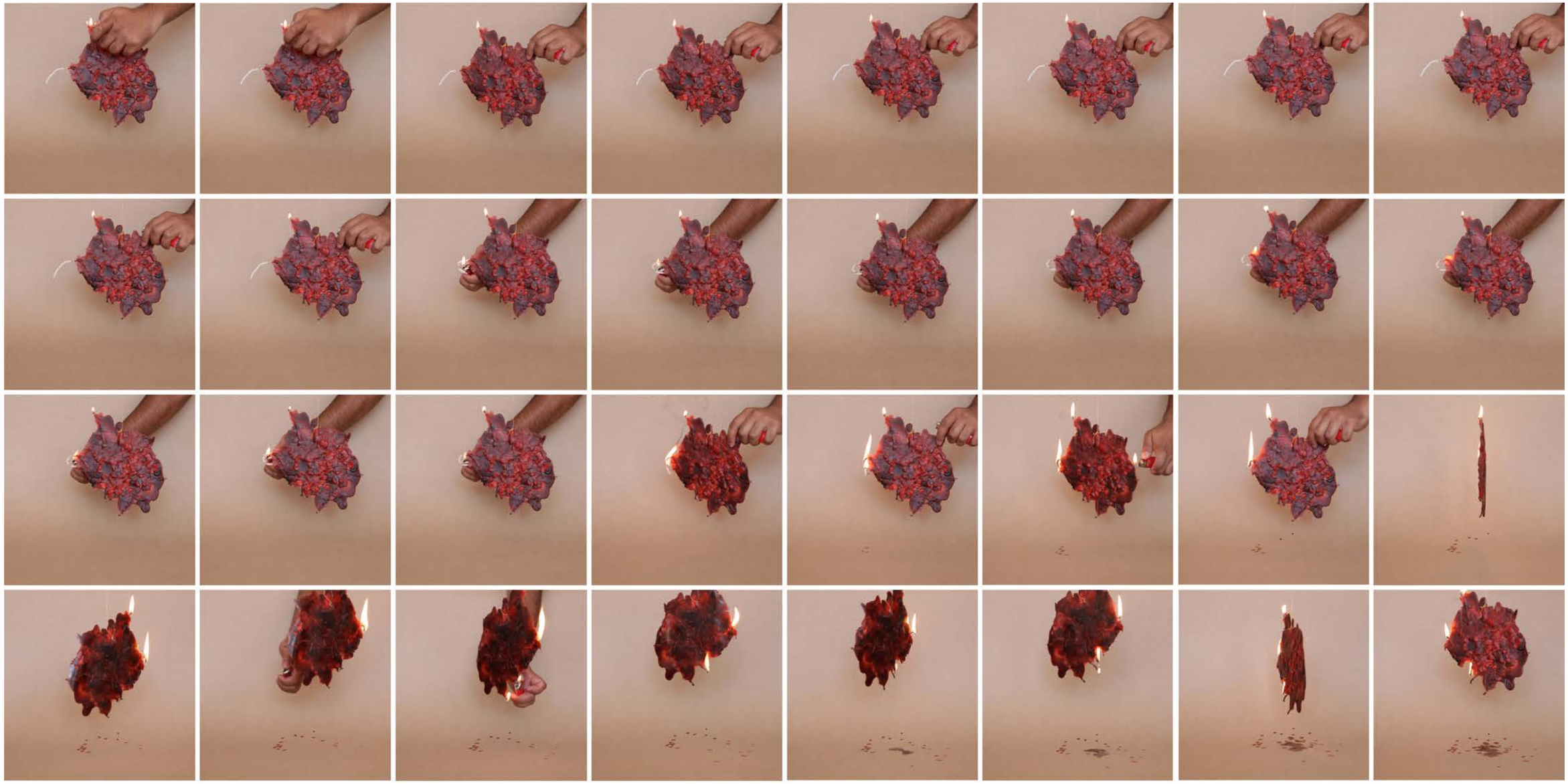


fig 10. 8 photographs showing the controlled burn of the toxic object (Author, 2021)



fig 10. 9 photographs showing the controlled burn of the toxic object (Author, 2021)



fig 10. 10 photographs showing the controlled burn of the toxic object (Author, 2021)

Exploration 2



fig 10.11: photographs of Wax models cast in rough sand with varied void volumes. (Author, 2021)

Exploration 3



fig 10.12: photographs of Wax models cast in oasis foam moulds. (Author, 2021)



fig 10.13: photographs of Wax models cast in oasis foam moulds. (Author, 2021)

Exploration 4

The last object created became a very valuable exercise that informed the development of this research report immensely.
As a solid object, very little is seen from the surface quality of it. However, when documenting the process of assembly, It was understood that the object emerged as a layered multifaceted toxic form. Relating to the conceptual formation of the site, it ties to the layers of histories that have played out to see the eventual creation of the toxic hub that exists today. and when cutting through the object, one is able to identify the depths of layering various forms of toxicity on top of each other.



fig 10.14: Perspective view of charette object 4. (Author, 2021)



Front



Left



Bottom



Right



Back



Top

fig 10.15: orthographic views of charette object 4. (Author, 2021)

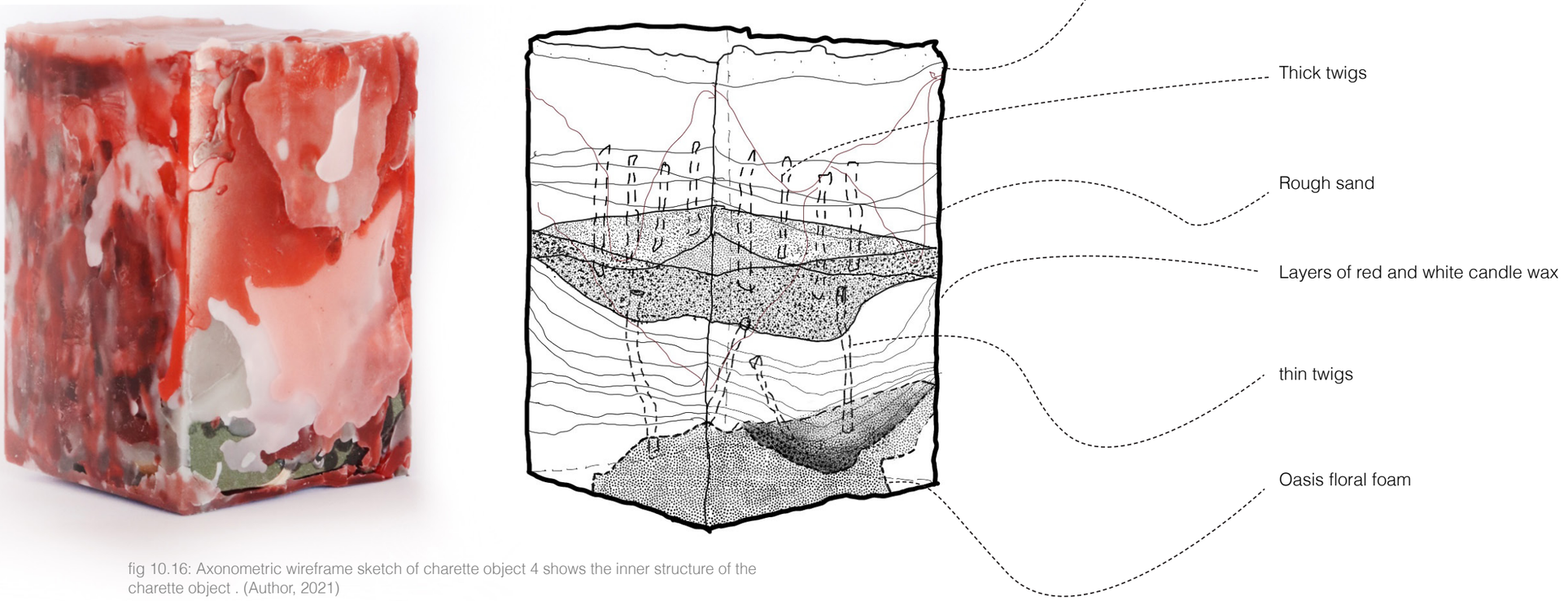


fig 10.16: Axonometric wireframe sketch of charette object 4 shows the inner structure of the charette object . (Author, 2021)



Deconstruct

Remember

Remove

Dismantle

Break

Suspend

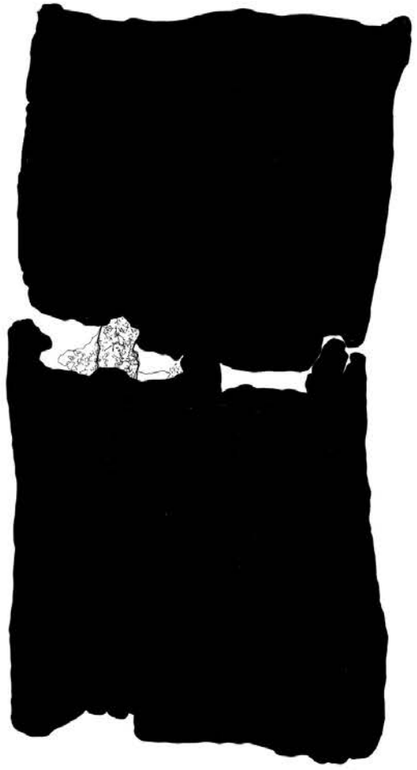
Anchor

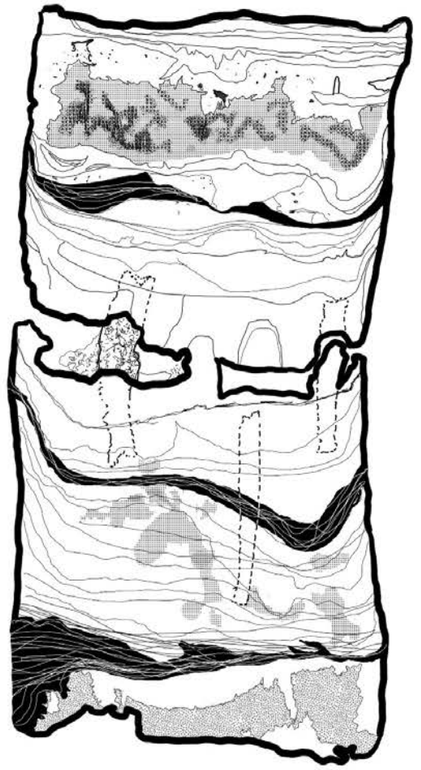


fig 10.17: Photograph of the broken charette object . (Author, 2021)

fig 10.18: figure ground sketch of the broken charette object . (Author, 2021)







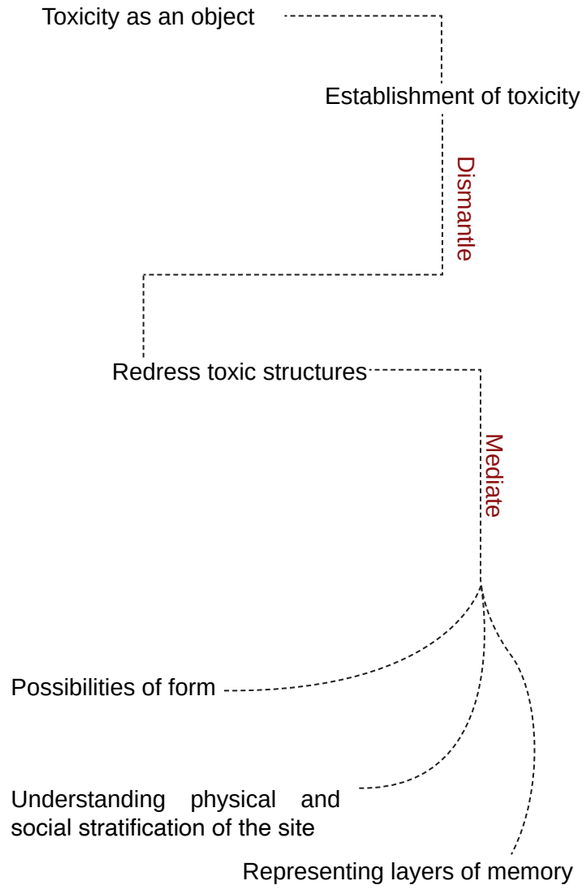


fig 10.19: exploration series of models and sketches of the final charette object that became a representative object for navigating the contents of this research report . (Author, 2021)

Precedent studies

Kinderdijk visitors centre (2019) by M & DB Architecten
Alexandra Heritage centre (2003) by Peter Rich Architects
Red location Cultural precinct (2006) by Noero Wolff Architects

Kinderdijk visitors centre (2019) by M & DB Architecten

Project description:

Declared as a UNESCO World heritage site in 1997, the village is an example of a typical Dutch windmill landscape. This earmarked the site for its new identity as a tourist attraction and meant that an update in the supporting infrastructure would need to take place. The intervention came in the form of a visitors centre and a series of strategically positioned paths, and bridges. The visitors centre sits on the edge of the quay giving the feeling of a dramatic cantilever which allows for panoramic views across the entire site.

Analysis:

The building almost disappears once one interacts with the views thereby placing significance on the landscape as opposed to the building as an object.

The protrusion of the floor slab over the water as well as the interaction at various levels also emphasises a connection to the landscape at a more manageable scale.

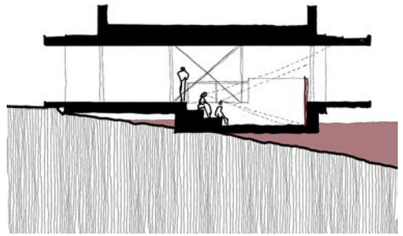


fig 10.20: split levels allow for interesting spaces (Author, 2021)

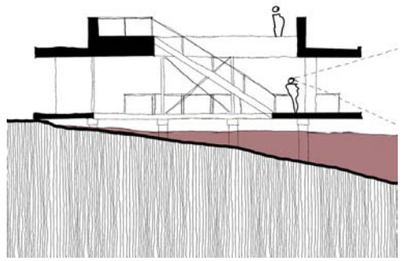


fig 10.21: the Building lends itself to the views (Author, 2021)

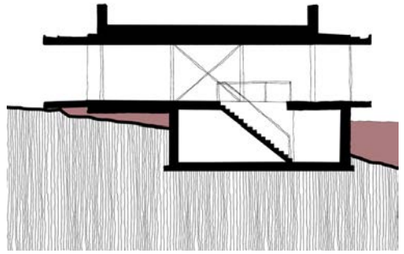


fig 10.22: the cantilevers give the impression of a floating building (Author, 2021)



fig 10.23: Aerial view of visitors centre (van Duivenbode and Hart Nibbrig, 2019)

Alexandra Heritage centre (2003) by Peter Rich Architects

Project description:

Alexandra township is a poor densely populated suburb in northern Johannesburg. As part of the “Alexandra Renewal Project” the appointed architects set out to investigate the area in which former president Nelson Mandela once lived in in 1942. Over a period of 5 years, prior to construction they worked with the community to build an oral history of the culturally rich area which led to the site being declared as a conservation area. Community involvement was also integral in the construction phase through skills development programs as well as the design of decorative marble collage panels. With building material manufacturers closely located to the township, most of the materials used were sourced within a 5km radius.

Analysis:

The Alexandra Heritage centre is an example of vernacular place making that draws on the technical knowledge of the architect in conjunction with the contributing efforts of the community. The site allows for maximum community engagement through the celebration of a historic landmark in the narrative of South Africa. The scale of the intervention does not interrupt the existing movement patterns but rather it becomes a sculptural element that encourages the community around it to engage with the spaces created.

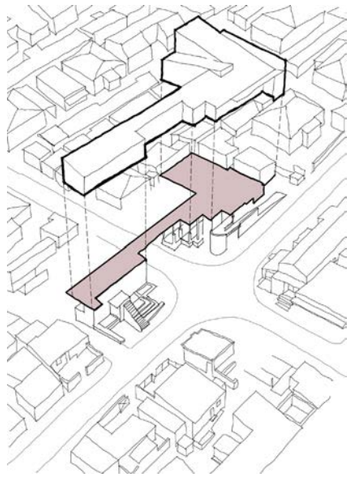


fig 10.24: Axonometric sketch of heritage centre (Author, 2021)



fig 10.25: View of the Heritage centre down a busy street (Baan, n.d.)

Red location Cultural precinct (2006) by Noero Wolff Architects

Project description:

The design of the museum was done to emulate the architecture of the informal settlements to celebrate the struggle of black people through apartheid specific to that region. The precinct consisted of a museum with housing facilities for people having to be relocated because of the museum construction. The second phase of the project included a library, archive, gallery space and theatres. Incorporating elements of the surrounding informal settlements into the architecture of the museum space was an attempt to adapt to the local context of the region. The problem, as outlined in a paper by Michelle Smith(2016), is that the presence of the museum was not received well by the local community who colloquially named it “a house for dead people”.

Analysis:
The architectural language of the cultural precinct is well developed and conceptually driven by contextual informants. However, the overarching problem is that the function of the buildings had very little benefit to the surrounding communities. Specifically in regard to addressing the problems that had been established through the very political powers who dictated the people’s historic placement on the site. The project highlights the importance of designing for all forms of contextual forces on a site. Historic reparations, urban geographies and the social economies of space all need to be considered on top of the physical site conditions when dealing with contested urban landscapes.



fig 10.26: Red location Musuem as seen from the community. (Noero Architects, n.d.)

Tectonics

Given that the intervention is meant to encourage the community to engage in bettering their surroundings with professionals, the concept of making will be explored in the materiality and structure of the proposed intervention. Using relatively standard building materials constructed in a sculptural manner, the building will offer itself as an exemplar for future interventions that could take place on the site once it has been cleaned. This chapter outlines how standard building materials found in the materiality of the local communities will be adapted into the architecture of the intervention through core building systems such as foundations, walls, floors, and roofs. By drawing on the local materiality, the spaces created will be more comfortably experienced at human scale but simultaneously respond as a sculptural object on the site. With large scale bioremediation taking place across the site, the building itself will be raised off the ground to facilitate the bioremediation processes taking place. By doing this, more area is offered up as public open space in the landscape and can be experienced publicly via walkways that facilitate the interpretation of the landscape.

The material quality that is hoped to be achieved is one of industrial decay. In stark contrast to the programmatic outputs of the building which advocates for urban rehabilitation, the intervention becomes a physical reminder of the toxicity that is being reformed. Using steel and sustainably produced concrete as basic building materials, the construction of the project becomes an exercise in sustainable design and construction that will exhibit conservation and efficiency in the use of resources while making positive contributions towards ecological rejuvenation.

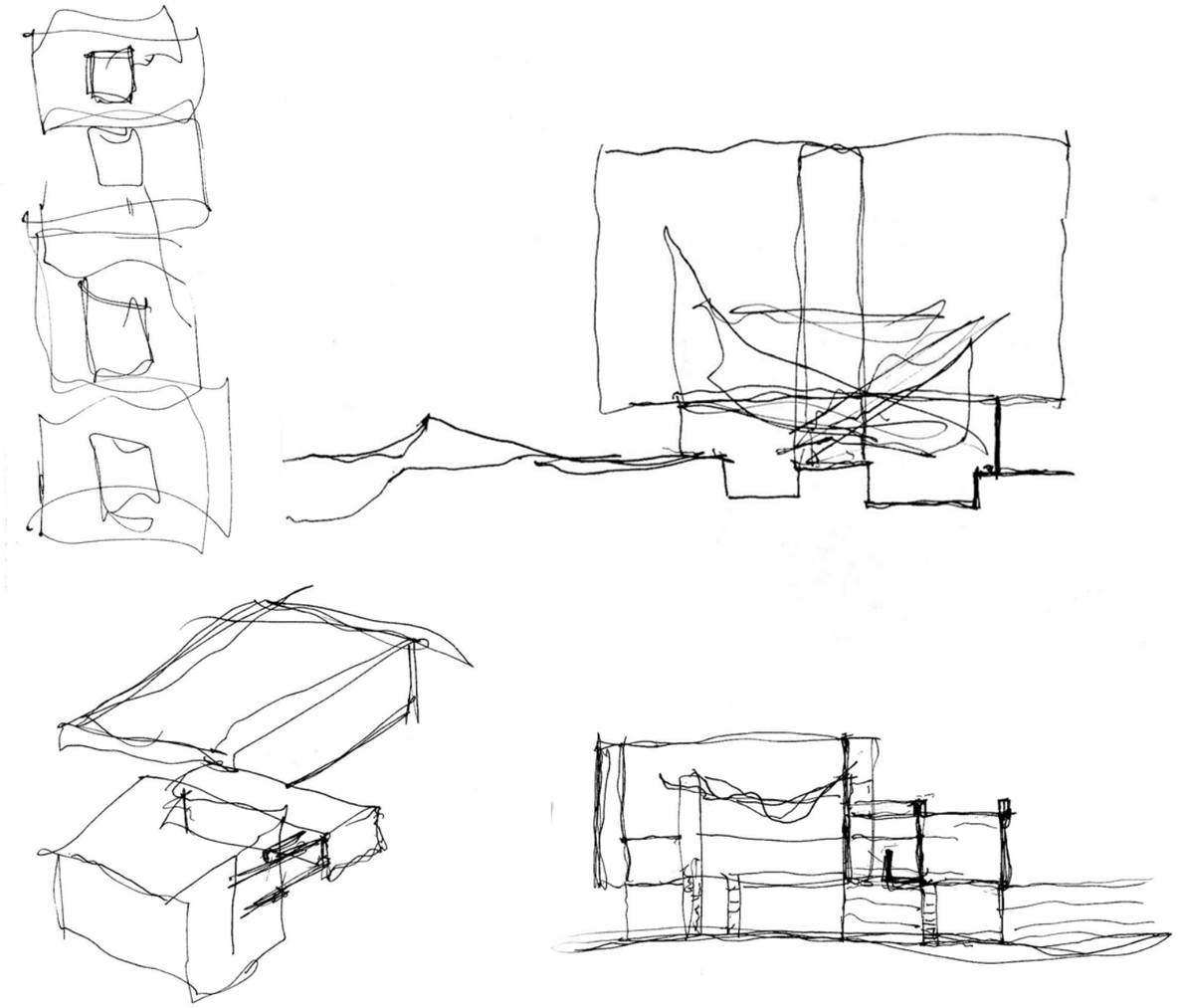


fig 10.27: Preliminary conceptual sketches (Author, 2021)

Interpretation walkway:
The layout of the walkways will be determined by the route of the pipe network on site as well as a central axis that runs along the spine of the production facility. The walkways located on the site will have breakaway spaces to allow users to venture off the path and into park/garden spaces. The route that runs along the central axis will still follow the path of the previously used pipe network, however it will restrict access into certain decommissioned areas of the production facility to prevent physical interactions with areas still under development. It will form part of the precinct plan to allow people to circulate safely amidst the industrial complex and into designed public spaces that connect to the larger network of park space.

The floor of the walkway will be a linear metal grate that is reminiscent of the pipelines that were once sprawling across the site. The supporting structure will be concrete pillars that are cast using crushed aggregate from demolished elements on the site. The structure used to hold up the grated walkway will be a steel frame structure that will be designed to give the feel of a floating walkway.

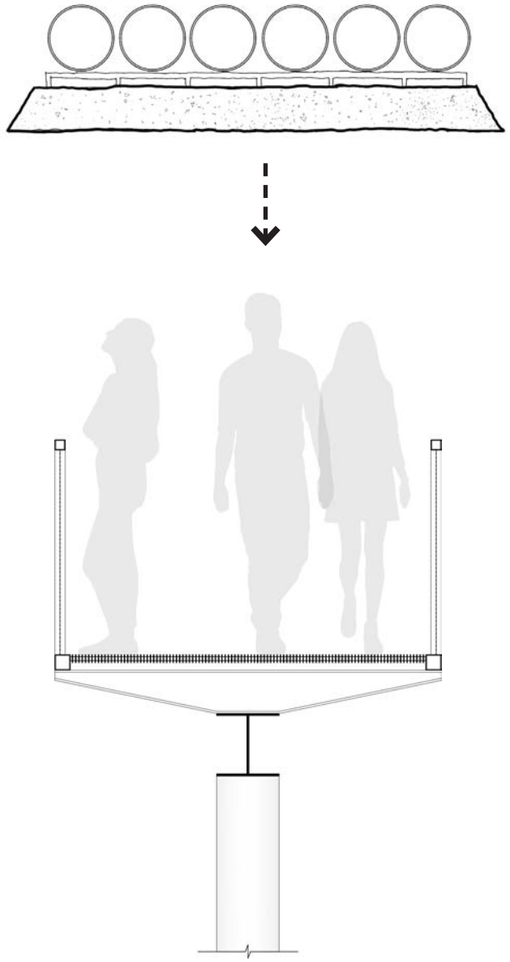


fig 10.28: Section resolution of walkway (Author, 2021)

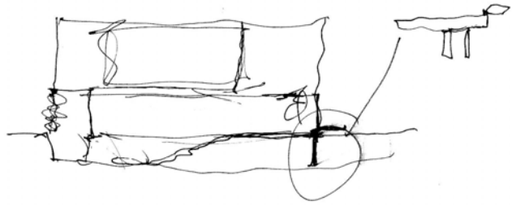


fig 10.29: Preliminary conceptual sketches of linking walkway to building (Author, 2021)

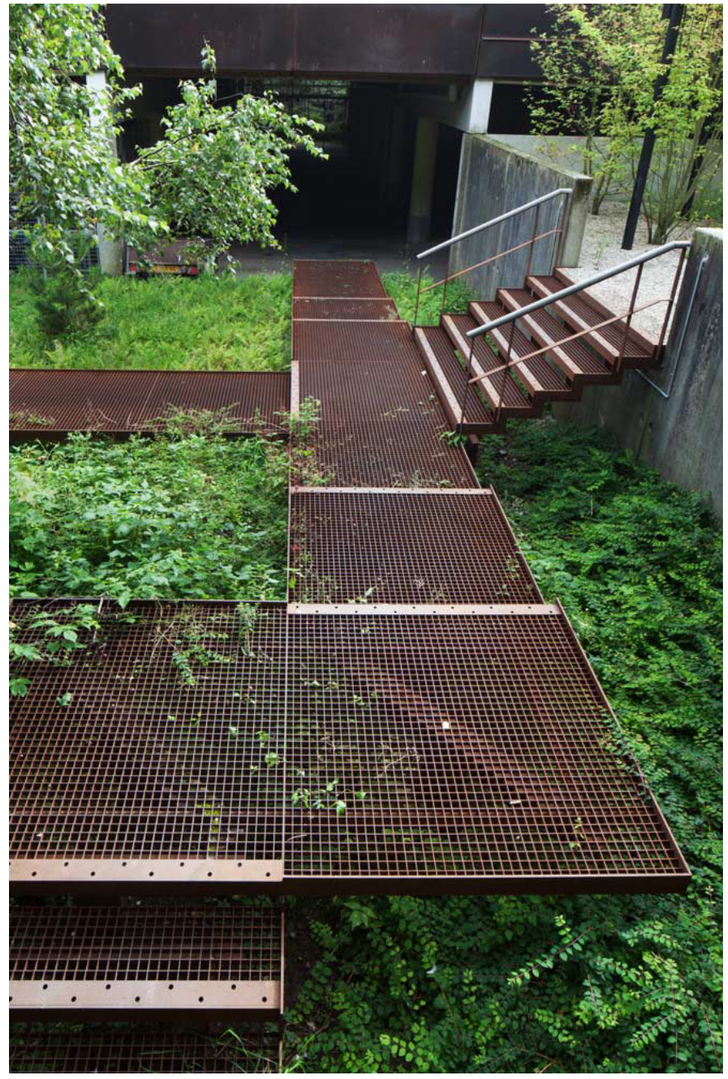


fig 10.30: Corten steel walkway (Landezine, 2021)

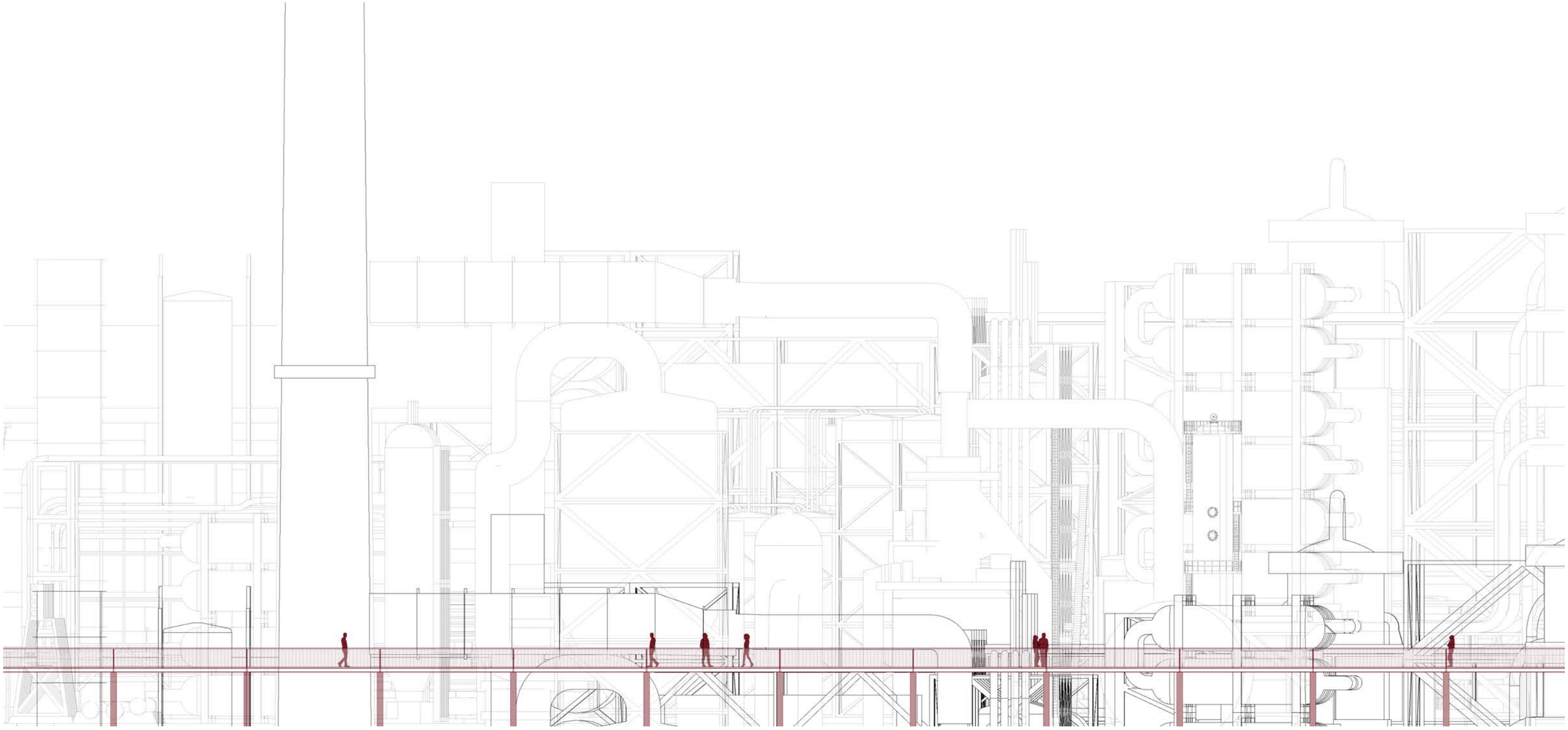


fig 10.30: Elevation of walkway through industrial site(Author, 2021)

Foundations:
With aggregate being provided from demolished concrete structures on site, the foundations of the library building will be concrete pile foundations with ground beams to support foundation walls made of concrete masonry units. The foundation walls draw on the materiality of the economic and subeconomic housing schemes developed as part of the group areas act and will now serve as the conceptual and physical support structure of the spaces above.

Due to the level changes on the site as a result of the two trenches being incorporated into the design, a retaining wall structure will also be introduced to create a sunken courtyard in the archive space to allow light into the lower ground levels. The retaining wall will also be constructed out of the concrete masonry units as demonstrated in figure 10.30

Floors:
A composite steel deck flooring system will used in the library because of the structural opportunities it presents. The steel decking acts as permanent formwork for a concrete slab and draws on the structural capabilities of the steel and concrete simultaneously while reducing the overall beam depth required to achieve large spans. The floor system will be placed on open-web joist framing that spans between the primary beams of the steel frame structure.

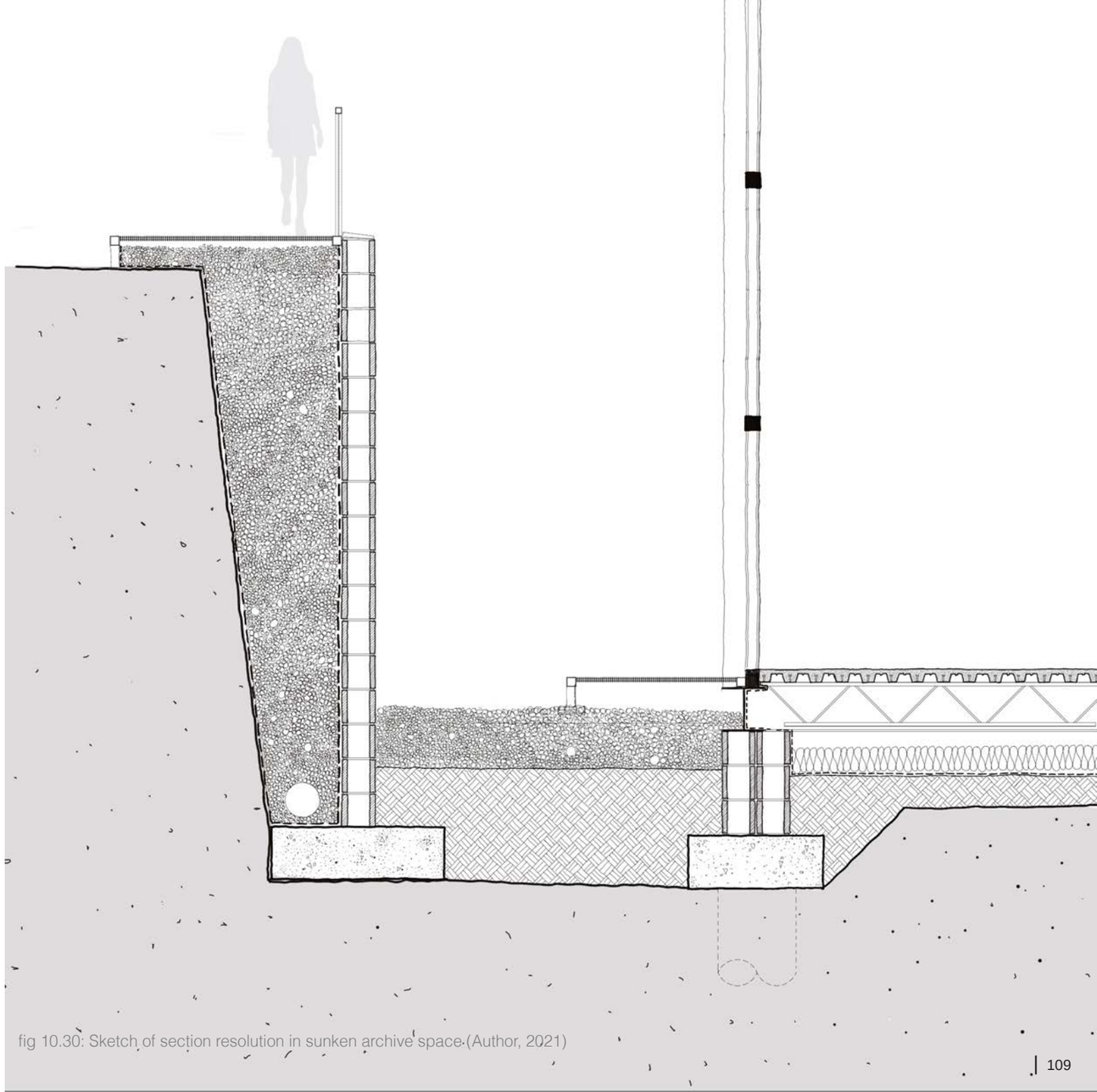


fig 10.30: Sketch of section resolution in sunken archive space (Author, 2021)

Roof Structure:
With the library roof fully inaccessible, a lightweight steel truss system will be used as a simple form of enclosure. However, with the roofs of the workspaces and laboratories fully accessible and forming part of the outdoor interpretation space, it will consist of a concrete slab structure with grated walkways on top of fine aggregate. This will be done as an extension of the walkways that will be circulating the landscape.

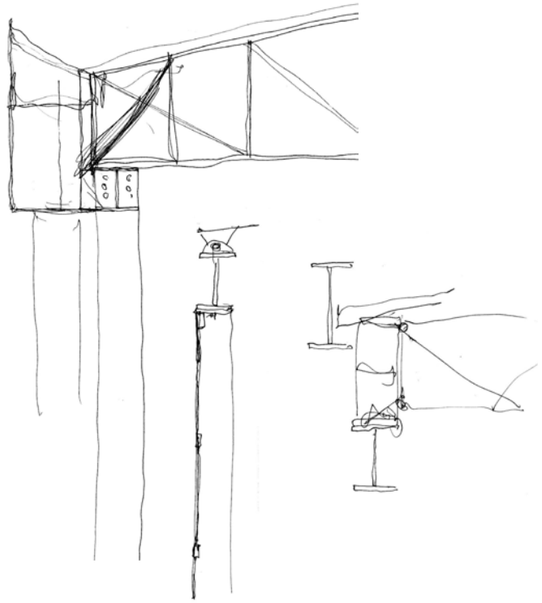


fig 10.31: preliminary roof section sketches (Author, 2021)

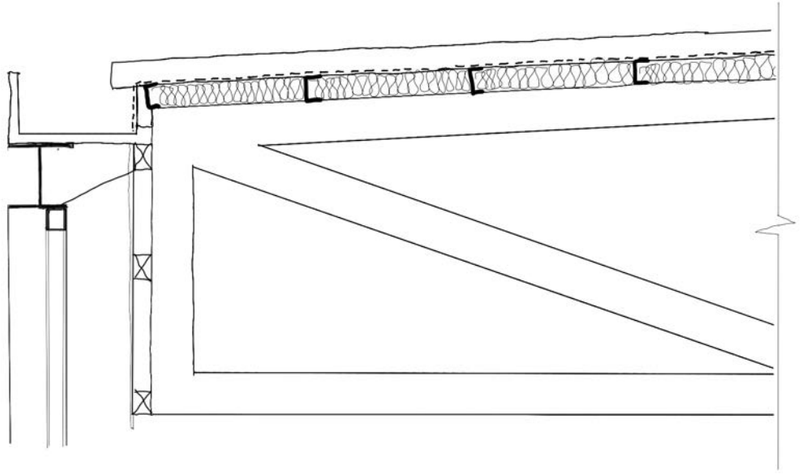


fig 10.32: preliminary roof section detailing (Author, 2021)

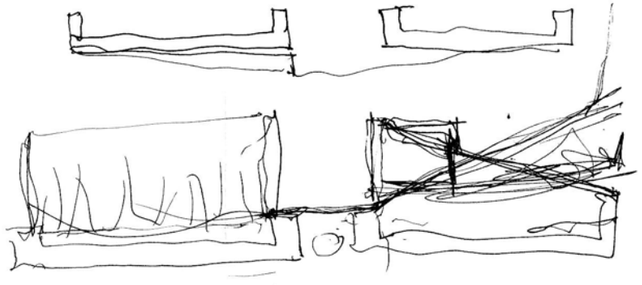


fig 10.33: preliminary roof section sketches (Author, 2021)

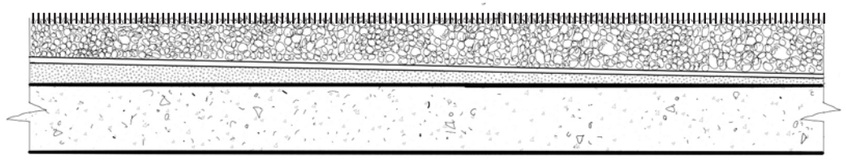


fig 10.34: preliminary roof section detailing of concrete roof (Author, 2021)

Wall systems : With the programme distributed in 3 main areas of activity, ranging from public to private. This notion of spatial programming will be emulated in the design of the walls that enclose these spaces. As such, the visual permeability of these walls become an important factor of exploration when enclosing the respective spaces.

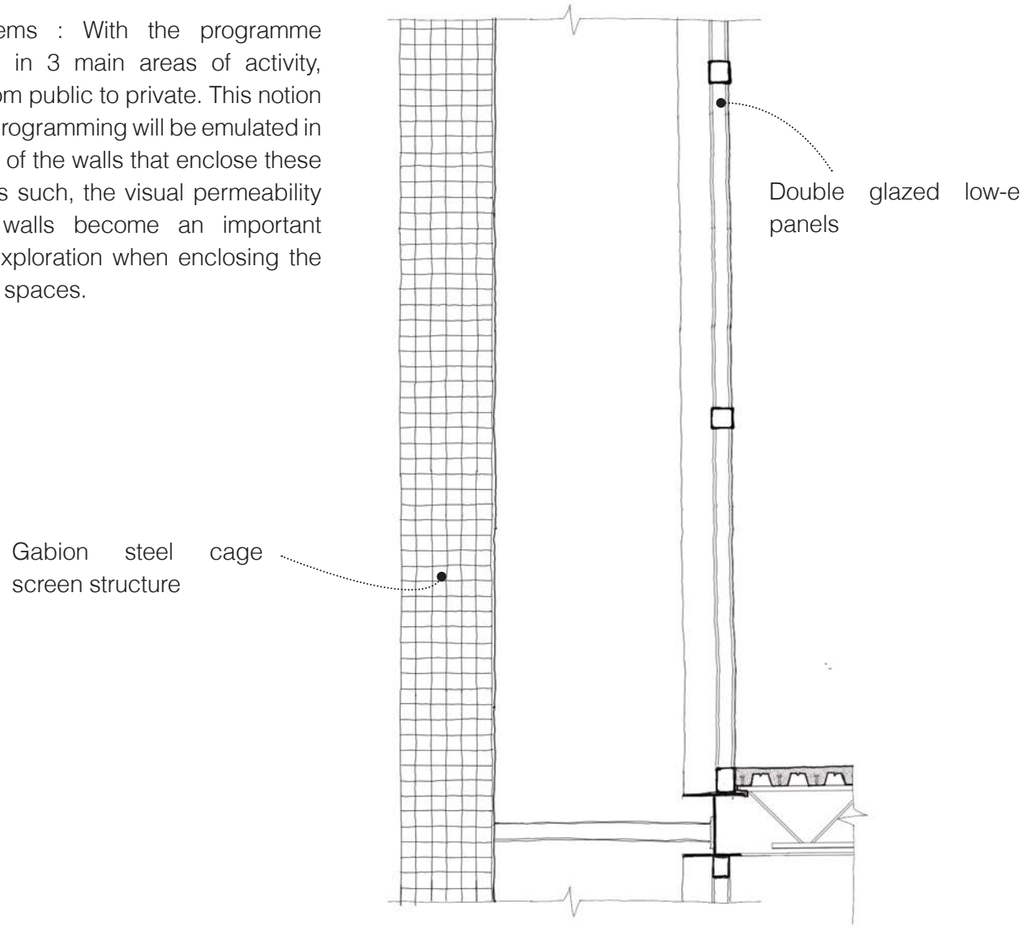


fig 10.35: Section resolution of library walls (Author, 2021)

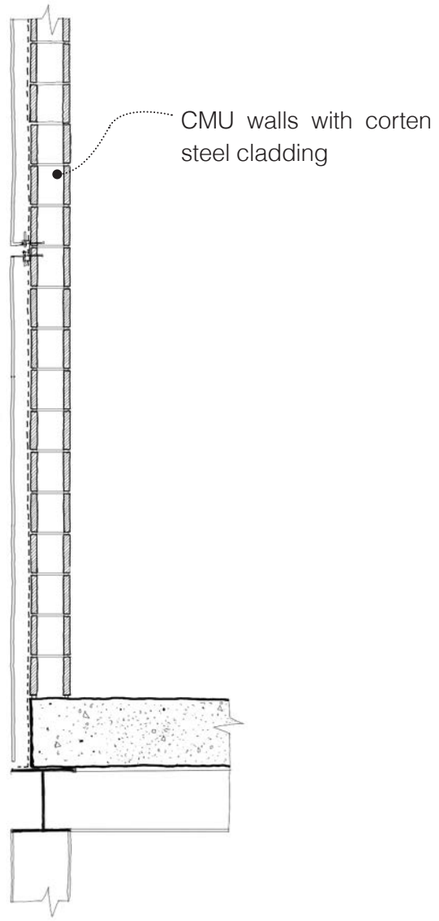


fig 10.36: Section resolution of Work space walls (Author, 2021)

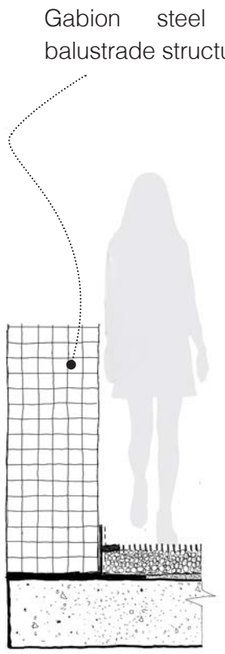


fig 10.37: Section resolution of Balustrade walls (Author, 2021)

Bioremediation Systems

The soil in KwaZulu Natal is important because it has a direct relationship with the emerging economies set up during the colonial period. Specifically, in regards to the coastal region, it had always been an area that has contributed to colonial power through the emergence of sugar cane plantations. During the early years of colonial occupation, various forms of experimentation took place to understand the crop production capabilities of the landscape. These experiments involved testing the yields of sugar cane cotton, indigo, arrowroot, and coffee, with sugar cane showing the most promising results (Christopher, 1977).

Drawing on the colonial experimentation on the landscape for economic advancement, this sub chapter deals with experimentation on the soil for ecological remediation. With the oil industry having a prevailing presence in the region for nearly 70 years, obsolete infrastructure has become a reality leading to expensive maintenance and in some cases equipment failure. With the leak that had occurred in 2001 the extent of the contamination may have detrimental effects to the natural conditions of the surrounding areas hence bioremediation forms an integral part of the future architectural proposal.

Bioremediation is the collective term used to describe various processes that involve actively breaking down environmental pollutants using naturally occurring microorganisms or deliberately introducing them into polluted landscapes to remedy contaminated areas. In 1968, Petroleum engineer, George M. Robinson, invented the bioremediation process when he successfully applied his microbial mixture onto a commercial oil spill. This later became known as the first form of bioremediation (Antizar-Ladislao, 2010).



fig 10.38: Workers work on pipeline in Tara road circa 1997 (Groundwork, n.d)

In her research which analyses the different types and effectiveness of bioremediation processes, Dr Sheetal Sonawdekar (2012) explores the beneficial outcomes of bioremediation when tackling contaminated petroleum sites. She states that, bioremediation doesn't fully remove contaminants but rather it breaks them down into less toxic forms. Thereby making it less hazardous to humans as well as providing cleaner soil for future uses. Accordingly, the method chosen to clean up the site is dependant on the nature of the contaminant, as well as the location of the site. This can be dealt with both on-site and off-site remediation.

In the case of the refinery site, due to the complex nature of the contaminants that may be present in and around the site, research and experimentation would need to be conducted on what the best possible solution could be for cleaning up the site. Two forms of Bioremediation that are commonly used to clean up contaminated petroleum sites include Bioventing and Phytoremediation. Both methods, which will be explored further in this thesis, deal with in-situ processes.

Given the large footprint that the oil refinery currently occupies, this proves to be the best possible solution due to large amount of soil that can be cleaned at once. It also alleviates large vehicles from moving in residential areas to transport the contaminated soil to treatment facilities. Thereby making the process a lot cheaper and more efficient.

Bioventing:

This process is particularly efficient at targeting pollutants from petroleum products. The process can take 6 months or up to 2 years depending on the conditions of the site and other geological factors. The process of Bioventing involves injecting air through injection wells from the atmosphere into the soil at depths determined by the spread of the contaminant. The number of wells required as well as their location is dependent on the geological conditions of the soil. When the air is pumped into the soil through the injection wells it stimulates the naturally occurring bacteria in the soil to increase the rate of degradation in the contaminants. In certain instances where the soil is severely contaminated, additives can be introduced in the injection wells to increase the growth rate of the naturally occurring microorganisms (Sonawdekar, 2012).

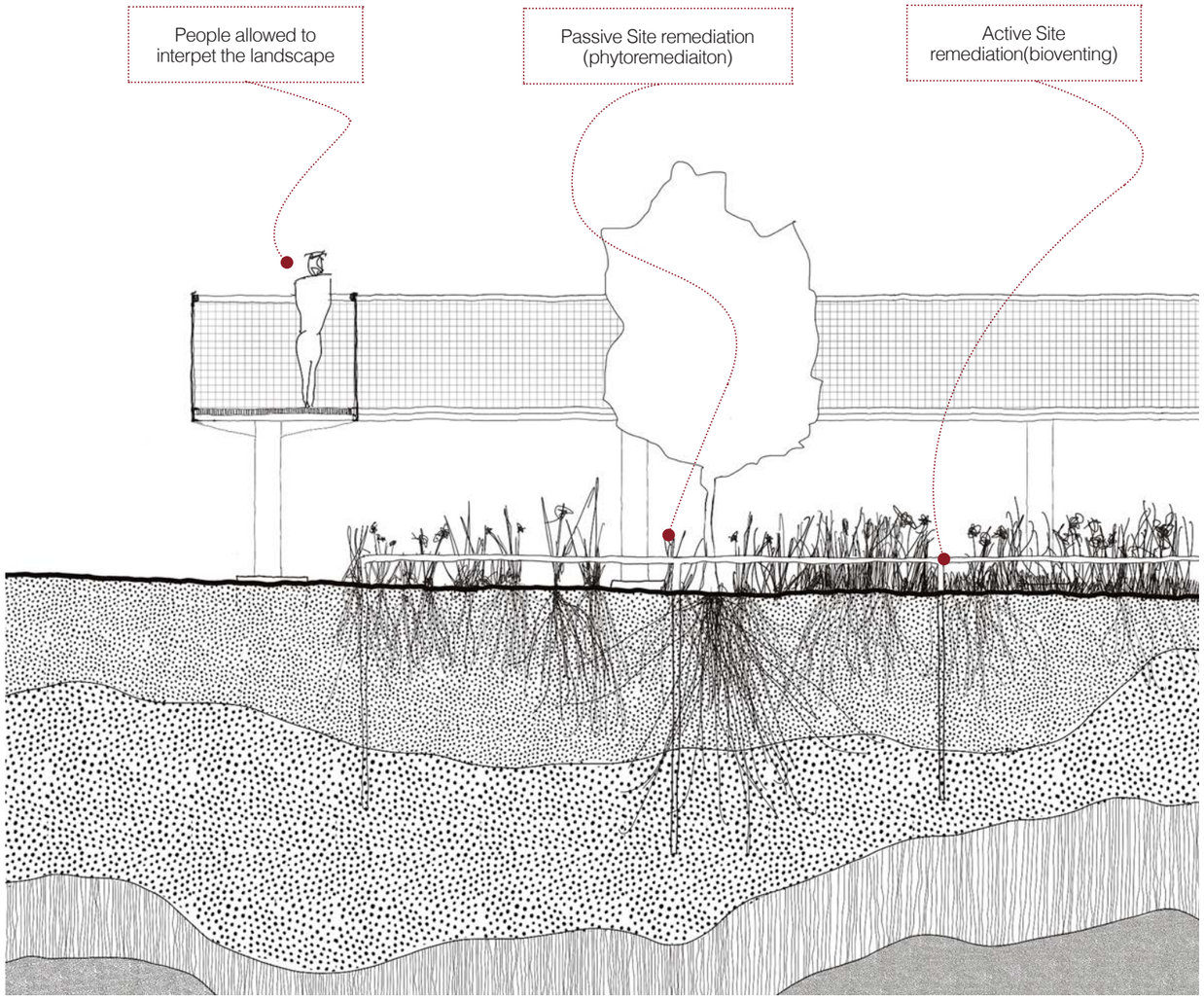


fig 10.38: Sketch showing bioremediation systems intergrating with landscape (Author, 2021)

Phytoremediation:

Phytoremediation is a contemporary approach to remediating contaminated sites. Unlike the active procedures required in bioventing, it is a much more passive approach. It involves the use of plants that are naturally capable of extracting and degrading contaminants in the soil without any form of mechanical intervention. The sub processes involved in the phytoremediation process includes phytoextraction,phytodegradation, phytovolatilization, rhizodegradation and phytostablilization (Lloyd et al, 2013).

In principle it provides an excellent opportunity to convert the obsolete refinery site into a park like space that is physically cleaning itself up through site specific interventions. However, it is important that in the design of the eventual architectural intervention, there needs to be on site research facilities to test the effectiveness of different plant species that would be used to tackle the petroleum hydrocarbons that are present in the soil.

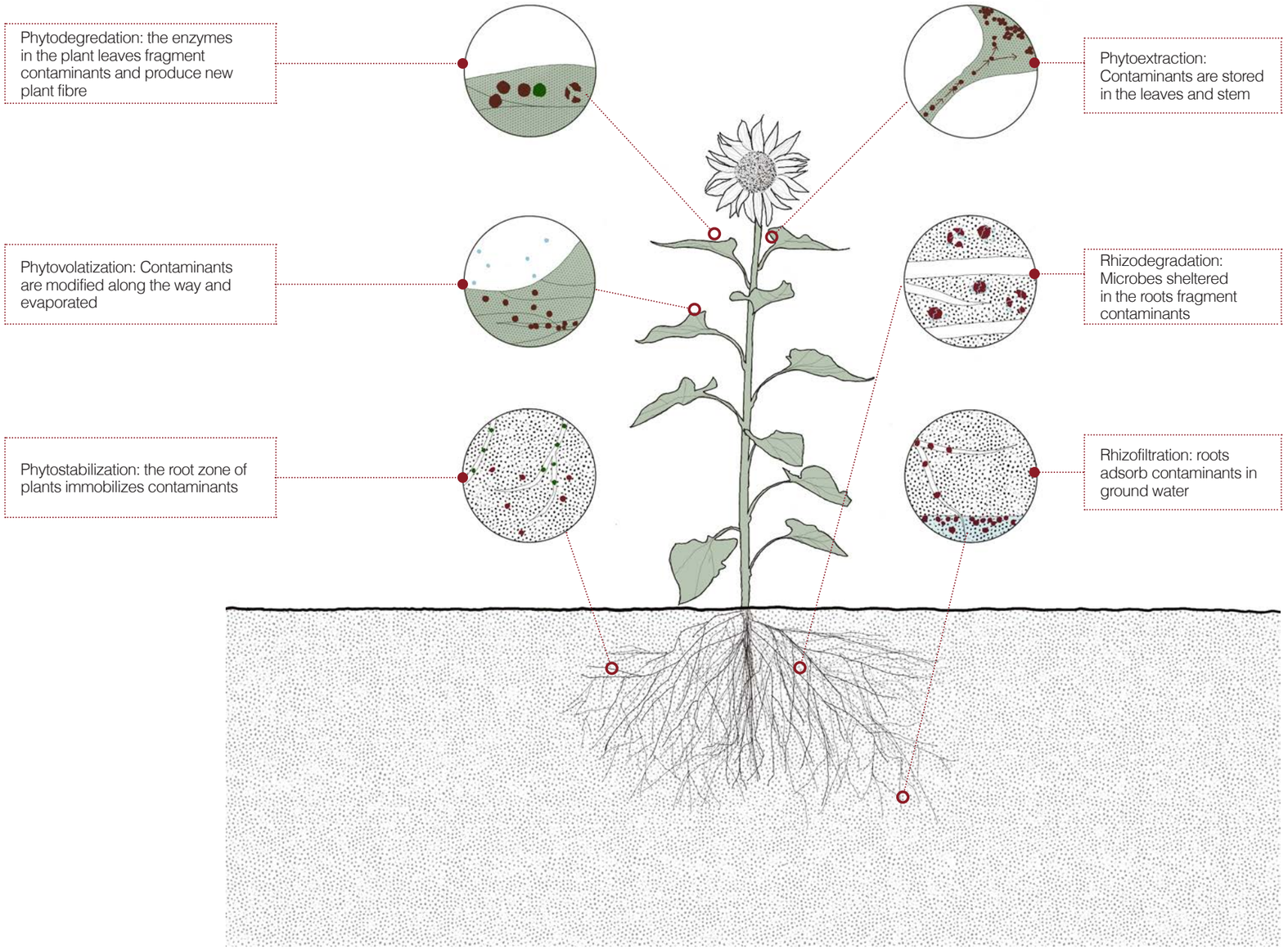


fig 10.38: Sketch showing phytoremediation processes in plants (Author, 2021) adapted from: (Powerplants team, n.d.)

Preliminary design

The preliminary design consists of a set of drawings of the building during the very early stages of the design process. The spaces will be further articulated as part of the November submission and will convey a much more coherent architectural language that ties together concept, research and architecture.

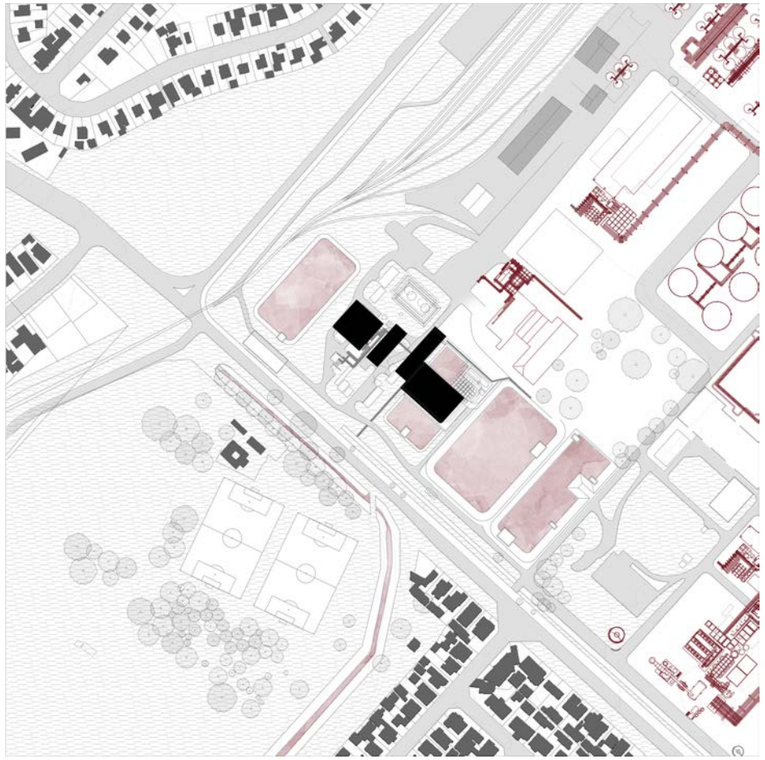


fig 10.39: Preliminary site plan showing building footprint (Author, 2021)

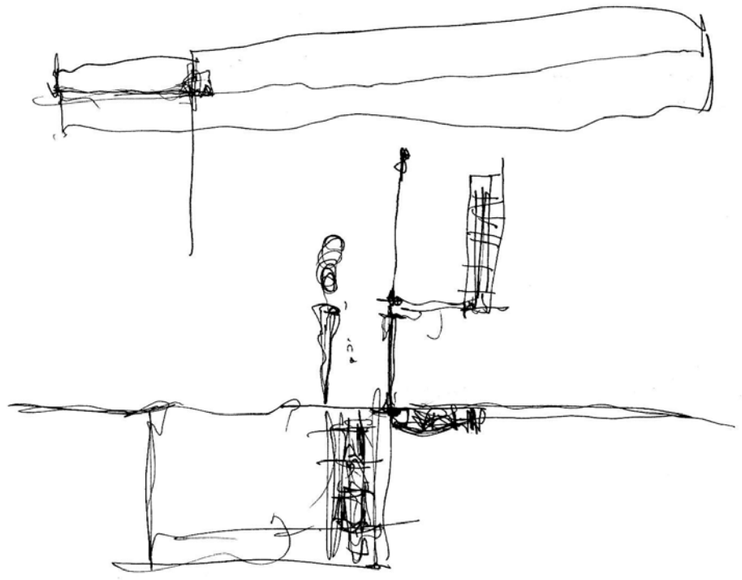


fig 10.40: conceptual section sketch (Author, 2021)

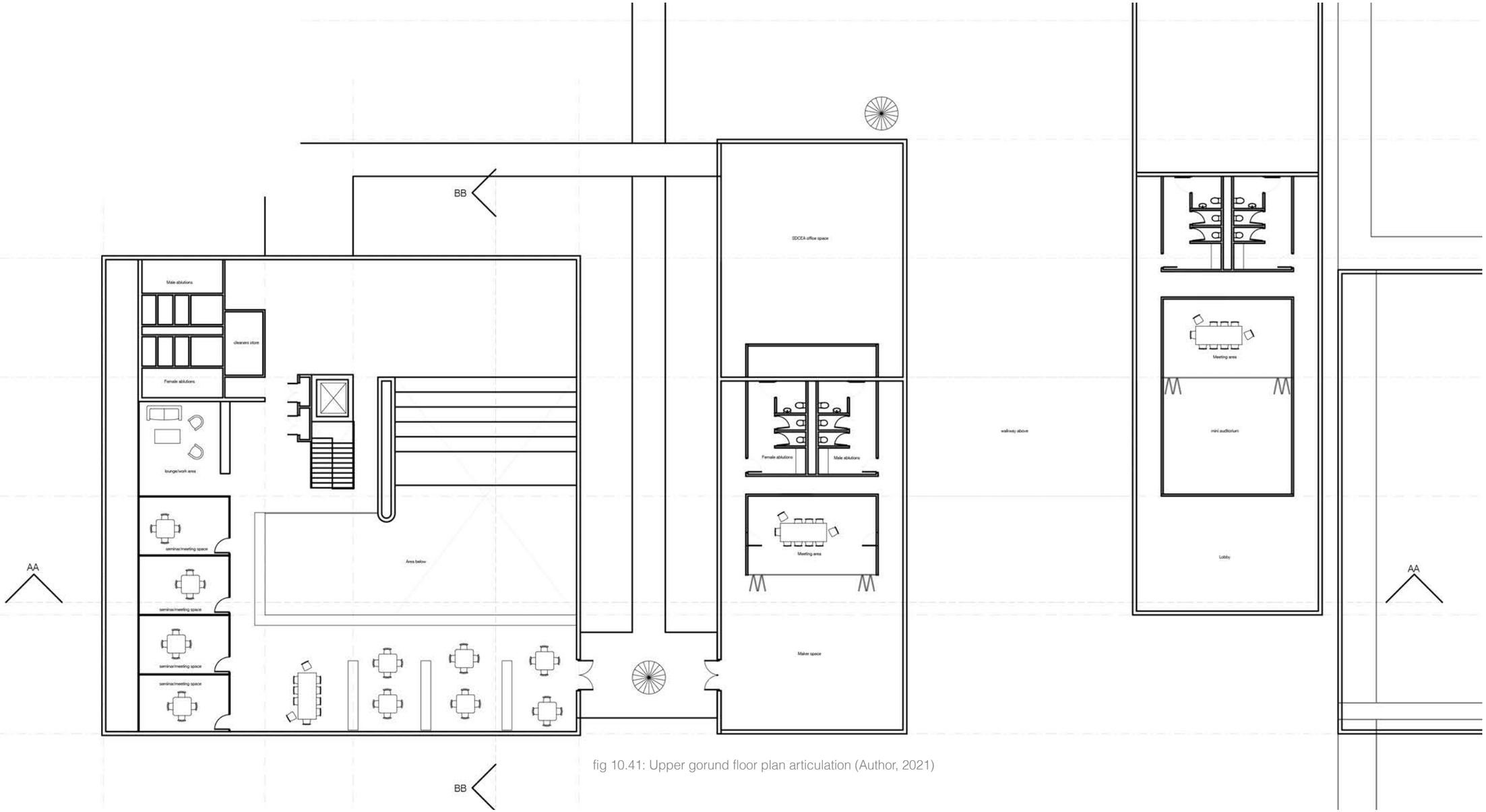


fig 10.41: Upper gorund floor plan articulation (Author, 2021)

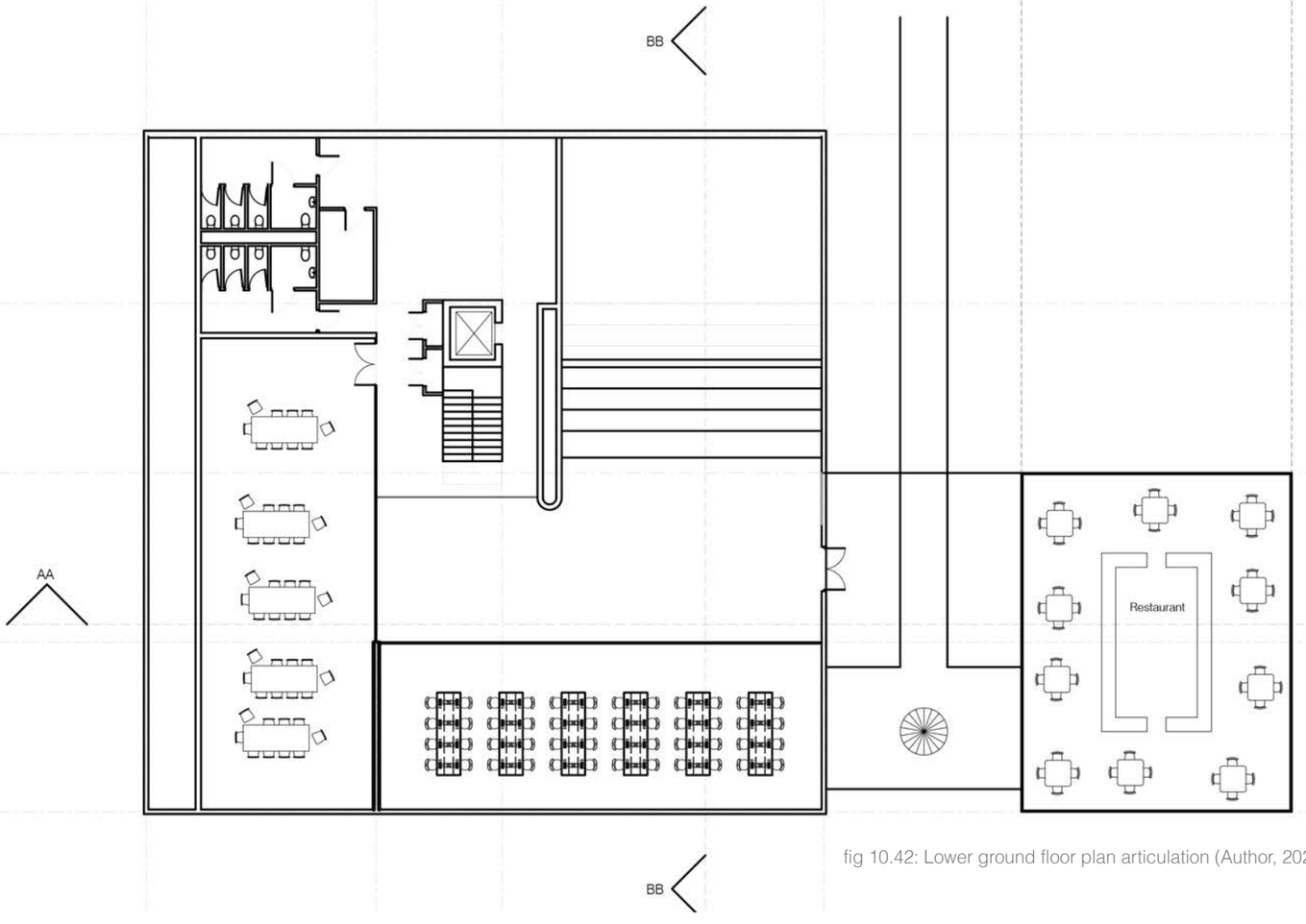


fig 10.42: Lower ground floor plan articulation (Author, 2021)

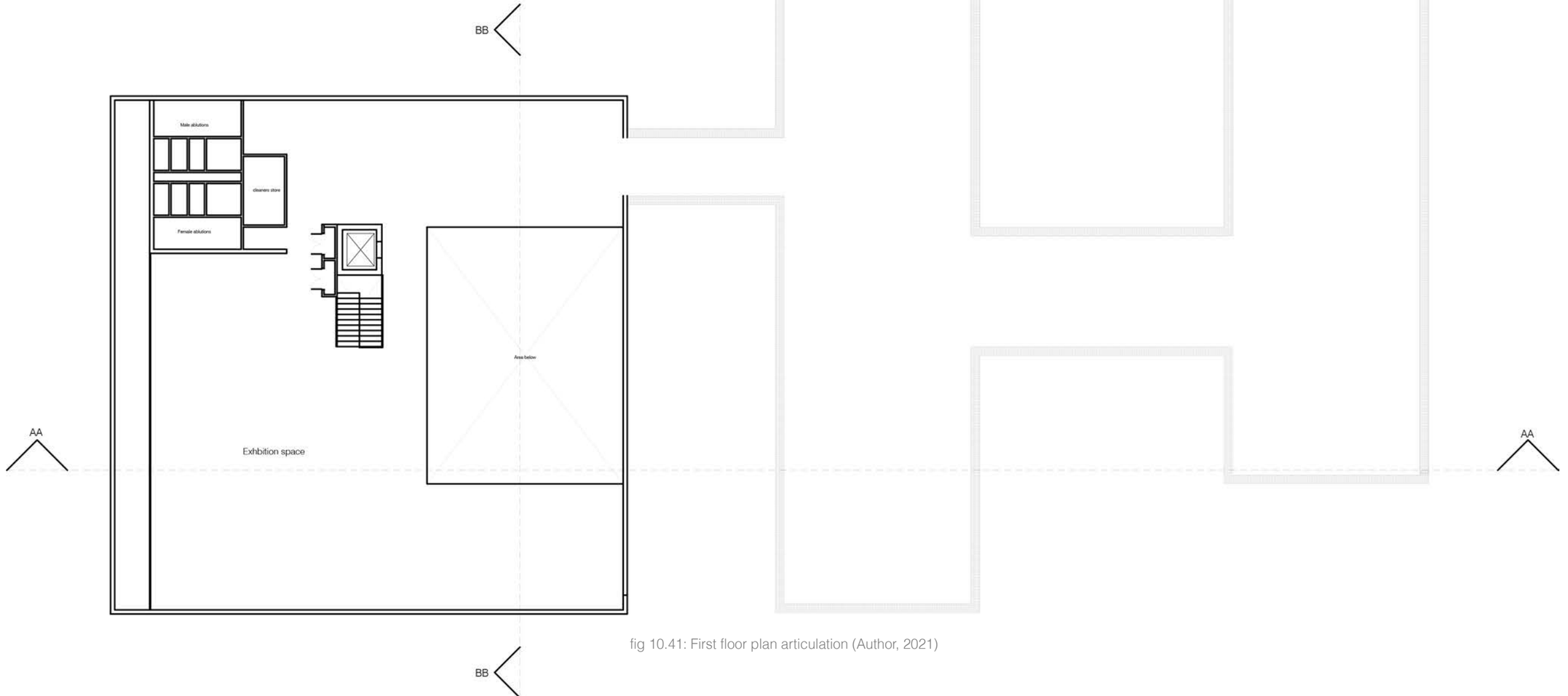


fig 10.41: First floor plan articulation (Author, 2021)

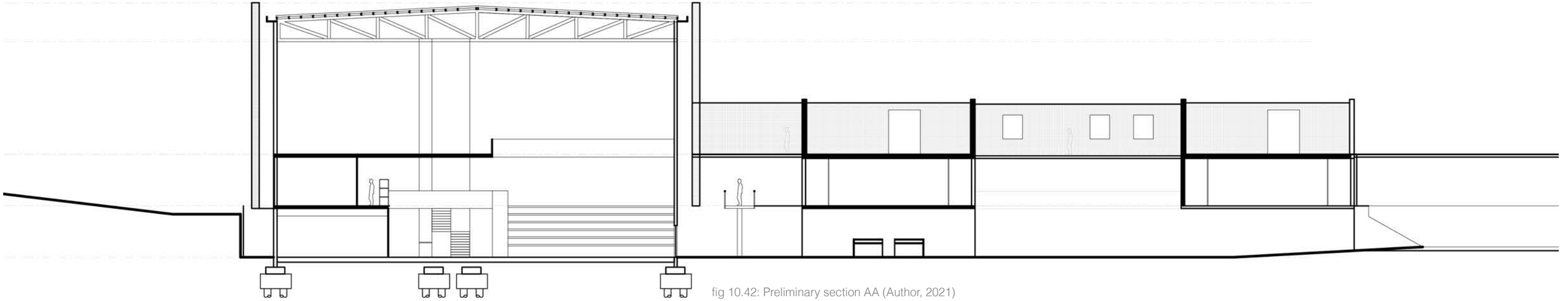


fig 10.42: Preliminary section AA (Author, 2021)

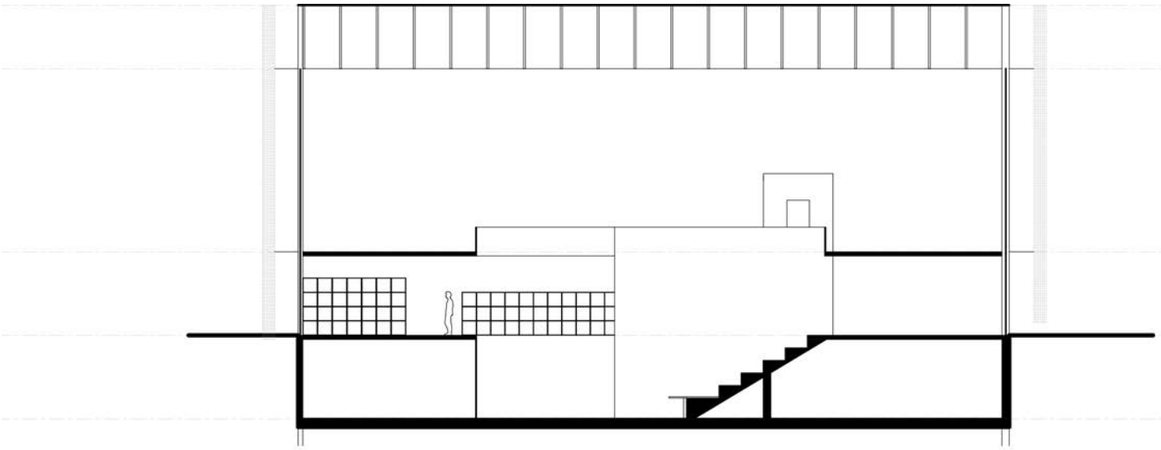
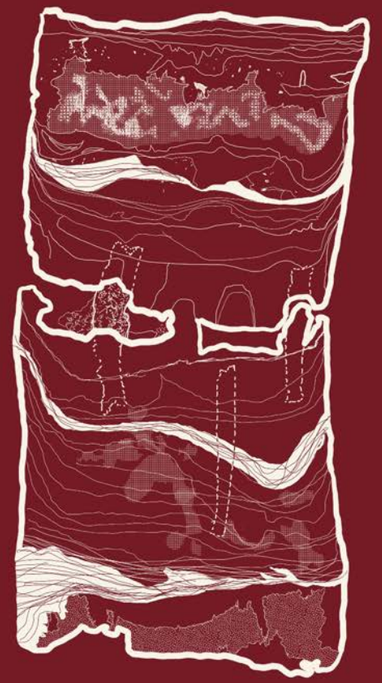


fig 10.43: Preliminary section BB (Author, 2021)



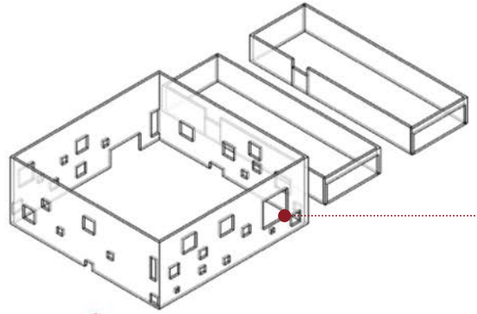
11. Final Intervention

- Design Principles
- Design drawings
- Technical resolution

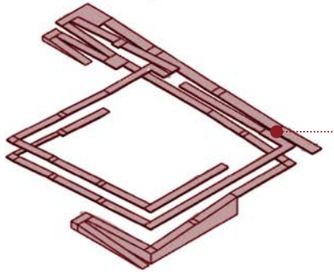


Approaching the reinterpretation centre from the north west

Design Principles



in keeping with the post industrial identity of the site, the screens that wrap the buildings celebrate the fall of the once toxic monument and become sculptural elements that house the workspaces of people involved with remediating the site.



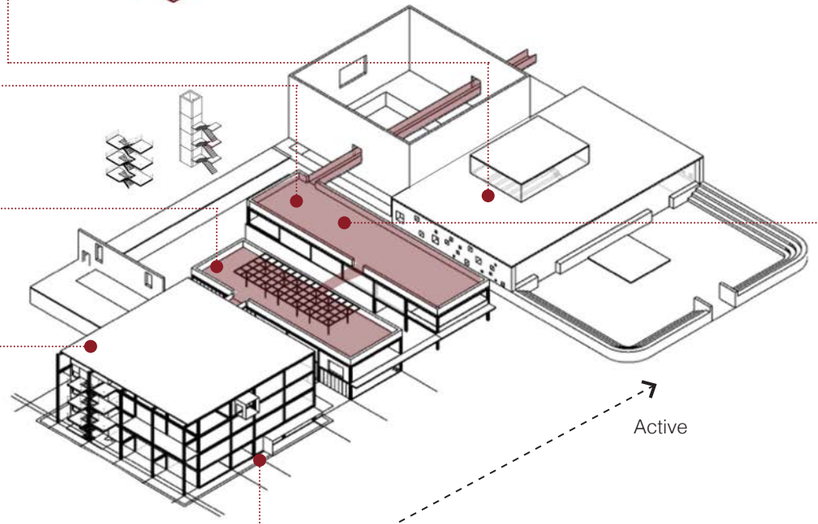
The space in-between the buildings and the screen becomes an important design feature which merges the functionality and ease of circulation of a ramp network with the view finding capabilities of a viewing tower/ deck. This becomes important because it allows for an expansive interpretation of the once toxic landscape

Auditorium
Gather

Laboratory
Remediate

Makerspace
Create

Library
Learn

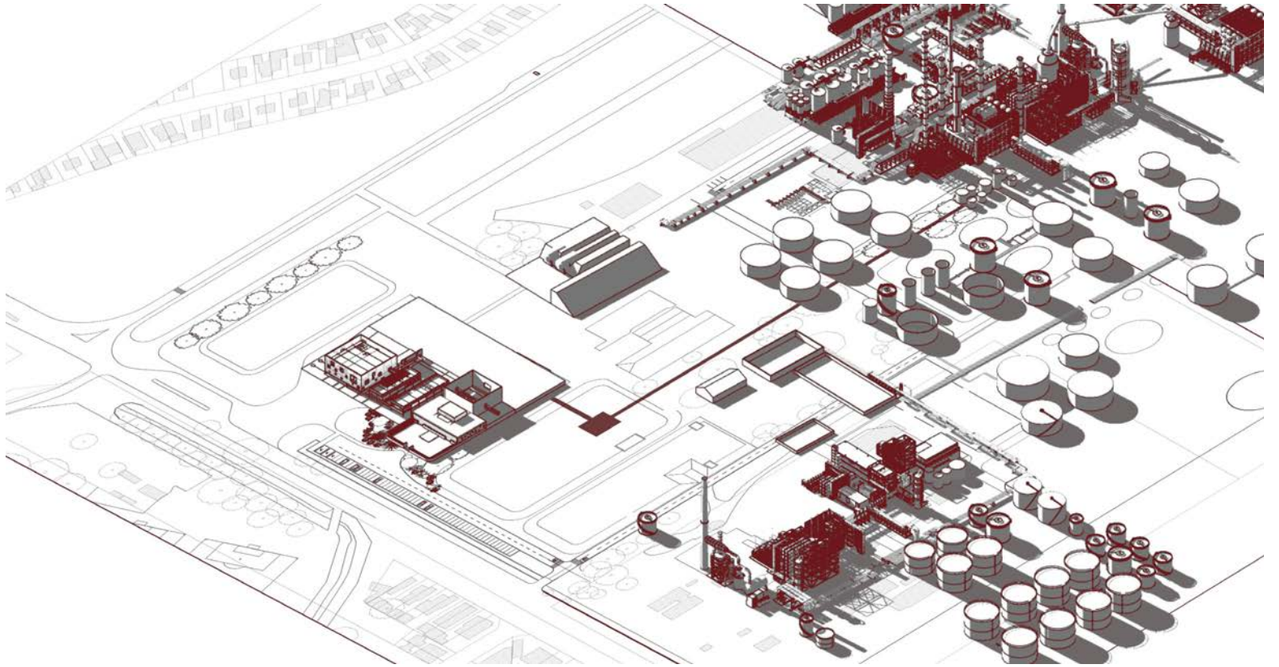


The roofs of the makerspace and labs serve as pause spaces before taking on the interpretative route through the refinery. Both serve as information pavilions that inform the public on the future urban development as well as the plant species used to clean up the toxic site.

these spaces can be access from the ramp network or from the first floor or the library.

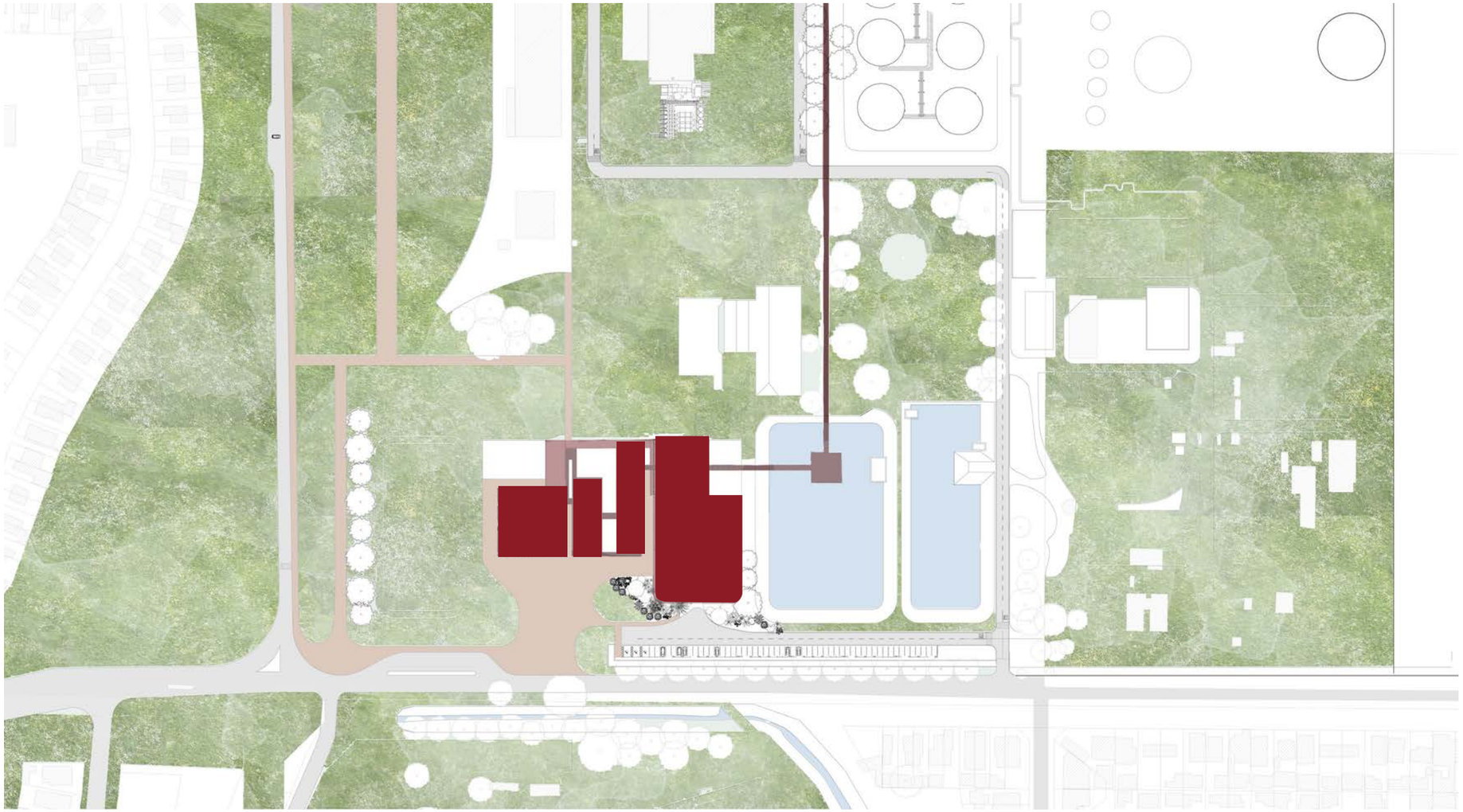
Working on a hierarchy of public to private access the spaces in the library are designed to so that as one moves up levels in the library the programme becomes more private and passive





Architectural intervention in the greater park network

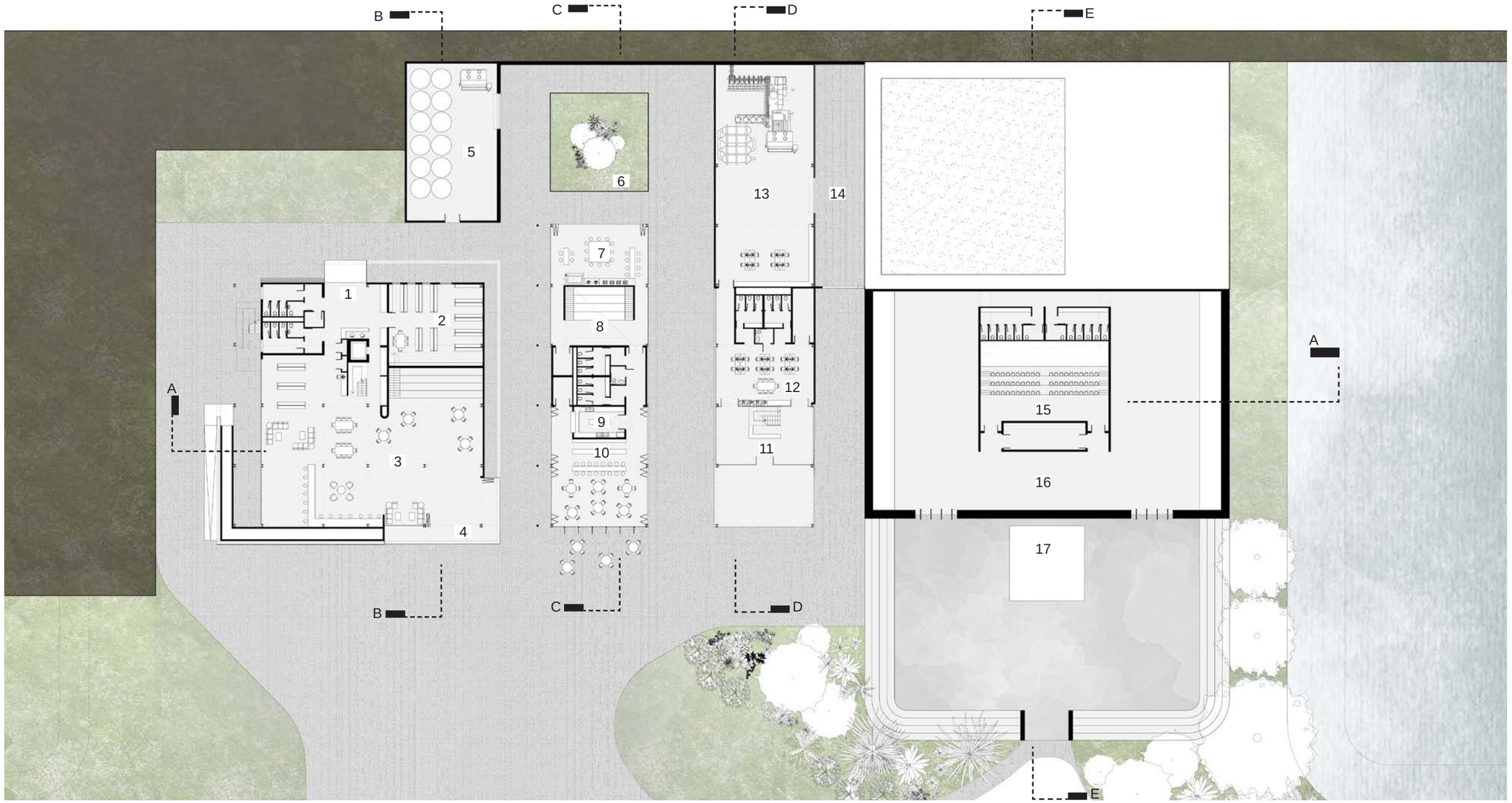
Left: 1: 5000 Masterplan
Above: Contextual axonometric (not to scale) (Author, 2021)



A: Library
B: Maker space
C: Research Laboratories
D: Multipurpose hall

Context plan

0 30 60 90 120 150 m

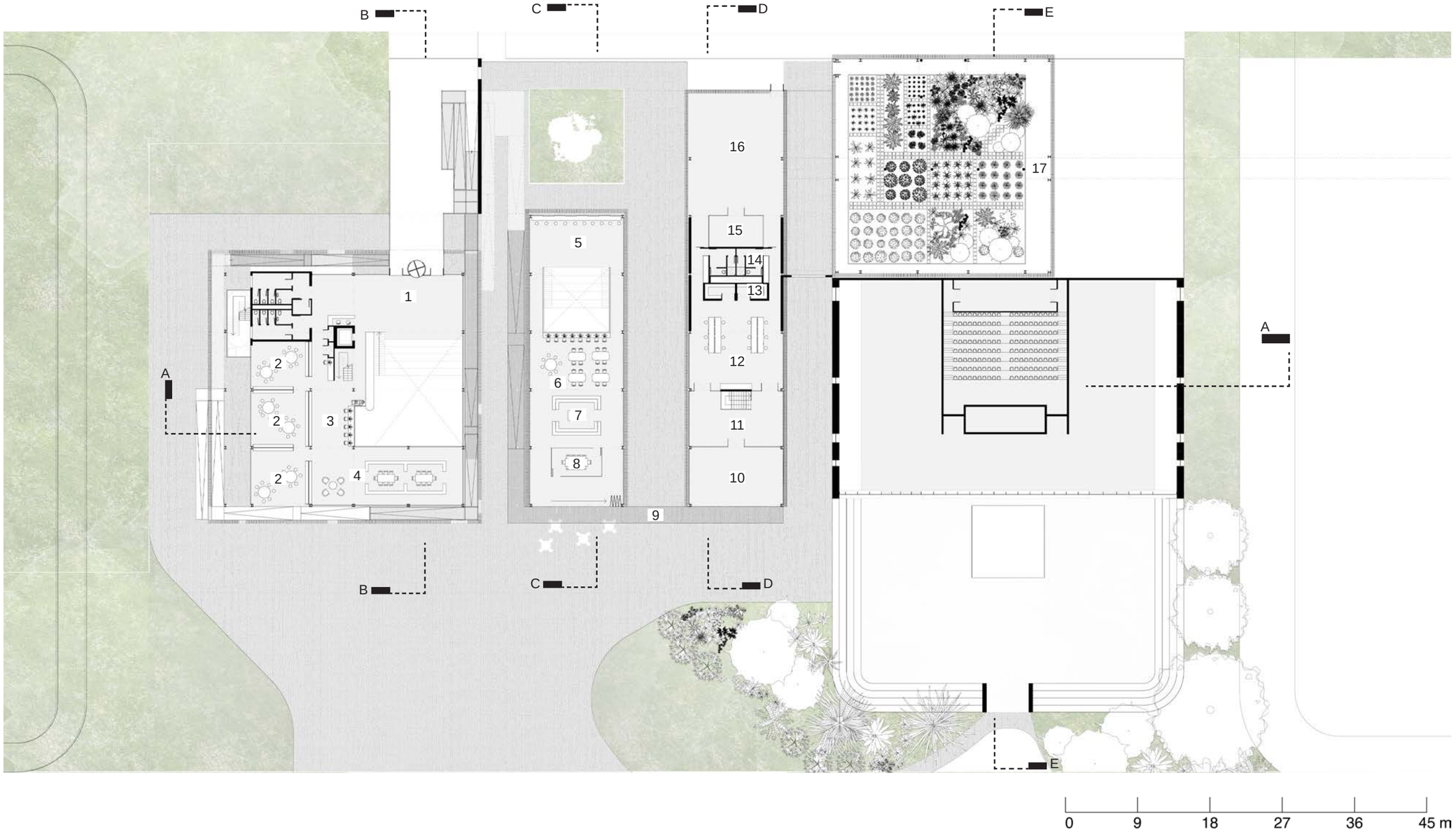


1: North entrance lobby
2: Archive
3: Open library and work area
4:Southern entrance Lobby
5:Water storage
6: Makerspace Courtyard
7:Digital fabrication studios
8: Mini Auditorium
9: Kitchen
10: Restaurant
11: Laboratory lobby
12:Laboratory offices
13:Bioventing monitoring station
14: Service yard
15: Main auditorium
16: Multi-purpose Hall
17: outdoor amphitheatre

Lower ground floor plan



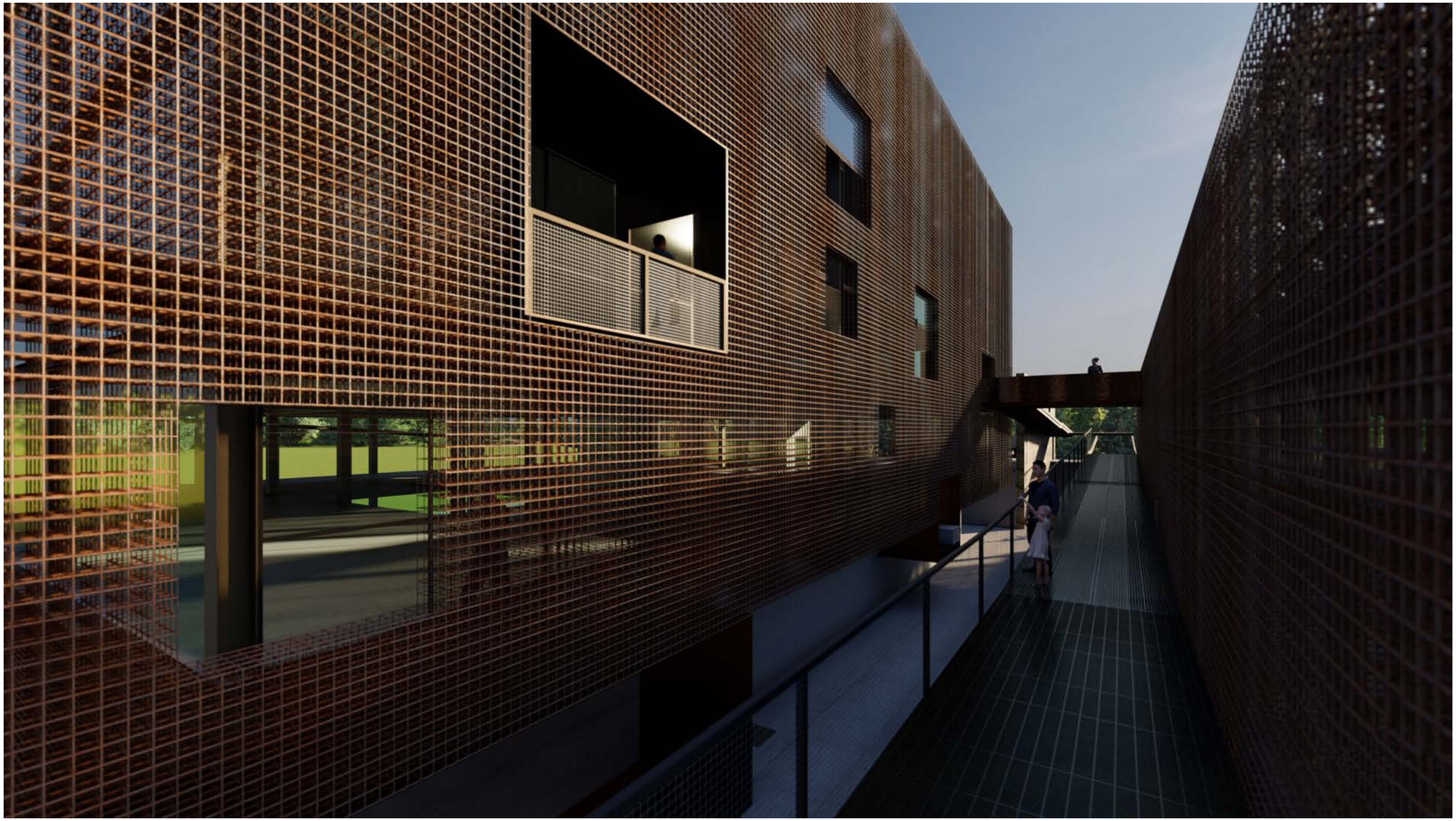
View of the open library and flexible gathering space in Library building (Author, 2021)



1: Main entrance
2: Seminar space
3: research and photocopying station
4: Research and study space
5:Hotdesk workspace
6: Makerspace work area
7: Storage and work area
8: meeting room
9: Walkway from main entrance ramps
10: Balcony
11: Office lounge area
12: Environmental research laboratory
13: General and lab storage
14: Male/Female change rooms
15: Seedling storage and mudroom
16: Cultivation room
17: Research gardens

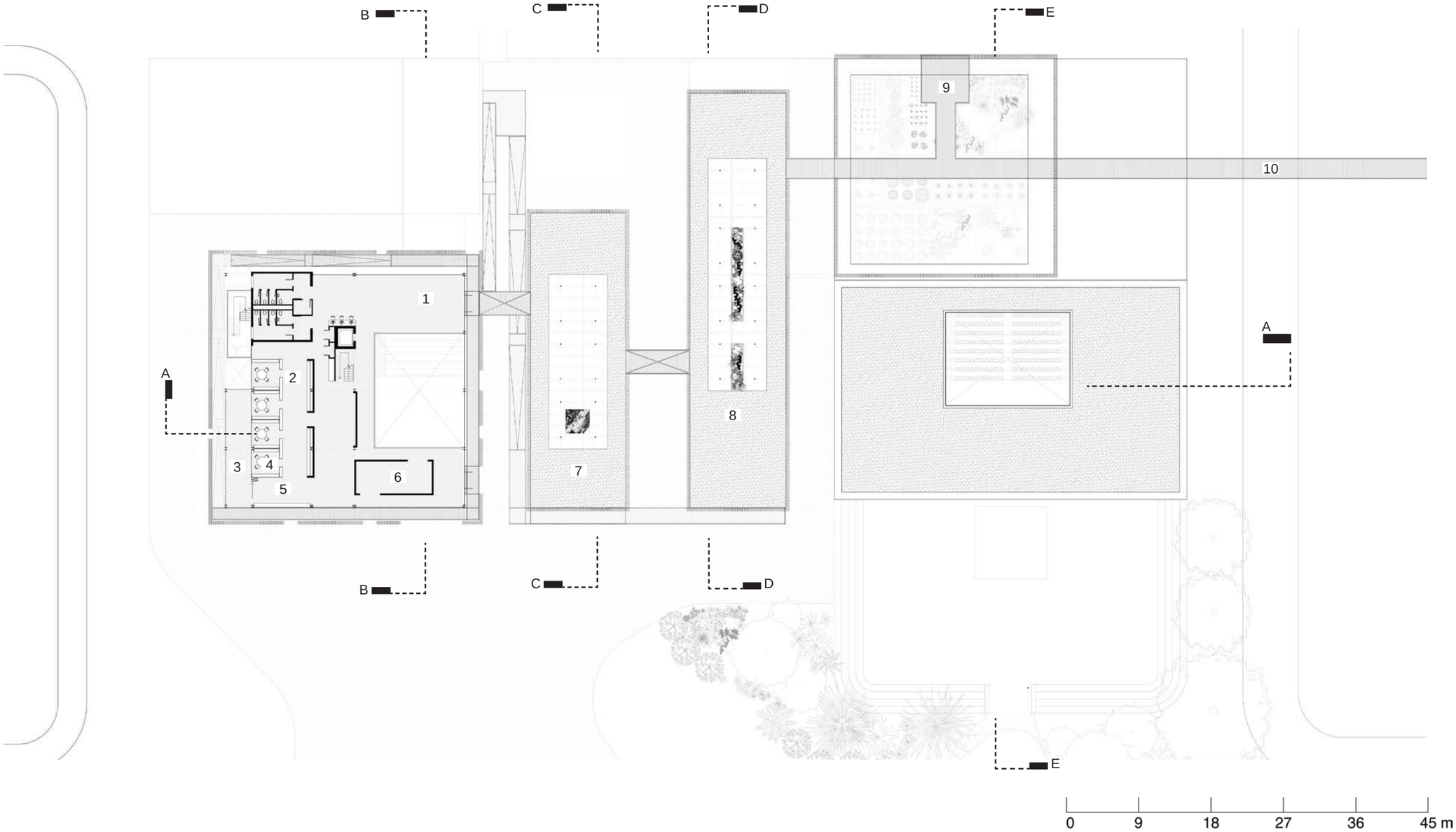
A: View north between facades

Upper ground floor plan



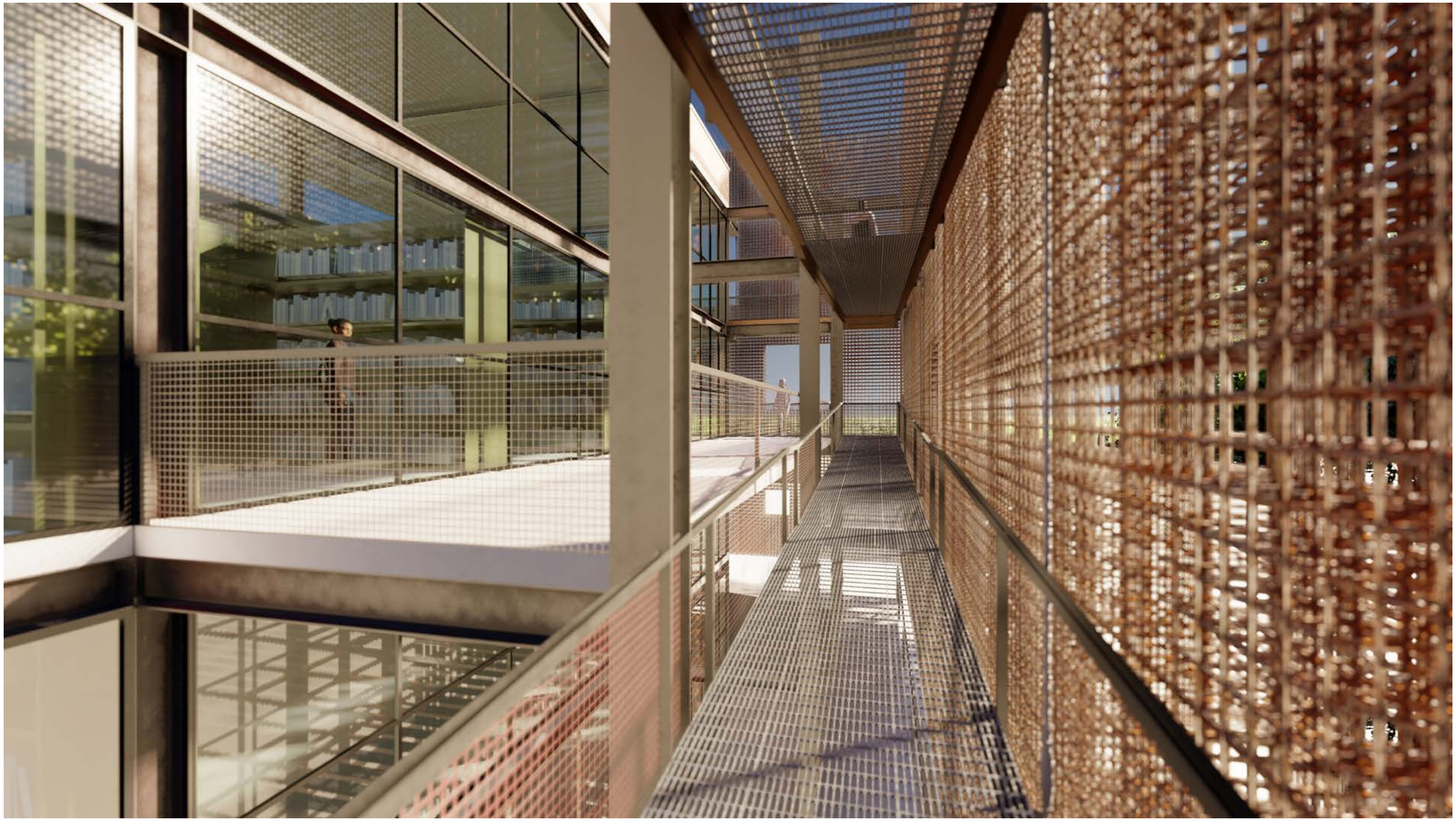


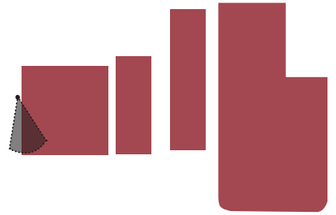
View North between makers pace and library from ramp (Author, 2021)



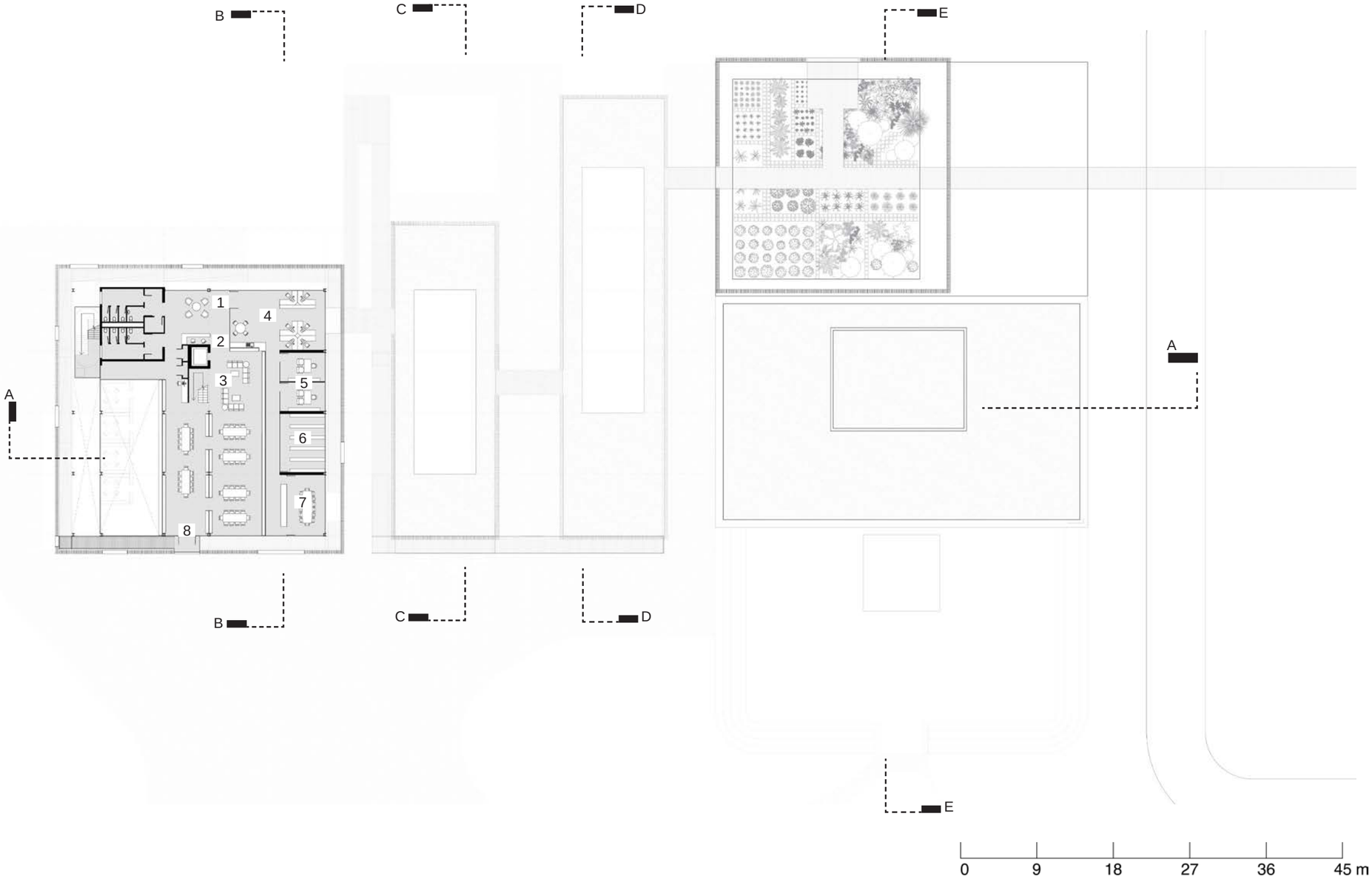
1: Entrance lobby from interpretive route
2: Open shelving area
3: Vlewing deck from ramp network
4: Seminar meeting space
5: Entrance into building from ramp network
6: Exhibition area
7: urban development information pavilion
8: Bioremediation information pavilion
9: Viewing deck
10: Beginning of interpretive route

First floor plan





Approaching the Viewing deck on the first floor from ramp network (Author, 2021)



1: Waiting area
2: Information desk
3: reading lounge
4: SDCEA office
5: consultation rooms
6: Archive and storage
7: Board room
8: Entrance from ramp network

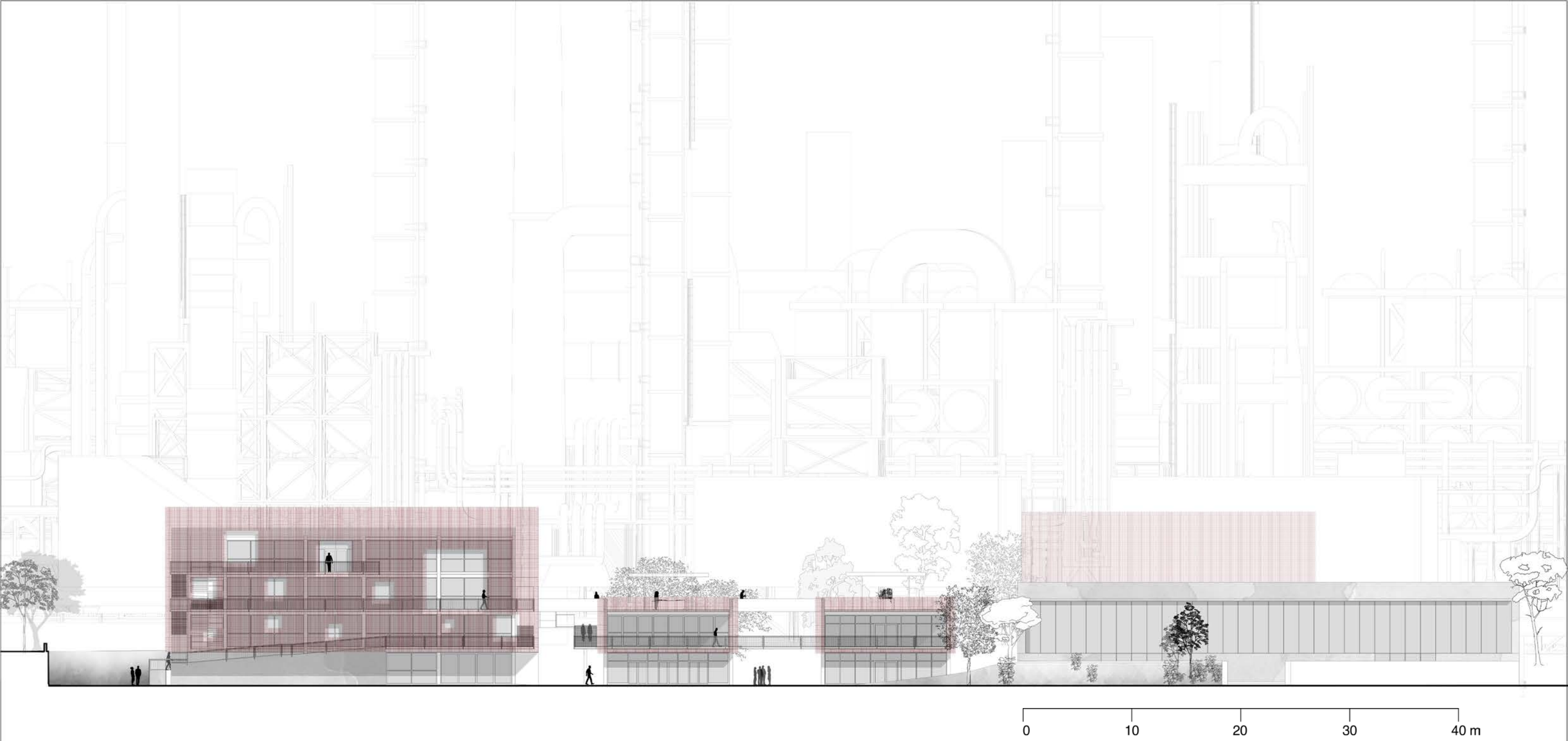
First floor plan

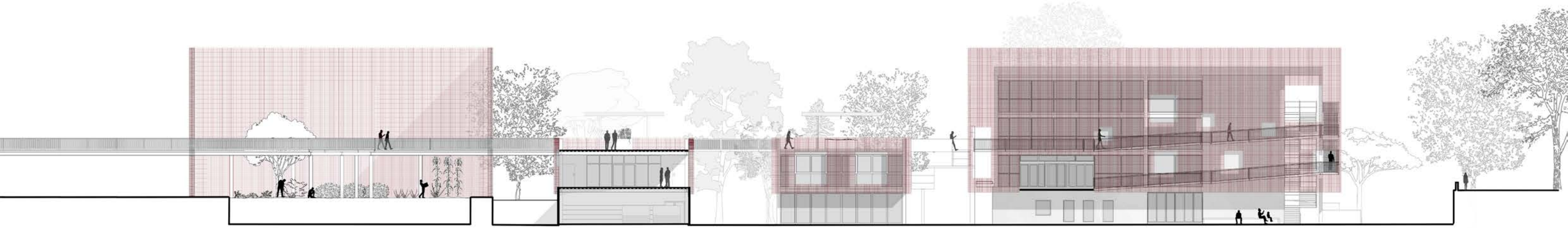


Interior view of multipurose hall (Author, 2021)

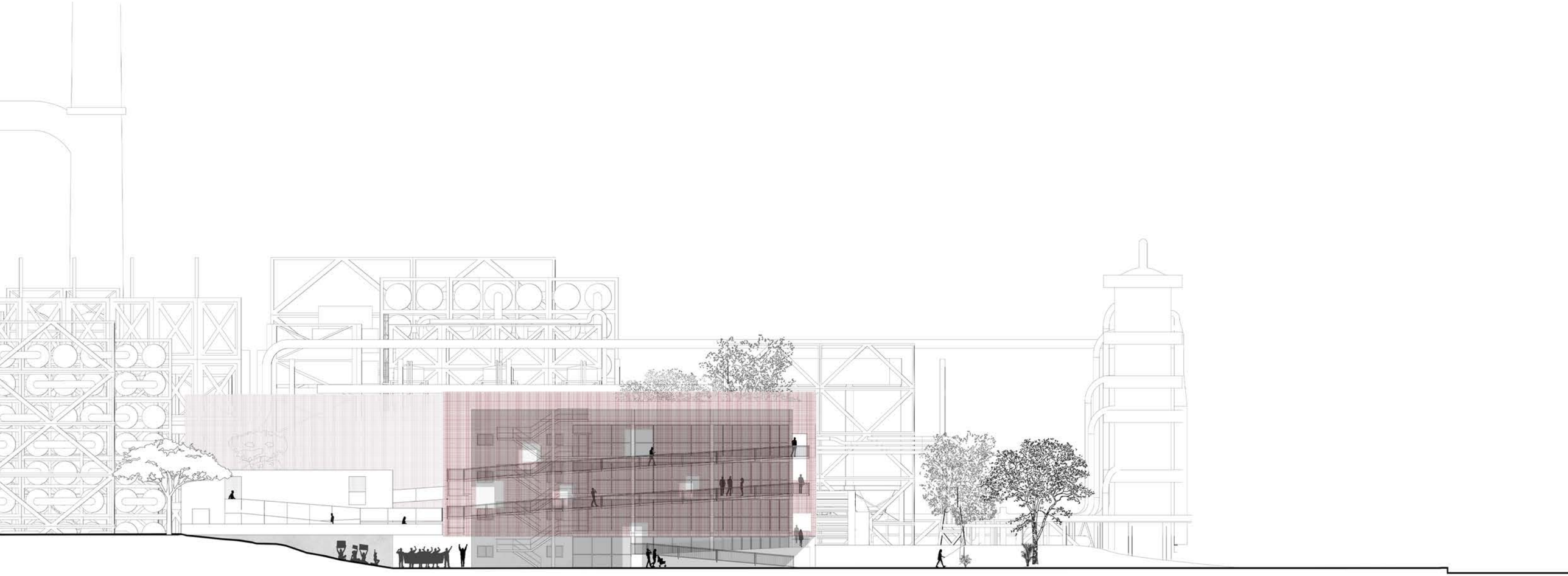


View of amphitheatre in re purposed pool (Author, 2021)

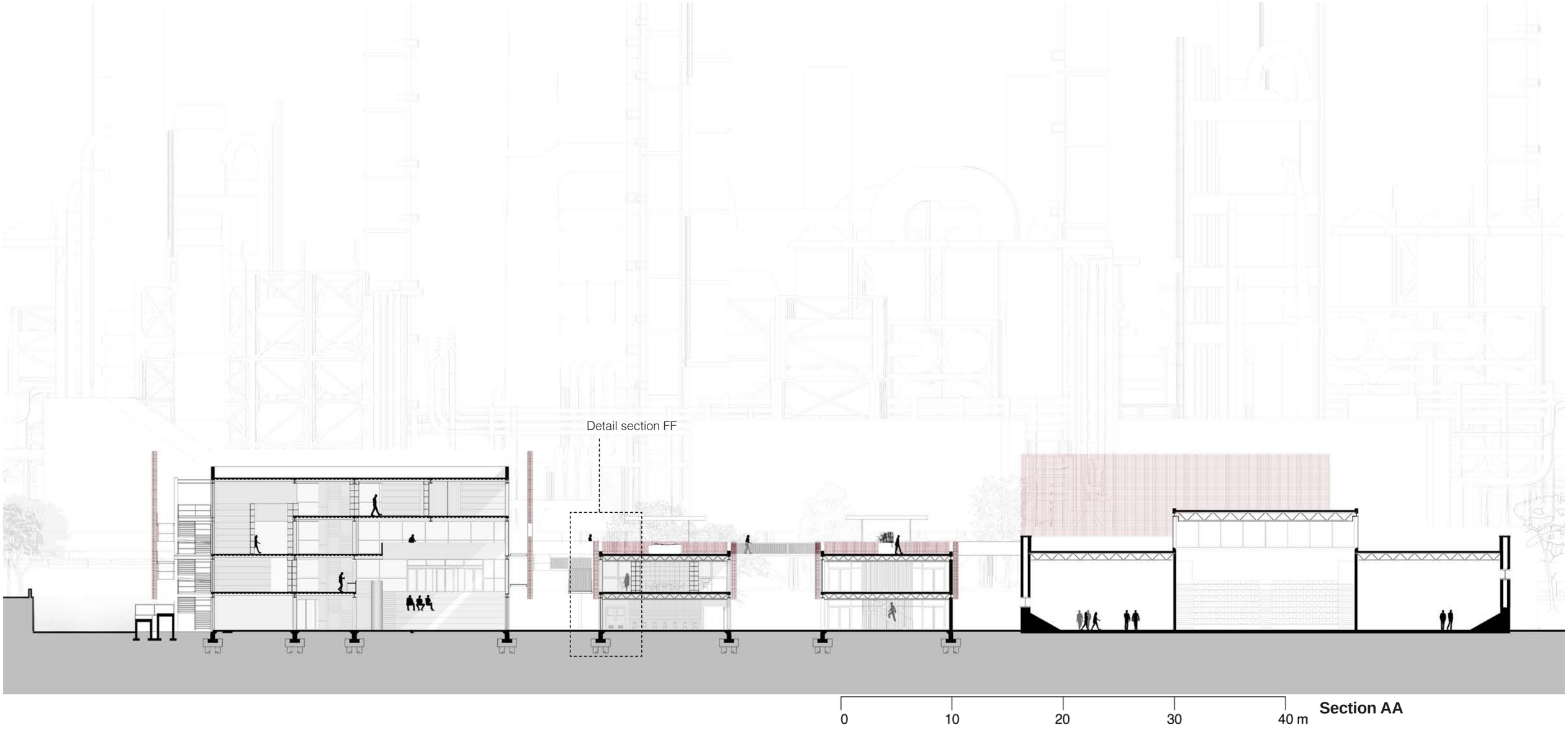

0
10
20
30
40 m



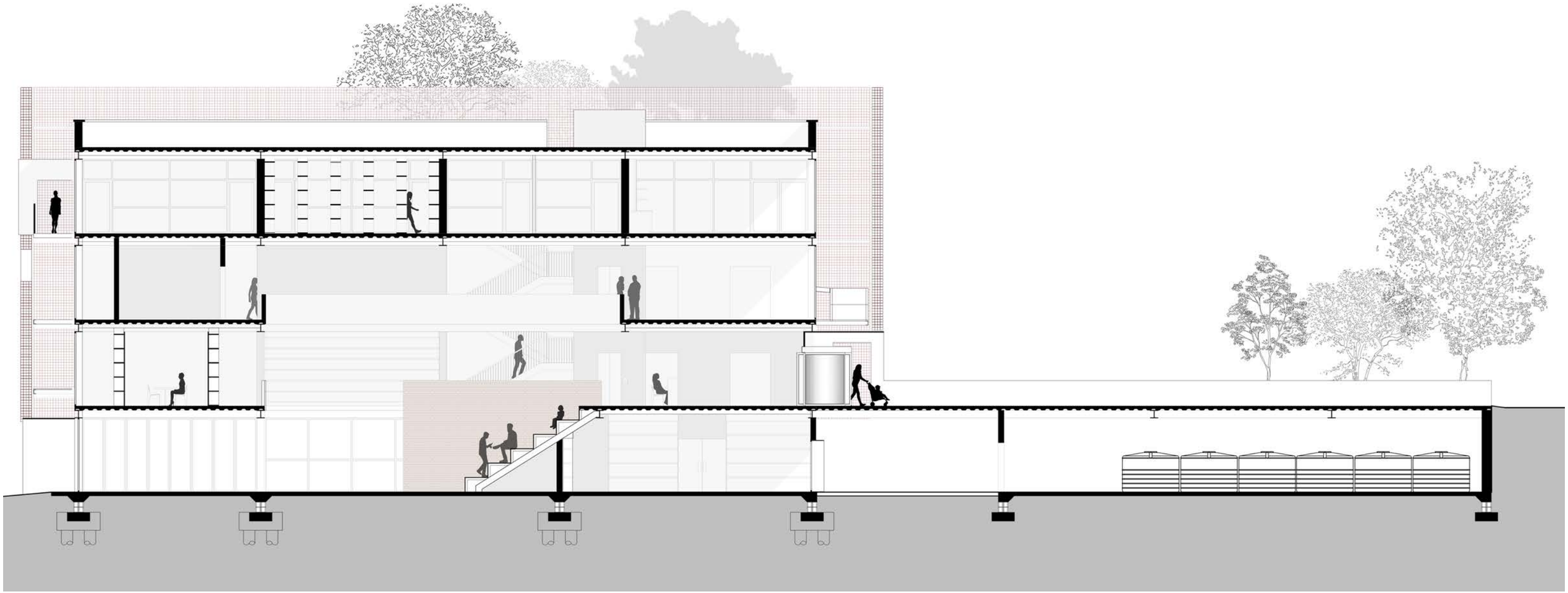
North sectional elevation



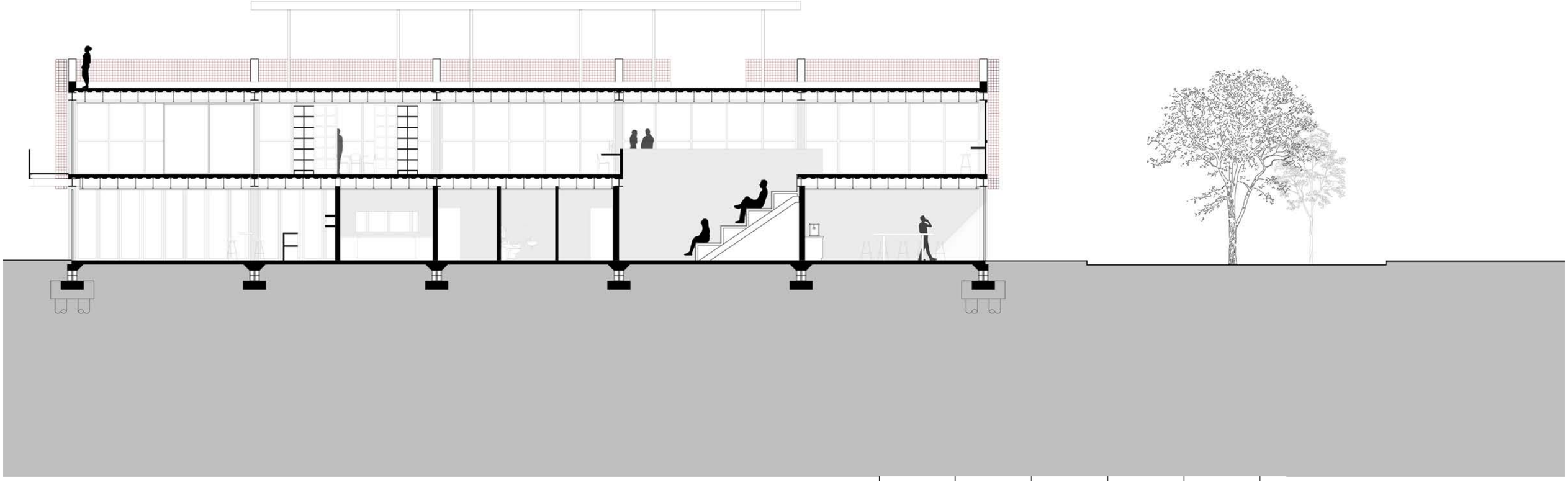
West elevation



Section AA

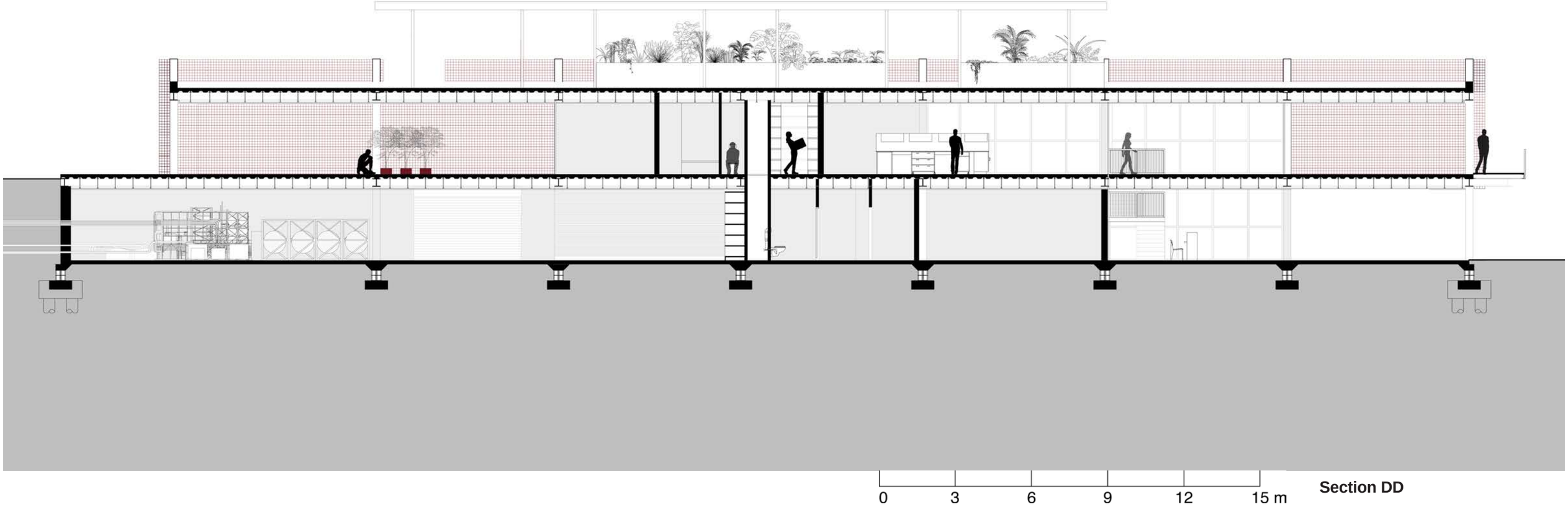


Section BB

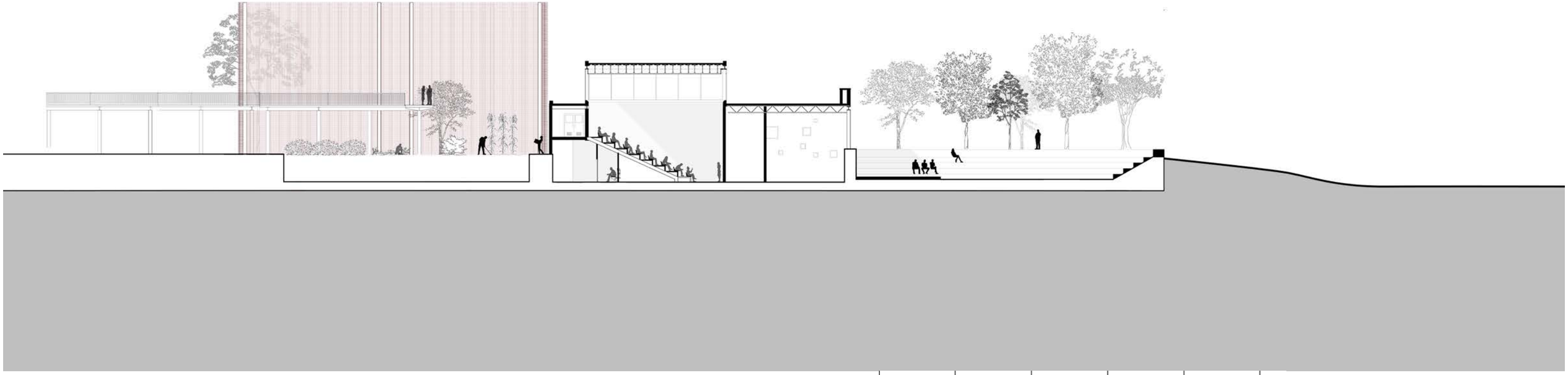


0 3 6 9 12 15 m

Section CC



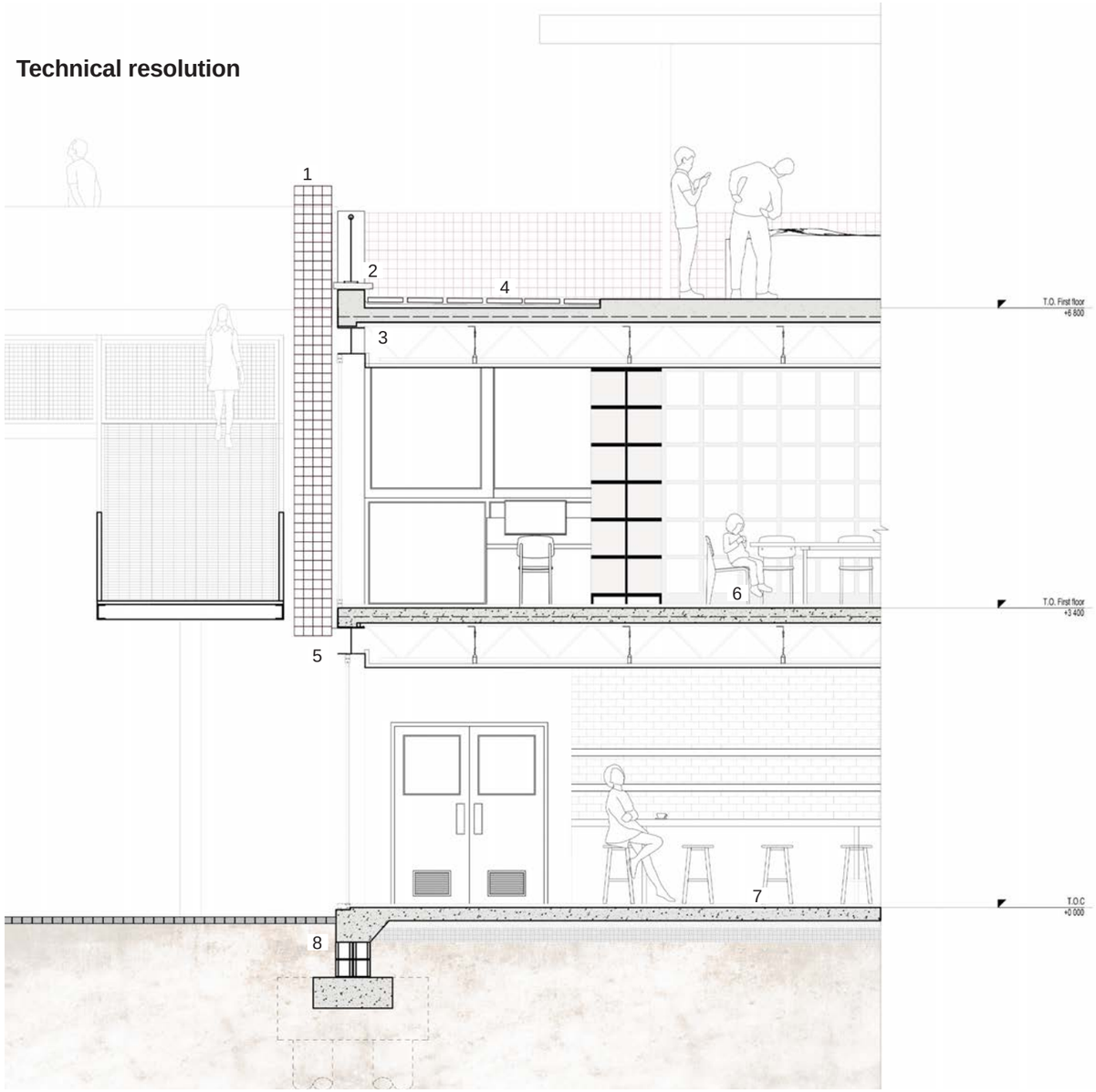
Section DD



0 3 6 9 12 15 m

Section EE

Technical resolution



1: Prefabricated 6mm diameter corten steel rod cage screen supported by steel angle formwork bolted to main structure.

2: Modcon Concrete Solutions precast concrete coping (Type: 012), overall size 305 x 75mm high with mastic sealed joints on cementitious bandage on top of RC upstand beam.

3: 305 x 305mm H-beam bolted to steel posts cast in columns with welded rods above to composite decking above

4: 400x400mm precast concrete pavers laid on rubber spacers with semi course aggregate infill. derbygum or similar approved torch on waterproofing on min 25mm screed laid to fall to FBO's. to be applied to horizontal and vertical surfaces with overlapping flashing

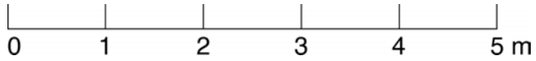
5: 305 x 305mm H-beam bolted to steel posts cast in columns with welded rods above to composite decking above.

6: 40mm finishing screed on top of composite Metal deck slab secured to anchoring rods on top of steel open web floor joists to eng spec.

7: 40mm finishing screed on top of RC raft foundation with floated steel finish to ENG spec on top of waterproofing membrane laid over compacted earth.

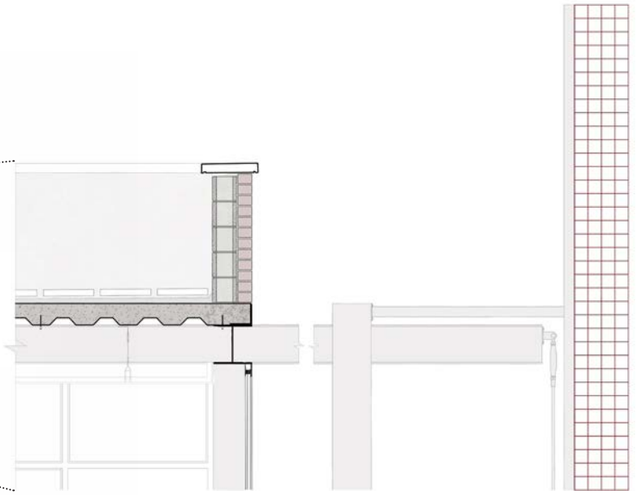
8: Line of pile foundation to engineer specification

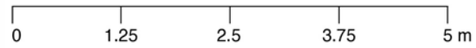
Section FF



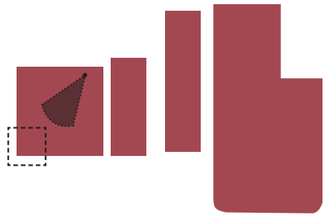


Internal view of digital model (Author, 2021)





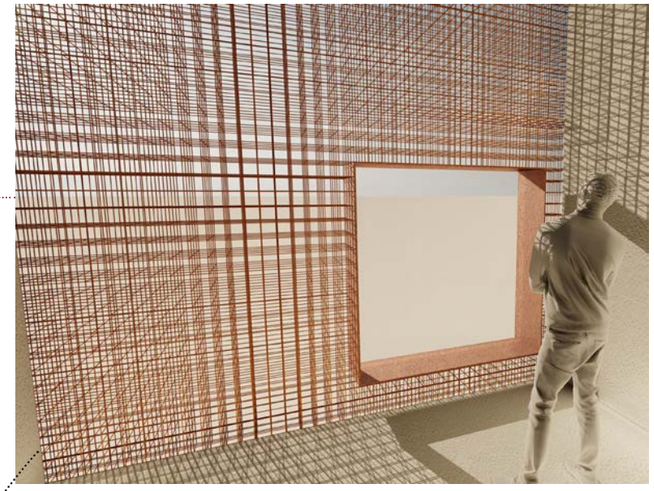
Roof detail



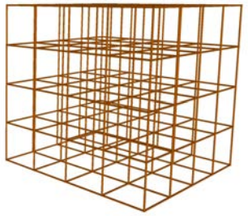
Digital axonometric model of library



External view of digital model (Author, 2021)



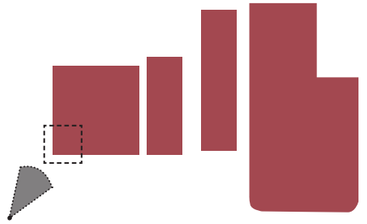
Design exploration of screen (Author, 2021)



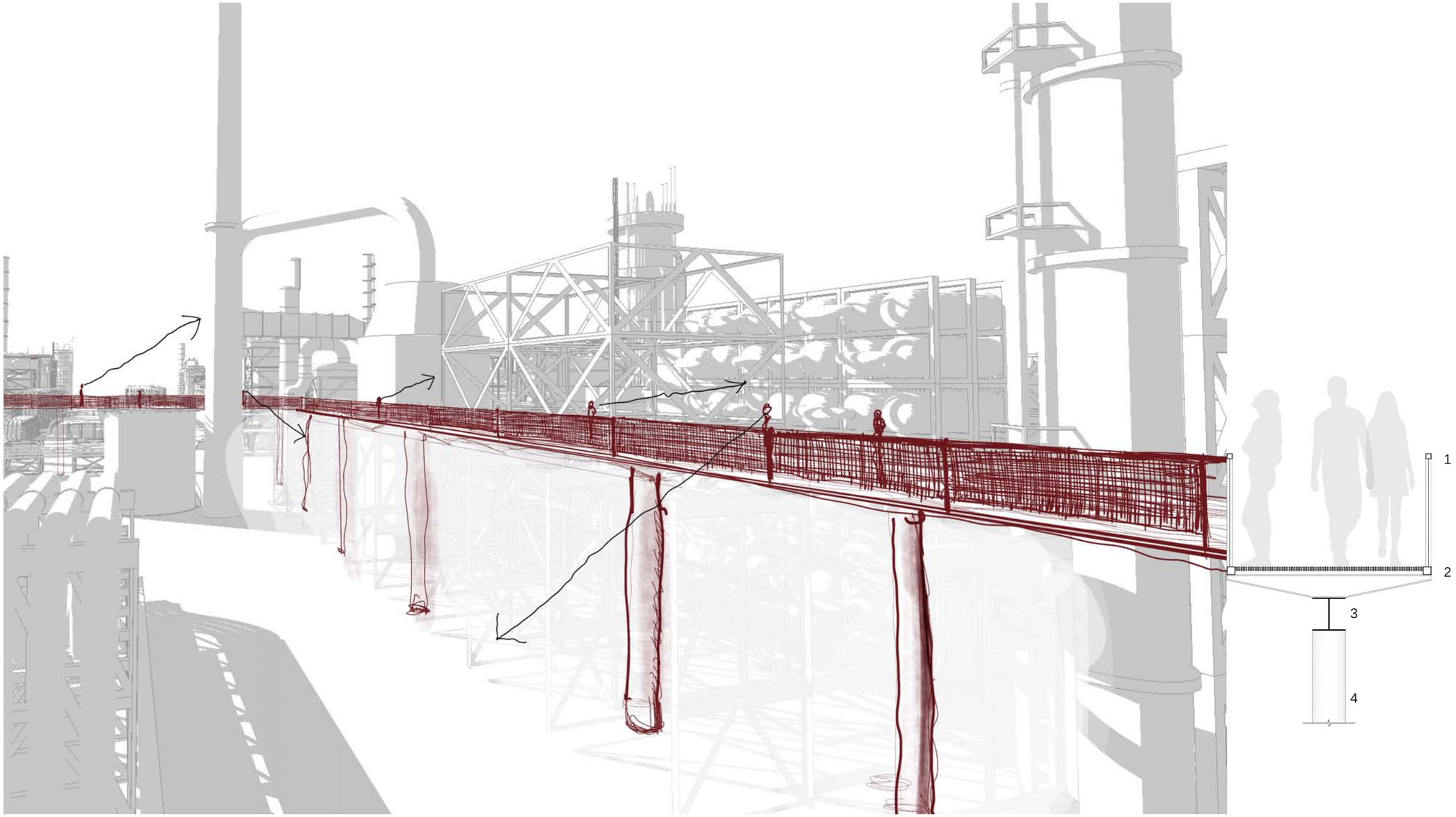
Prefabricated 6mm diameter corten steel rod cage screen supported by steel angle formwork bolted to main structure.

The facade system is not only expressed as a sculptural object but it also lends itself as a response to the harsh climatic conditions of the region

it also becomes a protective element towards people using the ramps around the building.



Digital axonometric model of library



1: 50mm steel square hollow section hand rail and balustrade bolted to 178mm x 58mm steel channel

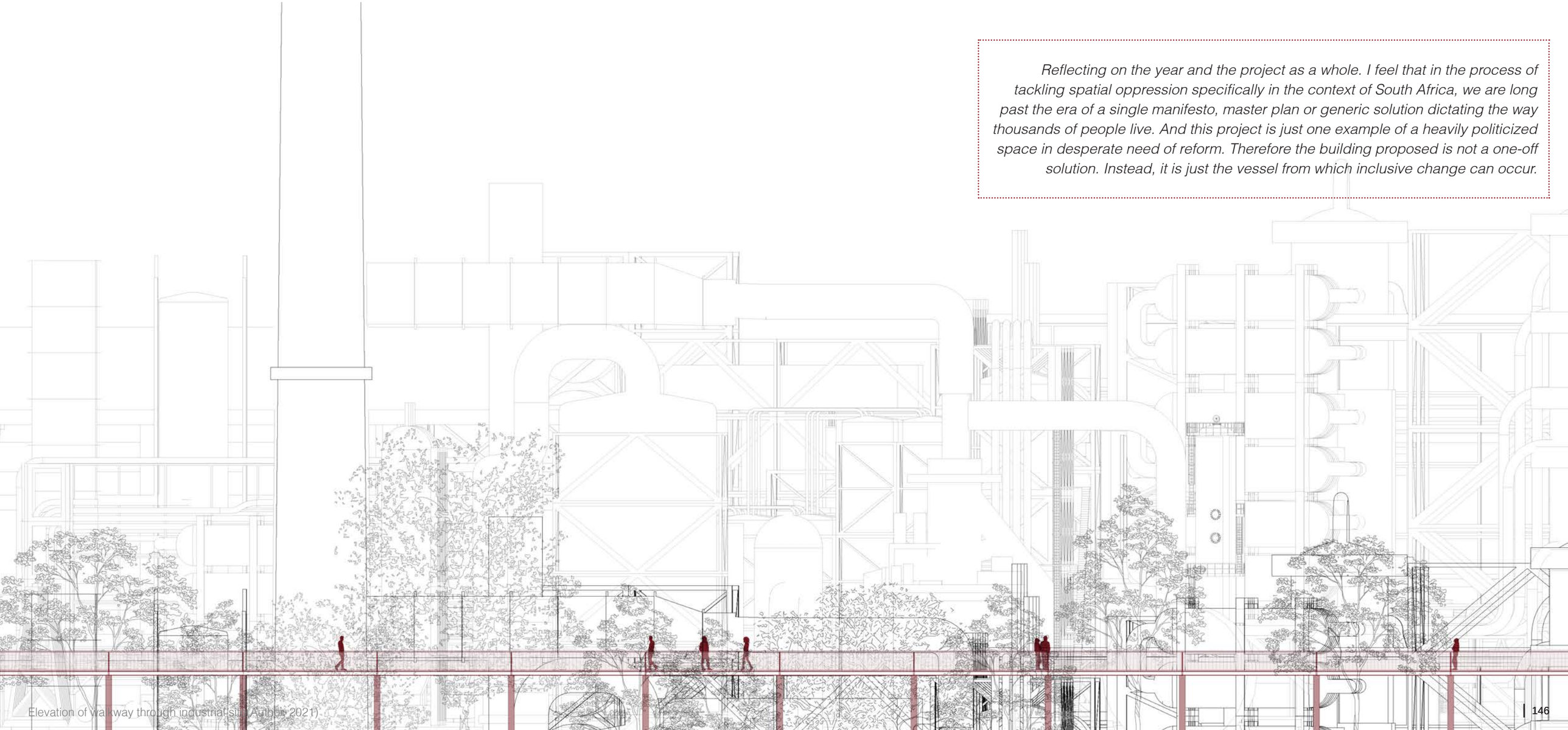
2: Rust protected mentis grate welded to 305 x 305mm tapered secondary beams

3: 305 x 305mm steel H-beam bolted to RC columns spaced at regular intervals.

4: RC coloumn to eng spec

Perspective sketch and section of interpretive walkways (Author, 2021)

Reflecting on the year and the project as a whole. I feel that in the process of tackling spatial oppression specifically in the context of South Africa, we are long past the era of a single manifesto, master plan or generic solution dictating the way thousands of people live. And this project is just one example of a heavily politicized space in desperate need of reform. Therefore the building proposed is not a one-off solution. Instead, it is just the vessel from which inclusive change can occur.



Elevation of walkway through industrial site (Author 2021)

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Endnotes

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2. Dr Elizabeth van Heyningen and a team of researchers compiled an online database containing information regarding the concentration camps of the Anglo Boer war. While there are some inconsistencies in the sources due to most of the information being produced during the war, the database does provide a holistic understanding of the overarching conditions of all the camps.

3. One-third of South Africa’s total black population occupied the six self-governing bantustans and while these numbers may seem low, the insufficiency of land allocation meant they were densely populated and this made the problem of poverty more significant. (Encyclopaedia Britannica. n.d. Bantustans, historical territory)

4. Further information regarding the historic progression of the oil refineries in the area of study can be sourced from: South African Petroleum Industry Association, 2021. SAPIA 20th Anniversary Celebration. [online] South African Petroleum Industry Association, pp.15-16. Available at: <https://www.sapia.org.za/doc/annual-report/SAPIA-Anniversary-2014.pdf

5. Campbell founded the Association for the Study of Peak Oil and Gas(ASPO) in 2000 based on the article he had written with Laherrère

6. See : Hallock Jr JL, Wu W, Hall CA, Jefferson M. Forecasting the limits to the availability and diversity of global conventional oil supply: Validation. Energy. 2014 Jan 1;64:130-53. And Mohr SH, Wang J, Ellem G, Ward J, Giurco D. Projection of world fossil fuels by country. Fuel. 2015 Feb 1;141:120-35.

List of Figures

fig 1.1: Author, 2021 adapted from: Ward, R., 2021. Children play football outside their homes. [image] Available at: <https://www.newframe.com/long-read-plan-to-clean-durbans-air-falters/> [Accessed 5 August 2021].

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fig 1.3: Author 2021, adapted from: Google Earth, 2021. Street view from Dinapur road. [image] Availableat:https://googleearth.gosur.com

fig 1.4: Author, 2021

fig 1.5: Verasamy, D., 2020. Looking towards the refinery from Austerville. [image] Available at: <https://mg.co.za/business/2020-12-12-fuel-boycott-looms-over-engen-refinery-fire/> [Accessed 11 August 2021].

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fig 1.7: African Climate Reality Project, 2021. lady traversing along an industrial pipeline. [image] Available at: <https://www.youtube.com/watch?v=5l6pS7bR3zY> [Accessed 4 August 2021].

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fig 2.6: University of California press, n.d. Major lines of Bantu migrations. [image] Available at: <https://publishing.cdlib.org/ucpressebooks/view?docId=ft3779n8vf&chunk.id=d0e1069&toc.id=d0e1069&brand=ucpress> [Accessed 29 July 2021].

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fig 2.11: Our Civilisations, n.d. the natalia republic. [image] Available at: <https://www.ourcivilisation.com/smartboard/shop/ransford/map7.htm> [Accessed 30 July 2021].

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fig 2.15: Imperial War Museum, n.d. Boer soldiers in a trench. [image] Available at: <https://en.wikipedia.org/wiki/Second_Boer_War#/media/File:Mafikeng_Second_Boer_War.jpg> [Accessed 30 July 2021].

fig 2.16: Encyclopaedia Britannica, n.d. Illustration of the siege at Ladysmith. [image] Available at: <https://cdn.britannica.com/90/141590-050-6DEED299/Boer-siege-Ladysmith-South-African-War-1900.jpg> [Accessed 30 July 2021].

fig 2.17: Teper,H,.Jacobs siding concentration camp. [image] Available at: <https://www.flickr.com/photos/hilton-t/41636816740/in/photostream/> [Accessed 30 July 2021].

fig 2.18: Teper,H, Merebank concentration camp. [image] Available at: <https://www.flickr.com/photos/hilton-t/41636816740/in/photostream/> [Accessed 30 July 2021].

fig 2.19: Unknown, n.d. stamp that marked the union of South Africa and it's ex- colonies. [image] Available at: <http://bigblue1840-1940.blogspot.com/2015/12/union-of-south-africa-part-i.html> [Accessed 30 July 2021].

fig 2.20: Chan, I,. n.d. Warning signage erected because of the land act. [image] Available at: <https://medium.com/@isaacdanielchan/the-triumphant-story-of-how-black-south-africans-today-are-reversing-the-effects-of-apartheid-e19e7c016c91> [Accessed 30 July 2021].

fig 2.21: Sporting Post, n.d. Aerial view of Clairwood park racecourse. [image] Available at: <https://www.sportingpost.co.za/2014/07/clairwood-final-days/> [Accessed 30 July 2021].

fig 2. 22: SS Singh Collection, 1946. Suriakala Patel leads the singing of the anthem. [image] Available at: <https://www.dailymaverick.co.za/article/2021-06-16-monty-naicker-and-the-1946-passive-resistance-campaign-memory-against-forgetting/> [Accessed 30 July 2021].

fig 2.23: Transnet Heritage Foundation, n.d. Louis Botha International Airport. [image] Available at: <https://www.fad.co.za/Resources/memoirs/beeton.htm> [Accessed 30 July 2021].

fig 2.24: Scott, D., 1994. Group Areas Proclamation in Durban. [image].

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fig 2.26: Engen, n.d. Aerial view of the Engen refinery. [image] Available at: <https://engen.co.za/about/manufacturing> [Accessed 30 July 2021].

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fig 2.28: Corcoran, B., 2008. Fuel storage tank on fire. [image] Available at: <https://www.thenewhumanitarian.org/fr/node/243281> [Accessed 30 July 2021].

fig 2.29: Author, 2021

fig 2.30: Southlands SUN, 2020. Fire at the Engen refinery view from Wentworth. [image] Available at: <https://southlandssun.co.za/162211/watch-engen-oil-refinery-on-fire-in-tara-road-bluff/> [Accessed 31 July 2021].

fig 2.31: Teper,H, Merebank concentration camp. [image] Available at: <https://www.flickr.com/photos/hilton-t/41636816740/in/photostream/> [Accessed 30 July 2021].

fig 2.32: Drawing adapted from : Scott, D., 2003. 'Creative destruction': Early modernist planning in the South Durban in-dustrial zone, South Africa. Journal of Southern African Studies, 29(1), pp.235-259.

fig 2.33: Author, 2021 adapted from: Bentham, J. and Boovi, M., 1995. The panopticon writings. Verso Trade.

Fig 2.34: Apartheid Museum, n.d. Officials examine Johannesburg 'Native Townships' plan.. [image] Available at: <https://www.theguardian.com/cities/2014/dec/02/architects-apartheid-picturing-place-johannesburg-map-planning> [Accessed 30 July 2021].

Fig 2.35: Author, 2021

List of Figures (continued)

Fig 2.36: Drawing adapted from : Scott, D., 2003. 'Creative destruction': Early modernist planning in the South Durban in-dustrial zone, South Africa. Journal of Southern African Studies, 29(1), pp.235-259.

Fig 2.37: Merebank concentration camp information website, 2021. images showing the conditions of the concentration camps.[image] Available at: <https://sites.google.com/site/merebankconcentrationcamp/-historic-photos> [Accessed 13 April 2021].

Fig 3.1 Drawing adapted from : Scott, D., 2003. 'Creative destruction': Early modernist planning in the South Durban in-dustrial zone, South Africa. Journal of Southern African Studies, 29(1), pp.235-259.

Fig 3.2 Apartheid Museum, n.d. Officials examine Johannesburg 'Native Townships' plan.. [image] Available at: <https://www.theguardian.com/cities/2014/dec/02/architects-apartheid-picturing-place-johannesburg-map-planning> [Accessed 30 July 2021].

Fig 3.3: Author, 2021 adapting images from figures 3.1 and 1.3

Fig 3.4: Hunter, M., n.d. urban's southern Berea ridge rising up from the harbour.. [image] Available at: <https://www.cambridge.org/core/books/race-for-education/larney-and-rough-and-tough-schools/92A4B5107D45CF89DDF50EAEE01B7044/core-reader> [Accessed 14 May 2021].

Fig 3.5: Author 2021, adapted from: Department of Rural Development and Land Reform, 1953. Historic aerial view of South Durban Basin. [image] Available at: <http://www.cdngiportal.co.za/cdngiportal/> [Accessed 24 April 2021].

Fig 3.6: Rajgopaul, J., 1983. A market gardener and her assistant clearing land adjoining Louis Botha Airport.. [image] Available at: <https://digitalcollections.lib.uct.ac.za/collection/islandora-5718> [Accessed 5 August 2021].

Fig 3.7: Author, 2021

Fig 3.8 Author, 2021 adapted from : Transnet, n.d. Layout of the transnet pipe network. [image] Available at: <https://www.transnetpipelines.net/operations/> [Accessed 24 September 2021].

Fig 3.9: Author, 2021

Fig 3.10 Author 2021, adapted from: Department of Rural Development and Land Reform, 1953. Historic aerial view of South Durban Basin. [image] Available at: <http://www.cdngiportal.co.za/cdngiportal/> [Accessed 24 April 2021].

Figure 3.11: Author, 2021

Fig 4.1: Author adapted from Datalens, 2012. racial population density in Kwazulu Natal. [image] Available at: <https://i.imgur.com/1oloL.jpg> [Accessed 5 August 2021].

Fig 4.2: Images in collage taken from: Du Toit, M. and Gordon, J., 2009. Photographic portraiture, neighbourhood activism and apartheid's industrial legacy: reflections on the Breathing Spaces exhibition. Kronos, 35(1), pp.175-193.

Fig 4.3: Author ,2021

Fig 4.4: Mbele, M., 2021. The Engen oil refinery in Durban's South Basin looms over a church in the foreground.. [image] Available at: <https://www.newframe.com/residents-breathe-easier-as-engen-refinery-to-close/> [Accessed 5 August 2021].

Fig 4.5: Ward, R., 2021. Children play football outside their homes. [image] Available at: <https://www.newframe.com/long-read-plan-to-clean-durbans-air-falters/> [Accessed 5 August 2021].

Fig 4.6: Sipho Kings, 2014. Dinapur road, Merebank. [image] Available at: <https://mg.co.za/article/2014-06-05-cancer-valley-pays-a-high-price-for-south-africas-oil-needs/> [Accessed 28 February 2021].

Fig 4.7: African Climate Reality Project, 2021. View of Austerville from the bluff ridge with Engen refinery in the foreground. [image] Available at: <https://www.youtube.com/watch?v=5I6pS7bR3zY> [Accessed 4 August 2021].

Fig 4.8 to 4.31: Author, 2021

Fig 4.32: Author 2021, adapted from: Ward, R., 2020. Residents walk home from a tuck shop in Merewent opposite the Engen refinery in the South Durban Basin.. [image] Available at: <https://www.newframe.com/long-read-plan-to-clean-durbans-air-falters/> [Accessed 18 May 2021].

Fig 4.33: Author 2021

Fig 4.34: Author, 2021 adapted from: Google Earth, n.d. Aerial view of Merebank and Austerville. [image] Available at: <https://www.google.co.za/maps/@-29.9520427,30.975248,14.93z> [Accessed 10 April 2021].

Fig 5.1: photos adapted from: Houston, N., 2009. Coloured lens: a study of the socio-cultural context of Wentworth in Durban, KwaZulu-Natal, South Africa, towards a photographic documentary (Doctoral dissertation).

Fig 5.2: photos adapted from: Houston, N., 2009. Coloured lens: a study of the socio-cultural context of Wentworth in Durban, KwaZulu-Natal, South Africa, towards a photographic documentary (Doctoral dissertation).

Fig 5.3: Grossman, A., 2018. Residents in Austerville. [image] Available at: <https://www.greengrants.org/2018/05/22/breathing-spaces/> [Accessed 5 August 2021].

Fig 5.4: Images in collage taken from: Du Toit, M. and Gordon, J., 2009. Photographic portraiture, neighbourhood activism and apartheid's industrial legacy: reflections on the Breathing Spaces exhibition. Kronos, 35(1), pp.175-193.

Fig 5.5: Author, 2021

Fig 5.6: Author, 2021

Fig 6.1: Mbele, M., 2021. Children watch a football match in a park opposite the refinery in Wentworth.. [image] Available at: <https://www.newframe.com/residents-breathe-easier-as-engen-refinery-to-close/> [Accessed 13 September 2021].

Fig 6.2: Author, 2021

Fig 6.3: Our world data, n.d. Hubbert's peak prediction vs. actual oil production in the United States. [image] Available at: <https://ourworldindata.org/grapher/hubberts-peak-vs-actual-oil-production-in-the-united-states?country=~USA> [Accessed 18 September 2021].

Fig 6.4: Majola, N., 2020. oil spill in Umbilo River. [image] Available at: <https://www.groundup.org.za/article/massive-oil-spill-umbilo-river/> [Accessed 18 September 2021].

Fig 6.5- fig 6.8: images adapted from : Emscher landscape park visitors guide. [ebook] Germany: Metropoleruhr. Available at: <https://climate-adapt.eea.europa.eu/metadata/case-studies/a-flood-and-heat-proof-green-emscher-valley-germany/11305605.pdf> [Accessed 10 September 2021].

Fig 6.9-6.15: Author, 2021

Fig 7.1: Gilili, C., 2021. Durban South residents protest at the Engen Refinery Gates on Tara Road on December 09, 2020. [image] Available at: <https://mg.co.za/environment/2021-02-09-engen-refuses-to-engage-with-durbans-affected-community/> [Accessed 10 September 2021].

Fig 7.2: Author, 2021

Fig 8.1-8.11: Author 2021

Fig8.12: Google Earth, 2021. Street view showing merebank shopping centre. [image] Available at:https://googleearth.gosur.com

Fig 8.13: Author, 2021

Fig 8.14: Street views sourced from: Google Earth, 2021. [images] Available at:https://googleearth.gosur.com

Fig 8.15: Street views sourced from: Google Earth, 2021. [images] Available at:https://googleearth.gosur.com

Fig 8.16: Street views sourced from: Google Earth, 2021. [images] Available at:https://googleearth.gosur.com
Fig 8.17-29: Author, 2021

Fig 8.17-29: Author, 2021

Fig 8.30: Author, 2021

Fig 8. 31- fig 39: Street views sourced from: Google Earth, 2021. [images] Available at:https://googleearth.gosur.com

Fig 8.40: Author, 2021

Fig 8. 41- fig 49: Street views sourced from: Google Earth, 2021. [images] Available at:https://googleearth.gosur.com

Fig 8.50 - fig 56: Author, 2021

List of Figures (continued)

Fig 9.1- fig 9.22: Author, 2021

Fig 9.23: Aerial view sourced from: Google Earth, 2021. [images] Available at:https://googleearth.gosur.com

Fig 9.24- fig 9.53: Author, 2021

Fig 9.60: Esin, S., n.d. Illustration of Greek Agora. [image] Available at: <https://semihcanesin.wordpress.com/2018/10/24/ancient-greek-architecture/> [Accessed 25 June 2021].

Fig 10.1- fig 10.23: Author, 2021

Fig 10.26: van Duivenbode, O. and Hart Nibbrig, M., 2019. Aerial view of the visitors centre. [image] Available at: <https://www.archdaily.com/934915/visitor-center-unesco-world-heritage-site-kinderdijk-m-and-db-architecten> [Accessed 12 May 2021].

Fig 10.27: Author, 2021

Fig 10.28: Baan, I., n.d. View of the Heritage centre down a busy street. [image] Available at: <https://www.peterricharchitects.com/alexandria-interpretation-centre> [Accessed 19 March 2021].

Fig 10.29: Noero Architects, n.d. Red location Musuem as seen from the community. [image] Available at: <https://www.noeroarchitects.com/project/red-location-museum/> [Accessed 27 September 2021].

Fig 10.30- fig 10.32 : Author, 2021

Fig 10. 33: Landzine, 2021. Corten steel walkway. [image] Available at: <http://landezine.com/index.php/2020/10/farum-midtpunkt-activity-park/> [Accessed 27 September 2021].

Fig 10.34-43: Author, 2021

Fig 10.44: Groundwork, n.d. Workers work on pipeline in Tara road. [image] Available at: <https://www.groundwork.org.za/publications/MD%20binnen%20Shell-VV3-Def2%20.pdf> [Accessed 19 September 2021].

Fig 10.45- 10.53 : Author, 2021