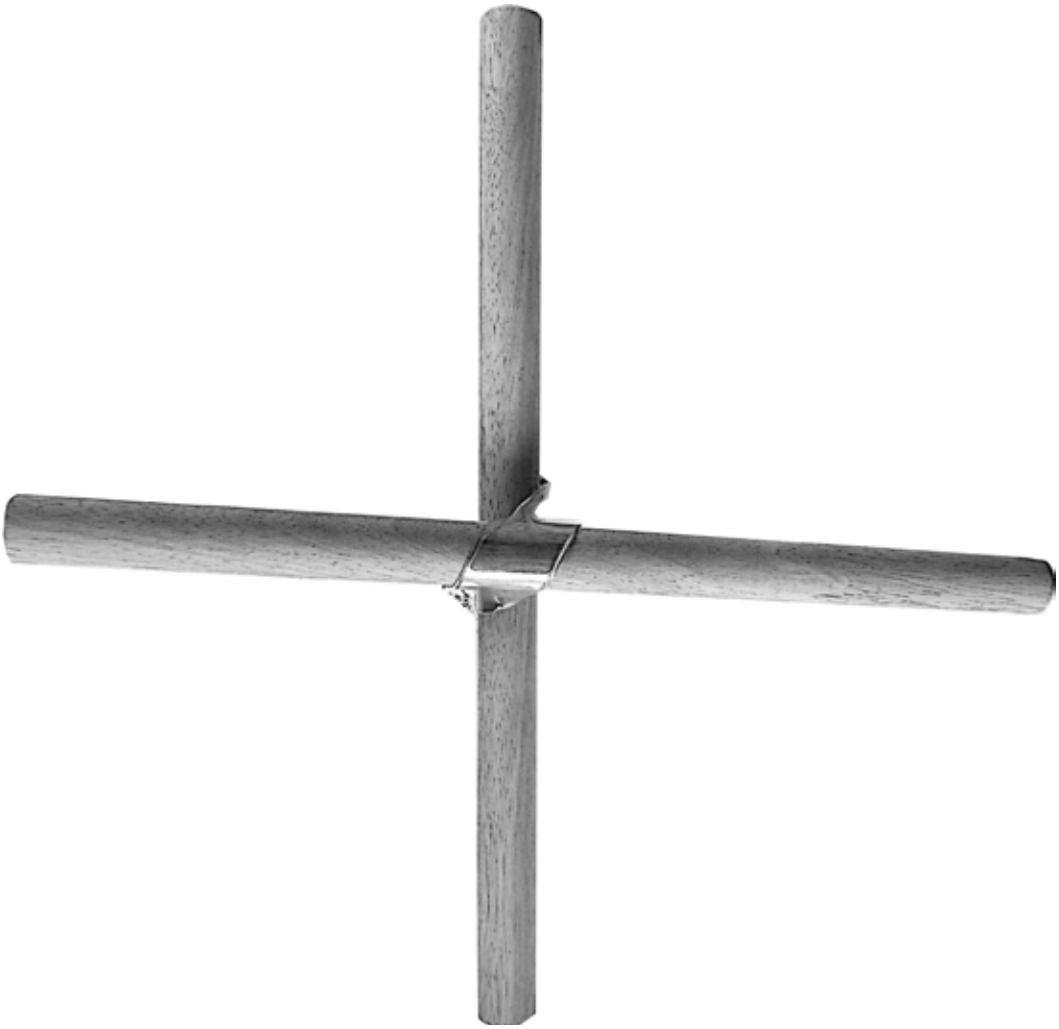

From Waste to Architecture:

The facilitation and integration of recycled plastic waste as a construction method in the built environment.

In accordance with Regulation 4(c) of the General Regulations (G.57) for dissertations and theses, I declare that this dissertation, which I hereby submit for the degree Master of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

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

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

Kallyn Bonhomme 15 November 2021

Project Title:
From Waste to Architecture:
The facilitation and integration of recycled plastic waste as a construction method in the built environment.

Author:
Kallyn Bonhomme
16060912

Research Field:
Regenerative and Resilient Cities

Programme:
Plastic focused recycling and management facility; Education, training and environmental awareness centre; Public makerspace and recycling centre; Informal market interface and fresh produce dropoff and food market.

Project Intention:
The facilitation of plastic recycling and the development of plastic-based materials as a contruction method within the built environment. Challenging existing prejudices on the role of waste plastic within society.

Studio Leader:
Cobus Bothma

Project Location:
Durban Central
45 Bram Fischer Rd, Durban Central, Durban, 4001
29°51’16.8”S 31°01’40.8”E

Clients:
Durban Tourism
eThekwini Municipality
eThekwini Water and Sanitation
Berea College of Technology

ABSTRACT

The high productivity and low biodegradation of plastics within the consumerist market has led to an abundance of waste material. The disproportionate relationship of waste creation versus waste management systems particularly within developing countries, has resulted in the adoption of dumping sites and landfills as a primary waste disposal method. This decision is inherently unsustainable due to limited capacity of allocated sites, and subsequent environmental consequences to fauna and flora ecosystems due to the burial of material with lifespans greater than centuries.

The material properties of waste material, particularly plastics and polymer-based products, provide potential use within the built environment due to range of structural, thermal, and aesthetic properties that can be achieved. The introduction of plastic waste as a building material would challenge preconceptions of what is possible with waste material, injecting financial incentive within recycling economies, and developing the recycling culture.

KEYWORDS

Domesticating
“the act of making a challenging or strange thing more familiar and acceptable” (Thesaurus English Dictionary).

Ecosystem
“a system or network of interco*nnecting and interacting parts*“ (*Thesaurus English Dictionary*).

Exotic Technology
“innovations that reshape perceptions of the social, the cultural and the human” (Michael, 2000).

Integration
“the act of combining into an integral whole” (Thesaurus English Dictionary).

Mundane Technology
“technologies whose novelty has worn off; these are technologies that are now fully integrated into, and an unremarkable part of, everyday life” (Michael, 2000).

Plastic
“from the Latin word ‘Plasticus” meaning flexible. Synthetic material formed from long chains of carbon polymers found in petroleum, coal, and crude oil” (Chukwudi, 2018).

Recycling
“the collection and reprocessing of discarded materials for reuse” (Thesaurus English Dictionary).

Waste
“products that are unused, unproductive, or not properly utilized“ (Thesaurus English Dictionary).

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1. INTRODUCTION

1.1 BACKGROUND

The first synthetic plastic,'Parkesine', was invented in 1862 by Alexander Parke, however, the 'plastic age' first started in 1907 with the invention of the first thermosetting plastic 'Bakelite'. These long chain thermosetting plastics were formed using carbon atoms found in coal, petroleum, and crude oil (Chukwudi, 2018:97).

Thermoset plastics provide structural rigidity when reinforced, solvent resistance, reduced number of allergens compared against raw materials such as timber, and low weight to strength ratio that reduces fuel costs in travel (Cooper,1955 & National Geographic,2019).

These advantages and the high malleability and manufacturability of plastic exponentially Increased plastic production post-WW2. Production increased from 2.3 million tons in the 1950s to 448 million tons in 2015, with that number predicted to double by 2050 (Parker, 2019).

The availability and convenience of plastic has led to a 'throwaway' culture in which plastic products are replaced resulting in plastic pollution crisis. According to Parker (2019) around 8 million tonnes of plastic wash down into the oceans every year, to be consumed by ocean life (Gilili, 2021 & Parker, 2019).

1.2 GENERAL

The high productivity and the chemical composition of thermoset and thermoplastics has made it difficult to manage the waste of a material with a life span of more than 400 years. Inefficient or otherwise non-existent waste management systems has led to an ever-growing environmental issue within developing countries. According to Roscam Abbing (2019), the collection of single use plastics such as packaging and sachets is not worth the extensive and costly sorting and collection processes, thus it is cheaper to re-manufacture the products because of original intent, small volumes, huge numbers or zero re-cycling value.

PET (polyethylene terephthalate) bottles however that can still be fished out of the garbage to be traded." (Roscam Abbing, 2019: 12). This highlights the issue at hand. Although there exists an economy within the recycling of waste products, many single use plastics are not worth the effort due to the low cost of just producing more.

South Africa is one of 34 countries in Africa, to have passed a law banning single use plastics. Falling under section 24(d) of the Environment Conservation Act (73/1989), this places a levy on the sale and purchase of consumer plastic bags whilst completely banning lightweight single use plastic bags. Although this Act was intended to limit the amount of plastic used, there remains a significant waste issue within South Africa, as shown in the aftermath of the Durban storm floods in 2019 (as shown in figure 1.1). This further exacerbated the need for improved waste management systems as spearheaded by environmental groups such as Green Peace and Bremen-Durban Marine Environmental Education Network (Somdyala,2019).

Figure 1.1 'Durban 2019 Flood' (News24, 2019)

1.3 LOCAL

According to the eThekwini Municipality (2016: 116) more than R180 million is spent by the municipality on the collection of waste from illegal dumping sites annually. This is due to the lack of formal disposal sites; inefficient waste management systems; and lack of public awareness which further exacerbates the problem. To counter these issues, the municipality has implemented community awareness programmes, however, the implementation of these programmes has seen limited success and public participation compounded by inadequate facilities provided at buyback centres and transfer sites (see figures 1.3-1.6).This has led to small-scale informal waste collectors seeking business and sales in privately own recycling businesses.

Although they play an integral role to the cleanliness of our streets, these waste pickers, as Mkhize et.al. (2014) states, are not welcomed by the Government. They are often harassed by law enforcement and threatened when navigating residential and commercial areas. These waste pickers also lack necessary facilities for sorting and storage of collected waste. Figure (1.7) shows the insufficient number of buyback stations in the greater eThekwini municipal area. Due to the lack of infrastructure to support their trade, and the lack of access to many residential areas and municipal landfill sites (Mkhize et Al., 2014:22 & Schoeman, 2018:15), these informal collectors assimilate into the private sector, as per a communication with Mrs Botha (2021).

There is an established informal recycling ecosystem in the eThekwini municipal area, specifically around the Durban CBD, however, it is beyond the public realm and spearheaded by private organizations with little cooperation with the local municipality. This ecosystem, as per a communication with Mrs D. Botha (2021) does not provide enough economic remuneration to draw entrepreneurial business. This ecosystem is not autonomous as many of these private businesses focus on specific types of waste material. This ultimately means that waste collectors are forced to travel greater distances just to sell their acquisitions. This disconnect is evidenced in that the only available municipal buyback centres (located at Brooke Street and Lorne Street) lack sufficient infrastructure and permanent on-site offices.

The lack of public awareness regarding the processes of recycling and the consequences of insufficient waste management systems should be the primary concern of government and society at large however, as consumer awareness of the hazards of plastic waste rises, systemic issues arise. Issues such as the fear of peer perception of using alternative products; the affordability of such products and the capabilities of developing countries to produce and implement new technologies (UNEP, 2021).

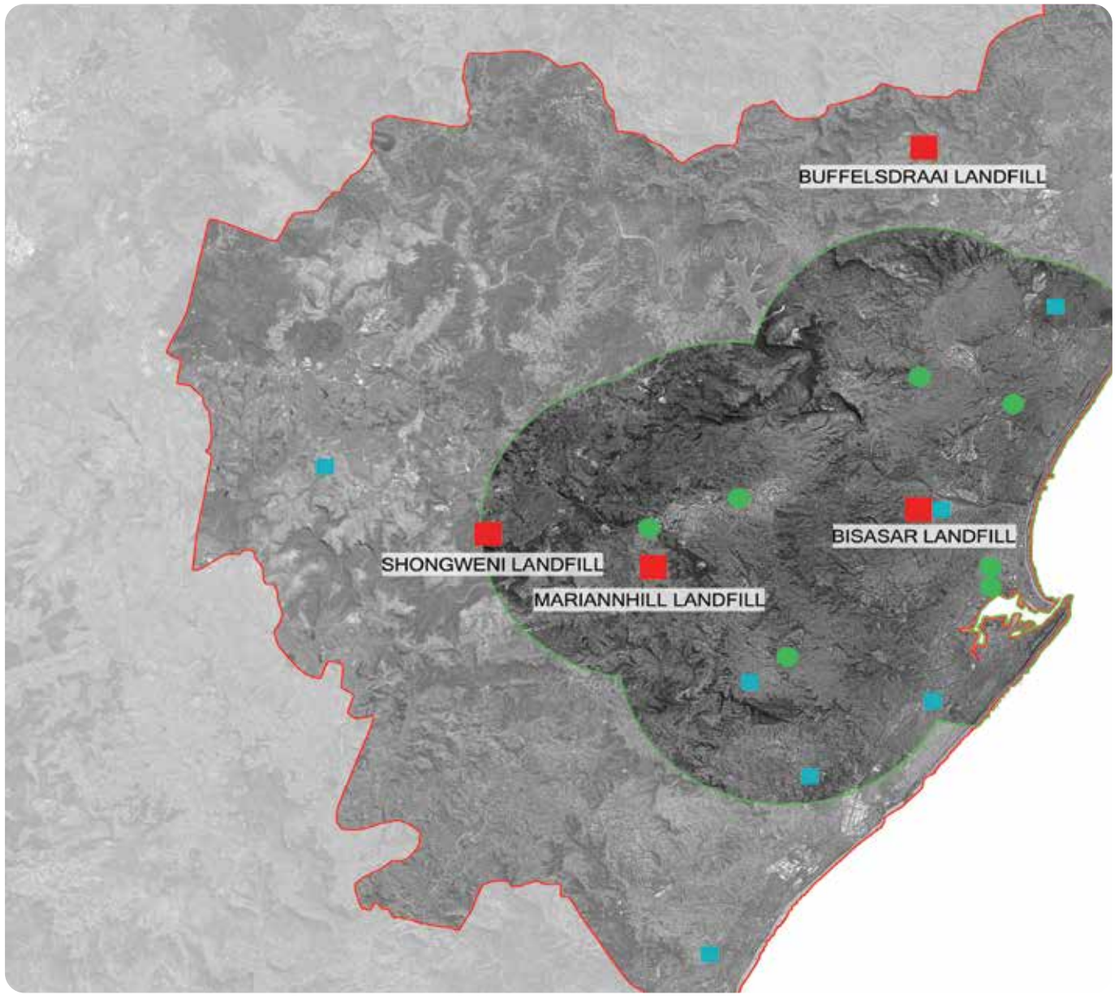


Figure 1.2 ‘eThekwini Landfill Sites’ (Author, 2021)

Figure 1.3 ‘North Coast buyback centre’ (eThekwini

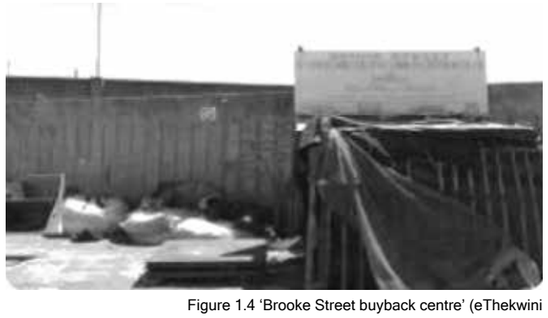


Figure 1.4 ‘Brooke Street buyback centre’ (eThekwini

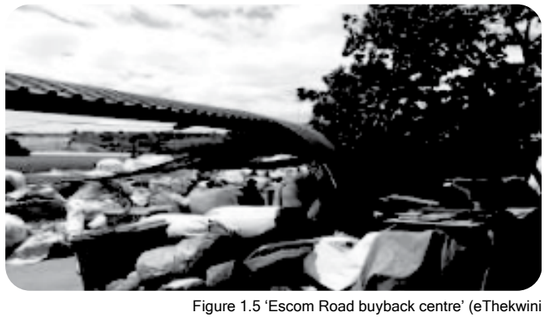


Figure 1.5 ‘Escom Road buyback centre’ (eThekwini

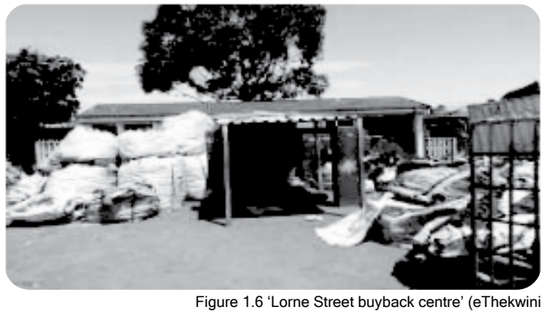


Figure 1.6 ‘Lorne Street buyback centre’ (eThekwini

1.4 ARCHITECTURAL

The energy usage of buildings has been explored and interrogated, not only academically, but also in practice. Such environmental considerations have been implemented on a legislative level in (SANS 10400-part XA) however these standards do not consider the embodied energy of materials used during the construction process. Thus, architecture should adopt a more sustainable and environmentally conscious approach to construction in the attempt to reduce the embodied energy of new developments. This approach as outlined by Gorgolewski and Morettin (2005: 105-107) makes use of salvaged or reclaimed materials from decommissioned buildings or from construction sites.

However, these methods, particularly within South Africa are limited to traditional materials that are commonly found within the built environment in South Africa (i.e., brick, timber, concrete or steel) and can be further expanded upon.

The adaptive reuse of material is the primary economic incentive for the plastic recycling ecosystem that already exists within the Durban CBD and South Africa, however their scope of work is limited to the collection and processing of this material, and not to the reuse of it (see figure 1.8). The literature of Manrich & Santos (2005) showcased the huge advancements in plastic recycling on an experimental and practical level. By introducing these new technologies into architecture, it expands the range of what is possible with plastic-waste as a method and material of construction. The integration of recycling technologies and processes into the architectural and construction process expands the range of products that can be made and sold by recycling plants and companies (see figure 1.9). This venture into different markets would inject a new financial stream, encouraging growth within the informal markets and introducing entrepreneurial business, whilst also providing opportunity for participation from recycling communities within the architectural process. This would indirectly challenge public preconceptions of the possibilities of waste material beyond just disposal.

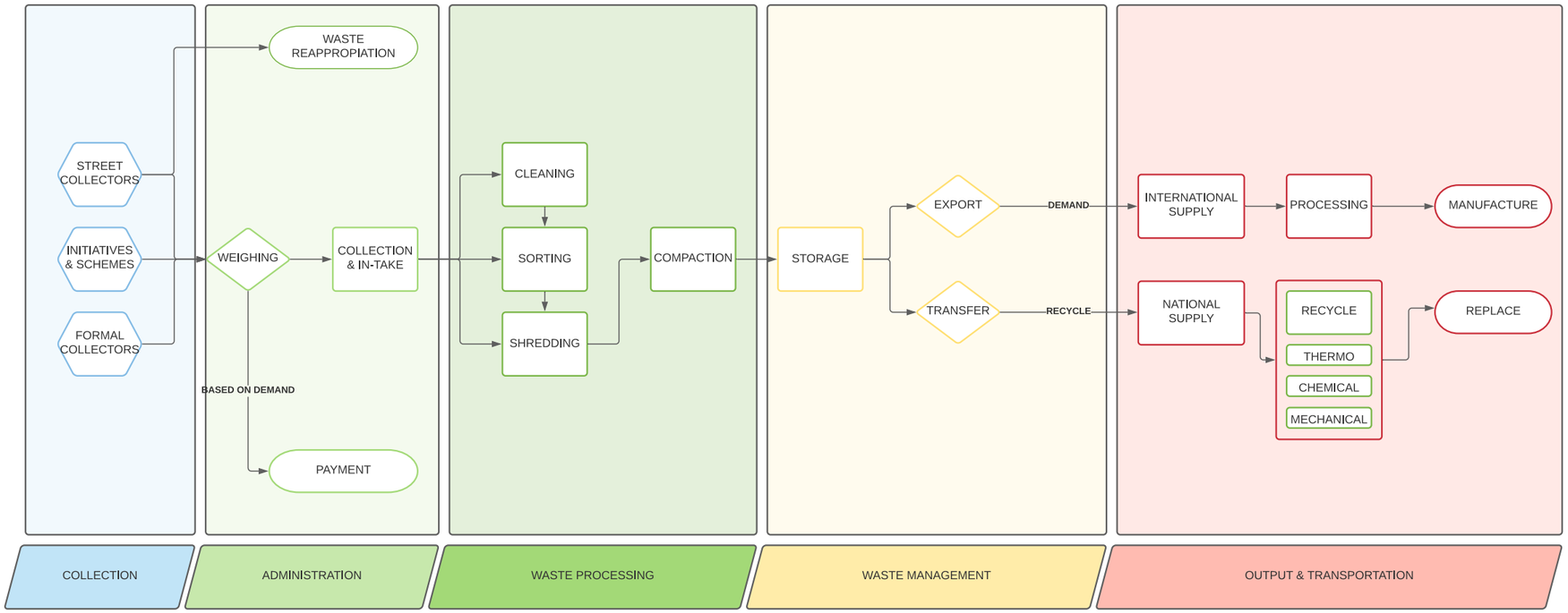


Figure 1.7 'Current recycling systeme' (Author, 2021)

The conceptual intention of this dissertation is to integrate the plastic recycling process, including the informal and formal collectors, into the architectural process with the aim to increase public participation and interaction with recycled materials on a daily level (as shown in figure 1.10). This merging of two distinct fields provides the potential of new economic incentive that is meant to encourage further entrepreneurial business within the recycling market, whilst introducing a cyclical adaptive approach to technology and construction within the architectural discourse.

This design intention can be broken into three supporting questions:

- How can the integration of the plastic recycling economy into architecture act as a catalyst; challenging existing prejudices against informal waste collectors, and become a facilitator; encouraging the development of waste management systems?
- How can the local recycling culture be integrated into the proposed architecture recycling system at a spatial level?
- How can plastic waste management, implemented at different complexity scales, accommodate different levels of knowledge or skill, with the intention to encourage further public participation?

The architectural intention of the dissertation is to challenge public perception of plastic waste as something without use and to change the lack of public awareness around the environmental concerns of plastic pollution. The dissertation is also intended to accommodate the local recycling economy at a developmental and infrastructural level by forming part of the current network and improving the livelihood and facilities provided to the informal workers within the field. Due to the malleability and range of plastic as a material, it can be implemented at different complexities to encourage public participation, creating a sense of spatial agency.

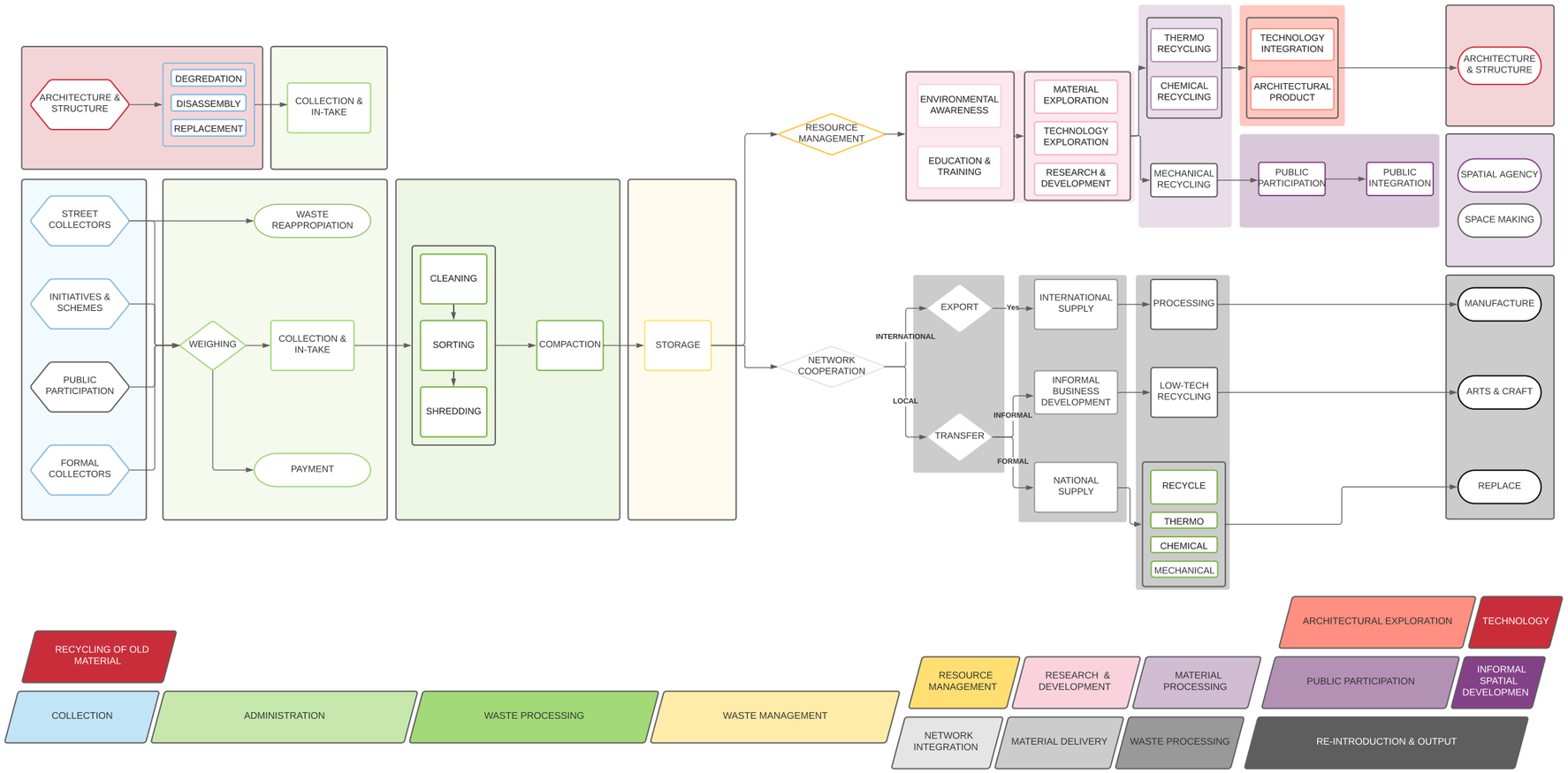


Figure 1.8 'Proposed recycling systeme' (Author, 2021)

2. THEORETICAL FRAMEWORK

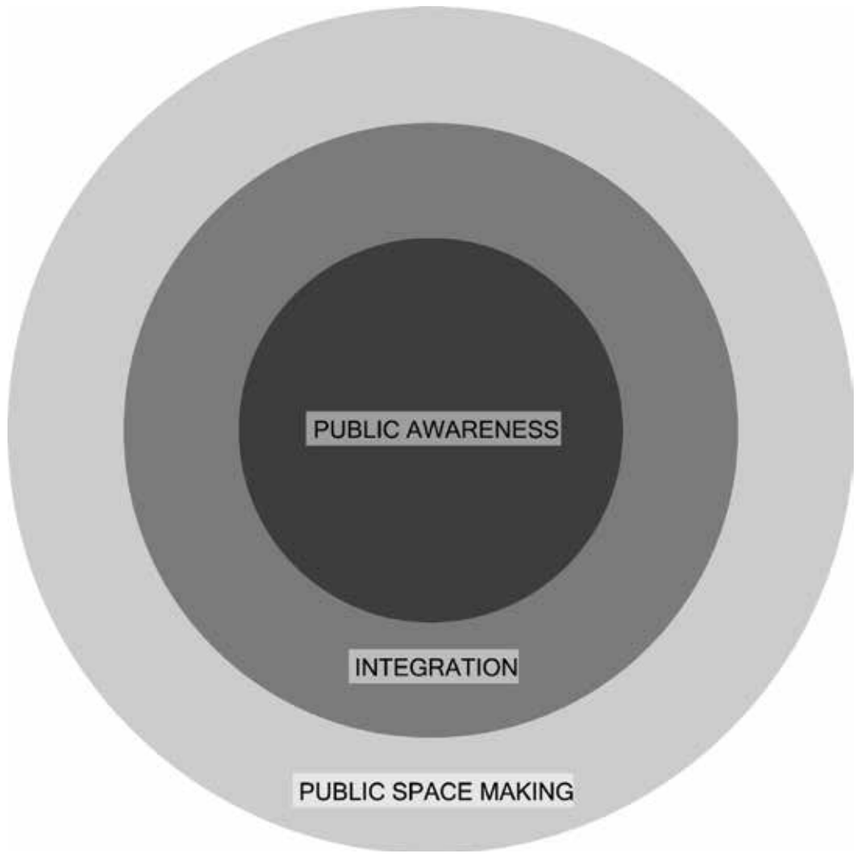


Figure 2.1 'Theoretical hierarchy' (Author, 2021)

2.1 INTEGRATION

Orr (1993) - Architecture as Pedagogy
Ellsworth, (2005) - Places of learning : media, architecture, pedagogy
Salama, (2021) - Transformative Pedagogy in Architecture and Urbanism
Petco (2019) - Design for Recyclability
Manrich & Santos (2008) - Plastic Recycling
Daftardar et al. (2017) - Use of Waste Plastic as a Construction Material

2.2 TECHNLOGY

Bencherki (2017) - Actor-Network theory
Michael (2000)- Reconnecting culture, technology and nature
Lovell (2004) - Material innovation and the development of form
Brookes (2004) - Production processes, sources and the uses of materials.
Brookes & Poole (2004) - Material developments in the twentieth century.
Aksamija (2016) - Integrating Innovation In Architecture
Jureviciute (2019)-Plastic < EMERGENCY > Architecture
Koehler (1955) - Plastics in Buildings

2.3 PUBLIC SPACE MAKING

Gehl (2010) - Cities for people
Whyte (2001) - Social life of small urban spaces
Wolfe (2019) - Urbanism without effort
Karssenberg & Laven (2016) - The City at Eye Level
UN Habitat (2014) - Placemaking and the Future of Cities
Dobson, Skinner & Nicholson (2009) - Working in Warwick

2.4 INTEGRATION

The intention of this dissertation is to introduce recycled plastic and polymer-based materials within the built environment and integrating new recycling technologies within urban culture. Thus, the relationship between the user and the technology becomes the primary consideration in the design process. This relationship provides insight into how material innovation within the architectural realm would be perceived by users in a technological and pedagogical sense.

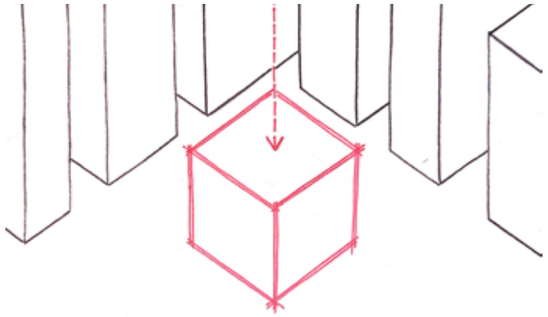


Figure 2.2 'Integration' (Author, 2021)

2.5 PUBLIC AWARENESS

Orr (1993) states; "The process of design and construction is an opportunity for a community to deliberate over the ideas and ideals it wishes to express and how these are rendered into architectural form. What do we want our buildings to say about us? What will they say about our ecological prospects?"These questions provide an understanding about the social and civic consequencesof architectural interventions. The design, construction and economy of architecture is perceived as a reflection of our ideals and ethics of ecological and material consciousness.

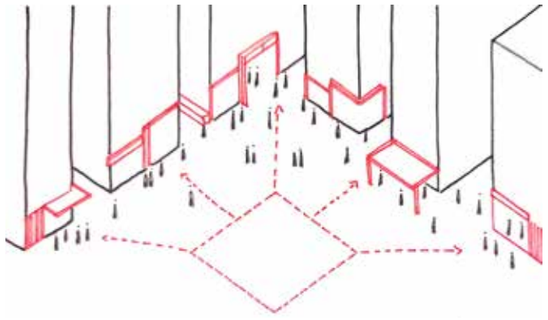


Figure 2.3 'Public awareness' (Author, 2021)

2.6 PUBLIC SPACE MAKING

After introducing a new recycling technology, the intention is to maximize interaction to ultimately achieve the domestication of this new 'exotic' technology (Michael,2000). This interaction would occur within these public urban spaces, and more specifically, within 'eye level'. According to Karssenberg & Laven (2016:14) the ground floor or eye level of a building receives the most interaction and experience. It is within this area that new technologies can be most efficiently received and domesticated. The ground floor also provides the most successful retail economy with cafés and informal markets. The site criteria are directly extrapolated from the three theoretical themes – Public Awareness; Integration: and Public Space making.

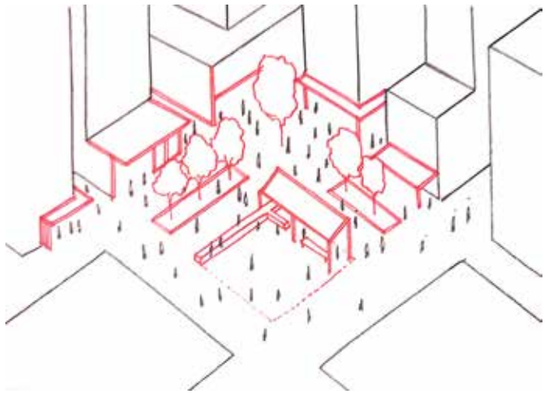


Figure 2.4 'Public space making' (Author, 2021)

2.7 METHODOLOGY

The research methodology of this dissertation follows a mixed method procedure as outlined by Creswell (2009). The data collection follows a sequential explanatory sequence, focussed on quantitative data within the first / initial stages followed by qualitative data. The quantitative and qualitative data is informed by the hypothesis / research question.

The quantitative data collection is comprised of semi-structured interviews with representatives from recycling plants and architectural product manufacturers. Analysis of this data was used as a feasibility study to understand the current limitations within the waste collection economy that the dissertation was grounded upon; and the range of architectural products manufactured from plastic and polymer-based material currently used in the construction field. Further desktop studies were undertaken to gain data on the products and precedents of plastic use globally.

Qualitative research was conducted via site visits and were analysed through the lens of social urban spaces, derived from the literature of Gehl (2010), Whyte (2001) and Wolfe (2019).

The feasibility data analysis provided insight into the spatial requirements of focussing the project within the existing recycling economy.

As per a communication with Mrs D. Botha (2021), well established recycling and collection plants projected an intake of roughly 5000 tonnes a month. This highlights the extensive spatial requirements of such plants and would limit the location of the site to the industrial and commercial belt of the city and not within the public suburban environment which would benefit most from public interaction.

Data gained from the architectural product manufacturer highlighted the difficulty of regulatory compliance of architectural products that have undergone multiple recycling processes due to quality control. However, the literature of Manrich & Santos (2008) provides contemporary recycling technologies that achieve higher quality control to maintain product integrity and strength.

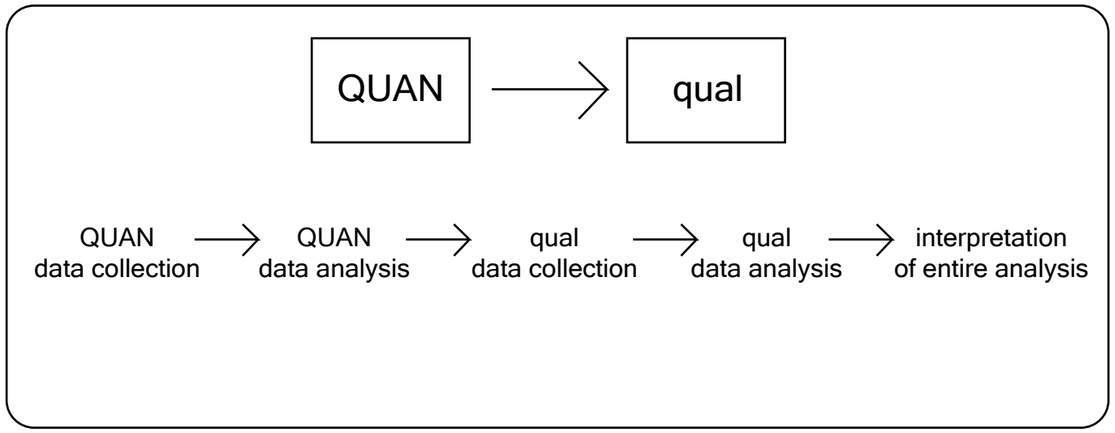


Figure 2.5 'Sequential explanatory design' (Creswell, 2009)

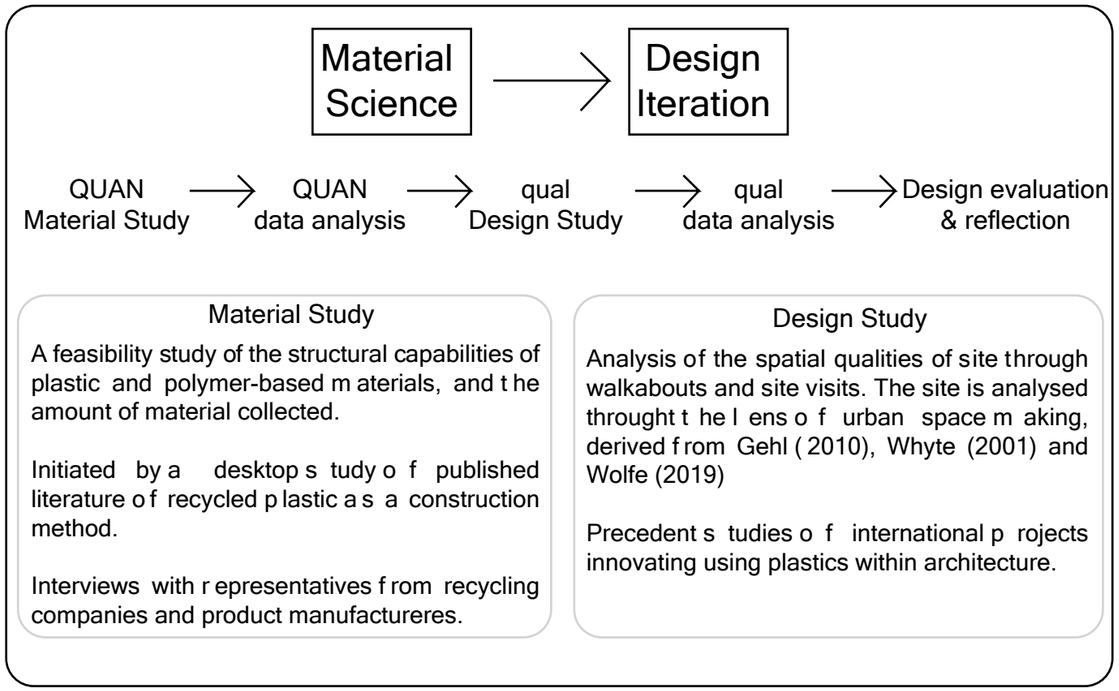


Figure 2.6 'Research Methodology' (Author, 2021)

3. THE SITE

3.1 SITE SELECTION

Although the programme would be the primary driver in challenging public awareness, the site can also indirectly contribute to the pre-conceptual shift. The site must provide contextual association with historically significant or recognizable buildings that shape the fabric of the Durban cityscape, thereby allowing the introduction of a recycling culture to be ingrained within the city culture. Michael (2000) states these new, 'exotic' technologies, "can be said to be instrumental in the reconfiguration of our conceptions of the social and of nature aspects." (Michael, 2000:9). This reconfiguration lies within our perception of the technology and subsequently, its association with its environment – introducing an 'exotic' technology in a context that complements it through social popularity. Once introduced, the 'exotic' technology must be domesticated to the extent that it becomes 'mundane', that is, "technologies that are now fully integrated into, and an unremarkable part of, everyday life." (Michael 2000: 9). To achieve this level of integration, hands-on interaction must be encouraged. Through spatial agency, new materials and technologies can be practically explored by users, by providing flexible and malleable spaces in which users can shape their surroundings with the tools introduced through the recycling of plastic waste. This exploration must form part of existing educational systems that have a similarly technological and ecological focus as the dissertation. Mundane technologies are associated with familiarity, their relationship with everyday life and how they serve local social life. To achieve maximum integration and interaction, the site must service high volumes of pedestrians within existing social and organizational structures to achieve a more fluid / natural assimilation of the exotic technology and proposed culture. Due to the demand of a site that features high pedestrian traffic and user interaction, these criteria have been filtered through an additional parameter which pertains to the walkability of the city. Through site analysis of the larger Durban CBD area, informal and formal transportation drop-off and stations are highlighted and used to extrapolate a 10-minute walking radius.

INTEGRATION	PUBLIC AWARENESS	PUBLIC SPACE MAKING
CONTEXT ASSOCIATION URBAN CONTRIBUTION To actively challenge public prejudices and preconceptions of plastic waste, indirect associations must be made. By situating the intervention adjacent to an otherwise well-known or infamous building, this association can be made.	SPATIAL AGENCY EDUCATIONAL INTEGRATION Any new intervention should be easily assimilated into daily life. This assimilation should be introduced into existing educational structures and a platform provided for practical execution	MAXIMUM INTERACTION URBAN INTEGRATION To achieve maximum interaction with the public, the site should currently service high volumes of predestrians. The intervention should be situated within existing social and organizational structures, thus fluid / natural assimilation can be achieved.

Figure 3.1 'Site selection criteria' (Author, 2021)

Figure 3.2 'Durban CBD movement routes' (Author, 2021)

MAXIMUM INTERACTION

URBAN INTEGRATION

Through mapping the primary vehicle and pedestrian access routes into the Durban CBD, a 10min walk radius can be drawn around the existing taxi and bus ranks. These taxi and bus ranks provide the largest intake of pedestrians into the city itself, and current buildings adjacent to these high-volume movement routes include the Workshop Shopping centre and Durban ICC.

Figure 3.3 'Durban CBD significant buildings' (Author, 2021)

CONTEXT ASSOCIATION

URBAN CONTRIBUTION

Many of the historic and significant buildings within the Durban CBD can be traced back to the establishment of the locomotive industry in the Durban settlement in the 1860s. The Workshop shopping centre and Berea Technical College were the original Railway workshop and offices respectively. The Durban ICC, constructed in 1997 and extended in 2004, was voted as one of the top 15 congress centres in the world.

Figure 3.4 'Durban CBD educational buildings' (Author, 2021)

SPATIAL AGENCY

EDUCATIONAL INTEGRATION

There are many established educational institutes within 10min walking radius, The Berea College of Technology and the Youth Development agency are two of the more prominent institutions with many historic and scientific museums in and around the area.

3.2 eTHEKWINI INNER CITY LOCAL AREAS PLAN

The eThekwini Municipality has outlined an inner-city areas framework for the future of the area. This framework is envisioned to accommodate an additional 450, 000 people within the inner city whilst creating 250, 000 jobs once completed. The intention of this framework is to improve the livelihoods of all residents within the area whilst opening up Durban to the world tourism market. A new transit system is proposed and 90% of buildings will implement grey water recycling systems.

The implementation of the dissertation is designed to integrate within this framework, emphasising the proposed principles and continuing within the spatial, infrastructural, and public requirements as set by the framework. The principles of this dissertation will accommodate increased waste production associated with increased population and visitor numbers by following these themes whilst using the framework to identify potential sites in nodes that have been demarcated for significant improvement or public accommodation. The resultant increase in waste production would feed the development of waste management and repurposing technology, leading to exponential growth in all sectors of the formal and informal sectors of the economy.

Through the extrapolation of the information from this framework, four key areas of intervention are highlighted as potential sites for selection. These four sites partially or completely satisfy the site selection criteria as outline in figure 3.1. The key identifying principal from the framework is the implementation of a new pedestrian priority network which would ultimately satisfy the requirements of high public interaction with the proposed subject matter.

Figure 3.6 'eThekwini inner city local area overview' (Author, 2021)

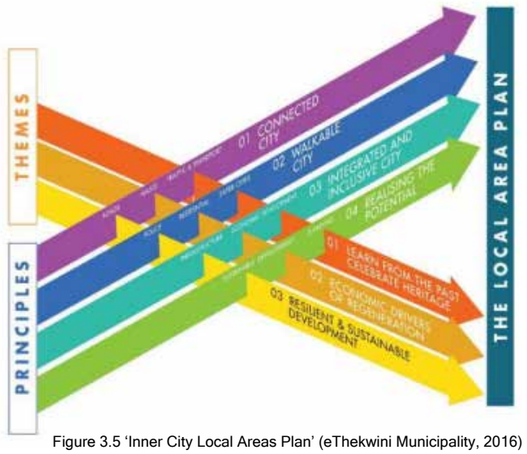


Figure 3.5 'Inner City Local Areas Plan' (eThekwini Municipality, 2016)

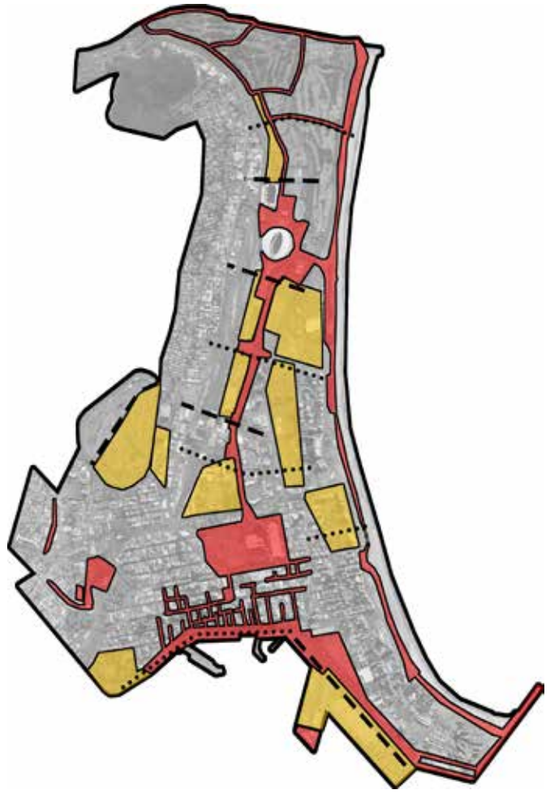


Figure 3.7 'Predestrianization and networking' (eThekwini Municipality, 2016)

PRINCIPLE 1 - A CONNECTED CITY

1.Reconfigure existing streets
2.New primary and secondary roads
3.New local streets
4.New pedestrian priority network

The intention of this principal according to the eThekwini Municipality (2016: 14) is to provide a variety of movement and mobility routes through the inner city which are designed to accommodate more public transport whilst highlighting the Gugu Dlamini park as the main civic core. From this principal, three areas are highlighted as high pedestrian priority nodes with emphasis on the continued development along the beach front to the East.

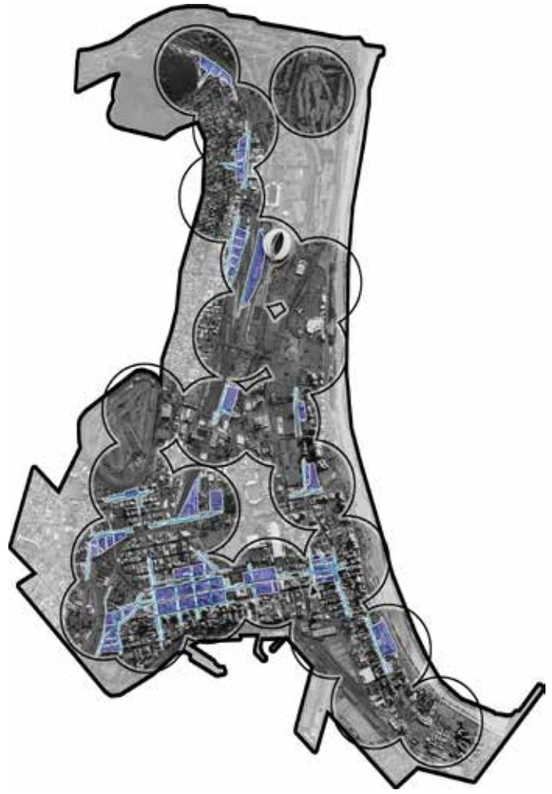


Figure 3.8 'Local neighbourhood clusters' (eThekwini Municipality, 2016)

PRINCIPLE 2 & 3 - A WALKABLE AND INCLUSIVE CITY

1.Walkable connected network of neighbourhoods
2.Land use density greatest at centre of nodes
3.Land use intensity high in open space areas
4.Periphery uses along connections between nodes
5.Less dense residential between central nodes

The intention of these principals is to implement a walkable city by introducing and developing the highlighted nodes. These nodes would facilitate a select range of civic and public programmes with additional low density residential development between nodes. The dissertation makes use of these nodes to highlight potential areas for the selection of the site.

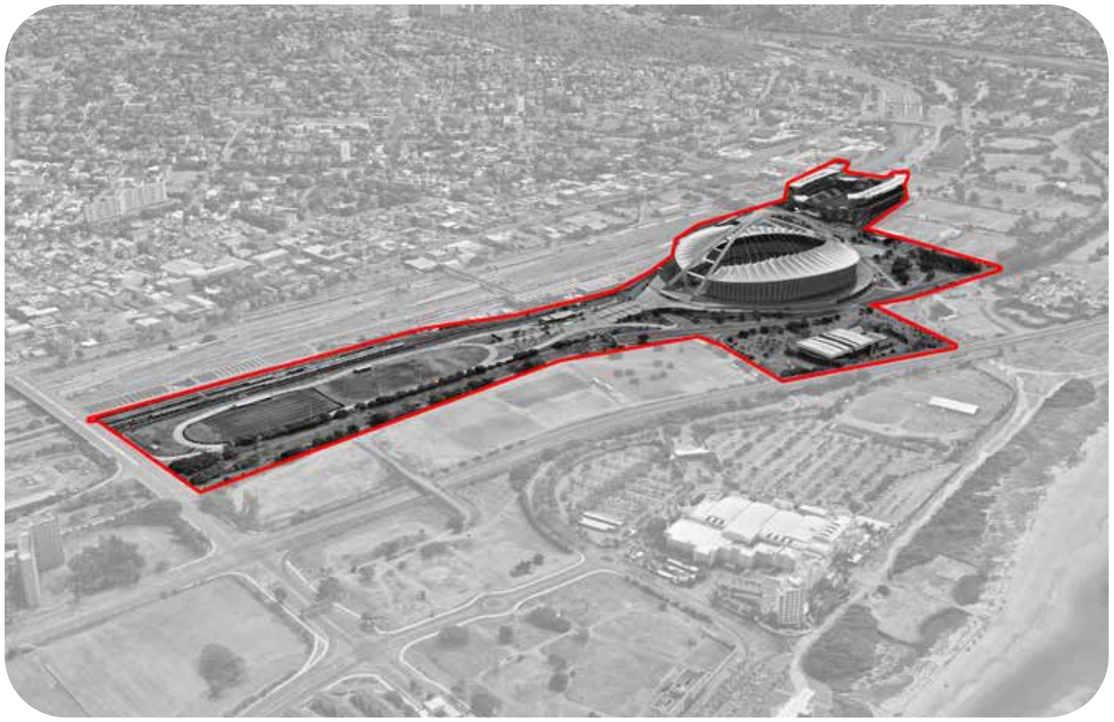


Figure 3.10 ‘People’s park’ (Author, 2021)

Figure 3.11 ‘Moses Mabhida stadium’ (Author, 2021)

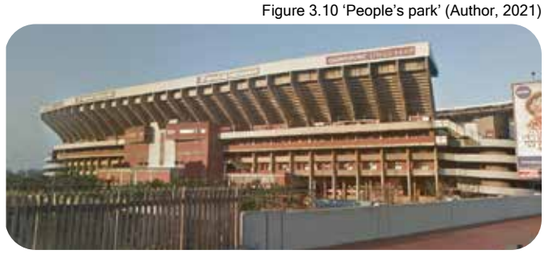


Figure 3.12 ‘Kings Park stadium’ (Author, 2021)

3.3 PEOPLES PARK

The area in and around People’s Park is predominantly regarded as a tourist destination with infrastructure largely dedicated to recreational and sporting activities. Formalized and renovated for the 2010 soccer world cup, the main attraction is the Moses Mabhida Stadium. According to the eThekwini Inner City Local Area Plan, the precinct has been envisioned to incorporate additional local streets that cut through the large blocks around the site (see figure 3.7), creating additional connections to the Beach front and along the North-South pedestrian axis. The site, due to the proximity of the sporting stadiums and direct beach fulfils the requirements of social popularity and contextual association. The adjacent railway stations transform the site into a public transport node that allows direct access, not only of pedestrians, but also the transportation of construction materials.

Due to the sporadic nature of sporting events, the site and the surrounding stadiums do not guarantee a constant supply of foot traffic and the site itself is on the periphery of the Durban CBD and so would become disjointed from the recycling ecosystem.

Figure 3.13 ‘Warwick markets’ (Author, 2021)

Figure 3.14 ‘Warwick markets bridge’(Dobson, 2009)

Figure 3.15 ‘Warwick food market’ (Dobson, 2009)

3.4 WARWICK MARKETS

The Warwick markets are a series of seven distinct marketplaces. The markets themselves see over 400 000 people daily, as surveyed before the covid pandemic (Dobsen et. al. 2009: 5). The site produces a large amount of pedestrian traffic due to the proximity of multiple taxi ranks and a bus station to the North. The Warwick triangle markets have undergone several rejuvenation schemes since 1995 that utilised public participation for input and implementation of necessary infrastructural development. This participatory development scheme can be used as a case study in the implementation of this dissertation.

Although the site satisfies many selection criteria such as public interaction and urban integration, the site poses a challenge to the introduction of new development due to the displacement of residents during infrastructural developments and the participation of local community and organization leaders when discussing potential developments.

Figure 3.16 'Golden mile' (Author, 2021)

Figure 3.17 'Golden mile landscape' (Tourism update, 2017)

Figure 3.18 'Golden mile overview' (Tourism update, 2017)

3.5 GOLDEN MILE

The Golden Mile is a stretch of land that runs along the coast from the uShaka water park in the south, to the Suncoast casino to the north. This area features a large volume of pedestrian traffic daily and has resulted in many foods and entertainment businesses being opened along this route.

Although this area is one of the main pedestrian routes within the heart of Durban and provides the contextual association as outlined by the site selection criteria, the site lacks an educational network in which the dissertation can be implemented. Beyond the entertainment and food destinations along this route, the average time spent at any point along this route is low and thus there is less public interaction with any space or structure, which is necessary for the implementation of the dissertation. This axis also has little interaction with the recycling ecosystem within the Durban CBD as very little waste collection takes place here as informal waste collectors are either prevented from roaming these areas or it remains outside their optimal collection routes.

Figure 3.19 'Durban ICC and Workshop centre' (Author, 2021)

Figure 3.20 'Durban ICC' (Grant Pitcher, 2018)

Figure 3.21 'Workshop shopping centre' (Author, 2021)

3.6 DURBAN ICC & WORKSHOP CENTRE

The Durban ICC and Expo Centre has a large pedestrian population due to the proximity of a taxi rank to the west and bus stops to the south. The Hilton hotel and Durban ICC satisfies the contextual association required within the site criteria. The site is also situated between tertiary educational institutions and natural science museum, whilst also being in close to the Department of Public Works and Water and Sanitation buildings, which have been identified as potential clients of the project. The eastern half of the site suffers from sporadic activity due to scarcity of events held in the Durban ICC and Durban Expo Centre and is further exacerbated by the fencing off from many interstitial spaces between conference halls that have potential for prolonged street activity.

Any intervention on the site would have to attract users from the existing informal markets and Workshop shopping centre from the west. Although most of the fenced off space is used as parking in the past, the courtyard just south of the main expo hall was used as an informal food market, creating an East-West axis of informal trade. This provides an opportunity to reactivate this East-West axis and use it to satisfy the spatial agency requirements of recycling integration. According to the eThekwini Inner City Local Area Plan, this block would act at the southern termination point of a proposed North-South pedestrian axis providing further movement from the North into the site.

3.7 THE CHOSEN SITE

Located centrally within the heart of the Durban CBD, the site features many historic buildings associated with the settlement and subsequent founding of the city of Durban. Originally constructed to facilitate the Durban port and locomotive transportation and trade industries, the railway station, and the railway workshop (now the Virgin Active gym and Workshop Shopping centre respectively) are two of the prominent buildings that the Durban Expo centre has responded to contextually, responding to the factory and workshop typology of pitched roof and vertical windows.

Renovations in 1986, rejuvenated the historic buildings, introducing new programmes and integrated the structure back into the fabric of the city. The old railway station had been retrofitted to house a gym with its original brickwork facades dating back to 1889. The original iron girders of the railway workshop are used today to hoist a vaulted glass roof over the countries first themed shopping mall.

There currently exists a rich and diverse, socio-cultural, and political identity within the site and its immediate context. The significant historical buildings, erected from the late 1800's to the mid 1900's, are in an architectural style reminiscent to a neo-classical and Edwardian architecture that reflected the apartheid regime and can be subsequently argued to be political in nature, especially in a post-apartheid society. These political spaces have, however, been reclaimed by the people of the city to reflect their current socio-economic status (a small, entrepreneurial trade) (see figure 3.26). The current commercial association of the mall has acted as a catalyst and an informal market has sprawled out to the entrance of the building, creating a new trade orientated culture along Church Street, linking to the historic Farewell square and World War Memorial in the foreground of the Durban City Hall to the south. This activity in the past, however, had further expanded along the west-east axis, connecting the taxi rank on the west and an informal food market to the east which has subsequently been fenced off, currently being used as vehicle parking for the Durban Exhibition Centre.

Figure 3.22 'The site's significant context' (Author, 2021)

Drawing from the existing informal markets to the west and the former food market to the east, the site proved successful in sustaining an informal economy and drawing in activity from the periphery of the site and from the city itself (see figure 3.26 & 3.27).

The area in and around the Gugu Dlamini Park provided one of the few walkable neighbourhoods in the city whilst providing access to the city via public transport (formal bus stations and informal taxi ranks). This neighbourhood is also supported by open soft green space that provided sanctuary from an otherwise harsh urban environment.

Even though the former food market has been fenced off, there remains remnants of the successful economic axis, which is currently being used for pedestrian movement along the West East axis (see figures 3.23-3.25). This pathway acts as a route for mobile traders to sell smaller goods to pedestrians commuting to and from the city with a few offshoot spaces providing a smoke break area to users of the Youth Development agency or employees of the Reserve Bank on the southeast corner of the site.

Walnut street, between the Durban ICC and Durban Expo centre, however, sees very little activity beyond that of a secondary route through to the rest of the city, particularly during the offseason in which no events are scheduled in the ICC. This is primarily due to the fencing off of the Expo premises.

Figure 3.23 ‘Activity along pedestrian corridor adjacent to workshop centre’

Figure 3.24 ‘Activity along pedestrian corridor adjacent to parking lot’

Figure 3.25 ‘Activity within informal markets’ (Author, 2021)

The eastern half of the site suffers from sporadic activity due to scarcity of events held in the Durban ICC and Durban Expo centre and is further exacerbated by the fencing off of many interstitial spaces between conference halls that have potential for prolonged street activity. Any intervention on the site would have to attract users from the existing informal markets and Workshop shopping centre to the west. Although most of the fenced off space is used as parking in the past, the courtyard just south of the main expo hall was used as an informal food market, creating an East-West axis of informal trade.

Figure 3.26 ‘Existing market and trading axis’ (Author, 2021)

Figure 3.27 ‘Existing market and trading axis overview’ (Author, 2021)

Figure 3.28 ‘Former food market used as parking lot’ (Author, 2021)

Figure 3.30 ‘Fenced off site’ (Author, 2021)

Figure 3.29 ‘Walnut road lack of activity’ (Author, 2021)

Figure 3.31 ‘Pedestrian corridor adjacent to parking lot’ (Author, 2021)

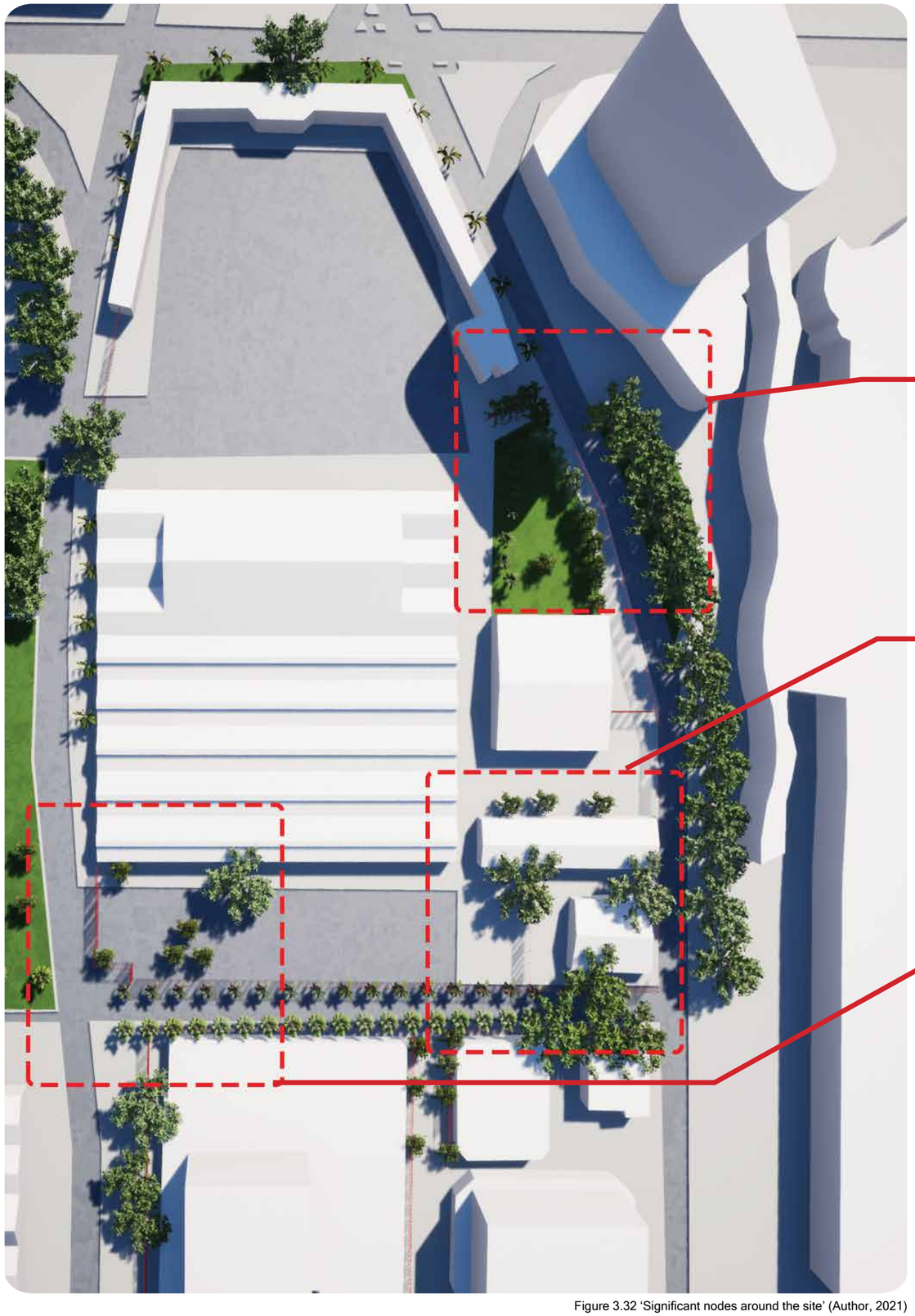


Figure 3.32 ‘Significant nodes around the site’ (Author, 2021)

Figure 3.33 ‘Hilton hotel to East entrance’ (Author, 2021)

Figure 3.34 ‘Durban ICC to pedestrian corridor’ (Author, 2021)

Figure 3.35 ‘Workshop shopping centre to pedestrian corridor’ (Author,

Further interrogation of the site on a block focused scale, three major areas were identified to possess the most potential for meaningful intervention. Firstly, the area currently being used as the vehicle entrance to the parking lot on the north of the Expo centre. This entrance opens to the street, providing a possible connection with the Hilton Hotel, however, due to the fencing and private access to the parking, the area is abandoned with activity focused within the interior of the block during events and conferences (see figure 3.31).

Secondly, the area intersecting Walnut Street and the proposed east west market axis. This intersection currently facilitates spill off activity from the ICC to the Expo centre by pedestrianizing the street, however this is only on occasions when events or conferences require two or more venues. It is otherwise under-utilised (see figure 3.32).

Finally, the former entrance to the food market. This area is the first threshold when navigating from the Workshop and informal markets to the west. Again, the space previously supported a significant economic market culture but has subsequently been fenced off for parking space (See figure 3.33).

The intention of this dissertation is to reactivate this East-West axis and use it to satisfy the spatial agency requirements of recycling integration. The pedestrianization of Walnut Street would counteract the temporality of street life on the eastern half of the site and provide opportunity and encourage the growth of informal trade along the street. A new source of pedestrians is envisioned through the introduction of new medium to long term accommodation to the north of the street, balancing the accustomed short-term accommodation provided by the Hilton hotel.

Figure 3.36 'Vehicle movement intensity' (Author, 2021)

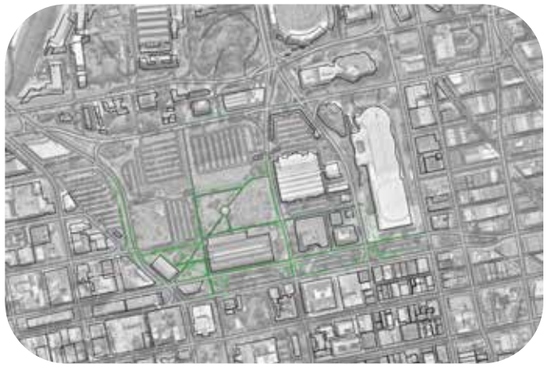


Figure 3.37 'Predestrian movement intensity' (Author, 2021)

Figure 3.38 'Informal trade and activity intensity' (Author, 2021)

Figure 3.39 'Green and recreational space' (Author, 2021)

Figure 3.40 'Site concept section' (Author, 2021)

4. THE PROGRAMME

The programme exploration is derived directly from the theoretical framework and the hierarchy of themes touched upon as shown in figure 2.1 . Each category of programmes pertains to increasing complexity of informality of interaction and integration of the recycling technology. These categories are broken down into three conceptual questions that are centred around the introduction of plastic recycling and the public's understanding of the subject matter. Paragraph 2.2 lists the theoretical literature that inform the theme of Technology. From this theme the conceptual question of 'WHY' is derived. This question highlights one's role within the subject matter and the study of the subject itself. Paragraph 2.1 lists the literature of Integration and from this theme outline the current practices of the recycling process and the question of 'HOW' does one fit into those practices. The paragraph 2.3 lists the literature that informs the theme of Space making. This theme brings about the question of 'WHERE' can these technologies and practices be implemented in the public realm.

4.1 WHY

The 'why' of the programme relates to the material characteristics of plastic. Questions such as 'why does plastic…' or 'why is pollution…' can be considered as questions that this part of the programme responds to. Answering questions on a theoretical level, the programme is focused on educating the public and the experimentation of plastic to challenge public opinion. These programmes could be integrated into the curriculum of the Berea College of Technology and form part of an expansion on the current standards in the Department of Public Works and Water and Sanitation

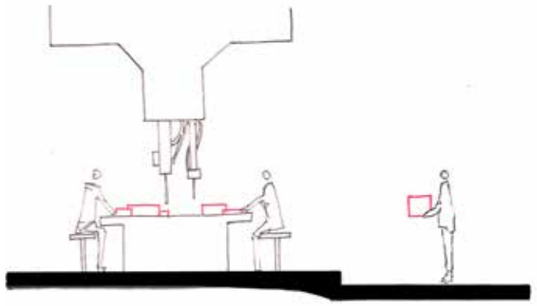


Figure 4.1 "Why" Programme parti' (Author, 2021)

4.2 HOW

The 'how' of the programme relates to the craft and trade of using plastic. Questions such as 'how can plastic…' are considered within this part of the programme. Focusing on the manipulation of plastic to create products or techniques, practical training, exploration, and the potential of material is used to challenge public opinion.

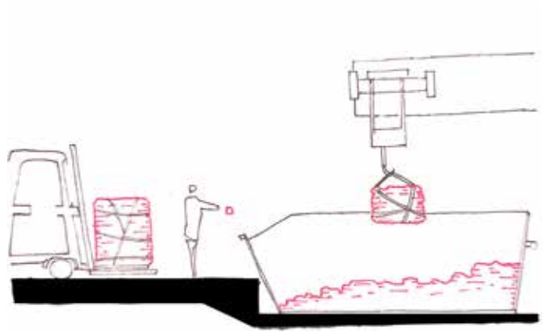


Figure 4.2 "'How" Programme parti' (Author, 2021)

4.3 WHERE

The 'where' of the programme refers to the integration of plastic. Questions such as 'where can plastic…' can be considered as questions this part of the programme responds to. It is focused on the real-world use of the above two programmes. This response would ultimately use the architectural intervention itself as a platform to showcase the use of plastic as a construction method as well as the proposed market along the East-West axis.

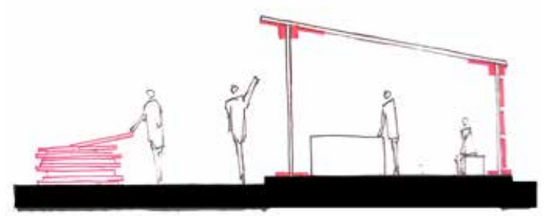


Figure 4.3 "Where" Programme parti' (Author, 2021)

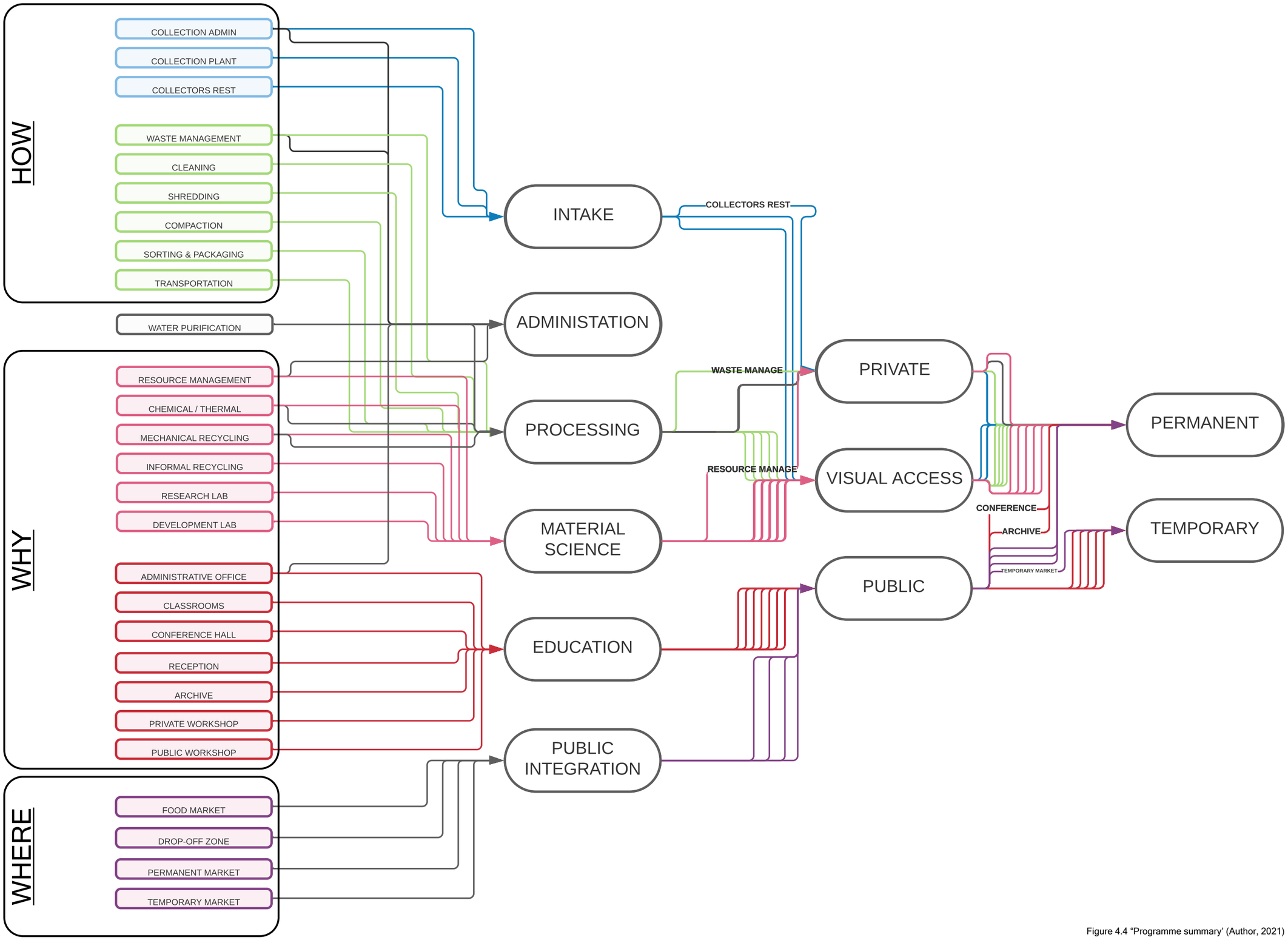


Figure 4.4 “Programme summary’ (Author, 2021)

ACTIVITY / PROGRAMME	DESCRIPTION	PROGRAMME TYPE	SANS 10400 CATEGORY	SANS POPULATION	# OF USERS	TOTAL AREA
COLLECTION	Open depot allocated to the intake of waste	PERMANENT	D3	1 person per 15m²	5 (13 max)	200
COLLECTORS REST ROOM	Rest and washroom for informal waste collectors	PERMANENT	H2	1 person per 5m²	2 USERS	100
WEIGHING	In-floor mechanism intended for weighing before and after drop-off to determine payment	PERMANENT	D3	1 person per 15m²	1-2 (2 max)	25
COLLECTION ADMIN	Administration for the collection facility	PERMANENT	G1	1 person per 15m²	10-15 (30 max)	450
CLEANING	Open air facility intended for the cleaning of collected waste	PERMANENT	D3	1 person per 15m²	3-6 (7 max)	100
SHREDDING	Closed facility intended for the shredding and processing of collected waste	PERMANENT	D2	1 person per 15m²	2 (7 max)	100
COMPACTION	Closed facility intended for the compaction of shredded waste	PERMANENT	D2	1 person per 15m²	2 (7 maxi)	100
SORTING & PACKAGING	Closed facility intended for the packaging and sorting of compacted waste	PERMANENT	D3	1 person per 15m²	5-10 (30 max)	500
STORAGE	Demarcated structures throughout the site that facilitate waste collection and waste storage to be processed	TEMPORARY	J3	1 person per 50m²		
WASTE MANAGEMENT	Waste processing administration offices	PERMANENT	D2	1 person per 15m²	15-20 (45 max)	675
WATER PURIFICATION	Permanent plant room for the collection and purification of storm water to be used for on-site processes	PERMANENT	D4	1 person per 15m²	1-2 (8 max)	125
TRANSPORTATION	Vehicle depot intended for the exporting and shipment of waste to other plants within the network system	PERMANENT	D3	1 person per 15m²	5 (13 max)	200
RESOURCE MANAGEMENT	Administration intended to oversee the handling and management of resources	PERMANENT	G1	1 person per 15m²	5-10 (13 max)	200

CHEMICAL / THERMO RECYCLING	Closed facility intended for the chemical and thermal recycling of plastic	TEMPORARY	D1	1 person per 15m²	2-5 (15 max)	225
MECHANICAL RECYCLING	Open facility intended for the mechanical recycling of plastic	PERMANENT	D2	1 person per 15m²	2-5 (13 max)	200
INFORMAL RECYCLING	Public facility that allows users access to equipment for low-scale waste recycling	TEMPORARY	D3	1 person per 15m²	15-20 (40 max)	600
RESEARCH LABORATORY	Closed facility that oversees the material sciences of the recycling process	TEMPORARY	D2	1 person per 15m²	2-3 (15 max)	225
DEVELOPMENT LAB	Laboratory and workshop that develops new materials and construction methods	TEMPORARY	D2	1 person per 15m²	5-10 (20 max)	300
CLASSROOMS	Learning facility for enrolled students, following a curriculum that forms part of the Department of Water and Sanitation	TEMPORARY	A3	1 person per 1m²	10 per class x 6	600
CONFERENCE / LECTURE HALL	Flexible space that is intended to accommodate the demolished conference halls and facilitate on-site lectures or events	PERMANENT	A2 / A3	1 person per 1m²	150-250 + speakers	250 SEAT +
ADMINISTRATIVE OFFICE	Administration that oversees the curriculum and management of students and staff	TEMPORARY	G1	1 person per 15m²	10 (15 max)	225
RECEPTION	Information desk	TEMPORARY	G1	1 person per 15m²	1-2 (6 max)	100
STORAGE / ARCHIVE	Underground facility intended for the storage and exhibition of products and technologies	PERMANENT	C2	1 person per 20m²	1 per room	50+ 75+38
PRIVATE WORKSHOP	Closed workshop area intended for enrolled students	TEMPORARY	A3	1 person per 1m²	5-10	113
PUBLIC WORKSHOP	Open workshop intended for public use for the creation and development of arts & crafts to be sold on site	TEMPORARY	A3	1 person per 1m²	20-40	400

FOOD MARKET	Open facility that accommodates the previous food market	PERMANENT	B2	1 person per 15m²	100+	525
DROP-OFF ZONE	On street parking and drop off zone to service the food market	PERMANENT			10-15 cars	300
PERMANENT MARKET	A series of permanent stalls	PERMANENT	F2	1 person per 10m²	100+	1000
TEMPORARY MARKET	Demarcation of an area on which informal stores can be erected during peak hours / events / weekends	TEMPORARY	F2	1 person per 10m²	150+	3125
PUBLIC GATHERING	Spaces open to the public for gathering or activity	PERMANENT	A1	1 person per 1m²	250+	3125
PUBLIC ABLUSIONS		PERMANENT				
CLASSROOM ABLUSIONS		PERMANENT				
ADMIN ABLUSIONS		PERMANENT				
WORKSHOP ABLUSIONS		PERMANENT				
COLLECTION ABLUSIONS		PERMANENT				
CLEANING ALBUSIONS		PERMANENT				
FLOOR LANDINGS	Open spaces adjacent to main movement core that act as a construction storage point when the building is under construction and as a landing/lobby when the building is in use	PERMANENT				

Figure 4.5 ‘Programme breakdown’ (Author, 2021)

5. ARCHITECTURAL APPROACH

5.1 MATERIAL CONSCIOUSNESS

The introduction of new recycling technologies and materials require explicit features that showcase the material origins. Meredith Miller (2018), states that the experiments of her exploratory work “Material Props” provided visual reference to the material origins of bioplastics and highlights the capabilities of these origins to reflect cultural and ecological territory. These material explorations provide a foundation on which materiality and technologies can be implemented and improved on at different scales. Materials can be refined and improved whilst still creating detailing that is recognizable. The intention is to celebrate and exhibit a technology of recycling that interfaces at different levels of cognisance, ultimately taming ‘exotic’ technologies to become common place within the public realm as outlined by (Michael, 2000). The methods and materials used at different scales would inform the architectural language at different levels of informality as associated with the programme it facilitates.

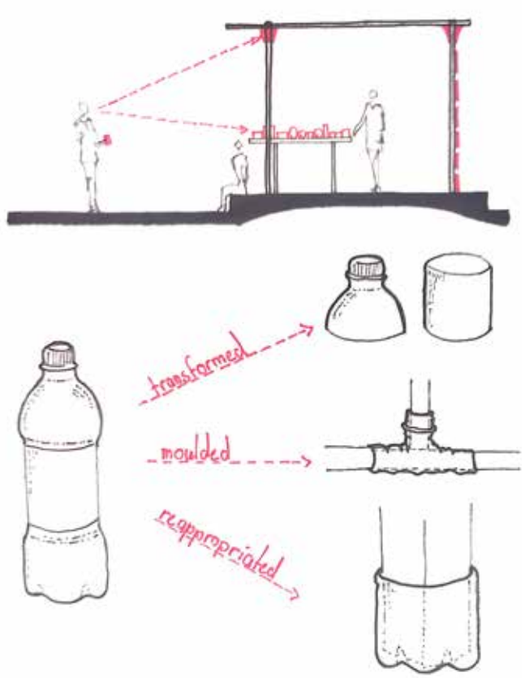


Figure 5.1 ‘Material consciousness’ (Author, 2021)

5.2 SPATIAL CONNECTION

In order to facilitate the ‘domestication’ of these new technologies, accessibility needs to be provided in each programme, ranging from increased access in the market spaces to visual access in the waste collection spaces. Thus, spatial organization is derived from precedents such as the Brunner innovation Factory by HENN in which visual access is achieved via the transparency of materials and intervisibility of production spaces and public spaces (Abdel, 2020). The Science Research Facilities by Ludwig Hansen Architects utilizes ‘programme detachment’ in which interstitial spaces are created, between primary educational programmes, that provides visual access to the public gathered in these spaces (Pintos, 2021).

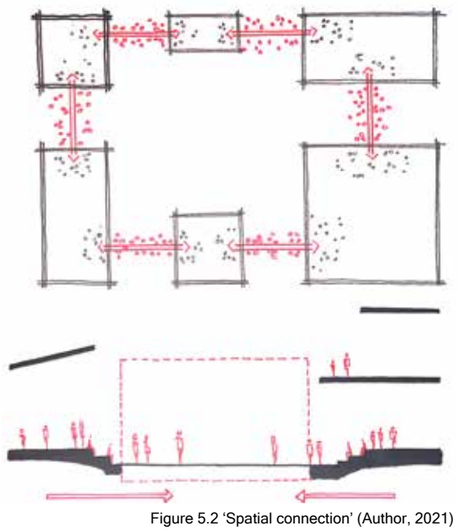


Figure 5.2 ‘Spatial connection’ (Author, 2021)

5.3 SPATIAL AGENCY

Spatial agency is given to the users of the space. This allows them to grapple and manipulate their surroundings, gaining knowledge about the materials that form their surroundings. The proposed programme of this dissertation follows the spatial operator of expanding briefs as outlined by Awan, Schneider and Till (2011: 69). Awan et al. states that “A traditional brief thus acts against the spirit of agency in as much that by setting parameters it tends to close things down and limit options” (2011: 69) thus, by allowing the brief to expand, and the parameters to evolve with the programme, agency is granted to the users within that programme. The spatial arrangement of the dissertation responds to another operator of spatial agency as outline by Awan et al (2011) ‘Making things visible’.

The primary intention of the dissertation is the use of plastic as a construction material, and many of the programmes and spaces within the dissertation all accentuate that intention. Technical processes are revealed to the public and some spaces are flexible, in that they change based on public need. This directly counters the division of intellectual and manual labour skill as mentioned by Smith (2013). The boundaries of what is learnt within the academic space and what is currently known in the general public should be broken, and knowledge should be shared. This knowledge should not be limited to users of the space but also other stakeholders within the process of design, construction, waste collection and recycling. This shared knowledge provides a deeper understanding of the space and the technology, of construction that constitutes it.

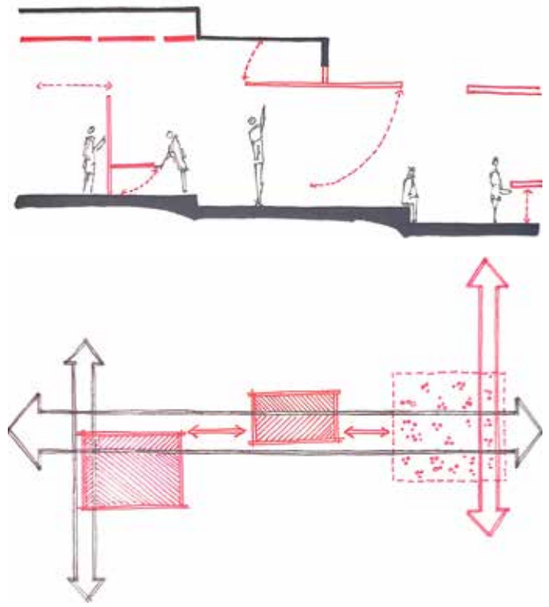


Figure 5.3 ‘Spatial agency’ (Author, 2021)

The initial design exploration focused on the reintroduction of the food market, which has since been fenced off and used as parking. This concept was intended to extrude the informal market activity along the West-East axis to activate street life south of Walnut Street, challenging the temporality of the street when the ICC and Expo centre are not in use. This reactivation, in conjunction with a proposed new flexible residential accommodation to the north of the street provides potential for retail and informal trade at street level to prolong street life throughout the year and take advantage of high traffic activity during ICC and Expo centre events.

Due to the low vehicular congestion along Walnut Street, particularly outside of scheduled events or conferences, a proposition of pedestrianizing the street to recreate and develop connections between the Hilton, ICC, and Expo centre and the interstitial spaces diverging from the market axis. This pedestrianization of Walnut Street is intended to prioritise pedestrian and bicycle movement whilst still accommodating single lane traffic at significantly reduced speeds. These design interventions, as outlined by Global Designing Cities Initiative (2021), is achieved by narrowing the street, changing the materiality of the street to prevent high vehicle speeds: providing sidewalk extensions for storefronts to spill out onto the street edge. Continuing to develop within the framework of the urban vision, the ground floor of blocks / masses is designated to serving the public realm, specifically, interfacing with the street.

The positioning of these blocks in relation to the street are subjected to the hierarchy of importance that they serve to achieving the underlying theme of the dissertation: challenging public preconceptions against plastic waste as a construction material.

Figure 5.3 'Street edge concept sketch' (Author, 2021)

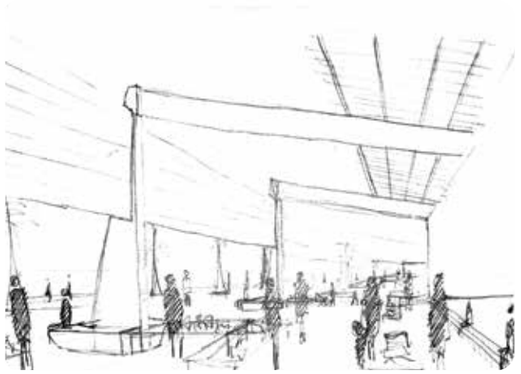


Figure 5.4 'Workshop concept sketch' (Author, 2021)

Figure 5.5 'Market concept sketch' (Author, 2021)

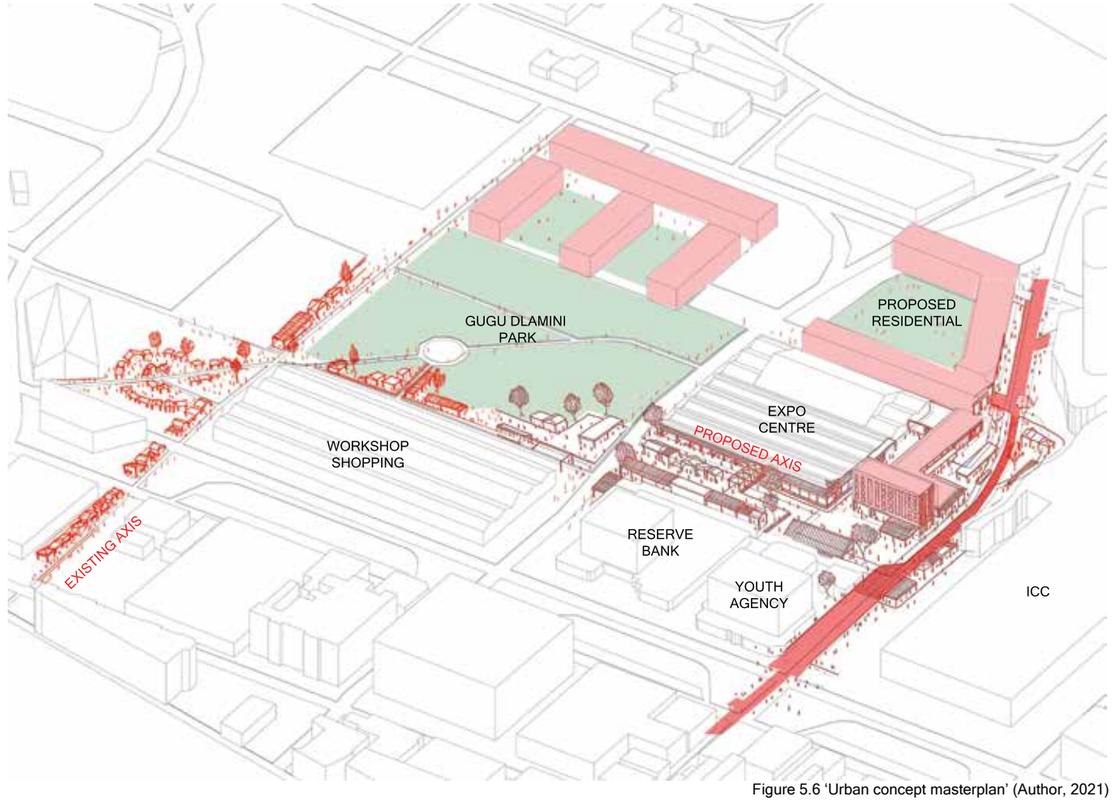


Figure 5.6 'Urban concept masterplan' (Author, 2021)

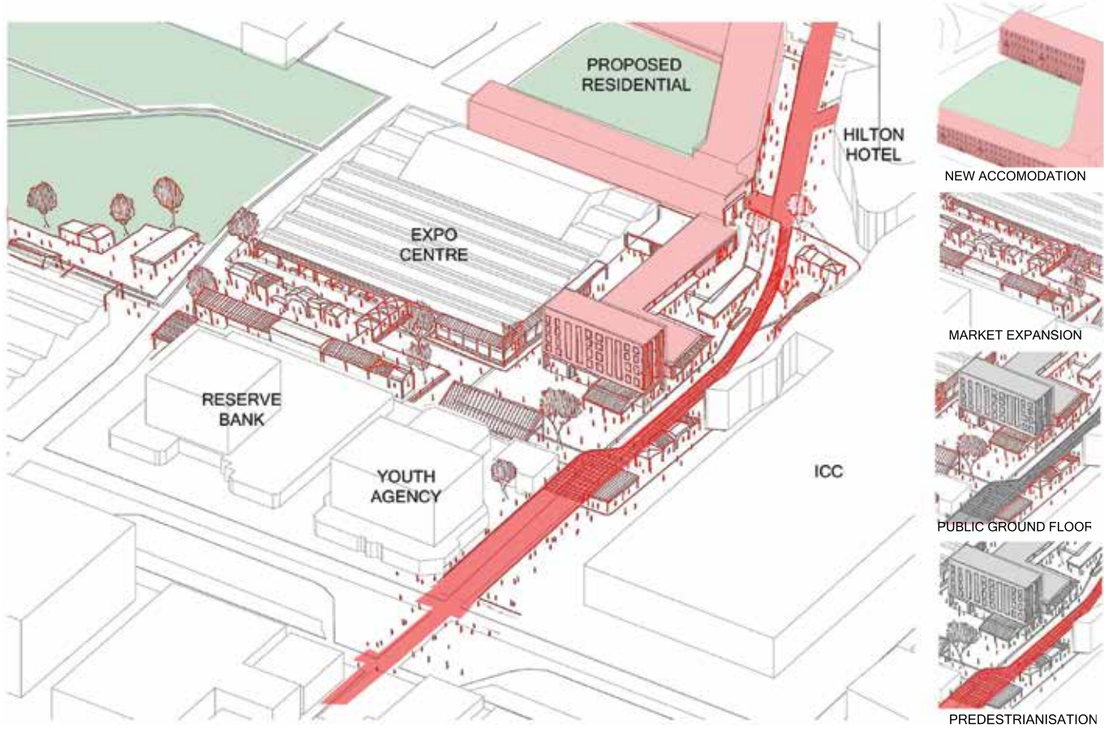


Figure 5.7 'Urban concept masterplan interventions' (Author, 2021)

6. PRECEDENTS

The chosen precedents are divided into three different categories, each responding to the concepts derived from the architectural approach principals as listed in paragraphs 5.1-5.3. Firstly paragraph 5.3 highlights the importance of spatial agency when introducing new technologies within the public realm, and how one's interaction with this technology facilitates ones understanding and education with the new subject matter. From these precedents were selected that give agency to inhabitants, particularly within market and trading spaces. These precedents provide insight into how the public utilizes the space and the materials at hand to manipulate their surroundings.

6.1 GREENMARKET SQUARE

The Warwick and Greenmarket square provide examples in which informal markets have been revitalized through the implementation of infrastructure and the subsequent entrepreneurial and economic opportunity for informal traders. The Greenmarket square, located within the inner city of Cape Town focused on the pedestrianization of the street to restore liveability and vibrancy in the city by targeting the problems caused by high vehicle congestion (Rothschild, 2016). The pedestrianization of the street acted as an economic catalyst through a publicly funded redesign of the public space which attracted private investment to the local area, improving surrounding buildings and introducing apartments which in return increased the population of the city. The project, although successful at an urban scale, marginalized informal agency by 'formalizing' the informal trading market. (Rothschild 2016). This formalization of the trading market was seen as a political alteration to the space. Rothschild (2016) states that the intervention brought about the privatization of the space, fuelling a capitalist agenda. Due to the market stalls being always present, it restricted the openness of the site and prevented alternative uses such as large gatherings and public protests.

Figure 6.1.5 'Greenmarket Square' (Rothschild, 2016)

PROJECT TITLE
Greenmarket Square

LOCATION
Capetown, South Africa

PROGRAMME
Informal market & Public Square

Figure 6.1.1 'National map' (Author, 2021)

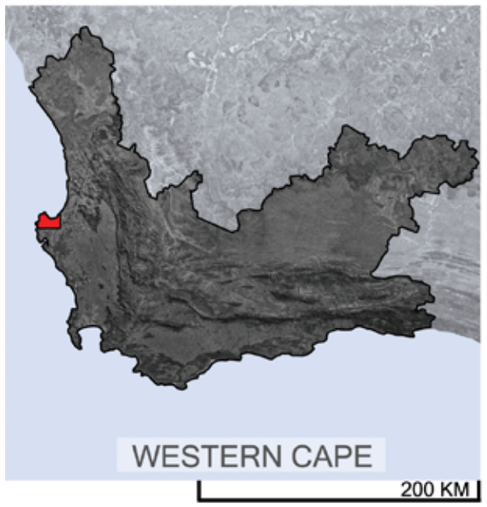


Figure 6.1.2 'Provincial map' (Author, 2021)

Figure 6.1.4 'Site plan' (Author, 2021)

Figure 6.1.3 'City map' (Author, 2021)

Figure 6.1.5 'Greenmarket Square' (Rothschild, 2016)

Figure 6.1.6 'Greenmarket Square' (Rothschild, 2016)

Figure 6.1.7 'Greenmarket Square trading stalls' (Rothschild, 2016)

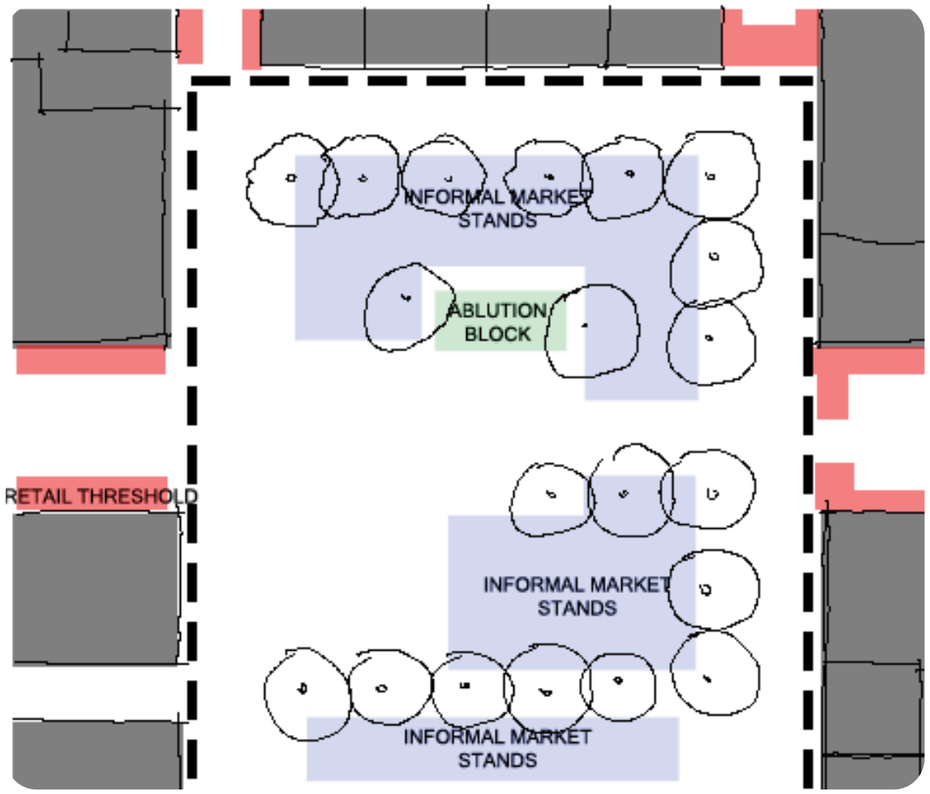


Figure 6.1.8 'Greenmarket Square Site plan' (Author, 2021)

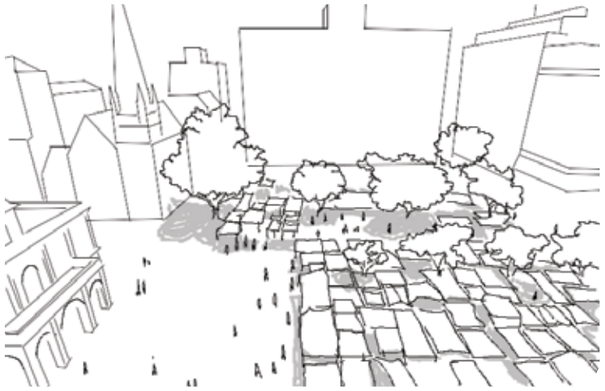


Figure 6.1.9 'Greenmarket Square overview' (Author, 2021)

Figure 6.1.10 'Greenmarket Square trading stalls' (Author, 2021)

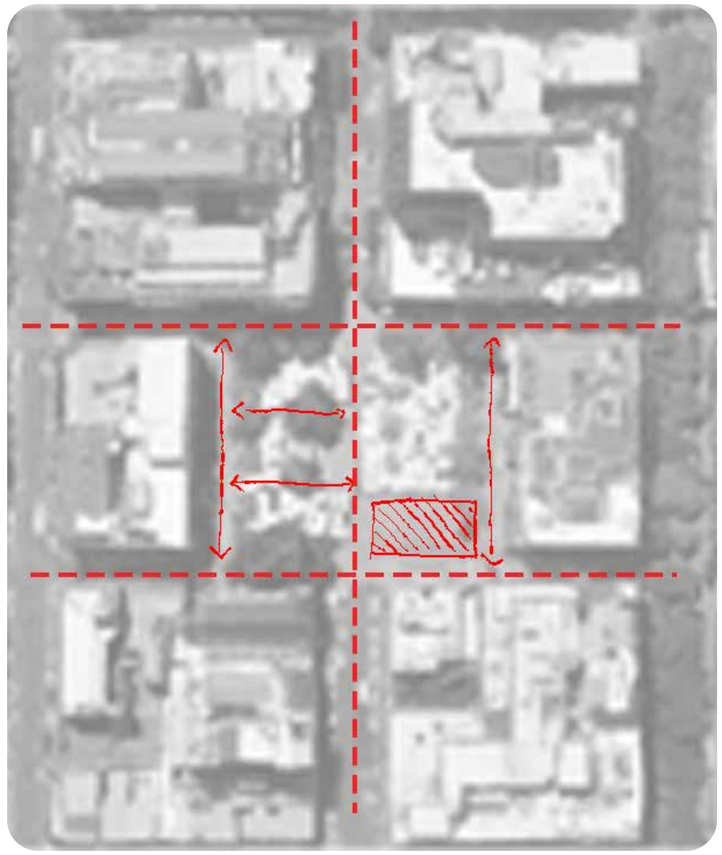


Figure 6.1.11 'Movement routes' (Author, 2021)

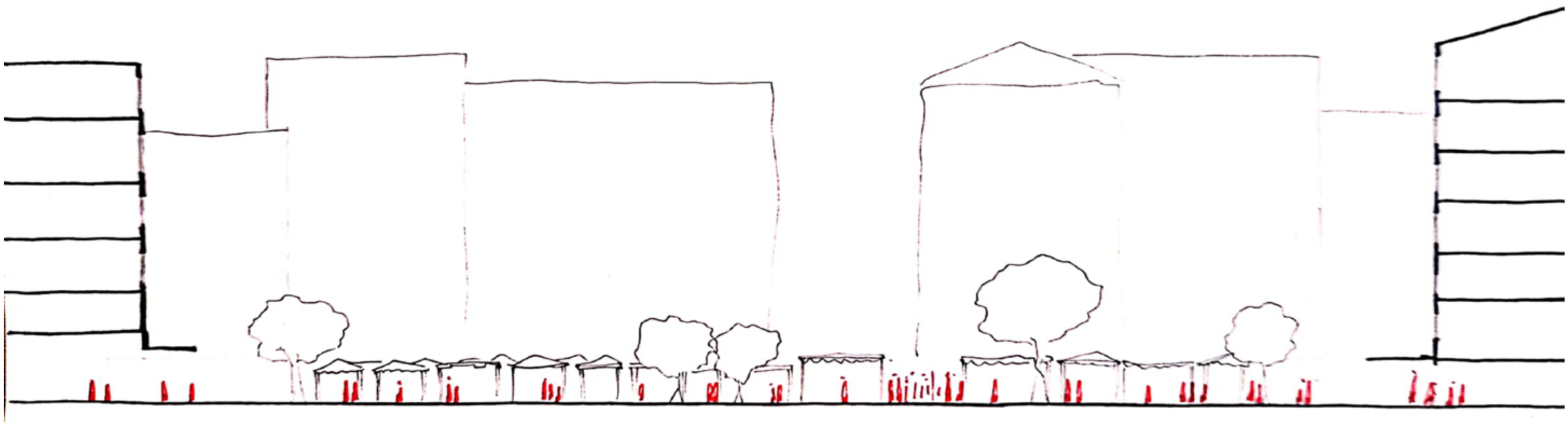


Figure 6.1.12 'Site section' (Author, 2021)

6.2 WARWICK MARKETS

the Warwick markets are comprised of seven distinct markets and a shared project centre in which different trading organization leaders consult with each other and invited local governmental officials. This is particularly important as the local community is seen as the custodians of the markets and government officials are brought in to consult and not the other way around. The facilities and infrastructure within the markets have seen renovation in the 1990's and existing structures altered to better accommodate the type of produce, food or products sold within each specific market. This is exemplified by the open fresh produce market that is accessible by trucks carrying produce directly from the farms to be sold to generally low-income traders. Carpenters within the market also sell benches and tables here to provide better facilities for stalls to traders. The early morning market has seen the most intervention and refurbishment to the existing structure. Previously a warehouse, the structure has been altered to allow better ventilation and lighting within the interior of the market. Utilizing an open floor plan, 670 stalls have been set up, each possessing provisions for security through wire enclosures that can be locked in conjunction with the market itself also being closed to alleviate the need for overnight storage. The Warwick markets, in comparison with the Greenmarket Square, is ultimately sustained through the informal trading communities and decisions are made by selected representatives on behalf of each organization. Each sector / market services the other, as fresh produce is bought by the food market, or furniture is bough from an onsite store to be used to improve stalls. Formal renovation and infrastructural improvement of the site from 1996 – 2008 were explored through "a combination of observation, snap surveys and consultation, all of which contributed to an appropriate market design." ((Dobson,et al., 2009). The allocation of sites was informed by previous relationships built through different traders. "You depended on your neighbour for survival on the streets." (Dobson, et al., 2009).

Figure 6.2.6 'Fresh market' (Dobson, 2009)

PROJECT TITLE
Warwick Markets

LOCATION
Durban, South Africa

PROGRAMME
Informal market & Taxi & Bus rank

Figure 6.2.1 'National map' (Author, 2021)

Figure 6.2.2 'Provincial map' (Author, 2021)

Figure 6.2.3 'Provincial map' (Author, 2021)

Figure 6.2.4 'Site plan' (Author, 2021)

Figure 6.2.5 'Music bridge' (Dobson, 2009)

Figure 6.2.6 'Fresh market' (Dobson, 2009)

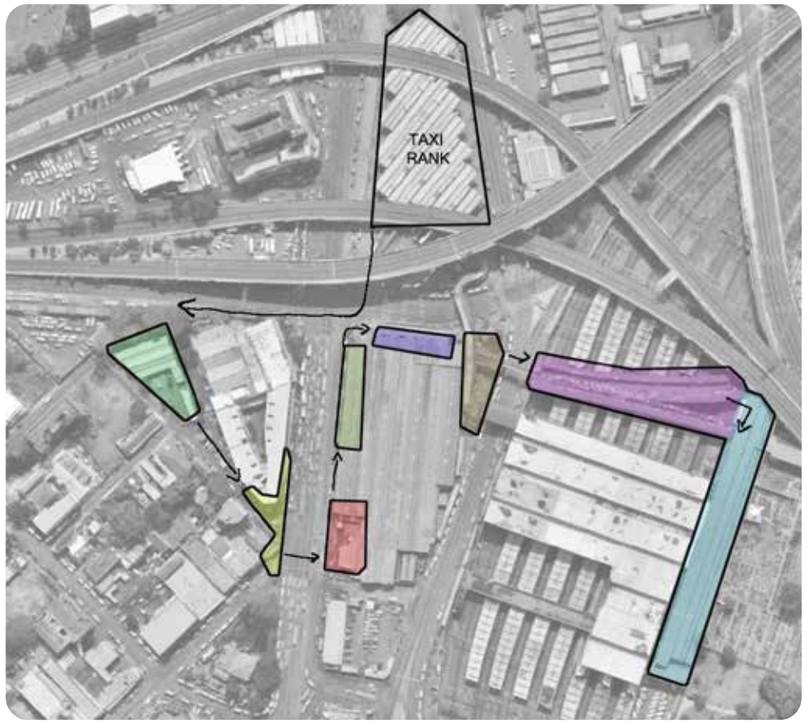


Figure 6.2.7 'The seven markets' (Author, 2021)

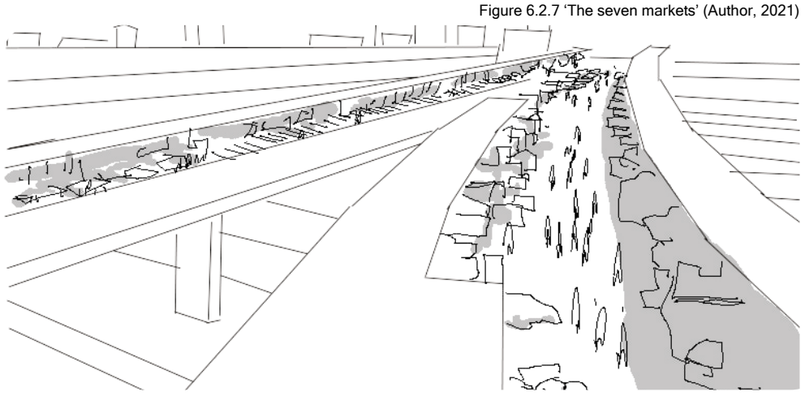


Figure 6.2.8 'Highway on ramp now used as market bridge' (Author, 2021)

Figure 6.2.9 'Music bridge' (Author, 2021)

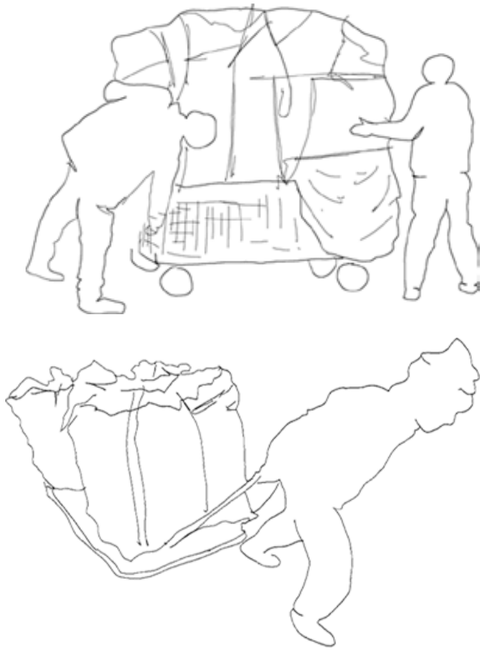


Figure 6.2.10 'Mobile vendors' (Author, 2021)

Many of the temporary stores are wares and products sold directly from trolleys and carts. Since there isnt enough on site storage, vendors have to commute daily to and from the markets and thus use their mobile carts as their stands.

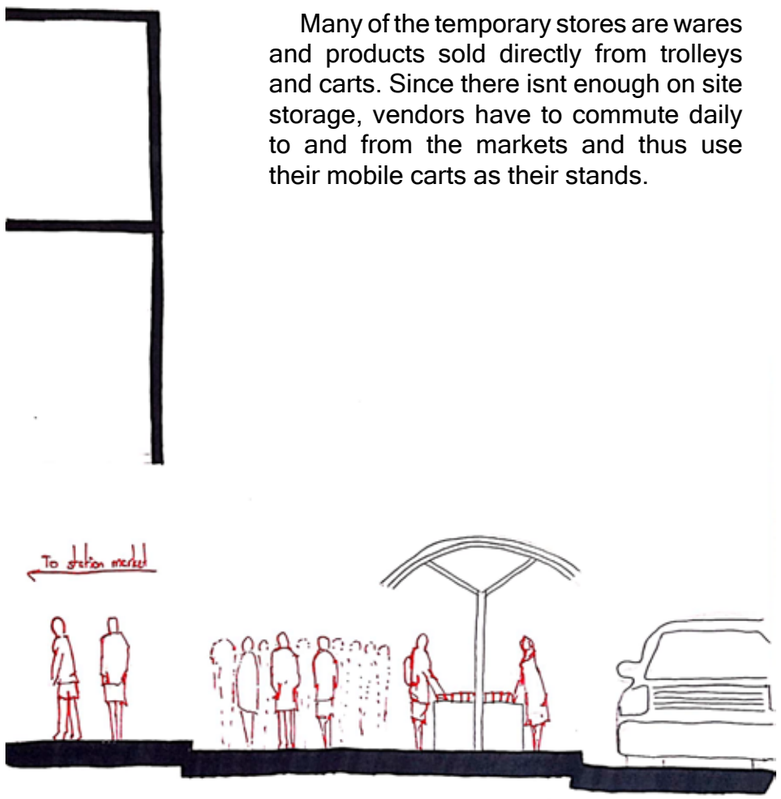


Figure 6.2.11 'Market to street section' (Author, 2021)

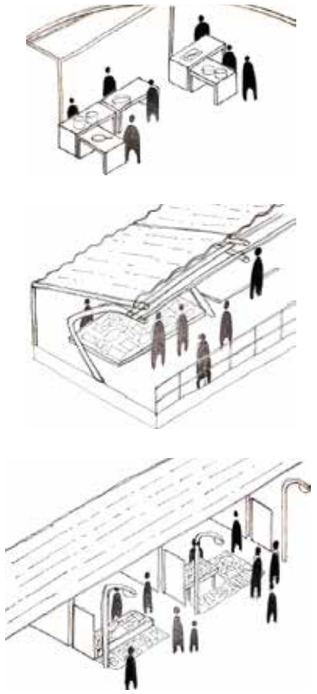


Figure 6.2.12 'Permanent vendors inhabiting infrastructure' (Author, 2021)

6.3 BRUNNER INNOVATION FACTORY

The education of the public regarding the recycling process is key in challenging existing prejudices and preconceptions against waste plastic as a construction material. Michael (2000) states that different users experience technologies in different ways. Thus, there are different proficiencies in which to introduce new technologies? Although these different levels of education are targeting specific members of the population, The Brunner innovation Factory (2018) by HENN in Germany, pays special attention to the openness and transparency of the building, within its interior and in relation to its exterior. The primary assembly plant within the central hall provides visual access that can be tracked step by step. The use of transparent glass walls and a longitudinal gallery spanning the length of the factory provides line of sight from the production facilities and the office areas on the upper floors. The roof high glazing also provides visual access to the exterior of the building, creating a direct visual relationship with potential clients, visitors, and workers within the factory itself. This glazing not only creates visual access but also provides natural daylighting within the hospitality focused spaces within the interior of the building (Pintos, 2021).

Figure 6.3.5 'North elevation' (Pintos, 2021)

PROJECT TITLE
Brunner Innovation Centre

LOCATION
Reihnau, Germany

PROGRAMME
Furniture Production Factory

ARCHITECTS
HENN

Figure 6.3.1 'National map' (Author, 2021)

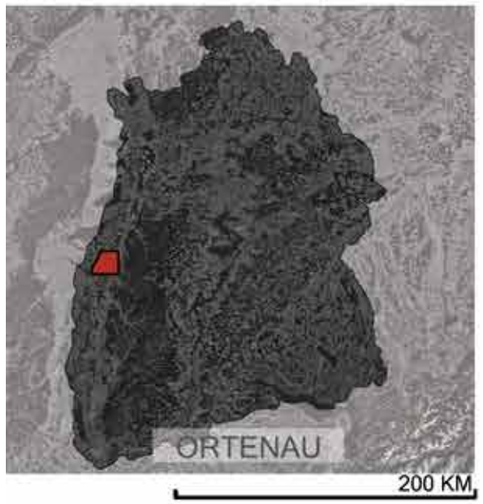


Figure 6.3.2 'Provincial map' (Author, 2021)

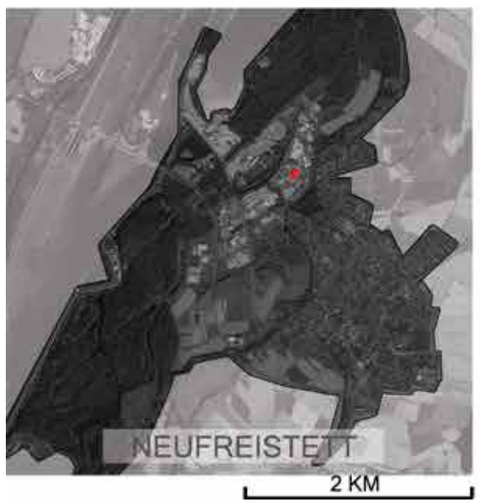


Figure 6.3.3 'Provincial map' (Author, 2021)

Figure 6.3.4 'Site plan' (Author, 2021)

Figure 6.3.5 'North elevation' (Pintos, 2021)

Figure 6.3.6 'Interior visual access' (Pintos, 2021)

Figure 6.3.7 'Workshop floor' (Pintos, 2021)

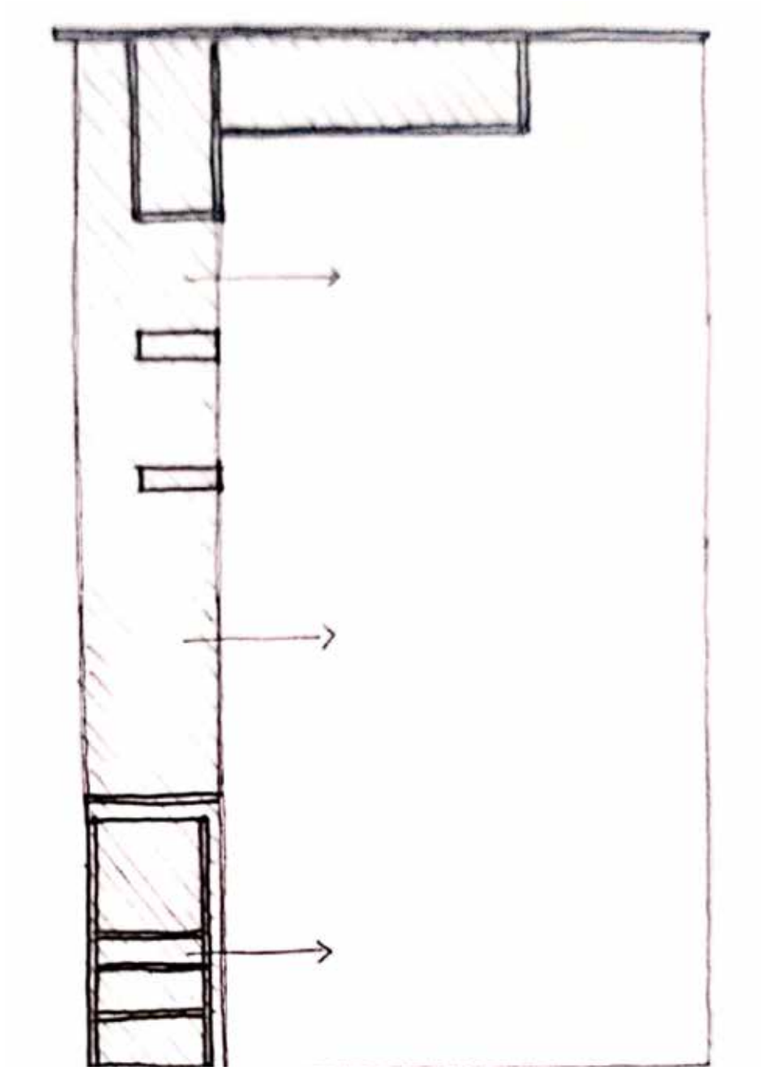


Figure 6.3.7 ‘Programme relationship’ (Author, 2021)

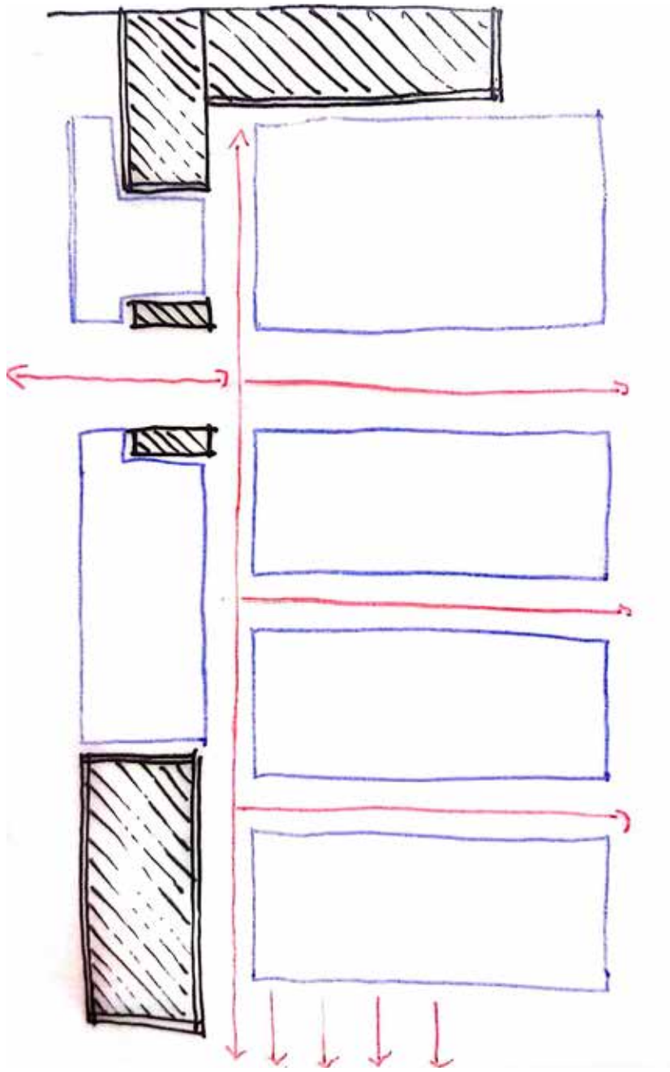


Figure 6.3.8 ‘Main movement passages’ (Author, 2021)

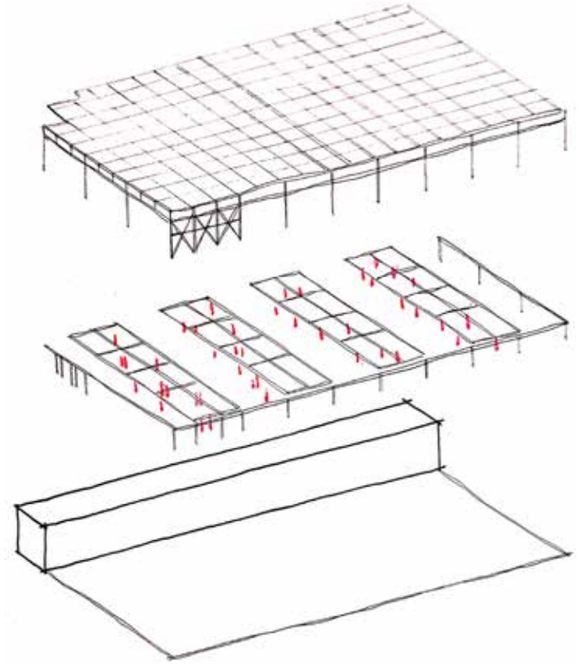


Figure 6.3.9 ‘Structural relationship’ (Author, 2021)

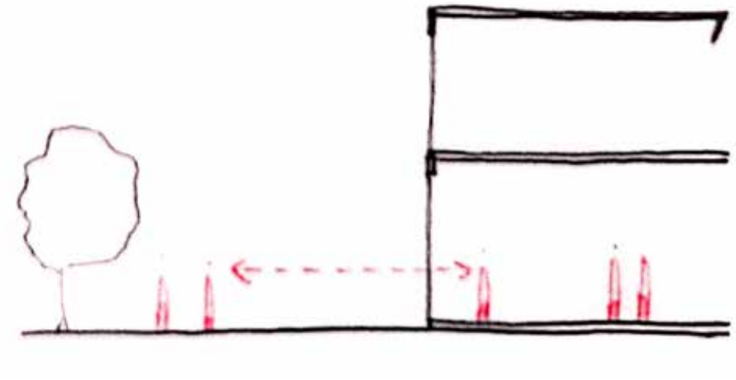


Figure 6.3.10 ‘Interior to exterior relationship’ (Author, 2021)

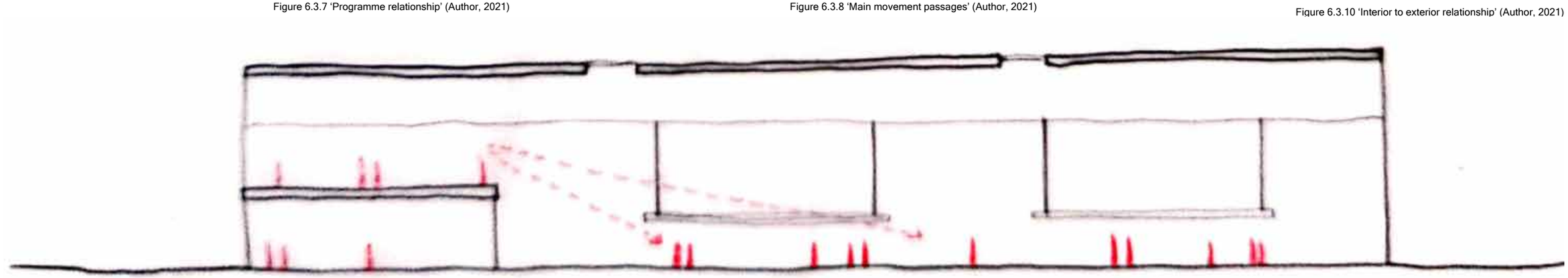


Figure 6.3.11 ‘workshop to office relationship’ (Author, 2021)

6.4 SCIENCE RESEARCH FACILITIES

According to the designers Ludwig Hansen Architects + Urban Designers, the Science Research Facilities constructed for the University of Mpumalanga Lower Campus, makes use of programme dispersion. Lecture halls, laboratories, and offices spaces, all traditionally associated with educational facility are dispersed across the site. This programmatic arrangement provides opportunity for new interstitial spaces in which new courtyards, threshold and exposed service rooms can be placed. These in-between spaces are then connected by covered walkways in which the main circulation is housed and wraps around a central courtyard. The new circulation route and the arrangement of programme, opens the interactions within each space to the public, providing visual connections for passersby to engage with the activity. The external interstitial spaces encourage people to occupy the space, lingering, and further establishing visual connections within the laboratories and lecture halls (Abdel, 2020).

Figure 6.4.5 ‘Central courtyard’ (Abdel, 2020)

PROJECT TITLE
Science Research Facilities

LOCATION
Mpumalanga, South Africa

PROGRAMME
Science Laboratory and lecture halls

ARCHITECT
Ludwig Hansen Architects + Urban Designers

Figure 6.4.1 'National map' (Author, 2021)

Figure 6.4.2 'Provincial map' (Author, 2021)

Figure 6.4.3 'Provincial map' (Author, 2021)

Figure 6.4.4 'Site plan' (Author, 2021)

Figure 6.4.5 'Central courtyard' (Abdel, 2020)

Figure 6.4.6 'Adjacent garden' (Abdel, 2020)

Figure 6.4.7 'Interior visual access' (Abdel, 2020)

Figure 6.4.8 'Central courtyard' (Abdel, 2020)

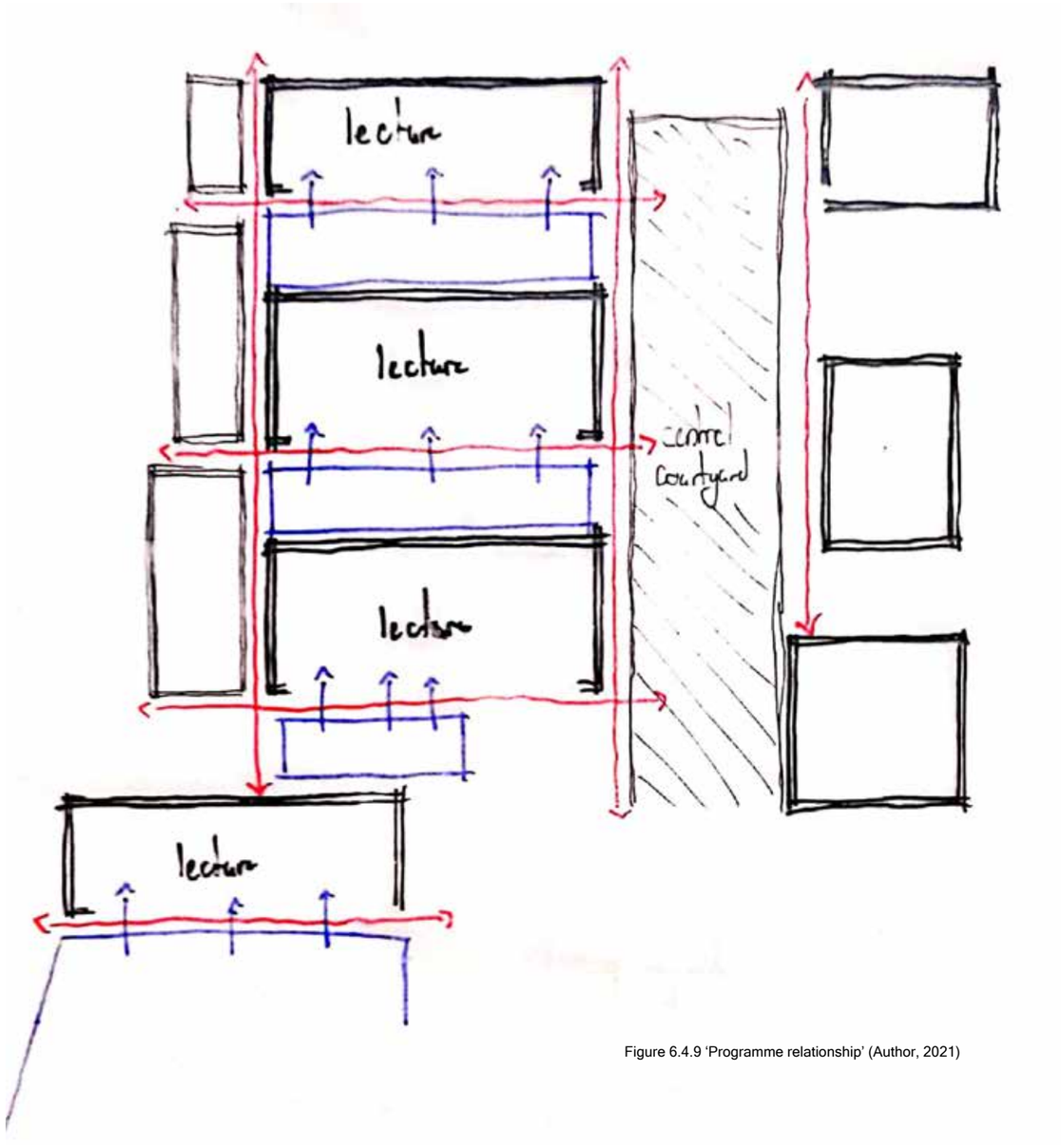


Figure 6.4.9 ‘Programme relationship’ (Author, 2021)

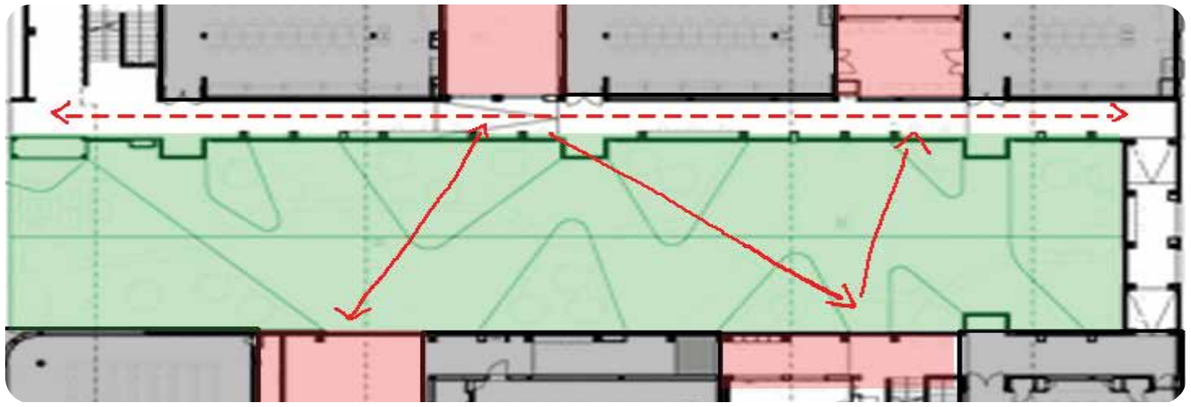


Figure 6.4.10 ‘Interior courtyard movement and gathering’ (Author, 2021)

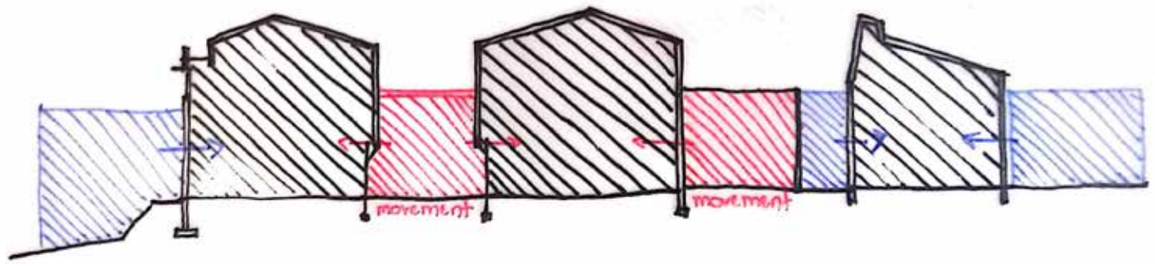


Figure 6.4.11 ‘Class to public space relationship’ (Author, 2021)

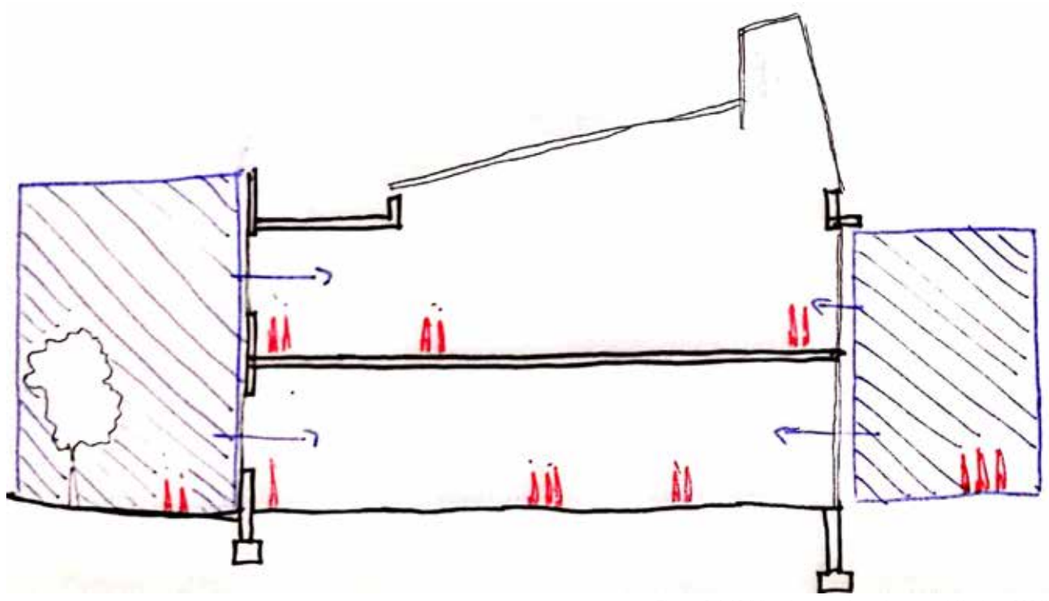


Figure 6.4.12 ‘Visual access into classroom’ (Author, 2021)

6.5 ARTISTIC MATERIALITY

These technological precedents provide insight into the use and integration of plastic as a structural component. Extrapolating from these precedents, the complexity of technology, availability of materials, and the skills required to install or construct, they provide a scale on which technology is introduced within the dissertation. The mundane technology, that is easily recognizable and replicable, to the exotic technologies that are to be taught, practiced, and ultimately tamed to form part of a new material culture that can then used as a tool of local labour.

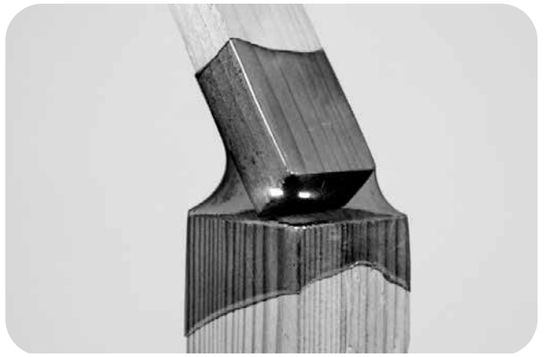


Figure 6.5.1 'Joining bottles' (Pedros, n.d.)

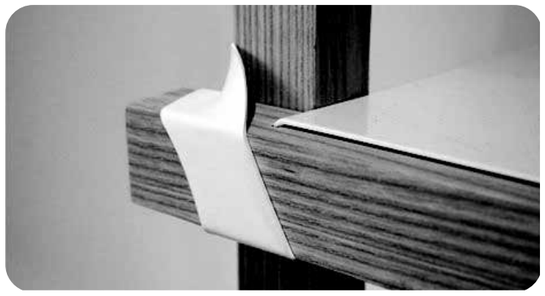


Figure 6.5.3 'Shrink wrap joinery' (Smith, 2010)

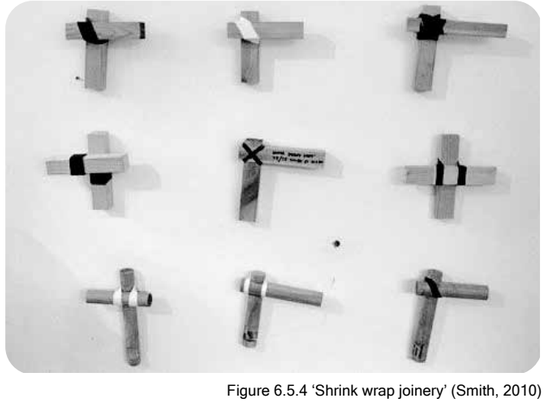


Figure 6.5.4 'Shrink wrap joinery' (Smith, 2010)

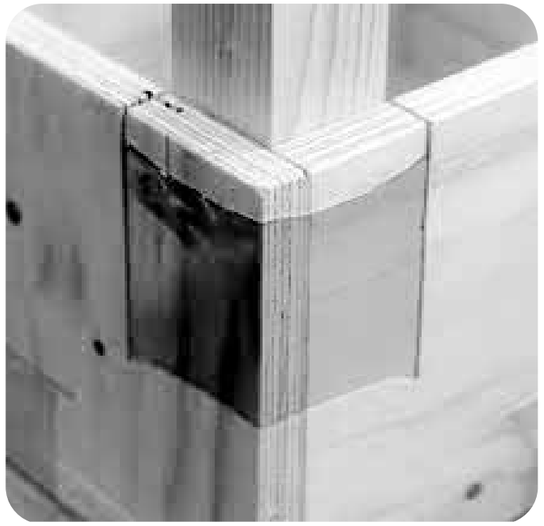


Figure 6.5.2 'Box Stool' (Pedros, n.d.)

Figure 6.5.5 'Voided slabs' (Souza, 2020)

7. DESIGN EXPLORATION

Figure 7.1 ‘Site overview’ (Author, 2021)

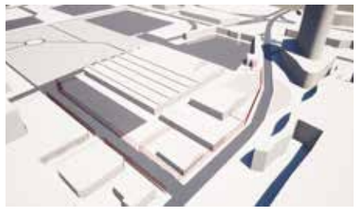


Figure 7.2 ‘Current site conditions’ (Author, 2021)

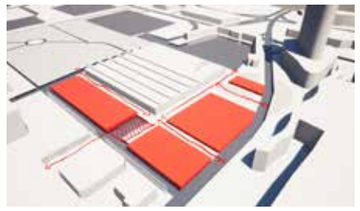


Figure 7.5 ‘Existing movement routes’ (Author,

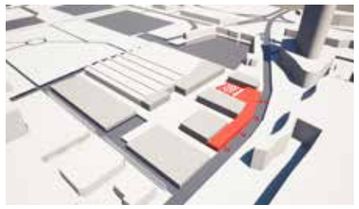


Figure 7.9 ‘Introduce street edge stores’ (Author,

Figure 7.2 ‘Existing conference sentences’ (Author,

Figure 7.6 ‘Raise developments’ (Author, 2021)

Figure 7.10 ‘Increase vertical scale’ (Author, 2021)

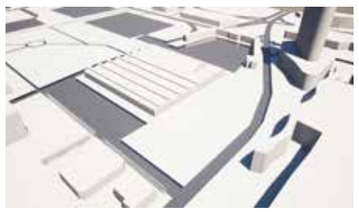


Figure 7.3 ‘Demolish conference centres’ (Author,

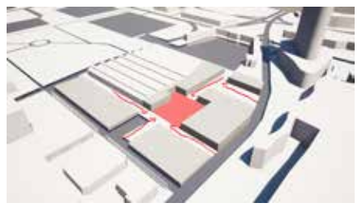


Figure 7.7 ‘Central courtyard access’ (Author, 2021)

Figure 7.11 ‘Introduce public theatre space adjacent

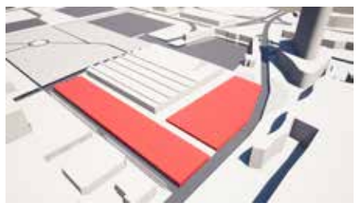


Figure 7.4 ‘Introduce new development’ (Author,

Figure 7.8 ‘Entrance from street’ (Author, 2021)

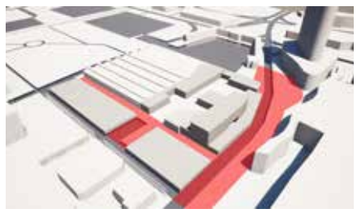


Figure 7.12 ‘Pedestrian priority at street and eye

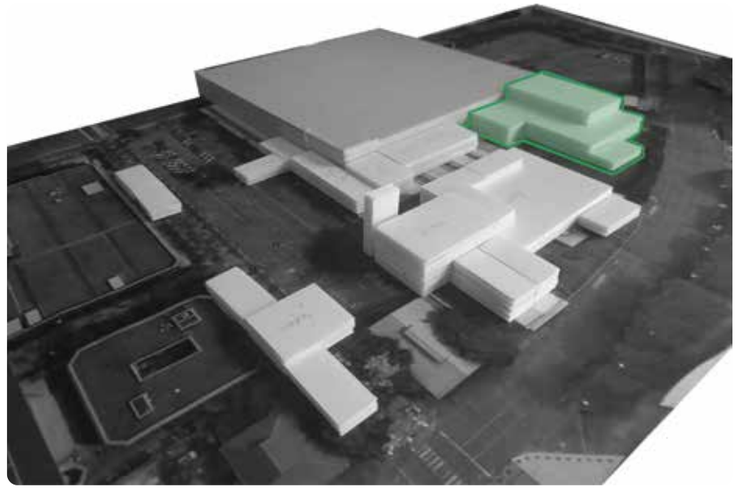


Figure 7.13 ‘Collection facility’ (Author, 2021)

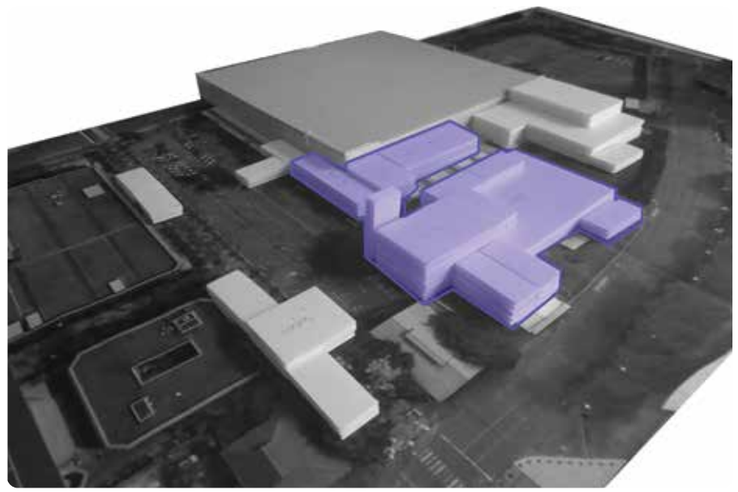


Figure 7.14 ‘Processing and education facilities’

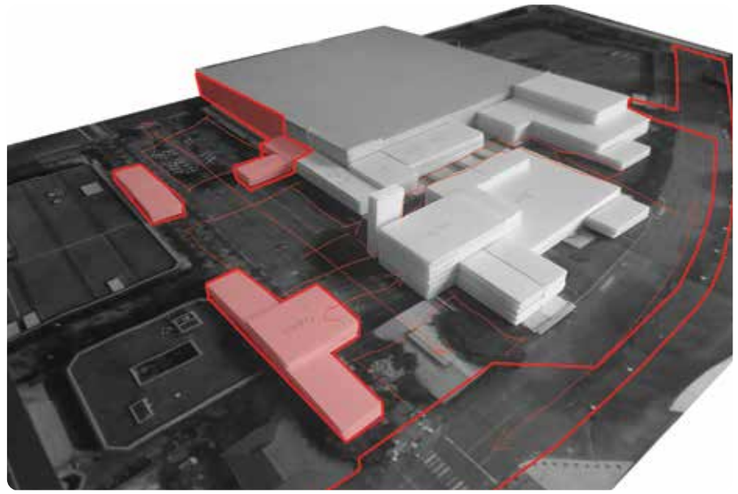
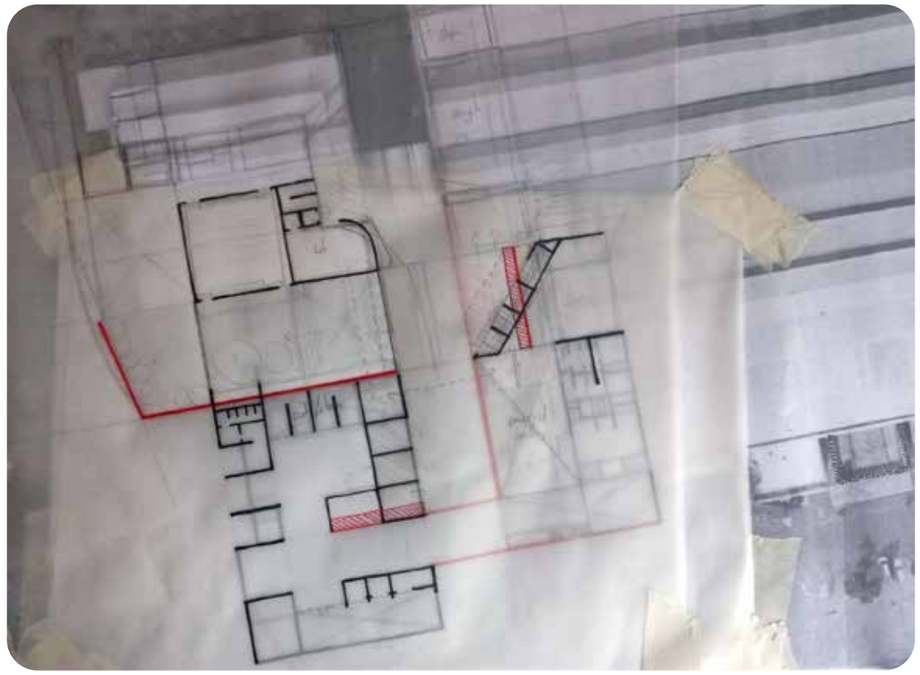
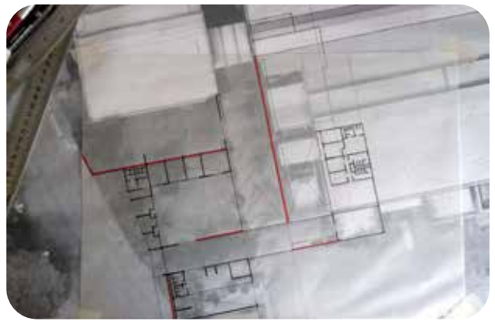
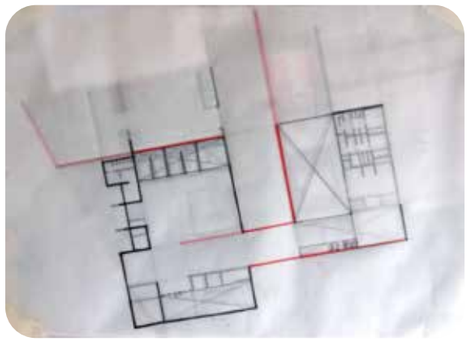


Figure 7.15 ‘public market along west-east axis’







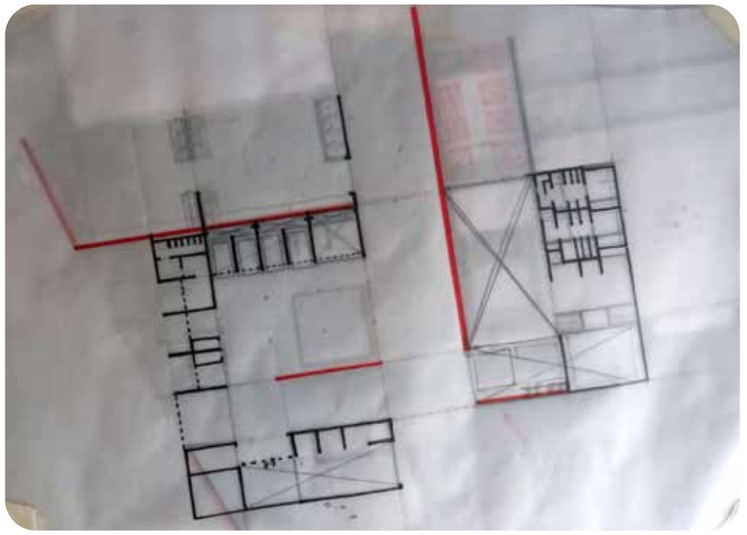
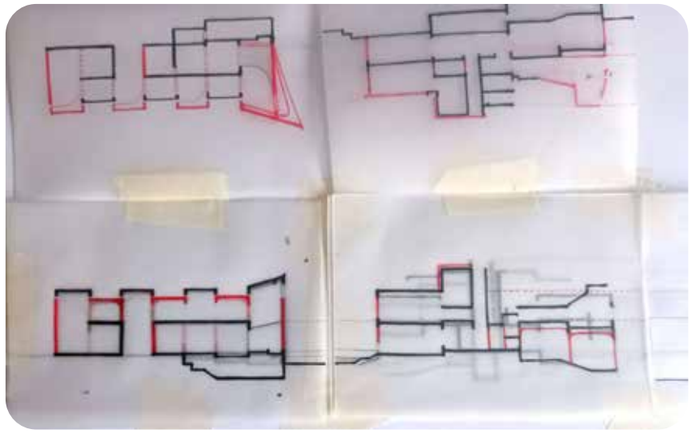
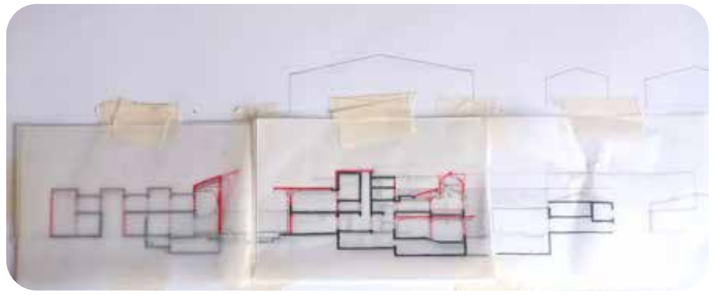
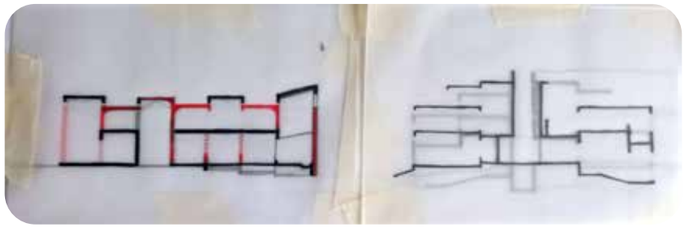
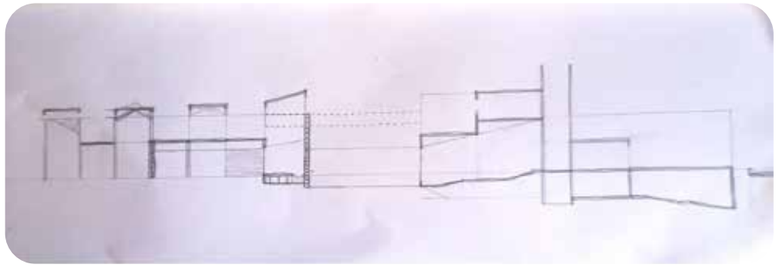


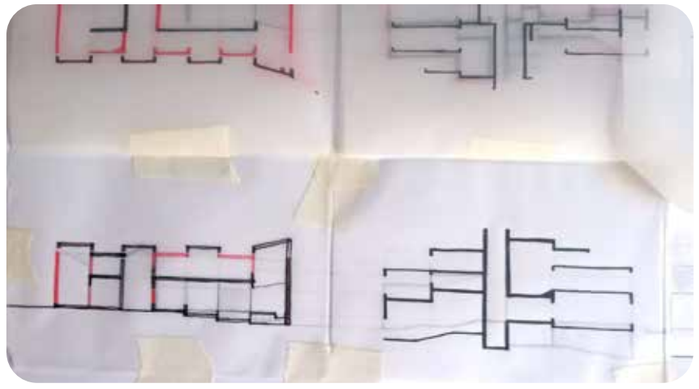
Figure 7.16 ‘Floorplan exploration’ (Author, 2021)











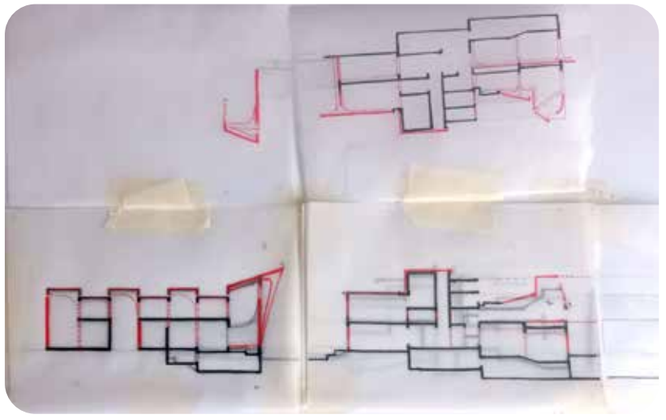


Figure 7.17 ‘Site section exploration’ (Author, 2021)

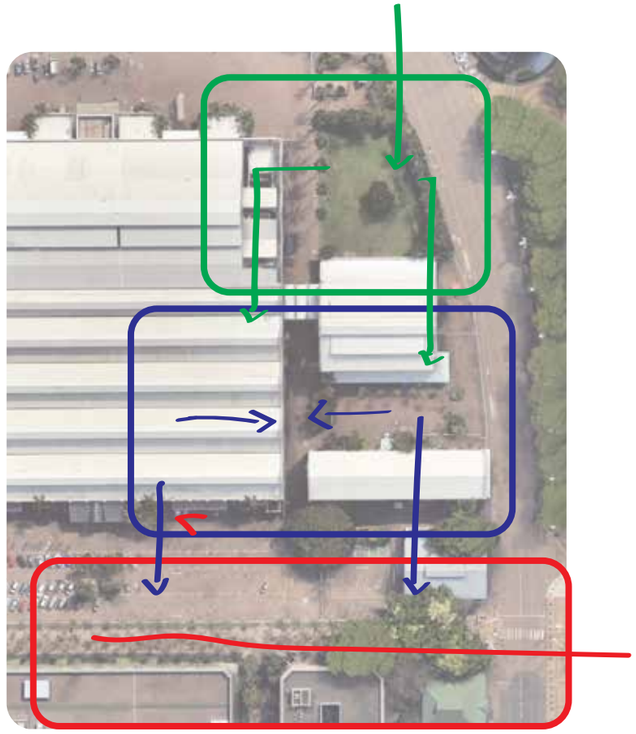


Figure 7.18 ‘programme relation’ (Author, 2021)

Figure 7.19 ‘programme plan’ (Author, 2021)

Figure 7.20 ‘programme plan’ (Author, 2021)

Figure 7.21 ‘concept activity sketches’ (Author,

Figure 7.22 ‘Relationship to existing forms’ (Author,

Figure 7.23 ‘Relationship between spaces’ (Author,

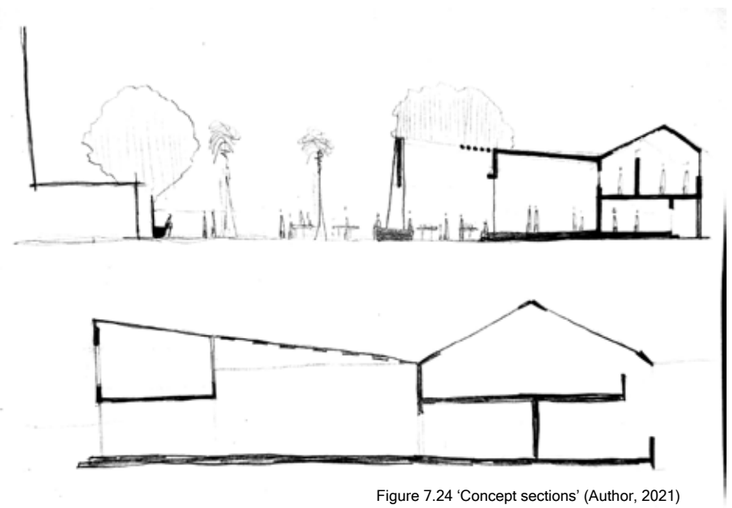


Figure 7.24 ‘Concept sections’ (Author, 2021)

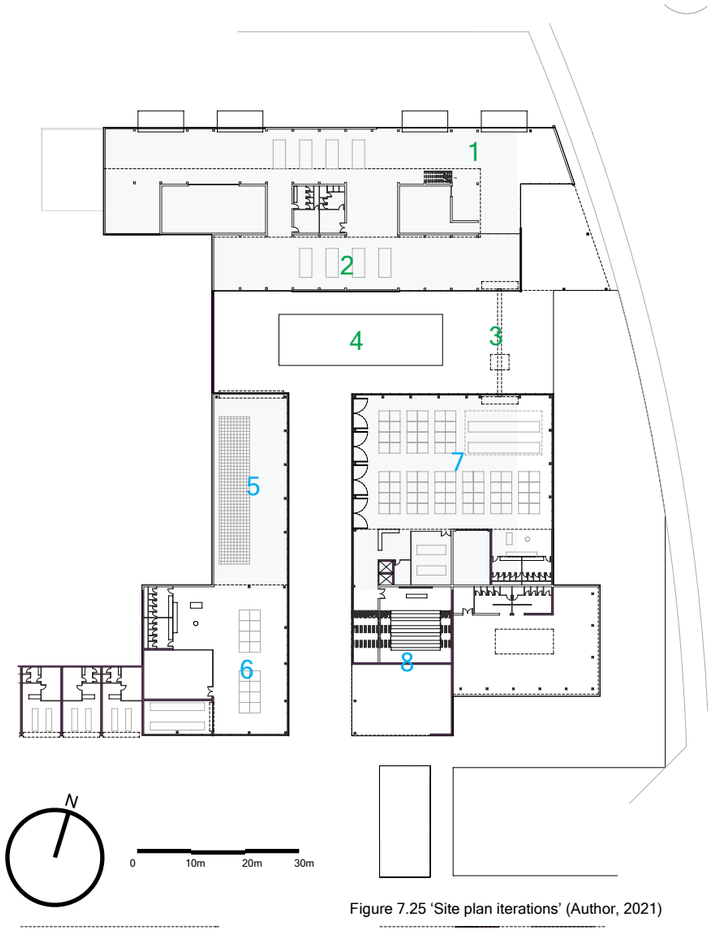


Figure 7.25 ‘Site plan iterations’ (Author, 2021)

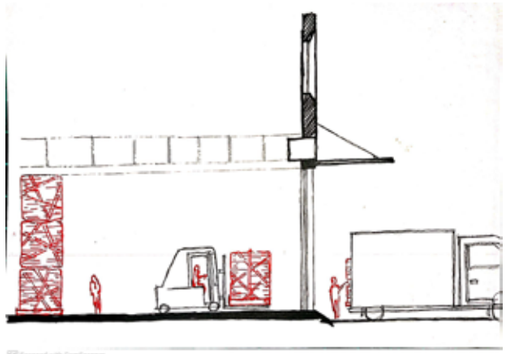


Figure 7.26 'Collection facility sketch' (Author,

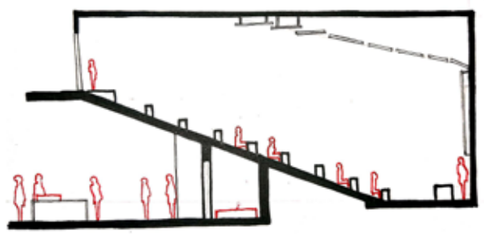


Figure 7.27 'Lecture hall sketch' (Author, 2021)

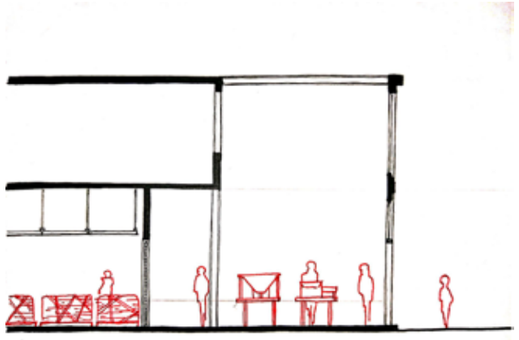


Figure 7.28 'informal recycling sketch' (Author,

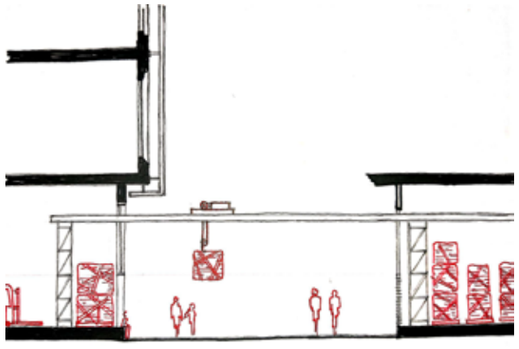


Figure 7.29 'on-site transportation and storage

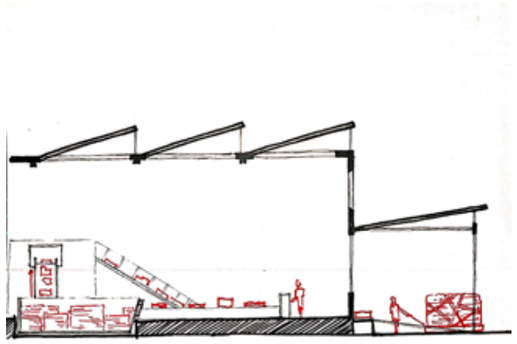


Figure 7.30 'processing facility sketch' (Author,

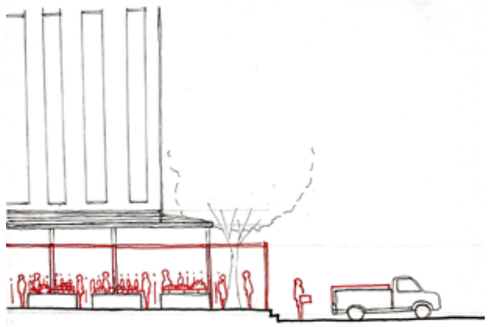


Figure 7.31 'fresh produce drop off sketch' (Author,

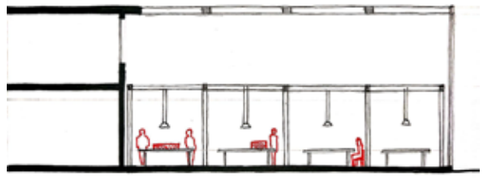


Figure 7.32 'laboratory sketch' (Author, 2021)

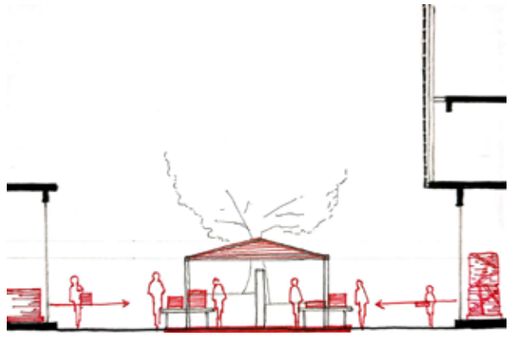


Figure 7.33 'workshop to trading sketch' (Author,

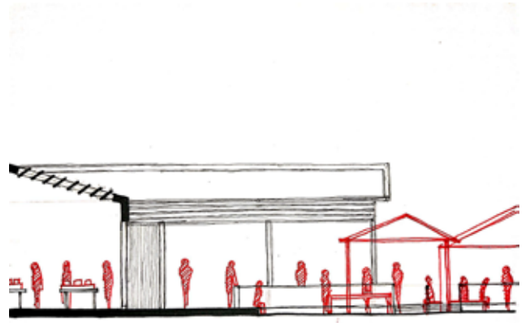


Figure 7.34 'permanent market sketch' (Author,

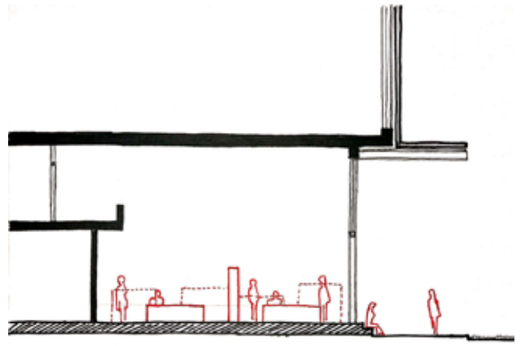


Figure 7.35 'workshop and makerspace sketch'

Figure 7.35 'temporary markets sketch' (Author,

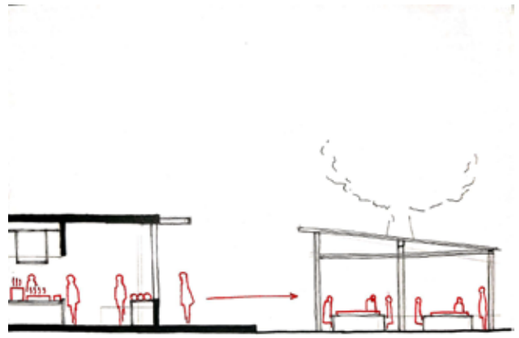


Figure 7.35 'food market sketch' (Author, 2021)

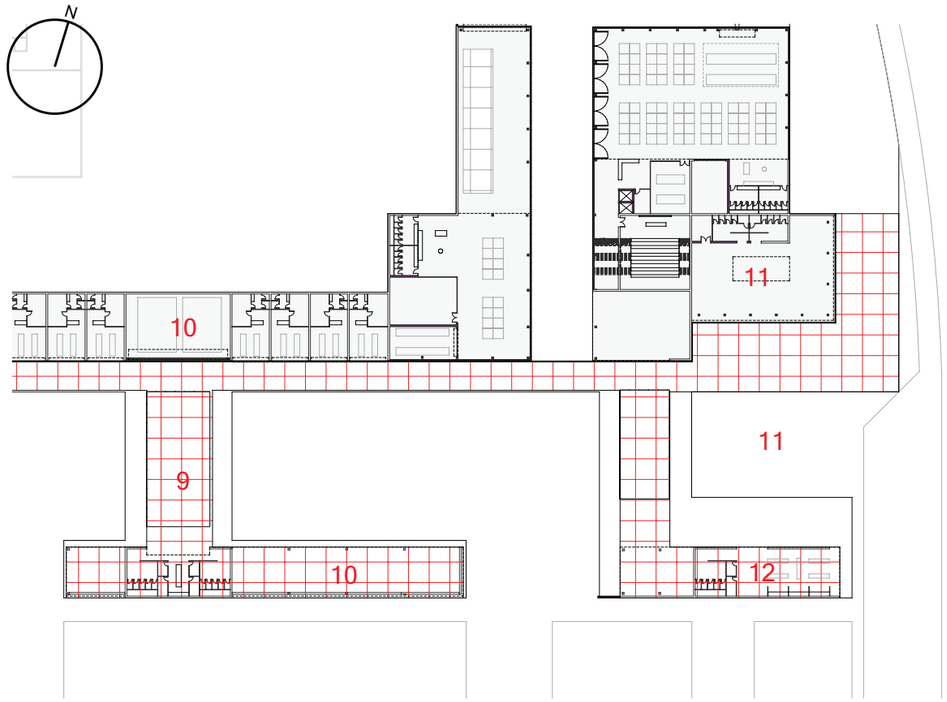


Figure 7.36 'Floor plan iterations' (Author, 2021)

Figure 7.37 'site elevation sketch' (Author, 2021)

Figure 7.38 'Site section sketch' (Author, 2021)

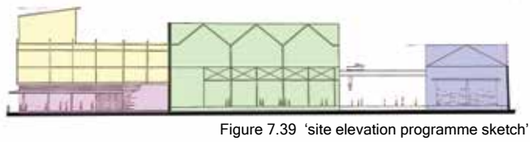


Figure 7.39 'site elevation programme sketch'

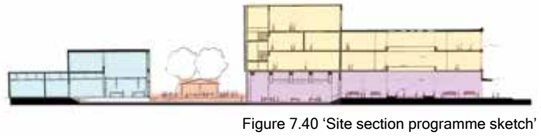
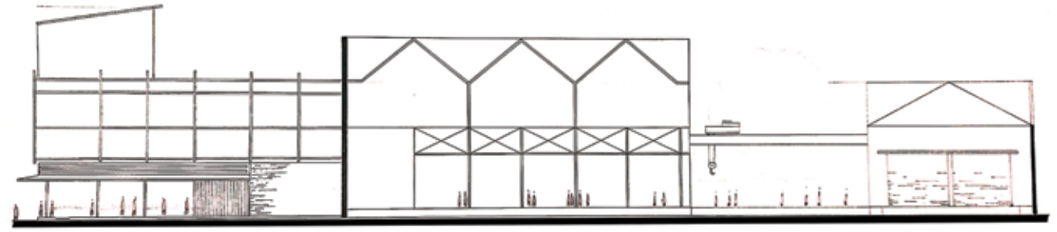


Figure 7.40 'Site section programme sketch'



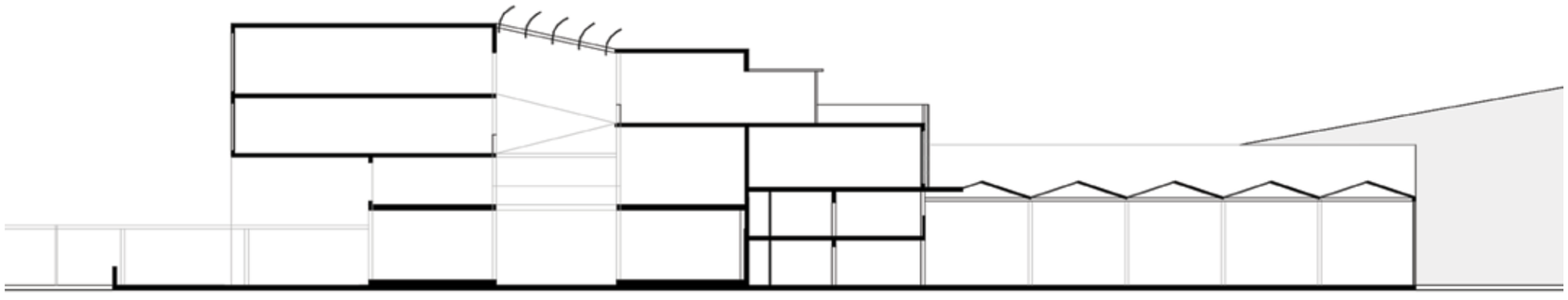


Figure 7.41 'Cross section iteration' (Author, 2021)

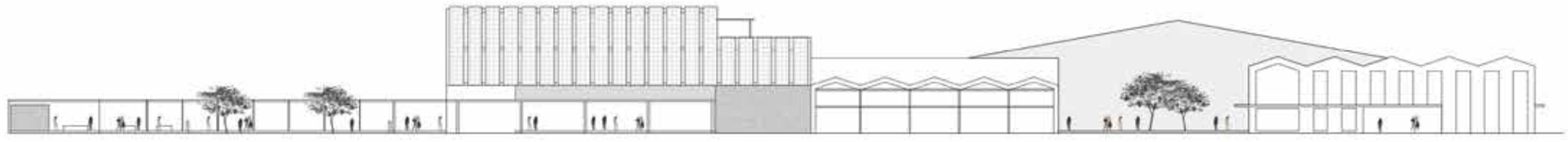


Figure 7.42 'Site Elevation iteration' (Author, 2021)

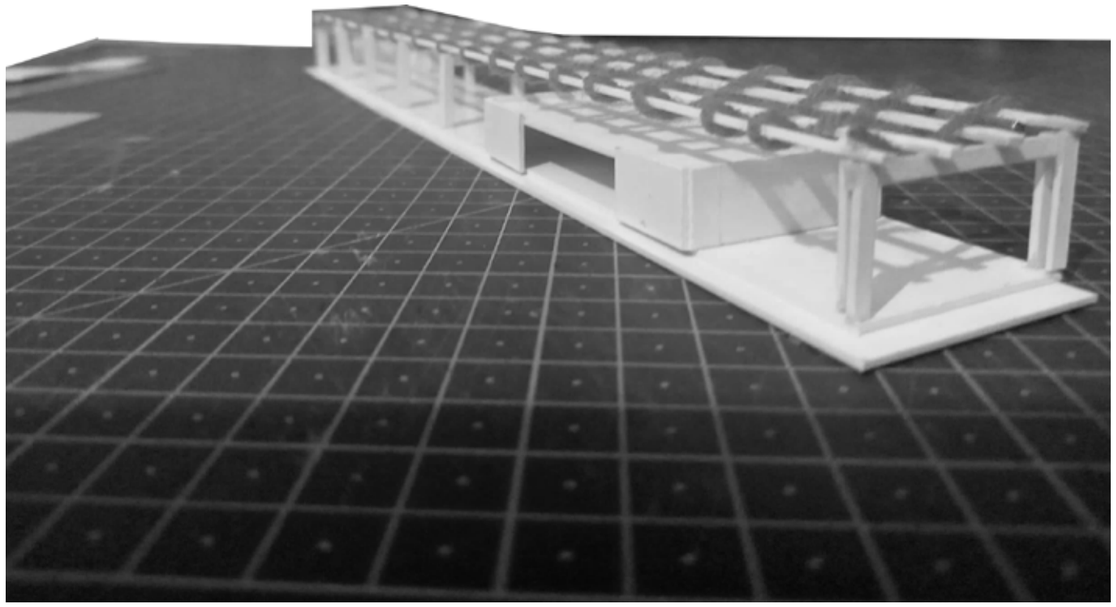


Figure 7.43 'Market typology maquette' (Author,

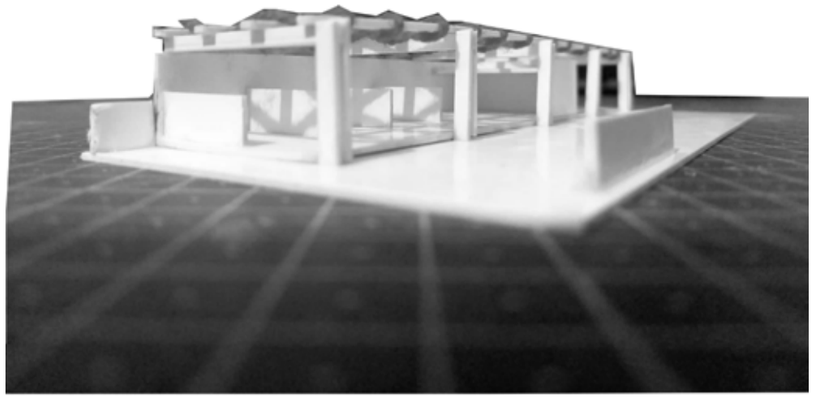


Figure 7.44 'Market typology maquette' (Author,

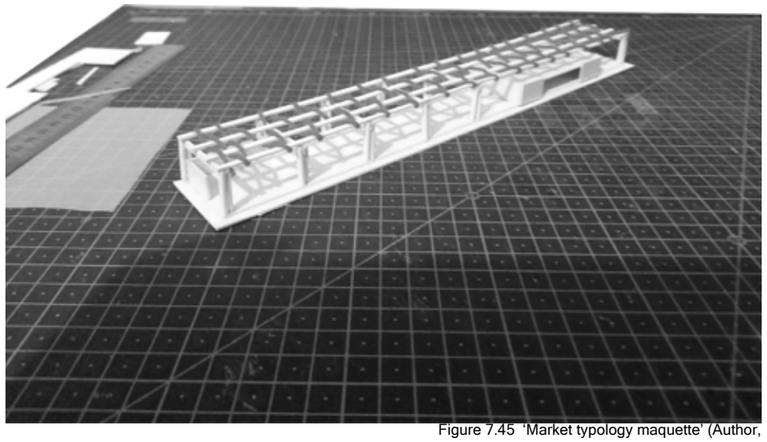


Figure 7.45 'Market typology maquette' (Author,

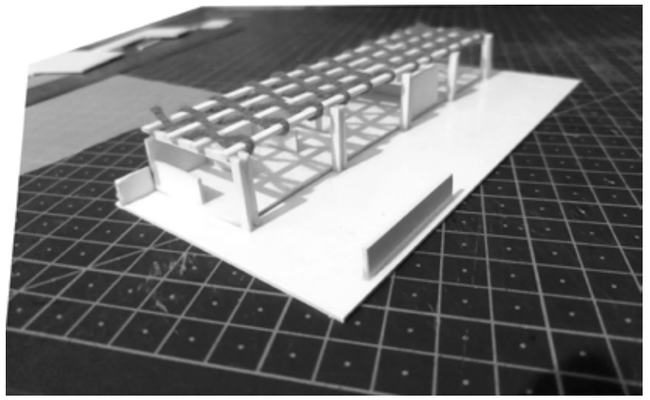


Figure 7.46 'Market typology maquette' (Author,

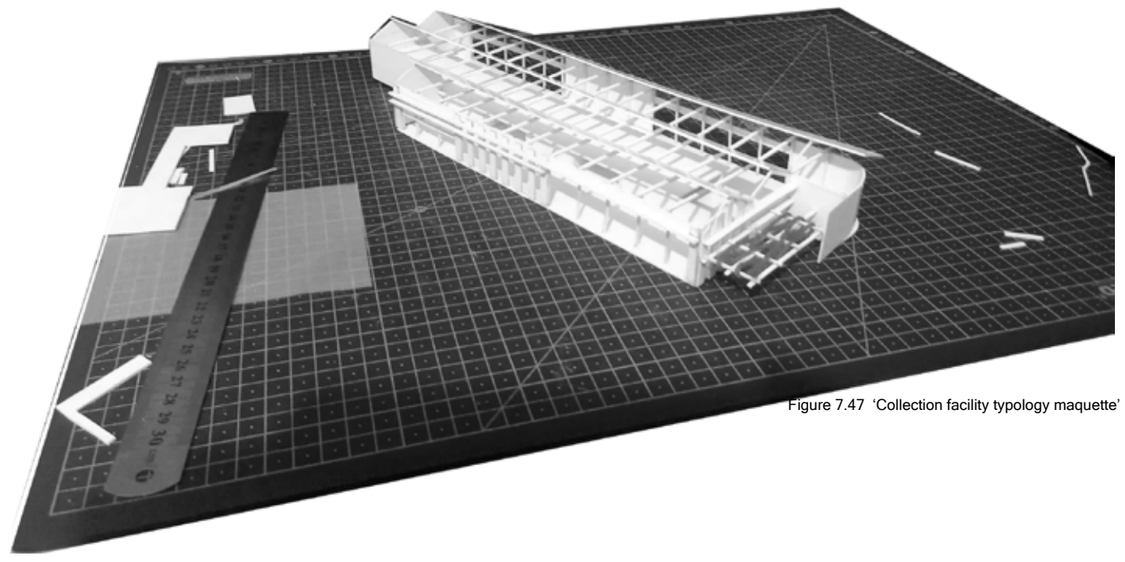


Figure 7.47 'Collection facility typology maquette'

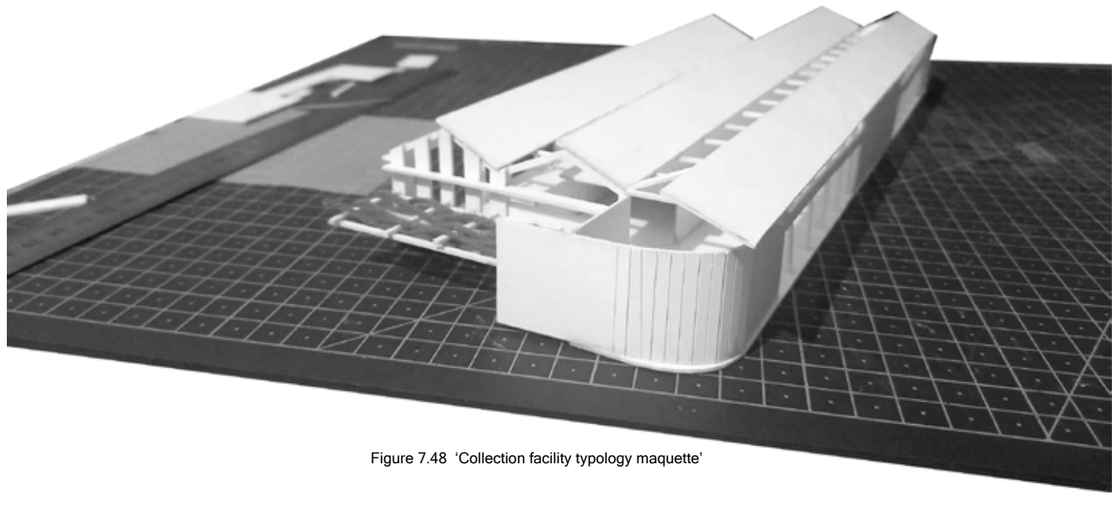


Figure 7.48 'Collection facility typology maquette'

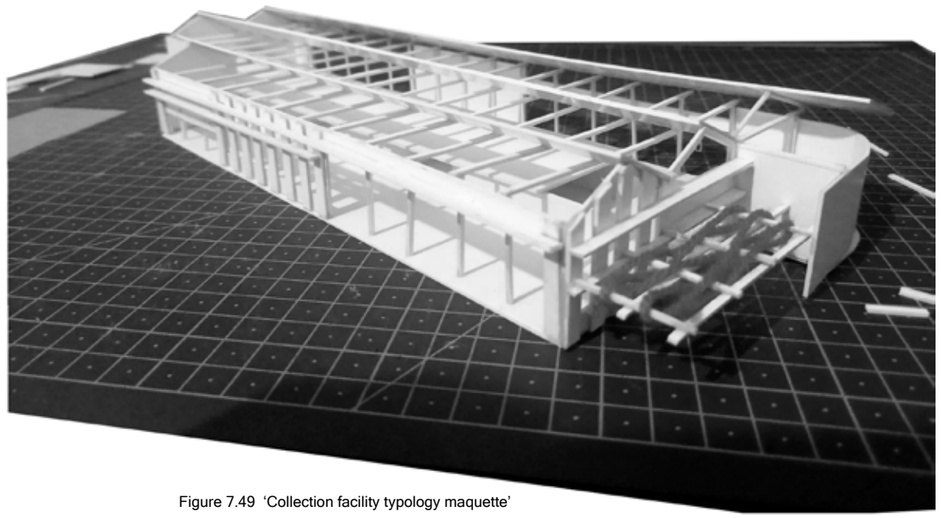


Figure 7.49 ‘Collection facility typology maquette’

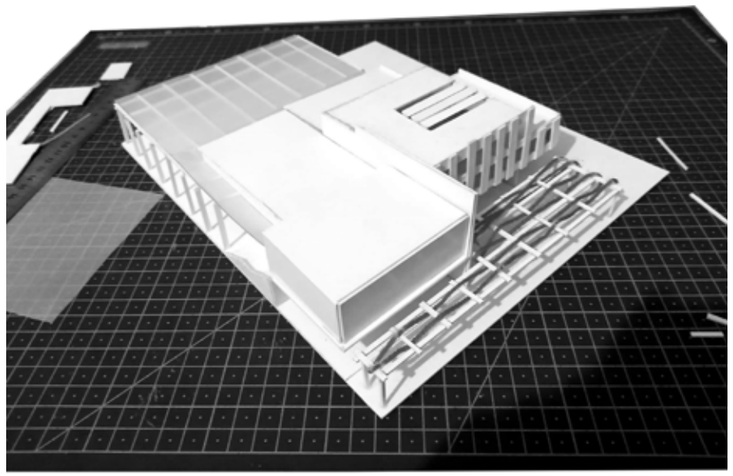


Figure 7.50 ‘Education facility typology maquette’

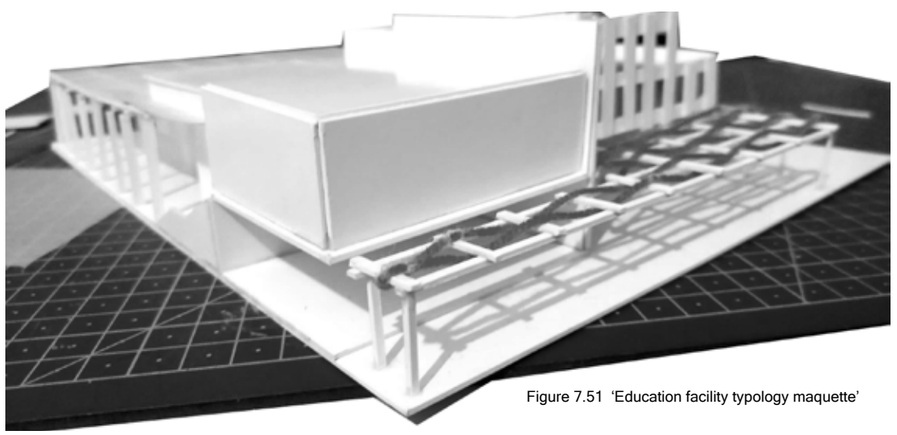


Figure 7.51 ‘Education facility typology maquette’

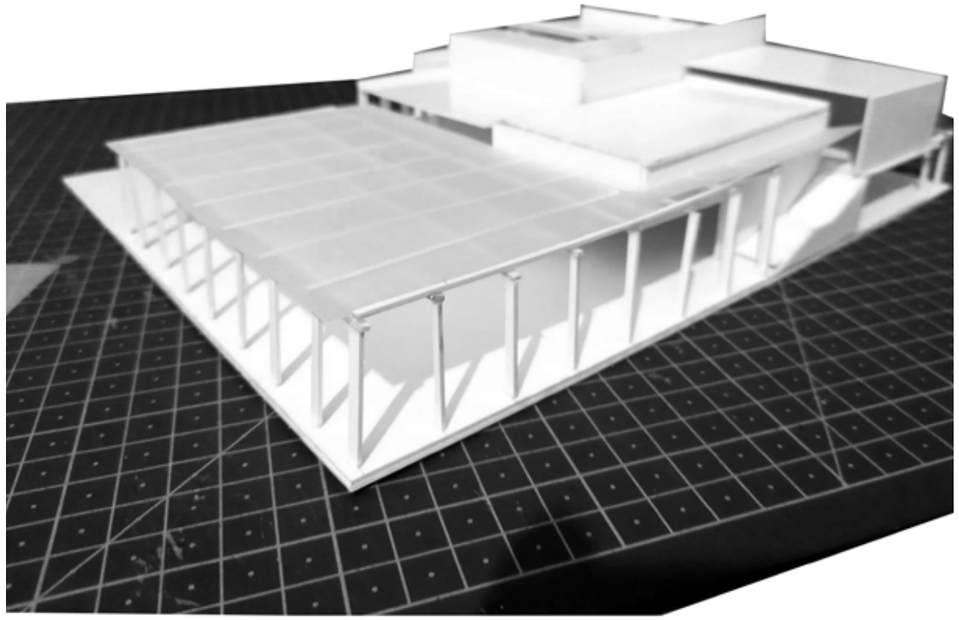


Figure 7.52 ‘Education facility typology maquette’

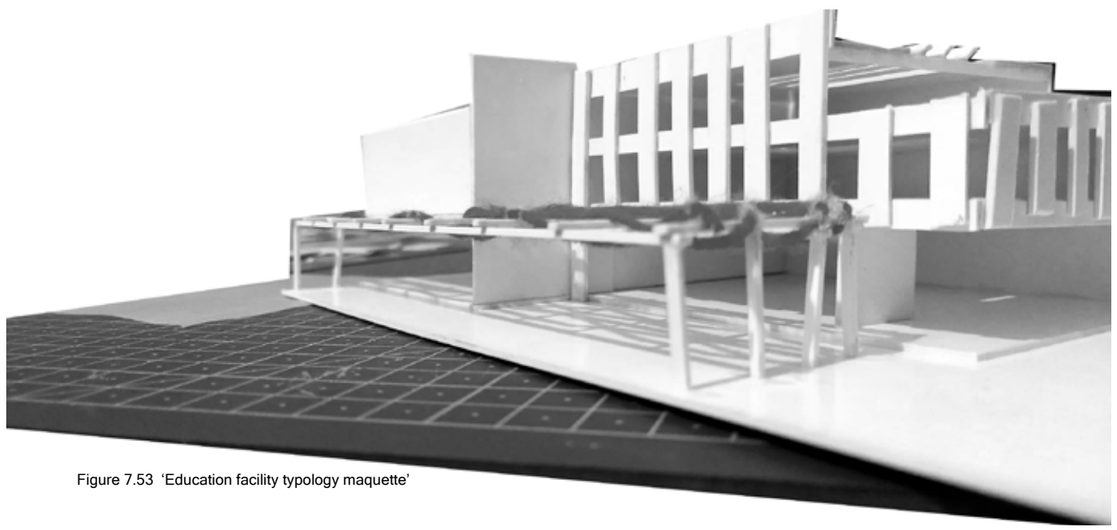


Figure 7.53 ‘Education facility typology maquette’

7.1 DESIGN CRITIQUE

Due to the nature of the dissertation and its response to informality, there remains a consequence of ‘formalizing’ the informal, comparable to the effects of the Greenmarket Square intervention. The Warwick markets, however, have successfully navigated the infrastructural development of informal activity. As outlined by Dobson et al. (2016) this is primarily down to public participation within the overall development and utilization of existing social structures within an open framework in which expansion and habitation can occur naturally. The public interface with the street and the proposed food market expansion should act as a catalyst, encouraging informal habitation through public access and facilities.

By extrapolating the four sites of spatial agency as outlines by Awan, et al. (2011) to the street and markets proposed, a set of criteria can be alluded to in defining a successful process in which spatial agency can be achieved. Although these four sites are largely artificial, Awan, et al. (2011:65) states, “what they together point to is not just the possibility, but the real necessity of seeing that architecture can be played out through a multiplicity of settings.” The small vertical scale of the site, in contrast to the high-rise Hotel, reserve bank and youth development agency require grounding to reduce the transition of scale, and to orientate the site and the users on the ground plane. Through mapping potential social structures that can be found in Warwick and the previous Food market, spatial structure can be overlayed onto the site.

The intervention is aligned to interface with the market square to the south and the street to the east, thus these are the primary facades for interaction. Drawing from this, site services and lower hierarchal programmes are to be positioned to the northwest of the site. These programmes include the sorting and collection facilities, recycling storage and drop off points to service fresh produce to the markets along Samora Machel street. Although the dissertation focuses on the southern half of the block, the northern half still features the proposed mixed accommodation. Still facing east, opening up to Walnut Street, the interior of this block acts as a more private courtyard to residents.

8. TECHNOLOGY

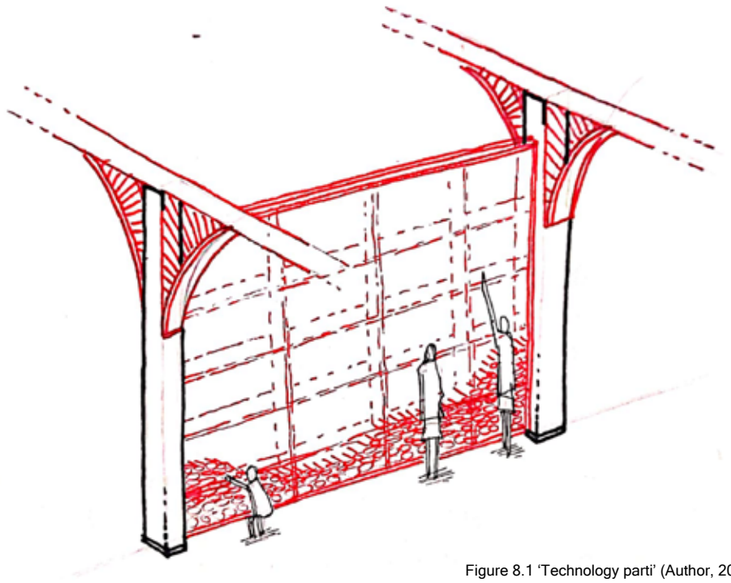


Figure 8.1 'Technology parti' (Author, 2021)

8.1 CONCEPTUAL TECHNOLOGY

The design has subsequently resulted in permanent service blocks that facilitate the education-based programmes within the public interior of the site. These service blocks are semi-public, with direct access intended for workers or users of the space, and visual access granted to the public. Most of the activity, however, would be accommodated within the interior of the site, with a completely public ground floor that facilitates an educational and workshop focused programme. This space features temporary structural elements that facilitate disassembly, expansion, or replacement. This spatial agency is responsive to the collective knowledge gains through public participation with the subject matter and allows for flexibility of space to accommodate different activities. This temporality challenges the sporadic street life of Walnut Street, a consequence of the event-controlled Durban ICC and Expo centre. The ground floor can be opened to the public when not in use allowing for a range of activity and public performance or gathering space. The technological concept of the dissertation is derived from temporary lightweight structures that are serviced by a central core. The temporality of lightweight plastic structures provide the opportunity for dismantling, expansion, and replacement. This structural evolution is directly responsive to the evolution of the programme and the knowledge gained and shared by users on the site. The limitation of plastic intake creates challenges in research and exploration and is intended to develop the efficient use of plastic as a construction material. The intention is to create spaces that facilitate different levels of knowledge, be it high or low-tech construction methods, and have them relate to each other. As knowledge and technology evolves, spaces are altered, expanded, or completely replaced, whilst still celebrating different knowledge systems

8.2 AN INTRODUCTION TO TECHNOLOGY

The exploration and interrogation of plastic as a construction material has evolved the dissertation into the realm of making and pedagogy. The synthesis of the design and the conceptual intention of technology and structure relates to these themes and ultimately should form part of an intrinsic whole with the plastic-centred programme proposed. The pedagogy of the programme reflects the interpretively flexible nature of technology as perceived by its user as Michaels (2000: 11) mentions. As one gains knowledge through the progression of the syllabus, so does one's interpretation of the technology presented around them evolve. this notion, however, raises questions about the relationship of space and user – how does the space evolve as the user evolves? To answer this question, we must discern between different types of knowledge. Smith (2013: 3) states that there exists segregation within labour skills or knowledge within material-based discourses within architecture. Smith mentions that this segregation can be categorized between 'intellectual' and 'manual' labour, referencing the Edward Robbins theory that advancements in architectural drawing techniques during the Middle Ages as "largely responsible for the social division of labour within architecture" (2013: 4). This division of labour skills poses a problem within the innovation of plastic-based materials. The extent at which intellectual and research-based knowledge progresses causes the manual labour force to fall behind, and as such new and exotic technologies are perceived as alien and cannot be tamed by unskilled labourers. Smith states that although the historical repercussions of the industrial revolution have been extensively debated, It is important to note that there is little discussion about how digital production methodologies might challenge or disrupt habitual assumptions about interrelations between design, fabrication processes and the organisation of labour" (2013: 2).

8.3 TAMING TECHNOLOGY

Although this technological disconnect possibly exists, Michaels (2000) explains that it is within these exotic technologies that cultural, paradigm and epochal changes exist. This, according to Michaels is because "they are the objects of extended academic and popular reflection." (2000: 10). The recourse to this the division is the bridging of this gap by 'taming' exotic technologies and making them become 'mundane' technologies. This can be achieved through examining Michaels' definition of the mundane being technologies that have "lost their novelty and now linger in the background, doing their 'job' largely outside the intense discursive glare that attempts to capture the exotic" (2000: 10). These mundane technologies constitute normality, and within the dissertation, this normality is achieved through interaction and manipulation with the subject matter (plastic-based materials).

8.4 FROM PROGRAMME TO PLASTIC

8.4.1 COLLECTION & SORTING

The collection and sorting facilities are intended to provide permanent facilities for informal waste collectors to sort, weigh and sell their loads. This facility also provides hygiene services for cleaning and temporary storage. The collection of waste material is 100% outsourced to informal and small-scale collectors to limit the intake of waste to about 2 tonnes a week. This weight restriction introduces challenges within the development and research fields on site, thus encourages innovative and efficient use of plastic in terms of weight to strength ratios. The sorting facilities also allow for informal collectors to be involved in the sorting of material to be recycled, thus allowing for increased financial incentive and the opportunity to be further involved within the process.

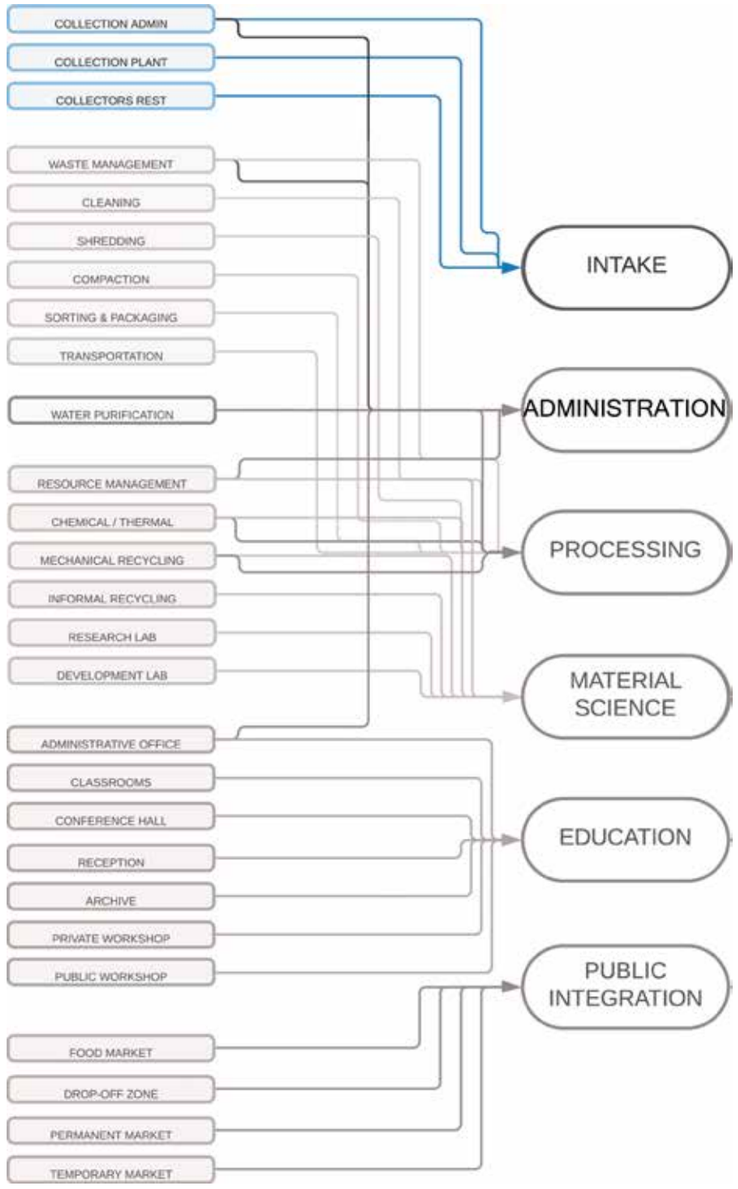


Figure 8.2 'Low-Tech material sourcing' (Author, 2021)

8.4.2 RECYCLING & PROCESSING

The recycling of plastic is divided into three distinct sectors: The shredding and processing of the waste into its smallest part; The processing of the waste into raw material to be moulded; And the small-scale recycling of products into new products to be sold. The first two sectors directly service the educational and research facilities, providing prototype moulds for innovative product design, and research potential in terms of chemical experimentation. The small-scale recycling is meant to encourage a more hands on, "DIY" approach that feeds directly into the market axis just south of the intervention. These recycled products are made and sold on site, and facilities are provided for the public.

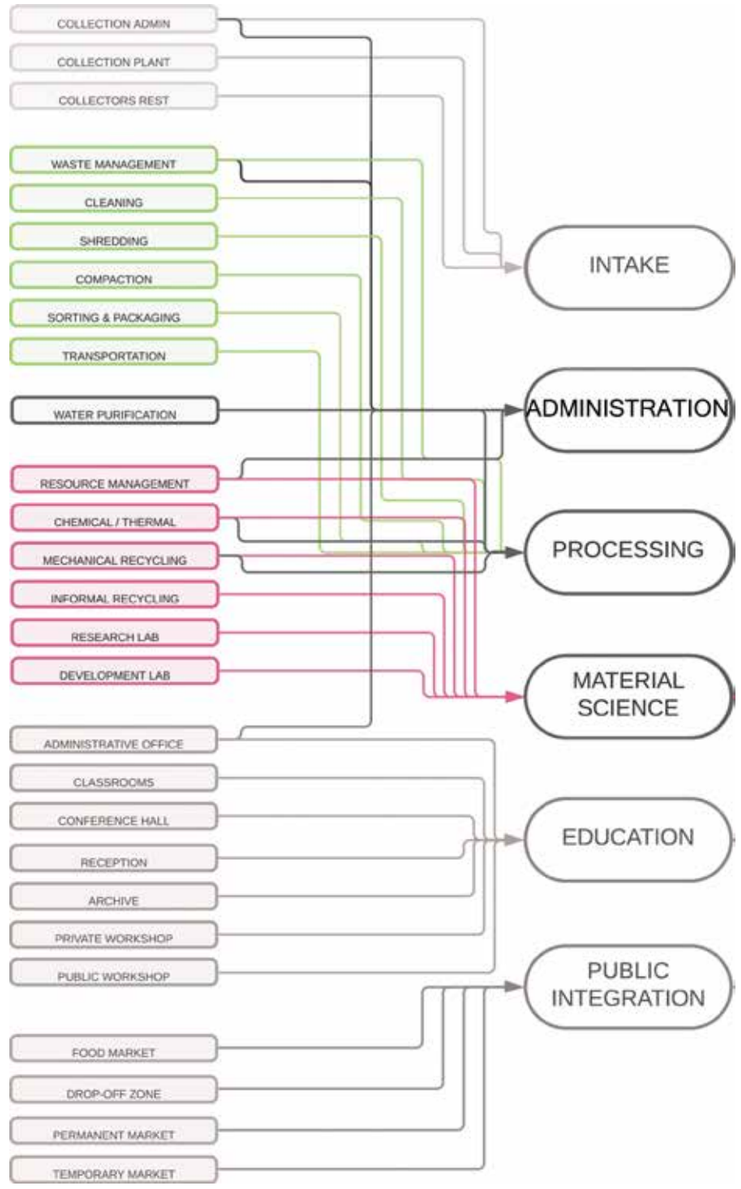


Figure 8.3 'Mid-Tech material sourcing' (Author, 2021)

8.4.3 EDUCATION

The educational and research fields are directly linked to the potential clients of the dissertation. This provides a tertiary education that relates directly to the eThekwini Municipality and the Department of Water and Sanitation. The research facilities relate to the Berea College of Technology and are focused on material sciences. The inclusion of these programmes is intended to substantiate the community awareness programmes as conducted by the eThekwini Municipality providing further education in waste management and consciousness.

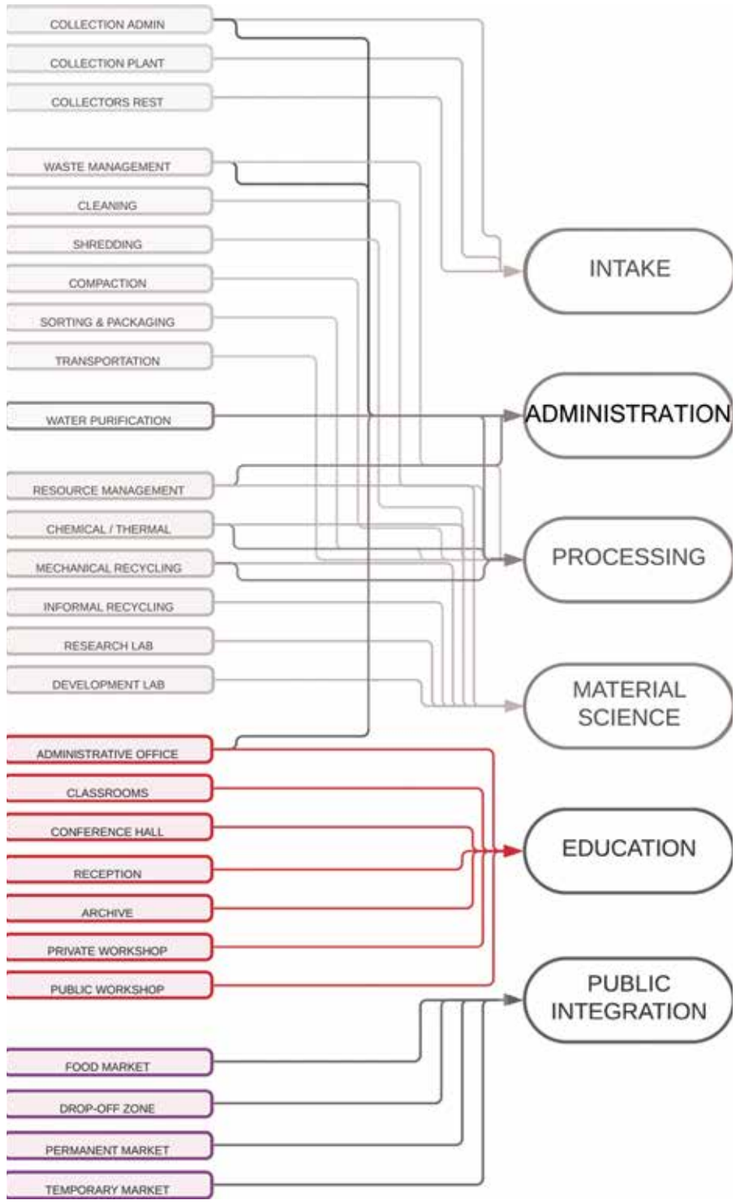


Figure 8.3 'High-Tech material sourcing' (Author, 2021)

9. MATERIAL EXPLORATION

9.1 WHY PLASTIC

Although there is an existing network of recyclers and formal and informal waste collection in and around the Durban CBD area, these organisations are ubiquitous and form no relation with one another. According to a communication with Mrs D. Botha (2021) these organizations also have very little cooperation with the local municipality, which only facilitates two community buyback centres servicing the entirety of the area. Considering the numerous recycling facilities within the area and their acceptance of informal collection, there is still a lack of plastic-specialized organisations or businesses. Thus, there is a lack of emphasis on plastic collection and processing initiative from these businesses. According to Mrs. D Botha (2021) many of these processing and collection plants do not have the capability to manufacture on site and therefore export or transport the raw materials to out-of-city mills or even internationally. The dissertation proposes to introduce a new facility that specialises in the collection, processing, and manufacturing from plastic waste material, whilst forming part of the existing network through the collection and sorting of other collected waste and the transportation of this waste thereafter.

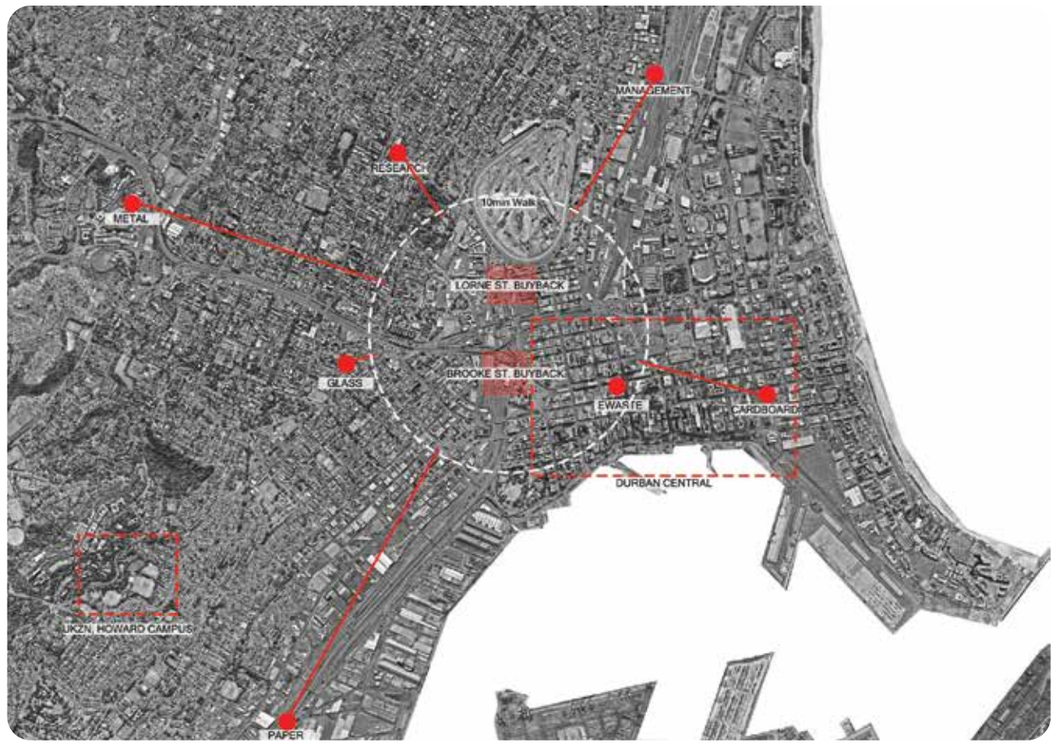


Figure 9.1 'Types of waste collection plants in Durban CBD' (Author, 2021)

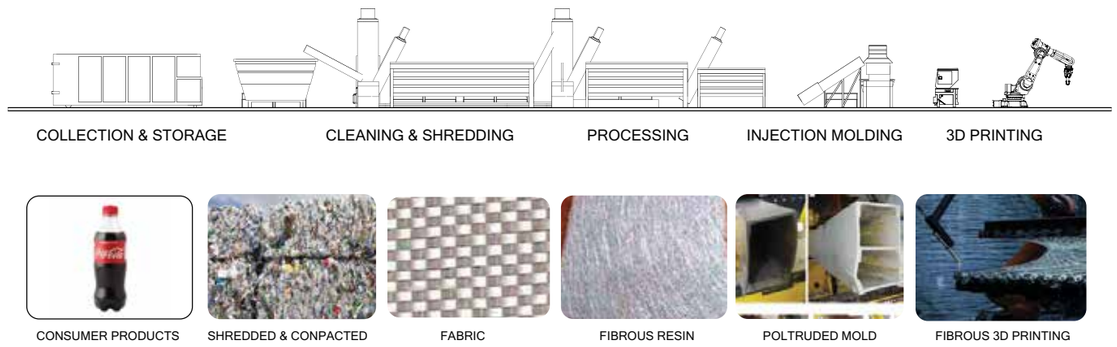


Figure 9.2 'Phases of plastic' (Author, 2021)

9.2 WHY PET/PE PLASTIC

Polyethylene (PE) and Polyethylene Terephthalate (PET) plastics are commonly found within package manufacturing of bottles. Both PE and PET are thermoplastics, which mean that they liquify when heated to their melting points and can be used again within the injection moulding process. This melting and remoulding of these plastics make them suitable for recycling and manufacturing into new products. According to Petco (2019) Polyethylene Terephthalate (PET) plastic bottles are the most recycled plastic product in South Africa and is 100% recyclable. PET plastic provides strength, thermostability and transparency and is most commonly found within traditional plastic bottles. Due to the availability and the commonality of plastic bottles not only as a consumer product but also a waste product, it proves to be a logical raw product to work with. PET bottles can be broken down into fibres and used to create fabrics, and due to its thermoplastic characteristics, can be recycled into any shape strength or form. PE plastic, according to Lotha (2009) are commonly found in packaging film, grocery bags and cable insulation. Due to the simple chemical structure of PE plastic can be altered and form different branches of PE plastic with a larger range of structural characteristics. These branches include Low density- Polyethylene (LDPE) which is flexible allowing for mechanical malleability and high-density-polyethylene, (HDPE) which provides more structural integrity. Ultrahigh-molecular-weight polyethylene form crystalline structures that showcase structural integrity greater than steel. Polyethylene can also be recycled to create polyethylene resins that can be reinforced using glass fibres to achieve structural capabilities.

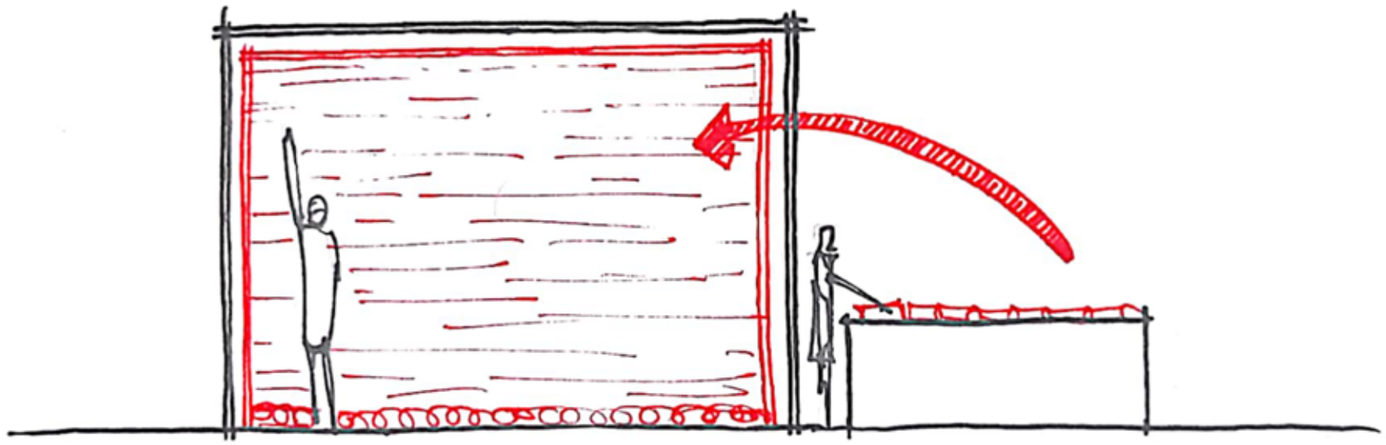


Figure 9.3 'Low-Tech plastic parti' (Author, 2021)

9.3 LOW-TECH EXPLORATION

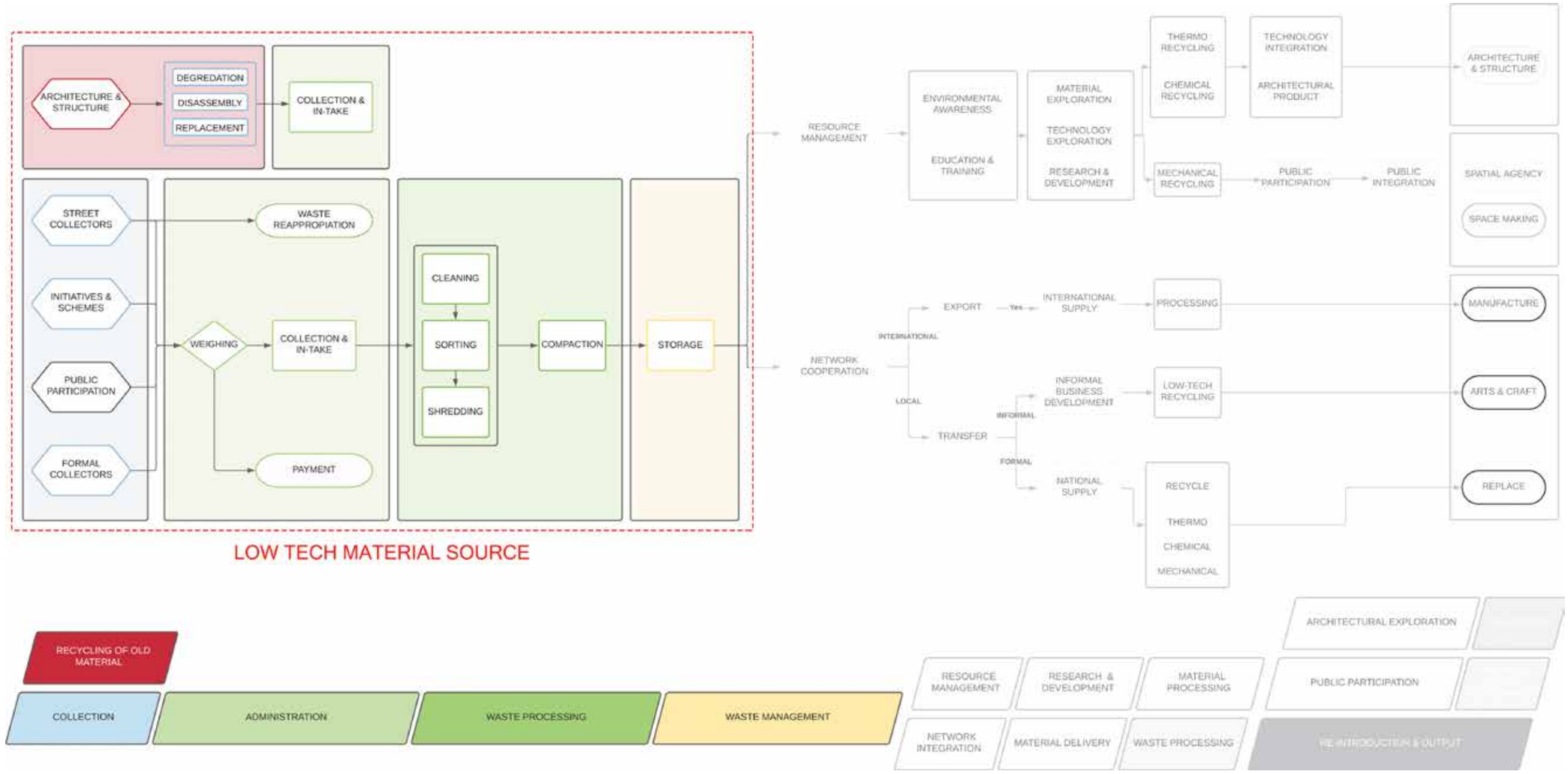


Figure 9.3.1 'Low-Tech plastic in the recycling process' (Author, 2021)

9.3 LOW-TECH EXPLORATION

Firstly, the collection of raw consumer products and the appropriation of those products as a construction material. Due to the low structural characteristic of this phase, the material is used as a screen or partition and furniture fixing method. The plastic itself is malleable when exposed to heat and provides a shrink wrap like technique when acting as a joint between two elements.

The artistic works of Micaella Pedros highlights the potential of plastic bottles as a means of furniture fixing. The process makes use of heat shrinking the plastic into channels cut into timber legs, tightening, and fixing two components together. The shrinking process allows for a range of joint angles, and once hardened, becomes a dismantlable, when formed around flat channels.

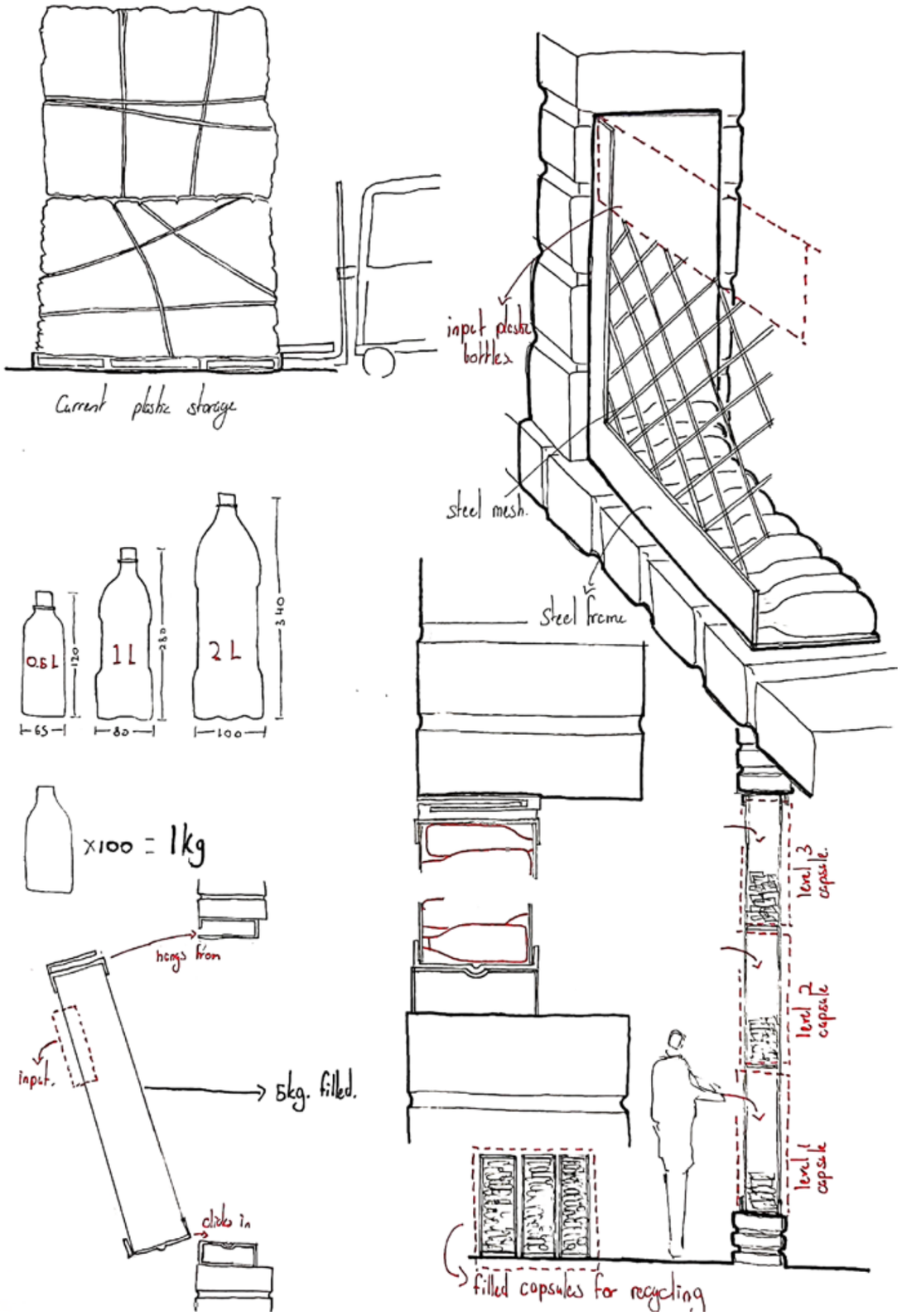


Figure 9.3.2 ‘Low-Tech plastic exploration’ (Author, 2021)

Figure 9.3.3 ‘Low-Tech junction and fixing exploration’ (Author, 2021)

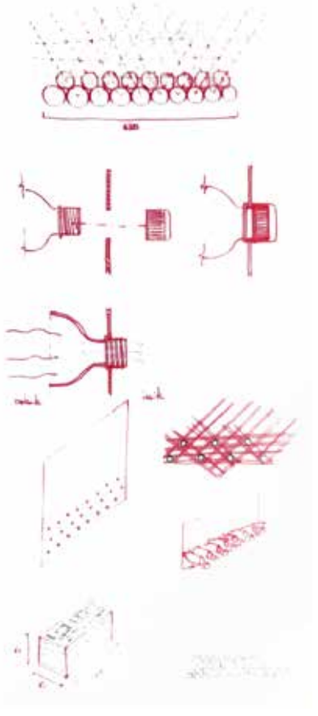


Figure 9.3.4 ‘Low-Tech bottle stacking exploration’ (Author, 2021)

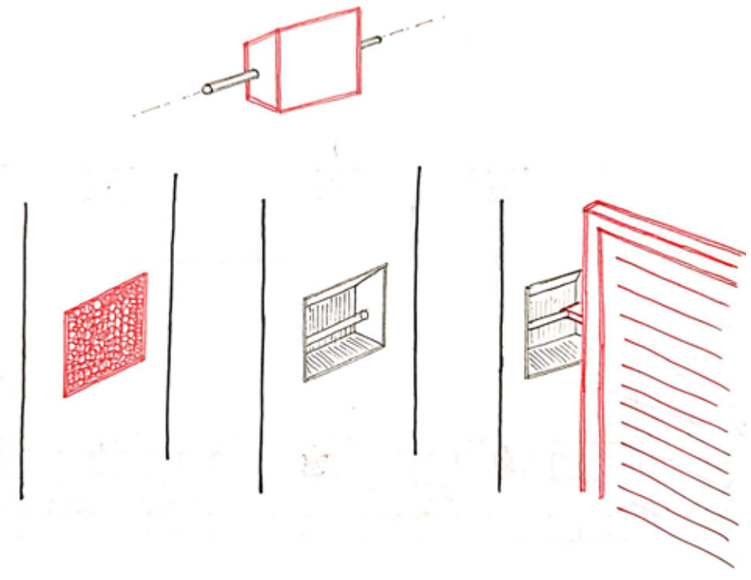


Figure 9.3.5 ‘Low-Tech plastic to concrete fixing’ (Author, 2021)

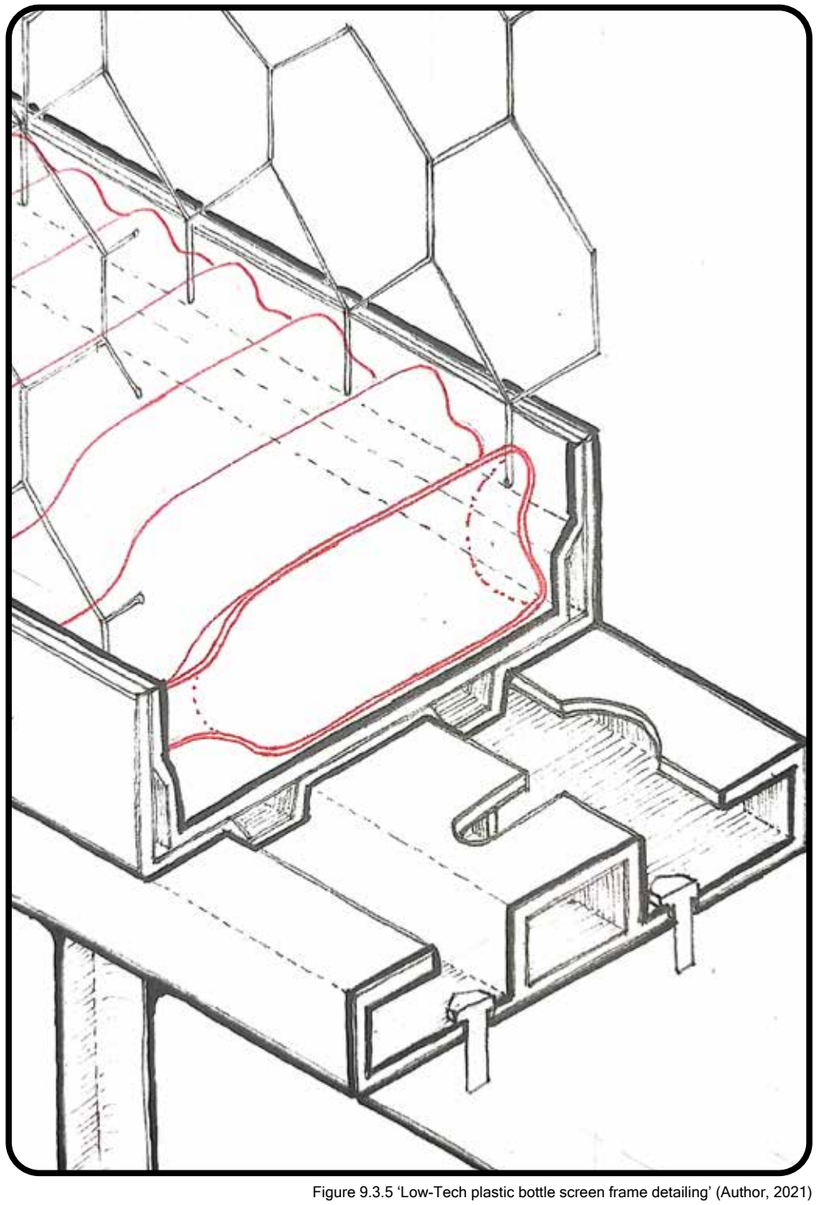


Figure 9.3.5 'Low-Tech plastic bottle screen frame detailing' (Author, 2021)

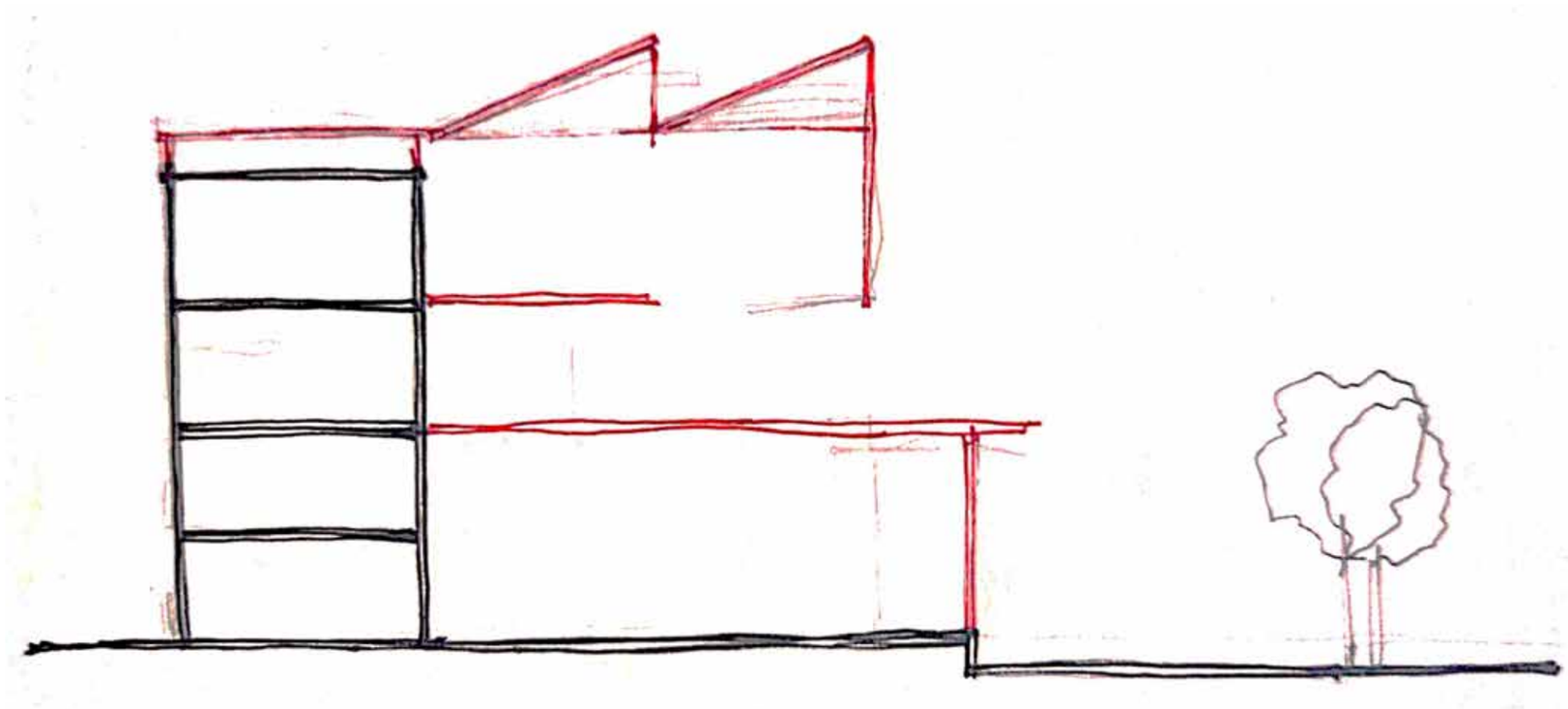


Figure 9.4 ‘Mid-Tech plastic parti’ (Author, 2021)

9.4 MID-TECH EXPLORATION

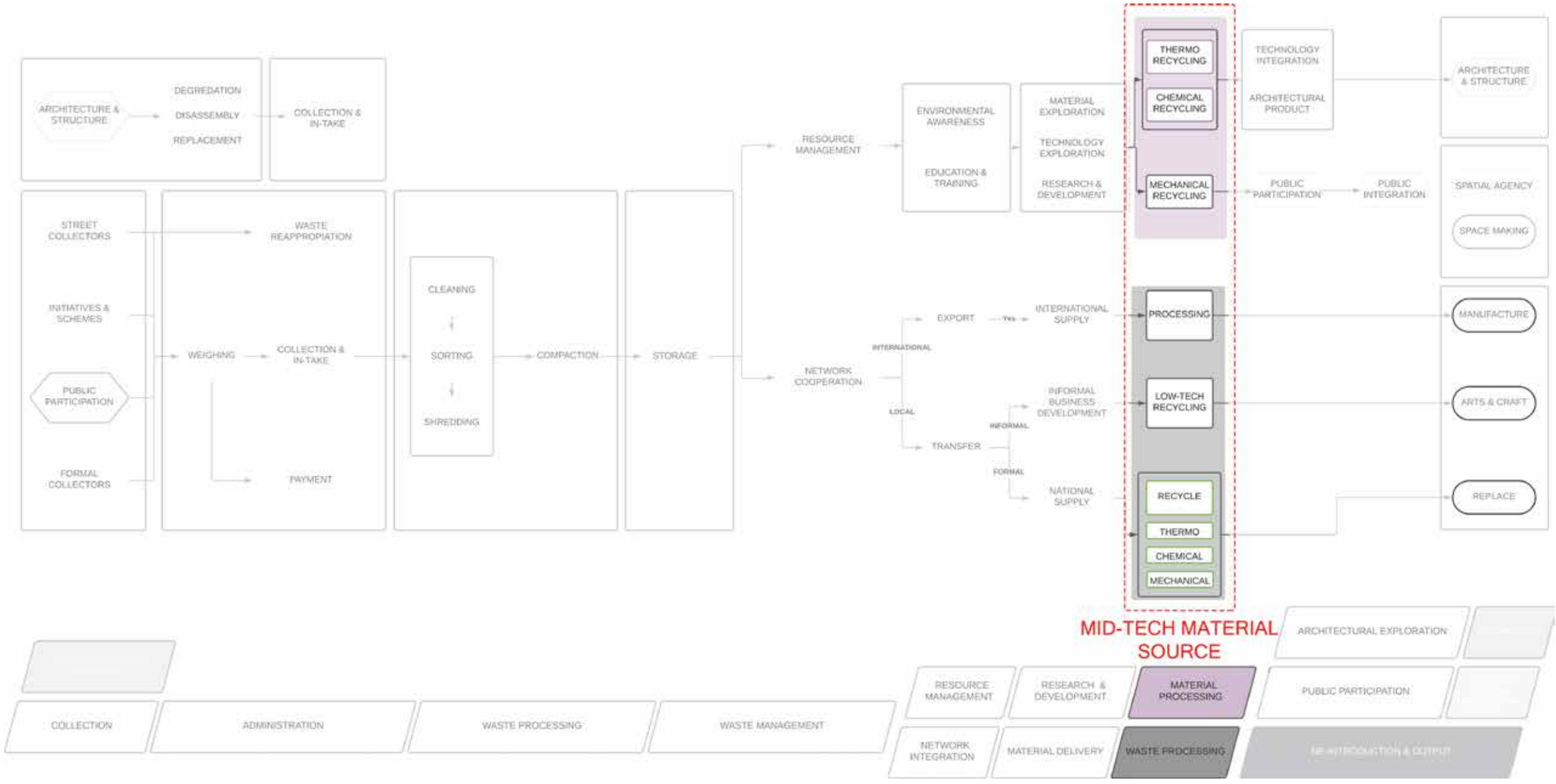


Figure 9.4.1 'Mid-Tech plastic in the recycling process' (Author, 2021)

9.4 MID-TECH EXPLORATION

Secondly, the plastic injection moulding process. The raw material is clean, processed and melted to be used as the matrix from which moulds are filled. These moulded components typically provide flat profile sheets with structural reinforcement or ribbing directly into the component. This allows for easy assembly and disassembly. The moulding process can be expanded upon, and structural columns and beams can be heat pultruded with glass reinforcements providing structural integrity comparable to steel sections.

First installed within a radio-frequency testing station, glass-fibre reinforced composite materials provide minimal weight to strength ratio, minimizing overall costs (Green, n.d.). Green states that "composite structures rely on the strengths while recognizing the limitations of the composite materials, without attempting to duplicate standard sections made of rolled or light gauge steels" (Green, n.d.: 73). However structurally sound, RFR composites are susceptible to shear forces (AZO Materials , 2012; Fibro lux, n.d.; Poly-Tech, 2011; The Engineering Toolbox, 2008) and as such requires steel reinforcements within spans of beams and junction points. These reinforcements however are cast directly into the matrix of the composite during the pultruding process.

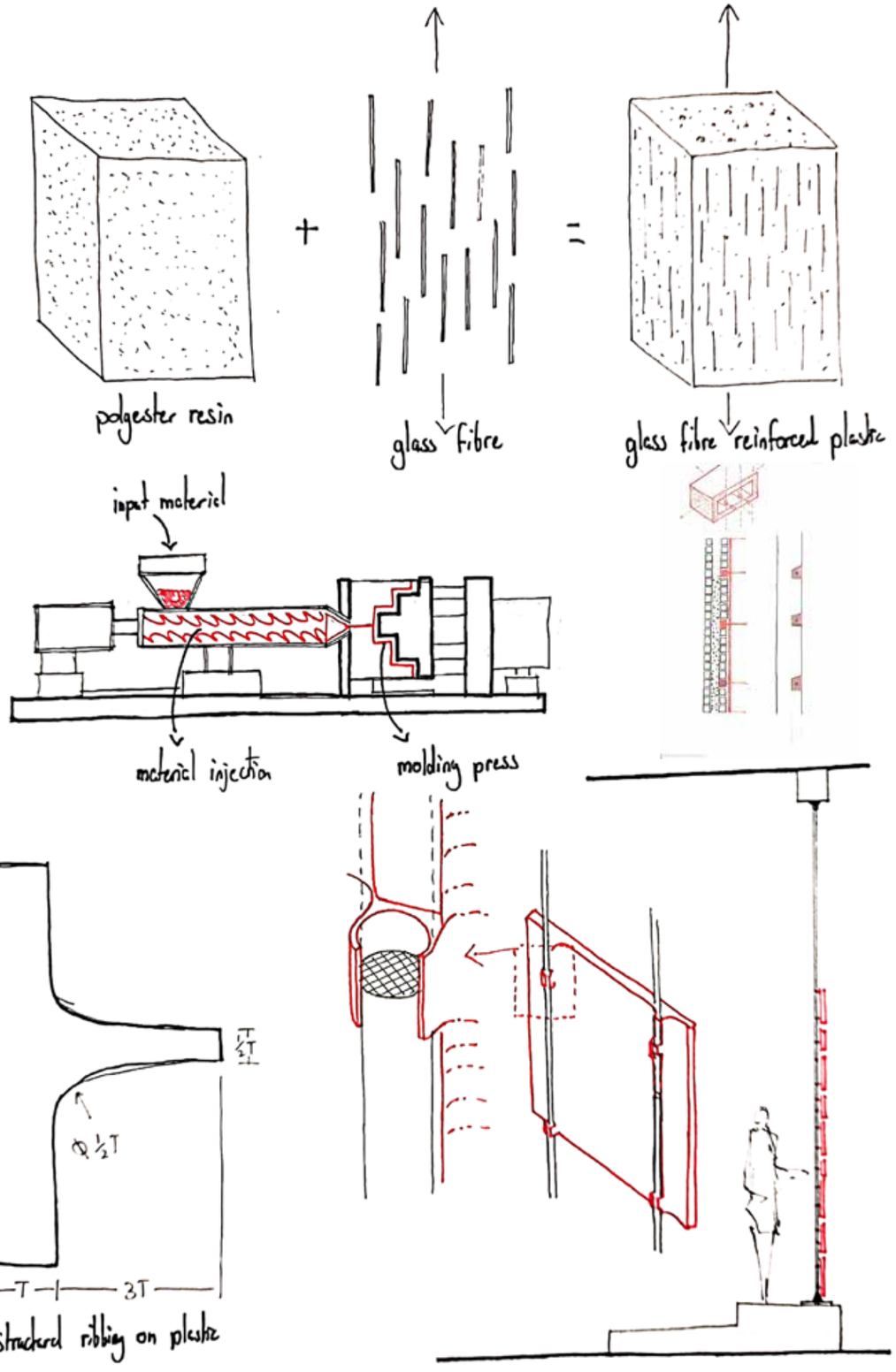
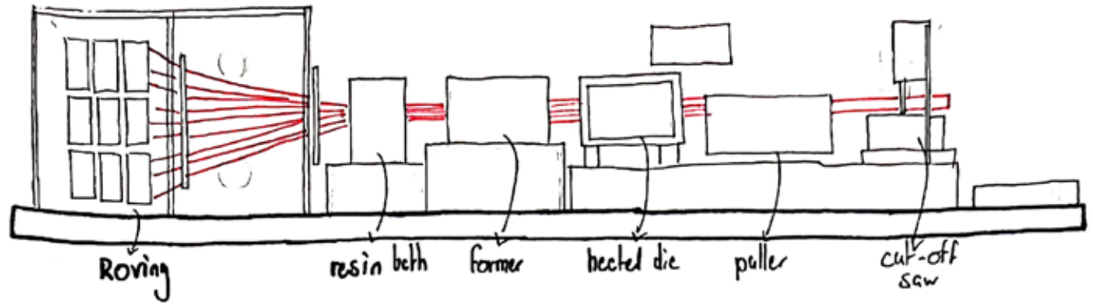


Figure 9.4.2 'Mid-Tech plastic exploration' (Author, 2021)



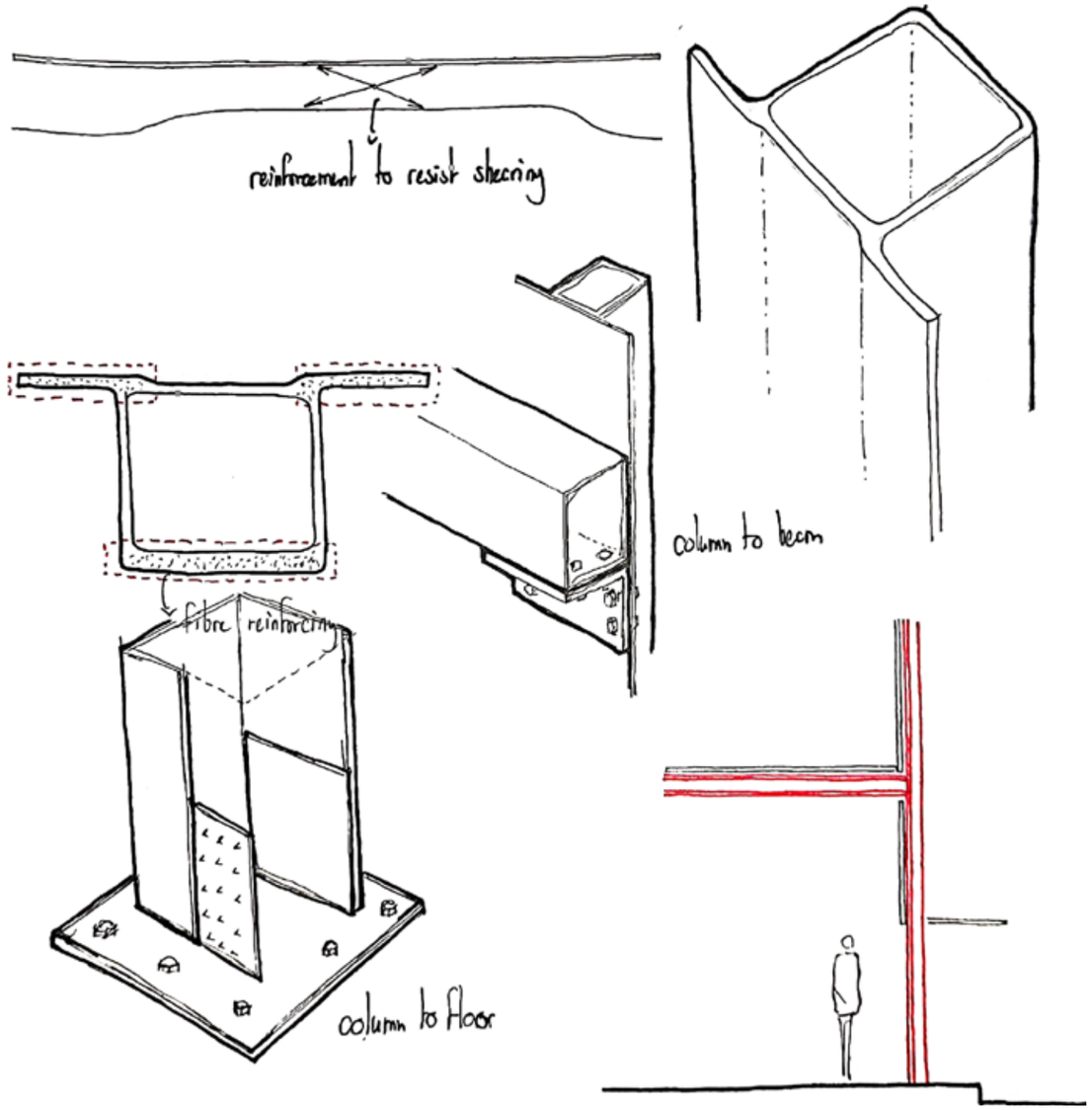


Figure 9.4.3 'Mid-Tech plastic exploration' (Author, 2021)

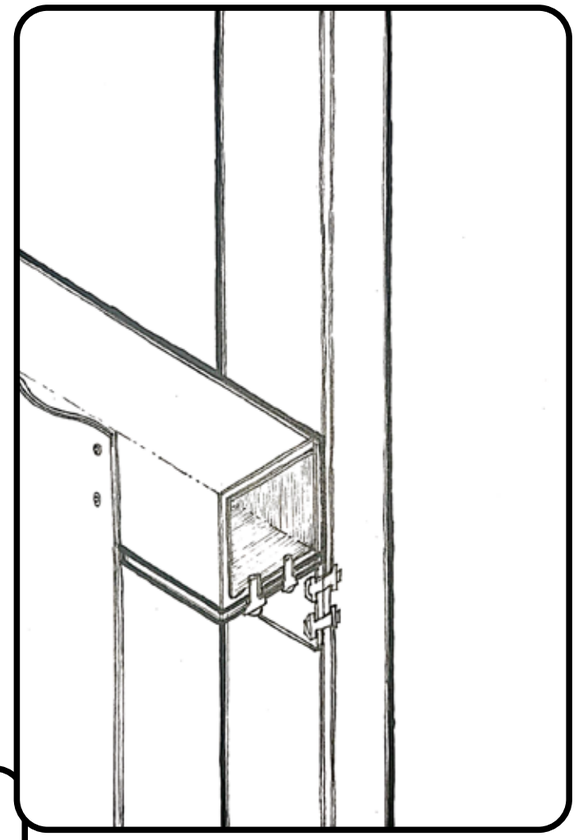


Figure 9.4.3 ‘Mid-Tech plastic column to beam junction’ (Author, 2021)

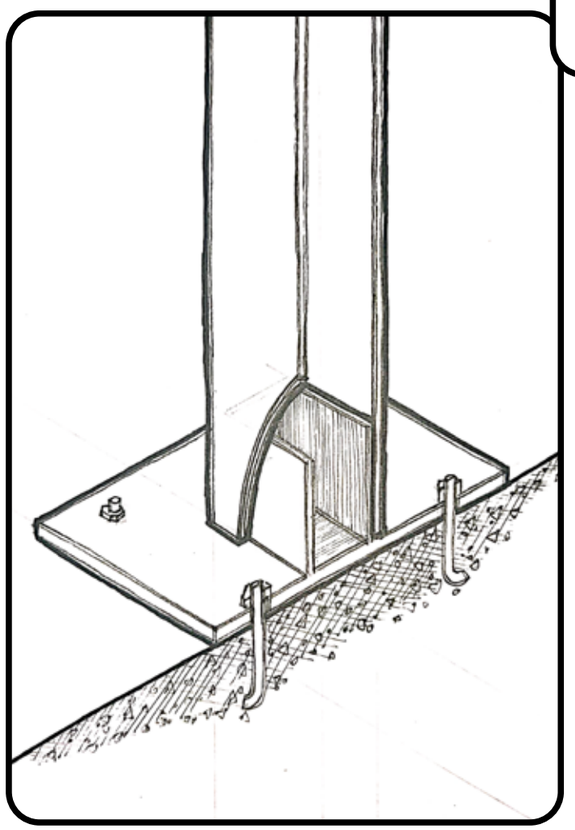


Figure 9.4.3 ‘Mid-Tech plastic column to floor junction’ (Author, 2021)

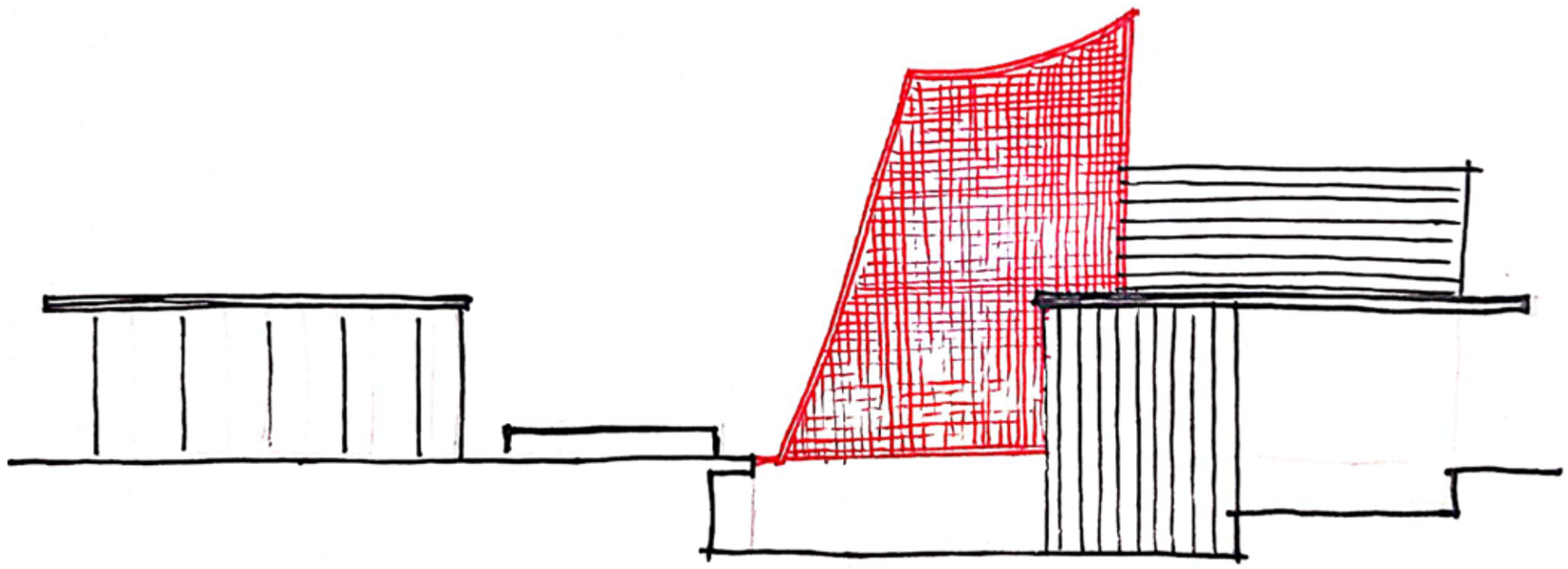


Figure 9.5 ‘High-Tech plastic parti’ (Author, 2021)

9.5 HIGH-TECH EXPLORATION

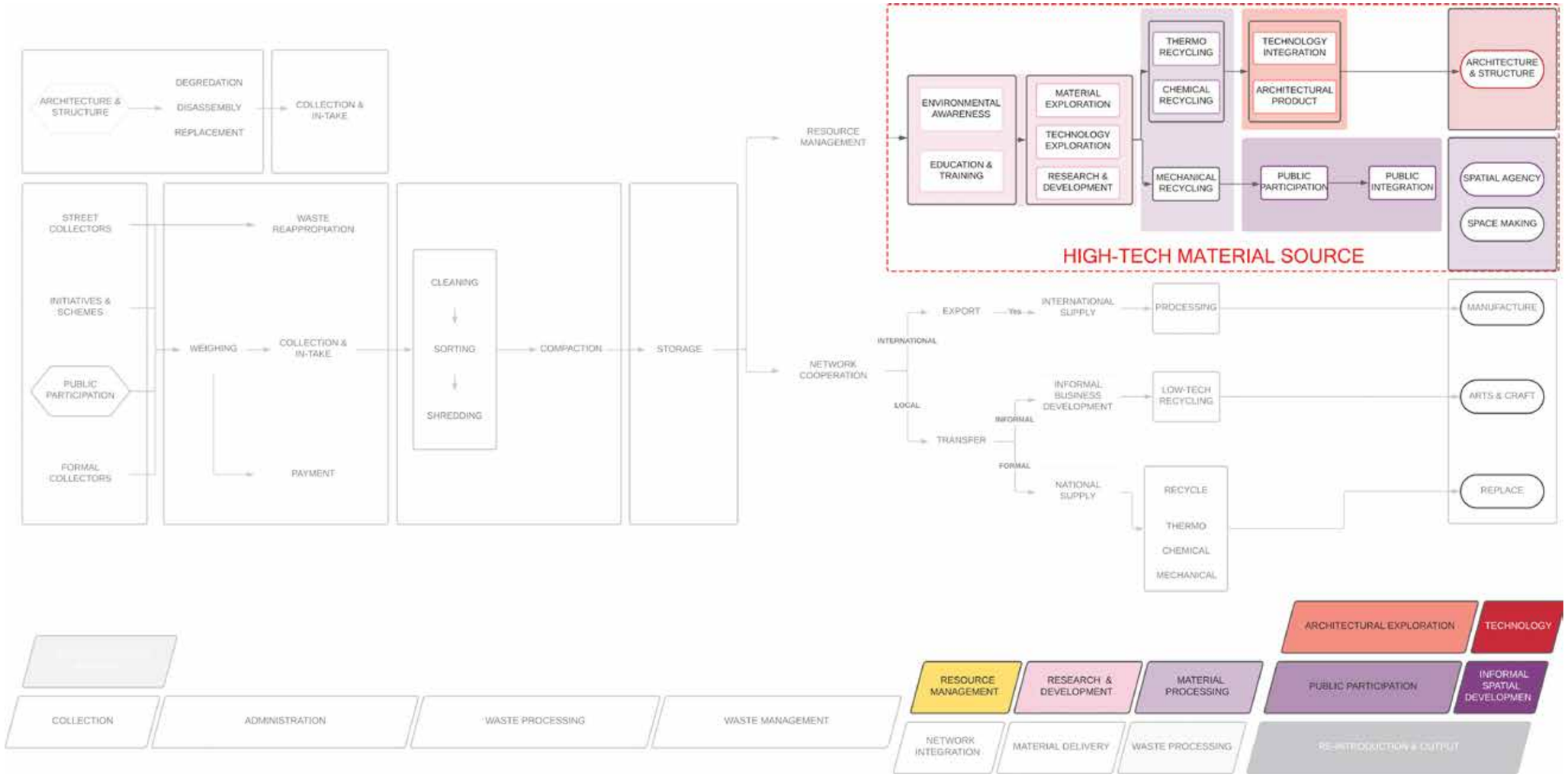


Figure 9.5.1 'High-Tech plastic in the recycling process' (Author, 2021)

9.5 HIGH-TECH EXPLORATION

The third phase makes use of fibrous cables in a plastic resin that is used as a material for 3d printing techniques. The fibrous cables are comprised of lateral glass fibres and plastic tendons within a polyester resin that becomes rigid after curing providing both tensile and compressive strength to the structure. Due to the parametric requirements of this technique, the 3d printing is conducted within a controlled environment and then assembled on site as a modular frame system.

This 3d printing technology (Maison Fibre) was first exhibited at the 17th International Architecture Exhibition - La Biennale di Venezia 2021 by Computational Design and Construction (ICD) and the Institute of Building structures and Structural Design (ITKE) of the Cluster of Excellence IntCDC at the University of Stuttgart. The technology is robotically made with fibrous materials and provides a fractional weight to strength ratio compared to traditional concrete-based structure. Achim Menges and Jan Knippers, the creators of this installation, have stated that architecture built using this method will remain adaptable and flexible in the long term (Shah, 2021).

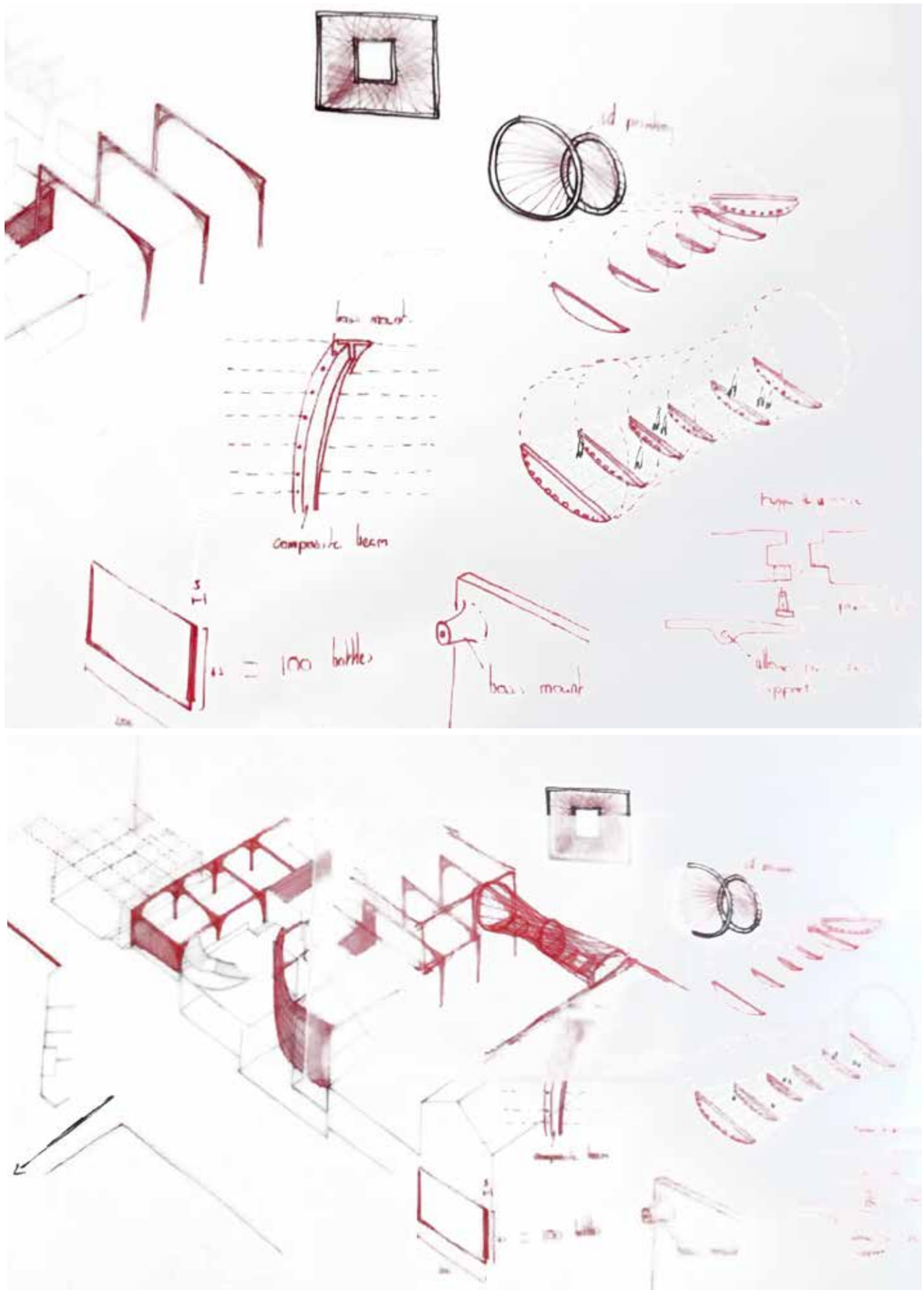
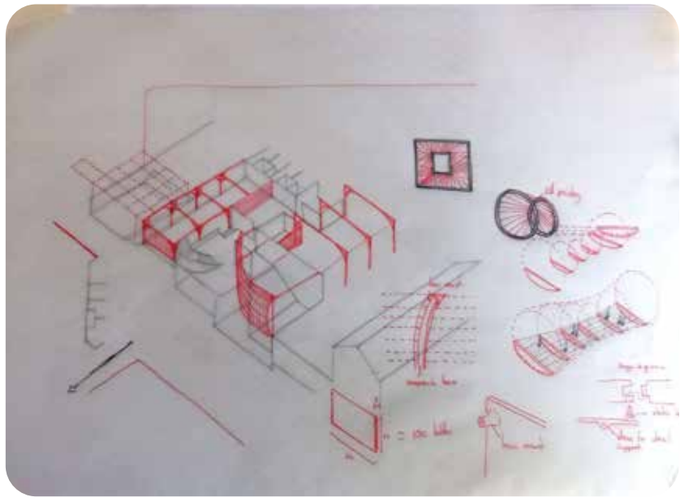
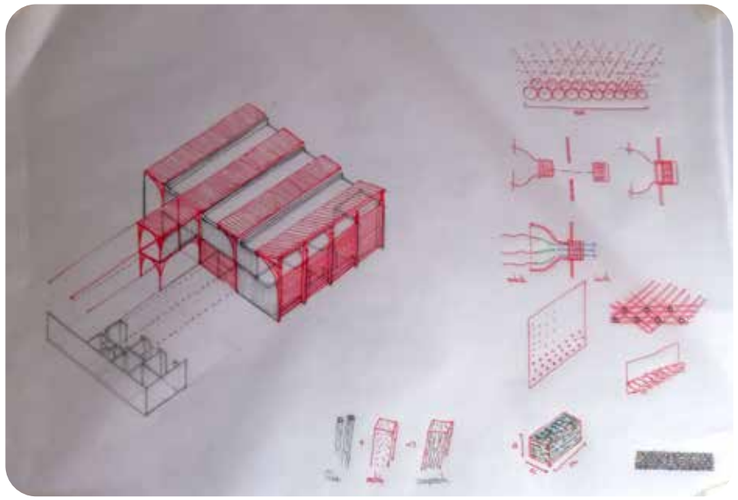
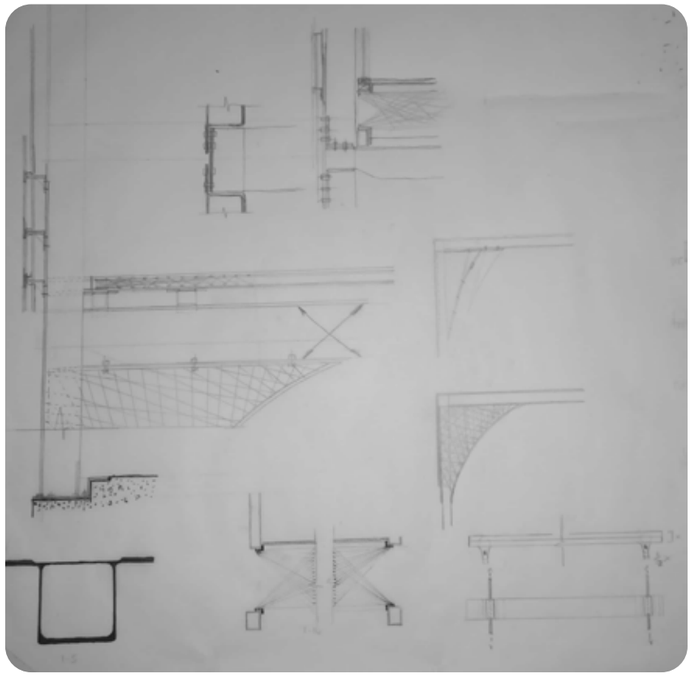


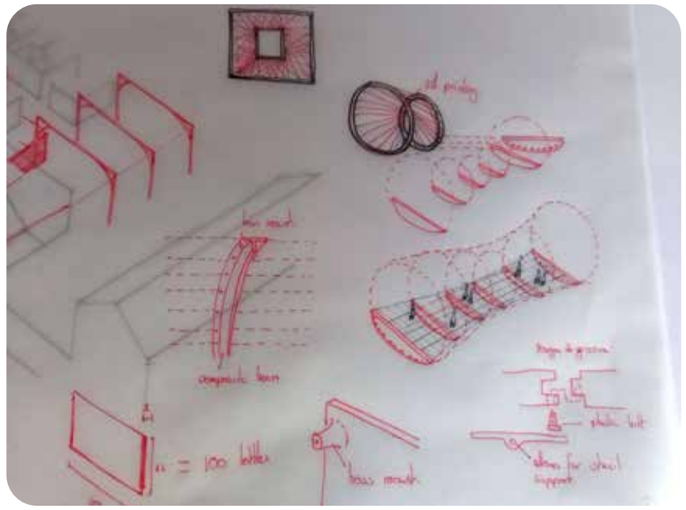
Figure 9.5.2 ‘High-Tech plastic exploration’ (Author, 2021)

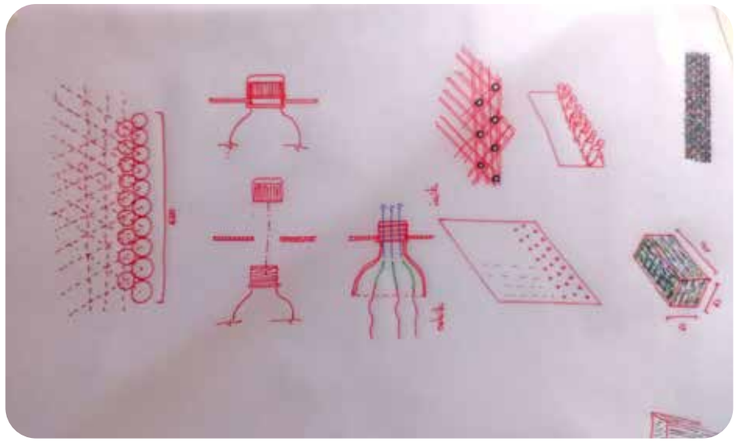
Figure 9.5.3 ‘High-Tech plastic marquette’ (Author, 2021)

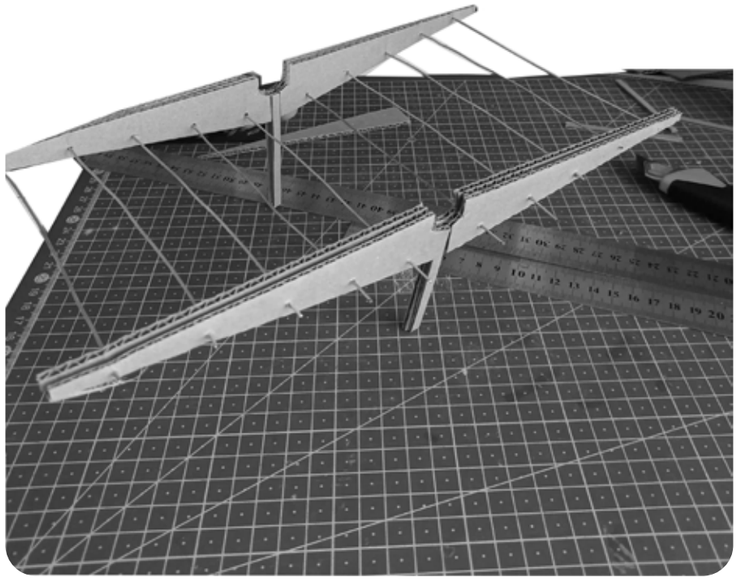


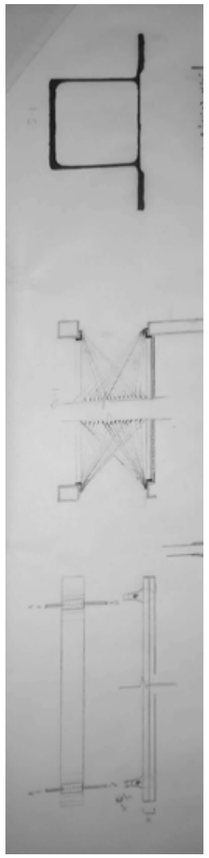












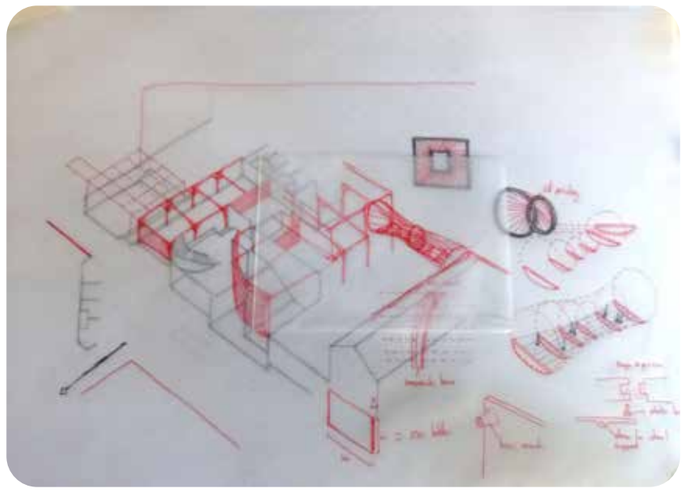


Figure 9.5.4 'High-Tech plastic exploration' (Author, 2021)

Figure 9.5.5 'High-Tech plastic structure maquette' (Author, 2021)

Figure 9.5.6 'High-Tech plastic column flange' (Author, 2021)

The construction of these three phases allows for full transparency on technology, materials, and fixing methods. This transparency satisfies the visual accessibility of the user and further deepens their knowledge and understanding, not only of the space, but also, of the assembly of the components and the potential of plastic as a construction material. By viewing material or components that look familiar to their common consumer waste, this provides an association of the potential of that plastic waste and the value that it holds within the built environment. This association of value influences the recycling culture, increasing the amount of intake whilst also increasing the economic incentive for the raw waste products that are bought at buyback stations. This increase in public awareness is the foundation on which the dissertation is built. By providing a prototype within South Africa of the capabilities of plastic waste in the built environment, this would positively influence all subsequent parts that make up the whole, including the recycling and informal waste sectors.

10. CLIMATE

DURING THE SUMMER

Due to the humid climate in Durban, ventilation is the key passive system to achieve comfort within the interior of the building. With the prodominant wind directions being a Northerly and South Westerly wind, the intention is to utilize this cross ventilations within the interior of the building, bringing in cool air and evacuating warm moist air within the interior caused by human activity.

This is achieved by providing openable glazing behind a temporary external screen. This screen acts as a wind break, reducing incoming wind speeds and also as a shading device from the sun. The interior skin consists of low e-value, single glazing as a compromise between summer and winter insolation. In summer, the intention is to limit direct sun light, whilst in the winter, the intention is to allow diffused sunlight. This screen would be installed on the Northern facade, however due to the permanent core of the building on the western facade all public activity is allocated facing east, receiving the morning sun and indirect sunlight for the rest of the day. The materiality of this screen consists of recycled high density polyethylene plastic components from waste collected on site as part of the programme, fixed by means of cables. This also allows for flexibility of the screen being removed.

DURING THE WINTER

Due to the cable fixing system, the exterior screen can be removed and replaced with a polyester fabric sheet (also produced on site from recycled plastic waste). This polyester fabric sheet also acts as a shading device, however, it allows more diffused light than the high density polyethelyne plastic screen. With the interior glazing closed to prevent excessive ventilations, soffit level vents are utilized as a evacuation point for warm air and floor level vents for incoming cool air.

Due to the lightweight plastic structure on the 1st floor and above, the structure provides a low R-value (low thermal resistance) thus, does not radiate heat over long periods of time. Because of this, more control over insolation is required during colder weather.

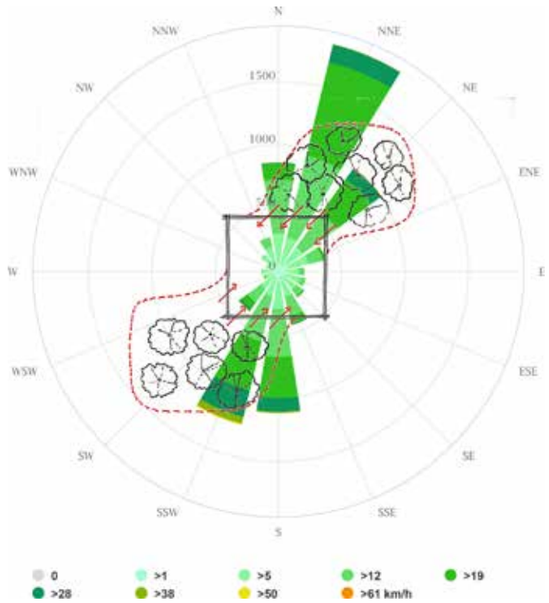


figure 10.4 'Durban prevailing wind direction' (Author, 2021)

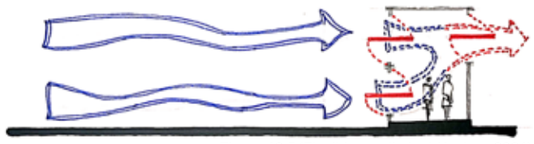


Figure 10.5 'Flexible ventilation' (Author, 2021)

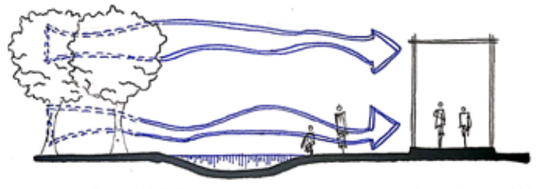


Figure 10.6 'Evaporative cooling and vegetation filter' (Author, 2021)

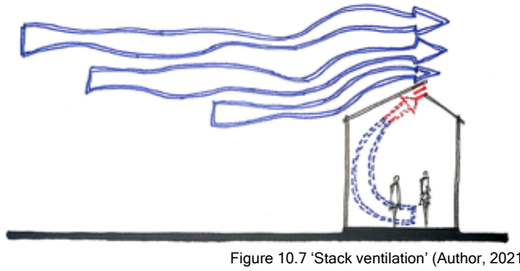


Figure 10.7 'Stack ventilation' (Author, 2021)

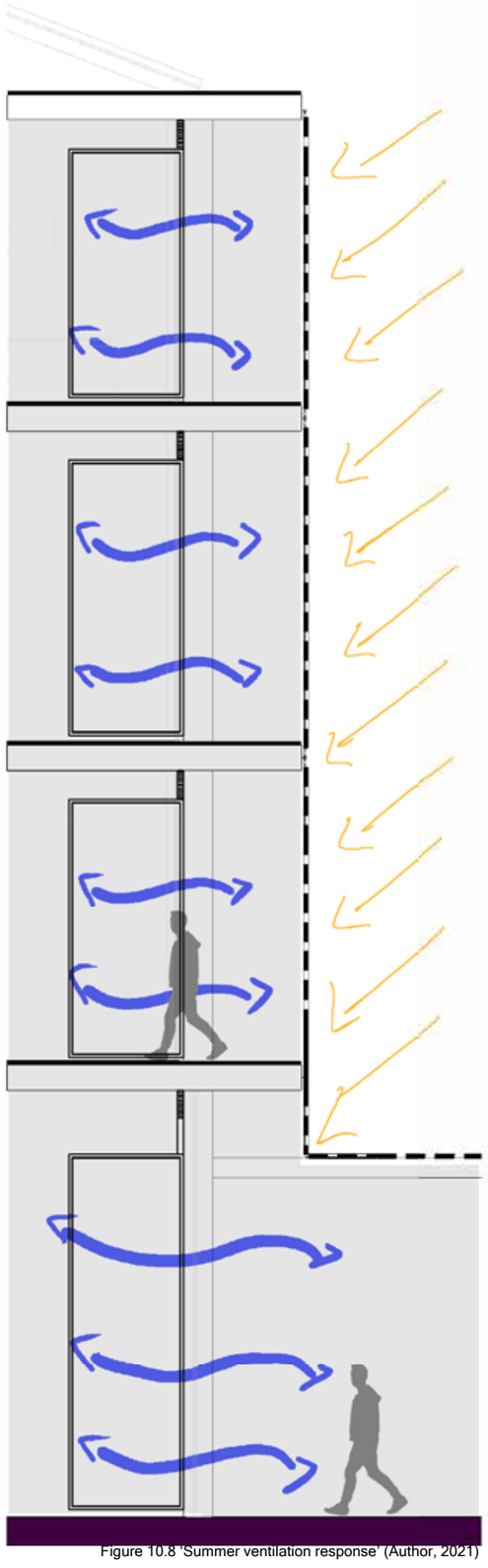


Figure 10.8 'Summer ventilation response' (Author, 2021)

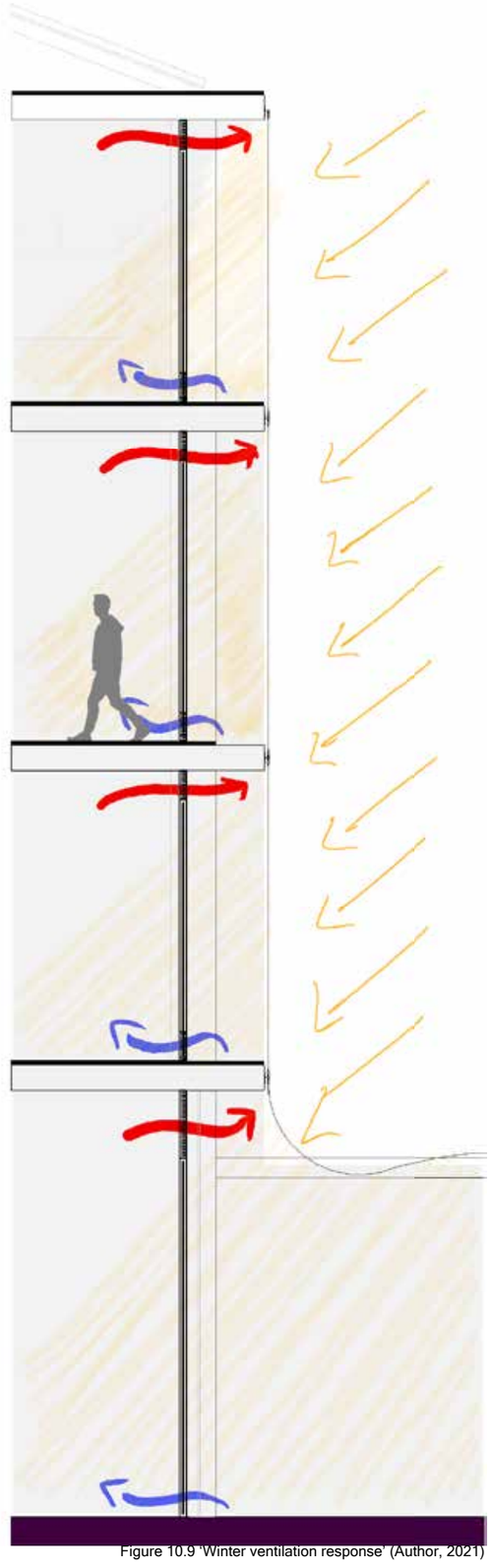


Figure 10.9 'Winter ventilation response' (Author, 2021)

Due to the material-centric nature of the dissertation, environmental and climatic responses are also dependant on materiality, and the temporality thereof. The warm temperate climate of Durban has a low temperature range between summer and winter; however, humidity remains the primary issue within interior spaces. Thus, natural ventilation is required to achieve comfortable conditions within the building. The intention of the dissertation is to harness the predominant North and South Westerly winds via an openable interior skin and provide shading via an external skin. The external skin allows for removal and replacement based on the amount of insolation required during the summer, winter or based on requirements of programme. The skin consists of materials produced on site and is easily removable due to a cable harness system rather as opposed to a permanent fixing system such as bolting or screwing. By restricting the climatic responsiveness of the building to passive systems that require human alteration and maintenance, it reinforces the notion of interaction and manipulation of the subject matter as outline by Michaels (2000).

Within the dissertation, the collection and cleaning facility poses the greatest demand on the resources created and used on site. The programme is centred around the collection and cleaning of waste products with additional supporting administration offices and storage facilities. This area provides three distinct types of resource and lighting demands and thus is selected to highlight the daylighting strategies to accommodate these three different programme requirements. Located to the north of the site, the space is unobstructed from direct insolation whilst its relatively small vertical scale does not cast shade on other significant buildings as proposed within the dissertation. The intention of the dissertation is to achieve relative comfortable daylighting levels through the implementation of plastic-based material to the envelope of the building. This intention aligns with the plastic material-centric focus of the dissertation and the altering of comfort levels by the removal and replacement of plastic components.

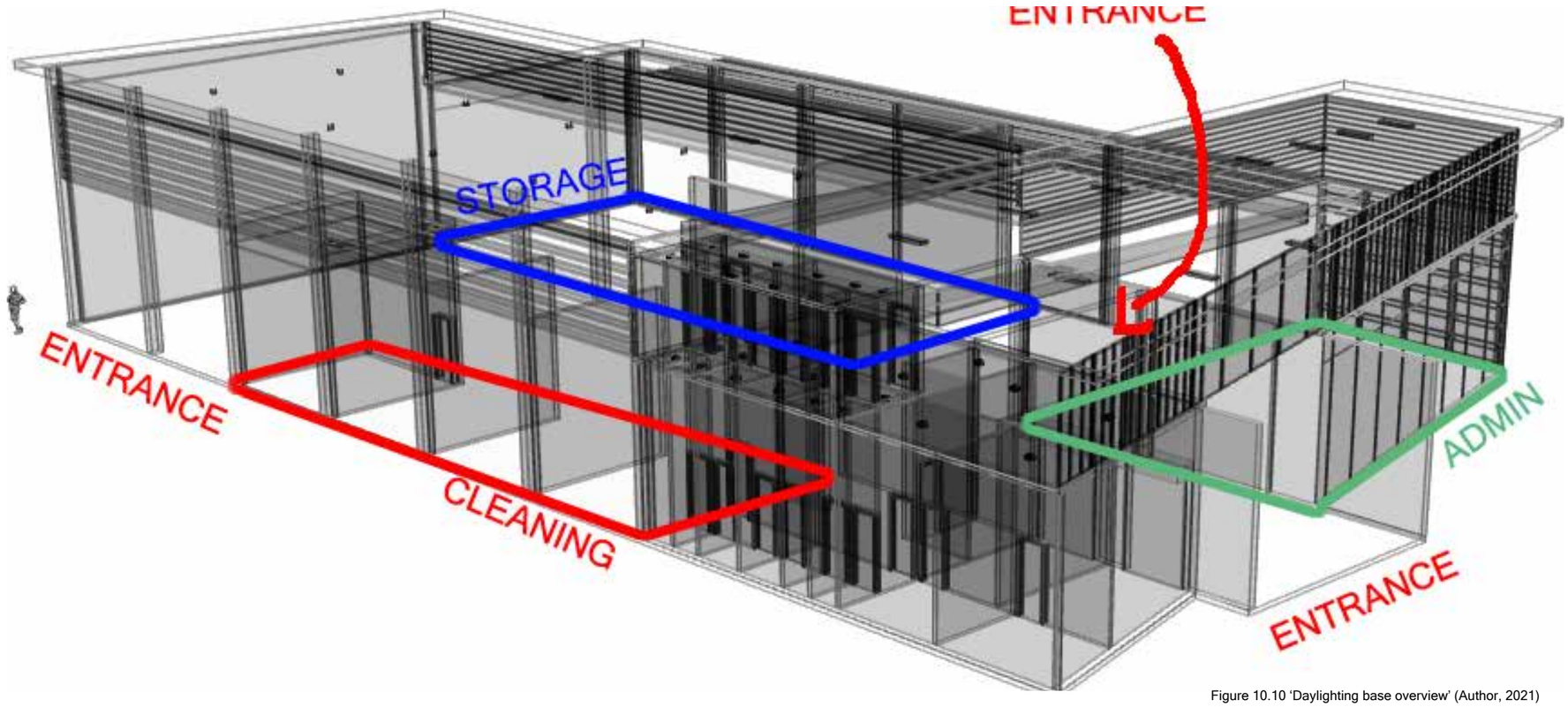
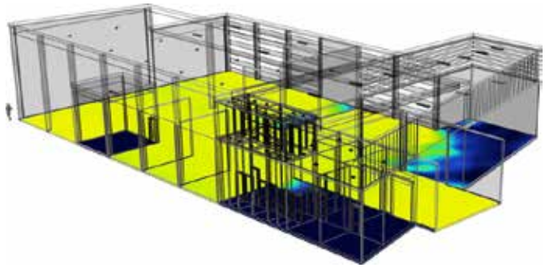


Figure 10.10 'Daylighting base overview' (Author, 2021)



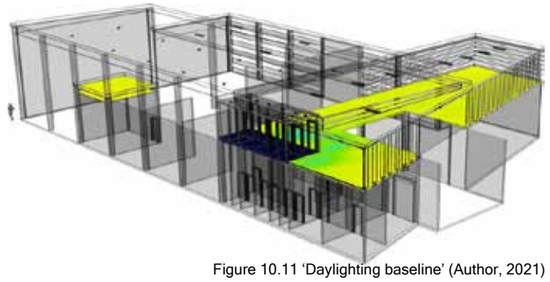
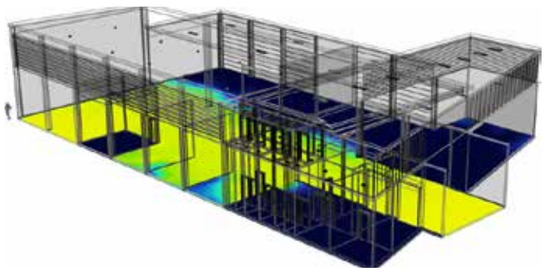


Figure 10.11 'Daylighting baseline' (Author, 2021)

The default layout makes use of single glazing on the envelope of the building to determine a baseline to work from. This implementation results in a mostly over lit ground floor on which the collection and cleaning takes place. With this default layout, there is no distinction of space by means of daylighting and all surfaces are equally over lit.



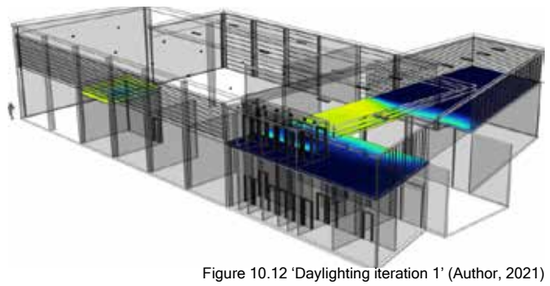
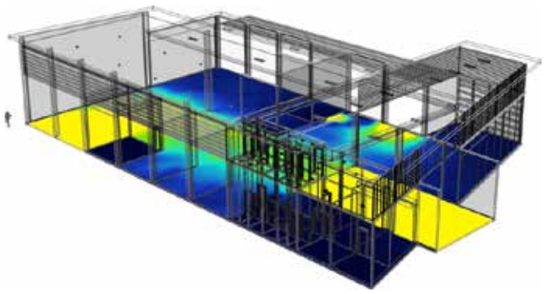


Figure 10.12 'Daylighting iteration 1' (Author, 2021)

The second iteration introduced horizontal louvres at an H:P ratio of 10 along the northern façade and additional louvre shading from the roof soffit on the southern side. This iteration resulted in the shading of the interior by completely obstructing the insolation, thus the storage spaces to the north of the building is underlit while the middle remains over lit due to the clerestory above the main sorting and cleaning space.



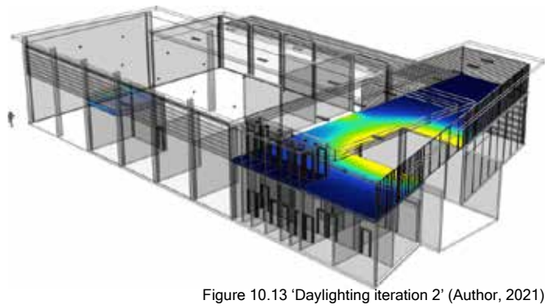
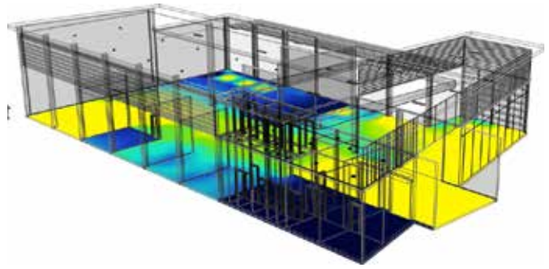


Figure 10.13 'Daylighting iteration 2' (Author, 2021)

The third iteration reduced the H:P ratio to 2 and introduced horizontal louvres on the northern facing clerestory. This resulted in increasing the daylight exposer within the storage space and reducing the duration of direct sunlight on the main sorting and cleaning space.



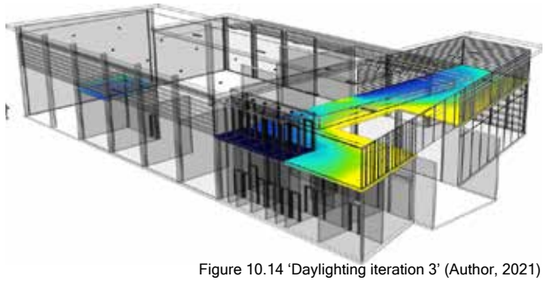
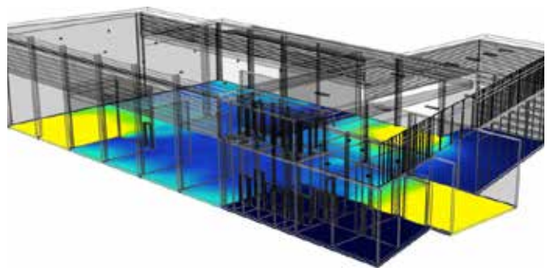


Figure 10.14 'Daylighting iteration 3' (Author, 2021)

The fourth iteration increased the overhang of all roof structure to 500mm, the removal of louvres from the glazing and replaced it by introducing pergola shading on the northern façade. This resulted in the over shading of the increase of direct sunlight in the northern storage spaces.



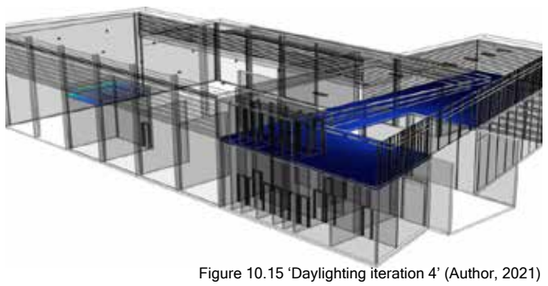


Figure 10.15 'Daylighting iteration 4' (Author, 2021)

The final iteration replaced all glazing with Low-Tech plastic screens. This resulted in a large amount of insolation diffusion and many spaces reduced the amount of direct sunlight. This layout sees all entrances being directly lit whilst the interior spaces are well lit.

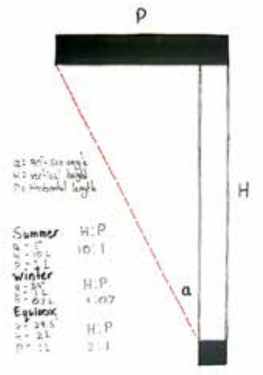


Figure 10.16 Shading - Aperture Ratio (Author,2021)

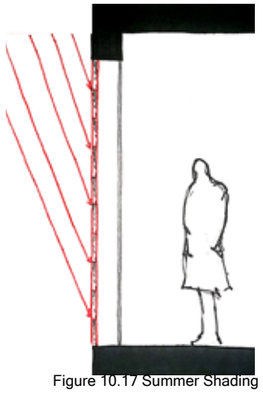


Figure 10.17 Summer Shading (Author, 2021)

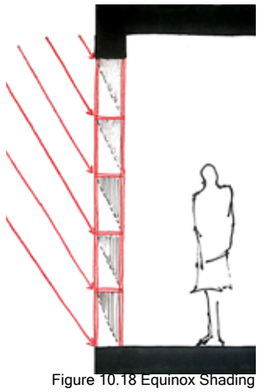


Figure 10.18 Equinox Shading (Author, 2021)

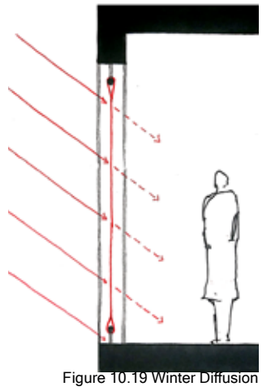


Figure 10.19 Winter Diffusion (Author, 2021)

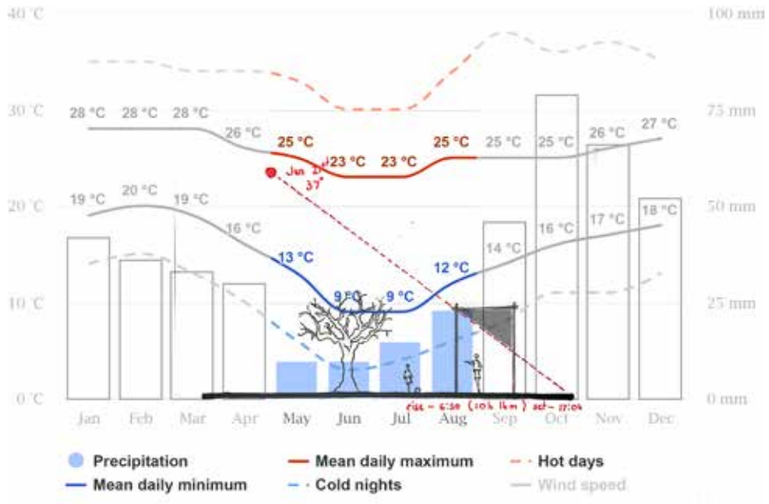


figure 10.20 'Winter Climate' (Author, 2021)

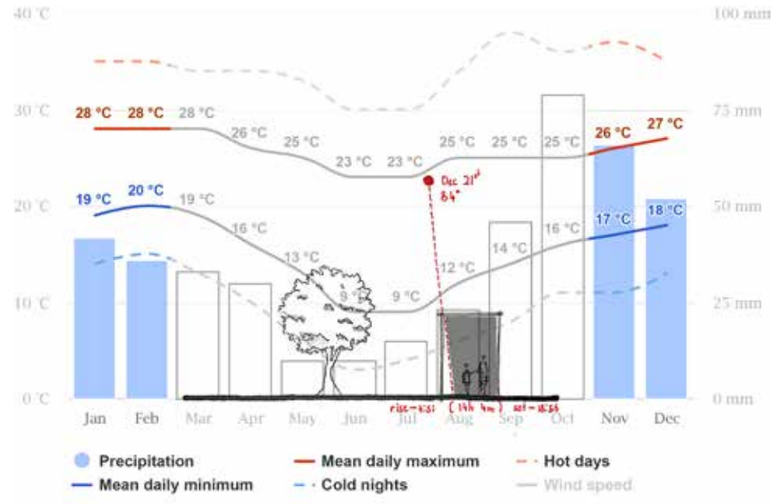


figure 10.21 'Summer Climate' (Author, 2021)

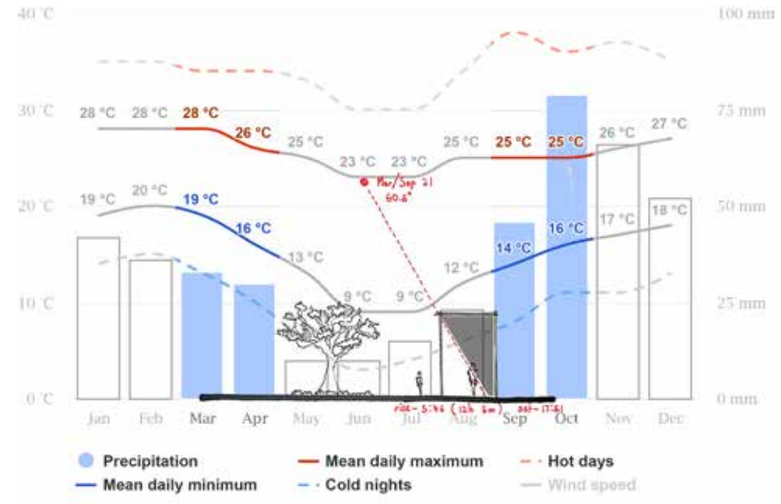


figure 10.22 'Autumn & Spring Climate' (Author, 2021)

ROOF COLLECTION	Area	Summer Rainfall	Runoff Coefficient	Water Collected	
Collection facility	963	0,05125	0,95	46,8860625	
Processing Plant	1476	0,05125	0,95	71,86275	
Education facility	2225	0,05125	0,95	108,3296875	
Existing Expo Centre	4614	0,05125	0,95	224,644125	
		TOTAL		451,722625	m3/month

ROOF COLLECTION	Area	Winter Rainfall	Runoff Coefficient	Water Collected	
Collection facility	963	0,014	0,95	12,8079	
Processing Plant	1476	0,014	0,95	19,6308	
Education facility	2225	0,014	0,95	29,5925	
Existing Expo Centre	4614	0,014	0,95	61,3662	
			TOTAL	123,3974	m3/month
			YEARLY AVERAGE	287.5600125	m3/month

SURFACE RUNOFF	Area	Summer Rainfall	Runoff Coefficient	Water Collected	
Collection facility	580	0,05125	0,7	20,8075	
Central movement corridor	1903	0,05125	0,7	68,270125	
Market axis	5359	0,05125	0,7	192,254125	
		TOTAL		281,33175	m3/month

SURFACE RUNOFF	Area	Winter Rainfall	Runoff Coefficient	Water Collected	
Collection facility	580	0,014	0,7	5,684	
Central movement corridor	1903	0,014	0,7	18,6494	
Market axis	5359	0,014	0,7	52,5182	
			TOTAL	76,8516	m3/month
			YEARLY AVERAGE	179,091675	m3/month

GROUND INFILTRATION	Area	Summer Rainfall	Runoff Coefficient	Ground water runoff	
Collection courtyard	467	0,014	0,05	0,3269	
Market axis	2073	0,014	0,05	1,4511	
			TOTAL	1,778	m3/month
			YEARLY AVERAGE	4,143375	m3/month

GROUND INFILTRATION	Area	Summer Rainfall	Runoff Coefficient	Ground water runoff	
Collection courtyard	467	0,05125	0,05	1,1966875	
Market axis	2073	0,05125	0,05	5,3120625	
		TOTAL		6,50875	m3/month

WATER DEMAND				
DRINKING WATER	Number of people	Demand per person	Water usage	
Drinking demand	200	0,09	18	m3/month
Cooking demand	20	0,3	6	m3/month
CLEANING WATER	Number of units	Demand per unit	Water usage	
Ablusions	92	0,5	46	m3/month
Cleaning	8	0,5	4	m3/month
	Tonnes of plastic	Demand per Ton	Water usage	
Plastic Recycling	20	100	2000	m3/month
		TOTAL	2074	m3/month

WATER RECYCLING			WATER EVAPORATION			WATER INFILTRATION		
water used	2074		average loss	0,117		averate infiltation rate	0,2	m / hour
loss to evaporaton	7,6		area (m3)	65		duration (hours / month)	30	
loss to infiltration	390		total loss	7,605	m3/month	area (m3)	65	
						total loss	390	m3/month
WATER RECYCLED	2102							

TOTAL WATER COLLECTED (m3/month)		
		Yearly Average
Roof Collection		287
Surface Runoff		179
Ground infiltration		4
Water Recycled		1676
	TOTAL	2146

figure 10.23 'Water demands and collection' (Author, 2021)

The collection and cleaning facility poses the greatest demand of water to the site. This is due to the amount of water required to clean waste plastic as well as cleaning of equipment and facilities. In addition, water is also required for the recycling of the plastic in various mechanical and chemical processes. However this water is proven to be the main source of water within the site whilst being supplemented by the water collected from storm water.

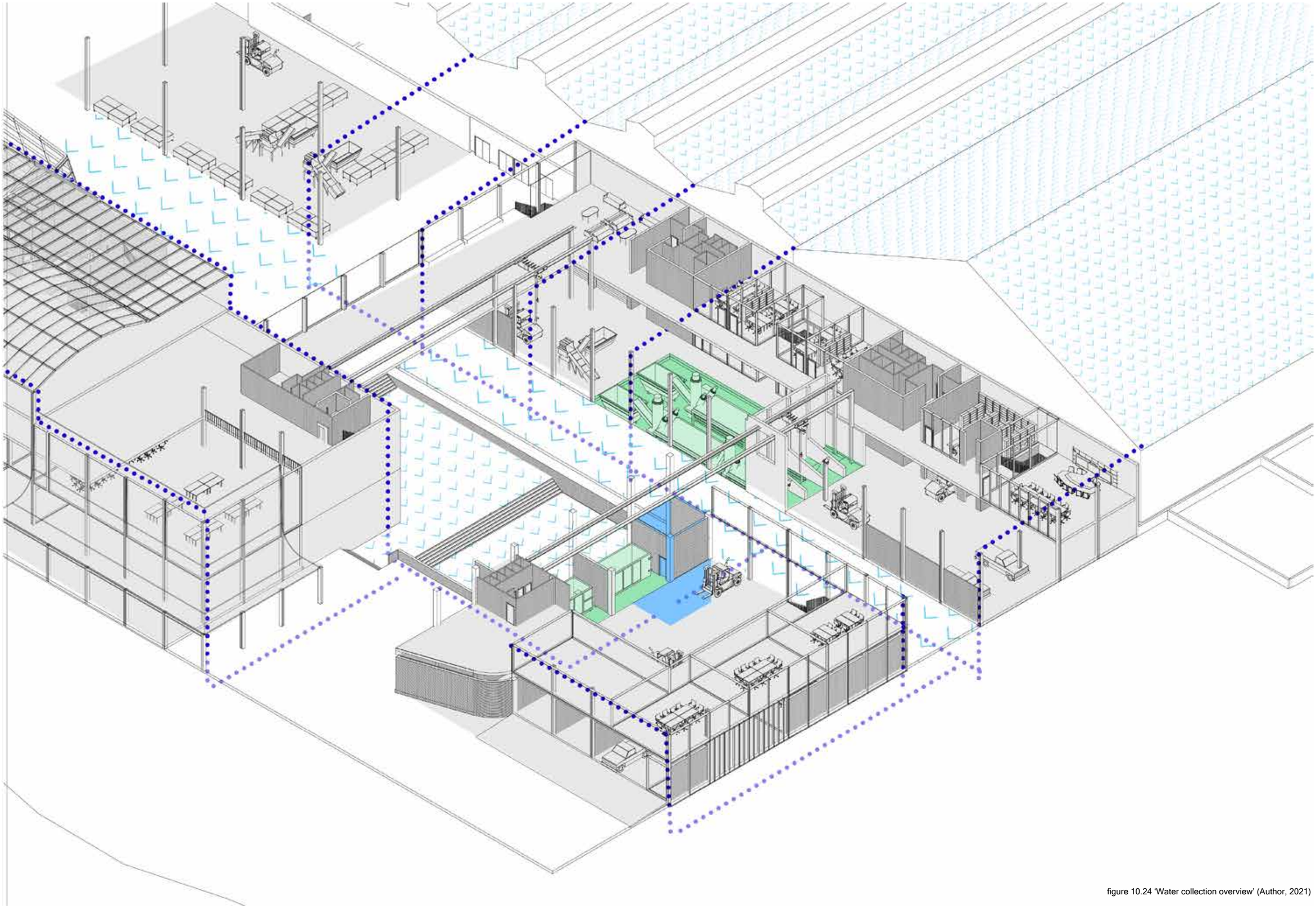
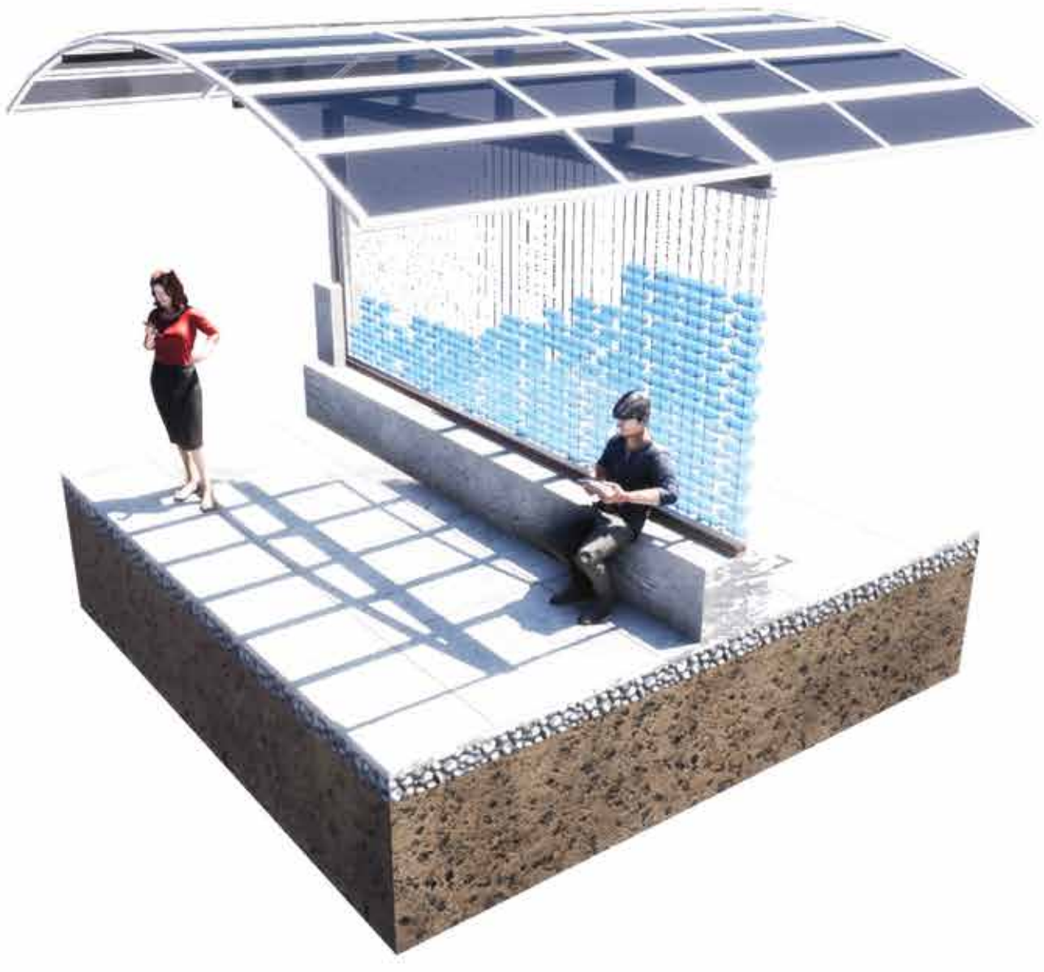
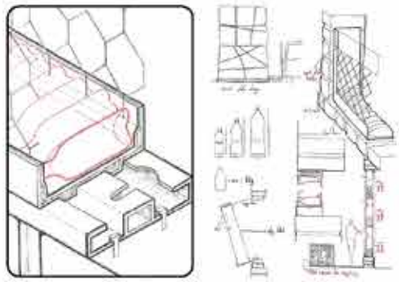


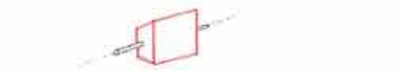
figure 10.24 'Water collection overview' (Author, 2021)

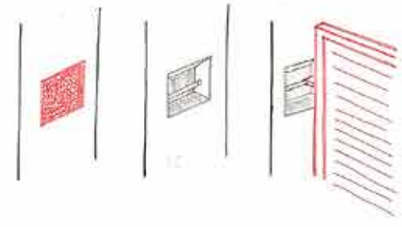
11. CONCLUSION

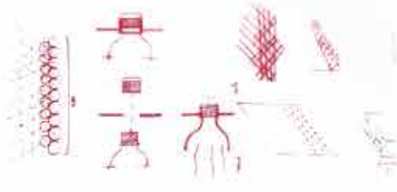
TECHNOLOGY 1

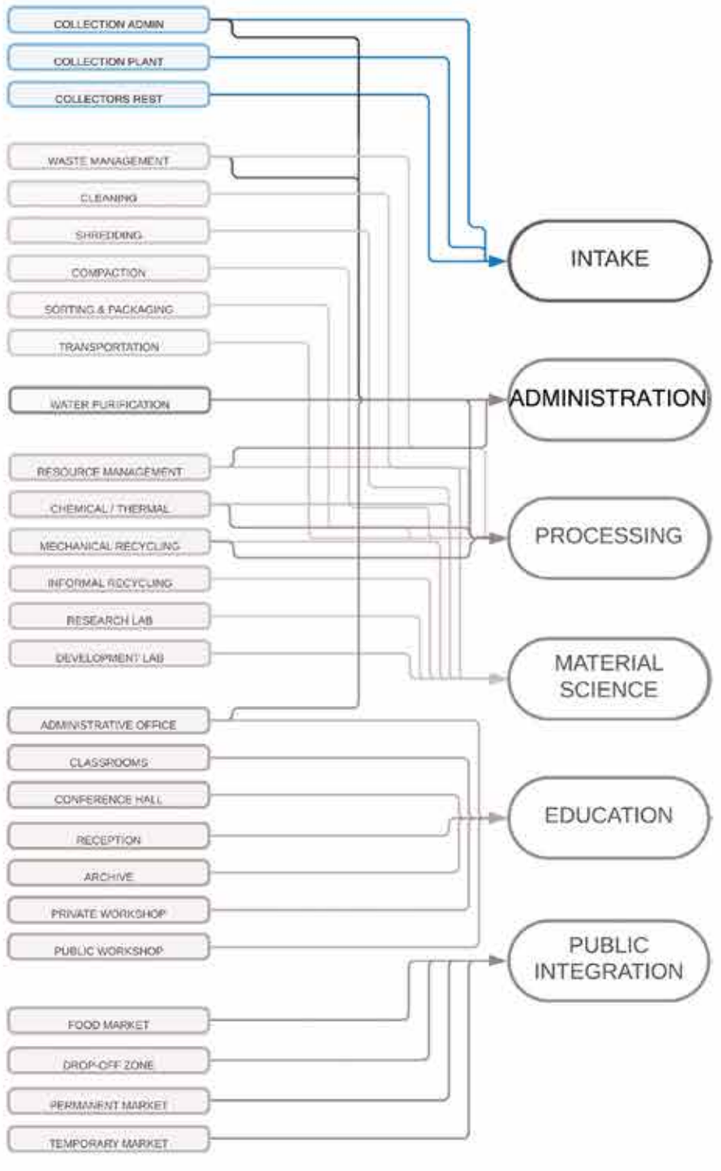




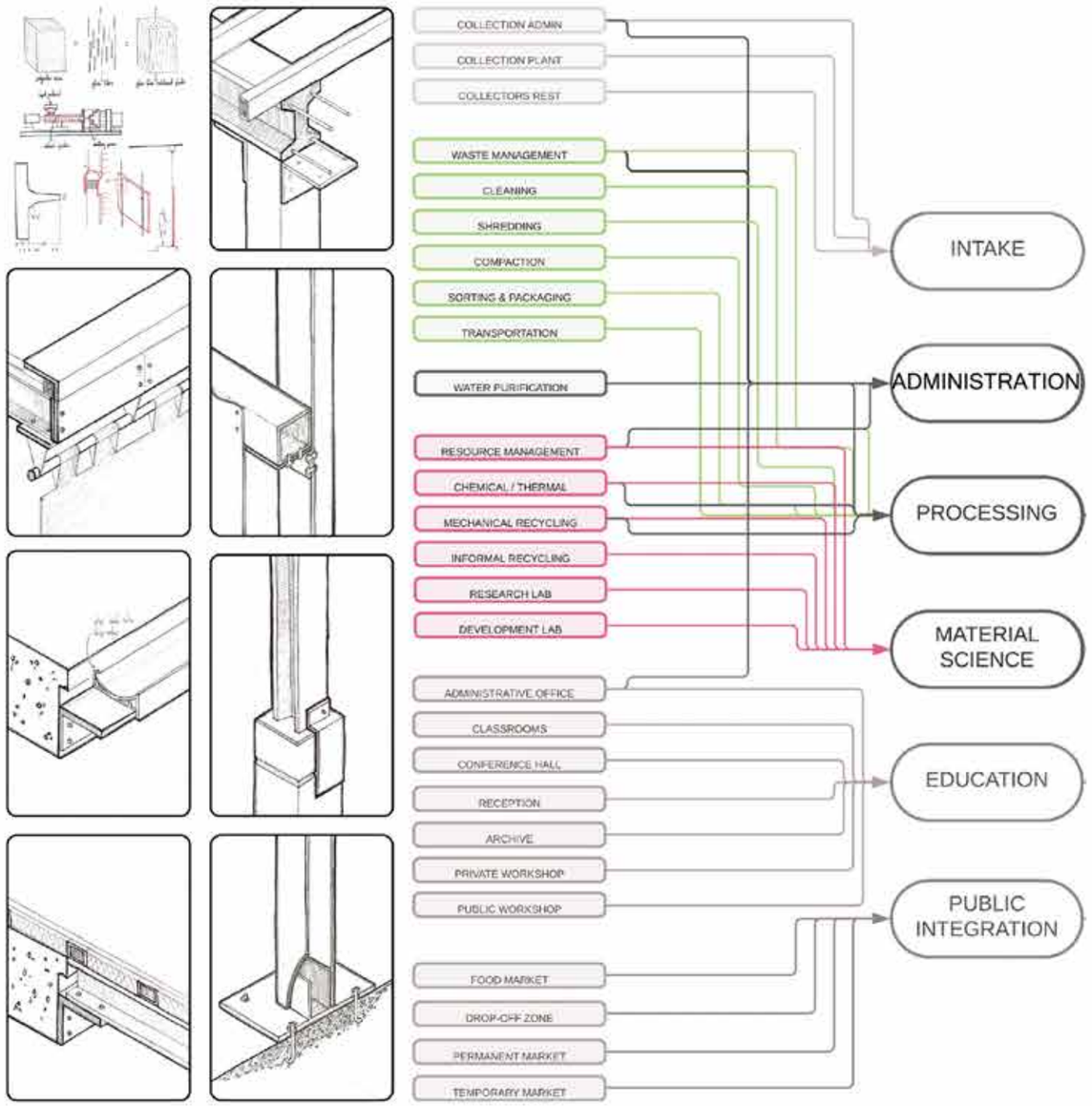




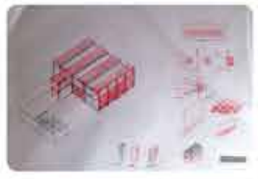


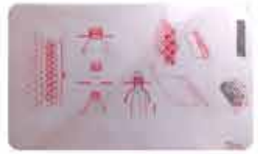


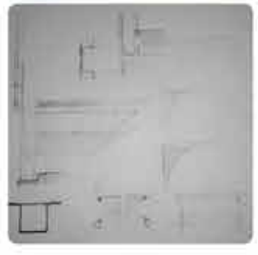
TECHNOLOGY 2

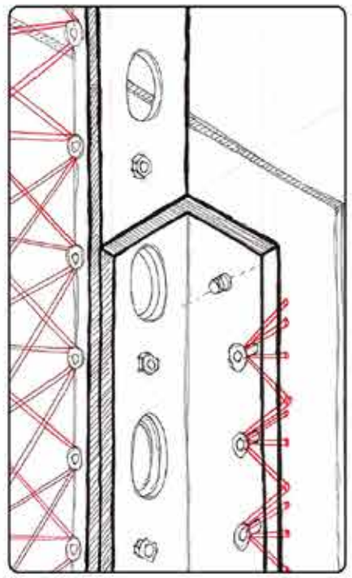


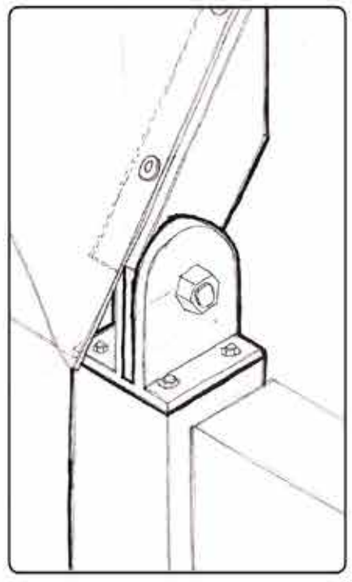
TECHNOLOGY 3

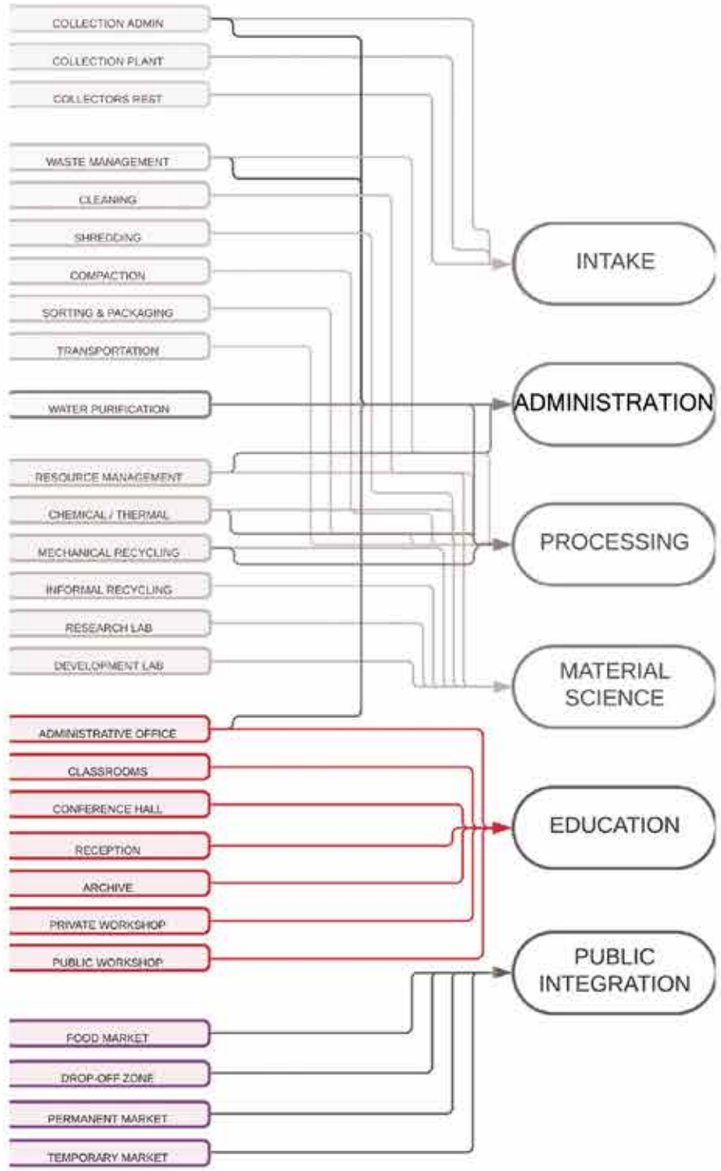


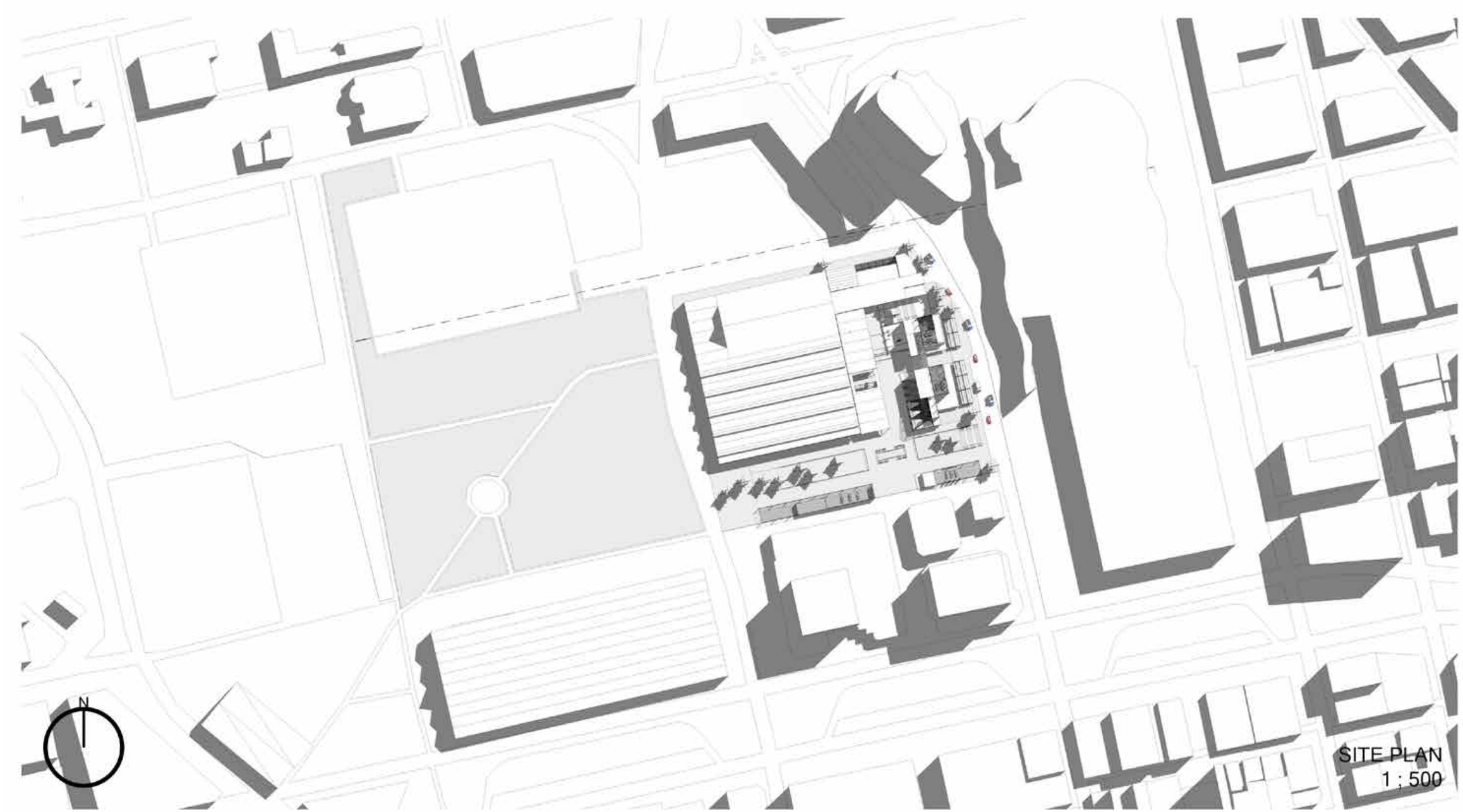


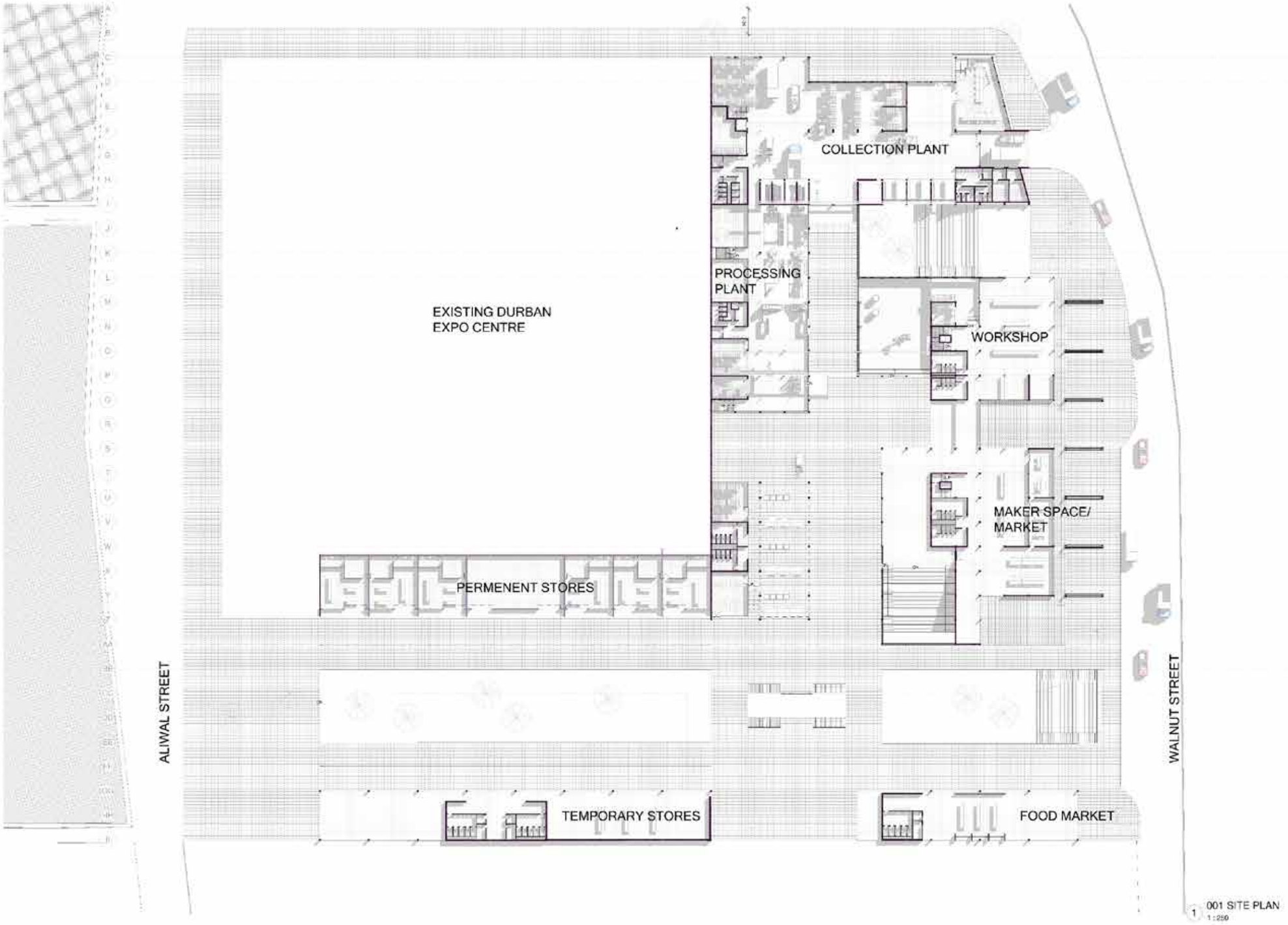


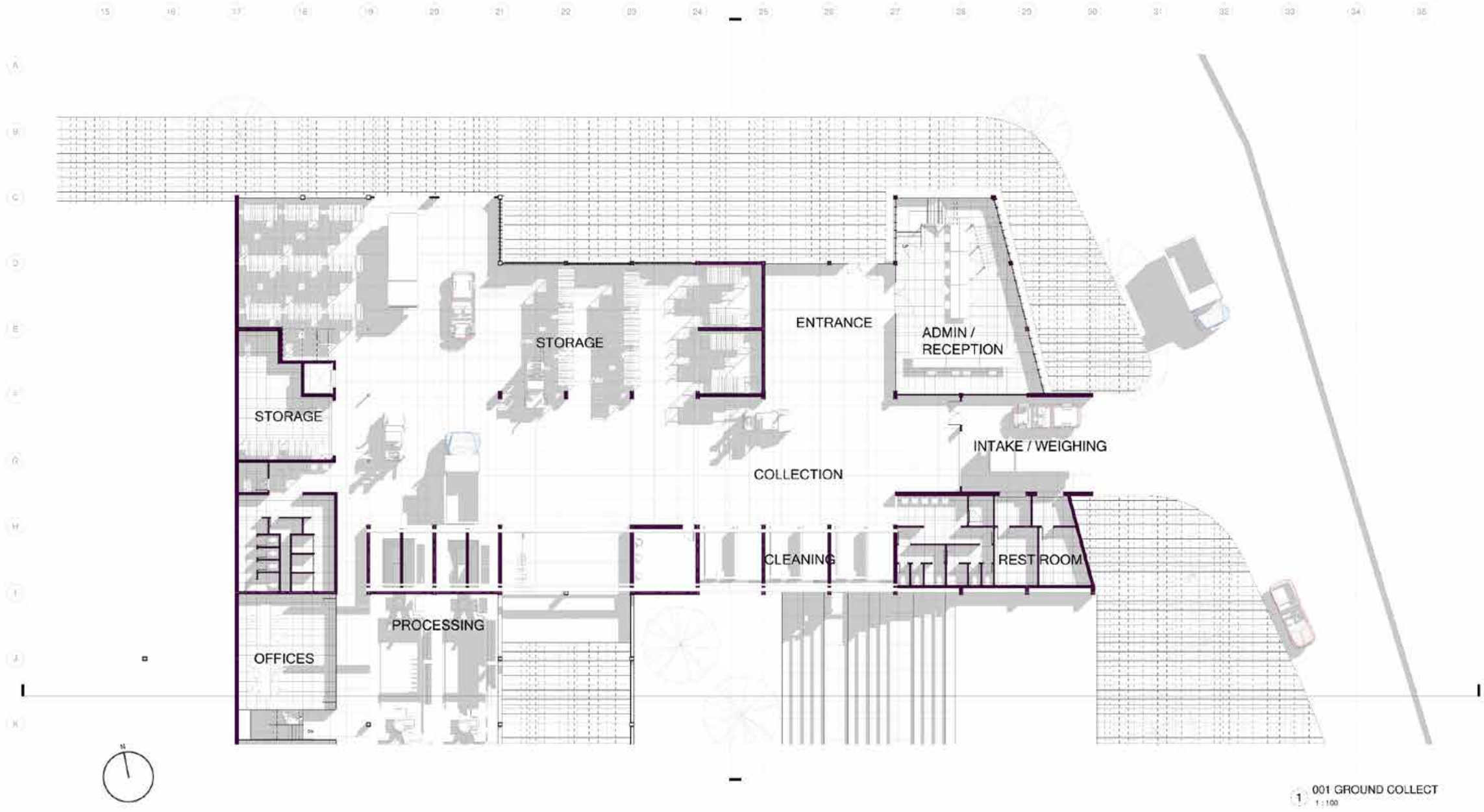


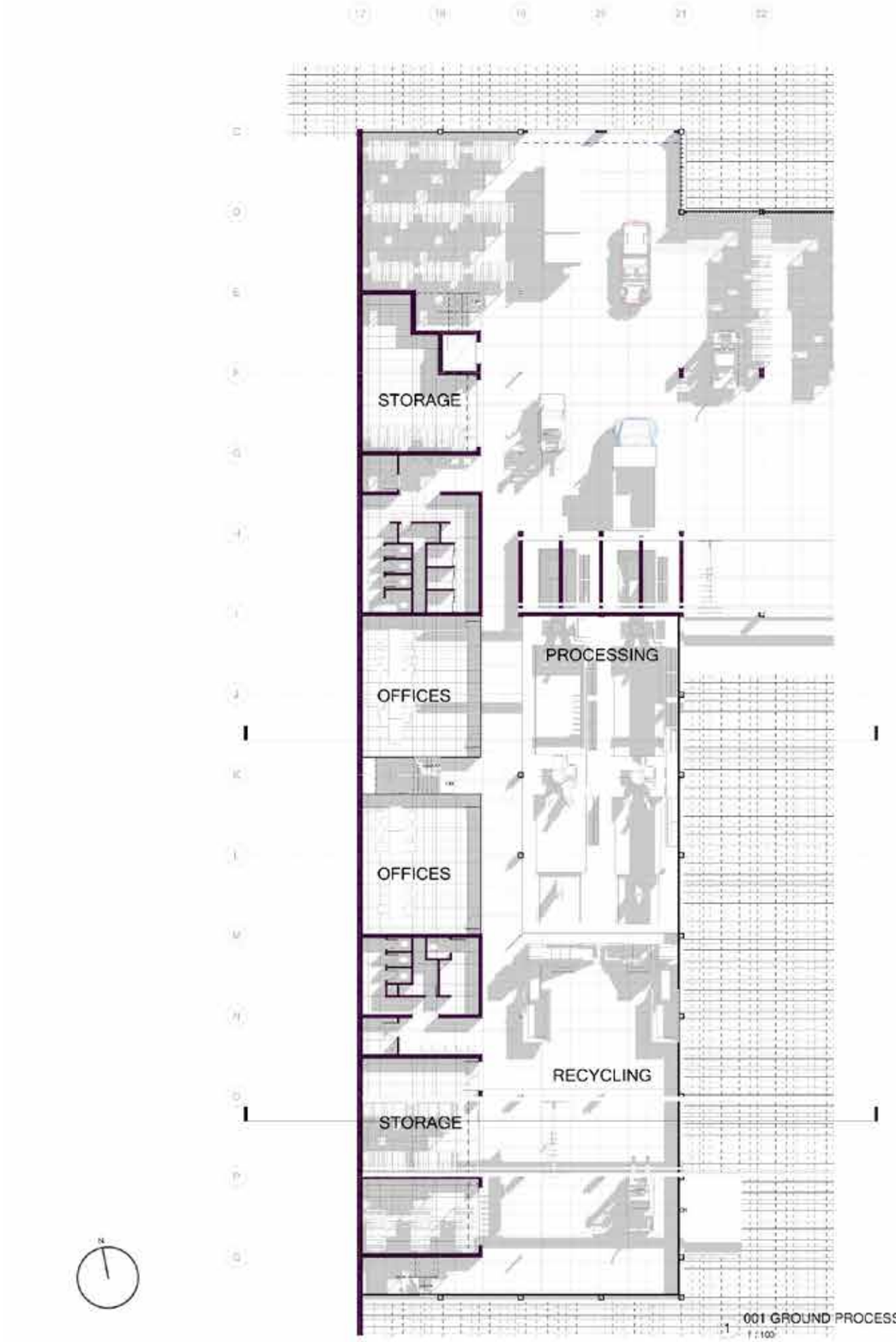












1 001 GROUND PROCESS
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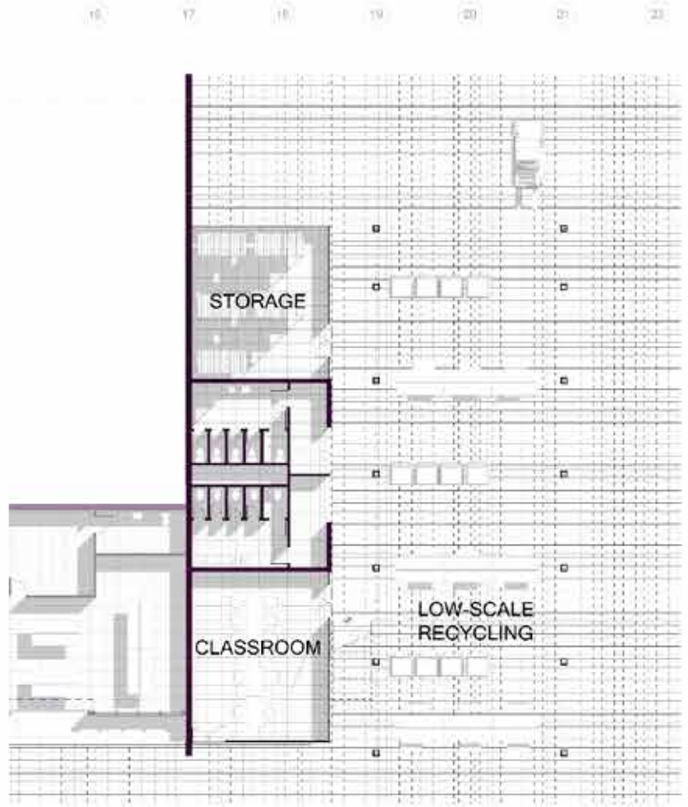

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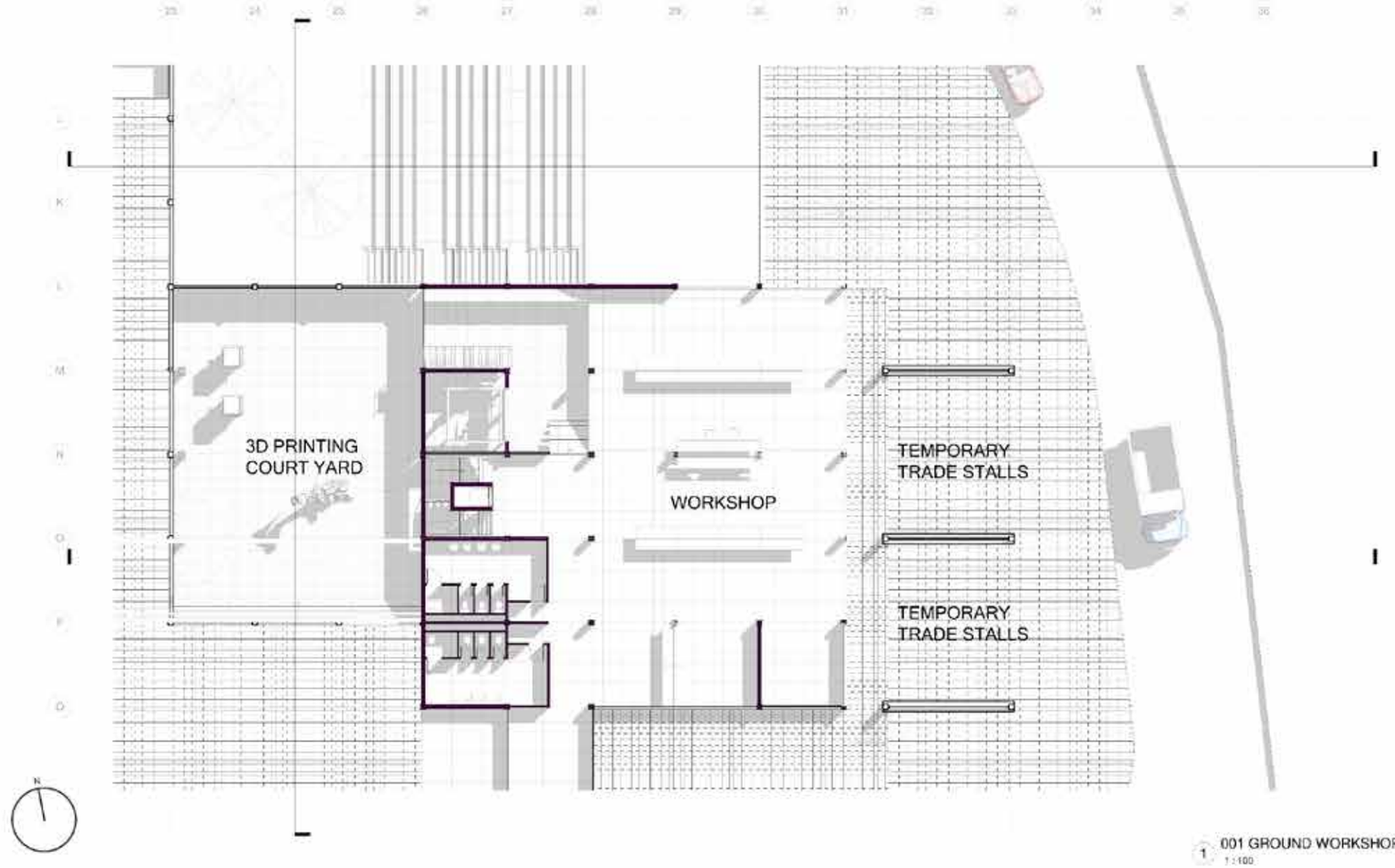

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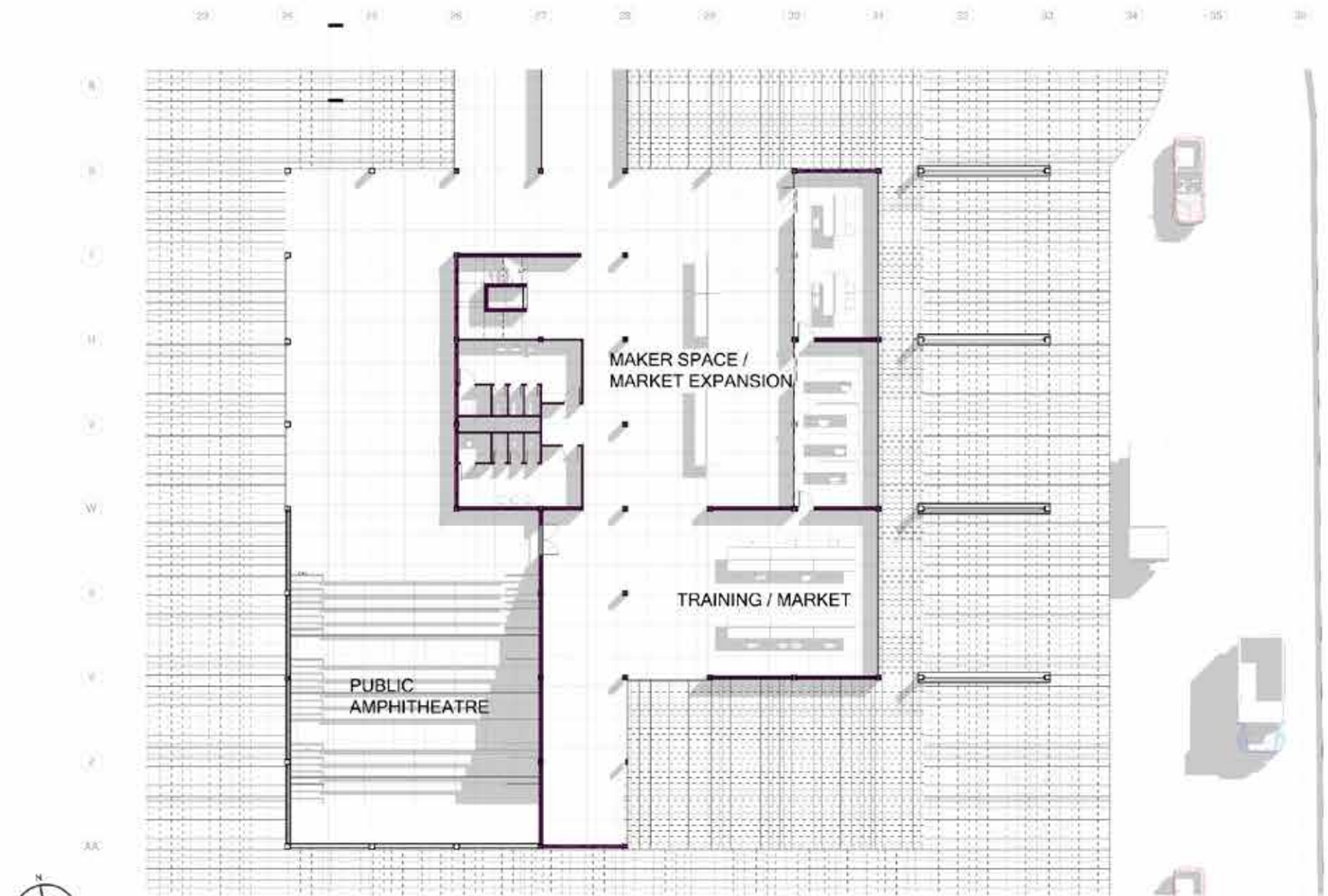

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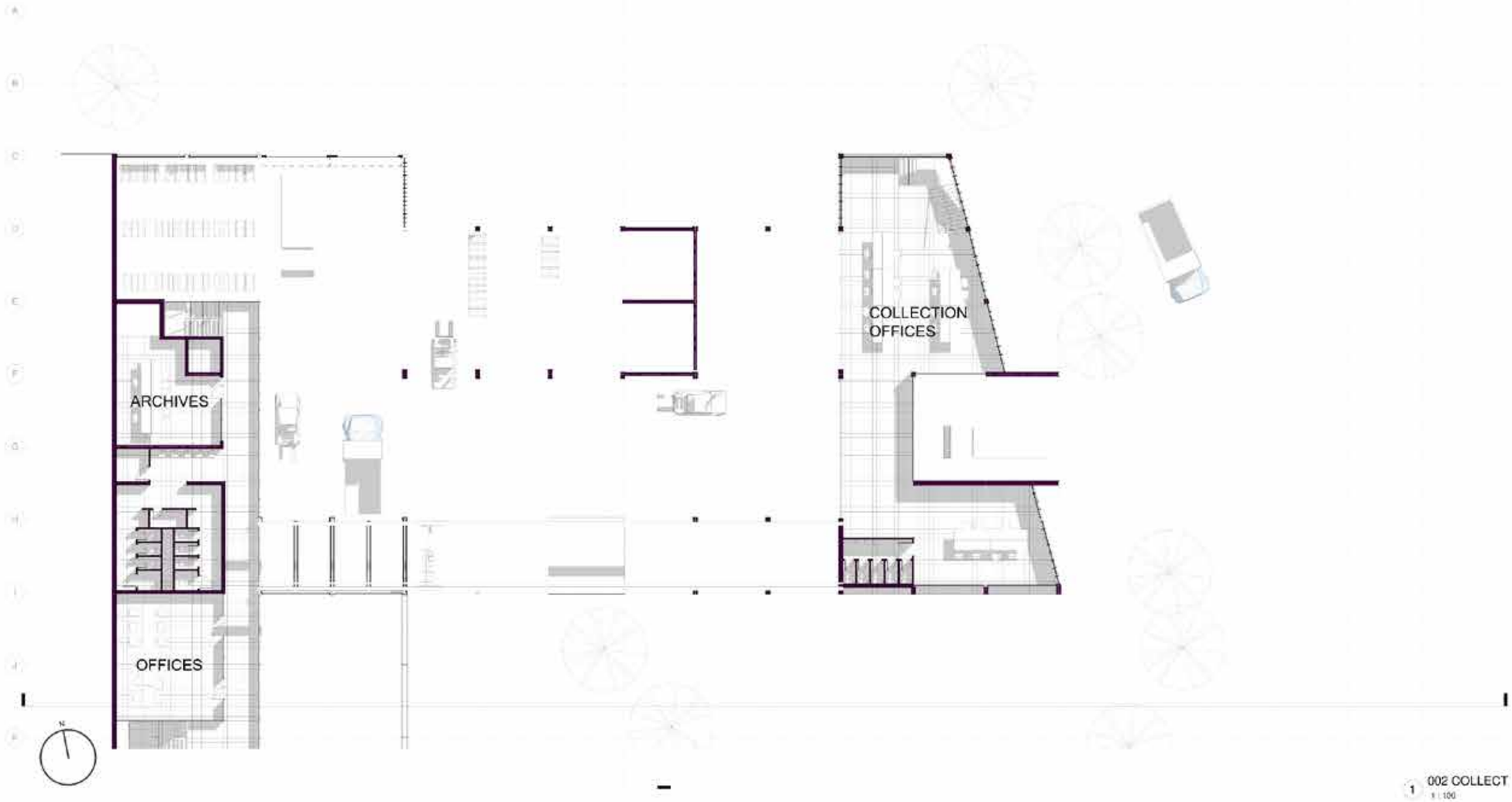
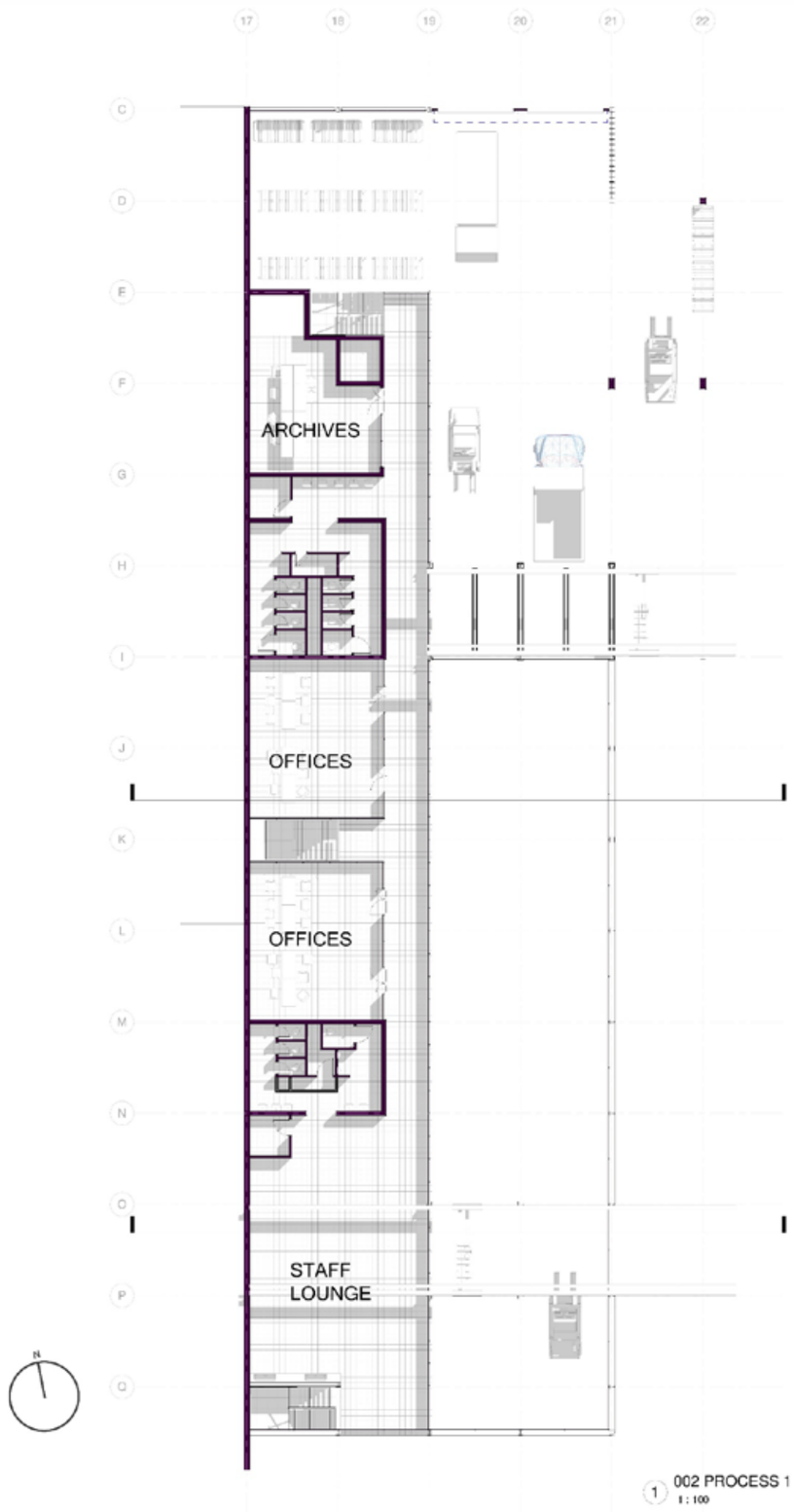


1 002 COLLECT
1 : 100



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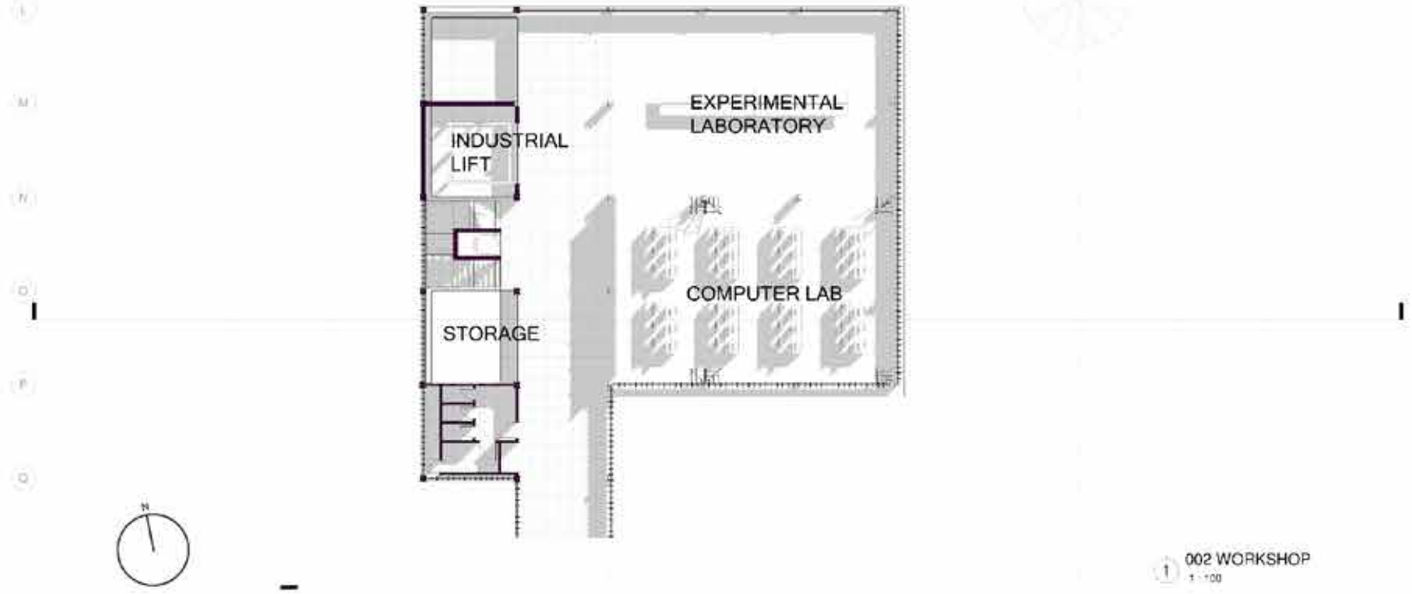
1 : 100

2 002 PROCESS 2
1 : 100



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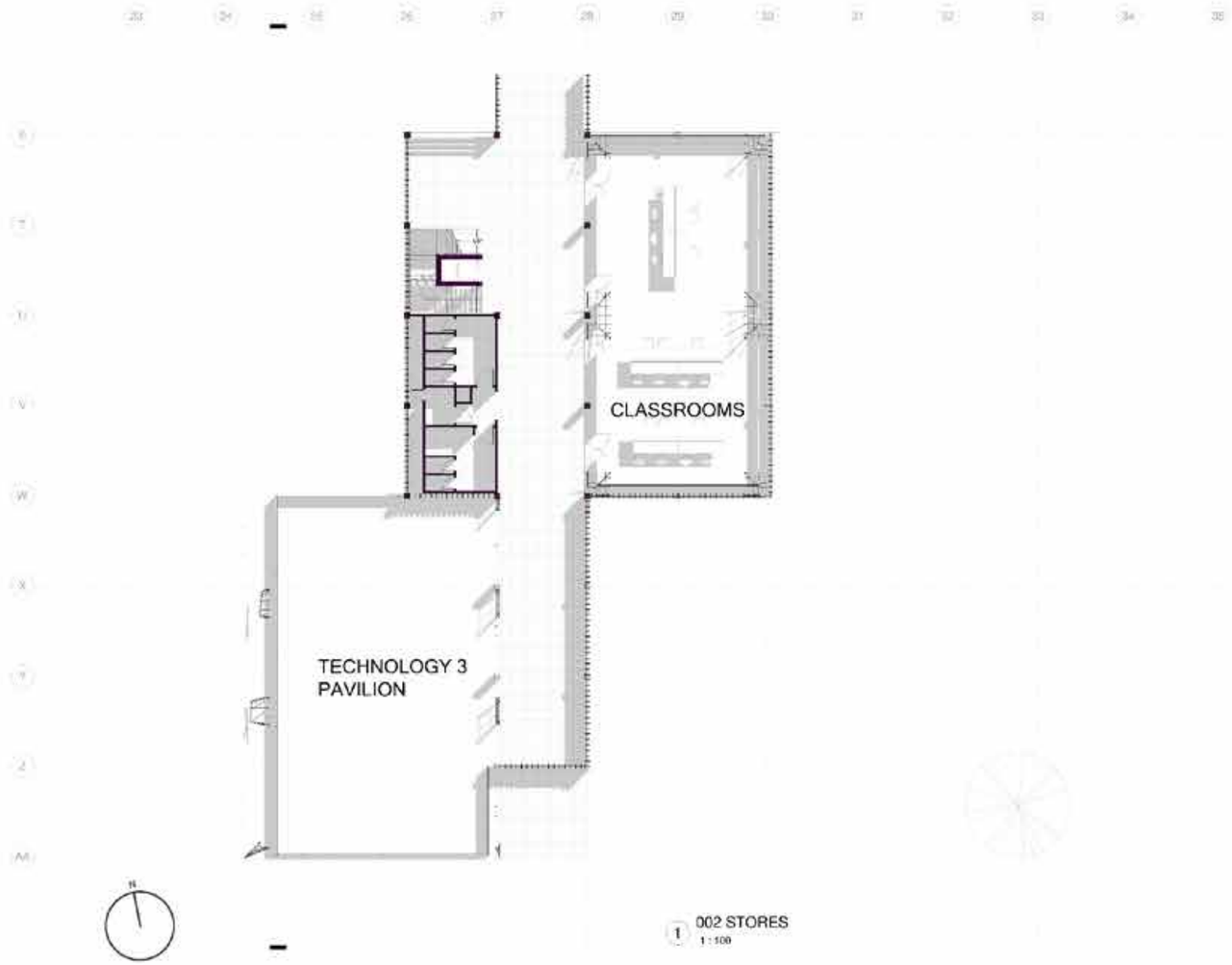
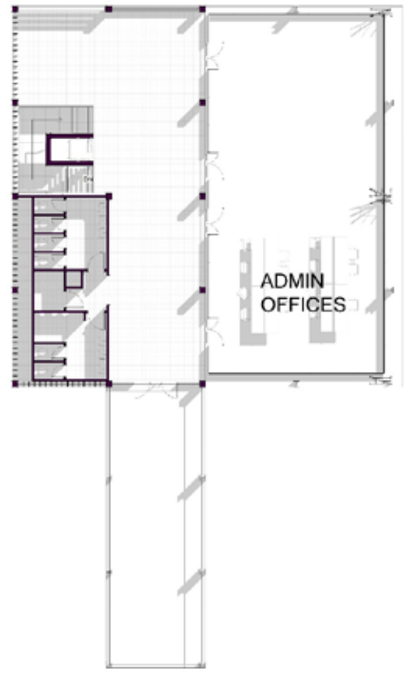
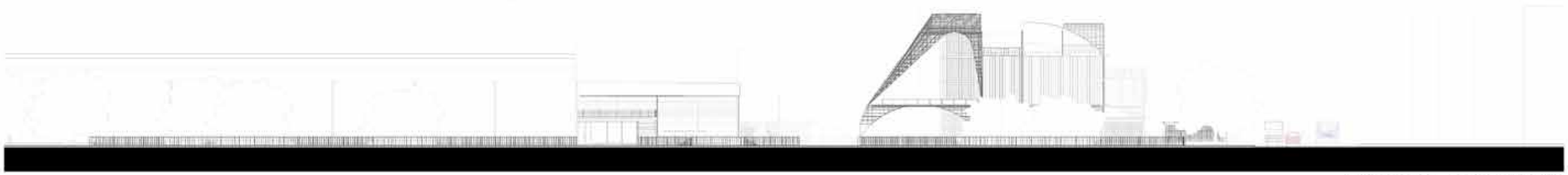


1 002 STORES
1 : 100

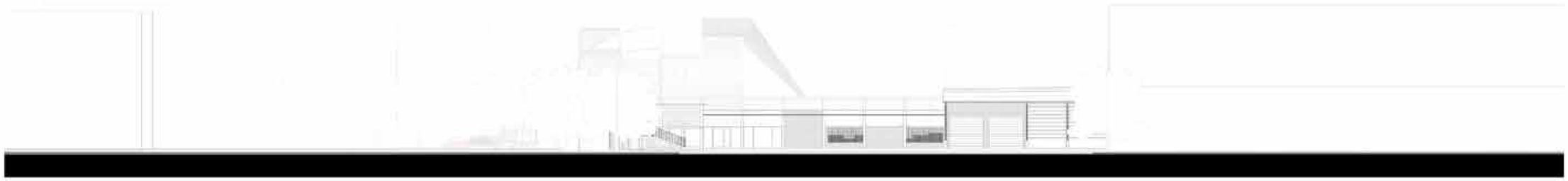
1 003 WORKSHOP
1 : 100



2 004 CLASSROOM
1 : 100



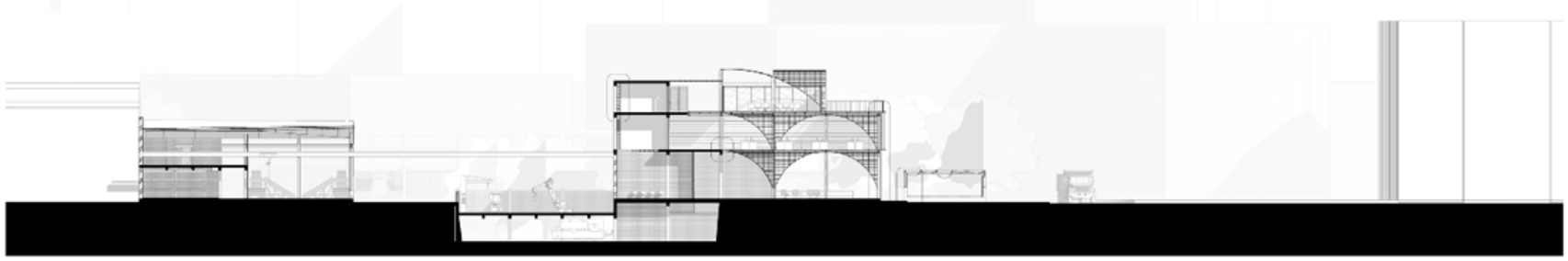
SOUTH ELEVATION



NORTH ELEVATION

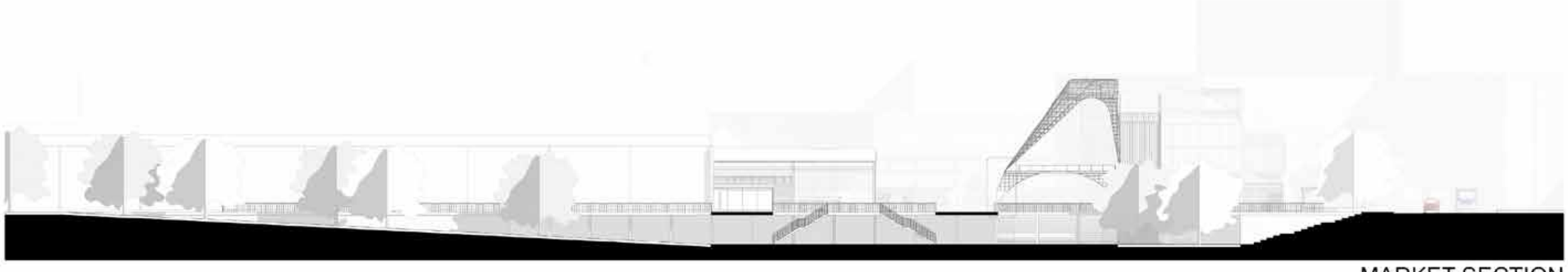
EAST ELEVATION

PROCESSING FACILITY SECTION

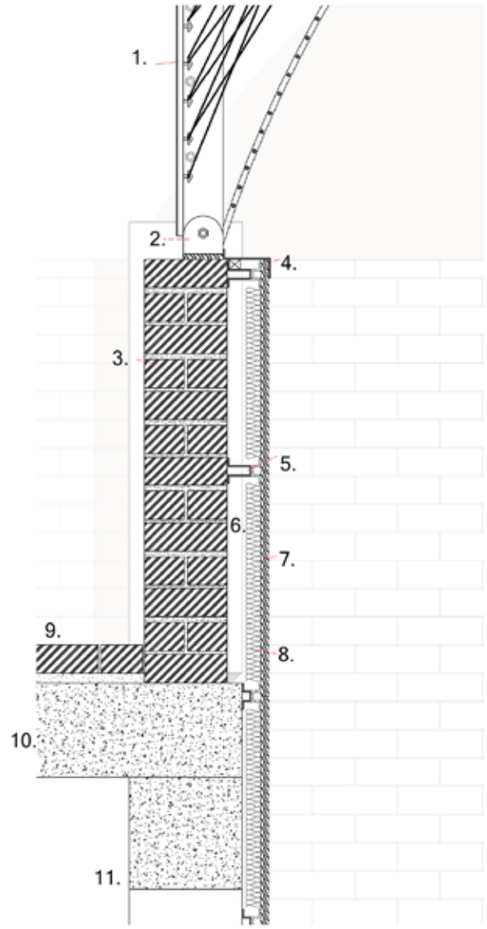


WORKSHOP SECTION

SITE SECTION



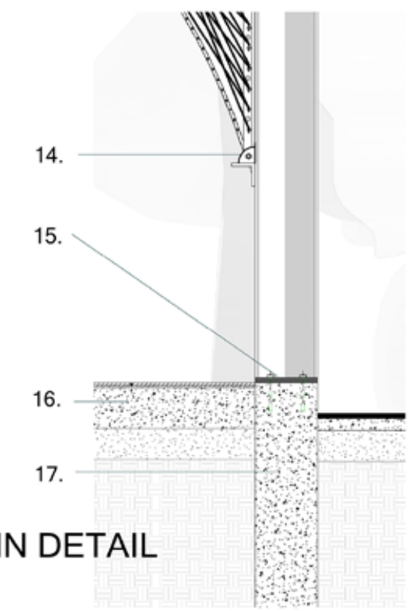
MARKET SECTION



TECHNOLOGY 3

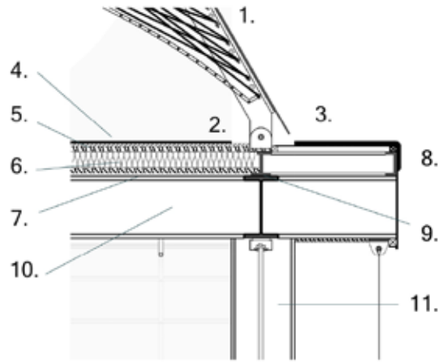
COLUMN TO FRAME DETAIL
1 : 10

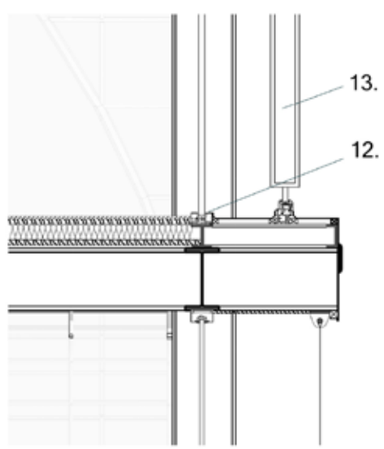
1. 1250 X 1250 X 50 GALVANIZED STEEL FRAME CORNER FILLET WITH 10mm 3D PRINTED COMPOSITE FIBRE COATED IN POLYESTER RESIN TENSILE SPOKES BOLTED TO STEEL PIVOT
2. 125mm GALVANIZED STEEL WEB PIVOT ALLOWING FOR LATERAL MOTION DURING THE CONSTRUCTION PROCESS BOLTED TO CONCRETE BOLLARDS
3. 220mm FACEBRICK WALL SUPPORTED BY 300mm X 300mm REINFORCED CONCRETE BOLLARDS @ 5m SPANS INTENDED TO ACT AS FOOTINGS FOR TECHNOLOGY THREE STRUCTURE
4. ALUMINIUM FLASHING ALONG BRICK WALL
5. GALVANIZED STEEL SECTIONS BOLTED TO WALL AND SCREWED TOGETHER AT THE FLANGE
6. STILL AIR CAVITY
7. 24mm HIGH DENSITY POLYETHYLENE BOARD SINK SCREWED TO STEEL SECTIONS @ 600mm INTERVALS
8. DENSE MINERAL WOOL INSULATION TIGHTLY PACKED INTO CHANNELS AND FIXED WITH ACCOUSTIC SEALANT
9. DRY-LAID BRICK PAVING LAID ON 50mm SAND BED
10. 250mm INSITU CONCRETE FLOOR SLAB
11. 300mm RETAINING WALL ON STRIP FOUNDATION



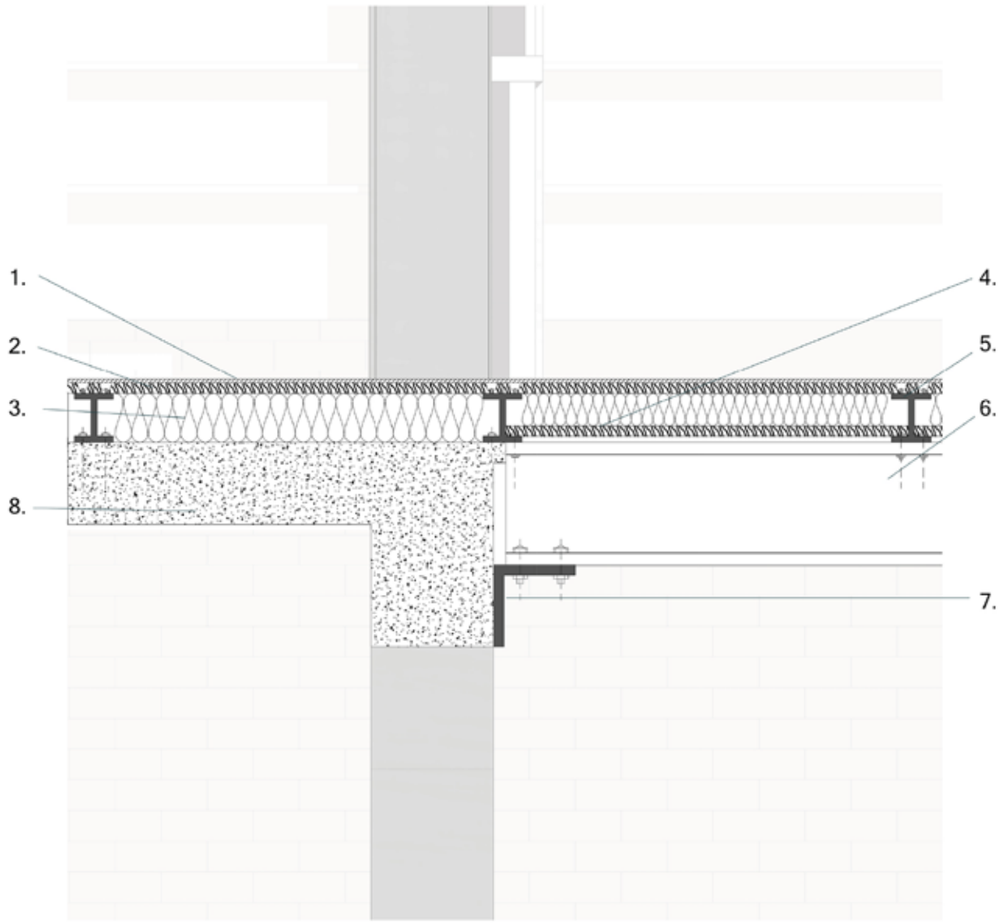
TECHNOLOGY 2

GROUND TO COLUMN DETAIL
1 : 10





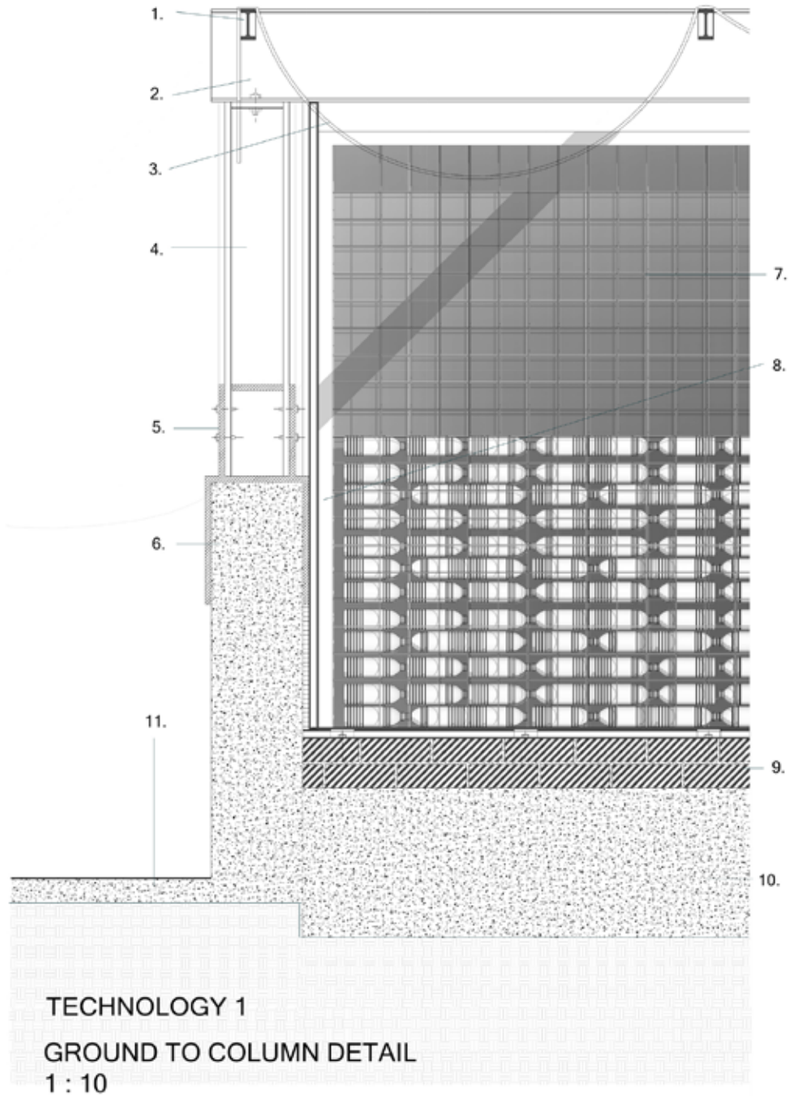
1. 1250 X 1250 X 50 GALVANIZED STEEL FRAME CORNER FILLET WITH 10mm 3D PRINTED COMPOSITE FIBRE COATED IN POLYESTER RESIN TENSILE SPOKES BOLTED TO STEEL PIVOT
2. 125mm GALVANIZED STEEL WEB PIVOT ALLOWING FOR LATERAL MOTION DURING THE CONSTRUCTION PROCESS BOLTED TO CONCRETE BOLLARDS
3. 5mm TRANSLUCENT PLEXIGLASS SHEET FLAT HEAD BOLTED TO STEEL FRAME @ 600mm INTERVALS WITH 1.8mm UV-RESISTANT ACRYLIC SHEET
4. 5mm VINYL TILE HEAT SEALED TO FLOOR BOARD
5. 38mm WOOD PLASTIC COMPOSITE FLOOR BOARD SINK SCREWED TO STEEL I SECTION
6. 50mm GLASS WOOL THERMAL INSULATION TIGHTLY PACK INTO CHANNEL RESTING ON CEILING BOARDS
7. 38MM WOOD PLASTIC COMPOSITE CEILING BOARD SUSPENDED WITHIN THE CHANNEL OF STEEL I SECTION
8. ALUMINIUM FLASHING RIVETED TO TIMBER CORNER FILLET WITH 10mm DRIP AT THE SOFFIT
9. 100mm X 50mm GALVANIZED STEEL I SECTIONS BOLTED TO GFRP BEAM
10. 300mm X 100mm GLASS FIBRE REINFORCED PLASTIC BEAM BOLTED TO GFRP COLUMN
11. 300mm X 300mm GLASSFIBRE REINFORCED PLASTIC BEAM WITH STEEL REINFORMENT TO ACT AGAINST TORSION
12. ALUMINIUM FRAME SINGLE PANE LOW-E GLASS
13. 250mm x 10mm HIGH DENSITY POLYETHYLENE LOUVRE
14. 100mm X 100mm GALVANIZED STEEL ANGLE BOLTED TO GFRP BEAM
15. 300mm X 300mm GALVANIZED STEEL WALL PLATE CHEMICALLY ANCHORED TO CONCRETE FLOOR
16. 250mm INSITU CONCRETE FLOOR SLAB WITH 5mm EPOXY RESIN FINISH
17. 300mm REINFORCED CONCRETE STRIP FOUNDATION



1. 5mm VINYL TILE HEAT SEALED TO FLOOR BOARD
2. 38mm WOOD PLASTIC COMPOSITE FLOOR BOARD SINK SCREWED TO STEEL I SECTION
3. 50mm GLASS WOOL THERMAL INSULATION TIGHTLY PACK INTO CHANNEL RESTING ON CEILING BOARDS
4. 38MM WOOD PLASTIC COMPOSITE CEILING BOARD SUSPENDED WITHIN THE CHANNEL OF STEEL I SECTION
5. 100mm X 50mm GALVANIZED STEEL I SECTIONS BOLTED TO GFRP BEAM
6. 300mm X 100mm GLASS FIBRE REINFORCED PLASTIC BEAM BOLTED TO STEEL ANGLE
7. 100mm X 100mm GALVANIZED STEEL ANGLE BOLTED TO CONCRETE UPRIGHT
8. 250mm INSITU CONCRETE FLOOR SLAB RESTING ON 300mm X 300mm CONCRETE COLUMN

TECHNOLOGY 2

BEAM TO FLOOR DETAIL
1 : 5



TECHNOLOGY 1

GROUND TO COLUMN DETAIL
1 : 10

1. 100mm X 50mm GALVANIZED STEEL I SECTION LOOSE FITTED INTO CHANNEL CUIT INTO GFRP BEAM
2. 300mm X 100mm GLASS FIBRE REINFORCED PLASTIC BEAM BOLTED TO STEEL COLUMN
3. TEMPORARY POLYESTER FABRIC TARP TIED DOWN TO STEEL SECTION
4. 100mm X 100mm GALNIZED STEEL COLUMN BOLTED TO PLASTIC COLUMN SLEEVE
5. 320mm X 320mm X 20mm INJECTION MOLDED PLASTIC SLEEVE FITTED OVER CONCRETE BOLLARD
6. 300mm X 300mm CONCRETE BOLLARD
7. 1200mm X 500mm X 90mm GALVANIZED STEEL GABION CAPSULE INTENDED TO BE FILLED WITH A MAXIMUM OF 100 0.5L BOTTLES AND THEN REMOVED FOR RECYCLING
8. 100mm ALUMINIUM FRAME BOLTED TO BRICK DIVIDER @ 1200mm INTERVALS
9. 110 FACEBRICK DIVIDER
10. 7500mm X 450mm INSITU CONCRETE BENCH
11. 1200mm X 1200mm CONCRETE TILES LAID ON 50mm SAND BED

11.1 METHODOLOGY

This dissertation adopted a methodological approach as outline by Creswell (2009). Data was gathered sequentially and then weighed quantitively. This data was primarily technologically based and was used as a feasibility study to understand the limitations of plastic-based materials. This quantitative data was then followed by qualitative data, sourced through site visits and experiences on site.

Critical reflection of this process, however, shows that there remains an opportunity for qualitative data extracted from the initial research conducted around plastic-based materials. This exploration was only conducted within the later stages of the dissertation, and as a result, does not necessarily follow a logical sequence of knowledge gained through the research phase of the dissertation.

11.2 DESIGN REFLECTION

After evaluation of previous iterations, these spaces are arguably too flexible, lacking the necessary language to associate the space with education and the hands-on exploration of material. It is for this reason that later iterations were explored to provide deeper connections with the technological aspects of the programme, such as the recycling and collection of plastic waste. These connections were intended to provide visual access to these programmes from the education and making spaces in which the public users are primarily gathered. The spatial operator - Expanding briefs - as mentioned by Awan, Schneider and Till (2011: 69) explains the notion of the parameters that a design fits in. These parameters, although act as boundaries or limits, have the potential to expand as the programme and design evolves. It is this concept that the latter iteration of the dissertation follows. Parameters should be more visibly and legibly demarcated within different phases of the building, illustrating the specified programme, until these parameters are expanded or changed to accommodate the new programme.

11.3 TECHNOLOGICAL REFLECTION

Upon reflection of the dissertation, the technological exploration proves to be the most influential to defining and redefining my normative position. This technological intention, although initially explored to challenge the throw-away culture and the embodied energy of construction materials, has shown potential in providing spatial agency to users due to the temporality of the plastic-centric structural components.

This plastic centric construction method, as previously argued, fulfils the spatial operators: Expanding Briefs; Making things visible; and Sharing knowledge, as outline by Awan, Schneider and Till (2011: 69). These spatial operators are accomplished through the integration of technology and programme within the public realm and public interaction. Naturally this interaction should accommodate manipulation without the need for tools or machinery; however, in order to satisfy the structural requirements of a multi-storey building, the challenge of the primary structural elements was to find mediation between highly skilled assembly which requires tools and machinery and an 'off-the street' approach. These spaces however still utilize low-technology interior partitions and elements that require no tools for the fixing of components expect for the application of heat to form components at the initial forming phases.

Ultimately the introduction and the exploration of a new plastic-based construction method was the primary intention of the dissertation. To facilitate this introduction, the proposal would have to garner a sufficient number of users to initiate this cultural and technological shift within the built environment and the everyday lives of the users of the space. Thus, the selection of the site is very integral to the dissertation's success and the introduction of a plastic centric constructed building within the cityscape of Durban. The site itself provided the necessary foot traffic and public interaction with the building. This interaction is crucial to the adoption of new technologies within existing culture, as argued by Michaels (2000:11-13) and to challenge the technological knowledge disparities of intellectual and manual labour as stated by Smith (2013:57).

The intention of the dissertation was to provide flexible spaces that not only provided the spatial agency to the users, but also facilitates programmes that bridge these knowledge gaps by providing spaces of learning and cooperation between different levels of knowledge. Iterations of the plastic construction explored the integration of temporary fixing methods directly into traditional construction and materials. Laying moulded plastic bricks directly into the course of a brick wall or cast into a concrete column. These methods centred around the use of plastic components that allow for prefabricated frames, walls, or parts to be fixed to brick or concrete walls. Although steel portal frames were explored, it posed little potential as compared to GRF composite columns and beam sections. Although there are limitations to the composite materials, these limitations are celebrated and mediated, creating a new structural language that is apparent within the temporary structures. This language is articulated through the structural flanges on composite columns that resist buckling and torsion, and the structural corner fillets applied to remove shearing forces on the beam at beam-to-column junctions. The floor structure adopts the 3D printed frame system as exhibited by Maison Fibre. This system remains completely visible from the underside and uses floorboards and vinyl tiling to achieve finished floor level.

Due to the low R-value of these materials and low density, they do not offer a lot of thermal resistance, thus do not radiate absorbed heat over extended periods of time. It is for this reason that insolation control on the external skin is so important to the climatic response of the building.

11.4 THE ROAD AHEAD

As a student, I admired the conceptual work of Lebbeus Woods. Although limited to 'paper architecture' it can be argued that conceptual architecture is unbounded by the limitations of the technology of our time, however Woods' work was very grounded in socio-political tense environments such as war or natural disasters. As I look forward, and towards my career as an architect, I believe that Woods' work still carries an important conceptual message of what architecture can be, however, through this dissertation and the explorations of technology and materials, I believe that the technological advancements in other fields could provide many answers, not only limited to architecture. I foresee my contribution to the profession through the exploration of these advancements in other fields and how they can be adapted, adopted, and integrated within architecture.

This dissertation, particularly the technological explorations and material precedents (Shah (2021) & University of Stuttgart (2021)) are testament to this. Through the intention of integrating a recycling culture and technology within the architecture itself, the dissertation was intended to merge the fields together, thereby sharing knowledge and improving the opportunity and potential of both as a result. This sharing of knowledge counters the labour skill disparities as mentioned by Smith (2013:57) by opening up these otherwise esoteric and private technologies to the public and encouraging interaction and participation to further 'tame' exotic technologies. However, much like the decision to focus on plastic waste within this dissertation, it should not be exploration for exploration's sake, but the exploration of technologies that have real-world impact and are capable to be adopted into mundane life.

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13. ADDENDUM

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Faculty of Engineering, Built Environment and Information Technology
Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

9 June 2021

Reference number: EBIT/79/2021

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

Dear Ms A van Aswegen

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Research Ethics Committee refers.

Conditional approval is granted.

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

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

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

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

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

The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

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

UNIVERSITY OF PRETORIA
FACULTY OF ENGINEERING, BUILT ENVIRONMENT & INFORMATION TECHNOLOGY
DEPARTMENT OF ARCHITECTURE

CPD 810 / DPD 801/2/3 / DIT 801/2/3

Student researcher declaration

(To be signed by each student and kept on record by the supervisor)

1. Title of research project:

From waste to architecture: The facilitation and integration of recycled plastic waste as a construction method in the built environment.

2. I Kailyn Bonhomme student number 16060912 hereby declare that:

1) I am acquainted with the Code of Ethics for Research and will apply the principles contained in the Codes in all my research activities;
2) I will conduct the study as specified in the application and principally responsible for all matters related to the research;
3) I will communicate all changes to the application/or any other documents before any such is executed in my research with my supervisor;
4) I will explain the objectives and implications of the research to informants;
5) I will indicate to informants that their participation in the research is voluntary and that they can withdraw from the research at any stage;
6) I will obtain written informed consent from each informant;
7) I will not to ask informants any questions requesting personal information (e.g., questions on name, ID number, etc.) or questions beyond the theme of the abovementioned project;
8) I will treat all responses of informants confidentially;
9) I will not engage in any form of research fraud (e.g., falsifying or distorting data);
10) I will obtain written permission letters from organisation(s) that may be contacted as for data related to the abovementioned project; and
11) I will not engage in research that presents conflict of interest or financial benefit, whether for the researcher, company or organisation, that could materially affect the outcome of the investigation or jeopardise the name of the University of Pretoria.

Student signature: _____ Date: 12/04/2021

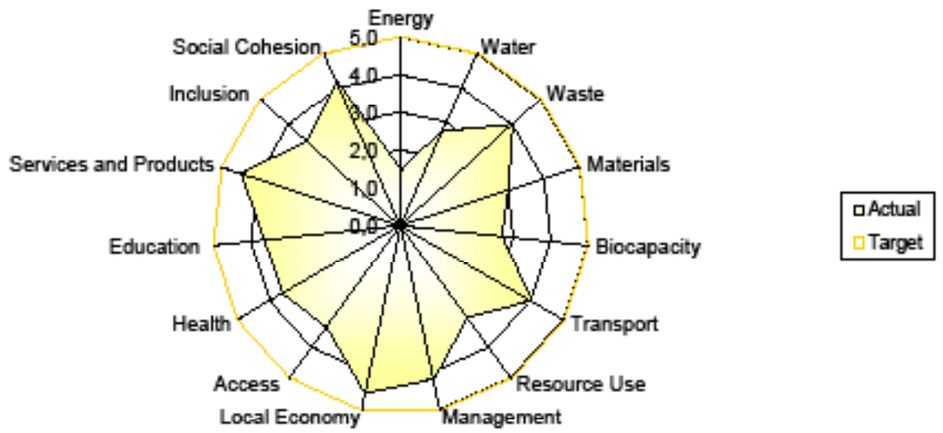
SUSTAINABLE BUILDING ASSESSMENT TOOL RESIDENTIAL 1,04

		Achieved
SB	SBAT REPORT	3,5

SB1 Project
Durban Plastic Resource Centre

SB2 Address
11 Walnut Rd, Durban Central, Durban, 4001

SB3 SBAT Graph



SB4 Environmental, Social and Economic Performance	Score
Environmental	2,8
Economic	3,8
Social	3,8
SBAT Rating	3,5

SB5 EF and HDI Factors	Score
EF Factor	3,2
HDI Factor	3,8

SB6 Targets	Percentage
Environmental	55
Economic	76
Social	77

SB7 Self Assessment: Information supplied and and confirmed by

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