Industry 4.0:

Revolutionize the SMEs Industry in Malaysia

KU JI YEE

A DESIGN THESIS SUBMITTED

FOR THE DEGREE OF MASTER OF ARCHITECTURE

THE SCHOOL OF ARCHITECTURE AND BUILT ENVIRONMENT

UCSI UNIVERSITY

2022

DECLARATION

I hereby declare that this design thesis is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in the thesis. This thesis has also not been submitted for any degree in any university previously.

Ku Ji Yee

20/05/2022

APPROVAL BY THESIS COORDINATOR & SUPERVISORS

This is to certify that the design thesis work submitted by Ku Ji Yee has been approved by the School of Architecture & Built Environment in the prescribed format of the Faculty of Engineering, Technology and Built Environment.

Thesis Coordinator

_____

Dr. Ng Keng Khoon

Thesis Supervisor (1)

_____

Dr. Allen Lau Khin Kiet

Thesis Supervisor (2)

_____

Dr. Taki Eddine Seghier

ACKNOWLEDGEMENTS

Throughout the journey, this thesis report will not be possible without the help from the people surrounding me. It is the privilege for me to meet multiple people providing guidance for me by widening my perspective toward architecture.

First of all, I would like to thank Dr. Ng Keng Khoon, our thesis coordinator that provides me direction and organises the unit system that encourages us to learn from peers.

Second, Dr. Allen Lau Khin Kiet and Dr. Taki Eddine Seghier, both of my thesis supervisors that lead me and encourage me all these times.

Once again, Thank you.

TABLE OF CONTENTS

Abstract

List of Tables

List of Figures

Chapter 1 Introduction of Thesis Topic

1.0 Background

1.1 Research Issues and challenges

1.2 Intentions and Objectives

1.3 Research Methods

1.4 Scope

1.5 Terminology

1.6 Thesis Outline

Chapter 2 **Literature Review and Precedent Studies**

2.0 Introduction of the Chapter 2

2.1 Industry 4.0

2.2 SMEs Challenge in Malaysia

2.3 Industry 4.0 and Architecture

2.4 Precedent Studies

2.41 Zhejiang Factory

2.42 CopenHill Energy Plant & Urban Recreation Center

2.43 Apple Dubai Mall

2.5 Conclusion

Chapter 3 **Site Analysis and Regulative Condition**

3.0 Introduction

3.1 Site Selection Criteria

3.2 Site Background

3.3 Site Analysis

3.31 Surrounding Context

3.32 Site Lot Typology

3.33 SMEs Building Data

3.34 Typical SMEs Building Space Analysis

3.4 Local Plan Guidelines and Planning Requirements

3.5 Site Synthesis

3.51 Analysis Summary

3.52 Site Planning Considerations

3.53 Micro Site Selection

Chapter 4 **Design Development**

4.0 Urban Strategy

4.1 Design Planning Strategy

4.2 Propose Pixel Planning Workflow

4.3 Digitizing the Existing Space in Pixel

4.4 Deconstruct and Analysis the Pixel

4.5 Reposition the Pixel

4.6 Undigitizing the Pixel into New Space

Chapter 5 Final **Design Proposal**

5.0 Design Statement

5.1 Site Plan

5.2 Building Floor Plans

5.3 Sections

5.4 Elevations

5.5 Isometric Views

5.6 Building Details

5.7 Building Services

5.8 Development Order

References

ABSTRACT

Industry 4.0 has been viewed as the next revolution for the manufacturing industry that has an enormous disruptive impact on the whole world. Small and Medium Enterprise (SMEs) is the most important sector to adopt Industry 4.0 because it makes up 98.5% of the manufacturing firm in Malaysia. If they fail to adopt, they will lose their competitiveness to the larger player in the market. Research had carried out to identify the constraint that SMEs faced when adopting industry 4.0. One of the reasons is current SMEs building typology design is not suitable for Industry 4.0 ecosystem. Therefore, a new intervention into the building typology itself is needed.

The project site was chosen at Taman Perindustrian Subang because it consists 90% of SMEs in the industrial zone. A pixel design workflow was proposed be part of the SMEs industry value chain for the building to be adaptable to industry 4.0 and can utilise it data to design the future version of SMEs building.

A building is proposed at the site that centralising industry 4.0 technology by housing multiple types of SMEs with public engagement in a safe, flexible and sustainable SMEs environment inside a value chain infrastructure.

Keyword: Industry 4.0, SME, Industrial

List of Tables

Table 1 – Function of Building in Taman Perindustrian Subang

Table 2 – Types of SMEs in Taman Perindustrian Subang

Table 3 – Size of Building in Taman Perindustrian Subang

Table 4 – Height of Building in Taman Perindustrian Subang

Table 5 – Space of Building in Taman Perindustrian Subang

Table 6 – Full Lot Digitization Infographic

Table 7 – Sub Lot Digitization Infographic

Table 8 – Terrace Digitization Infographic

Table 9 – Propose Program for New Building Typology

Table 10 – Planning Study 1 Digitization Infographic

Table 11 – Planning Study 2 Digitization Infographic

List of Figure

Figure 1 – Zhejiang Factory Bird Eye View (Sources: https://www.archdaily.com/925151/zhejiang-perfect-production-factory-phase1-gad-star-line-plus-studio)

Figure 2 – Copen Hill Energy Plant & Urban Recreation Center Bird Eye View (Sources: https://www.archdaily.com/925970/copenhill-energy-plant-and-urban-recreation-center-big)

Figure 3 – Apple Dubai Mall Front View (Sources: https://www.archdaily.com/870357/apple-dubai-mall-foster-plus-partners?ad_source=search&ad_medium=projects_tab)

Figure 4 – Taman Perindustrian Subang Site Hierarchy

Figure 5 – Satellite Map Indicating Residential Zone

Figure 6 – Satellite Map Indicating Mix Development Zone

Figure 7 – Satellite Map Indicating Infrastructure

Figure 8 – Taman Perindustrian Subang Site Mapping

Figure 9 – Typical Sub Lot Industrial Building Ground Floor Plan

Figure 10 – Typical Sub Lot Industrial Building Mezzanine Floor Plan

Figure 11 – Typical Sub Lot Industrial Building Section

Figure 12 – Buffer Zone Requirement Section

Figure 13 – Micro Site Satellite Plan

Figure 14 – Urban Strategy Evolution Diagram

Figure 15 – Advantage of Pixel Diagram

Figure 16 – Pixel Planning Workflow

Figure 17 – Micro Site Digitization Plan

Figure 18 – Site Massing Transformation Diagram

Figure 19 – Undigitizing Space Diagram

Figure 20 – Site Plan

Figure 21 – Zoning Plan

Figure 22 – Circulation Plan

Figure 23 – Main Building Formation Diagram

Figure 24 – Modular Cube Diagram

Figure 25 – Terrace CFD Simulation

Figure 26 – New Building CFD Simulation

Figure 27 – Production Building Ventilation Diagram

Figure 28 – Modular Possibility Diagram

Figure 29 – Ground Floor Plan

Figure 30 – Basement Plan

Figure 31 – First Floor Plan

Figure 32 – Second Floor Plan

Figure 33 – Third Floor Plan

Figure 34 – Fourth Floor Plan

Figure 35 – Front Elevation

Figure 36 – Rear Elevation

Figure 37 – Right Elevation

Figure 38 – Left Elevation

Figure 39 – Section A

Figure 40 – Section B

Figure 41 – Sectional Perspective C

Figure 42 – Proposed Building Bird Eye View

Figure 43 – Main Building Perspective

Figure 44 – Centre Plaza Perspective

Figure 45 – Main Building Internal Perspective

Figure 46 – Walkway Between Main Building and Production Building Perspective

Figure 47 – Walkway Between Production Building Perspective

Figure 48 –Production Building Perspective

Figure 49 –Production Building Internal Perspective

Figure 50 – Production Building Service Road Perspective

Figure 51 – Centralized Warehouse Perspective

Figure 52 – Production Building Sectional Detail

Figure 53 – Production Building Connection Detail

Figure 54 – Fire Fighting Plan

Figure 55 – Building Service Plan 1

Figure 56 – Building Service Plan 2

Chapter 1 - Introduction of Thesis Topic

1.0 Background

Our world has experienced three times of industrial revolution throughout history. Each industrial revolution brings technology breakthroughs to our life and changes the way humans produce and consume products. The First industrial revolution started in the late 18th century with the introduction of water and steam powered machines in manufacturing. The Second industrial revolution started in the late 19th century with the introduction of electrical powered machines for mass production. The third industrial revolution started in the mid-20th century with the introduction of computational and electronics capability into machines for automation production. The next industrial revolution has not arrived, but it was widely speculated in the industry and academic work that the next revolution will be Industry 4.0 with the introduction of Cyber- Physical System to bridge the gap between virtual and reality. The concept of Industry 4.0 was first brought up in the “Germany 2020 High-Tech Strategy" initiative in 2011 as a way of enhancing the competitiveness of the German manufacturing industry. After that the word ‘Industry 4.0’ was rephrased around other conferences representing the next industrial revolution and now it has been viewed as the next revolution for the manufacturing industry that has an enormous disruptive impact on the whole world.

1.1 Research Issues and Challenges

In 2016 the eleventh Malaysia Plan, Malaysia government has also positioned itself to prepare the manufacturing industry in Malaysia for the next industrial revolution brought by Industry 4.0. The reason is to increase the competitiveness of the manufacturing in Malaysia and bring Malaysia to become a developed country. Follow up with the Malaysia Plan, a policy named Industry4WRD was introduced by the Minister of International Trade with the target to transform 30% of Malaysian manufacturing industry into adopting Industry 4.0 by

2025. In the policy, Small and Medium Enterprise (SMEs) was mentioned as the most crucial sector among the manufacturing industry in Malaysia to adopt industry 4.0. This is because SMEs make up 98.5% of the manufacturing firm and most of these SMEs do not have a strong global presence in the market. Therefore, if they fail to reinvent themselves to adopt industry 4.0 technologies they will lose their competitiveness in the local and global market. If they cease to exist, Malaysia will lose the diversity of the manufacturing industry with only big players in the market and will increase Malaysia unemployment rate that SMEs in 2016 accounted for 892,165 employees.

1.2 Intentions and Objectives

The intention of this project is first to study the root cost on why the SMEs industry is hard to adapt to new technology of Industry 4.0 from various perspectives like social, economic and policy situations. Secondly, explore the benefit of Industry 4.0 technologies on the way it functions and how it could fit into the current SMEs workflow. Thirdly, look at architecture as a whole and how it can play a role in implementing Industry 4.0 technology into design and building envelopes that could help the SMEs industry upgrade themselves from their current low technology state.

Hence the main objective of this project is to propose a building typology built around industry 4.0 technology that will revolutionize the SMEs industry in Malaysia.

1.3 Research Methods

The literature review is selected as the priorities research method to grab an overview on the research issue. It can summarize the information into identifiable knowledge that is useful to answer our research objective. The literature review was done by searching academic research papers online that are within 5 years to keep its relevance to today's world. The

searching keyword for the thesis is ‘Industry 4.0’ ‘SMEs’ ‘Industrial Revolution’ ‘Malaysia’ and any combination of relevant words that will give more information to the research. After that each research paper was studied and categorized into 3 different topics under literature review. And summarized into highlighting the important findings related to the topic researched. This is to provide an overview of the research topic into an easy to understand format.

The second research method used is site analysis. It was carried out throughout the whole research period to provide an understanding on the actual SMEs condition in Malaysia. The site analysis was done in Taman Perindustrian Subang, the selected site of the research. Thanks to the help of the community, 85 units of SMEs factory, warehouse, workshop were visited to study SMEs building typology. At the same selective interview was conducted to a few of the SMEs business owners to further understand their condition and viewpoint on the research issues. All this was recorded and discussed in the site analysis section of this paper.

1.4 Scope

The building typology of this research is focused on the SMEs industry in Malaysia only, this is because the issue is localised which are different because of its historical, geographic and political context. Hence the SMEs issue discussed in the research is only meant for Malaysia context. Therefore, it might not be applicable to apply the solution for different countries.

1.5 Terminology

Industry 4.0 is viewed as the next chapter of the industrial revolution. It brings digitization and automation in the manufacturing environment by adopting a cyber-physical ecosystem that creates a digital value chain to enable the communication between products and its environment.

SMEs is the term short form of Small and Medium Enterprise. It represents the manufacturing industry with sales turnover from RM15 million to not exceeding RM50 million. Another criterion under SMEs is that full-time employees do not exceed 200 people.

1.6 Thesis Outline

Main Objective

- Revolutionize the SMEs industry in Malaysia by adopting Industry 4.0

Research Issue

1. SMEs industry are lacking in knowledge and resources in adopting Industry 4.0.
2. Lack of young generation in the SMEs industry.
3. Current SMEs buildings are not designed for industry 4.0.

Research Question

1. What are the constraints that SMEs face in adopting industry 4.0?
2. Why do the public possess negative impression toward the SMEs industry in Malaysia?
3. How can architects implement industry 4.0 into the SMEs building?

Research Objective

1. Provide a guideline to implement industry 4.0 for the SMEs industry.
2. Educate and encourage the public to understand the SMEs industry.
3. Propose an architecture framework for Industry 4.0 to SMEs industry.

Research Proposal

- Propose a new typology of building design that can help SMEs industry achieve Industry 4.0 objective at the same time educating the industry to the public.

Chapter 2 - Literature Review and Precedent Studies

2.0 Introduction

This chapter is about the literature review on the thesis research. It is separated into 4 sections. The first section is literature review on Industry 4.0 to understand more on that concept. The second section is literature review on State of SMEs in Malaysia to have an overview on the situation. The third section is literature reviews on the relationship between industrial revolution and architecture to find out the link between Industry 4.0 and architecture. The last section is precedent studies on existing projects that were related to the industry. All this helps give a clearer understanding for the thesis topic for the design development.

2.1 Industry 4.0

Industry 4.0 has been discussed in many different media. One of the most recognized papers discussing the objective of industry 4.0 is published by the World Economic Forum, a global leading independent organization that focuses on improving the global economy. In the paper 'Fourth Industrial Revolution Beacons of Technology and Innovation in Manufacturing' listed down 6 objectives of industry 4.0 to address in the future development.

1. Augment, instead of replace, the operator.

Industry 4.0 implementation will replace the low skill worker that is doing repetitive tasks in the future. Therefore, in this transition all organizations should change how we use our resources to allow the traditional human operators to prioritize value-adding activities. Therefore in the future, the human workforce will be put focus on developing ideas and decisions that could bring new value in this new situation.

2. Invest in capability-building and lifelong learning

The changing in job profile from low skill to medium and high skill work inside an organization will create a gap of transition among workers. Therefore, all organizations should rework on the educational system to invest in training for retooling their workforce to adapt into this new environment. Upbringing the low skill worker to higher skill will make sure the worker credibility at the same time help the company to break the barrier of new technology.

3. Diffuse technologies throughout geographical areas and include SMEs

The full potential of Industry 4.0 can only be considered success if a complete value chain and production systems was established to all organizations including SMEs, and in any geographical area. Hence, we should diffuse Industry 4.0 technologies to all parts of the ecosystem and production network to grow the developing economies. We also must ensure the fairness and equality of sharing the knowledge to small players in the market to create a positive environment for the future.

4. Protect organizations and society through cybersecurity

Stepping into the industry 4.0 era, cybersecurity will be one of the most challenging jobs to ensure the safety of the people and nation. More devices will be inserted into the internet with the help of IoT devices. Therefore, it is all organization's job to ensure the safety of the Industry 4.0 infrastructure. Developing the technology at the same time investing in more advanced cybersecurity to ensure the economic future is not compromised by the cybersecurity threat.

5. Collaborate on open Industry 4.0 platform and handle data carefully

Industry 4.0 must be an open platform to allow different organizations to collaborate together to reduce the chance of monopoly and vendor lock-in situations in the market. This will also

help all organizations with a bigger data pool to improve the analytics algorithms of everyone. Moreover, transparent and open clear rules among organizations is important to create an integrated future.

6. Address the climate change challenge with Industry 4.0 technologies

The environment is facing climate changes and Industry 4.0 technologies must be used as a tool to help combat the climate challenges. All organizations should improve energy efficiency, reduce waste and emission while increasing production yield as the way going forward.

All these 6 objectives must be addressed in the new building design for SMEs in Malaysia. Because it is to ensure the building holds up to the international standard.

2.2 SMEs Challenge in Malaysia

SMEs find it hard to adapt themself to new technology like industry 4.0 compared to large firms. Upon research, the issue of SMEs in Malaysia has been categorised into three sections, Self Issue, Public Issue and Building Issue.

Self Issue

Unlike large firms which have high capital, the SMEs industry has limited resources in investing in new technology. Investing in a unprovent new production model like industry 4.0 is a high risk investment for them.

There is a lack of platforms that educate SMEs on Industry 4.0 technology. Since it is a new concept, there is a lack of knowledge transfer from experts to SMEs for the implementation of Industry 4.0.

Public Issue

The younger generation is reluctant to join the SMEs industry, this causes no new fresh minds inside the SMEs industry to grow. Hence innovation is lacking in this industry that leads to lower high skill workers in the industry.

The public possesses a negative impression toward the SMEs industry because the industry is associated with dirty, dangerous and difficult jobs. And youngsters felt not respected if working in it therefore it became a declining industry.

Building Issue

Current SMEs buildings are not designed for automating internal transports or processes or for new manufacturing technologies. Therefore, it has a higher financial barrier to new manufacturing technologies.

Moreover, the current building typology of single enclosed buildings does not promote cooperation, openness, and trust among other SMEs. Thus, limiting the information sharing on new technology among SMEs.

The new building typology should address all the issues discussed.

2.3 Industry 4.0 and Architecture

Each industrial revolution brings innovation not only in manufacturing, it also brings fresh architecture design theory into that era.

After the 2nd industrial revolution modernist architecture started to influence the architecture landscape. Walter Gropius was one of the most prominent architects of that era, he

advocated the standardization of precision component parts by treating buildings like a machine. He started the idea of mass production house with the goal to produce standardized, interchangeable house components that could be assembled rationally into various combinations or forms.

Today, at the 3rd industrial revolution, computerized design has become a norm in today's architecture practices. One of the architecture firms that specializes in computational design is MVRDV. They developed a software called function mixer, a planning development software that used pixels to transform the space into an enabler of diversity catering for different occupants and their individual necessities.

Looking at the coming 4.0 revolution focusing on seamless connection between cyber and physical space. Architecture itself should also evolve to suit the environment of the future. However there is no framework on how we as architecture should adapt to these new changes.

2.4 Precedent Studies

Zhejiang Factory

Architect: gad · line+ studio

Area: 26004m2

Location: Zhejiang, China

Year: 2019

Concept:

In the era of excessive efficiency requirements and reflection on spiritual demand, we try to explore the differentiation direction from the surrounding closed-management parks. With reference to the traditional village collective work and everyday life social pattern, we try to mine the interaction with surrounding gradually incoming enterprises and to reshape a "mountain house" collective memory of life through "streamline reconstruction

Figure 1 – Zhejiang Factory Bird Eye View

Copen Hill Energy Plant & Urban Recreation Center

Architect: Bjarke Ingels Group (BIG)

Area: 41000m2

Location: Copenhagen, Denmark

Year: 2019

Concept:

CopenHill is conceived as a public infrastructure with intended social side-effects from day one. Replacing the adjacent 50-year old waste-to-energy plant with Amager Ressourcecenter (ARC), CopenHill's new waste incinerating facilities integrate the latest technologies in waste treatment and energy production. Due to its location on the industrial waterfront of Amager, where raw industrial facilities have become the site for extreme sports from wakeboarding to go-kart racing, the new power plant adds skiing, hiking and rock climbing to thrill-seekers' wish lists.

Figure 2 – Copen Hill Energy Plant & Urban Recreation Center Bird Eye View

3. Apple Dubai Mall

Architect: Foster + Partners

Area: -

Location: Dubai

Year: 2017

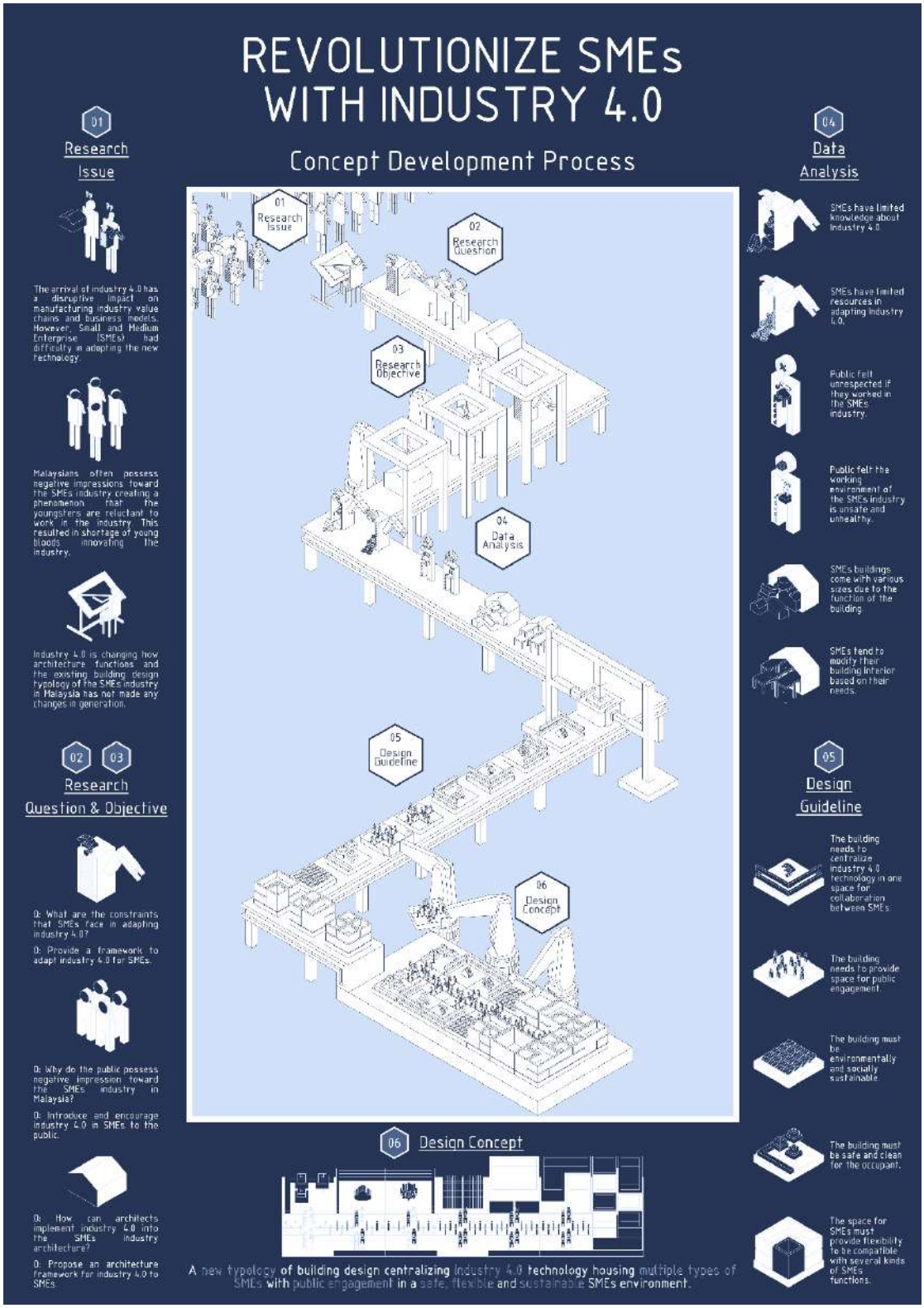
Concept:

The design of Apple Dubai Mall is a celebration of the sun, using the abundant daylight to create a special ambience within. Reinterpreting the traditional Arabic Mashrabiya, innovative, 'Solar Wings' gently shade the outside terrace during the day and open majestically during the evening to reveal the 'best seat in the house' with a breath-taking view of the waterside promenade and fountains. With their movement path inspired by a falcon spreading its wings, the 'Solar Wings' are in itself a theatrical experience – an integrated vision of kinetic art and engineering. The wings have been carefully crafted to inspire delight, a delicate combination of form and function.

Figure 3 – Apple Dubai Mall Front View

2.5 Conclusion

In conclusion, we need propose a new typology of building design that centralising industry 4.0 technology by housing multiple types of SMEs with public engagement in a safe, flexible and sustainable SMEs environment inside a value chain infrastructure.



Chapter 3 - Site Analysis and Regulative Condition

3.0 Introduction

This chapter is covering all about the site for the thesis research.

3.1 Site Selection Criteria

From the scope of the project, the site selection of the thesis research was based on 3 criteria. The first criteria, the site must be in an Industry site with majority SMEs to provide an overview of SMEs building typology study. The second criteria, the site must have connection to other building typology that provide opportunity to study public relation to the SMEs industry. The third criteria are the site must be near Klang Valley, Malaysia for easy reachable because of the Movement Control Order set by the Malaysia government during the research period.

Based on the criteria, Taman Perindustrian Subang, Kawasan Perindustrian Balakong and Kawasan Perindustrian Kampung Baru Sungai Buloh are the 3 potential sites. After consideration, Taman Perindustrian Subang was selected because out of all 3 sites, It has the most among SMEs with 90% of the building in the area is occupied by SMEs.Second reason is the site is located within a well-developed city with a mixture of residential, office and high rise surrounding the site creating a more dynamic study on the effect of the site Industry area to its surroundings.

3.2 Site Background

Taman Perindustrian Subang located at Subang Jaya Selangor. It is an industrial zone which was established in the 1970 from the rubber plantation zone into current condition. In the early days, it started with pocket development of few SMEs building establishments.

The site hierarchy starts from the Subang Area then zoning up based on land used to become an industrial zone of Taman Perindustrian Subang. Then the industrial zone is separated into multiple lots of land for different landowners as boundaries of each building typology. Some of the lot is then further divided into small plots for individuals to build their individual factories on it by multiple SMEs.

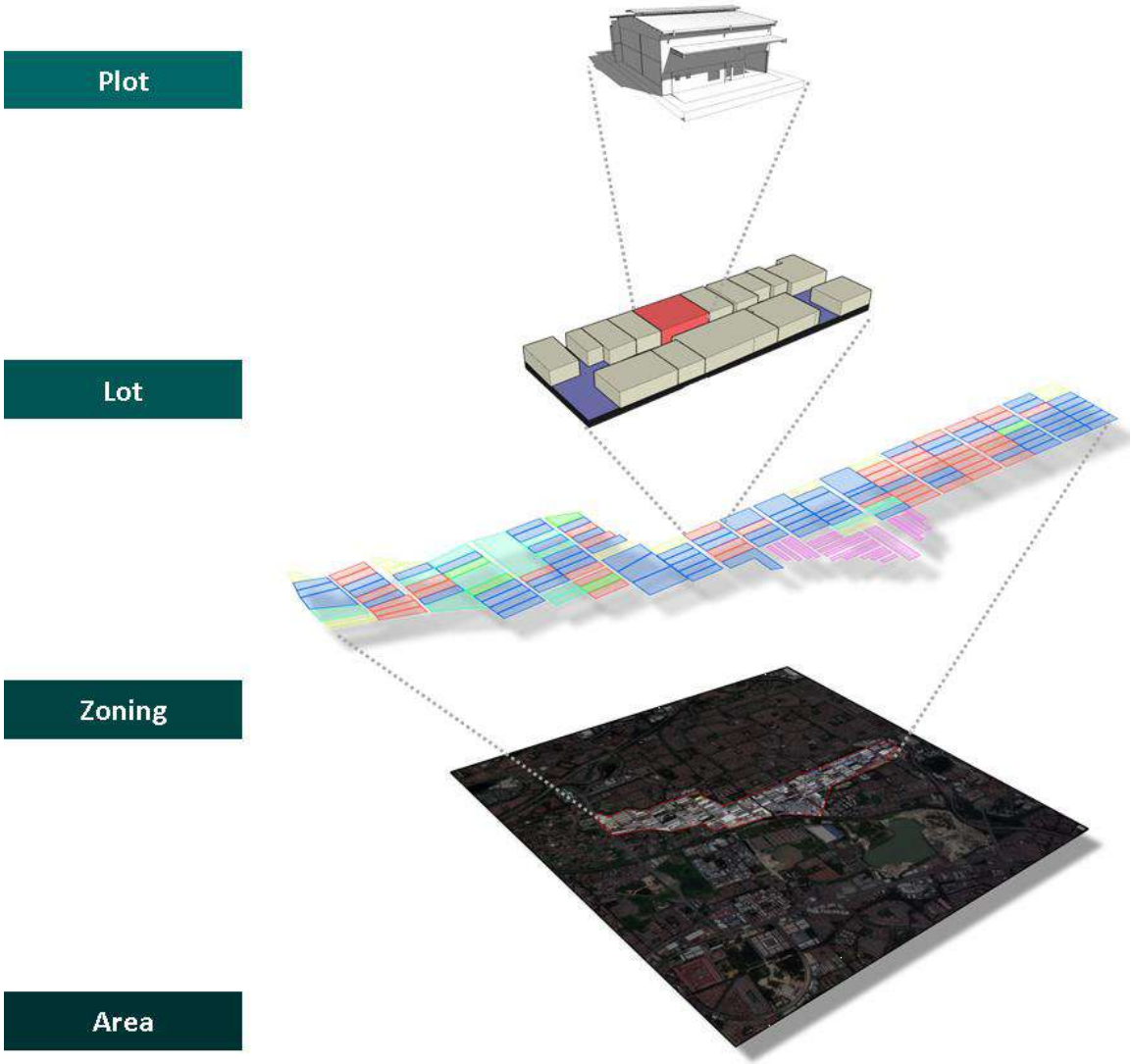


Figure 4 – Taman Perindustrian Subang Site Hierarchy

3.3 Site Analysis

Surrounding Context

The site is surrounded by the USJ resident zone developed by IJM in the 1970. It is a well-established township in Subang Jaya. The resident zone directly adjacent to Taman Perindustrian Subang is USJ 1, USJ 14, USJ 19, USJ 20, USJ 22, Taman Subang Mewah and Goodyear Court. The building of the resident zone is a typical two storey terrace house. At the South side of the site, there are two kampung, Kampung Kenangan and Kampung Tengah that have preserved the kampung lifestyle in the city area.

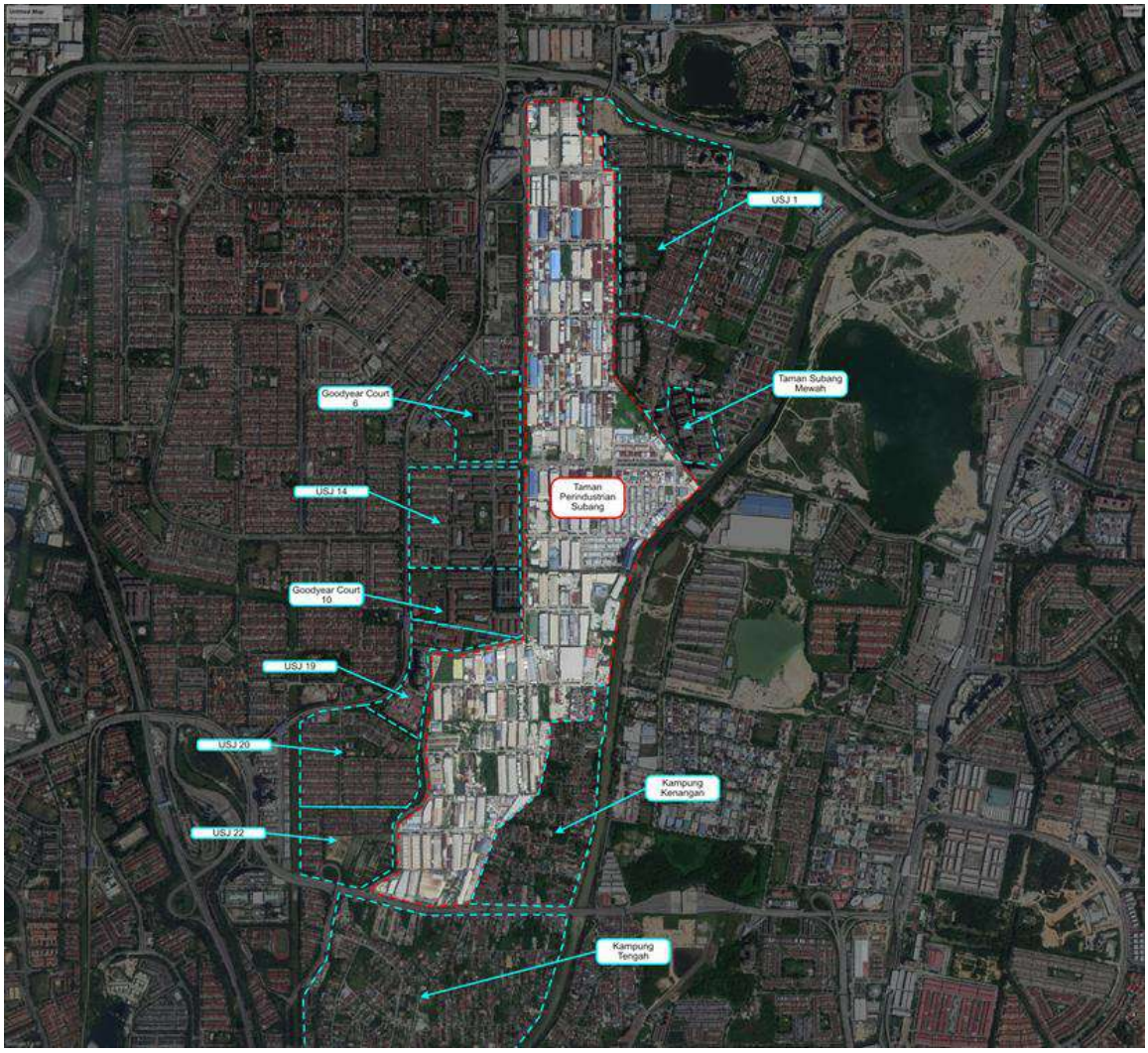


Figure 5 – Satellite Map Indicating Residential Zone

The recent trend of new development in this area is focused on the mixed development of shopping malls, office buildings and apartments together to become an integrated city concept proposal by Subang Jaya Local Plan 2035. One of the earlier mixed development buildings at the site is Summit USJ malls which were built in 1998 with a shopping mall and office. Since then, it has become the icon of the area. One of the newer mixed developments is the 19 USJ Mall that was established as a local mall for F&B and groceries for the locals. On top of the mall there are also 4 blocks of apartments.

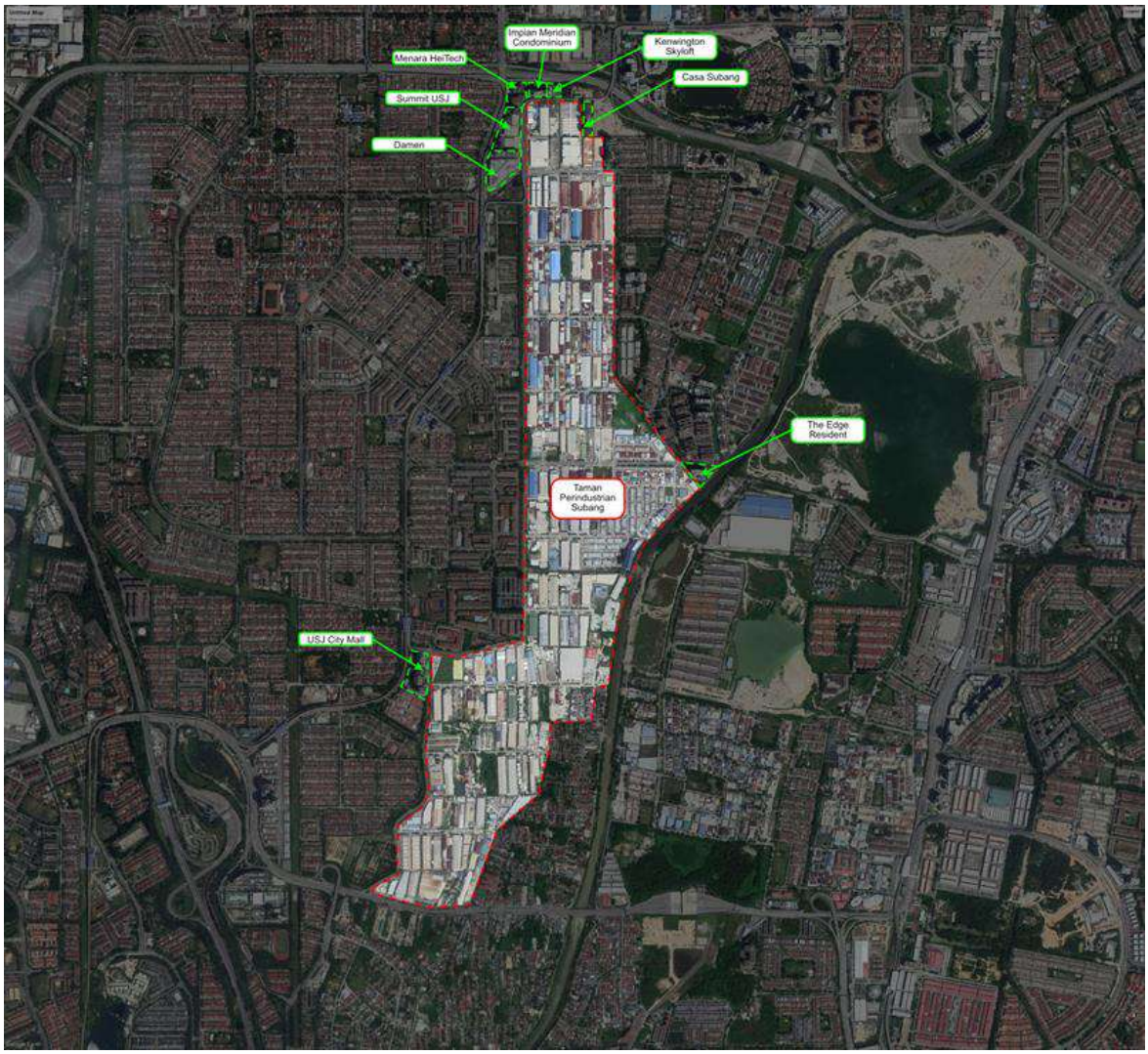


Figure 6 – Satellite Map Indicating Mix Development Zone

The site is a well-connected site to other parts of Klang valley through a matured road system and multiple public transport options. In the road system there are two major highways, at south is LDP highway and at north is Kesas highway. The LDP highway connects the site to the Puchong and Damansara area and becomes the main road of travel for the people. The latest infrastructure upgrade is the LRT station connecting Subang to other parts of Klang Valley that make the site become a TOD development zone.

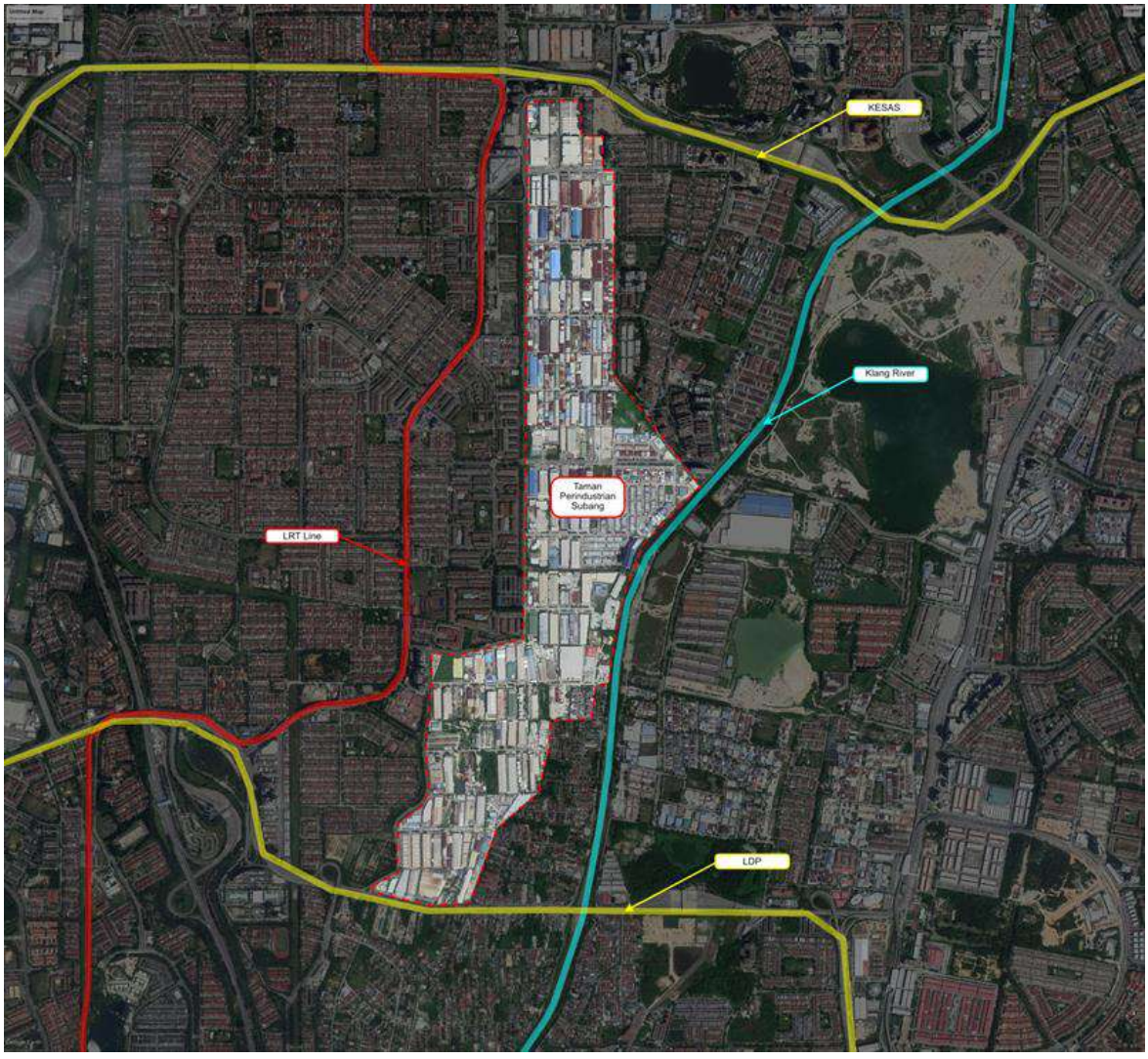


Figure 7 – Satellite Map Indicating Infrastructure

Site Lot Typology

Inside the site there are 5 types of lot typology for different types of SMEs and purposes. The first type is Full Lot Building. There is a total of 79 of Full Lot Buildings inside the site. It is the largest building type among all and the entire lot is owned by one owner for a larger manufacturing operation. Inside this building consists of well-defined office, production and storage space. Based on the site survey, large firm and bigger scale SMEs are occupied by this typology.

Second lot typology is Sub Lot building; it is a full lot further separated into small individual sub lots as its own smaller factory building. Inside a single lot can separate into 12 to 8 Sub Lot building sharing on internal road in the middle. In the site there are a total of 484 Sub Lot buildings and all are occupied by medium to small size SMEs.

The third lot typology is Terrace building: it is multiple buildings arranged in linear form and sharing a party wall to the next unit. It is the smallest type of building among all and the building ground floor is all multifunctional open space and with a mezzanine floor for office space. In the site there are a total of 484 Sub Lot buildings and all are occupied by medium to small size SMEs.

The fourth lot typology is Open Warehouse; this type of lot doesn't have the permanent structural building. At most there are only temporary container buildings or small huts. This is because the main space is for storing large machinery or goods that require a large open area. It is for SMEs or Large firms that work offside that require space for storing their equipment before moving to another site. Inside the site there are 13 of this kind of typology.

The firth lot typology is Undeveloped Land: this type of lot might be owned by a private party but has not developed the land for any function. It consists of brown or green fields and might develop into another industry building in future. Inside the site there are 5 of this kind of typology.

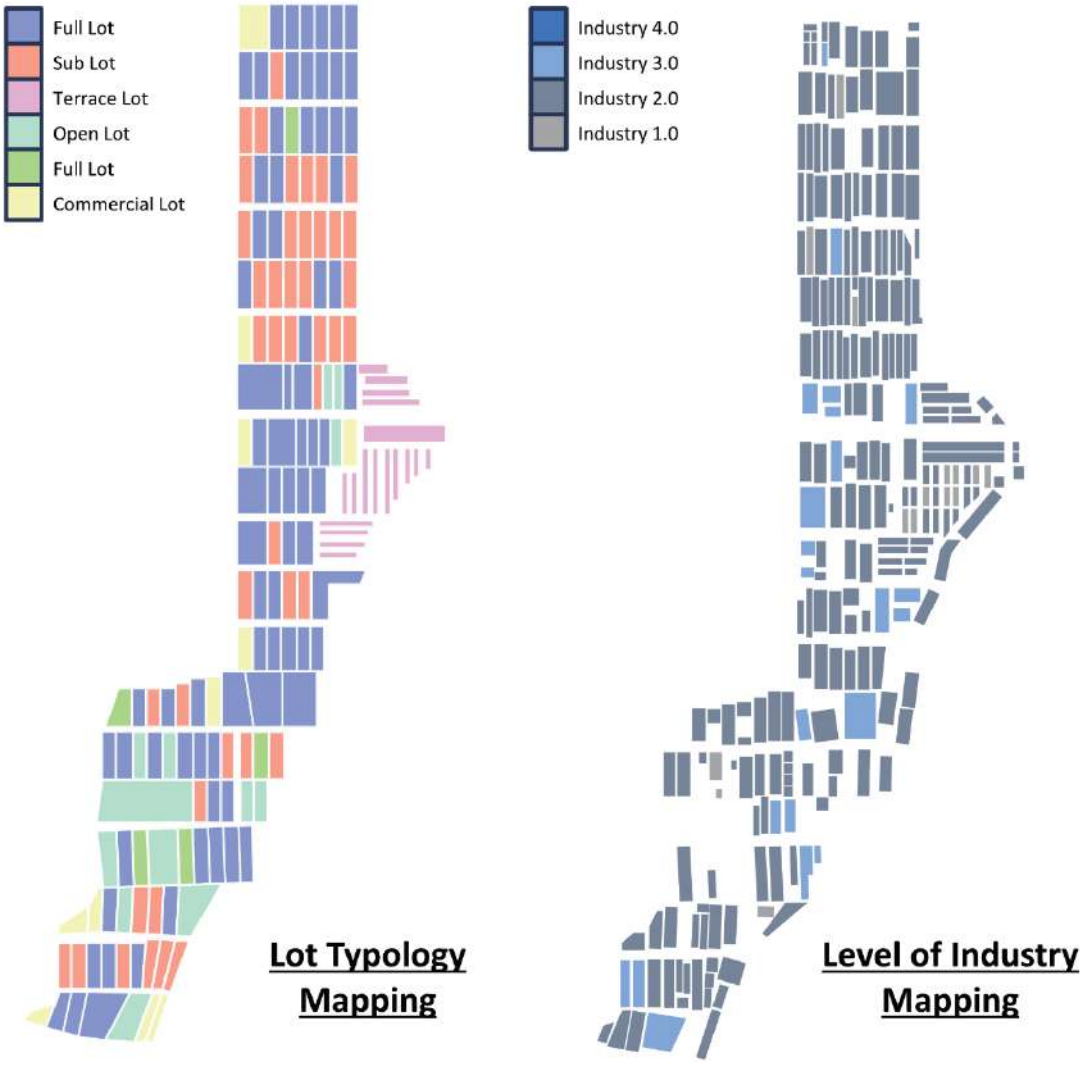


Figure 8 – Taman Perindustrian Subang Site Mapping

SMEs Building Data

A site study was conducted for 85 SMEs building in Taman Perindustrian Subang to gather data related to building function to give insight on the typical SMEs need for building.

First, none of the SMEs have any Industry 4.0 technology in their building for use in production. All are still using labour intensive methods to produce their product. In this we notice that the level of technology integrated into the SMEs is very low.

In the area, 45% of SMEs buildings function as workshops to produce custom made products. 29% are warehouses for storing goods for distribution and 16% of buildings are mass production factories.

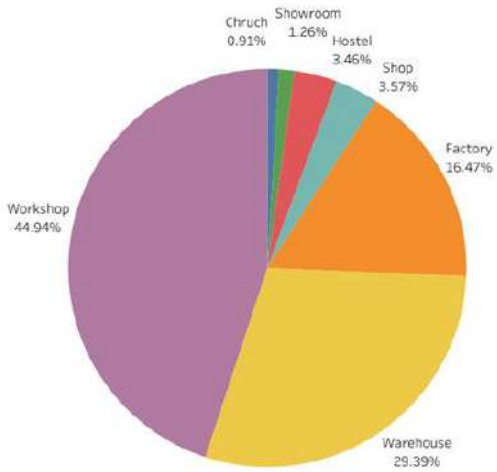


Table 1 – Function of Building in Taman Perindustrian Subang

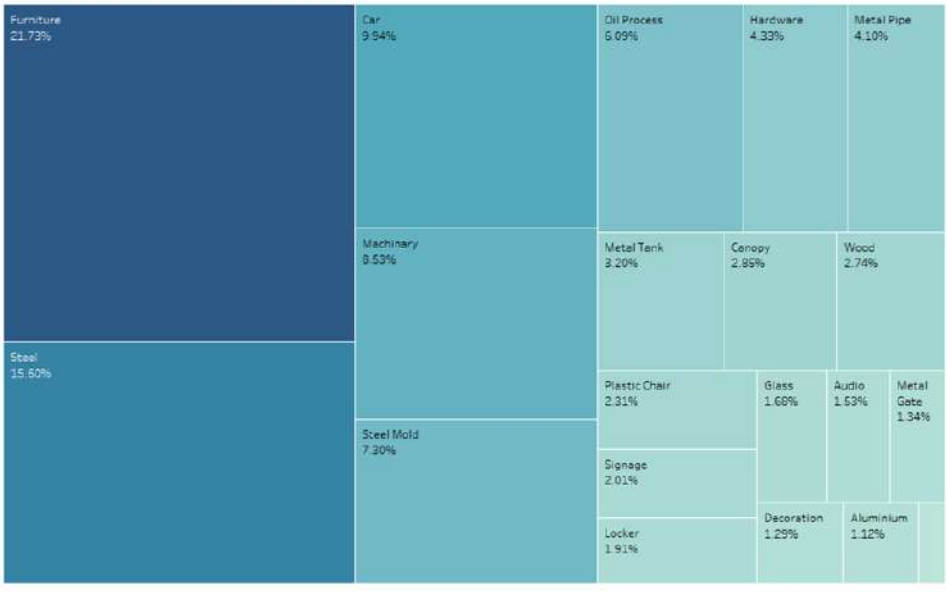


Table 2 – Types of SMEs in Taman Perindustrian Subang

Among all buildings, furniture production is the main business model at the site with 22% and second are the steel fabrication for building construction. Conventional furniture production is using hand tools to produce goods because of the custom-made nature of the furniture.

The size of the building ranges from 100 m2 to 2800 m2 based on the type of operation inside. The mean of the building size is 800 m2 and 9m height, however based on the graph, SMEs buildings come in different sizes and forms. Therefore, one rigid fixed size factory is not suitable for all SMEs.

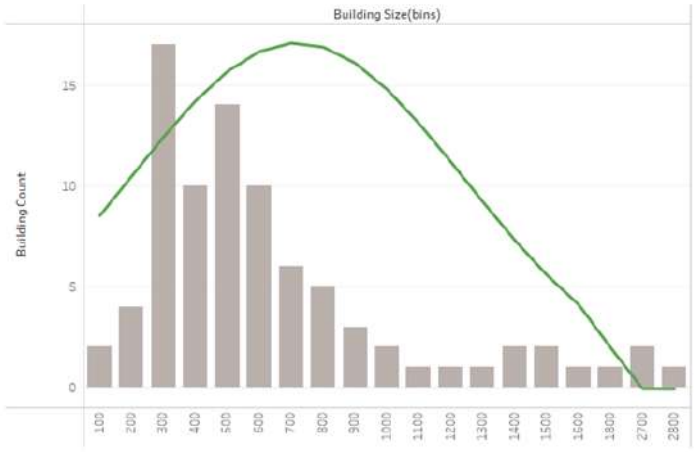


Table 3 – Size of Building in Taman Perindustrian Subang

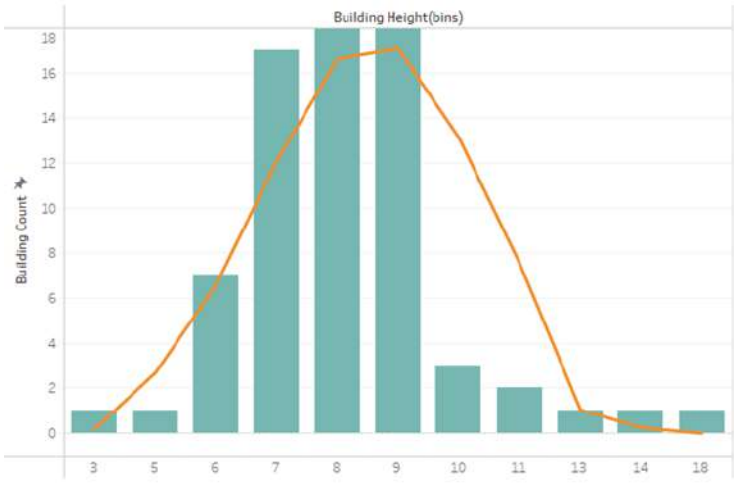


Table 4 – Height of Building in Taman Perindustrian Subang

The three most important spaces in SMEs building are production space, storage space and office space. Other spaces like showroom and worker accommodation space are less and depend on the SMEs situation.

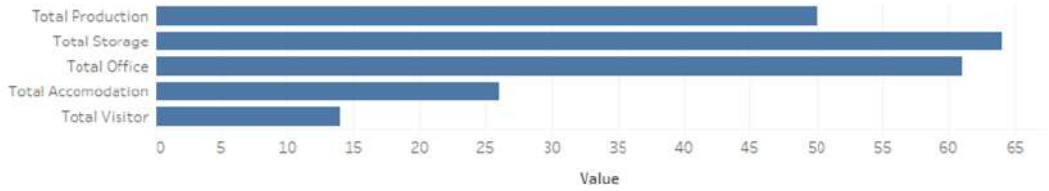


Table 5 – Space of Building in Taman Perindustrian Subang

Typical SMEs Building Space Analysis

A measure drawing was produced on one of the existing SMEs buildings that produce furniture inside a Sub-lot building. The purpose of it is to understand the operation flow of SMEs and analyze the building performance.

The main area of a SMEs building is the production area. It has the largest floor area and is located at the ground floor because it is easily accessible. The function of this space is to produce goods for customers.

The showroom area functions as a space for customers to visit or acquire information about the product. Not all SMEs buildings have this space, but having this space makes the building more inviting to the public.

The storage area is a space to store raw material or finished goods before delivery. This space has a racking system that makes the space to store more material effectively. This space is usually an enclosed space to protect the material or goods.

The office area is where the SMEs carry out procurement, development, and management of the business. This space is located on the first floor to separate it with other spaces because it needs a clean and undisturbed space.

The internal road area acts as a delivery space for material and finished goods. It is a very congested area with different SMEs sharing the same road.

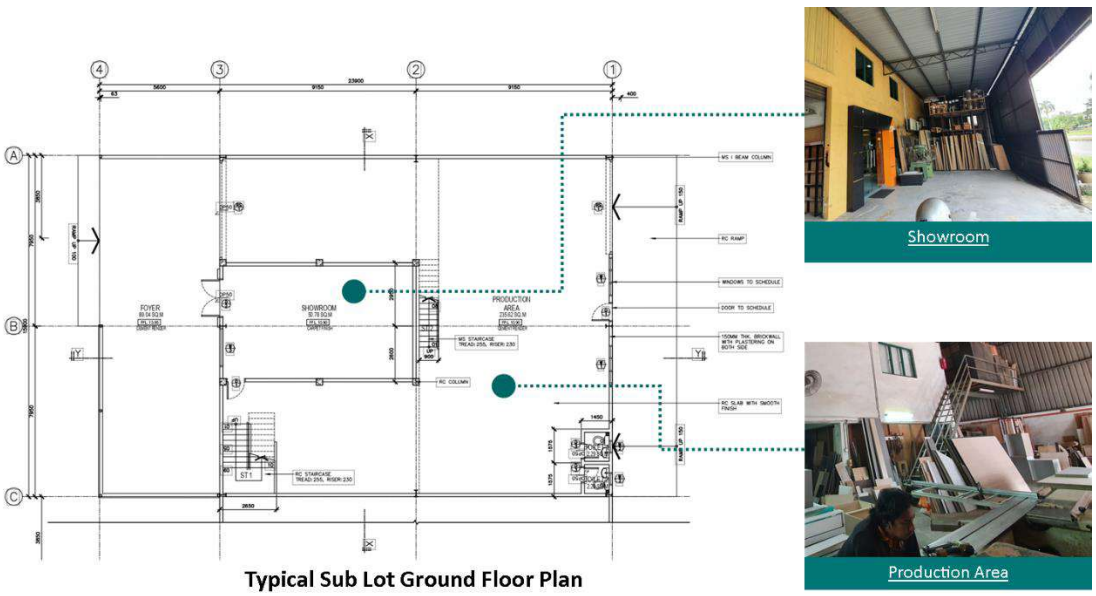


Figure 9 – Typical Sub Lot Industrial Building Ground Floor Plan

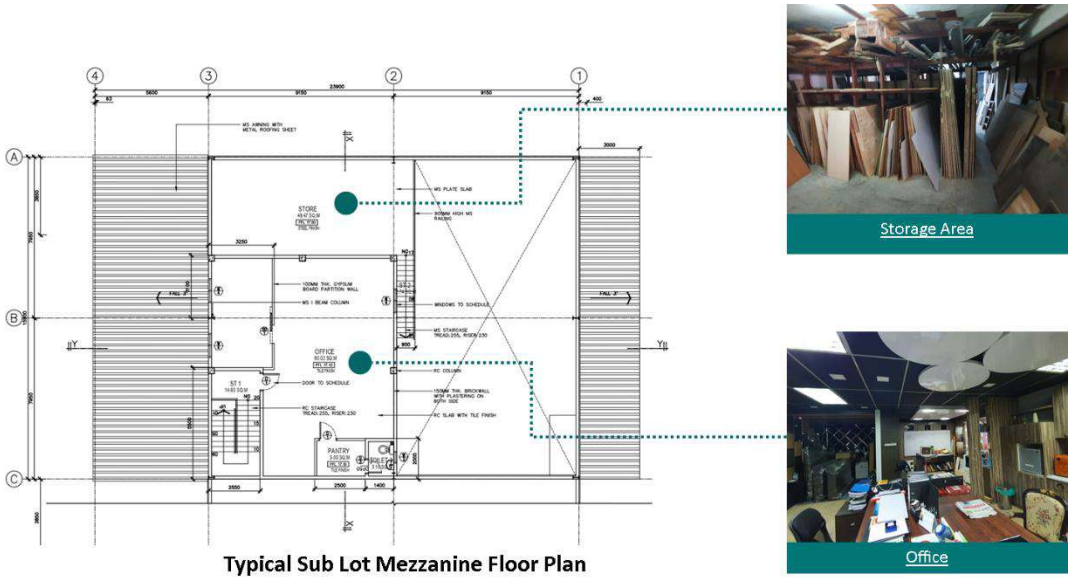


Figure 10 – Typical Sub Lot Industrial Building Mezzanine Floor Plan

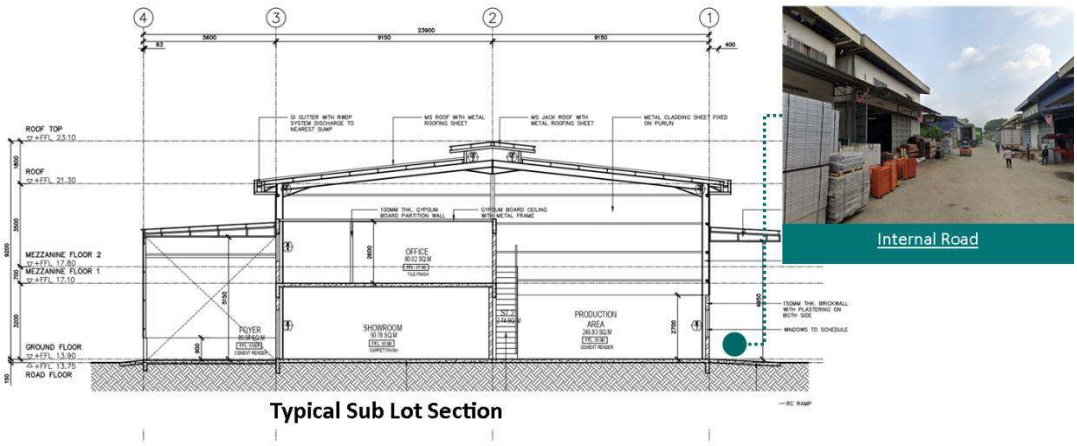


Figure 11 – Typical Sub Lot Industrial Building Section

3.4 Local Plan Guidelines and Planning Requirements

In Malaysia, planning of industry building is governed by the local authority and Department of Environment (DOE). Building requirements like plot ratio, build up area and space requirement are set by local authority.

The one difference from other types of building is the buffer zone requirement between residential area and industry zone. This is to make sure the industry zone is away from residential areas from a set distance of 50m to 300m depending on the type of industry. Taman Perindustrian Subang is categorized under light industry with the buffer requirement of 50m to residential area. The purpose of this requirement is to safeguard the healthy environment of the resident area. However, this requirement created a disconnection between residential and industry zones and the local authority has no intent to connect both zones to become an integrated city. This has further isolated industry areas from the public.

Figure 12 – Buffer Zone Requirement Section

3.5 Site Synthesis

Analysis Summary

1. Typology Summary:

   For the industry typology, the current building design is not linking to any value chain infrastructure and in Malaysia it does not have this infrastructure that provides data and seamless transition of cyber-physical space among different industries. Therefore, a proposal regarding this is needed.

2. Building Summary:

   The common theme here is each SMEs building is detached from one another, there is no common space that allows collaboration among SMEs which is one of the objectives of Industry 4.0. This isolation makes each SMEs need to invest in industry 4.0. one by one. Making the investment and risk cost high for each SMEs

3. Local Plan Summary:

   The buffer zone policy by the Department of Environment created a disconnected city that isolating the industry area became a closed zone from the public. From the town planning perspective, it has 0 public engagement opportunities that further stop that public to understand the industry. If the industry wants to attract youngsters to the industry, this needs to be improved.

Site Planning Considerations

After the site analysis, 5 site planning considerations were set as building design guidelines for the future of SMEs.

Centralized Industry 4.0 Technology

- The building needs to centralize Industry 4.0 technology in one space to lower the barrier of entry to the technology and promote collaboration among SMEs.

Incorporate Public Engagement

- The building needs to provide space for public engagement to promote and attract younger generation to the SMEs industry

Environmentally and Socially Sustainable

- The building must be environmentally and socially suitable to support the World Economic Forum objective of Industry 4.0.

Safe and Clean Environment

- The building must be safe and clean to break the negative public perception toward the SMEs industry.

Flexibility in Space

- The space provide for SMEs must be flexible to accommodate several kinds of SMEs

Hence the design objective of this project is to propose a new typology of building design centralizing industry 4.0 technology housing multiple types of SMEs with public engagement in a safe, flexible and sustainable SMEs environment.

3.6 Micro Site Selection

Based on the building design guideline the undeveloped site beside USJ Mall was chosen as the micro site. The site is close to not only industry but also connected to shopping malls, public transport and residential areas that give the building exposure to the public.

Figure 13 – Micro Site Satellite Plan

Chapter 4 - Design Development

4.0 Urban Strategy

The proposed building will be the first building of the site that will connect to the value chain and act as the industry 4.0 enabler.

And from there, the building started to influence its surroundings and other buildings started to be built using the same value chain system that further broadened the infrastructure.

From the start of designing the building, a design method needs to be considered for how it is going to connect to the value chain. The design information can be used in not only architecture but also can integrate production efficiency and be used for the next industry building design this way.

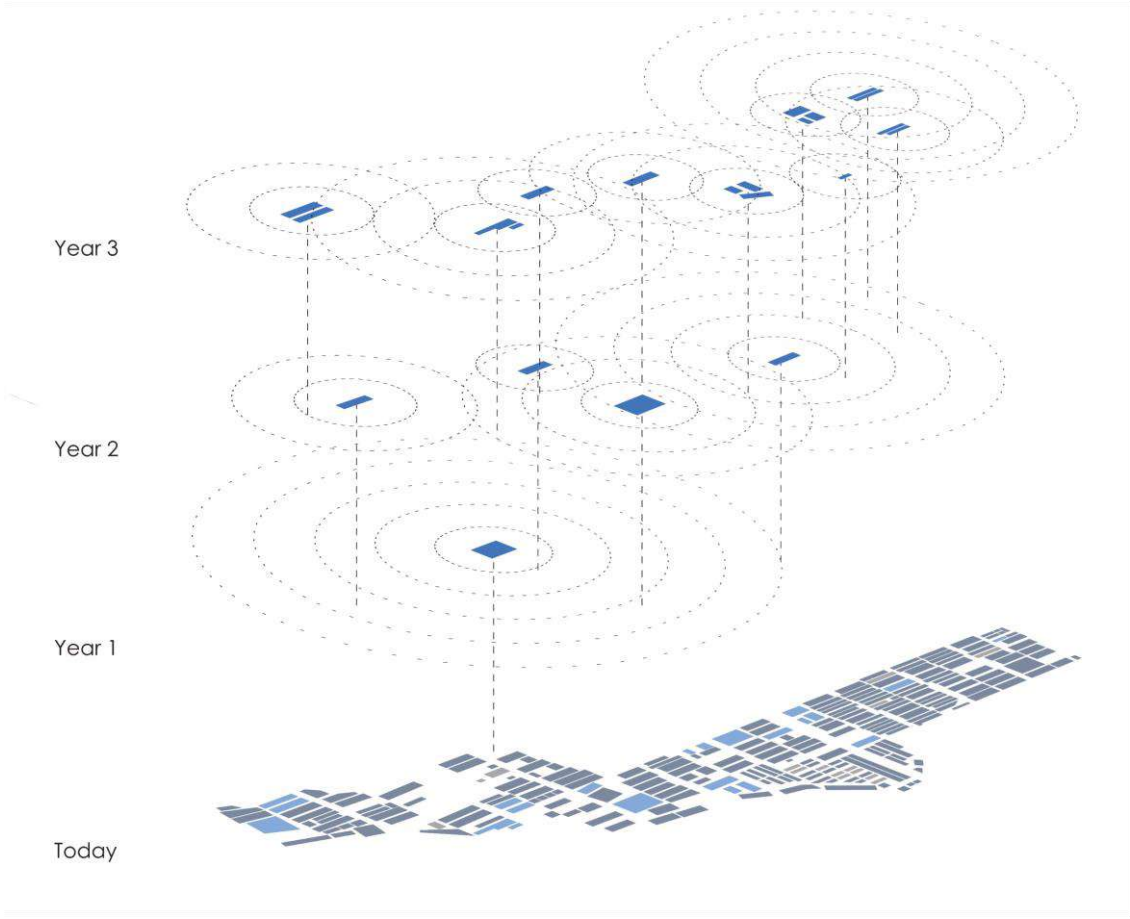


Figure 14 – Urban Strategy Evolution Diagram

4.1 Design Planning Strategy

The preliminary concept of the design planning strategy is coming from MVRDV developed function mixer software. Then from there it is further developed into suiting Industry 4.0 objectives to create a future planning strategy.

Function Mixer was simplifying the planning into pixels to represent a space for it to test up site planning faster. The advantage of pixel planning for using pixel are:

1. Pixel can store data inside a pixel to become useful information.
2. Pixel is easy to define by how many pixels it has in a space.
3. Pixel has the same size that can seamlessly combine and be divided into different modules.
4. Pixel had limited possibility because of four straight angle constraints unlike vectors which have unlimited possibility.
5. Pixels can be translated into space because of the volume nature of pixels.

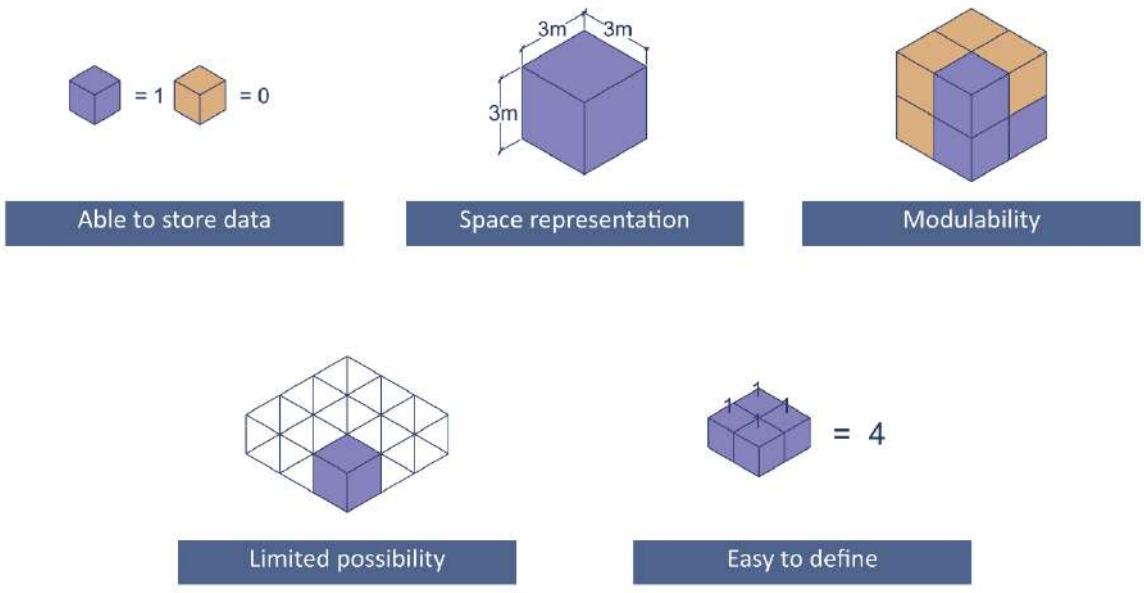


Figure 15 – Advantage of Pixel Diagram

4.2 Propose Pixel Planning Workflow

The Pixel Planning workflow is separated into 3 main sections and 8 steps for the whole development.

The first section is Data Collection & Digitization, inside this section there are two steps. The first step is collecting existing building information. The existing building information will become the stock data the build as the references for this project. Then the second step is digitizing existing space into pixels. This step is to convert all the building information collection and convert it to a pixel as a representation of space. So that this pixel can be analyzed and shared to be used in later building design.

The second section is Undigitization of Space, inside this section there are three steps. The first step is deconstructing and analyzing the pixel. This step, the existing building pixel was analyzed in terms of its usability, space planning and relation of space and this information is key into each pixel that represents it. The second step is repositioning the pixel. Here, the pixel with information was rearranged into a new combination to test out the new possibility of space relation based on the above-mentioned SMEs building guideline. Then the third step is undigitizing the pixel into new space. This step, the pixel was translated back into architecture space design that became the new SMEs building.

The third section is User Based Program. This stage is inspired by the concept of Industry 4.0 that every product will start evolving itself. Inside here, there are three steps. The first step is to collect users' responses, the new building must have IOT devices that can collect information such as space usage, efficiency of machines and energy to help monitor the existing building. Then this information will be stored into the pixel that represents the space. The second step, behavioral analytics of user response, is that the information will be

analyzed based on AI and algorithm to provide useful insight on the use case of this new SMEs building. The third step is to reconfigure the space, meaning the architect can access this information to make changes to the new SMEs building to better suit the SMEs. So the building is new to design with modulability in mind for future modification and this new analysis pixel will become the backbone of the next SMEs building.

By using this system architecture information 'the pixel' can be shared among architects and together architects collaborate and build a better tomorrow with this big data pool of knowledge. So, architects can evolve and adopt this industry 4.0 ideology too.

Figure 16 – Pixel Planning Workflow

4.3 Digitizing the Existing Space in Pixel

The first step of collecting existing building information has been done in the previous section, therefore here is focusing on the second step of converting the building into pixels. Each pixel is represented as a 3m x 3m cube and overlaps into the actual site to generate the result. Items that are digitized are site plan and the three main building typologies.

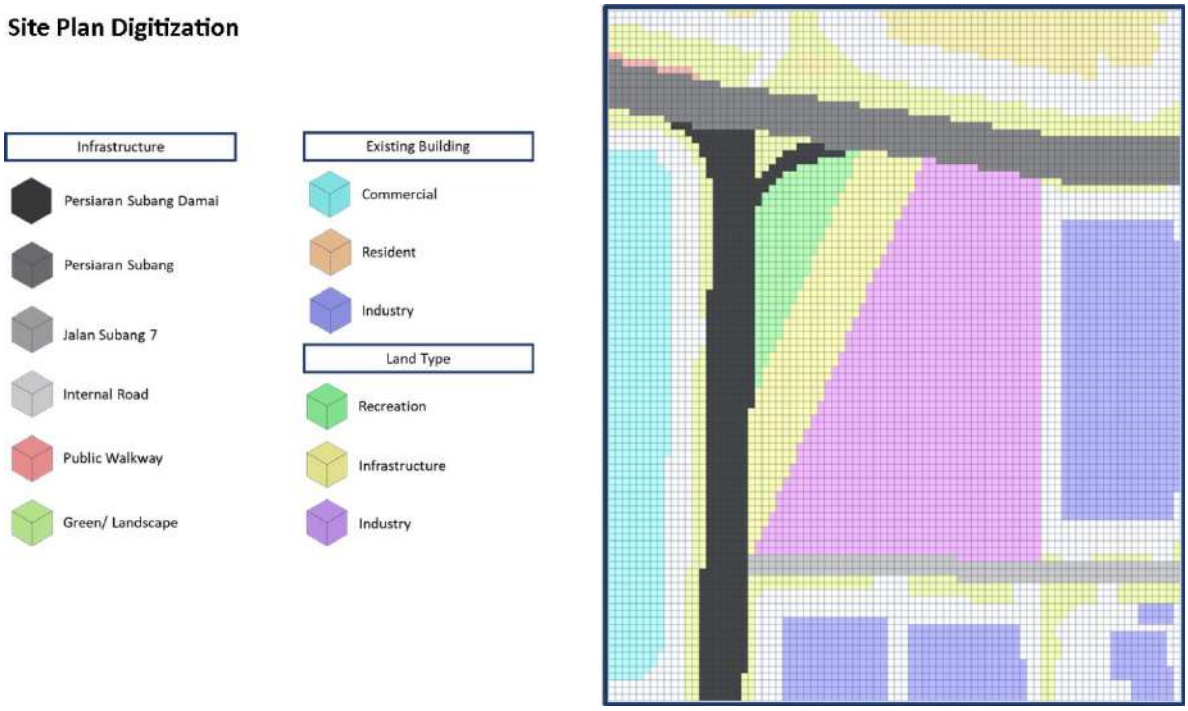
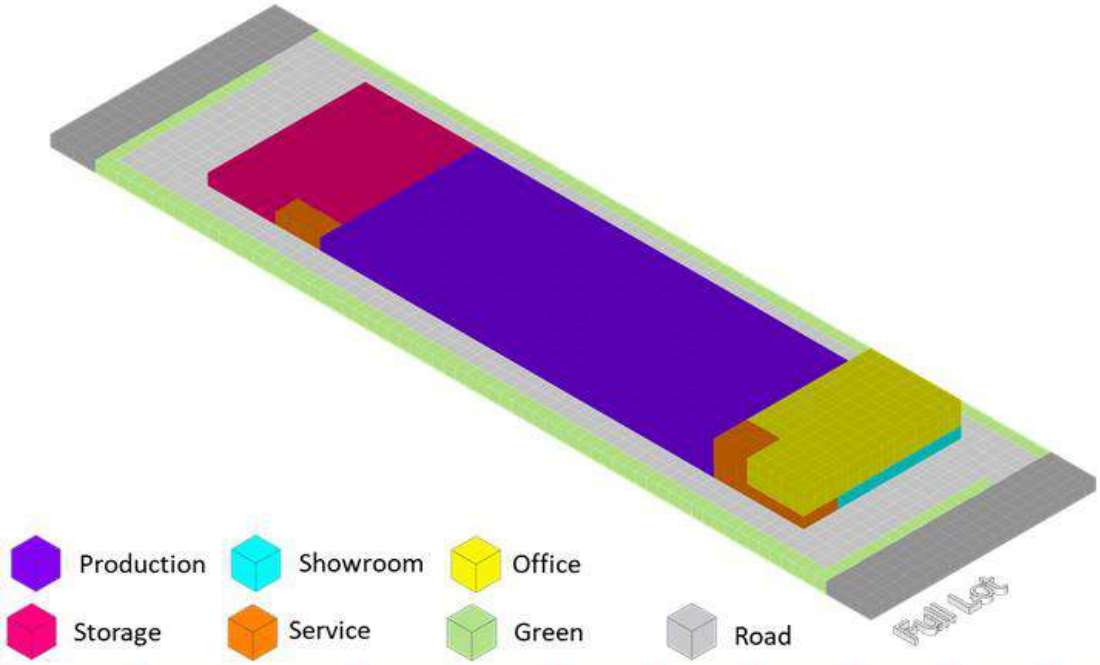


Figure 17 – Micro Site Digitization Plan

Full Lot Building



Full Lot	Number of Cube	Area m2	Building & Open Area Total	Ground Area	Ground Building & Open Area Total	Total Percentage	Building Percentage	Ground Percentage	Plot Ratio	Density
Production	490	4410		490		32%	51%	38%		
Storage	132	1188		132		9%	14%	10%		
Office	206	1854		0		14%	21%	0%		
Showroom	88	792		88		6%	9%	7%		
Service	50	450	8694	32	742	3%	5%	2%	57%	
Road	400	3600		400		26%		31%		
Green	158	1422	5022	158	558	10%		12%	43%	
	1524	13716	13716	1300	1300	100%	100%	100%	100%	6.69

Full Lot SMEs Building

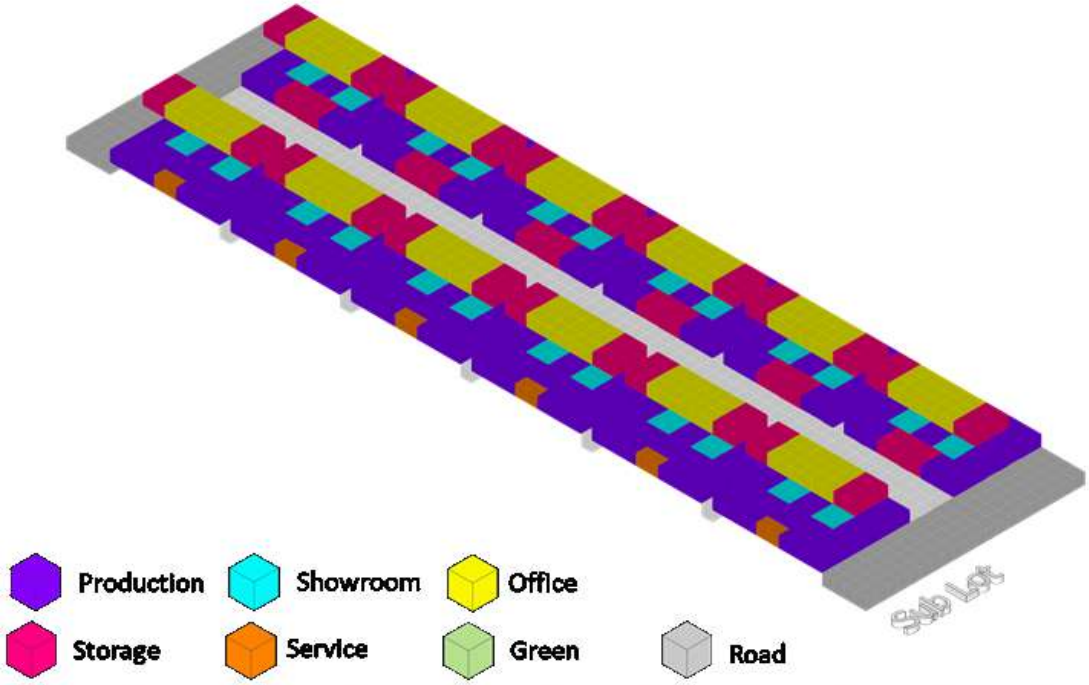
Advantage
1. Have building frontage.
2. Easy to implement new technology because of a centralized office.
3. Service and Public internal road is demarcated clearly.

Disadvantage
1. Building only for single SME

Potential
1. Wide uninterrupted layout that can further subdivide into smaller units.

Table 6 – Full Lot Digitization Infographic

Sub Lot Building



Sub Lot	Number of Cube	Area m2	Building & Open Area Total	Ground Area	Ground Building & Open Area Total	Total Percentage	Building Percentage	Ground Percentage	Plot Ratio	Density
Production	696	6264		696		42%	53%	54%		
Storage	240	2160		96		14%	18%	7%		
Office	216	1944		0		13%	16%	0%		
Showroom	144	1296		144		9%	11%	11%		
Service	24	216	11880	24	960	1%	2%	2%	74%	
Road	340	3060		340		20%		26%		
Green	0	0	3060	0	340	0%		0%	26%	
	1660	14940	14940	1300	1300	100%	100%	100%	100%	9.14

Sub Lot SMEs Building

Advantage

1. Have clear demarcation of each SME.
2. Concentrated community layout.

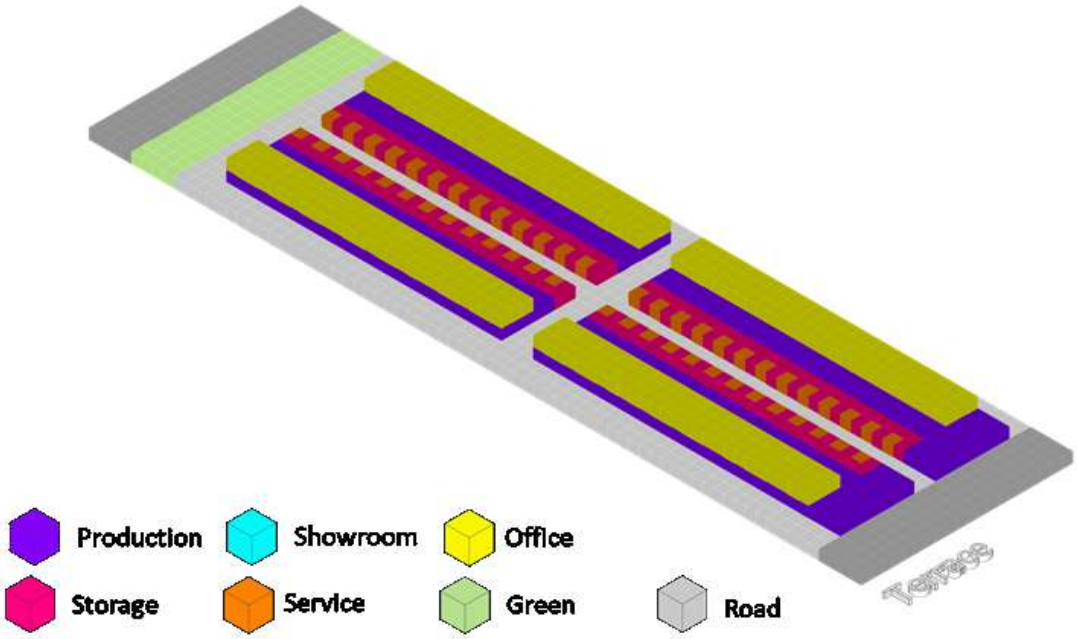
Disadvantage

1. Limitation in expendability because of division between unit
2. New technology need to incorporate separately
3. The front road is also the service road
4. The subdivide space between unit is unusable because of it narrow width

Potential

Table 7 – Sub Lot Digitization Infographic

Terrace Building



Terrace	Number of Cube	Area m2	Building & Open Area Total	Ground Area	Ground Building & Open Area Total	Total Percentage	Building Percentage	Ground Percentage	Plot Ratio	Density
Production	562	5058		562		35%	52%	43%		
Storage	156	1404		156		10%	14%	12%		
Office	312	2808		0		19%	29%	0%		
Showroom	0	0		0		0%	0%	0%		
Service	52	468	9738	52	770	3%	5%	4%	59%	
Road	450	4050		450		28%		35%		
Green	80	720	4770	80	530	5%		6%	41%	
	1612	14508	14508	1300	1300	100%	100%	100%	100%	7.49

Terrace SMEs Building
Advantage 1. Can combine multiple unit into one. 2. Service and Public internal road is demarcated clearly.
Disadvantage 1. No dedicated showroom or storage space 2. New technology need to incorporate separately
Potential 1. Green can become a public park

Table 8 – Terrace Digitization Infographic

4.4 Deconstruct and Analysis the Pixel

After analysing it, 5 new building space was defined into pixels based on the design objective and the new intervention proposed for the site.

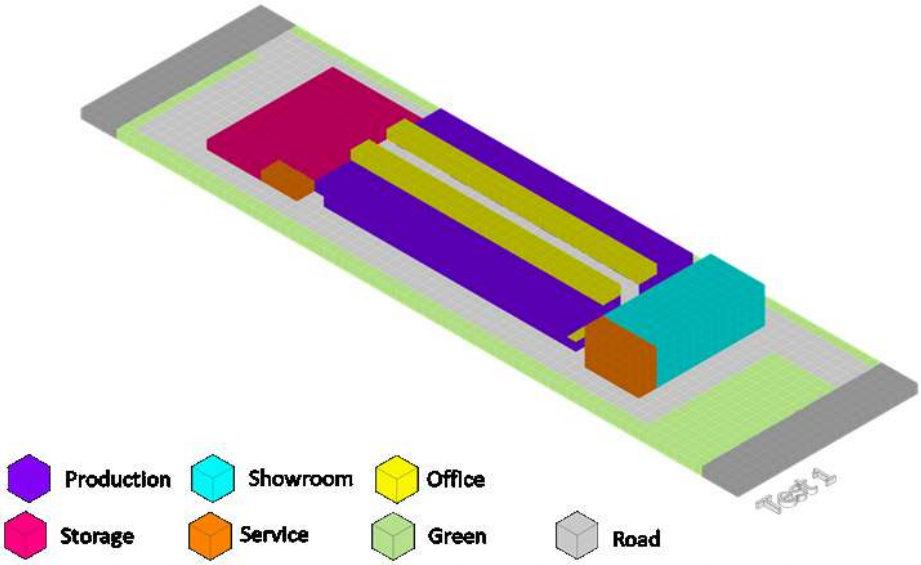
Zoning	Public -Allow all public to access at all time	Semi Public - Open to public in certain period	Private - Only allow invited public to access
Function	A space as connection point to other part of the building at the same time provide public space.	A space that is centralizing industry 4.0 technology for Multiple SMEs to showcase the R&D Process	A space consist of multiple production spaces for different SMEs
Key Activity	Recreation, Connection, Experience	Education, Interaction, Collaboration, Researching, Analysis, Design, Testing, exhibition	Production, Management

Zoning	Private - No public access allow	Private - No public access allow
Function	A space that as a collection point that house all raw material and finish goods.	A space housing essential services to support the building
Key Activity	Storing, Distribution, Delivery	Data Processing, Building Services

Table 9 – Propose Program for New Building Typology

Then the new space pixel is tested into new arrangement. Two planning studies have been carried out to test up the typology composition of the pixel.

Planning Study 1



Test 1	Number of Cube	Area m2	Building & Open Area Total	Ground Area	Ground Building & Open Area Total	Total Percentage	Building Percentage	Ground Percentage	Plot Ratio	Building Density
Production	672	6048		336		31%	49%	26%		
Storage	132	1188		132		6%	10%	10%		
Office	224	2016		0		10%	16%	0%		
Showroom	288	2592		72		13%	21%	6%		
Service	56	504	12348	20	560	3%	4%	2%	43%	
Road	554	4986		498		26%		38%		
Green	242	2178	7164	242	740	11%		19%	57%	
	2168	19512	19512	1300	1300	100%	100%	100%	100%	9.50

Test 1 Building

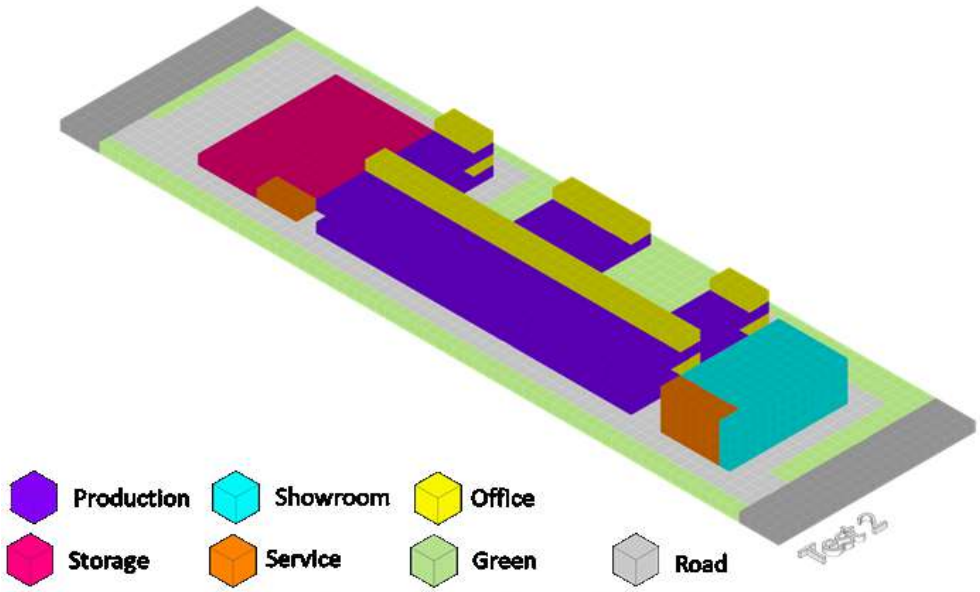
Inspiration
1. Following the full lot layout then sub dividing the production area.
2. Unit layout follows the Terrace building.
3. Added park in front of the building.
4. Replace the office to become showroom
5. Each unit added an individual office on it.

Advantage
1. Clear space demarcation
2. Unit able to expand horizontally and vertically
3. Service and Public internal road is demarcated clearly.
4. Have building frontage.
5. Have a public park.

Disadvantage
1. Lacking in sense of community because of linear layout
2. Park has no integration with other part of building

Table 10 – Planning Study 1 Digitization Infographic

Planning Study 2



Test 2	Number of Cube	Area m2	Building & Open Area Total	Ground Area	Ground Building & Open Area Total	Total Percentage	Building Percentage	Ground Percentage	Plot Ratio	Density
Production	616	5544		280		30%	49%	22%		
Storage	132	1188		132		6%	10%	10%		
Office	176	1584		0		9%	14%	0%		
Showroom	288	2592		72		14%	23%	6%		
Service	56	504	11412	20	504	3%	4%	2%	39%	
Road	466	4194		466		23%		36%		
Green	330	2970	7164	330	796	16%		25%	61%	
	2064	18576	18576	1300	1300	100%	100%	100%	100%	8.78

Test 2 Building

Inspiration

1. Improvement from Test 1 Building.
2. Extended the park to connected the production area
3. Unit become cluster layout

Advantage

1. Clear space demarcation
2. Unit able to expand horizontally and vertically
3. Service and Public internal road is demarcated clearly.
4. Have building frontage.
5. Have a public park that connects the showroom & production area.
6. Have better sense of community because of cluster layout

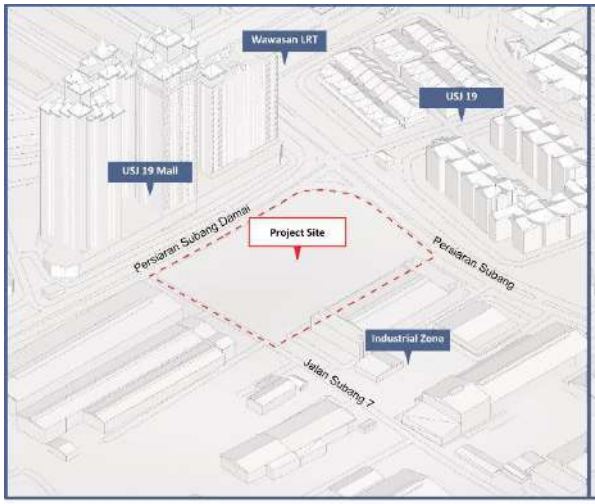
Disadvantage

Table 11 – Planning Study 2 Digitization Infographic

4.5 Reposition the Pixel

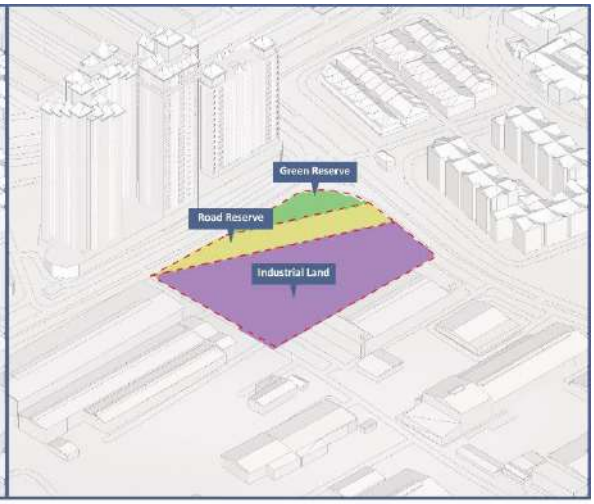
After having the typology of planning study 2, it is time to apply it to the project microsite to become the building massing. The position of the pixel is determined by the site context as an axis to create the form of the building.

1.



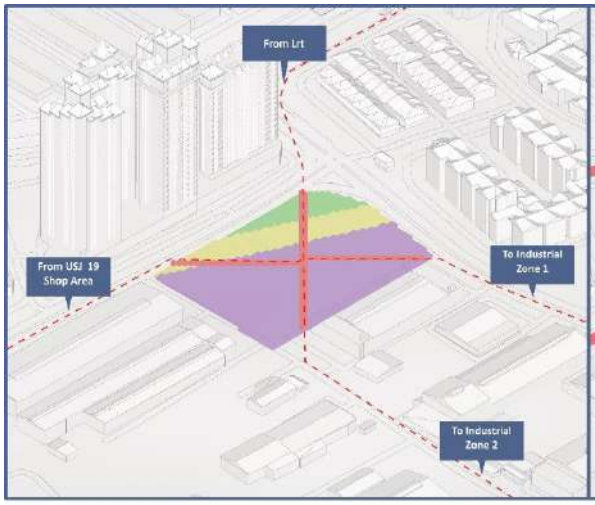
Site context s study to provide 2 site axis on the microsite to guide the building arrangement into form.

2.



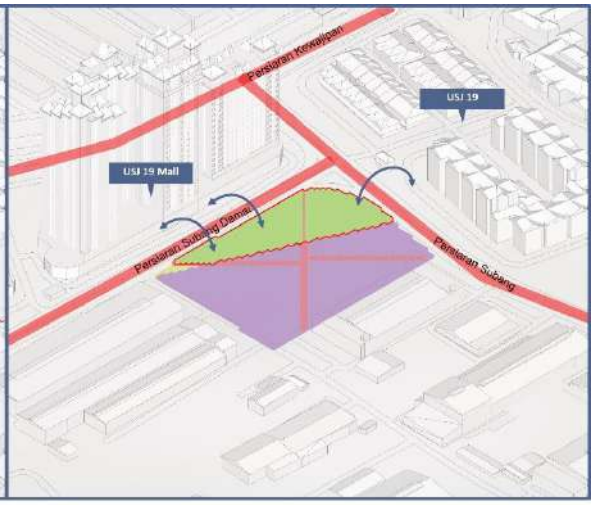
The first axis is the site land boundary set by the authority divided by 3 lots in terms of usage.

3.



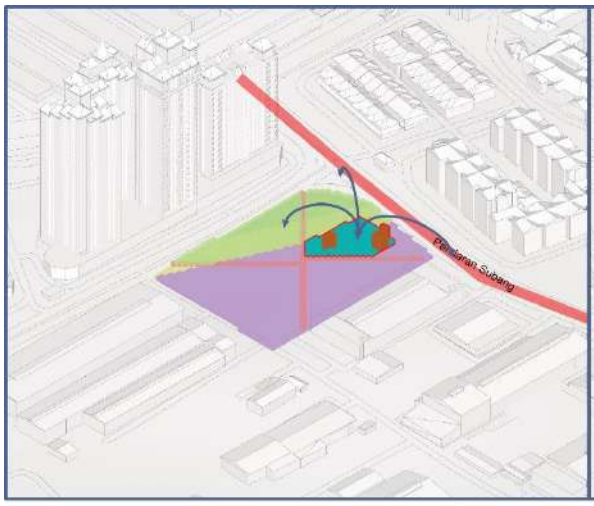
The second axis is formed by observing public walking patterns on site and the opportunity path that is created if the site is open up to the public. This will form a natural walking habit from the public as they are taking shortcuts through the site.

4.



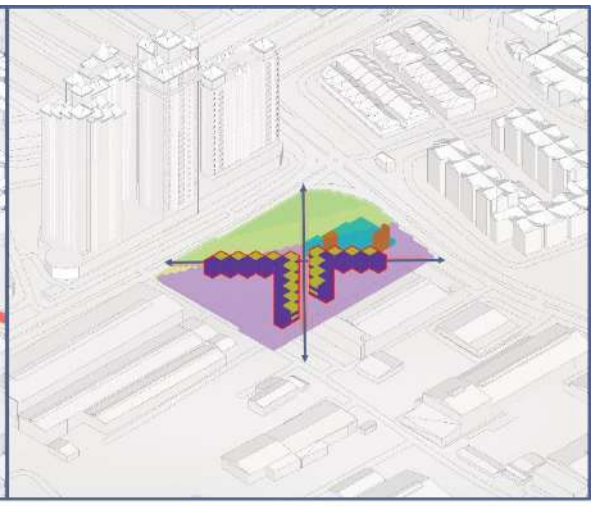
Having the site axis, the site zoning is set based on the visibility of the public from the main road. The area that has the most views is set as the public zone and the connection park is introduced at the location.

5



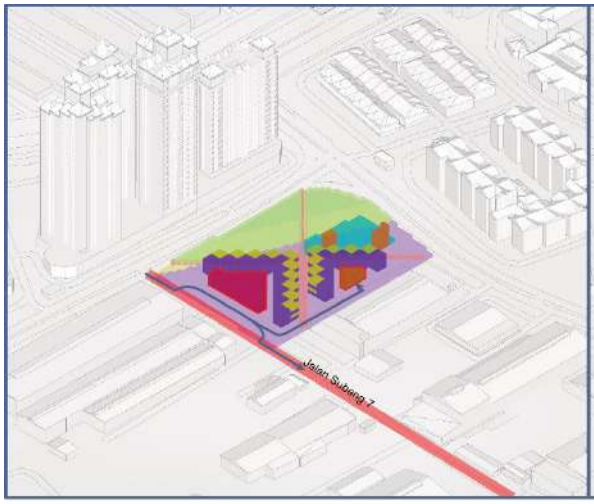
Then the main building is set to be located at the most visible semi private area beside the park and main road which gives direct access and visibility from the area.

6



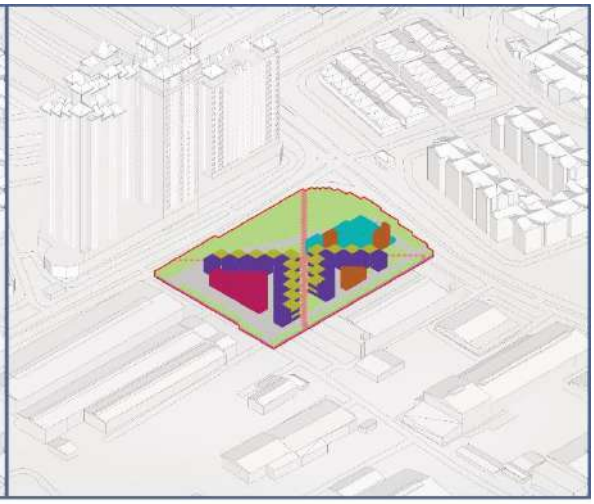
2 clusters of production buildings are introduced to be the private zone along the walking pattern axis to allow direct connection to the main building and the public to walk pass and view what is happening inside each production building.

7



A warehouse and service building was added behind the production building as they are the most private building that don't want any public to access it. It is directly connected to the service road for not overlapping the circulation from public access.

8

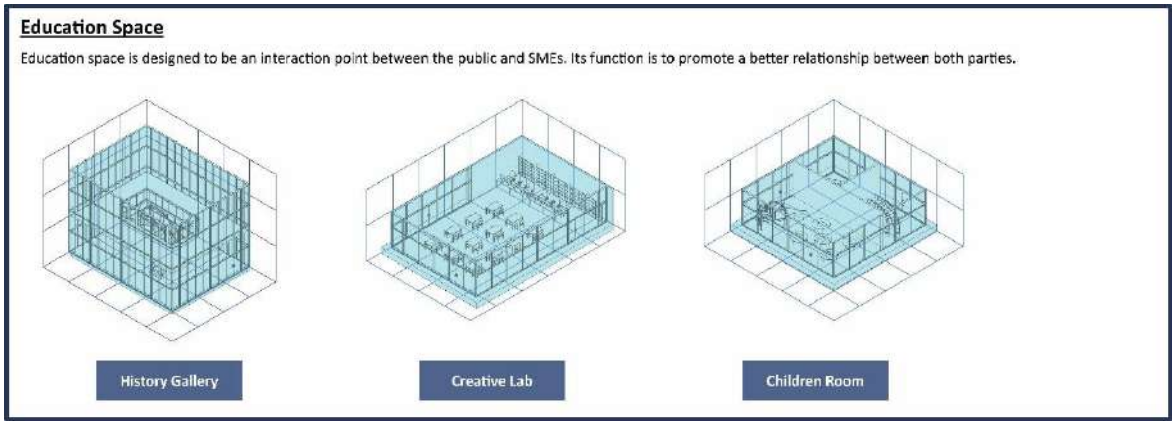


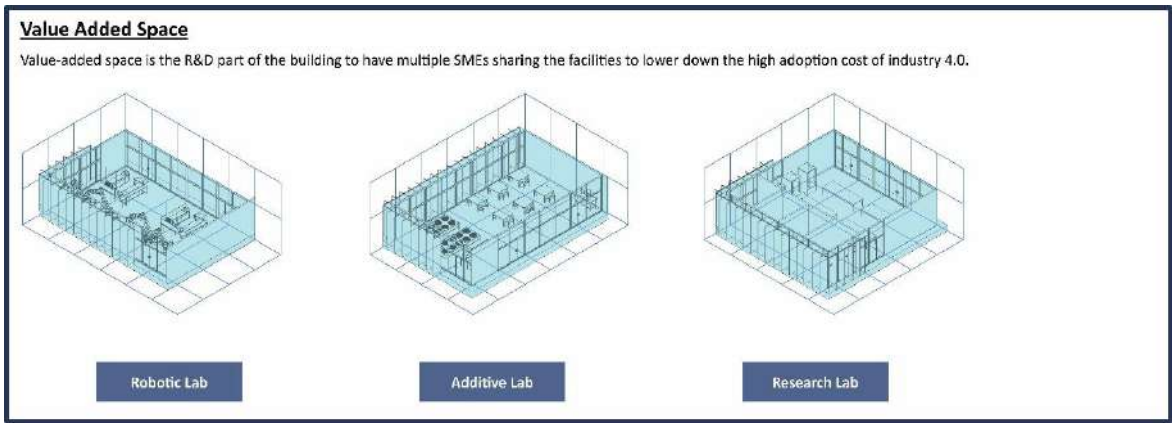
The final pixel massing was formed and ready to be developed into space.

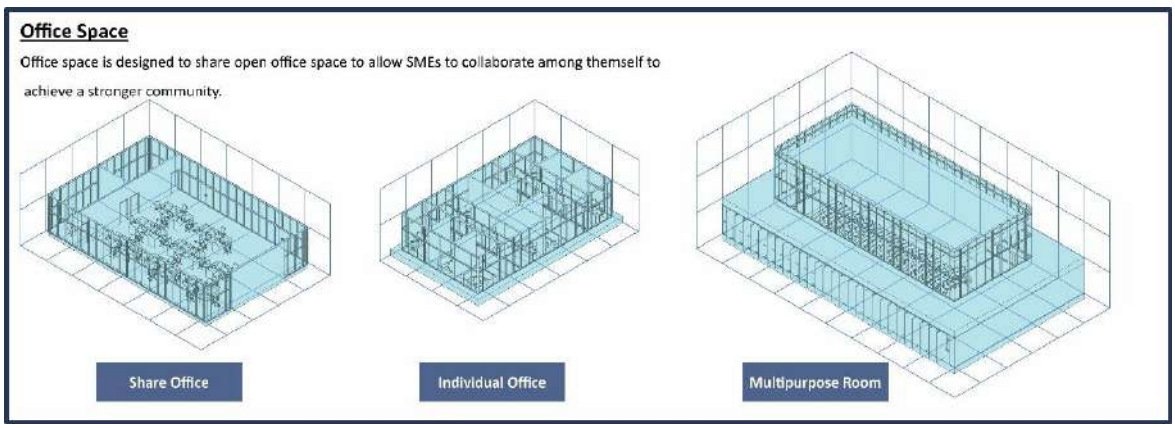
Figure 18 – Site Massing Transformation Diagram

4.6 Undigitizing the Pixel into New Space

Based on the pixel building massing, new spaces are being designed in the constraint of pixel grid. This is to test out the space composition and determine the space size required inside the final building.







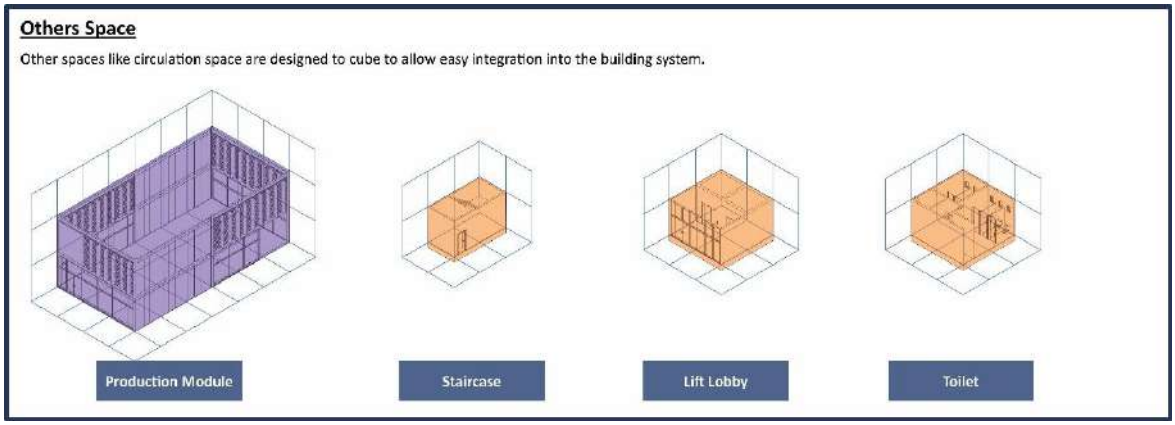


Figure 19 – Undigitizing Space Diagram

Chapter 5 – Final Design Proposal

5.0 Design Statement

The final design of the building has 4 elements, the main building, production building, centralize warehouse and connection park.

Main Building

The design intern of the main building is to be eye catching that will attract people interested to visit the building. It is not designed the same as typical SMEs building to stand out at the site.

The ground floor and first floor are for public usage as educational and interaction space for them to understand SMEs. Second floor to third Floor is an R & D function that houses different kinds of Industry 4.0 technology to encourage experiment among SMEs. At the top floor, it is an open office adopting the concept of co working space to promote collaboration.

Production Building

Production building will house multiple SMEs from various sizes and shapes. The building layout adopted modularity of the structural system to allow the occupant to remove the intermediate wall that can further extend the layout to another unit. The unit can also be subdivided to become a smaller unit to cater smaller SMEs.

Centralize Warehouse

The Centralized warehouse handles all the transportation service by connecting to other zone warehouse facilities. It streamlines the material handling process and help SMEs reach larger potential buyers in this system. The warehouse is using an automation system to smartly deliver and sort material.

Connection Park

The connection park is to bring the much-needed green to the SMEs industry. This will help change the perception of the public toward SMEs and encourage the public to also enjoy the facilities provided here. The park is also the connection point that connects the residential zone to the building.

5.1 Site Plan

The connection park is to bring the much-needed green to the SMEs industry. This will help change the perception of the public toward SMEs and encourage the public to also enjoy the facilities provided here. The park is also the connection point that connects the residential zone to the building.

Figure 20 – Site Plan

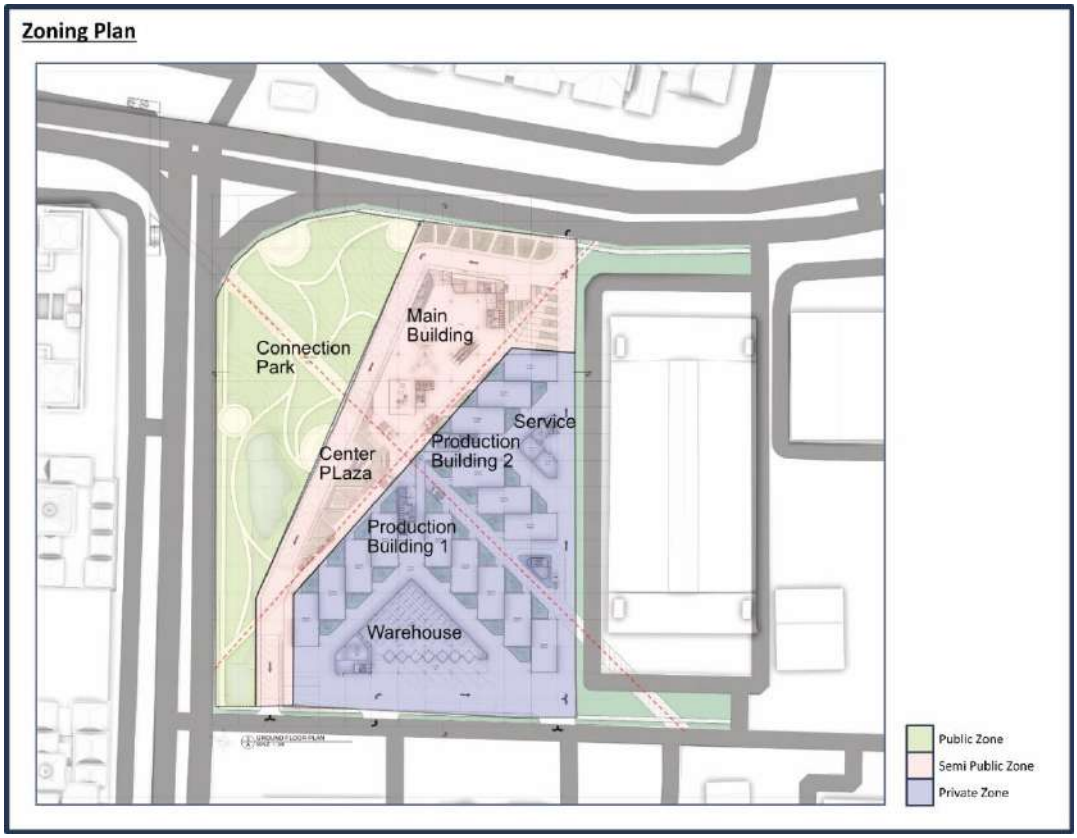


Figure 21 – Zoning Plan

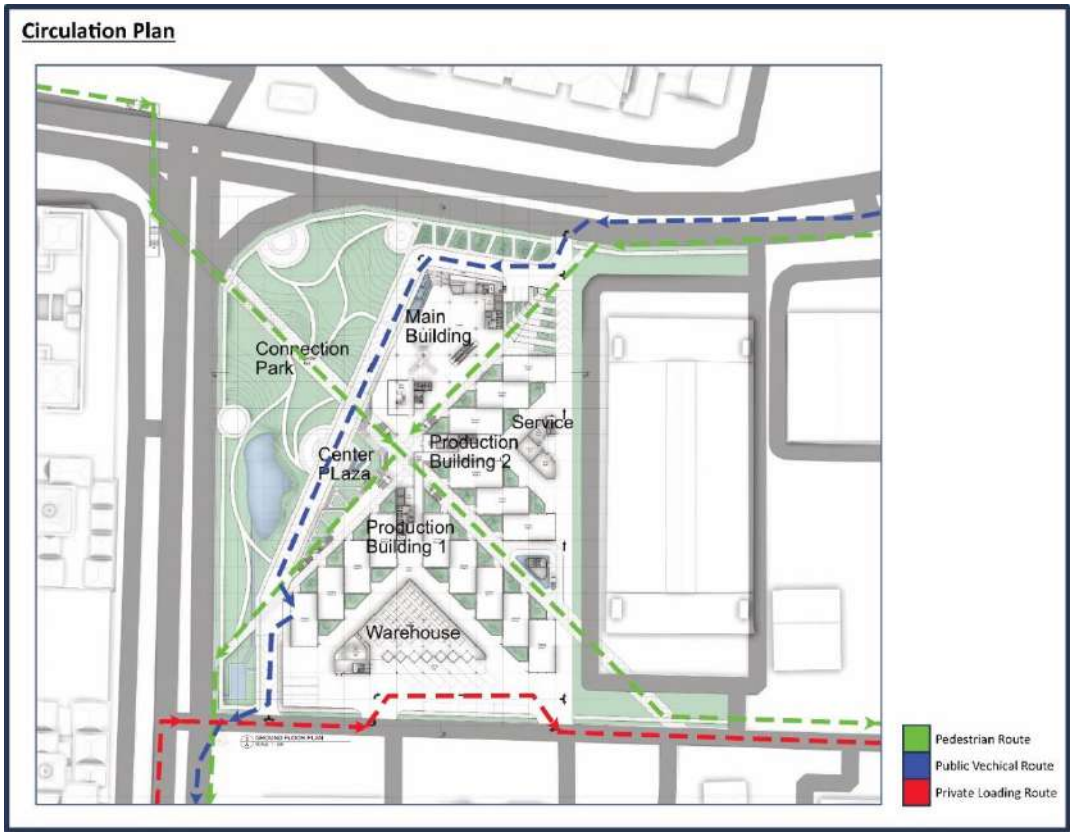


Figure 22 – Circulation Plan

5.2 Main Building

The concept of the main building is to have multiple spaces stacking on top of each other to create the dynamic facade in order to break through the typical industry building perception. This can create a positive landmark to the area by giving a positive effect on the industry to the public.

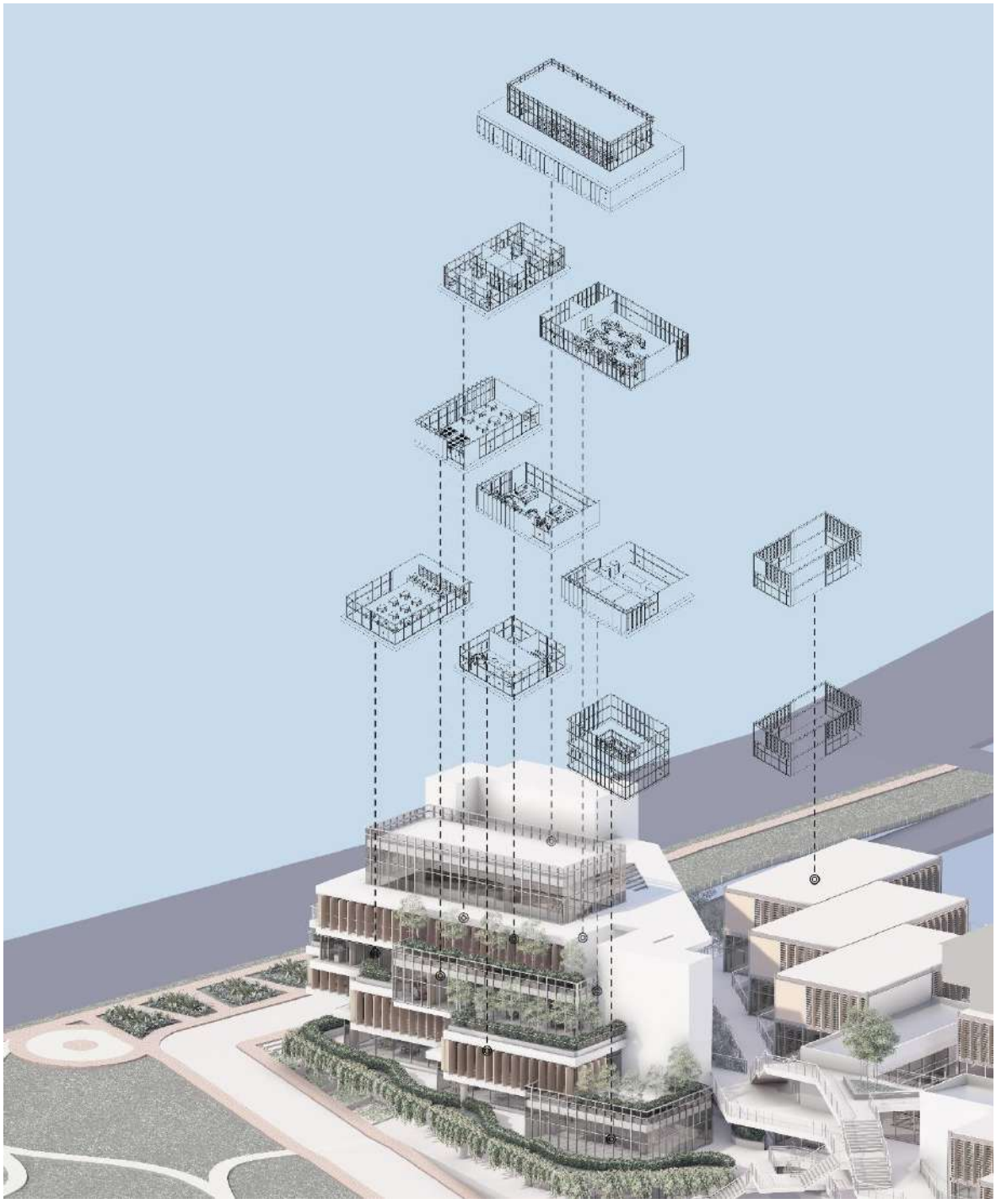


Figure 23 – Main Building Formation Diagram

5.3 Production Building

Modularity

The production building implemented a modular system to incorporate different kinds of SMEs. The modular part enabling by industry 4.0 to integrate the building production inside the value chain infrastructure. Every part is the standard 3m x 3m size that is easy to fix and remove for remodelling the unit.

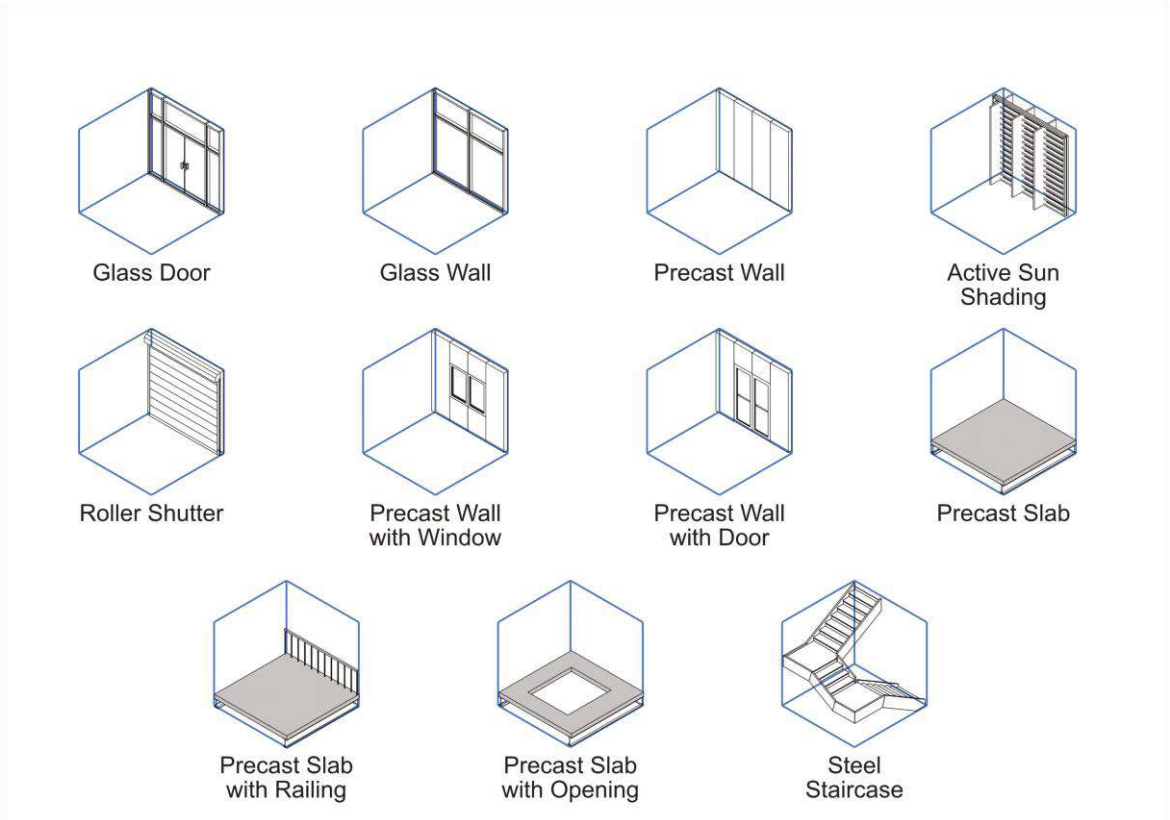


Figure 24 – Modular Cube Diagram

Modular Arrangement

The module is arranged in a 45 degree arrangement because in studying the natural ventilation and sunlight of terrace typology, the building interior does not have sufficient sunlight and wind, hence they must reliare on artificial solution.

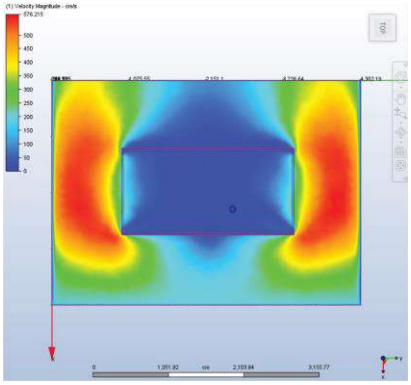


Figure 25 – Terrace CFD Simulation

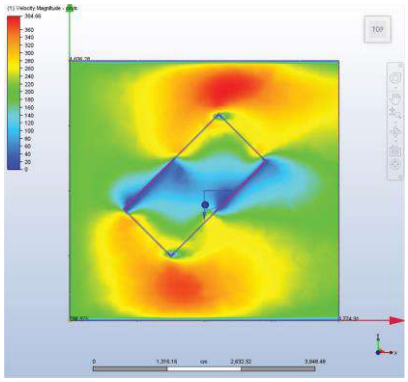


Figure 26 – New Building CFD Simulation

When the building is angled 45 degrees, the building receives 60% more natural ventilation capability and with the help of IOT sun and wind shading, we can control the allowable natural sun and wind entering the building. Therefore, this form was chosen for the building.

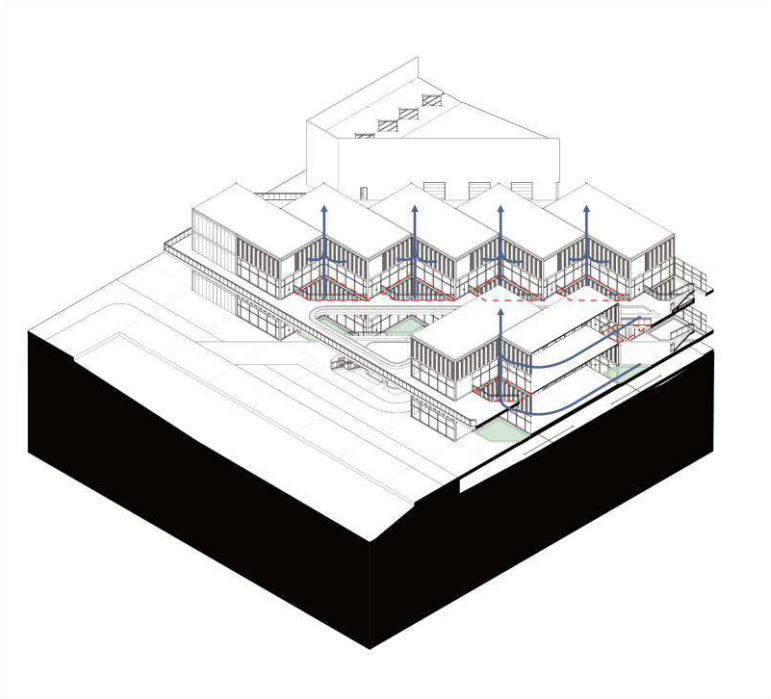


Figure 27 – Production Building Ventilation Diagram

Modular Possibility

The production module is designed into a cluster setup with double stories. This is because it allows SMEs to combine multiple modules into a larger module to suit their needs

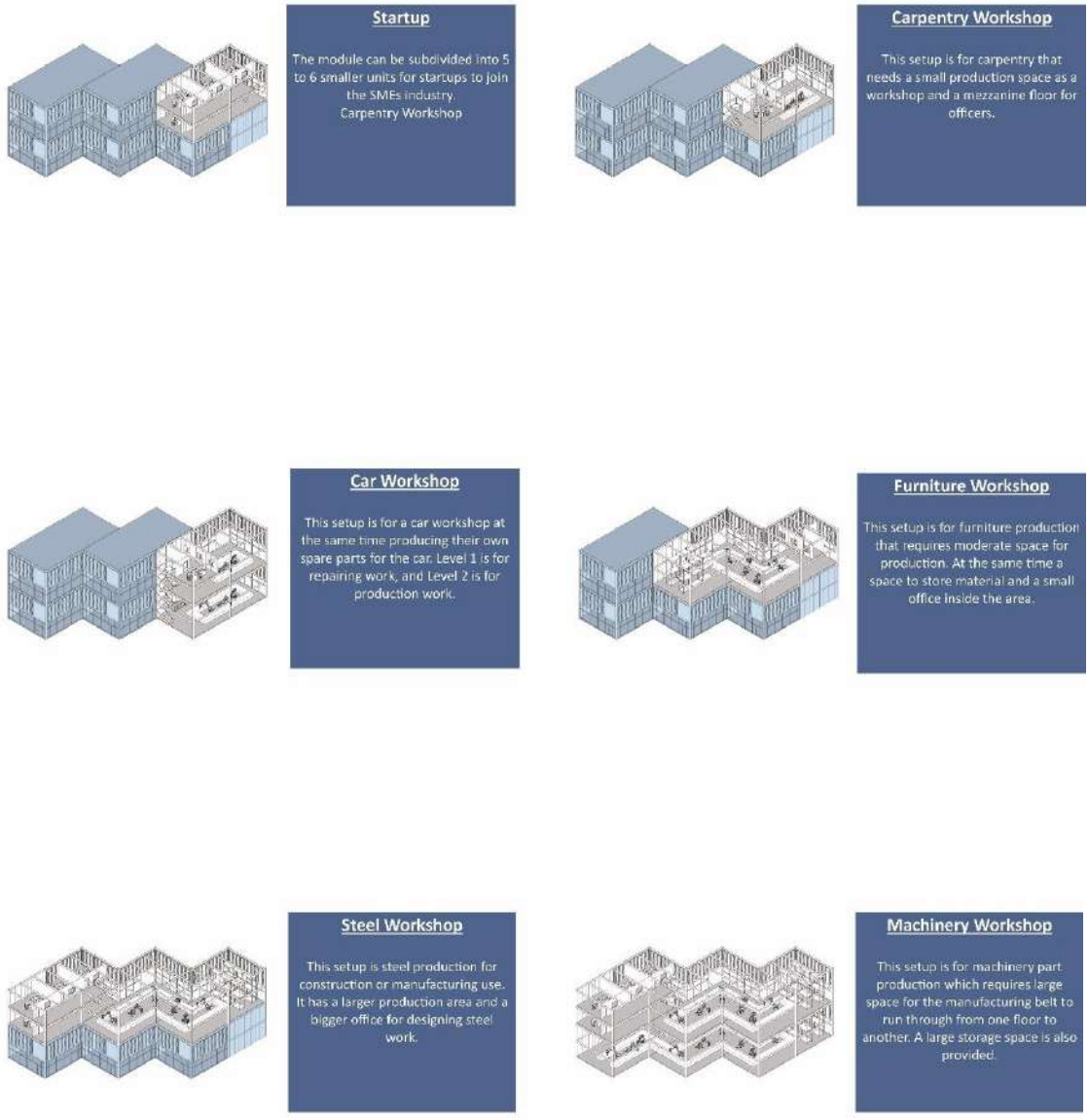


Figure 28 – Modular Possibility Diagram

5.4 Building Floor Plan

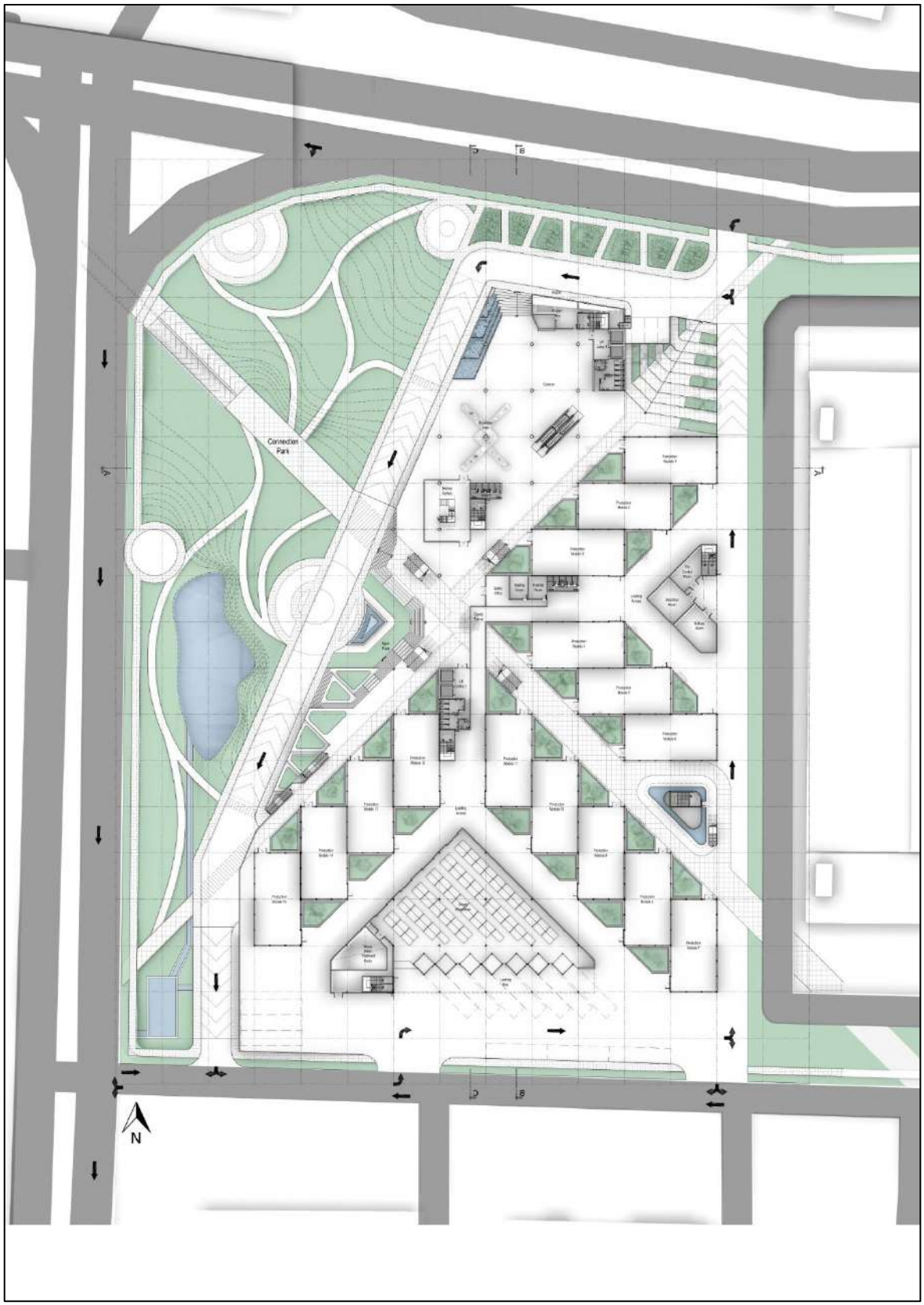


Figure 29 – Ground Floor Plan

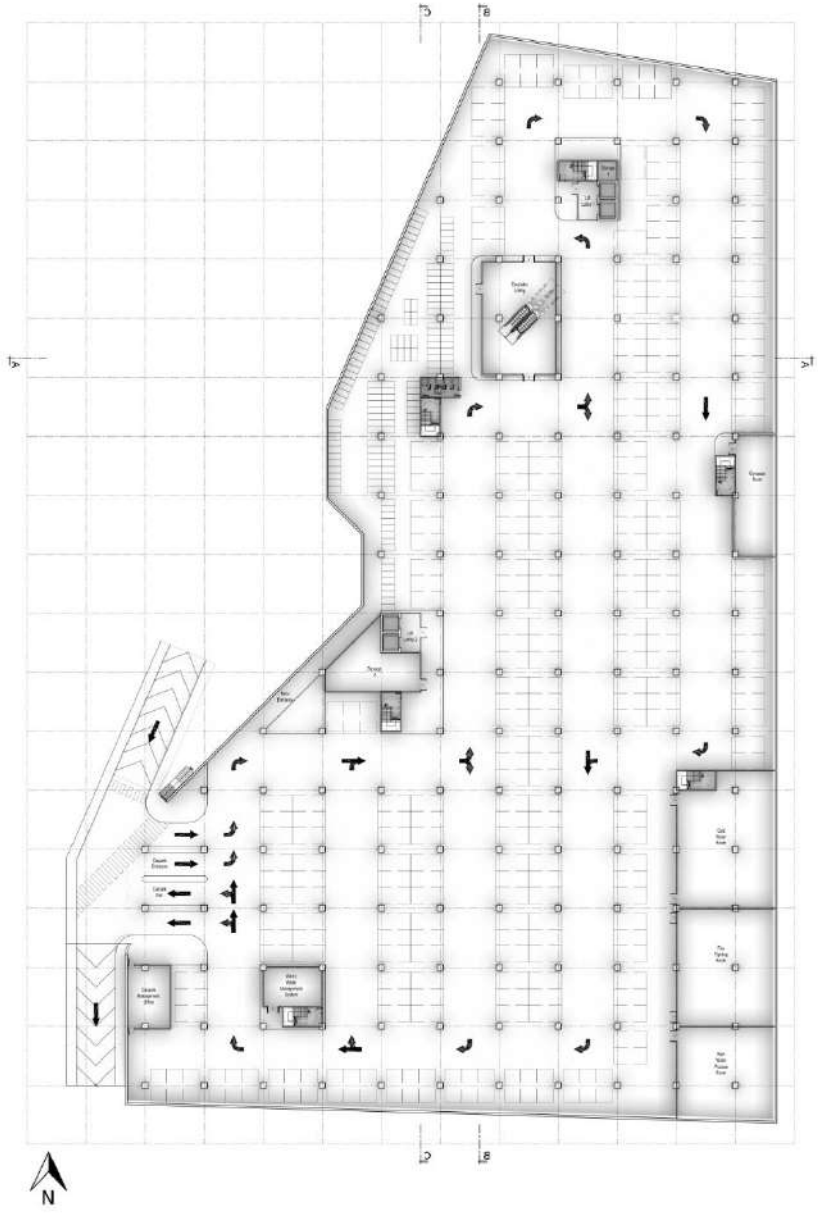


Figure 30 – Basement Plan

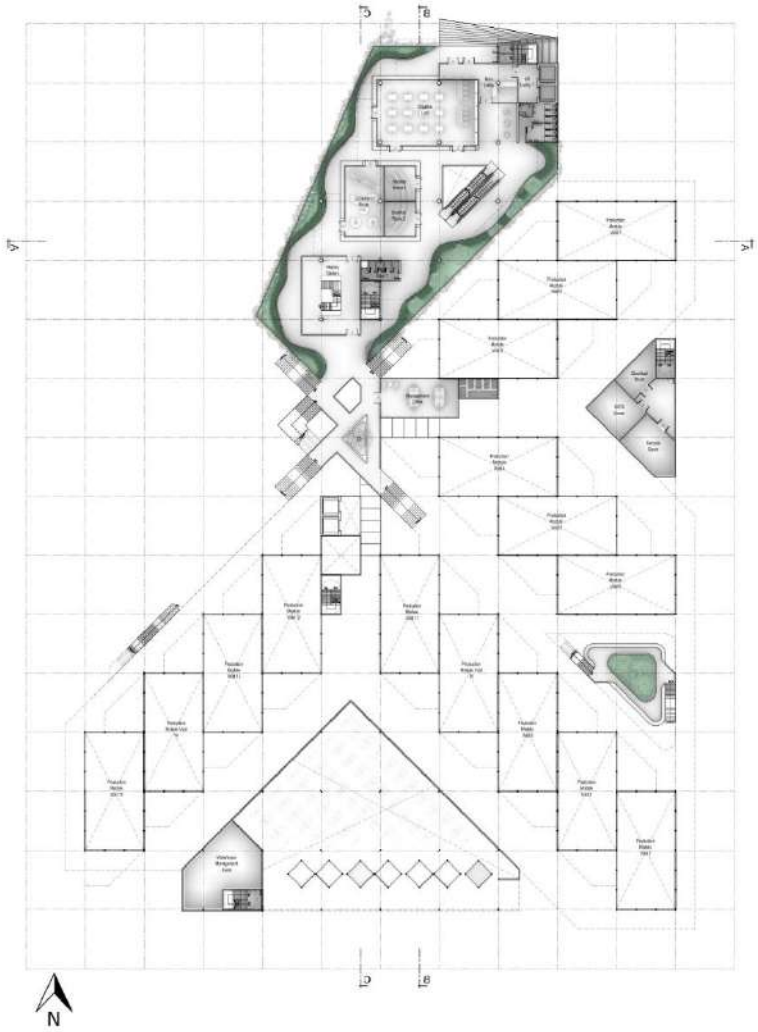


Figure 31 – First Floor Plan

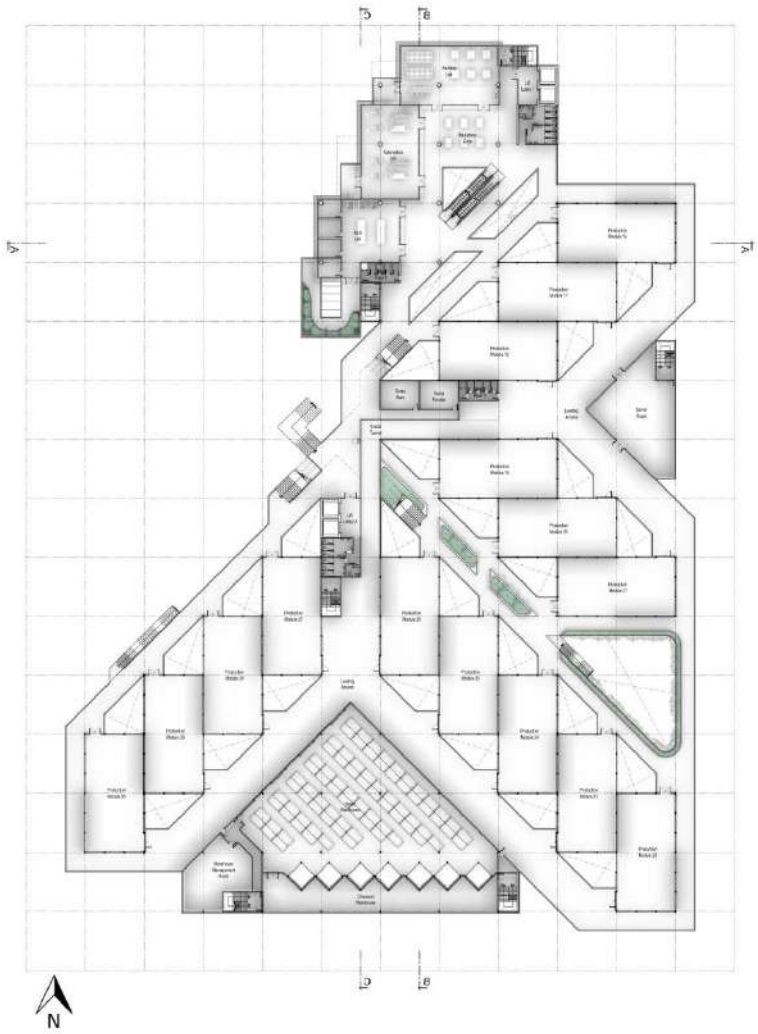


Figure 32 – Second Floor Plan

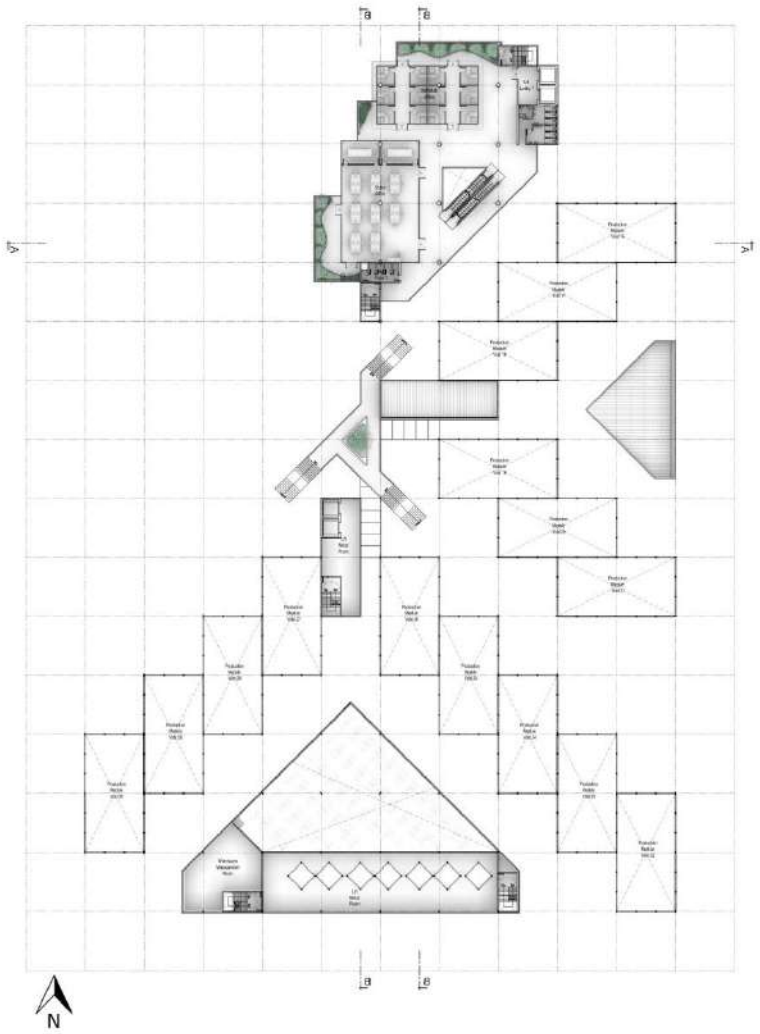


Figure 33 – Third Floor Plan

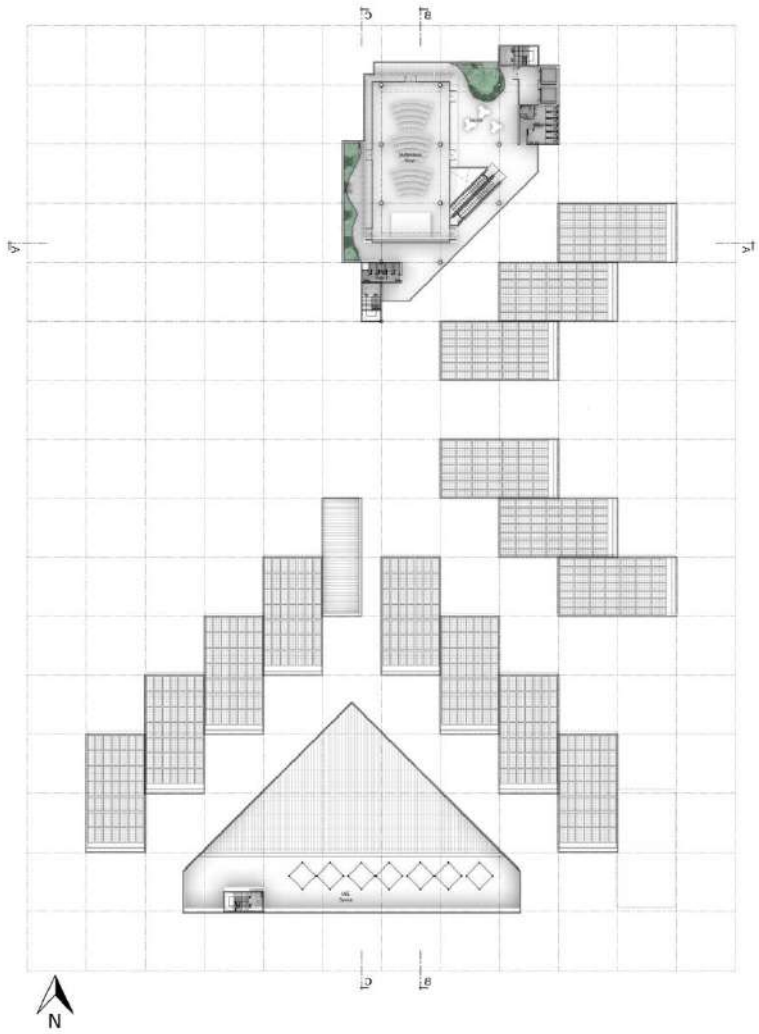


Figure 34 – Fourth Floor Plan

5.5 Elevations

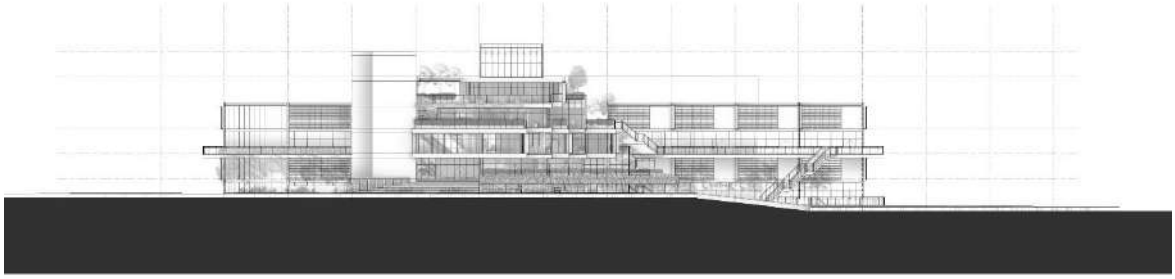


Figure 35 – Front Elevation

Figure 36 – Rear Elevation

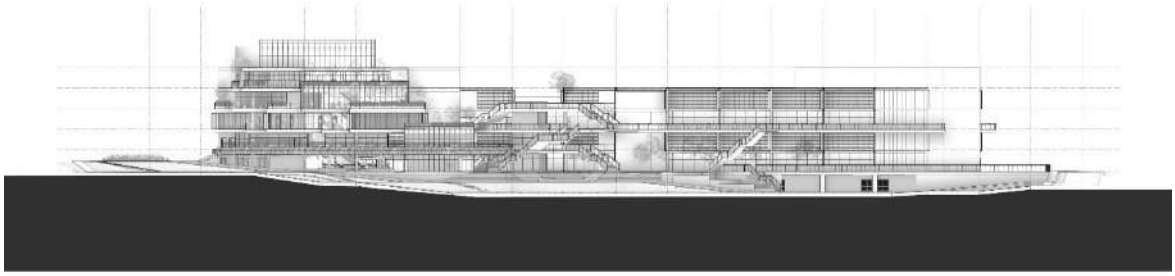


Figure 37 – Right Elevation

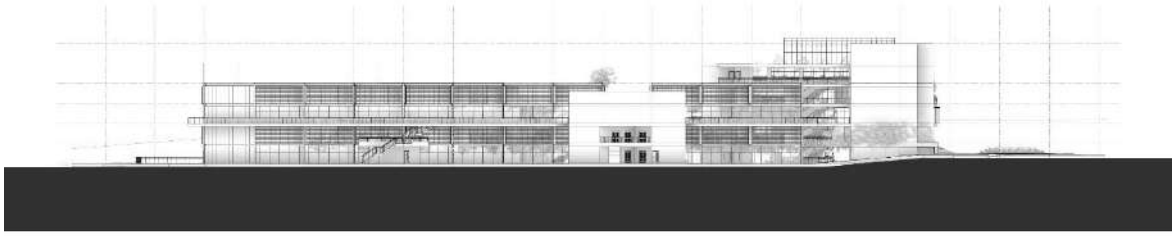


Figure 38 – Left Elevation

5.6 Section

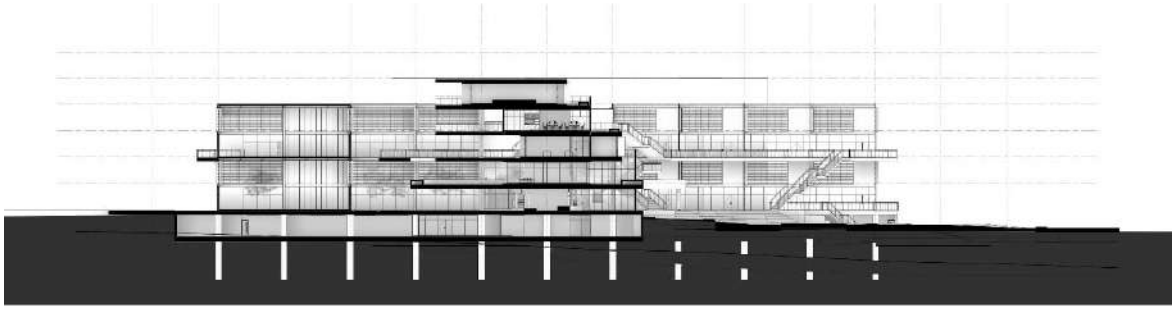


Figure 39 – Section A

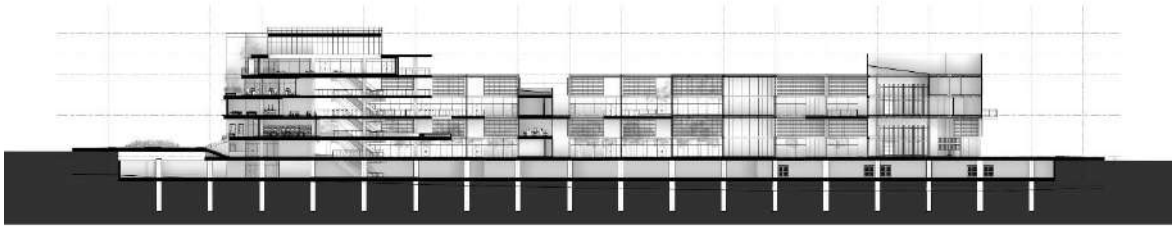


Figure 40 – Section B

Figure 41 – Sectional Perspective C

5.7 Perspectives

Figure 42 – Proposed Building Bird Eye View

Figure 43 – Main Building Perspective

Figure 44 – Centre Plaza Perspective

Figure 45 – Main Building Internal Perspective

Figure 46 – Walkway Between Main Building and Production Building Perspective

Figure 47 – Walkway Between Production Building Perspective

Figure 48 – Production Building Perspective

Figure 49 – Production Building Internal Perspective

Figure 50 – Production Building Service Road Perspective

Figure 51 – Centralized Warehouse Perspective

5.8 Building Detail

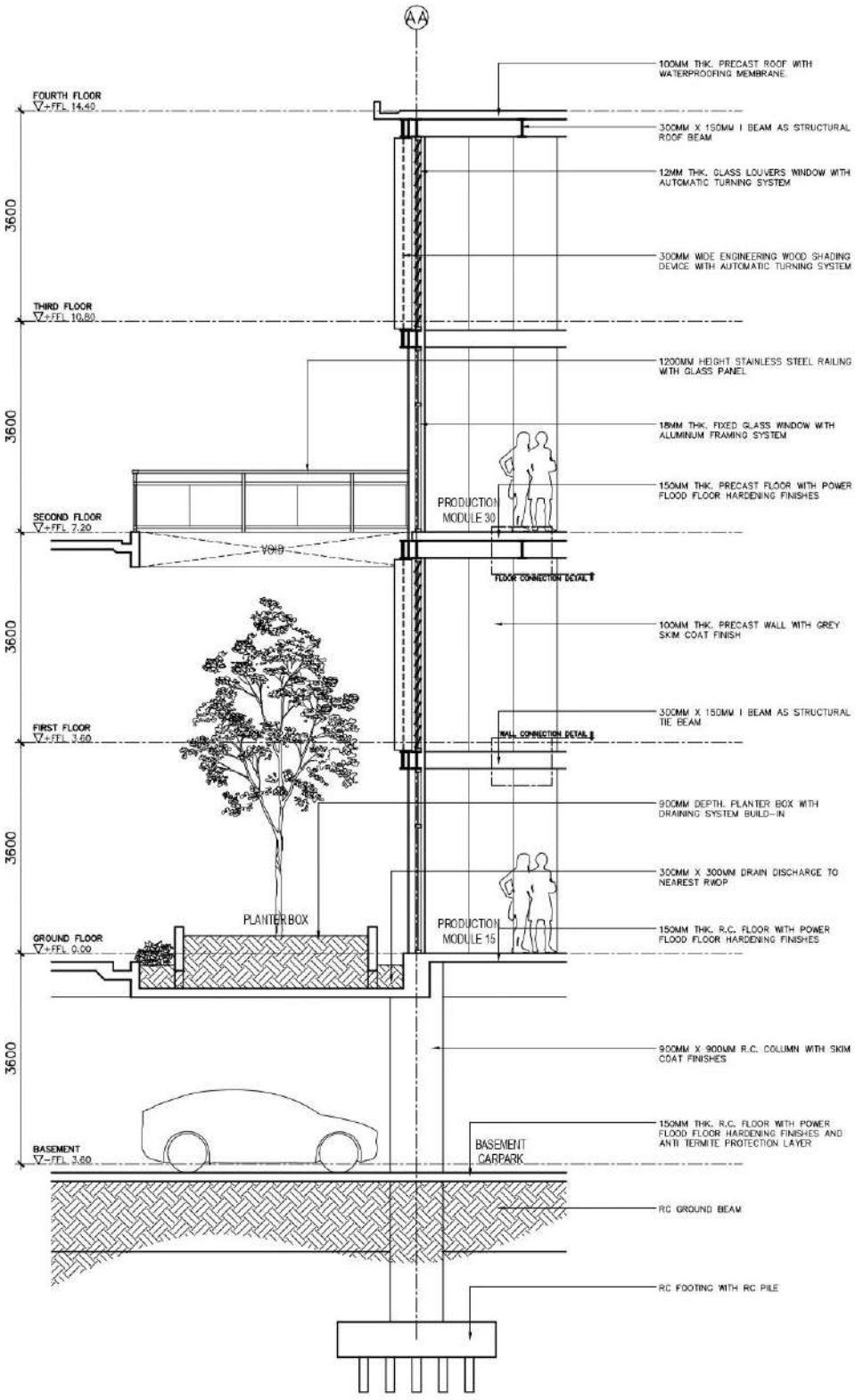


Figure 52 – Production Building Sectional Detail

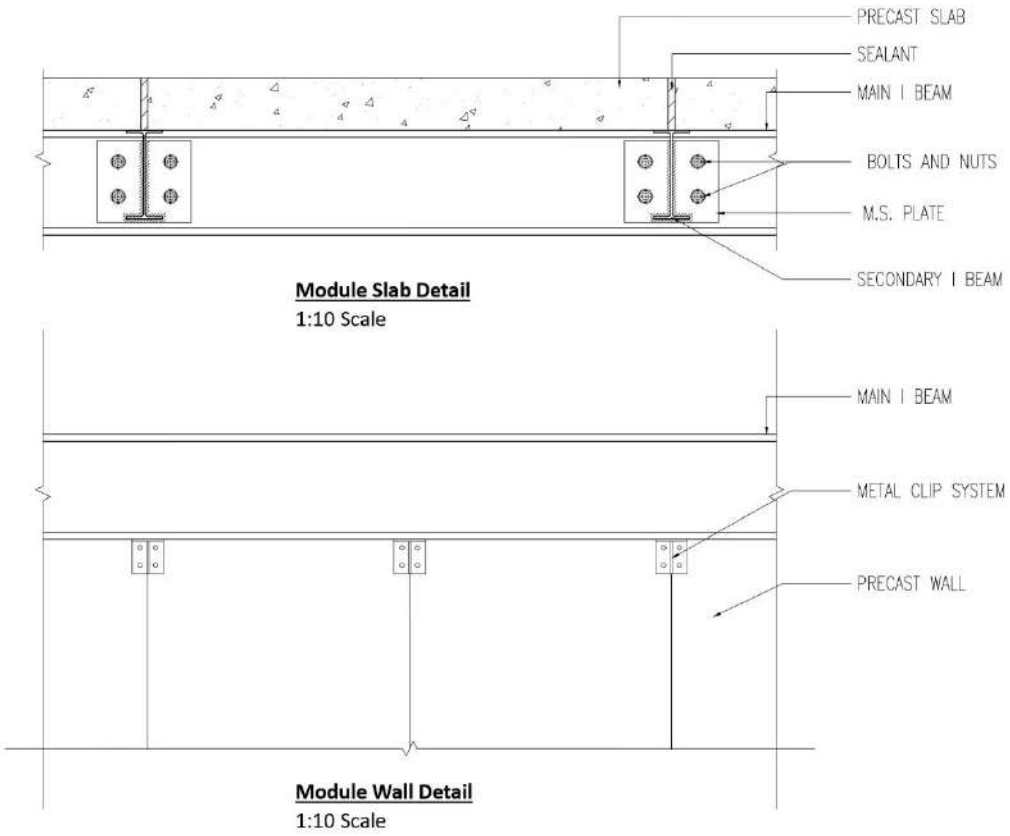


Figure 53 – Production Building Connection Detail

5.9 Building Services

Occupant Load and Capacity of Exits Calculation

The occupant load is designed according to Seventh Schedule Calculation of Occupant Load and Capacity Exits in UBBL.

Factory Calculation

Building Function: Factory

Building Gross Area: 4330 m2

Building Occupant Load per square meter: 1.5Gross

Building Occupant Load: 4330 / 10 = 433

Capacity of Exit: 60 per unit

Exit Width Required: 433/60 = 7.2unit

Total Exit Width Required: 7.2 x 550mm = 3960mm

Total Number of Staircase: 9

Redundancy Calculation: 9 – 1 = 8

Minimum Width per Staircase: 3960mm / 8 = 495mm (Minimum 8 Units = 1100mm)

Therefore, minimum width of residential staircase is 1100mm.

Staircase Provided = 9unit x 1500mm width

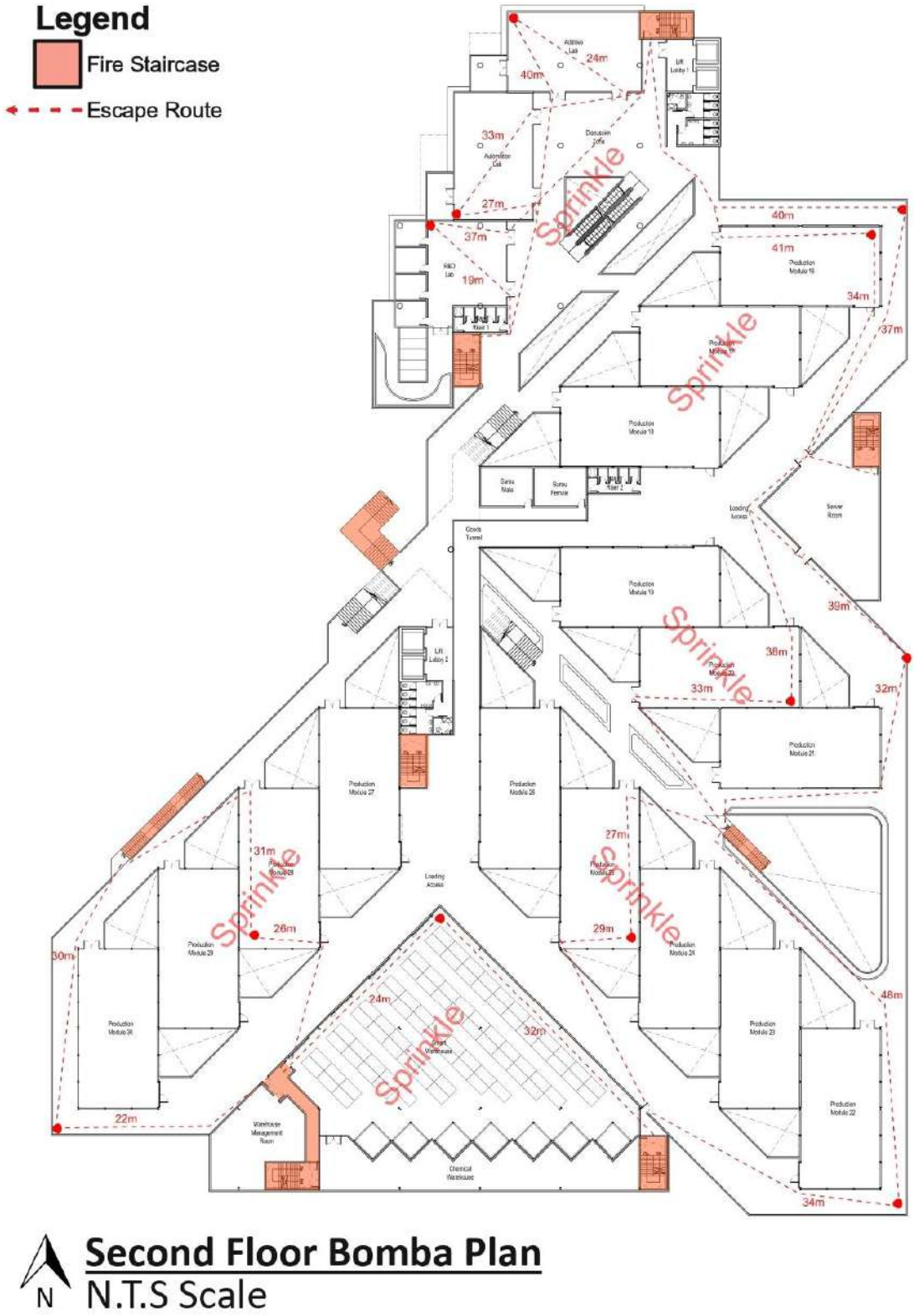


Figure 54 – Fire Fighting Plan

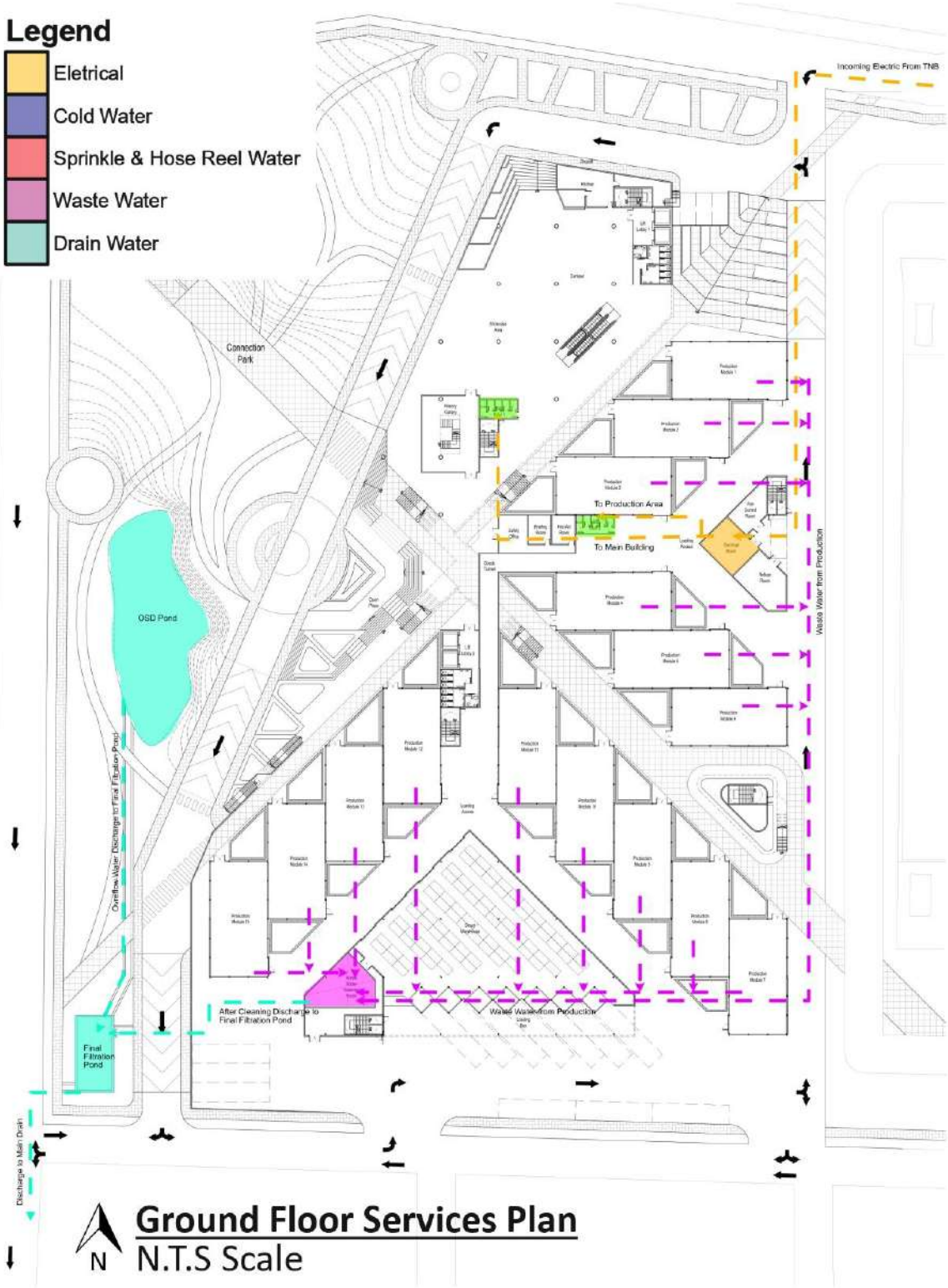


Figure 55 – Building Service Plan 1

Figure 56 – Building Service Plan 2

5.10 Development Order

A) KELUASANTAPAK

NO LOT	MP	KP	EKAR
LOT833	14656	157755.87	3.622

B) PENGIRAANNISBAH PLOT& BANIRDINDING

KIRAAN NISBAH PLOT

NISBAH PLOT = JUMLAH LUASLANTAI KASAR(BUILT-UP AREA)
KELUASANKAWASAN TAPAK

NISBAHPLOT= (11998 MP/ 14656 MP)
1: 0.82

KIRAAN NISBAH KAWASAN PLINTH (BANIRDINDING)

BANIRDINDING(PLINTH AREA) - KESELURUHANTAPAK

BANIRDINDING= JUMLAH LUASTANAH YANGDIDIRIKAN BANGUNAN
X100%
KELUASANKAWASAN TAPAK

BANIRDINDING= (5322 MP/ 14656) X100%
36.31 % (MAKSIMUM 60%)

C) PENGIRAAN KAWASAN LAPANG

JUMLAH KESELURUHANKAWASANLAPANG:	0.918	(	25.36	%)			
KELUASANPERIMETERPLANTING		=	900	MP	0.222	EK	
KELUASANKAWASANLAPANG/ HIJAU/ LANDSKAP		=	2817	MP	0.696	EK	
KELUASANTAPAKCADANGAN		=	14656	MP	3.622	EK	
PERATUSKAWASAN LAPANG/ HIJAU YANGDIPERLUKAN		=	14656	X	5%	=	732.8
PERATUSKAWASANLAPANG/ HIJAU YANGDISEDIAKAN		=	3717	/	14656 X100	=	25.36163

D) PENGIRAANRUANGKANTIN / PANTRI

RUANGKANTIN/ PANTRI :		245				
2%KELUASAN DARI LUASLANTAI KILANG/ PEJABAT						
KELUASANLANTAI KASARKILANG/ PEJABAT	=	8840				
KELUASANPANTRI YANGDIPERLUKAN	=	8840	X	2 %	=	176.8
0.5%KELUASAN DARI LUASLANTAI GUDANG						
KELUASANLANTAI KASARGUDANG	=	3158				
KELUASANPANTRI YANGDIPERLUKAN	=	3158	X	0.5 %	=	15.79
JUMLAH KELUASANPANTRI YANGDIPERLUKAN	=	176.8	+	15.79	=	192.59
JUMLAH KULUASAN PANTRI YANGDISEDIAKAN	=	245				

E) JADUAL PENGIRAAN LUASKASAR(GFA)

TINGKAT	JUMLAH MP	KP
TINGKATBAWAH	5322	57285.53
TINGKAT ATAS	6676	71859.87
JUMLAH	11998	129145.4

F) JADUAL PERINCIAN KELUASAN LANTAI KASAR

	KELUASAN
TINGKAT BAWAH	
KILANG	2617
GUDANG	1175
PEJABAT	1530
JUMLAH KESELURUHAN	5322
TINGKAT ATAS	
KILANG	2710
GUDANG	1983
PEJABAT	1983
JUMLAH KESELURUHAN	6676

PERBEZZAZONE	JUMLAH
KILANG	5327
GUDANG	3158
PEJABAT	3513
JUMLAH	11998

G) PENGIRAAN PENYEDIAAN RUANG SOLAT/ MUSOLLAH

RUANGSOLAT/ MUSOLLAH : 9 MP (LELAKI) 9 MP (PEREMPUAN)

KELUASANRUANGSOLAT LELAKI DENGAN TEMPAT MENGAMBIL WUDHUK

=	3.95 M	X	3.675 M	=	14.52	

KELUASANRUANG SOLAT PEREMPUANDENGAN TEMPAT MENGAMBIL WUDHUK

=	3.925 M	X	3.675 M	=	14.42	

H) PENGIRAAN TEMPAT LETAK KENDERAAN
GARISPANDUAN

TEMPAT LETAK KERETA										
KILANG		1	TLK	:	92.9	MP	RUANG LANTAI KASAR	+	10 %	PELAWAT
BIASA	=	5327	/		92.9	*	=	57.34123		
PELAWAT	=	57.341227	X		10	%	=	5.734123		
DIPERLUKAN	=	57.341227	+	5.734123			=	63.07535		
DISEDIAKAN	=	115								
PEJABAT		1	TLK	:	46.4	MP	RUANG LANTAI KASAR	+	10 %	PELAWAT
BIASA	=	3513	/		46.4	*	=	75.71121		
PELAWAT	=	75.711207	X		10	%	=	7.571121		
DIPERLUKAN	=	75.711207	+	7.571121			=	83.28233		
DISEDIAKAN	=	110								
GUDANG		1	TLK	:	232.2	MP	RUANG LANTAI KASAR	+	10 %	PELAWAT
BIASA	=	3158	/		232.2	*	=	13.60034		
PELAWAT	=	13.600345	X		10	%	=	1.360034		
DIPERLUKAN	=	13.600345	+	1.360034			=	14.96038		
DISEDIAKAN	=	20								
JUMLAH DIPERLUKAN	=	63.07535	+	83.28233	+	14.96038	=	161.3181		
JUMLAH DISEDIAKAN	=	115	+	110	+	20	=	245		
TEMPAT LETAK MOTOSIKAL										
JUMLAH		1	TLM	:	185.8	MP	RUANG LANTAI KASAR			
DIPERLUKAN	=	11998	/		185.8	*	=	64.57481		
DISEDIAKAN	=	148								
TEMPAT LETAK LORI										
JUMLAH		1	TLL	:	929.9	MP	RUANG LANTAI KASAR			
DIPERLUKAN	=	11998	/		929.9	*	=	12.90246		
DISEDIAKAN	=	13								

I) PERATUS LUAS LANTAI PEJABAT BERBANDING LUAS LANTAI KESELURUHAN

PERATUS LUAS LANTAI PEJABAT BERBANDING LUAS LANTAI KESELURUHAN = RUANG LANTAI PERJABAT / JUMLAH LUAS LANTAI KASAR

= (3513 MP/ 11998) X100%

29.27988 % (MAKSIMUM 30%)

	Office	Production	Warehouse	Carpark
GF	1530	2617	1175	12151
1F	570	93	311	
2F	538	2617	1175	
3F	449	0	497	
4F	426	0	0	
=	1983	2710	1983	

Reference

1. Ahmed B. F. (2020, November). Industry 4.0: Architecture and Equipment Revolution

2. Thuy D. O. (2016, December). Understanding the implications of digitisation and automation in the context of Industry 4.0: A triangulation approach and elements of a research agenda for the construction industy

3. Malaysia, Ministry of Economic Affairs. (2018, October). Mid-term Review of the Eleven Malaysia Plan 2016-2020.

4. World Economic Forum. (2019, January). Leading through the Fourth Industrial Revolution Putting People at the Centre.

5. Mathew A. (2014). The Architecture of Industry