One to One A New Container For Lagos

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One To One A New Container For Lagos

This Thesis is Presented to

Professor Ameen Farooq
Professor Peter Pittman

Faculty of the Department of Architecture
College of Architecture and Construction Management

by

Alhussien Anthony Bah

In partial fulfillment of the requirements for the Degree

Bachelor of Architecture

Kennesaw State University
Marietta, Georgia
Spring 2018
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RESEARCH: pg.4-10, pg.28-33
DESIGN: pg.35-36, pg.37-52
This thesis investigates an overused landfill for municipal garbage of Lagos, Nigeria. Currently, Nigerians live in uncontrollable amounts of waste. Research has shown cases of forgotten garbage next to homes, in someone’s backyard. It is now common to see kids becoming sick from contaminated water and dying from diarrhea, typhoid, cholera. Lagos Authority of Waste Management have been involved in the global exchange of waste, but a solution needs to apply to help soften the effects waste has on the environment.

The amount of waste contained at this landfill, obtains forty percent of Nigeria’s waste. Research shows that the population of Lagos will grow over the next thirty years to eighteen million people, this means more waste. By examining models from Denmark, the United States, and Spain, spatial organization, landscape, infrastructure, and materiality, become starting point to creating a new container for the future of Lagos.

This thesis aims to show how a city container will be a part of social engagement and practice, for a better Lagos. This thesis aims to raise public awareness and provide space allow everyone to get engaged in the city agora. This idea introduces a new type of container space along with waste facility that responds to the need for waste treatment and as alternate source of energy within the context of Lagos. This thesis operates as a facility that contains public spaces, collaborative workshops, environment research spaces for Nigerians to aid the rapid growth of the city.
The Nigerian National Population Commission shows the total population of Nigeria at about 143.33 million in 2006 to 192.05 million in 2017. Lagos has around 14,550,598 people in 2017, it's expected to grow to about 24,239,000 in 2030. The projected growth of Nigeria is due to the rural Nigerian migrate to developed areas searching for work (figure 1). According to the Central Intelligence Agency Nigeria’s electricity demand is projected to grow from 15,730 mw to 41,133 mw by the end of the year in 2015. Nigeria electricity capacity has fallen between 3,500 mw and 4,400 mw pervious years because of the short of gas supply. Nigerian’s with power generators marked low capacity compared to the estimated demand of 12,800.

This diagram explains that over time the human population in this region of Nigeria will rise.
Sub-Saharan Africa is facing three problems simultaneously: rapid population growth, dehealth issues related to enviroment, and massive migration to urban cities. Nigeria is one the fastest growing populated countries. In 2006 census has it at 140 million. In the past few year Nigerian is now home to 186 million people, the current technogy of Nigeria will need an upgrade to accomodate the steady climb of population.

This growth is coming from the number of rural farmers coming to the city. The population growth resulted from rural to urban migration and rapid urbanization caused homelessness, and lead to an over crowed city with slums. The rapid growth lead to informal structures placed in unorganized layout. A survey was done on spatial analysis of housing quality in different urban areas in Nigeria. A various collect of six cities housing types were classified in three components. Component 1 characterized houses to be with electric light, waster closet toilet, good sources of water, with high quality roofing. Component 2 were houses of poor quality, made of wood, earth, palm and mud, traditional compound and semi detached house types. Component three accounted for the house types made of zinc walls and public form of toilets and was not investigated heavily on by the surveyor. The good quality homes made up 31%, and the poor quality made up 38% of the survey. This thesis tries to implement waste to energy to help on the poor quality living standards, but providing district heating and electricity to the 55% of the population who don’t have access adequate energy supply.

Relevance of Hypothesis
The existing flow of waste handled in Nigeria is in a linear manner. The waste is picked up from certain areas and taken to the targeted landfill where municipal solid remains are uncovered, often next to residential houses with low value.

LAWMA has planned to station satellite spots where sorting is to be done before exporting what is deemed unusable to the main facility. Smart dumpsters and smart vehicles are supposed to be implemented to help track waste levels of bins and dump trucks daily.

This thesis proposes a new type of facility never before made in Nigeria. This current form of a container space is transformed into something that is beneficial to the surrounding context and the natural environment.
A survey across Nigeria shows that most existing dumpsites/landfills are neglected by the Environment/Public Health Officers. This results in people dumping near bodies of water, canals, under bridges, excavation sites, and river for landfill operations. The inappropriate location of waste disposal sites has resulted in contamination of surface and ground water, soil, air pollution, spreading of diseases, aesthetic problems and societal nuisance. The problems of open Landfills in Nigeria present a common issue for the entire Nigeria.

Studies show in Delta Benin State in Lagos Nigeria, the environment is polluted through various dumpsites resulting in the affect of urban air quality. The levels of Suspended Particulates Matter were three times greater than the allowed 250ug/m³.
It is common in all parts of Nigeria to see the accumulation of waste dumps in the urban and commercial cities. The average individual generates an estimated 0.115 kg of waste daily in Nigeria. One notable issue that contributes is the lack of modern technology and infrastructure available.

LAND DEVELOPMENT OF IKEJA REGION OVER A COURSE OF 54 years. These diagrams are meant to show the emergence of the landfill over the course of 54 years. The Black represents the undeveloped which eventually become the landfill operated by LAWMA and LAGOS GOVERNMENT takeover by LAWMA in 1994.

OLUSOSUN LANDFILL RECEIVES FORTY PERCENT OF GARAGE FROM INDUSTRIAL AREA PER DAY TO OLUSOSUN LANDFILL

0.115 kg PER PERSON A DAY

25 MILLION PEOPLE IN 2025

40%

1,150 kg
Aim & Objective of this redevelopment is to implement a Lagos State Resettlement Template with a view that showcases Lagos example and peculiarities in view of the existing World Bank Safeguard Policies.

The Objective of the Proposed LAWMA's proposed plan.

- To train waste pickers on site on best methods of waste recycling and thereby Prevent Outbreak of Diseases among waste pickers.
- To ensure displaced persons will be compensated for their losses at full replacement cost and provided assistance for disturbance prior to beginning of civil works.
- To upgrade Olushosun Dumpsite under the LAWMA/LMDGP arrangement.
1.3 Underlying Principles of Architecture and Infrastructure

This thesis aims to incorporate a new type of facility never before explored in Lagos Nigeria. By implementing architectural methods to achieve equal distribution of program, an integration of human and mechanical elements are fused. Educating Nigerians about waste and its harmfulness on oneself and the environment are the key drivers for architectural spaces combined with mechanical. This project must use contemporary technology, and use unique building technicals. This architectural model used as a pilot project. This type of building will reflect the growth of Nigeria and help bridge the gap between social and economical class.
CASE STUDY
1.4 Tersa Waste to Energy Facility in Barcelona, Spain
Tersa waste to energy is a case of architecture and the integration of infrastructure combined to serve Barcelona Metropolitan area.

This program spaces are completely opposite in nature. This contrast created by the built and natural environment are components that are successful in this project.

The landscape provides public space along the coast of the island. At the plant materials are recycled and sorted by series of process. This complex takes up 2.3 hectares which contain private spaces for engineering equipment and public spaces for recreational of Barcelona.

Key takeaway from this project are the programs arrangement of program that helps the transformation of the city garbage.

A problem presented in this project was the private interior spaces of the factory are dark, secluded from other activities of the site and the surrounding context of Barcelona. Possibility to take this project a step further, the new program could be designed in manner that incorporates space exploration inside the structure.
1.4 Tersa Waste to Energy Facility in Barcelona, Spain

Here the landscape introduces public space for the city. This element is an idea to consider in the investigation of the thesis. This is an example of community space that engage the city through the programs of the site. This project is a waste to energy facility that is positioned near the beach. The project is adjacent to the edge of the city which is divided by a major highway.
1.4 Tersa Waste to Energy Facility in Barcelona, Spain

This process is performed to claim any recyclable material before being sent to the incinerator. The primary sorting equipment are made up of trommels, ballistic separators, plastic film separators, secondary sorting cabin, and induction separators. Any rejection or non-recyclable waste like organic waste are sent to the waste to energy line for incineration. The energy produced from incineration is used to generate steam and electricity. The byproduct that this process creates receive treatment depending on their characteristics. In these facts, the maximum number of hours per furnace are 8,400 which 95.9% of the year. There are three main refuse lines each line capacity is 14.5 per hour. The average temperature of combustion is 900 degrees Celsius and the turbines use 30 tons per hour to supply vapors to urban heating and cooling network. As an overview of this building treated 291,037 in 2014, but in 2016 this plant treated 363,261 tn.
1.4 Tersa Waste to Energy Facility in Barcelona, Spain

1. Platform
2. Ecoparc residue feed
3. Refuse pit
4. Grapple crane for refuse
5. Refuse feed chute
6. Pusher
7. Operator room
8. Ammonia injectors
9. Natural gas burners
10. Grates
11. Boiler furnace
12. Electrostatic filter
13. Atomizer for dissolution of calcium
14. Acid gas absorber
15. Carbon injector
16. Sleeve filter
17. Induced draft air fan
18. Ash and dross channels
19. Dross evacuations
20. Metal and rubble separation
21. Fly ash receptor
22. Sweater for cooling
23. Condensers
24. KKK turbine
25. Alstom turbine
26. Monitoring of atmospheric emissions
27. Chimney Stack
1.4 Precedent Analysis Factory Processing

FIGURE XVIII
This project can be seen as dehumanize because of the amount of metal and scale of the machinery in the interior. In thesis, the challenge is to make a more inviting spaces because of the program being supported in the mixed use factory.

This is the portion of the building that is semi underground. The openings spaces stretch along side of the retaining wall, Truss hold up the roof above the height of the machines.

On the exterior the building is cladded in translucent blue polycarbonate material and corrugated metal.

This project can be seen as dehumanize because of the amount of metal and scale of the machinery in the interior. In thesis, the challenge is to make a more inviting spaces because of the program being supported in the mixed use factory.
This project incorporates sculptural architecture to enhance the user experience by focusing on social characteristics. The program of The Why Studio is a collaborative learning facility at the Delft University of Technology. It serves as a think tank for graduate students interested in future city growth. The idea is to have the bright piece of architecture stand out from the surrounding building context. Built in a courtyard the program can be seen through glass. The visual connection of the interior actives help integrated building programs within this structure in correlation to the exterior context. The interior is kept work-friendly by the use of colors. The interior spaces are a different shade of color.

This diagram shows how the courtyard space is turned into a gather space for program. The layered program becomes more private and inclusive as the users travel up the stairs. This diagram illustrates a social gathering space as between two or more people collaborating together.

Architect: MVRDV

1.4 The Why Studio in Netherlands
The program of this building adds various uses to the building which would help the longevity of the building, also it provides exercise for the city of Copenhagen. The ideas of layering of spaces are clearly articulated. The interior is programmed for the workers, and mechanical equipment. The exterior is used as a public ingament “device”. The facade offers a climbing wall. This seems

This diagram shows the designated activities of the building. What is taken away from this project is the merged program of the building with the factory.

1.4 Copenhagen Hill Copenhagen, Denmark

Architect: BIG
This building is the largest waste to energy plant to be built in China. The plant plans to incinerate 5,000 tonnes of rubbish per day. This building is 66,000 sqft that is rapped in a facade that allows air to move through. The Facade is noise and smell proof. The circuler building footprint allows the visitors to view the activities in a panoramic experience.

This diagram shows how air moves through this preformative facade. This allows the activities inside to be done in natural air. This also allows for a passive approach for cooling the building.

**1.4 Shenzhen Waste to Energy Power Plant Shenzhen, China**

Architect: Schmidt Hammer Lassen Architects & Gottlieb Paludan Architect
SITE INTRO
Lagos is the largest city in Nigeria. It was once the Nigerian Capital, and it is the main import and export commercial center of Nigeria. The nearest body of water is the Lagos Lagon. According to the CIA, Nigeria total area of land are categorized in 3 parts, 38.97% Arable Land (able to be plowed), 3.46% (understood as year around crops), 57.57% other. There are about 2,932 sq km of irrigated land separate throughout the country. Lagos is categorized as a monsoon climate area. This location of the world experiences wet and dry climates. Rainy seasons accrue in two distinct phases a rainy intense are between April and July and a lesser during October to November. The dry seasons are through August and September. In Lagos the average temperature is 91 to 77 degree Fahrenheit the highest temperature happen during the dry season in March.
## 2.1 Site Selection

<table>
<thead>
<tr>
<th>Landfill</th>
<th>Active</th>
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<tbody>
<tr>
<td>Olusosun</td>
<td>Yes</td>
<td>11/1992</td>
</tr>
<tr>
<td>Souls 1</td>
<td>No</td>
<td>10/2006</td>
</tr>
<tr>
<td>Souls 2</td>
<td>Yes</td>
<td>07/2006</td>
</tr>
<tr>
<td>Souls 3</td>
<td>Yes</td>
<td>07/2008</td>
</tr>
<tr>
<td>Abule Egba</td>
<td>No</td>
<td>07/2008</td>
</tr>
<tr>
<td>Ewu Eleje</td>
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<td>12/2008</td>
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<td>Owutu</td>
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<tr>
<td>Epe</td>
<td>Yes</td>
<td>02/2009</td>
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<tr>
<td>Ogombo</td>
<td>No</td>
<td>03/2009</td>
</tr>
<tr>
<td>Anthony Village</td>
<td>No</td>
<td>11/1992</td>
</tr>
<tr>
<td>Isolo</td>
<td>No</td>
<td>01/1995</td>
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<tr>
<td>Makoko</td>
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<td>01/1983</td>
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<tr>
<td>Agunlejika</td>
<td>No</td>
<td>01/1990</td>
</tr>
<tr>
<td>Omole</td>
<td>No</td>
<td>01/1995</td>
</tr>
<tr>
<td>Billings Way</td>
<td>No</td>
<td>01/1997</td>
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</table>

One of the main driving factors of the site criteria was location of highways and connection routes. In each of the areas selected, major roads are near densely populated areas. Each area needed to be within the urban context because of the rapid development and economic factors Lagos is known for.
The Lagos Waste Management Authority is an organization that controls the processing of waste and recycling. LAWMA once managed sixteen sites around Nigeria, roughly 31.25% of the Landfills are still active around Nigeria. Olusosun Landfill is the largest landfill in Nigeria stretching over a 100 arces with building associated within the landfill to reach 245 arces within a mile radius. This landfill was selected because it receives 40% of Lagos waste daily, and its close proximity to the airport which helps the growth of the city.

### 2.1 Site Selection

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</tr>
</tbody>
</table>

Olusosun

Omole

Abule

Isolo
2.1 Site Selection

"Because Lagos state has become the commercial center of the country, it has a massive human population and wastes are generated at higher levels than of the country side."

"40 airlines that fly from Lagos to over 60 destinations worldwide, carrying over 10 million passengers every year. Lagos has a domestic and international terminal. There are hotels about 3500 ft away from the Murtala Muhammed International Airport."
2.2: Site Documentation of Existing Landfill

Site line of the different locations around the site.

Figure XXXIII

Figure XXXIV

Figure XXXV

Figure XXXVI
The city operates around this dump-site. Express Way A1 & E1 are major arteries connecting Northwest and Southeast Lagos. The Secondary roads around the site connect equal half of the site within a 1.5 mile radius.

The westside of the site nearest to the Airport are highend apartments and houses. The eastside of the site is where roads become more dense are smaller homes shack and mixed market type buildings. This area is where the majority of the waste from the city.

**MAP LEGEND**
- Major Highway
- Secondary Road
- Thrid Road
- Buildings
- Canals, Water way
- Green Region

**FIGURE XXXVII**
These are the existing building types around Olusosun Landfill. These buildings are mainly industrial and commercial. The highways and primary routes surrounding these buildings give the buildings access to the local routes. The buildings that are closer to the landfill become more shack type informal structures, but as the buildings move away they are more up scale.
2.2: Existing Building Types

Cement shows in urban areas the common used material around Lagos, Nigeria. Here I'm looking at the materiality of the nearby buildings. Each category is categorized to floor, wall, roof common materials.

Existing Material Palette

<table>
<thead>
<tr>
<th>Floor Finish</th>
<th>Wall Finish</th>
<th>Roof Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth</td>
<td>Tile</td>
<td>Palm</td>
</tr>
<tr>
<td>Wood</td>
<td>Wood</td>
<td>Concrete</td>
</tr>
<tr>
<td>Cement</td>
<td>Zinc</td>
<td>Stone</td>
</tr>
</tbody>
</table>

Figure XXXX
2.3 Existing Site Context

This diagram looks at the overall land use of buildings nearest to the landfill. The Westside (Government High End Living) and the Eastside divided by the E1 & A1 highway become Residential / Commercial.
The survey shows the land is mainly flat with not much change in elevations. The lower elevations are usually accompanied by water ways and vegetation. The red outline is the landfill. The contours represent a high-end and a lower in of the site. The landfill is 42 acres long and 3000ft across from the site boundaries which are the highways and the main secondary roads.
Design Process
3.1 Site Design

The site selection is based off where exactly the building can set on the site. The structure that would be built here has to be near the landfill. The idea of such a facility was to take place near the landfill where the logistics of waste is already being processed and kept. The placing the building at position 1 brings a discontinuity to the overall site. Position 2 posses the same issue not connecting the highways for trucks to the main road. Position 3 posses the best option because it is closest to the main road and secondary highway as well as connects to the existing roads of the landfill.
3.1 Site Design

These roads are existing and allow easy entry and exit of the LAWMA trucks and pedestrian cars to pass through. The choice to keep the existing roads makes sense to use what is already familiar to the drivers.

North portion of the landfill selected for the logistics of the site.
3.2 Spatial Design

These are spatial diagrams. The square footages are used as a basic beginning to allocate the waste process and the social program together. These two programs are different, but seamless approach to the building. The idea is to create a learning experience as the user moves throughout the building. This informs the spatial adjacency of space. The social side of the building are more public, but as the one moves throughout the building it becomes more private where the waste is transformed into energy.

<table>
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<tr>
<th>Incinerator Space</th>
<th>Social Space</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Co</td>
</tr>
<tr>
<td>L</td>
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<td>W</td>
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These are spatial diagrams. The square footages are used as a basic beginning to allocate the waste process and the social program together. These two programs are different, but seamless approach to the building. The idea is to create a learning experience as the user moves throughout the building. This informs the spatial adjacency of space. The social side of the building are more public, but as the one moves throughout the building it becomes more private where the waste is transformed into energy.
Collaborative Space: ★ ★

Is an area for public and private use to have access to equipment, technology, education material methods to test samples and provide resources for engagement between LAWMA and the public sector of the Ikeja, Ogun, Ketu within a mile from the site. The collaborative space is organized to have hands on training for additional trade skills like barbers, welders, waste handling, recycling, carpenters. This provides program and engagement amongst public and private entities. Providing opportunities to learn an require formal training could soften the unemployment/poverty rate increasing in Urban Nigeria.

Lobby Space: ★

The entry is where the visitors are greeted by a front desk and indie of spaces which assist visitors with the way around the building. This serves as a buffer between the beginning of the building and outside landscape.

Incinerator Space:

This area receives waste and processes it to entry. The growth of the city will continue to grow so a need for such facility is needed to reverse the effect of the landfills on the land. Visitors will be able to come here to visually see the process of the city's waste to emerge.

Administrative Space: ★ ★

Administrative offices are used primary by LAWMA managers. Meeting spaces and office rooms are provided to house documentation of LAWMA activities. This allow LAWMA to have an operation space on a day today setting nearest to the site for close monitoring.

Classroom Space: ★ ★

This space is used to teach anyone that wants to learn about what LAWMA and LMSGP is doing towards the Okohosen Kroft. These space also provide a classroom setting for any training that would be required from LAWMA to waste pickers before they are incorporated recycling facilities.

Laboratory: ★ ★

This area is used to collect data from the incinerator. The environmental engineers and scientists use this space to monitor and test the function of the incinerator.

3.3 Spatial Adjacency

All the dump trucks are displayed here, as well as the repairmen.

Administrative Space: ★ ★

All the administrative offices are located here. This includes the main entrance to LAWMA, the reception, and all the office spaces.

Classroom Space: ★ ★

This space is used to teach anyone that wants to learn about what LAWMA and LMSGP is doing towards the Okohosen Kroft. These space also provide a classroom setting for any training that would be required from LAWMA to waste pickers before they are incorporated recycling facilities.

Collaborative Space: ★ ★

All the collaborative spaces are located here. This includes the collaborative workshop, research lab, and all the spaces for public and private use.

Incinerator Space: ★ ★

This area receives waste and processes it to entry. The growth of the city will continue to grow so a need for such facility is needed to reverse the effect of the landfills on the land. Visitors will be able to come here to visually see the process of the city's waste to emerge.

Lobby Space: ★

The entry is where the visitors are greeted by a front desk and indie of spaces which assist visitors with the way around the building. This serves as a buffer between the beginning of the building and outside landscape.

Locker Space: ★

All waste changes into uniforms. This is important because uniforms actually give the former waste pickers an official outfit which gives them an identity, and most importantly a role in LAWMA.

Gallery Space: ★

Area is for meeting and education of the history of the site and the vision for a clean city. This program is arranged for the public to have a visual connection to education and softening the accumulation of waste in the Okohosen Kroft.
The first plan essentially breaks down the floor into spatial adjacency from public gathering to individual private educational spaces. Second and Third floors are separate into work/classrooms spaces, where the programs allow the waste pickers to learn about new skills, like welding, carpentry. The Fourth floor, private, is used as lab to test the productivity of the factory. This level has maximum visibility so that it's easy to collect data. These two levels serve as the collaborative component of the waste facility. The atrium space intersects with the floors incorporate visual education between users. Connections.

There are three major entities that will constantly use the recycling facilities programs. They are the waste pickers, near by citizens, and LAWMA. The waste pickers are incorporated into the development of the program to provide a proper facility to earn money and learn how to handle waste. Scientist, researchers, environmental engineers are given spaces that will hold information on the current progression of the site development points, which are outlined by the World Bank-Assisted Lagos Metropolitan Development and Governance Project (LMDGP). The building will be used as a new branch of LAWMA's office branch.
Process sketch:
Here the sketches represent the thought process of the structure, floor spacing and design concept of interlocking space.
3.5: Materials and Materiality

**SHELL:** The materiality of the shell is wrapped in corrugated metal. The purpose is because of its readiness availability in Nigeria, and its durability through the rainy season in Nigeria. The corrugated metal is easy to repair as well as fits in to the industrial context. The required skill to repair this type of metal is low. This skill taught to anyone, but will be taught in the facility as part of the program to incorporate savanger.

**RECYCLING AREA:** The waste management area house the main jobs which are, the garbage separator lines, and incinerator, the waste reflections area. The diagram shows the direction of the trucks leaving from the garages incorporated in the plan. Were the trucks go in and out also the housing of the garbage tipping hall.

**FLOOR PLATES:** The area where the skills are taught are designed to have a visual connection of what is going on in the floors below. This is done by having a slanted atrium space. The outside areas are designated for skills that require more space, like welding, are covered from the temperature and traps air underneath making a desirable climate for working.
3.6: Design Proposal

1) Landfill
2) Parking
3) LAWMA Truck Check in Station
4) Pedestrian Entry
3.6: Design Proposal

This diagram shows how staggered floor plates with an atrium space connects all the vertical elements in social side of the building. (public) The program is design so that the users experience the public space near the entry. As one process up and through the building, the spaces becomes more private because of the specific to the user’s work.
3.6: Design Proposal

exterior training station
3.6: Design Proposal
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