LABORATORIUM KOMUNIKASI
DAN BISNIS ARSITEKTUR

DESIGN OF MIXED USE BUILDING OF BOGOR STATION WITH INCLUSIVE DESIGN APPROACH

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STATEMENT OF AUTHENTICITY

I declare that all parts of this work are my work, except for the works in which are referred to as references, and that there is no assistance from other parties in whole or in part in the process. I also declare that there is no conflict of intellectual property rights in this work and submit it to the architecture department of the Universitas Islam Indonesia to be used for educational and publication purposes.

Bogor, July 16, 2021

Faiz Rizky Nauli Harahap

FOREWORD

Assalamualaikum. Wr. Wb.

Alhamdulillah, all praise for Allah SWT who has bestowed grace and guidance, that because of His approval author can complete the final project report with the title "Design of Mixed Use Building of Bogor Station with Inclusive Design Approach", to fulfill one of the requirements to achieve architecture bachelor's degree at Universitas Islam Indonesia. The success of the writing of this final project, of course, could not be separated from the encouragement and support of various parties. The author would like to express appreciation and thank towards:

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6. My parents, who never stop supporting, praying, and loving myself.
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8. Members of batch of 2017 especially the international program for all the close support, shared emotions, and all the precious memories.

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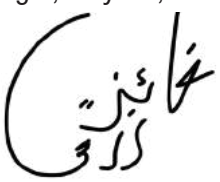
10. All friends outside my academic circle that contributes to this project.

The author realizes that the work of this final bachelor project is still far from perfect. Therefore, the author expects a variety of constructive criticism to develop better works and also the development of future works from lessons learned from ideas and knowledge contained within this work. The author hopes this final bachelor project can be useful and contribute to the advancement of science and society.

Wassalamu'alaikum Wr. Wb.

Bogor, July 16, 2021



Faiz Rizky Nauli Harahap

Design of Mixed Use Building of Bogor Station with Inclusive Design Approach

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ABSTRACT

One of the main issues in Bogor city is congestion. Within the urban scale, the issue is caused by the centralized city amenities, the street that is unable to accommodate the number of private vehicles, and the inefficient public transportation. One of the congestion hotspots of the city is the area of Bogor station where many important urban amenities are located. Around the area traffic on the road worsened as the pedestrian pathway is inconvenient makes the road more crowded as people depend on private motorized vehicles to reach destinations around the area.

One of the solutions for the congestion problem is through the transit oriented development (TOD) concept that shifts the city development to the area around the transit infrastructure and develops better pedestrians to reduce the dependency on private motorized vehicles. However, the increase of mobility could turn the development to be exclusive as the area become more commercially strategical while higher accessibility is required for a more impactful urban solution.

The development of Bogor station to be a mixed-use building with TOD and inclusive design approach are proposed. The design implementation on the development consist of addition of entrance and pedestrian circulation to increase the walkability on the area, the development of apartment with hybrid modular concept to increase affordability and adaptability for more inclusive residentials, and addition of commercial facilities of conventional retail units and non inventory display store to increase commercial productivity of the development.

Keyword: Transit Oriented Development, Inclusive Design, TRIZ, Station Area, Mixed Use Building

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1.1 PROJECT TITLE

Design of Mixed Use Building of Bogor Station with Inclusive Design Approach

1.1.1 DEVELOPMENT

The process in which someone or something grows or changes and becomes more advanced (Cambridge University Press, 2021).

1.1.2 INCLUSIVE DESIGN

Inclusive design, also referred to as universal design, accessible design, and barrier free design is an international concept that is intended to allow environments to be inclusive of all people. Application of this concept would reduce current environmental and social barriers faced by some groups in the population, for example, people with disabilities (R. Mace, 1985).

1.1.3 MIXED USE BUILDING

Mixed use building is a design that seeks to unite various activities and functions which is in the urban area that that is limited, relatively expensive land purchase price, strategic location, as well as high economic value into a complex structure where all uses and facilities that are linked in the framework strong integration (Endy Marlina, 2008).

1.1.4 BOGOR STATION

Bogor train station is a large class type A train station located in Bogor Tengah sub-district, Bogor. The train station became the terminus station for Commuter Line KRL (commuter rail) trips serving the Greater Jakarta (Jabodetabek) area.

1.2 BACKGROUND

1.2.1 BOGOR AND ITS CONGESTIONS

In the mid-1990s, Bogor mayor Eddy Gunardi once said that traffic in his city was very difficult to solve. According to him even though it has changed mayors up to ten times and even more exagerrating that until the apocalypse of the world, Bogor will still be jammed. The problem of traffic in Bogor is complex and latent.

Just how chronic the congestion in Bogor is legitimized by a latest survey by Waze, in 2016 an international traffic and navigation app. Waze surveyed 235 major cities in 38 countries to measure their driving comfort and satisfaction. As a result, Bogor came in second as the worst city to drive with an index record of 2.15 (out of a high score of 10).

The prediction of Bappenas (2004) that the demand for trips in the Jabodetabek area will increase by 26 million trips per day or 40% in 2020 from 17.2 million trips per day in 2002 also illustrates that as part of the Greater Jakarta metropolitan area, the City of Bogor will experience increase of mobility. This growth not followed by a proper city development that the expansion of roads area is only 0.1 percent per year compared to the growth in the number of vehicles which reached 13 percent. Vehicles that populate the streets automatically make the congestion level worse.

With an area of 118.50 square kilometers the streets of Bogor are flooded with approximately 200 thousand motorbikes, 60 thousand private cars, 12 thousand trucks, and 3,412 *angkot* (2018) roaming the streets of Bogor City. While the role of public transportation is very important to serve the increasing mobility in the city, the current main public tranpostation are considered inefficient (Ministry of Transportation, 2002).

There at least seven congestion hot spots in Bogor, consists of Kujang Monument intersection, Otto Iskandardinata (Otista) street, Denpom intersection, Yasmin intersection, Tajur street, Baranangsiang intersection, and Kapten Muslihat street. Most of the congestion points take place on the area nearby center of crowd such as commercial and transit facilities.

Bogor station is a large train station that functions as the main transit of the city with average train passenger 41.775 persons each day (PT KAI Commuter Jabodetabek, 2014). The train station located by Kapten Muslihat street and neighboring Pasar Anyar traditional market which could explain why the street become the point of congestion.

1.2.2 CITY GOVERMENT SOLUTIONS TO SOLVE THE CONGESTION

Alleviating the problem of congestion is included in the six priority scales of the Bogor City Government which is the main target of current governor, after poverty, licensing, village, street vendors and bureaucratic reform. Bogor City Government had made efforts to solve the congestion in the city. The concept of transportation arrangement has been compiled in the Bogor Transortation (B-TOP) road map for the next 20 years. The efforts that have been compiled into short-term, medium-term, and long-term programs.

The short-term program referred to is the placement of supervision, traffic control, law enforcement, and controlling street vendors. For the medium term program is carried out by accelerating the road distribution to break the congestion in the city center. The long-term efforts are including alteration of current public transportation system by development of new bus corridor, re-routing *angkot* (small public transport van), and reducement of *angkot* as inefficient modes of public transport that cause traffic in the city center as shown in figure 1.2.2.1. by converting three of the vehicle to one bus.

Re-layouting of the city also part of the important part of the effort to reduce the city traffic. Currently spatial planning has been centered in the city center including government facilities, tourist center, economic center, trade and religious center. This condition adding more with current inefficient public transport lead to the street congestions as it crowded with the private vehicles of the city dwellers that try to access city center from the city outskirts. Therefore within this scope of problem, the city goverment seeks a development that could reduce the needs to mobilize by private vehicles especially within the city center.

Figure 1.2.2.1: Angkot crowding road traffic nearby Bogor railway station
Source: Antara Foto

1.2.3 CONTEXT OF BOGOR STATION

Following the establishment of the Java railway network in the 1870s railway stations were successfully developed in the cities across Java. One of the constructed railway stations is the Bogor station. In the beginning, Bogor station had the main function as a facility for transporting passengers to the stations across Java, and at the time the user is still limited.

Along with the development of the city, the railway station area becomes part of the city center. The busy daily travel and also its location that neighboring other city amenities create problems such as traffic. Pedestrian circulation is inconvenient as the path are limited. The issue makes people prefer using a private motorized vehicle to reach directions around the area which causes the road around the area to be more crowded.

As shown in figure 1.2.3.1 the location of a railway station is surrounded by the commercial area, government buildings, schools, and religious center.

Figure 1.2.3.1: Location of Bogor station
Source: Open street map

1.2.4 WALKABILITY PROBLEM OF BOGOR STATION AREA

Bogor station is the station for commuter rail trips serving the Jabodetabek area. There are many problems related to mobility around the station area. Other than the congestion itself there is also a walkability issue. According to the research of Listantari, et al. (2015) the user's satisfaction of Bogor station is very poor with one of the main causing issues is the convenience aspect of walking from the station door to the location of public transport. The pedestrian circulation is limited as the current access to the station is only through the south gate. Direct access to the gate from the south is connected through the crossing bridge as shown in figure 1.2.4.1 as there is no access by crossing the road with the sidewalks alongside the station gate is partitioned as shown in figure 1.2.4.2 in which is least convenient especially for the elderly and disabled user.

The limited access towards the railway station is understandable as a solution to control the crowd of angkot that would lead to the traffic on the road nearby the station. Therefore to improve the convenience of walkability the development of the railway station access needs to follow after the alteration of the present public transportation towards the new planned bus corridor system.

Figure 1.2.4.1: Bridge that connect to the railway station gate
Source: Author (2021)

Figure 1.2.4.2: Partitioned sidewalk alongside the station gate
Source: Tribunnews Bogor

1.2.5 TRANSIT ORIENTED DEVELOPMENT: BENEFIT AND ISSUE

According to Peter Calthrope (1993) transit-oriented development (TOD) is a concentrated mixed-use development at strategic points along with the regional transit system. In general TOD consist of moderate/high-density housing, transportation facility, commercials, and public space. TOD approaches were able to increase mobility and expedite traffic (Guerra et al., 2018) as the methods can reduce the private automobile dependency as many urban amenities could be reached by walking or by micro mobilities and by the development of effective city transit system make it easier to reach many destinations in the city by public transportation that in turn could reduce number of vehicles on the street.

While TOD has demonstrated a number of advantages in terms of sustainable development and smart growth, there may be drawbacks, such as segregation. To put it another way, the advantages of TOD, such as increased mobility, walkability, and the environment, could be factored into land values, rising house prices, and rents. In a developing country, such projects are usually taken by single ownership and single parcel development that in turn creating a closed area more exclusive for the housing residents that in turn doesn't bring many benefits for the development of its surroundings.

As an example is TOD projects around some LRT stations with the private developers in Jakarta are developing that resulting in a form of mixed-use development with housing as the main component. To qualify as a "TOD" project, the layout must provide direct and convenient access for both pedestrians and vehicles from the project area especially from the housing area to the station To put it another way, "TOD" projects in Jakarta mostly still concentrate on properties inside the parcel boundary, leaving the outside undeveloped. The development of the project area is not integrated with, or even isolated from the surrounding areas (Sri Suryani et al, 2020). An overview of the current TOD development showed in figure 1.2.5.1.

In principle, TOD aims to maintain social and economic balance, improve the functional and spatial development around transit points of an area, through developing accessibility towards public transport and improving interconnectivity among transport modes to promote mass transportation in urban mobility (Dittmar, H. and Ohland, G, 2004). Therefore to bring greater impact for the city TOD project should be more inclusive while able to maintain stability within the wide range of interest and needs of mixed community.

Figure 1.2.5.1: TOD Projects in JABODETABEK
Source: Sri Suryani et al (2020)

1.2.6 INCLUSIVE DESIGN APPROACH

According to F.M. da Silva and R. Almendra (2007) the concept of inclusive design refers to the creation of environments that are accessible and usable by the widest possible range of people of all ages, sizes, and abilities, allowing them to participate equally in society.

Inclusive design is concerned with global sustainability, which is defined not only in terms of natural resource depletion and the need for better management of these resources over time, without sacrificing human life quality, but also, and above all, social, cultural, and relational sustainability, which is stimulated by material culture.

Some of the project strategies to achieve inclusivity is by two types of approaches according to Clarkson and Keates (2003) namely top-down and bottom-up. The question is whether an assistive product should be made more mainstream-friendly or a “normal” product should be made more inclusive. Stigmatizing products may be prevented by creating inclusive products in this way, because mainstream items cannot be stigmatized by definition.

Different than the framework of inclusive design for the disabled or elderly as shown in figure 1.2.6.1, the design of the inclusive development of mixed-income community would follow the framework of socio-economic capabilities of the user that would consist of the smaller portion of the higher income group and the bigger portion of the lower-income group. In this project the development of the design would aim for mixed use building that able to mainstream the quality of housing, access to urban amenities, and gain of commerce.

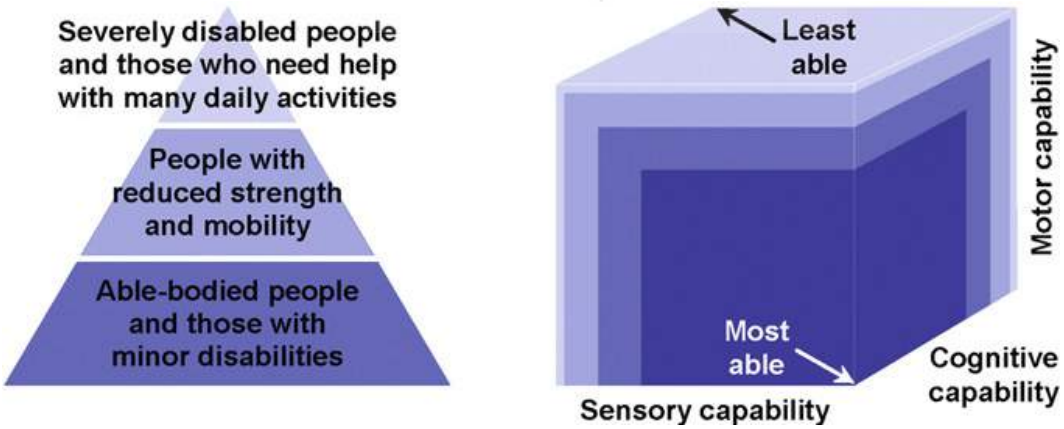


Figure 1.2.6.1: Example of Benktzon inclusive design cube with range of cognitive ability
Source: Keates and Clarkson (2004)

1.2.7 THE CITY HOUSING DEMANDS: MIXED-INCOME DEVELOPMENT SOLUTION

The housing backlog is currently still an unfinished task in Bogor that still left a high number to be provided. This problem could be traced as 50% of the demographic in Bogor is in productive age which is the most demanding group for housing. The resolve for the issue tends to be the construction of residential in the outskirt area of the city but without the follow of city amenities construction it might worsen the congestion problem. Therefore the development of the residential function is proposed within the mixed-use building project as the solution for both the housing demand and the congestion issue.

The mixed-income housing development is one of the considered approaches to resolve the issue, other than being able to create an inclusive housing environment it is more financially sustainable than low-income housing. Mixed-income neighborhoods are also desirable as they can lead to substantially better outcomes for families because the higher disposable incomes of a broader economic mix of families attract additional private investment, amenities, and opportunities.

Mixed-income housing may accomplish a number of outcomes. Leverage federal subsidies, substantially improve living environments, deconcentrate poverty, reduce crime (Sanbonmatsu et al., 2011), increase workforce participation (Chetty, Hendren, & Katz, 2016), improve education and health outcomes (Ludwig et al., 2013), increase real estate values, increase private investment in surrounding neighborhoods (Popkin, 2010).

In Indonesia mixed-income housing is also encouraged by the government through a balanced housing approach. Balanced housing is an approach to maintain the socio-economical balance of the development. The concept mixed aimed would lead to ensuring harmony between the differences of residents with different economical backgrounds in one residential environment while essentially also solve the main issue of housing backlog. The development of balanced housing is through the pattern of 1:2:3 ratio or 1 luxury house, 2 medium house, and 3 affordable houses.

However, some challenges also occurred in mixed-income housing development. The high cost of urban land ends up increase the cost of mixed-income development construction and preservation that leads to the affordability problem. Community building behind the diverse group is found to be infrequent that mostly occurs between the same group. The needs of living space re-arrangement because of issues such as shifting of family constellations of the lower-income user in that live in limited space are restricted in which leads such users moving out from the development area.

The goals or purposes for mixed-income housing strategies can be categorized as poverty alleviation (benefiting low-income families), desegregation (affecting both disadvantaged and advantaged neighborhoods which may or may not lead to a number of benefits or challenges to residents), and urban revitalization (bringing investment to disinvested neighborhoods) (Brower 2009; Duke 2009; Joseph 2006; Joseph and Chaskin 2010; Joseph et al. 2007; Kleit 2005). Therefore to develop an inclusive TOD design of Bogor Station that includes mixed-income community into the development the concern should also consist the strategy to reduce the cost of the development in the urban area, community building for the mixed-income groups, the strategy to respond to the needs of change/preference of the residents in the development.

1.2.8 STAKEHOLDER MODEL FOR THE DEVELOPMENT

Building development may have an effect on a wide range of interests. Among the beneficial consequences may be the improvement of bridges, infrastructure, and living conditions. Construction projects, on the other hand, invariably result in a degree of deterioration and change at local level, which is not limited to the construction site. The project's stakeholders are the representatives that affected by the interest. A stakeholder, therefore, is any individual or group of individuals, which may influence or be influenced, regarding the realization of the purpose of an organization (Freeman, 1984). They can be classified into two categories based on whether they are internal or external to the organization (Gibson, 2000): those that are internal to the organization and those that are external to the organization. External stakeholders are those that are impacted by the project in substantial ways but are not directly associated with it, such as local residents, the government, the public interest, and other businesses. The illustration of the scope of the stakeholders shown in figure 1.2.8.1.

The development of mixed-use building of Bogor station would have an urban scale effect therefore the interest would be wider not just within the developer but also the city community. Within the aim to bring positive impact of reducing the needs of private vehicles and also accessible facilities for the people. The internal stakeholders of the Bogor station mixed-use development project would at least include PT. KAI (the Indonesian train company) and the city government. The external stakeholders would at least include the nearby residents and wider Bogor city communities.

The design of the project as the response towards the issues would be negotiated with the stakeholders. The design is aimed to achieve ZOPA (Zone of Possible Agreement). ZOPA can be defined as the intersection between the sets representing the different configurations of interests of the involved parties as shown in the figure 1.2.8.2 The negotiation structure is composed of three basic elements: i) the involved parties; ii) the issues to be negotiated; and iii) the preferences, thus the interests of the parties. The response from the negotation would be used to complete the design.

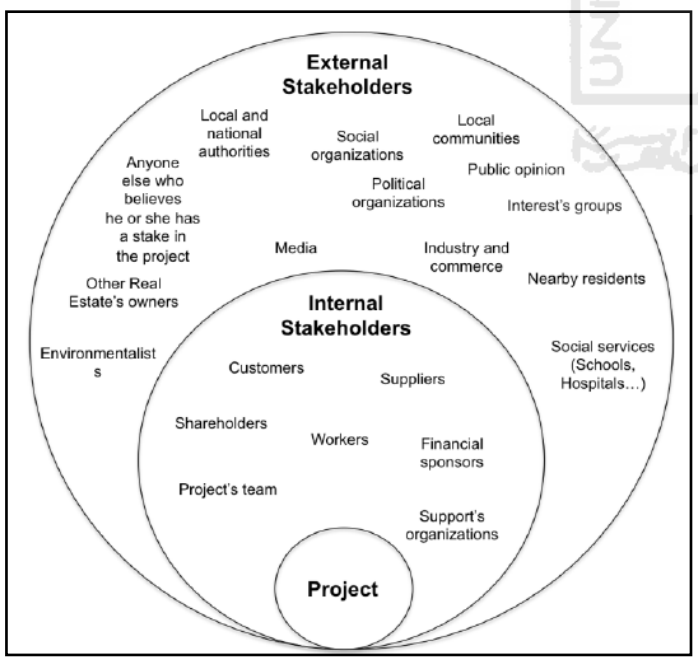


Figure 1.2.8.1: Scope of possible stakeholders of a project
Source: Caputo, Andrea (2013)

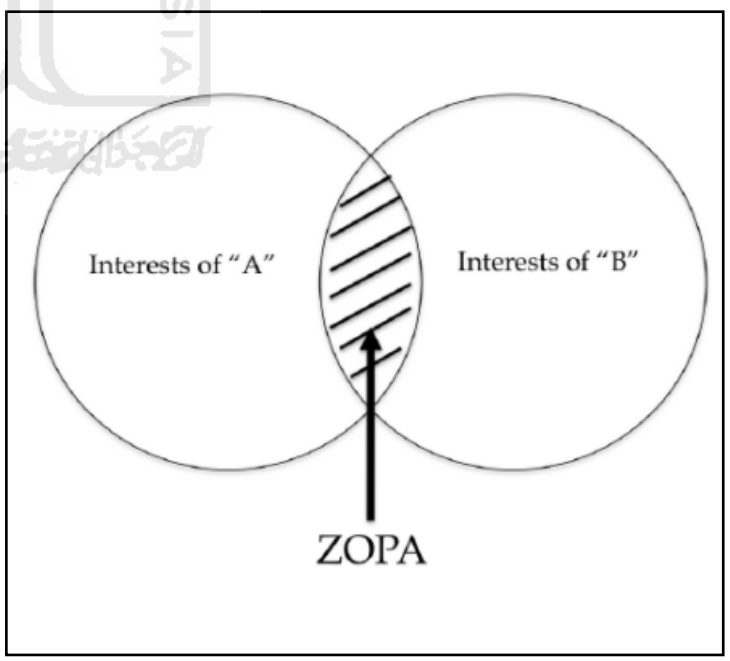


Figure 1.2.8.2: Venn diagram of ZOPA
Source: Caputo, Andrea (2013)

1.3 DESIGN STUDY PRELIMARY ESSAY

One of the problems of Bogor city is the congestions. Just how chronic the congestion in Bogor is legitimized by the latest survey by Waze of 2016 of comfort and satisfaction on the street that resulting from the city as the second worst out of 235 cities around the world. The congestions are mainly caused by the street expansions that can't follow the growth of vehicles numbers.

There are at least seven congestion hot spots that need to be solved in Bogor and one of them is the area nearby Bogor station. Bogor station is a large train station that functions as a commuter train terminus destination with an average train passenger of 41.775 persons each day.

One of the responses to congestion problems is through Transit-Oriented Development. TOD is a concentrated mixed-use development at strategic points along with the regional transit system. Concentrated urban amenities make many necessities that could be reached by walking or micro-mobility (bicycle etc.) therefore reducing the dependency on the automobile.

While TOD has demonstrated several advantages in terms of sustainable development and smart growth, there may be drawbacks, such as segregation. The advantages of TOD, such as increased mobility, and walkability, could be factored into land values, rising house prices, and rents, which could end up as an exclusive closed environment that would reduce the TOD approach as the solution of the urban issue.

However, in principle, TOD aims to maintain social and economic balance, improve the functional and spatial development around transit points of an area, therefore to create a wider positive influence on the city TOD should be more inclusive while able to maintain stability within the wide range of needs and interest that created by the diverse communities.

In this final architectural project, the intention is to design a mixed-use building with TOD and an inclusive design approach. Although in concept transit-oriented development (TOD) is more of urban design, however in this project would be limited to design mixed-use buildings development on the existing plot of transit infrastructure to increase the mobility of the area and reduce the congestion by applying the TOD principles. The inclusive design approach is used to respond to the contradicting issues that would come from the increasing mobility which is segregation. Further, the design also responds to contradicting issues that would come from the more inclusive development which is the decrease of commerciality.

1.4 PROBLEM MAP

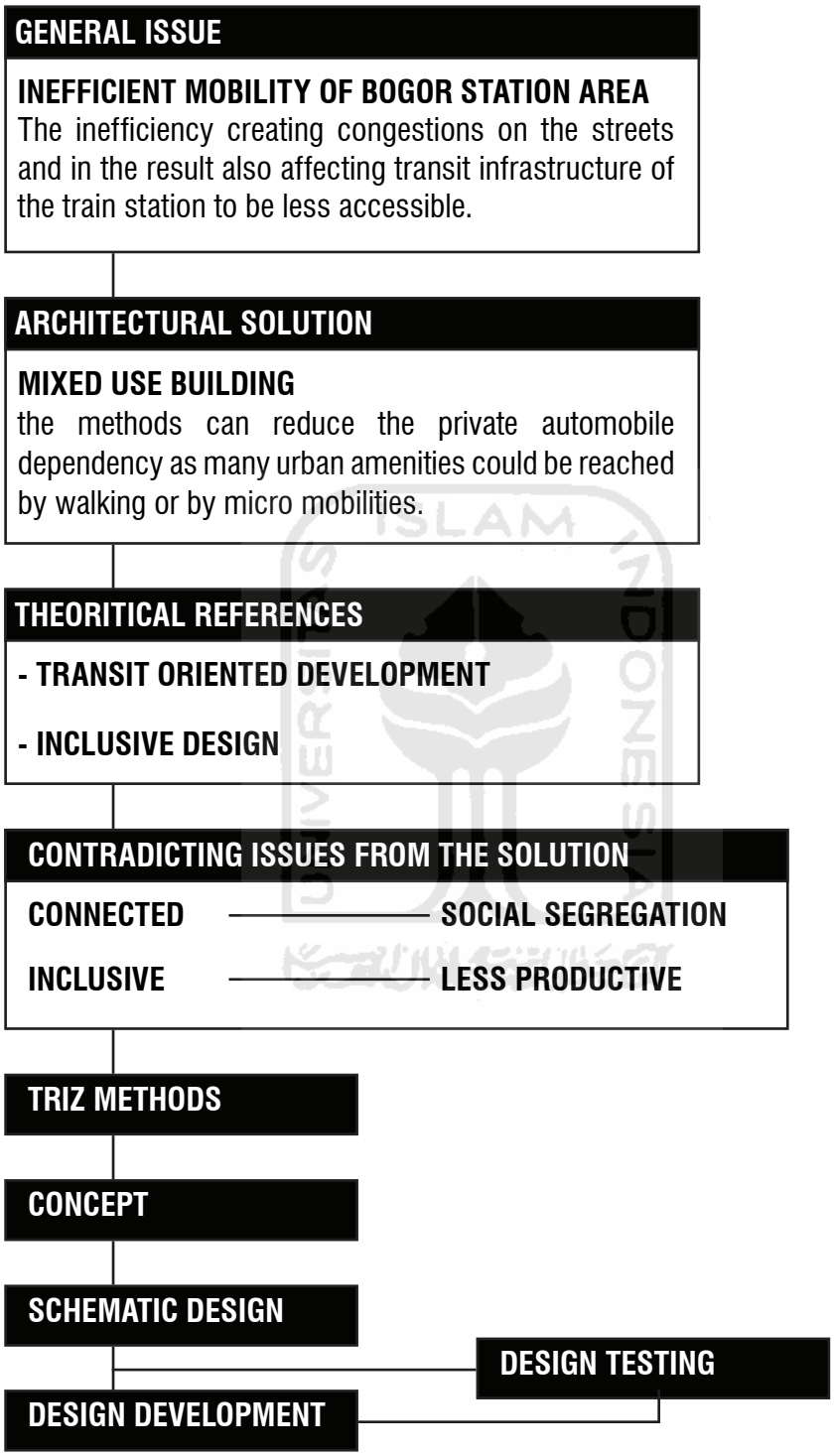


Figure 1.4.1: Problem map
Source: Author (2021)

1.5 PROBLEM STATEMENT

1.5.1 GENERAL PROBLEM

How to design a mixed use building of the Bogor Station Area with the approach of Transit Oriented Development and Inclusive Design ?

1.5.2. SPECIFIC PROBLEMS

1. How to design mixed-use building that can increase walkability of the development area and its surrounding ?

2. How to design residential functions for mixed-income groups that maintain stability within its community ?

3. How to design commercial functions in mixed-use buildings that increase the commerciality of the development ?

1.6 PROJECT AIM

This final architectural project aims to design a mixed-use building of Bogor station with Transit-Oriented Development (TOD) and Inclusive Design approach to creating mixed-use functions for mixed-income communities and promoting walking and micro-mobility in the development area and its surroundings to reduce the dependency of private motorized vehicles.

1.7 PROJECT NOVELTY

Some of the results of research and design with the theme Mix Use Building including:

No.	NAME	PROJECT TITLE	YEAR	CONTENT	LOCATION
1	Aulia Ariestiarini Feridianti	Redevelopment Mixed Use Building In Lempuyangan Area With Transit Oriented Development Approach	2019	Mix use building design consist of residential and street vending kiosk with the aim to solve population growth and gentrification from the development using TRIZ method	Yogyakarta
2	Ken Husnan Isard	Designing Students Apartment with Co-Working Space Functions in Bulaksumur Yogyakarta	2020	Mix use building design consist of student apartment and co-working space with the aim to solve congestion and boredom in the area from the development using TRIZ method	Yogyakarta

Table 1.7.1: Previous bachelor final projects related to mix use building design of UII architecture faculty
Source: Author (2021)

The previous final architectural project by Aulia (2019) design a mixed-use building with a TOD approach to solving the rise of population and also aimed to solve gentrification that could occur by the development. The author solved the main problem by containing the mixed-use building a residential facility and solving the contradicting problem by adding the space for street vendors kiosks. Further, the author also thought of the stability between the mixed community by using TRIZ inventive principles.

The other final architectural project by Ken (2020) design a mixed-use building of student apartments and co-working spaces to solve the congestion on the streets and also the boredom that could occur in the enclosed building environment. To solve the issue the author designs the enclosed building with amenities for the student as its main user and adding the sequential change of the spatial experience in the building by using TRIZ inventive principles.

This final architectural project aims to design a mixed-use building that solves 3 issues. The first is the congestion problem that tried to be solved through the TOD approach by making integration of urban amenities and accessibility in the area that could be reached by walking. The second problem is how to design the developed area through an inclusive design approach so lower-income groups could be benefitted. The third problem is how to design commercial functions to increase the commerciality of the development.

The project novelty highlighted by the use of TOD approach by connecting to the existing pedestrian network to increase walkability to solve the congestion compared to project by Ken (2020) that responded by the design of enclosed mixed use building. The other highlighted difference is that this project tried to solve the segregration by design mixed use building of residential and commercial for mixed community through inclusive design of mixed income development. Compared to project by Aulia (2019) that limit the response of the gentrification issues by design the mix use building of street vendor kiosk and residential units.

1.8 DESIGN METHOD

The design method of the project is using TRIZ (Theory of Inventive Problem Solving). TRIZ is a problem-solving, analysis, and forecasting tool derived from the study of patterns of invention in the global patent literature developed by the Uni Soviet inventor Genrich Altshuller and his colleagues begin in 1946 and still researched and developed until contemporary time.

The steps for TRIZ method are:

1. Identifying the isssues
2. Specify the issues and find the possible solutions in ‘TRIZ language’ (feature to improve)
3. Find contradicting issues that might happen from the solution ‘TRIZ language’ (worsening feature)
4. Obtain the alternative of inventive principles from TRIZ matrix of the features
5. Develop the alternative of inventive principles from TRIZ matrix as the real design solutions

The cotradicting problems formed in IF.., THEN.., BUT,.. sentences to be analyzed with TRIZ in the next step. The contradicting problems in this project would be:

1. **IF** mixed use building with the TOD approach apllied in the area, **THEN** congestion issues can be solved, **BUT** it will create seclusion towards the lower income group and informal sectors

2. **IF** inclusive approach is applied, **THEN** more space could benefit lower income group, **BUT** the area commerciality would be reduced

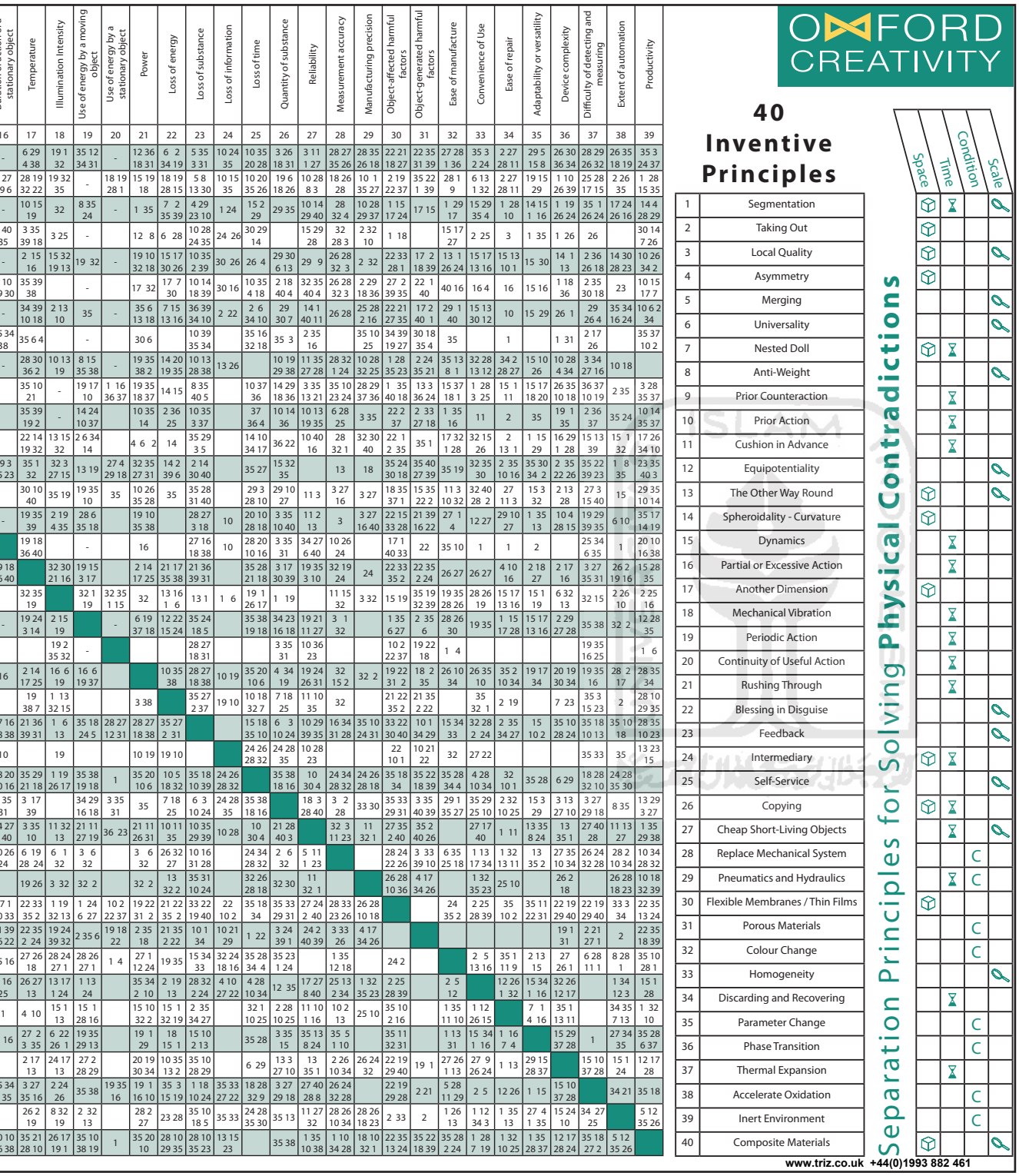
1.8.1 TRIZ MATRIX

According to the TRIZ method, all technological innovations that occurred in different industries are based on a set of “inventive principles”. TRIZ method states that every specific problem that a project tries to solve can be reduced to a general contradicting problem.

To analyze the project’s problems, the problems need to be identified into contradicting issues and then translated to general problems with ‘TRIZ language’ of the improving and worsening feature that is contained in the matrix. The general problem then has a general solution based on 40 inventive principles the matrix contains in which could be developed to a more specific solution for the project.

Improve this one without making this one worse ↓ / → 39 Technical Parameters		1 Weight of moving object	2 Weight of Stationary Object	3 Length of moving object	4 Length of Stationary object	5 Area of moving object	6 Area of stationary object	7 Volume of moving object	8 Volume of stationary object	9 Speed	10 Force (intensity)	11 Stress or pressure	12 Shape	13 Stability of the object's composition	14 Strength	15 Duration of action of a moving object
1	Weight of moving object		-	15 8 29 34	-	29 17 38 34	-	29 2 40 28	-	2 8 15 38	8 10 18 37	10 36 37 40	10 14 35 40	1 35 19 39	28 27 18 40	5 34 31 35
2	Weight of stationary object	-		-	10 1 29 35	-	35 30 13 2	-	5 35 14 2	-	8 10 19 35	13 29 10 18	13 10 29 14	26 39 1 40	28 2 10 27	-
3	Length of moving object	8 15 29 34	-		-	15 17 4	-	7 17 4 35	-	13 4 8	17 10 4	1 8 35	1 8 10 29	1 8 15 34	8 35 29 34	19
4	Length of stationary object		35 28 40 29	-		-	17 7 10 40	-	35 8 2 14	-	28 10	1 14 35	13 14 15 7	39 37 35	15 14 28 26	-
5	Area of moving object	2 17 29 4	-	14 15 18 4	-		-	7 14 17 4		29 30 4 34	19 30 35 2	10 15 36 28	5 34 29 4	11 2 13 39	3 15 40 14	6 3
6	Area of stationary object	-	30 2 14 18	-	26 7 9 39	-		-		-	1 18 35 36	10 15 36 37		2 38	40	-
7	Volume of moving object	2 26 29 40	-	1 7 4 35	-	1 7 4 17	-		-	29 4 38 34	15 35 36 37	6 35 36 37	1 15 29 4	28 10 1 39	9 14 15 7	6 35 4
8	Volume of stationary object	-	35 10 19 14	19 14	35 8 2 14	-		-		-	2 18 37	24 35	7 2 35	34 28 35 40	9 14 17 15	-
9	Speed	8 28 13 38	-	13 14 8	-	29 30 34	-	7 29 34	-		13 28 15 19	6 18 38 40	35 15 18 34	28 33 1 18	8 3 26 14	3 19 35 5
10	Force (Intensity)	8 1 37 18	18 13 1 28	17 19 9 36	28 10	19 10 15	1 18 36 37	15 9 12 37	2 36 18 37	13 28 15 12		18 21 11	10 35 40 34	35 10 21	35 10 14 27	19 2
11	Stress or pressure	10 36 37 40	13 29 10 18	35 10 36	35 1 14 16	10 15 36 28	10 15 36 37	6 35 10	35 24	6 35 36	36 35 21		35 4 15 10	35 33 2 40	9 18 3 40	19 3 27
12	Shape	8 10 29 40	15 10 26 3	29 34 5 4	13 14 10 7	5 34 4 10		14 4 15 22	7 2 35	35 15 34 18	35 10 37 40	34 15 10 14		33 1 18 4	30 14 10 40	14 26 9 25
13	Stability of the object's composition	21 35 2 39	26 39 1 40	13 15 1 28	37	2 11 13	39	28 10 19 39	34 28 35 40	33 15 28 18	10 35 21 16	2 35 40	22 1 18 4		17 9 15	13 27 10 35
14	Strength	1 8 40 15	40 26 27 1	1 15 8 35	15 14 28 26	3 34 40 29	9 40 28	10 15 14 7	9 14 17 15	8 13 26 14	10 18 3 14	10 3 18 40	10 30 35 40	13 17 35		27 3 26
15	Duration of action by moving object	19 5 34 31	-	2 19 9	-	3 17 19	-	10 2 19 30	-	3 35 5	19 2 16	19 3 27	14 26 28 25	13 3 35	27 3 10	
16	Duration of action by Stationary object	-	6 27 19 16	-	1 40 35	-		-	35 34 38	-				39 35 3 23		-
17	Temperature	36 22 6 38	22 35 32	15 19 9	15 19 9	3 35 39 18	35 38	34 39 40 18	35 6 4	2 28 36 30	35 10 3 21	35 39 19 2	14 22 19 32	1 35 32	10 30 22 40	19 13 39
18	Illumination Intensity	19 1 32	2 35 32	19 32 16		19 32 26		2 13 10		13 19 10	26 19 6		32 30	32 3 27	35 19	2 19 6
19	Use of energy by moving object	12 18 28 31	-	12 28	-	15 19 25	-	35 13 18	-	8 15 35	16 26 21 2	23 14 25	12 2 29	19 13 17 24	5 19 9 35	28 35 6 18
20	Use of energy by stationary object	-	19 9 6 27								36 37			27 4 29 18	35	
21	Power	8 36 38 31	19 26 17 27	1 10 35 37		19 38	17 32 13 38	35 6 38	30 6 25	15 35 2	26 2 36 35	22 10 35	29 14 2 40	35 32 15 31	26 10 28	19 35 10 38
22	Loss of energy	15 6 19 28	19 6 18 9	7 2 6 13	6 38 7	15 26 17 30	17 7 30 18	7 18 23	7	16 35 38	36 38			14 2 39 6	26	
23	Loss of Substance	35 6 23 40	35 6 22 32	14 29 10 39	10 28 24	35 2 10 31	10 18 39 31	1 29 30 36	3 39 18 31	10 13 28 38	14 15 18 40	3 36 37 10	29 35 3 5	2 14 30 40	35 28 31 40	28 27 3 18
24	Loss of Information	10 24 35	10 35 5	1 26	26	30 26	30 16		2 22	26 32						10
25	Loss of Time	10 20 37 35	10 20 26 5	15 2 29	30 24 14 5	26 4 5 16	10 35 17 4	2 5 34 10	35 16 32 18		10 37 36 5	37 36 4	4 10 34 17	35 3 22 5	29 3 28 18	20 10 28 18
26	Quantity of Substance	35 6 18 31	27 26 18 35	29 35 14 18		15 14 29	2 18 40 4	15 20 29		35 29 34 28	35 14 3	10 36 14 3	35 14	15 2 17 40	14 35 34 10	3 35 10 40
27	Reliability	3 8 10 40	3 10 8 28	15 9 14 4	15 29 28 11	17 10 14 16	32 35 40 4	3 10 14 24	2 35 24	21 35 11 28	8 28 10 3	10 24 35 19	35 1 16 11		11 28	2 35 3 25
28	Measurement Accuracy	32 35 26 28	28 35 25 26	28 26 5 16	32 28 3 16	26 28 32 3	26 28 32 3	32 13 6		28 13 32 24	32 2	6 28 32	6 28 32	32 35 13	28 6 32	28 6 32
29	Manufacturing Precision	28 32 13 18	28 35 27 9	10 28 29 37	2 32 10	28 33 29 32	2 29 18 36	32 23 2	25 10 35	10 28 32	28 19 34 36	3 35	32 30 40	30 18	3 27	3 27 40
30	Object affected harmful factors	22 21 27 39	2 22 13 24	17 1 39 4	1 18	22 1 33 28	27 2 39 35	22 23 37 35	34 39 19 27	21 22 35 28	13 35 39 18	22 2 37	22 1 3 35	35 24 30 18	18 35 37 1	22 15 33 28
31	Object-generated harmful factors	19 22 15 39	35 22 1 39	17 15 16 22		17 2 18 39	22 1 40	17 2 40	30 18 35 4	35 28 3 23	35 28 1 40	2 33 27 18	35 1	35 40 27 39	15 35 22 2	15 22 33 31
32	Ease of manufacture	28 29 15 16	1 27 36 13	1 29 13 17	15 17 27	13 1 26 12	16 40	13 29 1 40	35	35 13 8 1	35 12	35 19 1 37	1 28 13 27	1 13 11	1 3 10 32	27 1 4
33	Convenience of Use	25 2 13 15	6 13 1 25	1 17 13 12		1 17 13 16	18 16 15 39	1 16 35 15	4 18 39 31	18 13 34	28 13 35	2 32 12	15 34 29 28	32 35 30	32 40 3 28	29 3 8 25
34	Ease of repair	2 27 35 11	2 27 35 11	1 28 10 25	3 18 31	15 13 32	16 25	25 2 35 11	1	34 9	1 11 10	13	1 13 2 4	2 35	11 1 2 9	11 29 28 27
35	Adaptability or versatility	1 6 15 8	19 15 29 16	35 1 29 2	1 35 16	35 30 29 7	15 16	15 35 29		35 10 14	15 17 20	35 16	15 37 1 8	35 30 14	35 3 32 6	13 1 35
36	Device complexity	26 30 34 36	2 26 35 39	1 19 26 24	26	14 1 13 16	6 36	34 26 6	1 16	34 10 28	26 16	19 1 35	29 13 28 15	2 22 17 19	2 13 28	10 4 28 15
37	Difficulty of detecting and measuring	27 26 28 13	6 13 28 1	16 17 26 24	26	2 13 18 17	2 39 30 16	29 1 4 16	2 18 26 31	3 4 16 35	36 28 40 19	35 36 37 32	27 13 1 39	11 22 39 30	27 3 15 28	19 29 39 25
38	Extent of automation	28 26 18 35	28 26 35 10	14 13 17 28	23	17 14 13		35 13 16		28 10	2 35	13 35	15 32 1 13	18 1	25 13	6 9
39	Productivity	35 26 24 37	28 27 15 3	18 4 28 38	30 7 14 26	10 26 34 31	10 35 17 7	2 6 34 10	35 37 10 2		28 15 10 36	10 37 14	14 10 34 40	35 3 22 39	29 28 10 18	35 10 2 18

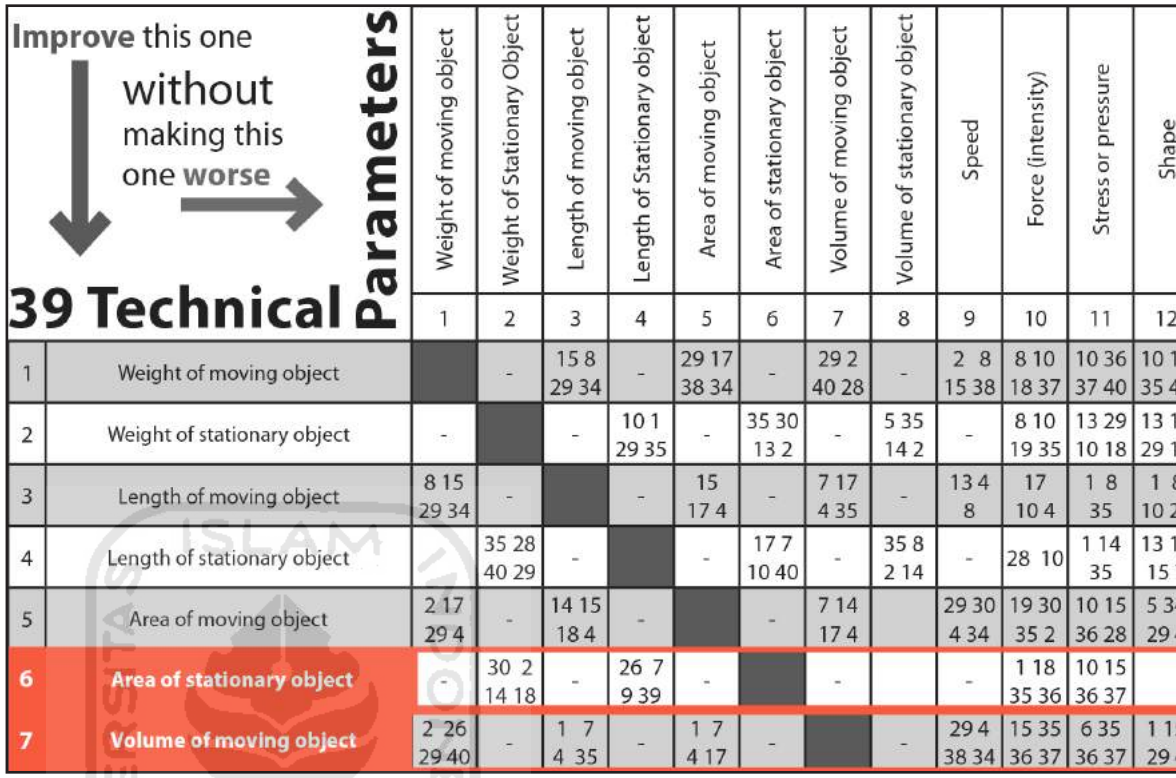
Figure 1.8.1.1: TRIZ matrix table
Source: triz.co.uk


OXFORD CREATIVITY
40 Inventive Principles
Space
Time
Condition
Scale
1 Segmentation
2 Taking Out
3 Local Quality
4 Asymmetry
5 Merging
6 Universality
7 Nested Doll
8 Anti-Weight
9 Prior Counteraction
10 Prior Action
11 Cushion in Advance
12 Equipotentiality
13 The Other Way Round
14 Spheroidality - Curvature
15 Dynamics
16 Partial or Excessive Action
17 Another Dimension
18 Mechanical Vibration
19 Periodic Action
20 Continuity of Useful Action
21 Rushing Through
22 Blessing in Disguise
23 Feedback
24 Intermediary
25 Self-Service
26 Copying
27 Cheap Short-Living Objects
28 Replace Mechanical System
29 Pneumatics and Hydraulics
30 Flexible Membranes / Thin Films
31 Porous Materials
32 Colour Change
33 Homogeneity
34 Discarding and Recovering
35 Parameter Change
36 Phase Transition
37 Thermal Expansion
38 Accelerate Oxidation
39 Inert Environment
40 Composite Materials
Separation Principles for Solving Physical Contradictions
www.triz.co.uk +44(0)1993 882 461

1.8.2 TRIZ MATRIX ANALYSIS

The first problem translated with the improving feature as 'Volume of moving object' refering to proposed solution of the congestion issue by creating compact vertical development of the transit area. The worsening feature translated as 'Stability of the object's composition' refering to the instability that might occur in mixed community.

The second problem translated with the improving feature of 'Area of stationary object' referring to additional rentable spaces for the mixed-income users within the development. The worsening feature of 'Productivity' referring to the inclusive development for mixed-income users can reduce the commerciality compared to the more exclusive establishment.



		Weight of moving object	Weight of Stationary Object	Length of moving object	Length of Stationary object	Area of moving object	Area of stationary object	Volume of moving object	Volume of stationary object	Speed	Force (intensity)	Stress or pressure	Shape
		1	2	3	4	5	6	7	8	9	10	11	12
1	Weight of moving object		-	15 8 29 34	-	29 17 38 34	-	29 2 40 28	-	2 8 15 38	8 10 18 37	10 36 37 40	10 1 35 4
2	Weight of stationary object	-		-	10 1 29 35	-	35 30 13 2	-	5 35 14 2	-	8 10 19 35	13 29 10 18	13 1 29 1
3	Length of moving object	8 15 29 34	-		-	15 17 4	-	7 17 4 35	-	13 4 8	17 10 4	1 8 35	1 8 10 2
4	Length of stationary object		35 28 40 29	-		-	17 7 10 40	-	35 8 2 14	-	28 10	1 14 35	13 1 15
5	Area of moving object	2 17 29 4	-	14 15 18 4	-		-	7 14 17 4		29 30 4 34	19 30 35 2	10 15 36 28	5 3 29
6	Area of stationary object	-	30 2 14 18	-	26 7 9 39	-		-		-	1 18 35 36	10 15 36 37	
7	Volume of moving object	2 26 29 40	-	1 7 4 35	-	1 7 4 17	-		-	29 4 38 34	15 35 36 37	6 35 36 37	1 1 29

Figure 1.8.2.1: Analyzed TRIZ matrix table
Source: Author (2021)

1.8.3 INVENTIVE PRINCIPLES OF THE ISSUES

The obtained inventive principles of TRIZ were used to further develop more specific design solutions by relating them with the context analysis and approaches of the project.

GENERAL PROBLEM	**PROBLEM IDENTIFICATION (IF.., THEN.., BUT..)**	1. **IF** mixed use building with the TOD approach aplli issues can be solved, **BUT** lower income group a secluded
IMPROVING FEATURE	**REFERENCE**	Compact vertical development of the transit area
	PARAMETER	7. Volume of the moving object
WORSENING FEATURE	**REFERENCE**	Seclusion of lower income group and informal sector
	PARAMETER	13. Stability of the object's composition
TRIZ INVENTIVE PRINCIPLES	**PRINCIPLES**	1. Segmentation 10. Prior Action 28. Replace Mechanical System 39. Inert Environm

Table 1.8.3.1: Analyzed issues with TRIZ
Source: Author (2021)

	Stability of the object's composition	Strength	Duration of action of a moving object	Duration of action of a stationary object	Temperature	Illumination Intensity	Use of energy by a moving object	Use of energy by a stationary object	Power	Loss of energy	Loss of substance	Loss of information	Loss of time	Quantity of substance	Reliability	Measurement accuracy	Manufacturing precision	Object-affected harmful factors	Object-generated harmful factors	Ease of manufacture	Convenience of Use	Ease of repair	Adaptability or versatility	Device complexity	Difficulty of detecting and measuring	Extent of automation	Area of moving object
	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
4 40	1 35 19 39	28 27 18 40	5 34 31 35	-	6 29 4 38	19 1 32	35 12 34 31	-	12 36 18 31	6 2 34 19	5 35 3 31	10 24 35	10 35 20 28	3 26 18 31	3 11 1 27	28 27 35 26	28 35 26 18	22 21 18 27	22 35 31 39	27 28 1 36	35 3 2 24	2 27 28 11	29 5 15 8	26 30 36 34	28 29 26 32	26 35 18 19	35 3 24 37
0 4	26 39 1 40	28 2 10 27	-	2 27 19 6	28 19 32 22	19 32 35	-	18 19 28 1	15 19 18	18 19 28 15	5 8 13 30	10 15 35	10 20 35 26	19 6 18 26	10 28 8 3	18 26 28	10 1 35 27	2 19 22 37	35 22 1 39	28 1 9	6 13 1 32	2 27 28 11	19 15 29	1 10 26 39	25 28 17 15	2 26 35	1 28 15 35
3 29	1 8 15 34	8 35 29 34	19	-	10 15 19	32	8 35 24	-	1 35	7 2 35 39	4 29 23 10	1 24	15 2 29	29 35	10 14 29 40	28 32 4	10 28 29 37	1 15 17 24	17 15	1 29 17	15 29 35 4	1 28 10	14 15 1 16	1 19 26 24	35 1 26 24	17 24 26 16	14 4 28 29
4 7	39 37 35	15 14 28 26	-	1 40 35	3 35 39 18	3 25	-		12 8	6 28	10 28 24 35	24 26	30 29 14		15 29 28	32 28 3	2 32 10	1 18		15 17 27	2 25	3	1 35	1 26	26		30 14 7 26
4 4	11 2 13 39	3 15 40 14	6 3	-	2 15 16	15 32 19 13	19 32	-	19 10 32 18	15 17 30 26	10 35 2 39	30 26	26 4	29 30 6 13	29 9	26 28 32 3	2 32	22 33 28 1	17 2 18 39	13 1 26 24	15 17 13 16	15 13 10 1	15 30	14 1 13	2 36 26 18	14 30 28 23	10 26 34 2
	2 38	40	-	2 10 19 30	35 39 38		-		17 32	17 7 30	10 14 18 39	30 16	10 35 4 18	2 18 40 4	32 35 40 4	26 28 32 3	2 29 18 36	27 2 39 35	22 1 40	40 16	16 4	16	15 16	1 18 36	2 35 30 18	23	**10 15 17 7**
5 4	**28 10 1 39**	9 14 15 7	6 35 4	-	34 39 10 18	2 13 10	35	-	35 6 13 18	7 15 13 16	36 39 34 10	2 22	2 6 34 10	29 30 7	14 1 40 11	26 28	25 28 2 16	22 21 27 35	17 2 40 1	29 1 40	15 13 30 12	10	15 29	26 1	29 26 4	35 34 16 24	10 6 2 34

ENGINEERING CONTRADICTIONS

ed in the area, **THEN** congestion and informal sectors would be	2. **IF** inclusive approach is applied, **THEN** more space could benefit lower income group, **BUT** the area commerciality would be reduced
	Development of area for mixed-income groups
	6. Area of stationary object
rs	Reduction of the commerciality
	39. Productivity
ent	10. Prior Action 15. Dynamics 7. Nested Dolls 17. Another Dimension

02 CONTEXTUAL ANALYSIS

- CONTEXT OF THE DESIGN
- DATA OF THE SITE
- MACRO CONTEXT
- MICRO CONTEXT
- SITE REGULATION

2.1 CONTEXT OF THE DESIGN

The design scope in this final project is study and design of mixed use building development of Bogor station which is located in Cibogor, Central Bogor, Bogor. Figure 2.1.1 shows the ground area that including rail area on the ground level of 95.000 m2. The project is aimed develop residential and commercial within the transit area to increase the walkability that able to reduce the traffic of the area while also more inclusive by including the lower income people into the development. The design would focused on the mixed use building over the ground area of the train station.

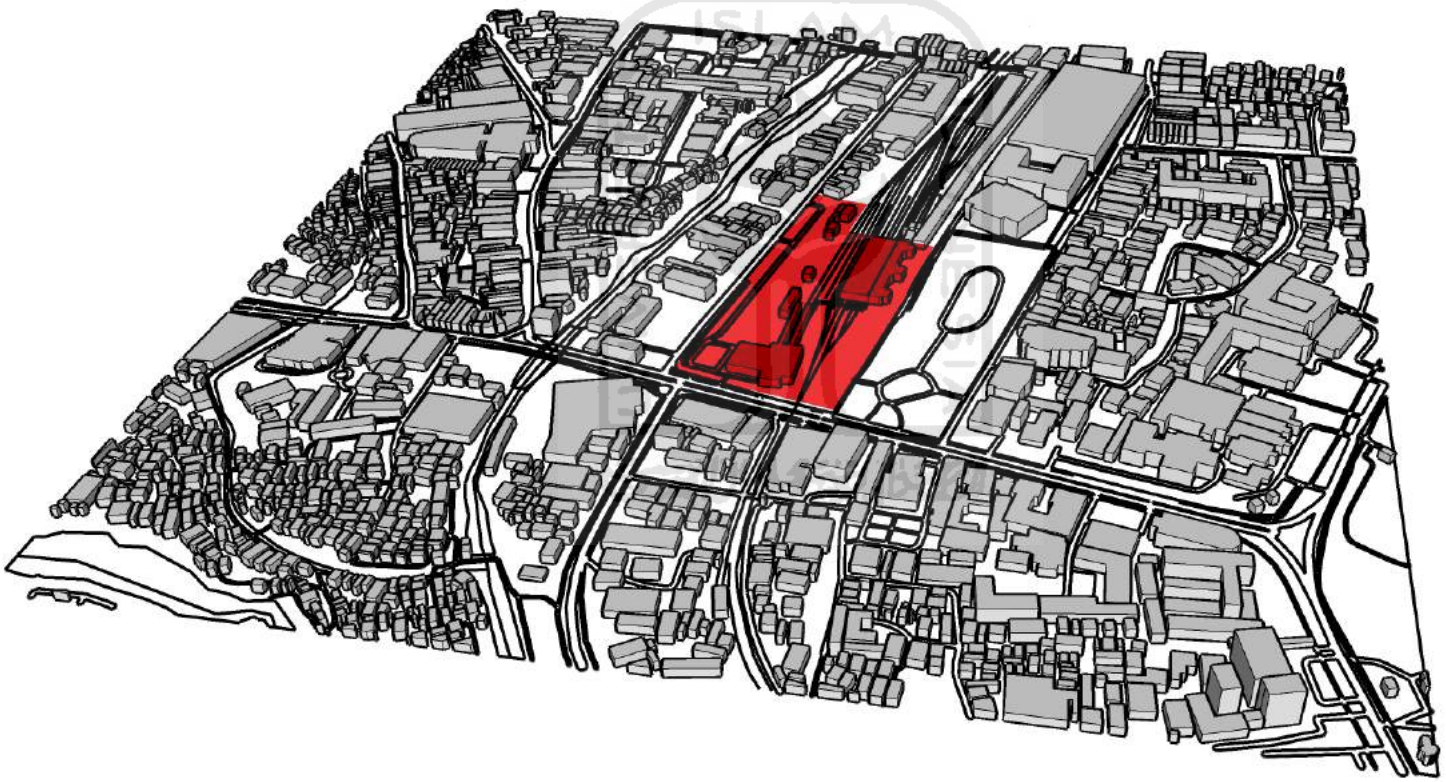


Figure 2.1.1: Context of the project
Source: Author (2021)

2.2 DATA OF THE SITE

AREA NAME	:	Bogor Station
SITE ADRESS	:	Cibogor, Central Bogor, Bogor City, West Java, Indonesia
SITE AREA	:	95.000 m2, 22.000 m2 without railroad area
AREA FUNCTION	:	Terminus and departure station of commuter rail for greater Jakarta area (JABODETABEK)
LAND USE STATUS	:	Public transportation area owned by PT Kereta Api Indonesia (Indonesian state railway company) with the east station building acknowledge as a heritage property
COORDINATES	:	6°35'39"S - 106°47'27"E
NORTH BOUNDARY	:	Pasar Anyar Market
SOUTH BOUNDARY	:	Kapten Muslihat Street, Commercial Area,
EAST BOUNDARY	:	Pedestrian road, Public open space
WEST BOUNDARY	:	Mayor Oking Street, Commercial Area
TEMPERATURE	:	21,8' C-30,4' C
PRECIPITATION	:	3 500-4 000 mm
HUMIDITY	:	70%

2.3 MACRO CONTEXT

Transit-oriented development (TOD) is a form of urban development that maximizes the amount of residential, commercial, and recreational space within walking distance of public transportation. It encourages a symbiotic integration between compact urban form and the use of public transportation.

Mixed use building is one of the design strategy to create a compact development over the limited land of the city. With the aim to reduce the need of travel using private vehicles, analysis of the availability of urban ammenities within the 5 minutes walking distance or 400 m radius used to determines the facilities include to the building development.

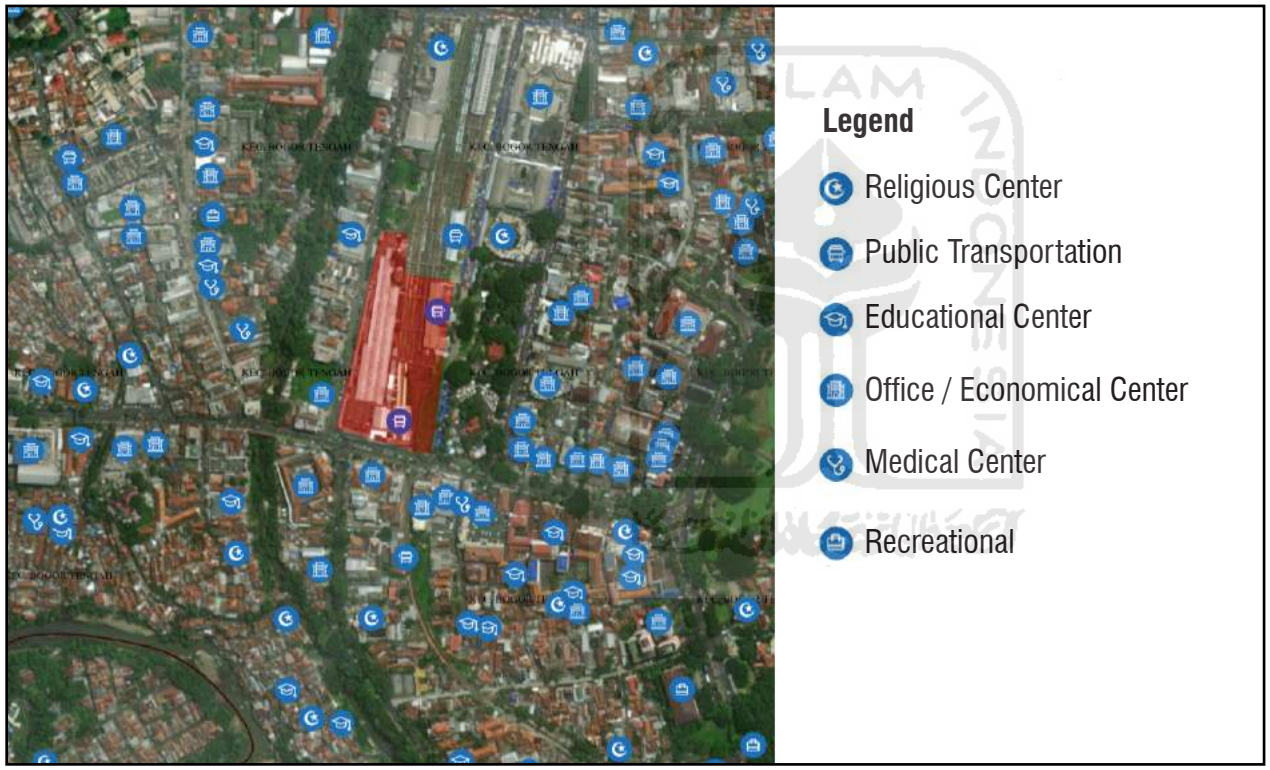


Figure 2.3.1: Macro context around site
Source: http://simtaru.kotabogor.go.id/ (2020)

As shown in the figure 2.3.1 availability of many urban ammenities within 5 minutes walking distance reduce number of additional ammenities that have to be included in the builiding development to reduce the needs of private vehicles as by integrating the mixed-use building with the pedestrian network many needs of the residents of the development area could be fulfiled by walking.

2.4 MICRO CONTEXT

Sheltered Parking Lot
Parking lot for park and drive of the station users and staff with the ground level for cars and upper level for motor cycles.

West Gate
Mainly function as the entrance and exit of the vehicles but also used for people that dropped on mayor oking street that needs to walk 200 m to the exiting station gate.

Pedestrian Bridge
Direct access to cross kapten muslihat street to the station gate is through the pedestrian bridge. This is one of the strategy to avoid congestions from *angkot* crowd along the sidewalk.

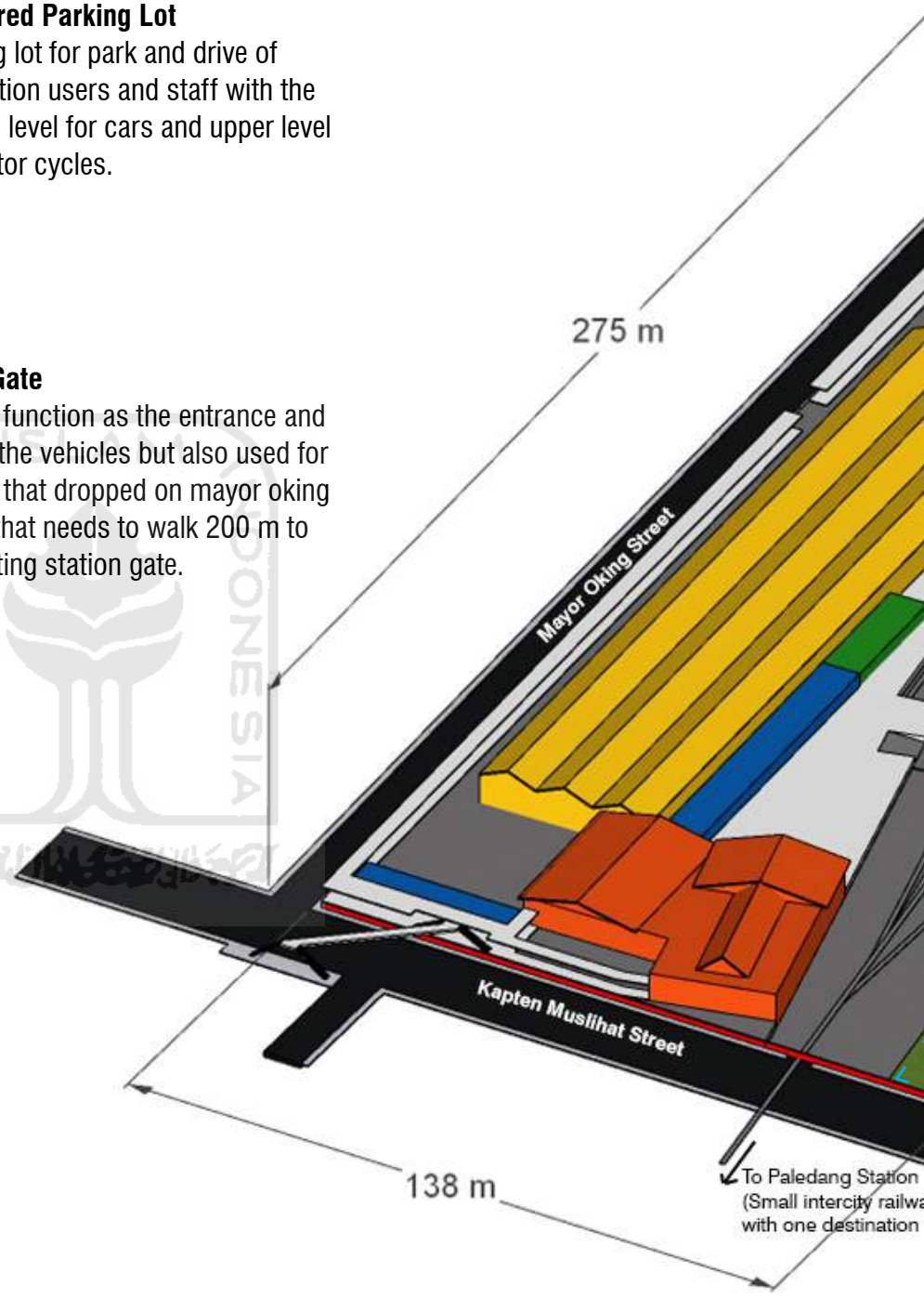
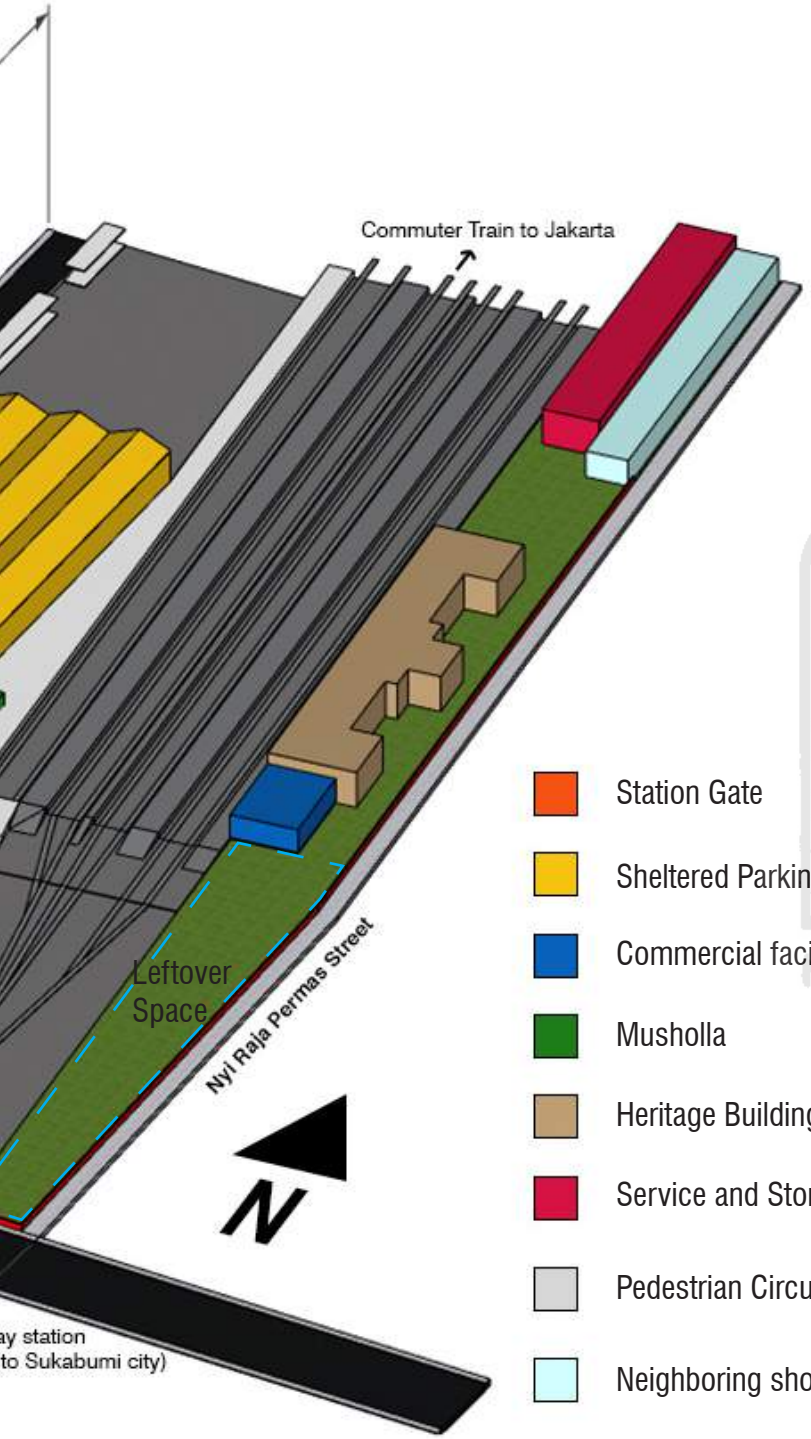


Figure 2.4.1: Existing context on site
Source: Author (2021)



Station Gate

Sheltered Parking Lot

Commercial facility

Musholla

Heritage Building

Service and Storage

Pedestrian Circulation

Neighboring shop house building

Service and Storage
The building of the station service and storage that consist of pump room, generator room and storage room are detached from main area. From the road level the building covered by existing neghboring shophouse.

Leftover Space
Currently nearby the heritage building there are areas of empty plot that not yet utilized.

Nyi Raja Permas Street
The street function as pedestrian way that connects to neighboring urban ammenities such the public park, mosque, and market. The street is currently not well maintained and organized.

2.4.2 KAPTEN MUSLIHAT STREET

Kapten muslihat which stretches to laladon *angkot* terminal, is 18 meters wide. This main road connecting the regency area with the city of Bogor with a fairly high level of density. Identified based on its location, this road becomes a connecting line (path) for the Bogor Botanical Gardens area (nodes) with the station area district so that this road has a high level of mobility.

2.4.3 MAYOR OKING STREET

This road is located to the east of the station which is also where the east entrance located as the main access especially for the vehicles. People that accessed from east entrance needs to walk about 200 m to the station gate on the south area of the station complex. On this road *angkot* usually queued to pick up passengers before heading to kapten muslihat street. In practice *angkot* would have to wait until almost 1 hour to get a full passenger while taking space of the road that might lead congestion problems.

2.4.4 HERITAGE BUILDING

Bogor station is the last stop terminal for the Batavia - Buitenzorg railway line (name of the city of Bogor at that time) was built by the dutch east indies government through the Staats Spoorwegen (SS) railway company and has been operating since 1872. Bogor Station has been designated as a cultural heritage station building based on the Minister of Culture and Tourism decree No: PM_ 26 / PW.007 / MKP / 2007, 26 March 2007.

Figure 2.4.4.1: Facade of the heritage building
Source: Author (2021)

2.5 SITE REGULATION

2.5.1 BUILDING BOUNDARY FROM ROAD

Based on Bogor city Regulation No. 40 of 2017 concerning technical guidelines for controlling space utilization in the framework of constructing buildings in the Bogor city. Building boundary line, abbreviated in indonesian as GSB, is a line that cannot be exceeded by a building plan in the direction of the fence line determined in the city plan. Bogor station is on mayor oking street, kapten muslihat street and nyi raja permas street. Each of the roads has different a GSB regulation as shown on table 2.5.1.1:

STREET	AREA UTILIZATION	GSB (m)	
		FROM MID. OF ROAD	FROM STREET BOUNDARY
Mayor Oking Street	Utilization of the area should according the city planning	15	8
Nyi Raja Permas Street	Utilization of the area should according the city planning	10	6
Kapten Muslihat Street	Utilization of the area should according the city planning	25	13

Table 2.5.1.1: Building boundary from road (GSB) of Bogor station area
Data Source: Peraturan Walikota Bogor (2017)

2.5.2 BUILDING COVERAGE RATIO (KDB)

Based on the regulation of the mayor of Bogor number 40 of 2017 concerning technical guidelines for controlling space utilization in the context of building construction in the city of Bogor, building coverage ratio (KDB) is the maximum ratio between the total area of the ground floor of the building to the area of land mapping in the planning area controlled according to the spatial plan and building and environmental plans. Building coverage ratio (KDB) of Bogor station area is shown in table 2.5.4.1.

2.5.3 FLOOR AREA RATIO (KLB)

Based on the regulation of the mayor of Bogor number 40 of 2017 concerning technical guidelines for controlling space utilization in the context of building construction in the city of Bogor, floor area ratio (KLB) is is the ratio between the total floor area of the building to the area of land / plot of land that can be built. Floor area ratio (KLB) of Bogor station area is shown in table 2.5.4.1.

2.5.4 GREEN COVERAGE RATIO (KDH)

Based on the regulation of the mayor of Bogor number 40 of 2017 concerning technical guidelines for controlling space utilization in the context of building construction in the city of Bogor, green coverage ratio (KDH) is the minimum percentage of the ratio between the total area of open space outside the building designated for softscape and vegetation in accordance with the spatial plan and the building layout plan and the environment. Green coverage ratio (KDH) of Bogor station area is shown in table 2.5.4.1.

BUILDING COVERAGE RATIO (KDB)	BUILDING FLOOR RATIO (KLB)	GREEN COVERAGE RATIO (KDH)
50%	3,5	15%

Table 2.5.4.1: Building coverage ratio (KDB), building floor ratio (KLB), and green coverage ratio (KDH)
Data Source: Peraturan Walikota Bogor (2017)

2.5.7 SITE UTILIZATION ACCORDING TO THE REGULATION

In accordance to the regulation the boundary of the space utilization on the site of Bogor station is shown table 2.5.7.1.

SITE AREA	22.000 m2 (excluding railroad area)	
BUILDING COVERAGE RATIO (KDB)	50%	11.000 m2
BUILDING FLOOR RATIO (KLB)	3,5	77.000 m2
GREEN COVERAGE RATIO (KDH)	15%	3.300 m2
BUILDING BOUNDARY FROM ROAD (GSB)	Mayor Oking Street	8 m
	Nyi Raja Permas Street	6 m
	Kapten Muslihat Street	13 m

Table 2.5.7.1: Boundary of site utilization on site according to the city regulation
Data Source: Peraturan Walikota Bogor (2017)

03 STUDIES ON DESIGN ISSUES

- CHAPTER SUMMARY
- PRINCIPLES OF TRANSIT ORIENTED DEVELOPMENT (TOD)
- TRIZ PRINCIPLES TO DEVELOP DESIGN
- MIXED-USE BUILDING TYPOLOGY
- INCLUSIVE DESIGN OF MIXED INCOME DEVELOPMENT
- VERTICAL HOUSING DEVELOPMENT
- COMMERCIAL CENTER DEVELOPMENT
- PRECEDENT STUDY
- EARLY DESIGN IDEAS

3.1 CHAPTER SUMMARY

The chapter of studies on design issues examine research, theory and typology to develop the design of mixed use building as a solution of issues that discussed in the chapter of introduction and contextual analysis.

The content of the chapter including the examine of TOD principles, TRIZ principles, typology of mixed-use building, framework of inclusive design, development of the residential function concept, and development of the commercial function concept.

3.2 PRINCIPLES OF TRANSIT ORIENTED DEVELOPMENT (TOD)

In principles TOD would direct the development to be integrated within many urban ammenities in walking distance and connected to the multi modal transit which would lead to the reducement of needs for private vehicles. Some of the TOD principles consist of:

1. Pedestrian & Non-Motorized Transport Friendly Environment

- Design for pedestrian safety, comfort and convenience.
- Create street-level activity and vibrant urban spaces.

2. Connectivity and Network Density

- Provide the shortest direct route to pedestrian and non-motorized modes to station as well between individual buildings/ complex.
- Create street-level facility and vibrant urban spaces.

3. Multi-Modal Interchange

- Minimize travel time and cost for majority of commuters. Provide multiple mode options for all sections of society with safety and affordability. Ensure reliable frequent and affordable public transportations transport systerns/ networks across the city. Minimize time required for mode transfers for maximum number commuters.

4. Inducing Modal Shift

- Locate public transport stations, homes job and civic facilities within easy acces of each other to incentive walking and cycling use especially for short distances.

- Disincentivize private motor vehicle use. Limit supply and appropriately price private parking spaces to discourage private vehicle use in TOD zone.

5. Placemaking and Enduring Safety

- Create a safe vibrant comfortable urban place, by providing round the clock active streets and incidental space to relax. Introduce mixed land use and other informal street activities like vendors, etc. to promote activities and surveillance.

- Maximize densities within TOD in order to facilitate maximum number of people walking, cycling or feeder services easily to access public amenities.

3.3 TRIZ PRINCIPLES TO DEVELOP DESIGN

The cotradicting problems formed in IF.., THEN.., BUT,.. sentences to be analyzed with TRIZ in the next step. The contradicting problems in this project would be:

1. **IF** mixed use building with the TOD approach apllied in the area, **THEN** congestion issues can be solved, **BUT** lower income group and informal sectors would be secluded

2. **IF** inclusive approach is applied, **THEN** more space could benefit lower income group, **BUT** the area commerciality would be reduced

From 1st contradicting problems, TRIZ principles to be developped to be design would be:

1. Segementation
Separation into smaller pieces is referred to as segmentation. A modular design might result in pieces that connect in a variety of ways, or it can be simple to produce, assemble, and disassemble, for example, while repairing or moving it. Example of the principle application is the open office 'cubicles' that employ segmentation to make changing the arrangement of workplaces more simple.

10. Prior Action
Prior Action refers to preparing or taking measures ahead of time to make an event go as smoothly as possible when something has to be done at a certain time. Building a device or a manufacturing process in such a way that anything is done when it is necessary sometimes is not effective or efficient. Therefore to produce things that ready to bring action or function for a certain time could be a better solution.

28. Replace Mechanical System
Replace mechanical system in literal to replace the system with other system such as with unseen effects, for example replacing train wheels with a magnetic lift system. Variable fields, such as high frequencies or pulsating, can also be used to generate diverse effects.

39. Inert Environment
When oxygen and other reagents are an issue in the environment, it's occasionally a good idea to remove them and replace them with chemicals that won't react with your equipment. To protect the thin filament from oxidizing and breaking, light bulbs are partially evacuated and filled with inert gases.

From 2nd contradicting problems, TRIZ principles to be developped to be design would be:

10. Prior Action

15. Dynamics
When a system is made up of firmly linked pieces, every force applied to the system is felt equally by all of the parts. As objects are fixed, they are unable to adapt with change when their surroundings changes. Dynamicity refers to the ability of systems to adapt to change and external intrusions. Dynamicity may be achieved by separating pieces, employing suspension systems, flexible connections, and cushioning.

7. Nested Dolls
Nested dolls are made by nesting one object inside another, as in a Russian doll, or by placing objects together in some other method. An object that is enclosed within another object is safe and reduces the overall size of the device. Nesting is used to focus the telescope as well as to fold it up into a smaller and more compact instrument.

17. Another Dimension
If theres an issues over the straight lines, consider utilizing a second or third dimension. Upwards or sideways are all options. Change the path, reflect energy, bend metal. The dimensions also could be changed by rotating it, altering the perspective, or changing the number of objects.

3.4 MIXED-USE BUILDING TYPOLOGY

In a urban area with a high land prices it would be an appropriate the approach by integrating building functions in a single building mass. As a fusion of office, lodging, industry, and other features. This function will make land use more efficient which in turn would saving cost. Other positive aspects from the planning strategy is to provide a convinience neighborhood that ease the residents fulfilment of needs by walking which in turn bring positive impact in a wider context of the area by reducing the needs of travel using private vehicles. According to the Shwanke et al. (2003) mixed used building characteristics are:

- Can accommodate 2 or more building functions contained in the area, (For example, consisting of hotels, hospitals, schools, malls, apartments and recreation centers)
- There is a physical and functional integration
- Relatively close access to one building and another with the interconnection relationship between the buildings
- Pedestrian network as the connector of the area

According to Danisworo (1996) with the development of mixed use building there would be positve impacts which consist of:

- Encouraging increase of various activities in an integrated manner
- Produce a more efficient and affordable system of facilities and infrastructure
- Improve circulation system of the area
- Encouraging clear separation of transportation system
- Provides a broad framework for environmental and building design innovation

The success of the mixed use building cannot be separated from its configuration of building layout as it function would be affected by form and connection between many functions. According to Sumargo (2003) there are various form of building layout configurations within a mixed-use area that consist of:

1. **Mixed Use Tower**
   Single structure building where functions are placed in layers. Mixed use tower in general is a high rise building.

2. **Multitowered Megastructure**
   Muiltiple tower that connected by podium. Generally the podium become the main building area because it would be the most accessible for many users and place for many building functions.

3. **Freestanding Structure with Pedestrian Networks**
   Is a structuring concept in a mixed use area with a collection of single building mass integrated by pedestrian path.

4. **Combination**
   Combination of the three forms on the site area

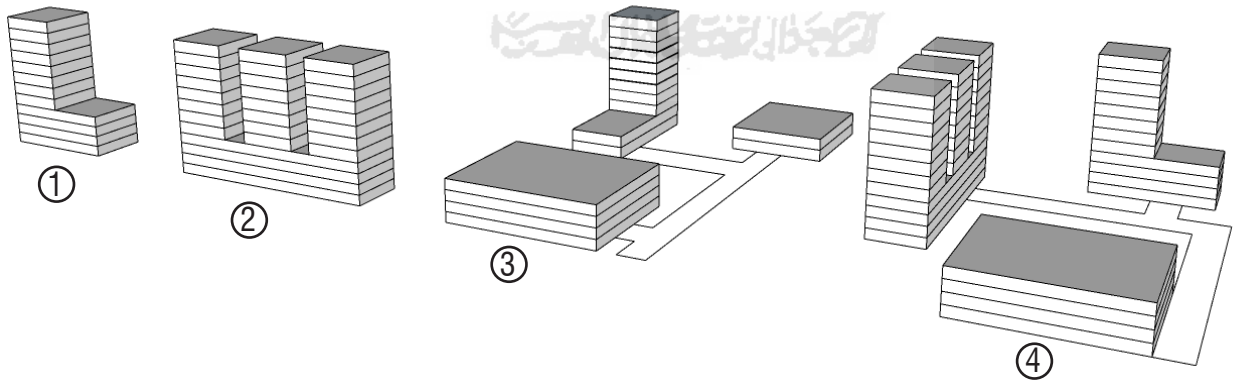


Figure 3.4.1: Illustration of different mixed use building layout
Source: Author (2021)

From the 4 typology of the mixed use building layout there are characteristics that could be reviewed to be choosed as the appropriate strategy for the development context, the characteristics would be:

1. **Mixed Use Tower** is an appropriate strategy on the limited site therefore many mixed functions stacked in form of highrise tower. The building layout offer advantage of integration of all the mixed function into one building form which make it more efficient for many building systems.

2. **Multitowered Megastructure** is an appropriate strategy to maximize mixed functions in a limited but larger site which would take maximum building coverage area on the ground level that vertically developped as the podium which could utilized as the public / semi public functions and connect towers that utilized as private functions such as residentials. The building layout offer advantage of integration of all the mixed function into one building form which make it more efficient for many building systems.

3. **Freestanding Structure With Pedestrian Networks** is an appropriate strategy to connect mixed functions in a large site that are have more advantage to be separated in different building system. Through the separation of functions that connected by pedestrian networks the development have an advantage to be more open/ inclusive.

4. **Combination** of all building layout is an appropriate strategy for a very large development area for wider types of functions.

In the context of large site of Bogor station area the mixed use layout of freestanding structure with pedestrian network is more suitable to be adopted into the design. This type of layout offers connection of mixed use building on a larger site through walkability. The circulation of the developed area that connected to the neighboring pedestrian networks would increase walkability not just on the site but also its surrounding area.

3.5 INCLUSIVE DESIGN OF MIXED INCOME DEVELOPMENT

Inclusive Design, also known as Universal Design or Design For All, is a broad strategy and philosophy aimed at ensuring that all individuals have equal access to modern society. This ensures that physical environment, goods, and facilities are all planned and built for everybody in mind.

According to Clarkson and Keates (2003), there are two forms of inclusive project strategies that are “topdown” and “bottom-up.” With this paradigm in place, a designer who wants their product to serve the user as diverse as possible then has to choose whether to make an assistive product more mainstream or a “normal” product more assistive.

In the development of mixed income project the targeted population of inclusive design would within the socio-economic aspects of income, educational qualifications and occupational status. Inclusive design cube as shown in figure 3.5.1 show the range of the socio economic aspects capability range of the least to the most capable that used determine design response to make the project accessible for wider population. The design should response the needs of affordability and self sufficiency as the assitive aspects of tof the least capable group.

Because the design is based on the mainstream market, the Bottom-up (create ‘normal’ design more assistive) method offers a higher possibility for a commercially viable product. This strategy, however, would have trouble covering the least capable group, as the less capable they are, the more help they require. Therefore the approach complemented with top-down design (assistive design more mainstream) approach that based on the ‘normal’ design. In this project the development of mixed use building in the city center might be inaccessible for the socio-economic least capable group, coupled with top-down and bottom-up design features that increase affordability and adaptability, could add more group of users that could be facilitated resulting an inclusive development.

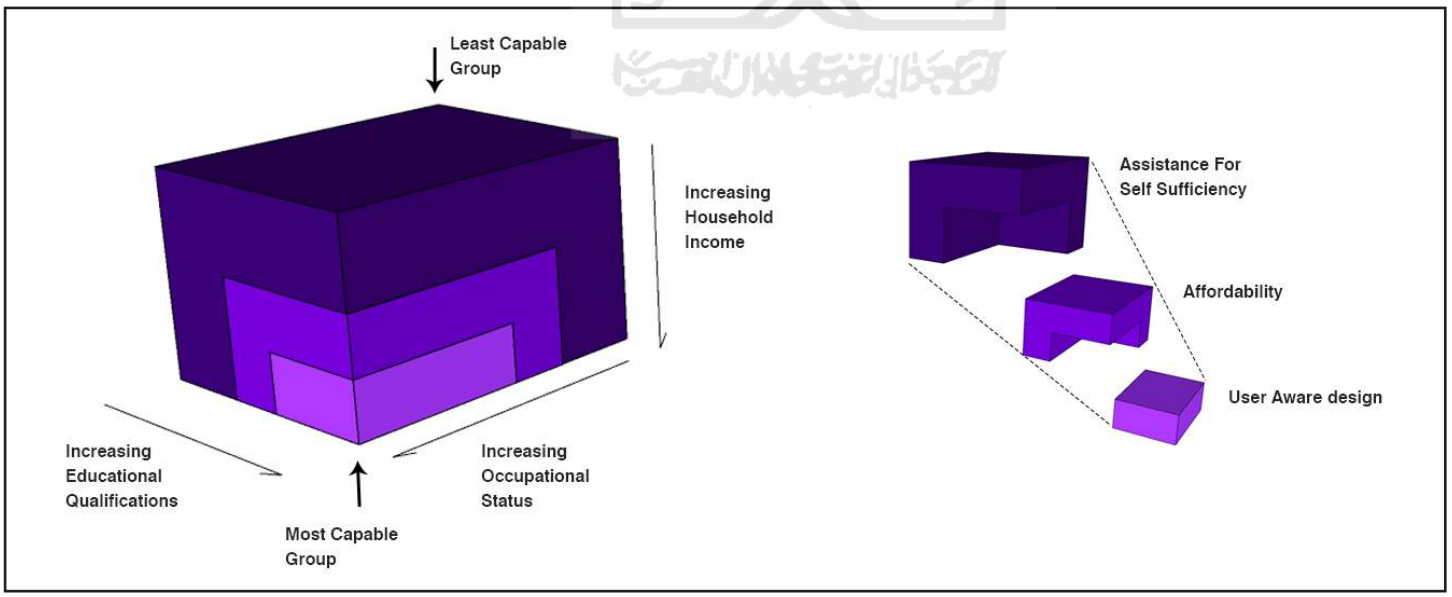


Figure 3.5.1: Benkzton inclusive design cube of the targeted population within socio-economic capability range
Source: Author (2021)

3.6 VERTICAL HOUSING DEVELOPMENT

3.6.1 RISING DEMANDS OF HOUSING AND CONGESTIONS IN BOGOR

According to the The Ministry of Public Works and Housing housing backlog from 2015 in West Java already reached 2.3 Million housing units. The high demand of housing could be traced from the current demographic profile of Bogor which have about 50% of the population range in the productive working age which is a major demand group of housing. Table 3.6.1.1 show the latest demographic data of Bogor city.

Range of Age	Male	Female	Total
0-4	49,087	46,050	95,137
05-09	46,893	44,166	91,059
10-14	43,715	42,033	85,748
15-19	47,618	48,045	95,663
20-24	51,753	49,732	101,485
25-29	48,521	46,336	94,857
30-34	46,168	43,835	90,003
35-39	44,017	43,259	87,276
40-44	41,515	40,265	81,780
45-49	35,776	34,813	70,589
50-54	30,336	29,554	59,890
55-59	24,052	23,440	47,492
60-64	16,068	14,690	30,758
65-69	10,098	10,468	20,566
70-74	6,382	7,246	13,628
75+	6,203	8,881	15,084
Total	548,196	532,813	1,081,009

Table 3.6.1.1: Range of age of Bogor city population demographic with the red box highlight the productive age population
Data Source: Badan Pusat Statistik Kota Bogor (2017)

The needs of housing lead many of the development of residentials area on the outskirt of Bogor which in turns might cause more congestions problem as many urban ammenities located in the city center. Therefore the issue should be responded through the city development planning that reduce the needs of mobility with the private vehicles. This planning including the decentralization of the city which means the development of urban ammenities in the outskirt of the city and the alteration of the current ineffective tranportation system.

Other planning approaches are by the development of the residential facility within transit-oriented development which according to Guerra et al. (2018) TOD approaches were able to increase mobility and expedite traffic as the methods can reduce the private automobile dependency because many urban amenities could be reached by walking or by micro mobilities and further by the development of effective city transit system make it easier to reach many city destinations by public transportation.

3.6.2 GOVERMENT POLICY ON BALANCED HOUSING

Balanced housing is an approach to maintain socio-economical balance of the development. The concept mixed aimed would lead to ensure harmony between the differences of residents with different economical background in one the residential environment while essentially also solve the main issue of housing backlog.

In the past balanced housing development could be understood through SKB of the Minister of Home Affairs, Minister of Public Works and State Minister of Public Housing Number 648-384 of 1992, Number 739 / KPTS / 1992, Number 09 / KPTS / 1992 concerning Guidelines for Housing and Settlement Development with a Balanced Residential Environment or better known as the development pattern 1: 3: 6 (1 luxury house: 3 medium houses: 6 affordable houses).

However the regulation have many obstacles in its operations mainly because the limited and high cost of land in the city. This issue leads to the renew of balanced housing development pattern of 1:2:3 that mandated on the Undang-Undang Nomor 1 Tahun 2011 tentang Perumahan dan Kawasan Permukiman.

3.6.3 HYBRID MODULAR DESIGN AS AFFORDABILITY AND ADAPTABILITY SOLUTION

Modular prefabricated building construction has the advantage to reduce the retrofit cost such as the construction time and energy. Furthermore, according to Ferdous, W. et al. 2019, modular construction is faster and safer construction processes, has better predictability to completion time, superior quality, fewer workers on-site, less resource wastage, and less sensitivity to the environment. However, the conventional technologies are still perceived as preferable by stakeholders as they involve reduced design complexity, fewer limitations in design variation, easier transportation, and supply of components, easier maneuverability on construction sites (Sharafi et al. 2018). As a result, combining modular and conventional design systems and grouping the more replicable and industrialized building elements separately from the individually customized building pieces might be an appropriate design to achieve replacement of construction costs aimed to create more affordable development.

Hybrid modular construction is a combination of on-site traditional structural technologies and off-site modular technologies (Lawson, Ogden, and Goodier 2014). Hybrid modular construction is a conceptual separation of long-life building systems from short-life building systems (Mussinelliet al. 2017). In such a system, a traditionally built permanent structure hosts changeable, modular living modules. This would reduce retrofit costs and the lifecycle footprint of the building, triggering economy of scale, standardization, modularization, and industrialization processes for the removable components (Mussinelli et al. 2017).

This design strategy not just could offer affordability through the replacement of retrofit costs but also response towards the adaptability issues for the lower-income people in the mixed-income housing development. According to Venkatesh, Sudhir (2008), mixed-income development that aimed to assist lower-income groups eventually makes the group left out as the development could not provide re-arrangement of the living space that urgently needed such as the occasion of changing family constellations. The hybrid modular design combines the host building as not modular-permanent component and the living unit as the replaceable modular component, therefore adaptation of living space could be implemented as a response to the urgency of expansion, user preference, and other occasions regarding the housing management issues.

Adaptability could also be part of the affordability solution where the lower-income group could be assisted by starting with a 'half good living unit'. The living unit would be 'completed' with the additional modules added to complete another half of the unit. Half unit is a small unit limited for single or a couple to live such as a studio apartment unit and the completed unit is the small apartment unit for a small family.

3.6.4 BUILDING ADAPTABILITY

In the time where sustainability is focused on the short-term reduction of carbon reduction, the understanding of the broader characteristic will establish the sustainability of spaces over the longevity of time. As the world progresses through technological innovations and economic prosperity, our understanding of time has become shorter with highly specialized buildings becoming more common and limiting the lifespan of the buildings despite the innovation of adaptable buildings also becoming more prominent.

Adaptability as a design characteristic involves strategies in the spatial, structural, and services design that will allow for levels of flexibility in the physical artifact, responding to change in operational parameters that might occur over time. The understanding of the shifting strategies involves the perception of buildings not as a finished work separated from the technological development, but instead as imperfect objects which forms are in constant changes evolving to fit the technological, functional, and aesthetic metamorphoses in society, adapting the design decision to incorporate time in the developments (Schmidt III, Eguchi, Austin, & Gibb, 2010).

In making the decisions for adaptable buildings for sustainable development, the strategies that can be included in the design are:

- **Adjustable:** involving the possibility of changes in the task accommodated, with the scope includes the rearrangement of furniture within the space

- **Versatile:** involving the change in the space to accommodate a broader range of activities, the scope of the changes is broader than adjustable parameters and with a longer cycle by including the rearrangement of the furniture and space itself.

- **Convertible:** involving changes in the function of the buildings. The scope of the changes involves broader rearrangement of the space, service,and skin necessary to fit a new function assigned to the building within 15 years time-range.

- **Refitable:** involving changes in the performance of the building, with the scope of the strategies includes the space, services, and the skin of the building, allowing the building to fit technological and aesthetic innovations that might happen in the time-range of 7 years.

- **Movable:** involving the location changes to fit a better context and function. The scope of the changes includes changes in the structure and site to allow the buildings to apply other strategies in the new location.

- **Scalable:** involving changes in the size of the building. The scope of the changes is interchangeable with convertible parameters, with the addition of the structure to be adjusted to adapt the building capacity over the 15 years range.

STRATEGIES	TYPE OF CHANGES	DECISION LEVEL	ELEMENTS SCALE	CYCLE SPEED
ADJUSTABLE	CHANGE OF TASK	USER	COMPONENTS	DAILY/ MONTHLY
VERSATILE	CHANGE OF SPACE	USER	COMPONENTS	DAILY/ MONTHLY
REFITABLE	CHANGE OF PERFORMANCE	USER/ OWNER	COMPONENTS	7 YEARS
CONVERTIBLE	CHANGE OF FUNCTION	OWNER	BUILDING	15 YEARS
SCALABLE	CHANGE OF SIZE	OWNER	BUILDING	15 YEARS
MOVEABLE	CHANGE OF LOCATION	OWNER	BUILDING	30 YEARS

Table 3.6.4.1: Strategy of building adaptation
Data Source: Schmidt III, Robert, et al. (2010)

Types of the building adaptation strategy is shown in Table 3.6.4.1. The scalable and refitable strategy could be a response to the project issues. This application of strategy into the design brings the opportunity to the building manager to reconfigure the living units to respond to many issues such as the change of needs or preferences of the tenants during the building's lifetime thus create sustainability. Moreover, the use of hybrid-modular design could speed up the cycle of building adaptation as the units system and structure are constructed separately from the main building, therefore more convenient for insertion or detachment of modules for the building's space scale and system adjustment.

3.6.5 APARTMENT AREA DEVELOPMENT GUIDELINE

Table 3.6.5.1 shows guidelines of the Indonesian national standard (SNI) of the area utilization for apartment in which would be used in the development of the design.

No	FUNCTION	LAND AREA	
		Maximum (%)	Minimum (%)
1	RESIDENTIAL	50	-
2	SERVICE	10	-
3	OPEN SPACE	-	20
4	BUILDING AMMENITIES	-	20

Table 3.6.5.1: Guideline of area development for apartment
Data Source: SNI 03-7013-2004 (2004)

3.6.6 APARTMENT FEATURES BASED ON MARKET RANGE

Table 3.6.6.1 shows guidelines of the apartment features based on market range and table 3.6.6.2 shows guidelines of the apartment unit element features based on the market range in which would be used in the development of the apartment design for mixed-income users.

AREA	LOW	MEDIUM	HIGH
IN APARTMENT UNIT	Few extras limited to security	Intercom, door signal, balconies, unit air conditioner	Doorman and telephone, large balconies, central air conditioning, service entrance, servants quarters
IN BUILDING	Laundry facilities, minimum lobby	Laundry room, commercial space, community room, central storage	Attended parking, convinience shopping, service elevators, doorman, closed-circuit TV, security system, valet service, meeting rooms, health club, sheltered swimming facilities
IN SITE	Open parking, drying yard	Secure open or sheltered parking, outdoor play and sitting area, swimming pool	Gardens, recreation areas, country club, amenities, swimming pool

Table 3.6.6.1: Apartment features based on market range
Data Source: Time saver standards for building types (1983)

UNIT ELEMENT	LOW	MEDIUM	HIGH
LIVING	Minimum areas: combined living, dining, and entry areas	Larger room sizes: dining alcove, entry alcove	Generous room sizes: separate dining room, separate entry foyer
KITCHEN	Minimum counter top and storage, standard appliances	Additional counter top and storage, snack bar, better appliances, space for dishwasher	Ample workspace,counter top, and storage, built in appliances, wall oven, dishwasher, eat in kitchen
BEDROOM	Minimum closets	Walk-in closets	Dressing room, storage closets, built in accessories
BATH	Minimal bath with standard fixtures and accessories, minimum finishes	Higher-quality fixtures, finishes, and accessories	Additional baths and half baths with custom cabinets and fixtures, stall showers, etc.

Table 3.6.6.2: Apartment unit element features based on market range
Source: Time saver standards for building types (1983)

3.6.7 STRUCTURAL CONSIDERATION

Within hybrid modular structure, buildings should be thought of as an interconnected framework that includes both a permanent host arrangement and portable living equipment. The host configuration lasts for a portion of the conventional building lifecycle, and the replaceable living modules enable the building to be technologically updated and its typology to be adapted to changing needs. Furthermore, this solution facilitates the operation of upgrades and retrofits, as well as the removal and reconditioning of used modules, while preventing intrusive approaches and lowering environmental impact. The most ideal for allowing removability and renewability of living components is the main conventional structural approach to modular architecture of a structure supporting a modular house. This structural design technique may be unusual in that it allows for the replacement of any single living module in the host system at any time. This structural design technique may be unusual in that it allows for the replacement of any single living module in the host system at any time.

Structural relations between the host structure and the living modules should be built as plug-in/plug-out components. This holds true for technical structures as well as systemic relations. A series of fixed rails on the host framework enables living modules to slip into their slots, and is the main connection function for plug-in and plug-out operations. To raise, set down, and align the living modules to the slot rails, a specially constructed scaffold frame is required, as well as various types of connectors to secure the modules to the host structure. The rails often use rail stoppers to block lateral travel in a given horizontal direction. The slot on the host frame has edge beams that obstruct the living module vertically on its entrance side to prevent vertical motions. Vertical moves on the opposite side of the module are controlled by special pins. Both plug-in, plug-out, and MEP device attachment and disconnection operations are built to be actuated from inside the facility, without requiring any operator to access the living modules when they are not secure or attached to the host structure.

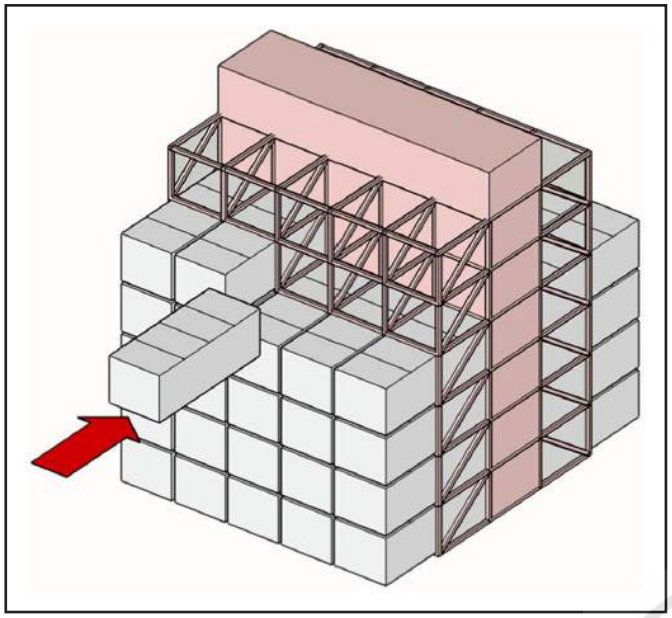


Figure 3.6.7.1: Mixed core-frame-supporting modular building
Source: Di Pasquale et al. (2020)

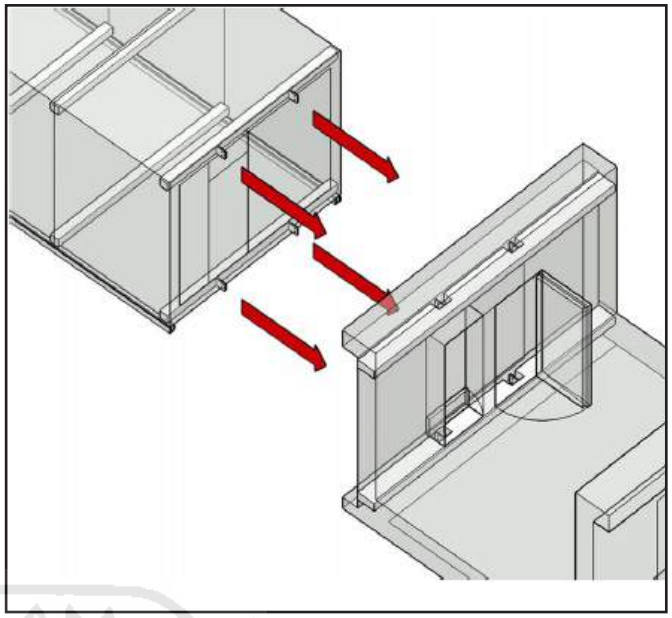


Figure 3.6.7.2: Access to rail stoppers installation points
Source: Di Pasquale et al. (2020)

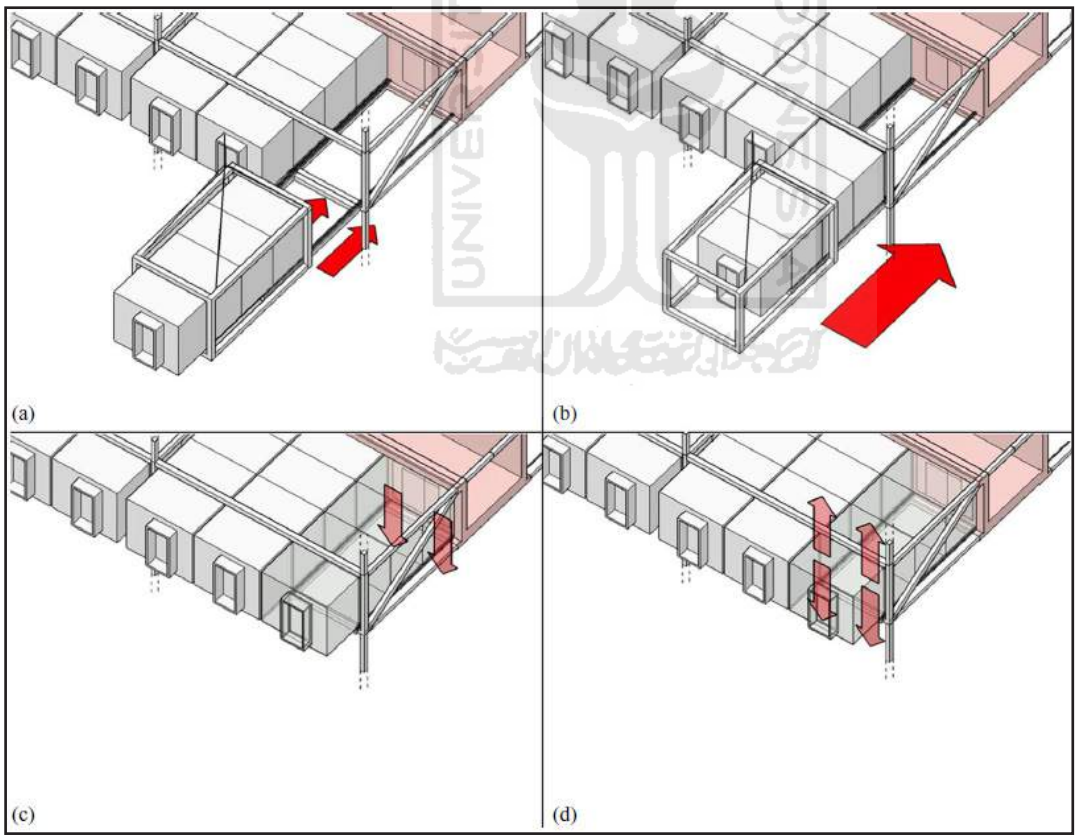


Figure 3.6.7.3: Sequence of module plug-in operations: (a) rail alignment; (b) module insertion; (c) stoppers to block insertion direction; and (d) vertical pins to block vertical movement of module
Source: Di Pasquale et al. (2020)

3.7 COMMERCIAL CENTER DEVELOPMENT

3.7.1 CHALLENGES OF PHYSICAL COMMERCIAL CENTER

According to research even before the pandemic foot traffic within mall having fallen. Many retailers are re-evaluating the profitability of bricks-and-mortar stores with regard to their real estate costs. This problem could be traced from the internet commercial rise of popularity which provide ease for the consumers from many aspects. Even the visit of the customer journey has been evolving. It's no longer simply about visiting a store. Many of the visitor to the commercial center already know what to buy and just get in and get out the mall without do many exploration through the building.

In response typology of commercial center should be shifted from simply as the place to buy and sell commodities to the place that offer solution for the customer needs and experience. In fact, if the element of experience is not elevated, the store will become almost irrelevant.

3.7.2 SIZE DOESNT MATTER

In response to the challenges many retailers are reconsidering the scale of the stores they keep, recognizing that a bigger physical presence does not always imply higher revenue volumes. Because of the increasing popularity of online shopping, retailers do not need to stock as much inventory and may now focus on providing a showroom experience. Retailers could use technologies to build a more immersive environment in a smaller physical room to create a more interactive interface with the brand and products, and arrange order and delivery from a fulfillment centre within 24 hours.

3.7.3 MIXED RETAIL STRATEGY TO INCREASE COMMERCIALITY

Internet commerce or e-commerce has revolutionized the way people embrace the market. For the retailers, e-commerce has significant advantages such the consumer engagement and inventory holding with convenience. However physical interaction between the product, seller, and the consumer still has its role to increase the commerciality of retails. A mixed retail strategy with a smaller space for display without ready-to-pick-up inventory offer reducement of cost while offering support to the retail commercial engagement by providing the product to be sensed by the consumer before buying, which is the feature that e-commerce lacking off. The role of the in-store sales associate would be elevated to be a person with a fully versed understanding of the product to help the consumer find the solution to their needs. Add more with the integration to the food assortment, centralized place for product returns, and other recreational features could help to keep or even enhance the traffic and productivity of the commercial center within the contemporary and future challenge.

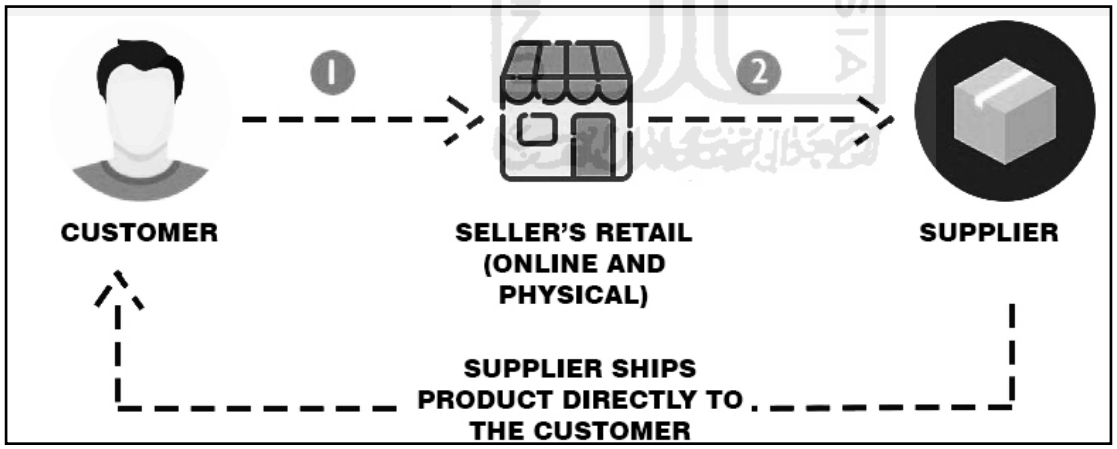


Figure 3.7.3.1: Scheme of mixed retail strategy with of retail, customer and supplier
Source: Author (2021)

3.7.4 DEFINITION OF COMMERCIAL CENTER

The term of commercial center has several meanings, including:

1. Individual businesses carried out collectively through capital pooling with the aim of commercial effectiveness (Beddington, Design for Shopping Center)

2. A place for exchange and distribution of goods / services with characteristics of commercial, involving proper planning and designing because it aims to gain as much profit as possible (Gruen, Centers for Urban Environment: Survival of the Cities)

3. Apart from functioning as a place for activities shopping or buying and selling transactions, also serves as a place for gathering or recreation (Beddington, Design for Shopping Center).

4. Planned shopping complex, with a management character centralized, with a system of renting units to merchants individuals, while the supervision is carried out by the manager overall responsibility (Beddington, Design for Shopping Center).

3.7.5 GENERAL LAYOUT FORM OF COMMERCIAL CENTER

Based on the circumstances in the United States, it is generally the most pattern success is a simple form such as the letters I, T, and L. This is in accordance with the characteristics the visitor usually wants easy to find shops / places to go. Mall shape parallel (double corridor) or other complex patterns are generally lacking successful, in the sense that relatively few people visited.

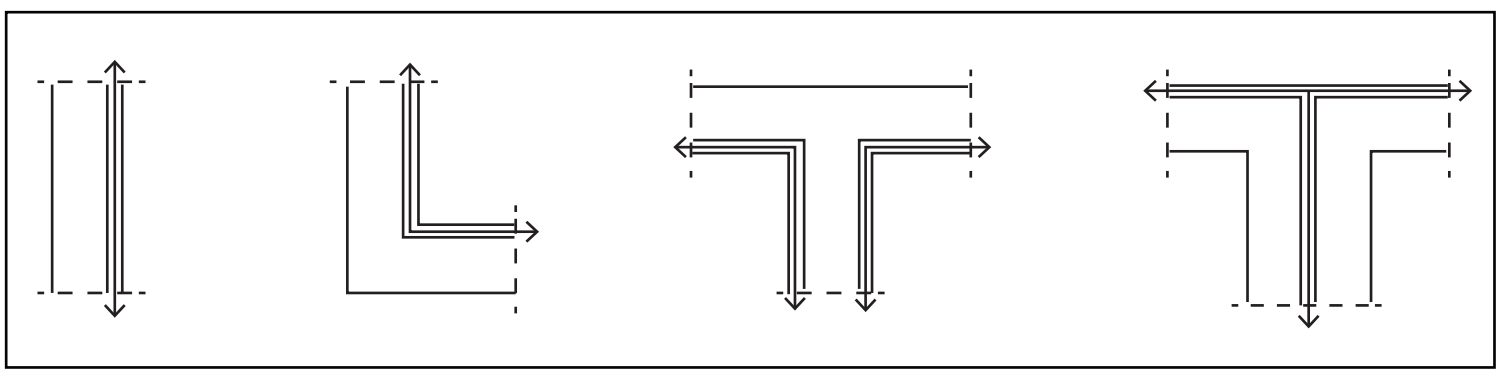


Figure 3.7.5.1: General layout form of commercial center
Source: Author (2021)

3.7.6 CIRCULATION OF COMMERCIAL CENTER

According to Maitland (1995), malls have a linear circulation. In general, malls have corridors between 8-16 m wide, this aims to provide easy circulation for visitors, malls must also have entrances that can be reached from all directions. Mall circulation system, namely the pedestrian corridor system as a circulation side of the corridor there are retail sales of goods. According to San Interior (2014) there are three retail structuring systems in shopping centers, namely as follows:

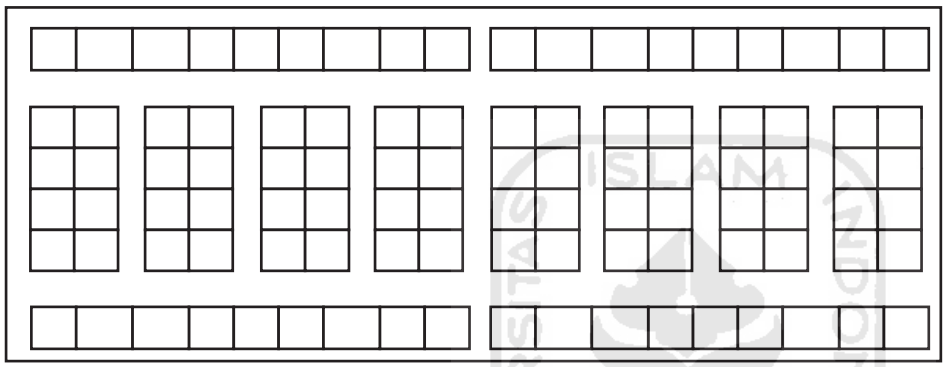


Figure 3.7.6.1: Multi-corridor system
Source: Author (2021)

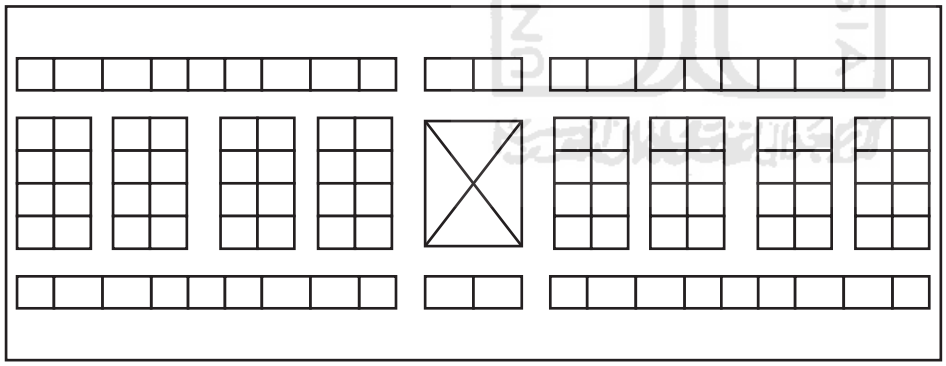


Figure 3.7.6.2: The plaza corridor system
Source: Author (2021)

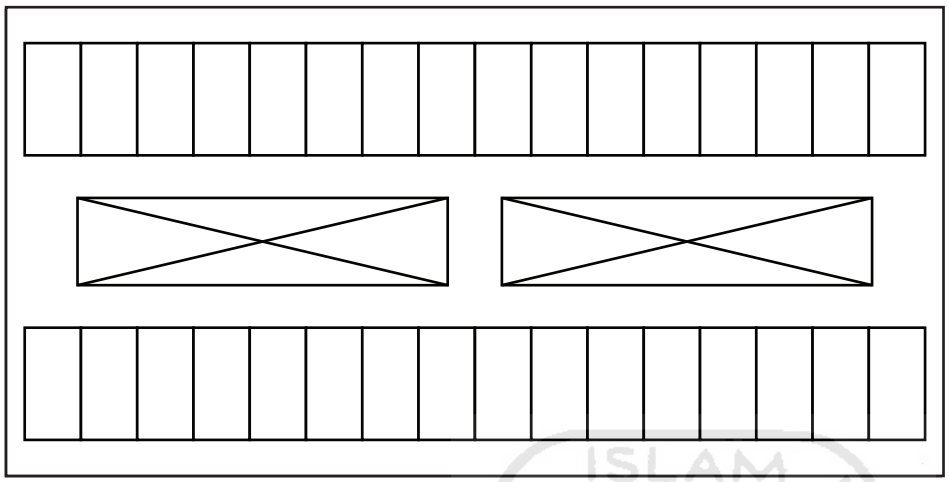


Figure 3.7.6.3: Mall corridor system
Source: Author (2021)

Multi-corridor systems as shown in figure 3.7.6.1 is system that take up a lot of space for retails. Plaza as shown in figure 3.7.6.2 corridor system makes use of the void as a space for visitors to see all the items being sold. Mall corridor system as shown in figure 3.7.6.3 uses a pedestrian corridor, which is located on the side of the corridor where there are retail places to sell.

Plaza corridor system found to be the most appropriate layout as the commercial center would have numbers of smaller retails that the addition of void utilized for the visibility of the stores.

3.7.7 COMPOSITION OF COMMERCIAL SPACE

According to McKeveer (1948), based on how it is used, shopping or shopping space is divided into:

1. Non-sales rooms or non-selling areas, namely spaces related to customer service, activities in this room, namely entering and exchanging merchandise and room management activities.

2. The display room or selling area is a room that is a place for interaction between consumers and sellers.

There are 4 general approaches in placing sales spaces based on the orientation of the mall space:

1. Sandwich approach has a weakness, namely an inefficient system for managers and consumers to carry out activities in non-selling areas.

2. Core approach is a system that places the non-selling area to the center of the core, where the flow of goods arrives mixed with supporting activities in the selling area.

3. Peripheral approach to this system is to regulate the entry of goods without disturbing visitor activities by placing a non-selling area around the sales area.

4. Annex approach is a system that groups all non-sales activities into one and is put separately from the sales area

3.7.8 STRUCTURE CONSIDERATION OF COMMERCIAL CENTER

According to Joseph De Chiara and John Callender (1983) in the book Time Saver Standard, there are design criteria related to structure, including:

1. The range between columns in the building is 6 m, 7.5 m, or 9 m

2. The ceiling height is 3-4 m to provide a good view for the user

3. Commercial center with multi level is recommended to have voids for vertical viewing

3.8 PRECEDENT STUDY

Precedent study related to implementation of the TRIZ inventive principles into the design.

3.8.1 TOD MIXED USE BUILDING

Project Name	:	Marine Gateaway	**Year**	:	2016
Architect	:	Perkins+Will	**Location**	:	Vancouver, Canada
Project Type	:	Mixed Use Building			

Marine Gateway is the initial phase of a bigger development that includes two neighborhood plazas, a 15-story office space, a 3-story retail pedestal, an 11-screen cinema, and two 25- and 35-story residential buildings. The incorporation of a Rail Rapid Transit station and a bus loop exchange into the design gives residents, employees, shoppers, and visitors with convenience of movement for residents, employees, shoppers, and tourists are all welcome. The plazas and elevated pedestrian high street provide a distinct feeling of place by focusing pedestrian traffic around retail businesses and connecting to Southwest Marine Drive and the residential neighborhood to the north.

Figure 3.8.1.1: Bird eye view of the Marine Gateaway
Source: archdaily.com

Problem solved/ improvement by the design:

- Accessibility that connect to many urban ammenities bring easier mobility for pedestrians in the area
- Placemaking of the TOD project area

Design solution:

- Providing a clear connection from transit to the neighbourhood's major thoroughfare,. the hlgh street brings people into the pedestrian environment and into the retail spaces, creating a vibrant community (source - Perkins+ Will

- Connection to the metro station is provided through escalators from the ground level that directly lead to the station. The integrated transit station and bus exchange has experienced an estimated 35 percent growth in average daily activity in a single year.

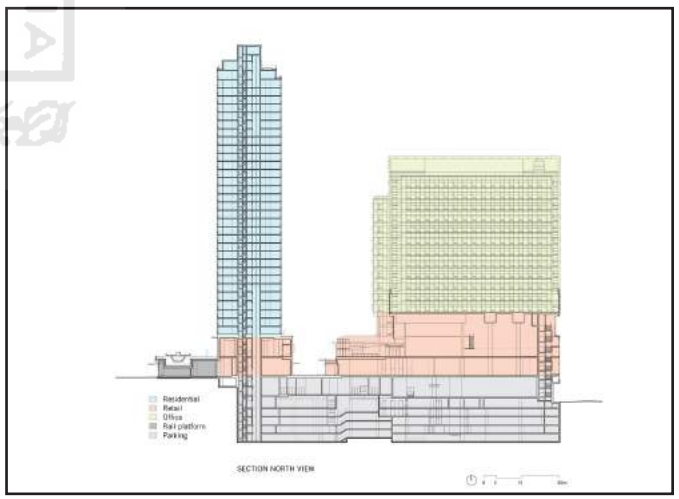


Figure 3.8.1.2: Section of Marine Gateaway
Source: archdaily.com

3.8.2 SEGMENTATION

Project Name	:	Nagakin Capsule	**Year**	:	1970
Architect	:	Kisho Kurokawa	**Location**	:	Tokyo, Japan
Project Type	:	Housing			

Capsule Tower Kisho Kurokawa (completed in Tokyo in 1972) accomodate the housing modules that have a completely manufactured concrete structure set-up in the factory and transported to the building site where they are simply positioned and connected. The apartments are very small to fit the transportable module (3.8 x 2.3 meters with height 2.1). The most interesting aspect of the building is that the Living modules are actually plug-in modules, removable and replaceable.

Figure 3.8.2.1: Exterior of Nagakin Capsule
Source: en.japantravel.com

Problem solved/ improvement by the design:
- Adaptability to reconfiguration

Design solution:
- Small prefabricated modular units with with integrated kitchen and bathroom and furnitures
- Hybrid modular structure with permanent core structure and modular living units

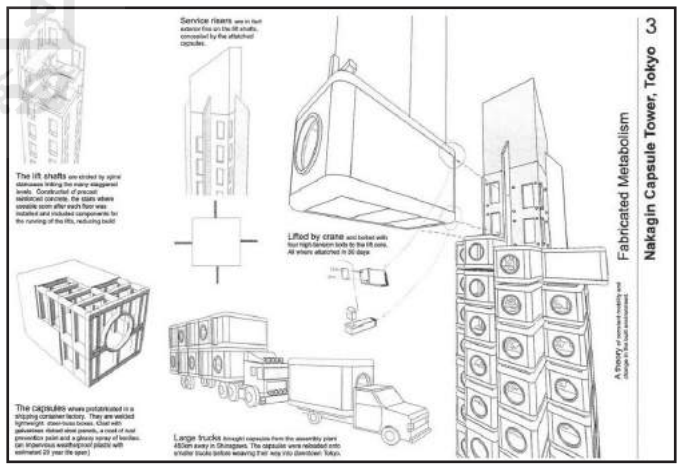


Figure 3.8.2.2: Construction of Nagakin Capsule
Source: metalocus.es

TRIZ inventive parameters related to design:
Through the hybrid modular structure strategy open a possibilities of adaptability which is a response of the dynamic conditions of contemporary city. Hybrid modular structure combine permanent structure of highrise building core and temporary module that able to be reconfigured and even used to be combined to expand the living unit.

3.8.3 PRIOR ACTION

Project Name	:	Modular Manchester Home	**Year**	:	2016
Architect	:	ShedKM	**Location**	:	Manchester, England
Project Type	:	Housing			

The housing units are affordable prefabricated units that installed according to the needs of the users. While the exteriors of these housing units are similar, the interiors are versatile and can be personalized by the owner or user to suit their unique needs. Each units was designed in a factory as a series of timber-framed shells with predetermined kitchen and bathroom layouts. The modules are craned into place after they have been shipped to the job site. Partition walls are added later, depending on the layouts chosen.

Figure 3.8.3.1: Front elevation of the Modular Home
Source: dezeen.com

Problem solved/ improvement by the design:
- Affordable residence to facilitate wider range of people
- Flexible room layout that could be adapted according to the user needs

Design solution:
- Prefabricated modular units with predetermined kitchen and bathroom layout
- Layout prior designed by architect to be selected by the user according to their needs

TRIZ inventive parameters related to design:
Through the prefabricated strategy the cost and time of construction on the site could be reduced which result to more affordable building. Added with the choice of spatial configurations, while still limited to the prior design by the architect, the design resulting to be more inclusive that could serve more people with their preferences.

Figure 3.8.3.2: Construction of Modular Home
Source: dezeen.com

3.8.4 NESTED DOLLS

Project Name	:	Nordstrom Local	**Year**	:	2018
Architect	:	Hoshide Wanzer Architects	**Location**	:	Los Angeles, USA
Project Type	:	Commercial			

Over the couple of years, Nordstrom began rolling out a new type of store. In a departure from the company's traditional large-department-store model, a Nordstrom Local location is a small store with no inventory. Instead of goods, it offers services, such as online order pickup and return, style advice, tailoring/alterations, and beauty services, and merchandise that can be delivered to the Local location within a few hours.

Problem solved/ improvement by the design:

- Saving space for storage which in return make many commercial features within small space to improve productivity

Design solution:

- Utilizing todays convinience of internet commercial and delivery service to make commercial center that connected to the supplier for a compact commercial space with many features
- Layers of architectural elements serve to highlight the various of store service with a flexible furnishing setting

TRIZ inventive parameters related to design:

Fitting two commercial model of online and physical to compliment both of its advantage to develop a compact commercial with many features. The store doesnt sell any ready to pickup inventory rather would be send from the supplier directly to the consumer address. This strategy make the store doesnt require any storage that makes the commercial center focused to function as display and service center for the consumer.

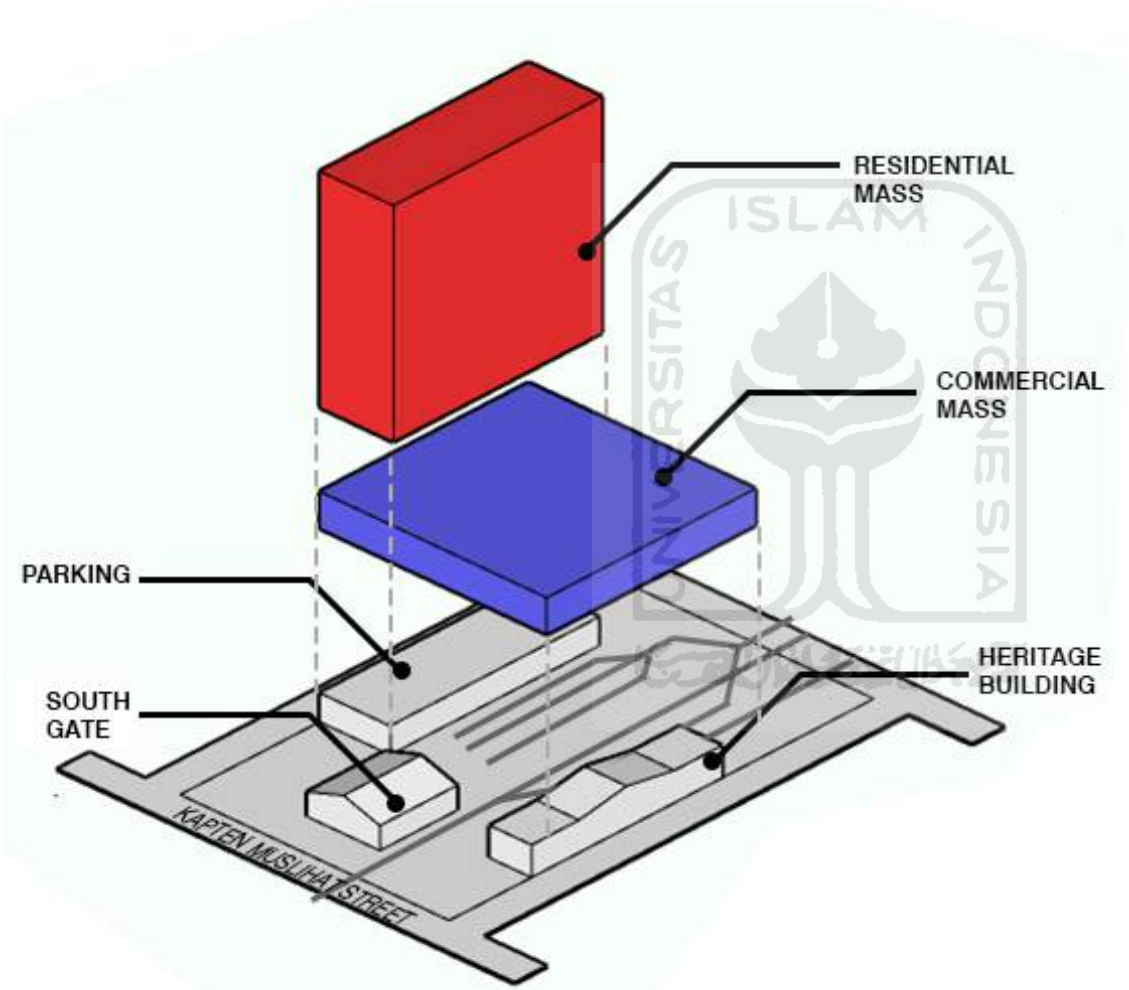
Figure 3.8.4.1: Front facade of the Nordsrom Local store
Source: https://hw-architects.com/

Figure 3.8.4.2: Interior with the commodities just to displayed
Source: https://hw-architects.com/

3.9 EARLY DESIGN IDEAS

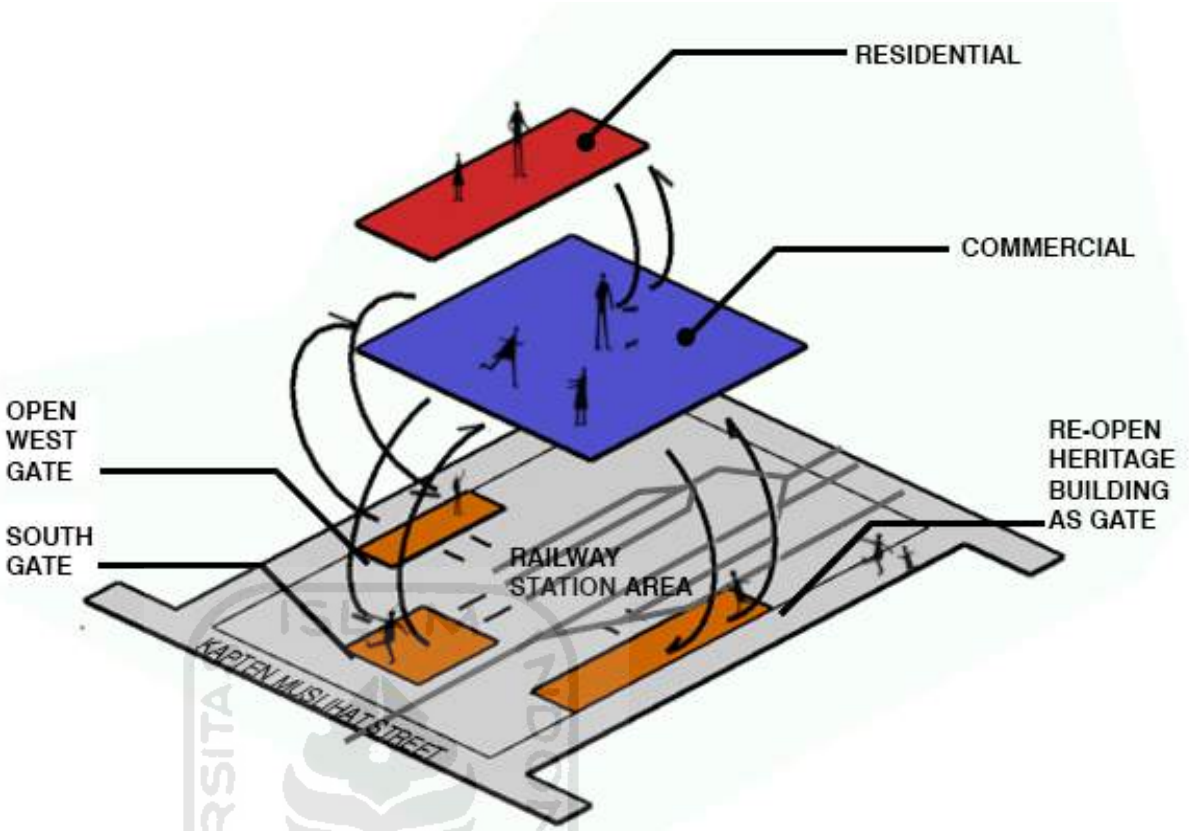
VERTICAL DEVELOPMENT

Residential and commercial mass added over the existing railway station to create compactness on the transit area. The mass takes over the existing parking and railway area structure and the south gate improved and the heritage building is re-opened as a gate.



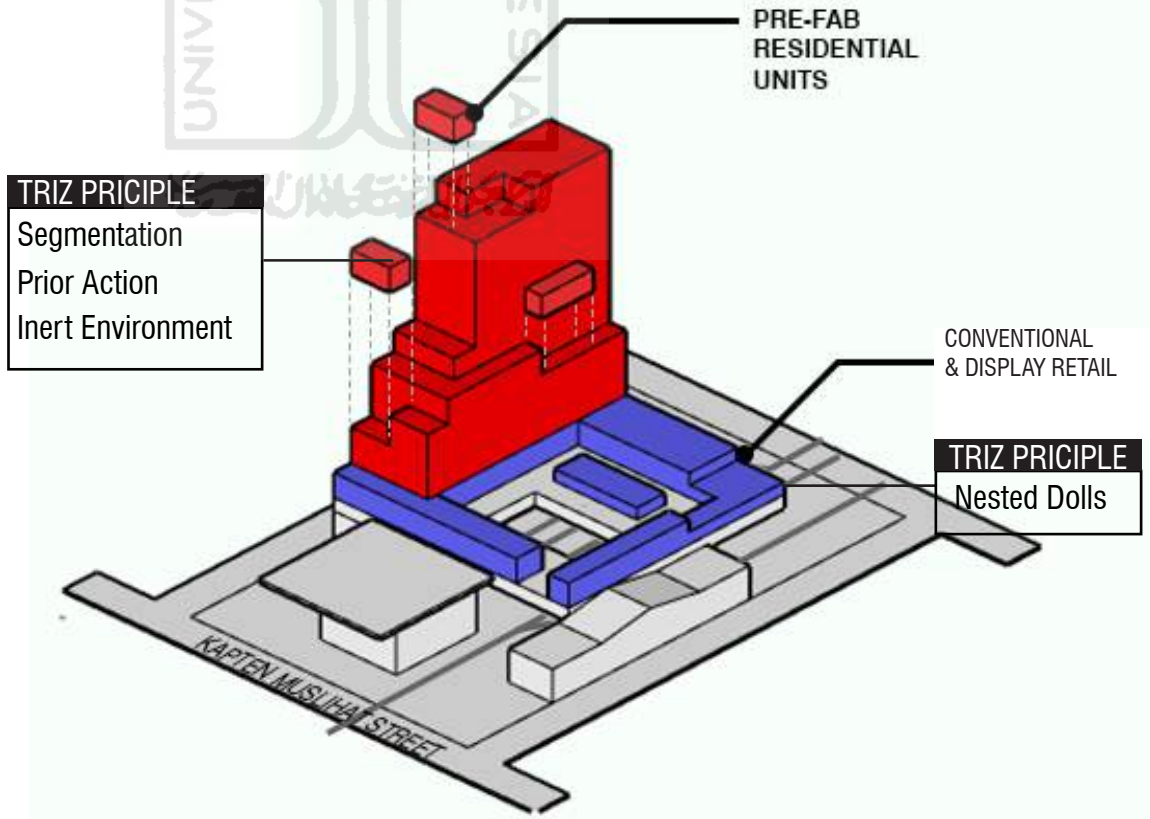
CONNECTING TO THE SURROUNDING

The design integrating the pedestrian way around the site with the additional gates and pedestrian path in the mixed building area. The integration of the circulations offers a shortcut to access destinations around the area for the mixed-use building users and the public to increase walkability in and around the area.



PRE-FABRICATION, ADAPTABILITY, PUBLIC SPACE, AND COMPACT RETAILS

The diverse community could be included through more affordable and adaptable residential units developed from segmentation & prior action inventive principle. Addition of public space to increase sociability between residents developed through the inert environment principle. Nested dolls principle used to develop the commercial area that integrates conventional retails and display retails (non-inventory retail integrated to e-commerce) to increase productivity.



04 PRELIMINARY DESIGN

- CHAPTER SUMMARY
- DESIGN FRAMEWORK
- SITE UTILIZATION ACCORDING TO THE REGULATION
- TRIZ PRINCIPLES APLICATION INTO THE DESIGN
- SITE DESIGN DEVELOPMENT
- MIXED-USE BUILDING DESIGN
- MIXED-USE BUILDING PERSPECTIVE
- APARTMENT DESIGN EXPLORATION
- APARTMENT ELEVATION
- APARTMENT PLAN
- APARTMENT UNIT MODULE SCHEMATIC
- APARTMENT COMMON SPACE
- COMMERCIAL CENTER PLAN
- APARTMENT STRUCTURE
- APARTMENT CLEAN & WASTE WATER SYSTEM SCHEMATIC
- APARTMENT SAFETY AND DISABLED PLAN SCHEMATIC

4.1 CHAPTER SUMMARY

The chapter of preliminary design discusses the early design results of the mixed-use building that developed from the concept that resulted from the studies in the earlier chapters. The content of the chapter including the design concept, preliminary site plan design, schematic mixed-use building design, schematic residential building design, and schematic commercial center design.

4.2 DESIGN FRAMEWORK

Figure 4.2.1 shows the framework of the development of the design from the project background to the TRIZ general solution in which would further developed to the specific design concept and be discussed in this chapter.

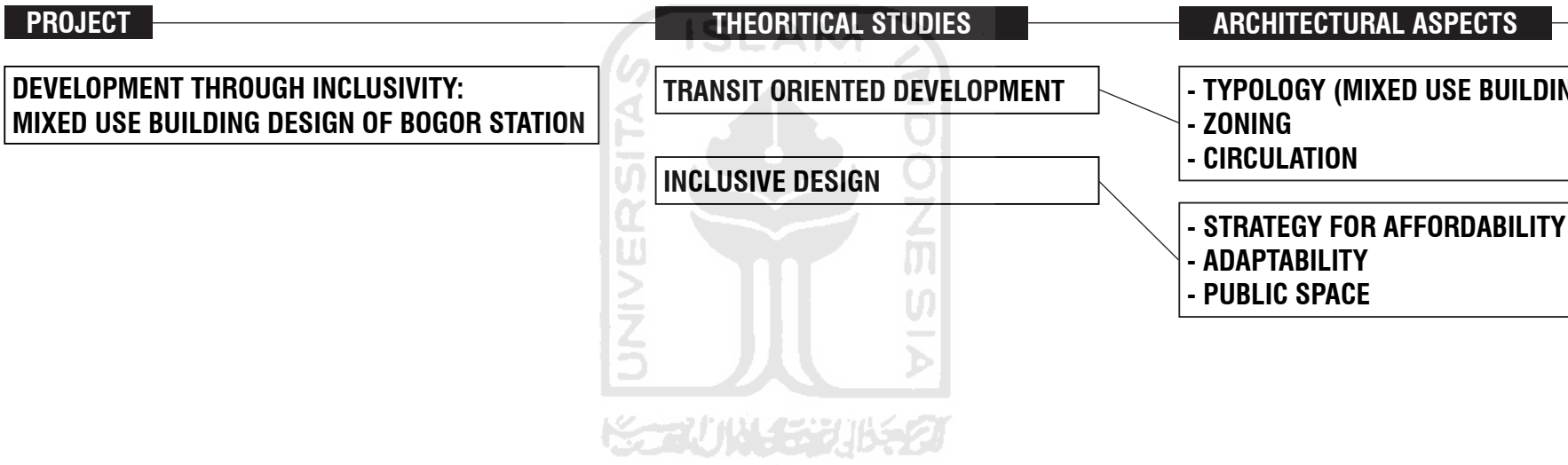
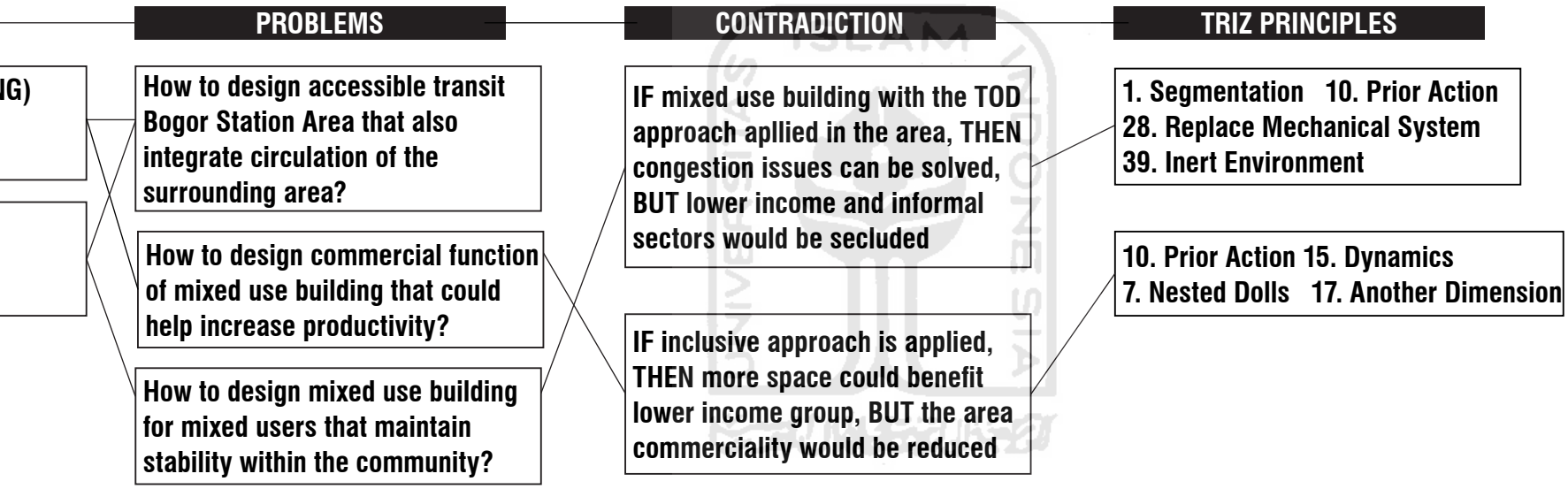


Figure 4.2.1: Design framework
Source: Author (2021)


PROBLEMS
CONTRADICTION
TRIZ PRINCIPLES
NG)
How to design accessible transit Bogor Station Area that also integrate circulation of the surrounding area?
How to design commercial function of mixed use building that could help increase productivity?
How to design mixed use building for mixed users that maintain stability within the community?
IF mixed use building with the TOD approach apllied in the area, THEN congestion issues can be solved, BUT lower income and informal sectors would be secluded
IF inclusive approach is applied, THEN more space could benefit lower income group, BUT the area commerciality would be reduced
1. Segmentation 10. Prior Action
28. Replace Mechanical System
39. Inert Environment
10. Prior Action 15. Dynamics
7. Nested Dolls 17. Another Dimension

4.3 SITE UTILIZATION ACCORDING TO THE REGULATION

In accordance to the regulation the boundary of the space utilization on the site of Bogor station is shown table 4.3.1.

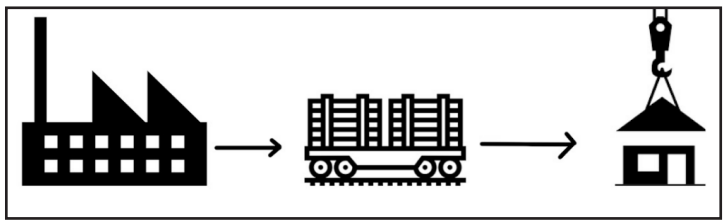
SITE AREA	22.000 m2 (excluding railroad area)	
BUILDING COVERAGE RATIO (KDB)	50%	11.000 m2
BUILDING FLOOR RATIO (KLB)	3,5	77.000 m2
GREEN COVERAGE RATIO (KDH)	15%	3.300 m2
BUILDING BOUNDARY FROM ROAD (GSB)	Mayor Oking Street	8 m
	Nyi Raja Permas Street	6 m
	Kapten Muslihat Street	13 m

Table 4.3.1: Site utilization according to the city regulation
Data Source: Peraturan Walikota Bogor (2017)

4.4 TRIZ PRINCIPLES APLICATION INTO THE DESIGN

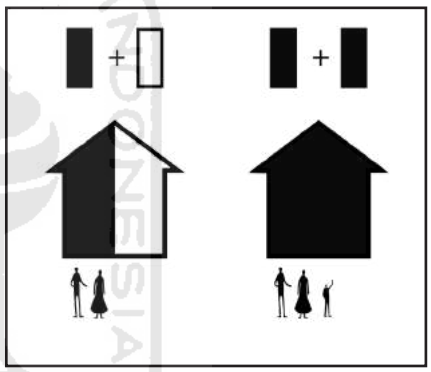
1. **IF** mixed use building with the TOD approach apllied in the area, **THEN** congestion issues can be solved, **BUT** lower income and informal sectors would be secluded
2.**IF** inclusive approach is applied, **THEN** more space could benefit lower income group, **BUT** the area commerciality would be reduced

(1) SEGMENTATION



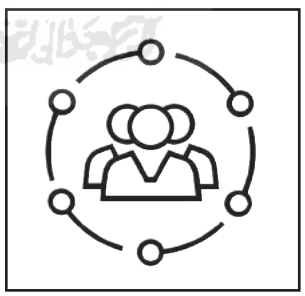
- PREFABRICATED MODULAR LIVING UNIT
Construction of unit modules in the manufacture has many advantages to reduce the retrofit cost such as the construction time and labor. Therefore it could help to achieve affordability. The module size adapted to the transportation mode capability so it could be transported to the construction site by the cargo train and truck.

(10) PRIOR ACTION



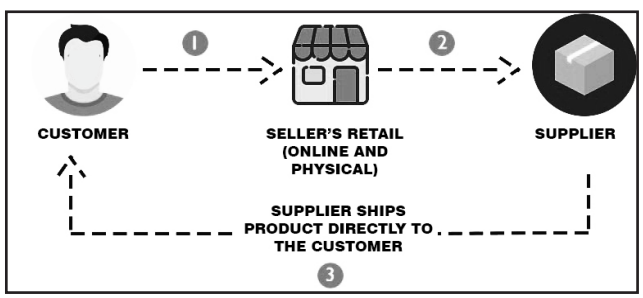
- ADAPTATION
Lower income group could start by having a small living unit as affordance another issue that they have. However change of family constelations is a natural occurance that need to be responded by extension or reconfiguration. By applying adaptation concept lower income group could be assisted by start their housing small but also bring scalable options for their living unit.

(39) INERT ENVIRONMENT



- COMMON SPACE
The inert environment is principles to add neutral atmosphere to prevent negative impact to occur. The addition of a common space as a semi-public space in the building for the residents to interact with each otherwould encourage community building to make the residential environment more sociable.

(7) NESTED DOLLS



- HYBRID RETAIL SYSTEM
Using two commercial models, online and physical, to complement each other's strengths allows to form more compact commercial center but able to increase productivity.

4.5 SITE DESIGN DEVELOPMENT

The mixed use building site consist of the residential and commercial that connected to the pedestrian circulation to the railway station and the public transportation modes (bus). As shown in the figure 4.5.1 the design intervention over the existing are the replacement of the parking area to residential , the addition of commercial over the railway station, and the development of gates with addition of west gate and east gate to create a shortcut for pedestrian network which increase walkability on the area.

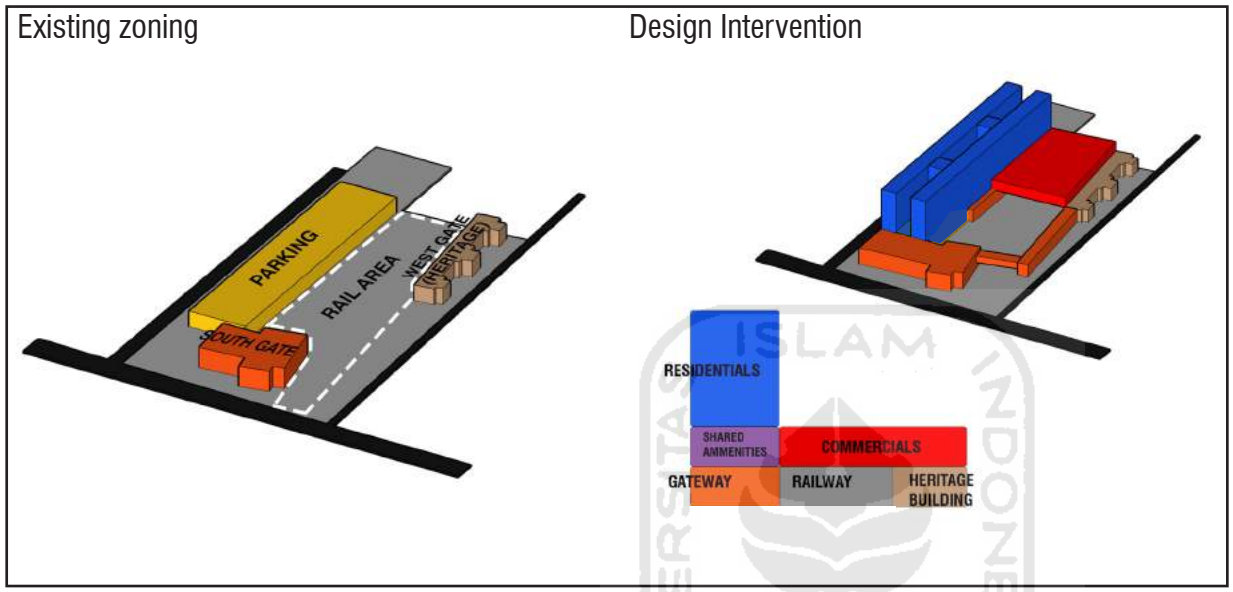


Figure 4.5.1: Design intervention over the existing zoning
Source: Author, 2021

As shown in the figure 4.5.2 the development of the mixed use building create integration towards many ammenities on site also towards the surrounding street network. This design intervention would increase walkability as the pedestrian from differnet point around the are south, east and west) able to walk half of distance compared to the former exisitng settings.

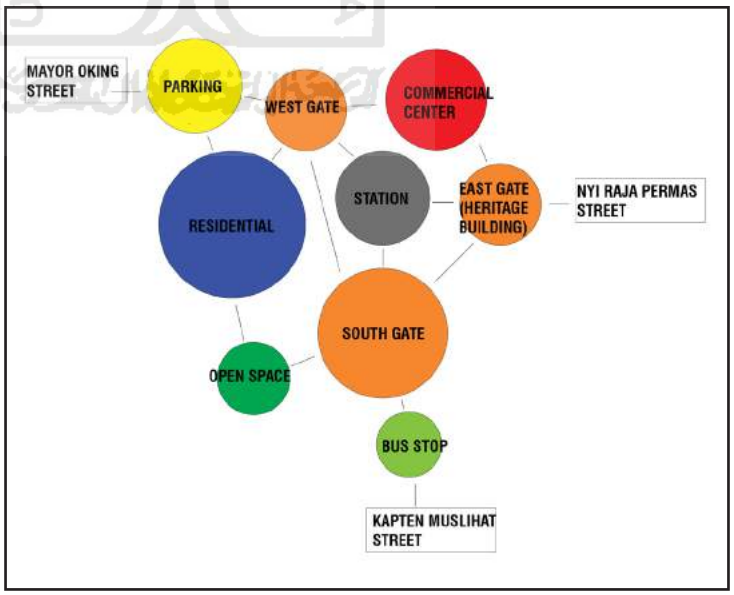


Figure 4.5.2: Bubble diagram of the site development
Source: Author (2021)

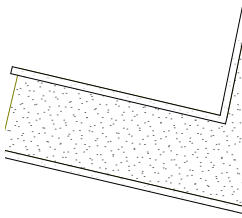
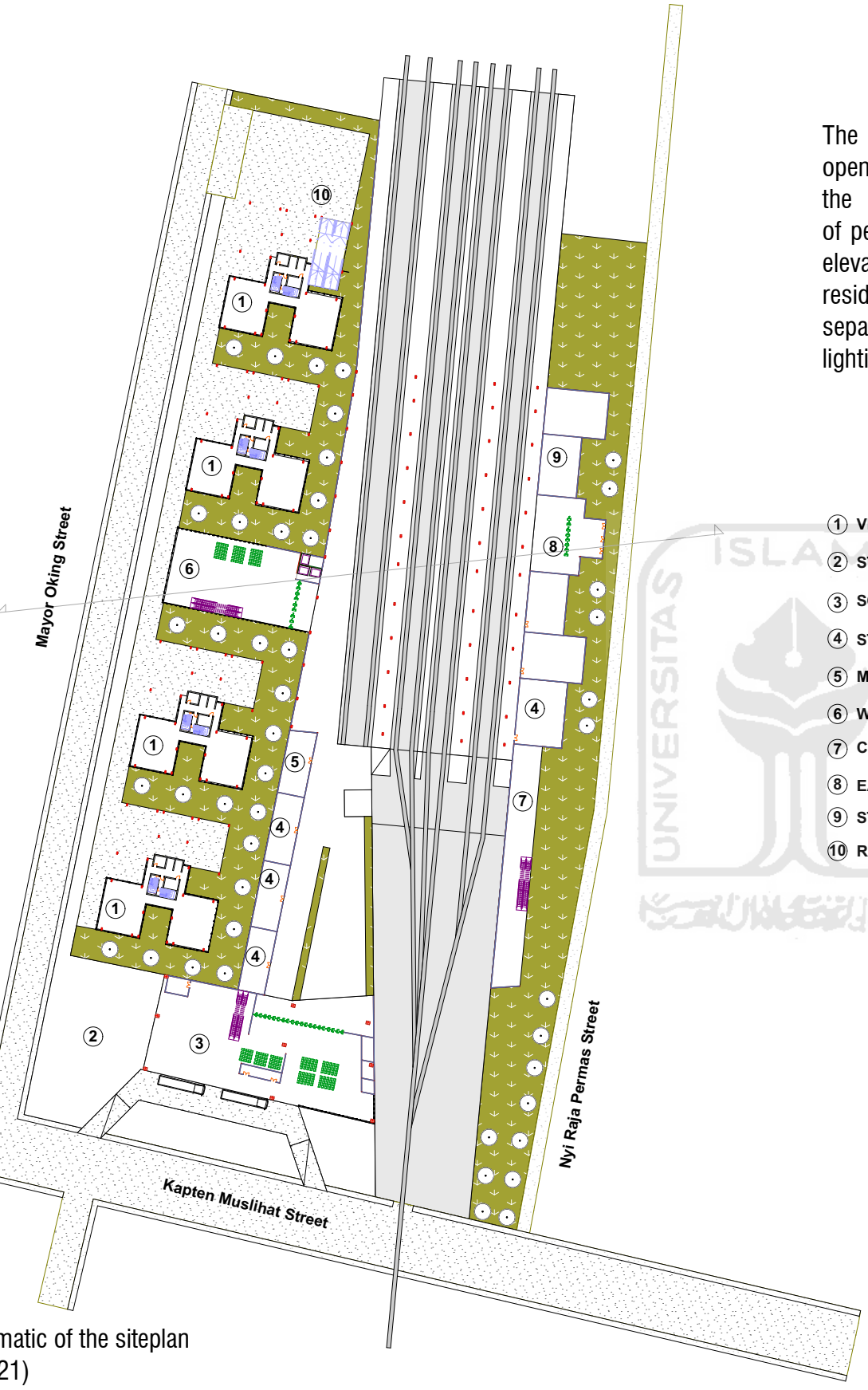


Figure 4.5.3: Scher
Source: Author (202



matic of the siteplan
21)

The development keep the segmentation of open public, gated public space of station and the private residential area. The development of pedestrian network on the site are in form of elevated circulation over the railway station. The residential building consist of 4 towers which separated to make gap for safety/privacy, natural lighting, and vegetations.

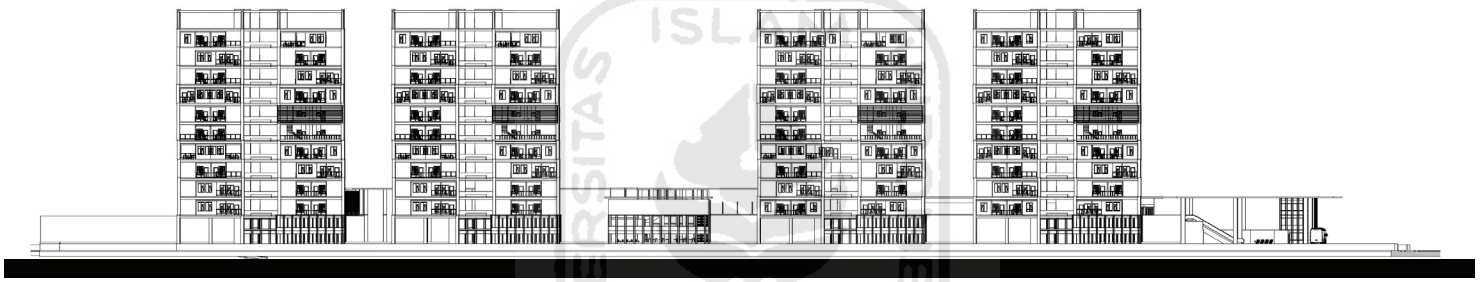
1. VERTICAL HOUSING
2. STATION OPEN SPACE
3. SOUTH GATE
4. STATION COMMERCIAL
5. MUSHOLLA
6. WEST GATE
7. CIRCULATION TO PEDESTRIAN NETWORK OVER THE STATION
8. EAST GATE (HERITAGE BUILDING)
9. STATION MANAGEMENT OFFICE
10. RAMP TO BASEMENT

N

4.6 MIXED-USE BUILDING DESIGN

The design intervention of the mixed use consist of housing units, addition of gate to improve walkability within the development area, and commercial center as recreational and occupational space for the community within the development area.

The development area consist of 3 main building mass which are the railway station, the apartment and the commercial center. The buildings connected through the pedestrian circulation on the ground and elevated over the railway area.



WEST SITE ELEVATION

EAST SITE ELEVATION

Figure 4.6.1: Site elevation of the mixed use development
Source: Author (2021)

Figure 4.6.2: Site section of the mixed use development
Source: Author (2021)

4.7 MIXED-USE BUILDING PERSPECTIVE

Figure 4.7.1 shows the bird eye perspective of the mixed-use building schematic design from the south of the development area.

Figure 4.7.1: Perspective of the mixed use building schematic
Source: Author (2021)

4.8 APARTMENT DESIGN EXPLORATION

The apartment building designed to assist the lower income group to be able to afford, sustain their living in the development and also community making to de-segregate mixed income groups in the development. This project propose the response towards the issues by the use of hybrid modular design which incorporate permanent core building structure and temporary prefabricated living unit. This strategy make use of the prefabrication to reduce retrofit cost of construction also adaptation strategy of the temporary units to allow reconfiguration to response the need of living space expansion and preference of the tenants. Common space added into the building design as the community space between the neighbors of the vertical residential. The common space designed to offer roomy space with high ceiling and wide view towards the city as a relaxing thirdspace and also the 'magnet' to bring tenants together which could help community building process.

The design exploration 1 as shown in figure 4.8.1 configure the units within clustered configuration. In between each floor have a open area with the largest open area on the 5 th floor of the 10 floor apartment. Through this configuration 8 units of apartment could be placed on each floor. However the configuration makes the inside of the building to be enclosed which makes it less vibrant. This configuration while could accomodate more unit but reduce the living quality within the residential floor.

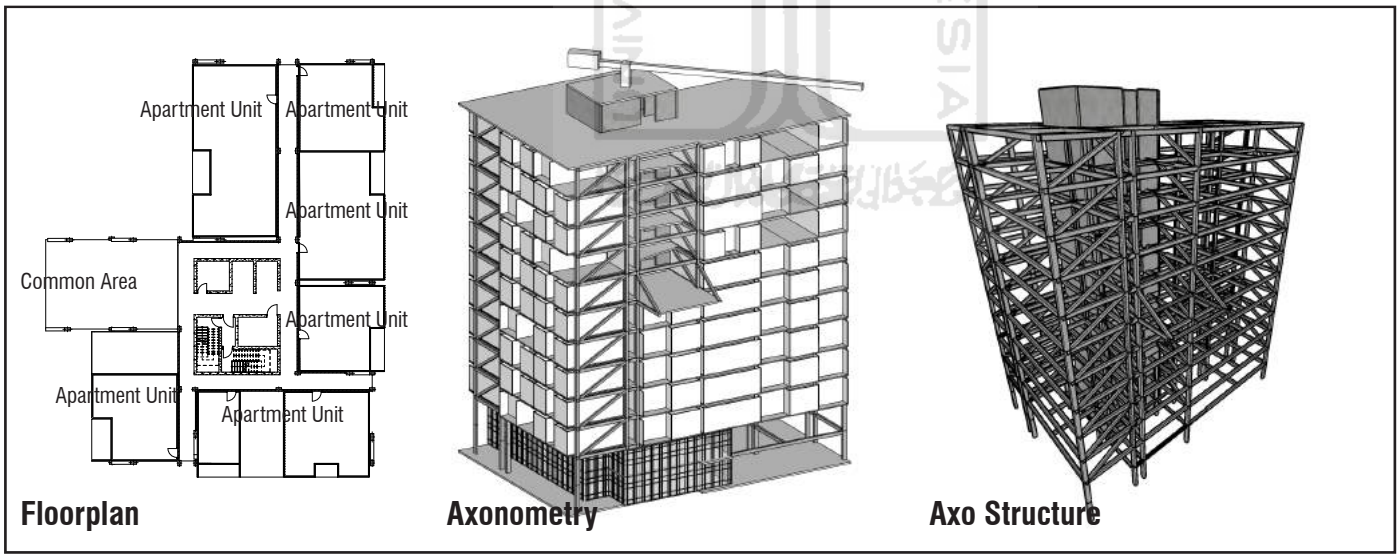


Figure 4.8.1: Design exploration 1
Source: Author (2021)

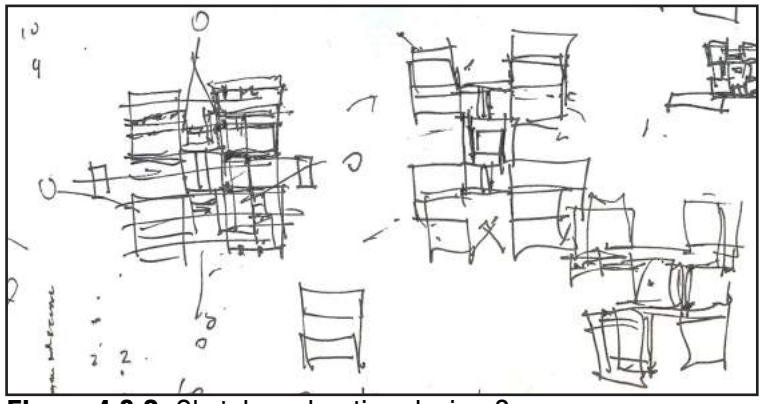


Figure 4.8.2: Sketch exploration design 2
Source: Author (2021)

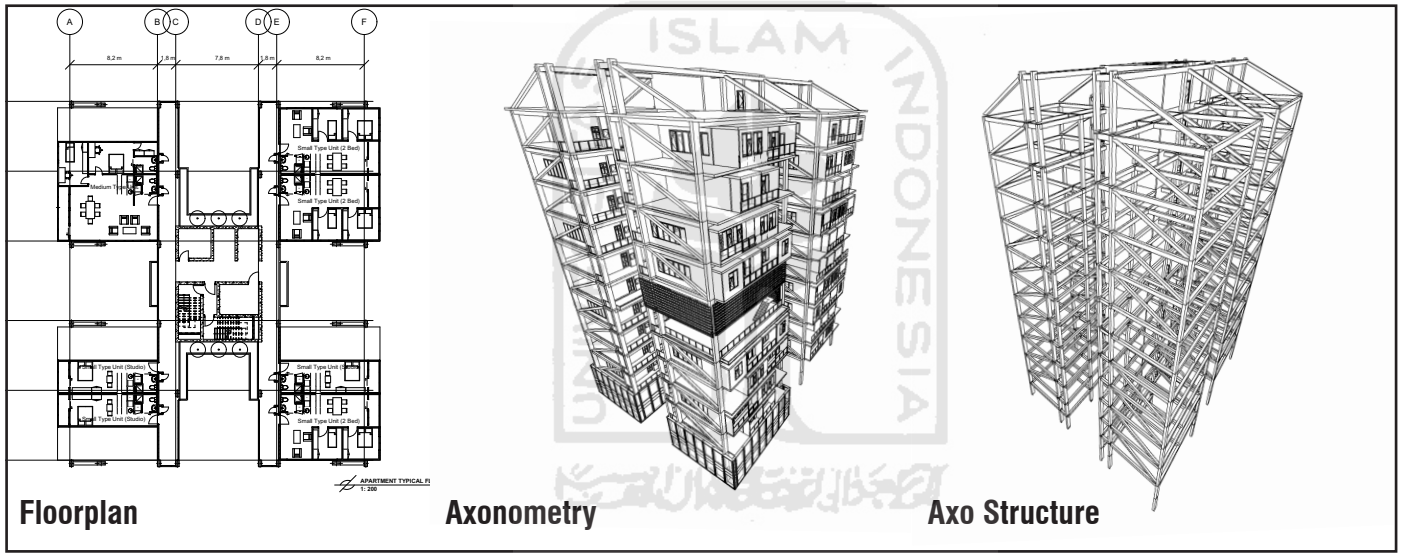


Figure 4.8.3: Design exploration 2
Source: Author (2021)

The design exploration 2 as shown in figure 4.8.3 try to resolve the issues of the previous design. The configuration of the units algned in radial configuration with gap of space functioning to bring more natural lighting and air circulation into the residential floor. With this design the apartment units could have openings on two side. The design improve the quality of living as the residential have more natural lighting and cross ventilation. However the number of units are decreased with 6 units per floor.

Although less economical with the number of units reduced but the improvement of cross ventilation and natural lighting are important to create residential with better quality of living. Maintaining the quality is appropriate as the residential are designed to mixed group with different income background. Rather to segment the groups or even reduce the higher income to 'lower income quality' this strategy offer quality housing of the more capable group towards the least capable group.

4.9 APARTMENT ELEVATION

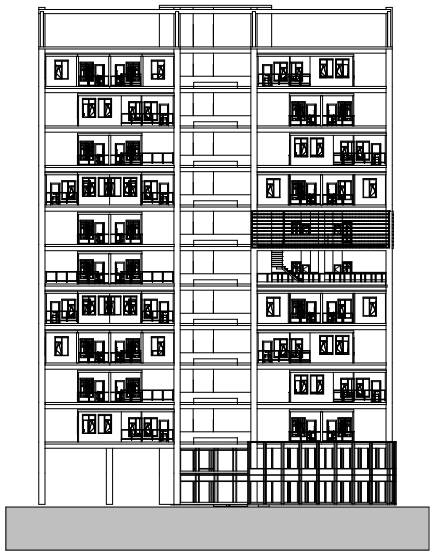


Figure 4.9.1: Apartment west elevation
Source: Author (2021)

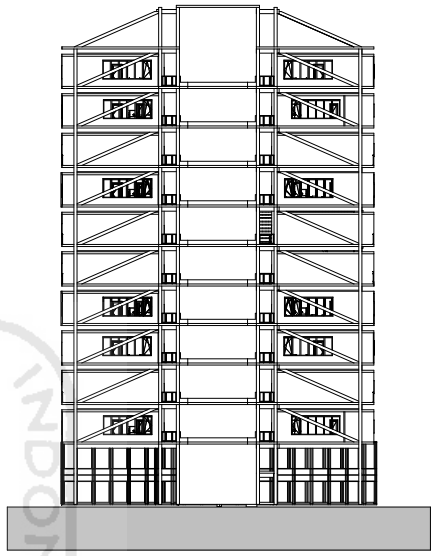


Figure 4.9.2: Apartment south elevation
Source: Author (2021)

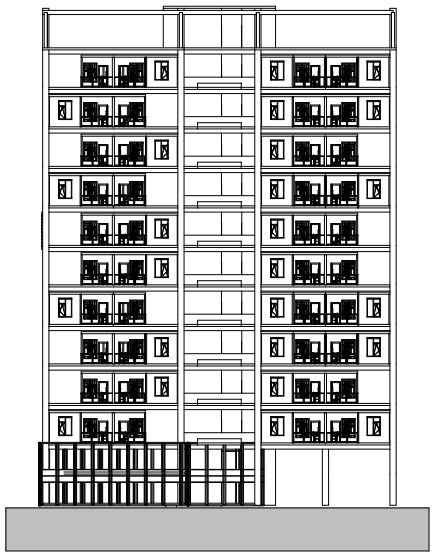


Figure 4.9.3: Apartment east elevation
Source: Author (2021)

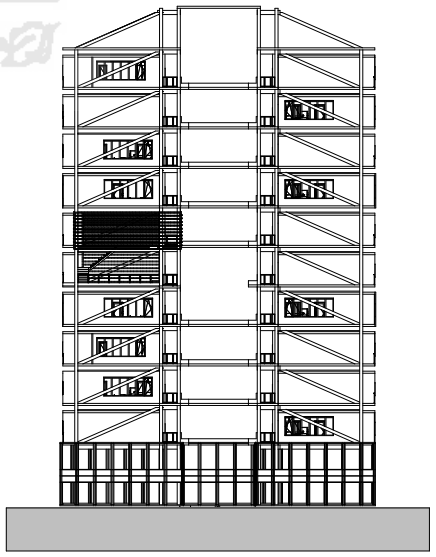


Figure 4.9.4: Apartment north elevation
Source: Author (2021)

4.10 APARTMENT PLAN

The apartment unit is formed by the basic module of 9 x 3 m in which could be transported by cargo train or truck. The formation of the unit is by insertion of the module into the host structure in which the module is lifted by the crane. The apartment unit types consist of studio units or half small units (1 module and 1 empty host structure compartment space), small units (2 modules), medium units (3 modules), and large units (4 modules). The typical residential floor plan of the apartment is configured for mixed user groups which consist of 3 small units, 1 medium unit, and 1 large unit but could be reconfigured depending on the circumstances.

Common space included within the building plan as social space for the apartment community. Common space placed typically on the 6th and 7th floor plan of the apartment.

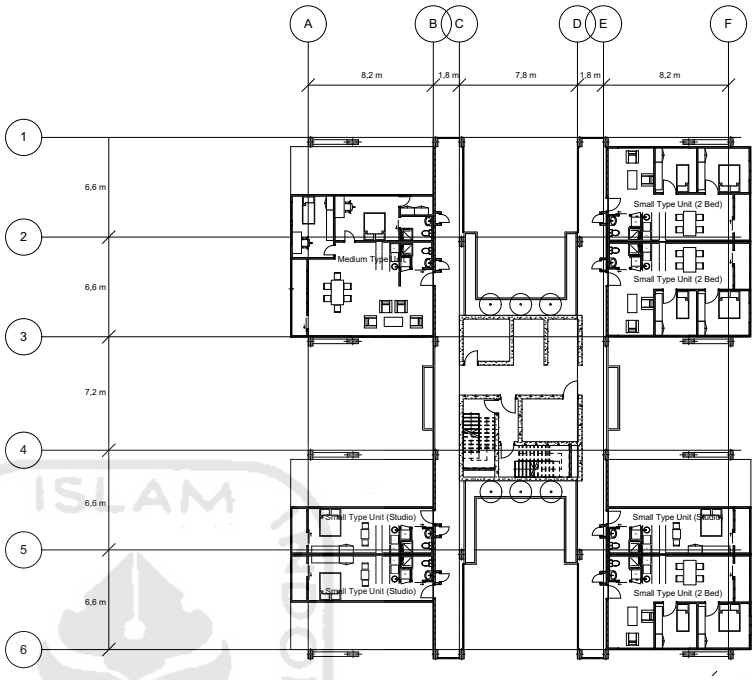


Figure 4.10.1: Typical residential floorplan
Source: Author (2021)

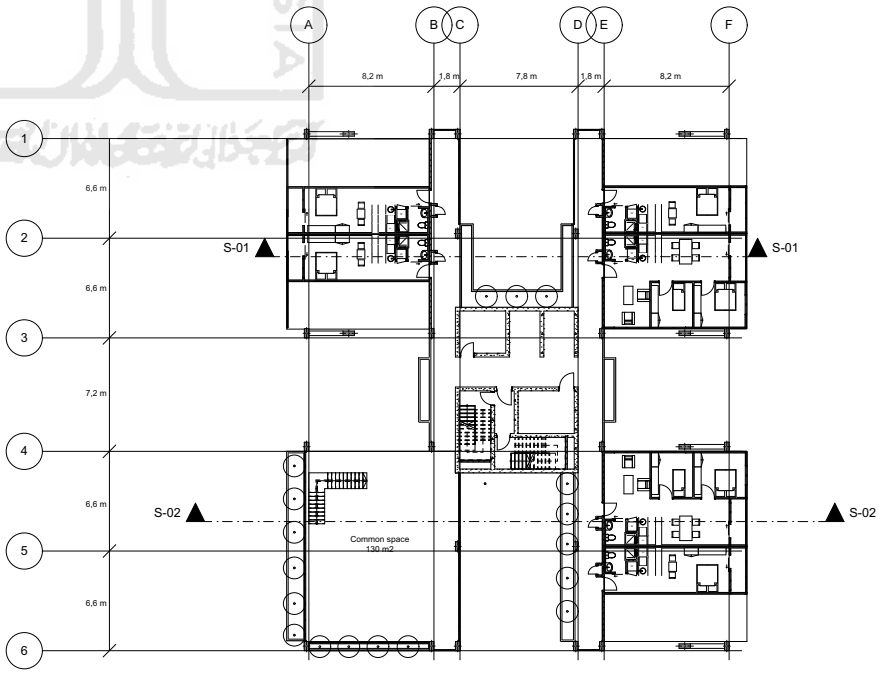


Figure 4.10.2: Residential floorplan with common space facility
Source: Author (2021)

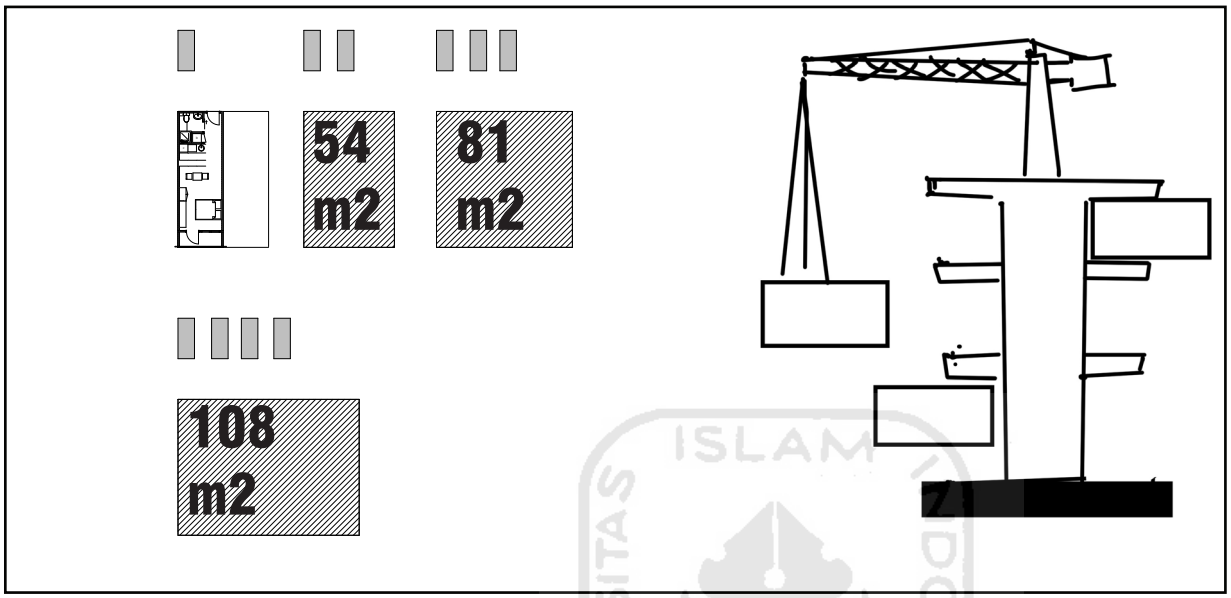


Figure 4.10.3: Apartment unit configured based on basic module
Source: Author (2021)

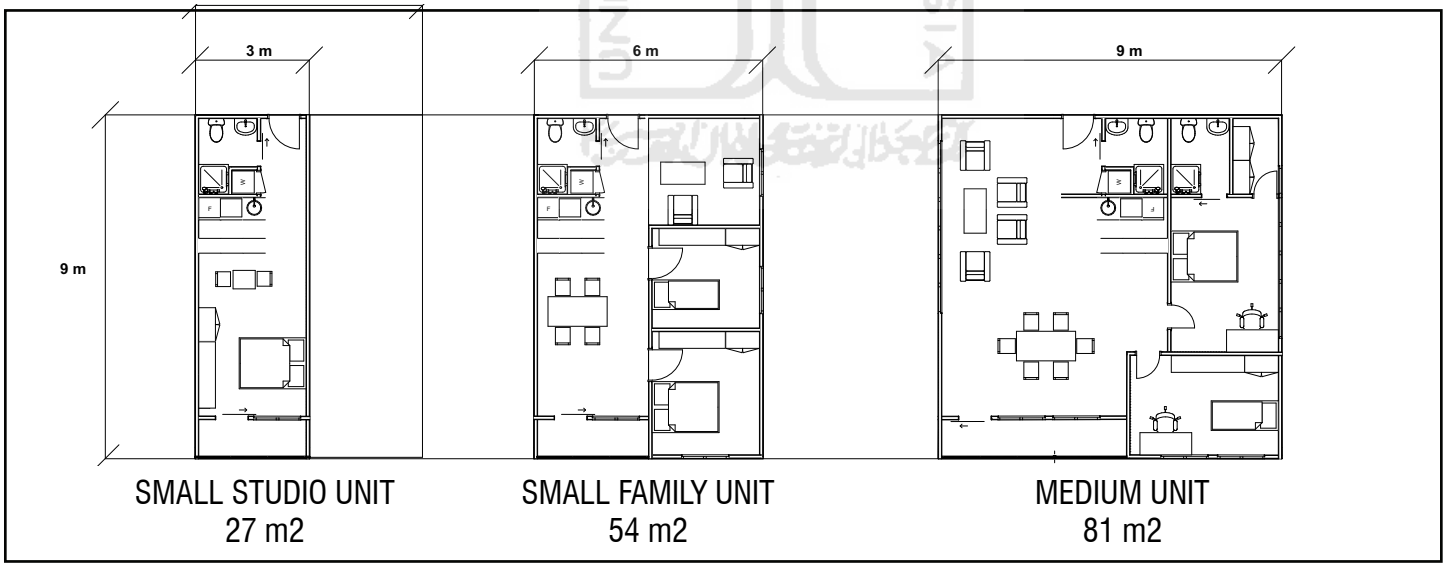


Figure 4.10.4: Apartment unit plan based on the module configuration
Source: Author (2021)

4.11 APARTMENT UNIT MODULE SCHEMATIC

Module of the apartment unit consist of the steel frame module structure, wall panel, MEP systems, ceiling, and flooring. When the module inserted into the host building, the wall of the host would be part of the module and the MEP system of the module connected to the host structure system.

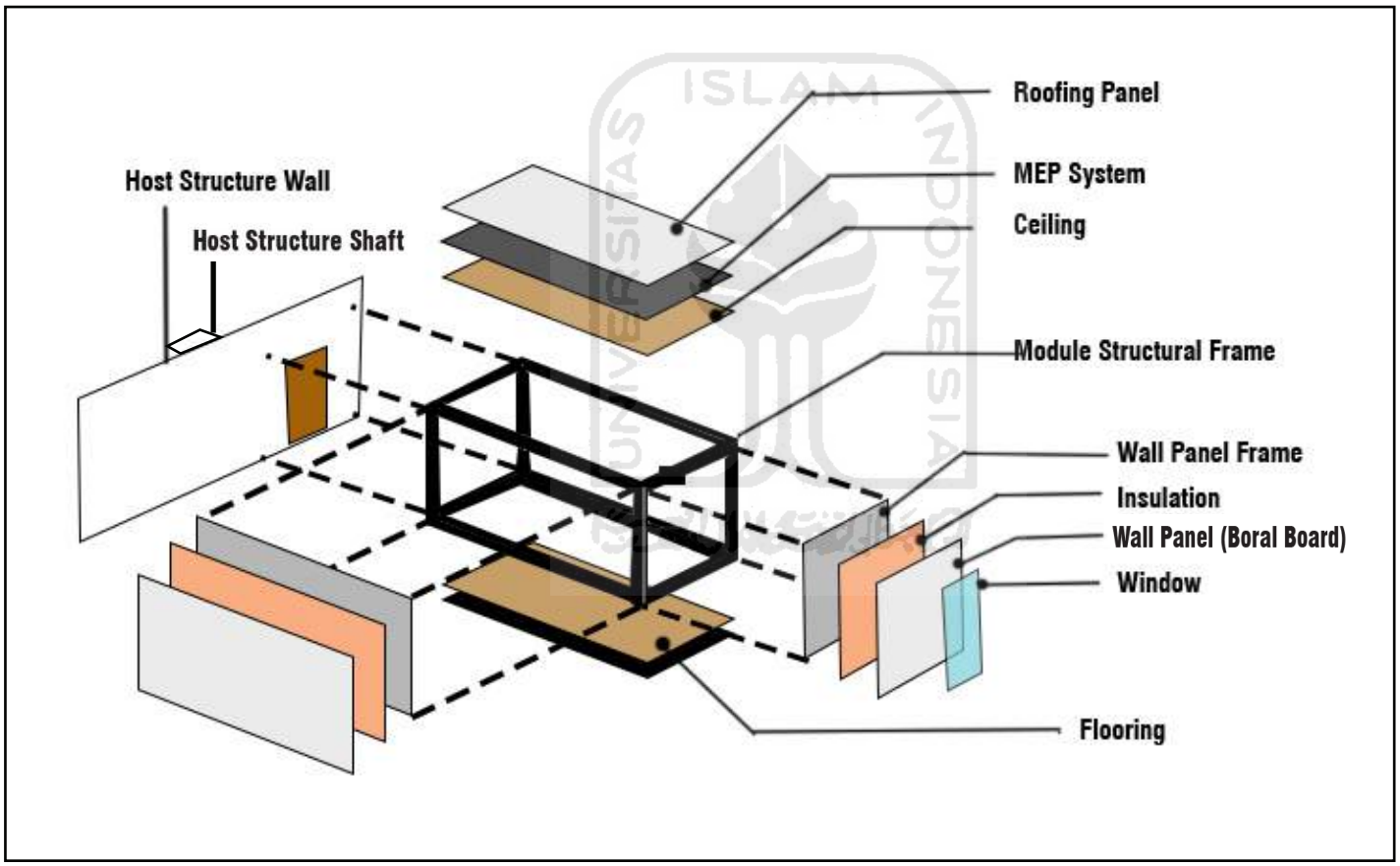


Figure 4.11.1: Schematic of the apartment module construction elements
Source: Author (2021)

4.12 APARTMENT COMMON SPACE

Common space added into the building design as the community space between the neighbors of the vertical residential. The common space designed to offer roomy space with high ceiling and wide view towards the city as a relaxing thirdspace and also the 'magnet' to bring tenants together which could help community building process.

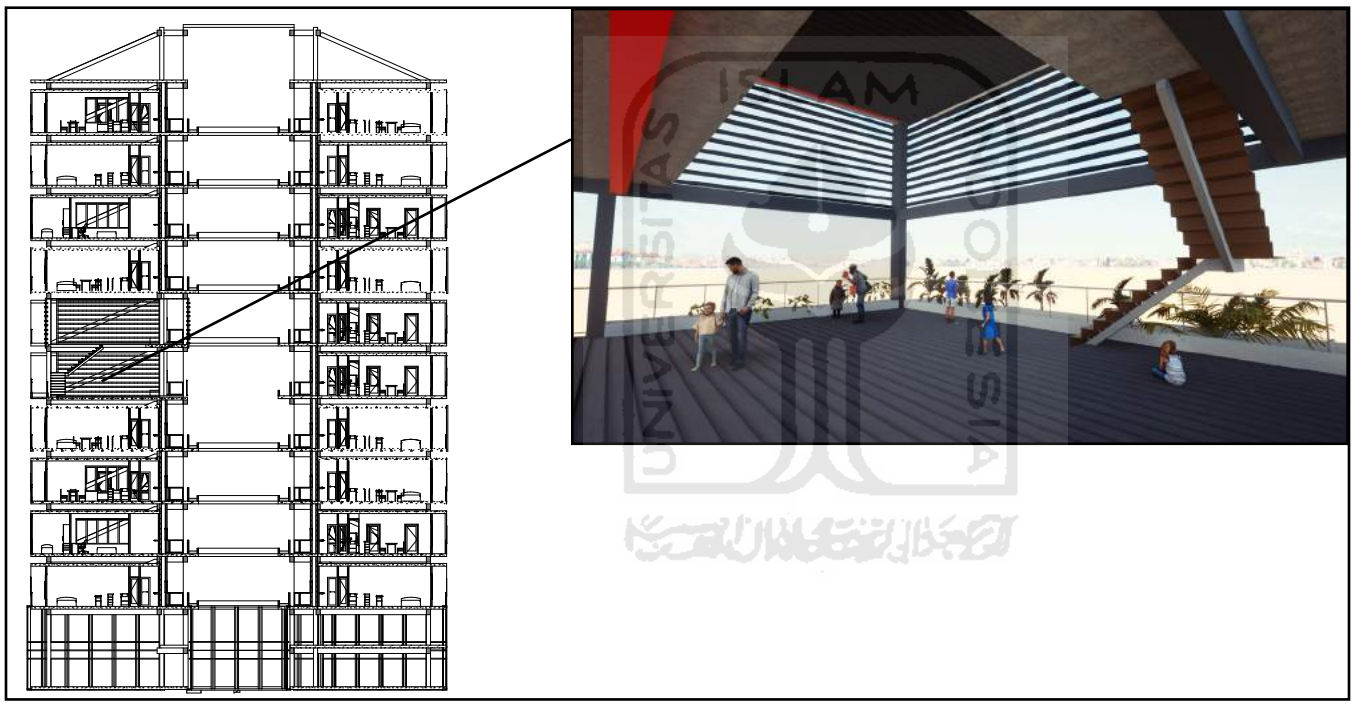


Figure 4.12.1: Common space of the apartment
Source: Author (2021)

4.13 COMMERCIAL CENTER PLAN

The commercial center consist of the conventional anchor store as commercial facility to support daily needs, display store in which function to showcase commercial items without ready to checkout inventory, and the food court.

By adapting the mixed retail strategy the display store would have a smaller size but could have the same or more commerciality compared to conventional store as the display store have more flexibility.

Commercial area placed over the station railway platform. The structural configuration follows the placement of the existing platform so that the design interevention not disturb the railway station system.

Elevated pedestrian circulation intersect the commercial area which could help maintaining the commercial area traffic and vibrancy that could help to increase commerciality.

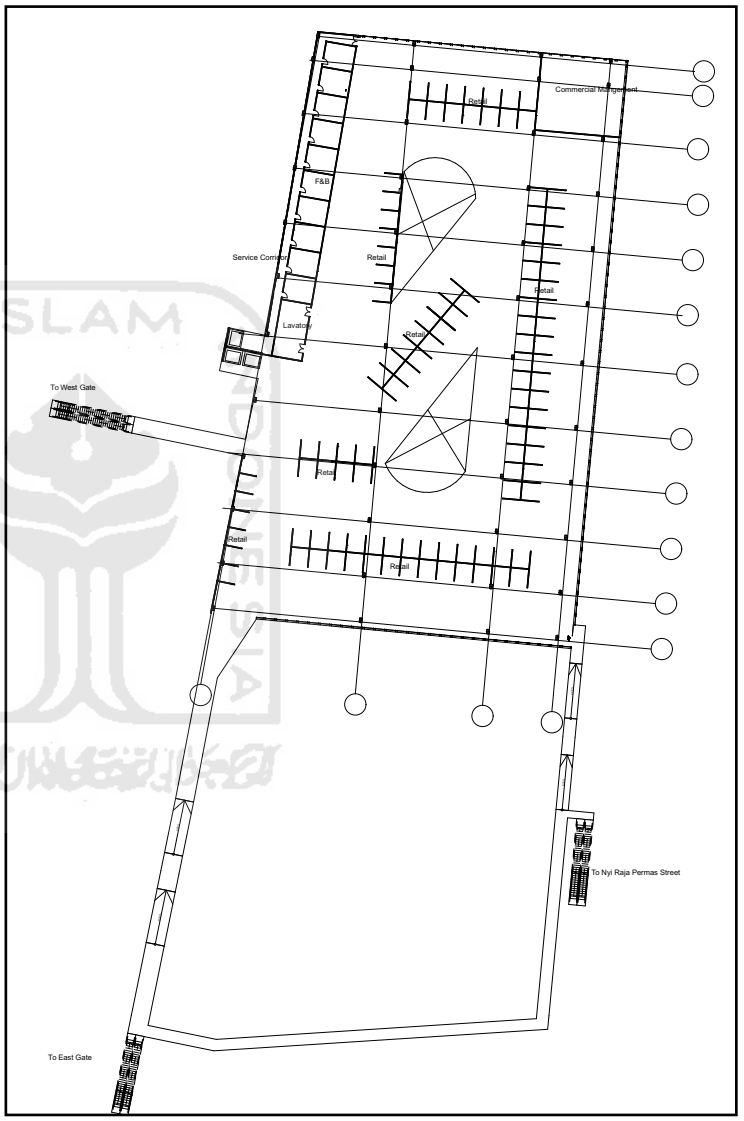


Figure 4.13.1: Commercial center floorplan
Source: Author (2021)

4.14 APARTMENT STRUCTURE

The structure of the apartment utilize hybrid modular design which consist of the permanent core structure, frame structure, and the temporary prefabricated modular structure.

The frame structure utilized steel material with the core built of reinforced concrete. The bracing function to resist the force from the insertion of the prefabricated modular units.

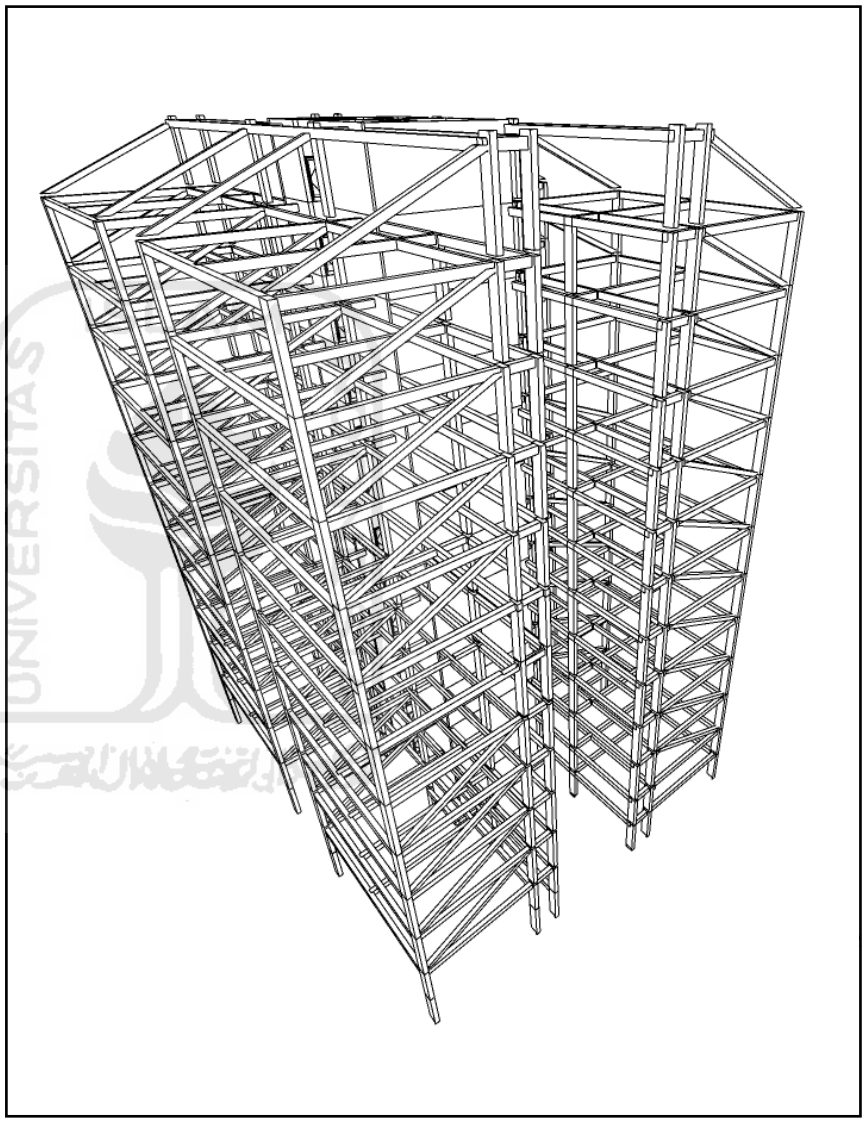


Figure 4.14.1: Schematic of apartment structure
Source: Author (2021)

4.15 APARTMENT CLEAN & WASTE WATER SYSTEM SCHEMATIC

Clean water used is the up feed system where the water comes from the ground water the tank is directly pumped to each unit of the water faucet through the building shaft. Waste water the discharge is directly passed to the shaft and accommodated into the septic tank.

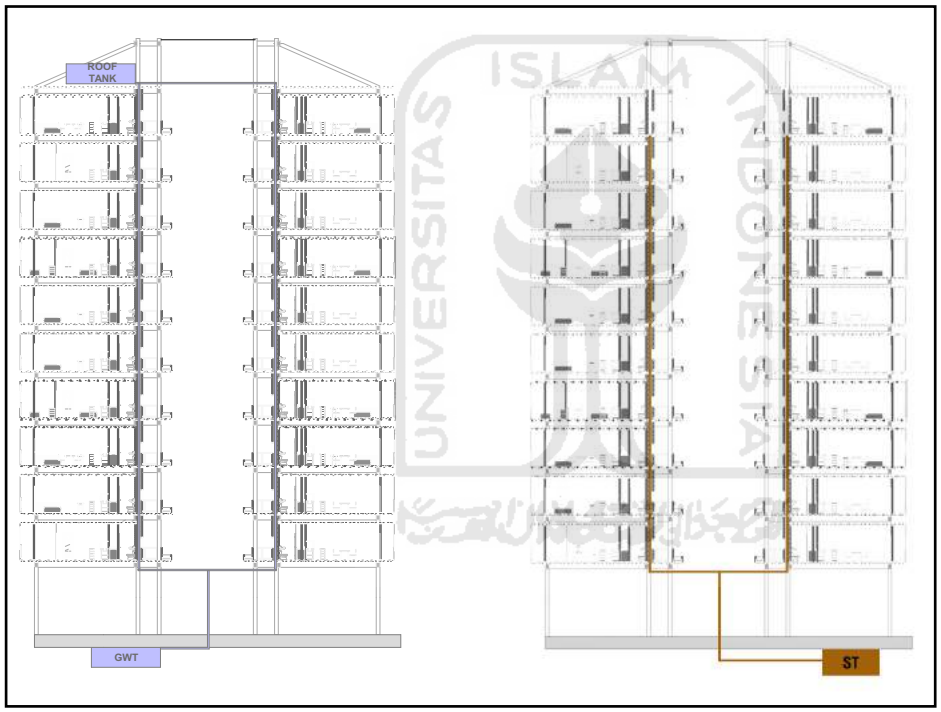


Figure 4.15.1: Apartment clean and waste water system
Source: Author (2021)

4.16 APARTMENT SAFETY AND DISABLED PLAN SCHEMATIC

The placement of a ladder as the vertical circulation for emergency positioned in the building core with the structural concrete wall make the stair a protected path. Hydrant positioned on the core area while light extinguisher positioned in front of each unit group area. Lift utilized as the vertical circulation that also serve for the disabled.

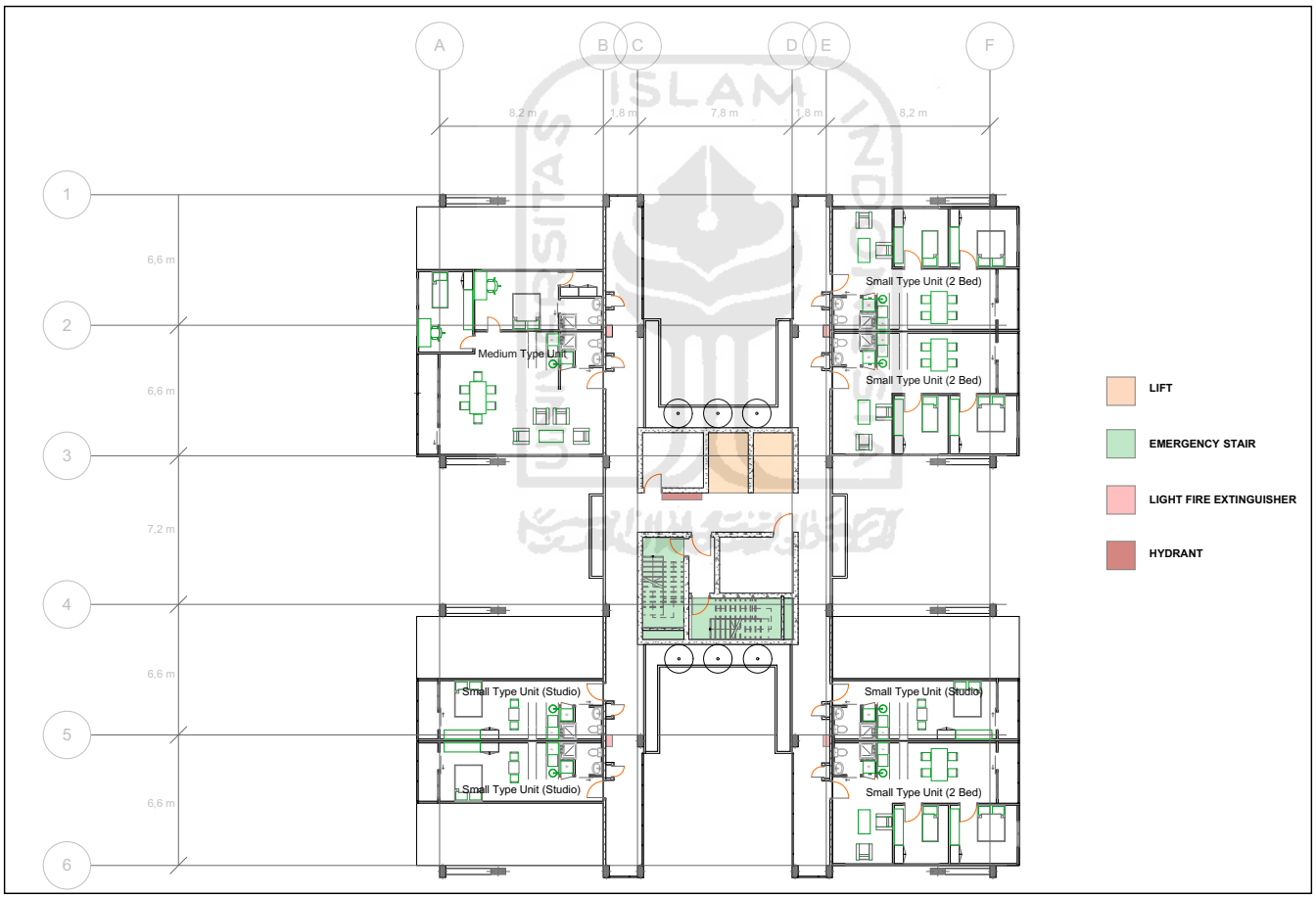


Figure 4.16.1: Apartment safety and disabled plan
Source: Author (2021)

05 DESIGN DEVELOPMENT

- CHAPTER SUMMARY
- INCREASE WALKABILITY TO REDUCE NEEDS OF PRIVATE MOTOR VEHICLES
- RESIDENTIAL DESIGN
- COMMERCIAL FACILITIES DESIGN
- DESIGN TESTING

5.1 CHAPTER SUMMARY

The chapter of design development discusses the improvement of the design of the mixed-use building based on the preliminary design. The content of the chapter including the site plan design, overall mixed-use building design, apartment building design, apartment unit design, commercial facilities design, and the design testing through the online questionnaire.

5.2 INCREASE WALKABILITY TO REDUCE NEEDS OF PRIVATE MOTOR VEHICLES

Design solutions to increase the walkability of the area is through the development of the circulation for the station users and the public pedestrian. For the station users, the ease of access provided by opening old station buildings and new station gates in the west area of the region The addition of public transportation facilities at the bus stop allows for a more open circulation from the south area.

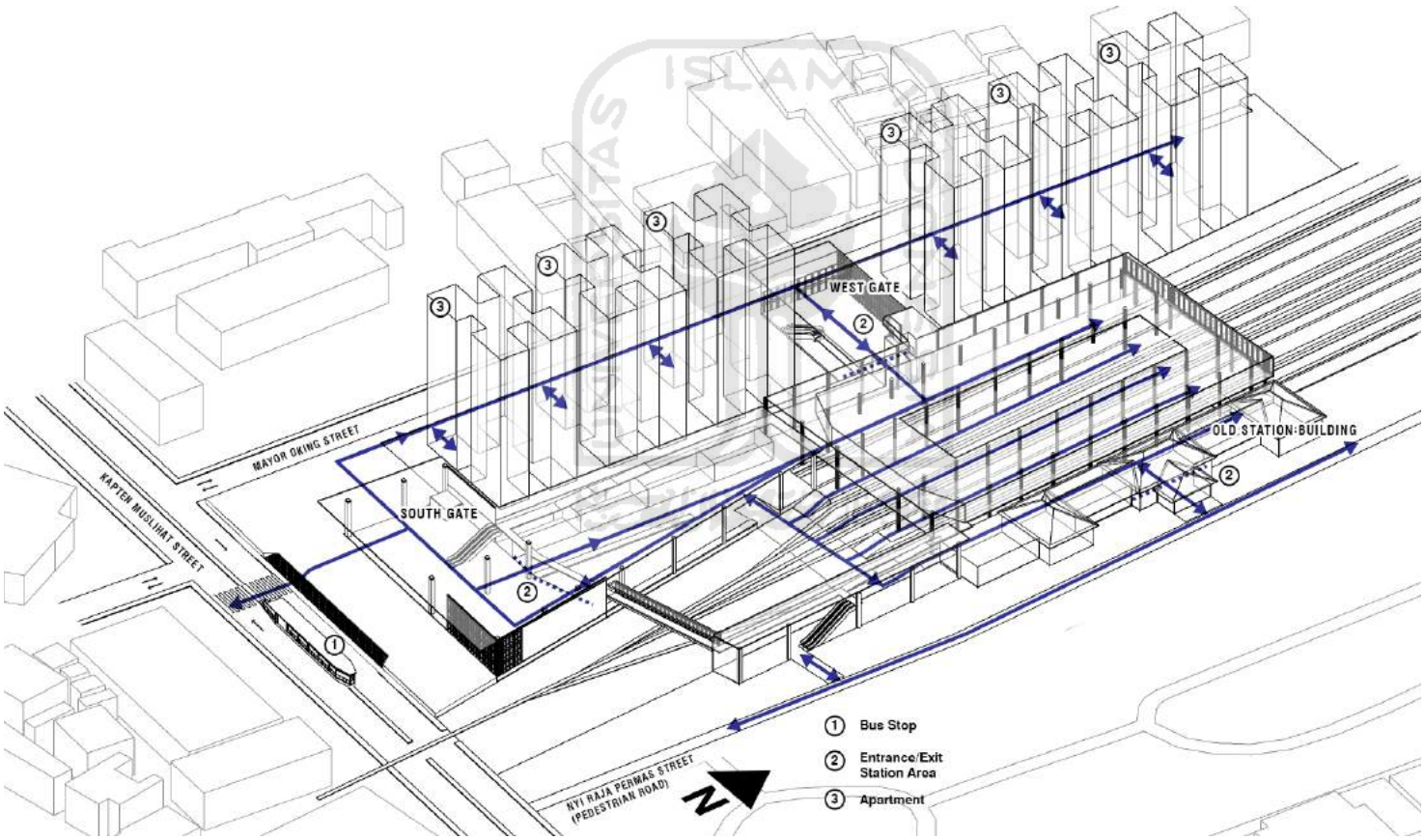


Figure 5.2.1: Circulation scheme of the station users
Source: Author (2021)

The design solution for the public pedestrian is by the development of circulation above the station area that allows the general public (not station users) to take shortcuts to walk to areas around the development area without having to go through ticket gates.

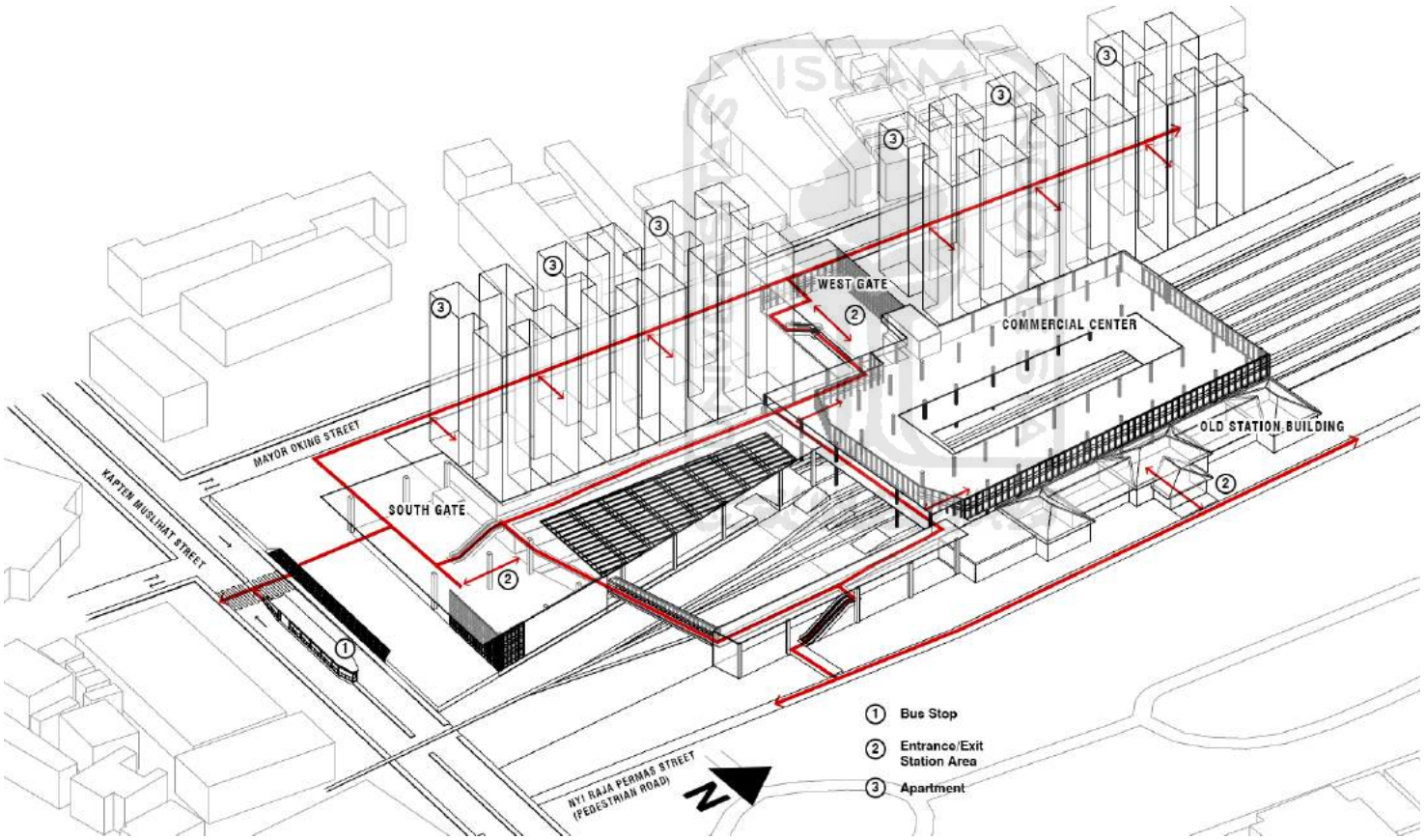


Figure 5.2.2: Circulation scheme of the public
Source: Author (2021)

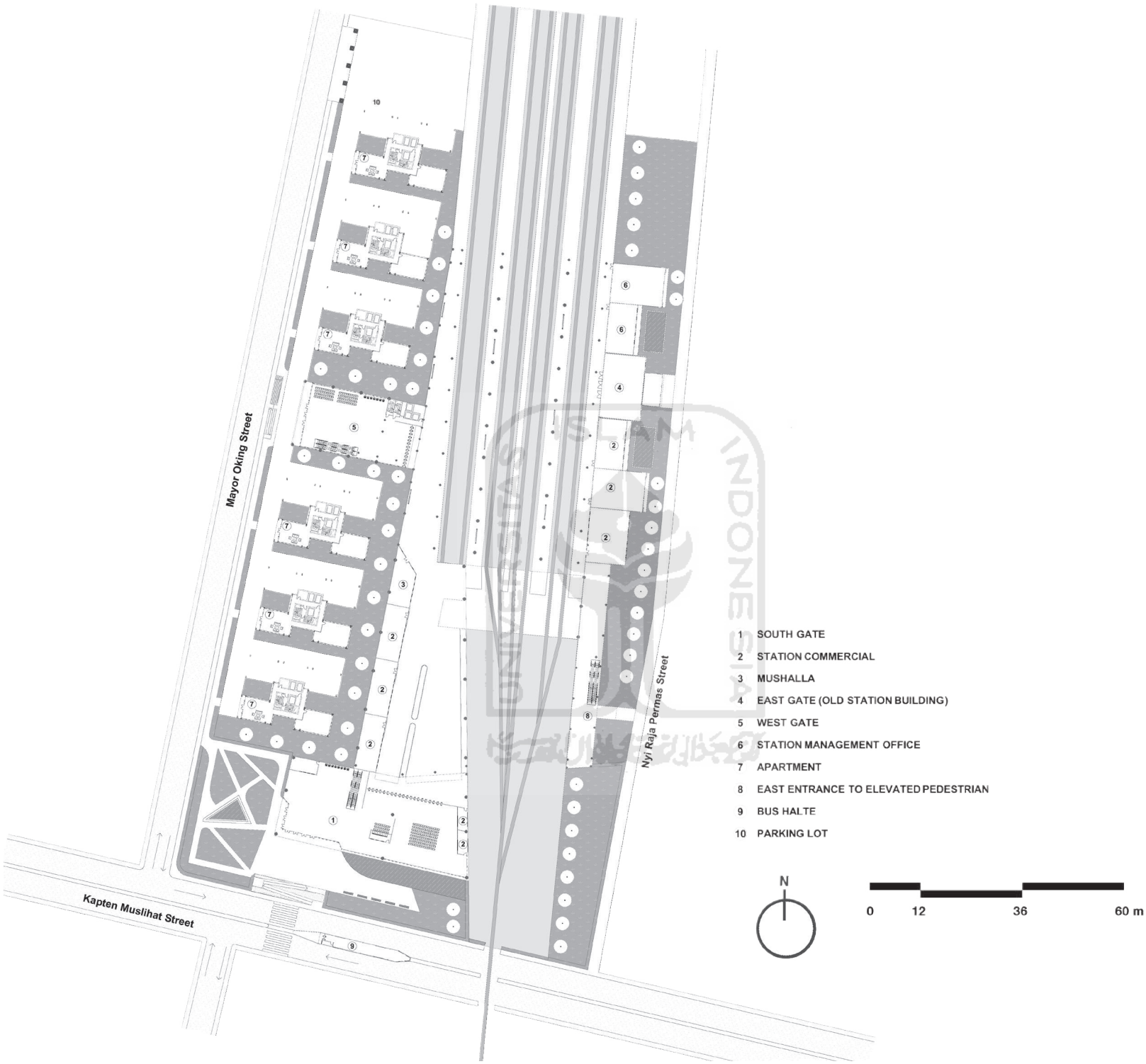


Figure 5.2.3: Siteplan of the development area
Source: Author (2021)

Figure 5.2.4: Mixed use building west elevation
Source: Author (2021)

Figure 5.2.5: Mixed use building north elevation
Source: Author (2021)

Figure 5.2.6: Mixed use building east elevation
Source: Author (2021)

Figure 5.2.7: Mixed use building south elevation
Source: Author (2021)

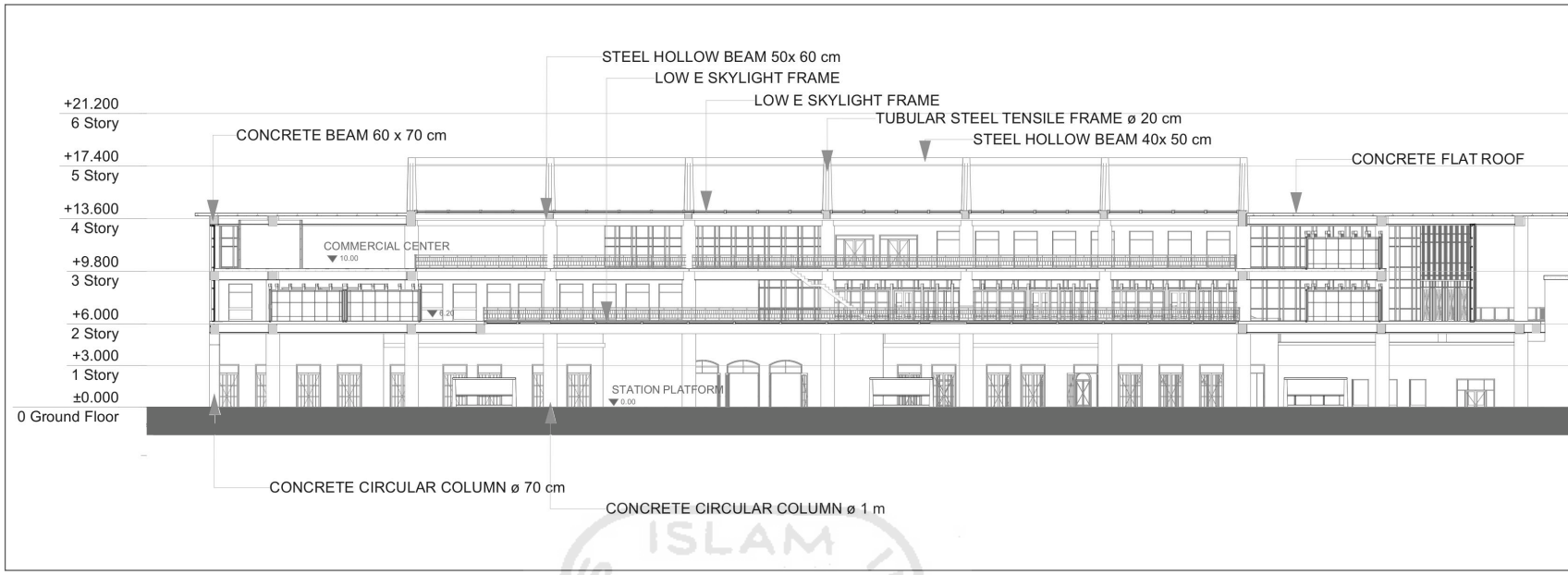
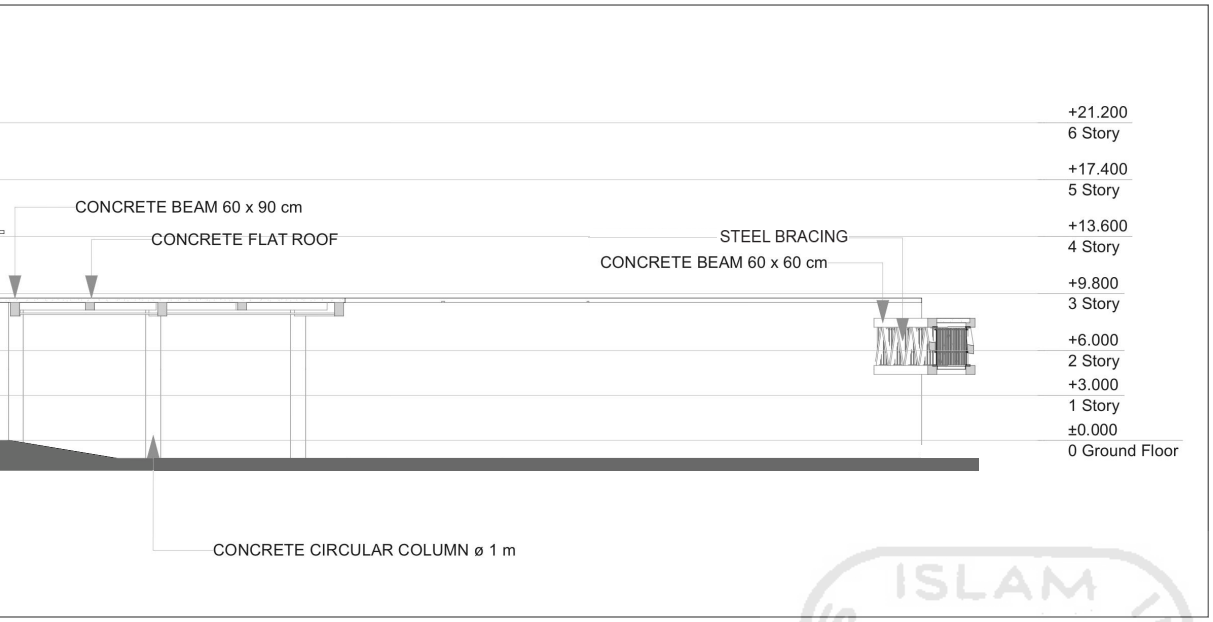


Figure 5.2.8: Mixed use building section A-A'
Source: Author (2021)

Figure 5.2.9: Mixed use building section B-B'
Source: Author (2021)


+21.200
6 Story
+17.400
5 Story
CONCRETE BEAM 60 x 90 cm
CONCRETE FLAT ROOF
STEEL BRACING
+13.600
4 Story
CONCRETE BEAM 60 x 60 cm
+9.800
3 Story
+6.000
2 Story
+3.000
1 Story
±0.000
0 Ground Floor
CONCRETE CIRCULAR COLUMN ø 1 m

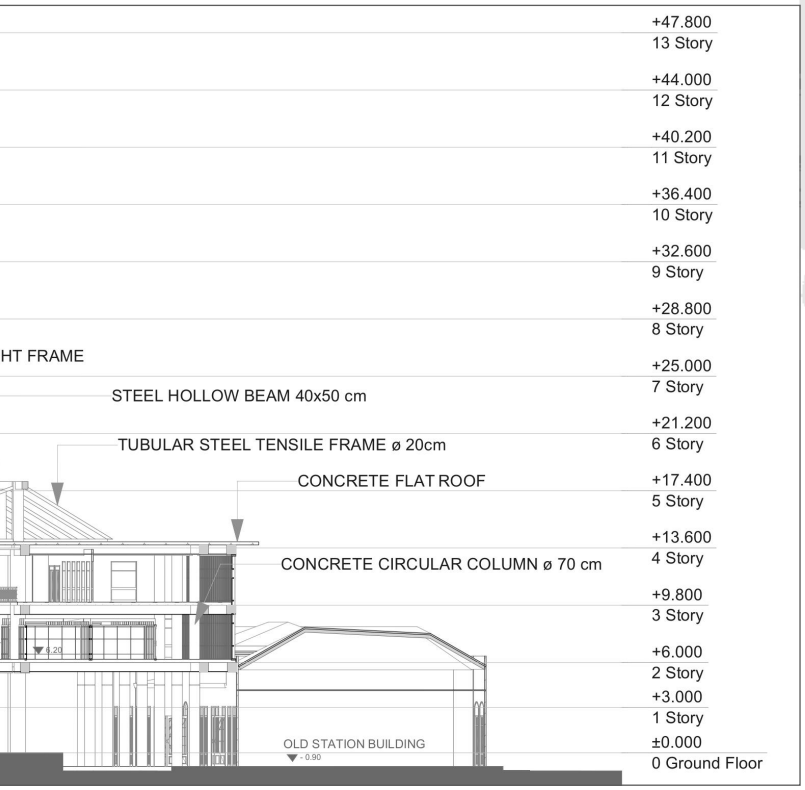

+47.800
13 Story
+44.000
12 Story
+40.200
11 Story
+36.400
10 Story
+32.600
9 Story
+28.800
8 Story
HT FRAME
+25.000
7 Story
STEEL HOLLOW BEAM 40x50 cm
+21.200
6 Story
TUBULAR STEEL TENSILE FRAME ø 20cm
CONCRETE FLAT ROOF
+17.400
5 Story
+13.600
4 Story
CONCRETE CIRCULAR COLUMN ø 70 cm
+9.800
3 Story
+6.000
2 Story
+3.000
1 Story
OLD STATION BUILDING
±0.000
0 Ground Floor

Figure 5.2.10: South gate
Source: Author (2021)

Figure 5.2.11: West gate
Source: Author (2021)

Figure 5.2.12.: Access to elevated circulation from east
Source: Author (2021)

Figure 5.2.13.: Access to elevated circulation from south gate
Source: Author (2021)

Figure 5.2.14: Birdeye perspective of the mixed use building
Source: Author (2021)

5.3 RESIDENTIAL DESIGN

With a strategic site location development tends to be exclusive while. In order to solve problems in the wider context of the city residential development within the area must be accessible to a wider variety of people. The design solution uses the hybrid modular that combine main structure and prefabricated modules that form the living unit. The design strategy able to increase affrodability as prefabrication could reduce cost and also open for adaptability in which the module might be reconfigured to response the need of the residents.

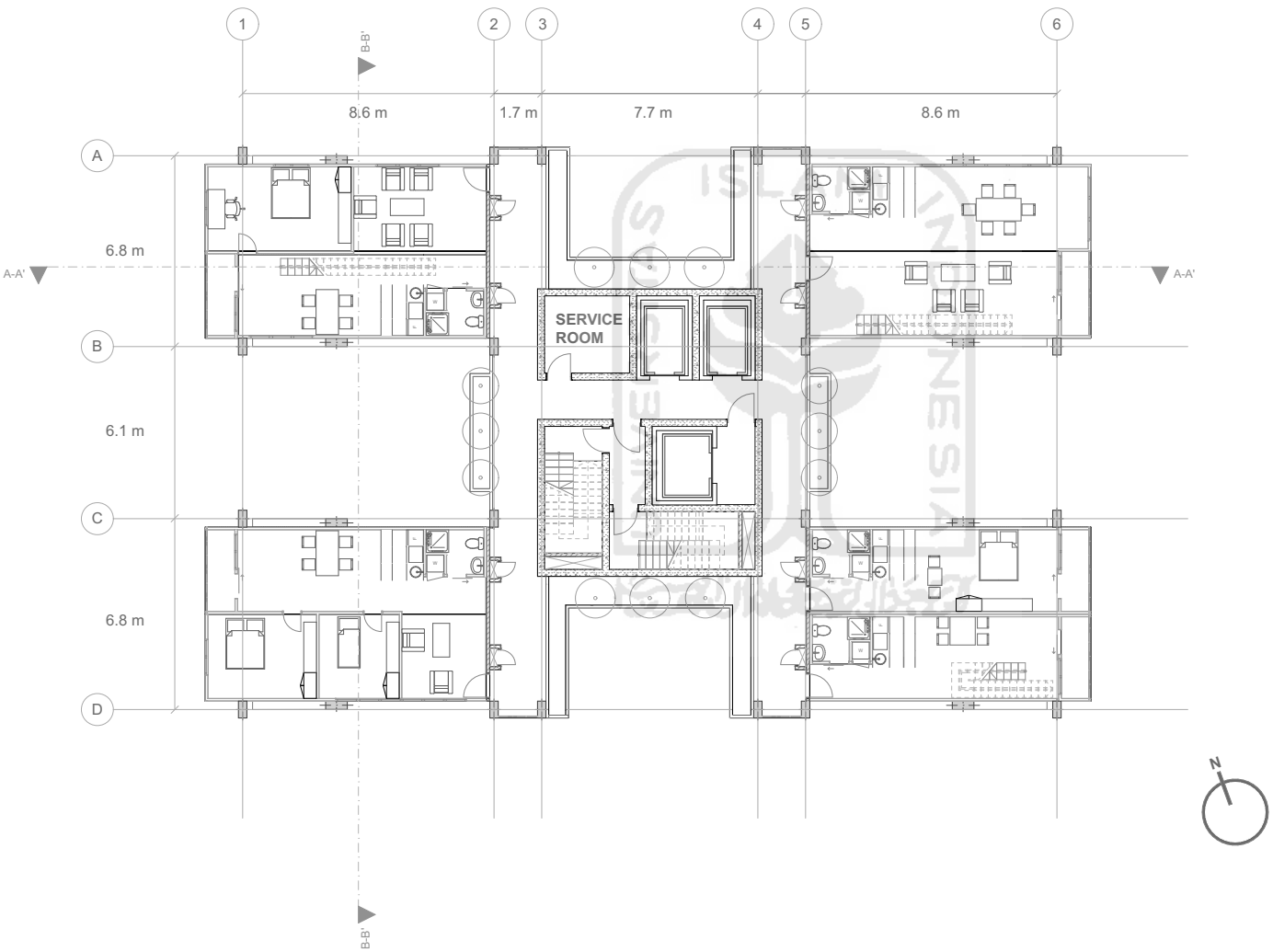


Figure 5.3.1: Typical floorplan of the apartment
Source: Author (2021)

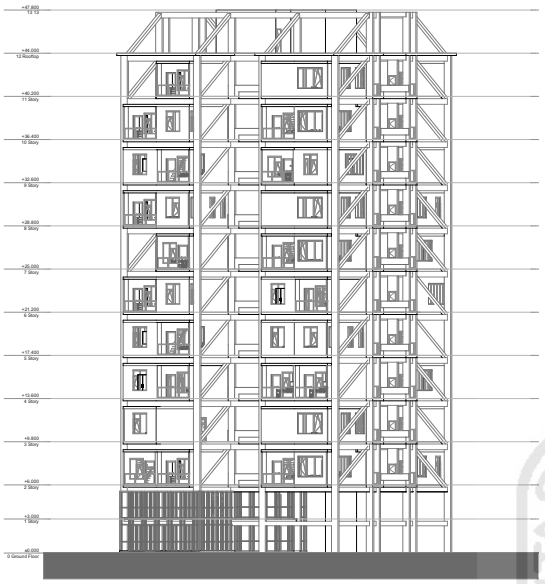


Figure 5.3.2: Apartment west elevation
Source: Author (2021)

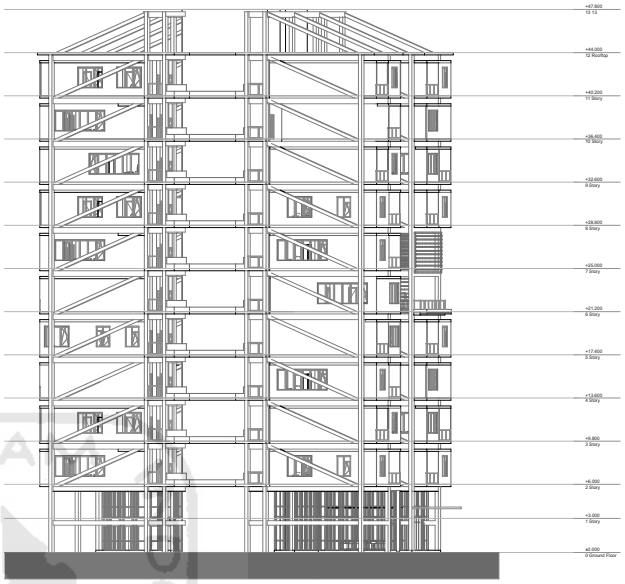


Figure 5.3.3.: Apartment north elevation
Source: Author (2021)

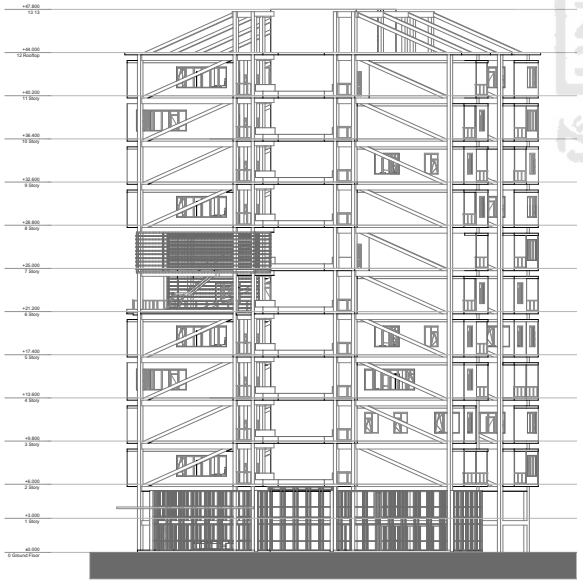


Figure 5.3.4: Apartment south elevation
Source: Author (2021)

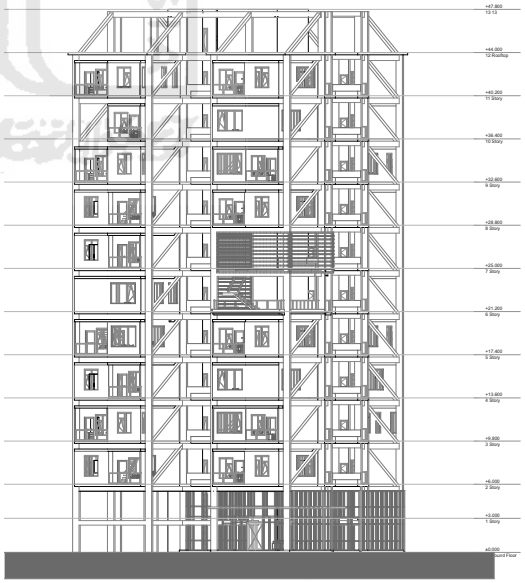


Figure 5.3.5.: Apartment east elevation
Source: Author (2021)

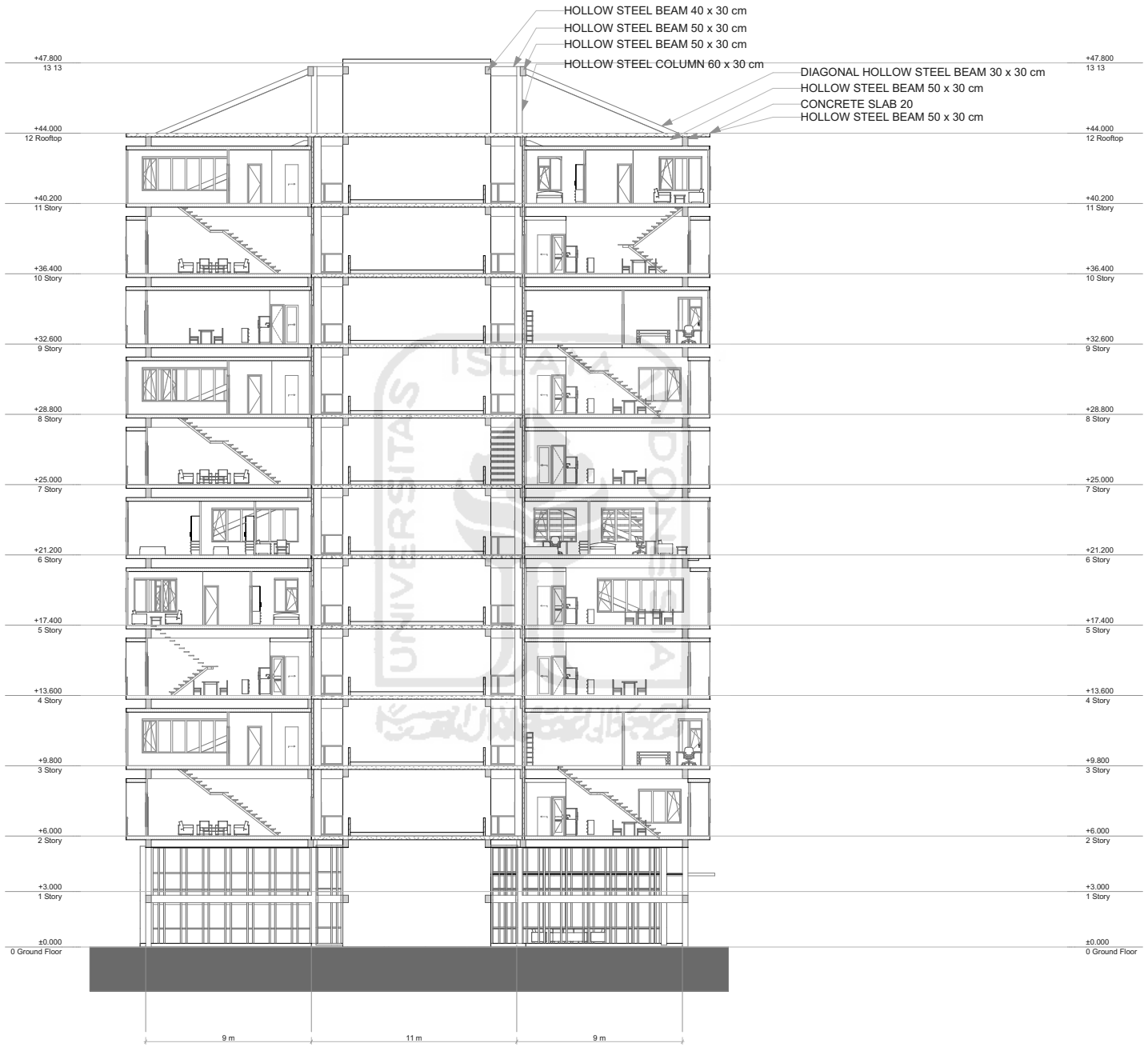


Figure 5.3.6: Apartment section A-A'
Source: Author (2021)

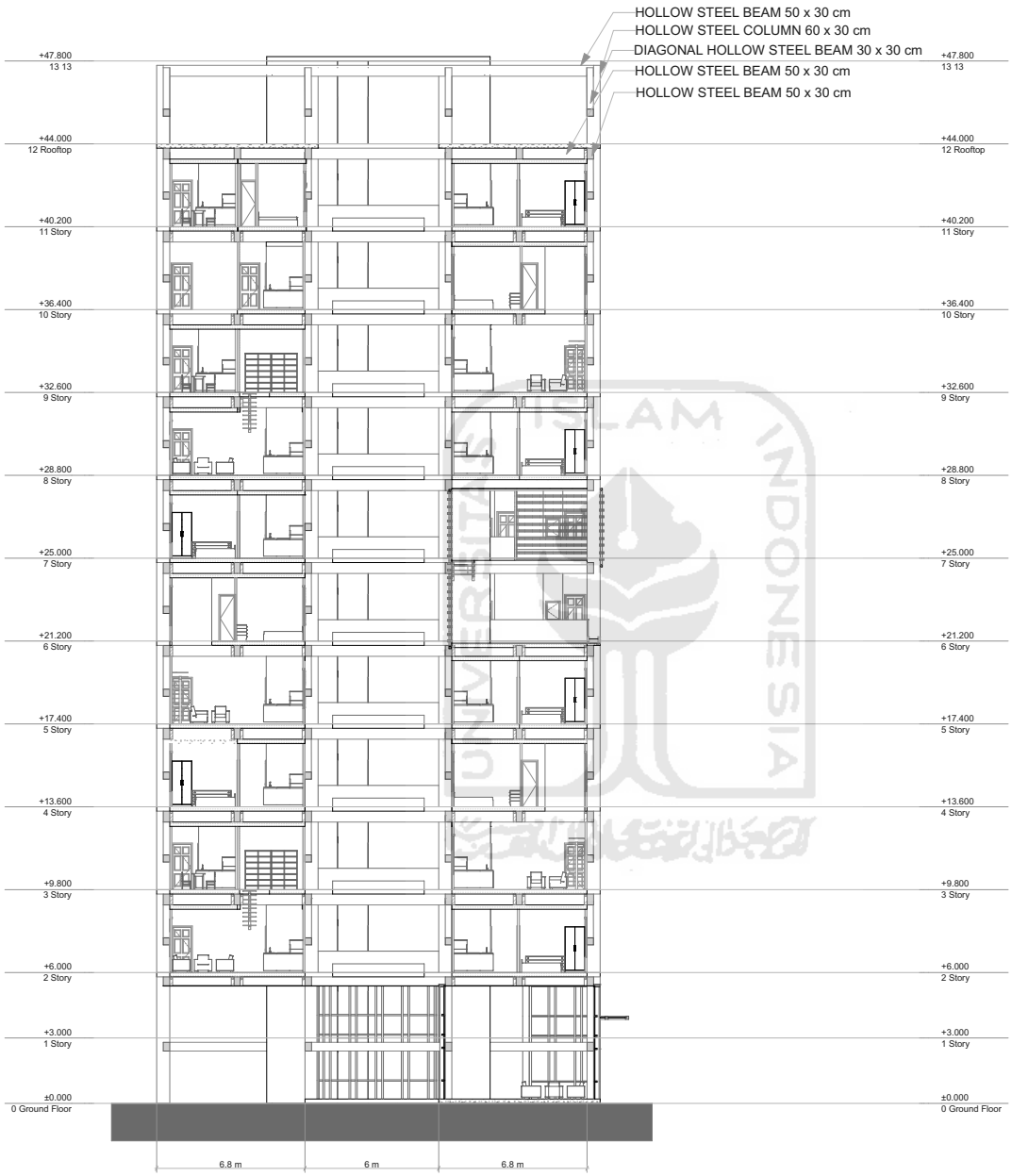


Figure 5.3.7: Apartment section B-B'
Source: Author (2021)

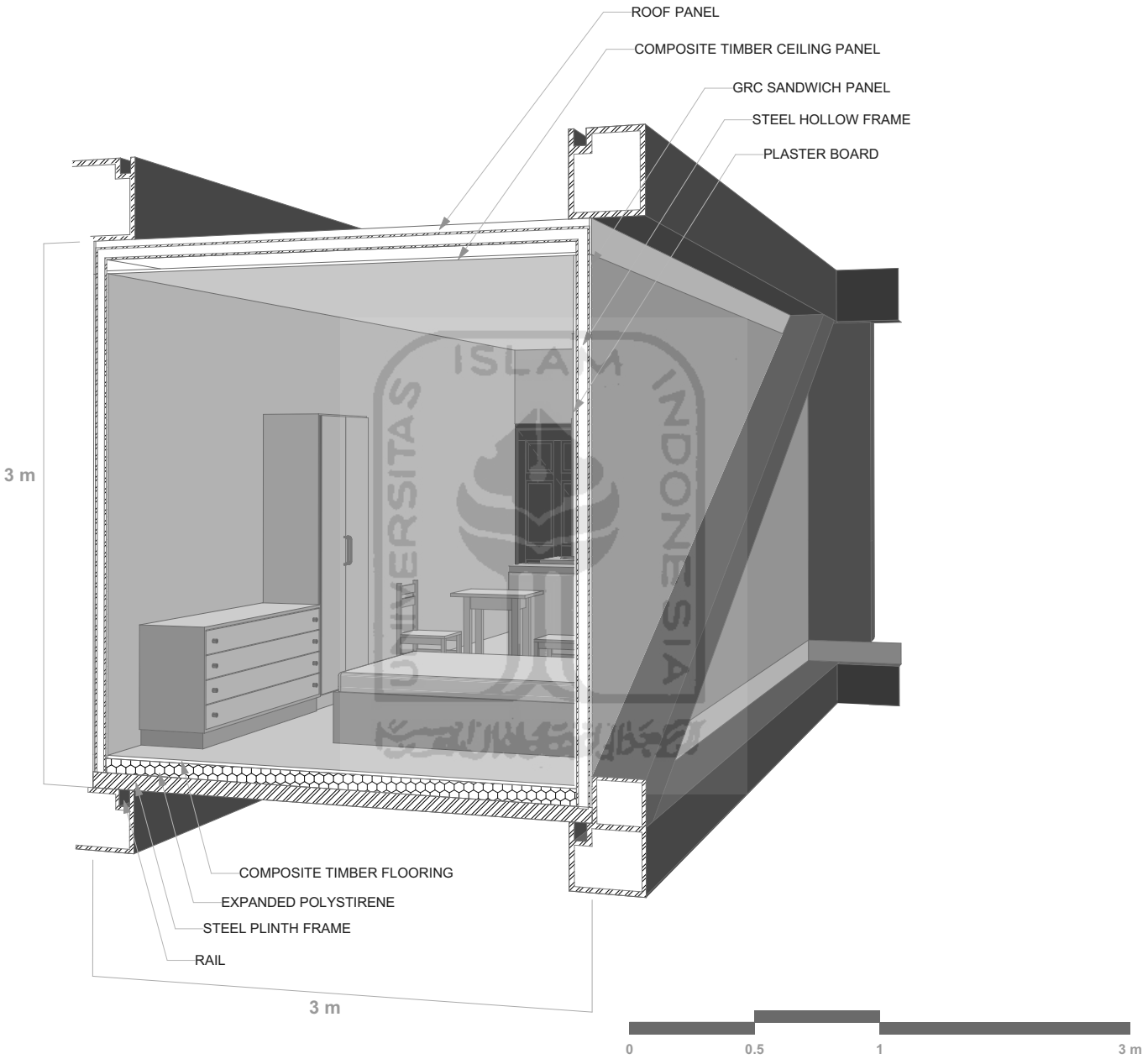


Figure 5.3.8: Module detail 1
Source: Author (2021)

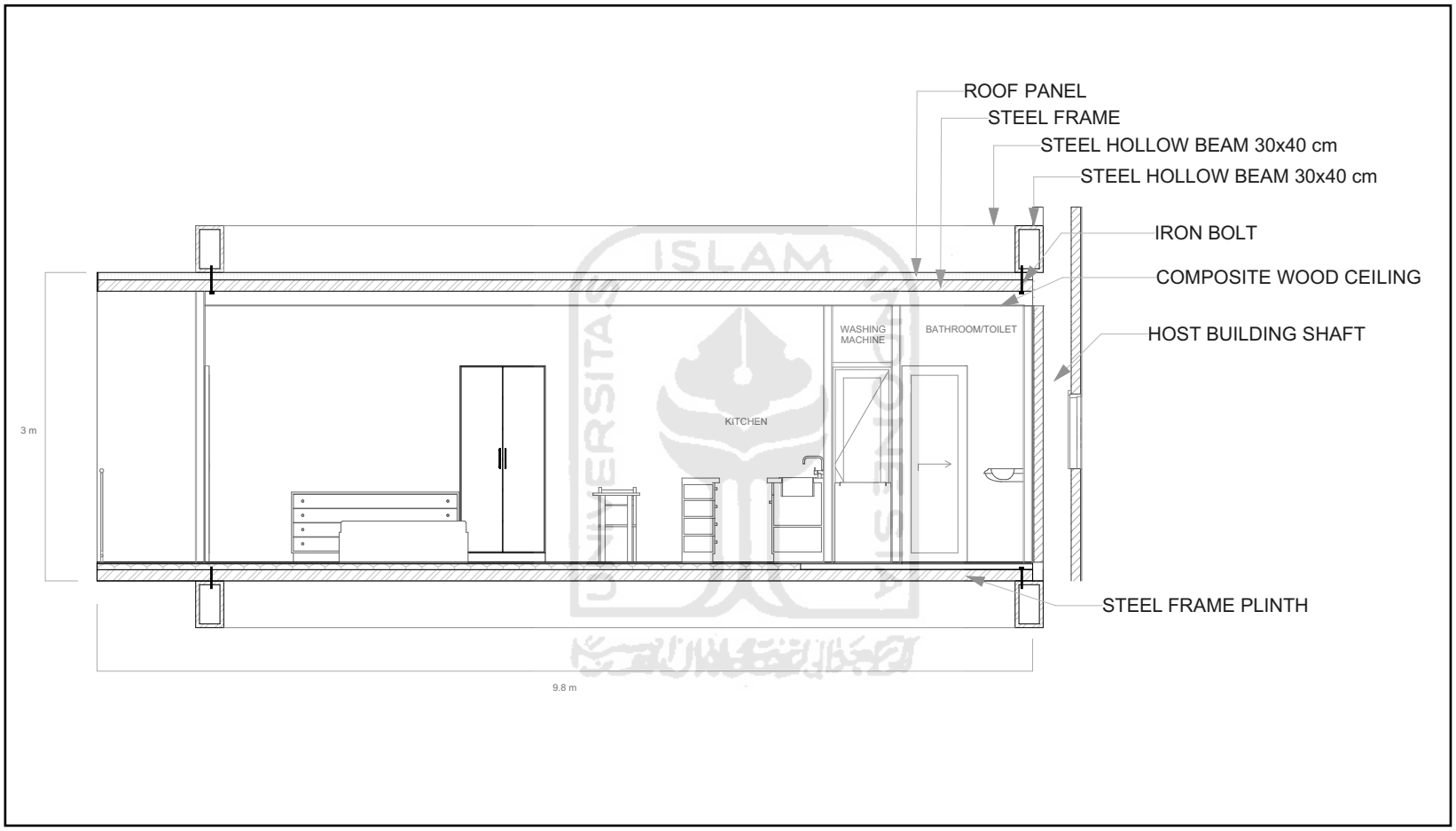
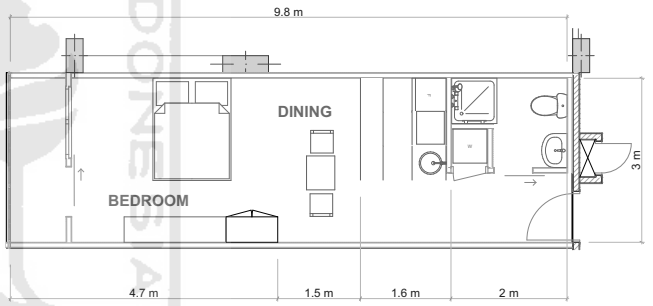


Figure 5.3.9: Module detail 2
Source: Author (2021)

5.3.1 APARTMENT UNITS

The design improved from the preliminary design that has the basic module of 9 x 3 m and the horizontal form of the apartment unit. The apartment unit is formed by the basic prefabricated module with the size of 10 x 3 m in which is able to be transported by cargo train and truck to the site to be inserted into the host structure of the apartment building. The formation of the unit is by vertically and horizontally to use space more efficiently. The configuration of the modules forms 5 types of apartment units.

5.3.1.1 STUDIO UNIT



30m2

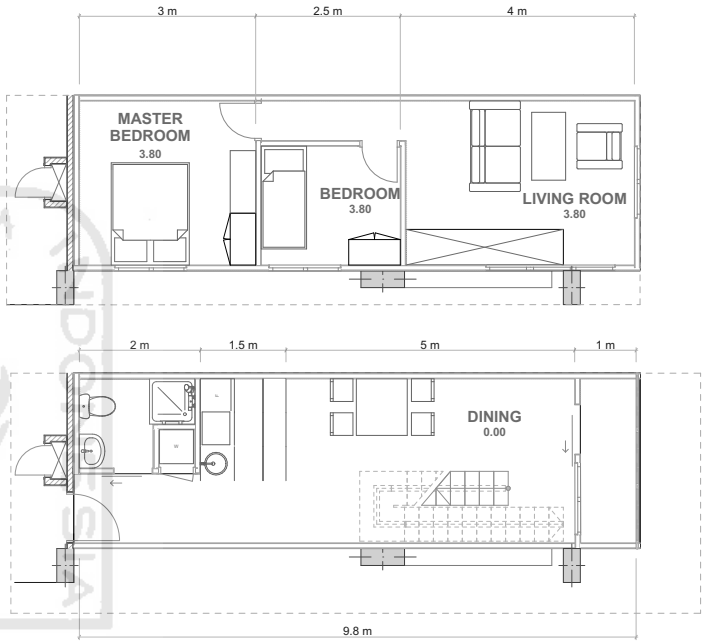
STUDIO UNIT 30 m2

- **Bedroom**
- **Bathroom/Toilet**
- **Kitchen**
- **Diningroom**
- **Balcony**

Figure 5.3.1.1.1: Studio Unit
Source: Author (2021)

Figure 5.3.1.1.2: Interior render of studio unit
Source: Author (2021)

5.3.1.2 SMALL UNIT



30m2 + 30m2

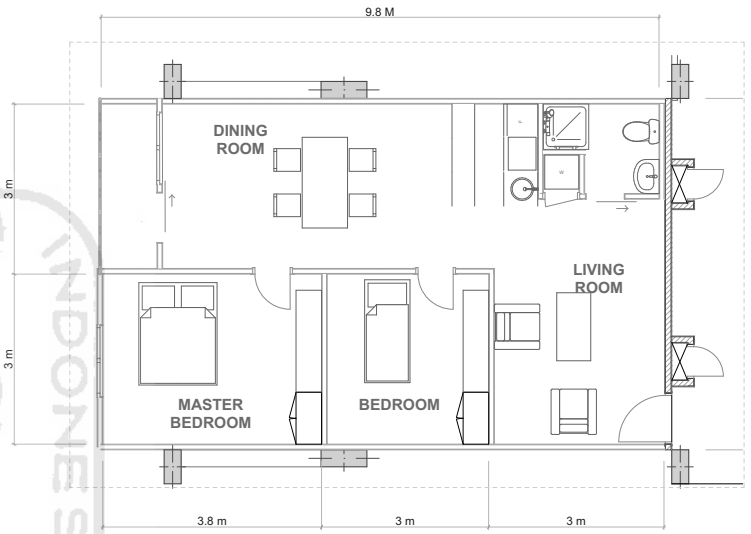
SMALL UNIT
60 m2

- **Master bedroom 9m2**
- **Bedroom 7.5 m2**
- **Bathroom/Toilet**
- **Kitchen**
- **Livingroom**
- **Diningroom**
- **Balcony**

Figure 5.3.1.2.1: Small Unit
Source: Author (2021)

Figure 5.3.1.2.2: Interior render of small unit
Source: Author (2021)

5.3.1.3 SMALL UNIT (HORIZONTAL)



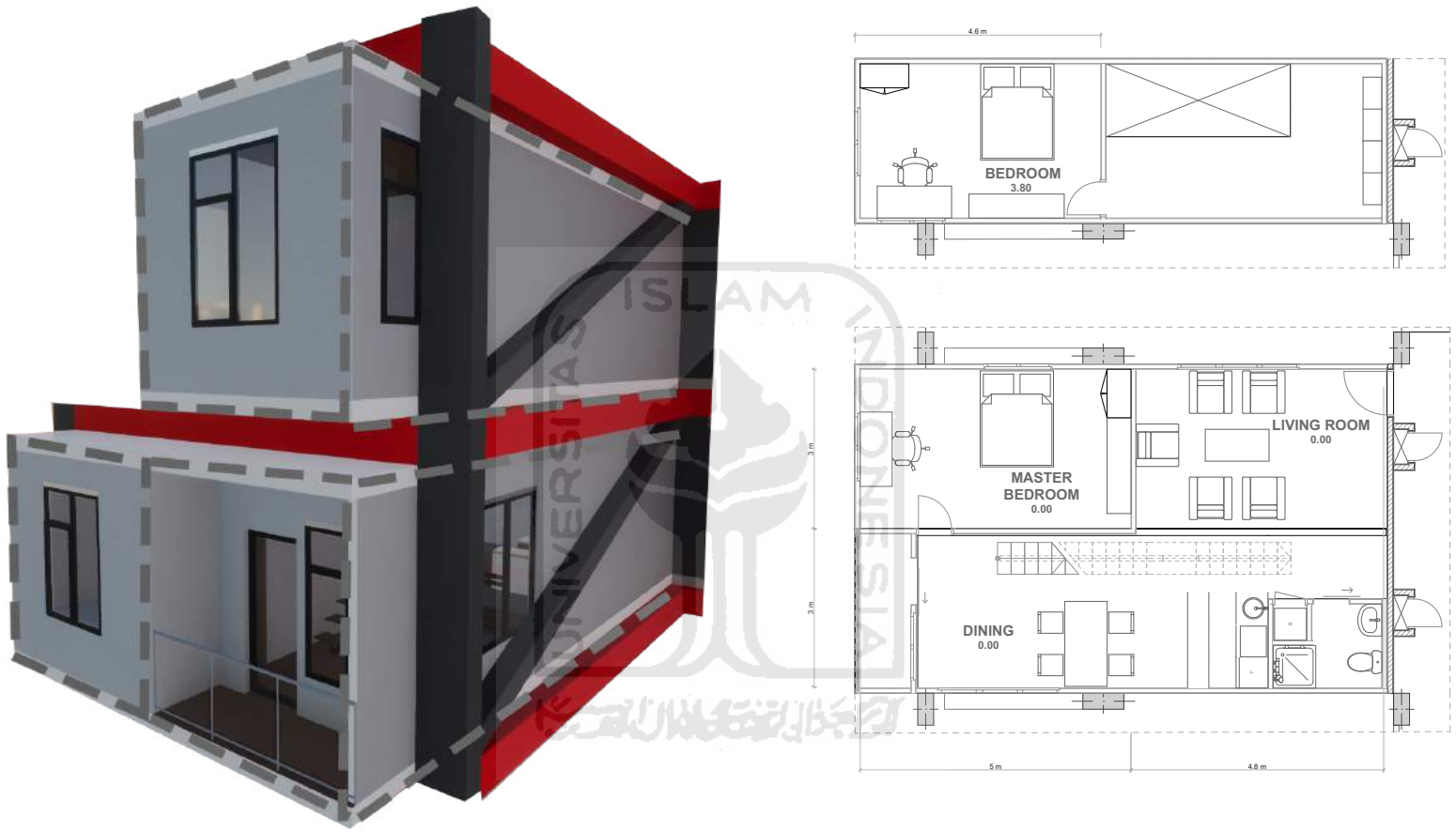
30m2 + 30m2 **SMALL UNIT**
60 m2

- Master bedroom 11.4m2
- Bedroom 9 m2
- Bathroom/Toilet
- Kitchen
- Livingroom
- Diningroom
- Balcony

Figure 5.3.1.3.1: Small Unit (horizontal)
Source: Author (2021)

Figure 5.3.1.3.2: Interior render of small (horizontal) unit
Source: Author (2021)

5.3.1.4 MEDIUM UNIT



30m2 + **30m2** **30m2**

MEDIUM UNIT
90 m2

- **Master bedroom 15 m2**
- **Bedroom 13.8 m2**
- **Bathroom/Toilet**
- **Kitchen**
- **Livingroom**
- **Diningroom**
- **Balcony**

Figure 5.3.1.4.1: Medium Unit
Source: Author (2021)

Figure 5.3.1.4.2: Interior render of medium unit
Source: Author (2021)

5.3.1.5 LARGE UNIT

30m2 + 30m2 / 30m2 + 30m2

LARGE UNIT
120 m2

- Master bedroom 20m2
- Bedroom 10.5 m2
- 2 Bathroom/Toilet
- Kitchen
- Livingroom
- Diningroom
- Balcony

Figure 5.3.1.5.1: Large Unit
Source: Author (2021)

Figure 5.3.1.5.2: Interior render of large unit
Source: Author (2021)

5.3.2 COMMON SPACE

One of the problem within the mixed income development is that the community building between the diverse group found to be infrequent which may reduce the advantage of the concept. Common space added in the building plan as the space for the apartment community socialization and activities. Common space placed typically on the 6th and 7th floor plan of the apartment. The space offer ample space with a high ceiling and wide view towards the city. The space have total area of 89 m2.

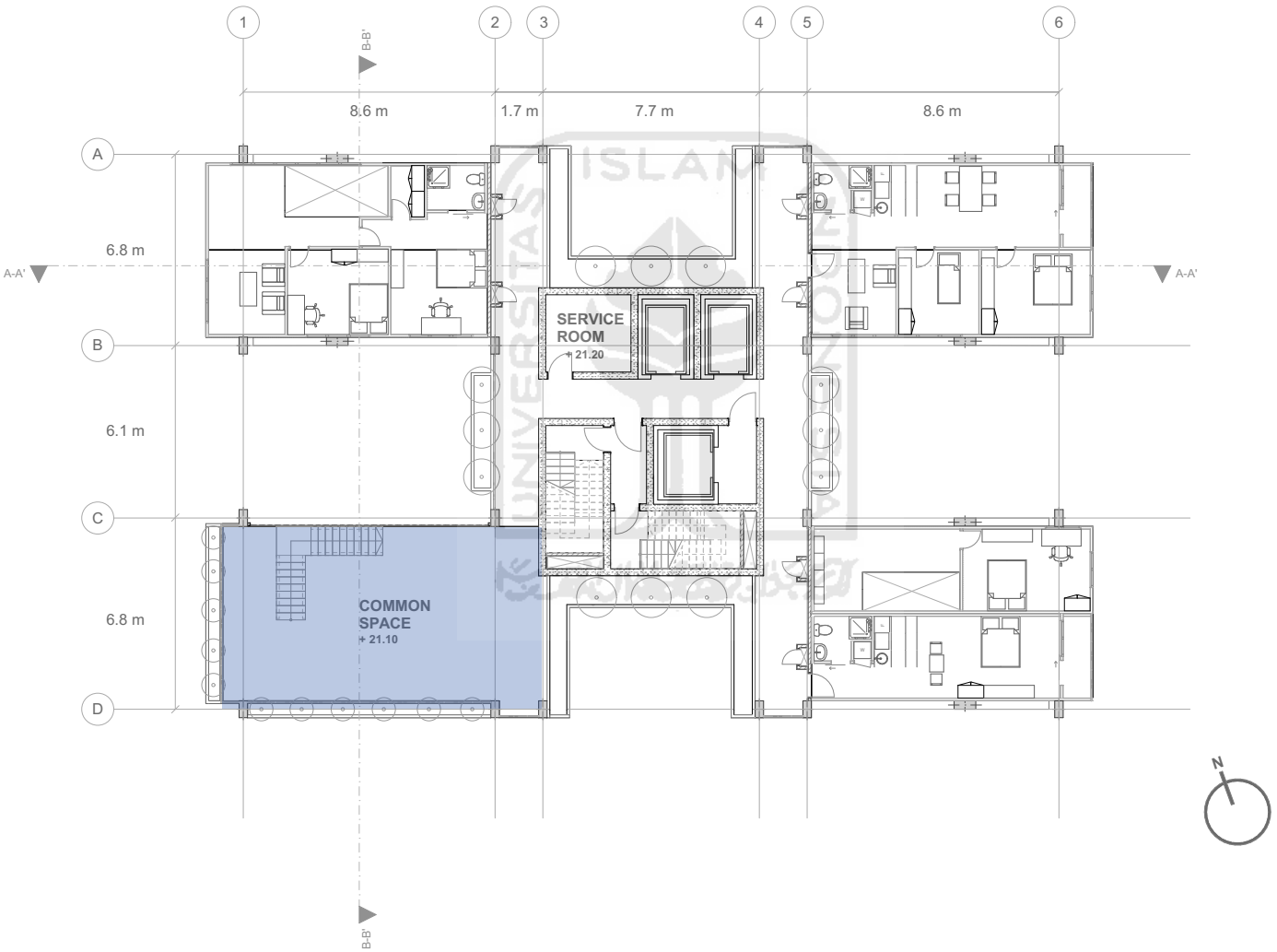


Figure 5.3.2.1: Typical 6th floor apartment plan with common space
Source: Author (2021)

Figure 5.3.2.2: Render of the common space
Source: Author (2021)

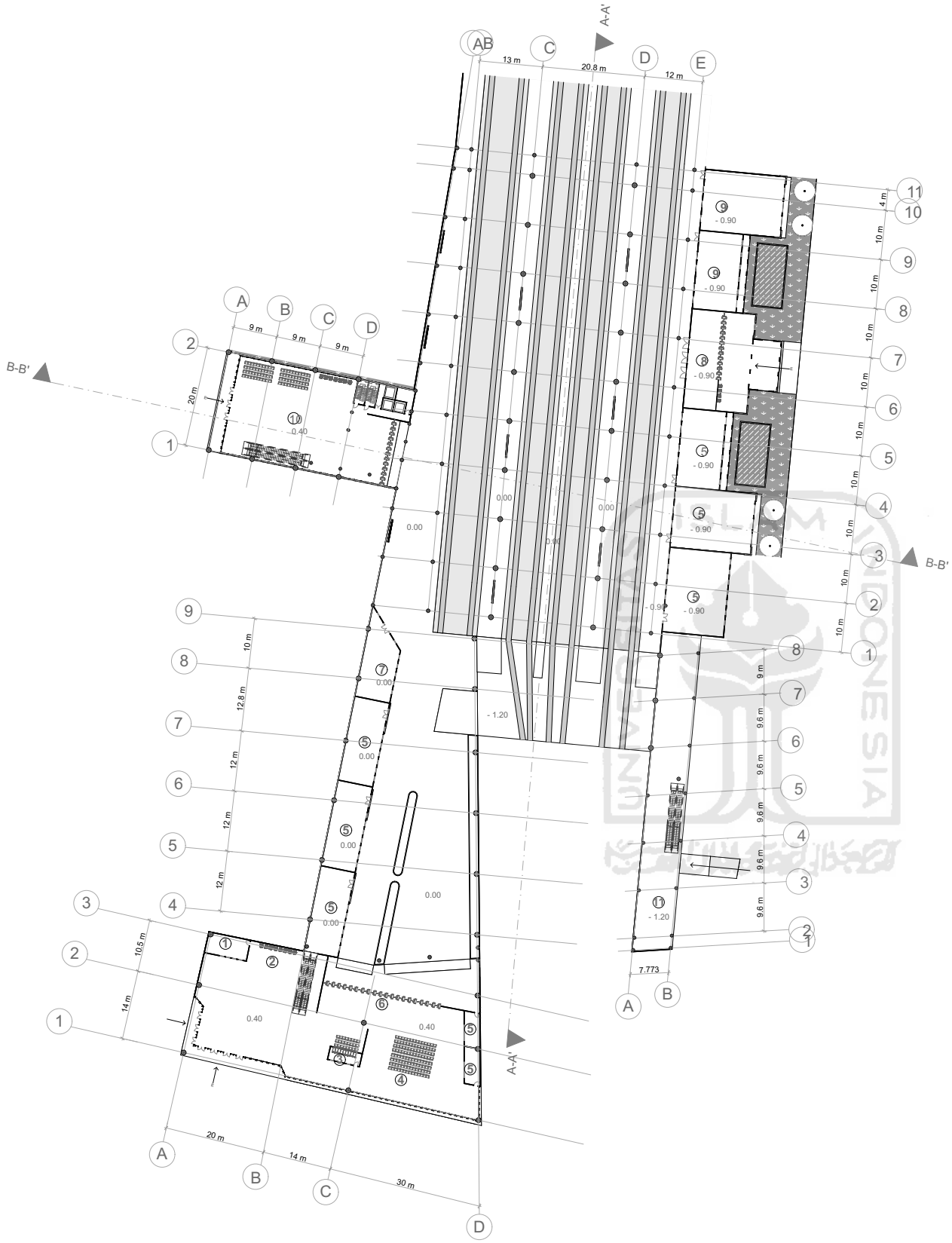
5.4 COMMERCIAL FACILITIES DESIGN

As a response to the congestion issues development of the commercial facility is important to be able to fulfill the needs of the people (apartment residents, station users, and public) around the station area so it could reduce the need of using private vehicles because of the ease to fulfill just by walking or public transportation. Other than that the developer of the area also needs to maintain and increase the commerciality for return of investment and profit.

The commercial facilities are situated around the circulation of the mixed-use building in which consists of the station user and the public. The commercial center is situated over the station platform that is connected by the elevated public circulation of the mixed building so that the center could be accessed by more people.

Commercial units in mixed-use areas consist of conventional units and display stores. Display store is commercial units with a mixed retail strategy (physical and e-commerce) that only use physical space to display the items. The display store opens for the opportunity to the investor that runs e-commerce to show they physical items to the potential customer to further convince them to buy. As a result, the space for the retail of the display store is reduced while still could maximize the productivity compared to the larger conventional store through its flexibility.

The commercial center consists of the display stores, the anchor store (supermarket and home appliance), and the foodcourt. Application of the technology of interactive digital billboards brings the stores of the commercial center closer to the station users to further take advantage of the station's high traffic. The digital billboard would advertise the items offered on the commercial center and transactions could be done directly through the billboard.



① TICKET OFFICE
② TICKET MACHINE
③ ATM CENTER
④ WAITING SPACE
⑤ COMMERCIAL SPACE
⑥ TICKET GATE
⑦ MUSHALLA
⑧ OLD STATION BUILDING/ EAST GATE
⑨ STATION MANAGEMENT OFFICE
⑩ WEST GATE
⑪ EAST ENTRANCE TO ELEVATED PEDESTRIAN

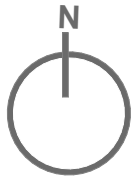


Figure 5.4.1: Groundfloor plan of the mixed use building
Source: Author (2021)

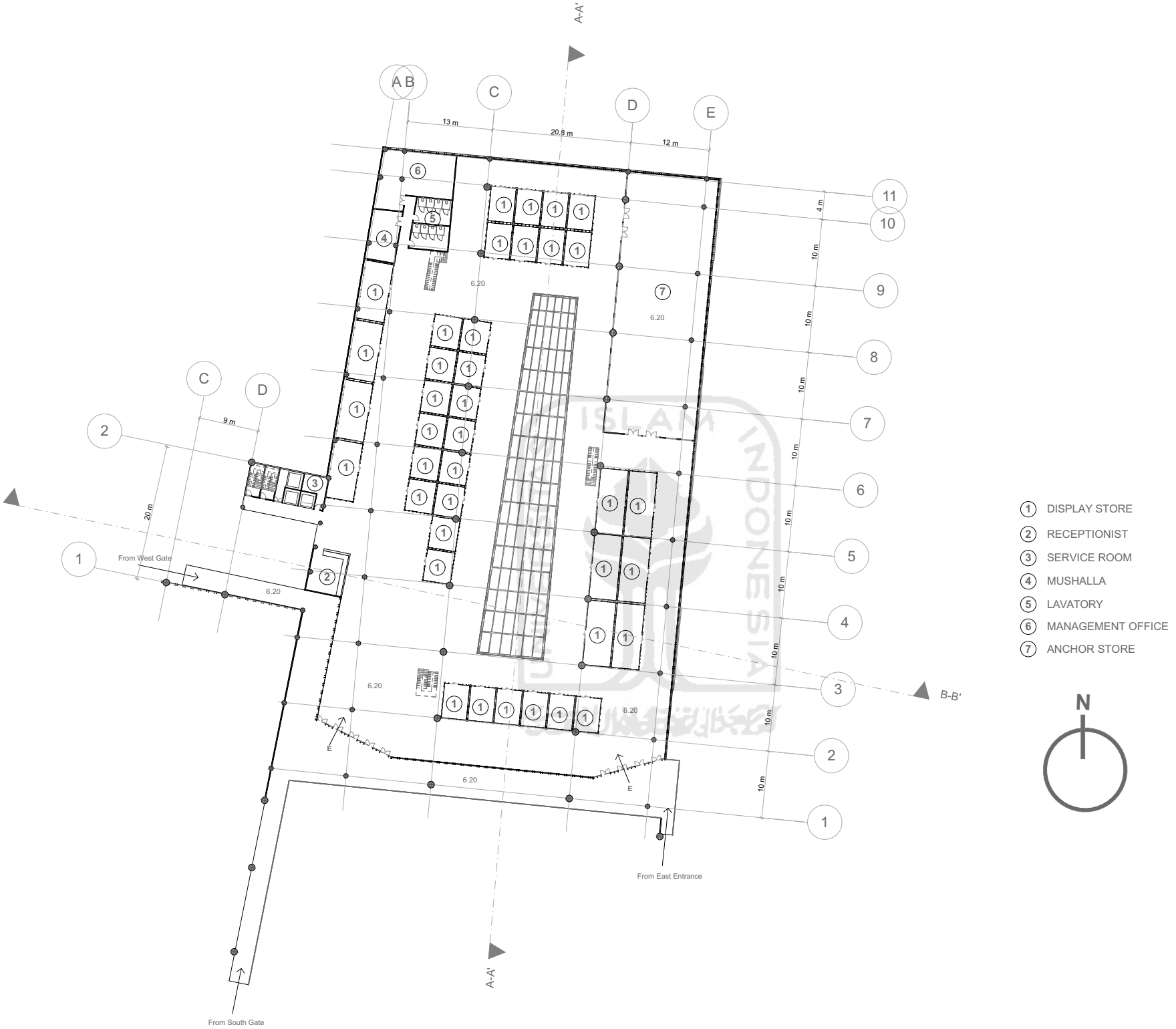


Figure 5.4.2: Groundfloor plan of the commercial center
Source: Author (2021)

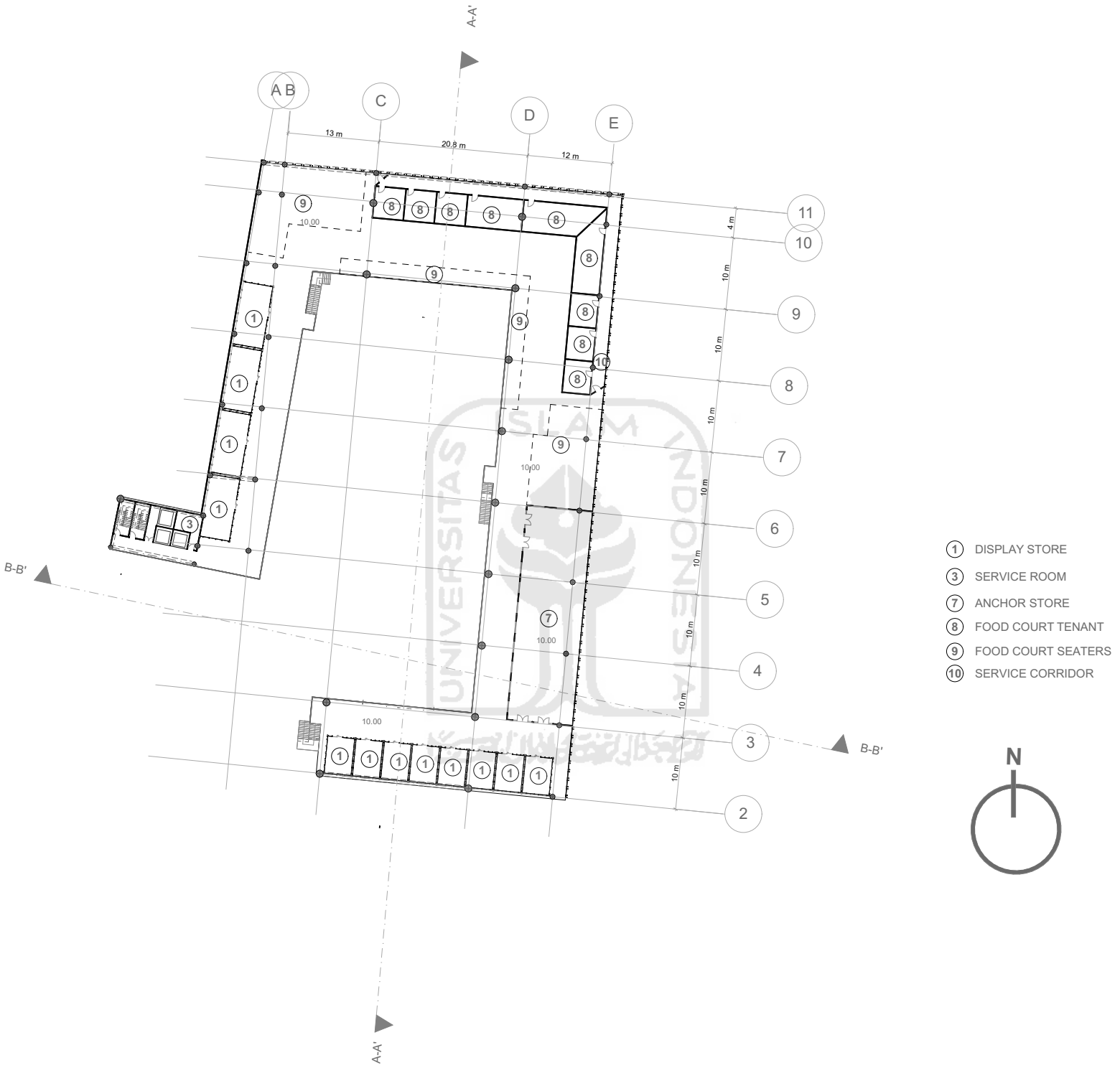


Figure 5.4.3: 1st floor plan of the commercial center
Source: Author (2021)

5.4.1 COMMERCIAL FACILITIES AROUND THE MIXED USE BUILDING CIRCULATION AREA

Figure 5.4.1.1: Commercial facilities in the south gate waiting space
Source: Author (2021)

Figure 5.4.1.2: Commercial facility on the circulation from the south gate to the station platform
Source: Author (2021)

Figure 5.4.1.3: Space below east elevated circulation used to support street vendors
Source: Author (2021)

Figure 5.4.1.4: Some space of the old station building utilized as the commercial facility
Source: Author (2021)

5.4.2 COMMERCIAL CENTER ABOVE THE STATION PLATFORM

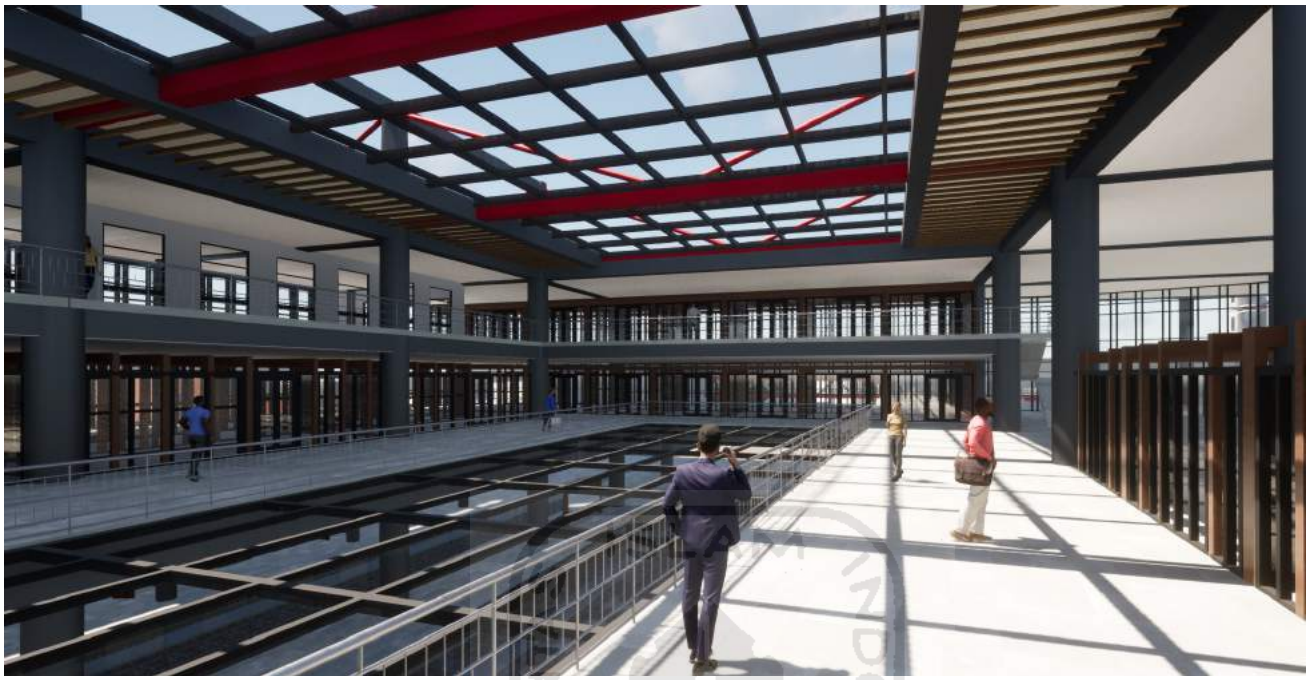


Figure 5.4.2.1: Render of commercial center interior above the station platform
Source: Author (2021)

Figure 5.4.2.2: Display store retail space
Source: Author (2021)

5.4.3 INTERACTIVE DIGITAL BILLBOARD FOR ADVERTISEMENT AND TRANSACTION

The function of the interactive digital billboard is to advertise and also as transaction medium commercial center stores above the station platform. Therefore the busy station user could have easier access to the store. If the customer purchase through the billboard then item would directly send to the customer adress. When in doubt about item then the customer could visit the commercial center and check the showcased item.

Figure 5.4.3.1: Interactive digital billboard of the commercial center placed on the station platform area
Source: Author (2021)

Figure 5.5.1: Online questionnaire
Source: Author (2021)

5.5 DESIGN TESTING

The design testing conducted through online questionnaire with public respondents. The questionaire first explain about the design intentions and the concept behind it then question about the perception of the respondent of the design as a solution and the interest in the design as commercial.

The question consist of:1. When around the station, do the design reduce your need to travel with a private motorized vehicle?
2. With the results of the design are you interested in owning/living the apartment unit?
3. Do the design make you interested in utilizing / enjoying commercial facilities in the area?
4. If as an entrepreneur, do the design make you interested in opening a business in a commercial space in the area?

From 32 respondents the result show 90% positive reponse for the first question, second question with 84% positive response, third question with 97% positive response, and fourth question with 94% positive response. Response and critic for the design could be used as the lesson learn and points for further development.

06 EVALUATION

- CHAPTER SUMMARY
- IMPROVEMENT ON THE OUTDOOR PEDESTRIAN PATH
- IMPROVEMENT ON STATION PLATFORM CROSSING CIRCULATION

6.1 CHAPTER SUMMARY

The chapter of design evaluation discusses evaluation on the design results and some improvement of the design based on jury feedback. The content of the chapter including the improvement of outdoor pedestrian path design and station platform crossing circulation.

6.2 IMPROVEMENT ON THE OUTDOOR PEDESTRIAN PATH

The improvement of the design is through the addition of canopy over the outdoor path to make more convinient pedestrian circulation as Bogor city has high rain precipitation.

Figure 6.1.1: Before improvement of outdoor pedestiran path design
Source: Author (2021)

Figure 6.1.2: Improvement of the outdoor pedestiran path by the addition of canopy
Source: Author (2021)

6.2 IMPROVEMENT ON STATION PLATFORM CROSSING CIRCULATION

The design before the improvement has the platform crossing feature of the existing station which is through the path that has the same level as the train rail. The existing crossing has such design as Bogor station is the last destination of the commuter train, so the rail to the next station is seldom to be passed by the train. But still, the design is less safe and unfit as the feature of the modern building. The improvement of the design is by the development of a basement path which has an unobstructed circulation and different levels with the train rail. The development offers safer circulation, more convenient path, and the separation of the public and station user could be maintained.

Figure 6.2.1: Before improvement of station platform crossing circulation
Source: Author (2021)

Figure 6.2.2: Improvement of the station platform crossing circulation to basement path
Source: Author (2021)

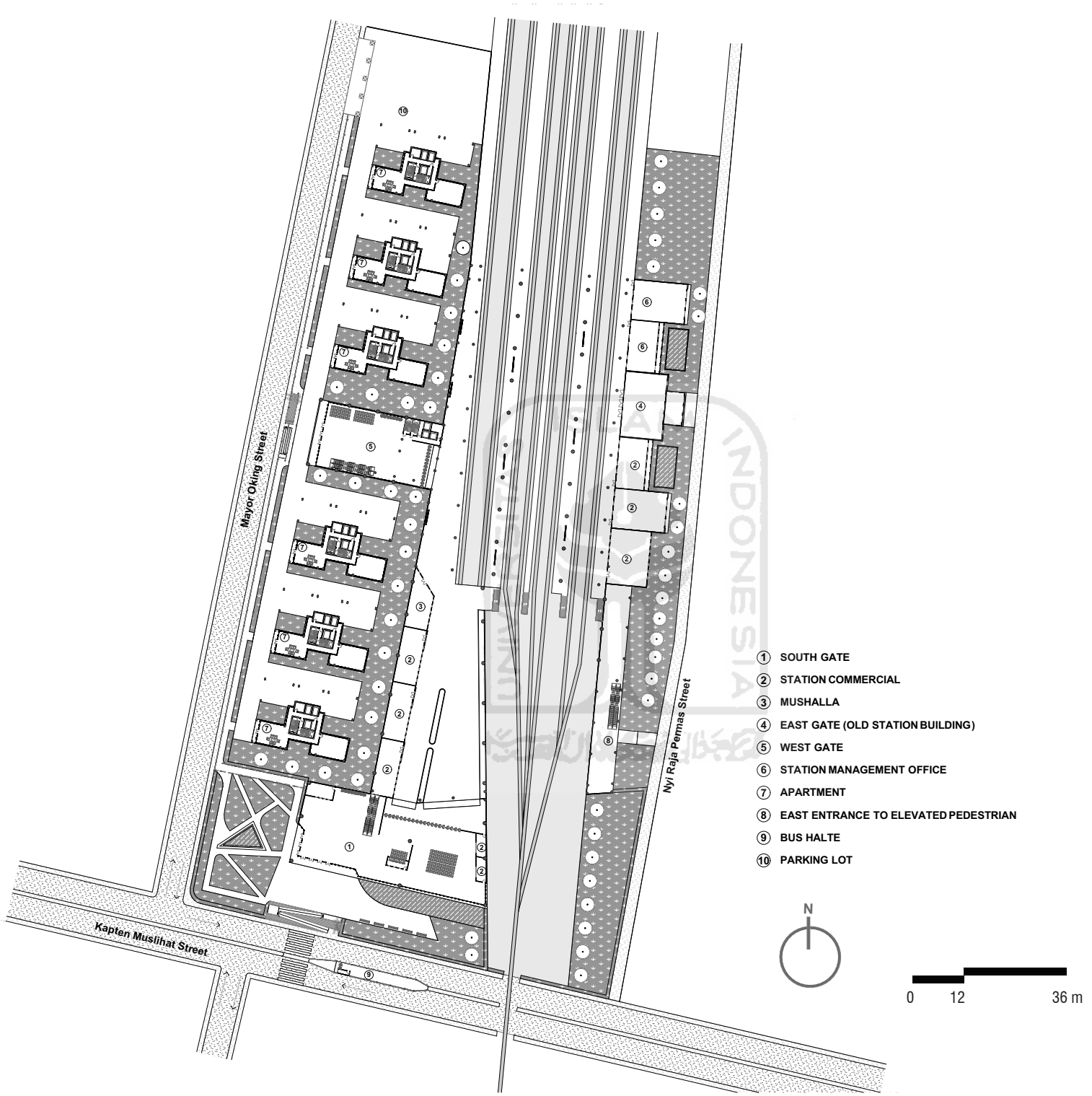
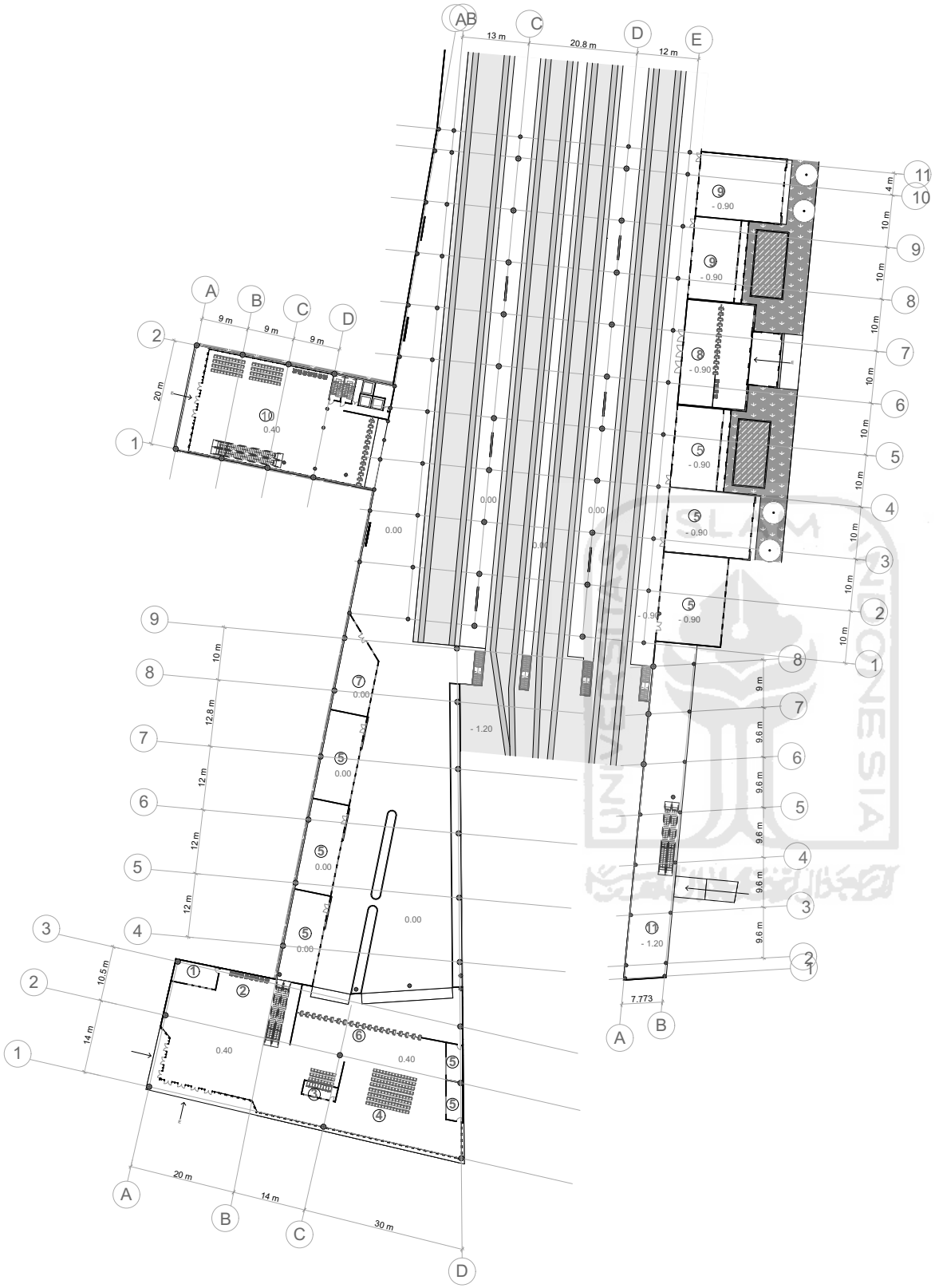


Figure 6.2.3: Update on siteplan by the improvement on the station platform crossing circulation
Source: Author (2021)



① TICKET OFFICE
② TICKET MACHINE
③ ATM CENTER
④ WAITING SPACE
⑤ COMMERCIAL SPACE
⑥ TICKET GATE
⑦ MUSHALLA
⑧ OLD STATION BUILDING/ EAST GATE
⑨ STATION MANAGEMENT OFFICE
⑩ WEST GATE
⑪ EAST ENTRANCE TO ELEVATED PEDESTRIAN

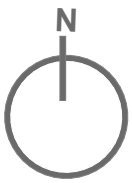
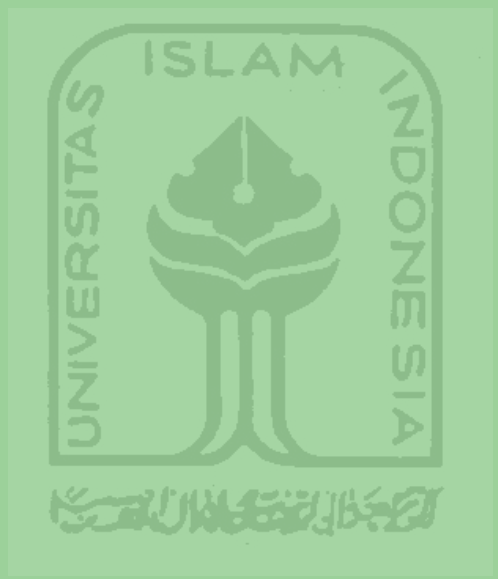


Figure 6.2.4: Update on building ground floor plan by the improvement on the station platform crossing circulation
Source: Author (2021)

07 CONCLUSION & REFERENCES



7.1 CONCLUSION

Based on the evaluation results, the jury provided input on the design walkability which was still considered lacking with the platform crossing circulation that still uses the old existing design in which the design is less safe and unfit as the feature of the modern building. Still, regarding walkability, the design of the outdoor pedestrian path is considered to be an inconvenience as the path does not have shelter. The design of the apartment with the hybrid modular concept considered by the jury to be still lacking in detail and the concept of construction of the apartment unit by modules needs more explanation by the drawing.

In the evaluation chapter, some of the input from the jury are responded to. The design of the platform crossing was improved by the basement path which has an unobstructed circulation and different levels with the train rail. Canopy added on the outdoor pedestrian path to make the circulation more convenient. However, the author cannot manage to provide more detailed drawings of the apartment module system and the construction of the units by the modules.

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ATTACHMENTS

- **PLAGIARISM CHECK**
- **PRESENTATION POSTER**

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Bismillaahirrahmaanirrahiim

Assalamualaikum Wr. Wb.

Dengan ini, menerangkan Bahwa:

Nama	: Faiz Rizky Nauli Harahap
Nomor Mahasiswa	: 17512006
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Judul Karya Ilmiah	: DEVELOPMENT THROUGH INCLUSIVITY: MIXED USE BUILDING DESIGN OF BOGOR STATION

Karya ilmiah yang bersangkutan di atas telah melalui proses cek plagiasi menggunakan **Turnitin** dengan hasil kemiripan (*similarity*) sebesar **11 (Sebelas) %.**

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Wassalamualaikum Wr. Wb.

Yogyakarta, 22 Juni 2021
Direktur

UNIVERSITAS ISLAM INDONESIA
DIREKTORAT PERPUSTAKAAN
YOGYAKARTA

Joko S. Prianto, SIP., M.Hum

DESIGN OF MIXED USE BUILDING OF BOGOR STATION WITH INCLUSIVE DESIGN APPROACH

Location: Bogor Station, Cibogor, Central Bogor, Bogor City, West Java, Indonesia

Congestions are one of the main issues of Bogor city. Just how chronic the congestion in Bogor is legitimized by the latest survey by Waze of 2016 of comfort and satisfaction on the street that resulting from the city as the second worst out of 235 cities around the world. The congestions are mainly caused by the city street expansions that can't follow the growth of vehicles numbers.

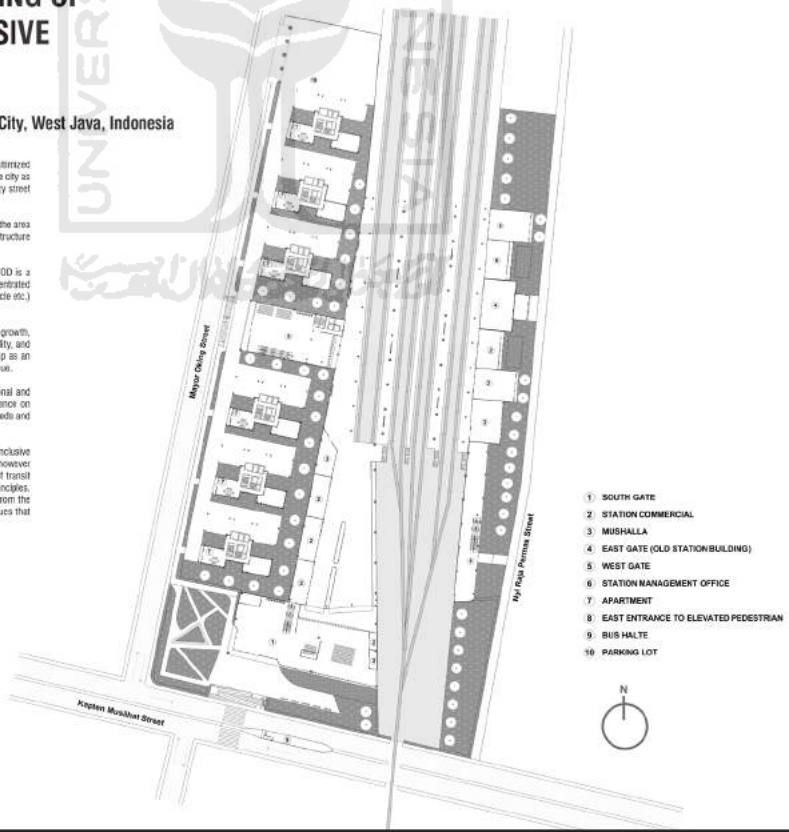
There are at least seven congestion hot spots that need to be solved in Bogor and one of them is the area around Bogor station. Bogor station is a large train station that functions as the main transit infrastructure of the city with an average train passenger of 41.775 persons each day.

One of the responses to solve congestion problems is through Transit-Oriented Development. TOD is a concentrated mixed-use development at strategic points along with the regional transit system. Concentrated urban amenities make many necessities that could be reached by walking or micro-mobility (bicycle etc.) therefore reducing the dependency on the automobile.

While TOD has demonstrated several advantages in terms of sustainable development and smart growth, there may be drawbacks, such as segregation. The advantages of TOD, such as increased mobility, and walkability, could be factored into land values, rising house prices, and rents, which could end up as an exclusive closed environment that would reduce the TOD approach as the solution of the urban issue.

However, in principle, TOD aims to maintain social and economic balance, improve the functional and spatial development around transit points of an area, therefore to create a wider positive influence on the city TOD should be more inclusive while able to maintain stability within the wide range of needs and interest that created by the diverse communities.

In this final architectural project, the intention is to design a mixed-use building with TOD and an inclusive design approach. Although in concept transit-oriented development (TOD) is more of urban design, however in this project would be limited to design mixed-use buildings development on the existing plot of transit infrastructure to increase the mobility of the area and reduce the congestion by applying the TOD principles. The inclusive design approach is used to respond to the contradicting issues that would come from the increasing mobility which is segregation. Further, the design also responds to contradicting issues that would come from the more inclusive development which is the decrease of commerciality.



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PROBLEM MAP

GENERAL ISSUE

INEFFICIENT MOBILITY OF BOGOR STATION AREA

The inefficiency creating congestions on the streets and in the result also affecting transit infrastructure of the train station to be less accessible.

ARCHITECTURAL SOLUTION

MIXED USE BUILDING

the methods can reduce the private automobile dependency as many urban amenities could be reached by walking or by micro mobilities.

THEORITICAL REFERENCES

- TRANSIT ORIENTED DEVELOPMENT
- INCLUSIVE DESIGN

CONTRADICTING ISSUES FROM THE SOLUTION

CONNECTED	SOCIAL SEGREGATION
INCLUSIVE	LESS PRODUCTIVE

TRIZ METHODS

CONCEPT

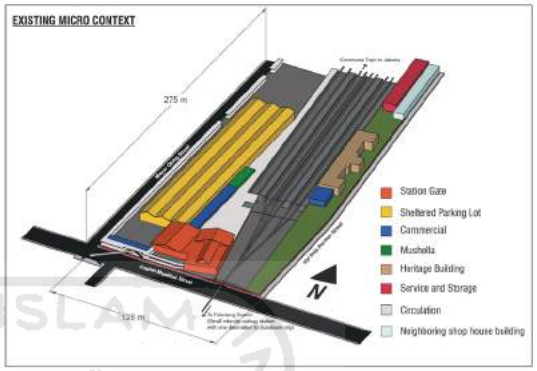
SCHEMATIC DESIGN

DESIGN DEVELOPMENT

DESIGN TESTING

EXISTING MACRO CONTEXT

EXISTING MICRO CONTEXT



TRIZ ANALYSIS

The design method of the project is using TRIZ (Theory of Inventive Problem Solving). TRIZ is a problem-solving, analysis, and forecasting tool derived from the study of patterns of invention in the global patent literature developed by the Uni Soviet Inventor Genrich Altshuller and his colleagues begin in 1946 and still researched and developed until contemporary time.

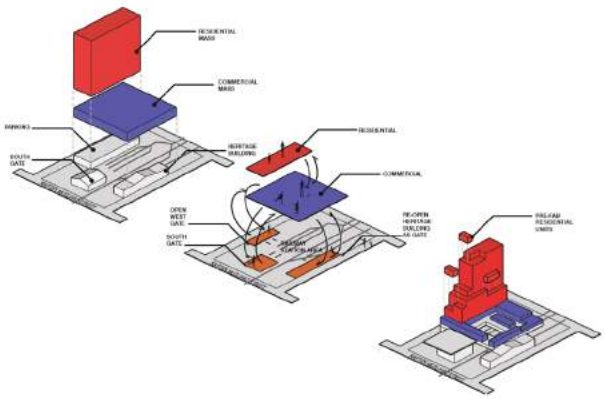
According to the TRIZ method, all technological innovations that occurred in different industries are based on a set of "inventive principles". TRIZ method states that every specific problem that a project tries to solve can be reduced to a general contradicting problem.

To analyze the project's problems, the problems need to be identified into contradicting issues and then translated to general problems with 'TRIZ language' of the improving and worsening feature. The general problem then has a general solution based on TRIZ 40 inventive principles in which could be developed to a more specific solution for the project.

		ENGINEERING CONTRADICTIONS	
GENERAL PROBLEM	PROBLEM IDENTIFICATION (IF... THEN... BUT..)	1. IF mixed use building with the TOD approach apllied in the area, **THEN** congestion issues can be solved, **BUT** lower income and informal sectors would be secluded	2. IF inclusive approach is applied, **THEN** more space could benefit lower income group, **BUT** the area commerciality would be reduced
IMPROVING FEATURE	REFERENCE	Compact vertical development of the transit area	Development of area for mixed-income groups
	PARAMETER	7. Volume of the moving object	6. Area of stationary object
WORSENING FEATURE	REFERENCE	Seclusion of poor and informal sectors	Reduction of the commerciality
	PARAMETER	13. Stability of the object's composition	39. Productivity
TRIZ INVENTIVE PRINCIPLES	PRINCIPLES	1. Segmentation 10. Prior Action 28. Replace Mechanical System 39. Inert Environment	10. Prior Action 15. Dynamics 7. Nested Dolls 17. Another Dimension

DESIGN FRAMEWORK

BASIC DESIGN IDEA



DESIGN CONCEPT FROM TRIZ PRINCIPLE

(1) SEGMENTATION

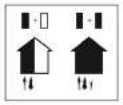
- PREFABRICATED MODULAR LIVING UNIT

Construction of unit modules in the manufacture has many advantages to reduce the retrofit cost such as the construction time and labor. Therefore it could help to achieve affordability. The module size adapted to the transportation mode capability so it could be transported to the the construction site by the cargo train and truck.

(10) PRIOR ACTION

- ADAPTATION

Lower income group start by having a small living unit as affordance another issue that they have. However change of family constelations is a natural occurance that need to be responded by extension or reconfiguration. By applying adaptation concept lower income group could be assisted by start their housing small but also bring scalable options for their living unit.



(39) INERT ENVIRONMENT

- COMMON SPACE

The inert environment is principles to add neutral atmosphere to prevent negative impact to occur. The addition of a common space as a semi-public space in the building for the residents to interact with each otherwould encourage community building to make the residential environment more sociable.

(7) NESTED DOLLS

- HYBRID RETAIL SYSTEM

Using two commercial models, online and physical, to complement each other's strengths allows to form more compact commercial center but able to increase productivity.

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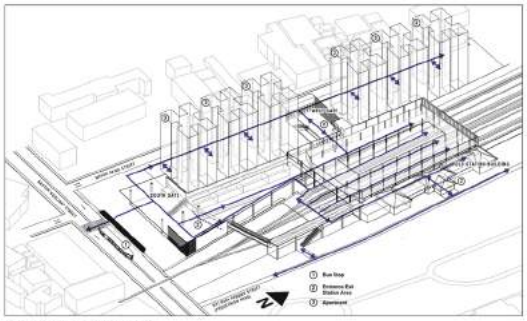
DESIGN OF MIXED USE BUILDING OF BOGOR STATION WITH INCLUSIVE DESIGN APPROACH

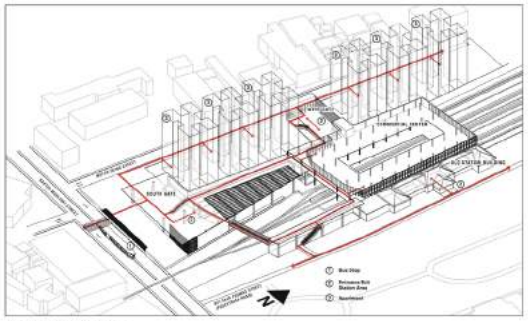
INCREASE WALKABILITY TO REDUCE NEEDS OF PRIVATE MOTOR VEHICLES

Design solutions to increase the walkability of the area is through the development of the circulation for the station users and the public pedestrian. For the station users, the ease of access provided by opening old station buildings and new station gates in the west area of the region The addition of public transportation facilities at the bus stop allows for a more open circulation from the south area.

The design solution for the public pedestrian is by the development of circulation above the station area that allows the general public (not station users) to take shortcuts to walk to areas around the development area without having to go through ticket gates.



Circulation diagram of the station user



Circulation diagram of the public

South gate

East entrance to elevated circulation

West gate

Access to the elevated circulation from south gate

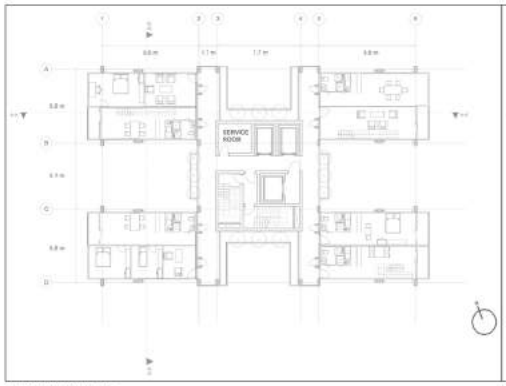
Sheltered circulation on the west of the area

Station platform crossing circulation

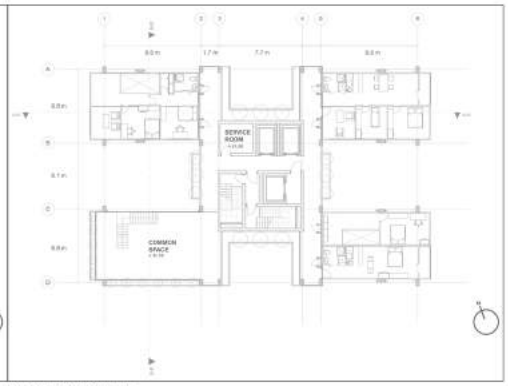
RESIDENTIAL

With a strategic site location development tends to be exclusive while. In order to solve problems in the wider context of the city residential development within the area must be accessible to a wider variety of people. The design solution uses the hybrid modular that combine main structure and prefabricated modules that form the living unit. The design strategy able to increase affrodability as prefabrication could reduce cost and also open for adaptability in which the module might be reconfigured to response the need of the residents.

The apartment unit formed by the basic prefabricated structure with the size of 10 x 3 m in which able to be transported by cargo train and truck to the site to be inserted into the host sturcture of the apartment building.

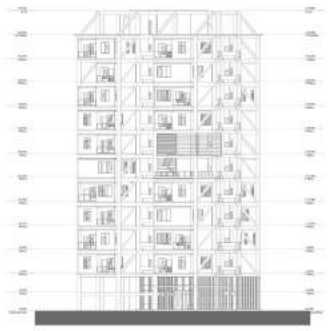


Typical floor plan apartment

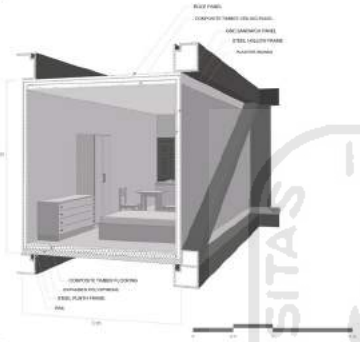


Typical 6th floor plan apartment

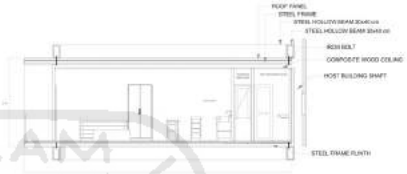
Section A-A' of the apartment



West (front) elevation of the apartment



Prefab module detail



Prefab module detail 2

APARTMENT UNITS

The apartment unit formed by the basic prefabricated structure with the size of 10 x 3 m in which able to be transported by cargo train and truck to the site to be inserted into the host sturcture of the apartment building. The configuration of the modules form 5 types of apartment unit.

STUDIO UNIT

Interior render of studio unit

30m2 **STUDIO UNIT** 30 m2

- Bedroom
- Bathroom/Toilet
- Kitchen
- Diningroom
- Balcony

SMALL UNIT

Interior render of small unit

30m2 + **30m2** **SMALL UNIT** 60 m2

- Master bedroom 9m2
- Bedroom 7.5 m2
- Bathroom/Toilet
- Kitchen
- Livingroom
- Diningroom
- Balcony

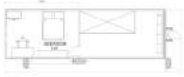
SMALL UNIT (HORIZONTAL)

Interior render of small (horizontal) unit

30m2 + 30m2 **SMALL UNIT** 60 m2

- Master bedroom 11.4m2
- Bedroom 9 m2
- Bathroom/Toilet
- Kitchen
- Livingroom
- Diningroom
- Balcony

MEDIUM UNIT



Interior render of medium unit

30m2 / 30m2 + 30m2 / 30m2 **MEDIUM UNIT** 90 m2

- Master bedroom 15 m2
- Bedroom 13.8 m2
- Bathroom/Toilet
- Kitchen
- Livingroom
- Diningroom
- Balcony

LARGE UNIT

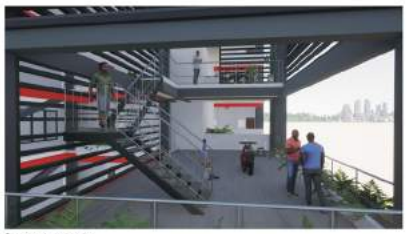
Interior render of large unit

30m2 / 30m2 / 30m2 + 30m2 / 30m2 **LARGE UNIT** 120 m2

- Master bedroom 20m2
- Bedroom 10.5 m2
- 2 Bathroom/Toilet
- Kitchen
- Livingroom
- Diningroom
- Balcony

APARTMENT COMMON SPACE

One of the problem within the mixed income development is that the community building between the diverse group found to be infrequent which may reduce the advantage of the concept. Common space added in the building plan as the space for the apartment community socialization and activities. Common space placed typically on the 6th and 7th floor of the apartment. The space offer ample space with a high ceiling and wide view towards the city. The space have total area of 89 m2.



Common space interior

COMMERCIAL FACILITIES

As a response to the congestion issues development of the commercial facility is important to be able to fulfill the needs of the people (apartment residents, station users, and public) around the station area so it could reduce the need of using private vehicles because of the ease to fulfill just by walking or public transportation. Other than that the developer of the area also needs to maintain and increase the commerciality for return of investment and profit.

The commercial facilities are situated around the circulation of the mixed-use building in which consists of the station user and the public. The commercial center is situated over the station platform that is connected by the elevated public circulation of the mixed building so that the center could be accessed by more people.

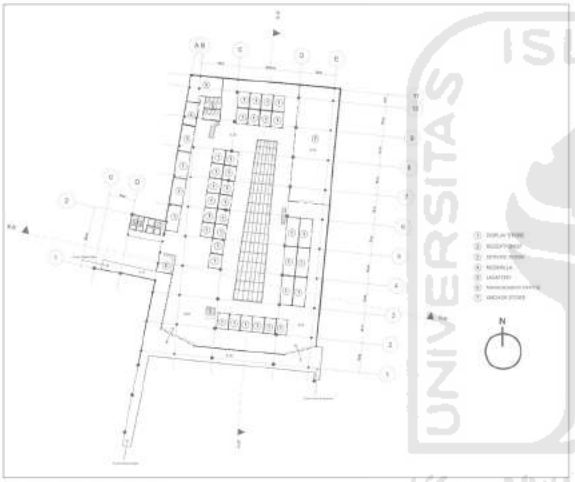
Commercial units in mixed-use areas consist of conventional units and display stores. Display store is commercial units with a mixed retail strategy (physical and e-commerce) that only use physical space to display the items. The display store opens for the opportunity to the investor that runs e-commerce to show they physical items to the potential customer to further convince them to buy. As a result, the space for the retail of the display store is reduced while still could maximize the productivity compared to the larger conventional store.

Commercial facilities in the south gate waiting space

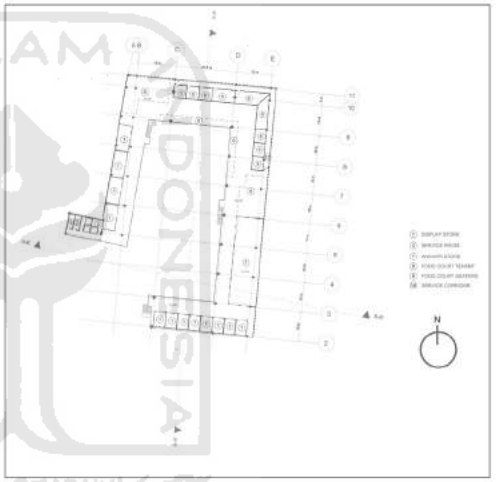
Commercial facility on the circulation from the south gate to the station platform

Space below east elevated circulation used to support street vendors

Some space of the old station building utilized as the commercial facility



COMMERCIAL CENTER GROUND FLOOR



COMMERCIAL CENTER 1st FLOOR

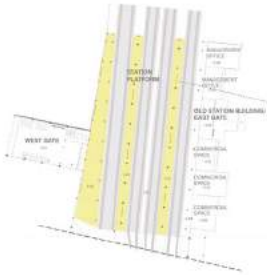
COMMERCIAL CENTER

Commercial center interior above the station platform

Display store retail space

INTERACTIVE DIGITAL BILLBOARD FOR ADVERTISEMENT AND TRANSACTION

The function of the interactive digital billboard is to advertise and also as transaction medium commercial center stores above the station platform. Therefore the busy station user could have easier access to the store. If the customer purchase through the billboard then item would directly send to the customer adress. When in doubt about item then the customer could visit the commercial center and check the showcased item.



Placement of the interactive digital billboard on the station platform

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