

WasteFarm

a productive landscape for
integratedwastemanagement

Mabasa Mashazhu

Waste Farm:

a productive landscape for integrated waste management

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Acknowledgements

I would like to express the deepest gratitude to the following;

The Lord Almighty, for allowing me to do what I love.

Mom and Dad, For their unsurpassable love & for sacrificing so much to afford their children the best education.

MArch UCT Class of 2015: For providing an amazing working environment and constantly setting high standards.

Abstract

In 2010 the city of Cape Town partnered with the Department of Environmental Affairs to initiate a project to investigate and evaluate the possible re-opening and licensing of Historic and Old landfill sites. The project to reassess these landfill sites is due to the fact that the three main operating landfill sites in Cape Town are nearing capacity. This calls for the city to re-imagine its waste management infrastructure. Meanwhile, within the urban areas of Cape Town, there exists a network and constellations of informal waste pickers working in conjunction with buy-back centres and recyclers to form an economically, environmentally and socially sustainable solution that diverts volumes of recyclable waste from landfills.

These informal waste pickers contribute to filling in a gap within the formal recycling system but there is no infrastructure supporting these individuals on whom the formal recycling industry depends on. Most of the waste pickers sleep 'on the streets' with little access to amenities such as water, toilets and washing facilities. The spaces they occupy/sleep make it hard to store their pickings and hence they are forced to sell as soon as they collect. It also forces them to make multiple trips to the buy-back centres whom they are always at the mercy of, particularly when the ever changing price of recyclable waste is low.

This project aims at creating a productive landscape that uses waste as a vehicle to enhance the livelihoods of informal waste pickers and encourage local communities to see the economic and environmental value of recycling waste. By providing secure storage and sorting, safe/hygienic sleeping and cleaning spaces coupled with social and productive areas; the project seeks to unlock the potential of recycling using a suitable architectural intervention that is self-sustaining.

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PART 1: INTRODUCTION

Room for Informal Waste Pickers

Municipal waste has become an undeniable reality continuously fuelled by an ever growing urban population and consumer economy that supports the practice of disposability. The management of this urban waste poses great challenges for most African cities environmentally, economically and socially. Cape Town generally has an efficient (curb-side) waste collection service, in particular when compared to other cities in economically developing countries (Engledow 2005). However, the bulk of this waste is not recycled and ends up in landfills that are nearing capacity as shown in Fig 2. This situation has created opportunities for the marginalized, unskilled and informal waste picking economy populated by those previously unemployable in the formal sector.

The activities of waste pickers are classified as informal, requiring low skills, minimum use of technology and being labour intensive (CSIR). However, their labours render the city and environment a great service and provides them with a means to make a living. The DEA estimates that there are over 83000 informal waste pickers active in South Africa. Plastics SA ‘employs’ 43500 people in the informal sector and they are partly responsible for diverting 20% of plastic waste from landfill. The Paper Recycling Association of South Africa reported that 64% of recoverable paper was diverted from landfill in 2014. This highlights the potential in the role played by informal waste pickers.

Background: The Metabolism of Cape Town

The City of Cape Town is the third largest city in South Africa with a population of 3.4 million. According to the Cape Town Spatial Development Framework (2011), the city is expanding at a rate of approximately 640 hectares per year, with a need for 15 000 to 18 000 new households each year to accommodate this growth. This continuously sprawling pattern of urban development puts a tremendous strain on the infrastructural needs of the city – these needs include the disposal of large volumes of municipal waste.

Households account for the largest source of solid waste in the city. In 2009/2010 the total extractive demands of material and food generated approximately 1 600 000 tons of solid waste; the equivalent of 4383 tons per day. It is estimated that households (residential sector) generates approximately 46% of the total waste in Cape Town, followed by the industrial sector with 27% and commercial sectors with 26%.

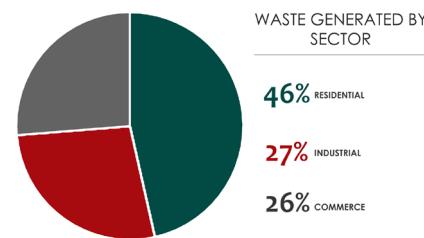


Fig 1. [above] Waste generated by land use sectors in Cape Town

Fig 2.[right] landfills in Cape Town



LANDFILL SITES IN CAPE TOWN

1. Vissershok Landfill:

117 Ha
65m above ground
6yrs till Capacity



2. Muizenberg Coastal Park Landfill:

75 Ha
40m above ground
Capacity expected between
2018-2022



3. Bellville South Landfill:

60 Ha
35m above ground
30 Ha till Capacity



Most recycling happens in the industrial sector, producing approximately two-thirds of the recycled materials. Recycling in the residential sector is relatively limited, where waste constitutes 46% of the total waste in the city and yet only 8% of this is currently being recycled. This poses a great need for recycling within this sector.

Cape Town's waste is disposed at the three landfills which are within three to eight years till capacity (Fig 2.). In Counter Currents: Experiments in Sustainability in the Cape Town Region (2010), Edgar Pieterse states that Cape Town has a predominant linear metabolism, where environmental resources are consumed and a high proportion are disposed of as waste (Fig 3.). This leads to a one-way flow of materials and energy as a large proportion of the resources consumed are not renewable. There is need for a more active role to implement a more sustainable cyclic approach to waste management.

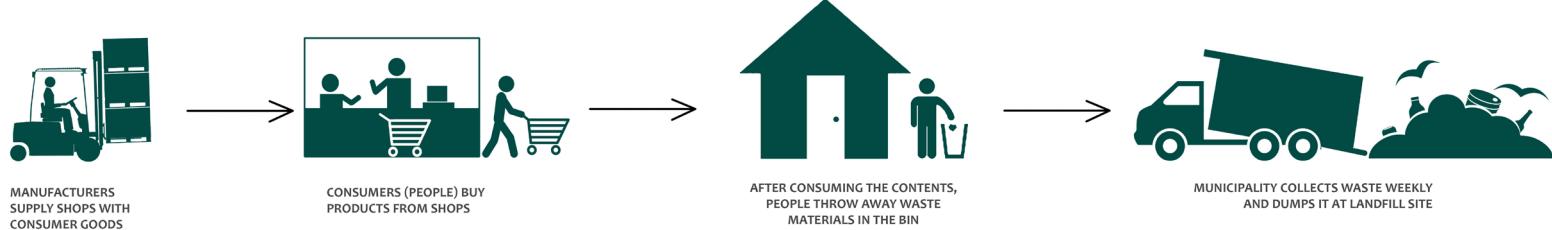


Fig 3.[above] linear waste management flow diagram

Fig 4. [right] landfill site reaching capacity



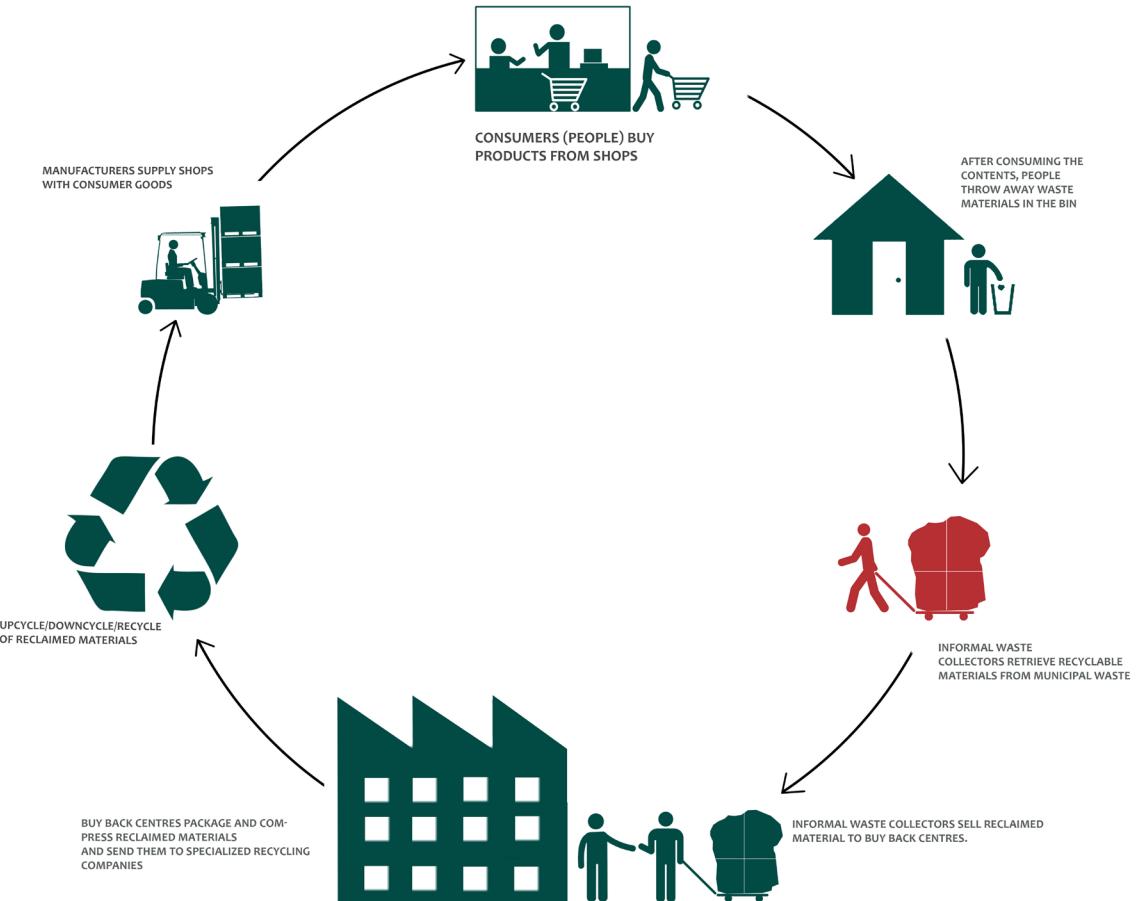
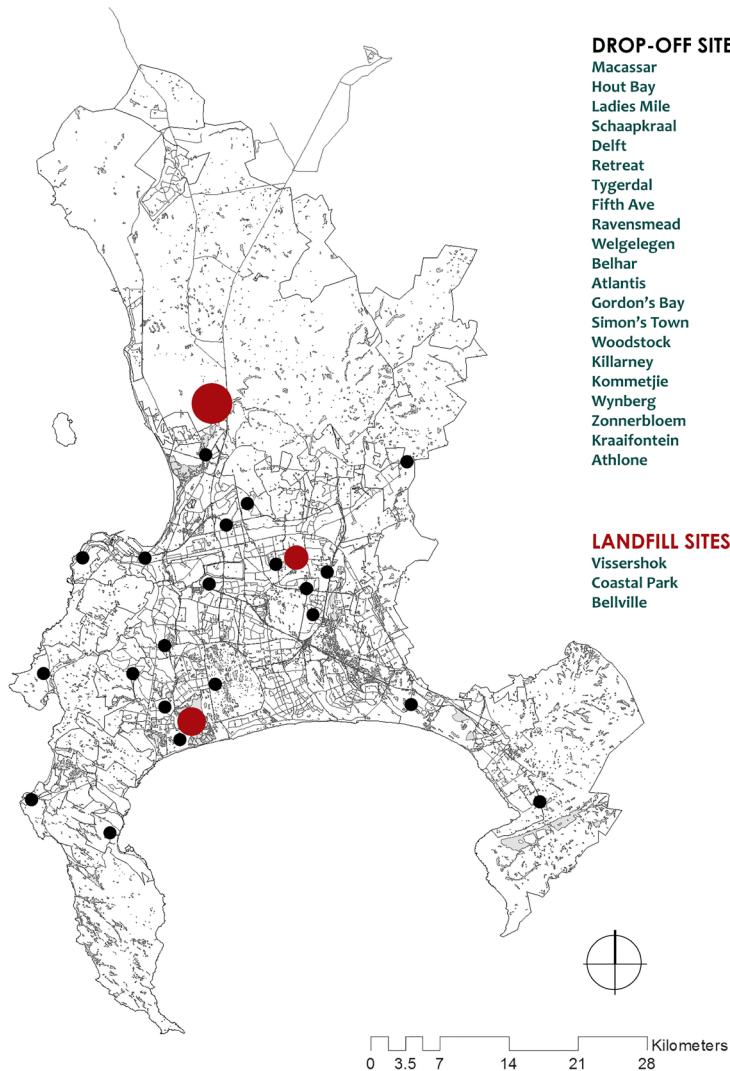


Fig 5. cyclic metabolic approach to waste management flow diagram



Noting the importance of recycling, the city has constructed one Materials Recovery Facility (MRF). This one MRF barely exploits the recycling potential the city has. The municipality has also pin pointed 25 formal drop off sites for local residents in urban communities [Fig6]. These sites are mostly placed at the peripherals of communities and lack activity, hence the recycling potential of these sites is not realised. There is no integration of these formal drop off sites and informal waste pickers.

Fig 6. drop-off sites in Cape Town

OBJECTIVES

The focus of the proposal looks at how a productive landscape in an urban context can improve the working and living conditions of informal waste pickers by linking them to the relevant role players.

The objective of the project is to:

1. Develop an alternative integrated waste management approach that reduces the amount of waste going to landfill.
2. Improve working conditions of the informal actors (particularly waste pickers) in the waste management industry hence increasing their work-flow, material capacity and earning potential.
3. Encourage local residents to see the economic, environmental and social value in recycling hence fostering a culture of re-using and recycling.
4. Creating indirect and indirect job opportunities in the informal and formal waste management sector.

KEY WORDS

Municipal waste/Waste: Damaged, used or unwanted material discarded by consumers from residential, institutional, commercial and industrial sources.

Recycling: The practice of collecting, sorting out, remanufacturing or converting of waste products into new materials suitable for reuse.

Landfill: A waste disposal site used for the controlled deposit of solid waste onto or into land run by municipality.

Productive Landscape: Sustainable infrastructure with multifunctional open and enclosed spaces for work, commerce and leisure.

Formal sector: The 'formal private sector' refers to private corporations, institutions, firms and individuals, operating registered and/or incorporated businesses with official business licences, an organized labour force governed by labour laws, some degree of capital investment, and generally modern technology (Furedy, 1990).

Fig 7. Down-cycling and Up-cycling



Down-cycling

Downcycling is the process of converting waste materials or useless products into new materials or products of lesser quality and reduced functionality. Downcycling aims to prevent wasting potentially useful materials, reduce consumption of fresh raw materials, energy usage, air pollution and water pollution. Its goals are also lowering greenhouse gas emissions (though re-use of tainted toxic chemicals for other purposes can have the opposite effect) as compared to virgin production. A clear example of downcycling is white paper that is converted into cardboard.



Up-cycling

Upcycling is the reuse of discarded objects or materials in such a way as to create a product of higher quality or value than the original. This is exemplified by the work of artist Heath Nash (pictured above), who is well known for converting waste material into covetable designs.





Informal Waste pickers: Individuals who reclaim waste from the streets, open spaces, or bins for sale or further use. Different terms are used to refer to informal waste pickers; which include reclaimers, garbage pickers, scavengers and waste salvagers (Shenck and Blaauw 2010).

Fig 8. Denver makes a living from collecting waste material using his trolley and sells it to buy back centres. He starts his routes at 6a.m and makes an average of R150 per day.

PROJECT OUTLINE :

Purpose of Research Study:

To get a profile and gain an understanding of how the informal recycling sector currently works within the Southern suburbs of Cape Town.

Problem Definition:

There is a lack of facilities that utilise the full potential of recycling. For those trying to participate in diverting waste reaching landfills such as informal waste pickers; there is no support infrastructure in the urban areas they operate to allow efficiency and ease of work.

These informal waste pickers are barely recognized by the Cape Town municipality and local government. They operate at the mercy of the buyback centres that buy their reclaimed materials and are forced to sell at whatever price stipulated by these bigger and established corporations. They don't have facilities or infrastructure that make their work more dignified and bearable.

Rationale

Rather than opening new or re-opening old landfills, my rationale suggests conceptualizing holistic productive landscapes conceptualized as machines that pick up and support the existing network made up of informal waste pickers who are an essential part of a closed loop of recycling waste material. The machines are placed within the urban context where the waste is produced. This benefits the environment, creates jobs for marginalized and unskilled members of society, and improves economic opportunities

of the communities linked with the recycling of waste from the waste pickers and buyback centres to artists and manufacturers who reuse/retrieve waste as raw materials.

Design Objectives:

To envision infrastructure in the (sub)urban community of Observatory that supports the labours of 100+ active informal waste pickers operating within the surrounding context and speaks of the ecological, economical and sociological benefits of recycling waste.

Design Question:

What is the architecture of a productive landscape that uses waste as a vehicle to uplift and integrate informal waste pickers while encouraging local urban communities to see the environmental and economic value of recycling waste.

Sub Questions

- What are the factors that contribute to an appropriate site?
- How does the intervention engage the context and local community (other users catered for)?
- What are the waste streams handled and what happens to the reclaimed materials?
- How is a fluid flow of waste volume ensured?
- How does the intervention smoothen the ties between the formal and informal sector.
- What support programmes are facilitated by the intervention?

Theoretical Framework

The rationale employed in this thesis suggests that informality and formality are interdependent. Traditionally, the formal and informal economies were viewed to operate parallel to each other, however these economies often intersect. This architectural proposition locates itself at that point of intersection in-order to enhance the economic and social components of both the informal and formal recycling systems. By facilitating this linking intervention, informal waste pickers aid in closing the materials use loop and contribute to a sustainable urban ecology.

Urban Informality

The current age of global restructuring driven by economically motivated migration has significantly increased the awareness of urban informality in recent decades. Ananya Roy identifies informality as a ‘state of exception and ambiguity’ employed as a survival strategy outside administrative systems. This is the state a majority of urban migrants find themselves in. Asef Bayat argues that this population is fully integrated into the urban society but on terms that leave them economically exploited and socially stigmatized. The discussion of informality stems from the advent of the “informal sector” as a concept in the 1970s. The concept was rooted in some of W. Arthur Lewis’ ideas from his 1954 essay where he identifies an emerging trend of labour migrating to the cities. He discusses the absorption of the traditional economy into a modern capitalist, or formal economy. After which he proposes two model; the Formal and the Informal sectors.

Economic and Social Integration

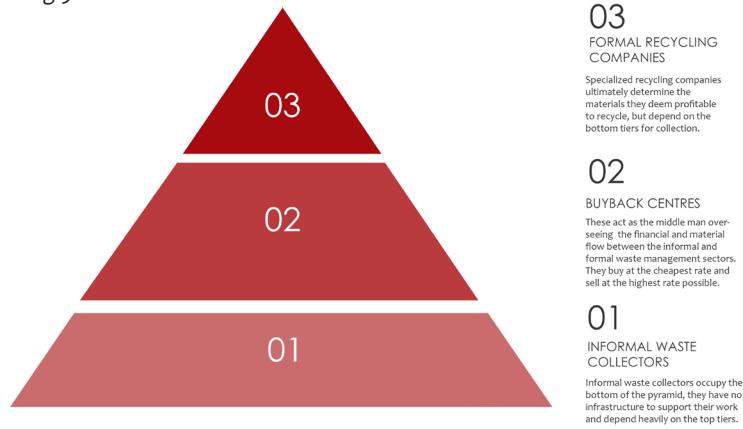
In recent years, there has been a great interest in the informal economy worldwide. This Informal economy materializes in different places; in open air, on the streets or in covered spaces. The heterogeneity of this economy makes it quite difficult to crystalize and define. Martha Alter Chen elaborates on the four schools of thought that try to define the formal economy:

- The Dualist school sees the informal sector of the economy as comprising marginal activities—distinct from and not related to the formal sector—that provide income for the poor and a safety net in times of crisis (Hart 1973; ILO 1972; Sethuraman 1976; Tokman 1978).
- The Structuralist school sees the informal economy as subordinated economic units (micro-enterprises) and workers that serve to reduce input and labour costs and, thereby, increase the competitiveness of large capitalist firms (Moser 1978; Castells and Portes 1989).
- The Legalist school sees the informal sector as comprised of “plucky” micro-entrepreneurs who choose to operate informally in order to avoid the costs, time and effort of formal registration and who need property rights to convert their assets into legally recognized assets (de Soto 1989, 2000).
- The Voluntarist school also focuses on informal entrepreneurs who deliberately seek to avoid regulations and taxation but, unlike the legalist school, does not blame the cumbersome registration procedures.

The informal economy is a whole lot complicated than these perspectives may suggest. The reasons for operating within the informal economy vary. Though some informal entrepreneurs may choose, or volunteer, to work informally, informal employment tends to expand during economic crises or downturns, suggesting that necessity—in addition to choice—drives informality (Chen, 2012). Although the four schools of thought have different views, they agree that rural-urban migration and necessity are catalysts for informality. Downsizing and closure of companies in the formal economy also contribute to people entering the informal economy to make ends meet.

The formal versus informal binaries cannot be understood as absolutes opposites. These terms merely try to define urban realities that are fluid and dynamic.

Fig 9.



There is a rising acknowledgement that much of the informal economy today is intrinsically linked to the formal economy and contributes to the overall economy; and that supporting the working poor in the informal economy is a key pathway to reducing poverty and inequality.

Waste pickers are linked to the formal sector, their activities are subordinate to and dependent on the formal sector recycling companies. Waste picking or reclaiming is in the bottom of the recycling hierarchy which includes buy-back centres and industrial recycling corporations. Fig 9.

An Integrated Model

This paper draws from the works of Moreno-Sanchez and Maldonado (2006) and Trask (2012), where they suggests a dynamic waste disposal and recycling model in which the role of informal waste pickers is explicitly introduced. The interaction between the informal and formal is viewed in light of sociological theories of functionalism as explained by Abuyuan (1999).

The functionalism theory states that institutions survive by adapting to changing circumstances by interdepending on the various partners or role players. By arranging the informal waste pickers and formal recyclers in a cyclic metabolic waste management system, they are viewed as partners that form parts of a whole organisation that delivers a service. ‘Here the partners (formal and informal) may be seen as interdependent organs of a larger organisation each having its specialised function working as a whole towards the common goal of delivering effective service’ (Ahmed and Ali, 2004).

It is essential to predefine and clarify demarcations of roles played by each party to make this partnership work. It is also essential to make sure both parties are comfortable and benefit from this partnership. The partnership between the informal and formal waste management sector must be considered dynamic, as factors like population growth, new regulations, new skills and new markets. The course of change in the roles played by the informal and formal sectors should be carefully monitored to maintain optimum satisfaction.

Formalization of the Informal

The debate around formalizing informal activities separates the different categories of informal workers. It distinguishes informal entrepreneurs who hire others, self-employed enterprises, wage workers in informal jobs. For self-employed individuals or enterprises, the value of formalization is not just in 'obtaining a license, registering their accounts, and paying taxes: these represent, to them, the costs of entry into the formal economy' (Chen, 2012). What they value are the benefit that come with operating formally. These include : 'enforceable commercial contracts; legal ownership of their place of business and means of production; tax breaks and incentive packages to increase their competitiveness; membership in trade associations; protection against creditors and clear bankruptcy rules; and social protection' (Ibid).

Spatial dimension to Informality

With economic transformations and transactions creating new opportunities for those at the margins, there is need to evolve our cities' urban and spatial planning to counter exclusion and marginalization. There is need for spaces that facilitate the interaction of formal and informal transactions. Most informal enterprises are constantly negotiating between space as it should be used by regulation and how space can be used to uplift themselves. AlSayyad (2004) refers to this appropriation of urban space by informal community as 'carving out autonomy'. Informality that takes place in open air and on the street shows that 'spatial practices are flexible, innovative, evolving, and transformational' (Parthasarathy, 2009). Informal activities normally find spaces that are easily modified to operate in. Space becomes a flexible container that takes the form desired to facilitate activity happening at a given time. Most post-colonial cities are developing with pockets of hybrid spaces that integrate formal and informal growth. As this hybridity gradually carves are cities, it is essential to understand the attributes of these inclusive spaces.

The rise of waste reclaiming in Cape Town is a narrative of how people come to organize themselves and find ways to contest their oppression through a communally beneficial activity. It is through this bid to recognise the role played by this army of waste pickers that the architect can make a meaningful contribution. Architecture becomes an instrument for testing hybrid solutions to social, ecological and economical issues. This is a proposition that attempts to do so.

PART 2: LOCATING THE SITE

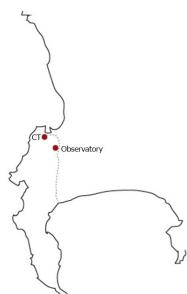
Project location



South Africa



Cape Town



Locating Observatory
from CBD Cape Town

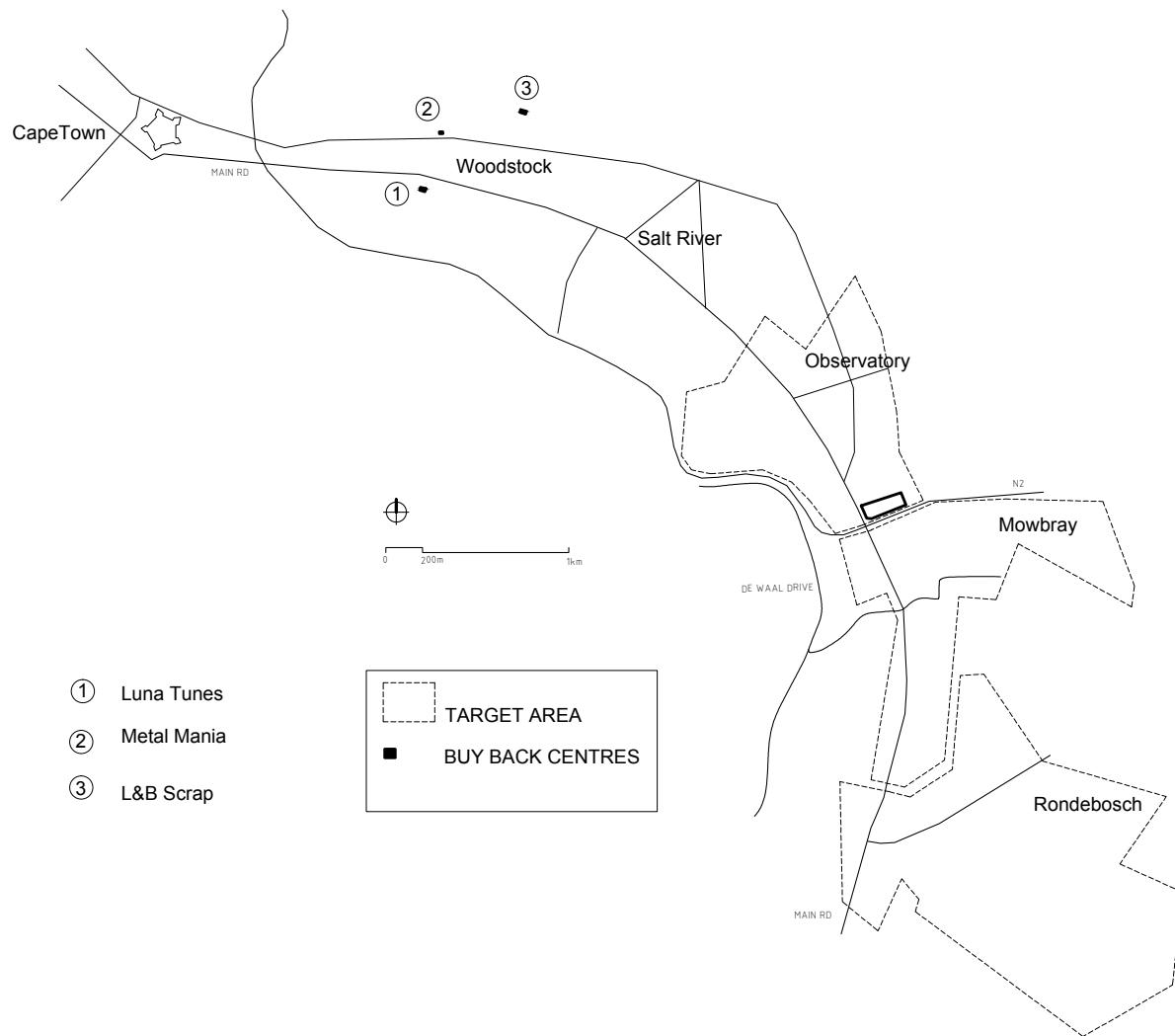
The area of Observatory is selected for this project because of its rich mix of land use and proximity to highly residential areas. Observatory is located in a strategic position that links the highly residential neighbourhoods of Newlands, Rondebosch and Mowbray with the light industrial neighbourhoods of Salt River and Woodstock. Waste pickers that collect their waste material from these residential areas find it challenging to make it all the way to Woodstock where 3 buy back centres (Metal Mania, L&B Scrap, Lunar Tunes) are located—Fig 10. Locating the intervention in Observatory would motivate recycling within the target residential areas by informal waste pickers and local residents.

The project site was selected from 3 possible options of open spaces that were viewed as highly visible wasted pieces of land, underutilized or even empty. The selected site was picked for its high potential to mix programme and for its visibility and ability to communicate with the public. Its location along prime movement routes provokes the public to recognise waste as a resource crucial to the material use cycle. This moves away from the current notion of having waste management sites on the outskirts or having them strictly in the industrial areas.

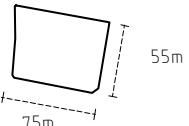
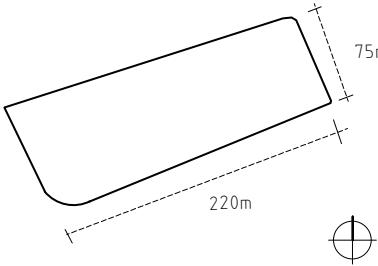
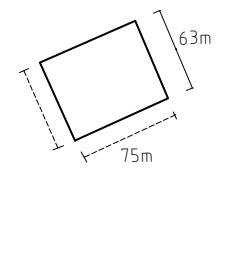
Fig 10. [left] Locating the project

Fig 11. [right]
Map showing where current buy back centres are and their distance from target residential areas

Buy back centres in the area





| |
|---|
|  <p>SITE A Current Use: Community Park</p> <p>This park is located along Main Road and is under utilized given its location. It sits in-between 2 satellite sites of a community college. It is flanked by 4 access roads. Maintaining the current function and adding a productive industrial function could make an interesting hybrid project.</p> <p>Challenges It is the only public park that feeds off main road for the high residential area of Rondebosch and Mowbray</p> |
|  <p>SITE B Current Use: Privatized Open Field</p> <p>This site used to be an open sports field but as of 2014, it has been privatized by its owner, CPUT. It is unclear whether it will maintain its recreational function or be developed for accommodation. It has access from 3 sides and has a strong visual presence on 2 major roads, Main Road and N2.</p> <p>Challenges This site is big, approx 2 urban blocks, it will need a programme that is productive and accommodating.</p> |
|  <p>SITE C Current Use: Fenced Open space</p> <p>The site sits along Main Road near a vehicle bridge that separates Mowbray and Observatory. It has access to 3 roads and sits adjacent to a row of residential stands on its southern side.</p> <p>Challenges The relationship of the site with its neighboring residents. It lacks the visual presence embodied by SITE B opposite it.</p> |

Context



Fig 12. [far left] Site located along Main Road which connects several residential area with industrial areas

Fig13. [left] comparing possible side

Fig 14. [right] Map shows land use of surrounding context and the major roads that run past the site



Fig 15. Urban fabric surrounding site



1

View of road infrastructure on the southern side of the site. The road disconnects the site from the neighbouring buildings on that side.



2

The road on the south side showing the off-ramp that merges into the N2 highway. The vehicle overpass can be seen in the background.



3

Residential component on the northern side of the site characterized by one storey buildings

Fig 16. Street Views from surrounding context

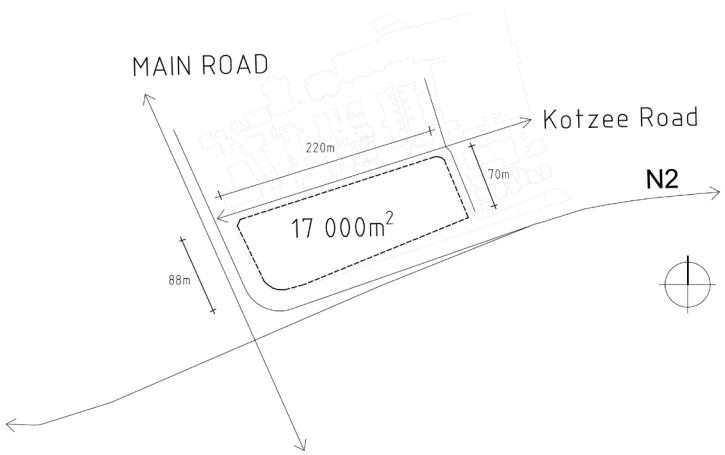


Fig 17. Dimensions of site

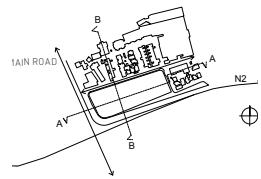


Fig 18. [a] section AA

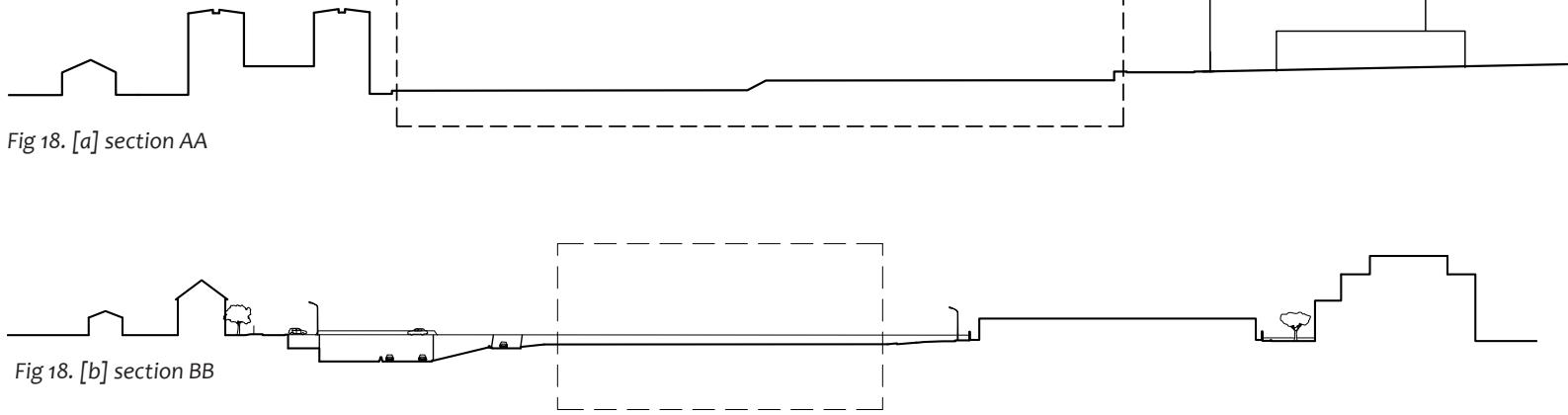


Fig 18. [b] section BB

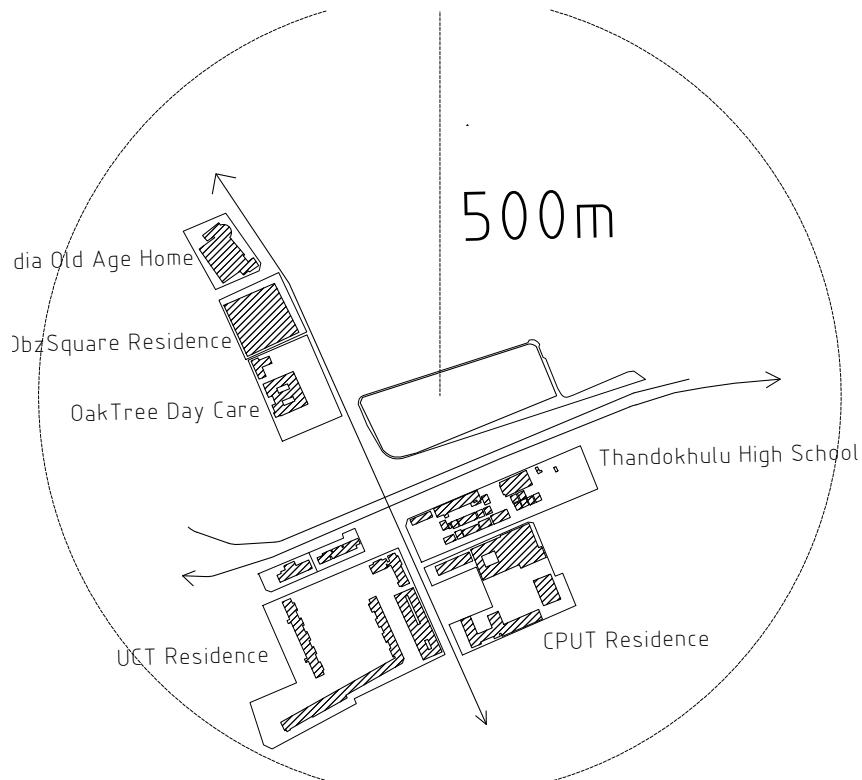
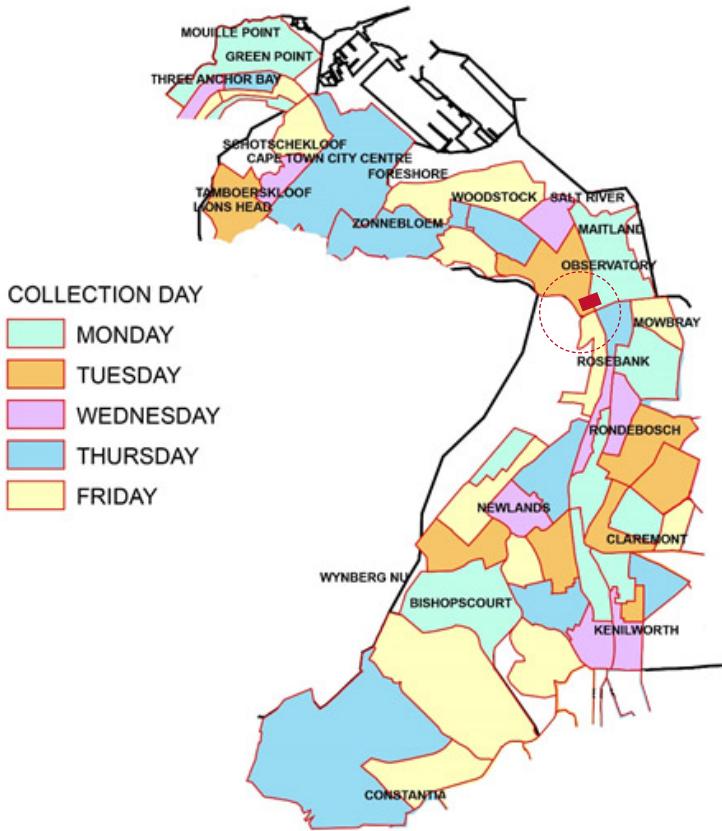


Fig 19. [top] Institutions that could share social and recreational space or programme on site

Fig 20. [right] Formal waste collection days by municipality



Waste pickers are familiar with the collection days schedule. They generally move ahead of the council trucks with their trolleys .

Trolley pushers assign each other streets in order to cover more ground and avoid conflict.

WARNING
Chubb
ARMED GUARD
TEL
061 031 911
TRESPASSERS
L. BE PROSECUTED



PART 3:FINDINGS ON WASTE PICKERS

A survey was conducted as part of the research study in order to attain a profile of the waste pickers. From a sample of 10; 8 waste pickers were male and 2 were female. The survey indicates that majority of the sample group of waste pickers were NOT from the target areas of collection: Newlands, Rondebosch, Mowbray, Observatory, Salt River and Woodstock. Only one was from Salt River. Nine are migrants from other areas which poses a housing challenge.

Education

Fig 22. below indicates the highest grades attained by the waste pickers that were interviewed. Most of the waste pickers have a low educational background. For many of them, this has led them to the informal waste management sector. One interviewee highlighted the importance of education and skills training in order to get a job. However, another interviewee indicated that he regarded waste picking as a full time job or business.

Suggestions:

- Educational/skills development centre or workshops



Housing and Living Conditions

The housing conditions of waste pickers show a diversity of accommodation typologies. Most sleep and live informally or on the street on a regular basis. They break away from the orthodox notion of homelessness by engaging themselves in productive work and logic in their sleeping conditions. Most sleep in groups for protection of themselves and their reclaimed materials. Some choose spaces that allow them to accumulate their reclaimed materials until they can sell off in bulk and these tend to be abandoned buildings. A large percentage of waste pickers choose to sleep informally in order to be closer to areas of collection and buyback centres which saves them on transportation money and time.

However living informally or on the street means little access to amenities toilets, water, washing facilities. The presence of waste pickers living on the street has a negative impact on themselves (their image as perceived by the public + their health) and on the city as they are mostly forced to use open spaces and natural resources to aid themselves.

Suggestions:

- Housing component with amenities
- Storage area

Fig 21. [left] Waste picker focuses on collecting cardboard

Fig 22. Highest grades completed by interviewed waste pickers

Accommodation Typologies



1

PRIVATE HOUSE PORCH

Observatory

Picker is not allowed storage



2

SHELTER

Observatory, Mowbray

Picker is not allowed storage



1

ABANDONED WAREHOUSE

Salt River

Pickers consider these favourable, but warehouses have very low security

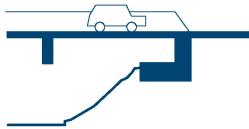


1

RENTED FLAT ROOMS

Woodstock

Safe and favourable accommodation



1

UNDER BRIDGES

Rondebosch

Often cramped and lack sorting spaces



2

PARKS AND OPEN SPACES

Observatory, Salt River

Exposed to the elements and often chased away



2

SHOP-FRONT PORCH

Mowbray, Salt River

Pickers and materials are exposed to the elements.

Fig 23. The accommodation typologies they occupy are documented in the image on the next page. The typologies are characterized by having no cover, no security, no storage, no water and no toilets.

Relationships

With One Another

Only 2 of the interviewees worked collaboratively or assisted each other in collecting materials. The rest work competitively and have therefore allocated each other streets to avoid clashes. At night there tends to be more of a connection as some cook together and sleep in groups for safety and security.

Suggestion:

- Spaces that encourage social activity amongst waste pickers and but also maintain a competitive approach to the business

With Buy Back Centre

The relationship between waste pickers and buy back centres is a symbiotic one. The more waste pickers collect, the better the business for both groups. There is a mutual appreciation of each other and waste pickers implied that they were generally treated fairly. However, waste pickers implied that they were at the mercy of buy back centres when it came to pricing, with some noting moments of being exploited. It was also apparent from observation that buy back centres dictated the materials they needed therefore limiting the range of materials waste pickers could collect and get an income from.

Suggestions:

- Giving waste pickers a stronger voice in pricing by allowing them to hold onto materials when price is bad or when buy back centres near-by don't take a said reclaimed material.

With Community (Households and Shops)

There are mixed feelings about waste pushers from the public ranging from 'actively helpful', 'sympathetic', 'indifferent' and 'finding them a nuisance'. There is hard any verbal interaction between the waste pickers and the household they get their materials from. However one waste picker has an agreement with a shop to save specific waste materials for him.

Suggestions:

- Promote partnerships with shops and restaurants in the collection model.
Render the waste pickers as a unit and propose a unified approach that residents recognise



Fig 24. Hessian bags used for storing waste material

Fig 25. [right]The average prices offered by 3 buyback centres in Cape Town. Recycling companies are unable to guarantee that collected recyclable materials can be sold into the commodities market at a guaranteed price hence the buying price fluctuates consistently.

RECLAIMED MATERIALS



AL

R 0.40 PER KG

ALUMINIUM
soft drink cans, cookware, window
or door scraps



TIN

R 0.35 PER KG

TIN
canned foods, paint containers,
polish containers



PET

R 2.50 PER KG

POLYETHYLENE TEREPHTHALATE
water bottles, softdrink bottles,
cooking oil bottles



PE-HD

R 1.00 PER KG

POLYETHYLENE - HIGH DENSITY
milk bottles, detergent bottles,
lunch box containers



HL-1

R 1.80 PER KG

HEAVY LETTER-1
white printing paper, exam pads,
envelopes



CARD

R 0.60 PER KG

CARDBOARD
corrugated packaging boxes,
manila boards, poster boards



GLASS

R 0.50 PER KG

GLASS
wine bottles, beer bottles,
medicine bottles

WASTE PICKERS CAN
EARN AN AVERAGE OF
R80 TO R150 PER DAY.

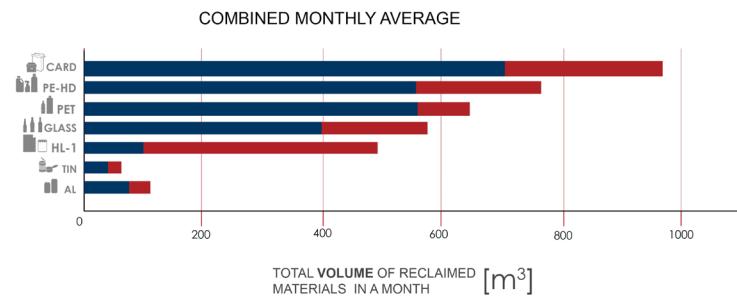
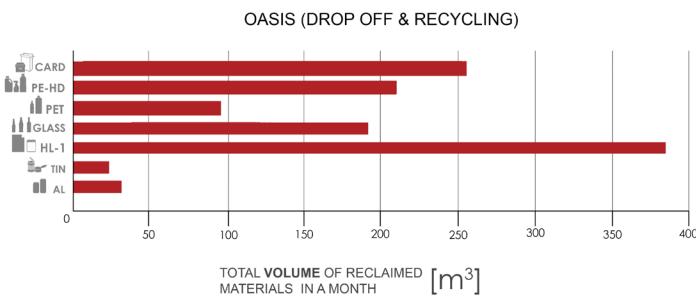
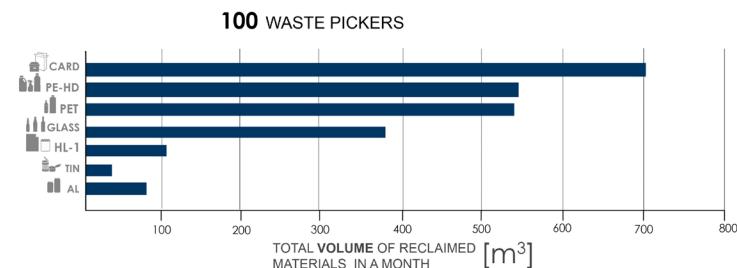
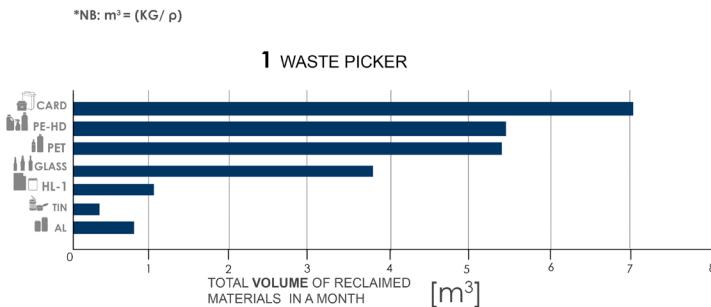
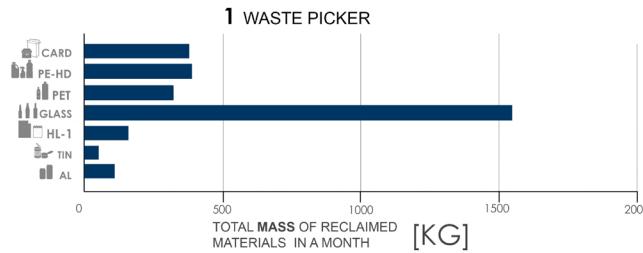
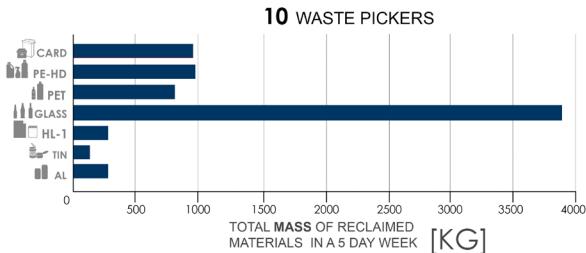
Exchange Rate September 2015 : USD 1= ZAR 13.2

*NB the prices shown are an average of different buy-back centers.

| |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| TOTAL MASS OF RECLAIMED MATERIALS IN A 5 DAY WEEK 10 WASTE PICKERS | KG | 285 | 142 | 823 | 987 | 412 | 970 |
| TOTAL MASS OF RECLAIMED MATERIALS IN A 5 DAY WEEK 1 WASTE PICKER | KG | 29 | 14 | 82 | 99 | 41 | 97 |
| TOTAL MASS OF RECLAIMED MATERIALS IN A MONTH 1 WASTE PICKER | KG | 116 | 56 | 328 | 396 | 164 | 388 |
| DENSITIES OF MATERIALS | KG/M ³ | 140 COM | 140 COM | 60 MEDIUM COM | 72 MEDIUM COM | 152 MEDIUM COM | 55 LOOSE |
| TOTAL VOLUME OF RECLAIMED MATERIALS IN A MONTH 1 WASTE PICKER | M ³ (KG/ p) | 0.83 | 0.40 | 5.46 | 5.50 | 1.08 | 7.10 |
| TOTAL VOLUME OF RECLAIMED MATERIALS IN A MONTH *100 WASTE PICKER | M ³ (KG/ p) | 83 | 40 | 546 | 550 | 108 | 710 |
| TOTAL VOLUME OF RECLAIMED MATERIALS IN A MONTH OASIS RECYCLING | M ³ (KG/ p) | 32 | 24 | 96 | 212 | 384 | 258 |
| TOTAL VOLUME OF RECLAIMED MATERIALS IN A MONTH COMBINED | M ³ | 115 | 64 | 642 | 762 | 492 | 968 |

Fig 26. Volumes of average waste material collected in a month by 100 waste pickers in a month.

Fig 27. Data from fig 26, expressed as graphs for comparative analysis.



PART 4: DESIGN DEVELOPMENT

Design Development

New Strategy

1) Clients and Users

The City of Cape Town's Social Development Strategy (Integrated Development Plan) in conjunction with Department of Environmental Affairs have interests that are embodied in this proposal. The city's waste management plan for 2013/14 list states the following as one of its long term goals:

'Developing multiple integrated initiatives that will reduce waste and the associated impacts substantially as well as contribute to and support economic growth'.

The recycling component of the project can assume different forms of ownership as long as there is empowerment and development of waste pickers. It could even act as a buy-back facility in its own right.

The users of this architectural intervention range from waste pickers, community members disposing their household waste, artists, buyback centres and the public co-sharing recreational spaces.

2) Operational and Economic Strategy

The proposal imagines an infrastructure that supports the activities of informal waste pickers and better connects them and their work flow with formal recyclers. This is imagined in the following ways:

(i)- Forming a cooperative that has one identity yet acknowledging the individual efforts of each trolley pusher. This gives waste pickers a unified voice, an address and a way to be assisted at a broad scale (ie with protective clothing). It offers them recognition when approaching shops, restaurants, offices or any operation that may need waste collected. Waste pickers combine their daily collections to quickly reach a bulk that is easy to sell. Participants are then paid proportional to what they collected and contributed to the bulk.

This allows some individual waste pickers to specialize in a waste material without fear of being turned away by a buy-back that does not deal in particular recyclables.

(ii)- The ability to hold onto collected waste materials is key to the economic strategy. It is what allows waste pickers to have a fairly equal hand with the buybacks and recycling companies they depend on. By holding onto their material, they can dictate the price they get to a degree. They are unlikely to be exploited and settle for the lowest price offered to them. In a similar way the grain elevator allowed farmers to hold onto their produce until the price was best. By having storage capacity, waste collectors can focus on the collecting without rushing to sell due to fear of bad weather that ruins materials, being robbed or lack of flexibility.

This also allows waste pickers to ‘invest’ in a collection in-case of rainy days or if they take ill. Each individual can dictate how they wish to retrieve their money; weekly, fortnightly or monthly.

(iii)- Dedicated sorting spaces allow waste pickers to refine their materials further. In the recycling industry, the purer the material, the more value it has. For example, used exercise books with no metal staples or plastic bottles with no stickers are more favourable to recyclers.

(iv)- The objective is to make an intervention that is self-sustaining by using natural and free resources such as solar, organic waste and natural phenomenon like gravity.

3) Programme

WASTE FARM proposes a new Infrastructure for waste management. The facility wont only recycle but bring different communities together (informal waste pickers, formal recyclers, artists, farmers and community members/consumers).

Storage, drop-off, Sorting, workshops, retail, recreation, housing, amenities, horticulture

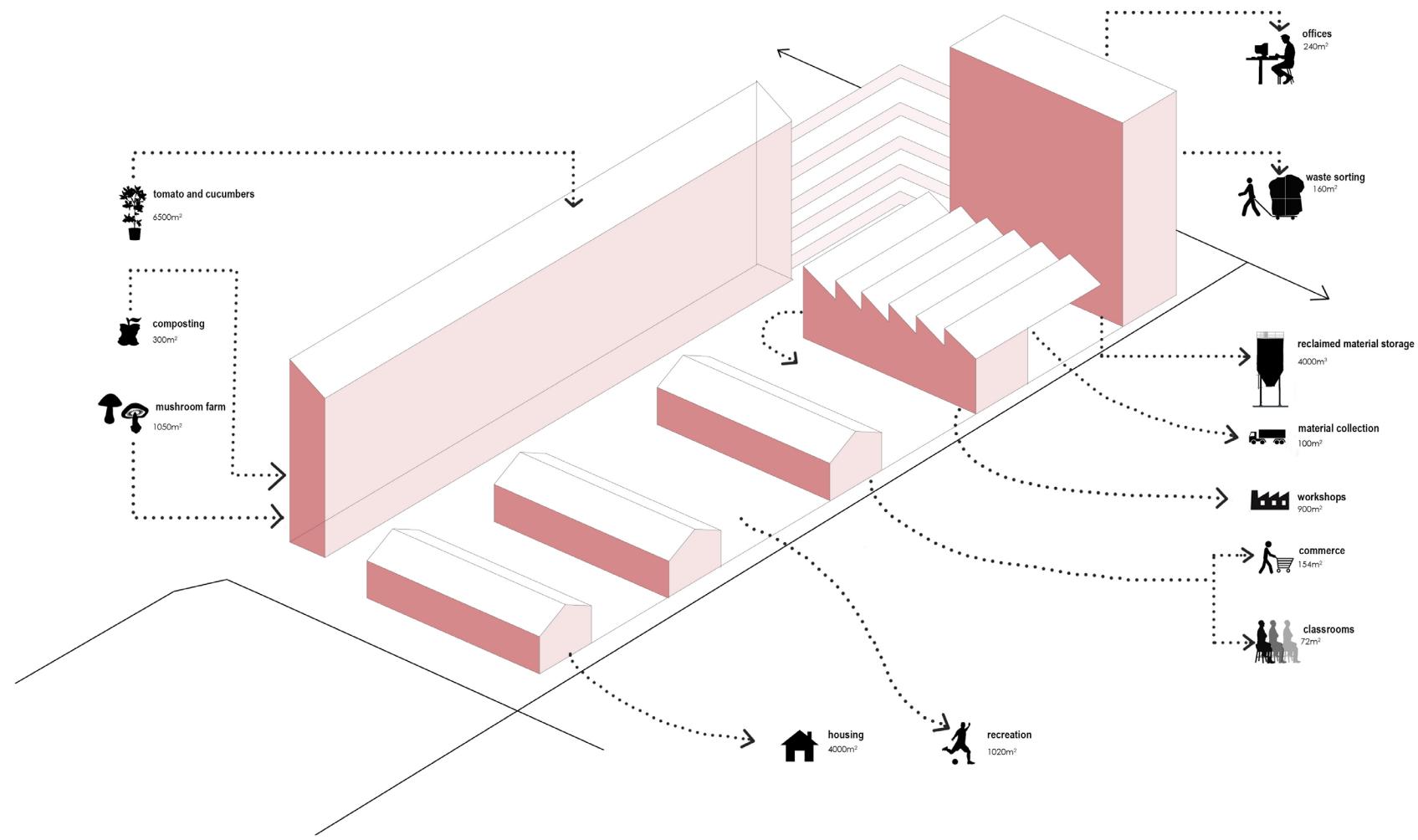


Fig 28. Schematic drawing of programmes on site

Case Studies

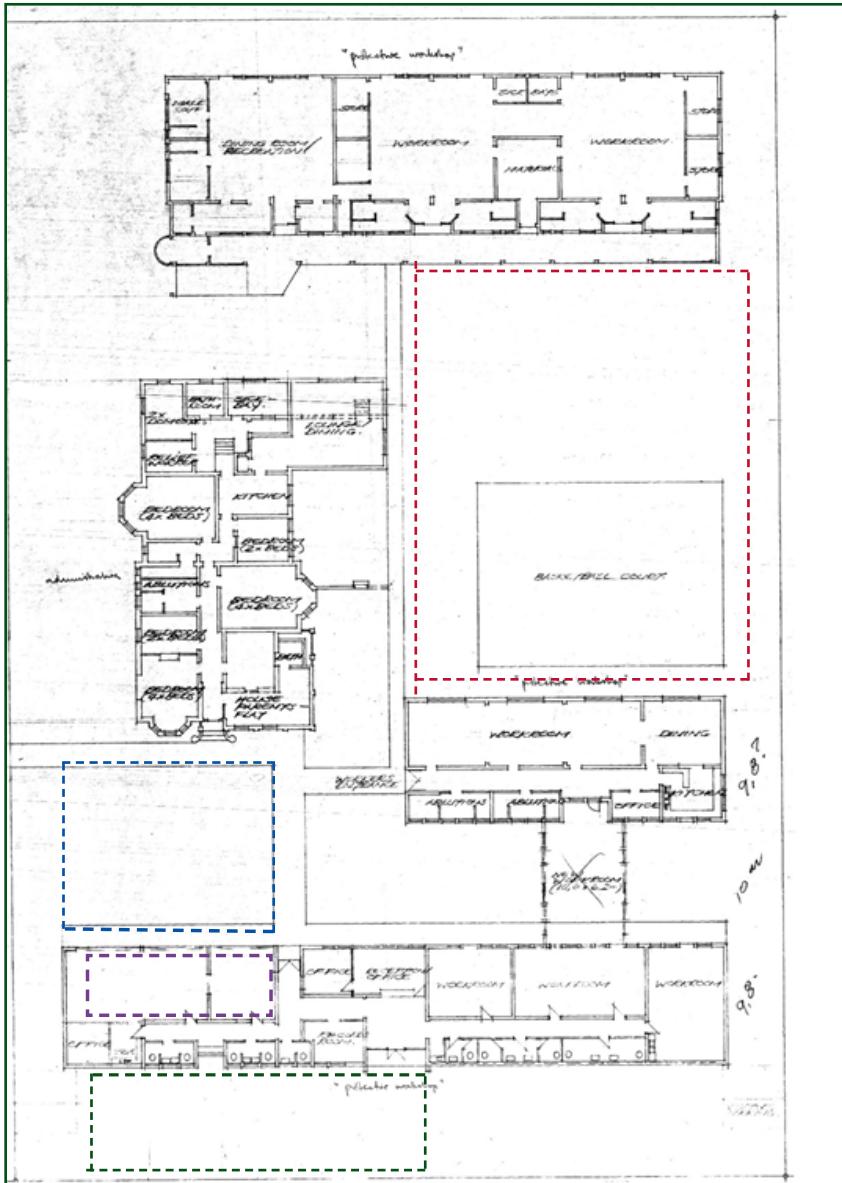
Oasis Association for Intellectual Disability

The Oasis Day Centre in Lansdowne runs a programme that accommodates the needs of adults with intellectual disability. Oasis tries to meet these needs as they are identified or as they evolve in each individual. The centre houses 200 participants that are involved in different projects throughout the day. These projects include recycling, baking (their cookies come highly recommended), a second hand book store, and workshops that provide floor space and labour outsourced by other companies. The centre allows a previously marginalized community to be involved in productive work.

NB. The drop off zone, sorting, workshops, retail
They sell their recyclable once they fill up containers.

- [Red dashed box] Drop-off zone
- [Blue dashed box] temporary storage
- [Green dashed box] storage for ready outgoing material
- [Purple dashed box] internal sorting area

Fig 29. Zoning of the recycling programme at OASIS



The grain elevator accord to William Cronon.

Cronon notes that the grain elevator revolutionized the agricultural industry as it shifted economic control to farmers who could now hold onto their grain.

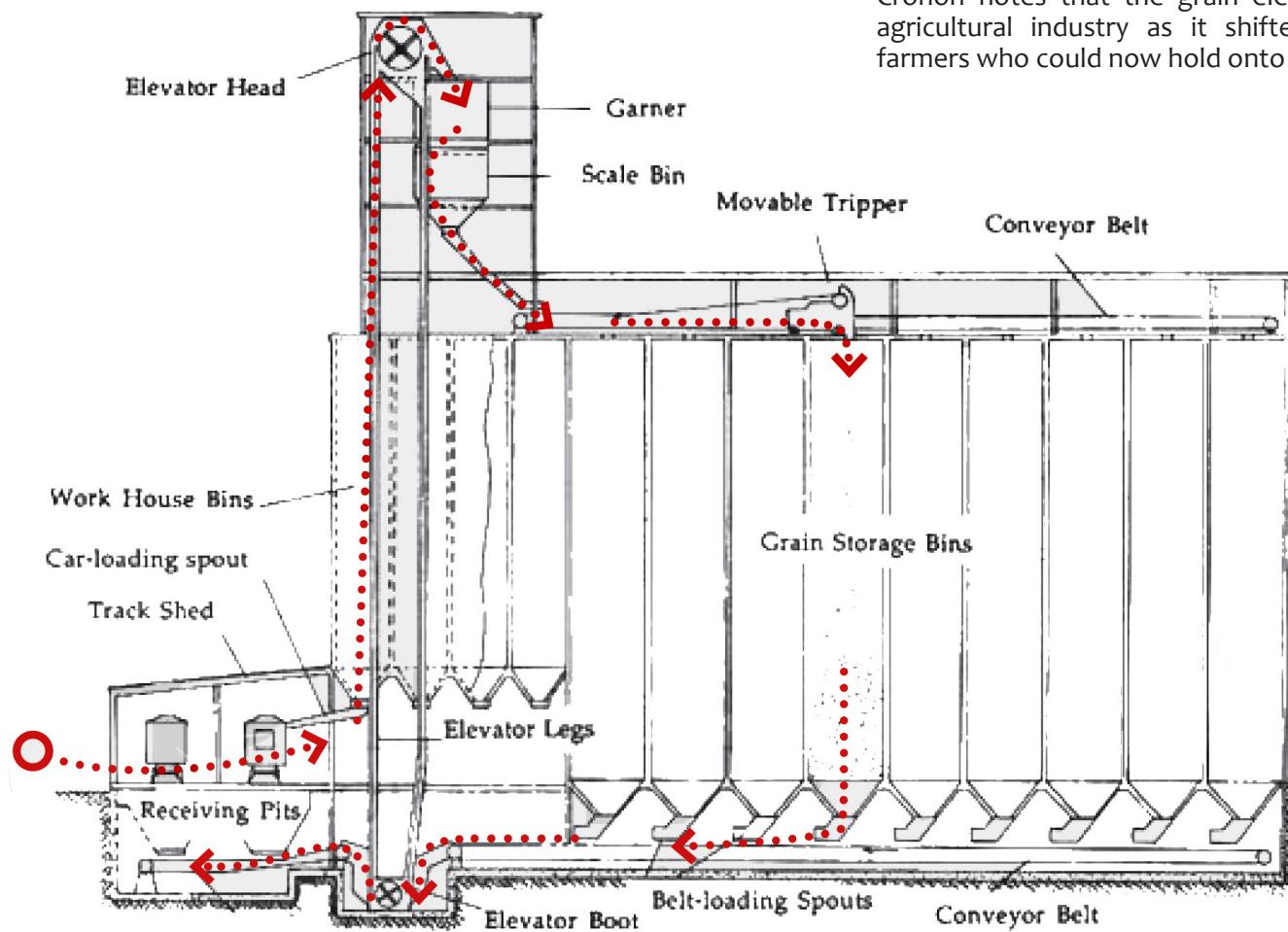


Fig 30. A study of the grain elevator's intake and output sequence

Design Process

Artefact A

The exercise of making an artefact proved inspirational in helping enact ideas I had been interested in. Key elements embodied in this artefact for me included:

- Self sustenance/self regulation
- mobility
- recycling

Self Regulation:

The water in the bottle waters the portable garden gradually without constant monitoring at a consistent rate. When it's hot, the air gap in the bottle expands and hence pushes the water down to increase the rate of drops per hour making sure the water leaving the leaves is equivalent the one entering the medium around the roots.

Mobility:

The bed is made in such a way that its mobile and portable. This addresses the need to grow your own vegetables for those without arable land.

The objects used here can be taken apart and be used to support a totally different function.

Materiality and Recycling:

The bag containing the medium in which the crops are grown and the bottle watering the plants are discarded objects that have been given a second life and use. The medium used to grow these crops is from composted organic waste.

Overall, the artefact sustains life; whether one is eating the produce or selling it.

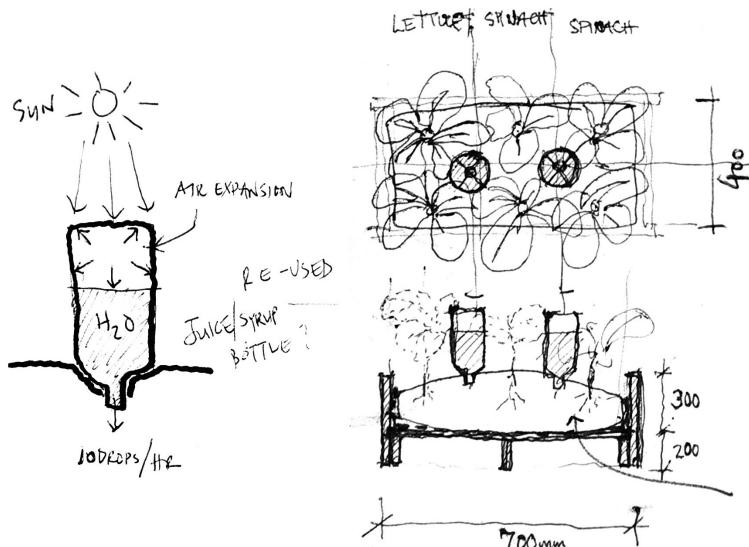
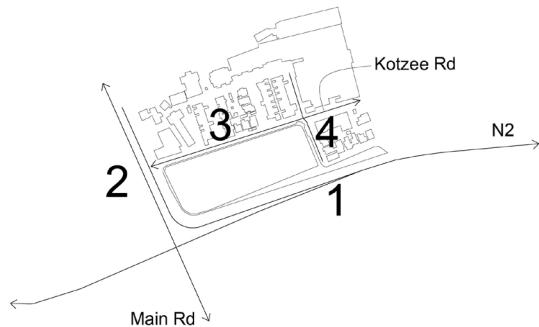


Fig 31. Testing the potential of organic waste recycling when combined with other forms of reclaimed materials.

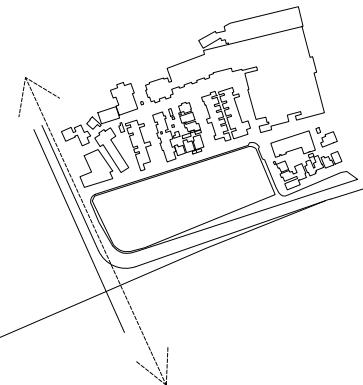
Site Informants



ROAD HIERARCHIES

The hierarchy of velocities on the road infrastructure surrounding the site need to be considered and used as informants to the design. The image above numbers the road speeds from the fastest to the slowest (pedestrian friendly).

clockwise: Fig 32-35



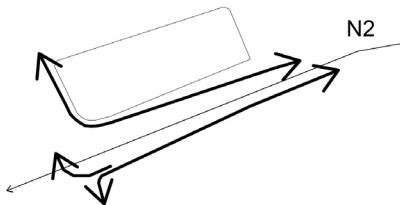
ACCESS ON MAIN RD

Main road has a mix of users. There is a fair amount of pedestrian activity that calls for the building to cater for their entrance at this level. This becomes the entrance for informal waste pickers pushing their trolleys.



ALIGNING PERIPHERAL ROUTES WITH CIRCULATION

Clues on entrances and access to the new site can be drawn from the smaller roads. By aligning these roads with the site's circulation, a continuity of the ground plane is created. This allows the site to relate with the residential fabric on its northern side.



RAMPS

The terrain on and around the site has been carved to create a car bridge / overpass. The change in levels is made possible by vehicular ramps. The notion of ramps can be adapted into the design to navigate the level changes with trolleys and wheelbarrows.



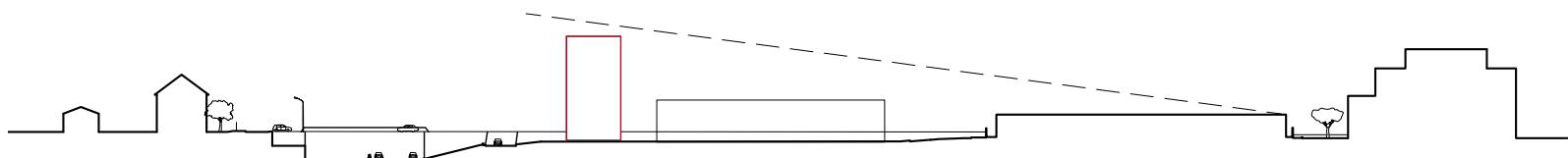
1. RESPONDING TO THE 2 MAJOR ROADS

The site is inaccessible from the N2 roadway but it had a major present, 220m of presence. A 'vertical' sculptural element that acts as a billboard is proposed for the N2. A similar but accessible element is suggested on the Main Road side.



2. RESPONSE TO THE RESIDENTIAL

Elements that are more porous and scaled down are proposed on the northern side of the site to relate to the residential. Access for pedestrians and trolleys introduced.





3. COURTYARDS

Programmed courtyards that correspond to the activities in the adjacent buildings are introduced. Courtyards are made by buildings parallel to main road offset from each other.

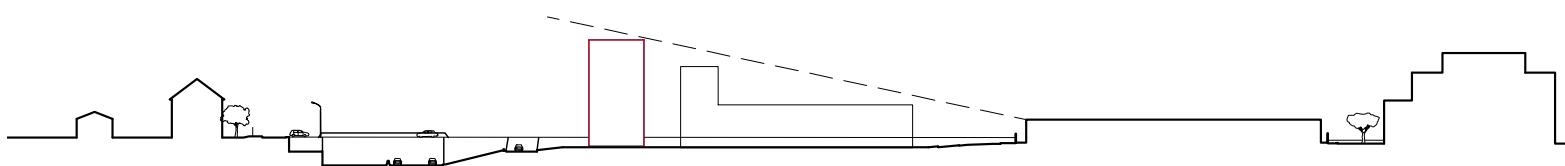


4. CONTINUITY OF THE GROUND & RAMP

The 'outside' fabric is allowed to flow into the site-precinct by aligning peripheral roads to the internal circulation where possible. This continuity of the ground is then continued inside the vertical element along the N2.

Fig 36. 1-4. Progression of the design

Fig 37. 1-2. Sections testing height restrictions on site



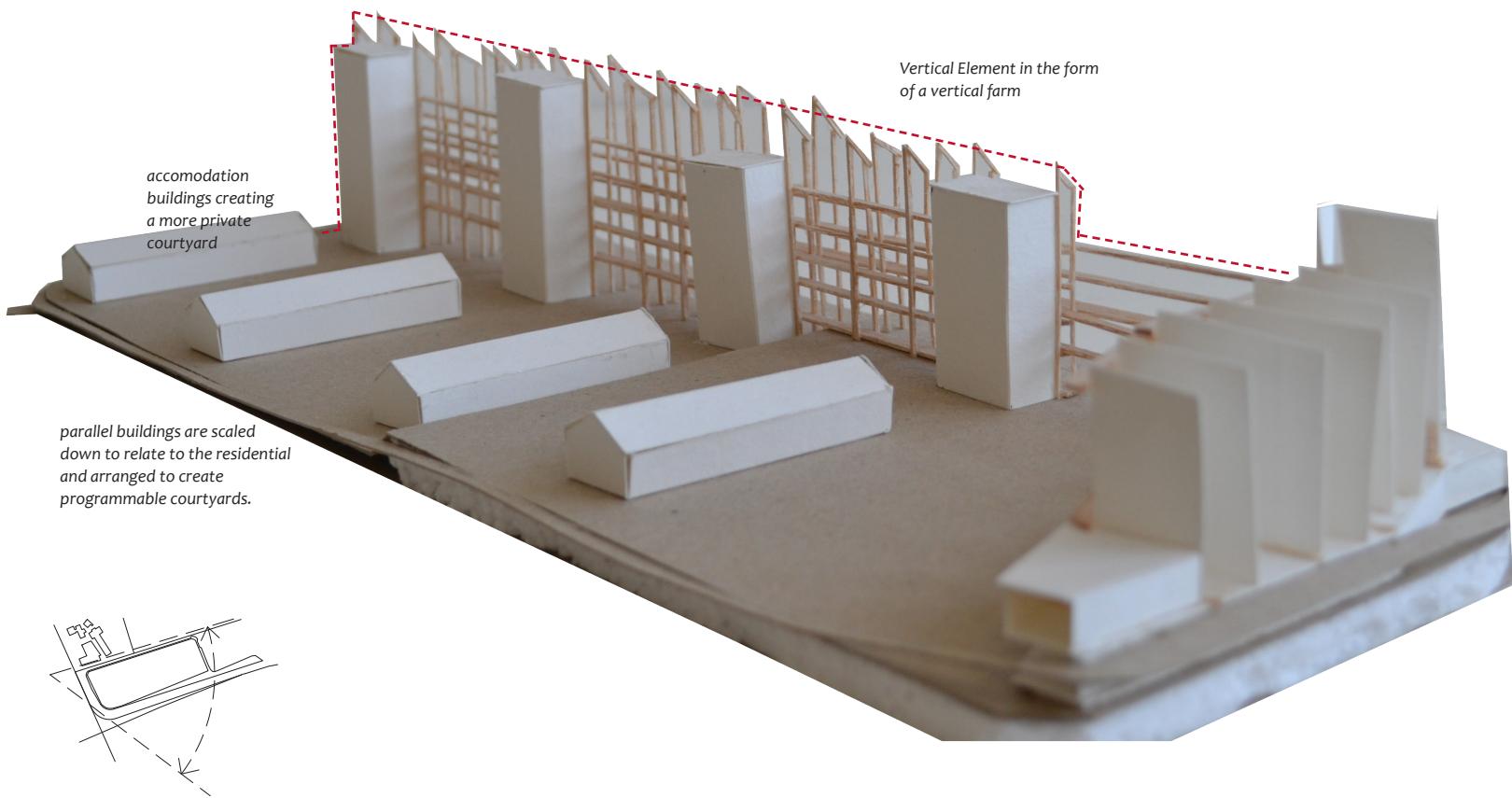
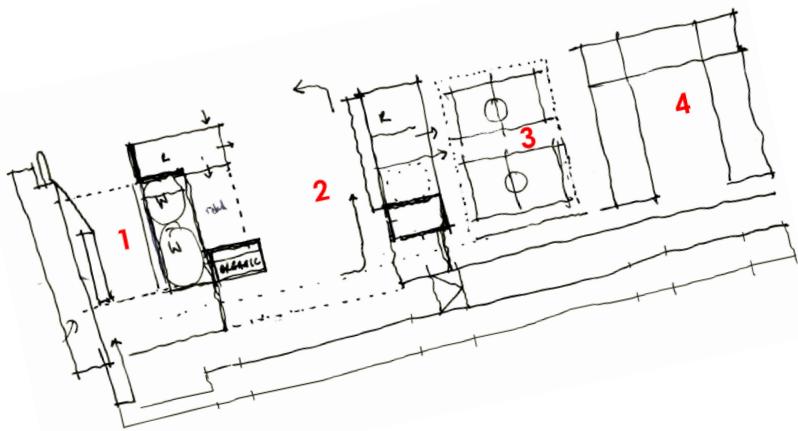


Fig 38. Testing the ideas mentioned on the previous page in model.



COURTYARD 1: acts as a drop off and sorting yard, working with the storage on the west and workshops that use selected materials on the right.

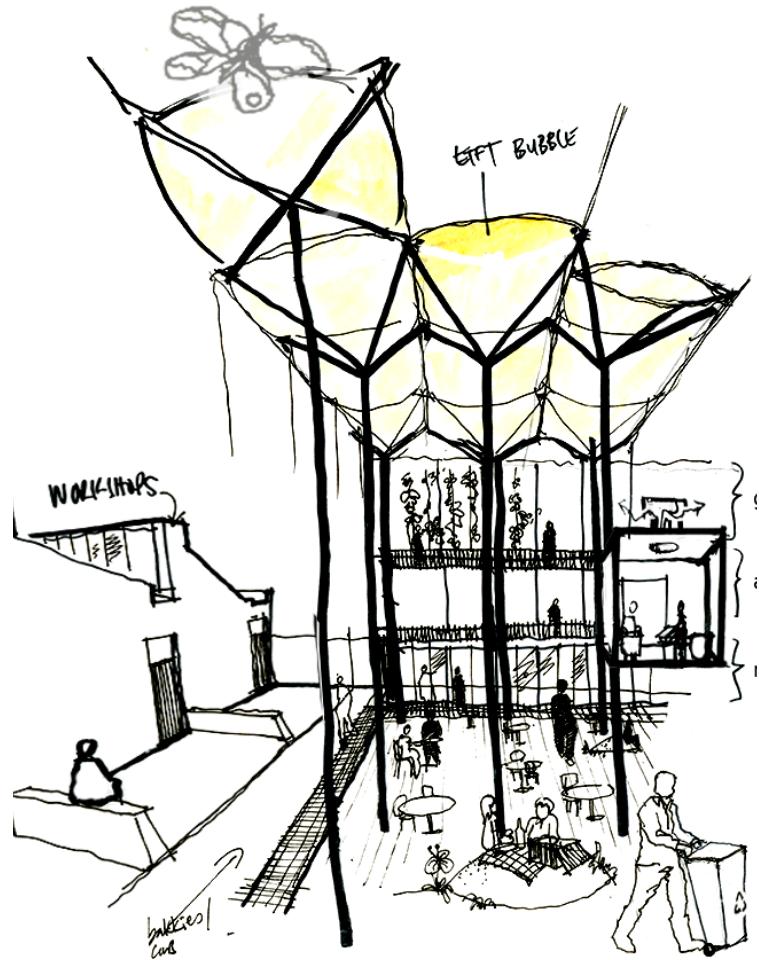
COURTYARD 2: acts as a retail and main entrance working with the workshops and stores and a vegetable shop that sandwich it.

COURTYARD 3: is the recreational courtyard that caters to the social needs of the waste pickers and the community (OBZ Square/day-care/old people's home have no recreational facilities).

COURTYARD 4: is exclusively the social space for the waste pickers, they do their laundry, dry it, personal sorting etc. This courtyard is flanked by 2 parallel accommodation buildings.

Fig 39. conceptual sketch showing site layout

Fig 40. Sketch testing the mixed use atmosphere of courtyard 2



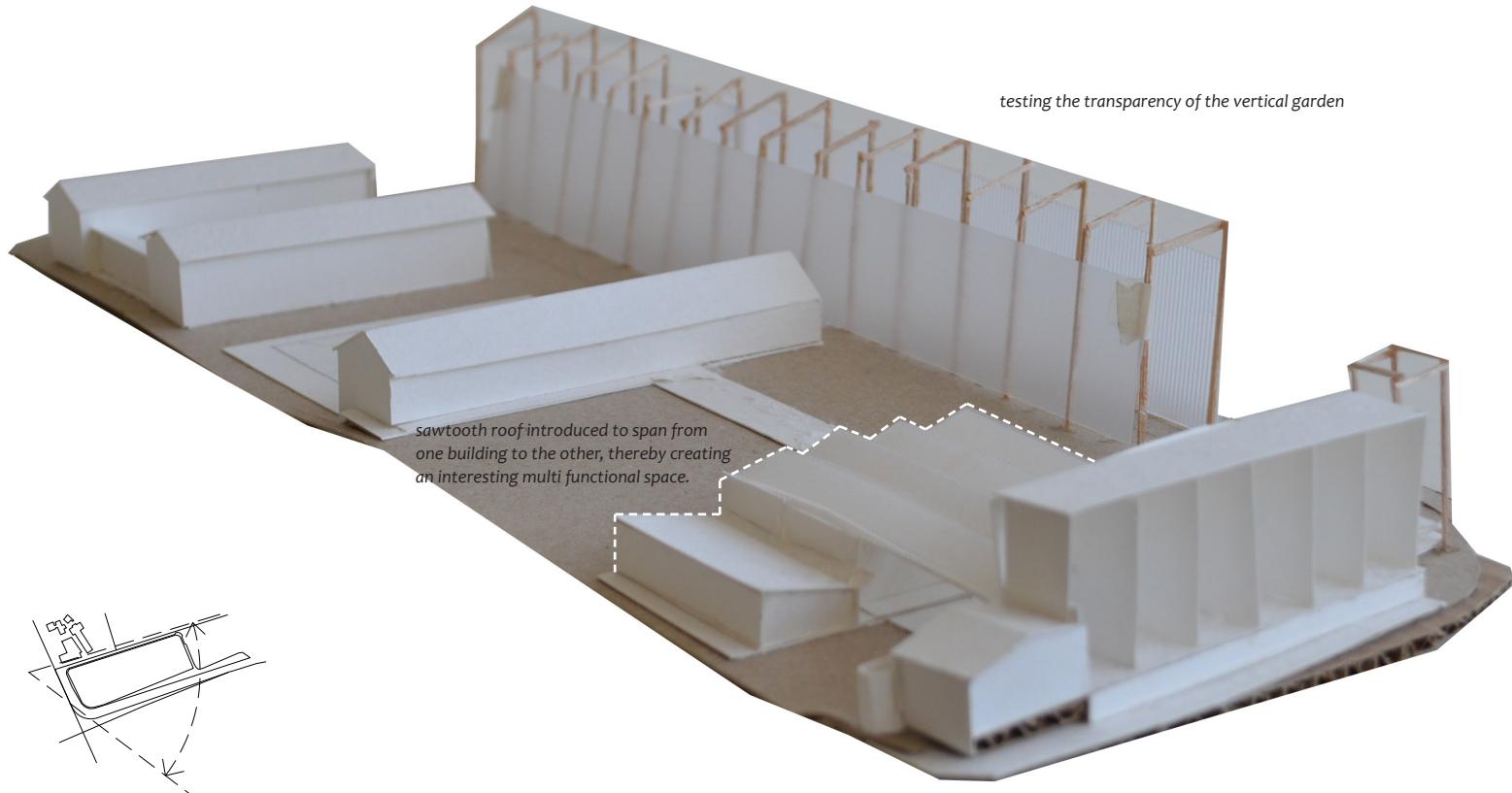
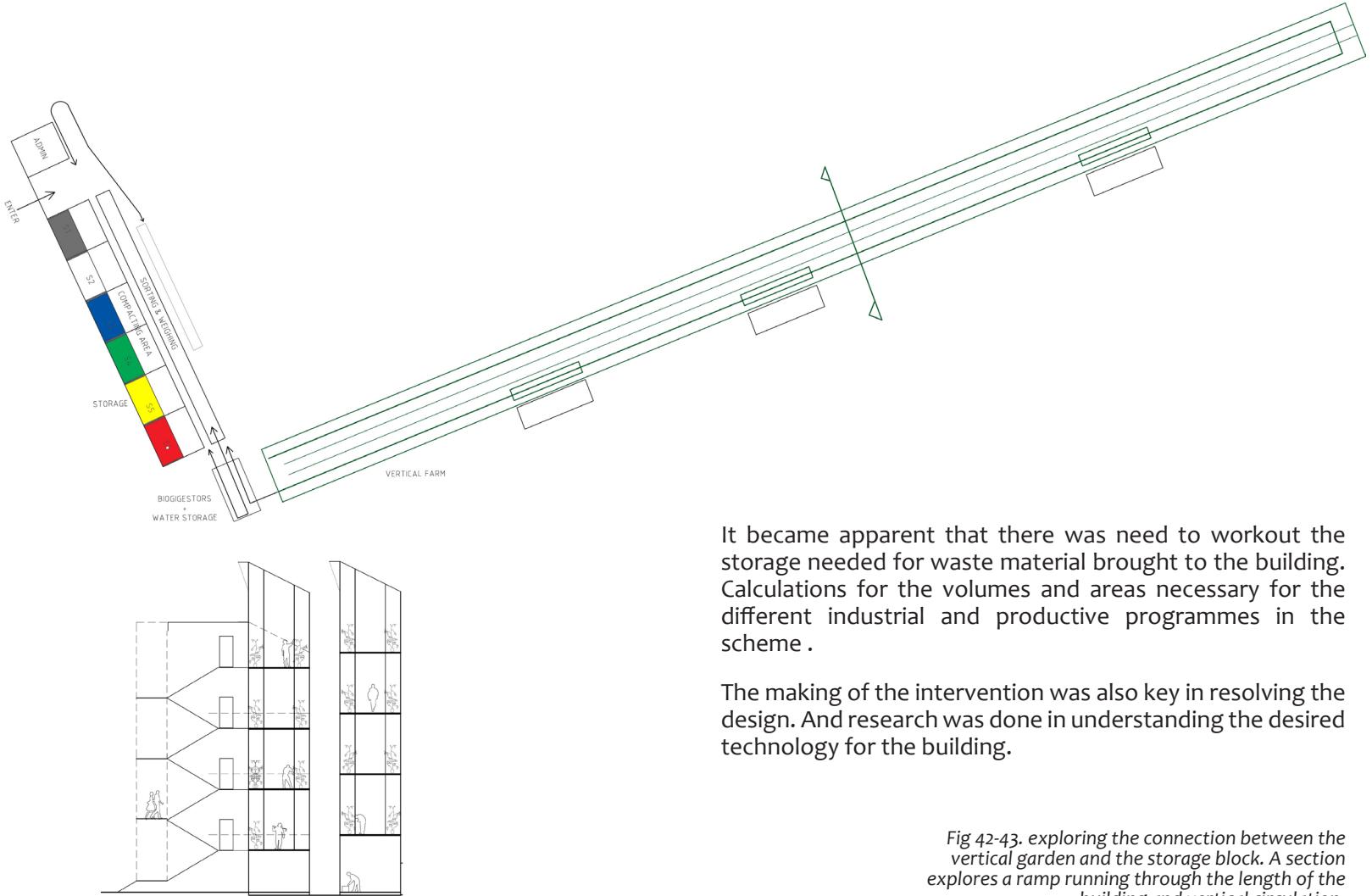


Fig 41. Option B tests the idea of having a covered drop-off/pick-up courtyard (Courtyard 1)



It became apparent that there was need to workout the storage needed for waste material brought to the building. Calculations for the volumes and areas necessary for the different industrial and productive programmes in the scheme .

The making of the intervention was also key in resolving the design. And research was done in understanding the desired technology for the building.

Fig 42-43. exploring the connection between the vertical garden and the storage block. A section explores a ramp running through the length of the building and vertical circulation.

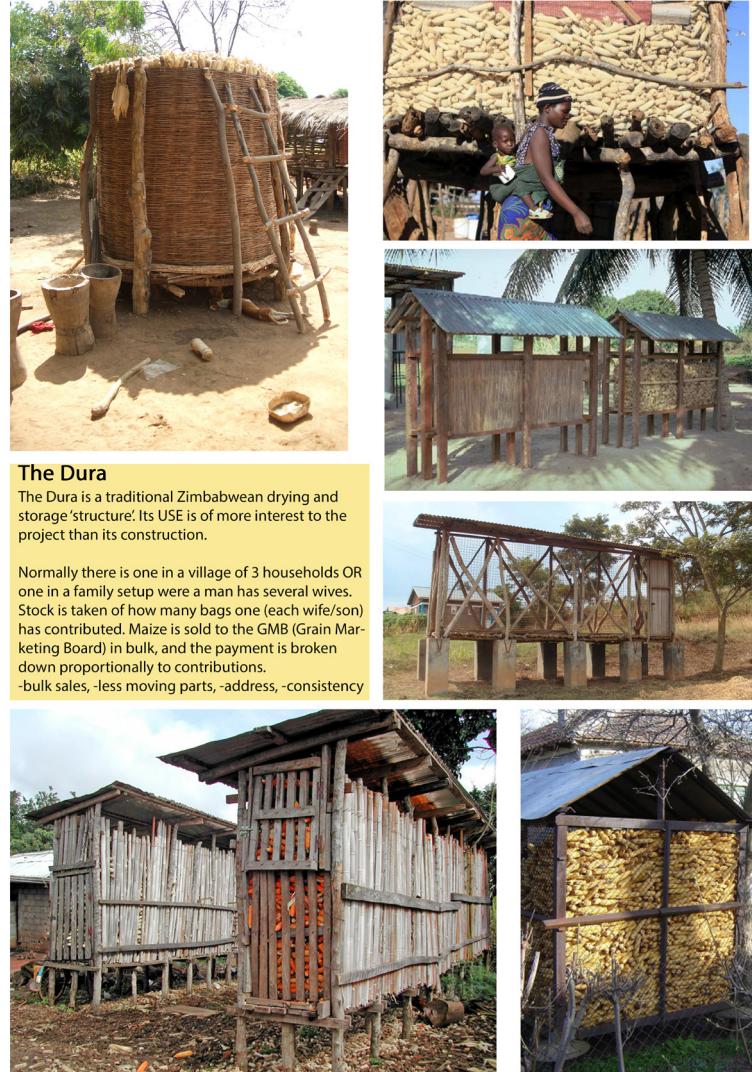
PART 5: BUILDING TECHNOLOGY

The City of Cape Town Waste Management Draft Sector Plan of 20013-14 indicated that building and demolition waste (rubble) made up an estimated 22% by mass of the city's landfill waste. A few factors can be identified as hindrances in the reduction of building rubble volume. When considering diverting demolition waste from landfills through deconstruction and disassembly, 'the main obstacles can be categorized as costs and time, with these being interrelated' (Guy, Shell & Esherick 2006). The cost of disassembling a building is dependent on the time and labour dedicated to the process. Most buildings are not designed for disassembly hence render it difficult to take down the building's components systematically and in reasonable time. This proposal attempts to implement principles recommended when designing for disassembly. Over time, as our society moves towards preventive solutions of waste management, the intervention may become obsolete and need to adapt itself to assume a new function/purpose or be disassembled.

Materiality

Light construction with prefabricated steel components would be favourable. An element of transparency is desired to give prominence to the activities inside the building therefore dissolving the materiality. Bolt and nut connections, pin joints and quarter turn joints would be ideal to allow disassembly yet maintaining the robustness of the building.

Fig 44. The Dura: disassemble-able materials can be taken apart and appropriated for another. The dura is raised off the ground to protect grain but also makes offloads easier.



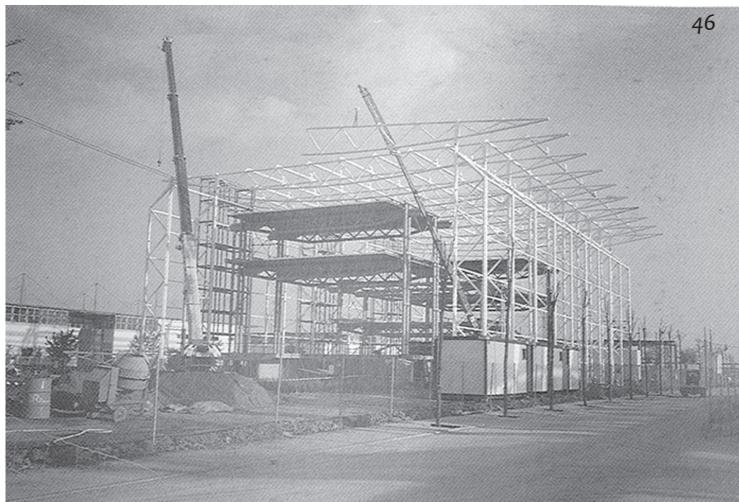
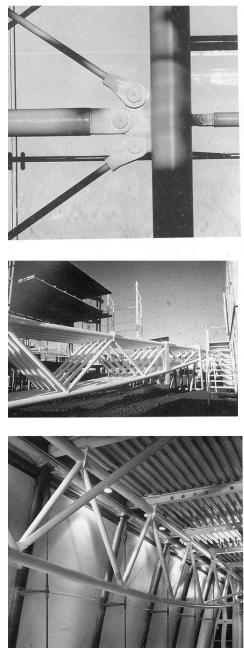
The Dura

The Dura is a traditional Zimbabwean drying and storage 'structure'. Its USE is of more interest to the project than its construction.

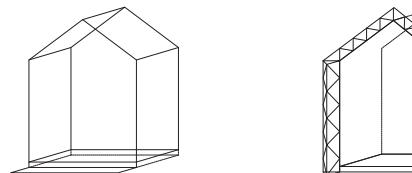
Normally there is one in a village of 3 households OR one in a family setup were a man has several wives. Stock is taken of how many bags one (each wife/son) has contributed. Maize is sold to the GMB (Grain Marketing Board) in bulk, and the payment is broken down proportionally to contributions.
-bulk sales, -less moving parts, -address, -consistency

British Pavilion Expo Seville, Spain

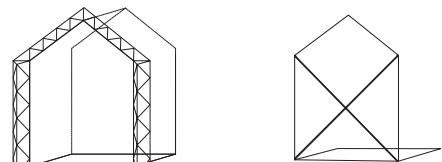
In 1989 Grimshaw designed the British Pavilion for the Expo '92 in Seville. The design is a single volume building, designed as a kit of parts so that the structure is clearly expressed. Grimshaw employs a series of standardized components that permit disassembly.



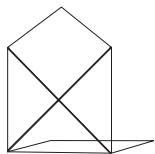
Dissolving the Skin + Contents as construction material



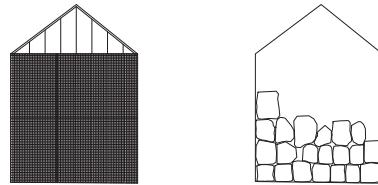
Storage volume according to waste stream



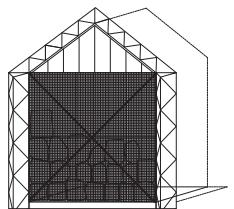
Triangular hollow Frame



Bracing with steel angles



100x100 steel mesh on the outside + glazing on the inside



fluctuating amounts of bagged/compressed waste

graduations of the facade

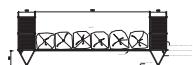
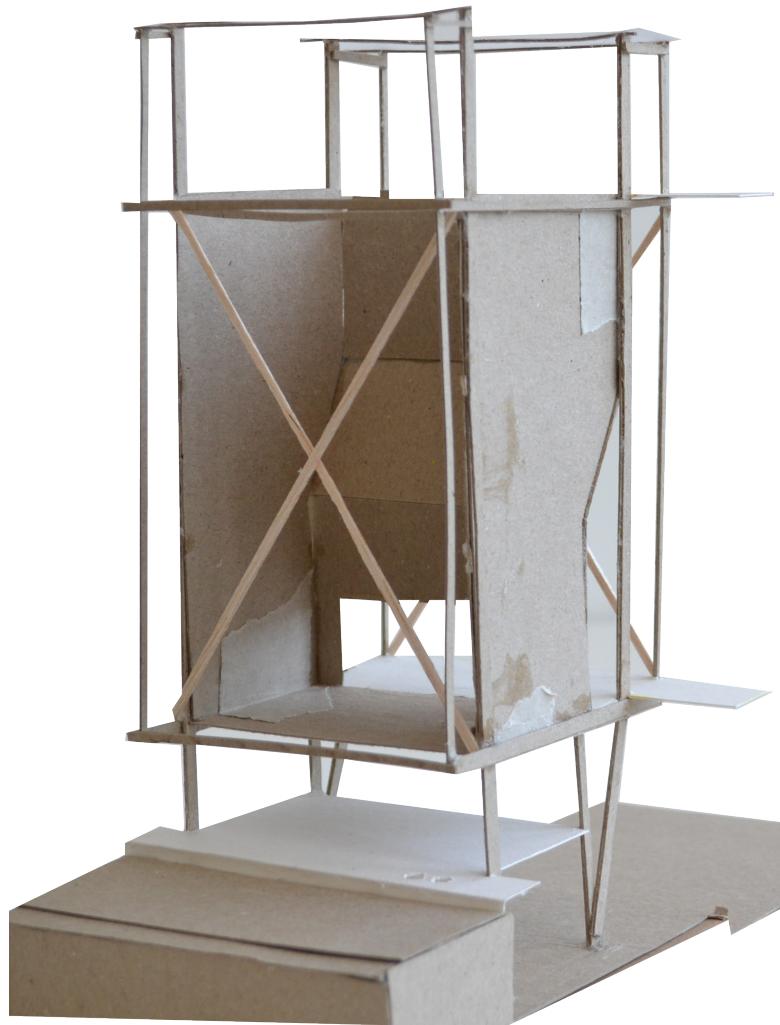


Fig 48. The materiality of the building fades as the contents of the storage bins fluctuates. Prominence is given to the content as the **contents becomes a ‘construction’ material**. The storage bins then act as a gauge for waste material interpreted subjectively by passer-byers.

Fig 49. exploring structure and making of storage bins. The principles of disassembly are subtly tested.



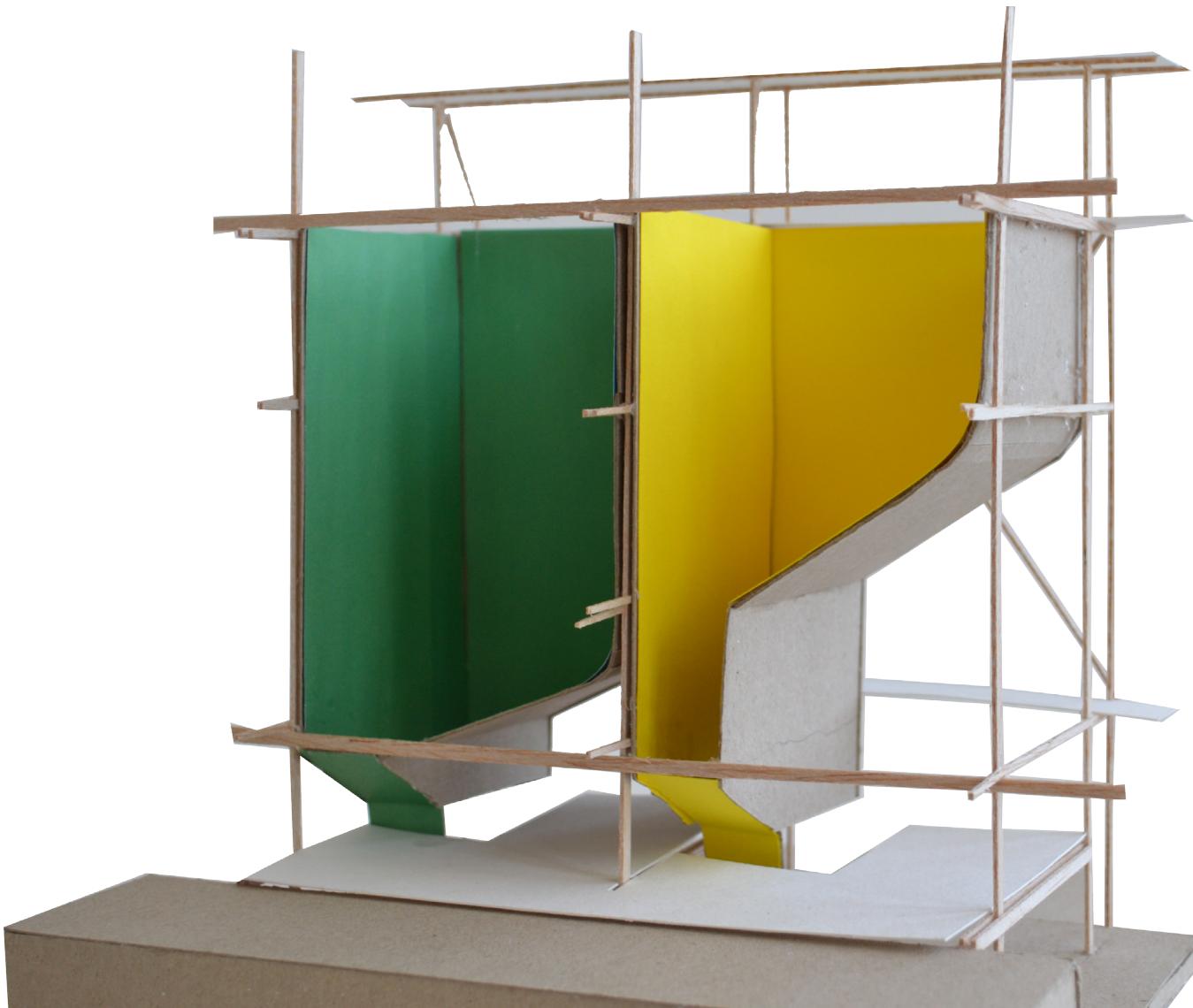
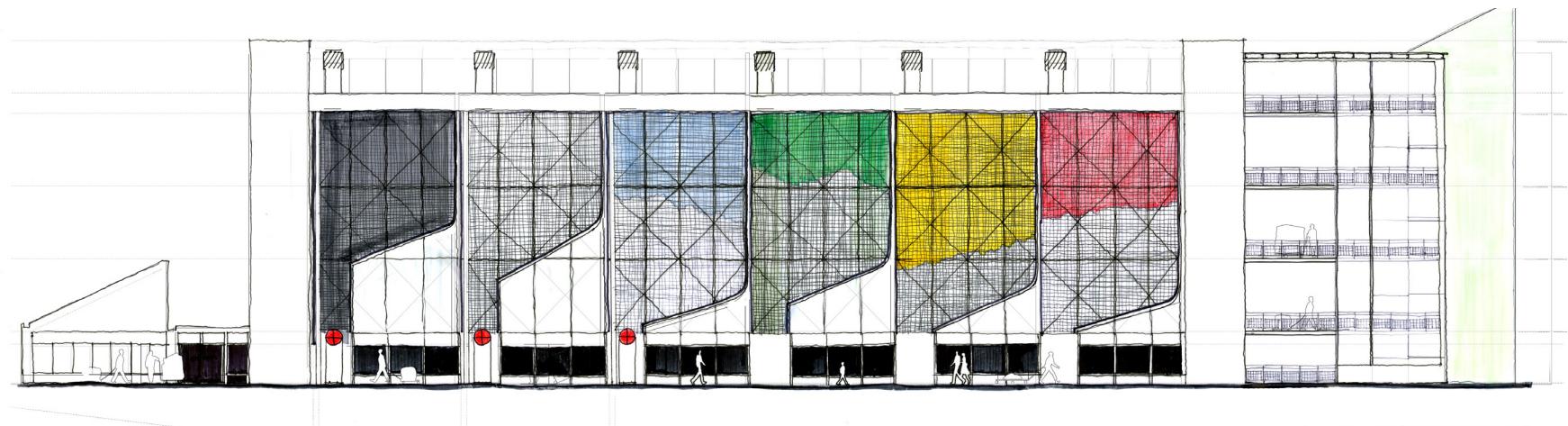
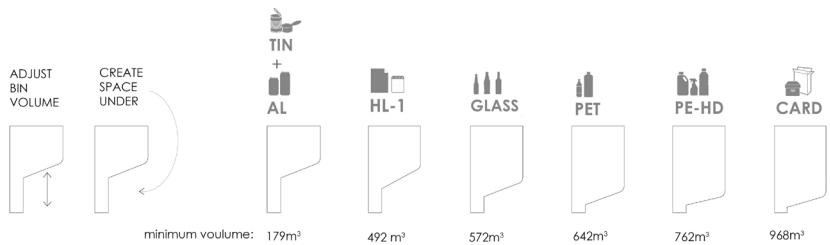


Fig 50. Investigating
disassembly, materiality,
form and spatial logic.
The Model shows a rough
impression of the form as
seen from Main Road



Opposite page, Clockwise.

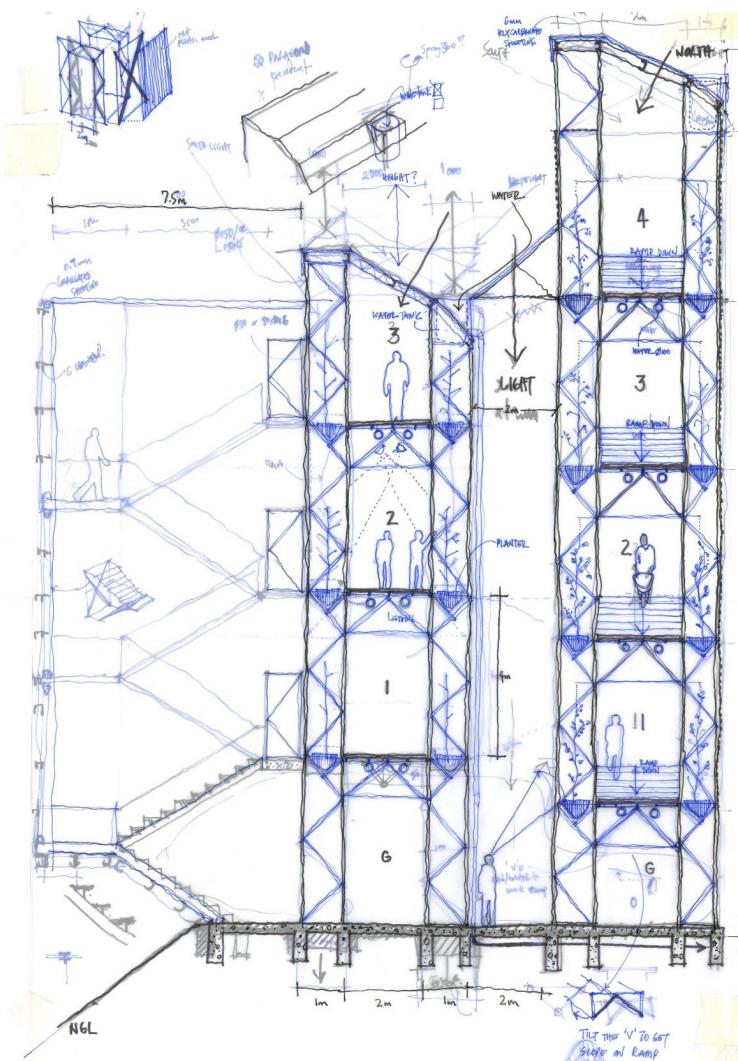
Fig 51. The volumes for storage bins are based on the average collections of 10 pickers and calculations on page 38 and 39.

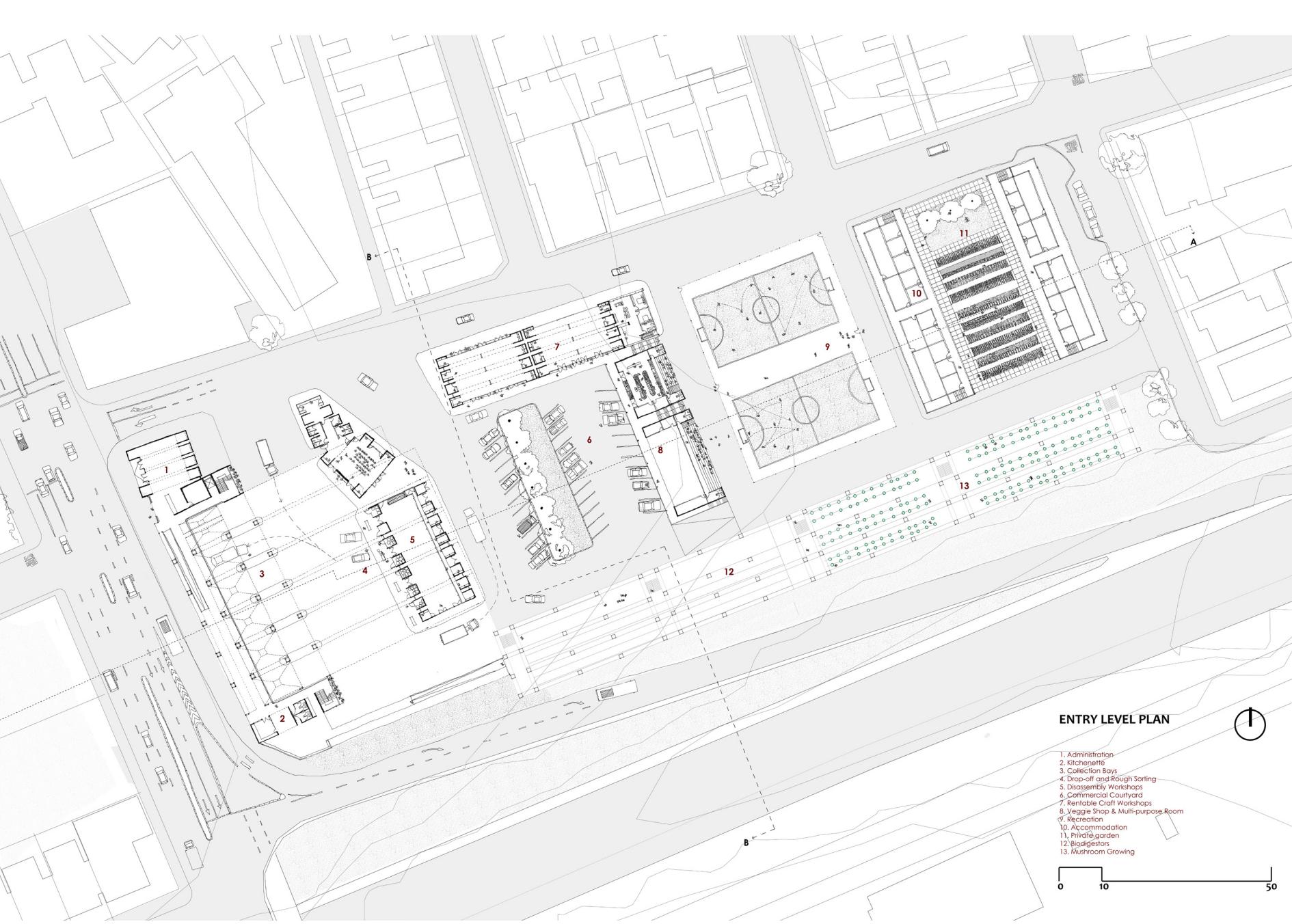
Fig 52. Model explores the making of storage bins/silos from the inside of the building

Fig 53. Elevation of building on western side, i.e from Main Road.

Right.

Fig 54. Structure, skin and circulation are combined into a hybrid component.





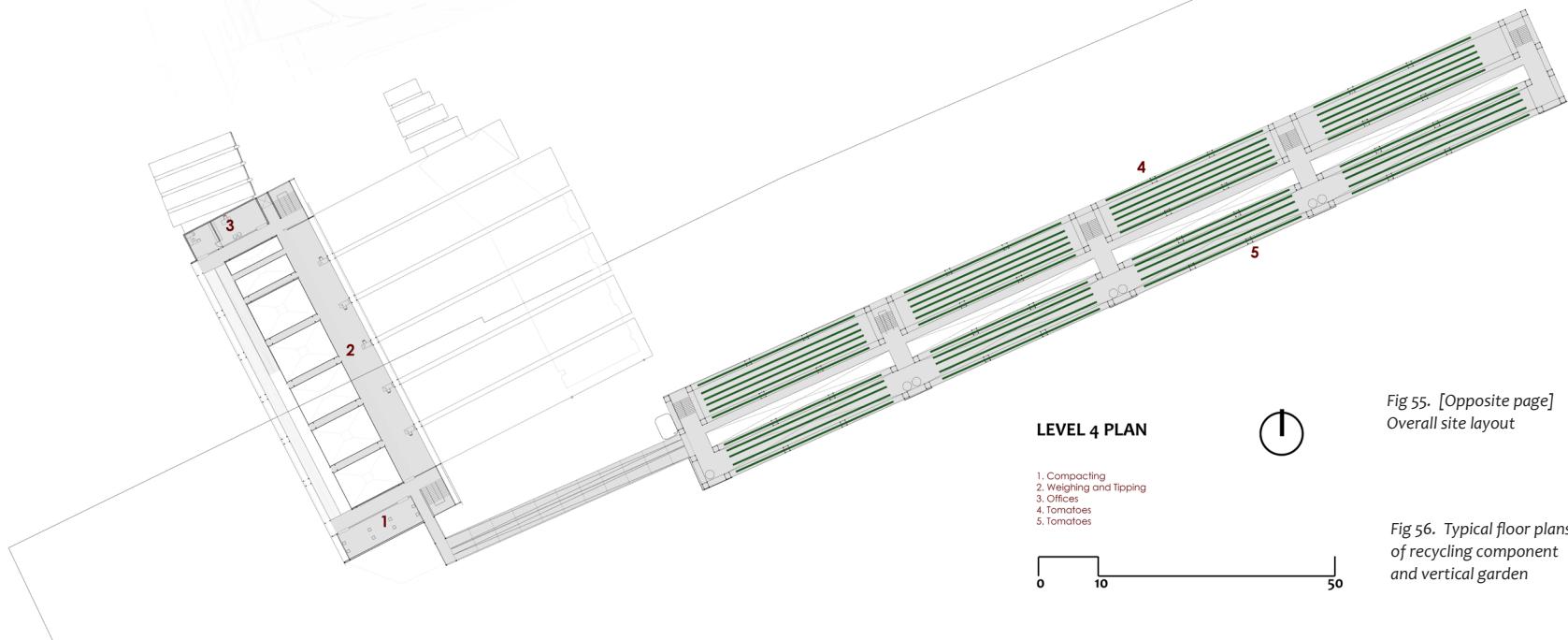
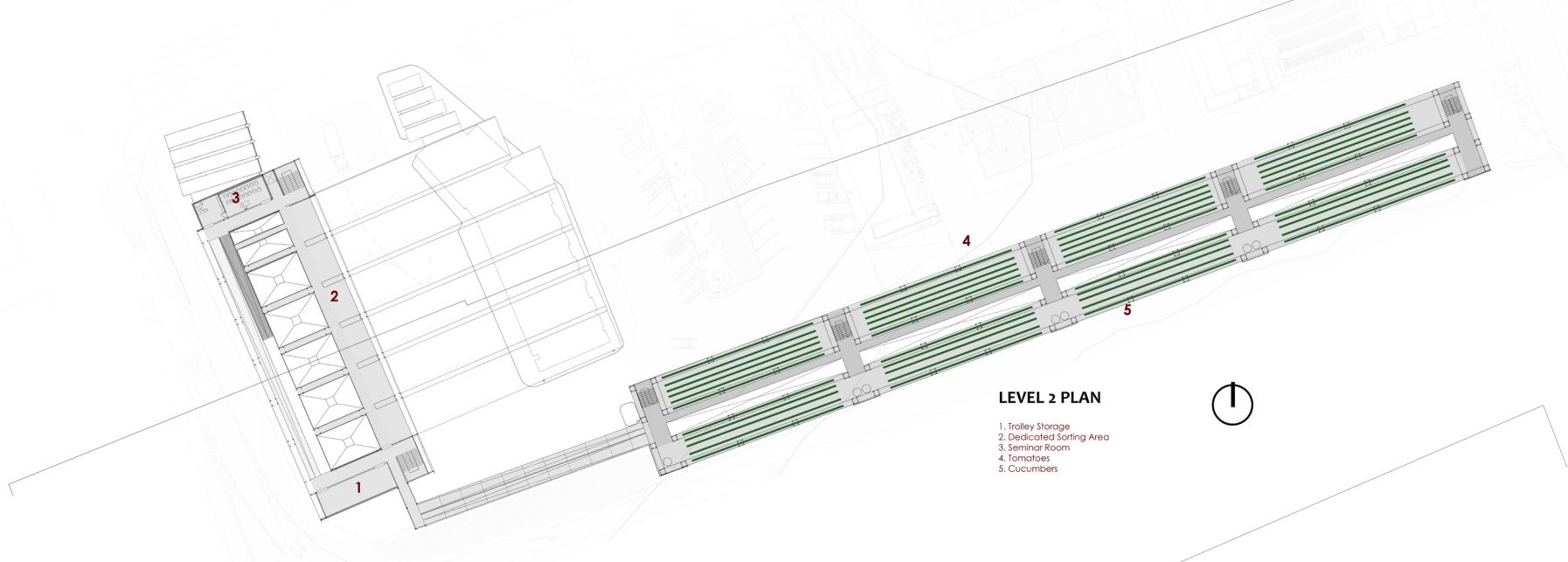


Fig 55. [Opposite page]
Overall site layout

Fig 56. Typical floor plans
of recycling component
and vertical garden

Section AA



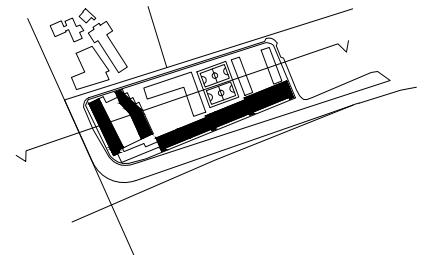
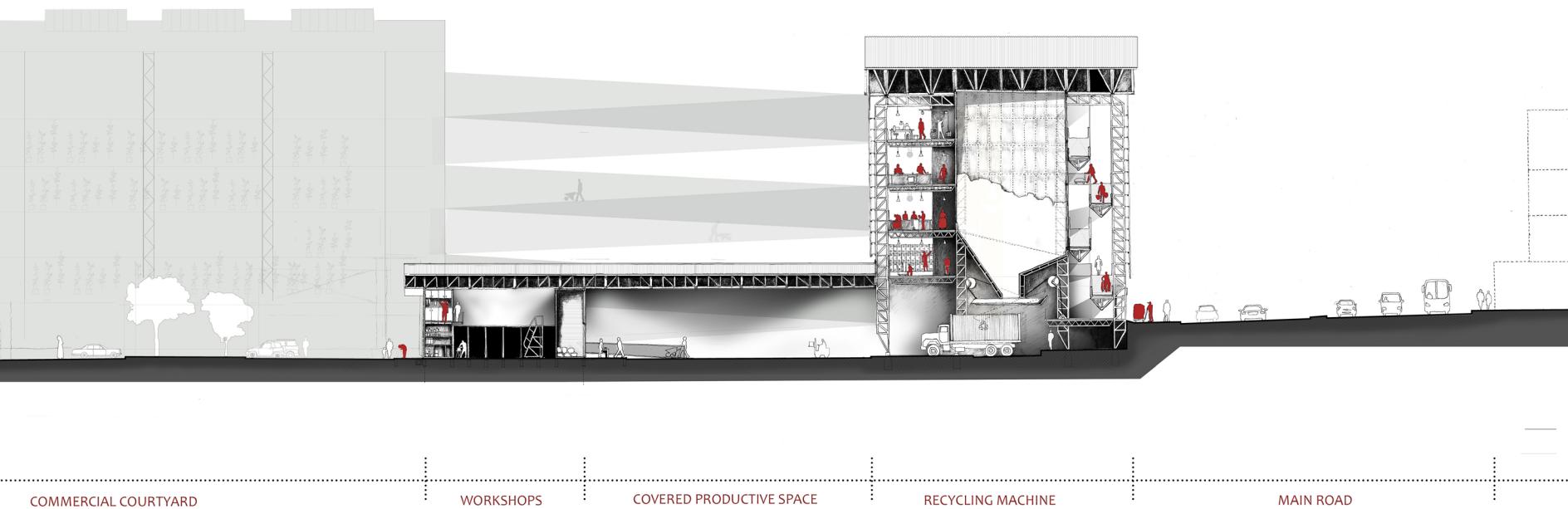
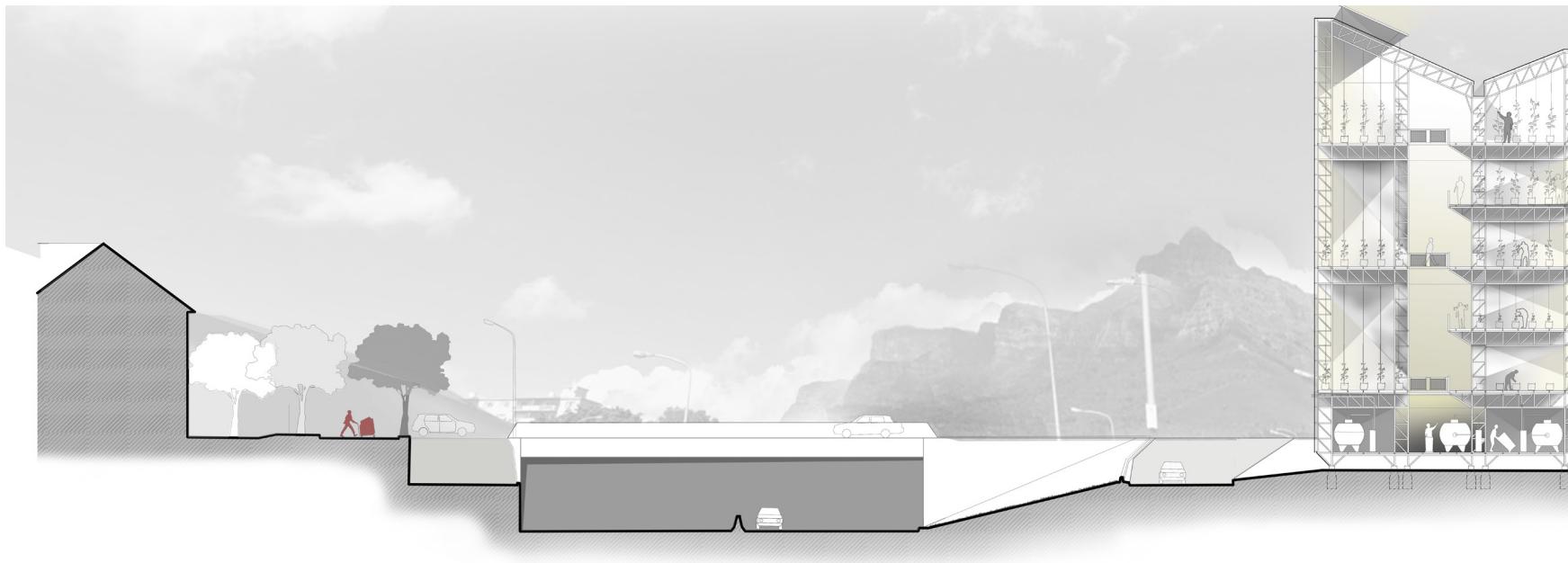
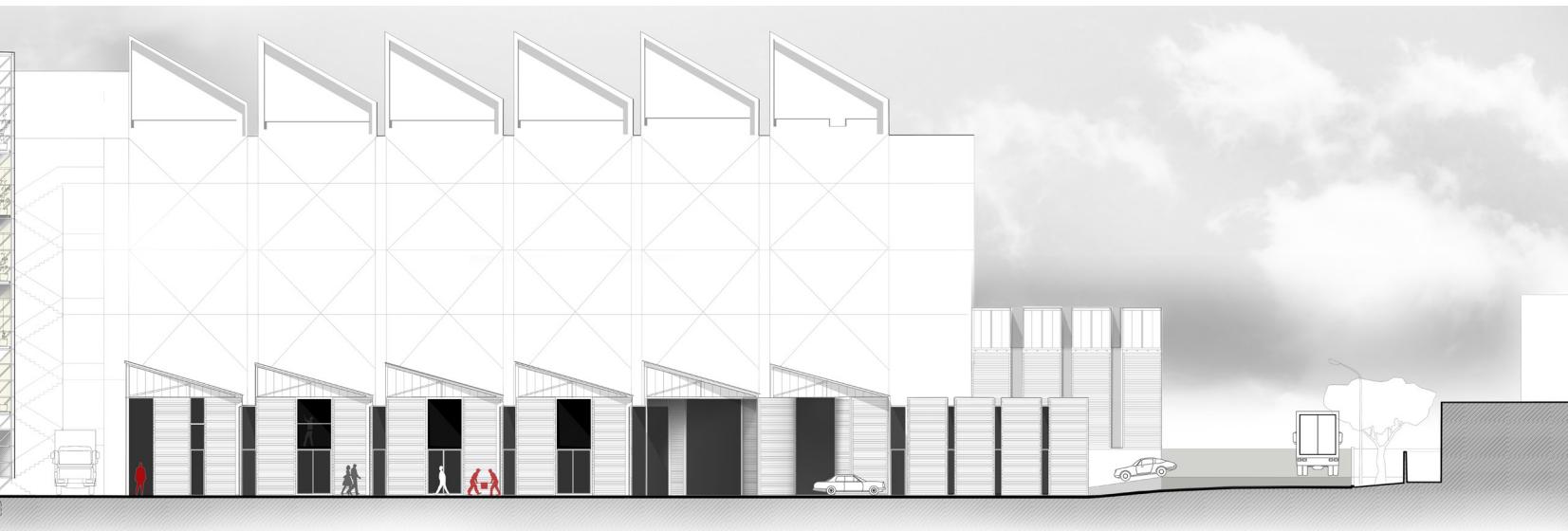


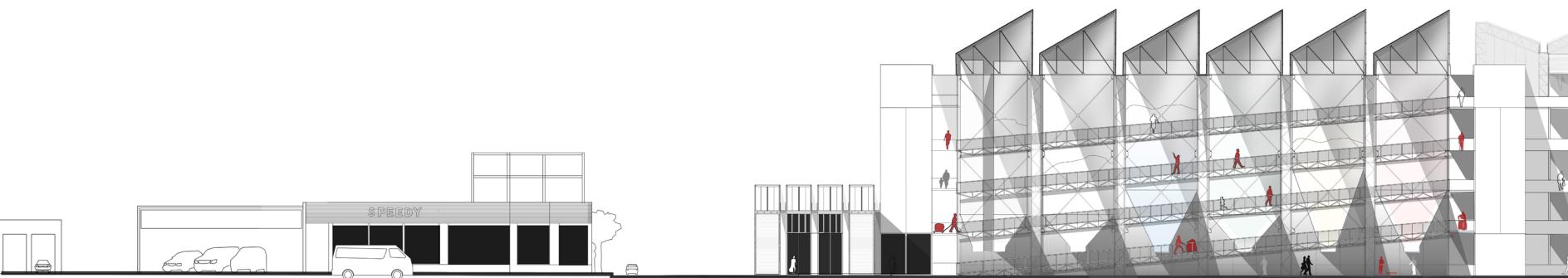
Fig 57. Long section through site



Section BB







Imagined view from N2 freeway

Parts of facade used for commercial advertising space



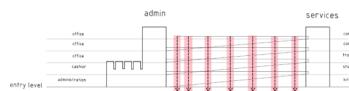
Recycling Component Layout



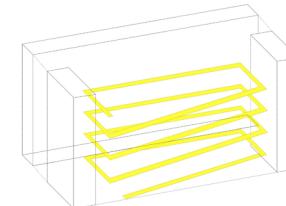
1. Administration and Services



3. Ramp: Acts as a "conveyer belt" moving people and mate



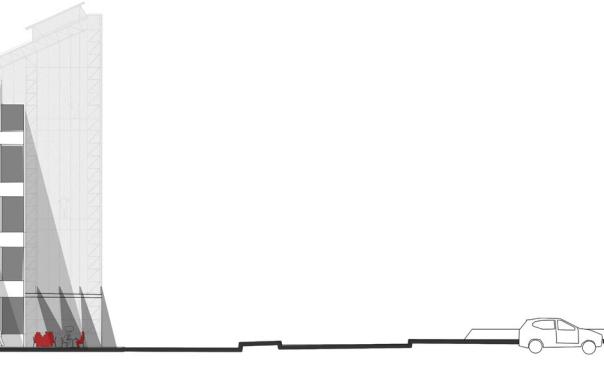
2. Storage Inbetween Services & Administration



4. Work Spaces along "conveyer belt"

Thabo: Waste Picker

Building Use Scenario

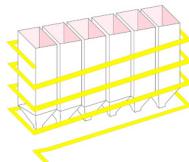


1. Enters building in the morning
2. Signs out a trolley
3. Exits and hits the streets

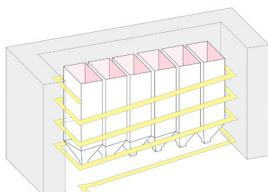
* Thabo is familiar with the municipal curb side collection date so he makes sure he arrives before they do.

* On his way back to WASTE FARM, he passes though a shop he has made arrangements with to collect used packaging boxes.

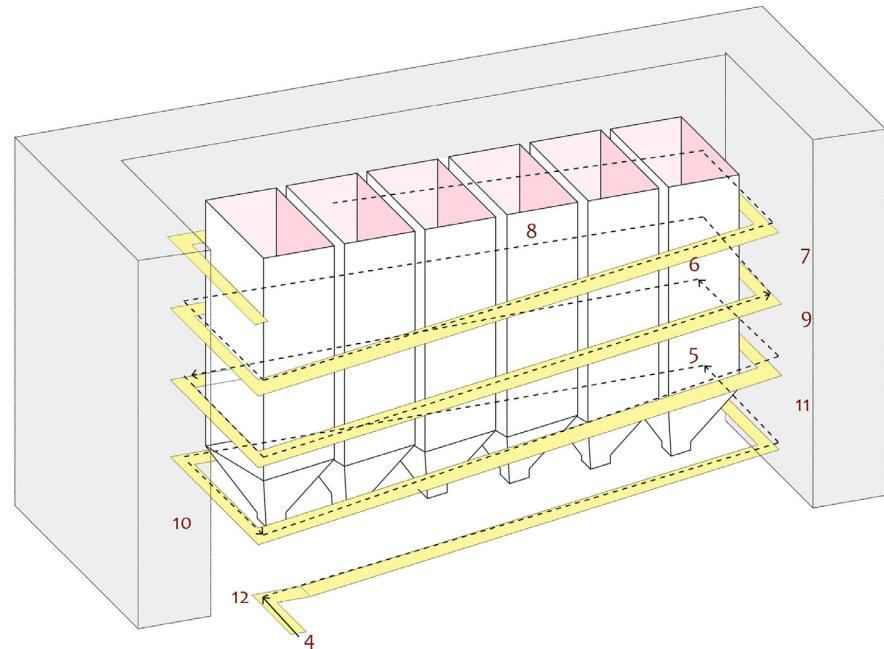
4. Thabo enters WASTE FARM from Main Road.
5. He takes the lift up /goes up the ramp to his personal locker to store some bottles an artist requested for.
6. He ramps up to the sorting floor where he separates his materials.
7. He takes his sorted materials to the compacting rooms and then goes to get it weighed by a co-op supervisor.
8. After weighing his materials, Thabo receives a slip documenting the weight of materials he brought.
9. He returns the trolley
10. Goes to the cashier's office
11. Goes to get a shower
12. Exits

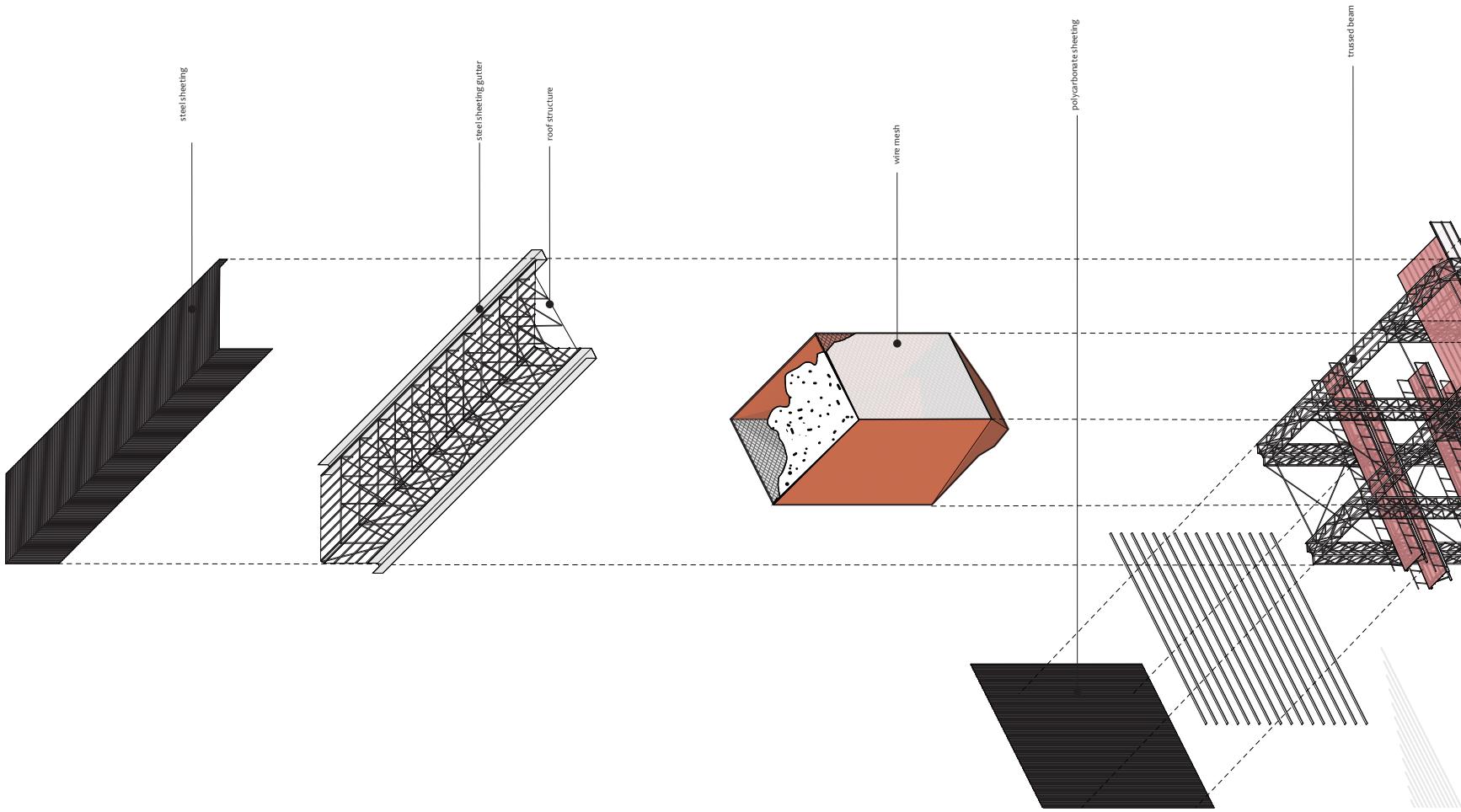


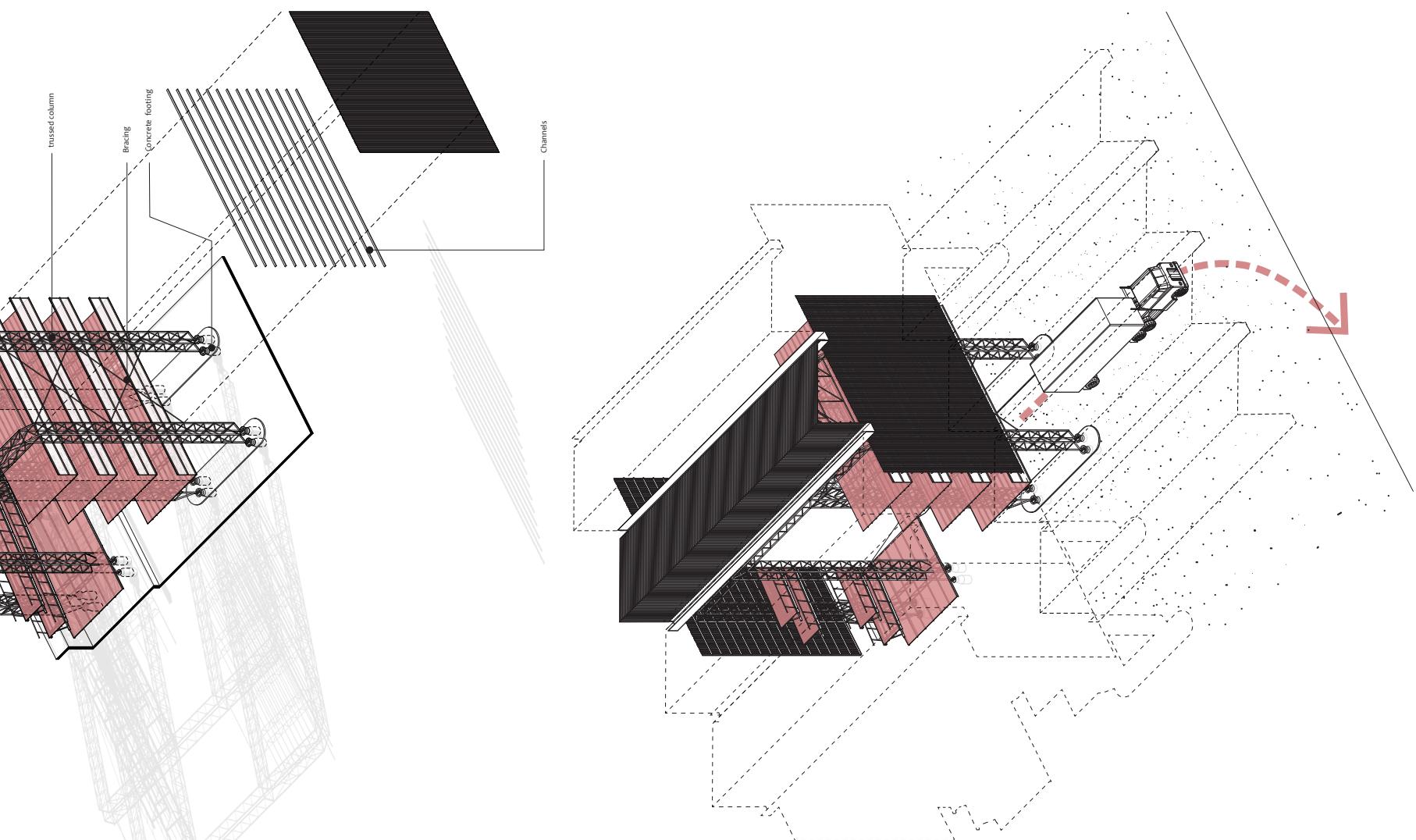
5. Storage placed Inbetween Circulation and Work Areas



6. All components put together







Conclusion

The work done by informal waste pickers is integral to a paradigm shift in perceiving the economic, social and ecological value of recycling waste. This architectural intervention responds to the infrastructural needs of informal waste pickers and local urban communities. The project exemplifies ‘design’ as a research tool. This proposal is not to be seen as the solution to waste management issues in Cape Town, but an alternative approach to reducing waste disposal to landfill by providing a productive landscape with hybrid spaces for:

- Sorting and storing different waste streams,
- Offloading and collecting of waste material,
- Food production and skills development,
- Socializing, cleaning, eating and boarding.

The objective is to increase the recycling capacity and income of informal waste pickers, improve their working conditions and negotiating power by creating a proposal that also speaks and serves to the local community. The proportions of the building speak to the capacity of waste being produced and bring to the foreground issues most cities have hidden for long on how waste is managed in the city. The vertical farm also brings to the public eye the good that can be achieved by converting organic waste into other forms of material; in this case a compost based growing medium. The vertical farm then connects local residents to the source of their food hence encouraging a circular metabolic food system that uses consumption as a catalyst for production.

The architecture of this proposal can then be assimilated in other urban areas with favourable conditions.

FIGURE REFERENCES

ALL DIAGRAMS WERE DONE BY THE AUTHOR UNLESS STATED UNDERNEATH:

Fig 4. on page 5: <http://cache2.asset-cache.net/gc/466556670-boys-play-as-cows-graze-through-garbage-at-gettyimages.jpg>

Fig 7. on page 9: collage created with images from, <http://www.heathnash.com/>

Fig 20. on page 23: https://www.capetown.gov.za/en/Solidwaste2/Wastecollection/Documents/Beat%20Map%20for%20website_Two%20Oceans.pdf

Fig 24. on page 28: <http://wp.wpi.edu/capetown/projects/p2013/blue-sky-recycling-programme/>

Fig 23. on page 24: <http://aet.org.za.www12.flk1.host-h.net/reflecting-on-aets-2014-activities-and-beyond-series-2-of-4/>

Fig 30. on page 37: Original by; https://www.osha.gov/images/lookback/grain_fig2.gif

Edited version by; Trask, S.L. (2014). Up | down | re [CYCLE]. Infrastructure for integrated waste management, A focus on informal trolley pushers in Newtown, Johannesburg. MTech (Architecture). [Unpublished]: University of Johannesburg. Retrieved from: <https://ujdigispace.uj.ac.za> (Accessed: 20 July 2015)

Fig 44. on page 46: Collage made up of the following sites; <http://www.reuters.com/article/2015/05/26/us-zimbabwe-drought-idUSKBN0OBoDL20150526>
http://www.fastonline.org/CD3WD_40/INPHO/DB_LOCAL/PHOTOBAN/PHOTOS/PH00336.JPG
<https://alwaysthesamemoon.files.wordpress.com/2011/06/maize-corn-storage1.jpg>
<http://ehp.niehs.nih.gov/wp-content/uploads/2013/08/ehp.121-a270.g001.png>
http://imagesfrombulgaria.com/d/96190-4/Yard_with_corn_storage.JPG

Fig 46. on Page 47x: Davies, C. (1993).British Pavillion Seville Exposition 1992, Nicholas Grimshaw and Partners. Phaidon. London

Fig 47. on Page 47: Davies, C. (1993).British Pavillion Seville Exposition 1992, Nicholas Grimshaw and Partners. Phaidon. London

Fig 48. on page 47: <http://grimshaw-architects.com/project/british-pavilion-expo/>

BIBLIOGRAPHY

- Aquino, M. J. (Ed.). (2010). *Beyond Shelter: Architecture and human dignity*. Metropolis Books.
- Abuyuanl, A. M. (1999). Collaboration: A sociological perspective. Yale/UNDP research clinic report. Yale/UNDP Public Private Partnership Programme, Yale University, USA.
- Ahmed, S. A., & Ali, M. (2004). Partnerships for solid waste management in developing countries: linking theories to realities. *Habitat International*, 28(3), 467-479.
- AlSayyad, N. (2004). *Urban Informality: Transnational Perspectives from the Middle East, Latin America, and South Asia. Urban Informality as a New Way of Life*. Lexington Books.
- Benson, K., & Vanqa-Mgijima, N. (2010). Organizing on the streets: A study of reclaimers in the streets of Cape Town. International Labour Research and Information Group (ILRIG), WIEGO Organizing Series. Available at: http://www.inclusivecities.org/toolbox/Organizing_on_the_Streets_web.Pdf. Accessed 25 July 2015.
- Bohn, K., & Viljoen, A. (2011). The edible city: Envisioning the continuous productive urban landscape (CPUL). *FIELD*, 4(1), 149-161.
- Castells, M. and A. Portes. 1989. "World Underneath: The Origins, Dynamics, and Effects of the Informal Economy." In A. Portes, M. Castells & Lauren A. Benton, eds. *The Informal Economy: Studies in Advanced and Less Advanced Developed Countries*. Baltimore, MD, USA: John Hopkins University Press.
- Chen, M. A. (2012). The informal economy: Definitions, theories and policies. Women in informal economy globalizing and organizing: WIEGO Working Paper, (1).
- Cronon, W. (2009). *Nature's metropolis: Chicago and the Great West*. WW Norton & Company.
- Department of Environmental Affairs. (2015). Annual Report 2014/15. https://www.environment.gov.za/sites/default/files/reports/environmentalaffairs_annualreport2014_5.pdf Accessed 12 October 2015
- Engledow, S. A. (2005). The strategic assessment of a curbside recycling initiative in Cape Town as a tool for integrated waste management.
- Engledow, S., & Eichestadt, L. (2007). Integrated analysis solid waste baseline report. Report compiled for the UN DP. Stellenbosch: Sustainability Institute.
- Guy, B., Shell, S., & Esherick, H. (2006). Design for deconstruction and materials reuse. *Proceedings of the CIB Task Group*, 39, 189-209.
- Hart, K. (1973). Informal income opportunities and urban employment in Ghana. *The journal of modern African studies*, 11(01), 61-89.
- Langenhoven, B., & Dyssel, M. (2007). The recycling industry and subsistence wastecollectors: a case study of Mitchells Plain. *Urban Forum*, 18(1), 114-132.
- International Labour Office. 1972. *Employment, Incomes and Equality: A Strategy for Increasing Productive Employment in Kenya*. Geneva: ILO.
- Material Pricing Report Aluminium Can Specification
http://www2.wrap.org.uk/recycling_industry/market_information/materials_pricing_reports/aluminium_can.html
- Mega-tech. 2004: Integrated waste management Plan for the City of Cape Town. Final Status Quo Report. City of Cape Town
- Moreno-Sanchez, R. D. P., & Maldonado, J. H. (2006). Surviving from garbage: the role of informal waste-pickers in a dynamic model of solid-waste management in developing countries. *Environment and Development Economics*, 11(03), 371-391.
- Moser, C.N. 1978. "Informal Sector or Petty Commodity Production: Dualism or Independence in Urban Development." *World Development*, Vol. 6.

- Paper Recycling Association of South Africa http://www.recyclepaper.co.za/wp-content/uploads/2015/08/LB413-PRASA-A4-July_2015-summary.pdf
- Parthasarathy, D. (2009). Rethinking Urban Informality: Global Flows and the Time-Spaces of Religion and Politics. International Conference on "Urban Aspirations in Global Cities", Max Planck Institute for the Study of Religious and Ethnic Diversity, Göttingen, Germany, 9-12.
- Plastics SA, <http://www.plasticsinfo.co.za/wp-content/uploads/2014/10/55841.pdf>
- Rispel, L. C., Molomo, B., & Dumela, S. (2008). South African case study on social exclusion. HSRC Press.
- Schenck, R. & Blaauw, P.F. (2011). The Work and Lives of Street Waste Pickers in Pretoria—A Case Study of Recycling in South Africa's Urban Informal Economy. URBAN FORUM, 22:411 - 430
- Sethuraman, S.V. 1976. "The Urban Informal Sector: Concept, Measurement and Policy." International Labour Review, Vol. 114, No. 1.
- Stohr, K., & Sinclair, C. (2012). Design Like You Give a Damn 2: Building Change from the Ground Up. Abrams.
- Solid Waste Management. 2015: Landfill Sites. <https://www.capetown.gov.za/en/Solidwaste2/Wastedisposal/Pages/Landfillsites.aspx>. Accessed 14 June 2015.
- Trask, S.L. (2014). Up | down | re [CYCLE]. Infrastructure for integrated waste management, A focus on informal trolley pushers in Newtown, Johannesburg. MTech (Architecture). [Unpublished]: University of Johannesburg. Retrieved from: <https://ujdigispace.uj.ac.za> (Accessed: 20 July 2015)
- Tokman, V., ed. 1972. Beyond Regulation: The Informal Economy in Latin America. Boulder, CO, USA: Lynne Rienner Publishers.
- Veness, A. R. (1993). Neither homed nor homeless: contested definitions and the personal worlds of the poor. Political Geography, 12(4), 319-340.
- Viljoen, J. M. M., Schenck, C. J., & Blaauw, P. F. (2012). The role and linkages of buy-back centres in the recycling industry: Pretoria and Bloemfontein (South Africa). Acta Commercii, 12, 1-12.
- Waste Materials – Density Data. <http://www.epa.vic.gov.au/business-and-industry/lower-your-impact/~media/Files/bus/EREP/docs/waste-materials-densities-data.pdf>
- Zack, T. 2012. Recycle Change, in The South African Informal City, edited by L. Poulsen & M. Silverman. Johannesburg: The Architects' Collective

