URBAN MINNING

FUTURE CITIES FROM WASTE: TOWARDS A POSSIBILITY

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SEMINAR II

Submitted in partial fulfilment of the requirements for the degree of bachelor of architecture

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PROBLEM OR POSSIBILITY

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ABSTRACT

Twenty 1st century, the world is obsessed with the myth of development; busy in building urban cities by extracting natural resources and constructing landfill sites. Its not million tons of waste rather million tons of resources that are being buried in these graveyards. Today 1/3 of our total natural resources have already been gone. How can we further continue the process of creating things without exhausting our nature? For hundred of years we designed cities to generate waste. Now it is time that we begin to design waste to regenerate our cities. Certainly, we can create a future where we can turn our biggest problems into the biggest possibilities. What are the possibilities for urban environments when our aged infrastructure has been recalibrated? How might urban intensification and waste mix? In that case, the question against waste should be " what can we make out of it?" instead of "How can we get rid of it?"

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CHAPTER 1: INTRODUCTION

1.1 Background of the project

Our economic system is based on the principle of the exhaustion of natural resources for the purpose of production, entailing the fabrication of waste. This system functions at the expense of our social integrity and environmental sustainability. Images of the urban poor searching steaming landfill for valuable items are iconic representation of our modern lifestyle. In a dramatic way the garbage sites show the entanglement of economic success and rapid urbanization with social segregation into “haves” and “have- nots”. Instead of being included in a metabolic cycle and flow model of goods and resources, waste is considered within a dead end scenario of a linear process to be literally buried from view- out of sight-out of mind- as a formless substance that has no value and is therefore covered by thick layers of earth or burned to ashes.

Looking, by contrast, at the waste products reveals a completely different story. It is a story of a resource that is being wasted. 1.3 billion tons of municipal solid waste is generated every year by the cities worldwide. This amount is expected to grow to 2.2 million tons by 2025. i.e. within the next ten years.

Marc Angelil and Cary Siress, in their article “Re: Going Around in Circles, Regimes of Waste” acknowledge the huge potential: “ waste and its meticulous handling are valued as gifts. Offered by society to itself. Where we turn the parables missed opportunity to our advantage.” The authors talk of waste as a gift that needs to be freed from its ‘pejorative stigma’. ‘Waste production is an investment that needs to be returned. So far this investment is deadlocked and we seem to have lost the key to how to open its potential and benefit from it as a life long revenue.’ (Drick E. Hebel, ‘Building from waste’)

1.2 Targeting Dhaka City

Dhaka, the capital of Bangladesh has been ranked consecutively 2nd time as the 2^{nd} least livable city in the world with a score of 38.7, by the Economist Intelligence Unit’s (EIU) Global Livability Survey (Daily star, 2013). While Australia’s Melbourne has retained it’s status as the most livable city with a score of 97.5, Dhaka a historic city with a legendary past 'running into hundreds of years‘ has got it’s position right before a war torn city Damascus (Syria) that has hit a score of 38.4 (Daily Star, 2013). The EIU scores each city on over 30 qualitative and quantitative factors, across five broad categories including stability, environment and

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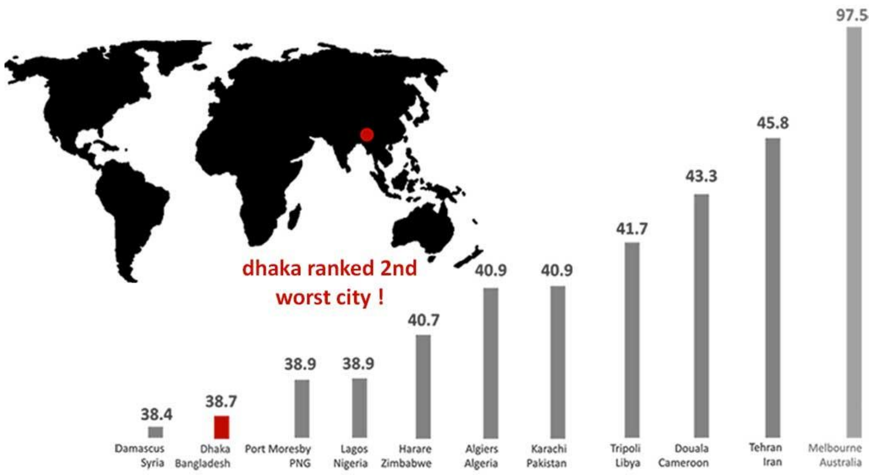
culture, healthcare, education and infrastructure. The ranking considers that any city with a rating of 80 or more will have few, if any, challenges to living standards and any city with a score of less than 50 will see most aspects of living severely restricted. Dhaka's rating is at the bottom (140) of the EIU ranking, where it scored only 43.3 in environment standard. Furthermore, Dhaka is rated as the ninth most polluted cities in the globe by the Global Environmental Performance Index 2014 (Dhaka Tribune, 2014) In this regard, the major issues concerned are the 'waste sector and the 'transport sector'.



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Located between India and Burma, Bangladesh has a land area of 144,000 square kilometers and a population of over 144 million people. Bangladesh is one of the developing third world country and is going through major political and economic changes in present years. In this context major cities of Bangladesh is working as development engines, showing high urban concentration with unplanned growth pattern. Since independence, Bangladesh's urban population has been growing at a yearly average rate of 6%, at a time when the national population growth was 2.2%. As a result, urban population has grown six-fold, compared with a 70 percent increase in rural population (World Bank, 2007). Bangladesh has one (1) mega city, three (3) metropolitan cities, seventeen (17) cities, one hundred and twenty six (126) medium size town and three hundred and ninety (390) small towns (BBS, 208). Among all these urban areas nations capital Dhaka itself is contributing to accommodate 37% of total urban population. At present Dhaka has a population of approximately 14.4 million including 3 million in unincorporated areas. Dhaka has the ninth largest population in the world with one of the highest population densities that exceed 19,447 people per square kilometer (BBS 2013). By 2020 Dhaka's population is expected to

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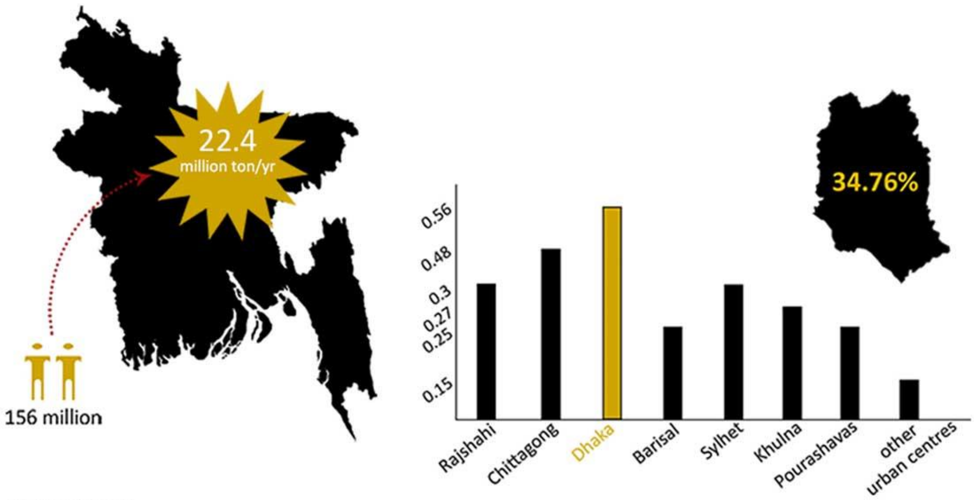
reach 20 million and by 2030 Dhaka is going to be the six th largest megacity adding at least 10 million more people (ICDDR 2014).



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With large city area and massive population it is certain to have huge solid waste generation and larger carbon footprint for transport travelling in the city area. Over 22.4 million tones of waste are generated in Bangladesh each year that is around 61,369 metric tons per day (Waste Atlas, 2013). 'In 2005, the urban areas of Bangladesh generated approximately 13,332.89 metric tons of waste per day which added up to 4.8 million metric tons annually. It was projected that this amount will grow up to 47,000 tons/day and close to 17.16 million metric tons per year by 2025' (JICA, 2005). This shows that, due to gradual rapid growth in population waste generation is exceeding its expected amount dramatically. Based on the present total urban population, per capita waste generation rate is found at 1.9 kg/capita/day in urban areas of Bangladesh (0.41 kg/capita/day in 2005). Among the entire urban areas Dhaka city alone is responsible for 34.76% of waste generation in the whole country that is about 5400 ton daily (DCC, 2013). Dhaka city is able to collect only 42% of the total generated waste that is transported all the way to Matuail and Aminbazar for landfilling. This secondary collection is done by 343 units of vehicles (open truck, container carrier, trailer truck), that need to make around 1900 times up- down for the final disposal. Again, it requires 142-acre space for 42% waste disposal and 273 acre space for 100% disposal. The waste sector is a significant contributor to greenhouse gas emissions because it generates methane, which is twenty four times more potent as a greenhouse gas than carbon dioxide (CO_2). Excluding carbon dioxide, this sector had produced 17 million metric tons of CO_2-equivalent or 27 percent of the nation's total non-CO_2 emissions. By 2020, waste related

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emissions are projected to increase by 22 percent, to 20 million metric tons. Dhaka city alone responsible for producing 34.76% of solid waste per day among all the urban centers of the country. Dhaka city potentially can produce 0.76 million-ton CO_2/ years; this in turn produces a carbon footprint of 239,592.704 gha (global hectares) (Ewing, Moore, Goldfinger, Oursler, Reed, & Wackernagel, 2010). While the second highest city Chittagong; can produce one third of Dhaka. That ecological footprint of 239,592.704 gha for solid waste shows it require 5.28 time Dhaka to absorb the carbon dioxide effect produced form solid waste (Dhaka's physical footprint is 360 square kilometers equivalent to 45360 gha, BBS, 2008). Again, on an average 2,806,992 ton CO_2/ year is produced form transport sector; this exceed the bio capacity of Dhaka by 90.86 times and around 19.58 times of Dhaka is required to absorb the CO_2 produced by transport sector. Solid waste and transportation clearly show that; this city is becoming more unsustainable due to over exploitation of its resources.

1.3 Project brief

The project has two major parts- the waste scrapper in the city and the waste to resource center in matuail. The waste scrapper is an urban prototype and will be placed inside the city and it will target the raw waste from the city and the suspended co2 particles in the air. The prototype will process the refuge of the city as well as will harvest the pollutants from carbon-di-oxide that will be turned into biofuel. The harvested renewable energy and composed fertilizer will be given back to the community and the raw material will be sent in the resource centre outside the city. These city elements will serve as functional machines and public space generator inside the city.

The resource centre will provide a space where consumers, designers of future cities and manufactures will work together for a better world. The incoming raw material from city will be recycled and reinvented in this resource center. The center will have 3 significant parts-

'**Design section '** it will be comprised of architects, engineers and biochemist group who will design building materials for the urban cities. Furthermore a product design section will design different products in their studios and workshop area that is provided in the centre.

'**Manufacturing section'** will manufacture the building materials and the products designed by the design section. Both the organic and inorganic waste will go through this process. The larger part of organic waste will go to the aerobic digestion plant that willgenerate electricity which will be distributed to the surrounding community.

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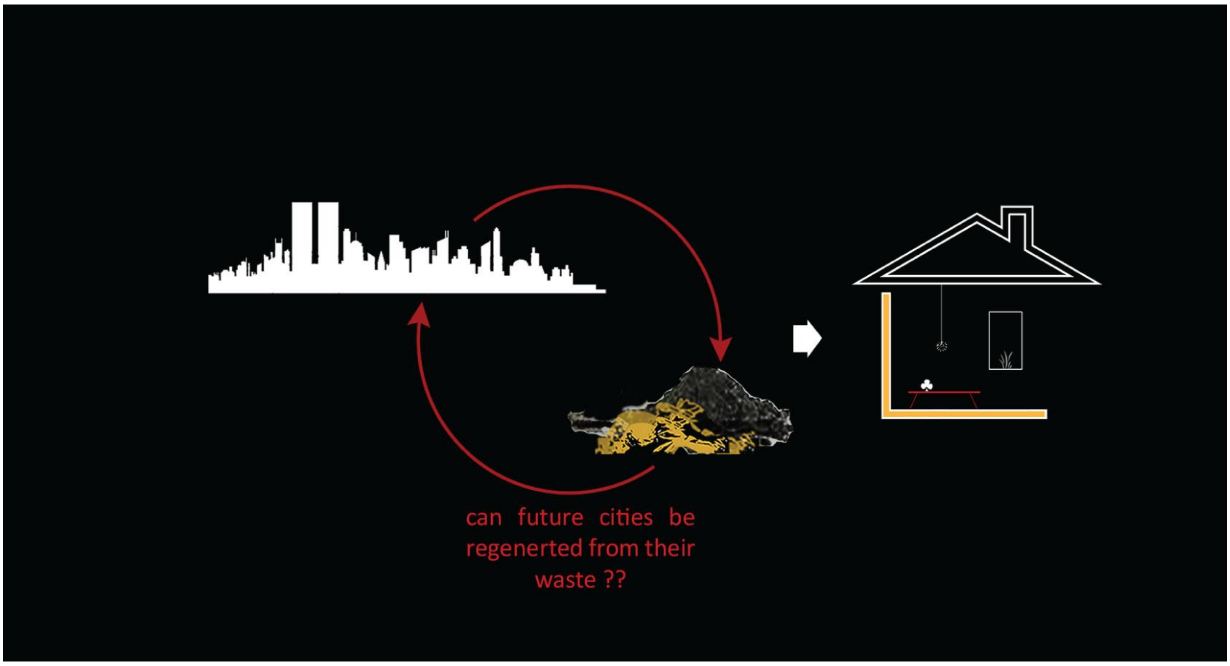
'Awareness centre and market plaza' it will attract the consumers means common public. The awareness centre will accommodate gallery space related to the problem and possibility of waste as well as community supporting facilities like library, multipurpose hall, café. The market plaza will hold the local markets that will sell waste related products and food courts.

1.4 Aim and objectives

Main focus of the project is to explore weather the future cities can be regenerated from waste, where we can get everything from this refuge- electricity, products or even building material. Intension is to create social acceptance for these products where we wont compromise rather will celebrate. There would be a group of professionals who will design these for us considering the aesthetics, durability and comfort.



Others-

- Change society's perspective towards waste.
- Explore possibilities of waste in future urban cities.
- Turn Dhaka into a zero waste city.

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- Introduce waste as a possible raw material in architecture
- Aware people about the waste problem as well as create social acceptance against the possibilities.
- Involve public into the process
- Establish a different perspective for utilitarian infrastructure.

1.5 Possible Programs

1. Waste scrapper

MRF and processing unit for-

- Organic waste
- Paper
- Plastic
- Glass
- Metal
- Textiles
- Other

Water harvesting system

Solar power generation

Pollutant collector

Administration

- Lobby/reception
- Office
- Conference Room
- Toilet

Workers Toilet

Workers dinning space

Public plaza

- Food court
- Retail shops
- Exhibition or rentable space

2. Recycling facility

Processing facilities

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Research unit

- Reduce sector
- Reuse sector
- Recycle sector

3. Reinventing facility

Research

Workshop

Studio

Office

Gallery space

4. Training centre

Seminar hall

Workshop/ living exhibition space

Office space

5.Awarness centre

Library

Market plaza

- Retail shops
  - Raw material
  - Designed product
  - Food
- Storage
- Truck delivery

Platform for ideas

- Seminar hall
- Workshop
- Exhibition space

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CHAPTER 2: SITE APPRISAL

Waste scrapper

2.1 Site Location

The site is located in zone 1 in the southern part of Dhaka city. It is situated beside the katabon vegetable market adjacent to elephant road.

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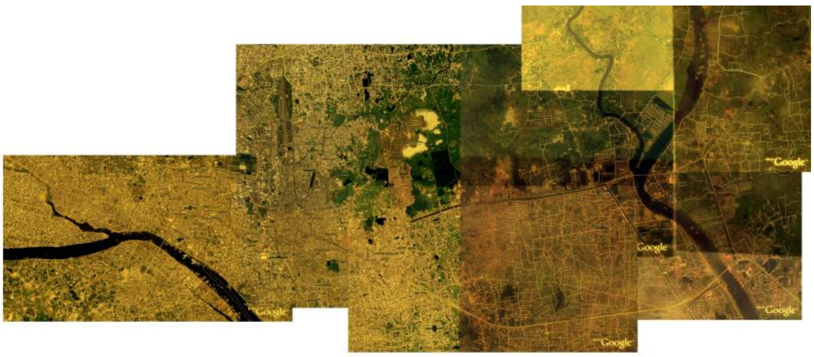
Resource centre

2.1 site location

The site is in the southern zone of Dhaka city. It is situated in matuail beside Dhaka- Demra highway. The biggest landfill of Dhaka city matuail landfill area is adjacent to the site.



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2.3 Swot analysis.

2.3.1 Strength

- The site is decentralized, which will not create extra pressure for the city centre.
- The site is in he middle of the city and urban periphery and has strong road network with the entire city zones as well as outskirt factories.

2.3.2 Weakness

- Awareness centre is an integral part for this project but the location of the project will not be able to attract a large group.
- During wet season a part of the site goes under water because of improper drainage system.

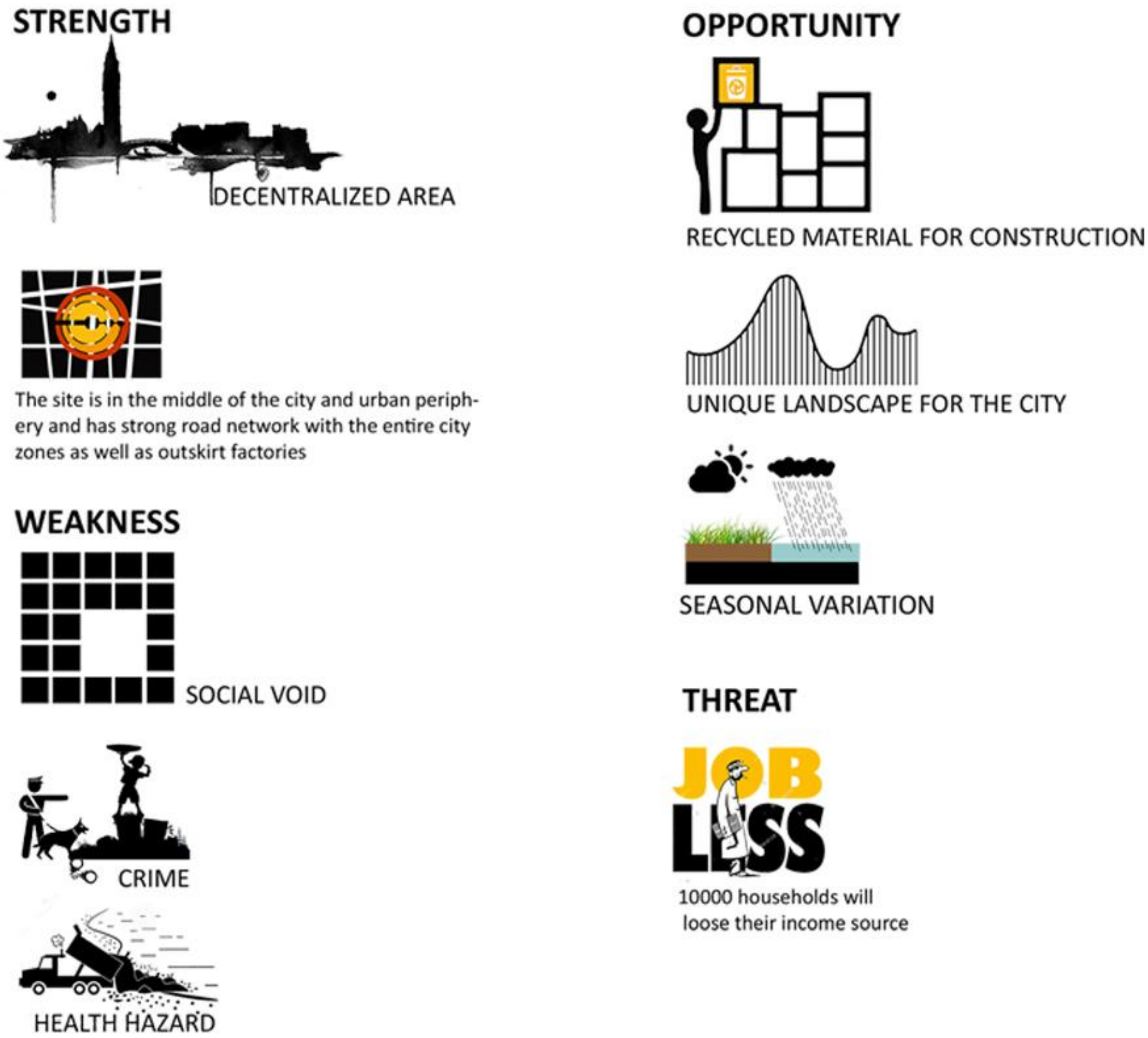
2.3.3 Opportunity

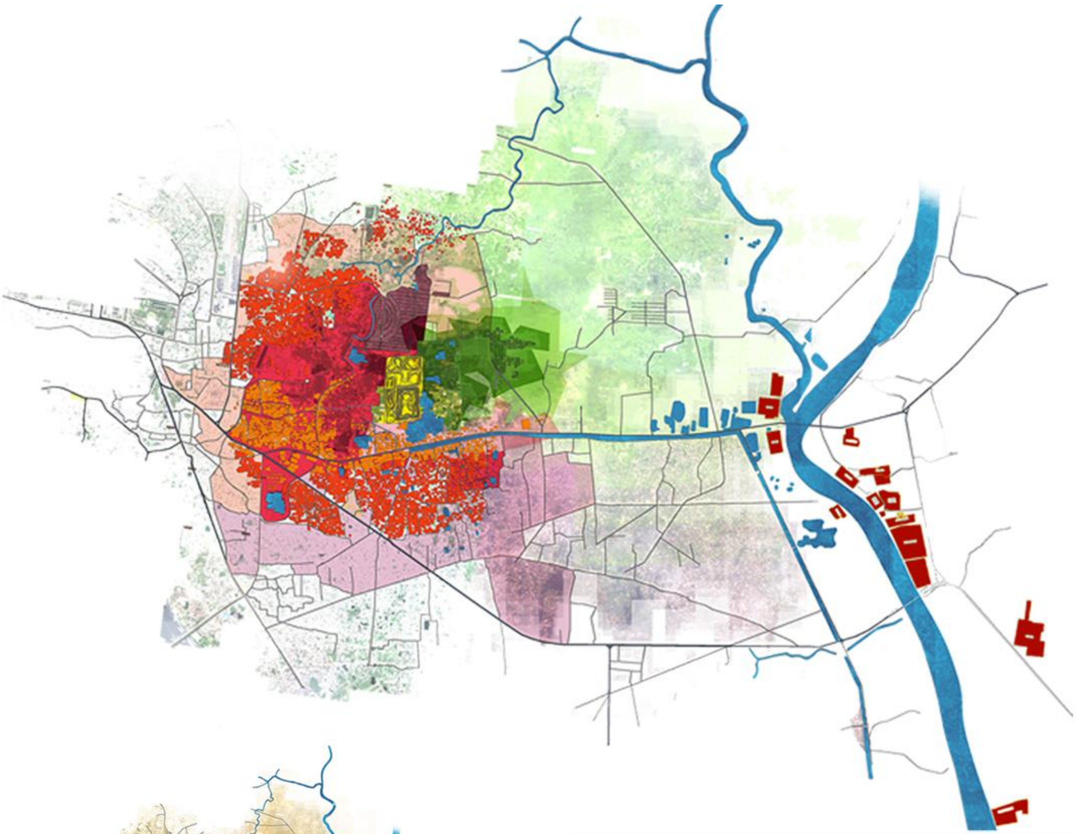
- The landfill site can provide recycled materials for construction.
- The contour topography and the diverse landscape of the site is very unique for the city, which can be an attraction area for both the city and matuail people.
- Since matuail area is underdeveloped and does not have any recreational space within it, the site can provide the surrounding neighbourhood its gathering space with necessary amenities.
- Since the site is adjacent to the city, the master plan of this 150 acres area will stitch together the urban fabrics.
- The south-east part of the site are low land areas that creates seasonal variations with water in the rainy season and agricultural fields in the dry seasons.

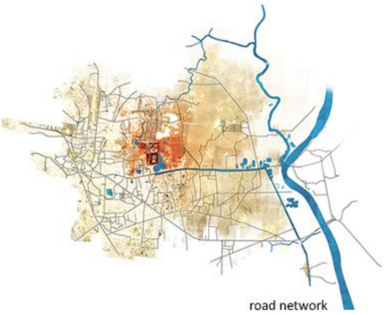
2.3.4 Threat

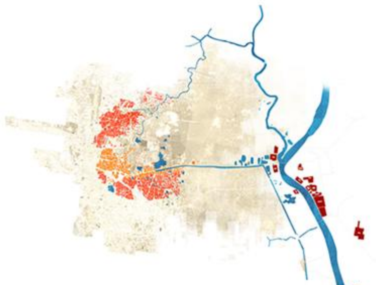
- A project adjacent to a 100 acres landfill site is a serious threat to public health.
- Absence of facility and management of methane gas collection and leachate treatment can extremely pollute the surrounding areas.

- Absence of the matuail landfill will make 10,000 households of matuail jobless, which will make them move towards the city.
- City expansion towards the southeast will turn the green fields into concrete blocks that will reduce green footprints as well as will ruin the experience of the site master plan.






road network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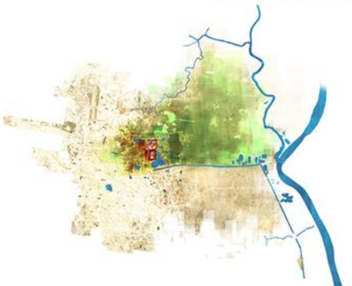
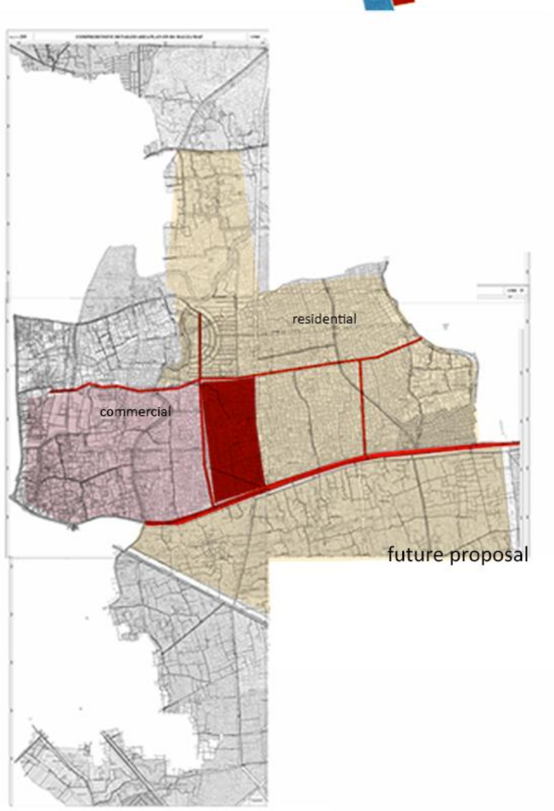

wetland



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CHAPTER 3: LITERATURE REVIEW

3.1 Dhaka population growth

The expansion of Dhaka City has developed over a long span of time. The city was under the suzerainty of different kings and rulers and its growth was hindered and distributed from time to time. In the Pre- Mughal period (13th -17th century) Dhaka city got it's importance as a market place. After the Sultans the Mughals took over the city and they covered an area of about 2.20 sq. km and was confined within the small continuous zone of the present old city. The city gained its reputation as a capital during the early period of the 17th century. Centring on the old market, the provincial capital Dhaka began to develop rapidly as a major city of the province.

During the rule of the Mughals Dhaka City grew in a north-western direction. In 1717 after shifting of the provincial capital to Murshidabad (due to a personal clash between the Emperor Azim-Us-Shan and Subadar Murshid Kuli Khan) a number of influences from European traders started to increase in Bengal. At that time the size of Dhaka City was about 4.5 sq. km. The main city was confined in a small area on the northern bank of the river Buriganga around the Lalbagh and Chawk-Mughaltoli area where the older part of the city is today. In 18th century, urbanised space started to expand towards the north on the Pleistocene terrace high lands during this time, mainly for residential and recreational purposes. Moreover, during that period in order to protect the riverbank of Buriganga from flooding and erosion and to add a face-lift to the riverside, the Buckland Embankment was completed. Thus the area of Dhaka City was expanded into 17.0 sq. km. and Dhaka City started to flourish again, its population increasing to a total of some 90 thousand in 1901 and reaching over a hundred thousand in the subsequent ten years. In 1901 only 2.43% of the country's population lived in urban centres. During the next two decades the urban population remained almost static. Between 1911 and 1921 there was only an 8.8% increase in the urban population. Plagues caused large-scale depopulation in many urban centres during this period. Since 1921 there has been slow but steady growth - except when thousands left the cities out of fear during World War II. But a famine, which ensued, soon pushed millions from rural areas back into urban areas.

In Bangladesh the first significant phase of urbanisation started in 1947 when the population was more than 250,000. The need for office space for administrative and commercial purposes as well as residential needs resulting from the increase in population led to the growth of the city on several levels. Initially, the needs for official, educational, residential and

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administrational spaces were fulfilled by the expansion of the city in Purana Paltan to Naya Paltan, Eskation to MoghBazar, Siddiheswari, Kakkrail to Kamlapur through Razar Bagh and Shantinagar, the Segun Bagicha, Azimpur, Mirpur, Mohammadpur, Shre-e-Bangla Nagar, Tejgaon, Gulshan Model Town and other areas were encroached on between 1950 and 1960. The Banani and Gulshan areas were acquired by the government in the early sixties under the 1959-Master Plan of Dhaka City and by 1961, the city population grew to 718,766 and the area at that time was about 125 sq. km. The urbanisation process achieved tremendous growth to meet the needs of the newly independent country's capital. The city's population suddenly increased to 2,068,353 in 1974, it began to expand in all directions including the low-lying areas of the east, such as Jurain, Goran, Badda, Khilgaon, Rampura, and to the west including the areas of Kamrangirchar, Shyamoli, Western Mohgammadpur, Kallyanpur. As very rapid urban growth (along with a fast increase in population and structural development) started to take place a new structural plan was needed. The population leapt to 3 million within a decade of the independence of the country and the city covered an area of about 510 sq. km. by 1981. During this period the swamps and wetlands within the city started to disappear quickly and new areas of residential, administrational, business and commercial importance began to develop. In addition, slum and squatter settlements also sprang up in different areas of the city. Keeping pace with the magnitude of the urban growth, the new urbanised areas began encroaching on the low-lying areas within the city limits and even on some adjacent outlying areas.

Dhaka City has faced its highest rate of physical and population growth during 1981-1991, with the population doubling during that decade and the city expanding from 510 sq. km to 1353 sq. km. The city now includes the surrounding areas of Gazirpur, Savar, Narayangong, Bandar thanas and the entire thana of Keraniganj that creates the Greater Dhaka. In 1995, a new master plan was prepared for the further development of Dhaka City and the recent construction of a bridge over the Buriganga river has encouraged the expansion of Dhaka City in a southerly direction to the other side of the river. A second bridge, which is likely to be completed within the next five years, will further increase this process. However, the expansion of Dhaka City is constrained by physical barriers such as the low-lying flood prone areas around the city. Also, valuable agricultural and forested land will have to be sacrificed if the built-up area is to increase. But as mentioned, the population of the city is increasing very rapidly due mainly to rural-urban migration. The population of the city reached to 5 million in 2005 and the population growth of Dhaka has been 56.5% in the last decade, which is very high. At present the population has turned to 14.4 million and is expected to reach 22 million within 2020. Understandably, these additional people have created tremendous pressure on the urban utility services and other amenities of urban life. This has resulted in an adverse

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effect on the urban environment.

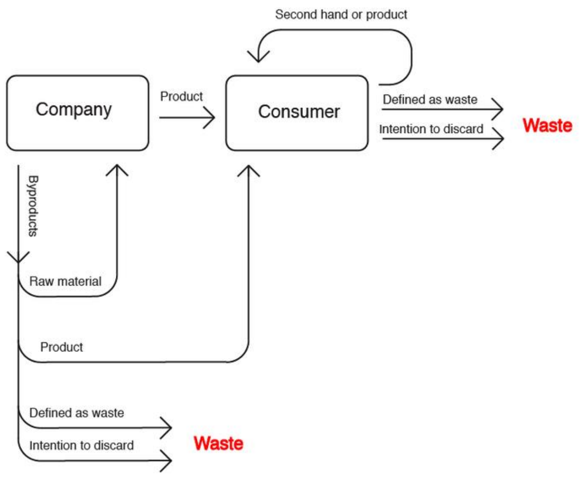
3.2 Understanding waste

3.2.1 Defining waste

Generally, waste and wastes are unwanted or unusable materials which is rejected after primary use, or it is worthless, defective and of no use. Waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded. All our daily activities can give rise to a large variety of different wastes arising from different sources. The term is often subjective because waste to one person is not necessarily waste to another.

Additionally, "Wastes' are substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law"(Base Convention, 1992). Furthermore, "Wastes are materials that are not prime products (that is products produced for the market) for which the initial user has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded" (UNSD, 1997).

However, on the basis of present ideas that waste is a resource, it is quoted on the book 'Millions from Waste' that, "Waste is merely raw material in the wrong place,"(journalist Frederick A. Talbot, 1920).



Schematic illustration of EU definition of waste

3.2.2 Sources of waste generation

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Depending on the properties and potential to cause harm municipal solid waste can be classified as –

Hazardous waste
Non-hazardous waste

3.2.2.a Hazardous waste

'Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can take the form of solids, liquids, sludge, or contained gases, and they are generated primarily by chemical production, manufacturing, and other industrial activities. They may cause damage during inadequate storage, transportation, treatment, or disposal operations. Improper hazardous-waste storage or disposal frequently contaminates surface and groundwater supplies' (Environment protection Agency). People living in homes built near old and abandoned waste disposal sites may be in a particularly vulnerable position. In an effort to remedy existing problems and to prevent future harm from hazardous waste governments closely regulate the practice of hazardous-waste management.

Hazardous wastes are classified on the basis of their biological, chemical, and physical properties. These properties generate materials that are toxic, reactive, ignitable, corrosive, infectious, or radioactive.

'Toxic wastes are poison even in very small or trace amounts. They may have acute effects, causing death or violent illness, or they may have chronic effects, slowly causing irreparable harm. Some are carcinogenic, causing cancer after many years of exposure. Others are mutagenic, causing major biological changes in the offspring of exposed humans and wildlife.

Reactive wastes are chemically unstable and react violently with air or water. They cause explosions or form toxic vapours. Ignitable wastes burn at relatively low temperatures and may cause an immediate fire hazard. Corrosive wastes include strong acidic or alkaline substances. They destroy solid material and living tissue upon contact, by chemical reaction.

Infectious wastes include used bandages, hypodermic needles, and other materials from hospitals or biological research facilities. Radioactive wastes emit ionizing energy that can harm living organisms. Because some radioactive materials can persist in the environment for many thousands of years before fully decaying, there is much concern over the control of these wastes. However, the handling and disposal of radioactive material is not a responsibility of local municipal government. Because of the scope and complexity of the problem, the management of radioactive waste—particularly nuclear fission waste—is

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usually considered an engineering task separate from other forms of hazardous-waste management and is discussed in the article nuclear reactor' (Environment protection Agency).

Hazardous waste generated at a particular site often requires transport to an approved treatment, storage, or disposal facility (TSDF). Because of potential threats to public safety and the environment, transport is given special attention by governmental agencies. In addition to the occasional accidental spill, hazardous waste has, in the past, been intentionally spilled or abandoned at random locations in a practice known as "midnight dumping." This practice has been greatly curtailed by the enactment of laws that require proper labelling, transport, and tracking of all hazardous wastes. Worldwide, The United Nations Environmental Programme (UNEP) estimated that more than 400 million tons of hazardous wastes are produced universally each year, mostly by industrialized countries (schmitz, 1999). About 1-percent of this total is shipped across international boundaries, with the majority of the transfers occurring between countries in the Organization for the Economic Cooperation and Development (OECD) (Krueger, 1999). Some of the reasons for industrialized countries to ship the hazardous waste to industrializing countries for disposal are the rising cost of disposing hazardous waste in the home country.

3.2.2.b Non- hazardous Waste

Non- hazardous waste means waste, which is not classified as hazardous waste. It is not toxic like hazardous waste and so does not need any especial transport or treatment facility. Mainly, MSW waste, agriculture waste, commercial waste and industrial waste is considered as non- hazardous waste.

Solid waste is the solid part of discarded material. Solid waste can be described from general housekeeping as residential waste, refuse, household waste or domestic waste. Waste produced in other areas is defined as industrial, commercial, institutional or agricultural waste, or street sweepings, depending on its source. The solid waste that is produced as a result of food preparation, or any foodstuff leftover after eating is kitchen waste or garbage. Generally solid waste refers to non- hazardous waste but the Resource Conservation and Recovery Act (RCRA) stated that, hazardous waste is also a part of solid waste. Understanding the appropriate methods for the management of solid waste is closely related to the characteristics of the waste and therefore to its source. The solid waste management involves disposal of solid waste to land (or ocean) or recovering and reproducing useful

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substances from the waste through recycling. The entire methodology of solid waste management is based on:

(A) Collection of Waste

(B) Disposal three broad

(C) Resource recovery

Solid waste generating sources are different and large in number. The primary sources of solid waste are-

Domestic waste: Domestic waste mainly refers to household waste. Domestic waste includes food preparation, cleaning, fuel burning, old clothes and furniture, obsolete utensils and equipment, packaging, newsprint and gardening. The composition of domestic solid waste or municipal solid waste varies greatly from municipality to municipality (country to country) and changes significantly with time. In municipalities (countries), which have a well-developed waste recycling system, the waste stream consists mainly of intractable wastes such as plastic film, and unrecyclable packaging materials. Domestic waste contains the largest part of the total generated waste in any country. In lower income countries domestic waste is dominated by food waste and ash, middle and higher income countries have large proportion of paper, plastic, glass, metal, discarded items and hazardous matters. At the start of the 20th century, the majority of domestic waste (53%) in the UK consisted of coal ash from open fires. In developed municipalities (countries) without significant recycling activity it predominantly includes food wastes, market wastes, yard wastes, plastic containers and product packaging materials. In mot case especially in the developing and underdeveloped countries, where waste management is very poor, waste left from household sources containing materials are not separated or sent for reprocessing.

Commercial waste: Commercial waste arise from commercial activities taking place in shops, restaurants, hotels, offices, markets in private housing estates, etc. It mainly consists of packaging materials, office supplies and food waste and bearing a close resemblance to domestic waste. In low-income countries, food makers may contribute a large proportion of the commercial waste. Commercial waste may include hazardous components like contaminated packaging materials. Mainly private waste collectors collect it. However, some commercial waste is mixed with domestic waste and collected by the FEHD.

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Industrial waste: Industrial waste arises from industrial activities and does not include construction waste and chemical waste. The composition of industrial waste depends on the kinds of industries involved. Basically industrial waste includes the components similar to domestic and commercial source waste, including food waste from kitchens and canteens, packaging materials, plastic, metal and paper items. Some production processes, however utilize or generates hazardous (chemical and infectious) substances. Disposal of hazardous waste routes are different from those of non-hazardous and depend on the composition of waste type. Private waste collectors usually collect industrial waste. However, some industries may deliver their industrial waste directly to landfills for disposal. But it should be noted that there are bulky items like furniture and domestic appliances, which cannot be handled by conventional compactor type refuse collection vehicles. These items are regarded as bulky waste and are usually collected separately. They may come from residential premises, commercial and industrial activities.

Institutional waste

Waste from school, hospital, clinics, military bases and so on. It is similar to most domestic and commercial waste, although there is more packaging materials than food waste. Hospital and clinical waste potentially includes more infectious and hazardous materials. It is important to separate hazardous and non- hazardous materials to reduce health risks.

Street waste

This waste is dominated by dust and soil together with varying amounts of paper, metal, plastic and other litter from streets. In lower income countries street sweepings may also include drain cleanings and domestic waste dumped along waste, plant remains and animal manure.

Considering physical components solid waste are two types -

1. Biodegradable waste
2. Non- biodegradable waste

1. Biodegradable waste

Biodegradable wastes are those that can be broken down (decomposed) into their constituent elements by bacteria and other microorganisms. The term can be applied to both liquid and solid waste. Approximately 60% of municipal waste is biodegradable. Human and animal wastes, food waste, paper, grass, and agricultural wastes are all biodegradable. This natural biological decomposition process ensures that, under the right conditions, these wastes do not accumulate in the environment. The bacteria responsible for biodegradation

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may be aerobic, meaning they require oxygen, or anaerobic, meaning they do not need oxygen to survive. Decomposition of biodegradable wastes by anaerobic bacteria is sometimes called digestion. A range of options is used to treat BMW. Alternatives to landfill include composting, mechanical-biological pre-treatment recycling and incineration (with and without energy recovery). As can be seen from the figure below, those countries and regions such as Denmark, The Netherlands, Flanders and Austria, which have a low reliance on landfill, employ a mixture of incineration, composting and recycling to treat BMW. Potential impacts associated with landfilling of biodegradable municipal waste include the production of leachate and landfill gas, odours, flies and vermin. In response to these concerns, the Landfill Directive (Council Directive 1999/31/EC), amongst other things, places targets for the reduction in the proportion of biodegradable municipal waste that may be consigned to landfill. By 2006 Member States are restricted to landfilling a maximum of 75% of the total amount by weight of BMW produced in 1995. This target increases to 50% in 2009 and 35% in 2016. To meet these targets, Member States are obliged to set up national strategies to reduce the quantity of biodegradable waste going to landfill.

2. Non- biodegradable waste

Non-biodegradable waste will not break down or at least not break down for many years. Non-biodegradables are plastics, metal and glass. Dangerous chemicals and toxins are also non-biodegradable, as are plastic grocery bags, plastic water bottles and other similar materials._Many plastics are not biodegradable and these create environmental problems because they remain unchanged for many years. Non-biodegradable trash has been a growing concern to environmentalists, but now is becoming a concern to anyone wanting to embrace a more eco-friendly lifestyle._Non-biodegradable trash that is discarded to be land filled will only accumulate. The most wide-reaching effect of non-biodegradable trash is the' Pacific Garbage Ocean' an area of the Pacific Ocean, which is heavily polluted with plastics and other waste. "The patch extends over a very wide area, with estimates ranging from an area the size of the state of Texas to one larger than the continental United States; however, the exact size is unknown." It is estimated that unless consumers reduce current levels of non-biodegradable waste, the Pacific Garbage Patch will double in size in the next 10-20 years endangering the life of an infinite amount of marine animals.

3.2.3 Waste volume

The quantity and composition of waste depends on how developed the community is and the state of its economy. Industrial growth is an important tool to increase per capita income and

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welfare of the population. In return, industrial growth and higher per capita income generate more waste, which if not properly controlled causes serious environmental degradation.

The amount of waste generated by a given household is directly related to lifestyle, culture, and economic status. Climate can also increase generation rates. General differences are great enough to produce different countrywide generation rates. The United States has the highest rate, 2.0 kilograms per person per day—probably the result of high economic status, a culture of consumption, and a lifestyle that includes large amounts of disposable items. Some European countries have generation rates varying from 0.9 to 1.7 kilograms per person per day. Developing regions tend to have still lower rates, ranging from 0.3 to 1.

3.2.4 Waste composition

Whatever the source of waste is the basic components are same but different in amount depending on the source. The primary components of solid waste are -

1. Food waste and yard waste (organic waste)
2. Plastic
3. Metal
4. Glass
5. Textiles
6. Paper
7. Others.

3.3 Waste impacts

A by-product of industrialization and modern living, wastes – in all its form – are not just a sociological concern. They destroy our environment; contribute to climate change; and damage our health. All these mean that waste affects our quality of life and the development of our country.

3.2.1 Waste impact on environmental health

Non-biodegradable wastes such as plastics and Styrofoam are found to be the primary cause of massive flooding in countries like the Philippines, Bangladesh, and Malaysia. Because they are not biodegradable, they clog waterways, canals, and drainage systems. They also find their way to our water bodies like rivers, lakes, and oceans where they are harmful to plants and animals. Toxic wastes such as motor oils, pesticides,

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industrial solutions, and batteries can contaminate our water supplies because they seep into our local waterways and aquifer. Also, leachate from landfills which may contain harmful amounts of persistent organic chemicals, heavy metals, and pathological microorganisms may reach our water systems. These are potentially harmful both to human health and to our biodiversity.

The United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) reported that close to 80% of the world's marine pollution come from land-based sources and between 60 to 95 percent of these is plastics debris. Most of the littered plastic wastes around the world eventually end up in our oceans. Some of them are obvious like the large masses of floating garbage patches such as the Great North Pacific Garbage Patch, discovered in 1997 by Captain Charles Moore. Some of these garbage patches are brought back to the land by strong currents such as what happened in Manila Bay in August 2012 where thousands of tons of plastic debris were washed ashore. Marine animals including dolphins, whales, sea lions and even the zooplankton - those microscopic organisms that are sources of food for other species - are affected by plastic. The global environmentalist group Greenpeace released a report in 2006 titled "Plastic Debris in the World's Ocean" and revealed that at least "267 different animal species are known to have suffered from entanglement and ingestion of plastic debris." These include the turtle that often mistakes plastic for jellyfish.

Again decomposing landfills release methane and other substances such as dioxins and furans (HFCs, SF6) that cause air pollution and destroy wildlife. Disposing of waste has huge environmental impacts and can cause serious problems. In the UK much of the waste is buried in landfill sites – holes in the ground, sometimes old quarries, sometimes specially dug. Some waste will eventually rot, but not all, and in the process it may smell or generate methane gas, which is explosive and contributes to the greenhouse effect. Leachate produced as waste decomposes may cause pollution. Badly managed landfill sites may attract vermin or cause litter.

Waste to energy plant cannot be considered as environment friendly as well. Although the emission from the plant can be processed but in that case the resources are lost, which create pressure on the environment any way especially on the forest. Incinerating waste also causes problems, because plastics tend to produce toxic substances, such as dioxins, when they are burnt. Gases from incineration may cause air pollution and contribute to acid rain, while the ash from incinerators may contain heavy metals and other toxins. Because of these problems there are active campaigns against waste incineration.

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3.2.2 Waste impact on human health

Improper management or no management of waste can cause serious impact on health along with environment. 'Uncontrolled emissions of Landfill Gas (LFG), which contains methane, carbon dioxide, hazardous air pollutants (HAPs), odorous compounds, and volatile organic compounds (VOCs), are very detrimental to public health. Waste can cause almost forty kinds of diseases. VOCs, for example, add to ground-level ozone formation or smog, which is known to cause respiratory diseases such as emphysema, bronchitis and asthma. Exposure to HAP is directly linked to rising incidents in cancer, reproductive health disorders, respiratory problems, and damage to the central nervous system' (World Health Organization). The group at risk from the unscientific disposal of solid waste include – the population in areas where there is no proper waste disposal method, waste workers and workers in facilities producing toxic and infectious material. Other high-risk group include population living close to a waste dump and those, whose water supply has become contaminated either due to waste dumping or leakage from landfill sites. Uncollected solid waste also increases risk of injury, and infection. Again, Toxic waste products such as Dioxins are harmful to human health. Dioxins enter our food chain, mainly in the fatty tissue of animals we eat and in the dairy products such as milk and butter. Accumulated dioxins are directly linked to diseases of the immune system, hormone dysfunctions, and cancer. Exposure to biological sludge – the combination of solid and liquid wasters – is known to cause various skin diseases as well as organ infections, bronchitis, skin ulcers, jaundice, and respiratory problems because of the pathological microorganisms it contains according to a study conducted by Cornell University. Inappropriately managed waste can attract rodents and insects, which can harbour gastrointestinal parasites, yellow fever, worms, the plague and other conditions for humans, and exposure to hazardous wastes, particularly when they are burned, can cause various other diseases including cancers. Toxic waste materials can contaminate surface water, groundwater, soil, and air, which cause more problems for humans, other species, and ecosystems.[7] Waste treatment and disposal produces significant green house gas (GHG) emissions, notably methane, which is contributing significantly to global warming. In particular, organic domestic waste poses a serious threat, since they ferment, creating conditions favourable to the survival and growth of microbial pathogens. Direct handling of solid waste can result in various types of infectious and chronic diseases with the waste workers and the rag pickers being the most vulnerable. Exposure to hazardous waste can affect human health, children being more vulnerable to these pollutants. In fact, direct exposure can lead to diseases through chemical exposure as the release of chemical waste into the environment leads to chemical poisoning. Waste from agriculture and industries can also cause serious health risks. Other than this, co-disposal of

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industrial hazardous waste with municipal waste can expose people to chemical and radioactive hazards. Uncollected solid waste can also obstruct storm water runoff, resulting in the forming of stagnant water bodies that become the breeding ground of disease. Waste dumped near a water source also causes contamination of the water body or the ground water source. Direct dumping of untreated waste in rivers, seas, and lakes results in the accumulation of toxic substances in the food chain through the plants and animals that feed on it. Disposal of hospital and other medical waste requires special attention since this can create major health hazards. This waste generated from the hospitals, health care centres, medical laboratories, and research centres such as discarded syringe needles, bandages, swabs, plasters, and other types of infectious waste are often disposed with the regular non-infectious waste. Waste treatment and disposal sites can also create health hazards for the neighbourhood. Improperly operated incineration plants cause air pollution and improperly managed and designed landfills attract all types of insects and rodents that spread disease. Ideally these sites should be located at a safe distance from all human settlement. Landfill sites should be well lined and walled to ensure that there is no leakage into the nearby ground water sources. The unhygienic use and disposal of plastics and its effects on human health has become a matter of concern. Coloured plastics are harmful as their pigment contains heavy metals that are highly toxic. Some of the harmful metals found in plastics are copper, lead, chromium, cobalt, selenium, and cadmium. In most industrialized countries, colour plastics have been legally banned.

Recycling too carries health risks if proper precautions are not taken. Workers working with waste containing chemical and metals may experience toxic exposure. Disposal of health-care wastes require special attention since it can create major health hazards, such as Hepatitis B and C, through wounds caused by discarded syringes. Rag pickers and others, who are involved in scavenging in the waste dumps for items that can be recycled, may sustain injuries and come into direct contact with these infectious items

3.2.3 Waste impact on climate change

The Earth’s atmosphere contains many types of gases, which includes GHG. GHGs absorb and retain heat from the sun. They regulate the Earth’s climate by holding heat in an atmospheric blanket around the planet's surface. Scientists call this phenomenon as “Greenhouse Effect”. Without GHGs, the average temperature on Earth would be -2 degrees Fahrenheit instead of the current 57 degrees Fahrenheit (www.pewclimate.org). The two

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major greenhouse gases are – carbon dioxide and methane - are by-product of the waste we create.

Carbon dioxide is the most abundant of these greenhouse gases and is produced when we burn fossil fuels to generate energy. We use this energy to heat our houses, mine and extract natural resources, manufacture goods and products and transport them. These products then end up in landfill. Wasting things means using energy to replace them. For example, when we dump aluminium cans in landfill, we have to make new cans from raw materials. This uses large amounts of energy and releases large amounts of carbon dioxide. The alternative, making new cans from recycled cans, only requires 5 percent as much energy.

Methane, the other major greenhouse gas, is the major concern of the waste industry. Methane is generated from the breakdown of organic matter such as food scraps, garden organics, wood and paper in landfill. This is the majority of mixed solid waste from households. Methane is at least 21 times more potent than carbon dioxide, which significantly adds to the greenhouse effect causing climate change. Methane from solid waste accounted for 86.5 percent of the total greenhouse gas emissions from the waste sector.

3.2.4 Waste impact on society

Waste management is a significant environmental justice issue. Many of the environmental burdens cited above are more often borne by marginalized groups, such as racial minorities, women, and residents of developing nations. NIMBY (not in my back yard) is the opposition of residents to a proposal for a new development because it is close to them. However, the need for expansion and siting of waste treatment and disposal facilities is increasing worldwide. There is now a growing market in the trans boundary movement of waste, and although most waste that flows between countries goes between developed nations, a significant amount of waste is moved from developed to developing nations. By reducing adverse impacts on health by proper waste management practices, the resulting consequences are more appealing settlements. Better social advantages can lead to new sources of employment and potentially lifting communities out of poverty especially in some of the developing poorer countries and cities.

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3.2.5 Waste impact on economy

The economic costs of managing waste are high, and are often paid for by municipal governments, money can often be saved with more efficiently designed collection routes, modifying vehicles, and with public education. Environmental policies such as pay as you throw can reduce the cost of management and reduce waste quantities. Waste recovery (that is, recycling, reuse) can curb economic costs because it avoids extracting raw materials and often cuts transportation costs. The location of waste treatment and disposal facilities often has an impact on property values due to noise, dust, pollution, unsightliness, and negative stigma. However, this waste sector plays an important role of creating jobs for unemployed people. The informal waste sector consists mostly of waste pickers who scavenge for metals, glass, plastic, textiles, and other materials and then trade them for a profit. This informal sector saves a huge amount of money from the waste management budget. This sector can significantly alter or reduce waste in a particular system, but other negative economic effects come with the disease, exploitation, and abuse of its workers.

Improving economic efficiency through the means of resource use, treatment and disposal and creating markets for recycles can lead to efficient practices in the production and consumption of products and materials resulting in valuable materials being recovered for reuse and the potential for new jobs and new business opportunities.

3.4 Law of good consumption

3.4.1 Waste management throughout history

Throughout most of history, the amount of waste generated by humans was insignificant due to low population density and low societal levels of the exploitation of natural resources. Common waste produced during pre-modern times was mainly ashes and human biodegradable waste, and these were released back into the ground locally, with minimum environmental impact. Tools made out of wood or metal were generally reused or passed down through the generations. However, some civilizations do seem to have been more profligate in their waste output than others. In particular, the Maya of Central America had a fixed monthly ritual, in which the people of the village would gather together and burn their rubbish in large dumps.

Following the onset of industrialisation and the sustained urban growth of large population centres in England, the build up of waste in the cities caused a rapid deterioration in levels of sanitation and the general quality of urban life. The streets became choked with filth due to

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the lack of waste clearance regulations. Calls for the establishment of a municipal authority with waste removal powers occurred as early as 1751, when Corbyn Morris in London proposed that "...as the preservation of the health of the people is of great importance, it is proposed that the cleaning of this city, should be put under one uniform public management, and all the filth be...conveyed by the Thames to proper distance in the country". However, it was not until the mid-19th century, spurred by increasingly devastating cholera outbreaks and the emergence of a public health debate that the first legislation on the issue emerged. Highly influential in this new focus was the report 'The Sanitary Condition of the Labouring Population' in 1842 of the social reformer, Edwin Chadwick, in which he argued for the importance of adequate waste removal and management facilities to improve the health and wellbeing of the city's population. In the UK, the Nuisance Removal and Disease Prevention Act of 1846 began what was to be a steadily evolving process of the provision of regulated waste management in London. The Metropolitan Board of Works was the first city-wide authority that centralized sanitation regulation for the rapidly expanding city and the Public Health Act 1875 made it compulsory for every household to deposit their weekly waste in "moveable receptacles: for disposal—the first concept for a dust-bin.

The dramatic increase in waste for disposal led to the creation of the first incineration plants, or, as they were then called, "destructors". In 1874, the first incinerator was built in Nottingham by Manlove, Alliott & Co. Ltd. to the design of Albert Fryer. However, these were met with opposition on account of the large amounts of ash they produced and which wafted over the neighbouring areas. Similar municipal systems of waste disposal sprung up at the turn of the 20th century in other large cities of Europe and North America. In 1895, New York City became the first U.S. city with public-sector garbage management. Early garbage removal trucks were simply open bodied dump trucks pulled by a team of horses. They became motorized in the early part of the 20th century and the first close body trucks to eliminate odours with a dumping lever mechanism were introduced in the 1920s in Britain. These were soon equipped with 'hopper mechanisms' where the scooper was loaded at floor level and then hoisted mechanically to deposit the waste in the truck. The Garwood Load Packer was the first truck in 1938, to incorporate a hydraulic compactor.

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3.4.2 3R strategy

The more we are being developed, the more we are loosing our resources. At the end we are trying to ignore it by calling it refuge and so dumping it in landfills or incinerating it. Before coming to the point that weather garbage is a refuge or resource there are some more point we need to identify.

3R strategy comprised of reduce, reuse and recycle have been the law of good consumption. But does it really work? The term reuse comes with compromisation but who would compromise or why should one compromise? Again, after industrial revolution a series of products have been launched to the planet with a tag of ‘warranty’. So how can we be expected to reduce our needs when a product cannot provide us lifetime warranty, let alone ‘ date expired’ tag with the foods. So it wont be wrong to say that the products of today are designed to be landfilled so that we can be dependent on consumption. If we talk about recycling then it actually works but again how much? Most of the products cannot be recycled and another half goes to down cycling process when recycled. As a result anyway these are going to be trash in future. After that 4R strategy has been developed which says the products that goes to landfill would be incinerated to generate electricity. The main idea of this process is recover. But the question is it the solution? Burning or burring cannot be the solution. In this way we have already lost 1/3 of the total natural resource of the world and achieved the tag of planet wrecker!

3.5 City and refuge

What is the key objective for ecological cities? A primary assertion for the city to come is that all necessities are provided from inside its physical borders. In this intensified version all its vital commodities for its population is provided by the city itself. In this city, food water, air quality, energy, waste mobility and is radically restructured to support life in every form. Infrastructure is celebrated as the new centre of the city.

This strategy includes the replacement of dilapidated structure with vertical agriculture and the merging of housing with road networks. Former streets become snaking arteries of liveable spaces embedded with renewable energy sources, soft cushion based vehicles, and productive green rooms. The former street grid provides the foundation for up-to the minute networks: by re-engineering the obsolete streets, we can ecologically active smart pathways.

These considerations are not just about a comprehensive model of tomorrow’s city, but are meant to provide an initial platform for discourse. Urban designers must expect that the future will necessitate marvellous dwellings to be coupled with a massive cyclical resource net.

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3.6 Building from waste

In the contrast of present context, imagine our colossal municipal landfills turning into sensible resource sheds to build our future urban and peri-urban paces. Now that the bulk of humanity has chosen to settle in urbanized areas, waste management needs a radical revision.

Through these years' researchers, designers have given both a conceptual and practical look into materials and products that use waste as a renewable resource for architecture, interior and industrial design. It is not about adaptable reuse that have been practiced earlier rather reinvention. The innovative materials are organized by the manufacturing processes, which lend them their specific characteristics. The manufacturing process has been divided into 5 stages –

Densified
Reconfigured
Transformed
Designed
Cultivated

Densified

The most obvious and direct way to process waste materials into building construction elements is densification. The garbage press, today a standard equipment in solid waste management and already introduced in England in the 19th century, is mainly intended to reduce the volume of refuse through compacting. The principle of these machines is always the same: waste products come always as a loose mix with a low bulk density.

On a popular level, Pixar's cinematic take on the garbage press and the theme of waste materials is the animated movie 'Wall- E', which playfully demonstrates the potential of compressed waste blocks for the construction sector. Wall- E is relentlessly collecting trash into his belly pressing it to condensed little bricks which fall literally out if him. Towards the end of the sequence, activating these added values of new material properties, the small robot builds a series of skyscrapers out of its creator's leftovers, constructing a new city skyline out of garbage.

The densification process based on the principle of compressed refuse. The act of pressing stores energy in the system, resulting in a higher state of material properties. The ensuing reduction of volume is not the main goal, rather a tool to activate a specific potential within a specific waste product.

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Reconfigured

A configuration describes the arrangement of elements in a particular form, figure or combination in order to perform a certain function. Reconfigured waste materials, in our definition, thus comprise all products where the components of raw waste have been rearranged before being processed into a new construction element. Shredding, grinding, sawing, or breaking are some of the forms of applied mechanical force used to change the original configuration of the waste material. The resulting pellets, chips, strands, fibres etc are then processed further, usually by mixing them with other components such as organic, inorganic or mineral adhesives and pressing them into moulds of any form and size. Depending on the intended funtionality of the construction elements to be conceived, the method allows manipulating and controlling their density, weight, alignment, or even aesthetic qualities. This is especially relevant for products for load bearing applications that are required to absorb external forces. Lumber waste materials for example can either be reconfigured in chips to function as open strand board elements with high mechanical performance due to their directional fibre arrangement within the chip, or they can be used a s saw dust with rather limited capacities.

Transformed

Next to densification and mechanical processing of waste, there is a third method used in the production of construction elements from refuse: through transformation of the molecular state of waste. This process enacts the conversion of garbage into a new state of existence in different form composition, shape, and function through the complete loss of the existing organization structure of the material.

Transformation is an alteration of the material state by direct intake or incorporation of other materials or forms of energy from the surroundings – these are typically manmade and come in a shape of mixing chambers or pressure modules. On the extreme end of the spectrum, vitrification- the transformation of a substance into a glass like condition under very high temperatures- could be a future technology to transform even problematic waste into building materials. The key benefit of this method is that hazardous substances can be converted to a new material state without facing any risks for health and environment.

Typically the first step in the process is grinding the material into a sand or powder like aggregate. After mixing it with other components, the crush is then usually heated to its melting point or beyond, put into a mould, and formed into any desired shape, Additional steps of cutting or milling may be applied.

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The involved additional input of energy to three of these processes may be considered a waste production in itself, depending on the source of energy sector a full fledged and convincing circular waste to product system can be achieved.

Designed

This is a ongoing, still futuristic idea of specially designed goods that potentially never go to waste: they spend their material lifetime in a constant state of refuse, readaption and recycling, without having to be densified, reconfigured, or transformed. Throughout their life cycle they are meant to keep their life cycle they meant to keep their original form, properties and material composition while their functions nay change dramatically. Once such products have been used in the way and at the location for which they were originally designed, their particular character allows for yet another- second, third and fourth- life cycle with different functions. They might also be combined (without being mixed) with other materials into a heterogeneous condition of being, maintaining their ability to change their state again when required**.**

Cultivated

A cutting-edge approach in the building sector might be summarized with a bold statement, " Grow your own house". The verb in this context refers to the change of volume to a layering or multiplication of particles in an effort to form construction elements overtime. The concept is based on the growth of microelements that until now were unappreciated or even considered hazardous: just waste. By contrast, microelements belong to a rich resource of new building materials that are not to be categorized as renewable but as self growing- an important difference. Their value and potential has been discovered in the construction sector only recently, but research and also implementation is already underway with several products.

The advantages of such products are significant: following the concept of metabolic thinking, most of them can be composted after their original use. In their second phase they become the fertile matrix for the next generation or even the generations of the materials natural recycling process. These materials can easily be grown wherever they are needed, decreasing the need for long and energy consuming transport. Last but not least, as most of them organic materials that absorb carbon-di-oxide during their growth, they function as a Co2 sink.

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3.5 Waste Stream In Dhaka City

3.5.1 Waste generation

Due to huge and dense population Dhaka city is facing acute problem in waste management in comparison to many cities of the developing countries. The Dhaka metropolitan area, which covered 816 square kilometers, accommodated around 14.4 million residents. The amount of waste generated in urban area is proportional to the population and the average income of the people. In addition, other factors such as climate, level of education, social and public attitude also may affect the amount and composition of waste. Each day, these 14.4 million residents generated about 8,300 metric tons of waste (DCC, 2014).

3.5.2 Waste category

Generally the waste stream is separated by two basic categories – organic waste and inorganic waste. Organic waste contains all the food waste, grass etc. all the biodegradable stuffs and inorganic waste contains paper, plastic, glass, metal and other man-made materials. In Dhaka, approximately 70 to 80 percent of the waste is organic and the rest 20%-30% of the total generated waste is inorganic (JICA, 2004).

3.5.3 Waste source

The basic sources of waste generation are domestic waste, commercial waste and street waste. The amount of waste in each sector depends on the income groups as well as dry and wet season. In this country, the wet season is the season of fruits and vegetables that automatically increases the waste amount comparative to the dry season.

Domestic waste

As of 2004, the total solid waste amount from domestic source is estimated at 1,945 ton/day generated by the population of 5.728 million with average generation rate of 0.34 kg/person/day (JICA, 2004). So the amount of domestic waste is 60% of the total generated waste.

Business waste

Here, 78% solid waste is coming from residential sector and 20% from commercial sector, 1% from the institutional sector and rest from other sectors (Alamgir and Ahsan, 2007).

Nationally, the country did not have a consistent waste recycling program and waste was disposed of in nearly any area – on the streets, in pits, in front of people's homes or in the

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best case, in large cement containers. Large deposits of waste exposed the population to over 40 diseases. It created insufferable odor and seeped into the land affecting soil fertility and ground water. During the monsoon season, extreme floods into the city carried waste. Mosquitoes and flies reproduced in waste and carried diseases to humans and other animals. In addition to the extreme health hazards, the physical mass of waste caused traffic problems on roads. Large deposits of waste also emitted harmful greenhouse gases (GHG) 8 into the atmosphere. It was estimated that Dhaka had an emission potential of 0.76 million tons of CO_2 gas per year.9 See Exhibit 2 for photos of Dhaka's waste challenges.

3.5.4 Waste Collection

The DCC was responsible for collecting all solid waste. However, due to its human, technological and financial resources, the DCC collected only 37 percent of all solid waste, even though it spent 50 percent of its operating budget on solid waste management. All waste collected by the DCC was piled into trucks and disposed of in low-lying areas outside of the city district. Observers believed that the collection process was inefficient given that the waste was handled four to five times before being disposed of. The cost of collecting one ton of waste by the DCC was estimated at 670 BDT (US$11.26). The cost of the entire waste management process (from collection through to landfill operation) by the DCC was estimated at 2,045 BDT (US$38) per ton. The price of collecting waste was exacerbated by many dwellers' habits of leaving their waste in front of their homes instead of taking it to designated concrete containers for pickup. In addition to the DCC, individual's known as Tokais or informal waste collectors sought plastic, glass or paper and attempted to sell the waste to recycling factories for cash. Approximately 120,000 people were involved in informal waste collection and collected about 15 percent of the inorganic waste. Also, small companies had begun offering services for house-to-house collection in exchange for money, which was more prevalent in affluent areas of the city.

3.6 Scope of intervention

'Hardcopy'

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CHAPTER 4: CONTEXTUAL ANALYSIS

4.1 Social context

Dhaka being the capital is the prime source of creating job opportunities. All the important job sectors are located within the city, which is forcing a large portion of the people to migrate to the city. So far RMG is playing the best role in creating jobs for the poor people who have no education and these are mainly located within the city. This is the main reason behind proposing these job sectors outside the city to reduce pressure from the city centre. Matuail is located in the periphery of Dhaka city which is a suburban area but part of the metropolitan Dhaka city. It should be noted that, 10,000 households call matuail their home due to their dependency on the landfill area. They are involved in collecting, sorting and selling stuffs to the recycling centres. This landfill has been the income source of these low-income group people from a very long time and disappearance of the landfill will make them move to the city centre. In that case, the 'trash town' in matuail will create job opportunity for them in the absence of the landfill. At the same time, it will help to prevent a large portion of low-income group people to move to city in search of job.

4.2 Urban context

The site is in the marginal line of two different tissues- one side is part of agricultural fields and the other part is integrated with the concrete block of city. Although the site is situated at the peri urban area still strongly connected with the city with primary roads.

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CHAPTER 5: CASE STUDY

4.1 Landfill Site

4.1.1 Fresh Kills Park, New York

Fresh kill was the largest landfill site in the world, which is now transformed into the largest public park in New York. This shows an immense opportunity of converting a landfill site into a public space.

Type: Public Park

Location: Fresh kills landfills site, Staten Island, New York, United States.

Area: 2,200 acres (8.9 sqkm)

Operated by: New York City Department of Parks and Recreation

Farm: Field operation

Architect: landscape architect James Corner

Created: 2008

Open: 2012 (partial)

2035 (full)

View of Fresh Kill Park

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4.1.1.a Draft Master Plan of Fresh Kill Park

Todays Fresh Kills Park was once the world's largest landfill. That landfill is now transformed into 2200 acres of public parkland in Staten Island, featuring a beautiful expanse of tidal marshes and creeks, over 40 miles of trails and pathways, and significant recreational, cultural and educational amenities, including a proposed hilltop earthwork monument to honor the September 11 recovery effort undertaken at Fresh Kills. Fresh Kills Park will be a diverse reserve for wildlife, cultural and social life, and active recreation.

The transformation of Fresh Kills landfill into a park heralds a significant enhancement to the quality of life and land use on Staten Island, and at the same time marks a new commitment to the transformation of once-industrial sites to new cultural, programmatic and environmental uses. Only 45% of Fresh Kills' four square miles is actually landfill; the other 55% is made up of wetland, creeks and tidal flats, open meadows and woodland.

Fresh Kills Past and Present

Many thousands of years ago, Staten Island was formed as glacial melt waters deposited gravels, sands and silts. Marshland soon developed and the higher moraine of eastern Staten Island shed most of its rainwater west into the lower marshes of what is now Fresh Kills—a name given by Dutch settlers meaning "fresh creek" or "fresh waters." The modifying effect of the Hudson estuary also created a special microclimate that allowed for rich ecosystems and plant communities to emerge. Indeed, naturalists on Staten Island have historically found species growing here that are outside of their normal geographical limits, meaning that many northern and southern Atlantic seaboard species commingle and create unusually rich ecological diversity. The island, and Fresh Kills in particular, is also a major destination of birds migrating along the eastern flyway.

Urban development on Staten Island has since destroyed much of the ecological richness originally found there, and certainly the use of the Fresh Kills marshes as landfill during the latter half of the 20th-century further eroded the quality of the environment. And yet today, with the closure of the landfill, the site has a hauntingly potent presence, where the pulse of life, new growth and greenery is surprisingly palpable. This is aided by the fact that less than half of the site is actual landfill; the rest of the site consists of meandering creeks and tidal flats; extensive marsh and wetland (including the William T. Davis Wildlife Refuge and the Isle of Meadows); areas of grassland, meadow and woodland. Today, four landfill mounds lend an unusual large-scale topographic character to the site. The largest of the mounds is

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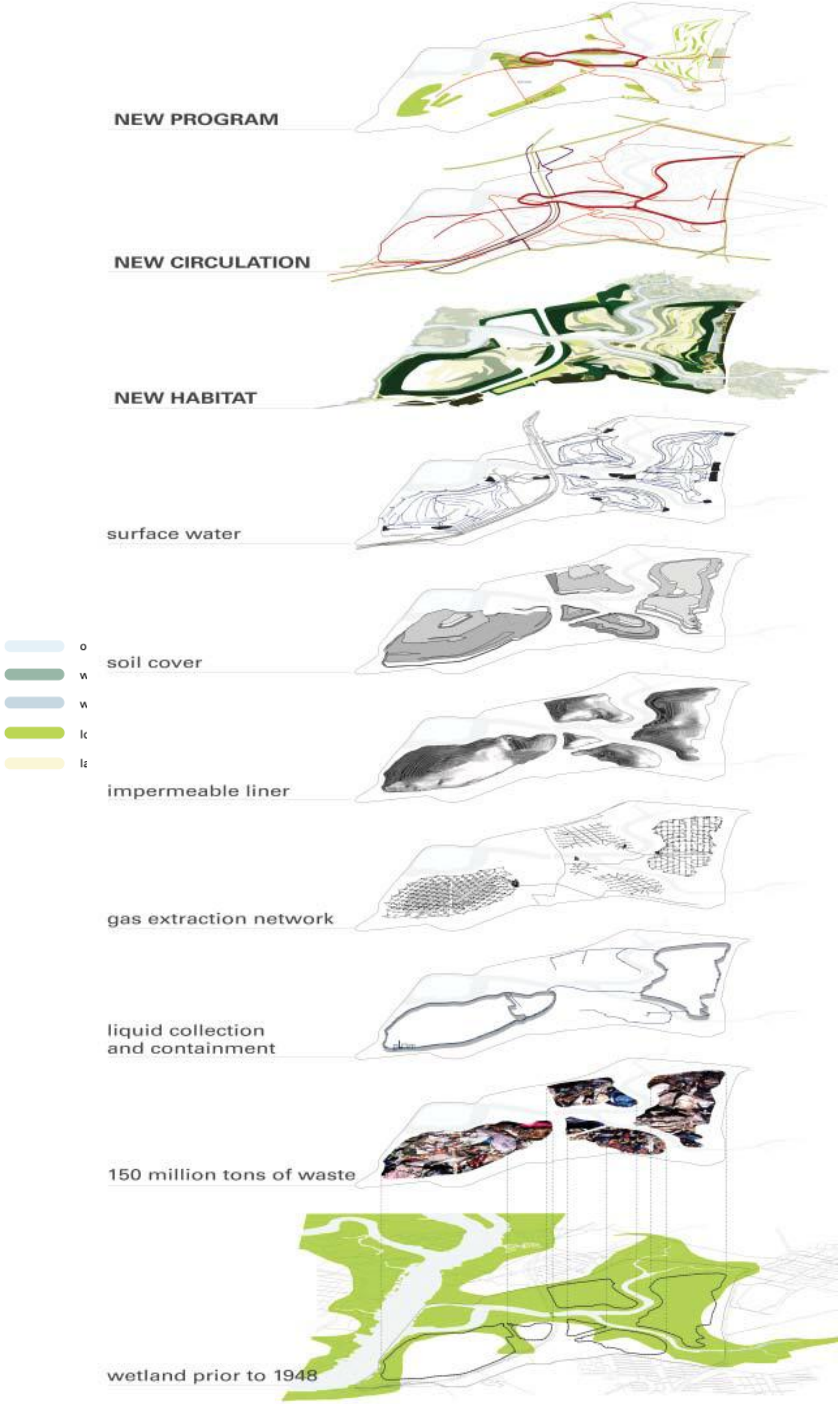
the westernmost mound. The next largest is the easternmost mound, the remaining two mounds making up the central spine of the



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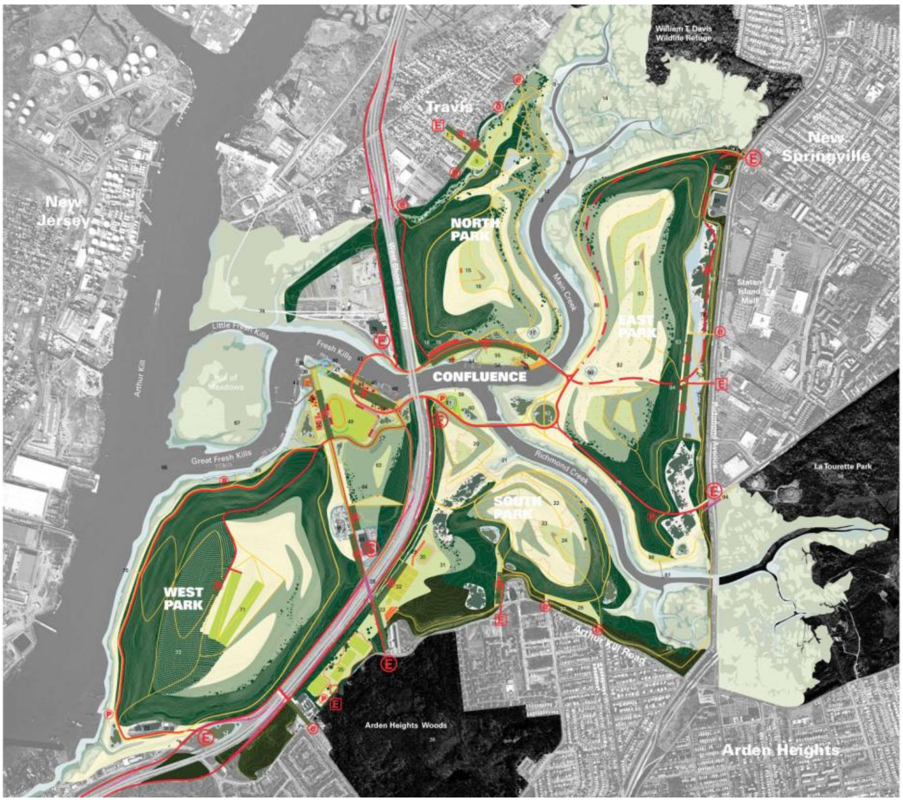
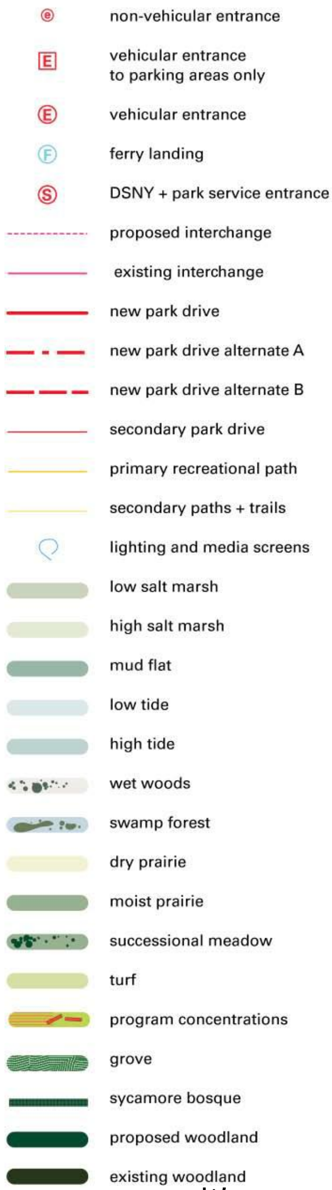
Proposed land use

The majority of the park-1740 acres are devoted to natural areas, including open water, salt marsh and fresh wetland, meadow and woodland. Over 40 miles of bikeways, trails and paths open up many of the meadow and woodland areas for recreation in wild settings and enjoyment of the large-scale open space. The waterways can be used for boating and fishing as well as habitat, while the wetlands are reserved for wildlife. The master plan will also include a wide array of sports and recreation facilities, cultural and educational activities, restaurants, market spaces, waterfront programs,
energy farming and greenhouses, art,
architecture, gardens and earthwork features for the
330 acres ofthe park designated for active programming.





The Fresh Kills Park Draft Master Plan

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1.1.b Five Areas of the park

THE CONFLUENCE — 100 acres
Programmatic core of the site + waterfront recreation hub
• The Point 50 acres
• Creek Landing 20 acres
• The Terrace 10 acres
• The Marsh and the Sunken Forest 20 acres

NORTH PARK — 233 acres
Lightly programmed natural and open areas + Travis neighborhood park
• Wetland and lowland natural areas that extend William T. Davis Wildlife Refuge
• North Mound natural areas with light trail network
• Travis neighborhood recreation area, with trails, fishing and bird watching

SOUTH PARK — 425 acres
Concentrated active recreation + programmed natural areas + Arden Heights neighborhood park
• Sports and active recreation center
• Mountain biking trails
• South Mound natural areas with mixed-use trail
• Lowland natural areas
• Arden Heights neighborhood picnic and play area

EAST PARK — 482 acres
Specialized programming + programmed natural areas
• Freshwater marsh and nature education center
• East Mound golf course
• Berm overlooks and trail
• Boat docks
• Public art installations

WEST PARK — 545 acres
September 11 programs + lightly-programmed natural areas
• September 11 earthwork monument to the recovery effort
• West Mound natural areas with light trail network
• Arthur Kill promenade and picnic areas with fishing piers

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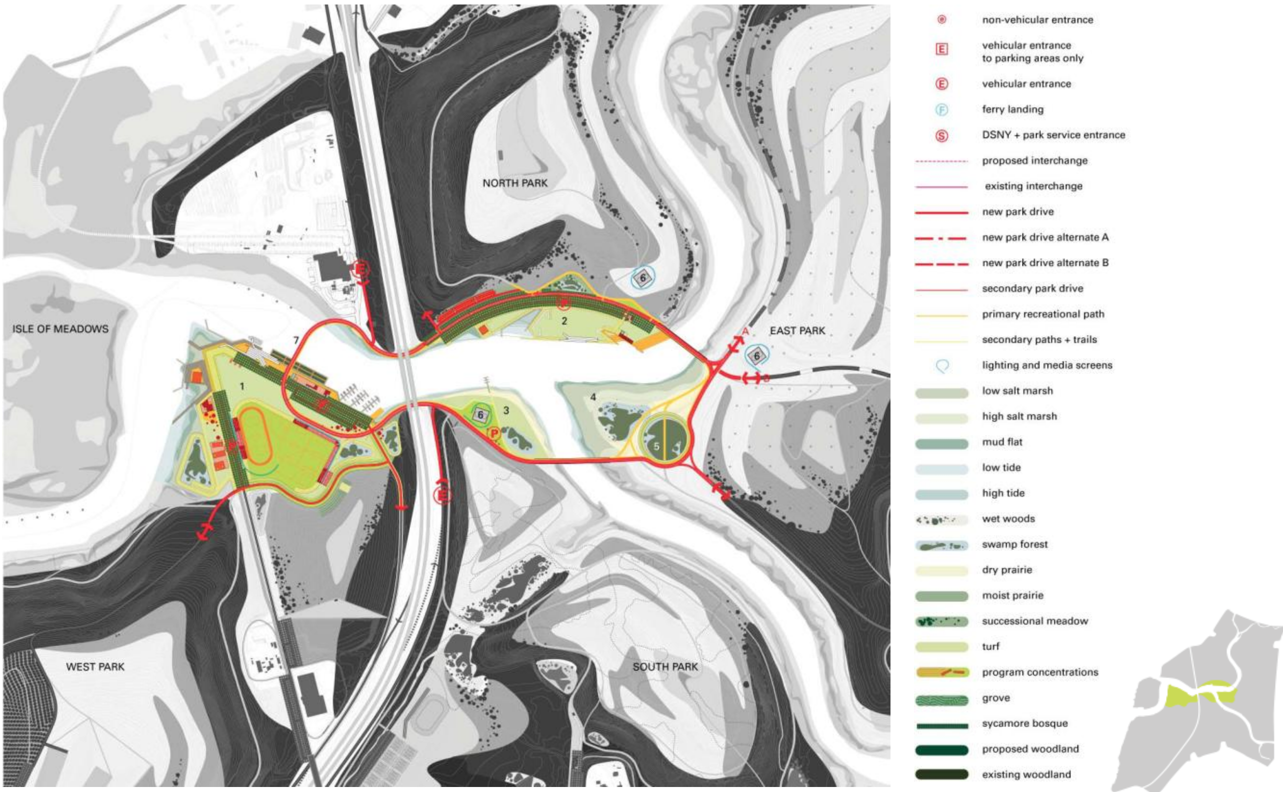
The Confluence



The North park

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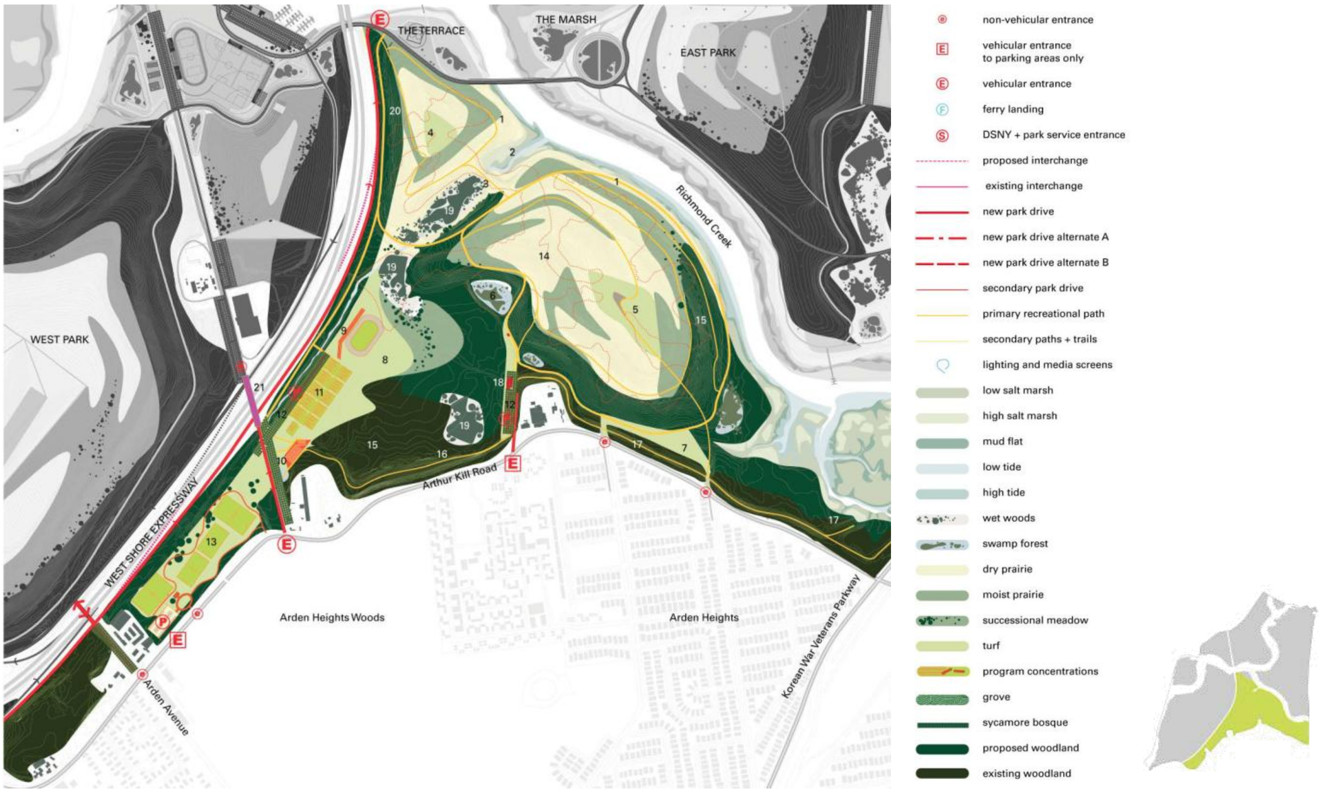
South Park



East Park

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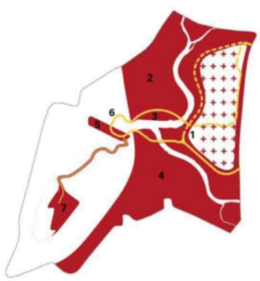
West Park

Growing a parkland overtime

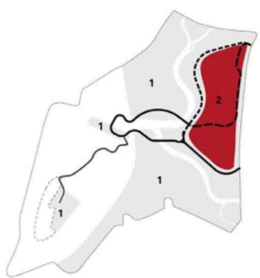
PHASE 1
first 10 years



1. PARK DRIVES
2. NORTH PARK & TRAVIS NEIGHBORHOOD PARK
3. CREEK LANDING
4. SOUTH PARK & ARDEN HEIGHTS NEIGHBORHOOD PARK
5. THE POINT WATERFRONT
6. SIGNATURE BRIDGE
7. 9/11 RECOVERY EFFORT MONUMENT

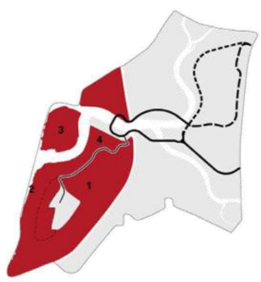
+ MIERLE LADERMAN UKELES INSTALLATION, "MORPHING TIMELINES: ENERGY"

PHASE 2
next 10 years



1. CONTINUED DEVELOPMENT, ONGOING HABITAT GROWTH & RESTORATION & ENHANCEMENTS TO PHASE 1 PROJECT AREAS
2. EAST PARK

PHASE 3
next 10 years



1. WEST PARK
2. ARTHUR KILL PERIMETER CIRCULATION
3. ISLE OF MEADOWS HABITAT RESTORATION
4. THE POINT BUILD-OUT

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4.2 Recycling Centre

4.2.1 Industrial recycling centre, Costa Rica

This project shows how architecture can convert a functional industry into a learning centre by letting public involve into the process.

Location: Río Azul landfill, Costa Rica

Project: Industrial

Architect: Julian Uribe Ateiler

Status: In design

Year: 2008

Project introduction

The project is an Industrial Recycling Centre, which looks for homogenize the machines with the surroundings, diminishing the impact of these on the environment, at same time to make them part of the architecture. This is generated sinking the machinery in the land as part of the topography. The force of gravity it's used as part of the process, producing a minimum energy cost. The project has nature continuity through space; in this way generate indeterminate spaces to be used like industrial thematic parks. At the same time, the project generates jobs to this conflict area.

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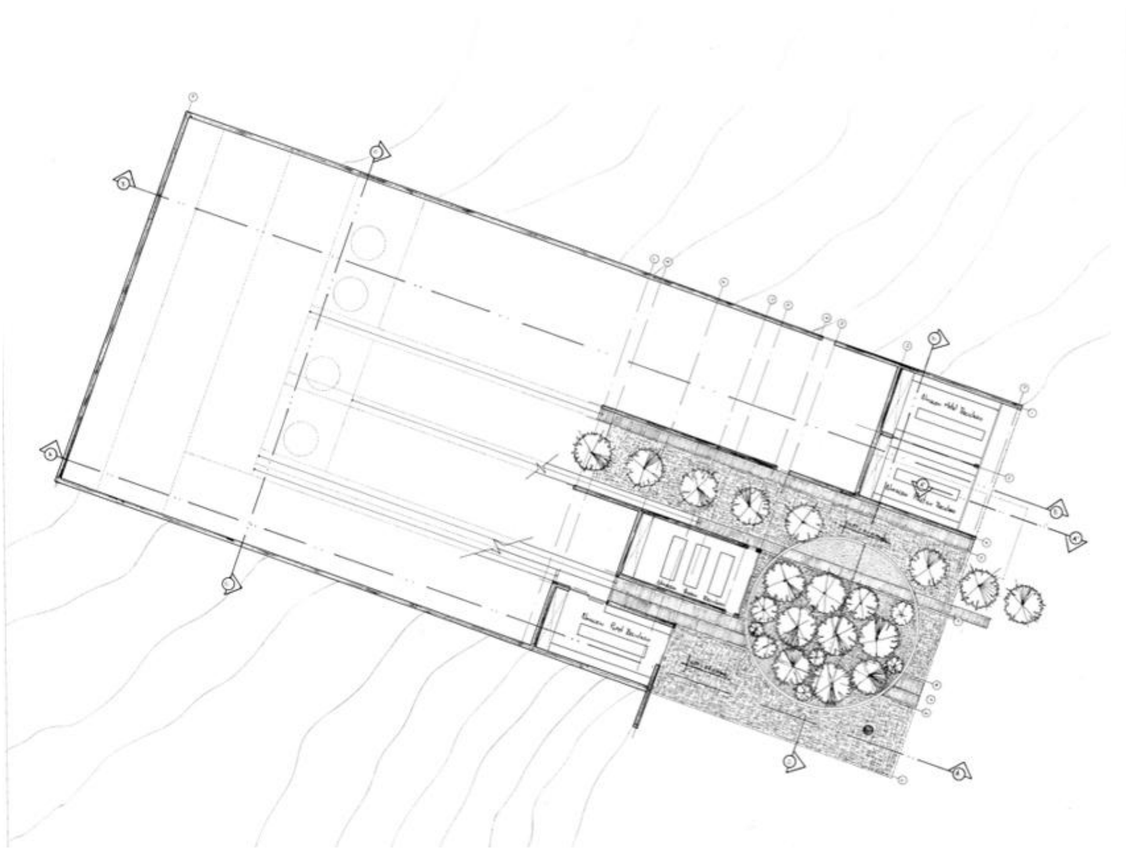
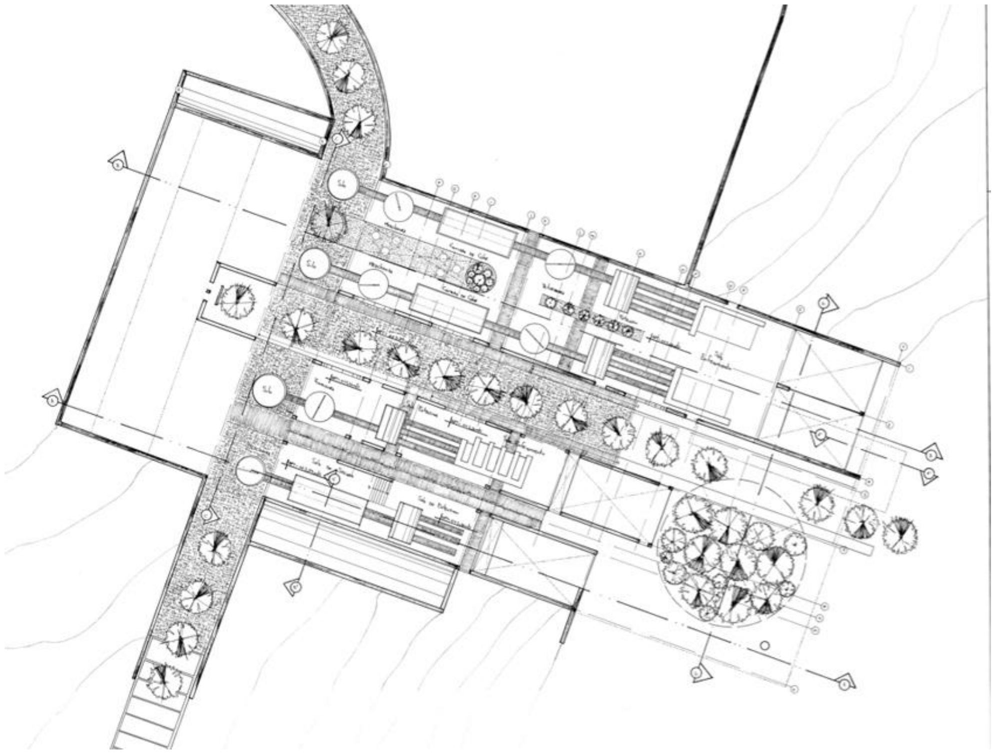
It is allowed that the user can be part of this process of recycling, approaching them to the process, trying to generate consciousness about this problem that concern to everybody with a sense of “Recycling Treatment Begins From Home”.

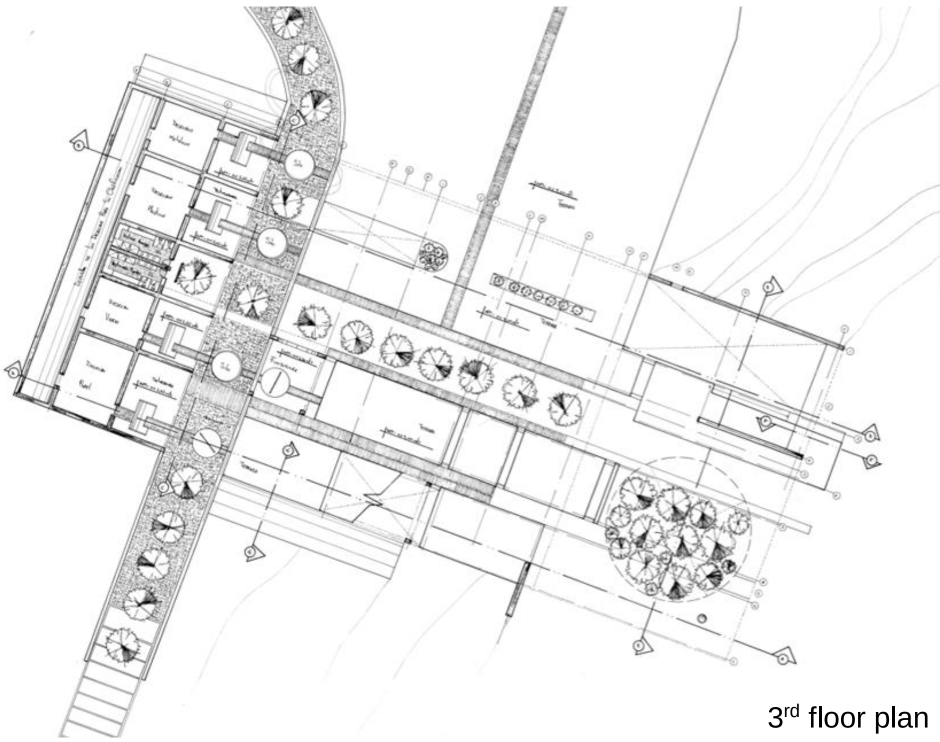
Each material has a different recycling system, so each processing line behaves in different way in a matter of topography and public space. Plazas levels connect all recycling systems; this becomes to be effective when the design uses a proportion system.



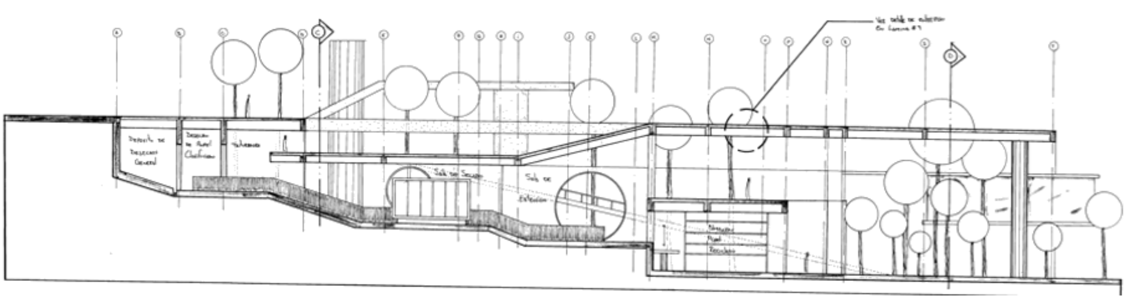
1st floor plan



2nd floor plan



3rd floor plan



Longitudinal section

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4.2.2 Recycling centre in Copenhagen

Recycling centre is not supposed to be a place with public activity, since it has been always perceived as a functional infrastructure. However, this recycling centre in Copenhagen is conceived as a public space, rather than a piece of utilitarian infrastructure, this proposed recycling centre in Copenhagen has explored the possibly architecture can offer. The ongoing scheme seeks to transform the existing concrete box typology of waste management, through the creation of a lively and attractive urban space.

Name: Sydhavns recycling centre
Program: Commercial
Status: In progress
Size: 1,500 sqm / 16,146 sqft
Project type: Commission
Client: Amagerforbrænding
Location: Copenhagen, Denmark

Project team
Partners in charge: bjarke ingels, david zahle
Project leader: nanna gyldholm møller
Team: julian salazar, jesper henriksen, karol borkowski, paolo venturella, tiago sa, rasmus pedersen, romain pequin, tobias hjortda

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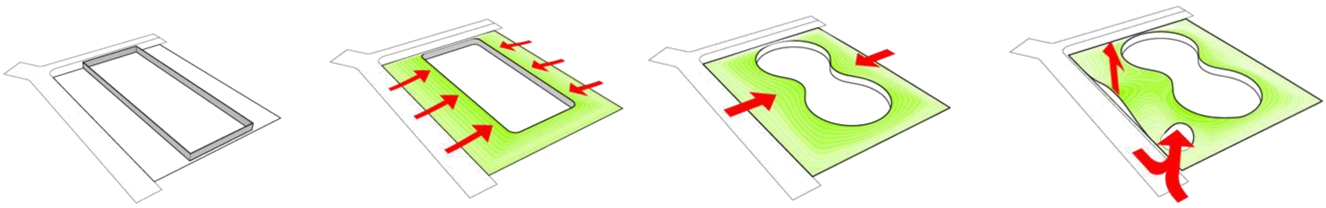
In Denmark, 42% of the waste is recycled, while only 6% ends in a landfill. at the core of the effort to enhance the resource extraction from household waste are the recycling stations, where people and professionals can drop off their recyclable waste for free and scavenge the leftovers of their fellow citizens. The figure of eight-shaped complex is set below ground level, where from the ridge of the basin, members of the public can look into the recycling square and learn about the journey of recycled materials graphically illustrated on the inside of the crater wall. The surrounding landscape provides facilities for fitness, running tracks, and picnic areas.

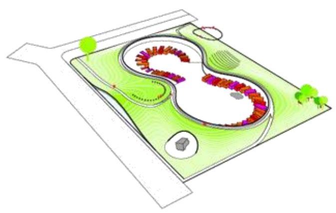


Area & Noise Mitigation
The site area is 12,000 M2 with parking along two facing streets. A noise barrier is required due to sounds from passing cars and trucks.

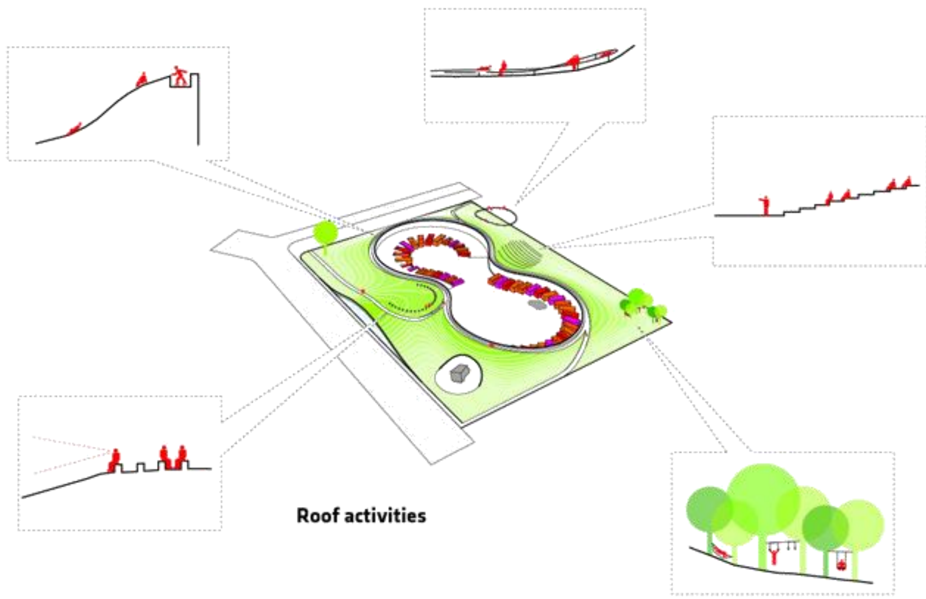
Green surroundings
Generous green-listed area surrounding the site will only be interrupted by a hollow hill around a concrete crater for the recycled goods.

Internal distances and overview
The sides of the recycling center are pushed closer together to create space for more activities under the sloping hills.

Entrances
Vehicles will enter on the north-east side. In the middle, the facade is lifted, creating a pedestrian entrance and better daylight conditions in the recycling center.



Connections
The green slopes are furnished with different activities and a path along the edge giving neighbors the opportunity to see and learn about the recycling process.



Conceptual development

Public activities associated with recycling facilities to allow public involvement in the process.

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4.3 Densified waste materials

Name: PHZ2

Project: Commercial

Status: completed

Resource: Discarded cardboard

Architect: Dratz and Dratz Architects

Manufacturer: Paper recycling facilities, Oberhausen, Germany

Location: Oberhausen, Germany

Discarded cardboard is typically pressed into bales because this allows more material to be stored in collection facilities before recycling. This densification process potentially prepositions the substance for use by architects and builders.

PHZ2 is a multifunctional event space which accommodate a bar and and small service rooms. The project activates this enormous potential for the building sector. The densified bales, held together by metal scraps, possess an extremely high compressive strength capacity. The bales are easy to stack and can form wall elements of up to 30 m in height without any additional support. Furthermore, their mass of approximately 500 kg per unit endows them with astonishing sound insulation qualities. In terms of thermal insulation, walls with a thickness of 1m or more and made out of corrugated as well as flat cardboard show highly appreciated properties.

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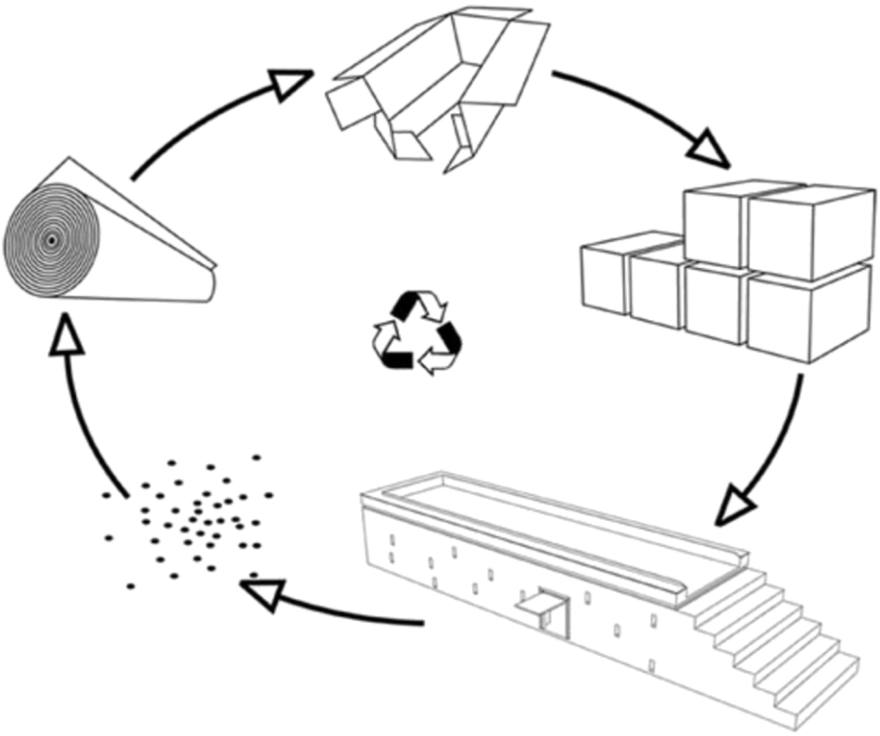

It was unfortunate that the planners and authorities decided against an additional fire protection of the bales or the overall building which could have been achieved with special impregnations or using sprinkler systems.

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4.4 Reconfigured waste materials

Name: Artek pavilion

Project: Commercial

Status: completed

Resource: Label printer waste

Architect: Shigeru Ban

Manufacturer: UPM biocomposities

Location: Lahti, Finland

In search of a material to build a showroom for the Artek furniture company at the 2007 Milan Furniture Fair, the commissioned architect Shigeru Ban selected a new wood –plastic composite created from label printing waste.

The principal material for the structural members is self adhesive label scraps composed of paper and plastic. UPM a Finnish forest Industry Company and producer of self adhesive label materials and bio composites, has developed a way to reuse the waste paper trimmings containing cellulose fibres and plastic polymers.

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4.5 Transformed waste materials

Name: Recy blocks

Resource: Discarded plastic bags

Designer and Manufacturer: Gert de Mulder, Hertogenbosch

Location: Netherland

Recy blocks are discarded plastic bags and other waste products with similar material properties to form new building bricks. The blocks combine structural capacities with a highly artistic approach. Aiming for products for division walls, furniture or for lighting objects. The process requires selection of appropriate plastics for semi transparent and colourful building materials. The materials can vary in transparency and texture depending on resources used. The blocks are waterproof, which allows for both interior and exterior applications. The interlocking block systems are based on holes and tubes. The pillow shaped bricks are manufactured under heat and pressure in specially designed moulds. The blocks can be decorated with motifs from other recycled synthetic materials

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4.6

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Designed waste materials

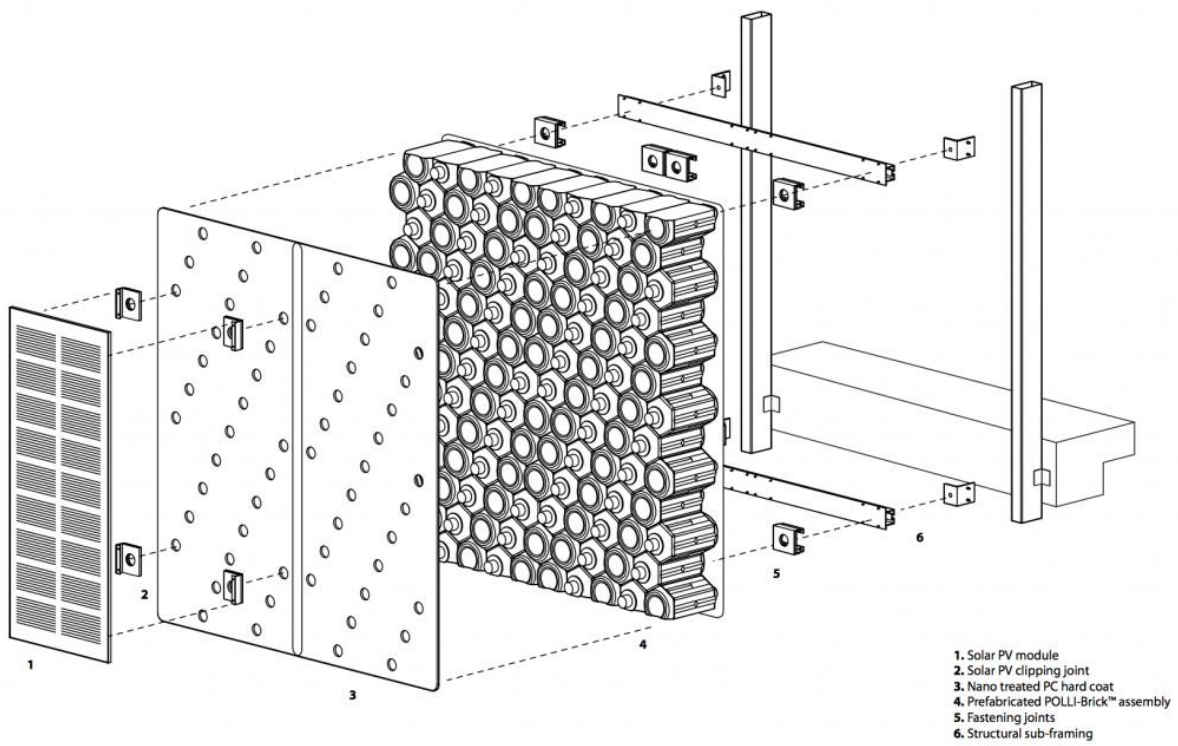
Name: Polli Bricks

Resource: Pet bottles

Designer: Miniwiz Taipei, Taiwan

Manufacturer: Far Eastern Group, Taiwan

Location: Taipei Taiwan



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The Polli brick is a multi functional product made from 100% recycled pet. The iconic Ecopark building of the 2010 international Flora Exposition in Taipei, Taiwan used the polli brick to create an unusual façade. Placed inside a metal frame structure, the bottles from an infill that is reinforced by an additional plastic panel system controlling UV light emission. The shape of the Polli brick enables the construction of modular structures. The bricks fit tightly due to their honeycomb design concept.

4.7 Cultivated waste materials

Name: Hy- Fi

Resource: Mushroom mycelium, agricultural waste.

Designer: The living, New York City

Manufacturer: Ecovative green island, NY, USA

Location: NY, USA

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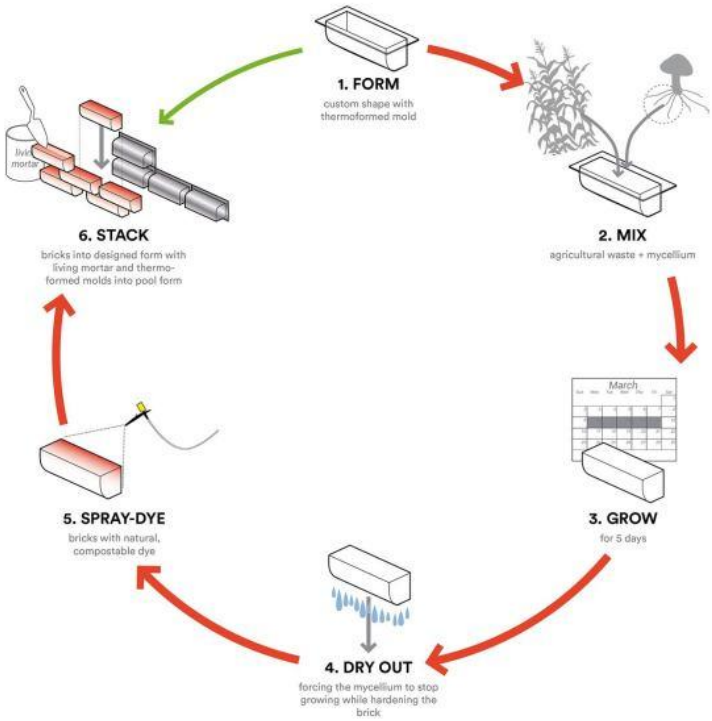
The Hy- Fi project is a collaboration with ecovative and a cluster of towers built out of bricks grown from mycelium at the PS1. The mycelium bricks, using corn stalk as their nourishment grow in special day lighting mirror film formworks in the block shape. In the construction process, the organic bricks are positioned at the bottom of the structure, while the reflective empty formworks are placed at the top and bounced light down onto the towers and the ground.

Hy Fi offers a familiar yet completely new structure in the context of the glass towers of the NewYork city skyline . After deconstruction the bricks are planed to be composted and distributed to the community gardens as compost and fertilizer. In this way the building is completely cultivated and compostable throughout its life cycle.



CHAPTER 6: DESIGN

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DEVELOPMENT

WASTE SCRAPPER

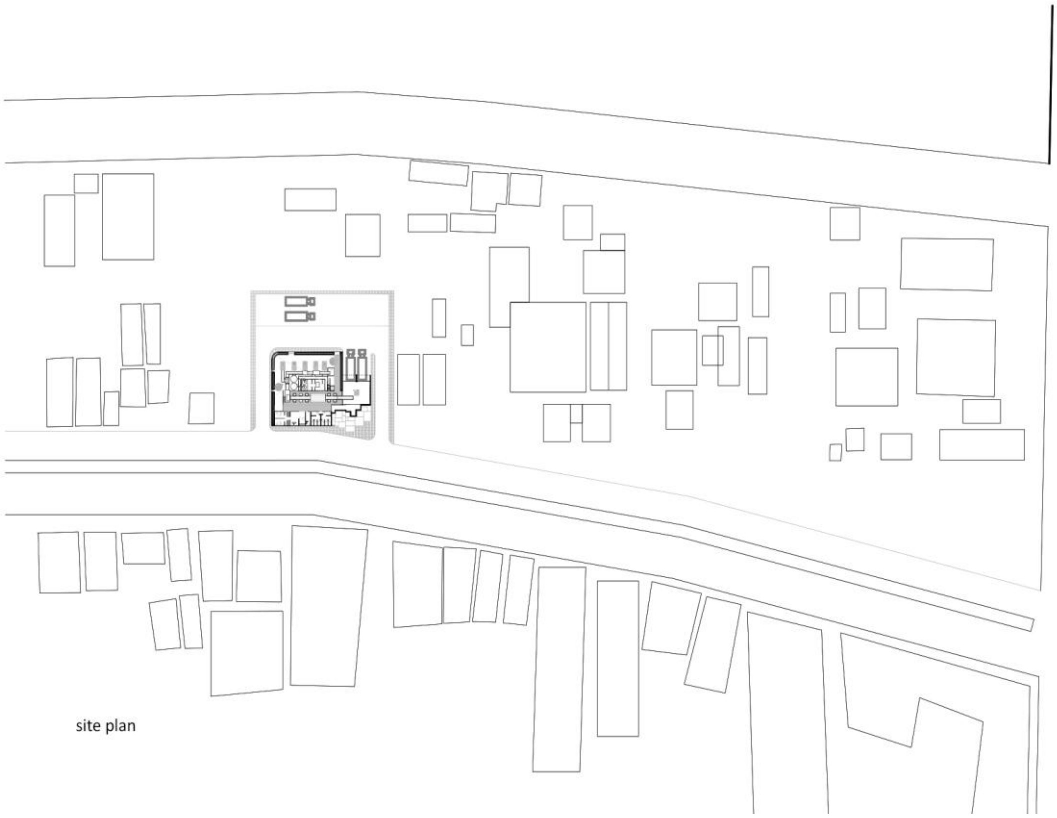
6.1 Conceptual idea

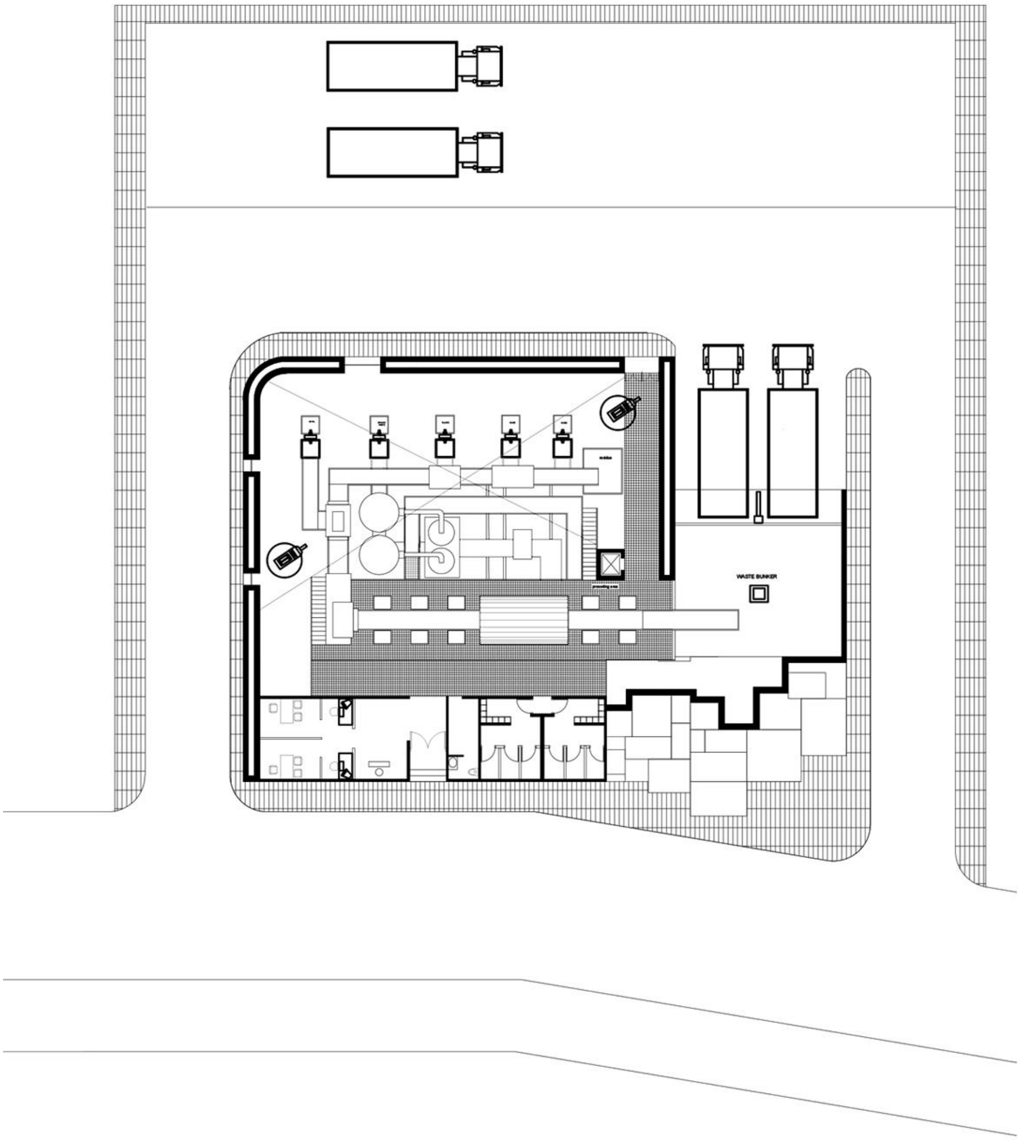
Generally the scrapper will accommodate a MRF that is municipal solid waste processor. The job of the MRF would be sorting inorganic and organic waste from the mixture and then compressed the processed waste to compact the volume that will ultimately reduce the transport footprint. This process will also help to store this raw material for a time period so that it can be transported at night.

The mrf is mainly consisting of three parts and none of these are connected to each other. The waste move from one part to another through horizontal conveyer belt that are mainly overlapped to one another.

The prime concern in the design process was the rapid population growth of Dhaka city. The scrapper needed to be easily adjustable with the rapid change of the city as well as very compact due to land scarcity.

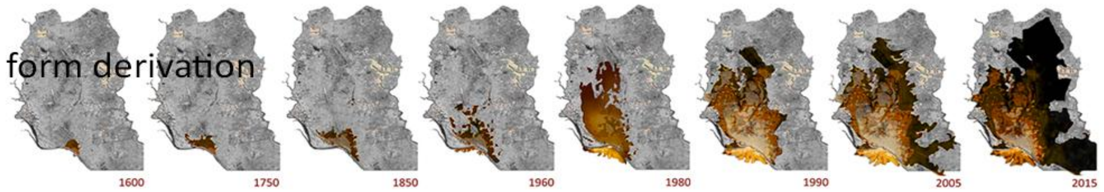
6.2 Design phase

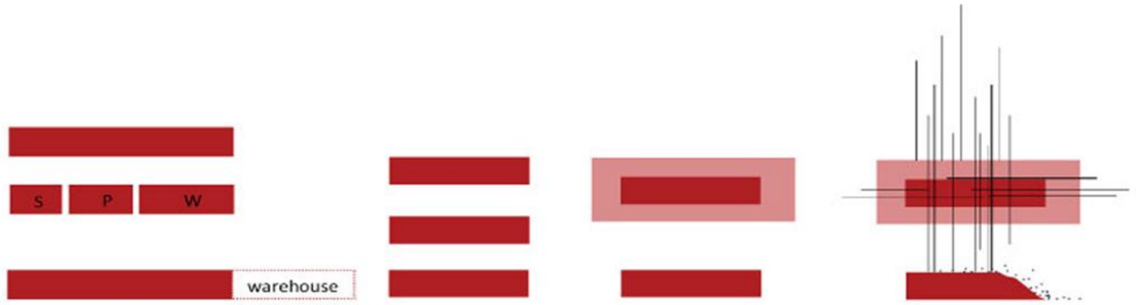


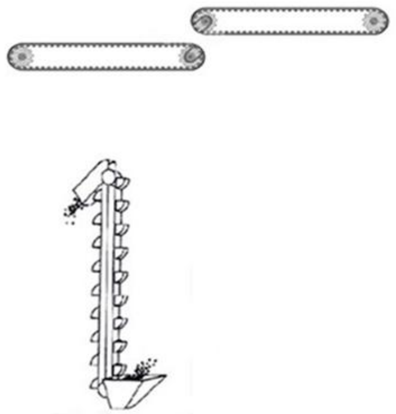


Waste scrapper ground floor plan

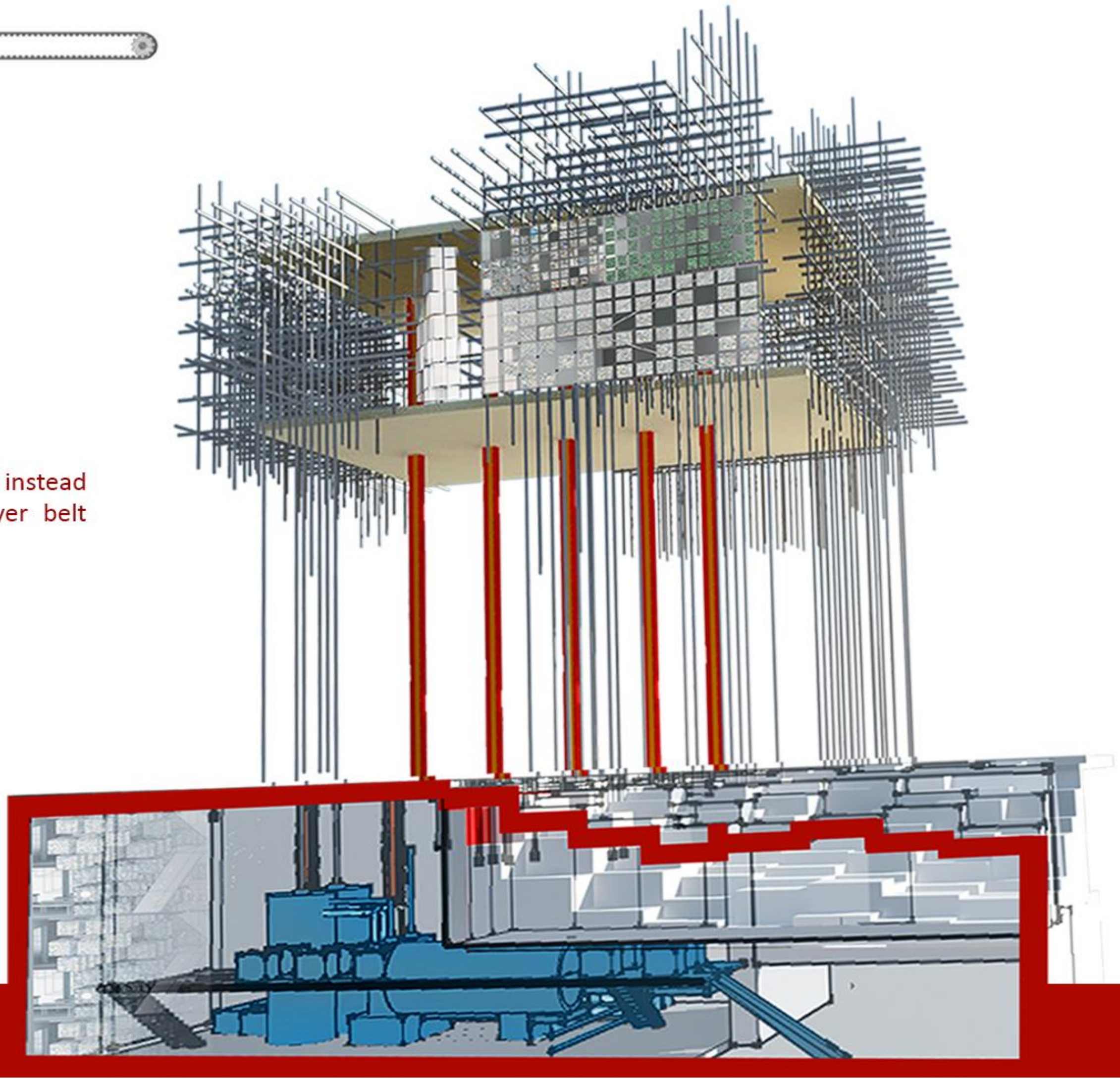
form derivation

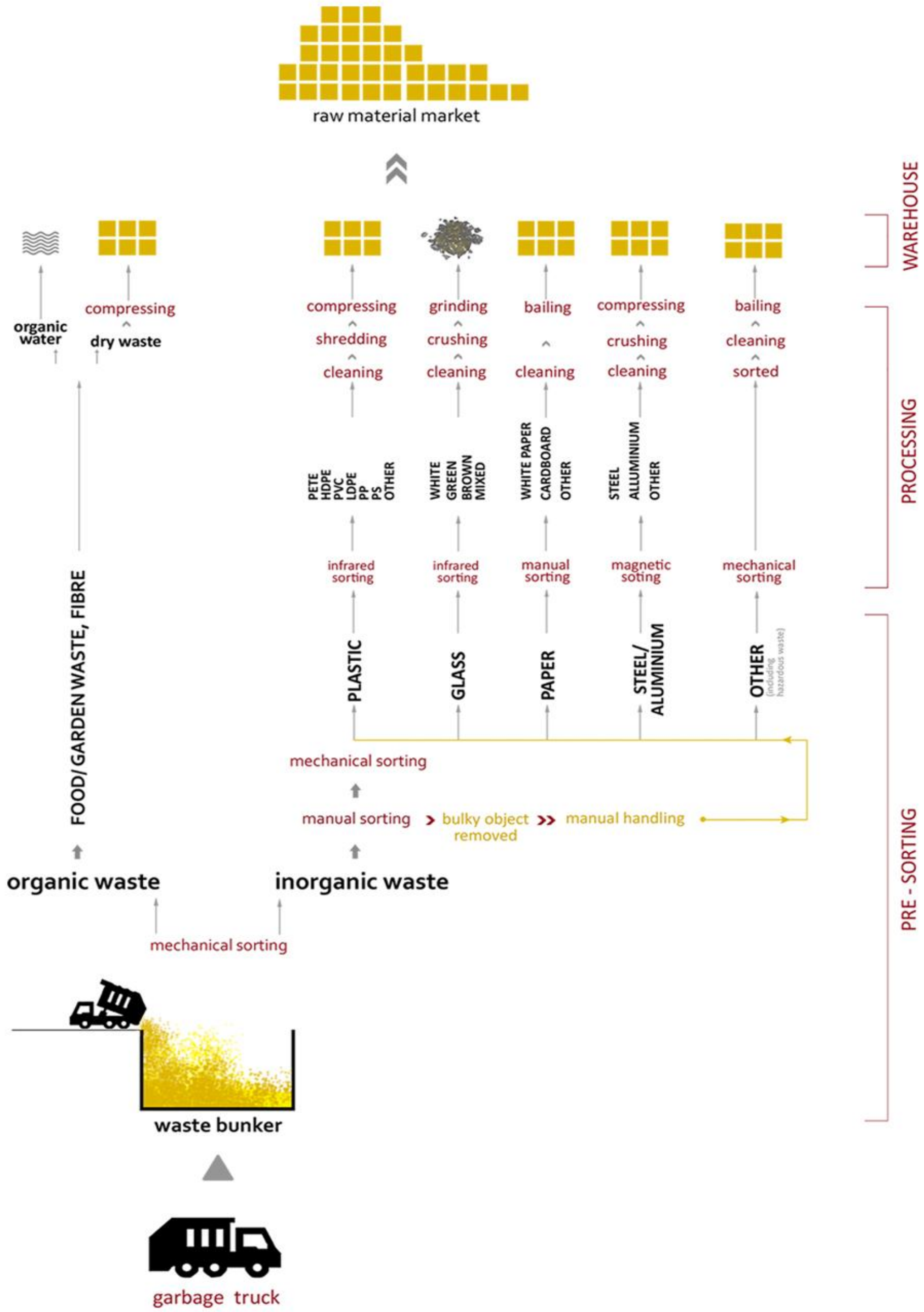






vertical conveyer belt instead of horizontal conveyer belt

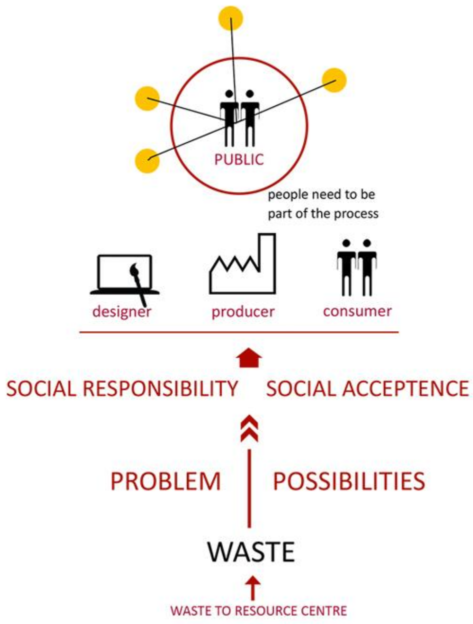


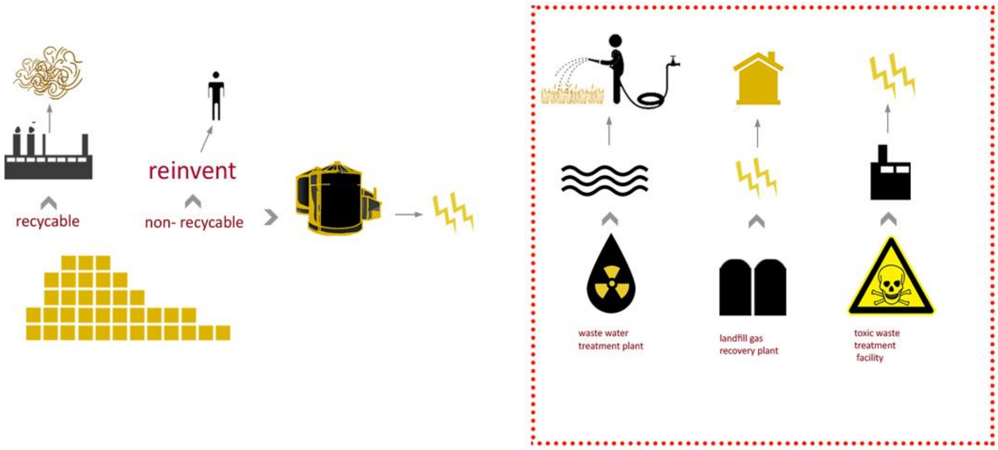


waste scrapper mechanism

RESOURCE CENTRE

6.1 Conceptual idea





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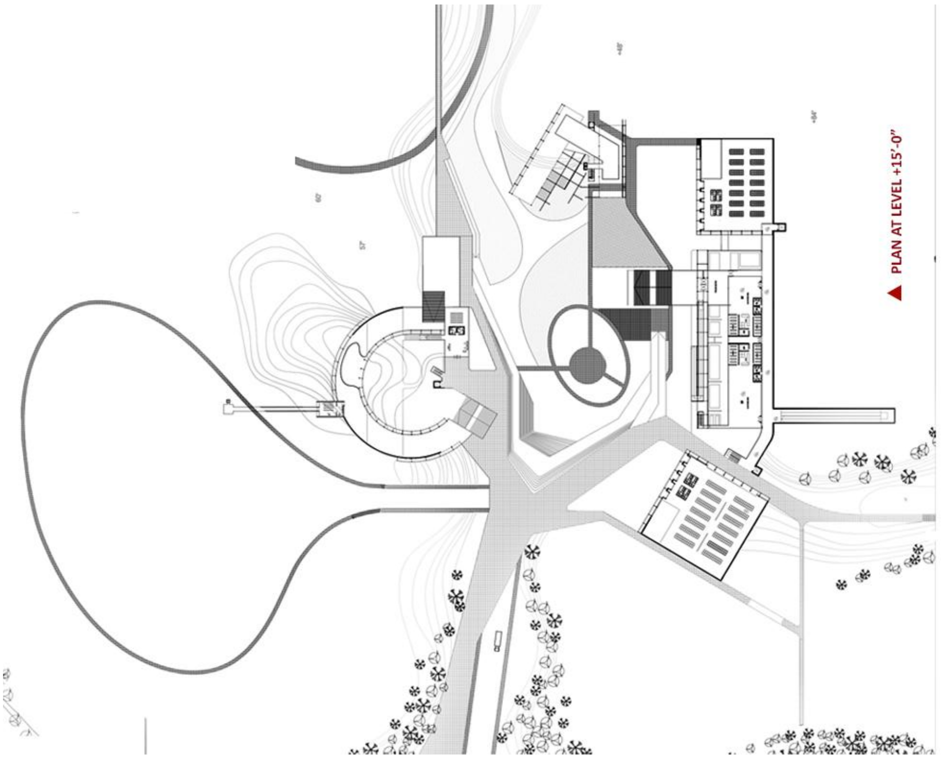
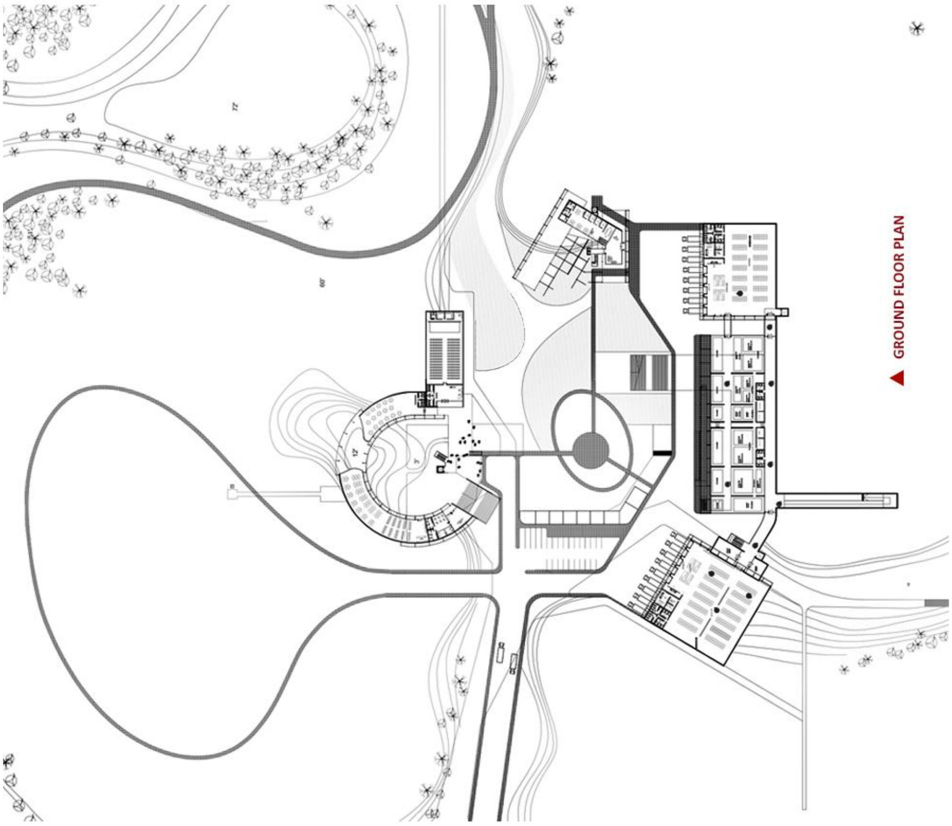
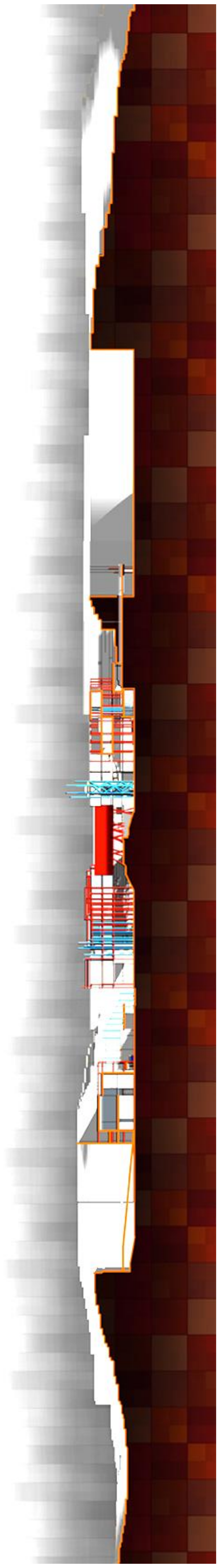
▲ master plan


PLAN AT LEVEL +15'-0"


GROUND FLOOR PLAN



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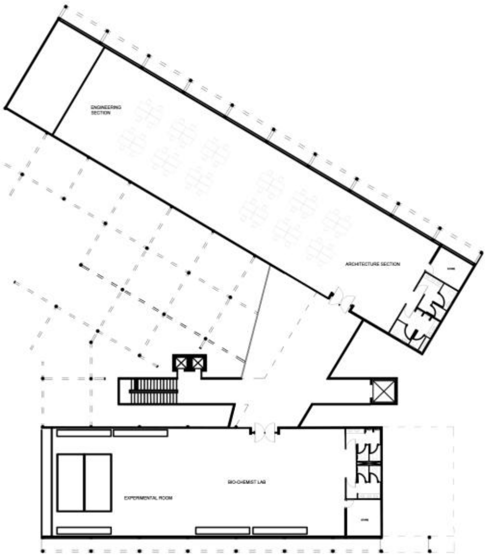
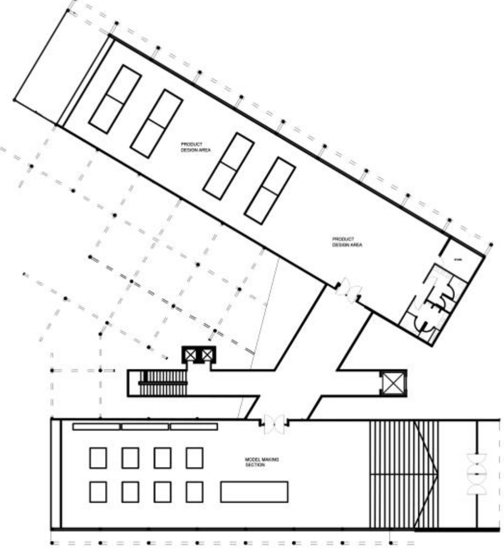
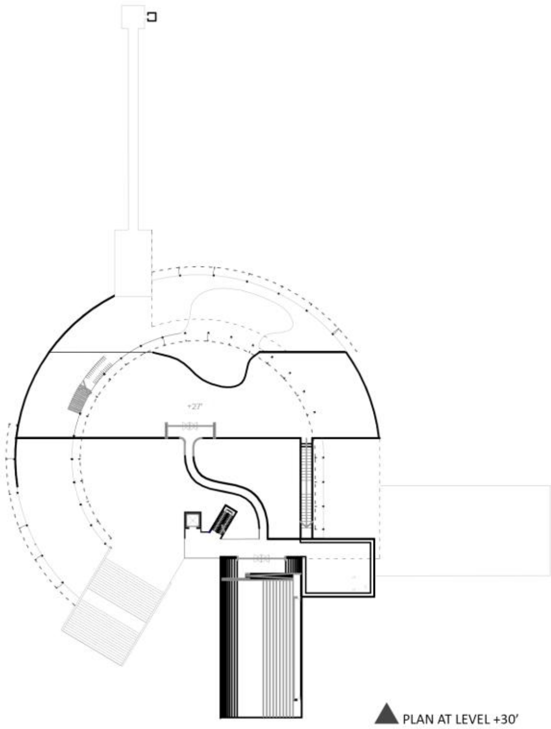


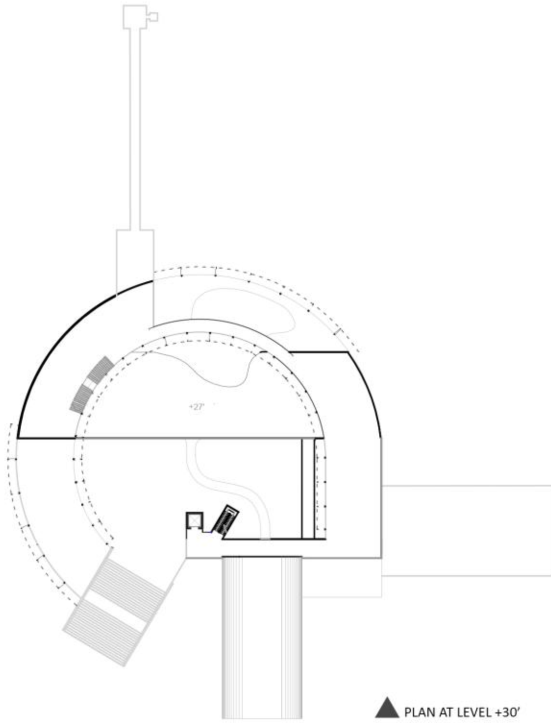
PLAN AT LEVEL +30’



PLAN AT LEVEL +30’



PLAN AT LEVEL +30'

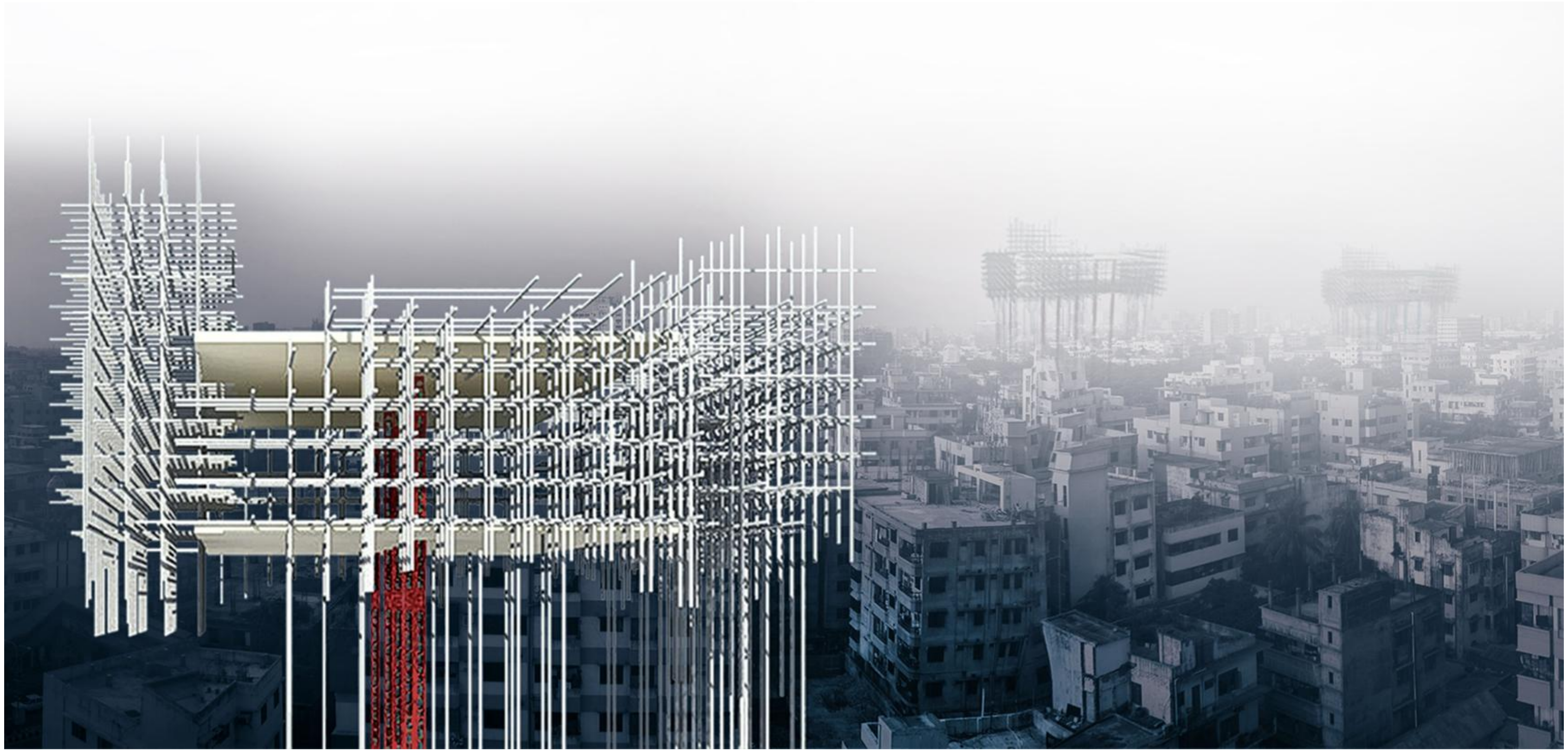


PLAN AT LEVEL +30'

warehouse would be the fenestration of the scrapper
The height of the warehouse will dominate the structure

The more sustainable life we will lead the less waste we will generate and so the less dominating the structure will be in the city skyline.

Because adaptibility is the solution not avoiding!!



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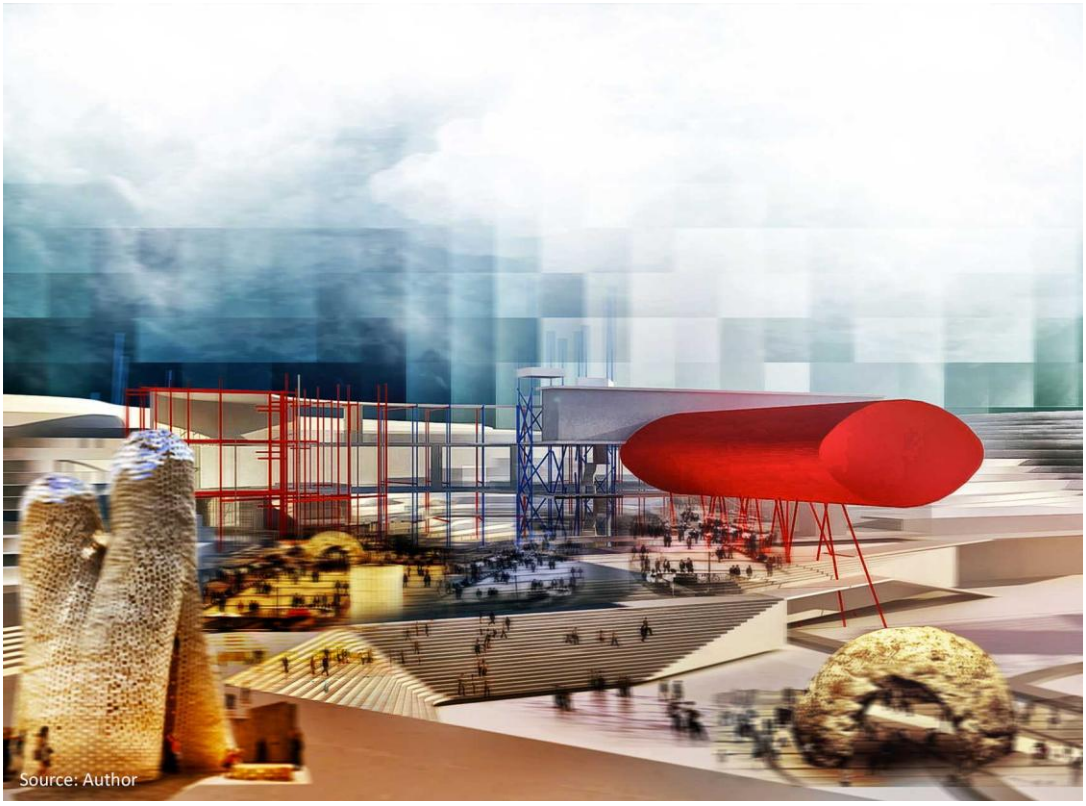
Source: Author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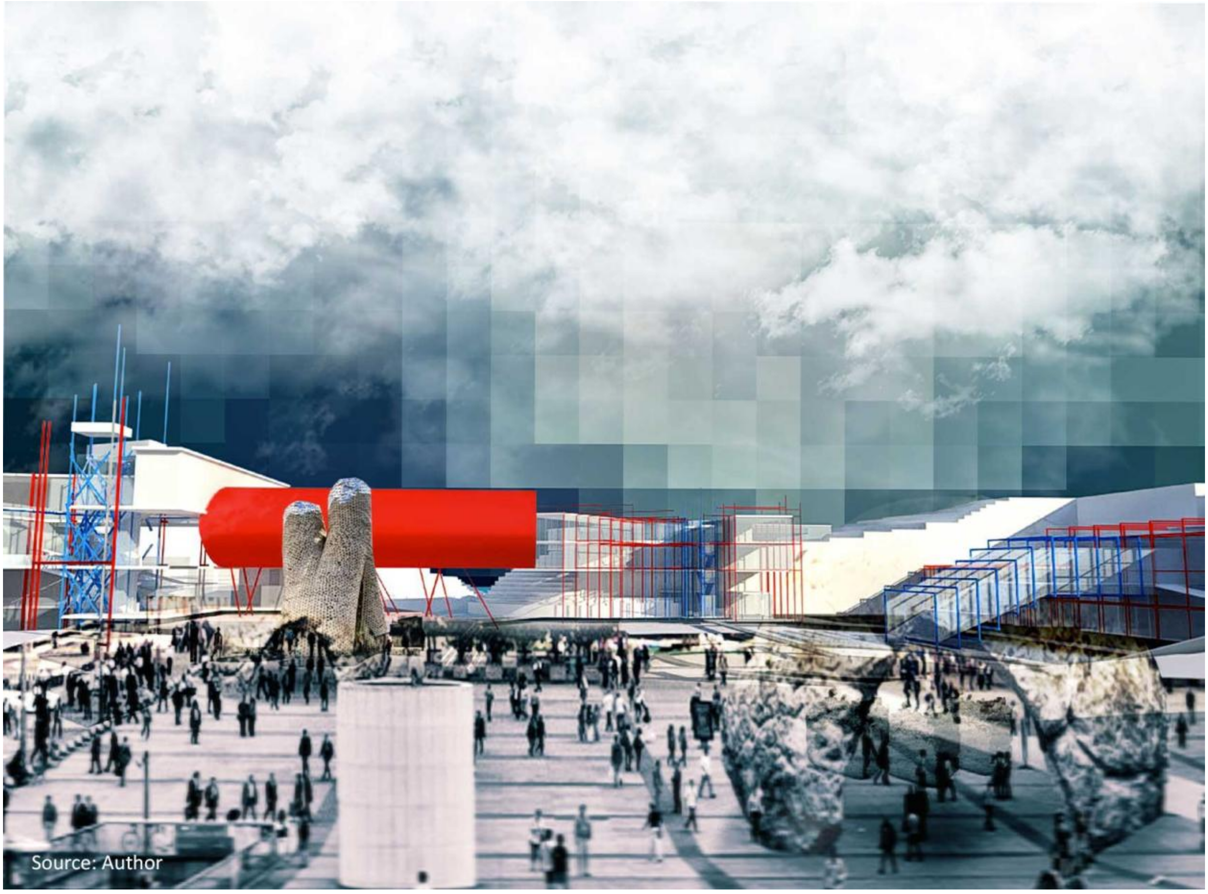
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CONCLUSION

The paper was an attempt towards a possibility against this burning issue of waste. We cannot go further if we still think the way we have thought of earlier. Adaptability should be the option not avoiding; this is what we need to understand. Waste is not a burden rather a resource but in a wrong place. We just need to place it at the right point.

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