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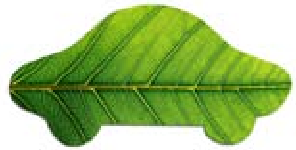

Stripped

A Vehicle Disassembly Plant in Pretoria West

by Marius Snyders

Course Coordinator: Jacques Laubscher
Study Leader: Gary White

Submitted in partial fulfilment of the requirements for the degree Masters in Architecture (Professional)
in the Faculty of Engineering, Built Environment and Information Technology,
Department of Architecture, University of Pretoria, 2011

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dissertation information

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

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

Signature
Marius Snyders

project summary

Programme:	Vehicle Disassembly Plant
Site Description:	Rebecca Station, Pretoria West
Client:	National Association of Automobile Manufacturers of South Africa (NAAMSA), in association with the International Organization of Motor Vehicle Manufacturers (OICA).
Users:	Employees and Management of the plant, the general public
Site Location:	Erf R/96, Pretoria West
Address:	c/o Rebecca Street and Carl Street, Pretoria West, Pretoria, South Africa
GPS Coordinates:	25° 40'26.44"S, 28° 9'16.75"E
Architectural Theoretical Premise:	Architecture Versus Automobiles
Architectural Approach:	Investigation of the relationship between architecture, automobiles (technology) and people – the connection between the social and industrial realm.
Research Field:	Environmental Potential

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_for my parents

abstract

Fig 1.1: Crushed Cars, Lee Jordan 2007

The key theme of this research document is the negative impact of an increasingly expanding motor vehicle industry. The urban infrastructure and dependence on individual transportation has become an integral part of everyday life for many. Continual growth in the numbers of new automobiles within cities has resulted in the disposal of old and broken (end-of-life) automobiles.

This dissertation investigates the potential of industrial architecture in assisting with the regulation of waste management through adaptive re-use of lost spaces and materials. The main objectives include recycling, recycling-awareness and education, re-use of materials, architecture promoting low embodied energy products, the production of energy and social consolidation.

Due to the high embodied energy of automobiles, the different range of materials used and the availability of discarded automobiles found within the surrounding industrial area of Pretoria West, a study of the recycling of automobiles will form the central theme for this dissertation.

A Vehicle Disassembly Plant, which would be located within the Pretoria West Industrial Area – West of the City of Tshwane CBD, would, by means of waste management, form the basis of the architectural intervention.

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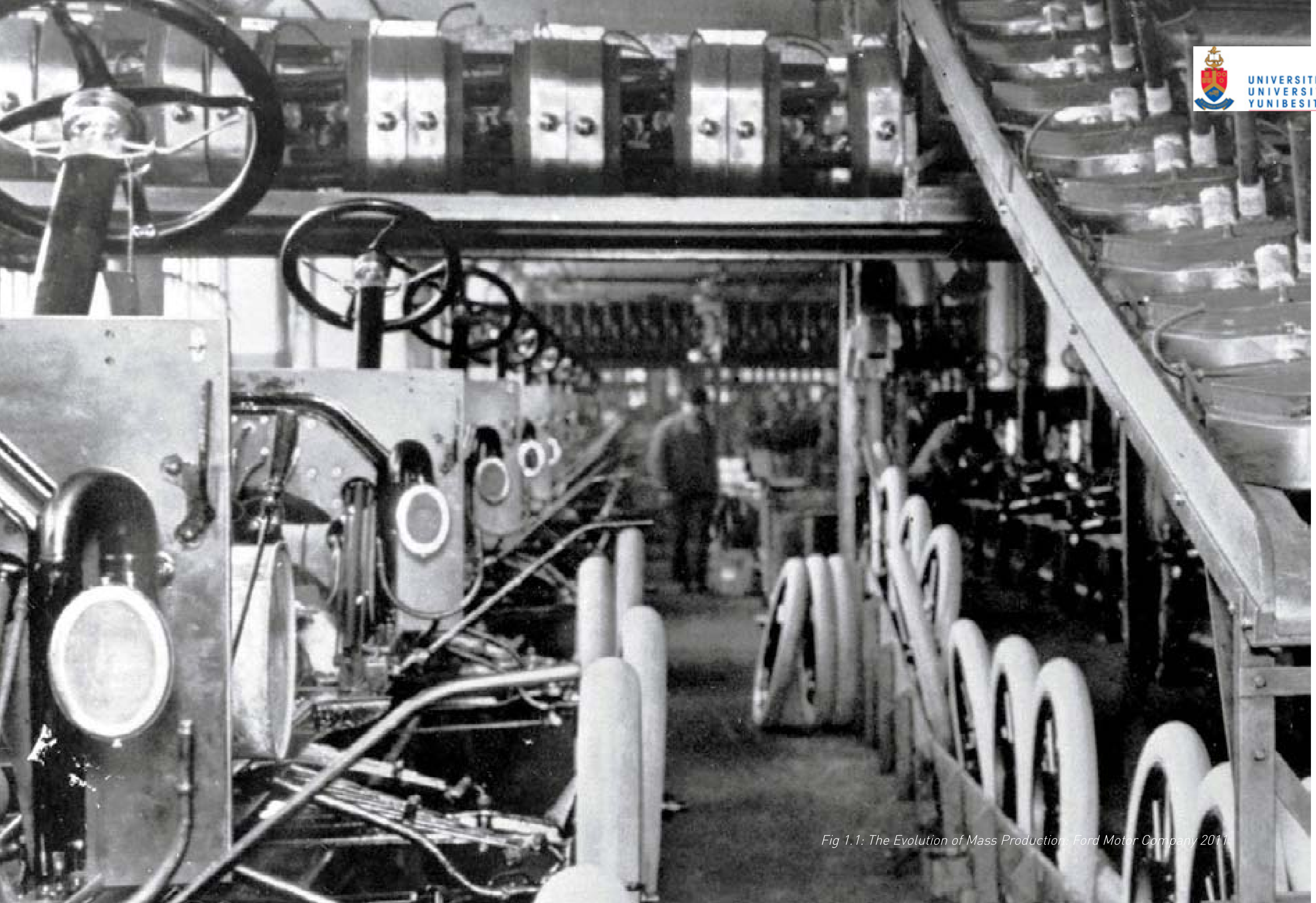


Fig 1.1: The Evolution of Mass Production: Ford Motor Company 2011

01 introduction

Fig 1.2: Impact of the Car, Image Collage by Author 2011

"We have experienced it ourselves, and suffered it almost to the point of self-denial: the car is a destroyer of our cities, an enemy of traditional architecture. And no wonder, for when the car was born those cities were geared to the dimensions and speed of an oxcart, and not in the remotest prepared for the dynamism of the motor car. This encounter between archaic immobility and an impetuous longing for forward movement has not been without its consequences. The car threatens and disturbs/destroys our habitats. We do not defend ourselves: indeed - and this is where we have a screw loose, because we adore it - the car is one of the habitats we love most. To tell the whole truth: it is the Golden Calf of modernity. We have surrendered ourselves irredeemably to automobility. And one thing is clear: for a very long time to come, our societies north and south, east and west, will neither want nor be able to exist without the car, but only with it. What might peaceful coexistence look like?"

Dirk Meyhöfer, 2003: 8

1.1 Background

One of the most relevant topics for urban planners in the past century has been traffic planning. Many historic cities in Europe and the oldest cities in America developed complex, irregular street patterns, shaped by the connection between urban growth and topography, and densely populated zones where housing was integrated with commerce and industry. These cities consisted of pedestrians and horse-drawn carts and carriages (Diefendorf, 2000: 175).

With the turn of the nineteenth century, industrialization brought a new dimension to transport in the form of railroads. Momentarily it seemed that rail transport was perfect for moving people and goods into city centres, which facilitated the development of urban sprawl.

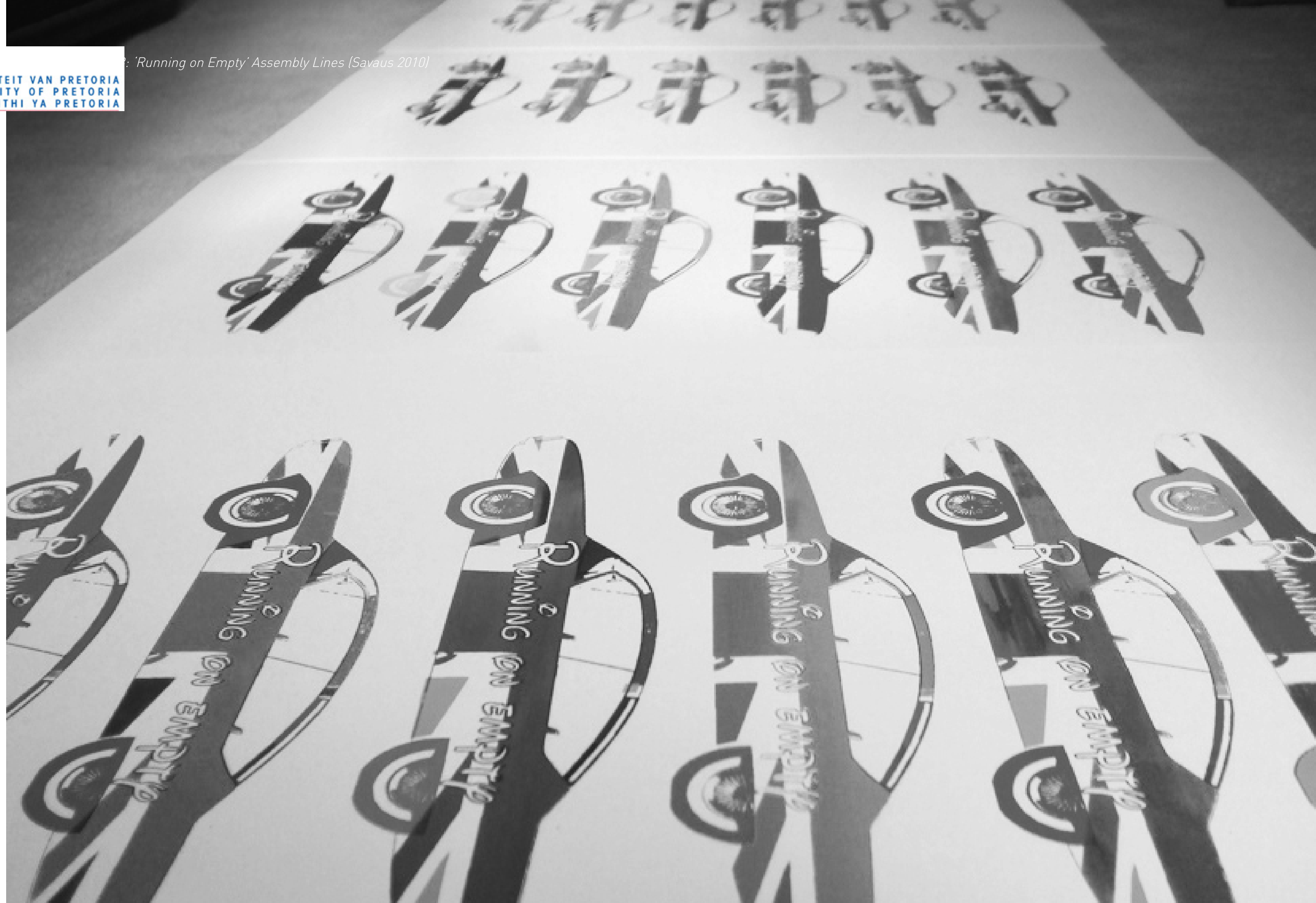
However, the development of traffic planning in cities was transformed by the mass production of automobiles for private use from the 1920's. The low cost of automobiles, access to fuel and individual freedom influenced this transformation. Soon, automobiles started to compete with other modes of transport within the city (Diefendorf, 2000: 176).

Two opposing themes became evident: the desire to serve the automobile, and the desire that their use be subordinate to other needs within the city (Mumford, 1963: 548). Despite the planning, the number of automobiles in urban environments and the need for parking spaces has increased exponentially. In order to accommodate increasing automobile use, an infrastructure of motorways was constructed to provide direct access to city centres (Siemiatycki, 2010: 828).

Lower density developments started to emerge on the periphery of cities, resulting in better accessibility to commodities for the larger share of the population (Siemiatycki, 2010: 828).

According to Gerrit Jordaan (1989: 28), the growth of Pretoria is an example of peripheral development, where highway systems have been forced into the urban structure of the city. The vast portions of land used for suburb development towards the eastern boundaries of Pretoria are a result of the ease of transport. The focus has shifted from the historic city centre to new suburbanized developments, and changes in individual transport are the origin.

Traffic infrastructure is an integral part of the city; mobility cannot be separated from the urban environment. The ubiquity of automobiles has resulted in the importance of finding ways/methods to regulate the motor vehicle industry.



: 'Running on Empty' Assembly Lines (Savaus 2010)

Fig 1.4: Disposed Cars: @NC

1.2 Problem statement

Today's society is increasingly dependent on disposability.

According to some accounts, more than 90% of materials used in the end-product of durable goods in the United States become waste almost immediately, with the product itself sometimes scarcely lasting longer (Braungart and McDonough, 2009: 27). Everything else is designed for you to throw away when you are finished with it. But where is "away"? Of course, "away" does not really exist. "Away" has gone away (Braungart and McDonough, 2009: 27).

Waste has become the social text on which a community's logic and illogic can be evaluated. The continual growth and expansion of cities has resulted in, amongst other issues, an increasing amount of automobiles in urban areas.

With an average life-span of 10 years, automobiles in South Africa are discarded due to accidents, mechanical problems, financial issues and the need for new models (Statistics South Africa, 2010). The discarded automobiles, depending on the condition, are either traded or resold, repaired for further use, stripped for parts, or end up as waste in the outer skirts of the city.

The industrial community of Pretoria West consists largely of local businesses specializing in different fields of vehicle maintenance. However, the vast majority of automobiles and materials taken from automobiles are left to decay, and regarded as useless.

The high embodied energy put into a motor vehicle during production, together with all the CO_2 emissions during its lifecycle need to be addressed by sustainable processes when getting rid of old and abandoned automobiles; possibly by reusing and recycling the different materials and parts.

"In spite of the urban highways, motor vehicles still clogged city streets, killed drivers and pedestrians in accidents, fouled the air, and claimed precious space for new roads and parking."

(Diefendorf, 2000: 177)

Fig 1.5: Industrial VS Residential (mle8

1.3 Aim of Study

The aim of this study is to investigate the relationship between architecture, automobiles (technology) and people – the connection between the social and industrial realm.

New systems and technologies housed in industrial architecture gave birth to the mass production of automobiles. It is the responsibility of architecture (design) and technology (process) to facilitate the manner in which end-of-life automobiles are put to rest. The unsustainable manner in which the industrial production process is currently operating will be addressed.

Ivan Illich (1973) explored the connection between technology and industrial production, looking at how both can serve people rather than dominate them. The systems and technologies which create waste can be harnessed to ensure sustainable growth.

This study aims to act as a catalyst to transform Pretoria West as a productive precinct of the City of Tshwane, where waste disposed of is reused and recycled making the city more sustainable and environmentally friendly.

Consolidation between economical (industrial) and social (residential) hierarchies can be reinstated and reorganised, resulting in a mutual benefit for both.

"Once these limits are recognized, it becomes possible to articulate the triadic relationship between persons, tools and a new collectivity"

(Illich, 1973: 5)

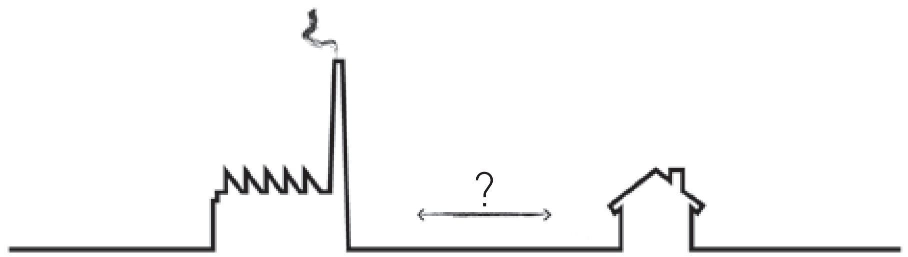


Fig 1.6: Connection between Industrial and Residential realm, Illustrated by Author 2011

1.4 Urban Context

Background:

Pretoria West was established in 1890s as a suburban residential area. Many of the Voortrekkers who rejected the idea of a farm in the Transvaal and preferred a large stand in close proximity to the city started settling in Pretoria West. Subsequently, an influx of farmers from the countryside entered the city. The residential area of Pretoria West, then called Goede Hoop, developed quickly (Pretoria News, 1996: 8).

Today Pretoria West is characterized by industrial activity, scrap yards, and impoverished citizens; it is dangerous, noisy and neglected. The growth of the area resulted in the urbanisation of Pretoria West. Critics, who commented on this issue, preferred the area with its rural character, parks and race course (today, Pretoria Show Grounds) (Jordaan 1989: 28)

Pretoria West underwent industrial growth with the establishment of Iscor (Pretoria News, 1996) in the area. Goede Hoop soon became the home of many industrial and railway employees and their families, and the need for housing increased.

The availability of transport via railway lines encouraged industrial growth and consequently the connection between industry and social programs was separated. The gradual conversion in character of Pretoria West has resulted in a low density residential area dominated by industry (Pretoria News, 1996: 8).

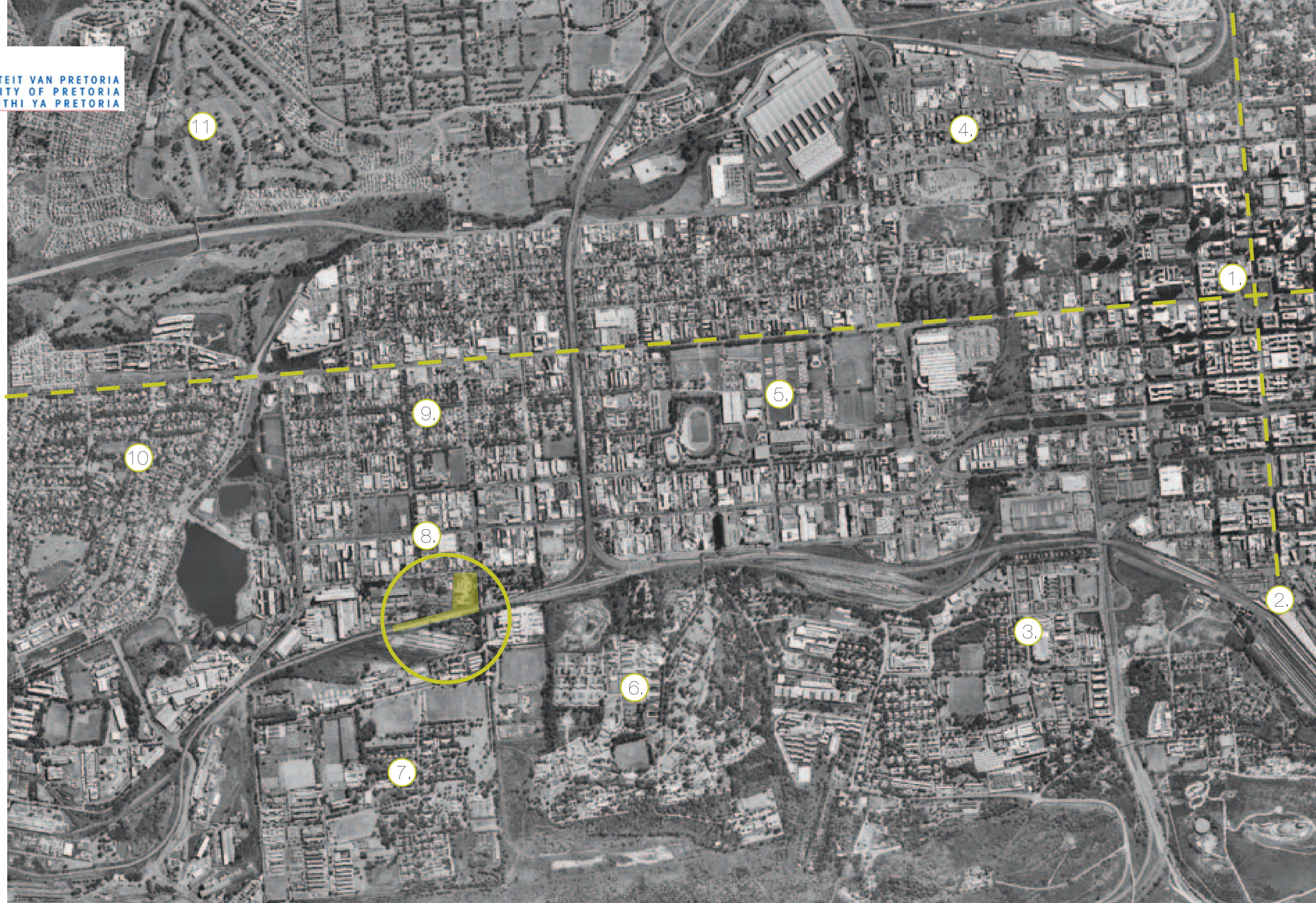
Due to the close proximity to Pretoria's CBD and connection with major public transport modes, Pretoria West could be regenerated as a whole, restoring the relationship between industry and social activities.

Map Legend: Pretoria (Oppisite Page)

1. Church Square
2. Pretoria Main Station
3. Pretoria Military
4. Marabastad
5. Pretoria Show Grounds
6. Weskoppies Mental Hospital
7. S.A.P.S Training Facilities
8. Pretoria West Industrial
9. Pretoria West Residential
10. Proclamation Hill
11. Pretoria West Golf Course

Proposed Study Area

Fig 1.7: Aerial photo of Pretoria West in context to Church Square: City of Tshwane Municipality, Edited by Author 2011



1.5 Site Selection

The City of Tshwane is cluttered with growing amounts of waste and dump sites, especially in areas that are poorly developed and disconnected from the city. The spectrum of waste types can often be a reflection on how a community treats its surroundings.

The industrial area of Pretoria West consists predominantly of small, car-related businesses like panel beaters, scrap yards, parts shops and mechanics, as well as open lots filled with disposed automobiles. Vacant spaces in the area have become dumping/storage sites for abandoned automobiles. While new automobiles are introduced to the city, these 'graveyards' overflow with unused material. Pretoria West consists of various types of dumping and technical harvesting sites where materials can be obtained from.

Fig 1.8: Dumping Sites in the Pretoria West Precinct
Photo Collage by Author 2011

Proposed Site - Rebecca Street | Open Lot in Servaas Street | Park in Mitchell Street | Open Lot - Car Street

Fig 1.9: Technical Harvesting Sites in the Pretoria West Precinct
Photo Collage by Author 2011

Metal - Soutter Street | Metal - Mitchell Street | Metal - Soutter Street | Rubber - Mitchell Street | Glass - Buitekant Street

Fig 1.10: Precinct in context with Pretoria CBD. City of Tshwane Municipality, Edited by Author 2011

[position of dumping & harvesting sites in context]

1.5.1 Resource Sites:

The identified sites in the surrounding precinct can serve as sites of resource for recycling. The unused materials on these sites should be sorted and taken through the necessary processes in order to be reused.

The resource sites form part of the research discussed in Chapter 4: Context

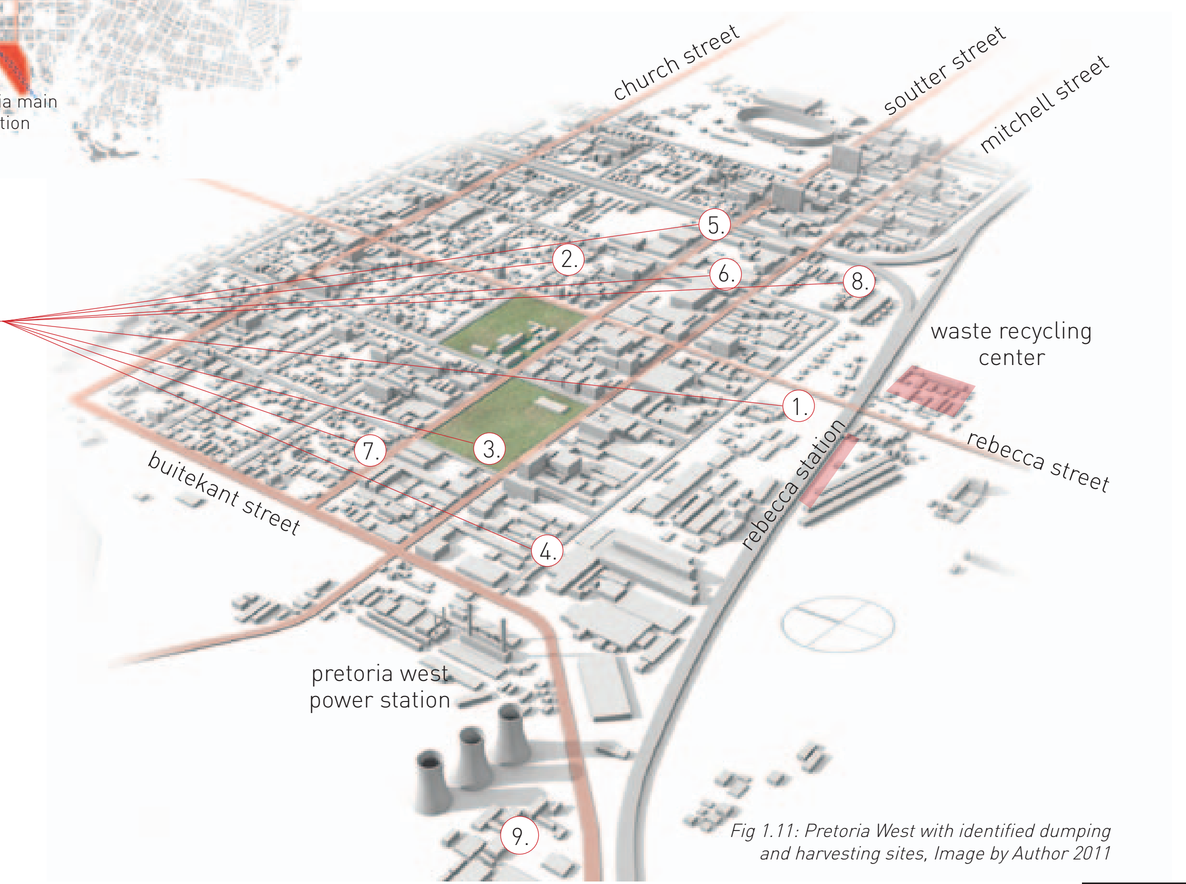


Fig 1.11: Pretoria West with identified dumping and harvesting sites, Image by Author 2011

1.6 Site Introduction

The study area is located in the predominantly industrial area of Pretoria West. The site is situated on the corner of Rebecca Street and Carl Street, which is bordered by the railway line to the South, connected to Rebecca Station. The study area also includes the surrounding residential and industrial precincts of Pretoria West.

Potential:
- Economic and urban regeneration
- Connection between social and industrial activities
- Can allocate a new identity to Pretoria West as a sustainable industrial area of The City of Tshwane
- Formalize recycling in the area of Pretoria West
- Creation of new job opportunities for semi- or un-skilled individuals
- Existing small businesses in the precinct can form part of the recycling/re-using process, creating a community based project
- Promotes emerging development, focused on sustainability
- Recycled and re-used materials can be redistributed into the surrounding community

Delimitations:
-Author will rely on the expertise and knowledge of an industrial engineers to determine disassembly process. The spatial requirements for these processes will be considered throughout the design of the plant.

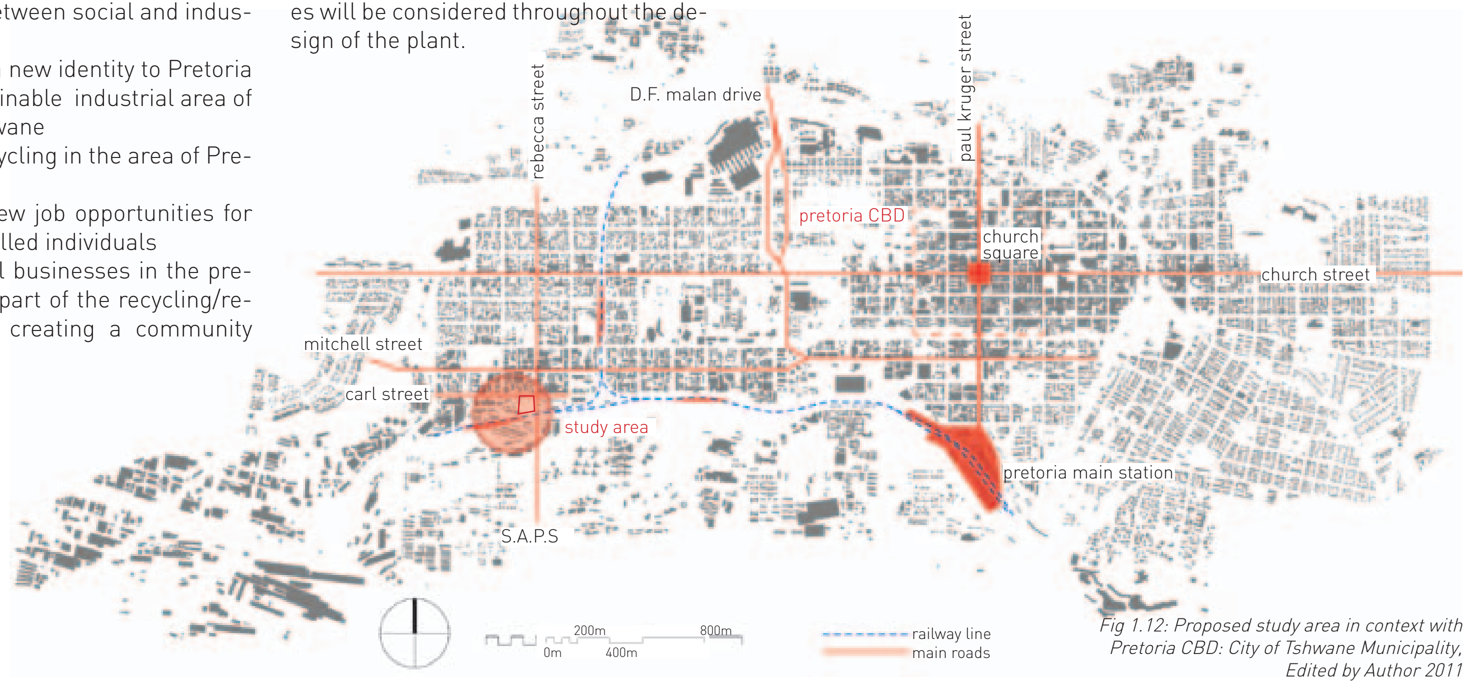


Fig 1.12: Proposed study area in context with Pretoria CBD: City of Tshwane Municipality, Edited by Author 2011

Fig 1.13: (Opposite) Proposed site in context to study a City of Tshwane Municipality, Edited by Author 2011

Map Legend: Study Area (Opposite Page)

1. Proposed Site
2. Old Houses (Protected by Heritage Act)
3. Railway Storage
4. Municipal Mixed Waste Facility
5. S.A.P.S Gate
6. Old Train Shunting Yards
7. Rebecca Station
8. Dilapidated Warehouses
9. Department: Water Affairs
10. Public Green Space

a. Soutter Street
b. Mitchell Street
c. Carl Street
d. Ct Street
e. Rose-Etta Street
f. Rebecca Street
g. Zeller Street
h. Railway Line

1.7 Automobile Statistics

In order to substantiate the real-world problem concerning the amount of unused automobiles in the City of Tshwane, a study of the automotive industry, worldwide and in South Africa, will briefly be discussed.

The estimated global population in the year 2009 stood at 6.6 billion people, with 50% of these living in urbanised conditions. The projection of these numbers to the year 2050 estimates a population size of 9.2 billion people, of which 71% will be urbanised (UN FOA 2009).

With the majority of the global population starting to flock towards urban areas, the need for transport and the supporting infrastructure will increase exponentially.

It is estimated that over 750,000,000 passenger automobiles are on the roads of the world today, and this number is predicted to reach the 2 billion meter mark by 2030. The amount of automobiles produced around the world, stands at an alarming 150,000 units per day, with South Africa producing over 220,000 passenger vehicles and 150,000 commercial vehicles per year (IOCA. [sa]).

Human demand for resources has passed unprecedented heights. In the light of the following statistics it has become evident that drastic plans need to be formulated to reduce the amount of waste produced by the automotive industry.

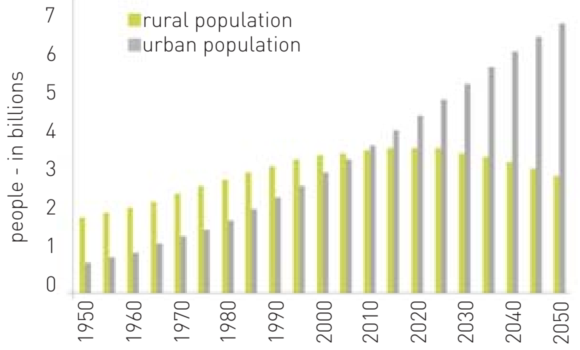


Fig 1.14: Urbanization of the population. Statistics adopted from UN FOA 2009

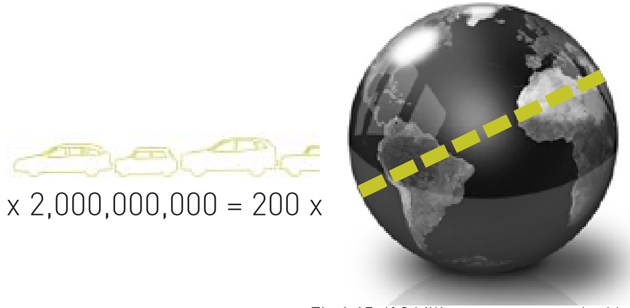
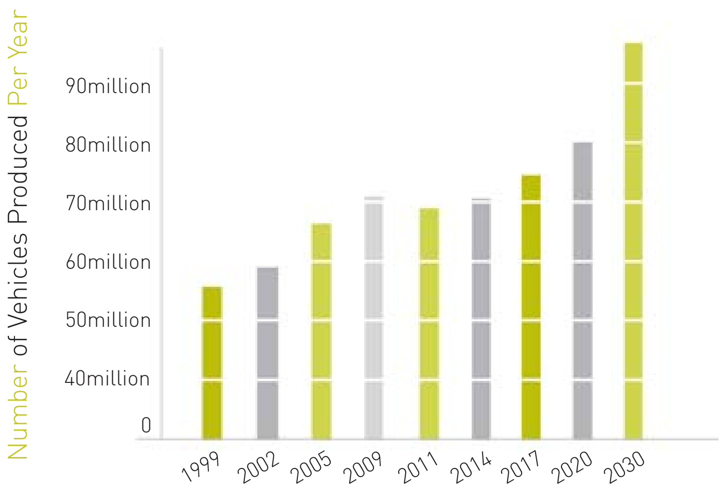


Fig 1.15: If 2 billion cars were parked bumper-to-bumper, they would encircle the Earth over 200 times. Illustrated by Author 2011

1.7.1 Growth of Production
worldwide



1.2b
Estimated number (in billions) of passenger cars around the world by 2030 (estimated around 750million in 2011)

62.5%
Estimated increase in the amount of passenger cars in the next 20 years

Fig 1.17: Growth of Production Worldwide - Passenger Cars: (OICA 2011) Illustrated by Author 2011

1.7.2 Growth of Ownership
south africa

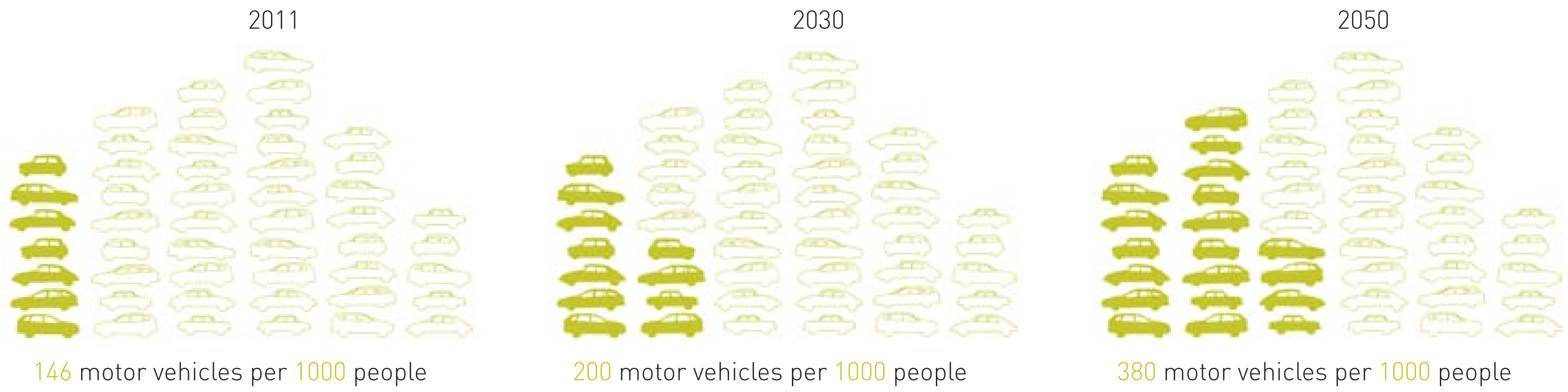
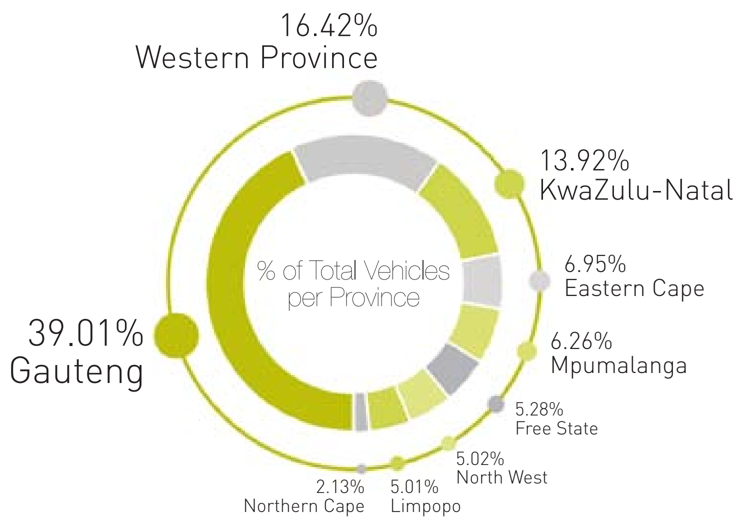


Fig 1.18: Number of Motor Vehicles per capita in South Africa: Statistics South Africa 2010, Illustrated by Author 2011

1.7.3 Number of Vehicles

south africa



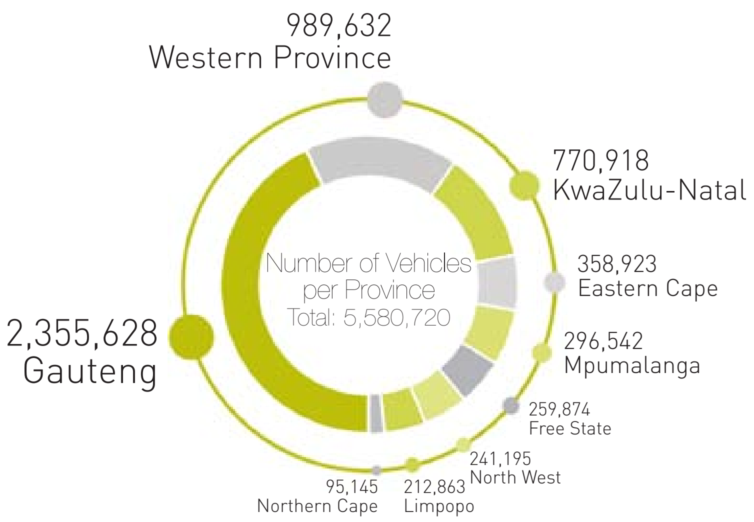


Fig 1.19: Number of Vehicles and Percentage per
[Statistics South Africa 2010] Illustrated by Au

1.7.4 Vehicle Statistics

city of tshwane

Estimated 342 502 Passenger Cars in Tshwane

4.5% cars dis[car]ded

that is: 15 412 disposed cars Per Year in Tshwane

Fig 1.120 Vehicle Statistics - City of Tshwane
[Statistics South Africa 2010] Illustrated by Author 2011

1.8 Hypothesis

Automobile manufacturers take little responsibility in producing a product that is environmentally sustainable. At its deepest foundation, the industrial infrastructure we have today is linear: it is focused on making a product and getting it to a customer quickly and cheaply without considering much else (Braungart and McDonough, 2009: 26).

This linear process results in manufacturers producing automobiles which are not designed to be disassembled and which are constructed from a wide spectrum of materials. This increases the problem of disposal of end-of-life automobiles which is left to the private sector.

However, taking a cradle-to-cradle approach to how we use materials (as well as looking at waste as nutrients for the future), creates a production process that forms a closed loop; an industrial ecosystem.

A cyclical production process, enforced by governing bodies (NAAMSA – National Association of Automobile Manufacturers of South Africa), would result in the development of automobiles that are easy to be disposed of, recycled and disassembled. The production and dismantling processes would be seen as equally important. Emergence takes place when novelty and creativity acts in response to change: New organizations form through emergence and this need to be designed. It is a cyclical, progressive and non-linear process, emerging exponentially (Hamdi 2004: 115).

Automobile manufacturers would want people to turn in their old automobiles in order to regain valuable industrial nutrients, instead of waving industrial resources good-bye as the customer drives off in a new car, never to enter the dealership again... Designing products as products of service means designing them to be disassembled (Braungart and McDonough, 2009: 114).

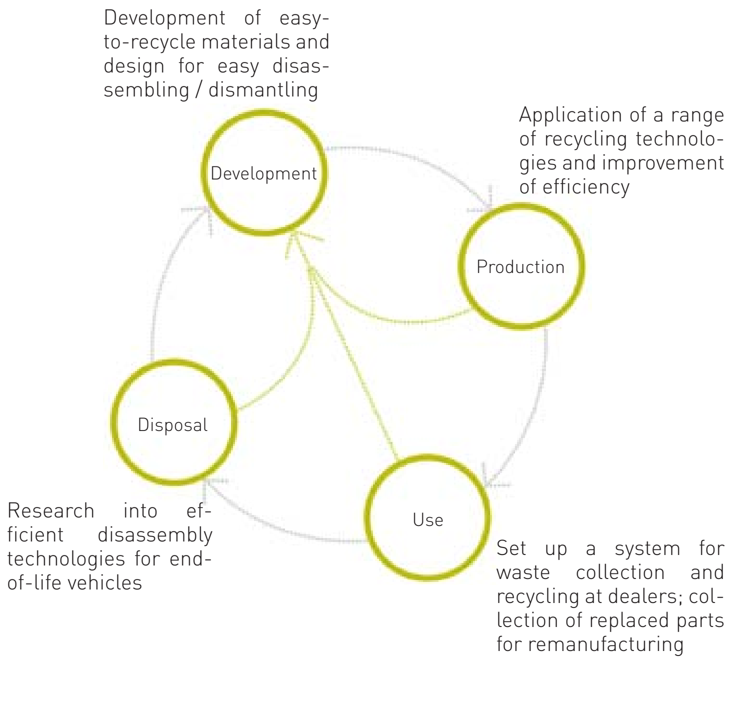


Fig 1.21: Cyclical Production process - Industrial Ecosystem, Illustrated by Author 2011

Fig 1.22: Dissection of a VW Beetle - Installation by Damian Ortega (wbur.org 2009)

1.9 Methodology

A brief summary of different modes of data collection will be listed in order to gain a better understanding of the context and the proposed framework of this study. These methods inform the critical issue that this dissertation aims to address: connection between the social and industrial realm.

Due to the nature of the proposed project and the connection with the railway line, mapping plays an integral part of the methods used for data collection in terms of movement and access.

Mapping: The layering of different relating patterns to reach an understanding of the context of Pretoria West - comparing the quantitative with the qualitative. The capturing of data consists of the following different techniques:
Psychogeographical & Drifting – The Situationists International;
Study of Cognitive Maps – Kevin Lynch;
Map Layering – Bernard Tschumi.

Participant Observation: The aim of this method is to get involved in the activities with a hands-on approach, but at the same time, stepping back to observe and reflect on the different aspects of the situation (which is in contrast to the Situationist approach). The observer should attempt to record the information in an objective manner, distinguishing between information which can be used and that which is useless.

Systematic Observation: This form of observation is space and time specific, where the space, users, programs, time and objects are identified by means of observation and examined – discovering the social patterns between these elements.

Fig 1.23: Station Mapping in Pretoria West, Illustrated by Bertus van Sittert 2010

1.10 Client & Brief

Client:
National Association of Automobile Manufacturers of South Africa (NAAMSA) member of, and in association with, the International Organization of Motor Vehicle Manufacturers (OICA).

Client Background:
OICA is the governing body of the international automotive industry. Automobile manufacturers worldwide must adhere to regulations specified by OICA. The focus of the organization over the last five years has shifted to the sustainability of the industry and how today's automobiles are designed. New regulations regarding the different types of materials as well as the disassembly and recyclable properties of materials have been put into place by OICA.

The local association, NAAMSA (a member of OICA), is responsible for enforcing these regulations in South Africa.

In a joint operation, these two organizations aim to provide vehicle disassembly plants to support the new regulations.

Funding: OICA

Brief:
The role of the architect is to assist the client in selecting an appropriate site and designing a vehicle disassembly plant which will focus on the treatment methods of and solutions to end-of-life automobiles.

Programmes:
- Research and development
- Waste management
- Public education and awareness
- Sustainability

Fig 1.24: International Organization of Motor Vehicle Manufacturers (OICA 2010)

Fig 1.25: National Association of Automobile Manufacturers of South Africa (NAAMSA 2010)

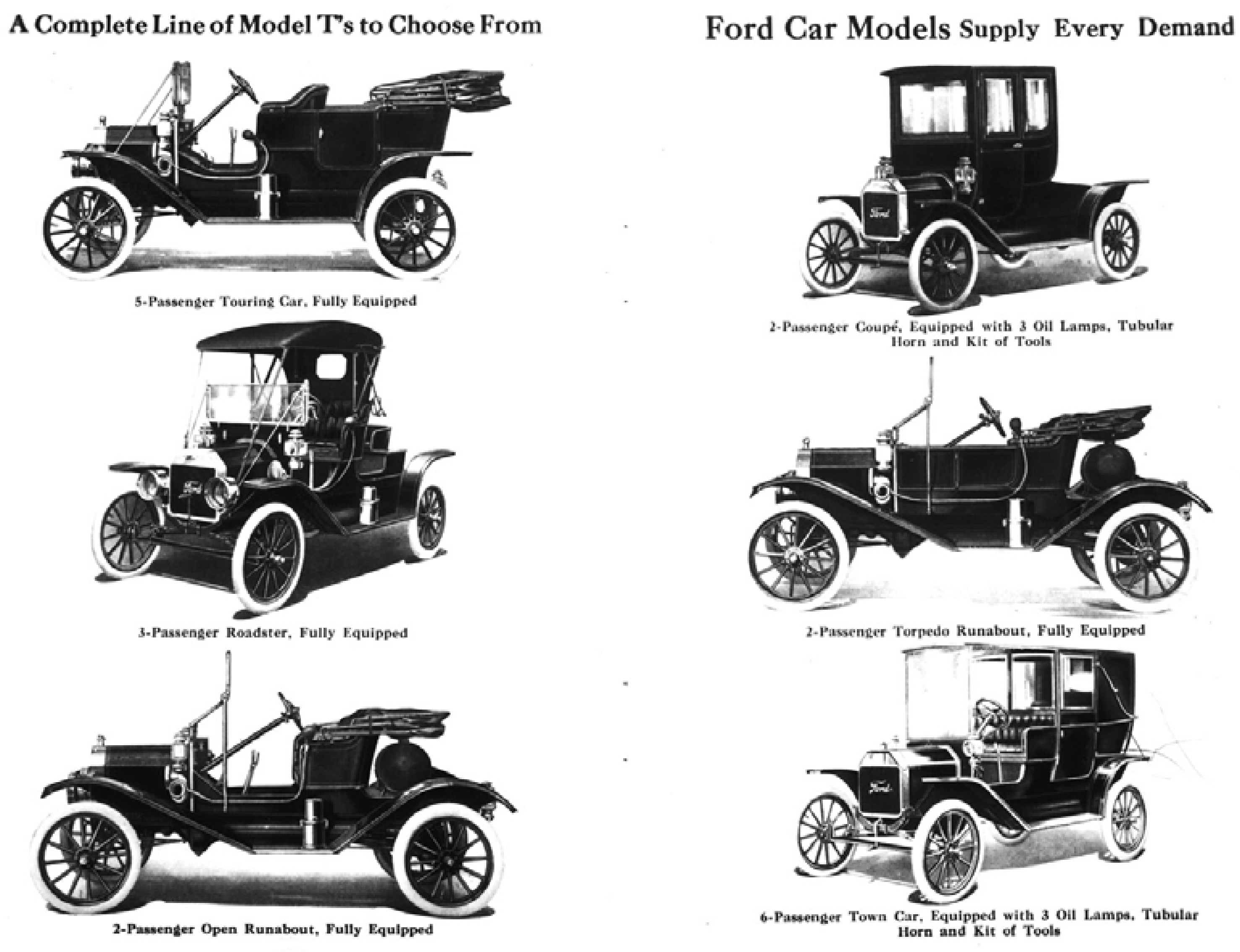


Fig 2.1: Ford Model-T Range, 1911: Curbside Classic 2011

02 theoretical discourse

2.1 Yesterday's Tomorrow

The lessons from the past must first be understood, in order to move forward. The city and the very idea of mobility have been transformed by the automobile. Before the car, squares and streets were almost exclusively populated by pedestrians, with little obstruction by horses or carriages. The street realm is described by Jan Jennings (1990) as the "locus of public life and the theatre for human ritual" – it was intended for people to stroll, wander around, converse, trade and socialise.

As the streets were infiltrated by the automobile, the available space reserved for the public decreased. A moving car requires sixty times more space than a person walking, and a parked one thirty times more than a person standing (Klose, 1965: 9). Together with the pollution, noise and threat of personal safety, the automobile resulted in the effective relegation of pedestrian life on the streets to a automotive dominated domain.

As use of the automobile increased, people demanded the freedom to be able to do all their daily travels by car. What the city offered in small proximities no longer mattered, instead, what mattered was adequate parking space and convenient connections to freeways (Klose, 1965:9).

Public transport around the world became second priority and prominent street networks between major cities started to develop on a massive scale. These drastic shifts could not have come without the visions of urban planners and architects. The radical proposals for future cities in the automotive age were mostly car-centric and totalitarian in approach. The result is a lesson in the challenges of designing cities today, some could be useful if implemented properly, and others that should be avoided.

In his 1935 manifesto for the Radiant City, Le Corbusier envisioned the future reconciliation of automobiles and cities. The proposed consolidation of high densities into towers, which were spread out and connected with high speed roads and elevated off the ground level, had a strong pedestrian notion. In his opinion, people and automobiles should never meet (Le Corbusier, 1967:121). This created a continuous park for pedestrian movement; however, the large towers resulted in inhumane spaces with little social interaction. Even though the radical approach of the vision would have led to separation and isolation, the core message is very important – people should be confident and free to utilise the ground plane.

A striking characteristic of Harvey Wiley Corbett's (1913) vision of New York City is that all the different modes of transport had been provided for in the urban fabric. The potentially vibrant space features a prominent pedestrian presence; however, Corbett's only conclusion was the separation of all the different modes of mobility. Each form is given an exclusive layer within the city and is not unlike the struggle of today's transportation systems. But like Le Corbusier, Corbett saw automobile traffic as something which needed to be channelled, contained and isolated.

Fig 2.2: Léon Krier's critiques on modern planning, zoning, and car-centric development (Krier 2006)

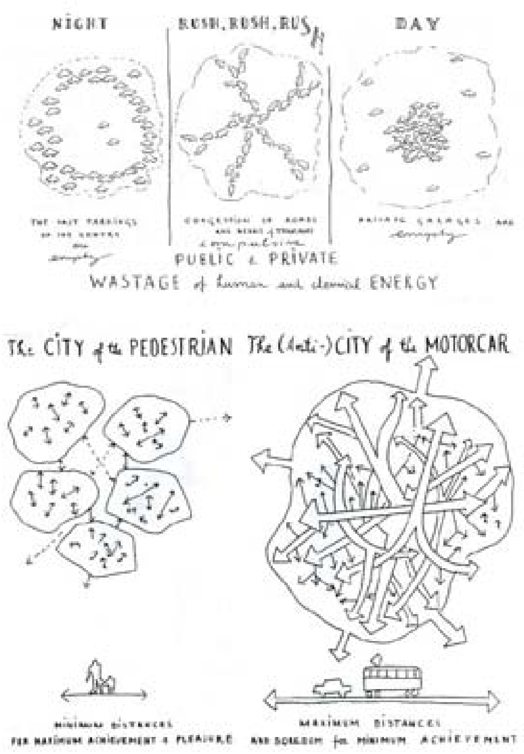


Fig 2.3: (Top) Le Corbusier's "Voisin" plan for Paris, from his proposal for the Radiant City (1922-25) (Le Corbusier 1967)

Fig 2.4: (Bottom) The ground plane in Le Corbusier's vision (Le Corbusier 1967)

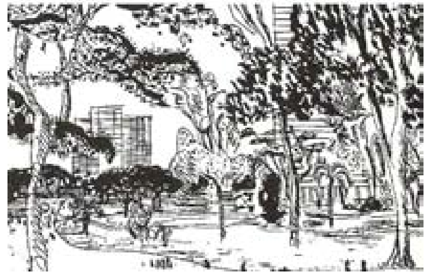
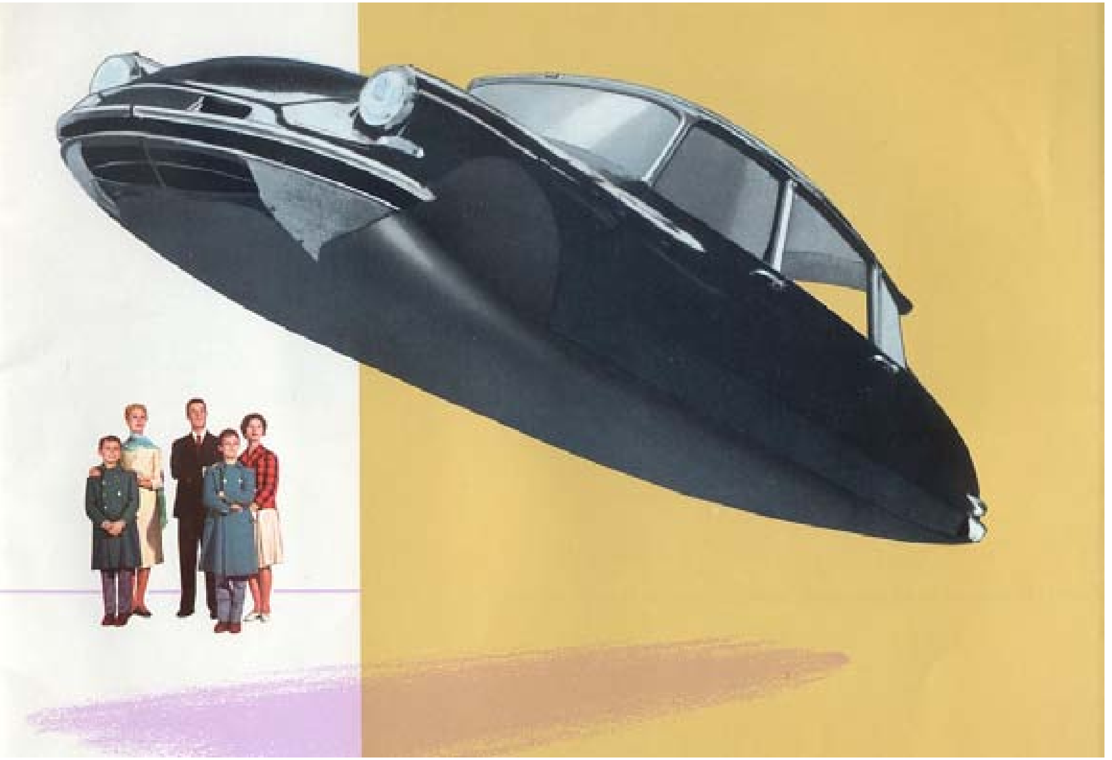


Fig 2.5: Harvey Wiley Corbett's City Section. 1913 (Arquinoias [sa])

Today, the car is intrinsically tied to our culture and everyday activities, its sudden extinction unimaginable. The automobile has become a part of the urban fabric and the experience of a city, the same as buildings by architects and engineers.

Roland Barthes (1957) stated when he wrote about the Citroën DS: *Cars today are almost the exact equivalent of the great Gothic cathedrals: I mean the supreme creation of an era, conceived with passion by unknown artists, and consumed in image if not in usage by a whole population which appropriates them as a purely magical object.*

Fig 2.6: The Citroën DS from a 1959 advertisement (Ukadapta 2010)



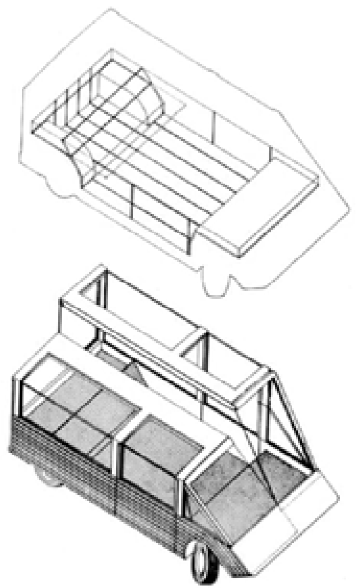
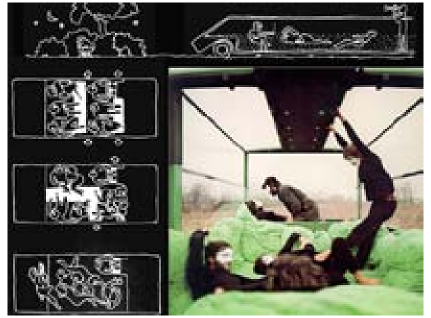


Fig 2.7: Concept drawings for the Kar-a-sutra, 1972 (Bellini 2010)

The automobile was designed to go anywhere at any time and to bring people together, promoting social interaction. It was a medium of transport to connect people with friends and family, activities and the world around them.

The Italian architect, Mario Bellini, explored the social potential of the automobile with the result of the world's first minivan - 'kar-a-sutra'. He wanted to design a space for people to interact, participate in activities and to play. According to Bellini, it was a mobile human space, intended for people and not automotive rituals (Margolius, 2000: 119).

Fig 2.8: Mario Bellini's design for the Kar-a-sutra, 1972 (Bellini 2010)



2.2 Architecture for Automobiles

The automobile age has not provided the city with enjoyable and pleasant spaces for citizens. As people were able to travel further by car, the distances between destinations grew further apart. The densities of cities spread out into suburban developments. Apart from creating barren spaces with no social character, suburban sprawl also created another plague – the 'commercial' landscape.

In his book *The Geography of Nowhere*, James Kunstler (1993) refers to this landscape as area between urban and rural life. These in-between spaces became removed from any real sense of place or location. These spaces are characterized by signage, instead of built form. They are designed to be experienced from your personal vehicle, rather than by any means of social interaction.

However, some of the early spaces designed for automobiles were based on

Fig 2.9: Robert Venturi and Denise Scott Brown (Venturi, Izenouer and Brown 1977)

Fig 2.10: A critique of the Las Vegas Strip by Robert Venturi (Venturi, Izenouer and Brown 1977)

social interaction and convergence. The drive-in movie theatre is an ideal example; it brought people together in one space and provided entertainment. Nevertheless, the idea of not experiencing one's surroundings and the confinement to a vehicle subsequently spilled over into everyday life.

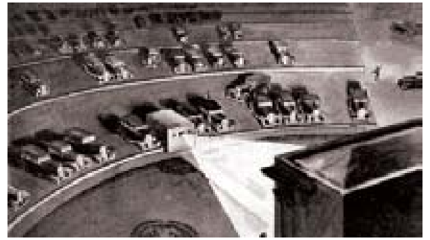


Fig 2.11: The world's first drive-in theatre, New Jersey, 1933 (Modern Mechanix [sa])

After the automobile became a daily commodity, the subject of car spaces infiltrated architecture in the form of parking garages. The necessity to 'store' or 'house' the car when not in use gave birth to a whole new building typology.

Garages, or car parks, quickly became an important addition to the urban structure. The ever-growing influx of automobiles into the city was now accommodated for by garages. But, this only solved the problem of car dominated cities to a certain degree.

Architecture, in many cases, has been reduced to an emotionless concrete box, an empty asphalt lot or oversized signage – all designed to be recognizable to the travelling motorist.

American architect, Robert Law Weed (1948), designed a parking garage in Miami, which had no façade at all. It consisted of no windows, walls or any decorative details – the parking garage as a building typology was born and has remained until today (Henley, 2007: 12).

Robert Law Weed's design stood disjointed within its context; only one function was provided by the building – the store of automobiles.

The quest for solving functional issues above other concerns has resulted in architecture that is impersonal and inhospitable. Even so, in recent years, architects have started to address these hybrid structures (combination of parking garages with other programs) in positive ways.

Fig 2.12: Robert Law Weed's parking garage in Miami, 1948 (Christie's 2011)

Fig 2.13: Herzog & de Meuron's parking garage in Miami, 2010 (Lincoln 2011)

Fig 2.14: Modern Car garage design (All Doing 2010)

Louis Kahn completed a number of studies (1947-1962) on traffic and different ways to incorporate the car into the city. One of his proposals was for a hub/node where automobiles could be parked, which leaves the city core dominated by pedestrians (Henley, 2007: 12).

The proposed hub has the potential to accommodate many automobiles entering the city on a daily basis. Subsequently, Kahn realized that these spaces of convergence can become hubs of public and social activity at the same time. He created a much more vibrant space by incorporating housing, commerce and office space into the project. Unfortunately, his schemes were never realized.

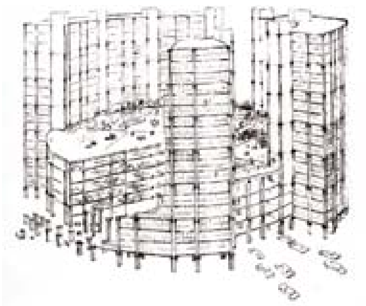


Fig 2.15: Louis Kahn's drawing for a vehicle hub in Philadelphia (Henley 2007)

An example of architecture accepting the automobile into the city and looking for ways to achieve co-existence is the Marina City Complex, Chicago, by Bertrand Goldberg. The project was a reaction against urban sprawling in Chicago, with many people moving to the developing suburbs. Goldberg addressed the negative effects of urban sprawl in the city which led to neglected urban spaces by a population of commuters.

The project, housed within five buildings, consisting of offices, shops, a theatre, a marina, housing and a multi-storey parking garage, drew people back to the urban centre. According to Simon Henley (2007) this "...reversed the American ideal of space, making the idea of proximity central to building a community."

Fig 2.16: Bertrand Goldberd's Marina City in Chicago. 1964 (Architect Gallery 2010)

2.3 Car Versus Building

The consideration of the relationship between architecture and automobiles has been an ongoing process since the start of automotive production. The inextricable role automobiles played in architectural history, through cultural, social and artistic interweaving during the past century, has lead to architecture's contention with this most ubiquitous of machines.

At the time of *Vers une* Architecture's publication in 1923, there was already a growing inequality between automobiles and architecture. The system featured in automobiles drove the car, provided climatic comfort for the driver and shelter against the elements. Such an object can be referred to as 'a machine to live in'.

Architecture at the same time was rather primitive, with systems that had progressed very little from the turn of the century. Even a large building for a well-known company in 1900 might have only had two systems: heat and light provided by fireplaces, and storm water piping to convey water from the building to the site (Kieran and Timberlake, 2004: 126). Architecture, as a machine to live in, was only a distant dream.

However, architecture has developed over the past century to finally become such a machine, with as much as fifty percent of the cost embedded in systems, not structure, wall or roof (Kieran and Timberlake, 2004: 126).

The automotive industry has determined that when expanding the supply chain into sub-tiers, improvement on quality and reduced costs can be obtained. Instead of having different parts arrive at the final stage of assembly, the tiers are gradually built up by a collection of parts before being supplied to the manufacturer. Subsequently, the different parts of a building and the manner in which it is put together followed the same path.

Fig 2.17: 1931 Ford Coupé (James Morrison 1931)

vs.

Fig 2.18: 1931 Construction of The Empire State Building (Acid Cow 2010)

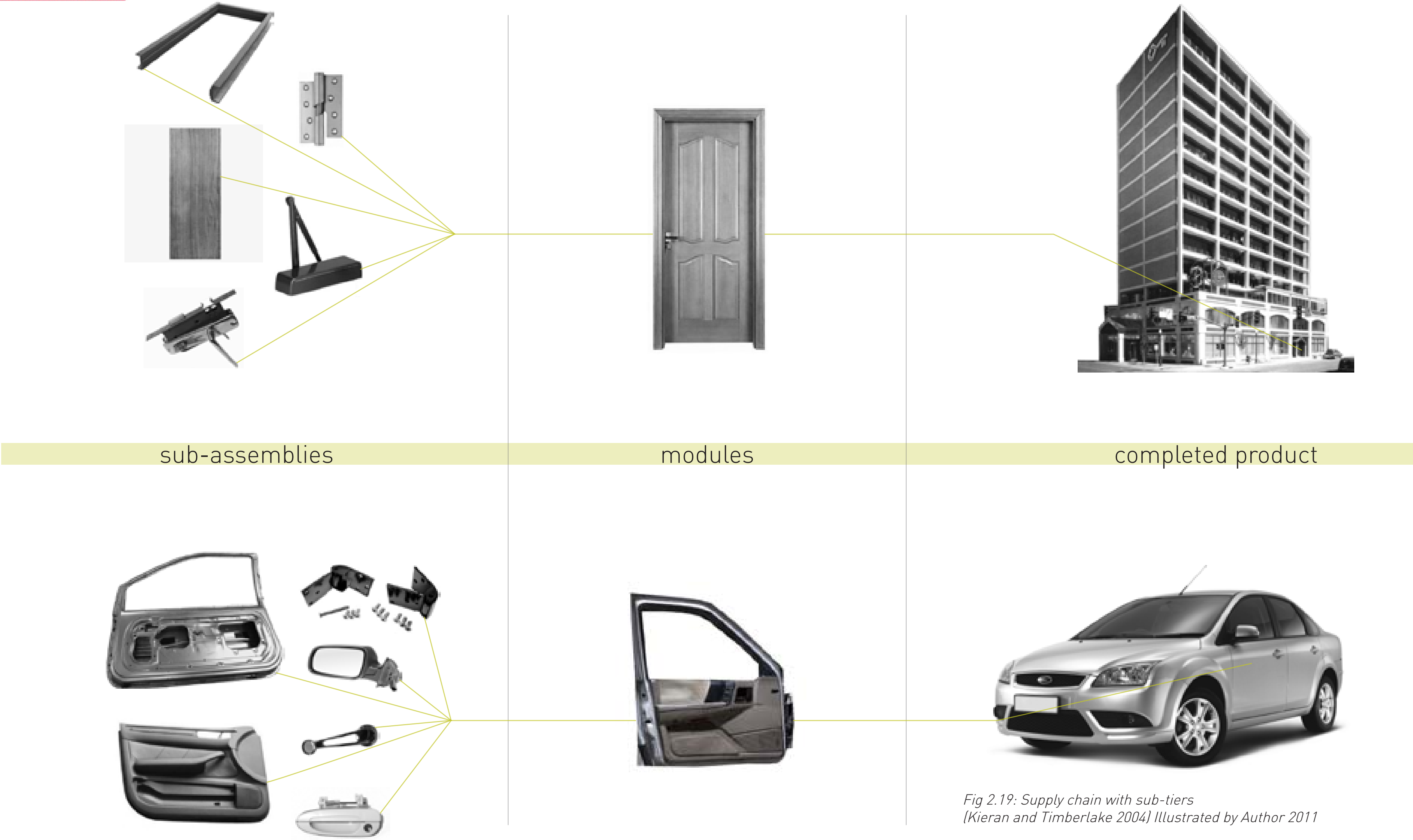


Fig 2.19: Supply chain with sub-tiers (Kieran and Timberlake 2004) Illustrated by Author 2011

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2.4 Waste Equals Food

This approach aims to inform the environmental sustainability of the research project, looking at how a cyclical process of treating waste as food for the future, can be implemented.

Braungart and McDonough (2009) use nature as a metaphor to illustrate how a world of eco-efficiency can be designed:

In order for one pit to fall on the ground, take root and grow, a cherry tree creates thousands of blossoms and fruit for birds, animals and humans. No one will complain about the ground underneath a cherry tree littered with pink blossoms and cherries – The tree creates copious blossoms and fruit without depleting its environment. Once on the ground, the materials break down and decompose into nutrients that are a source for microorganisms, insects, plants, animals and soil. Even though the cherry tree produces more of its products than it needs for its own success in an ecosystem, this abundance has evolved to serve a wide range of purposes. In fact, the tree's fecundity nourishes just about everything around it.

What is eco-efficiency? In essence, the term means, to do more with less, a principle which comes from the early days of industrialization. Henry Ford implemented an early form of eco-efficiency when he used the crates in which Model-A trucks were shipped in as the vehicle's floorboards when it reached its destination (Braungart and McDonough, 2009: 51).

The design of artificial ecosystems has the ability to consume surrounding buildings, neighbourhoods and cities as a whole, to enrich the environment. Industrial areas should be designed to be effective, safe and intelligent and have a positive contribution to the community. In this way, industry does not need to be fenced off from other human activity. According to Braungart and McDonough (2009), this can turn the idea of zoning

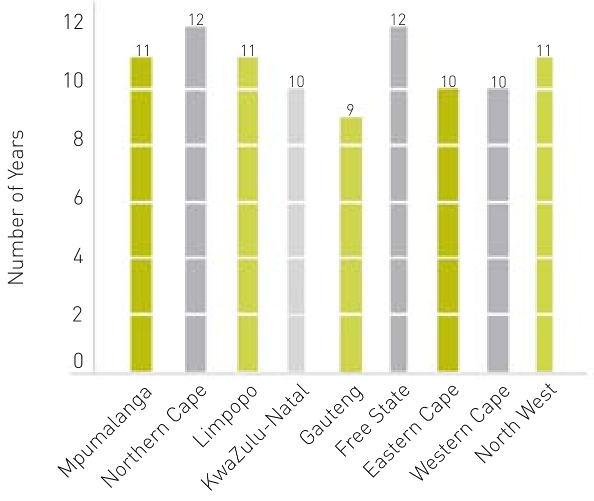


Fig 2.20: Average life-span of vehicles per Province (Statistics South Africa 2010) Illustrated by Author 2011

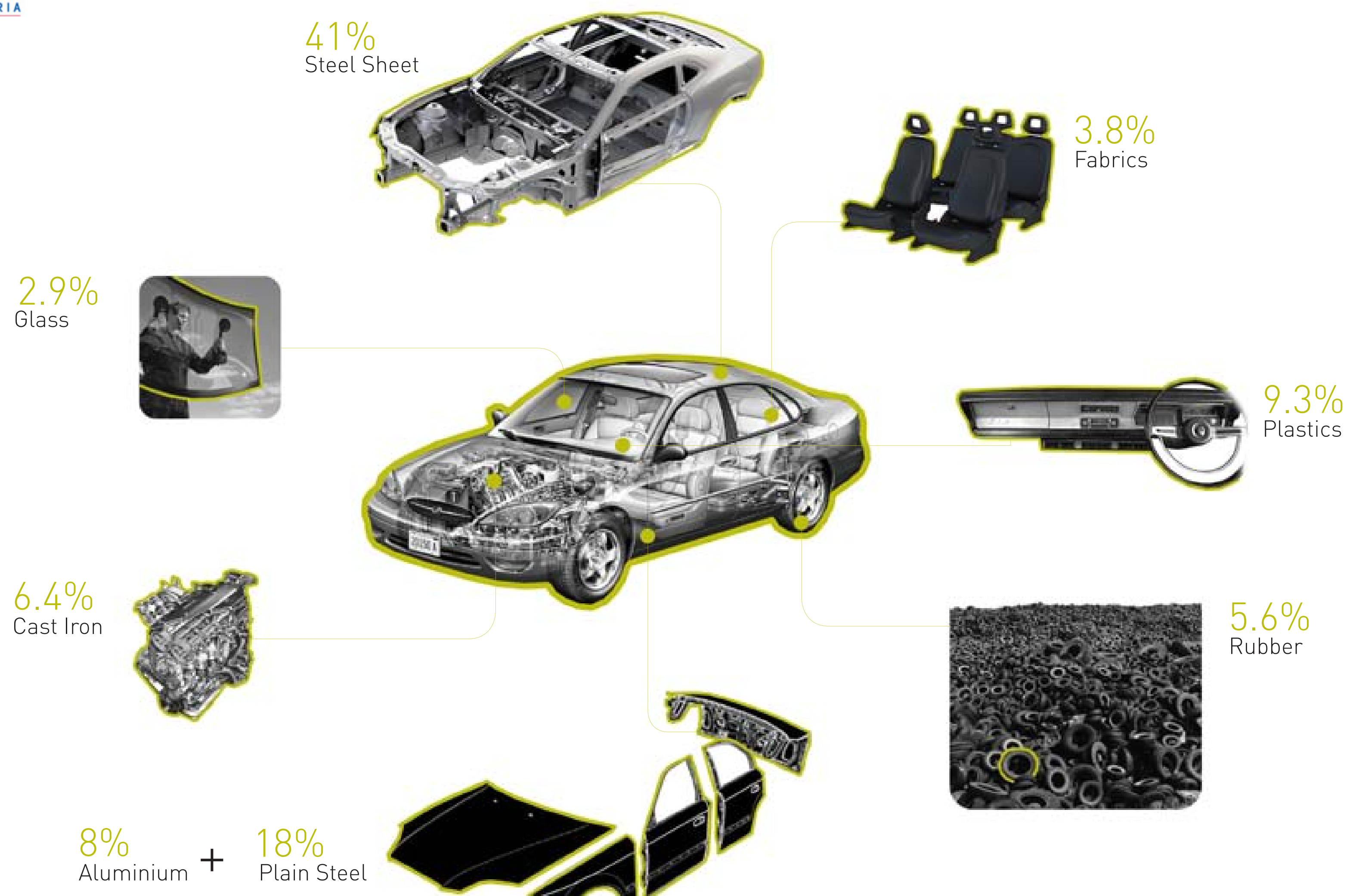


Fig 2.21: Material Composition of a Vehicle (Statistics South Africa 2010) Illustrated by Author 2011

Fig 2.22: Resource Sites in the Pretoria West Precinct
Photo Collage by Author 2011

in cities on its head, enabling residential and commercial sites to co-exist alongside factories with mutual benefit.
The fundamental theme of the Cradle-to-Cradle approach is seeing any type of waste as food. The idea tries to mimic nature, which operates according to a system of metabolisms and nutrients – and which contains no such thing as waste.

The waste humans produce can be divided into two groups: namely biological mass and technical/industrial mass. Biological nutrients are utilized by the biosphere, where the technical nutrients are useful to the 'technosphere', which forms part of industrial processes (Braungart and McDonough, 2009: 92, 93).

To ensure a cyclical process that is efficient, products must be designed as products of service. What this concept means is that a consumer is seen as a patron of service/customer, who will not be paying for a product that is constructed by complex materials which can't be used after the product's current life.

When the customer is done with the product or wants to upgrade to a better model, the manufacturer replaces it by obtaining the old product, breaking it down and using the materials as food for future products. Through this, manufacturers retain ownership and responsibility for the materials they use.

3: Metal Recycling Plant, Dekleva Gregoric Arhitekti 2007
(ArchDaily 2010)

Fig 3.1: Deserted oil pump (Linda L

03 beyond fossil fuels

3.1 Introduction

This chapter studies the unsustainable condition of the present automotive industry, the future thereof and the resources it depends on.

In order to design spaces for automobiles to be transported, disassembled, stored and displayed in different categories of components, the technical issues regarding automotive recycling and waste management must first be understood. The current life cycle of automobiles will be studied and critiqued in order to form a new strategy of sustainable development, correctly positioning the proposed project within this cycle.

The process of automotive disassembly forms the basis of the strategy as well as the programme of the proposed building through the adaptive re-use of materials and parts.

Finally, the relevance of the proposed project and the contribution it can make to the surrounding community, as well as to the greater City of Tshwane, will form the conclusion.
The following aspects of the automotive industry will be analysed:

- Environmental impacts
- Embodied energy
- Life cycle of automobiles
- Disassembly process

Fig 3.2: "Fill it up!" (Foshie 2001)

3.2 Environmental Factors

Today's society assumes that an abundance of oil will be available for future generations and transport systems. The basic infrastructure of communities depends on the reliable supply of affordable oil. However, the growing demand for oil indicates that the days of affordable, ample oil will come to an end (Electrification Coalition 2010).

There are two underlying challenges regarding the state of fossil fuels: the extraction and consumption of oil.

More than 80 million barrels (13.25 billion litres) of oil are consumed around the world per day, with 44.2% used by automobiles in the form of petroleum (U.S. Energy Information Administration, Petroleum Statistics 2010).

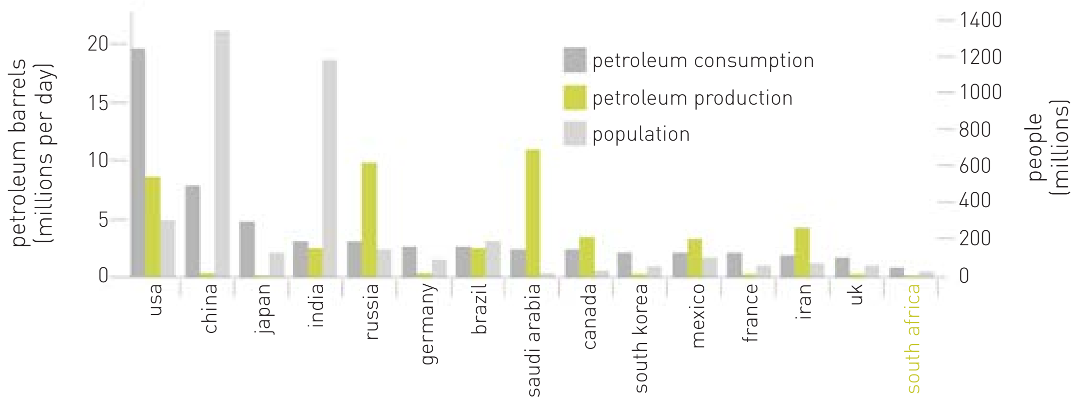
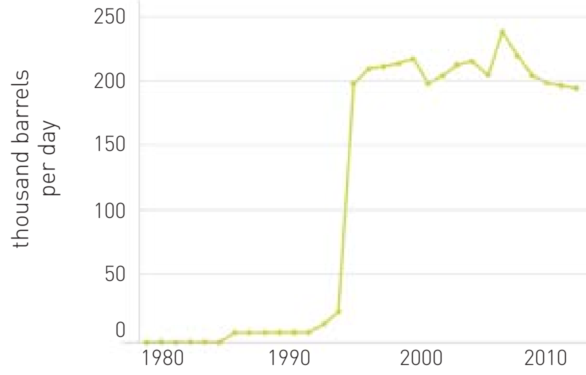
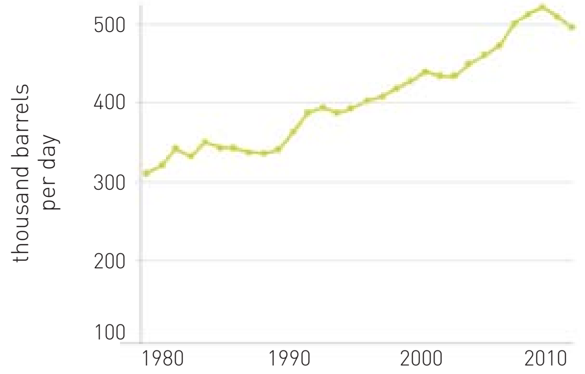


Fig 3.3: (Top) World Map of annual oil consumption per capita (Electrification Coalition 2010)

Fig 3.4: (Bottom) International petroleum consumption, production, and population (Electrification Coalition 2010)

Fig 3.5: Oil rig pump in operation (FAQS 2005)





The widespread use of automobiles has resulted in dangerous environmental impacts. Various toxic emissions (Carbon Dioxide $[CO_2]$, Carbon Monoxide [CO], Nitrous Oxide $[NO_x]$, Volatile Organic Compounds [VOC] and Sulphur Dioxide $[SO_2]$ are released into the air when burning large quantities of oil in the form of petroleum (Institute for Energy Research (IER) 2010).

According to the United States Information Administration (2010), the emission of Carbon Dioxide (CO_2), which is the most influential Greenhouse Gas contributing to global warming, will double by the year 2035. On average an automobile releases approximately 9 tons of CO_2 every year, which adds up to 10% (1.5 billion tons) of total CO_2 emissions annually (National Resources Defence Council 2010).

Fig 3.6: (Top) Total oil produced in South Africa (Statistics South Africa 2010)

Fig 3.7: (Bottom) Total oil consumption in South Africa (Statistics South Africa 2010)

Fig 3.8: Toxic exhaust fumes (Carsala 2009)

Pollution, by means of burnt fossil fuels, is most intensive in large metropolitan areas where high densities of automobile activity take place. The prevailing use of internal combustion engines is one of the sources of major environmental issues we face today.

However, recent studies suggest that the production of oil has reached its peak, making the future of obtaining oil and the reliance on imports more difficult, pushing prices of oil past the point which make personal mobility feasible (Index Universe 2010).

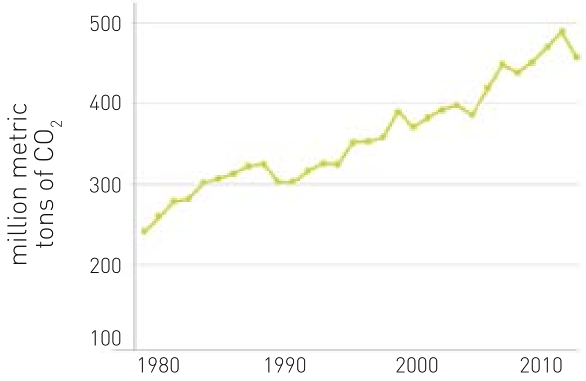


Fig 3.9: Average CO_2 emissions by cars in South Africa (Statistics South Africa 2010)

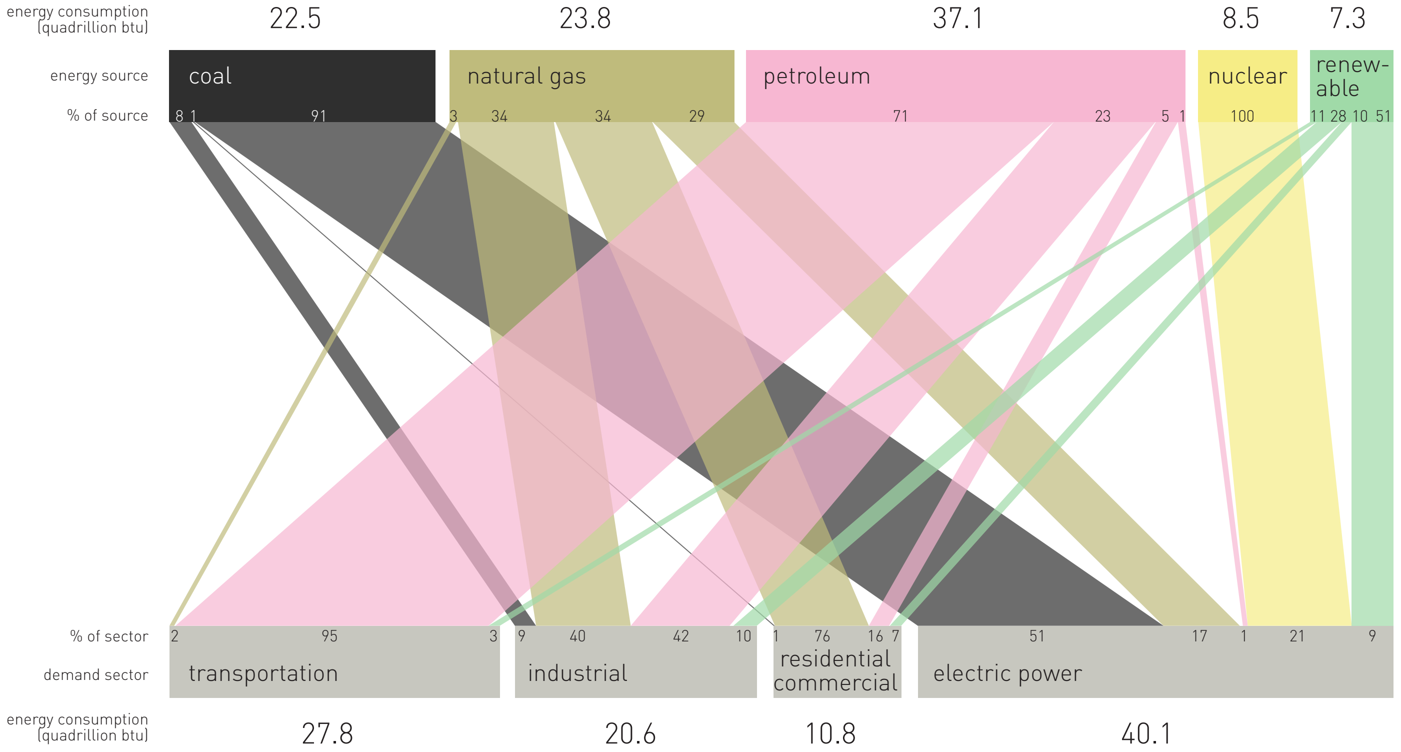


Fig 3.10: Worldwide energy consumption by source and end-use sector (Electrification Coalition 2010)

3.3 Embodied Energy

The term 'embodied energy' refers to the amount of energy (expressed in Joules) used in the entire life cycle of a product. The life cycle consists of raw material extraction, transport, manufacture, assembly, installation, disassembly, decomposition and recycling (Grant and Pearce, 2007: 435).

Therefore, a relationship forms between the embodied energy and the type/number of processing steps. For example, if a material's production consists of fewer and simpler processing steps, the embodied energy will be less - a material's embodied energy is often reflected in its price (Sustainable Design & Technology 2004).

Embodied energy units are generally measured in MJ/Kg, which is the number of megajoules of energy needed to produce a kilogram of product, providing a good indication of the sum total of the necessary energy for an entire product life cycle (WattzOn 2009).

There are a number of underlying problems regarding automobile manufacture. Besides the fact that automobiles are constructed using a wide spectrum of materials with high embodied energies, the production of materials occurs at various plants around the world. In the end of an automobile's production process, all the different components must converge at a single geographical location for assembly.

Recent studies show that the Toyota Prius, the world's most popular environmentally friendly passenger car, is not as sustainable as Toyota claims it is (WattzOn 2009).

Nickel, for example, has a high embodied energy (164 MJ/Kg) and is used in the batteries of a Prius to power its electric (hybrid) motors. The nickel in this case suffers a higher embodied energy due to transportation between three continents to reach the assembly format (Hammond and Jones, 2008: 12).

Fig 3.11: Toyota Prius (Motor Trend 2009)

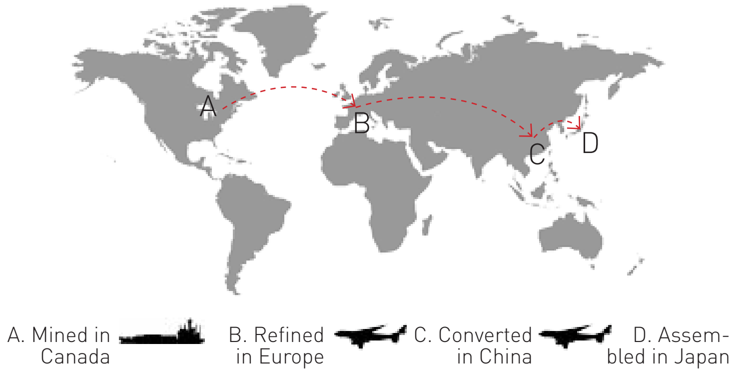
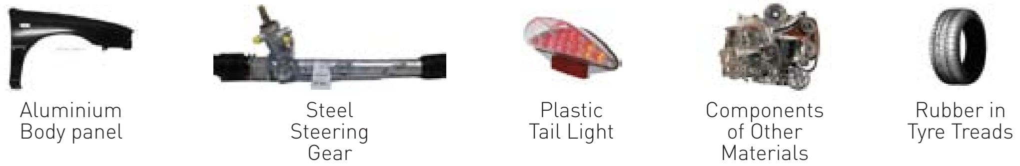


Fig 3.12: Toyota Prius Nickel production (Motor Trend 2009)

Material	Joule	Weight	Embodied Energy
Aluminium	49 897.812 MJ	269.82 Kg	184.9 MJ/Kg
Steel	32 089.087 MJ	734.51 Kg	43.6 MJ/Kg
Plastic	25 483.000 MJ	251.83 Kg	101.1 MJ/Kg
Other	11 992.000 MJ	122.92 Kg	97.5 MJ/Kg
Rubber	10 249.562 MJ	115.56 Kg	88.6 MJ/Kg
Manufacturing	35 500.000 MJ	-	-
Transportation	4 511.240 MJ	(12 038 Km)	-
Total	169 772.701 MJ	1494.64 Kg	515.7 MJ/Kg

Fig 3.13: Embodied energy of a automobile's main materials (Motor Trend 2009)

Fig 3.14: Automobile components made from different materials, Image Collage by Author 2011



Advances in technology, performance, safety and style have resulted in the use of materials with a higher embodied energy. It is estimated that the energy needed to manufacture an automobile is equivalent to 15% of the total fuel used during a 20 year life cycle (Green Choices 2010).

The purpose of automotive recycling through disassembly can lead to an automotive industry which use the minimum required spectrum of materials, materials with low embodied energy and automobiles that are designed specifically for this end result.

Fig 3.15: Components of a Toyota Prius (Motor Trend 2009)

3.4 Life Cycle of Automobiles

Similar to any other product that is used and/or consumed on a daily basis, automobiles can be seen as products with an expiry date. Whether the expiry is reached through mechanical failure or an accident, automobiles have a limited life span (average of 9 years in the Gauteng Province) (Statistics South Africa 2010).

All stages of a product's life cycle require evaluation in order to determine the environmental attributes of the product. The product's production, use and disposal must be taken into account.

Currently, the automotive industry is geared to produce automobiles on a monumental scale, concentrating on making the final product available to the user – an "Open Life Cycle".

A new strategy of a "Closed Life Cycle" will be formed to substantiate the proposed building programme and to address the sustainability of automobiles.

Fig 3.16: Daily consumption of milk (Drink Milk Campaign 2002)

Fig 3.17: Best before date of a vehicle (Junkmail 2010) Edited by Author 2011

3.4.1 Open Life Cycle:

Characterised by the disposal of products (automobiles) after use, this cycle is generally adopted by the automotive industry. The focus here is to produce a product; preservation of resources by saving energy and materials are not a priority. The outcome is poor waste management of end-of-life automobiles (ELV's).

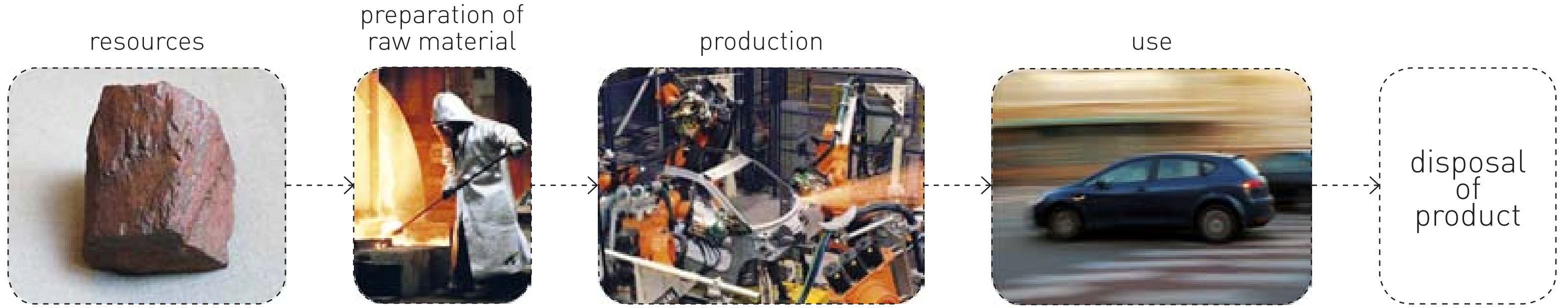


Fig 3.18: Open life Cycle of automobiles (Joachim Schmidt 2011), Illustrated by Author 2011

3.4.2 Closed Life Cycle:

Instead of focusing on the product, this cycle concentrates on how automobiles can be recovered after their service life – creating a system where waste equals food for future use. Materials can be recycled and reintroduced in the production of new parts. Operational parts obtained from recovered automobiles can be re-used as spare parts (without reworking/repair of the parts) or as exchange parts (reworked and repaired parts/components by different industrial methods for re-application).

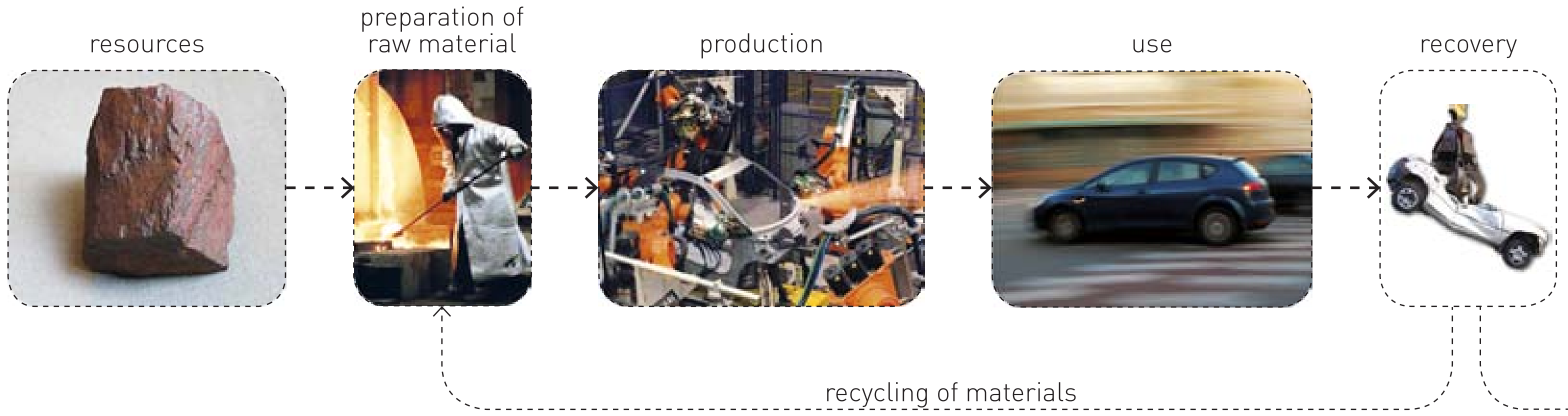


Fig 3.19: Closed life Cycle of automobiles (Joachim Schmidt 2011), Illustrated by Author 2011

The proposed building programme is specifically positioned in the life cycle and use of cars to ensure reuse and recycling of materials and parts.

Fig 3.20: Positioning the proposed project, Illustrated by Author 2011

3.5 Disassembly Process

The term 'disassembly' can be described as the process of systematic removal of desirable individual parts and components from an assembly, while ensuring that there is no impairment of the parts due to the process (Brennan, Gupta & Taleb: 2003: 59).

A substantial percentage of total manufacturing activity worldwide consists of discrete parts manufacturing. As the term suggests, discrete parts manufacturing includes the production of distinct end products such as automobiles, computer systems, weapons systems and consumer appliances.

The initial manufacturing systems, which dealt with assemblies, consisted of one way flows and were driven by material requirements (as discussed in 'The Life cycle of Automobiles' p. 50). New forces, such as increased awareness of the condition of the environment, have led to new challenges, such as the reappraisal of the traditional manufacturing paradigm.

According to Brennan et al (2003) forward-thinking companies are anticipating opportunities arising from this environmental change. Therefore, item segregation (the separation of a part or group of parts from an assembled component by adopting a reverse assembly process) is currently being facilitated in the form of disassembly plants and the introduction of designs which specifically regard disassembly processes. Once disassembled, components can be reused, recycled or stored for future use.

Leaders amongst car manufacturers regarding disassembly research and design are BMW, Volkswagen and Audi. BMW has invested in a disassembly plant where five automobiles are dismantled every day. Problems arising from disassembly are then studied to improve the design automobiles (Nussbaum and Templeman, 2007: 3).

Fig 3.21: Crushed Cars (Lee Jordan 2007)

Automotive manufacturers are confronted with two main sets of issues when addressing the disassembly of a car, namely technical and operational issues (Brennan, Gupta & Taleb: 2003: 59-62).

3.5.1 Technical:

The most significant technical challenge is to design a product with 'easy' assembly properties as well as 'easy' disassembly properties. Traditionally, machines were designed only with the assembly in mind, but designers should start thinking about disassembly and recycling of parts. Certain design criteria have been identified regarding the technical aspects of disassembly:

- Ease of separation: Design for easy separation, handling and cleaning

- Reduced energy use: The design must aim to reduce the embodied energy

- Intelligent fasteners: Existing screws, glues and welds should be replaced by new two-way snap-fit fasteners

- Reduced number of material types: The spectrum of different materials must be minimised and changed to accommodate recycling processes

- Component/Part consolidation: Reduced total number of operational components through consolidation allows for easier sorting

Fig 3.22: Completely disassembled automobile (Team BHP 2003)

3.5.2 Operational:

In order for a disassembly process to work, the following major operational guidelines must be investigated:

- Accumulation: The treatment of materials and components after disassembly

- Location: The transportation cost of materials to different facilities (recycling, storage and market/retail area) is the main issue regarding location

- Resource availability: A constant supply of resources for the plant to operate

- Networking systems: Operations must be planned from a larger perspective to accommodate different role-players, for example manufacturing plants, resource sites, scrap yards and recycling facilities.

The disassembly scenario has the following economic and environmental advantages (Brooke: 2000: 71):

3.5.3 Reduction in lead time:

Products might have to be disassembled in order to recover some of their subassemblies or component parts which are scarce or in urgent demand by other products and customers. In such an event, substantial lead time (time interval between the initiation and the completion of a production process) reduction can be achieved with the procurement of disassembled components.

3.5.4 Forced disassembly:

As in the case of automotive disassembly, plants are forced by recycling regulations to disassemble automobiles before discarding the materials and components, even if the parts are rendered useless.

3.5.5 Discontinued products:

In some instances, for example a suddenly discontinued product line, this can lead to excess inventory of undesirable assemblies. Disassembly scheduling can be harnessed to retrieve valuable components used in other products which are still being produced. The remainder of the components and materials can be recycled, sold or stored for future use.

The proposed vehicle disassembly plant focuses on the recovery of subassemblies and components of ELV's found in Pretoria West. Thus, the building programme will adapt the reduction in lead time strategy by making components available that are scarce or in urgent demand.

Due to the fact that recycling and safety regulations must be adhered to, the forced disassembly strategy forms part of the project when dealing with ELV's which are recycled.

Fig 3.23: Car Recycling Systems, Holland (Joachim Schmidt 2011)

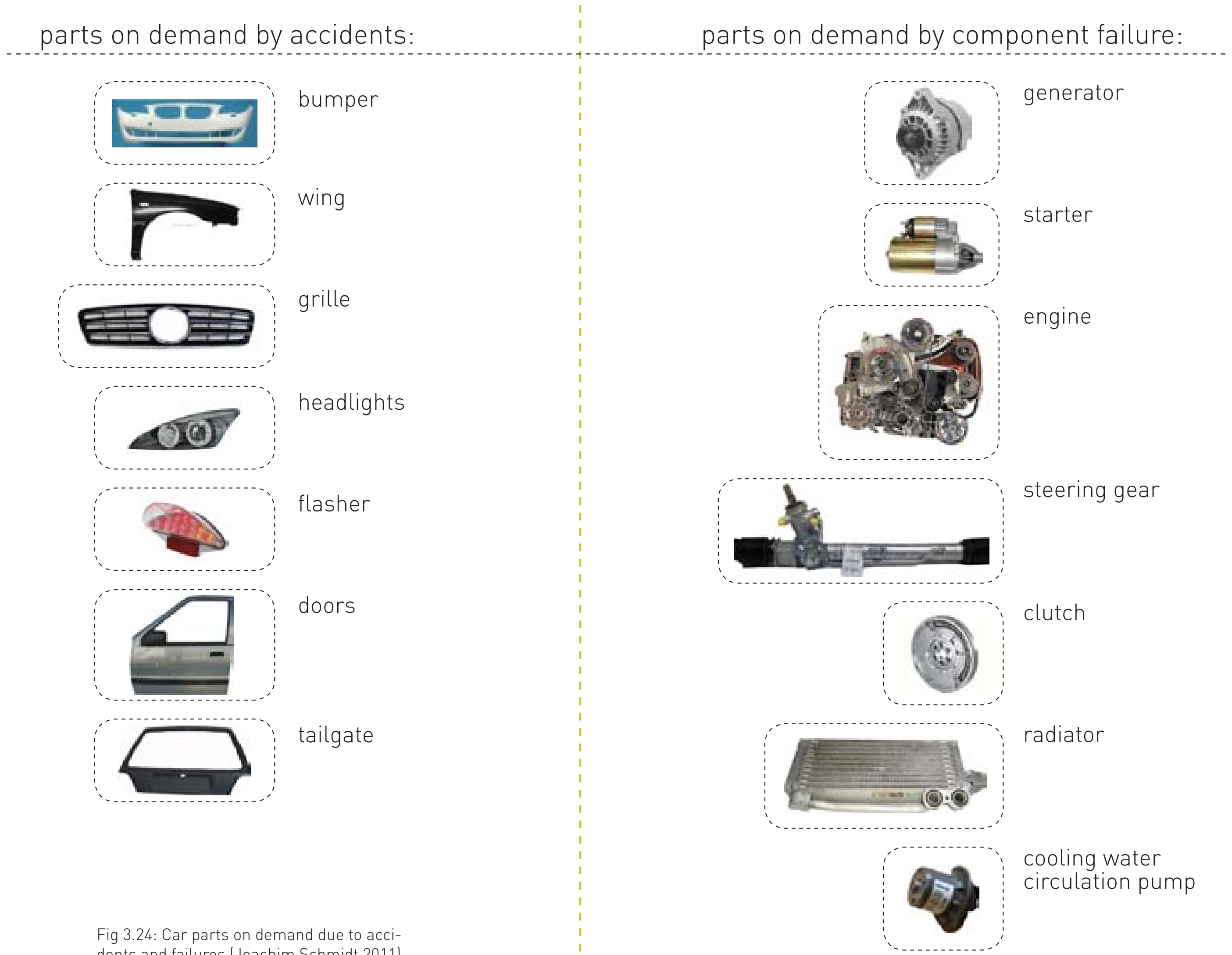


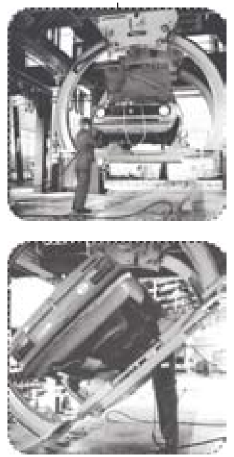
Fig 3.24: Car parts on demand due to accidents and failures (Joachim Schmidt 2011)

Fig 3.25: Prescribed disassembly process, Joachim Schmidt 2011, Illustrated by Author 2011

prescribed steps of the disassembly process

storage of end-of-life vehicles (ELV's)

Vehicles mounted on 'C-Arm', enabling workers to manipulate vehicles in any position for better ergonomics.



1

air bags
seat belt
tensioners

Neutralization of explosive components: Air bags and seat belt tensioners are disassembled in an explosion control chamber by specially trained staff in order to adhere to safety regulations.

2

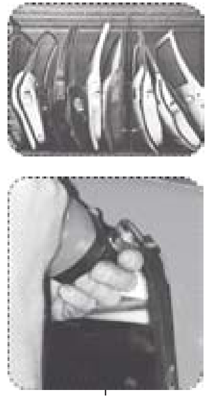
batteries
tyres

Standard specification for tyre and battery removal is recommended.

3

oil
petrol/diesel
brake fluid
anti-freeze

Removal of 20-30 litres of liquids:
Fuel: Tank is bored into with a drill containing a hole in the centre where the fuel is pumped through. Oil: Drained through provided plugs by free fall.



4

glass
bumpers
doors
suspension

Bumpers, doors and suspension are generally dismantled by standard tools found in automotive workshops.
Glass: The adhesive bond must be dissolved by induced heating or cut by a hydraulic/electric knife in order to remove the glass panel.

5

seats
upholstery
plastics

The interior components are disassembled with standard tools found in automotive workshops.

6

engine
catalytic-converter
transmission

Engines and transmission systems are generally dismantled by standard tools found in automotive workshops, additional systems to lift and move heavy components are essential.

7

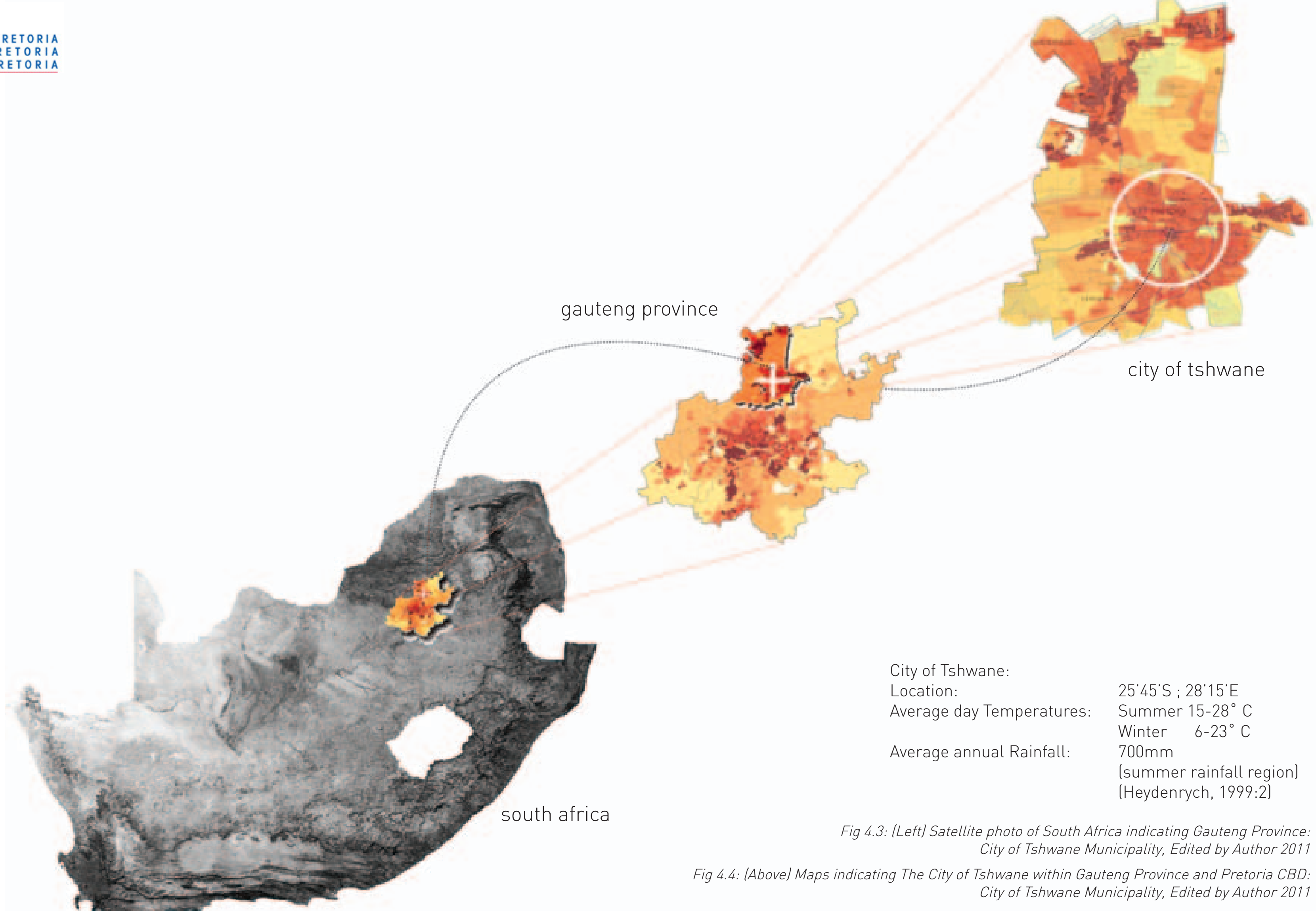
compression of body

After the disassembly process the empty shell of the car is compressed by a hydraulic compressor, improving the ease of transport to the shredder plant.

Fig 4.1: Superimposed maps of context, Edited by Author 2011

04 context

Fig 4.2 Typographic World Map
(VladStudio 2010), Edited by Author 2011



City of Tshwane:	
Location:	25˚45'S ; 28˚15'E
Average day Temperatures:	Summer 15-28˚ C
	Winter 6-23˚ C
Average annual Rainfall:	700mm
	(summer rainfall region)
	(Heydenrych, 1999:2)

Fig 4.3: (Left) Satellite photo of South Africa indicating Gauteng Province:
City of Tshwane Municipality, Edited by Author 2011

Fig 4.4: (Above) Maps indicating The City of Tshwane within Gauteng Province and Pretoria CBD:
City of Tshwane Municipality, Edited by Author 2011

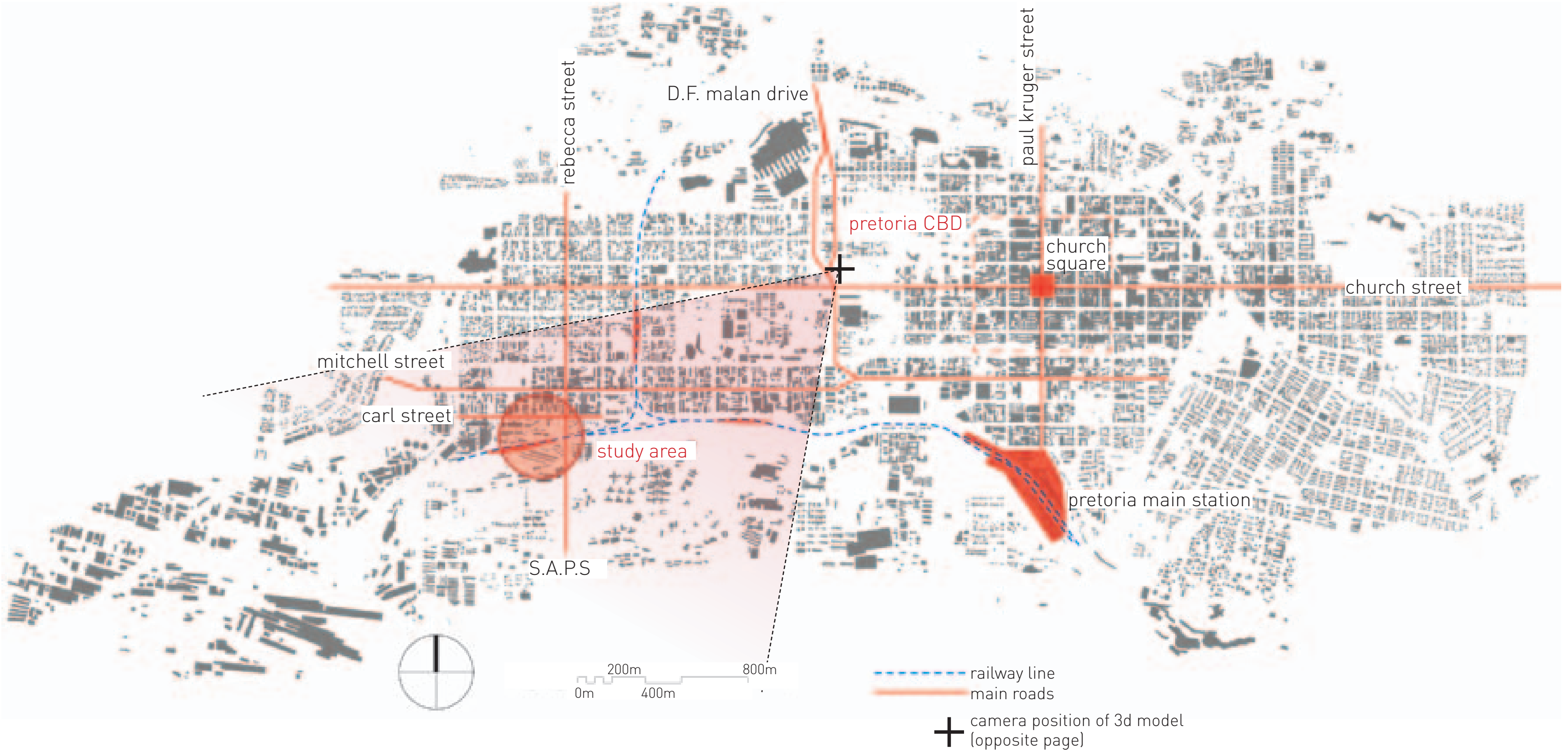


Fig 4.5: Proposed study area in context of Pretoria CBD: City of Tshwane Municipality, Edited by Author 2011

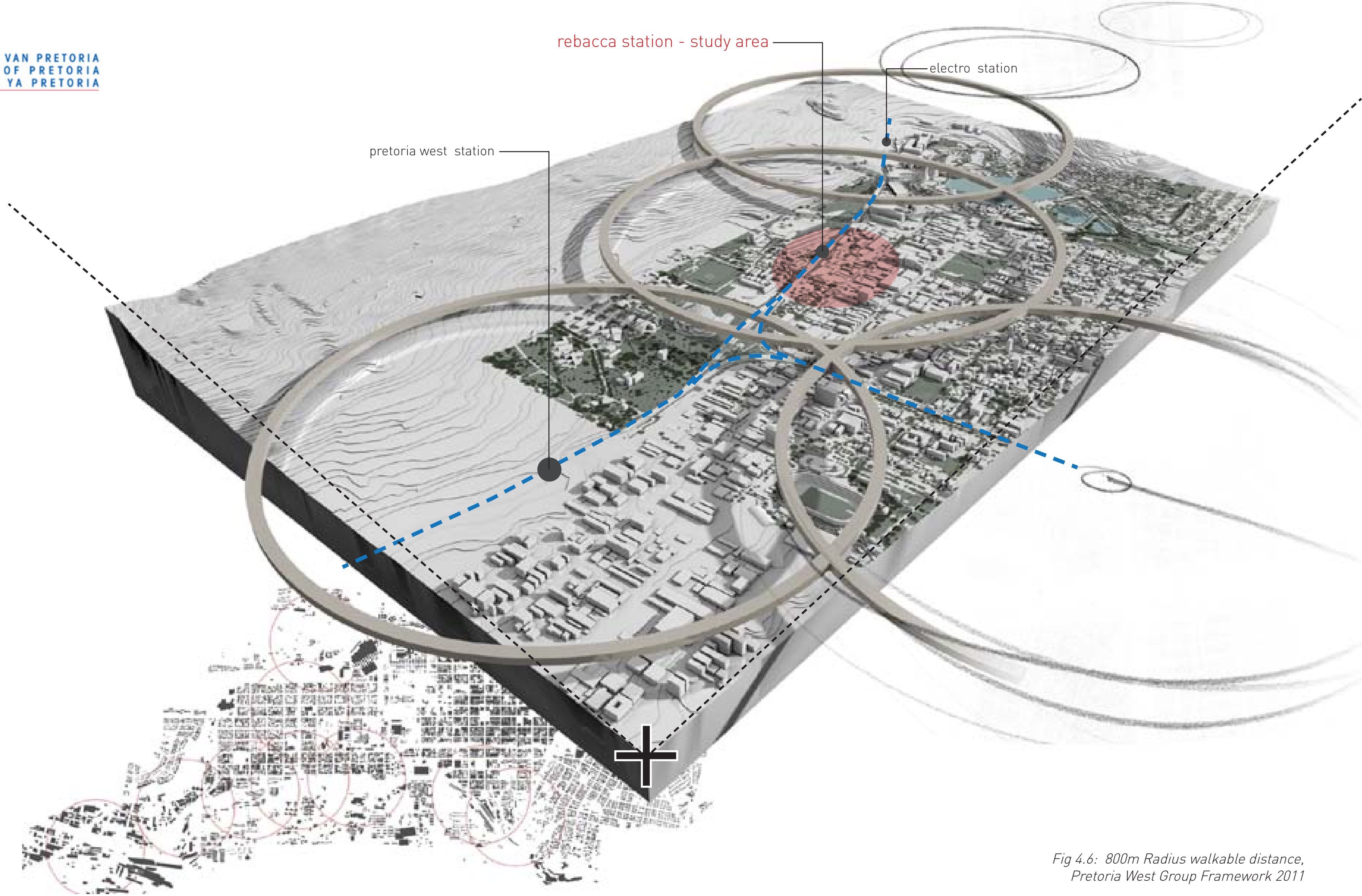


Fig 4.6: 800m Radius walkable distance, Pretoria West Group Framework 2011

4.1 Railway System

Due to the nature of the context and the location of the proposed site, the railway line plays an important role in the proposed framework. According to the *Station Mapping* study (4.2), the majority of labourers who work in the surrounding industrial area do not live in the City of Tshwane and has to travel from settlements outside the city. Transport by train forms a central part of Pretoria West, as it serves the industry, but most of all, it serves the people who makes the industrial area work and grow.

The settlements surrounding the greater Pretoria region have been identified in order to understand their connection to the City of Tshwane. The *Station Mapping* (4.2), indicated that majority of people coming in and out of the precinct on a daily basis live in Soshanguve, Ga rankuwa and Atteridgeville. The railway routes connecting these settlements converge in Pretoria West, Belle Ombre (Marabastad) and Pretoria Main Station. From these points, people disperse into the city for their daily activities, some of them with the help of other forms of public transport.

The pedestrian traffic at certain stations is much higher than other stations. To understand the use of trains in Pretoria, the links between important sites and the different train stations has been researched, exploring why particular stations are used, and by whom.

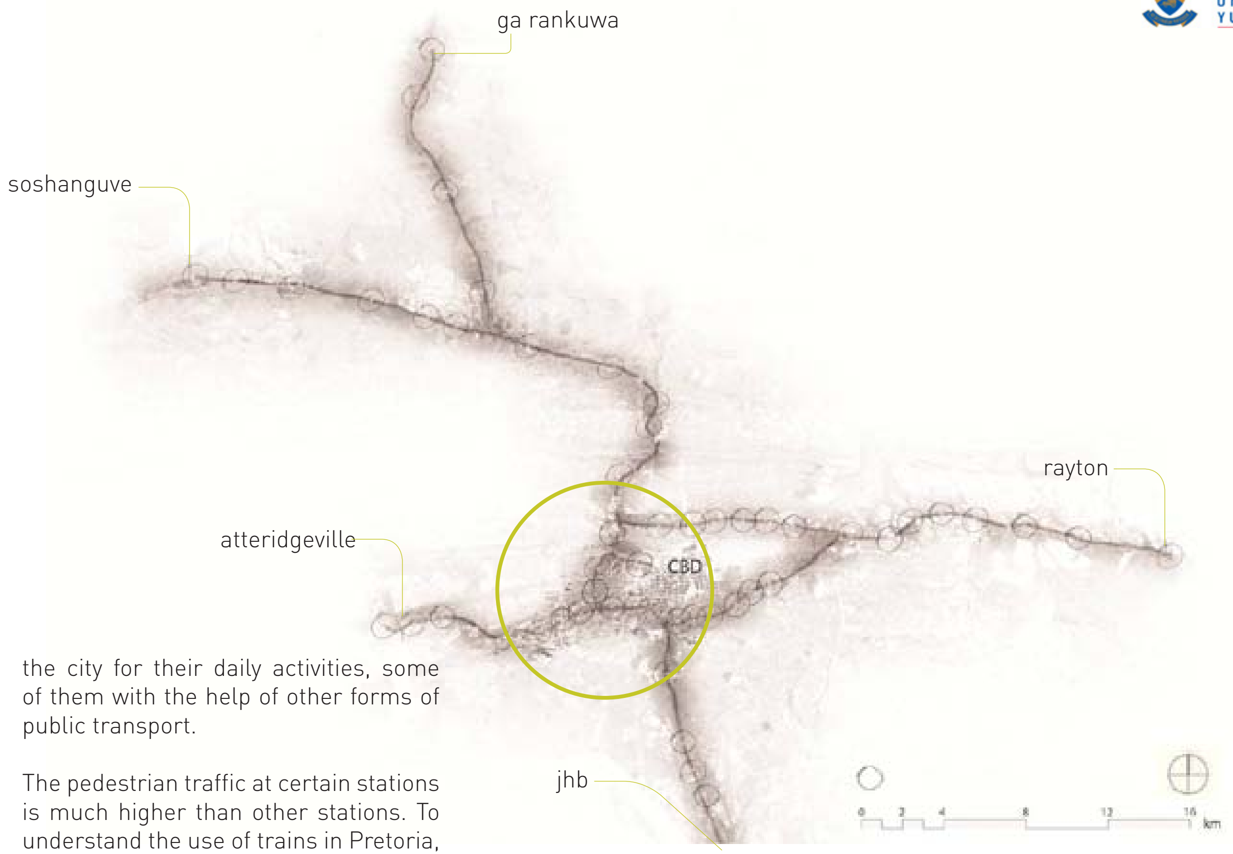


Fig 4.7: Railway line connecting to surrounding settlements, Pretoria West Group Framework 2011

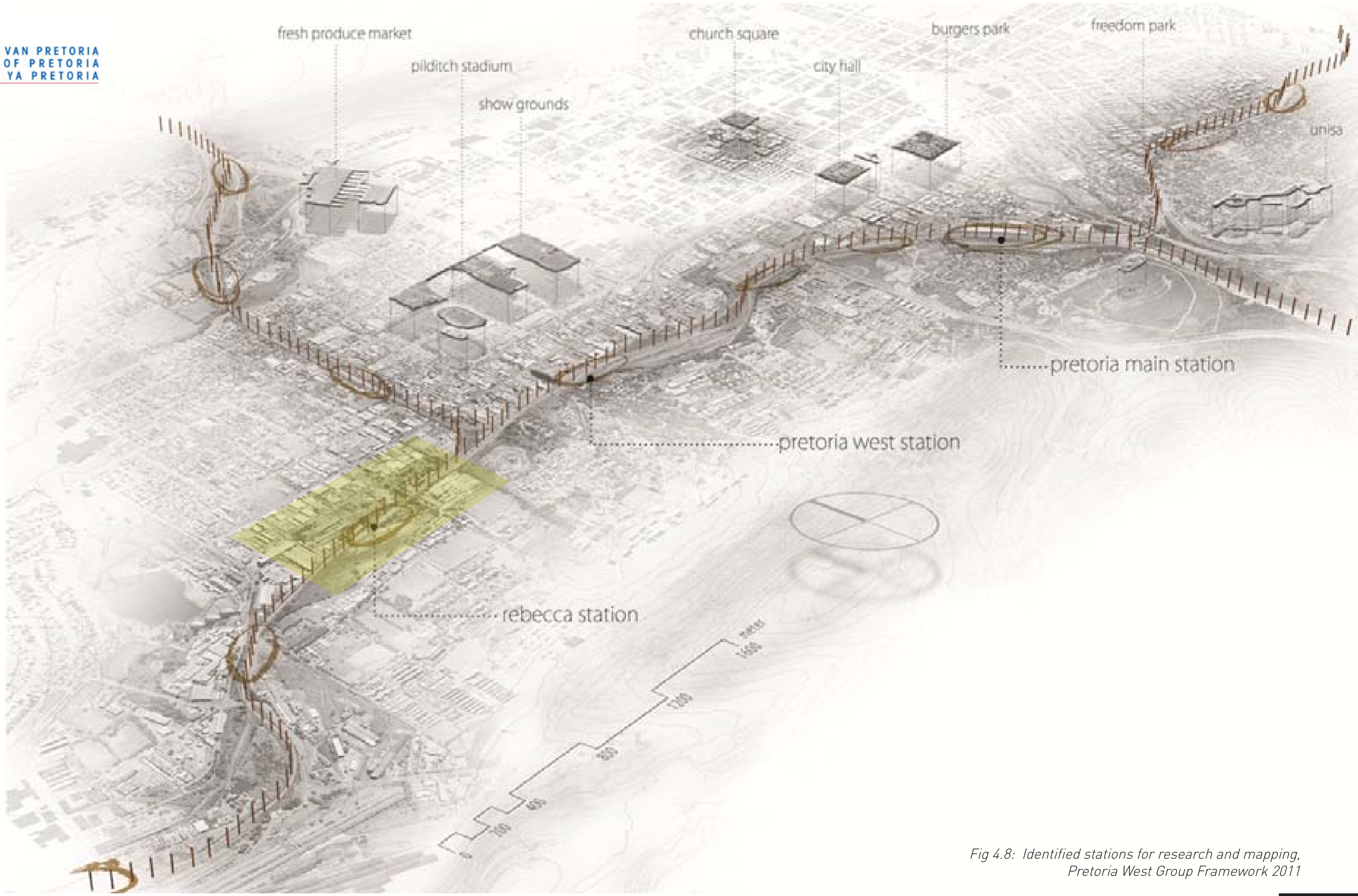
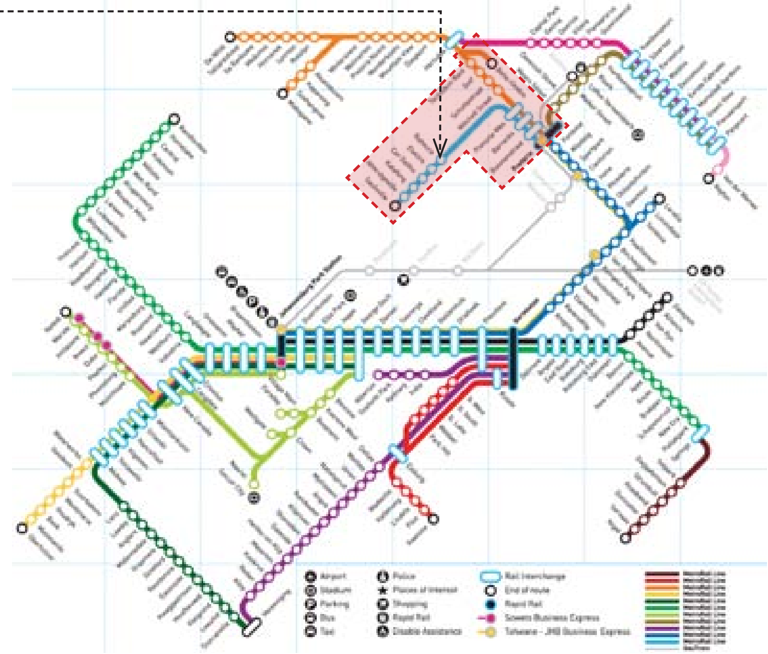


Fig 4.8: Identified stations for research and mapping, Pretoria West Group Framework 2011

4.2 Movement Analysis

Fig 4.9: (Left) View of railway line (Rebecca Station) adjacent to the proposed site, Pretoria West Group Framework 2011

Fig 4.10: (Bottom) Position of Pretoria West railway within the Gauteng railway system, City of Tshwane Municipality, Edited by Author 2011



4.2.1 Influence on Pretoria:

Relevant to the improvement of Pretoria's railway station and the surrounding urban environment, the framework raises the following important points.

• The railway should inform the city's structure to promote transformation of the urban area.

• The metropolitan area is well served by rail infrastructure and although the integration of the different rail systems will be a major challenge, it could in the future form the core of a public transportation system for the entire region.

The Gautrain rapid rail link should also contribute a great deal towards an improved public transport system.

• New large-scale development initiatives should be planned around public transportation facilities, with a strong pedestrian focus.

The dependency on private automobiles should be minimised through the development of a first class public transportation system.

The large volumes of commuters entering and leaving the CBD during the peak periods need to be addressed. The regional public transport arrival points should be linked to a dedicated feeder distribution.

The aim of this is to move people around the inner city in a convenient, safe, and comfortable manner that will reduce the need for private automobile use in line with national policy.

• The existing railway infrastructure of the metropolitan area is well located around the city to fulfil this function in the future.

• Other public transport infrastructure should be integrated with the railway system in order to facilitate and to contribute to the sustainability of the city.

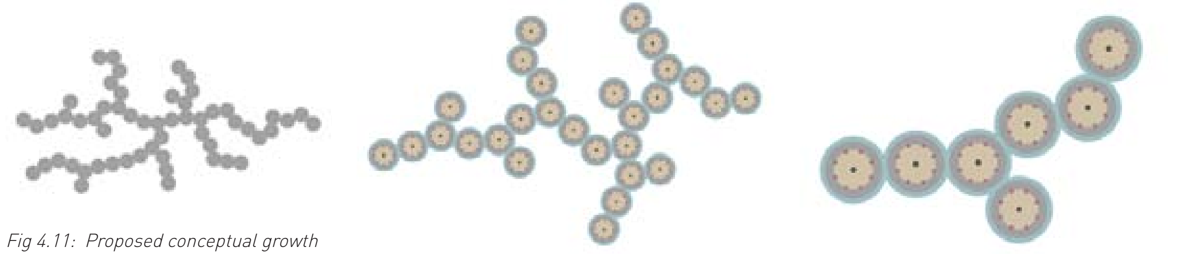


Fig 4.11: Proposed conceptual growth for Pretoria - Ideal for shrinking the hard urban fabric, allowing for green belts on outer perimeters, Pretoria West Group Framework 2011

Application in Pretoria West Precinct:

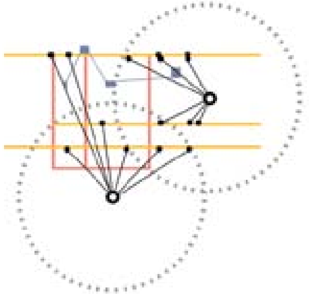


Fig 4.12: Linked fast and medium transport systems, Pretoria West Group Framework 2011

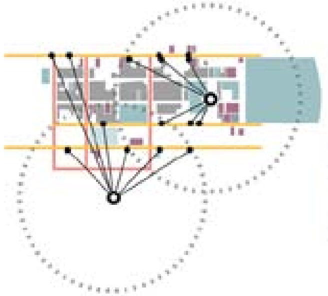


Fig 4.13: Transport and residential buildings, Pretoria West Group Framework 2011

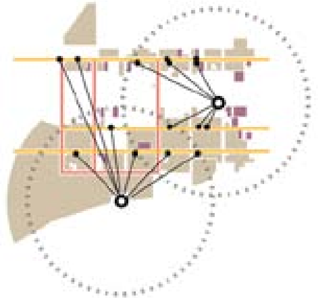


Fig 4.14 Transport and commercial areas highlighting current housing systems, Pretoria West Group Framework 2011

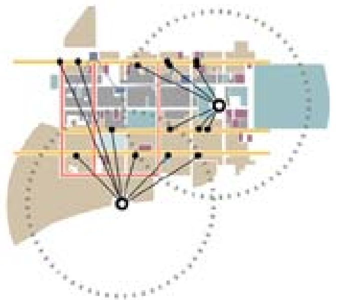


Fig 4.15: Diagram of all links, commercial, recreation and residential, Pretoria West Group Framework 2011

4.2.2 Railway Nodes:

In order to gather information on how the train stations in the City of Tshwane operate, each station has been mapped individually in terms of the number of people who use the station, the average time a commuter spends on the station and the connection the station has with the city.

The two most frequented stations are Pretoria Main Station and the Belle Ombre Station in Marabastad further north of the city's CBD. Both stations serve the greater area of the central four quadrants of Pretoria with important nodes such as: Church Square, Burgers Park, Freedom Park (Salvokop), Pretoria Zoo and the residential area of Marabastad. These stations are well catered for with public toilets, informal trading spaces and other transport possibilities connected to the city.

The Pretoria West Precinct is served by Elektro- (near the Power Station), Rebecca-, Schutte Straat- and Pretoria West Stations. All these stations are busy during peak hours, and are connected with the city by important nodes and have adequate access and sheltering.

The mapping exercise proved the underutilization of Rebecca Station, although it is an important transport node in the precinct.

Fig 4.16: Railway Repair Warehouses, Illustrated by Bertus van Sittert 2010

Fig 4.17: View of Rebecca Station, Photo by Author 2011

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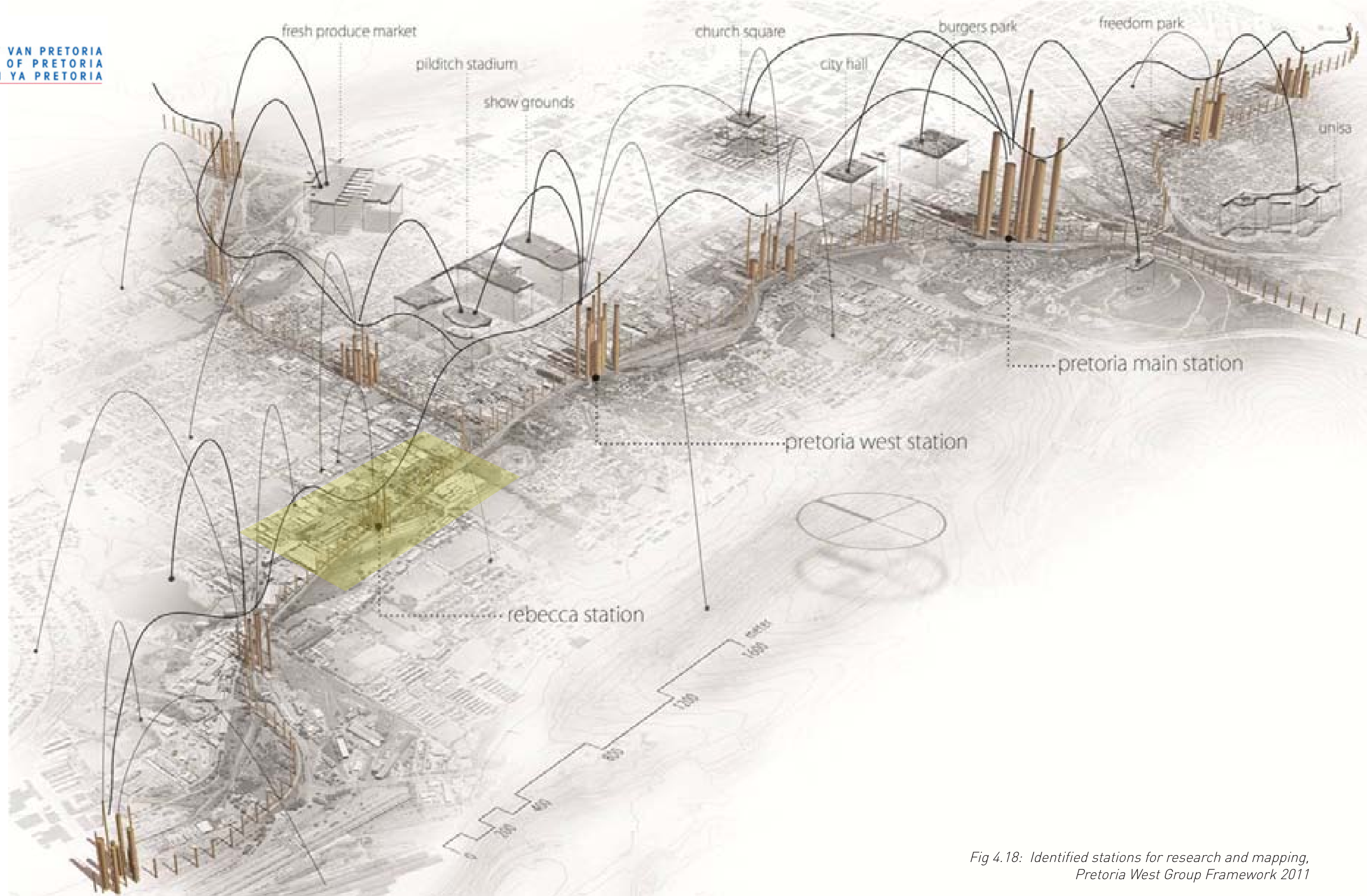


Fig 4.18: Identified stations for research and mapping, Pretoria West Group Framework 2011

4.3 Pretoria West Precinct

4.3.1 Macro Scale:

It is clear that in the existing urban fabric of Pretoria West there is a lack in density compared to the blocks of the city's CBD. The grid layout, which extends from the city centre to the west, results in equal block sizes, but urban density cavities exist.

In order to link all the activities and programs of the city, the lost urban spaces need to be filled to result in a consistent density pattern throughout the city. The intention of the proposed site and various programs is to form a catalyst for urban renewal and future growth (emergence) process.

Pretoria West could be developed into a productive district in the city. The density will not try to compete with that of the inner city blocks, but rather allow for a gradual transition from the city centre to Pretoria West.

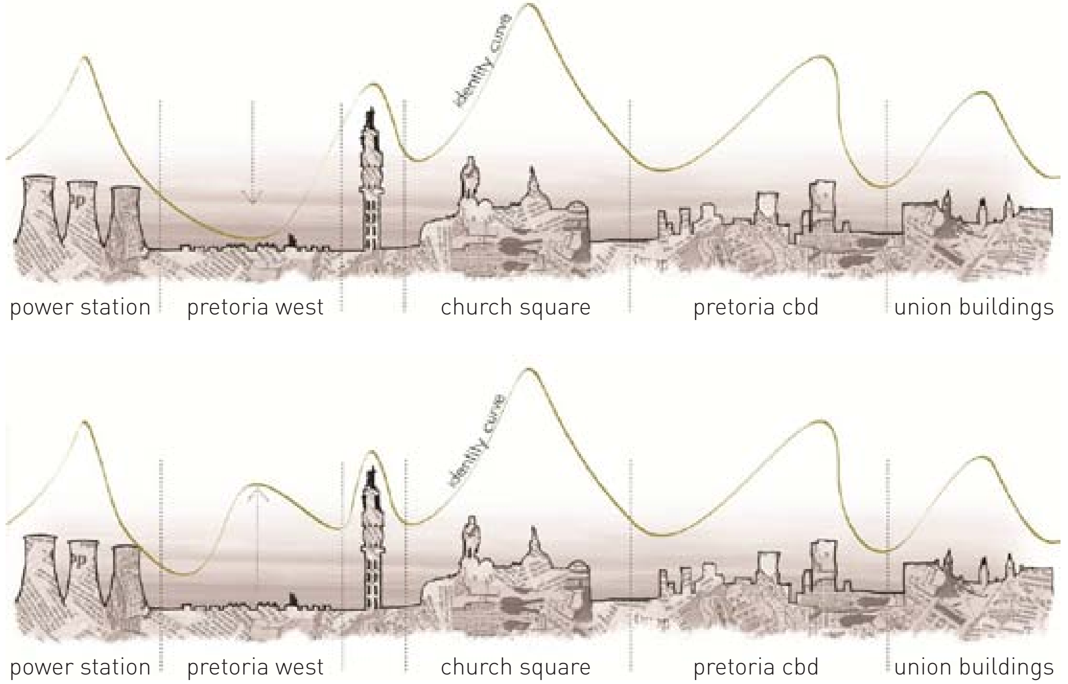
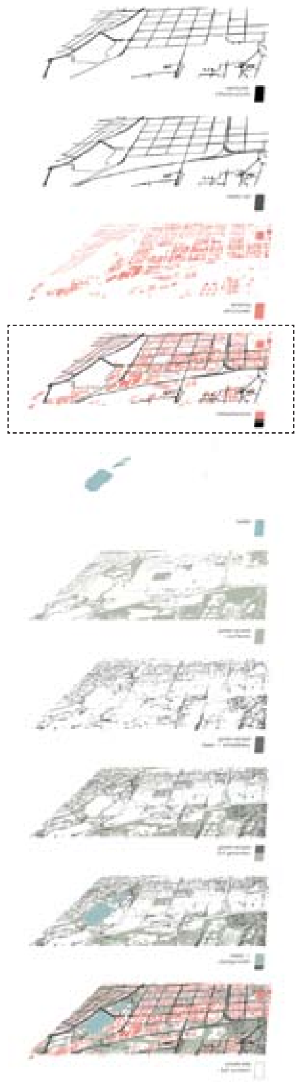


Fig 4.19: Identity Curve of Pretoria West in comparison to the rest of the City, Pretoria West Group Framework 2011

Fig 4.20: View of Pretoria West Industrial in relation to the city's CBD, Photo by Author 2011

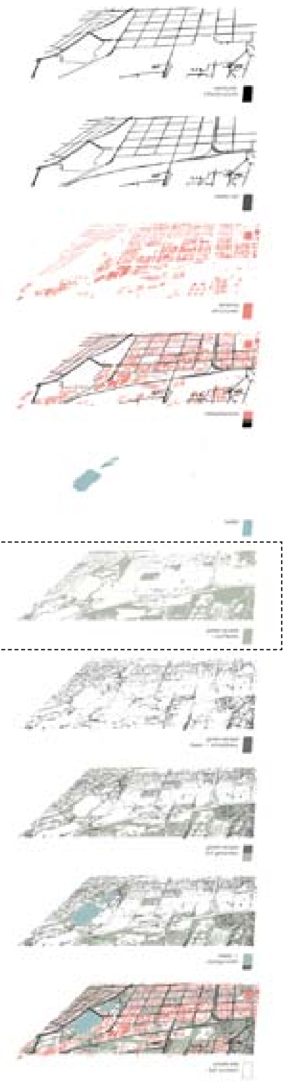


Basic Infrastructure

Rebecca Station is within 5 minutes walking distance to major industrial buildings and roads that link the site with Pretoria CBD and Attridgeville. The site is also within 10 minutes walking distance of the S.A.P.S training facilities and the residential suburb to the north.

Fig 4.21: Basic Infrastructure, Pretoria West Group Framework 2011

Fig 4.22: Existing urban fabric of Pretoria West, Pretoria West Group Framework 2011



Open Spaces

Due to the industrial nature of the area, there exist open, hard surfaced areas between structures. These spaces are used as circulation and storage by the factories and warehouses.

The proposed site contains two open lots and dilapidated warehouses, which will play host to a wide range of proposed programs.

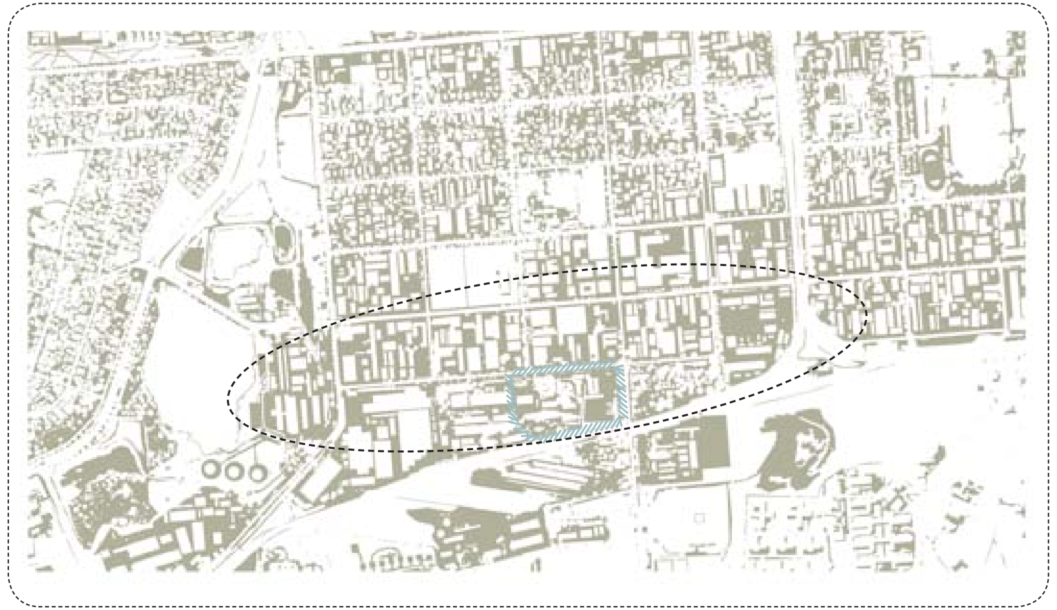


Fig 4.23: Open Spaces, Pretoria West Group Framework 2011

Fig 4.24: Open spaces in Pretoria West, Pretoria West Group Framework 2011

Green Scape

The map indicates a healthy green scape in the residential area (north of the industrial warehouses), on Proclamation Hill (North West), the Government Institutions (South) as well as a large water body within the Pretoria West Power Station. However, the core industrial district consists of very little vegetation due to hard surfaces.

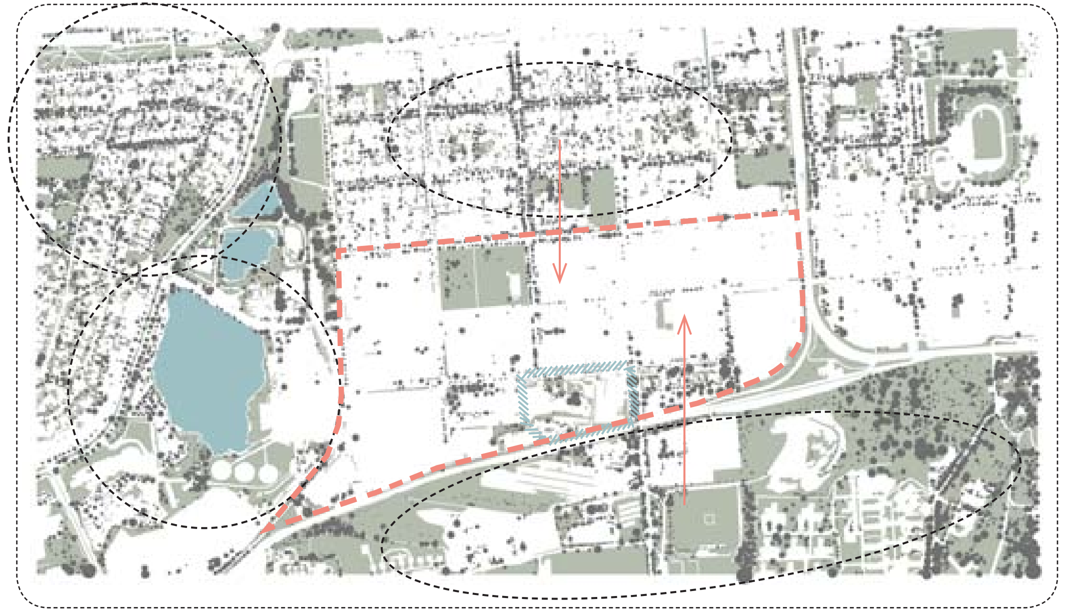


Fig 4.25: Green Scape, Pretoria West Group Framework 2011

Fig 4.26: Green Scape of Pretoria West, Pretoria West Group Framework 2011

Full Layering

The layering of all the levels illustrate that Pretoria West has potential to be regenerated as a healthy precinct where the industrial and social characteristics can be connected to form a sustainable environment - The position of the proposed site is in close proximity to all the programs of the precinct.

Fig 4.27: Full Layering, Pretoria West Group Framework 2011

Fig 4.28: (Opposite) Various elements of Pretoria Pretoria West Group Framewor

4.3.2 Meso Scale:

Apart from the Pretoria West Power Station and neighbouring glass facility, the area can be characterized as a small to medium sized industrial zone, with most of the businesses focusing on repair and maintenance work rather than production.

This being said, the area consists of a number of sites that contain unused technical/industrial mass. These materials could be reintroduced into the surrounding 'technosphere'. The sites containing large amounts of unused materials are regarded as lost/discarded urban spaces and add to the low density problem of the area.

The area is clustered with car-related businesses, panel beaters, scrap yards, parts shops, mechanics, paints shops and open lots filled with disposed cars. A specific number of sites will be chosen as proposed resource sites.

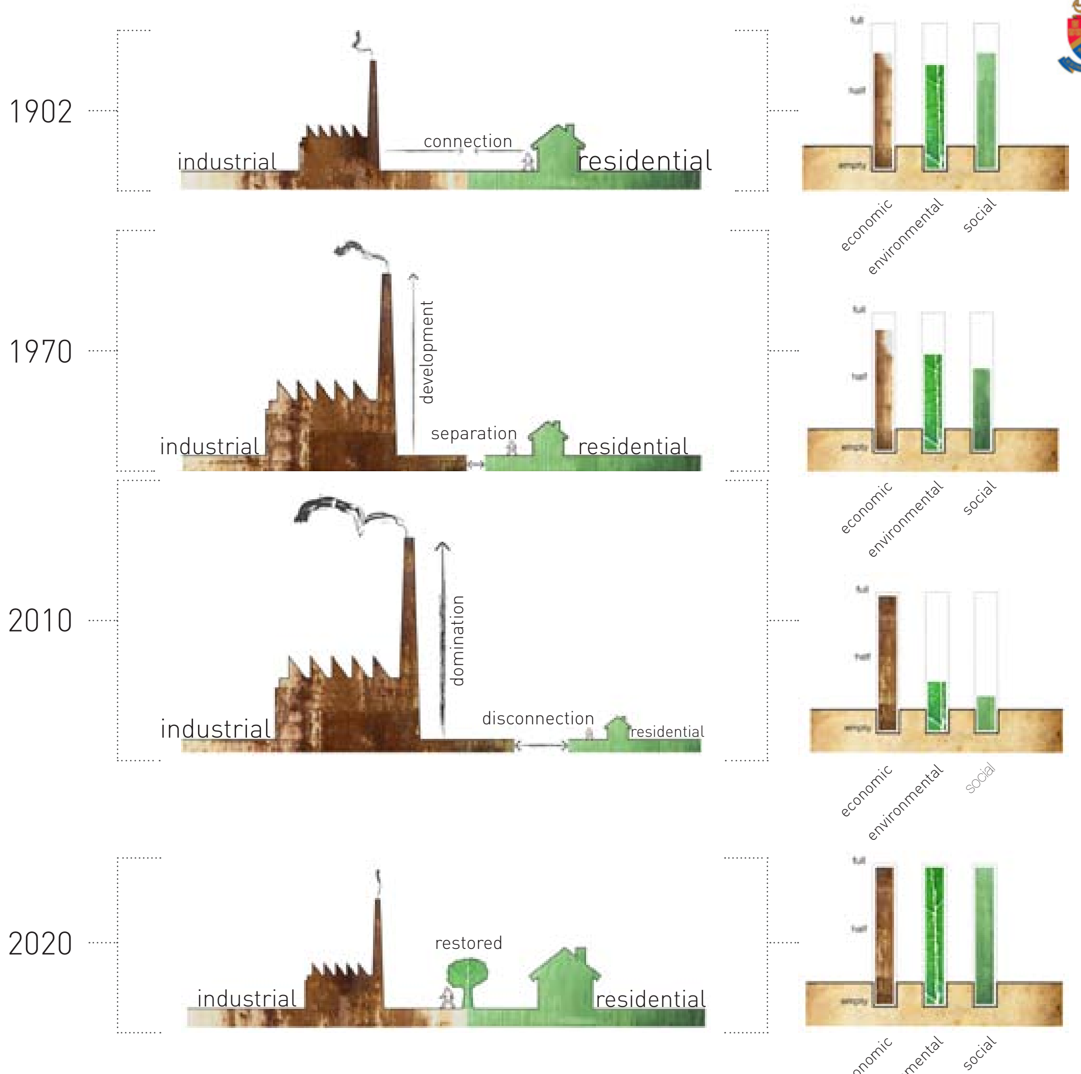


Fig 4.29: Residential VS Industrial Development, Pretoria West Group Framework 2011

Fig 4.30: Zeller Street with water channel, Illustrated by Bertus van Sittert 2010

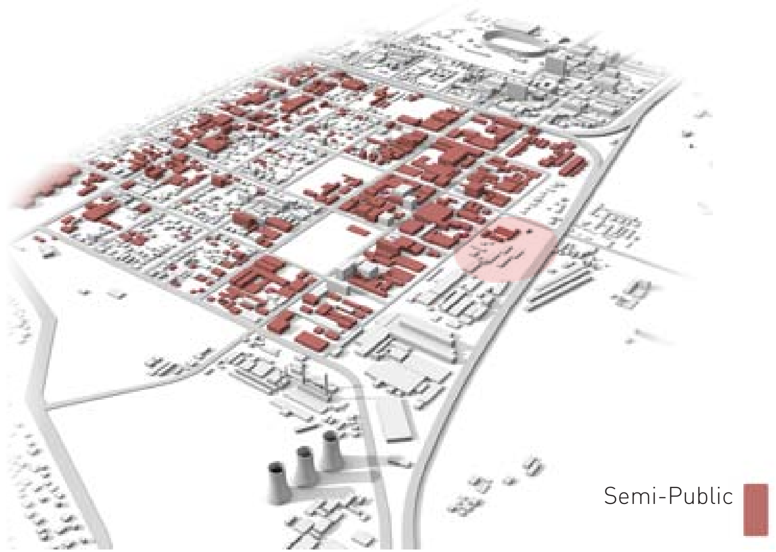
Fig 4.31: Walking route adjacent to proposed site, Illustrated by Bertus van Sittert 2010

Fig 4.32: Mitchell Street with car dealerships, Illustrated by Bertus van Sittert 2010

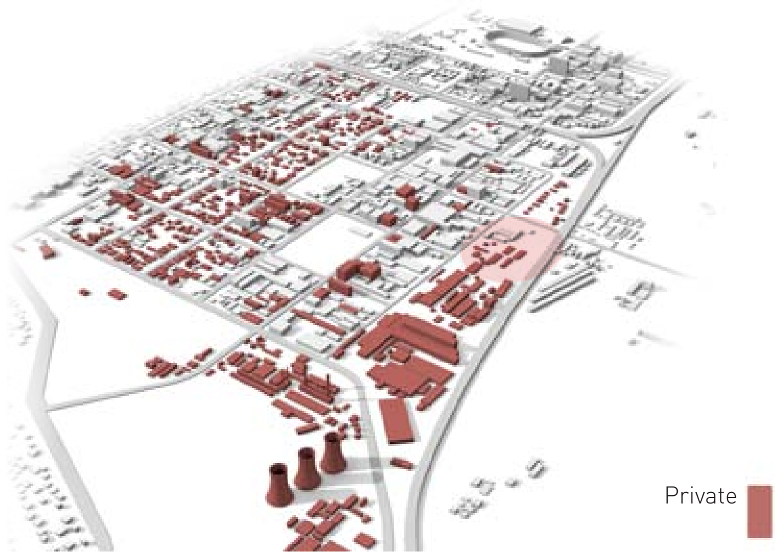
Fig 4.33: Zeller Street with water channel, Illustrated by Bertus van Sittert 2010

Fig 4.34: (Left) Semi-Public Spaces in Pr
Pretoria West Group Framewor
Fig 4.35: (Right) Private Spaces in Precinct, Pretoria West Group Framework 2011

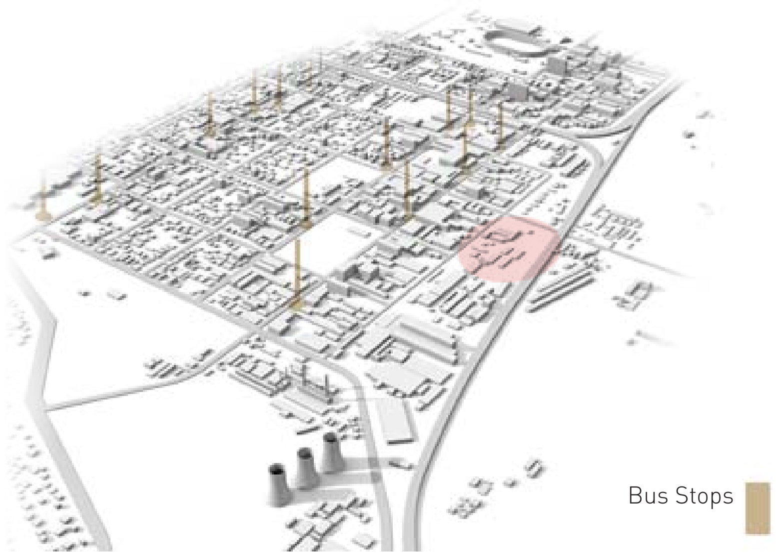
6: (Left) Bus Stops in Precinct,
ia West Group Framework 2011
Fig 4.37: (Right) Educational & Sports Facilities in Precinct, Pretoria West Group Framework 2011



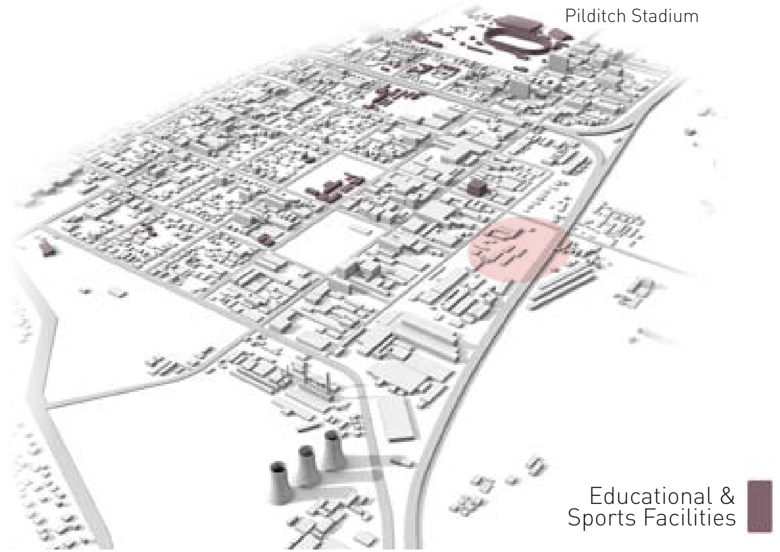
The semi-public spaces consist of local businesses and industrial buildings with limited access due to health and safety regulations.



A large amount of the precinct consists of spaces which are considered to be private: the residential houses to the north and government facilities like the Department of Water Affairs and the Pretoria West Power Station form part of this zone.



The precinct has adequate access to bus services. These transport nodes should be connected to train stations of the area.

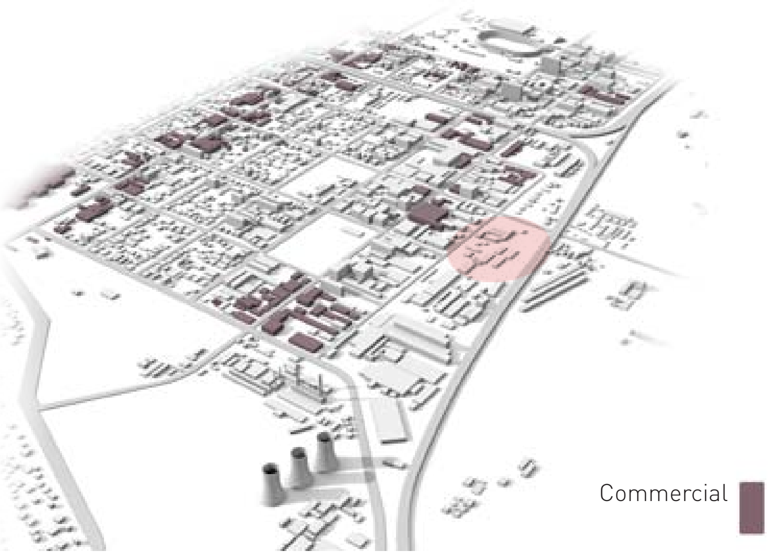


The most prominent sports facility in the area is Pilditch Stadium, which is located next to the Show Grounds to the east.

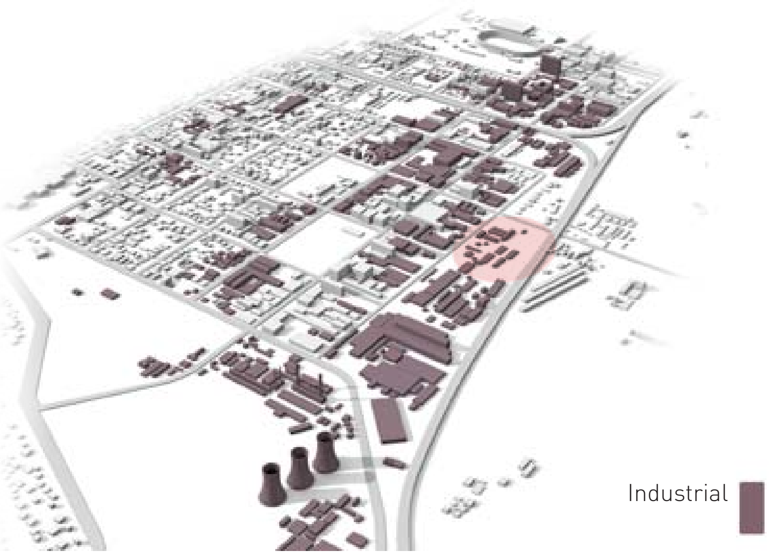
Fig 4.38: (Left) Commercial buildings in Pr
Pretoria West Group Framewor

Fig 4.39: (Right) Industrial buildings in Precinct,
Pretoria West Group Framework 2011

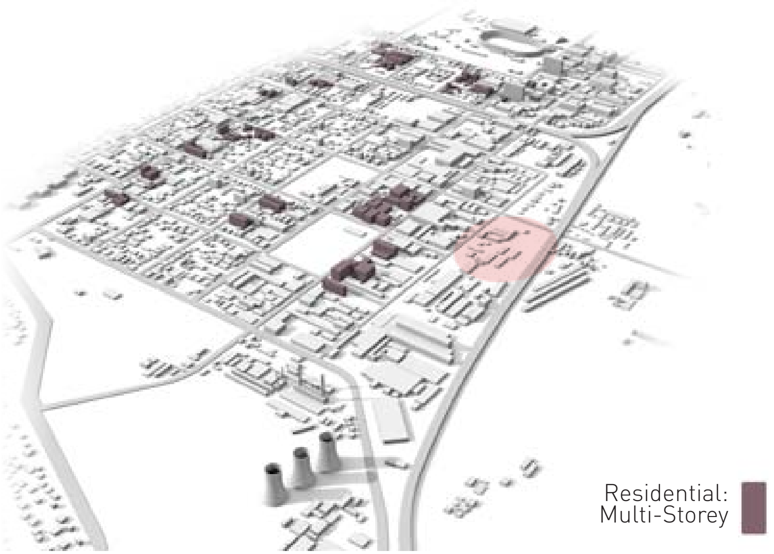
0 & Fig 4.41: Residential buildings in Precinct,
ia West Group Framework 2011



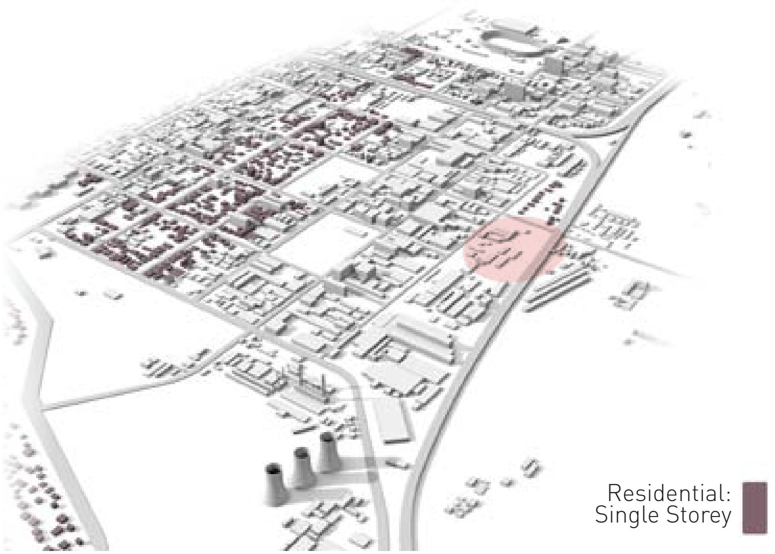
The commercial buildings consist mainly of car related businesses like panel beaters, parts shops, fitting centres and spray painting.



A wide range of industrial buildings is located in the area, all of which can be classified as small to medium in size.



The area consists of very low densities with little multi-storey residential buildings. Part of the framework will be to propose new housing development around the parks in the area.



The old Goede Hoop houses covers a large part of the area, these houses are older than sixty years and are protected by the Heritage Act.

2: [Opposite] Aerial photo of Train stations in the ia West Precinct: City of Tshwane Municipality, Edited by Author 2011

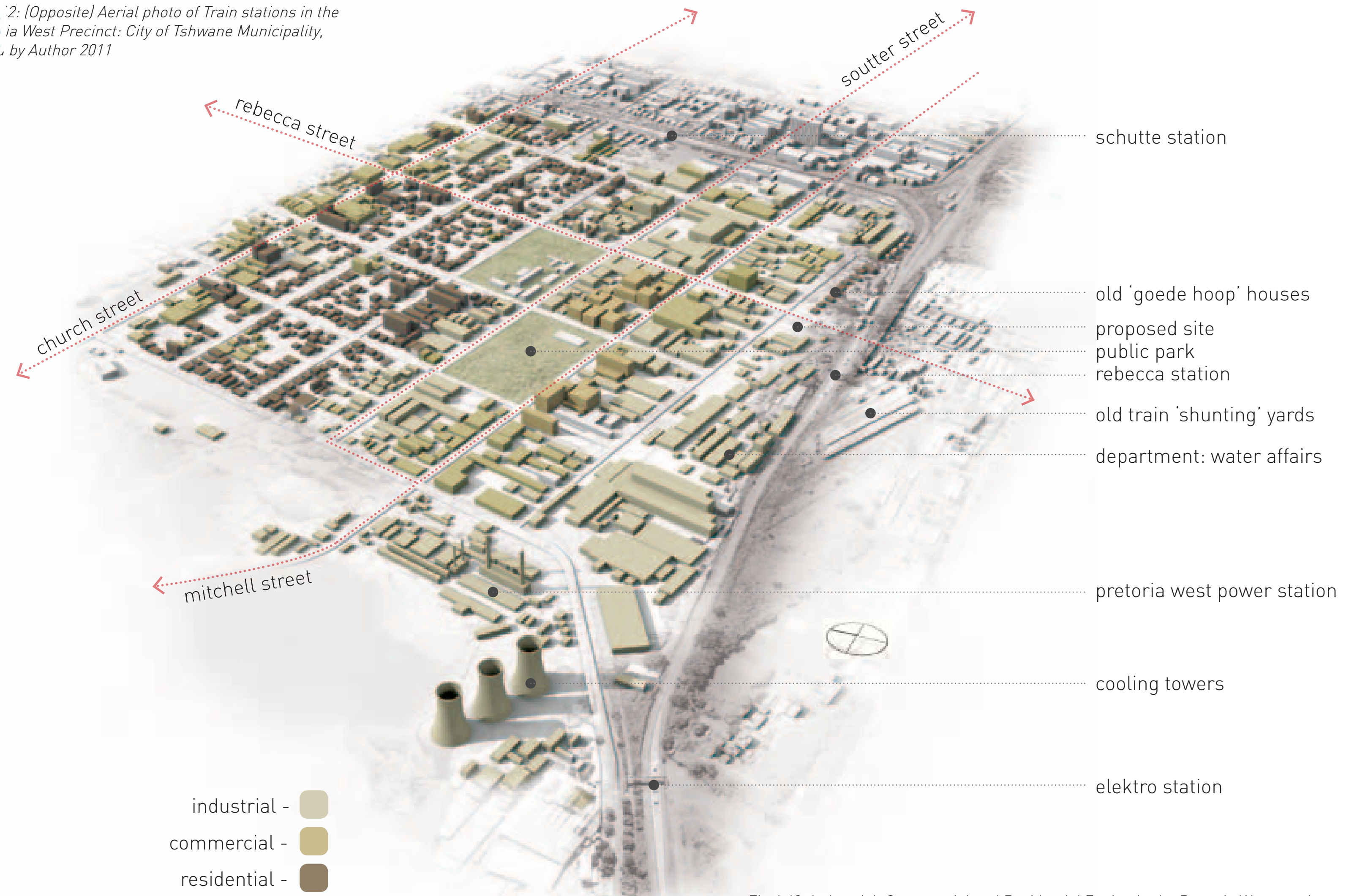


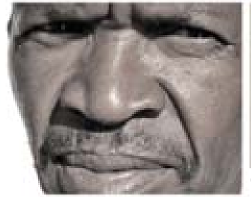
Fig 4.43: Industrial, Commercial and Residential Zoning in the Pretoria West precinct, Pretoria West Group Framework 2011

Local People

A diverse range of people attend to their daily business in the streets of Pretoria West, conversations with some of them gave another perspective of the precinct.

david masego:
"there is no taxi going there to philip nel"

michael de klerk:
"ek maak trokke reg, in rosslyn"

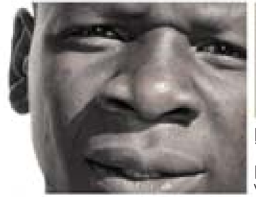


daniel agedi:
"soshanguve"

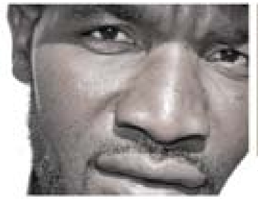
leboli mahlango:
"from philip nel to town is 7 bucks"

peter webo:
"I broke my leg when I got off the crowded train"

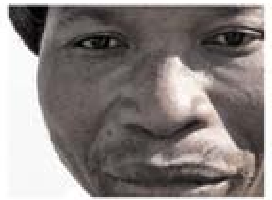
chicken mareto:
"sunnyside is saturated with foreigners with diverse ideas"



progress december:
"the police are always patrolling, ja, they are visible"



silas makoli:
"get it from marabastad"



patric bongaan:
"ja, ek praat afrikaans en portugees"

gouws gouws (aka prince):
"en die ding is die - ons almal is lief vir mekaar"

Fig 4.44: Local People of Pretoria West: Pretoria West Group Framework 2011

Fig 4.45: The soul of Pretoria West, Pretoria West Group Framework 2011

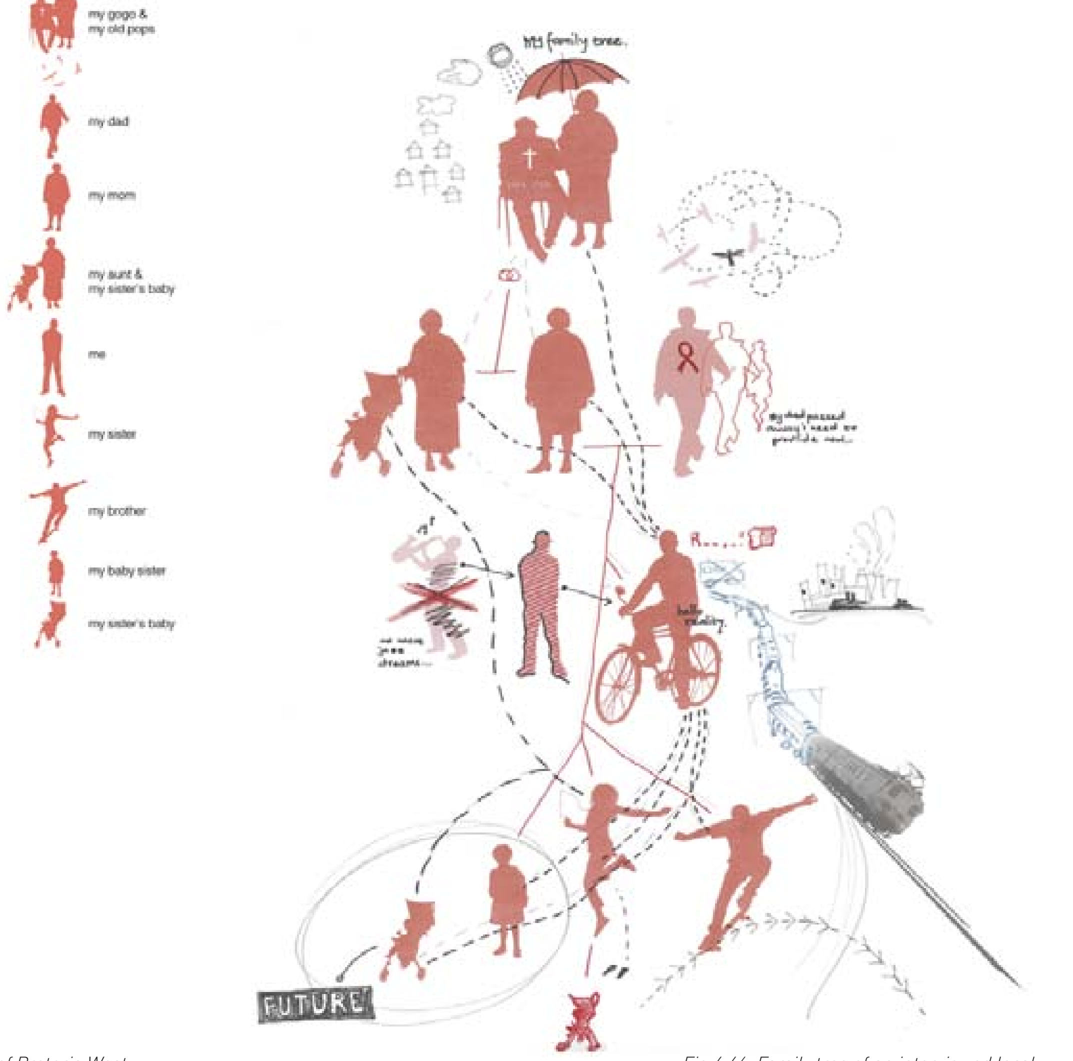
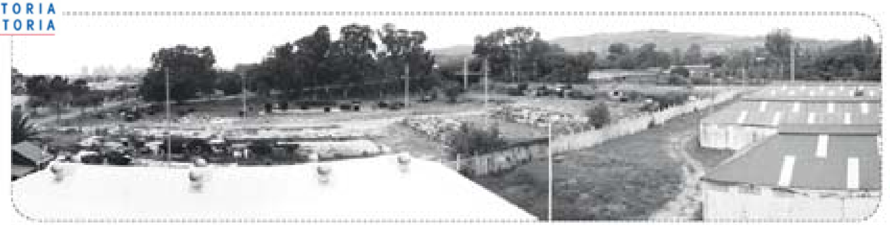


Fig 4.46: Family tree of an interviewed local, Pretoria West Group Framework 2011

Automotive Resource Sites

Fig 4.47: Identified resource sites in Pretoria West, Group Framework 2011



1. Proposed site - c/o Rebecca and Carl Street
Owner: Municipality of Tshwane
Use: Waste Containers Storage

Legend:
body, air bag, seatbelt fastener, battery, tyres, petrol diesel, oil, body panels, seats upholstery, interior plastics, suspension, engine transmission

Resource Sites:

2


2: Car Scrap Yard - Mitchell Street
Amount of Cars: 55
Distance from Site: 0.9km

3


3: Car Spare Parts - Ct Street
Engine & Body Spares
Distance from Site: 0.7km

4


4: Car Spare Parts - Ct Street
Engine & Body Spares
Distance from Site: 1.1km

5


5: Old Car Tyres - Soutter Street
Amount of Tyres: 500 (approximately)
Distance from Site: 0.9km

6


6: Car Scrap Yard - Soutter Street
Amount of Cars: 30
Distance from Site: 1.9km

7


7: Car Scrap Yard - Soutter Street
Amount of Cars: 47
Distance from Site: 1.9km

8


8: Car Scrap Yard - Mitchell Street
Amount of Cars: 72
Distance from Site: 1.3km

9


9: Car Scrap Yard - Carl Street
Amount of Cars: 37
Distance from Site: 0.4km

Fig 4.48: Identified resource sites in Pretoria West, Photos by Author 2011

4.3.3 Rebecca Station:

The station is situated at the foot of the industrial area, bordered by the railway line itself. Its five minute walking radius is able to serve more than 70% of the industrial warehouses and residential area to the north.

Transport of industrial materials played an important part in the history of the station (Jordaan 1989: 29). The shunting yards, where train carriages were parked for loading of industrial materials south of the railway line, are not in operation due to the increased use of other modes of transport over the last few decades.

However, the main reason for the station not having reached its full potential is because of the lack of access to the site and to the station itself. The small number of people using the station by day gain access by a secluded path next to the proposed site from Carl Street, crossing the railway lines by foot to the raised concrete structure that form the base of the station.

A number of interviews with users of the station indicated that this is the easier access route to take, rather than the official pedestrian route which is far more dangerous (Interviews by Author 2011).

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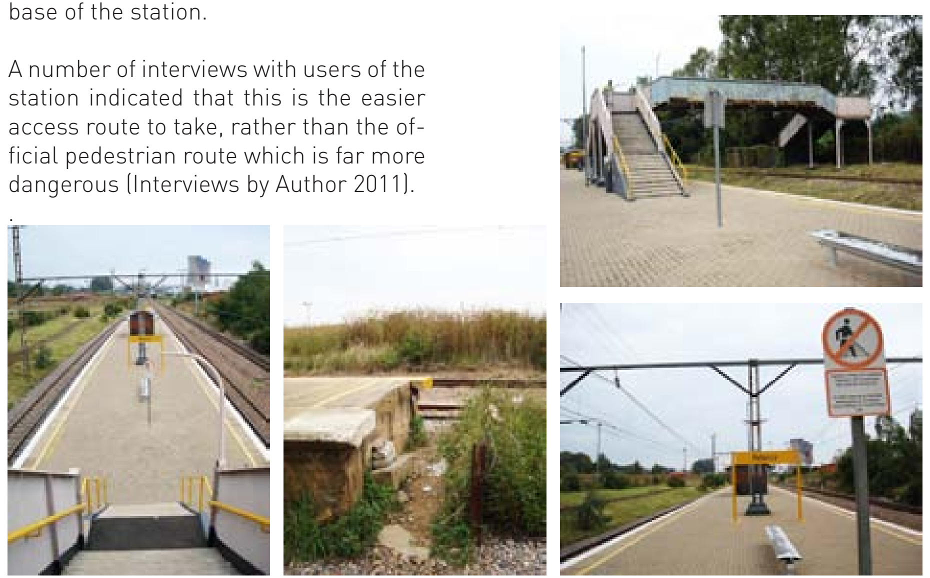


Fig 4.49: Views of Rebecca Station, Photos by Author 2011

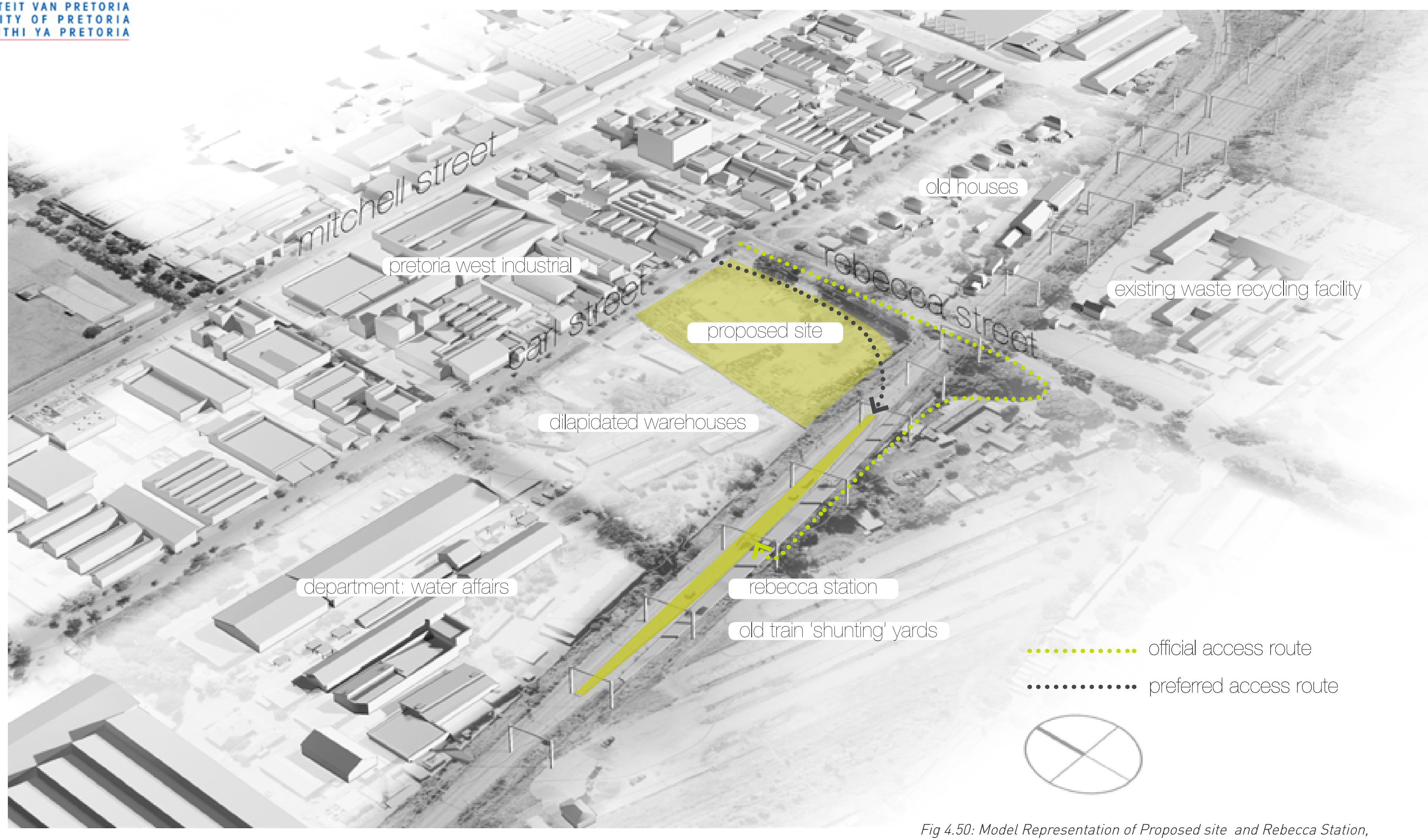


Fig 4.50: Model Representation of Proposed site and Rebecca Station, Pretoria West Group Framework 2011

Fig 4.52: [Opposite] View of Structures surrounding the propose
Photos by Autho

4.3.4 Micro Scale:

The selected site is currently owned by the Municipality of Tshwane and is used as temporary storage for waste containers. Waste trucks transport filled containers to the site, and the waste is then transported across the railway line to an existing waste recycling facility less than five hundred meters away. The proposed intervention aims to cater for and strengthen this established recycling system as an extended component of the new building's main program.

The site's location is directly adjacent to Rebecca Station, which is connected with Pretoria Main Station and Elektro Station in an East-West direction by the railway line. The site plays host to an informal and dangerous connection corridor for pedestrians who commute to/ from Rebecca Station [crossing the railway line by foot], resulting in the under utilization of the station.

Fig 4.51: Model Representation of Study Area,
Pretoria West Group Framework 2011

4.4 Synthesis of Context Analysis

Urban problems associated with the study area:

1. Vacant Lots
adds to poor urban character of the area
2. Dilapidated Warehouses
structures are no longer in use
3. Rebecca Station
the station is cut off from the precinct & the railway line is no longer used for industrial purposes
4. Shunting Yards
taking up a large area of land
5. Workshops
structures remain empty and unused
6. Mixed Waste Recycling Facility
facility lacks access to appropriate transport
7. Old 'Goede Hoop' Houses
significance of historic houses not celebrated
8. Light Industrial Buildings
poor urban spaces and street edges
9. Department: Water Affairs
private government buildings - no pedestrian access

Fig 4.53: Mitchell Street with car dealerships, Illustrated by Bertus van Sittert 2010

These problems will be investigated in *Chapter 6: Design Development* by means of new interventions and opportunities, resulting in a proposed site development and vision for the area.

Ultimately, the proposed Vehicle Disassembly Plant should plug into the existing urban fabric through the newly developed site proposal.

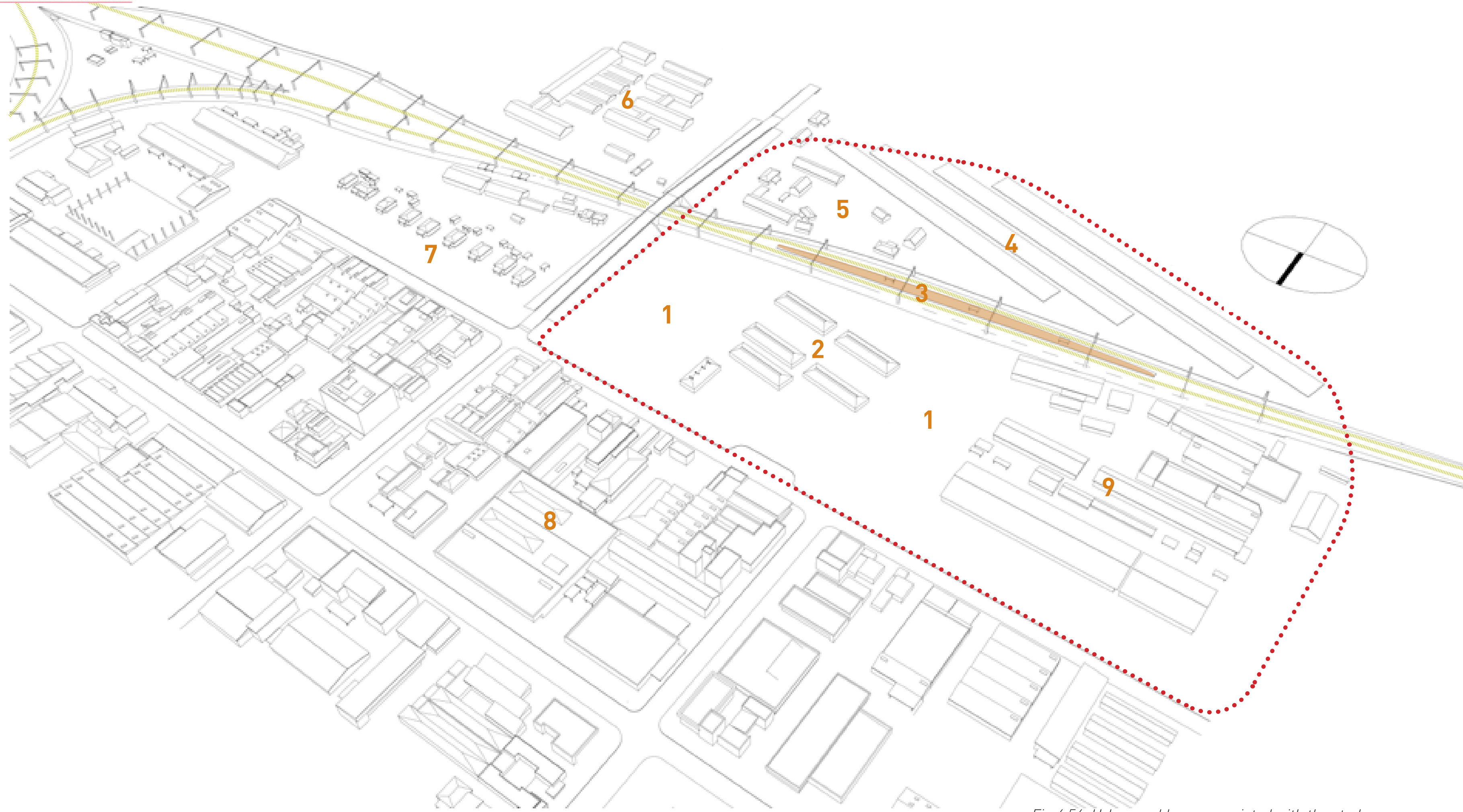


Fig 4.54: Urban problems associated with the study area, Pretoria West Group Framework 2011

Fig 5.1: Photo Collage of the Pompidou Centre, Paris, France (Pirate Shrooms 2011)

05 precedent studies

Fig 5.2: (Opposite) View of Harmania Office Green Wall (Triptyque 2008)

Introduction

A precedent should be studied to stimulate the designer, whilst informing the design process through specific qualities and aspects.

This chapter evaluates existing projects that are similar to this thesis proposal. The projects were selected for their functional, typological, theoretical or thematic similarities.

The precedent studies focused on the following premises:

• Wannenburg Scrapyard: an example of a local business to aid in the understanding of the day-to-day requirements of the project

• BMW Central Building: the relationship between production processes and the user of the building

• Masons Bend Community Centre: adaptive re-use of alternative and cheap material resources

• Harmania // 57 Office Building: a building as a passive ecosystem

• Centre for Global Ecology: understanding the application of a cooling tower as a primary cooling system

5.1 Project: Wannenburg Scrapyard, 2000-Present
Location: Pretoria, South Africa

Aim of Precedent: Serves as an example of a local scrapyard to aid in the understanding of the day-to-day requirements of the project.

5.1.1 Purpose:

In essence, the Wannenburg Scrapyard is an example of what the proposed disassembly plant aims to achieve - the re-use of old car parts and materials.

Even though the proposed project intends to work with a larger number of cars at a faster rate, this precedent is of high value. Aesthetically, the precedent does not contribute to the proposed design, but the process will have an influence on how the proposed Disassembly Plant will function.

The business procedure and site operation will be critically analysed in order to inform the design of the project.
The precedent also aims to convey the fact that there is a demand for facilities specialising in disassembly of end-of-life automobiles.

Fig 5.3: Panoramic view of the storage area located at the back of the premises, Photo by Author 2011

5.1.2 Business Procedure:

The scrap yard operates fundamentally the same as any other 'cash-for-scrap' business, where old and broken goods are bought, sorted, repaired and redistributed to the public or other recycling facilities to generate an income.

The automobiles, normally fresh from an accident or break down, are bought at auctions for discount prices. Flatbed trucks transport the automobiles to the site where they are stored in the back yard for disassembly.

When arriving on site, the automobile is logged and given a log number. When the time comes for the automobile's disassembly, all the disassembled parts which can be re-used are listed on the database under the automobile's log number. The parts and components are then logged and stored in the yard area.

This process, when applied thoroughly, works well. Once a customer requests a specific part, the system can be checked for stock or a disassembly schedule can be created to determine a time/date upon which a part will become available for purchase.

This business procedure will be applied to the site circulation and plan layout of the proposed disassembly plant.

From top, left to right:
a. Automobiles transported to site on flatbed trucks
b. Forklift for moving automobiles in back yard
c. Storage of disassembled vehicles before compression
d/e. Disassembly of a vehicle
f. Storage ruck with different nuts and bolts

Fig 5.4: Photo collage of automobiles arriving on site and disassembly, Photos by Author 2011

Fig 5.6: (Opposite) Automobile bodies are sent away to be compressed and recycled, Photo by Author 2011

Fig 5.5: Photo Collage of storage arrangements for different components, Photos by Author 2011

5.1.3 Unofficial/Informal 'Market':

The site consists of two main aspects: the payment/reception counter on street level and the yard situated at the back of the site.

The reception counter acts as a threshold space between the street and the yard and is the first space the user is exposed to. From here one moves through to the back yard, which operates as an informal market area where the different components and parts are displayed.

Of the five visited scrap yards, Wannenburg was the most welcoming, allowing me to browse around and take photos on my own. However, the other scrap yards gave the impression that customers are not welcome in the back yard, making it feel more like a private storage space than a market area supplying used car parts. These spaces also made me feel unsafe whilst moving through them alone.

The proposed project aims to re-address the manner in which the back yard space of a typical scrapyard operates. A market area forms part of the disassembly plant's programme, intended to make the user feel save and wanted in the space whilst browsing, creating a space with social interaction.

From top, left to right:
a. Storage rack for boots
b, Tyres and petrol pumps
c. Interior door panels
d. Exterior door panels

5.1.4 Storage:

Storage and display racks play an important role in the efficiency of the business. Firstly, space is limited, requiring storage to be economical, and secondly, the wide spectrum of parts requires custom made storage racks to achieve maximum storage capacity.

A thoroughly designed storage system ensures a well organised stock of components, which is often one of the main problems facing scrap yards, resulting in theft and other security problems.

In the Wannenburg Scrapyard, innovative use of available and inexpensive steel members (pipes, rods, sections and sheeting) for storage and display racks contributes to the character of the site. Maximum storage is achieved with minimum use of materials.

The proposed design aims to incorporate the following aspects regarding storage:

- Maximum storage capacity in relation to floor area
- Ease of movement and storage of parts
- Clear display of available stock in market area
- Placement of storage to allow for passive security
- Innovative design of different storage racks

Fig 5.7: Photo Collage of storage arrangements for different components, Photos by Author 2011

From top, left to right:
a. Storage rack for glass panels
b, Covered storage for suspension modules
c. Seat belt fasteners
d. Brake callipers

From left to right:
a. Storage for smaller components
b. Bonnet/boot storage racks
c. Interior components and upholstery
d. Petrol tanks

Fig 5.8: Photo Collage of storage arrangements for different components, Photos by Author 2011

5.1.5 Influences:

- Innovative use of materials
- Hierarchy of spaces: the different thresholds
- Back yard as an informal market area
- Adequate storage space

5.1.6 Application:

The precedent aims to inform the day-to-day activities of the proposed disassembly plant. The process of disassembly is not as ordered and technologically advanced as that of an assembly plant, however, existing businesses like the Wannenburg Scrapyard is a good example of how this industry operate in the area of Pretoria West.

5.2 Project: BMW Central Building, 2003-2005
Location: Leipzig, Germany
Architects: Zaha Hadid Architects

Fig 5.9: Central Building in context (ArcSpace 2006)

Fig 5.10: Relationship between assembly process and office space (ArcSpace 2006)

Aim of Precedent: To investigate the relationship between production processes and the user of the building.

5.2.1 Purpose:

The building is the result of an architectural competition held by BMW with the aim to connect the three existing industrial production buildings (auto bodies fabrication, paint shop and assembly hall), all of which play an integral part in the production of BMW's 3 Series.

The Central Building functions as the core, serving as the link between the assembly process steps and the employees. The activities and processes of the whole factory complex gather at the Central Building, where they branch out to different production points again. The building is designed as a series of different overlapping and interconnected spaces and levels, creating a unified whole between the cars, visitors and employees through constant interaction (Zaha Hadid Architects 2005).

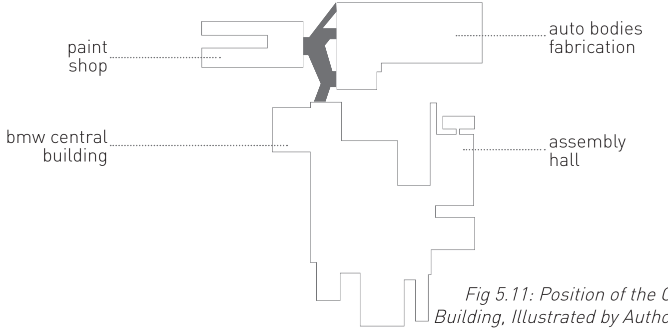


Fig 5.11: Position of the Central Building, Illustrated by Author 2011

5.2.3 Materials used:

- Cast in-situ concrete structure
- Structural steel beam and space frame roof
- Corrugated metal sheeting
- Glass curtain walls

5.2.4 Application:

The precedent study aims to inform the connection of social and industrial spaces in the proposed project. The relationship, hierarchy and interaction between these spaces will be investigated to ensure program cohesion.

Fig 5.12: Elevated conveyor system (ArcSpace 2006)

5.2.2 Influences:

- Elevated conveyor system, transporting partially assembled cars to one of the three existing industrial buildings, blue LED lights illuminate the vehicles as they become more and more complete each time they return to the Central Building.
- Converging flows - All the spaces catering for the employees (offices, meeting rooms, public relations facilities and social spaces) are inhabited by the elevated conveyors, creating an interesting relationship between the industrial and social activities of the building.

5.3 Project: Masons Bend Community Centre, 1999-2000
Location: Masons Bend, Alabama, USA
Architects: Rural Studio - Auburn University

Fig 5.13: Masons Bend Community Center, Rural Studio 2000 (Forrest Fulton Architecture 2009)

Aim of Precedent: Adaptive re-use of alternative and cheap material resources; tectonics of the structure.

5.3.1 Purpose:

Located on a site privately owned by three extended families that make up the community, a small group of Rural Studio thesis students designed and built the centre based on the community's needs.

The proposal included a public, multifunctional, open-air space in the form of a transportation stop (used by the local mobile library and health centre) and a small chapel. The chapel is utilized by the local prayer group and also serves free school meals to children in the summer months (Forrest Fulton Architecture 2009).

5.3.2 Influences:

- Achieves impressive effect with a small budget
- Innovative use of alternative and cheap material resources, improvised construction techniques - the structure's most striking feature is the glass and aluminium roof constructed of salvaged car windshields obtained from a local scrap yard.
- The collection of different materials and fixing mechanisms creates a temporary character, a structure than can easily be disassembled and put together on another site – the architecture language adapts to the multifunctional nature of the space.

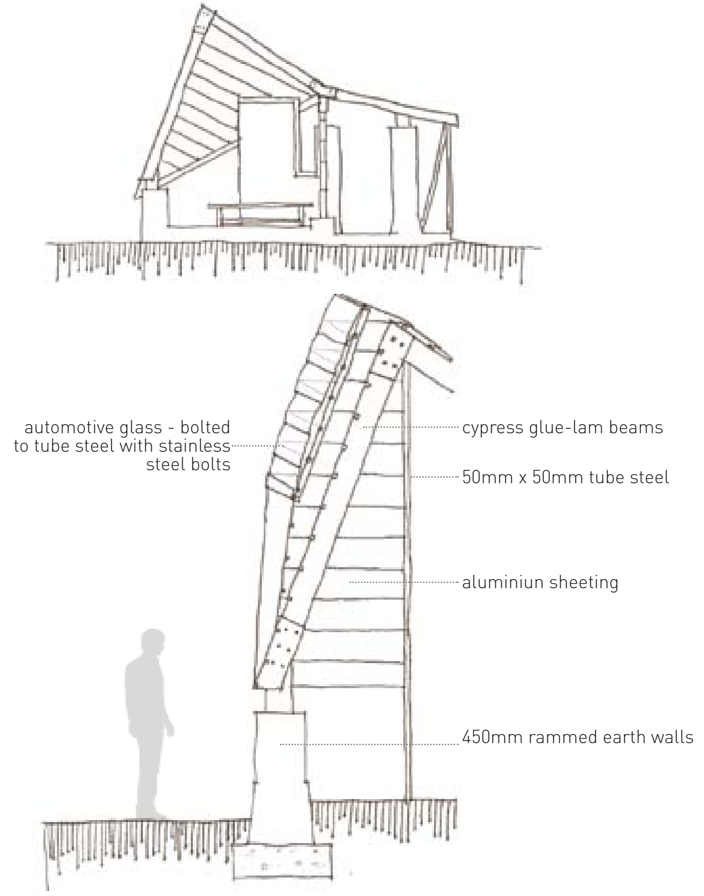


Fig 5.14 & 5.15: Section indicating structure elements, Rural Studio 2000, Illustrated by Author 2011

Fig 5.16: Views of building structure and materiality, Rural Studio 2000 (Forrest Fulton Architecture 2009)

5.3.3 Materials used:

- Rammed earth walls
- Cypress glue-lam beams
- Steel tube sub-structure
- Aluminium
- Automotive glass
- Stainless steel bolts

5.3.4 Application:

The "lightness" and proportion of the structure as a building skin, as well as the effective use of materials, will be investigated and applied to the car part vendors/market area of the proposed building.

5.4 Project: Harmonia // 57 Office Building, 2006-2008
Location: Sao Paulo, Brazil
Architects: Triptyque Architects

Aim of Precedent: Investigation of a building as a passive ecosystem

5.4.1 Purpose:

The walls are thick and covered externally by a vegetal layer that works like the skin of the structure. This thick wall is made of an organic concrete that has pores, where several plant species grow, giving the façade a unique look.

In this 'machine', where the rain and soil waters are drained, treated and reused, a complex ecosystem is formed within the local. This ecosystem is a multifunctional universe made of several interconnected machines (Triptyque 2008).

5.4.2 Influences:

• Exposed inner workings of the different systems on the building façade (pipelines, pumps and treatment systems are presented as veins and arteries of a living body).
• Cut openings in the concrete mass, framed with a concrete 'lip'.
• Green walls and mist irrigation system
• Adjustable timber shading doors - the building can be closed of towards street level

Fig 5.17: Views of the organic concrete walls and externally placed systems (Triptyque 2008)

Fig 5.18: An ecosystem where rain- and soil water are drained, treated and re-used (Triptyque 2008)

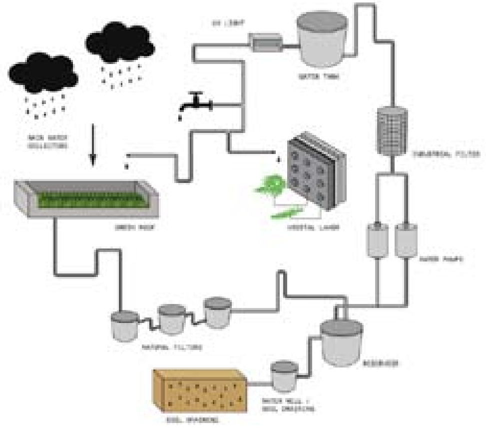


Fig 5.19: Adjustable timber shading mechanisms (Triptyque 2008)

Fig 5.20: Irrigation system on façade (Triptyque 2008)

5.4.3 Materials used:

• Timber shading elements
• Steel sub-structure
• Organic Concrete with 'pores'
(Organic concrete has a permeable surface which allows plants to grow out of it. (Inhabitat 2005).)

5.4.4 Application:

Implementation of passive systems and the inter-relationship between these systems: Rain water harvesting (green roof), filtering system, irrigation of green walls and the mist system, regulates interior temperatures.

5.5 Project: Centre for Global Ecology, 2003-2004
Location: Stanford, California, USA
Architects: EHDD Architecture

Aim of Precedent: Application of a cooling tower as a primary cooling system

5.5.1 Building Systems:

The design of the centre responded to the climatic conditions with a number of passive and active design strategies.

The building consists of a mix of natural ventilation and mechanical ventilation, known as mixed mode ventilation, allowing the building to save energy on mechanical ventilation and cooling only in the spaces that need them at the times where natural ventilation is not sufficient.

As a general rule, offices are naturally ventilated using operable windows and ceiling fans, and cooled using a radiant slab, while lab spaces requires a higher level of ventilation and cooling and thus resorted to mechanical solutions.

The design also includes natural ventilation of the main building lobby using a wind tower, common in traditional islamic architecture (Carboun 2010).

Fig 5.21: Views of the building's cooling tower and foyer entrance (Carboun 2010)

Fig 5.22: Views of roof openings for maximum daylight exposure (Carboun 2010)

Fig 5.23: Section describing the ' Night Sky' cooling system (Carboun 2010)

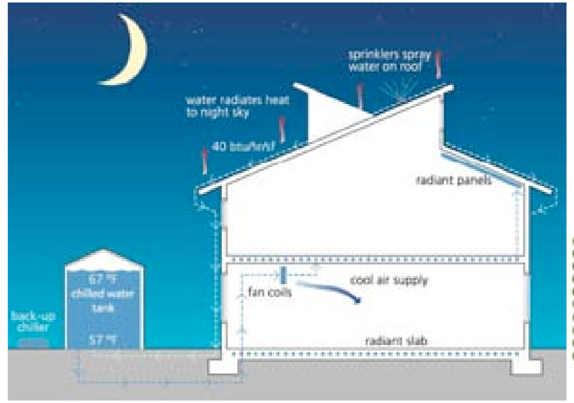
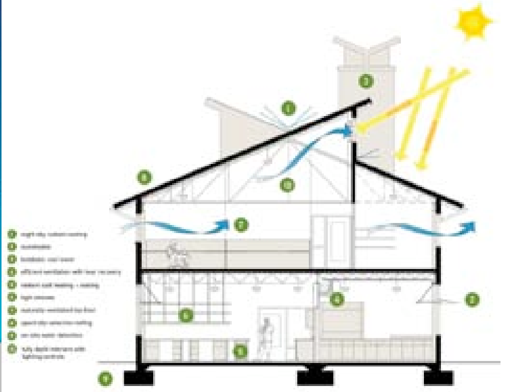


Fig 5.24: Section indicating sun angles and ventilation patterns (Carboun 2010)



5.5.2 'Night Sky' Cooling System:

Another application of evaporative cooling is the use of the 'Night Sky' on the building roof at night. This strategy is based on the fact that the building radiates heat to the sky at night and aims to encourage this shedding of heat by spraying water on the roof. This considerably minimizes the need for cooling the next morning, and reduces water since the night sky system uses 50% less water than a standard cooling chiller (Carboun 2010).

5.5.3 Traditional 'Wind Catchers':

Evaporative cooling towers can be seen as the modern enhancement of a traditional 'wind catcher'.

A wind catcher is an architectural device used for many centuries to create natural ventilation in buildings. The function of this tower is to catch cooler breezes that prevail at a higher level above the ground and to direct it into the interior of the buildings (Solaripedia 2010).

Fig 5.25: (Bottom Left) The burj al hawwa, the need to draw air down into the compact, courtyard houses resulted in the construction of these towers: Rafeek Manchayil 2010

Fig 5.26: (Bottom) Traditional mono-directional wind tower in Cairo (left) and multi-directional wind tower in Bahrain (right) (Rafeek Manchayil 2010)

Fig 5.27: (Top) Yazd, a city of wind towers or "badgirs" (wind catchers) lies quietly in the middle of a desert. The wind towers of Yazd are built with thick walls and tall arches (N. Kasraian 2010)

Fig 5.28: (Bottom) A portion of the old quarter of Dubai, Near Creek (Rmnathan 2010)

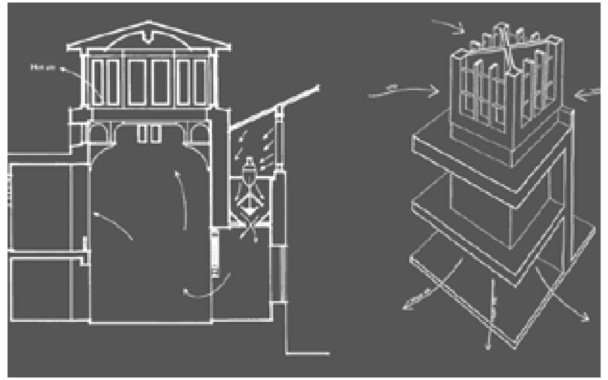


Fig 5.29: Views of the building's cooling tower (Carboun 2010)

5.5.4 Evaporative Cooling Towers:

Evaporative cooling towers use the principles of direct evaporative cooling and downdraft to passively cool hot dry outdoor air and circulate it through a building. The resulting cooler and more humid air can be circulated through a building using the inertia inherent in the falling cool air. Cooling towers are sometimes referred to as reverse chimneys (Kwok and Grondzik, 2007: 151).

Hot dry air is exposed to water at the top of the tower. As water evaporates into the air inside the tower, the air temperature drops and the moisture content of the air increases; the resulting denser air drops down the tower and out of an opening at the base. The air movement down the tower creates a negative (suction) pressure at the top of the tower and a positive pressure at the base. Air exiting the base of the tower enters the space or spaces requiring cooling. (Kwok and Grondzik, 2007: 151).

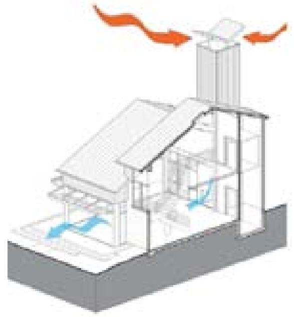


Fig 5.30: Cooling tower's ventilation diagram (Carboun 2010)

5.5.5 Implementation Considerations:

Evaporative cool towers work best under dry, hot conditions. Under these conditions (in an arid climate) the wet bulb depression is high so the cooling effect is maximized. Also, the increase in relative humidity of the exiting air is not a problem (and is likely a benefit) (Kwok and Grondzik, 2007: 151).

According to Baruch Givoni (1994) the effectiveness of a cooling tower does not depend upon wind, so cooling towers can be used in areas with little or no wind resources and on sites with limited or no wind access.

The technical composition of the proposed cooling tower will be discussed in Chapter 7 - Technical Development

Fig 6.1: Concept collage,
Illustrated by Author 2011

06 design development

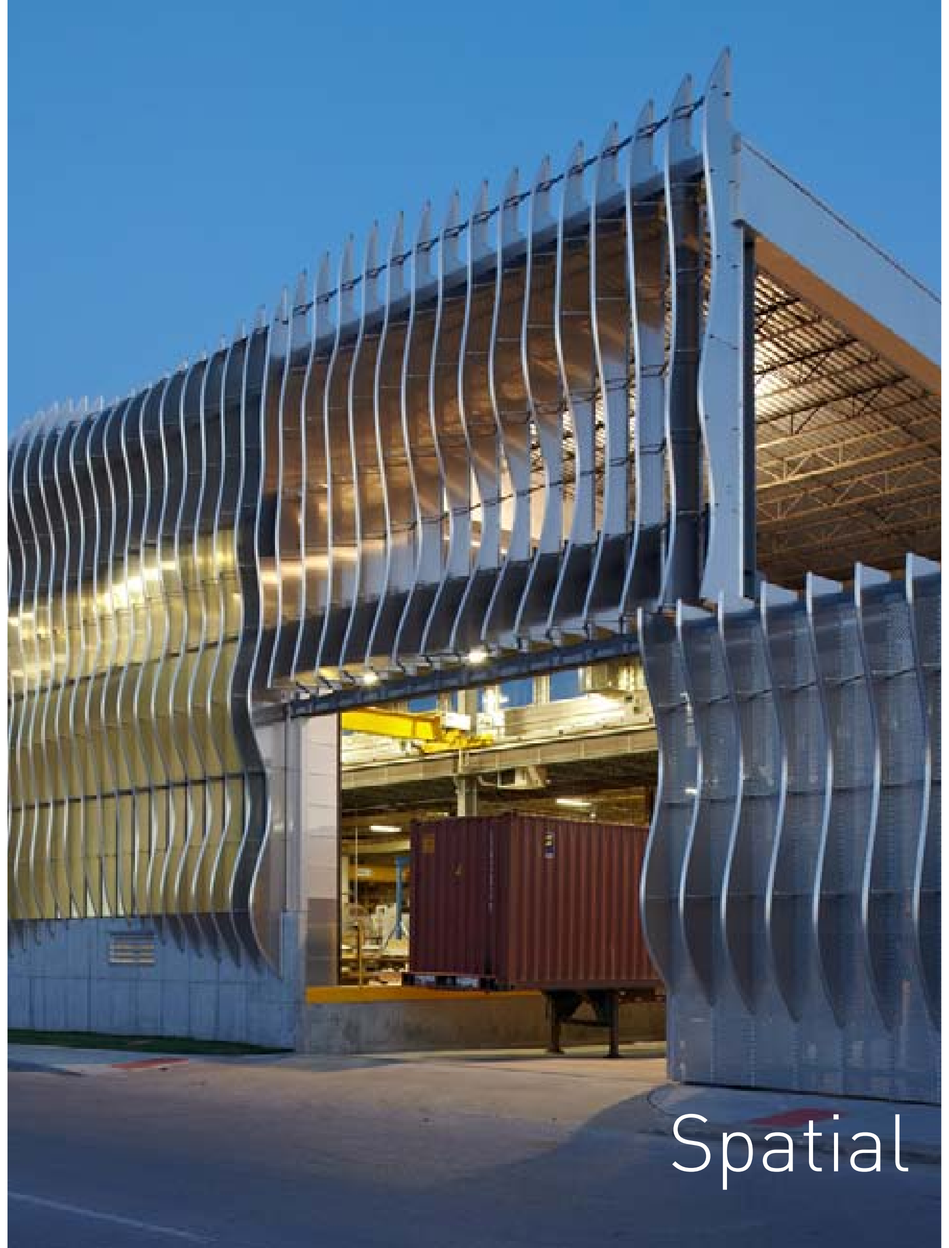


Fig 6.2: View of exterior skin and interior workshop, Zahner Factory Expansion: Crawford Architects 2011 (ArchDaily 2011)

6.1 Introduction

This chapter will illustrate the design development through the investigation of the aims set out in this dissertation. It will define the project and the site as well as how the concept is developed and translated into a building.

Due to the nature of the project, the design development process is separated into two main categories:

• Technical Development:

Exploring the functional design guidelines regarding the process of automotive disassembly.

The investigation was conducted in collaboration with Industrial Engineer, Gerhard le Roux, who has considerable experience regarding industrial processes.

• Spatial Development:

Integrating the functional design guidelines to appropriate spatial qualities between the process (Disassembly plant) and the surrounding urban fabric, demonstrating sustainable urban integration.

6.2 Technical Design Development

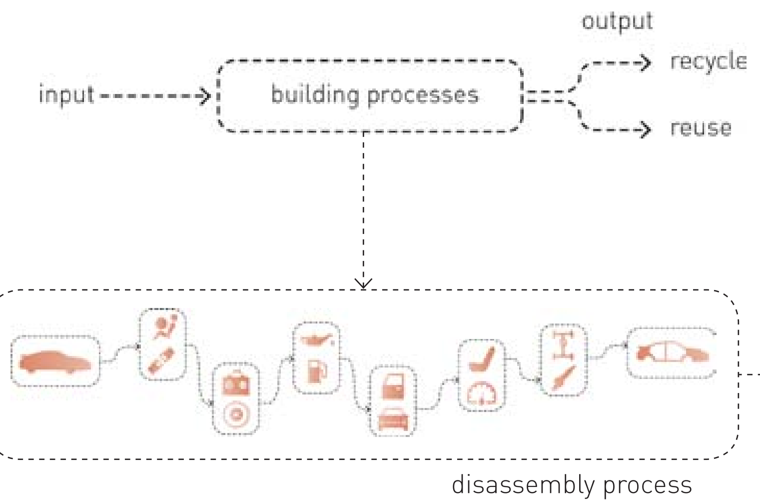
The technical design development will be discussed first as it was important to determine the technical requirements before moving on to the actual design of the site and building.

At the core of the input/output cycle lies the seven stages of disassembly. These seven stages are investigated and applied in-depth to ensure the project functions economically.

6.2.1 Input & Output Cycle:

The aim of the dissertation is to maximise the possibilities of the industrial building such that it operates less as an isolated process and more as an integrated ecosystem in the urban fabric; addressing social needs by providing economic empowerment and skills development, and for the building to contribute in a positive manner to the character and wellbeing of the urban fabric.

Due to the industrial nature of the proposed building, an input and output cycle forms the foundation from where the design will be developed - a constant inflow of resources (automobiles) and dispatch of products for re-use or recycling is active.



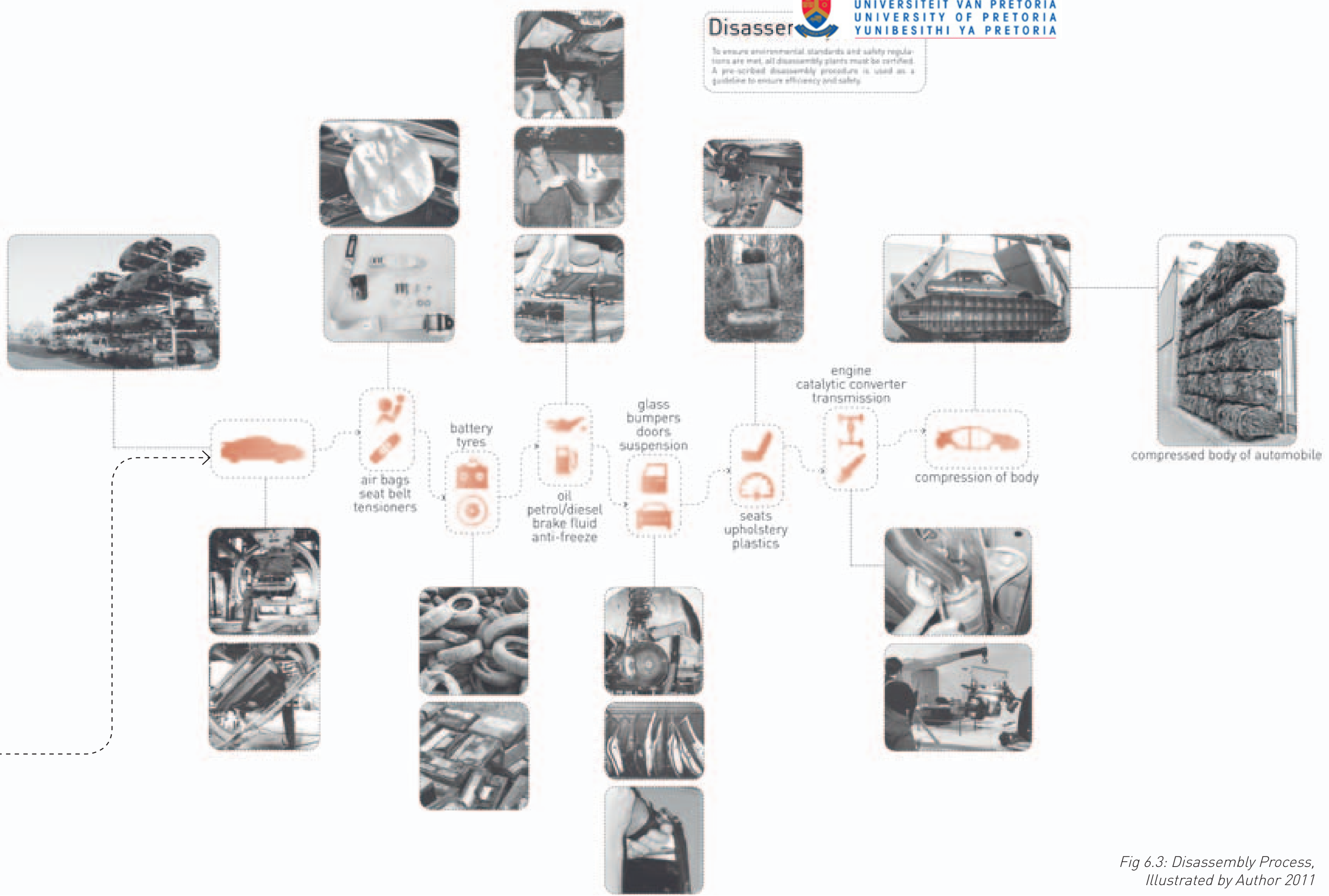


Fig 6.3: Disassembly Process, Illustrated by Author 2011

6.2.2 Process Needs:

The seven stages of disassembly form the backbone of the process (and building) as a whole. Each one of these stages has specific requirements to ensure optimal performance as a process and as a work space.

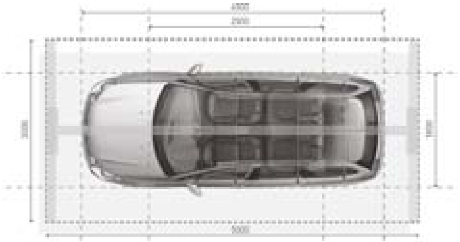
Each stage is influenced by:

- The type of equipment used in order to disassemble the specific part/parts of an automobile
- Appropriate floor area for circulation of parts and workers
- Number of workers per stage to ensure each step take an equal amount of time to complete, avoiding bottlenecks (refer to 6.2.4 Process Timing)
- Risks regarding the disassembly of certain parts
- The overall needs of a stage
- Valuable materials obtained from certain stages

(Le Roux 2011)

	1 explosive parts treatment (air bags, seat belt-tensioners)	2 pre-treatment (batteries, tyres)	3 fluid collection (oil, petrol/diesel, brake fluid, anti-freeze)
equipment	basic hand-operated tools	basic hand-operated tools	pressure drill & pump; storage tanks system
work area size	140 m^2	170 m^2	150 m^2
number of workers	4	4	3
risks	volatile substances	improper disposal of batteries	flammable liquids
overall needs	explosion control chamber	ventilation	drainage system with oil trap and tank; ventilation of fumes
valuable materials	none	nickel (batteries)	none - oil is recycled by the *R.O.S.E foundation

Vehicles are mounted on a 'C-Arm', enabling workers to manipulate vehicles in any position for better ergonomics. The 'C-Arm' mechanism is situated at the centre of stage 4-6. The first three stages will be fitted with a normal vertical hydraulic lift (le Roux 2011).



	4 exterior parts dismantling (glass, bumpers, doors, suspension)	5 interior parts treatment (seats, upholstery, plastics)	6 mechanical parts treatment (engine, catalytic- converter, transmission)	7 compression (compression of body)
equipment	inductive coil; grinder; basic hand-operated tools	basic hand-operated tools	basic hand-operated tools; grinder; pressure drill; hydraulic cutter	compression machine
work area size	180 m^2	175 m^2	160 m^2	145 m^2
number of workers	5	4	5	2
risks	dangerous equipment; heavy components	fragile electronic components	dangerous equipment	dangerous equipment
overall needs	hand-operated crane for heavy components		hand-operated crane for heavy components	forklifts
valuable materials	aluminium; steel	expensive electronics	platinum; rhodium	large amounts of steel

Fig 6.4: Process Needs table, Illustrated by Author 2011

R.O.S.E

* R.O.S.E Foundation - Recycling Oil Saves the Environment: The foundation manages the environmentally acceptable collection, storage and recycling of used lubricating oil in South Africa

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6.2.3 Disassembly Rate:

In order for the project to be feasible, a suitable process rate for automotive disassembly must be formulated to provide adequate labour resources.

Time is the most important factor of the process rate. According to Gerhard le Roux (2011) it would be appropriate for each stage to take forty minutes to be completed.

The number of disassembled automobiles per month must be determined to calculate the number of workers and floor area per stage required.

Capacity:

The following calculations have been formulated according to the optimal performance of the plant.

The number of cars disassembled per month (4 x five day working weeks):

On the first day of every month the disassembly line will contain no automobiles, which means that it will take 280 minutes/ 4 hours & 40 minutes (40 min. x 7 Stages) for the first automobile to reach the end of the process (Fig. 6.#)

This means that on the first day (8 hours of every month only 6 automobiles will be disassembled.

However, once the disassembly line has been filled up, the plant is able to disassemble 12 automobiles per day after that (producing a disassembled and compressed vehicle every 40 minutes).

Calculation:

Working minutes per day / stage duration = number of automobiles disassembled per day

» 480 minutes / 40 minutes = 12 automobiles

Week 1:

Day 1: 6 automobiles (due to empty disassembly line - Fig. 6.#)
Day 2-5: 12 automobiles each day (12 x 4 days = 48 automobiles)
Total: 48 + 6 = 54 automobiles

Week 2-4:

Day 1-5: 12 automobiles each day (12 x 5 days = 60 automobiles)
Total: 60 automobiles x 3 weeks = 180 automobiles

Total number of disassembled automobiles per month:
54 + 180 = 234 automobiles

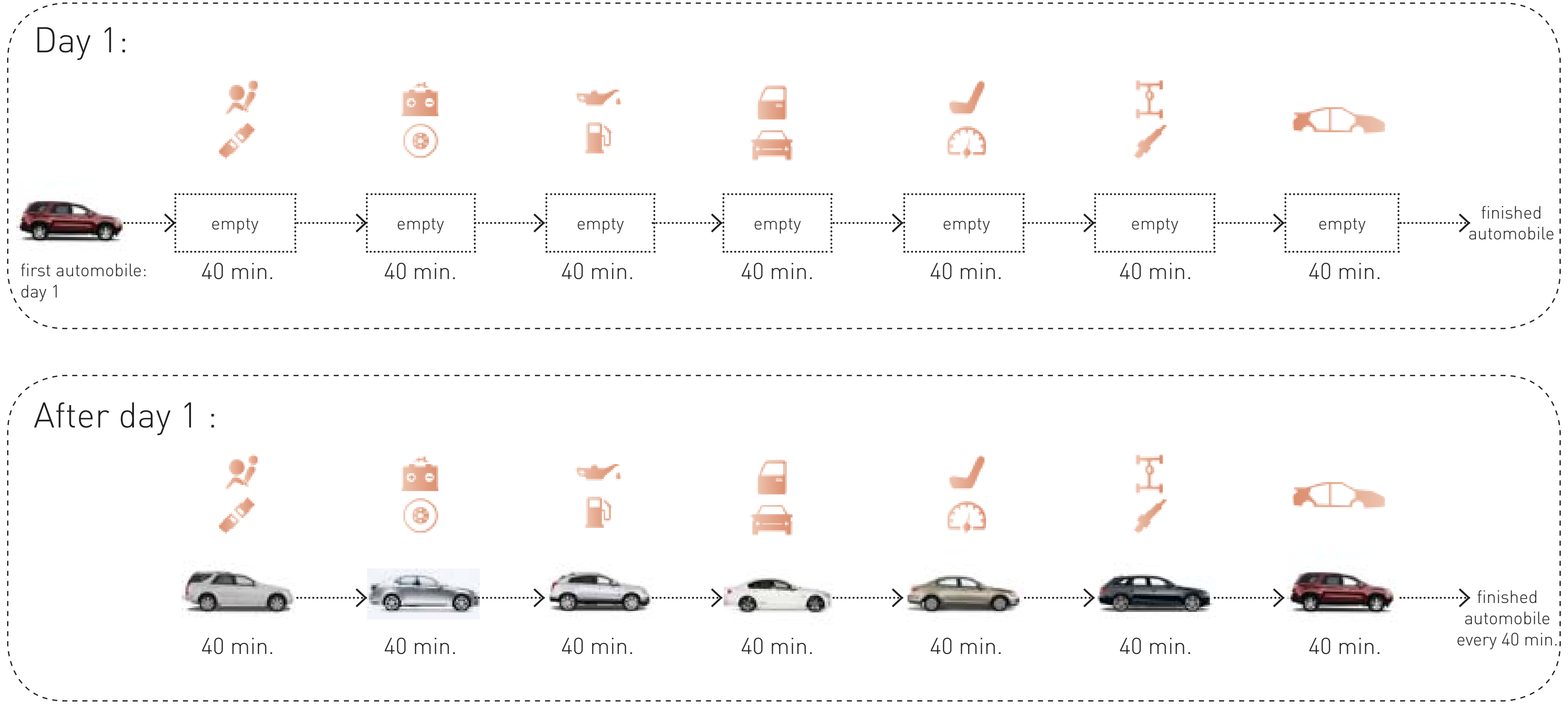


Fig 6.5: Disassembly Rate diagram, Illustrated by Author 2011

»time per process (minutes)

number of workers	1	2	3	4	5
1	85min.	70min.	55min.	40min.	25min.
2	100min.	70min.	50min.	40min.	30min.
3	70min.	55min.	40min.	30min.	20min.
4	100min.	80min.	65min.	50min.	40min.
5	80min.	65min.	50min.	40min.	25min.
6	120min.	90min.	70min.	55min.	40min.
7	40min.	40min.	30min.	30min.	30min.

6.2.4 Process Timing:

Although the plant consists of a number of different machines and equipment, the most important part is the workers who wield the equipment.

The stages of disassembly require a certain amount of labour to be completed. According to Gerhard le Roux (2011) each stage must be assigned a specific number of workers in order for all the stages to be completed in the same amount of time, ensuring a constant flow of automobiles.

The number of workers in the disassembly workshops could be accurately determined once a time/process table was formulated.

Total number of workers (disassembly workshops): 27

Fig 6.6: Process Time table, Illustrated by Author 2011

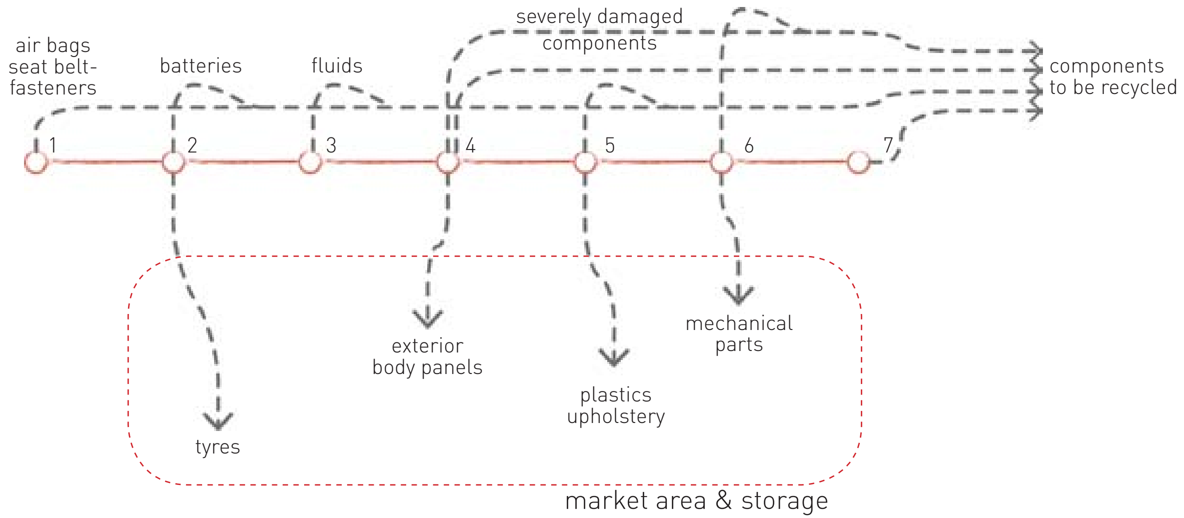


Fig 6.7: Components Circulation diagram, Illustrated by Author 2011

6.2.5 Components Circulation:

Now that the parameters are set for the disassembly process (input), the components and parts from each stage needs to be attended to.

The building's output consists of two divisions:

- Recycling division: Components and parts failing the quality assessment test are sent away to appropriate recycling facilities via railway transport or transported by heavy automobiles.

- Reuse division (Market Area): After the quality assessment test has been passed by components and parts, they are moved to the storage (in existing warehouses on site) and market area, awaiting re-use.

6.2.6 Process Flow:

All the technical parameters are then fused together as a single system / machine.

According to Gerhard le Roux (2011) a process diagram should establish a solid basis when determining the circulation on the site and proposed building as a whole.

The diagram should be simple and clear, with no crossing of process routes, showing the entire system from start to finish.

The process diagram is the main technical design generator, influencing the form, layout, orientation and circulation of the proposed Vehicle Disassembly plant.

In essence, the technical development has formed the concept of the proposed building. The diagram is used as the genesis for the spatial design development, translating it into a building.

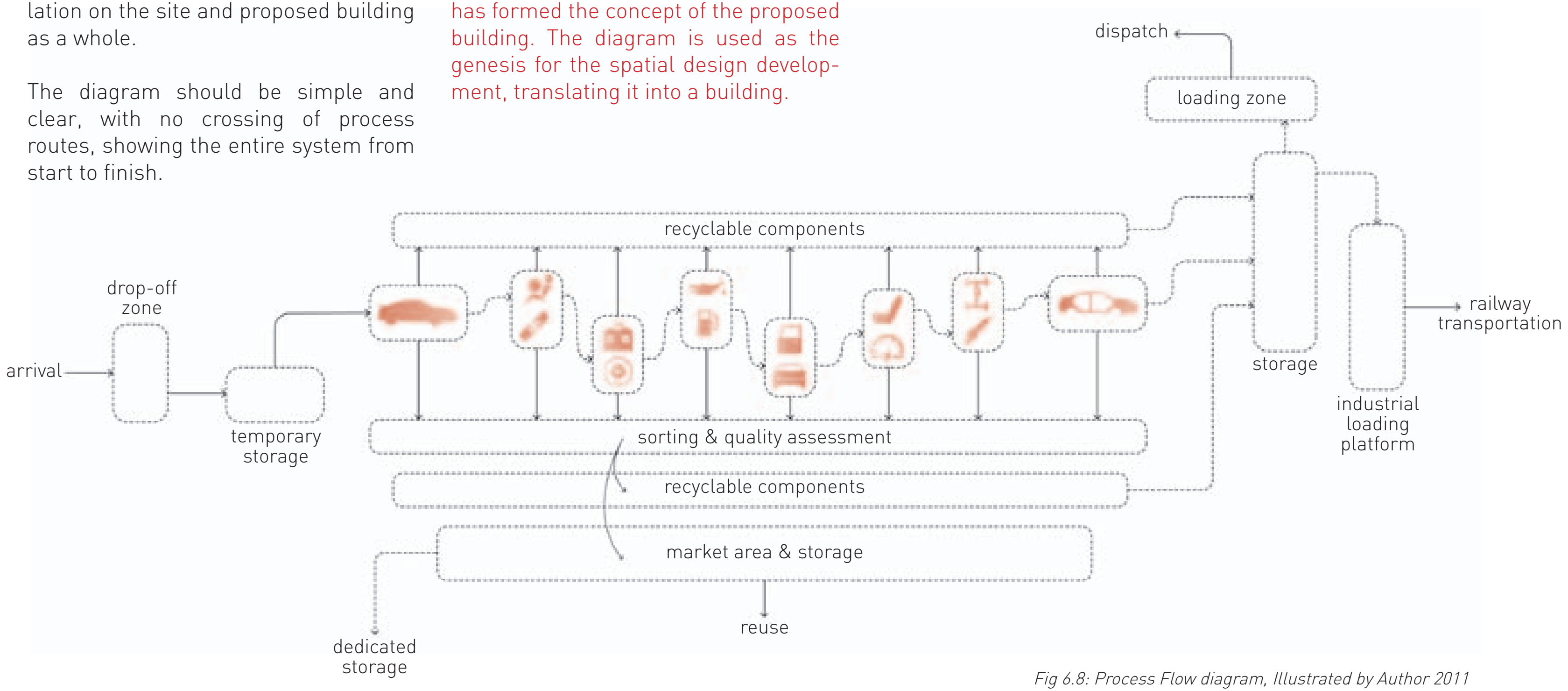
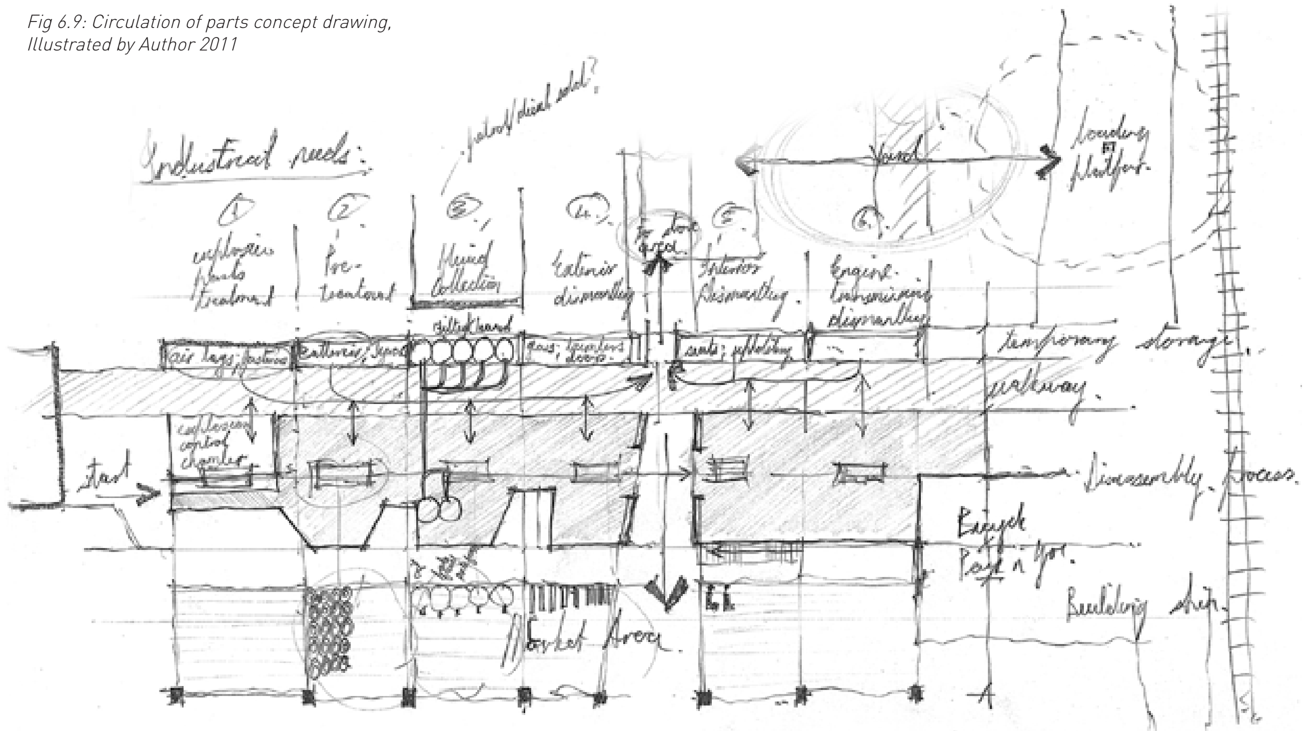


Fig 6.8: Process Flow diagram, Illustrated by Author 2011

Fig 6.9: Circulation of parts concept drawing, Illustrated by Author 2011



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6.3 Spatial Design Development

6.3.1 Project Aims & Objectives:

The objective is the design of a Vehicle Disassembly Plant that responds to the historical context, addresses current cultural and social aspects, whilst adapting over time.

The structure aims to become a liaison between the social and industrial activities of the surrounding setting. Supporting programmes will be positioned alongside the main function (disassembly line) to ensure that the liaison becomes a catalyst for future growth and sustainability of Pretoria West.

This project aims to address the urban context, culturally and historically, by engaging with the local economy of automotive repairs, by adaptive reuse of discarded spaces and transport infrastructure.

As the site is of historic and cultural value to Pretoria West, the design should introduce not only new functions, but also reinstate the historic and existing functions of the site. Through this, the design should ensure the sustainability and adaptability for future functions.

The formulation of development guidelines to ensure lower greenhouse gas emissions will be informed by waste management and recycling strategies, as well as the Green Star SA technical manual (Version 1, 2008) to achieve an industrial building that will function efficiently within its context.

As proposed by studies of ecological construction approach, the materials used will be analysed in terms of life cycle performance and ease of assembly/disassembly on-site, informing the application of materials and the design of the structure. This approach will tie in with the building programme, the reuse and recycling of materials.

The design intends to minimize its embodied energy and carbon footprint, but at the same time, also adapt to the future functions and needs of the context it is placed in.

What will become of the structure in 50-100 years time if the issue regarding end-of-life automobiles has been addressed?

The construction method and detailing of the structure ties in with the theory of products which are designed for disassembly – the entire structure will be designed for easy disassembly.

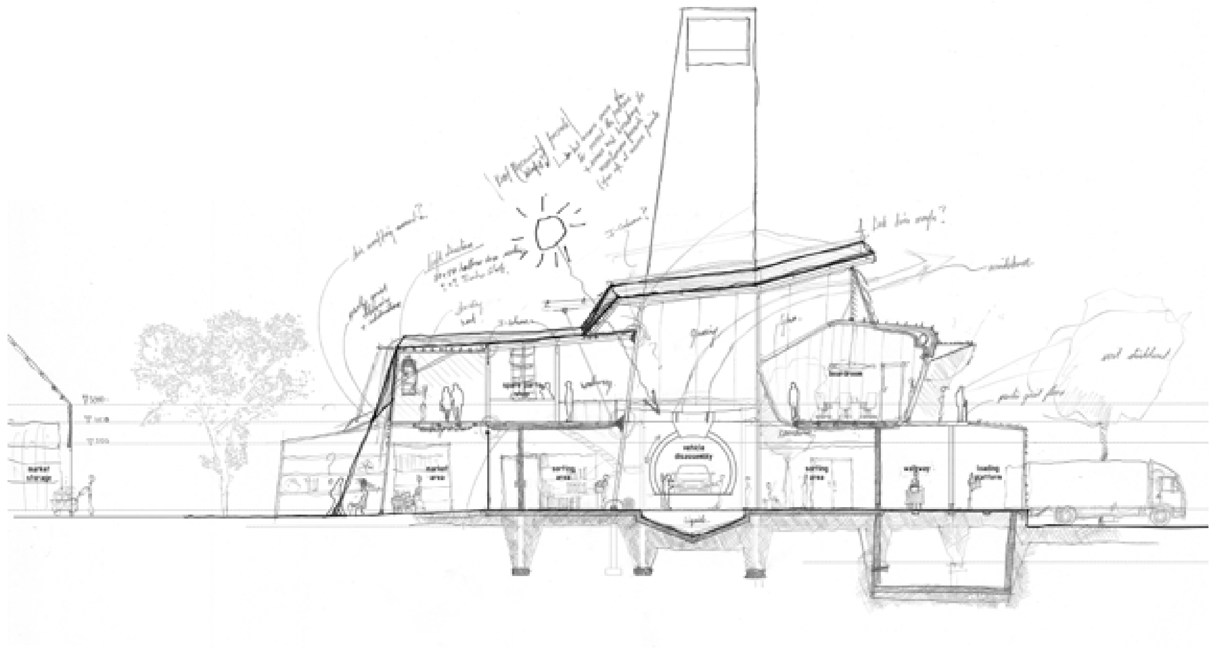

Fig 6.10: Spatial investigation :section drawing, Illustrated by Author 2011

6.3.2 Accommodation & Function:

The design of the plant aims to accommodate major waste management and recycling systems of the surrounding context. The structure will focus on the recycling of automobiles, but the intervention also aims to restore the historic function of the site by providing an important railway transport link for the waste recycling centres of the surrounding area.

The functions of the proposed intervention will be chosen to support one another to ensure economic and social diversity. These functions will stretch further than merely an industrial building, introducing additional functions to enable coherence.

The structure should be able to adapt to different future functions and users, ensuring a generative life-cycle for the building.

6.4 Design Generators

The spatial development process is constructed by a series of inter-connected design generators and investigations:

• *Technical design development*

• *Urban Investigation/Site development:*
-Influences of the existing urban fabric on the site and its surroundings; proposed vision for the area

• *Concept Model Investigation:*
-Development of the building's structure, scale, orientation, layout and circulation

• *Energy efficiency, sustainability: Passive Design Strategies:*
-Including sustainable systems from the start of the design process, opposed to attaching them on the structure after the design process is complete

Fig 6.11: Zeller Street with local automotive fitting centres, Pretoria West, Illustrated by Bertus van Sittert 2010

6.5 Site Development

6.5.1 Study Area:

Due to the character of automotive repairs and industrial processes of the area, the context plays an important role as a design generator.

The study area proved to have numerous urban problems. The investigation of the site and its surroundings gave birth to new opportunities and interventions.

The proposed site plays host to two dissertation projects:

- The Vehicle Disassembly Plant and
- A Production Facility (Gerhard Janse van Rensburg), where automotive parts and components are used to create art forms.

The two projects are seen as one system of inter-depending programmes, working as a whole on one site, rather than two buildings on two separate sites next to each other (refer to Fig 6.59).

Fig 6.12: Pretoria West study area, Pretoria West Group Framework 2011

Fig 6.13: (Opposite) Proposed site with surrounding points of interest, Pretoria West Group Framework 2011

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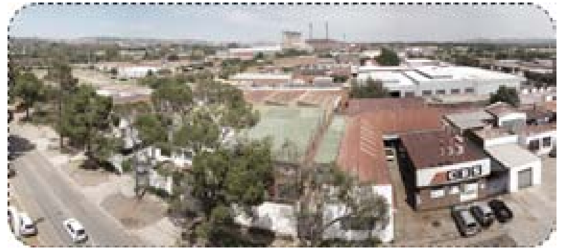


Site in Industrial Context:

The industrial area of Pretoria West can be characterised as a small to medium sized industrial zone, with most of the businesses focussing on repair and maintenance work rather than production.

Proposed Site:

The selected site is currently owned by the Municipality of Tshwane and is used as temporary storage for waste containers.

Goede Hoop Houses:

Once occupied by workers of the railway and industrial area, these houses are dominated by industrial buildings due to the development of the industrial sector.

Railway Service Station:

The site consists of warehouses and materials for maintenance of the railway lines and trains.

Dilapidated Wareho

Re-use of the existing warehouses as spaces for production will be incorporated in the site programme and spatial connection.

Rebecca Station:

Able to serve more than 60% of the surrounding industrial area, Rebecca Station is under-utilised due to the lack of access.

Existing Concrete Platforms:

The concrete platforms indicate traces of the heritage of the site and the connection with the railway line due to the angle on the site. The position of the platforms informs the orientation of the proposed building.

Fig 6.14: Proposed site with surrounding points of interest, Photo collage by Author 2011

6.5.2 *Urban problems associated with the study area:*

1. Vacant Lots
adds to poor urban character of the area

2. Dilapidated Warehouses
structures are no longer in use

3. Rebecca Station
the station is cut off from the precinct & the railway line is no longer used for industrial purposes

4. Shunting Yards
taking up a large area of land

5. Workshops
structures remain empty and unused

6. Mixed Waste Recycling Facility
facility lacks access to appropriate transport

7. Old 'Goede Hoop' Houses
significance of historic houses not celebrated

8. Light Industrial Buildings
poor urban spaces and street edges

9. Department: Water Affairs
private government buildings - no pedestrian access

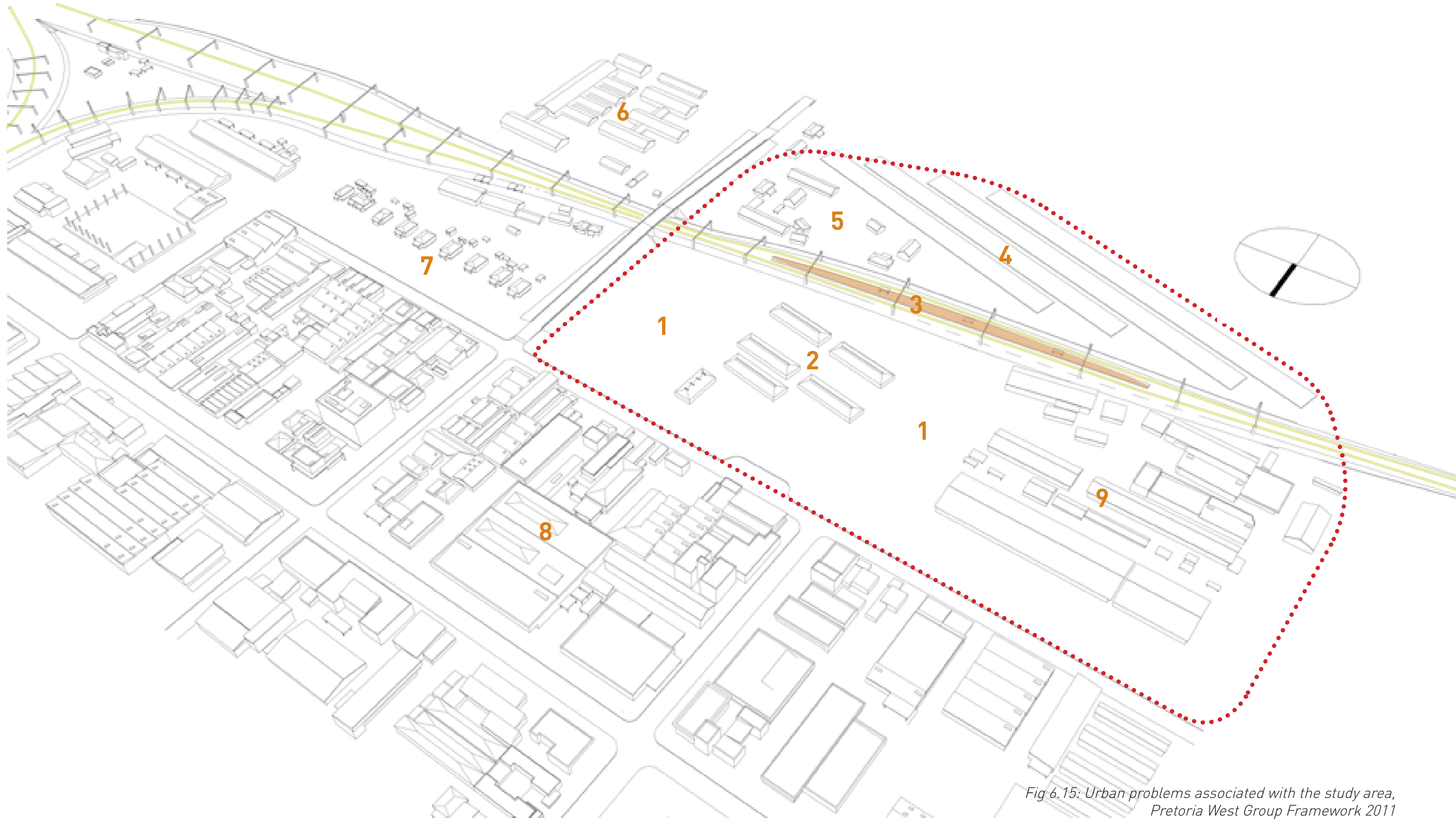


Fig 6.15: Urban problems associated with the study area, Pretoria West Group Framework 2011

6.5.3 *Interventions & Opportunities:*

1_The vacant lot will play host to the proposed *Vehicle Disassembly Plant* with a new connection to the railway line for industrial transport purposes, as well as a link to the proposed pedestrian platform at Rebecca Station.

2_The dilapidated warehouses is transformed into a *Production Facility* by another Masters dissertation project (Gerhard Janse van Rensburg).

3_Rose-Etta Street is extended as a pedestrian boulevard, connecting Rebecca Station to the surrounding area.

4_Development of Park Rebecca as a green space for pedestrians who commute by train.

5_An additional pedestrian platform is proposed to connect with Park Rebecca.

6_Densification of the area by replacing existing workshops with mixed use buildings of an appropriate urban scale.

7_Development of urban agriculture for the proposed housing (part of 6), the proposed Vehicle Disassembly Plant and Produciton Facility.

8_Establish a transport relationship between the proposed industrial transport platform and the Mixed Waste Recycling Facility.

9_Development of active urban edges towards Carl Street.

10_Development of a second access route for the proposed *Vehicle Disassembly Plant (Market Area)* and as a pedestrian route, coming from the East.

11_Proposed new informal trading along the pedestrian boulevard towards Rebecca Station, the informal trading forms the edge of the site.

12_Landscape development of the eastern edge of the site, addressing the slope formed by the bridge crossing the railway line and covering the back yard area.

13_The proposed axis originates from an existing park in the precinct.

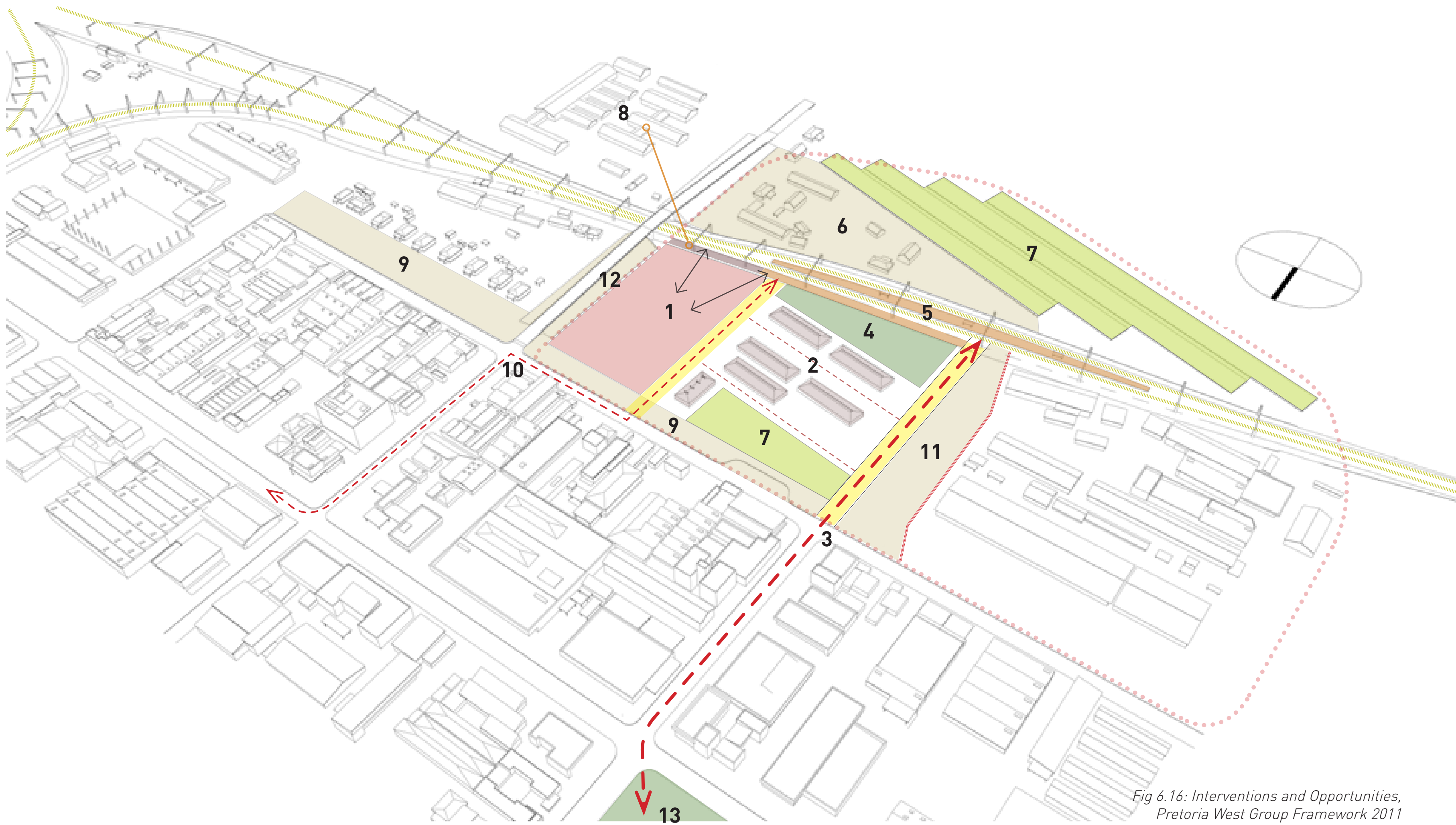


Fig 6.16: Interventions and Opportunities, Pretoria West Group Framework 2011

6.5.4 *Urban Design Development:*

1_Position of new proposed *Vehicle Disassembly Plant.*

2_ Warehouses to be transformed into proposed *Production Facility.*

3_Additional programs on street level part of proposed project.

4_Use existing warehouses as storage for proposed *Market Area.*

5_Proposed industrial platform for transport of materials and parts.

6_Existing Eucalyptus 'Blue Gum' Trees with additional landscaping.

7_Park Rebecca incorporated into proposed buildings.

8_Landscaping alongside pedestrian boulevard and informal market.

9_New proposed pedestrian platform to be incorporated with proposed buildings.

10_Proposed new mixed-use building footprints.

11_Agriculture ties in with the theme of production and self-sustainability of the site.

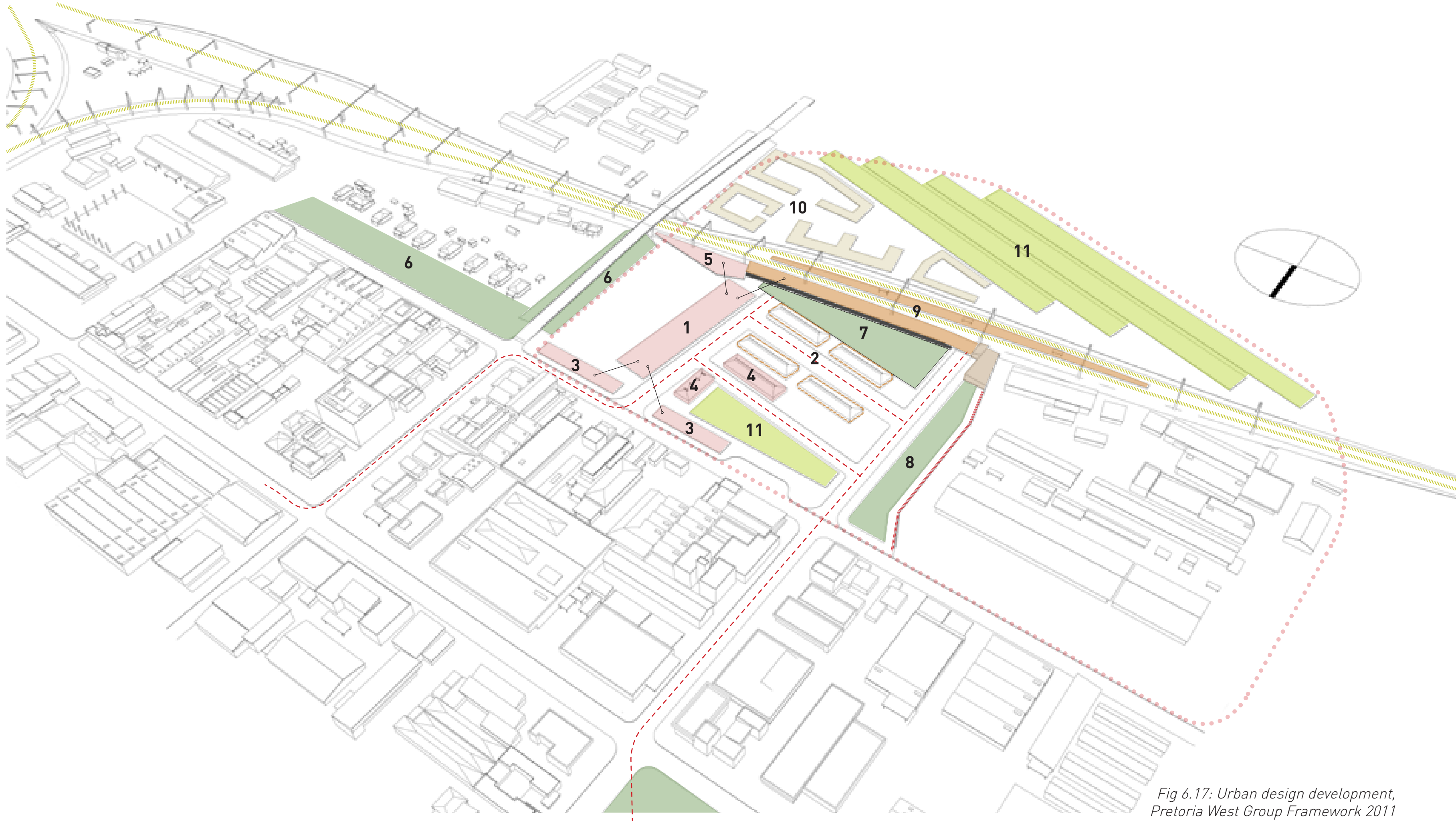


Fig 6.17: Urban design development, Pretoria West Group Framework 2011

6.5.5 *Massing & Scale:*

1_Development of proposed *Vehicle Disassembly Plant* position on site in relation the structures on site.

2_The design of the proposed *Production Facility* features an axis which connects the pedestrian platform (11) with the proposed taxi drop-off zone (14).

3_Activated urban edge on Carl Street.

4_The existing warehouses will be refurbished to accommodate storage of automotive parts for the *Market Area.*

5_The *Market Area* is located along the pedestrian access route between the two proposed projects.

6_The industrial loading platform.

7_Landscaped edge.

8_Park Rebecca.

9_Informal trading and pedestriran boulevard.

10_Station services: ticket sales; toilets; information.

11_Rebecca Station.

12_Mixed-use building between 3-6 storeys.

13_Agriculture.

14_Proposed taxi drop-off zone.

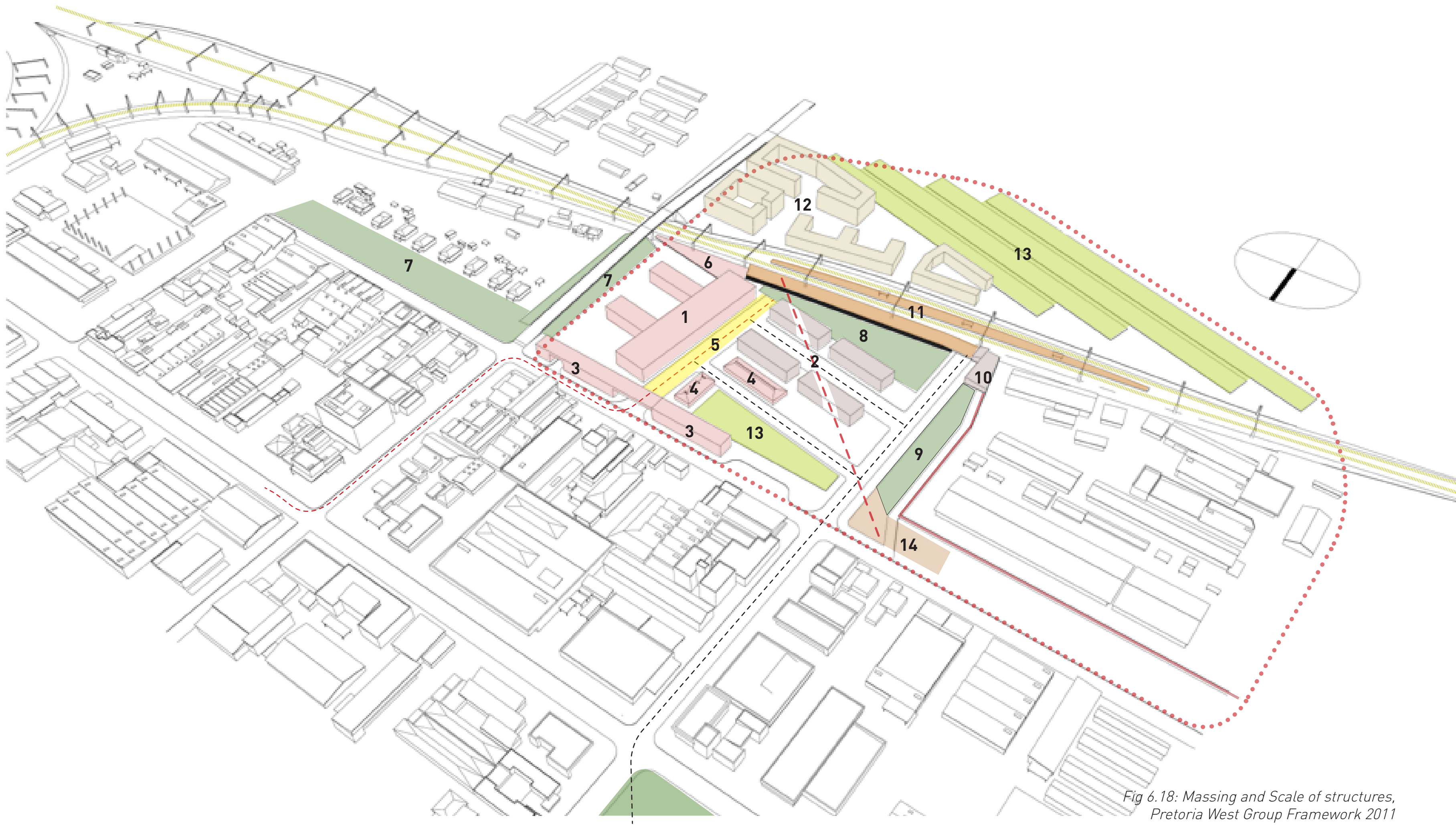


Fig 6.18: Massing and Scale of structures, Pretoria West Group Framework 2011

6.5.6 Site Spatial Development:

Due to the site size and orientation of the two interventions, the spaces between each intervention become an important spatial connector.

The synergy between the programmatic responses allows for the interventions to partly share functions and for users to move between buildings.

Both interventions relate to the recycling of automotive parts, collectively articulating the urban space through adaptive reuse of materials.

1_*Vehicle Disassembly Plant* (Marius Snyders)
2_*Production Facility* (Gerhard Janse van Rensburg)
3_Rebecca Station
4_Industrial Loading platform with crane structure
5_Back Yard area: Movement for trucks
6_Access to yard area
7_Market Storage: Refurbish existing warehouses
8_Agriculture: Utilising old tyres for planting purposes
9_Park Rebecca
10_Informal Trading
11_Building connected with pedestiran platform

Axis A-A_Pedestrian boulevard: Extension of Rose-Ette Street
Axis B-B_Market Area: Paved access road for pedestrians and automobiles (delivery/pick-up)

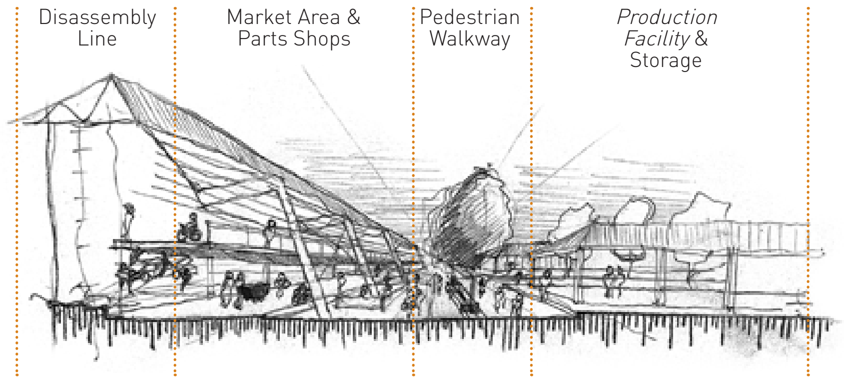


Fig 6.19: Conceptual section through market area, Illustrated by Author 2011

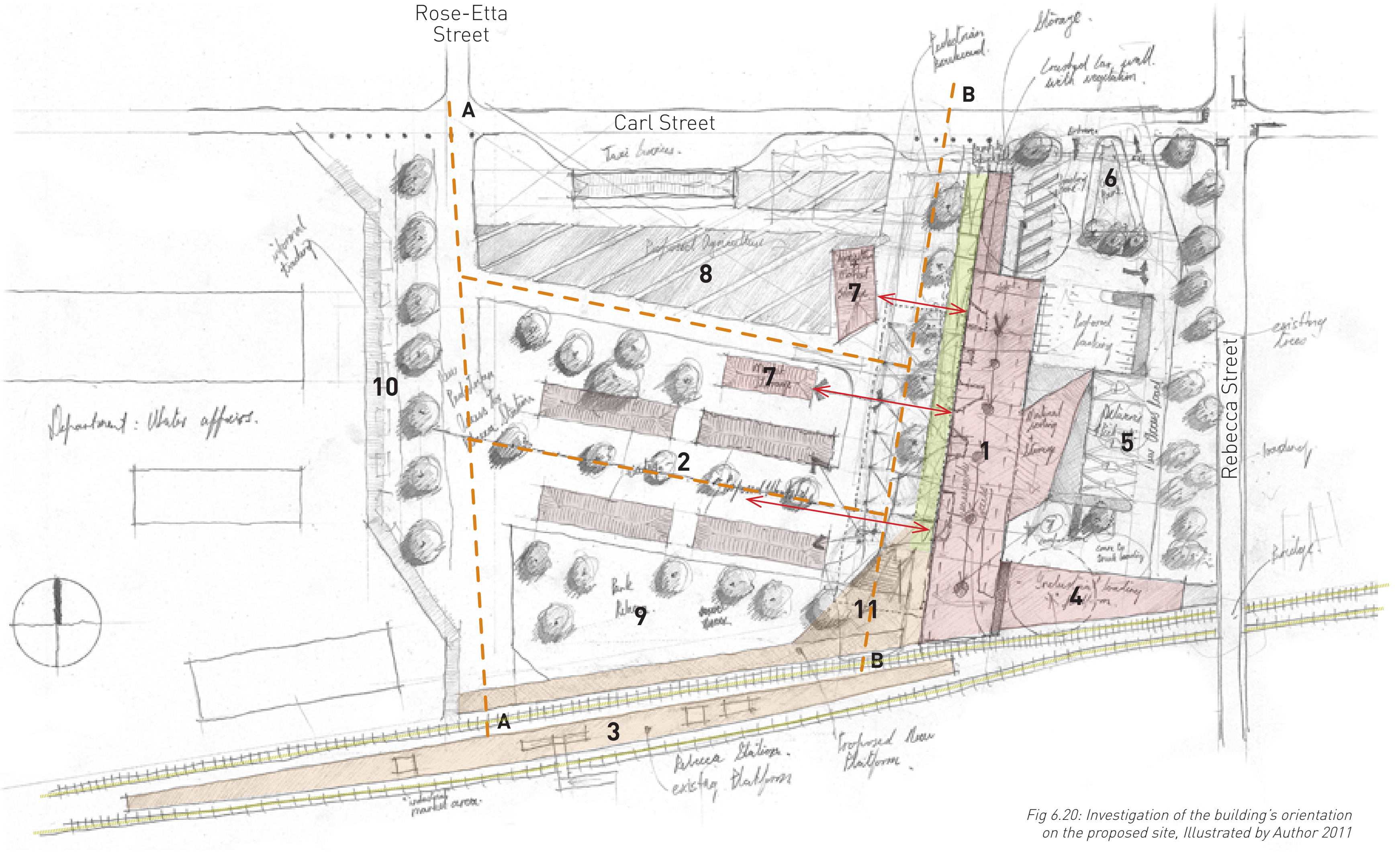


Fig 6.20: Investigation of the building's orientation on the proposed site, Illustrated by Author 2011

6.6 Concept Development

6.6.1 Building Core:

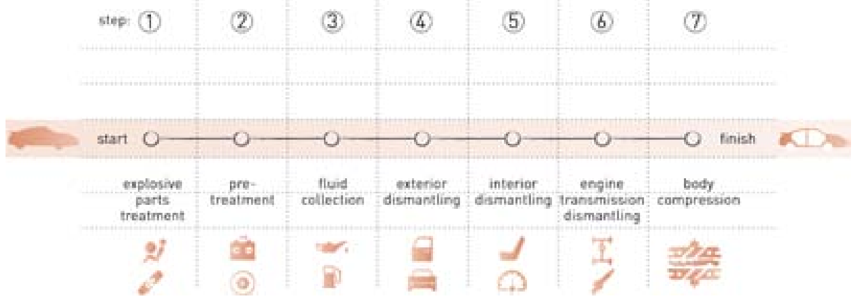
The long and linear form of the building is dictated by the disassembly process (7 stages), which forms the core of the building.

6.6.2 Industrial Circulation:

Each stage of disassembly acts as a point of distribution from where parts move (see 6.2.5 Components Circulation)

Fig 6.21: (Top) Disassembly line, Illustrated by Author 2011

Fig 6.22: (Bottom) Component circulation diagram, Illustrated by Author 2011



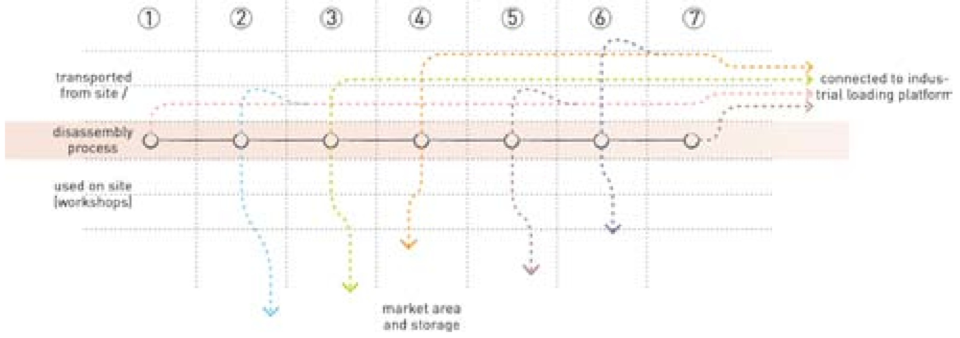
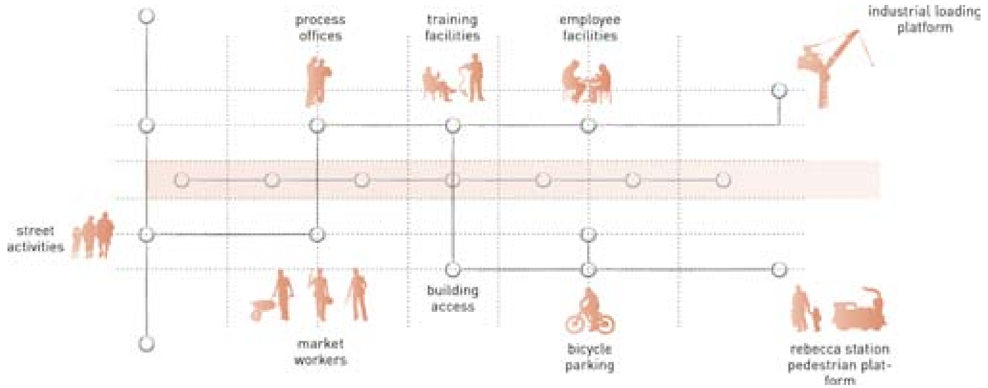
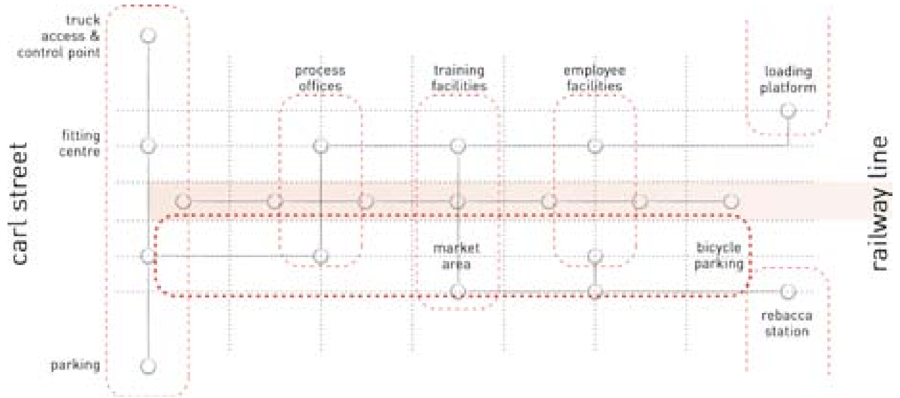


Fig 6.23: (Top) User circulation, Illustrated by Author 2011

Fig 6.24: (Bottom) Cross Programming, Illustrated by Author 2011





6.6.3 User Circulation:

Circulation of the building users (members of the public and the employees) is superimposed on the industrial process, determining public and private spaces within the structure.

6.6.4 Cross Programming:

Starting to orientate the social and administrative programs around the building core.

Concept Model 1

6.6.5 Imposing Structure:

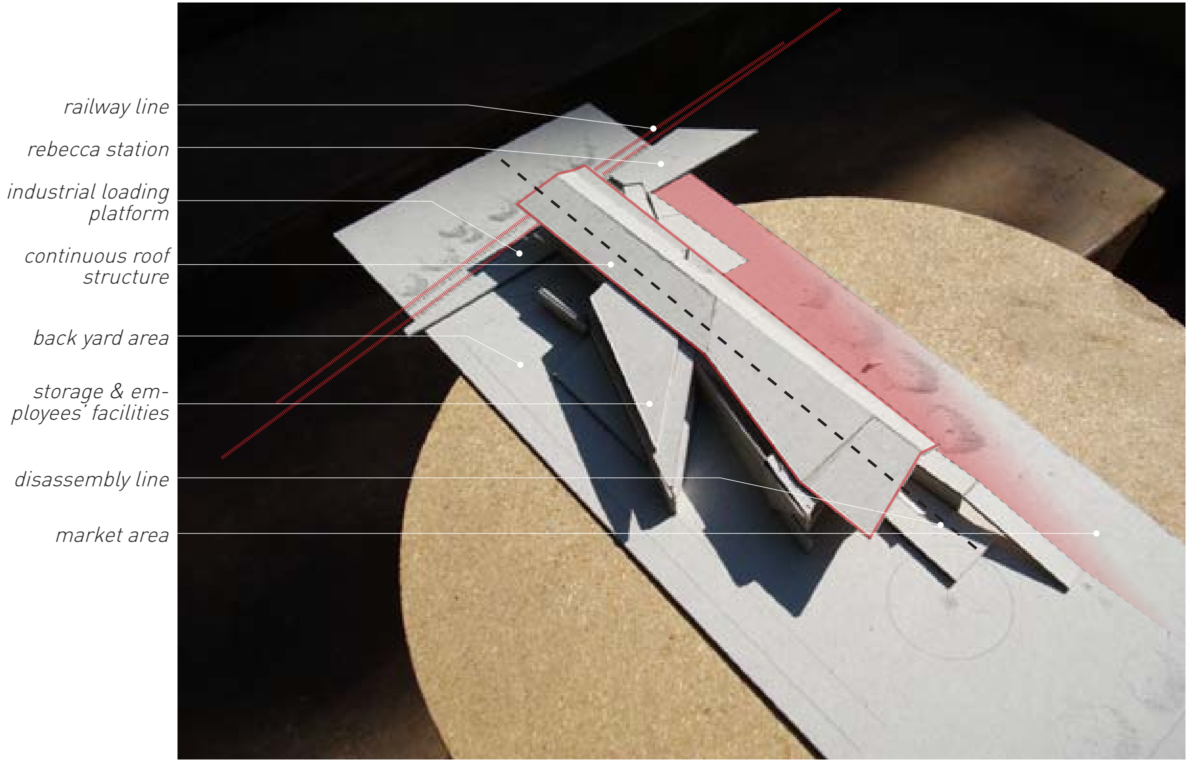
The first concept model aimed to transform the investigated technical flow diagrams and informants into a structure.

The structural approach was to design a building which stands out in its surroundings, a landmark in a context with little urban character. The form of the building was very brutal and imposing in its scale and sharp angles.

The structure consisted of the disassembly line at its core, covered with a single, continuous roof structure.

A separate volume extruding from the eastern façade was dedicated to storage, employees' facilities and other administrative programs on first level.

Fig 6.25: Concept model 1: basic layout, Model by Author 2011



The access route leading from street level towards the pedestrian platform at Rebecca Station aims to be connected by the market.

Movement along the western façade next to the market area would form visual connections with the disassembly process, and through this, generating conversation that would interweave the disassembly process into the urban fabric.

However, it was found that the building's edge was to linear. The process and social activities called for a threshold space to connect these two programs spatially.

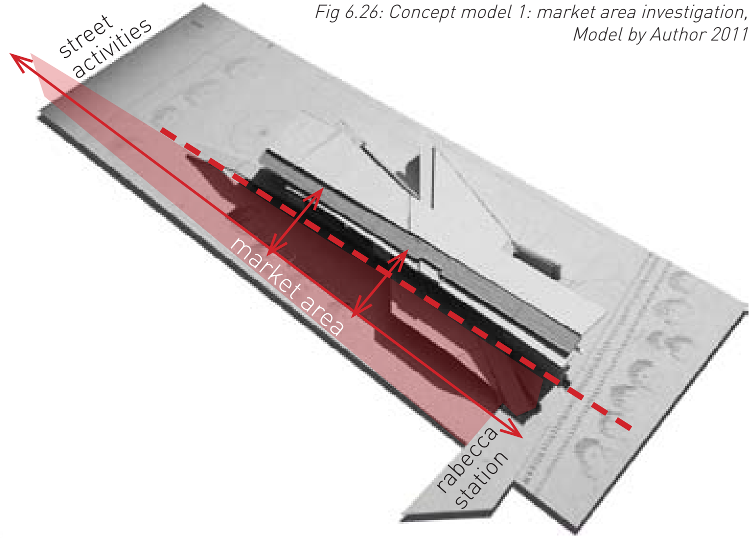
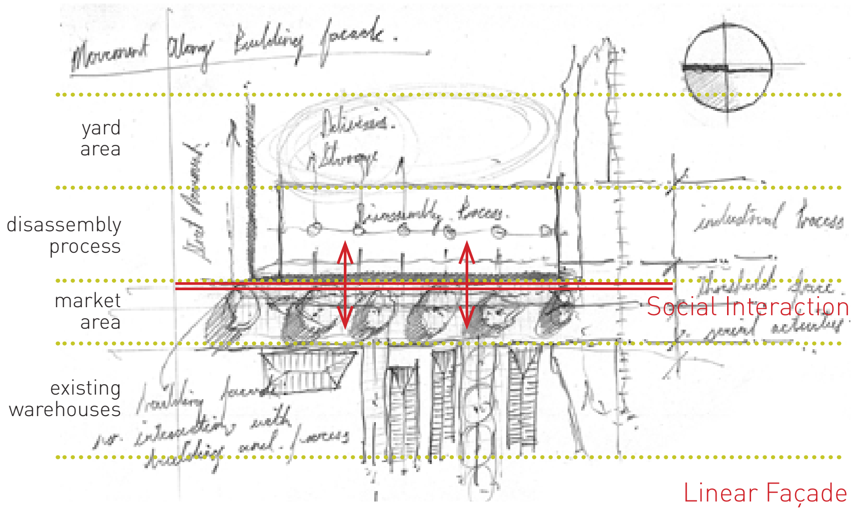


Fig 6.26: Concept model 1: market area investigation, Model by Author 2011



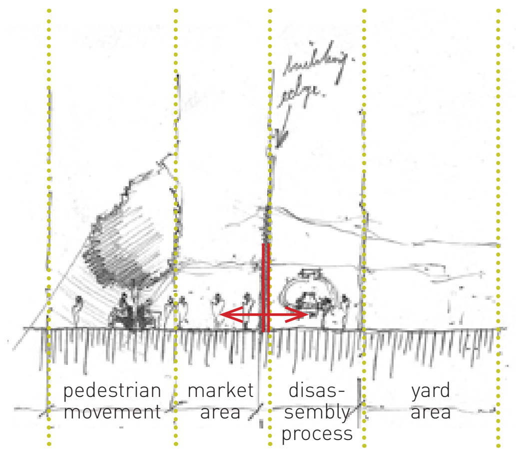
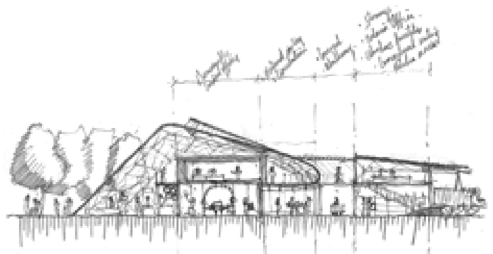


Fig 6.27 & Fig 6.28: Concept drawing of market area, Illustrated by Author 2011



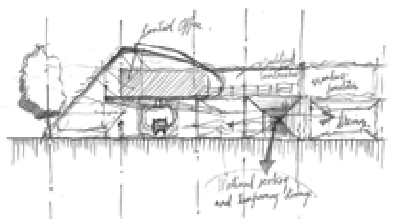


Fig 6.29: Investigating different roof structures, Illustrated by Author 2011

The model started to investigate the circulation within the structure. Access to the building was provided by a ramp stretching from the pedestrian platform into the structure, with another ramp connected to street level.

In order to prevent the building from becoming a 'factory' without any social interaction, additional programs like a café, green spaces and a bicycle parkade was added to the western edge of the disassembly plant.

The initial idea was to draw people who commute by train into the building by providing a bicycle 'park-and-ride' service. A day pass can then be bought to commute to the factories or business within the precinct and back to the plant/station by bicycle.

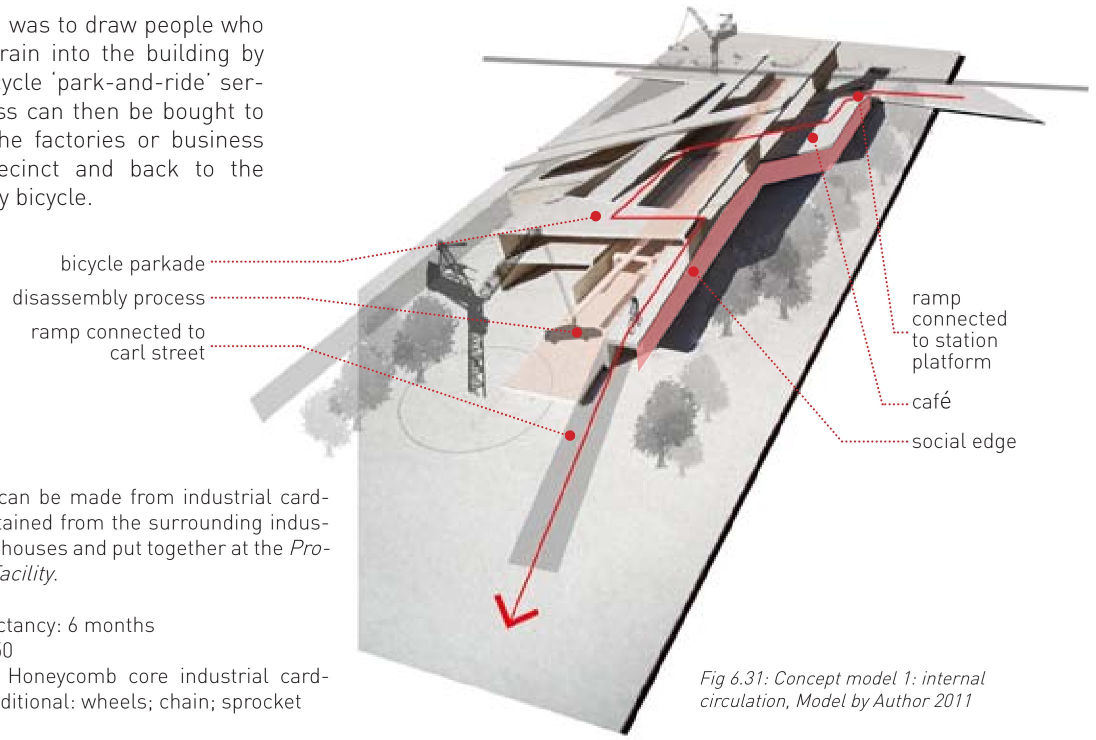


Fig 6.31: Concept model 1: internal circulation, Model by Author 2011

Industrial Cardboard Bicycle

Fig 6.30: Industrial Cardboard Bicycle (Inhabitat 2009)

Bicycles can be made from industrial cardboard obtained from the surrounding industrial warehouses and put together at the *Production Facility.*

Life expectancy: 6 months
Cost: R150
Material: Honeycomb core industrial cardboard; additional: wheels; chain; sprocket

The bicycle 'park-and-ride' would create a space within an industrial building where people move through on foot or bicycles, whilst, in the background, automobiles are disassembled.

Interplay between the disassembly line and the provision of a new sustainable and inexpensive transport mode starts to be created within the structure.

Fig 6.33: Conceptual section with threshold spaces, Illustrated by Author 2011

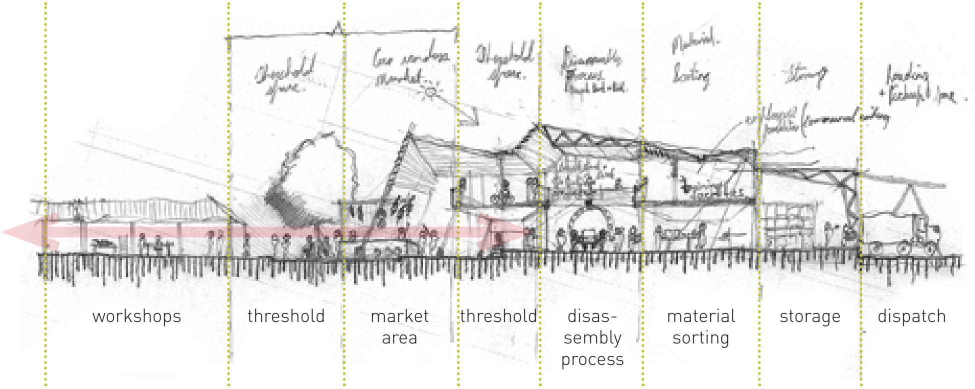


Fig 6.32: Industrial loading platform with crane structure, Illustrated by Author 2011

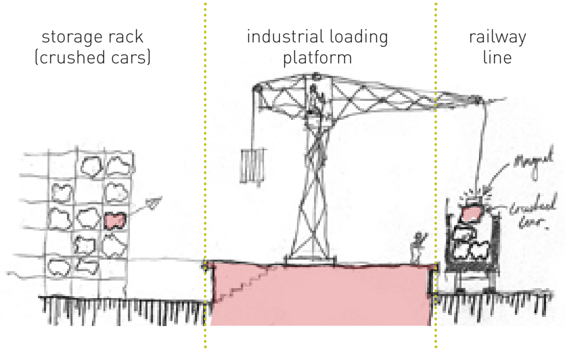


Fig 6.34: Concept model 1: internal circulation, Model by Author 2011

Concept Model 2

6.6.6 Fragmented Structure:

The second approach continued with a similar orientation on the site. However, the solid and brutal planes of Concept Model 1 have been fragmented into small, finer grained planes which wrap around the main structure.

The fragmented structure aims to tie in with the building program of disassembly by exposing the tectonics of the building.

The relationship between the social (yellow) and industrial (orange) circulation/programming were investigated.

With reference to the BMW Central Building precedent study (page 96), the internal organisation is designed to create a constant connection between the process and the social programs. Walkways and thresholds on different levels are designed to achieve this.

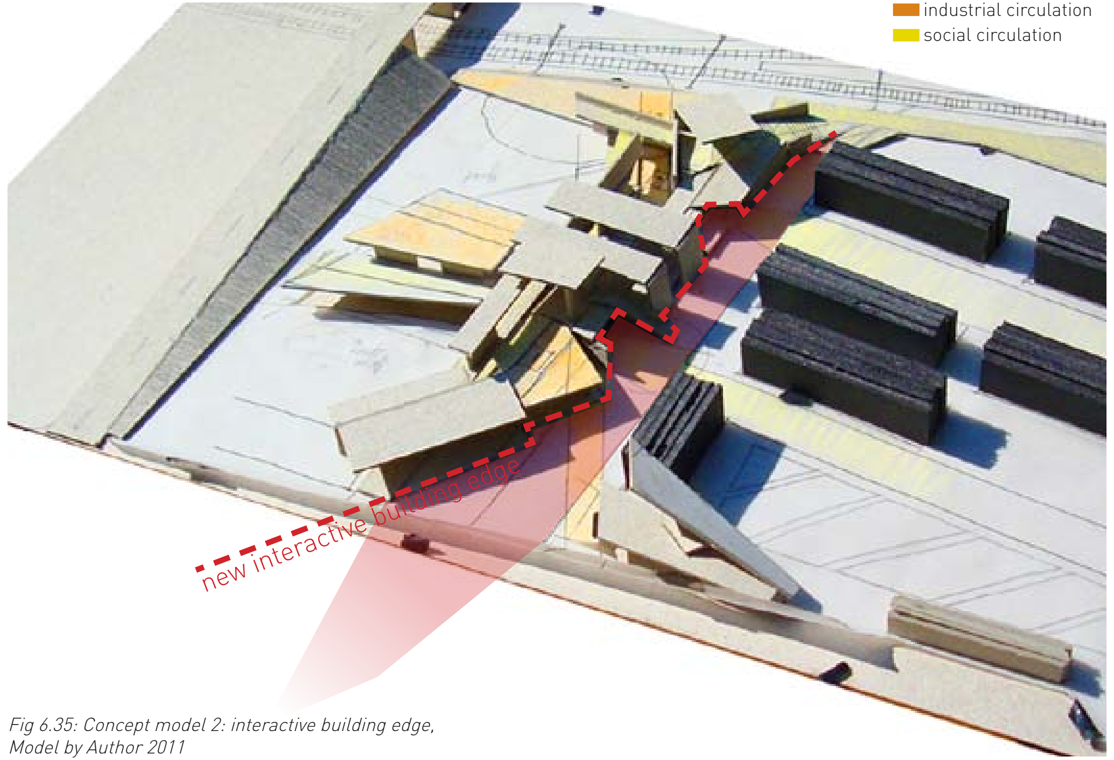


Fig 6.35: Concept model 2: interactive building edge, Model by Author 2011

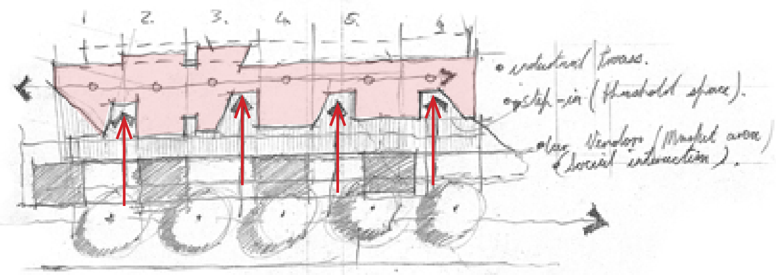
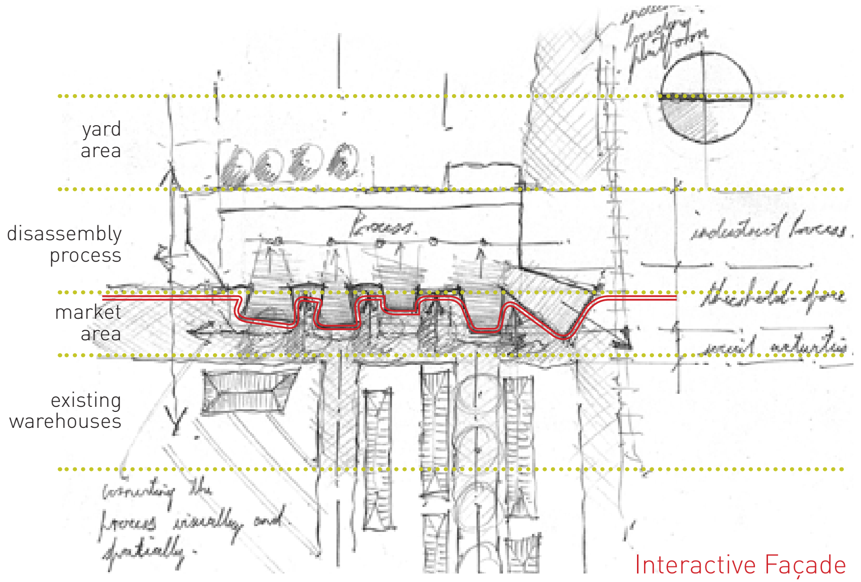


Fig 6.36: Stepped building edge, Illustrated by Author 2011



The building aims to expose the process of disassembly towards the market area by opening up the façade. Market users will constantly be aware of the processes taking place inside the structure.

The linear façade of Concept Model 1 towards the market area has been stepped to create a series of smaller spaces along the building's skin, drawing the outside spaces closer to the structure and disassembly process.

Some of these smaller spaces are dedicated to the market area, while others aim to open up as access cores to the building.

Fig 6.37 and Fig 6.38: Interactive façade as a threshold space, Illustrated by Author 2011

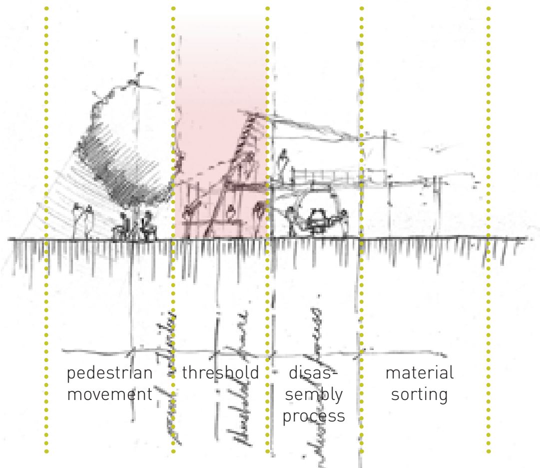


Fig 6.39: Fitting centres in Zeller Street, Pretoria West, Photos by Author 2011

The interaction between the street edge and the structure was investigated. The big industrial structure should connect to the street on a sensitive level with the appropriate scale and supporting programs.

A fitting centre was introduced to accommodate the market area if automotive parts needed to be installed on automobiles.

The urban quality of Pretoria West of fitting centres opening up onto the street is captured here, also forming/framing the entrance to the market area.

With reference to the Wannenburg Scrapyard precedent study (page 90), the administration offices and reception counter will be the first contact from street level.

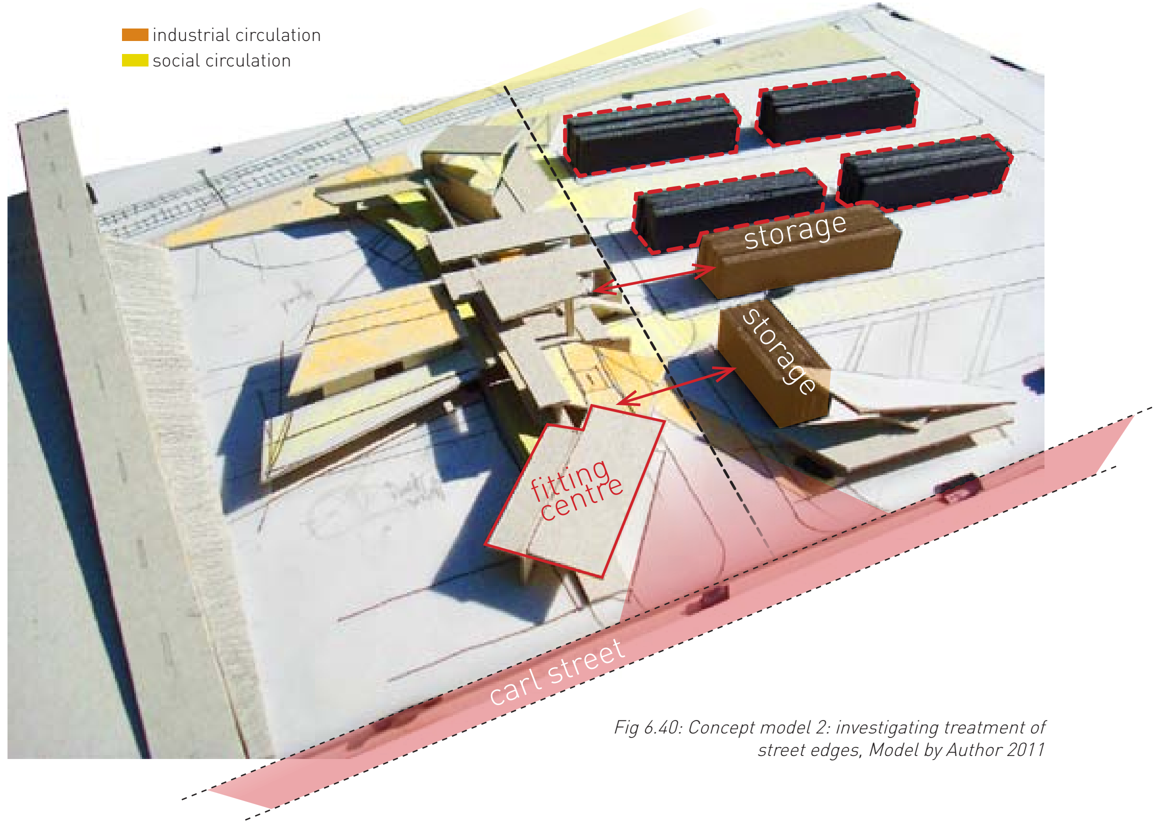
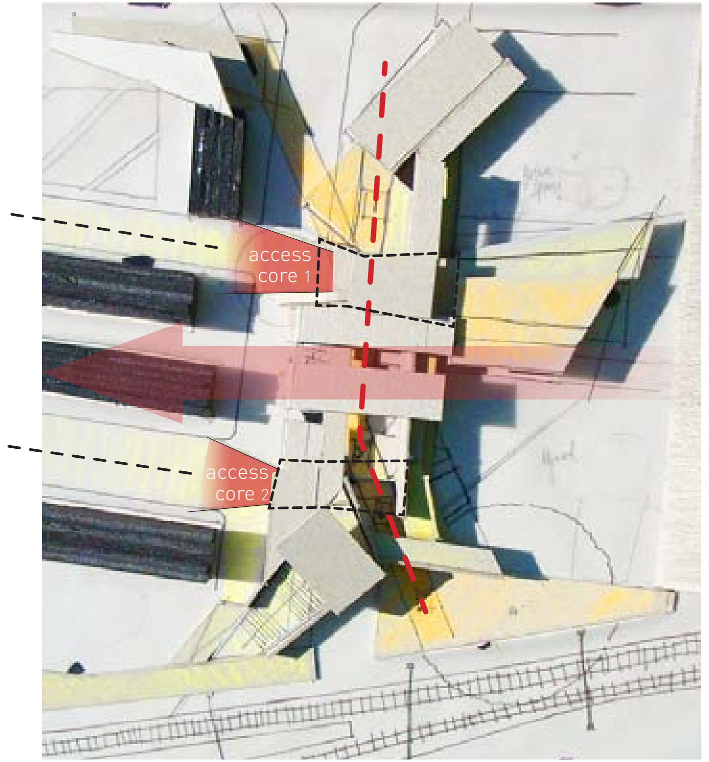


Fig 6.40: Concept model 2: investigating treatment of street edges, Model by Author 2011

Fig 6.41: Concept model 2: building access cores, Model by Author 2011



The two access cores line up with the pathways formed by the existing warehouses. These cores are connected to a network of elevated walkways within the structure.

Threshold spaces are formed where the yellow walkways cross/connect to orange spaces - the industrial processes are not directly accessible to the general public due to safety regulations.

However, the structure is perceived as a transparent arrangement of spaces when moving through it due to the structure's steel construction (Chapter 7 - Technical Development).

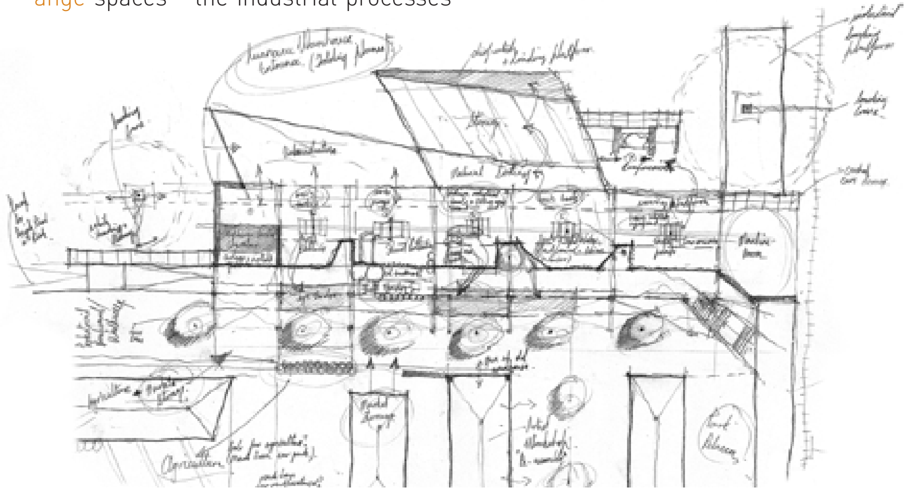


Fig 6.42: Concept drawing of the building layout, Illustrated by Author 2011

Concept Model 3

6.6.7 Combination of Structures:

The third approach aimed to combine valuable lessons learned from Concept Models 1 and 2:

The building as a landmark within its context has been maintained, however the imposing structure proved to hinder the functionality of the process. The sharp edges and angles of the structure resulted in awkward spaces for a process inside the building. A more conservative approach has been opted for.

The stepped building façade and fragmented building structure from Concept Model 2 have been incorporated in this investigation. Exposure of the structural tectonics and display of the disassembly process has also been included in Concept Model 3

The model revisited the core concept of the seven stages of disassembly and the flow/circulation of parts.

These two fundamental concepts were connected back with the idea of stepping the building edge and a fragmented structure.

The structure aimed to articulate every stage of disassembly as a separate workshop, but, at the same time, connecting the structure as one entity.

Offsetting each stage from the process line with the different floor areas (page 114-115) meant that new spaces were starting to be formed along the structure.

* Only six stages form part of the building in this concept, stage 7: *Body Compression* has been incorporated with the industrial loading platform next to the railway line

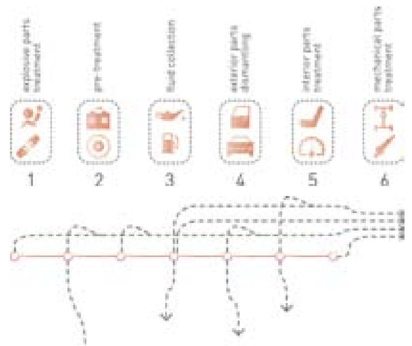


Fig 6.43: (Above) Flow Diagram, Illustrated by Author 2011

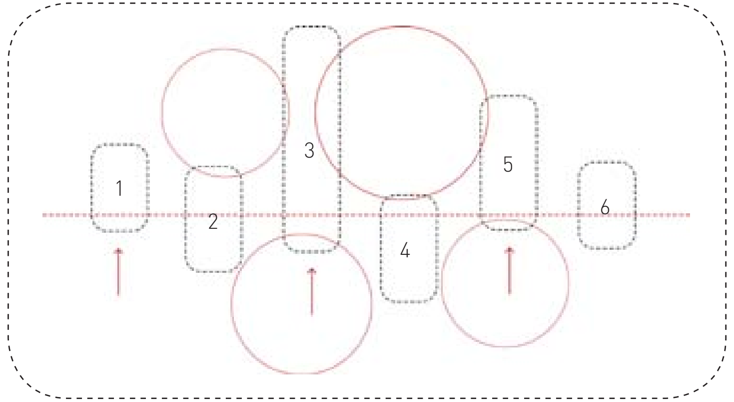


Fig 6.44: Parti Diagram, Illustrated by Author 2011

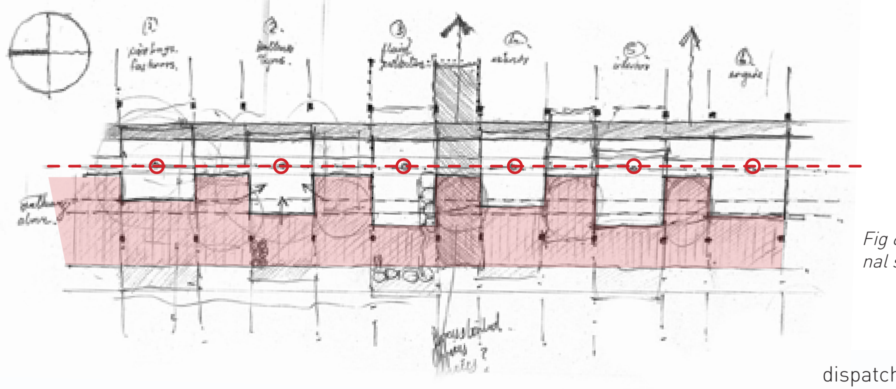


Fig 6.45: Concept drawing of internal and external spaces, Illustrated by Author 2011

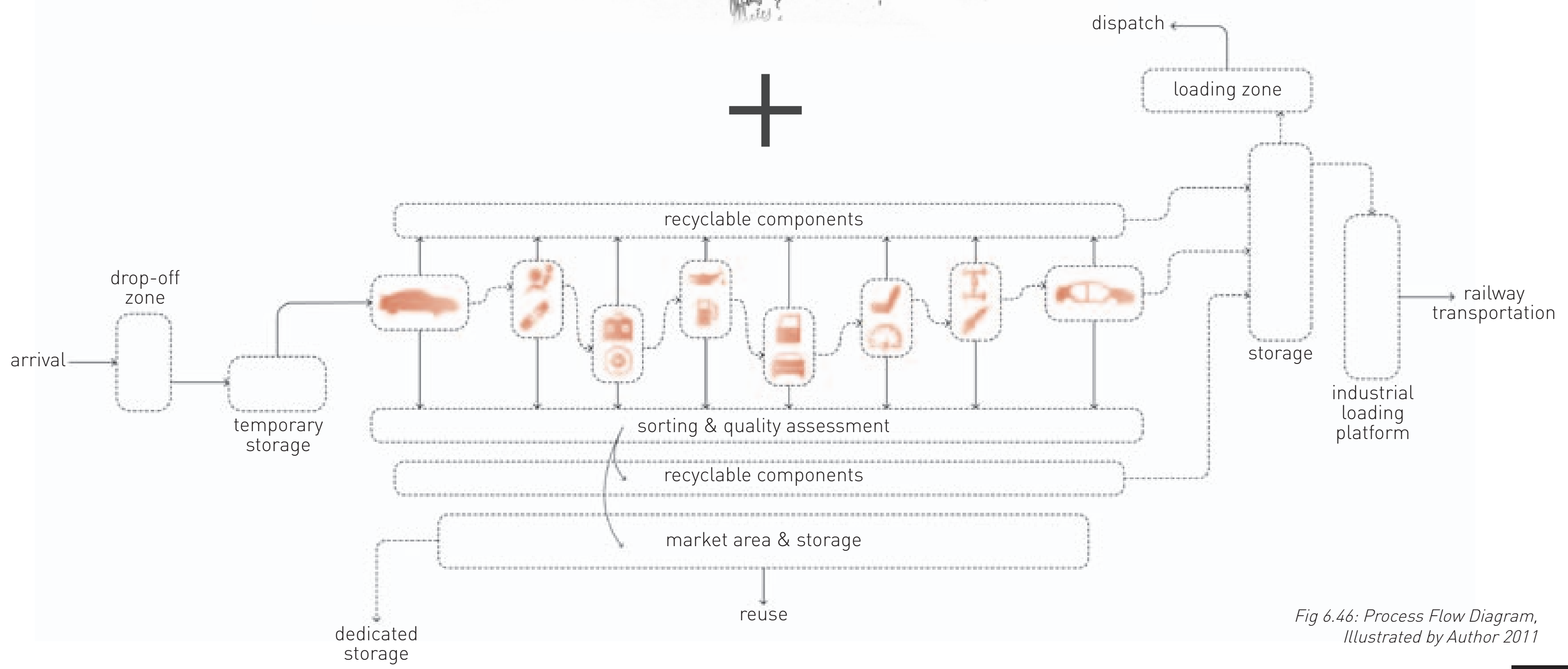


Fig 6.46: Process Flow Diagram, Illustrated by Author 2011

The concept was further developed into a sketch where the layout of the building plan started to display the relationship between Concept Model 3 and the process diagram.

The spatial layout of the yard area started to take form, looking at the circulation (turning circles) of trucks for deliveries and pick-ups.

Facilities for the employees (rest rooms, lockers, bathing facilities, communal eating hall and kitchen) are extended to the east, extruded as a separate volume. Through this, the employees are separated from the industrial process during lunch breaks, also, providing the space with enough exposure to daylight.

The workshop area, where repair work is done, is treated in a similar fashion. The two volumes frame a social green space for the employees and is covered from the yard area with trees and landscaping.

Fig 6.47: Site circulation and plan layout, Illustrated by Author 2011

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Composition of Concept:

1_Disassembly line
2_Circulation corridor for recycled materials
3_Multi-functional tower with 'wind catcher'
4_Fitting Centre
5_Start of disassembly line
6_Emplyees' Facilities
7_Workshop/Laboratory
8_Market Shading structure
9_One of seven disassembly workshops
10_Rebecca Station

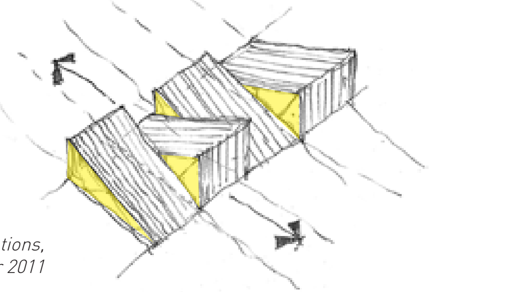


Fig 6.48: Module configurations, Illustrated by Author 2011

Concept Model 3 is constructed with a series of steel structures wrapping around each step of disassembly. By moving the structures away from each other, daylight can filter through into the structure.

The market structure aims to act as a shading device for the building's western façade and forms spaces for the display of parts in the market area.

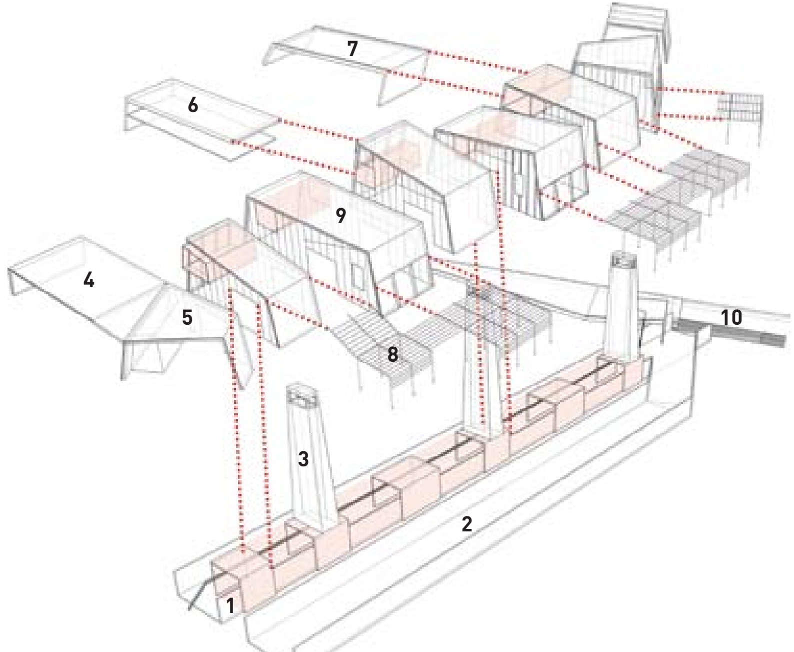


Fig 6.49: Composition of concept model, Model by Author 2011

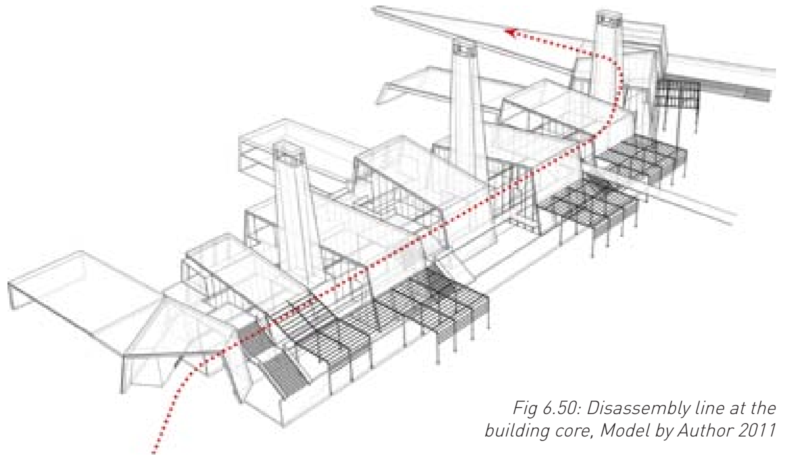


Fig 6.50: Disassembly line at the building core, Model by Author 2011

Tower Structures:

With reference to the *Centre for Global Ecology* precedent study (page 108), three tower structures has been introduced as part of the structure.

The main function of these towers is to extract heat, generated in the workshops. This extraction of heat forms part of a trombé stack, and the system is situated on the plane facing north.

The second function is to cool down the workshops in warm summer months. The system is composed of an evaporative cooling tower, and is situated on the cooler southern face of the main tower structure.

The towers will be designed to enhance the idea of the structure as a landmark in Pretoria West.

*The tower structures will be discussed in detail in Chapter 7 - Technical Development

Fig 6.51 and Fig 6.52: Passive cooling system - Evaporative cooling tower, Model by Author 2011

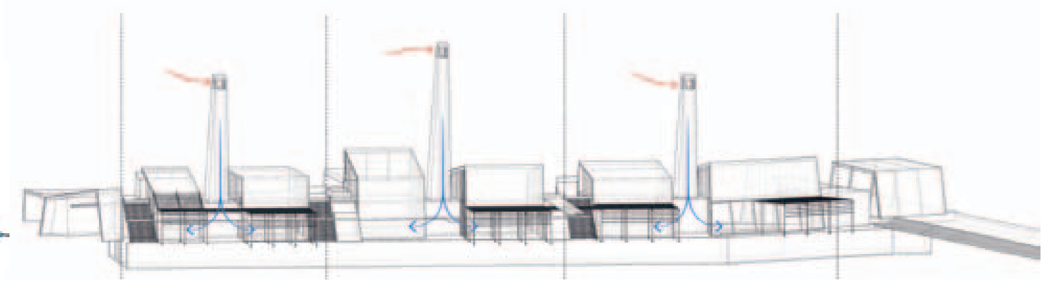


Fig 6.53: Centre for Global Ecology (Carboun 2010)

Fig 6.54: The burj al hawwa (Rafeek Manchayil 2010)

Fig 6.55: A portion of the old quarter of Dubai, Near Creek (Rmnathan 2010)

Fig 6.56: Concept model 3: view towards the market area, Illustrated by Author 2011

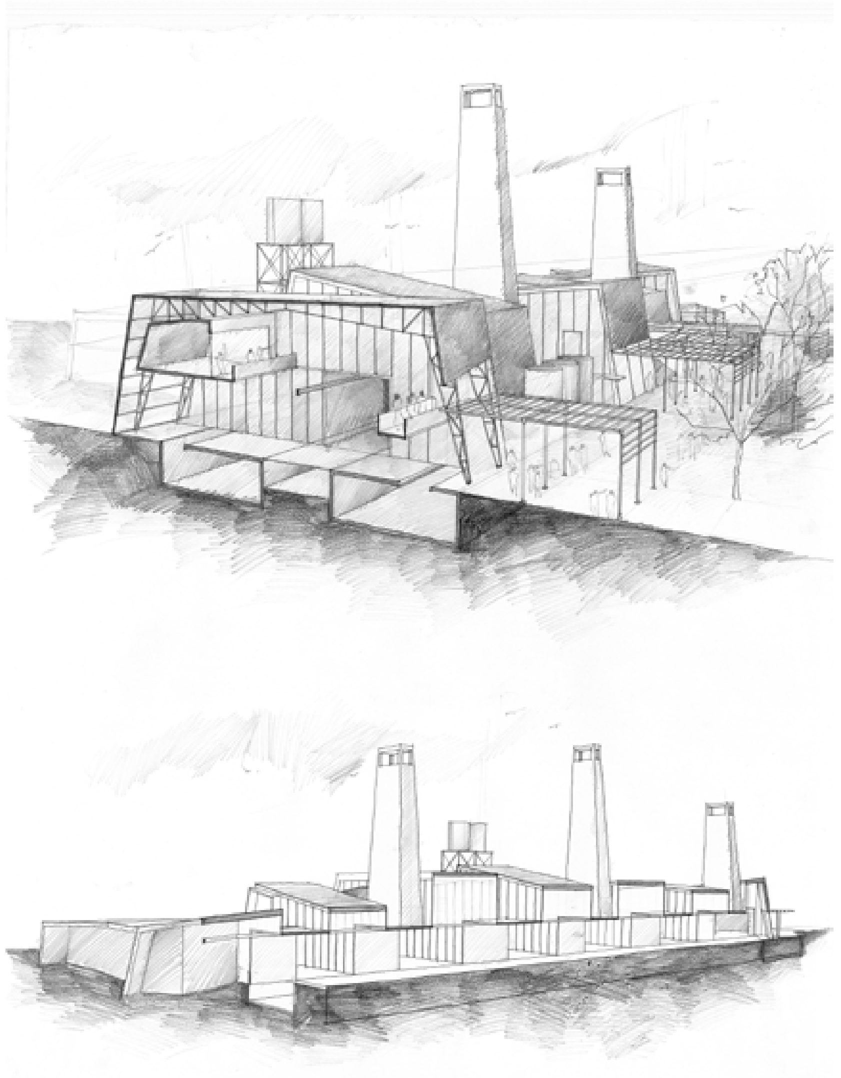


Fig 6.57: Concept model 3: section drawings, Illustrated by Author 2011

Proposed Building Programs

1 *Disassembly process:*
- Drop-off zones
- Automobile logging office
- Temporary storage
- Disassembly workshops
- Material / Component sorting
- Repair workshop / Quality assessment
- Storage
- Electrical / Machine room
- Deliveries & Dispatch / Waste collection

2 *Yard Area:*
- Access for heavy automobiles
- Industrial loading platform
- Crane structure
- Temporary storage
- Loading Zone
- Waste Collection

3 *Employee facilities:*
- Training facilities
- Rest rooms
- Locker rooms / Shower facilities
- Communal kitchen & eating hall
- Outdoor green space & social area

4 *Administration*
- Admin / Management offices
- Boardroom
- Process offices

5 *Market area:*
- Car parts shops
- Market storage
- Pay points

6 *Fitting Centre:*
- Workshops
- Reception & Waiting area
- Rest rooms
- Management Office

7 *Rebecca Station based functions:*
- Bicycle service
- Connection Park / Green space
- Kiosk

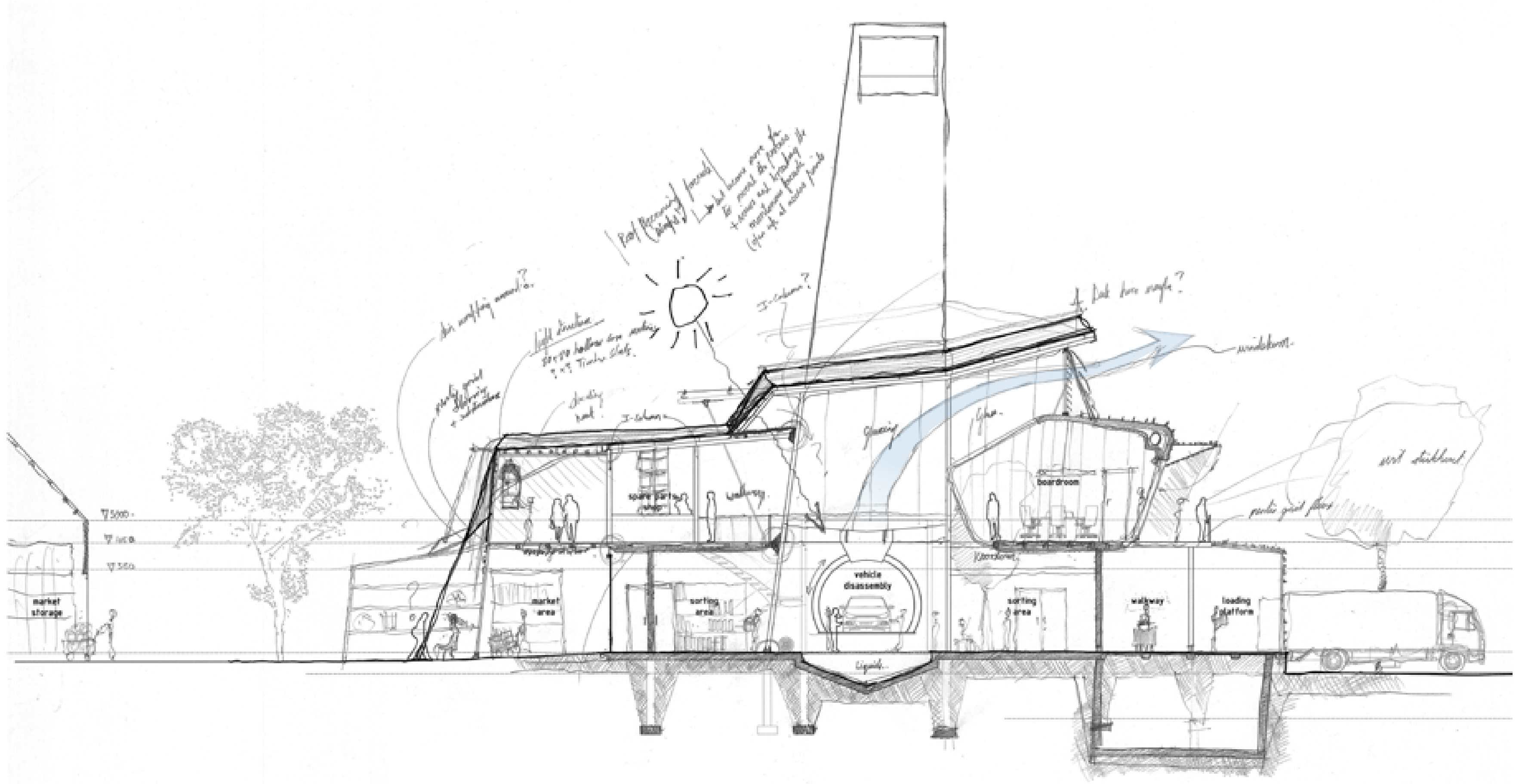


Fig 6.58: Conceptual section investigating the spatial relationships, Illustrated by Author 2011

Fig 6.59: View of Concept model 3 (A) in context with the proposed Production Facility (B), Illustrated by Author 2011

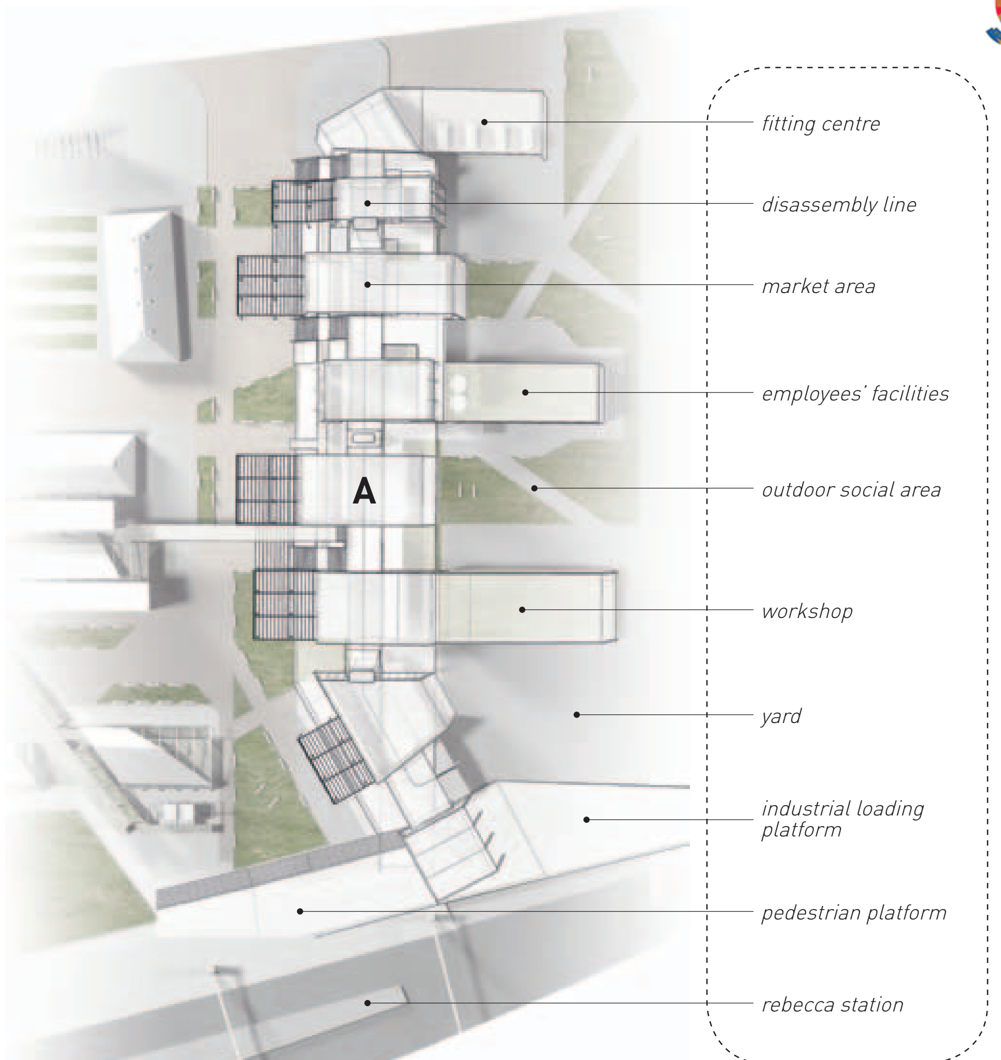


Fig 6.60: Concept model 3: basic layout of programs, Illustrated by Author 2011

Conclusion:

Concept Model 3 will form the basis for the technical development.

The design is not final as illustrated here, as all the investigated elements will be revisited in Chapter 7 to form the final design proposal.

The structure of the proposed industrial building will add much needed character to the basic form decided upon in *Concept Model 3*.

The composition of this structure aims to form a link with the process of disassembly of products. The building itself, should become a product designed for disassembly.

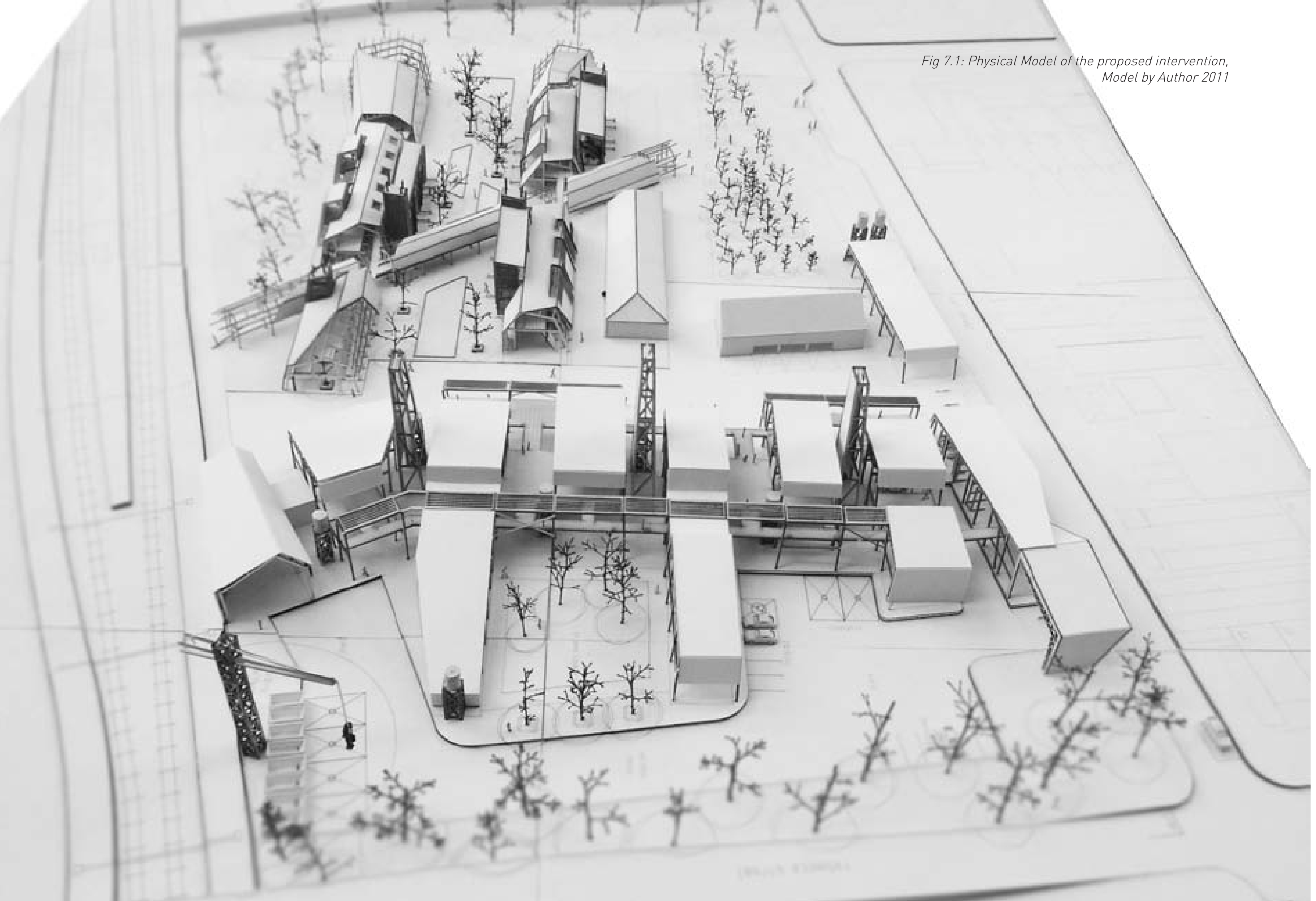


Fig 7.1: Physical Model of the proposed intervention, Model by Author 2011

07 design solution & technical development

7.1 Design Solution

In this chapter the design of *Concept Model 3* will be developed further into a structure that presents the industrial and tectonic characteristics of the plant.

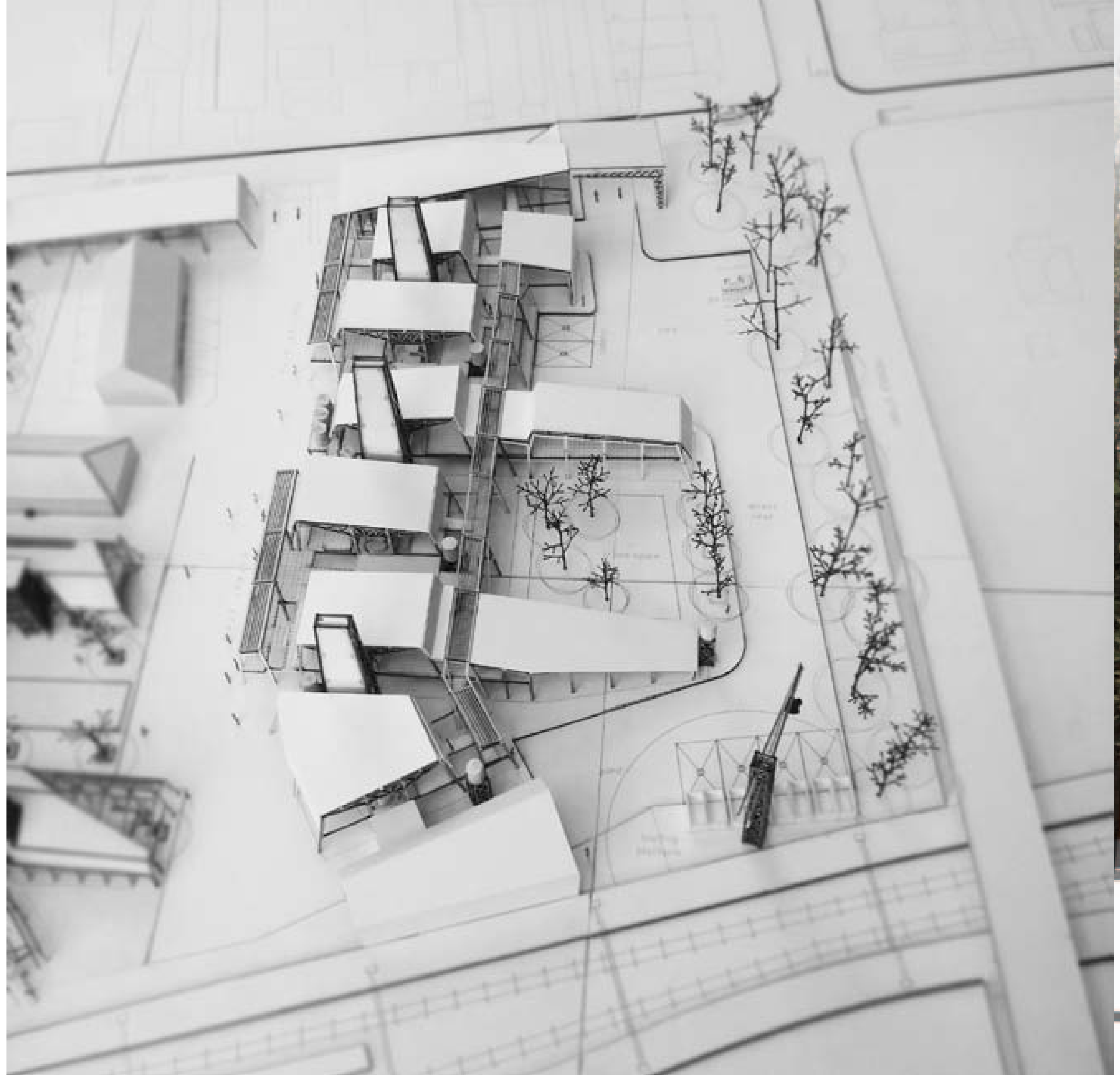


Fig 7.2: Physical Model of the proposed intervention, Model by Author 2011

3: Perspective view of the market area, Illustrated by Author 2011

Fig 7.4: Physical Model of the proposed intervention, Model by Author 2011

Fig 7.3: Proposed Vehicle Disassembly Plant within the surrounding context, Illustrated by Author 2011

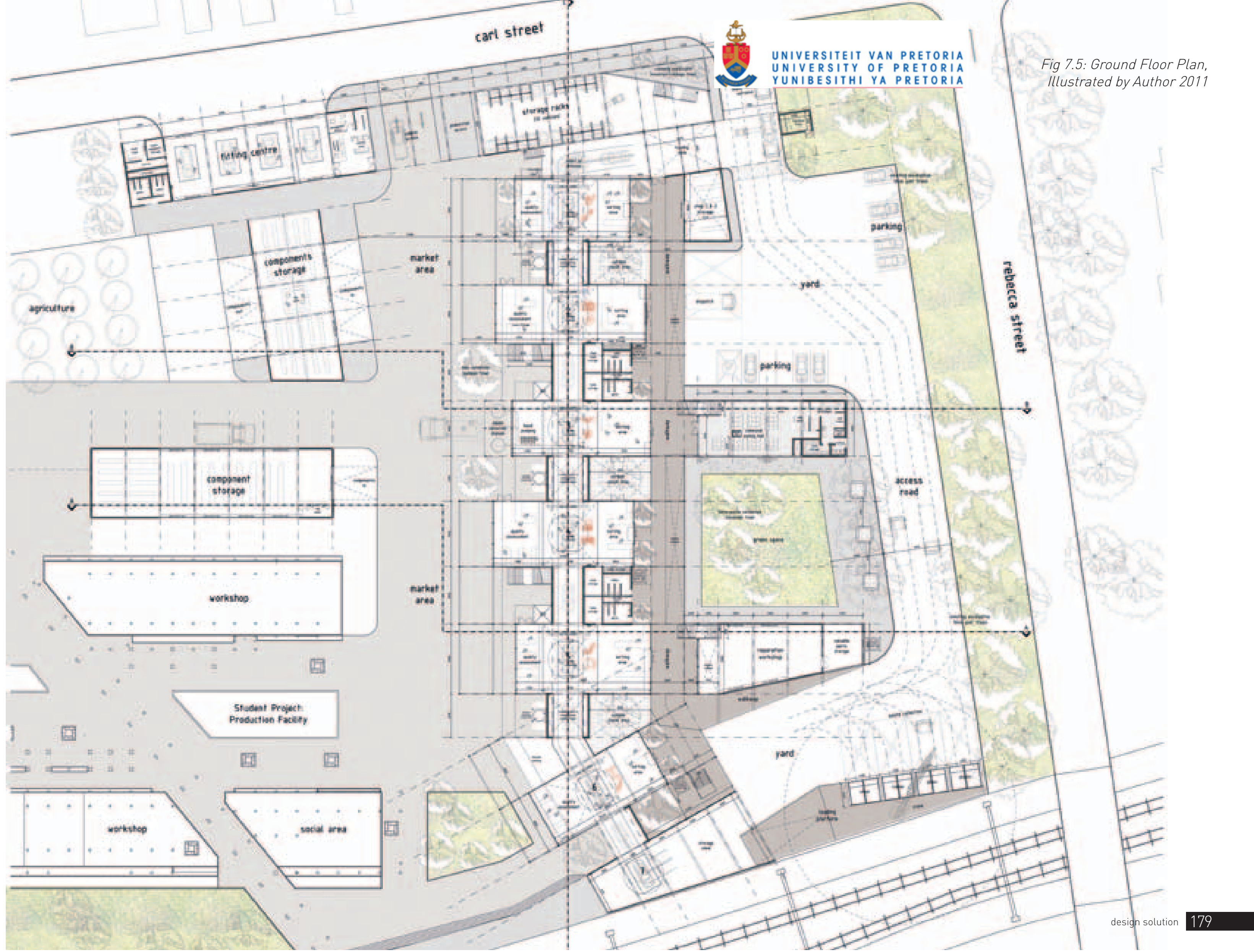


Fig 7.5: Ground Floor Plan, Illustrated by Author 2011

7.2 Technical Investigation

This investigation aims to illustrate the technical concept and how the structure and materials relate to the concept of disassembly. The focus during the technical investigation phase of the study was the following:

- Material choice and application
- Composition of the primary, secondary structural and ventilation (tower) systems
- Building systems - Sustainable active / passive systems
- Construction technology and detailing

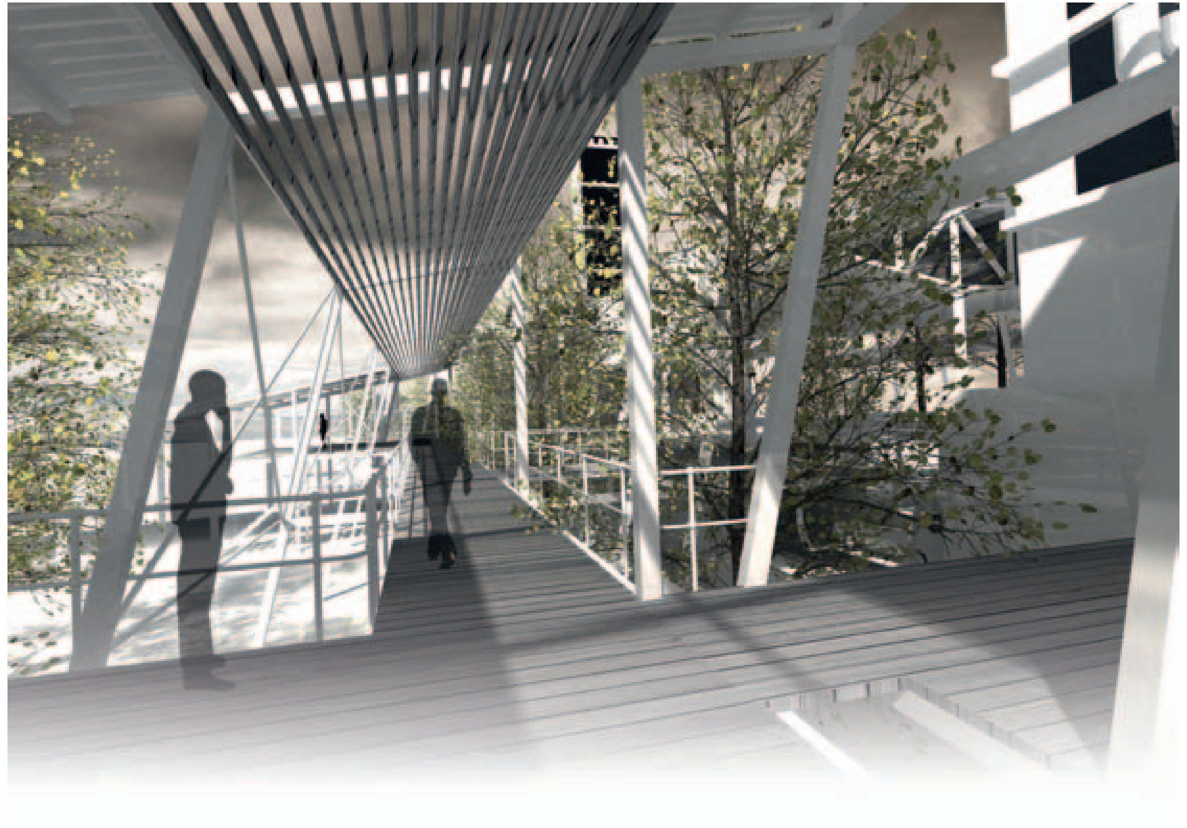


Fig 7.6: Perspective view of the circulation walkway, Illustrated by Author 2011

7.3 Technical Concept

The term, 'assembly', can be described as a group of machine parts that fit together to form a self-contained unit.

The technical concept is derived from the process of assembly, and disassembly, of a product (automobile/machine). Even though the definition of assembly is true for any building, the proposed structure aims to be disassembled with ease once the building reaches the end of its life-span.

Similar to an automobile, the proposed building is constructed by a series of elements, forming different components which function together as a whole.

The technical concept aims to tie in with the building program and the sustainability of project.

Fig 7.7: Supply chain with sub-tiers (Kieran and Timberlake 2004), Illustrated by Author 2011

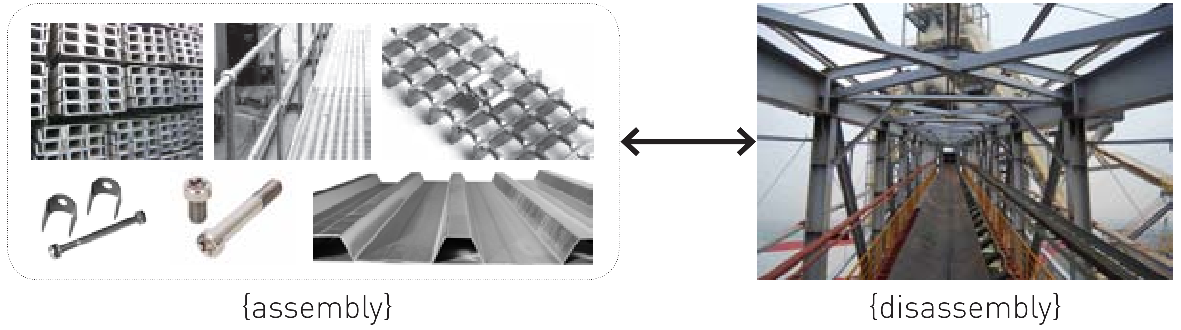


Fig 7.8: Technical Concept of assembly and disassembly of the proposed structure (Andrew Mentis 2006), Illustrated by Author 2011

7.4 Material Choice and Finish

The material choice for the disassembly plant was determined by: the robust nature and durability, materials which can be re-used and assemble/disassembly with ease.

7.4.1 Steel:

Steel will be utilised as the primary load-bearing structure. The following attributes of steel substantiates its use in the proposed building:

• Steel is a product of service - It can be re-used in the same capacity once the building's life-span is complete.

• Steel is an economic building method, it has the following positive impacts on an industrial building when compared to a brick-and-mortar alternative: reduced construction time, reduced logistical costs due to the increasing fuel prices and a drastic reduction of rubble on building sites (Bernard 2008).

• Steel is sustainable and energy efficient - light steel frame buildings are considerably more energy-efficient than heavy construction methods with regard to embodied energy of the materials and components, operational energy relating to heating and cooling of the building over its life-span. While the embodied energy of high strength steel is significantly higher per kilogram than conventional building materials, a considerably lower mass of steel is used, resulting in low-steel construction to be vastly superior in this regard (Barnard 2008).

7.4.2 Timber:

Timber will be used to distinguish between the disassembly process and the socially related programs. The timber aims to incorporate a softer finish in contrast to the extensive use of steel.

Existing sleepers, used for the railway tracks in the abandoned train shunting yard, will be utilised as floor boards. The sleepers are cut into smaller planks and treated to increase durability.

7.4.3 Concrete and Masonry:

The two service cores of the disassembly line as well as sections of the worker's facilities wing consists of pre-cast, hollow-core concrete slabs with masonry infill. The slabs are laid on top of the steel structure and can be removed with the disassembly of the building.

The use of masonry has been kept to the minimum to accommodate the disassembly process of the structure.

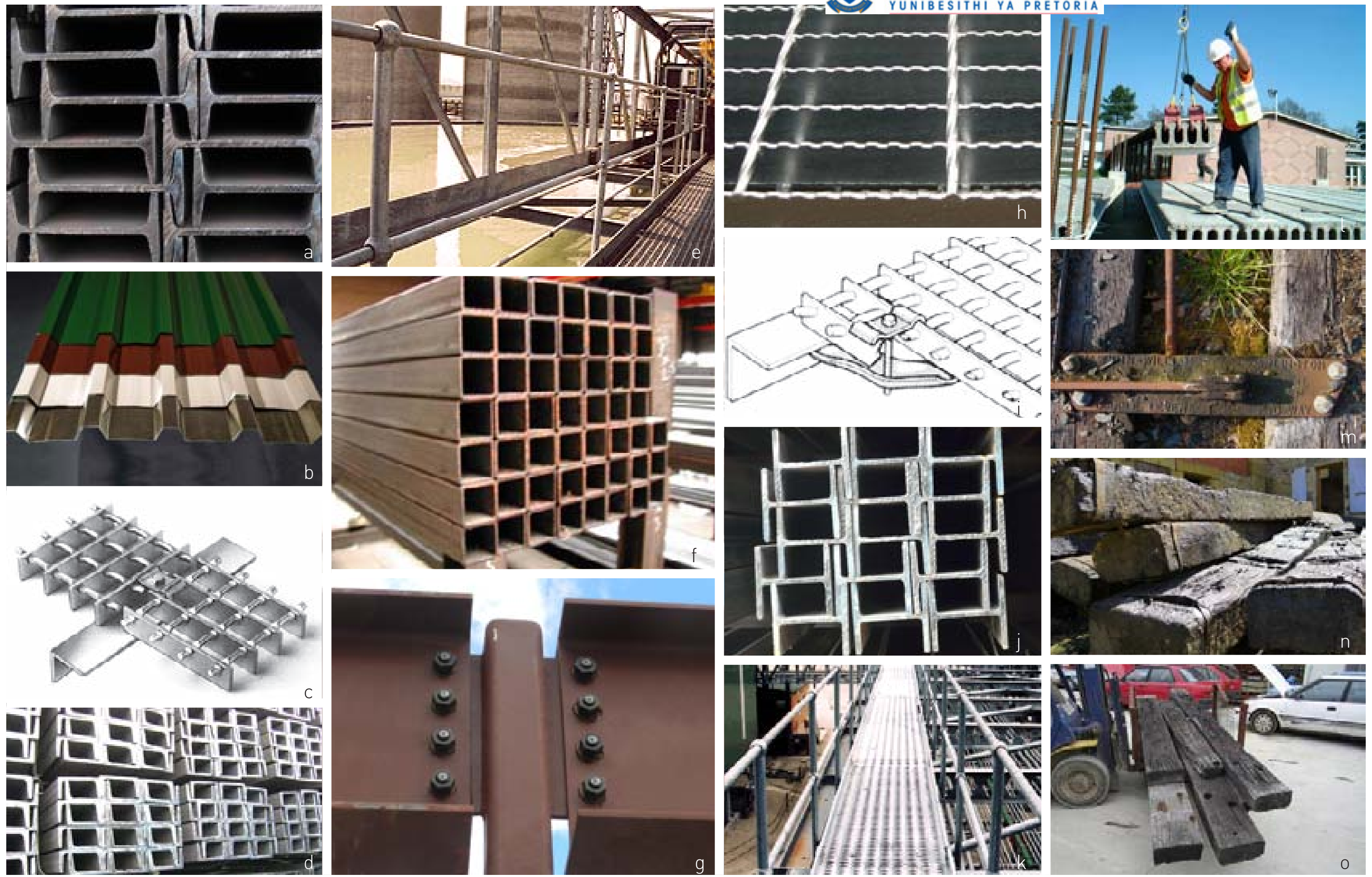


Fig 7.9: (a-k) Photo Collage of proposed steel elements (Andrew Mentis 2006)

Fig 7.10: (l) Pre-cast Conrete Slabs (British Precast 2007)

Fig 7.11: (m-o) Re-use of existing timber sleepers (Our French Garden 2010)

7.5 Structural Systems

The proposed structure consists of three main systems: the primary and secondary structural systems, and the ventilation tower structures (7.5).

7.5.1 Primary Structural System:

The primary structure acts as the core of each disassembly workshop. The roof structures of the disassembly workshops form the primary structural system. All the roof sections carry their loads independently.

However, these structures share the loads imposed by the disassembly line.

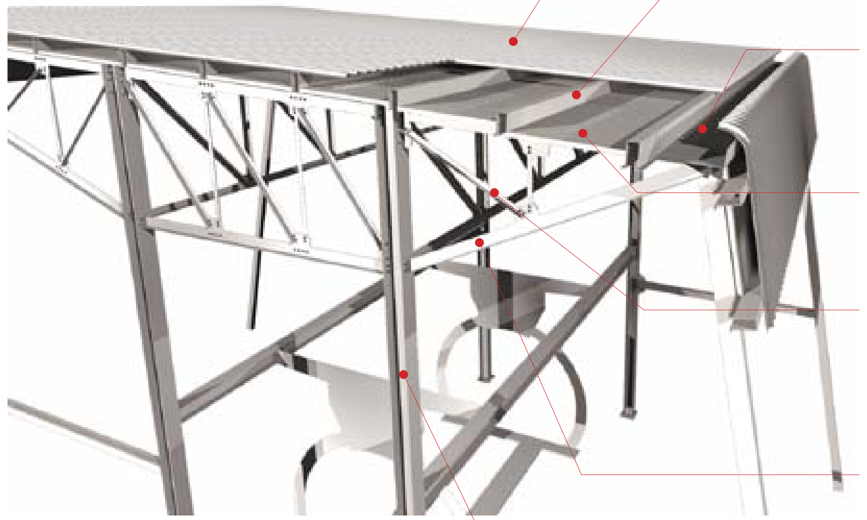


Fig 7.12: Perspective view of the primary structure's composition, Illustrated by Author 2011

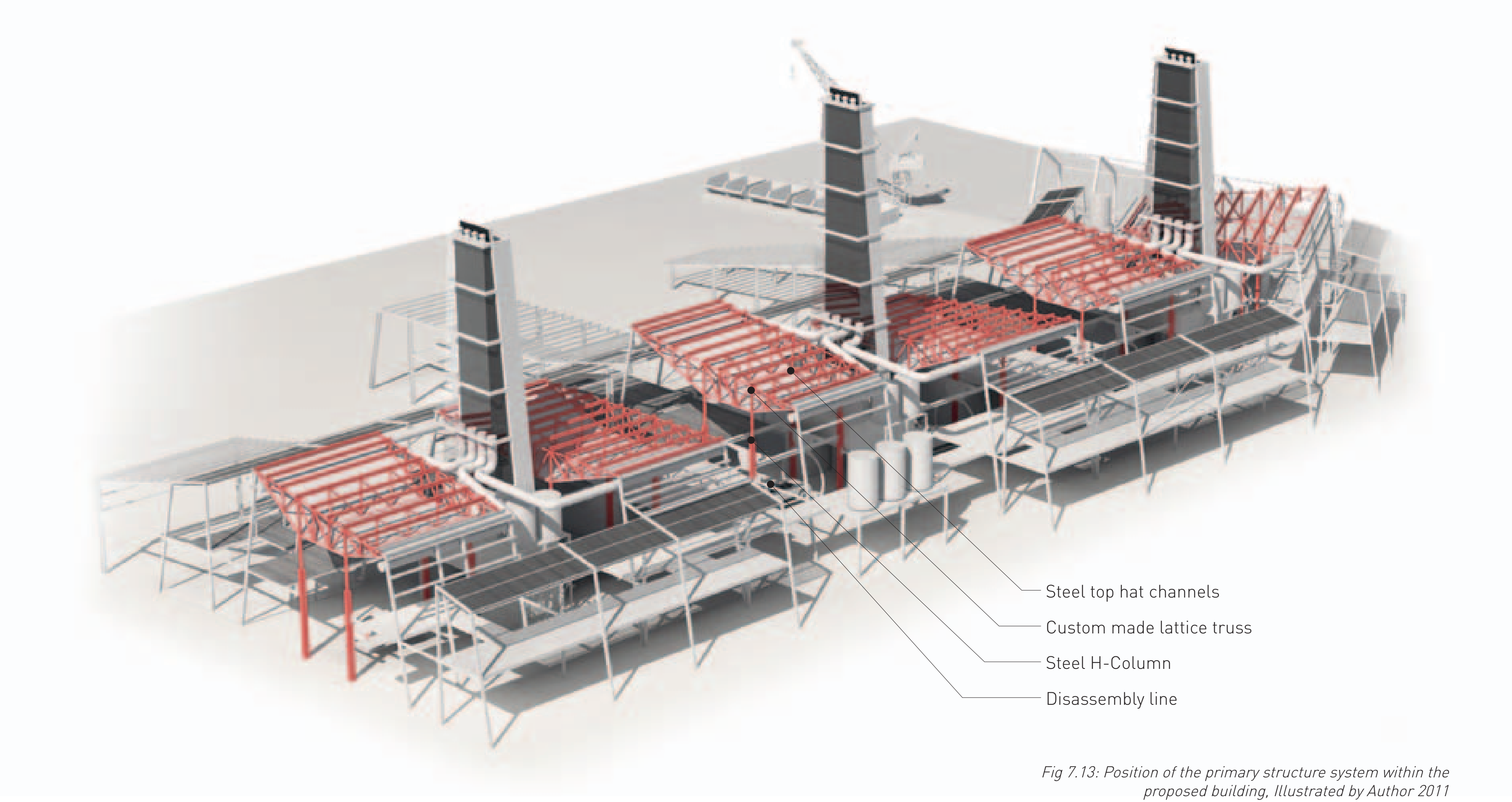


Fig 7.13: Position of the primary structure system within the proposed building, Illustrated by Author 2011

7.5.2 Secondary Structural System:

The secondary structure consists of a transparent light weight steel construction which latches onto the primary structure. The structure acts as a circulation space, provides areas for technical assistance and parts shops, and serves as a shading device for the building's eastern and western façades.

The secondary structure, or skin, wraps around the different workshops, binding the different stages of disassembly together as a whole. The skin structure is a composite system - steel, timber, mentis grating and polycarbonate sheeting.

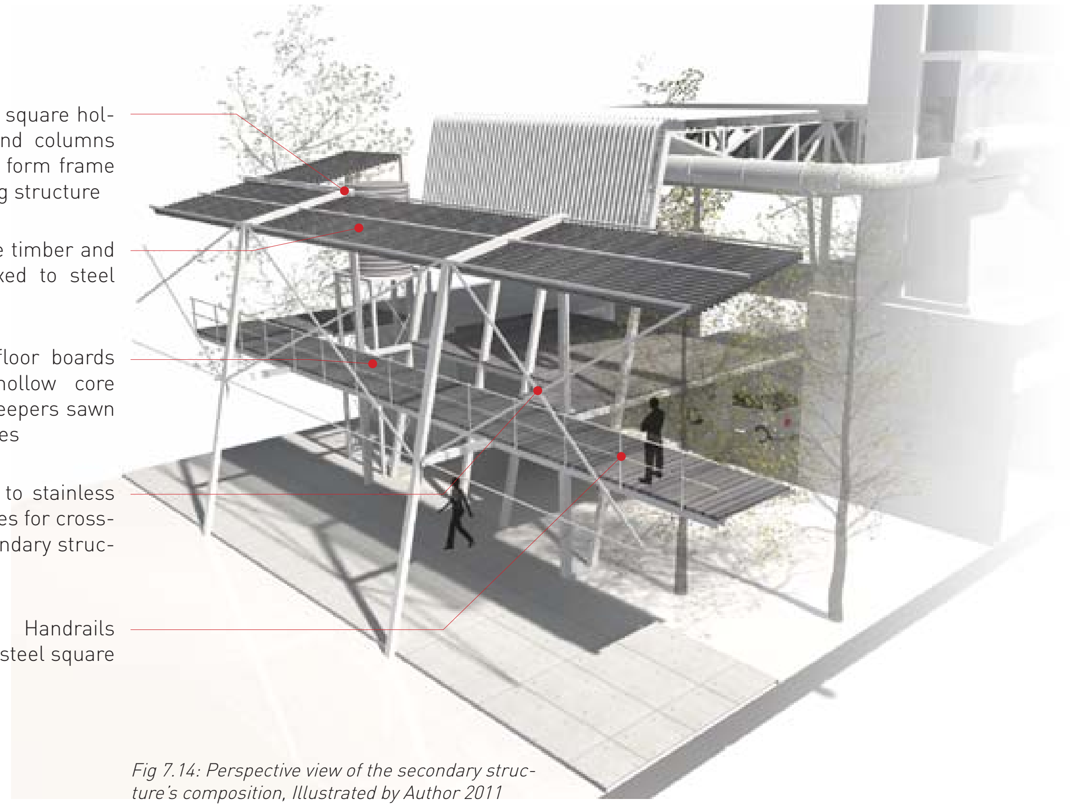


Fig 7.14: Perspective view of the secondary structure's composition, Illustrated by Author 2011

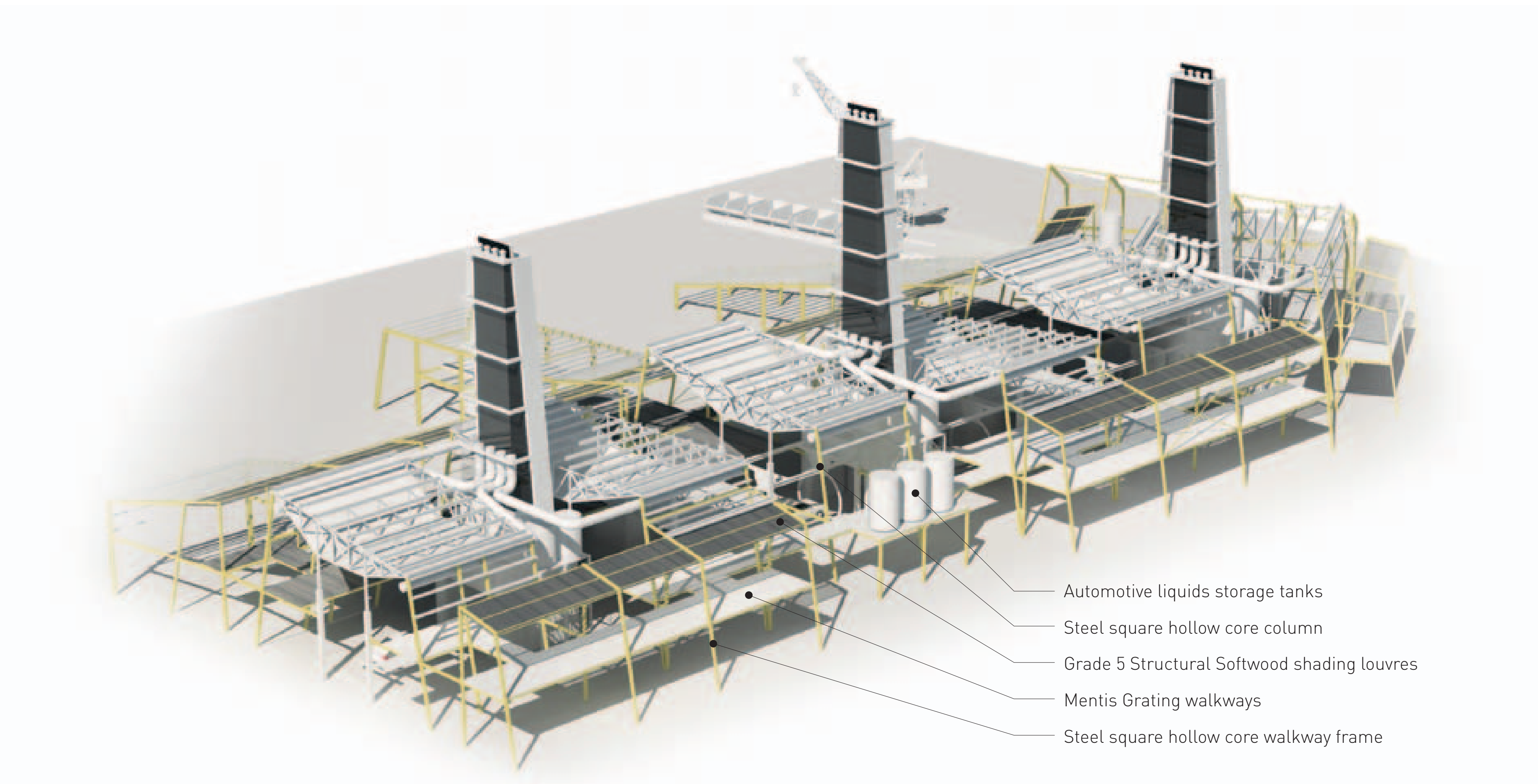
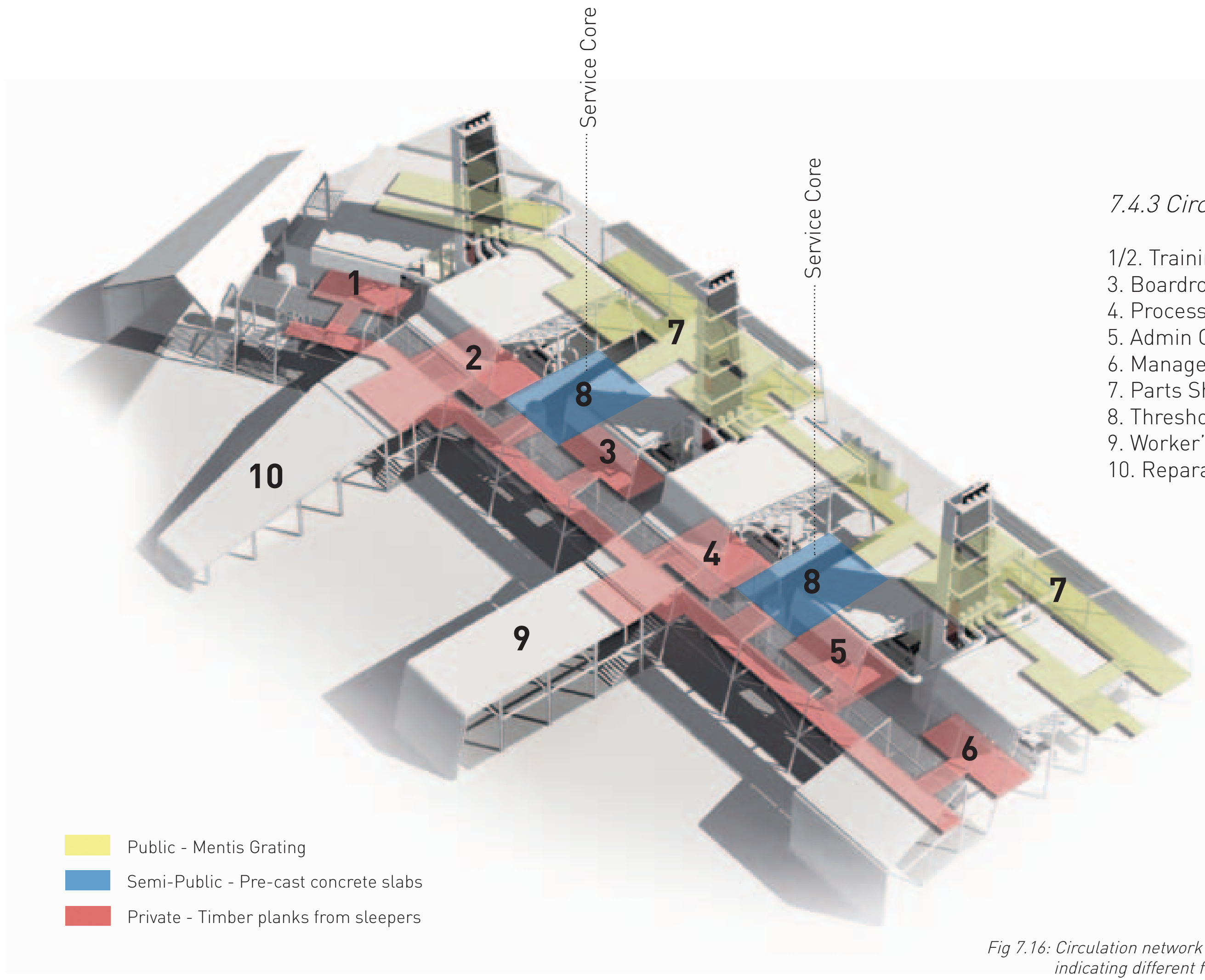


Fig 7.15: Position of the secondary structure system within the proposed building, Illustrated by Author 2011



7.4.3 Circulation Network (first floor)

1/2. Training Facilities
3. Boardroom
4. Process Office
5. Admin Office
6. Management Office
7. Parts Shops & Assistance
8. Threshold Space
9. Worker's Facilities
10. Reparation Workshop

Fig 7.16: Circulation network within the secondary structural system indicating different floor finishes, Illustrated by Author 2011

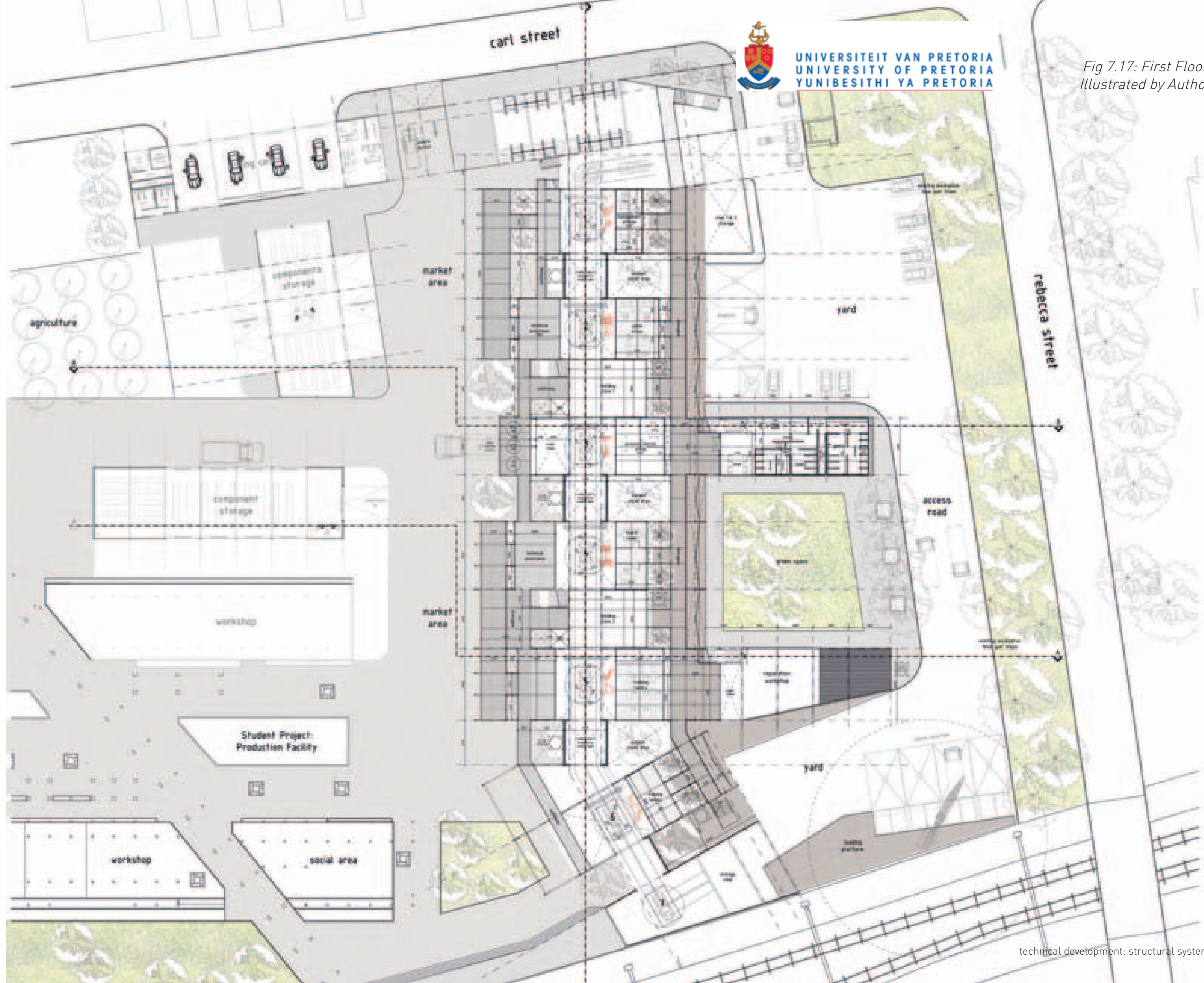


Fig 7.17: First Floor Plan, Illustrated by Author 2011

7.6 Sustainable Active/Passive Systems

7.6.1 Ventilation Tower Structures:

Each of three towers ventilates two workshops. The ventilation system is a combination of active and passive systems:

• *Passive System*: The extraction of warm air is driven by a passive trombé stack system, which utilise the solar gain in the summer months. The system is situated on the northern face of the tower structure to ensure maximum exposure to the sun.

The system consists of a glass box where solar radiation is utilised to heat up the air in the northern face of the tower structure, causing the warm air to rise, which creates a negative air pressure (suction) in the workshops.

• *Active System*: The distribution of cool air is caused by an indirect evaporative cooling system, where ambient air is introduced into the building from the top of the tower (south) by a wind scoop and fan. The air is then cooled down by the evaporative cooling system and circulated through the workshops, creating a positive air pressure.

The two systems are designed to function together in order to achieve efficient ventilation throughout the building.

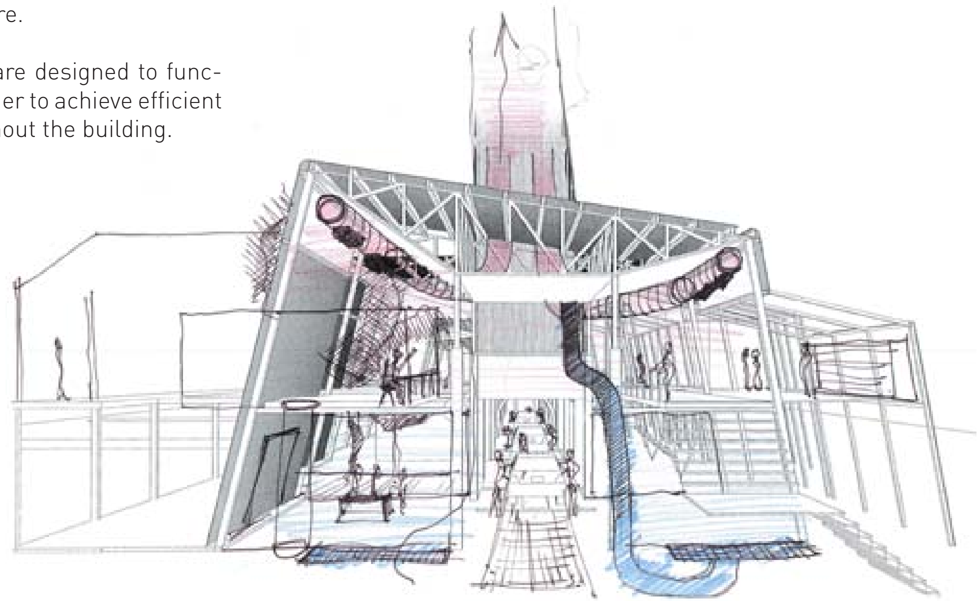


Fig 7.18: Conceptual section investigating the ventilation system, Illustrated by Author 2011

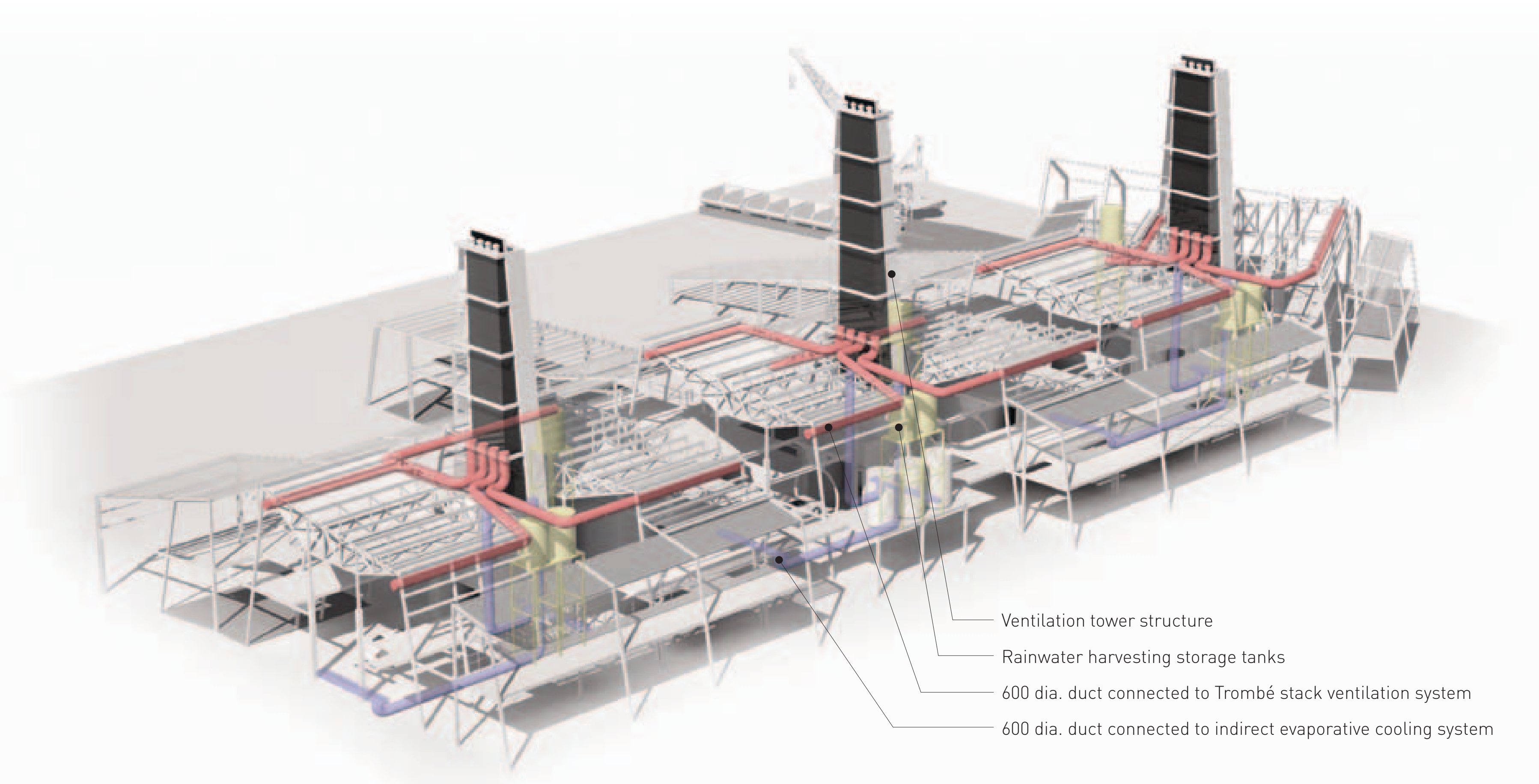


Fig 7.19: Ventilation system - extraction of warm air (red ducts) and distribution of cold air (blue ducts), Illustrated by Author 2011

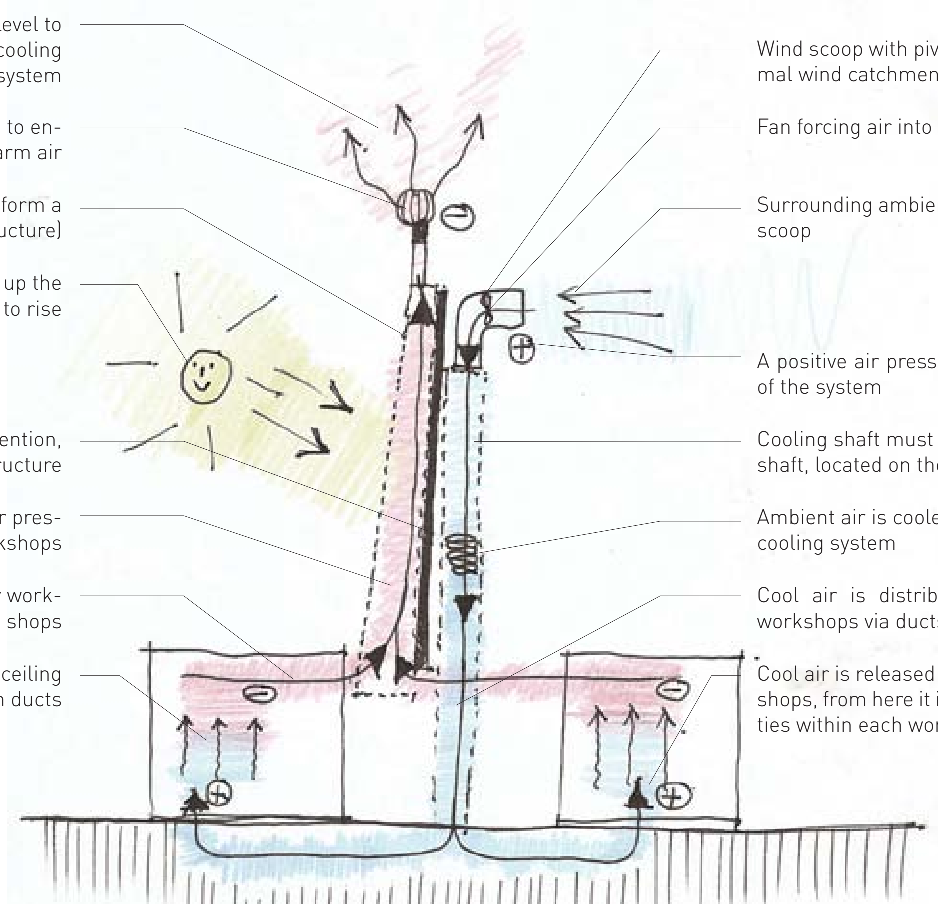


Fig 7.20: Diagram of the ventilation system and tower structure, Illustrated by Author 2011

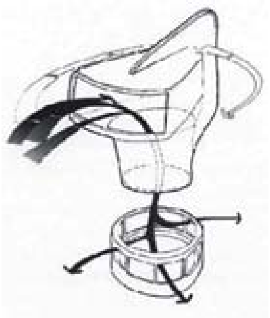


Fig 7.21: Wind scoop with pivot mechanism and fin (HVAC Systems 2001)

Fig 7.22: Whirlybirds mounted on top of shaft to encourage extraction of warm air (VentaNation 2005)

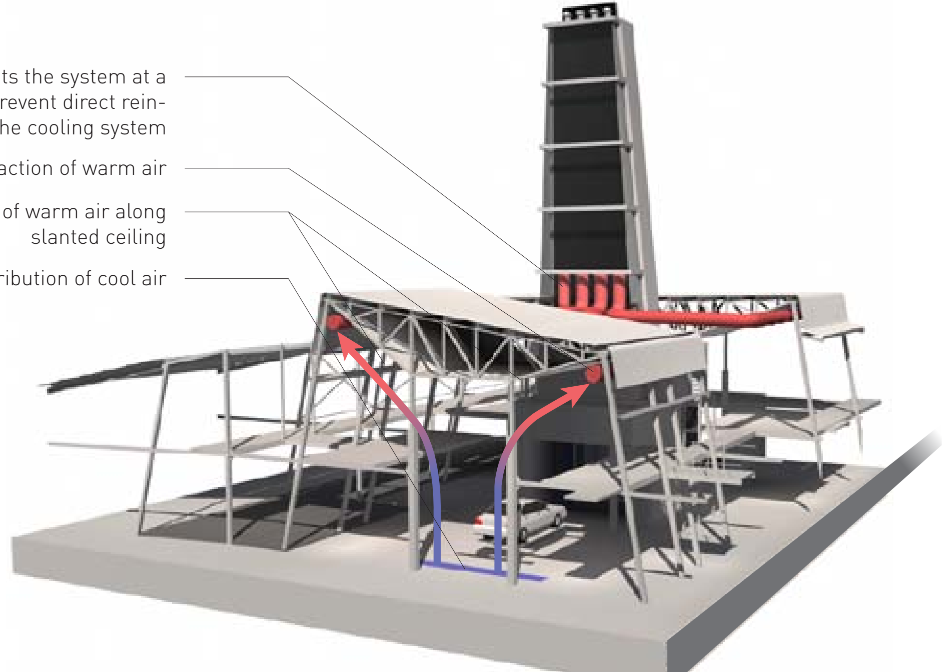


Fig 7.23: Circulation of air in a typical disassembly workshop, Illustrated by Author 2011

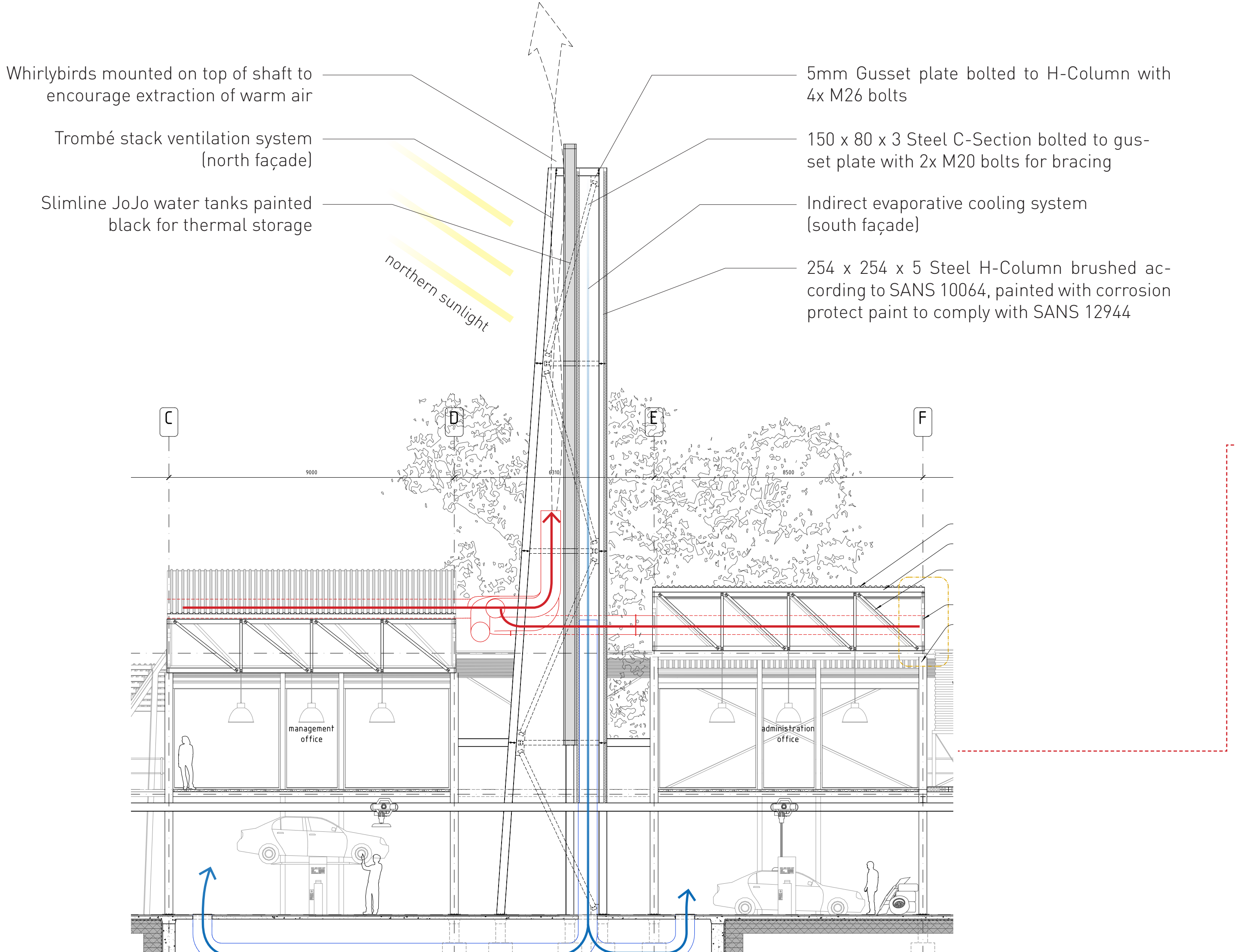


Fig 7.24: Ventilation system - extraction of warm air (red ducts) and distribution of cold air (blue ducts), Illustrated by Author 2011

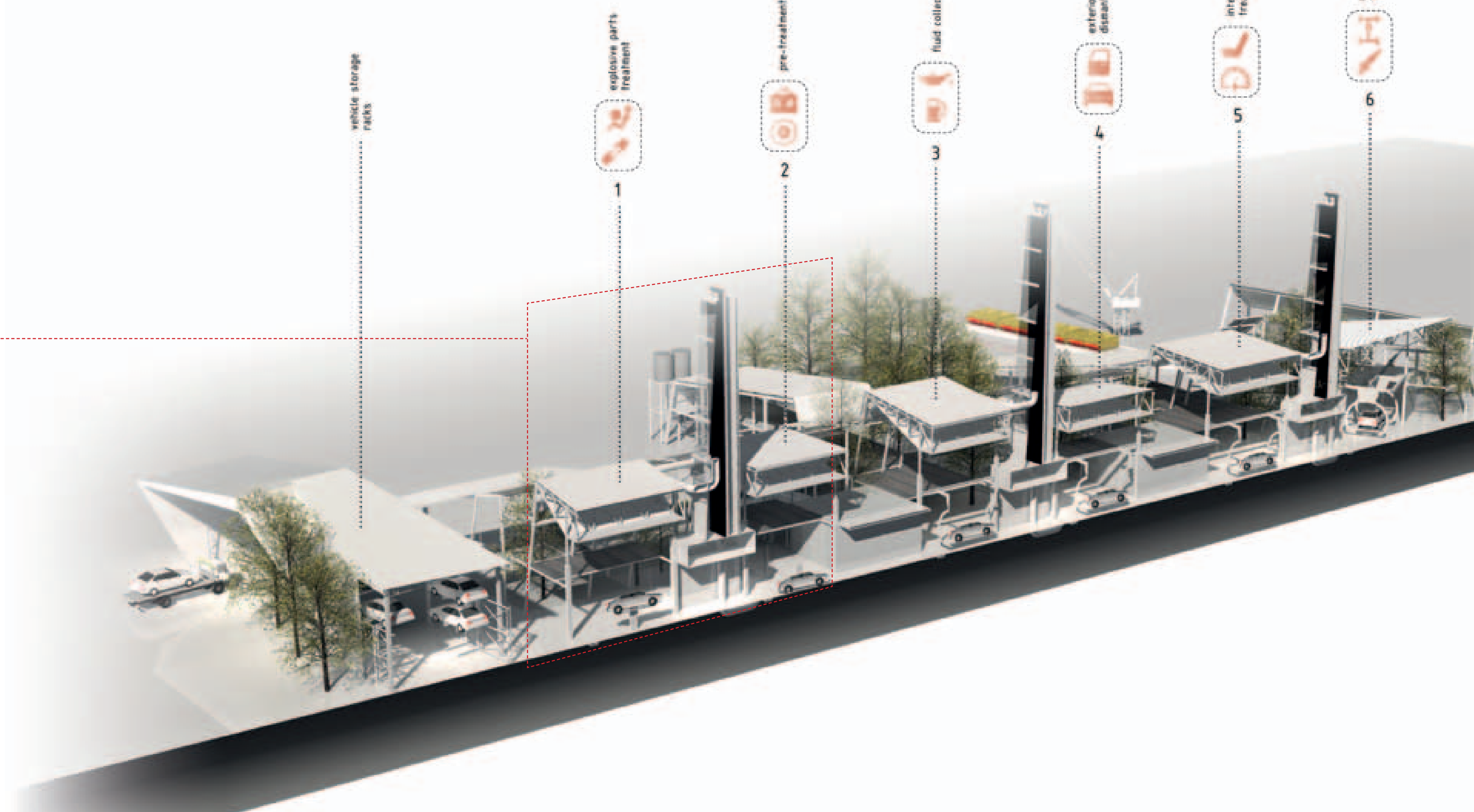
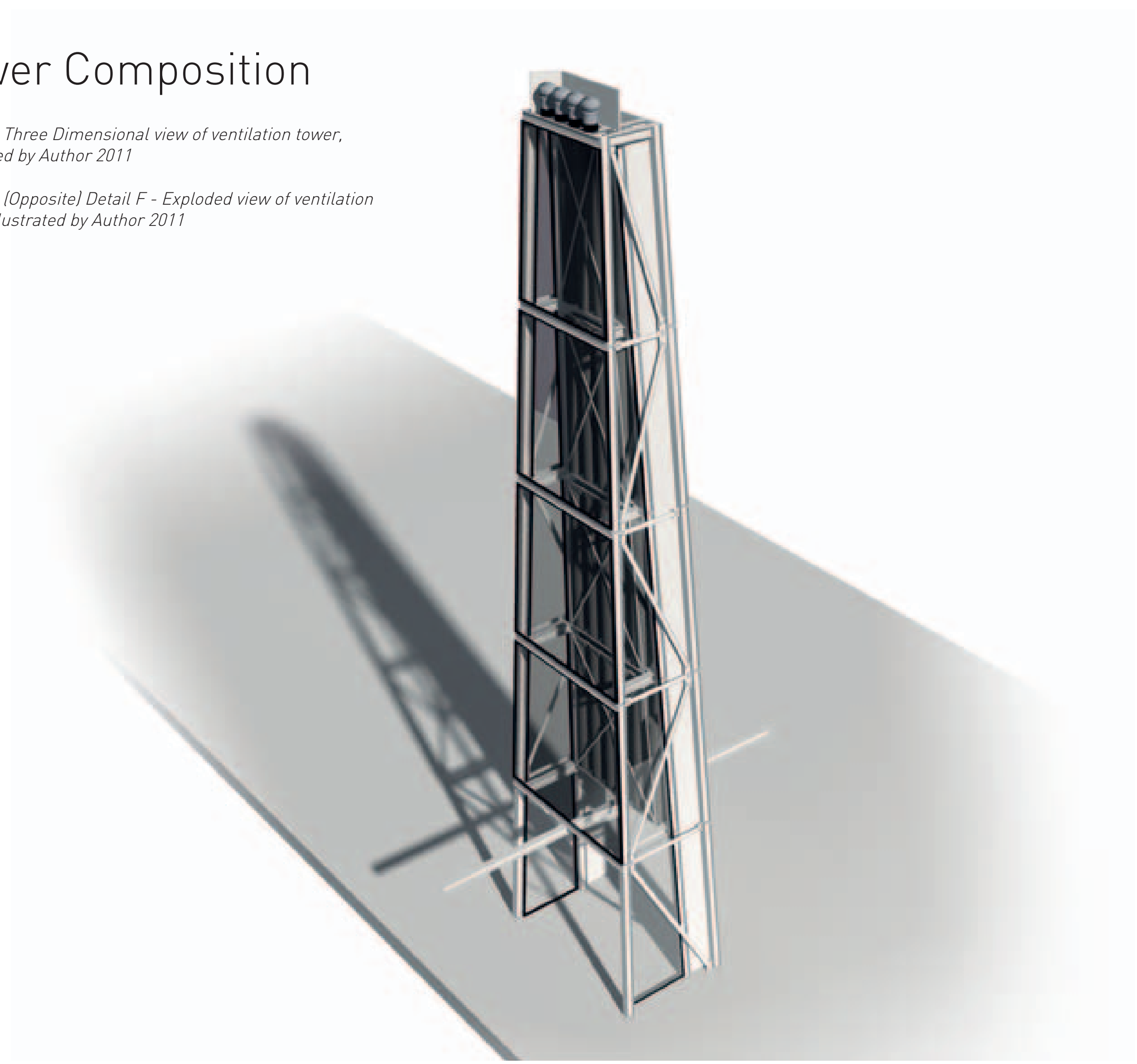


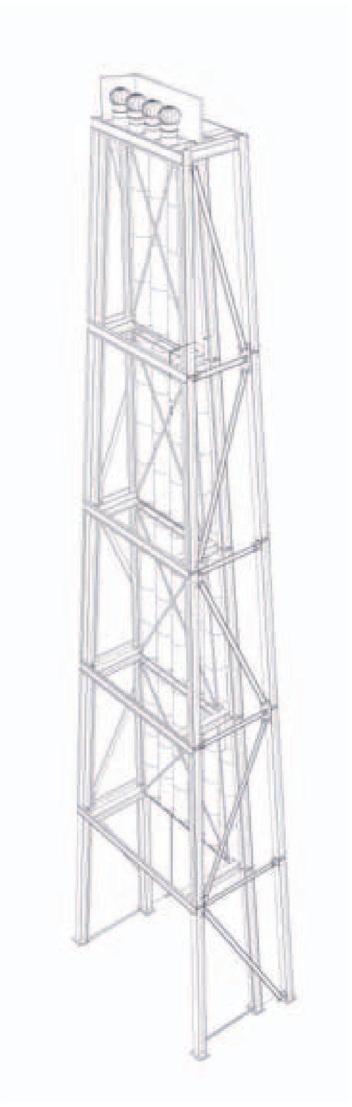
Fig 7.25: Three Dimensional section through cooling system, Illustrated by Author 2011

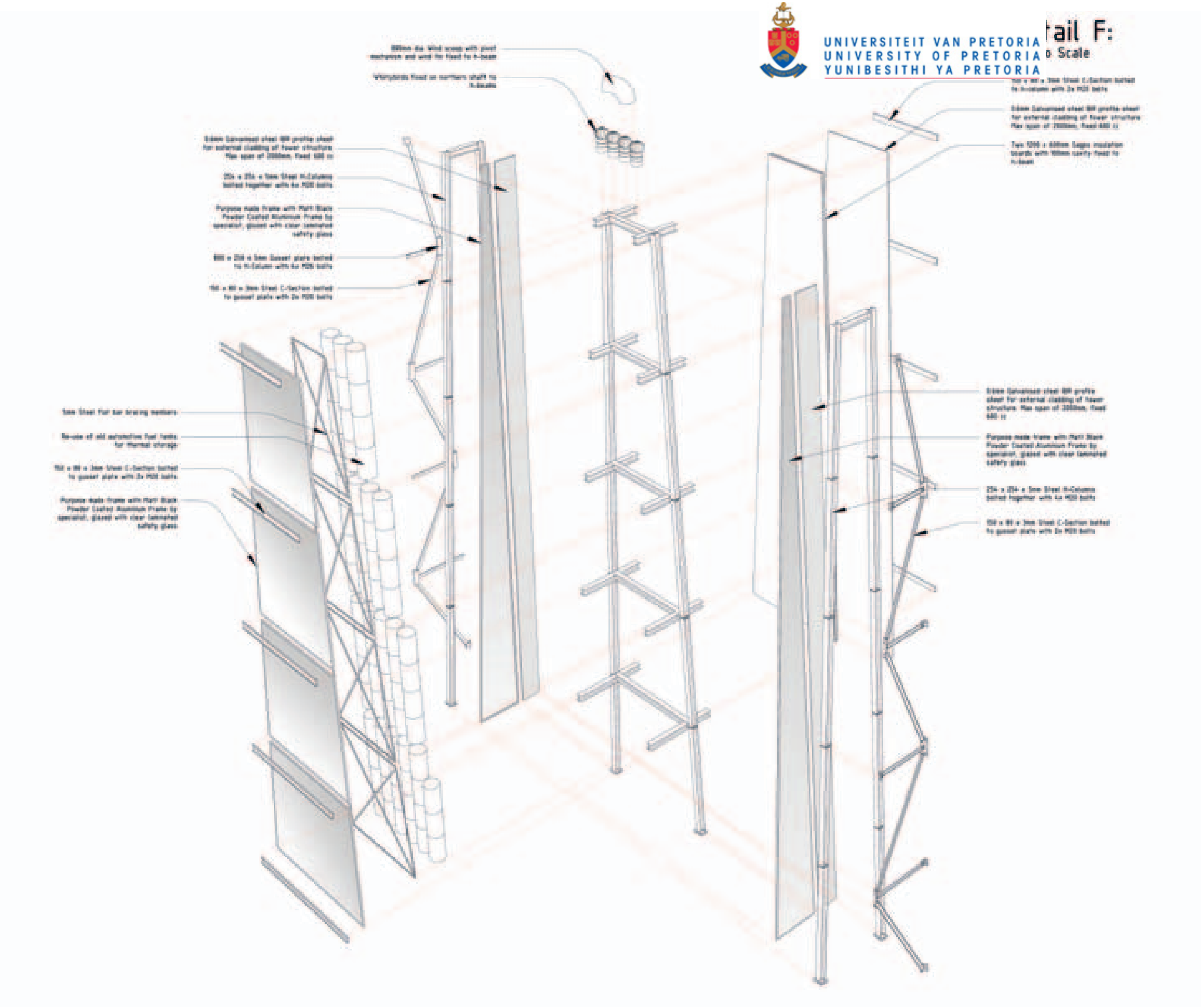
Tower Composition

Fig 7.26: Three Dimensional view of ventilation tower, Illustrated by Author 2011

Fig 7.27: [Opposite] Detail F - Exploded view of ventilation tower, Illustrated by Author 2011







7.6.2 Rainwater Harvesting:

Rainwater is collected to serve several purposes:

- As irrigation for all the planted trees and landscaping.
- In the cooling and heating systems of the disassembly workshops.
- To service all the toilets of the plant.
- In the workshops: cleaning and rinsing.

The total roof area is 1890m^2, according to Jeremy Gibbert (2009) 90% of the total rain water can be harvested. Several water storage tanks are located across the site, serving specific functions, rather than using a central storage system. The tanks are positioned to be in close proximity to down pipes leading from roofs as well as the systems it serves, preventing the pumping of water of longer distances.

Month	Rain Fall (mm)	Harvest (90%)
January	136	231336 L
February	75	127575 L
March	82	139482 L
April	51	86751 L
May	13	22113 L
June	7	11907 L
July	3	5103 L
August	6	10206 L
September	22	37422 L
October	71	13419 L
November	98	166698 L
December	110	20790 L

Fig 7.28: Roof areas (m^2) used for rainwater harvesting and storage tanks , Illustrated by Author 2011

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7.6.3 Natural Lighting:

The two main issues regarding natural daylight exposure were: the building's north-south orientation and the need for connections (visual) between the work spaces and the outdoors.

Exposing the workshops to adequate daylight ensures that less artificial lighting is used during the day. By pulling the workshops away from each other, enables sunlight to diffuse into each disassembly stage, also providing the staff with constant views of the outdoors.

The eastern and western façades are shaded by the louvres of the circulation walkways which form part of the secondary structure. Trees area planted in the double volumes the walkways create, forming green social spaces in-between the workshops for the workers to retire to during breaks.

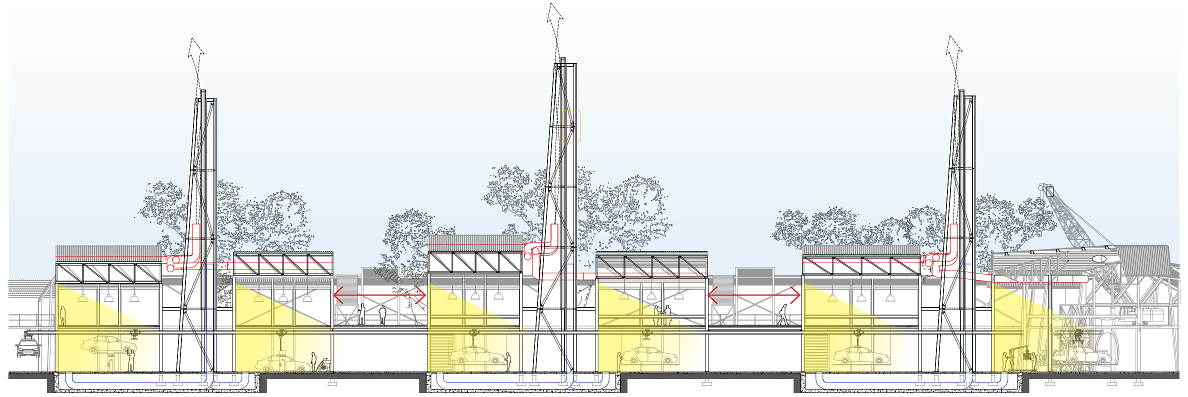

Fig 7.29: Penetration of daylight into the disassembly workshops, Illustrated by Author 2011

The worker's facilities and reparation workshop has been positioned next to the disassembly line as separate extruding volumes. This orientation enabled the social programs in the worker's facilities wing to be exposed to adequate daylight.

7.6.4 Solar Water Heater:

Solar water heaters in combination with electrical geysers are used to heat the water for the workers' shower facilities. Glass heat evacuating solar water collectors are proposed to be installed above the ablution facilities (worker's facilities).

Water consumption of the shower facilities are controlled with by only allowing a five minute shower with controlled water valves and limiting the flow rate (10 litres per minute) (Gibbert 2009: 131).

Fig 7.30: Worker's facilities and reparation workshop, position next to the disassembly line, are exposed to daylight, Illustrated by Author 2011

7.7 Habitat and Vegetation

Industrial precincts are often characterised by hard concrete and steel surfaces. The proposed building aims to soften these surfaces by introducing vegetation in between the structure's steel elements.

As discussed under *Natural Lighting*, the trees aim to act as shading elements in summer months while allowing light to filter through in winter months (deciduous trees).

The species and the placing of the trees are important to ensure that the trees will fit in between the structure, and to keep the trees healthy.

A

Heteropyxis Natalensis
(Lavender Tree)
Location on site: Outside Social Area
Application: To create shaded spaces for workers to socialise and rest

B

Dais Cotinifolia
(Pompon Tree)
Location on site: In-between workshops and walkways
Application: To supply the workshops of constant views of colourful vegetation

C

Cussonia Paniculata
(Mountain Cabbage Tree
Location on site: Sidewalk - Carl Street
Application: To provide shaded spaces on street level before entering the market area

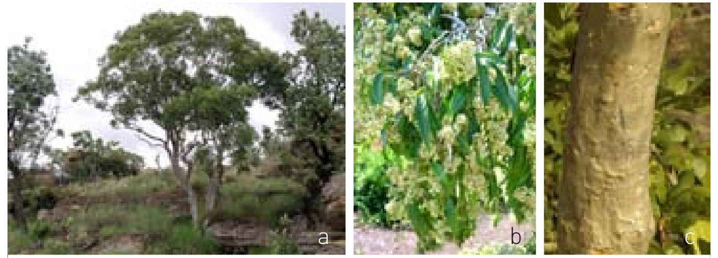

Fig 7.31: (a-c) Heteropyxis Natalensis, Lavender Tree (Witkoppen Wildflower Nursery 2010)

Fig 7.32: (d-f) Dais Cotinifolia, Pompon Tree (Fernkloof Nature Reserve 2011)

Fig 7.33: (g-i) Cussonia Paniculata, Mountain Cabbage Tree (Dave's Garden 2011)

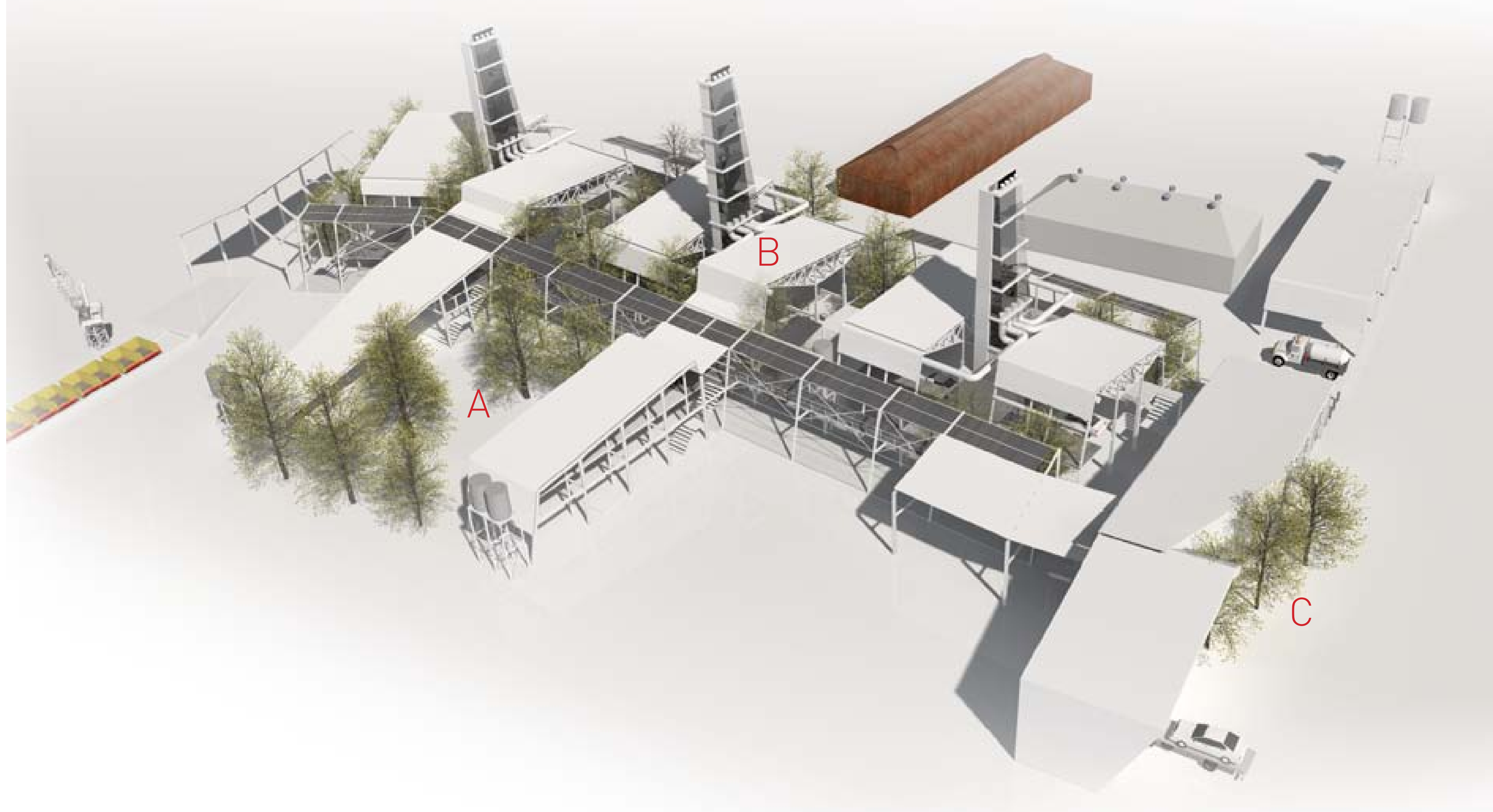

Fig 7.34: Positioning of new tree species on site, Illustrated by Author 2011

7.8 Construction Technology & Detailing

The composition of the structure will be illustrated by three sections, each focussing on different details:

- Section A-A:
  Detail Portion 1: Shaded Walkway
  Detail Portion 2: Disassembly Line
- Section B-B:
  Detail Portion 3: Worker's Facilities
- Section C-C:
  Detail Portion 4: Disassembly Workshop

Fig 7.35: Proposed Vehicle Disassembly Plant within the surrounding context, Illustrated by Author 2011

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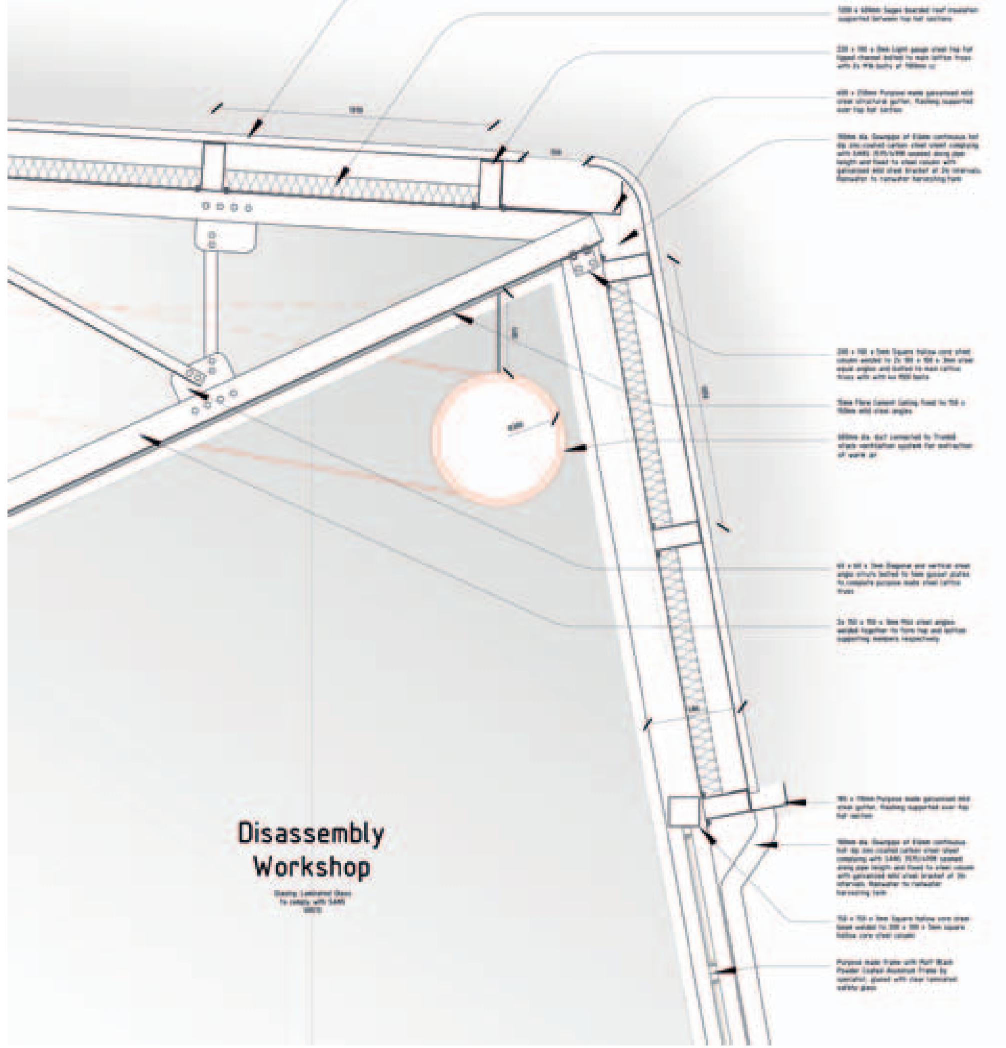
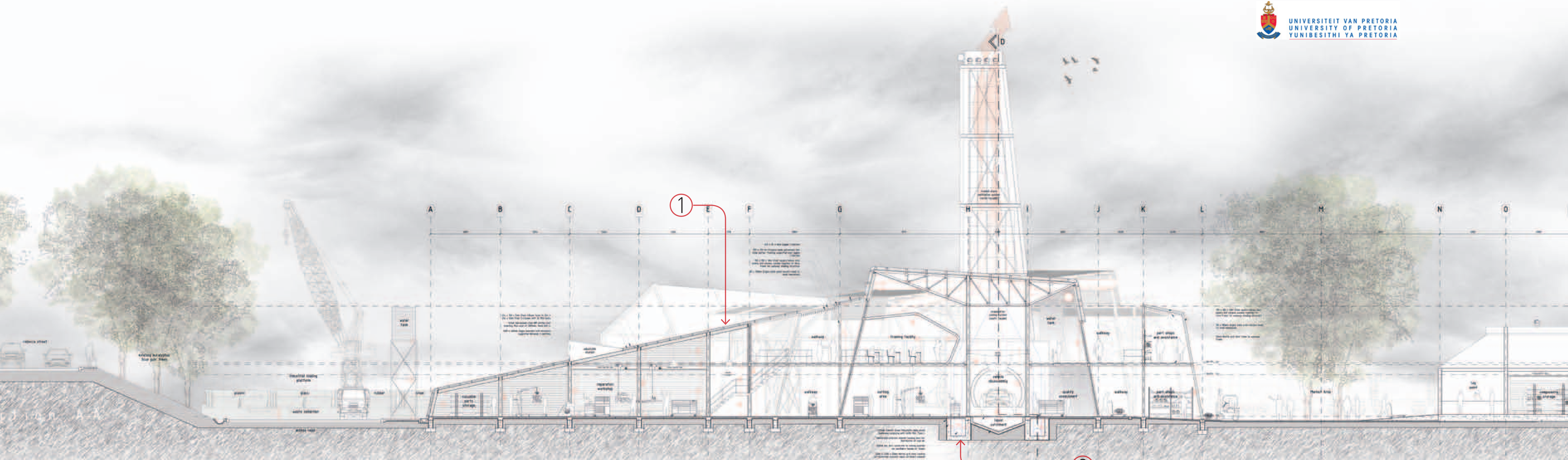


Fig 7.36: Detail A - Main roof structure, Illustrated by Author 2011



section a-a

not to scale

Fig 7.37: Section A-A, Illustrated by Author 2011

Detail Portion 1: Shaded Walkway

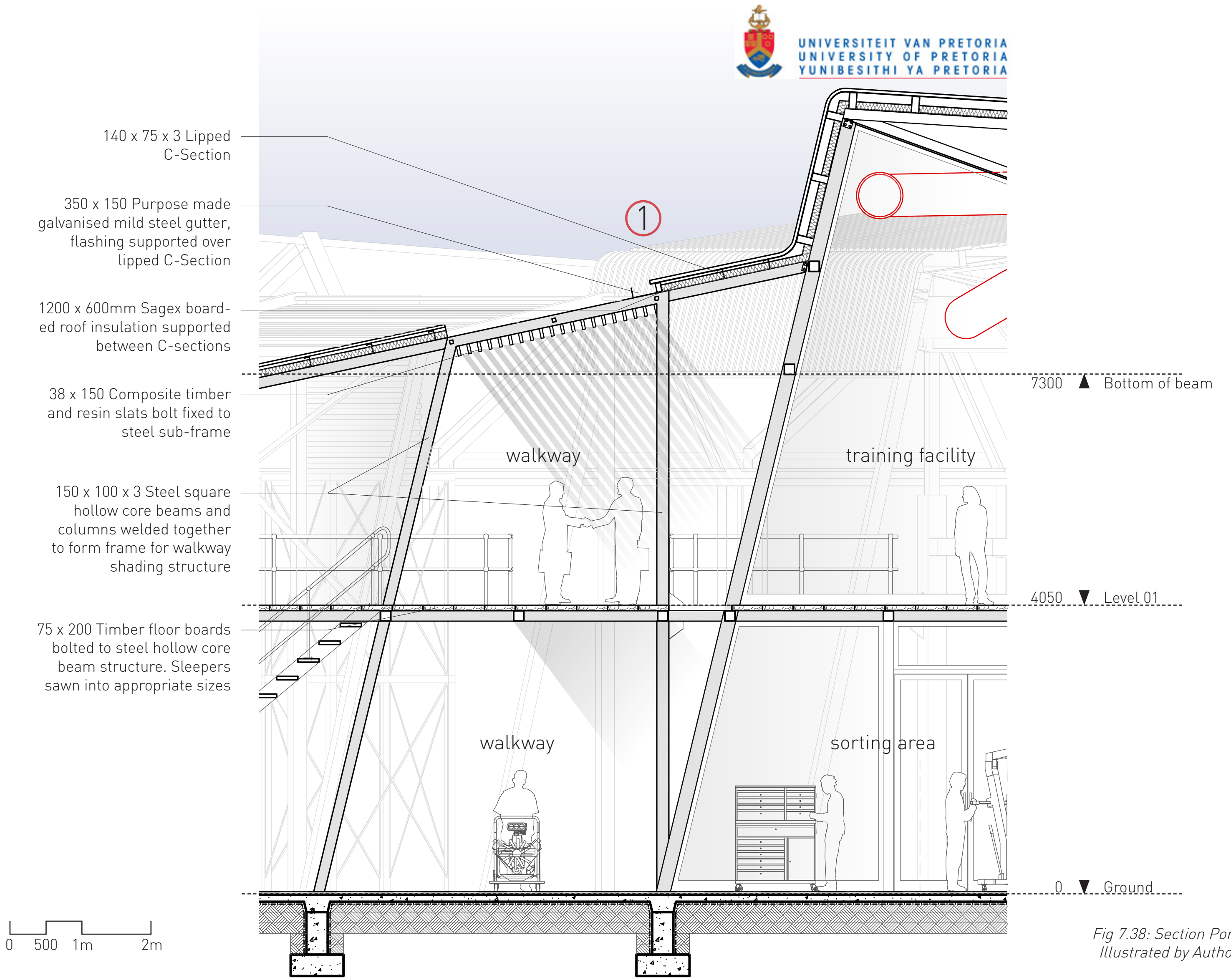


Fig 7.38: Section Portion 1, Illustrated by Author 2011

Detail Portion 2: Disassembly Line

2x 150 x 150 x 3 Mild steel angels welded together to form top and bottom supporting members respectively. 60 x 60 x 3 Diagonal and vertical steel angle struts bolted to 5mm gusset plates to complete purpose made steel lattice truss

600 dia. duct connected to Trombé stack ventilation system for extraction of warm air

Fibre cement ceiling fixed to bottom of main lattice truss

254 x 254 x 5 Steel H-Column

600 dia. duct connected to cooling system on southern façade of tower

254 x 254 x 5 Steel H-Beam

C-Arm mechanism fixed to H-Beam as per engineer's specifications

5000 x 4200 x 50 Mentis grid floor resting on reinforced concrete liquid catchment channel

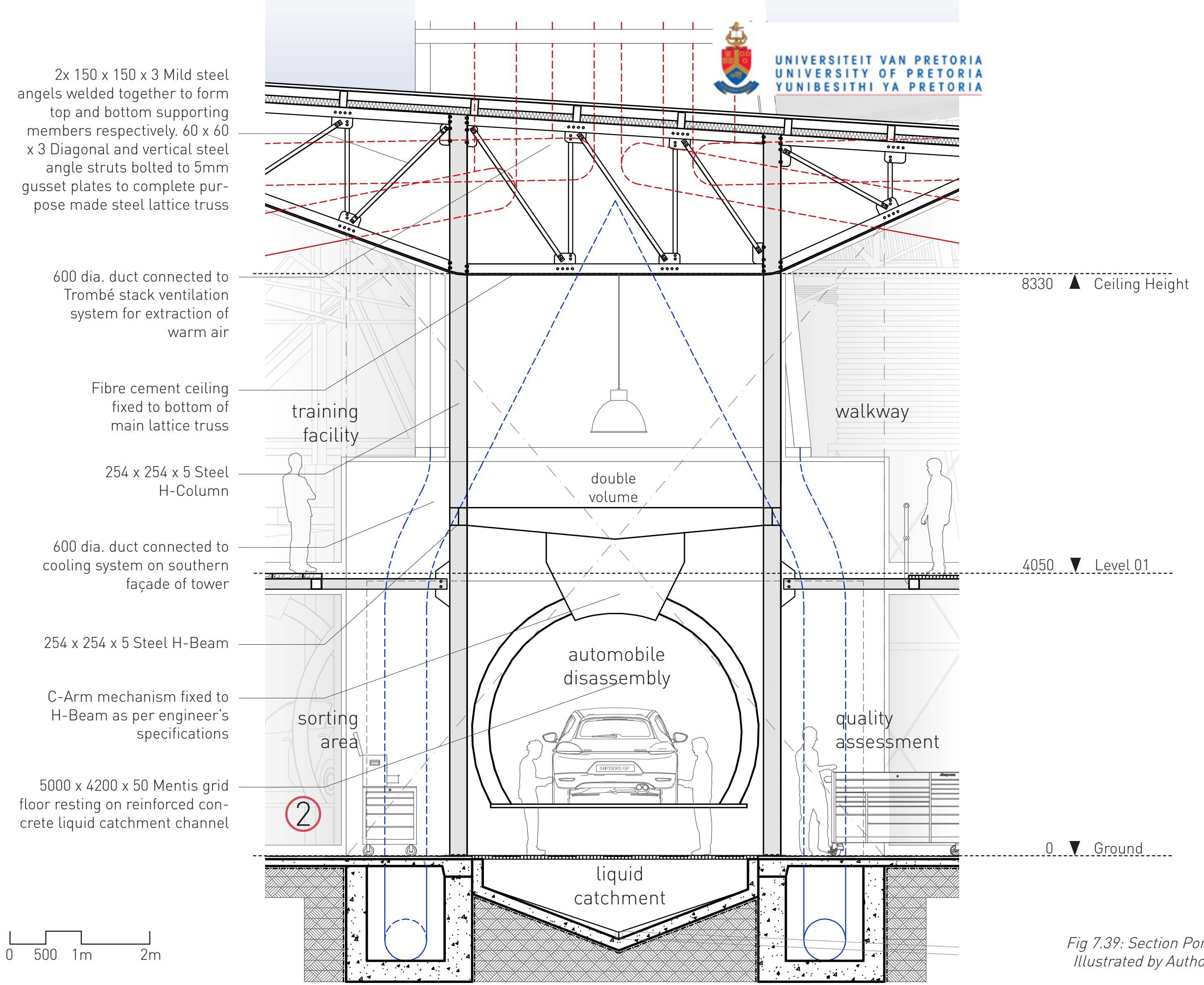
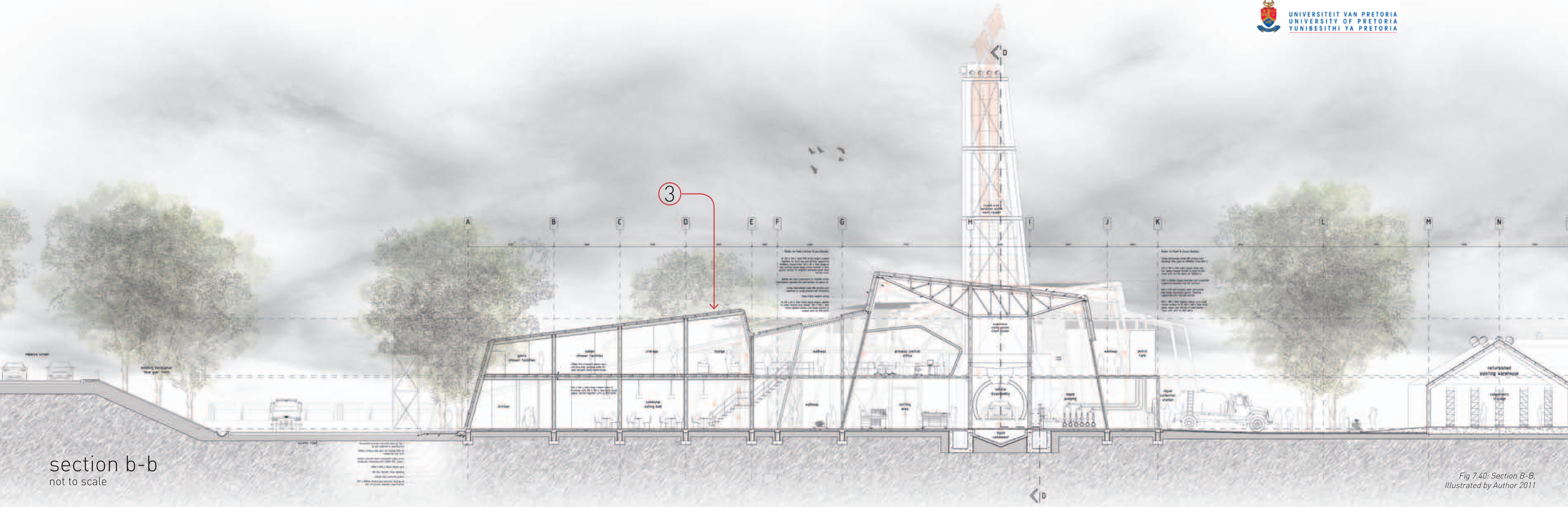


Fig 7.39: Section Portion 2, Illustrated by Author 2011



section b-b
not to scale

Fig 7.40: Section B-B, Illustrated by Author 2011

Detail Portion 3: Worker's Facilities

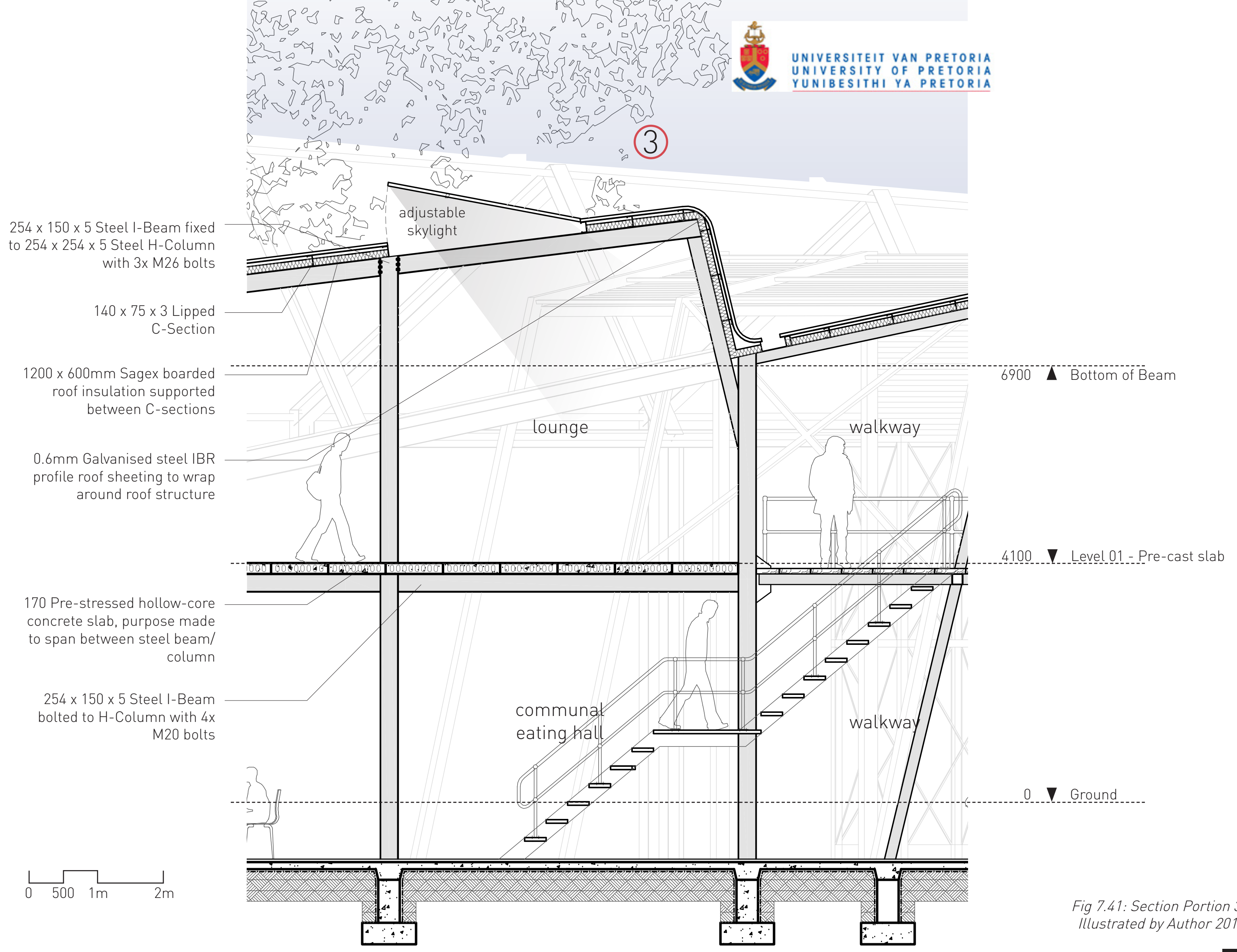
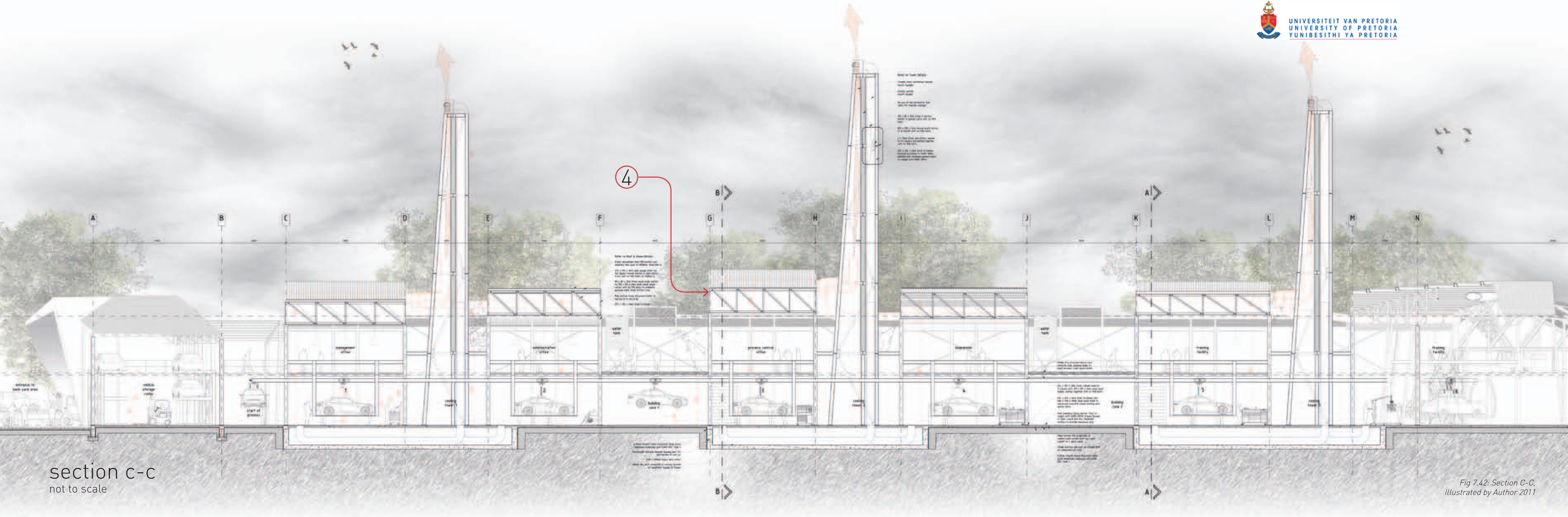


Fig 7.41: Section Portion 3, Illustrated by Author 2011

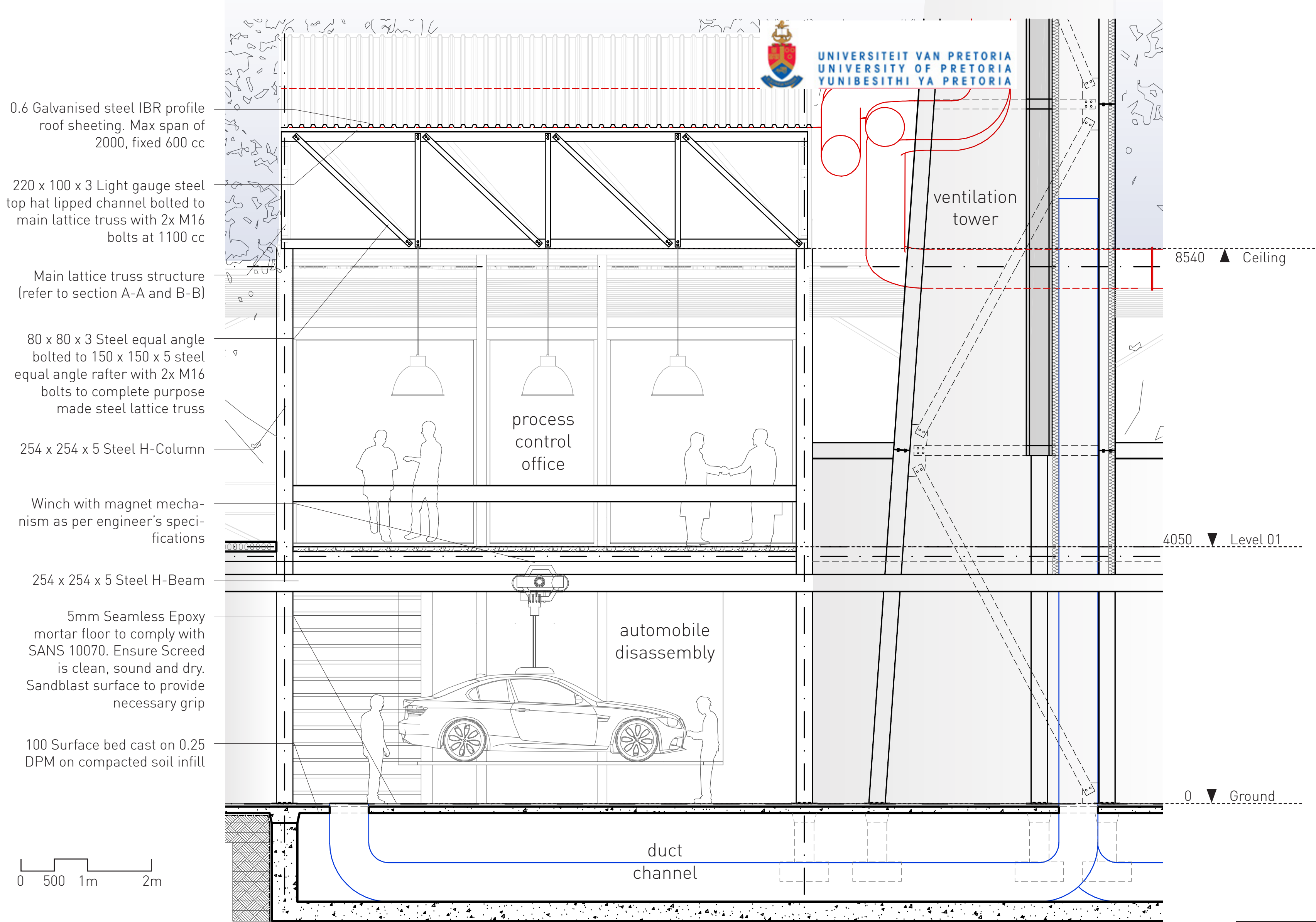


section c-c
not to scale

Fig 7.42: Section C-C, Illustrated by Author 2011

Detail Portion 4: Disassembly Workshop

Fig 7.43: Section Portion 4,
Illustrated by Author 2011



08 conclusion

A Cyclical Process

The thesis investigation has indicated that the unsustainable industry of automobiles and the linear process of automotive manufacturing should be altered to accommodate a cyclical process. This cyclical process should address the development of automobiles, from the design stage through to the disposal process.

The investigation of the Pretoria West precinct indicated a need for a cyclical process. The proposed Vehicle Disassembly Plant aimed to break the linear process by connecting the last stage (disposal) with the first stage (development/design) through the idea of seeing waste as food for the future.

It is important that the industrial process of the project, function as an ecosystem that will establish a connection to the surrounding context. Therefore, the plant showcases and facilitates the connection between the process and the urban fabric.

Sustainable principles together with passive and active systems were utilised to lower the invention's energy consumption during its functional phase.

Finally, by enabling the proposed building to be disassembled, the project's argument of designing products for disposal is better substantiated.

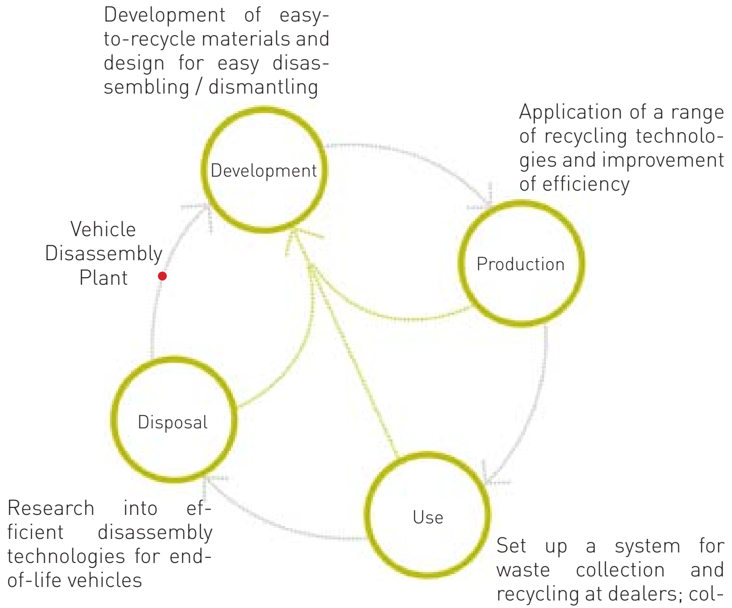


Fig 8.2: Cyclical Production process - Industrial Ecosystem, Illustrated by Author 2011

Fig 8.1: Discovering a new possibilities of making the automotive industry more sustainable (Five Non Blonds 2008)

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