



UNIVERSITAS
ISLAM
INDONESIA

Laboratorium
Pemodelan
Arsitektur &
Perkotaan

Final Architecture Design Studio Project
**Residence Module Design
for Flood Affected Area
in Bengkulu City**

Design By:

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Supervisor:

**IR. WIRYONO RAHARJO, M.ARCH.,
PH.D.**



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Residence Module Design for Flood Affected
Area in Bengkulu City

Desain Modul Tempat Tinggal untuk Daerah
Terdampak Banjir di Kota Bengkulu

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VALIDATION SHEET

Final Architecture Design Studio entitled:

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Desain Modul Tempat Tinggal untuk Daerah Terdampak Banjir di Kota Bengkulu

Student's Full Name : Athiya Syavira Rinalson

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Abstract

Flood is a universal problem, and it has also becoming a national problem in Indonesia. Several places in Indonesia has different reasons on to why the area got affected by flood. It can be due to trash, overflowing of river, lack of absorption land, etc. In Bengkulu, flood is also a problem, and it is especially apparent in several specific spots. In one particular spot that has a bad history of flood and is still until today is the area that will be talked about in this paper. The cause of the flooding, the effect of the flood to residents and residentials, flood resilience and management, and how to create a safe and comfortable residential for the people affected by the flood in this area by using modular architecture.

Keyword: *flood, resilience, modular, housing*

Abstrak

Banjir adalah masalah universal, dan juga telah menjadi masalah nasional di Indonesia. Beberapa tempat di Indonesia memiliki alasan yang berbeda mengapa daerah tersebut terkena banjir. Bisa jadi karena sampah, meluapnya air sungai, kurangnya lahan resapan, dan lain sebagainya. Di Bengkulu, banjir juga menjadi masalah, dan ini terlihat jelas di beberapa titik tertentu. Salah satu titik yang memiliki sejarah banjir yang buruk dan masih terjadi hingga saat ini adalah daerah yang akan dibahas dalam tulisan ini. Penyebab banjir, dampak banjir terhadap penduduk dan hunian, ketahanan dan penanganan banjir, serta bagaimana menciptakan hunian yang aman dan nyaman bagi masyarakat yang terdampak banjir di daerah ini dengan menggunakan arsitektur modular.

Kata kunci: *banjir, resilien, modular, perumahan*

Preface

Assalamu'alaikum Warahmatullahi Wabarokatuh

Praise and gratitude are due to Allah SWT who has given blessings and grace to His servants. Starting from the beginning of the process of making to the completion of the Final Studio of Architectural Design which was well completed, and do not forget the sholawat and greetings from the author conveyed to our prophet Muhammad SAW and his family and friends.

Thank you to the Islamic University of Indonesia, especially the Department of Architecture who have shared and taught a lot of things as well as experiences and opportunities to develop and expand knowledge and knowledge especially for myself became part of the UII Architecture student.

Thank you to Mr. Revianto Budi Santoso as my DPA lecture Islamic University of Indonesia along with all the lecturers and related staff who have provided insight as well knowledge in architecture branch.

The author realizes that the process of implementation, preparation and completion of the Architectural Design Final Studio is inseparable from the support both materially and spiritually from many parties, therefore the author would also like to thank those relevant :

- 1.Allah SWT, for the blessings and mercy that always accompanies, expedites, and facilitates every step.
- 2.My Father, mother, little sister, families, and relations who always give prayers, support and love.
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- 5.All of my friends, especially Sharfina Utami Widyasari, who have become my comrades-in-arms in this Final Studio of Architectural Design. Putri, Tabina, and Ansari that had given me support from the beginning until the end.
- 6.Dottore and Medicine Pocket who have provided me with indirect support and giving motivation to complete this project.
- 7.As well as support from all my friends who have been giving encouragement and direction, and all those who has been involved in supporting during the course of this undergraduate study and final project.

Therefore, the author is fully aware of the limitations and abilities possessed by the author himself. All criticisms and suggestions to build this Architecture Design Final Studio project are very much expected.

STATEMENT OF AUTHENTICITY

By signing this form, I :

Student Name : Athiya Syavira Rinalson
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Study Program : Architecture
Faculty : Faculty of Civil Engineering and Planning
University : Universitas Islam Indonesia

state that all parts of the thesis work / final project entitled

Residence Module Design for Flood Affected Area in Bengkulu City

Desain Modul Tempat Tinggal untuk Daerah Terdampak Banjir di Kota Bengkulu

is a work of its own except for the work mentioned in the reference and there is no help from any other party either in whole or in part in the process of making. The final result of this work was handled over to the Department of Architecture, Islamic University of Indonesia for educational and publication purposes, although the intellectual property rights are still own by the author.

Yogyakarta, 11 December 2024



Author
Athiya Syavira Rinalson

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INTRODUCTION

DESIGN PREMISE

Bengkulu is a province located on the island of Sumatra, Indonesia. The provincial capital of Bengkulu is located in the city of Bengkulu. This province is located in the southwestern part of Sumatra Island and the west coast in the southern part of Sumatra Island which is directly adjacent to the provinces of West Sumatra, Jambi, South Sumatra and Lampung in the surrounding area.

Bengkulu city is right by a sea shore and it has a river that went through its city. One of the area it went through is called Tanjung Agung. Tanjung Agung is an area near the center of the city. Along this road, there are a lot of people selling Bengkulu's specialty food like Pendap, Bai Tat, Lempuk, etc. Tanjung Agung is also an area that is lower than its surrounding. With its land lower in elevation than the surrounding area, and also due to it being next to the river.

DESIGN BACKGROUND



Flooding is an event where water overflows onto land. This can happen naturally or be brought on by human activity. Nearly every area of Indonesia experiences this calamity on a regular basis, particularly during the rainy season. Floods in West Sumatra and Jakarta have garnered significant public attention recently. In Indonesia, there have been 123 flood catastrophes between January and March 2024, according to data from the National Agency for Disaster Countermeasure (Badan Nasional Penanggulangan Bencana (BNPB)). A total of 95,024 people have been displaced and 16,765 persons have been harmed by these disasters.

As per the catastrophe statistics published by BNPB, Indonesia experienced 8,333 flood disasters between 2014 and 2023. With the exception of 2019, the trend has been dynamic throughout the past ten years, but overall, the number of flood incidents grew from 2015 to 2020. The highest number of flood incidents—1,531—occurred in 2020. Floods in 2020 affected 3,843,714 people and claimed 132 lives. In addition, there were damages to 28,824 homes, 511 educational establishments, and 625 places of worship.

The impact of the floods was greater in 2021 even though there were 335 fewer events in 2021 than

in 2020. That year's floods harmed 4,273,938 people and claimed 337 lives. 98,717 homes, 913 educational establishments, and 818 places of worship were among the structures damaged. Nonetheless, since 2021, there have been fewer flood occurrences. With just 351 events, 2023 saw the fewest flood disasters over the previous ten years.

The National Agency for Disaster Countermeasure noted in its annual report that hydrometeorology—the weather-and climate-related cycle of water and precipitation—is responsible for almost 90% of natural disasters in Indonesia. The organization documented at least 862 flood catastrophes in Indonesia as of August 8, 2022. According to a Ministry of Finance estimate, flood disasters account for the majority of the IDR 22 trillion in annual state losses caused by natural disasters in Indonesia.

Floods in Indonesia have already impacted the regions of South Sumatra, West Kalimantan, Central Kalimantan, East Kalimantan, North Sulawesi, Southeast Sulawesi, Central Sulawesi, Riau Islands, and Gorontalo, according to a report from the UN Office for the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). Suprayoga Hadi, the Deputy Chairman of the Indonesian Disaster Experts Association, claims that a large number of regional heads either lack

or improperly implement a Disaster Management Plan (Rencana Penanggulangan Bencana (RPB)). "Many regional leaders still lack a thorough understanding of catastrophe management or show little care for it. They construct this infrastructure and that without taking potential disaster risks into account," stated Suprayoga.

Bengkulu is a province located on the island of Sumatra, Indonesia. The provincial capital of Bengkulu is located in the city of Bengkulu. This province is located in the southwestern part of Sumatra Island and the west coast in the southern part of Sumatra Island which is directly adjacent to the provinces of West Sumatra, Jambi, South Sumatra and Lampung in the surrounding area.

Bengkulu has long shoreline across its city, which is connected to a river called Sungai Serut. This river span across the city and passed by the area called Tanjung Agung. Tanjung Agung is an area near the center of the city. Tanjung Agung is an area that interconnect Bengkulu city with Kepahiang, one of Bengkulu's regency. Along this road, there are a lot of people selling Bengkulu's specialty food like Pendap, Bai Tat, Lempuk, etc.

Tanjung Agung is also an area that is lower than its surrounding. For the past 50 or so years, Tanjung Agung had gotten flooded in several occasions, mostly during heavy rain. With its land lower in

elevation than the surrounding area, and also due to it being next to the river. The government had made the road in Tanjung Agung higher to prevent it from flooding, so the traffic from the city to the regency is not blocked. Although, this caused the residences in this area to be in lower elevation than the road.

Despite the government prevention, the area of Tanjung Agung continued to be flooded annually. Although the flood wasn't as bad as it was before, with it causing minimal damage, it still caused inconvenience to residents that has their houses flooded every time.

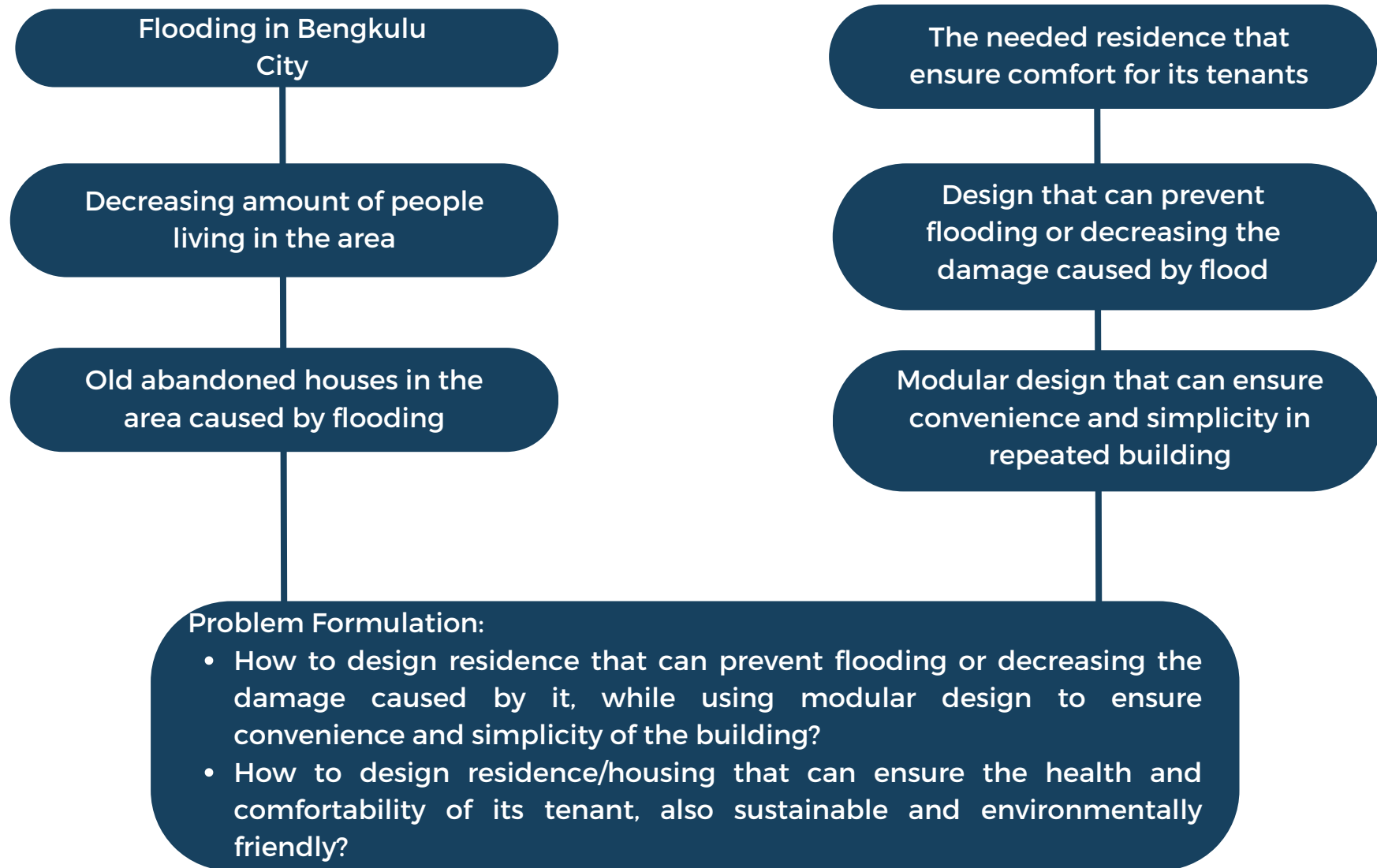
DESIGN PROBLEMS

- **Problems**

Bengkulu had always suffered from flood, especially during rainy season. Although, there are hot spots for flooding in Bengkulu. The government had made water canals to control the flow of water in the area, yet flood would still occur from time to time. The flood height itself varied from only 1 meter to as high as 3 meters, although nowadays the highest flood is around less than 2 meters. It took several days for the flood to fully dried up, depended on the weather. If it's sunny for the whole day, the flood would dried up in 2-3 days. On the contrary, if it kept raining, even if it's only a drizzle, it could take up to a week to dried up.



- **Problematique**



• Problem Statement

General Problem

How to design residence that can prevent flooding or decreasing the damage caused by it, while using modular design to ensure convenience and simplicity of the building which also healthy and comfortable for its tenant, and also sustainable and environmentally friendly?

Architectural Problem

- Houses are flooded during long rainy days due to difference of height from the road to the ground.
- Most houses are lower in elevation than the road, which cause it to be prone to flood.

Aim

To design residence that can prevent flooding or decreasing the damage caused by it, while using modular design to ensure convenience and simplicity of the building which also healthy and comfortable for its tenant, and also sustainable and environmentally friendly.

Specific Problem

- How to design residence that can prevent flooding or decreasing the damage caused by it, while using modular design to ensure convenience and simplicity of the building?
- How to design residence that can ensure the health and comfortability of its tenant, also sustainable and environmentally friendly?

Non Architectural Problem

- The residences day to day life getting obstructed by the flood.
- Inability to do daily tasks normally during flood.

Objective

To create residence that can prevent flooding or decreasing the damage caused by it, while using modular design to ensure convenience and simplicity of the building.

DESIGN LIMITATION

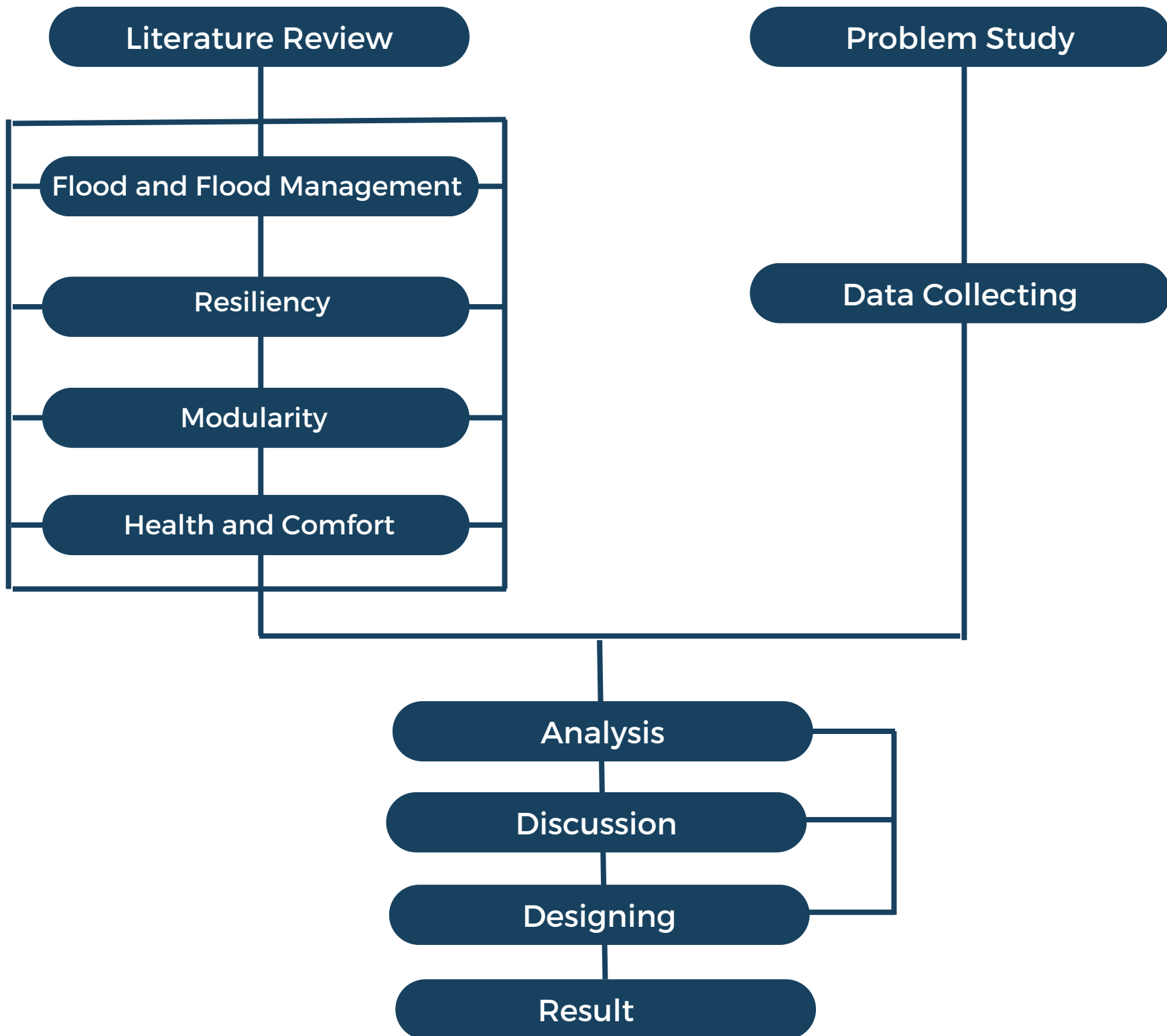
Limitation of the design:

- Time constraint, due to this work to be done only in one semester, which is roughly around six months, not including the time of idea changes which reduced the time of executing the work, several details might not be included
- Possible design and hypothetical building to be made are all according to data available and observed for the exact problem that is the main object of this study
- Limitation of building material available, in the area where this study is going to be based upon, the limitation of building material available will also be a point used in the study
- Specific location, the design made is specifically made for the area of this study, thus may not be useful for other areas that are experiencing the same problem due to difference of typology, environment and condition.
- Design of buoyant foundation is made for a slow rising of flood, thus not suitable for flash flood. The area where the study is conducted had been confirmed to be an area that experienced slow rising flood, thus the design is not suitable for areas that are affected by flash flooding.

The design will be conducted inside the administrative line of Tanjung Agung. Due to different elevations of the ground height to the road, this project would be focusing on the site with higher elevation difference between the ground height to the road.

This project would focus on the houses that are often affected by the flood and the densely housing area.

DESIGN METHOD



DESIGN FRAMEWORK

General Problem

How to design residence that can prevent flooding or decreasing the damage caused by it, while using modular design to ensure convenience and simplicity of the building which also healthy and comfortable for its tenant, and also sustainable and environmentally friendly?

Specific

- How to design residence that can prevent flooding or decreasing the damage caused by it, while using modular design to ensure convenience and simplicity of the building?
- How to design residence that can ensure the health and comfortability of its tenant, also sustainable and environmentally friendly?

Literature Study

- Flood
- Resiliency
- Modularity
- Health and Comfort

Synthesis

Designing residence that can prevent flooding or decreasing the damage caused by it, while using modular design to ensure convenience and simplicity of the building which also healthy and comfortable for its tenant, and also sustainable and environmentally friendly.

ORIGINALITY AND NOVELTY

Hereby similar cases related with this project to ensure its authenticity of the project:

1. Title : Design of Inclusive Modular Housing with Open Building Approach Responding to Flood Disaster in Kemang, South Jakarta

Author : Rahman, Abdur

Differences :

- This paper's problem is about the flooding in Kemang, South Jakarta. The design is aiming for the increase of social and environmental value in the area by designing an inclusive housing that respond to the flooding, reforestation and break exclusivity using an open building approach.
- The difference with this paper is the solution made for the problem available and the approach used on it.

2. Title : Design of Flood Resistant Housing in Tambelan Sampit Riverfront with the Open Building Approach

Author : Adro, Muhammad Kemal

Differences :

- This paper's problem is about the flooding in Tambelan Sampit Riverfront. The design is aiming for the design of a housing complex that is able to resist flood and create a comfortable and safe living space by using an open building approach.
- The difference with this paper is the implementation of solution for the problem and the approach used on it.

LITERATURE STUDY

FLOOD

- **Types of Flood**

An overflow of water onto normally dry land; an inundation of normally dry land due to rising water in an existing waterway, such as a river, stream, or drainage ditch; a puddle of water at or near the location of the precipitation; flooding is a more prolonged event than flash flooding, lasting several days or even weeks.

There are four different types of floods: coastal, river, urban, and areal flooding. Intentionally flooding areas that would normally remain dry is another option. This could be done for river management, military, or agricultural reasons. For instance, in many nations, when preparing paddy fields for the cultivation of semi-aquatic rice, agricultural flooding may occur.

- *Coastal Flooding*

Storm surges combined with high tides and big wave events at sea can cause coastal areas to flood, either by waves overflowing flood barriers or, in more extreme situations, by tropical cyclones or tsunamis. This includes storm surges that originate from tropical or extratropical cyclones. Storm surges are "an additional rise of water generated by a storm, over and above the predicted astronomical tides". The damage caused by coastal flood events has escalated and more

people are being affected as a result of climate change effects (such as rising sea levels and an increase in extreme weather events) and an increase in the population living in coastal areas.

Large waves meeting high upstream river flows and storm surges brought on by winds and low barometric pressure frequently result in flooding in estuaries.

- *River Flooding*

All kinds of river and stream channels experience flooding, from the world's greatest rivers to the tiniest ephemeral streams in wet regions to generally dry channels in desert climes. On tilled fields, overland flow can produce a muddy flood in which sediments are conveyed as suspended matter or bed load by runoff. Beaver dams, ice, debris, and landslides are examples of drainage blockages that can induce or worsen localized flooding.

All kinds of river and stream channels experience flooding, from the world's greatest rivers to the tiniest ephemeral streams in wet regions to generally dry channels in desert climes. On tilled fields, overland flow can produce a muddy flood in which sediments are conveyed as suspended matter or bed load by runoff. Beaver dams, ice, debris, and landslides are examples of drainage blockages that can induce or worsen localized flooding.

Floods with a slow rise are generally found in big rivers with vast catchment basins. There are a few possible causes for the increase in flow: tropical cyclones, quick snowmelt, monsoons, and prolonged rainfall. However, since they may have enormous basins but narrow river courses, and because rainfall can be quite heavy in certain sections of those basins, large rivers may experience rapid flooding episodes in arid climates.

Flash floods and other rapid flooding events are more common on smaller rivers, rivers with steep valleys, rivers that flow over impermeable terrain for a significant portion of their course, and generally dry channels. Localized convective precipitation (strong thunderstorms) or an abrupt release from an upstream impoundment formed by a glacier, dam, or landslide could be the reason. In one case, eight people were murdered by a flash flood while having fun in the water on a Sunday afternoon at a well-known waterfall in a small canyon. In just one minute, the flow rate jumped from roughly 50 to 1,500 cubic feet per second (1.4 to 42 m³/s) without any rainfall being seen. Within a week, the same location saw two worse floods, although no one was near the waterfall on those days. A thunderstorm over a portion of the drainage basin, where steep, exposed rock slopes are widespread and the thin soil was already saturated, caused the fatal flood.

- Urban Flooding

When rainfall exceeds the capacity of drainage systems, such as storm sewers, it can create urban flooding, which is the inundation of land or property in cities or other built environments. Whether or whether the impacted neighborhoods are situated near any body of water or within officially designated floodplains, urban flooding is a real possibility. For instance, flash flooding, snowmelt, and river and lake overflows can all cause it. Stormwater or water discharged from broken water mains may collect during the flood on private property and in public rights-of-way. It can back up into buildings through sewer lines, cellars, sinks, and toilets, or it can leak through building walls and flooring. Urban flooding can take many distinct forms, each with its own unique reason. Flooding brought on by heavy rain, adjacent rivers overflowing their banks, and coastal flooding—often brought on by storm surges—are all classified differently by city planners. Flooding in urban areas poses a risk to people and property.

- Areal Flooding

When water is provided by precipitation or snowmelt more quickly than it can either penetrate or drain off, flooding can occur on level or low-lying terrain. The excess builds up in situ, occasionally to dangerously high levels. Saturation

of the surface soil can result from heavy rain from a single or multiple storms, or from areas with a shallow water table, like a floodplain, which effectively prevents infiltration. Additionally, infiltration through frozen ground, rock, concrete, paving, or roofing is slow to nonexistent. As the surface slope determines the overland flow velocity, areal flooding starts in local depressions that are not connected to a stream channel and in flat areas such as floodplains. Areal flooding in endorheic basins can occur when precipitation is greater than evaporation.

Generally speaking, prolonged heavy rainfall (locally concentrated or throughout a catchment area), highly accelerated snowmelt, strong winds over water, unusually high tides, tsunamis, or failure of dams, levees, retention ponds, or other structures that retained the water are the main causes of floods, or a combination of any of these. Increases in impermeable surface or other natural disasters like wildfires, which diminish the amount of plants available to absorb precipitation, can worsen flooding.

- **Flood Management**

Understanding how social (such as communities, properties, and authorities) and infrastructure (such as transportation, green spaces, buildings, and energy) systems interact, as well as how their combined performance characteristics can manage excess water and provide multiple functions, is a major challenge in upscaling single multifunctional designs to multisystem urban flood management (Ahern, 2013; Haghighatafshar et al., 2018; Hoang & Fenner, 2016). Urban flood management must be approached from a systems perspective because cities are such intricate "systems-of-systems." Additionally, it is necessary to investigate and assess the benefits and drawbacks of utilizing both new and old infrastructure (and social) systems to reduce the risk of flooding in urban areas.

RESILIENCY

- **Flood Resiliency**

Although resilience is still mostly conceptual, it is used extensively in flood risk management strategies. Despite its many interpretations, the idea of resilience has had a significant impact on how flood risk management strategies have developed over the past 20 years. The introduction of this notion at the start of this century has fueled the shift away from structural protection and toward a risk-based approach, which is then followed by a more comprehensive entire systems approach.

Resilience, as opposed to resistance, which is typically defined as a system's ability to remain unchanged in the face of disturbances, offers a fresh perspective on flood risk management, extending its goal beyond the capacity to "resist" high water levels that were anticipated in the design to include the capacity to "recover" from a flood event (and/or lessen the effects that result from flows that exceed the design standard) and to "adapt" or "transform" the current strategy in light of the knowledge that conditions have changed or will change in the future. Reactive and proactive resilience are also utilized in this context.

Thus, the idea that society should learn to live with floods and should lessen severe outcomes rather

than strive to eliminate them totally has been aided by the concept of resilience in flood risk management. The above suggests that in order to minimize the flood hazard and its related effects, a resilient flood risk management strategy should include the implementation of measures reducing flood risk through a combination of protection, prevention, and preparedness spanning a wide range of flood probabilities (from regular to rare flood events).

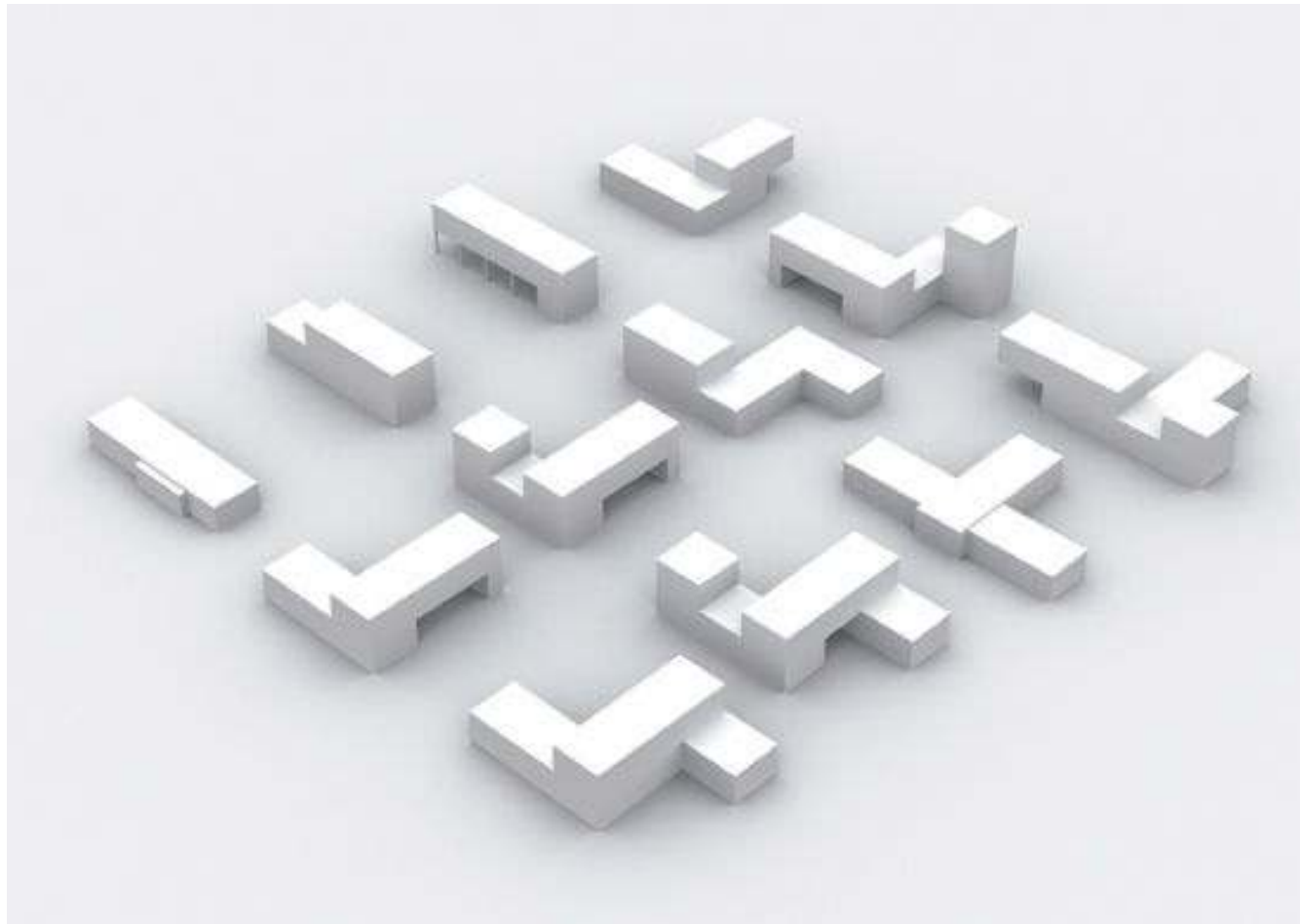
Some architecture had their vision on future flood resiliency. Their vision involves the comprehensive planning of big communities to enhance their readiness against flooding and climate change. Low-carbon dwellings would be arranged around multipurpose landscapes that serve as significant flood storage sites or as a means of controlling surface water floods. The highest terrain in new towns would be used to build streets of flood-resistant homes, and the areas where development meets the natural environment would be home to amphibious residences. The long-term objective is to plan communities that continue to operate normally throughout floods and droughts.

MODULARITY

- **Modular Building**

A modular building is a prefabricated structure made up of repeating sections known as modules. Building sections off-site and delivering them to the designated location is the process of modularity. On site, the prefabricated sections are fully installed. Cranes are occasionally used to place prefabricated sections. The modules allow for a multitude of configurations and styles when stacked, arranged end to end, or side by side. Inter-module connections, sometimes referred to as inter-connections, are used to join the modules together after they have been placed. The individual modules are joined to form the overall building structure by the interconnections.

Long-term, transient, or permanent facilities like construction camps, classrooms and schools, residential buildings for civilian and military personnel, and industrial facilities can all be made from modular construction.



HEALTH AND COMFORT

- **Healthy Building**

Beyond being aesthetically pleasing and useful, a healthy building prioritizes the mental and physical health of its occupants while reducing its negative effects on the environment. Several significant in healthy building are as stated below.

- *Boosting Occupants' Productivity With Healthy Building*

Research has demonstrated that occupant productivity can be greatly increased in healthy buildings. The provision of adequate lighting, indoor air quality, thermal comfort, and acoustics can enhance concentration and reduce health concerns for both residents and employees. Better performance and increased efficiency at work and in daily activities follow from this.

- *Reducing Absenteeism*

A well-planned, health-conscious facility can help lower employee absenteeism. Buildings can reduce the incidence of sick building syndrome (SBS) and other health-related issues that cause individuals to miss work or school by addressing elements like indoor air quality, appropriate ventilation, and ergonomic design.

- *Enhancing Overall Life Quality*

The general quality of life of building tenants can be improved by healthy structures. These structures can support better mental and emotional health by encouraging well-being and a sense of connection with the outdoors. Spaces that are created with biophilic principles and with the comfort of its residents in mind can lower stress levels and foster a nurturing atmosphere.

- *Increasing Property Value and Appeal*

The need for healthy buildings is rising along with knowledge of their advantages. Buildings that prioritize health and well-being are therefore better able to draw in renters and customers, increasing their market appeal and property prices. Healthy buildings can therefore result in higher rental and sales prices, which makes them a wise investment for developers and property owners.

- *Reducing Greenhouse Gas Emissions and Resource Conservation*

Energy-efficient design methods and systems can help reduce greenhouse gas emissions in

healthy buildings. By utilizing passive design strategies, renewable energy sources, and sustainable materials, these structures can reduce their carbon footprint and support global sustainability goals. Furthermore, by reducing waste, using recycled or renewable materials, and implementing water-saving techniques, healthy buildings can encourage resource conservation.

There are also several strategies to achieve a healthy building includes.

1. Natural Light and Ventilation
2. Indoor Air Quality
3. Biophilic Design
4. Acoustic Comfort
5. Ergonomics and Spatial Organization
6. Integrating Technology

- **Air Ventilation**

Research has repeatedly shown that people are more healthy and productive when they are in buildings with proper ventilation than when they are in ones without enough fresh air supplied to the building's occupants.

Understanding and adjusting the building's heating, ventilation, and air conditioning (HVAC) system to suit the needs of the building occupants throughout the day should be a top priority because good ventilation is essential for a comfortable, healthy, and productive indoor environment.

The dangers of poor ventilation can be defined as such.

- *Health Risks*

Inadequate ventilation can cause allergens, Volatile Organic Compounds (VOCs), mold spores, and other indoor pollutants to accumulate. These pollutants can aggravate or cause respiratory conditions like asthma and allergies, as well as cause long-term health issues.

- *CO2 Accumulation*

Low intake of fresh air can raise carbon dioxide (CO2) levels, which can be especially dangerous in enclosed environments like offices and schools since it can cause drowsiness, diminished cognitive function, and poor decision-making.

- *Moisture and Mold*

A build-up of surplus moisture brought on by inadequate ventilation can encourage the growth of mildew and mold. Long-term mold spore exposure can cause allergic reactions, respiratory issues, and other health problems.

There are some steps to improve the ventilation at home, which are opening windows and doors, have cross-ventilation and/or natural ventilation, have indoor plants, use dehumidifiers, and so on.

- **WELL Building Standard**

The WELL Building Standard (WELL) is a performance-based system for assessing, validating, and keeping track of built environment elements that affect human health and well-being, such as air, water, food, light, fitness, comfort, and mental health.

The seven elements of a space that WELL takes into account are air, water, nourishment, light, fitness, comfort, and mind. A building must obtain passing scores in each concept, demonstrating that every feature satisfies the standard's requirements for human well-being, in order to be certified as WELL.



AIR

- Quality
- Purification
- Humidity



WATER

- Quality
- Treatment
- Drinking Promotion



LIGHT

- Natural Access
- Color
- Dimming/Circadian Rhythms



NOURISHMENT

- Selection/Availability
- Serving Size
- Information



FITNESS

- Fitness Centers
- Stairs
- Bike Room
- Incentives Programs



COMFORT

- Ergonomics
- Sound Reduction
- Olfactory Comfort



MIND

- Collaboration
- Quiet Rooms
- On-site Child Care
- Health & Wellness Library

• Thermal Comfort

Thermal comfort is generally characterized by the kind of environment: outdoor, semi-outdoor, or interior. In terms of interior thermal comfort, the present debate is largely divided between two approaches. The basic steady-state model for air-conditioned environments, created by Fanger in the 1970s and based on a heat balance model of the human body, is the initial method. The Predicted Mean Vote–Predicted Percentage Dissatisfied (PMV–PPD) indices are used in Fanger's model to forecast the mean thermal sensibility of a group of people and their respective percentage of discontent with the thermal environment.

The majority of current comfort standards and assessment methods owe their legitimacy to a long history of research and development in the middle of the twentieth century, which resulted in numerous publications, including Fanger's important work. During this time of research, a system for determining human comfort based on the heat balance of the human body was developed, which took into account six parameters: air temperature, mean radiant temperature, relative air velocity, relative humidity, clothing level, and metabolic rate. More than that, commonly used comfort standards and definitions presume that occupants must experience an environment for a specific amount of time in order to form a proper reaction.

Thermal comfort is a mental state that expresses satisfaction with the thermal environment (Nugroho, 2006). Thermal environment conditions that are typically appropriate for 80% or more of the users are influenced by personal factors and the indoor environment. Even so, it will never achieve the precise standard measurement because, according to the research community, user satisfaction and thermal comfort are closely related.

According to Santoso (2012), it is likely difficult for indoor spaces with natural ventilation in humid tropical climates to meet the international comfort standard ASHRAE 55-92 due to the high average air temperature and current humidity. As a result, the neutral temperature in these spaces does not fall within the necessary comfort zone, which is between 23 °C and 26 °C. In humid tropical climate areas with various types of buildings, research by Iftikhar et al. (2001), Alison (2003), Henry and Nyuk (2004), Roonak et al. (2009), Nugroho (2011), and, Sulaiman et al. (2011) shows neutral temperature between 26.1 °C and 29.8 °C. According to those studies, it is hard to attain the balanced temperature based on thermal comfort zone due to a number of factors, such as the building design that results in high levels of solar radiation, the air circulation that is caused by low air velocity, and the humidity that is brought on by the present environment (humid tropical climate).

In all climates, reducing the existing control equipment is necessary to achieve thermal comfort using the passive method. Good evaporation and shade cooling are helpful in hot climates and large buildings to increase comfort (Wang et al., 2015).

DESIGN STUDY

SITE AND CONTEXT STUDY

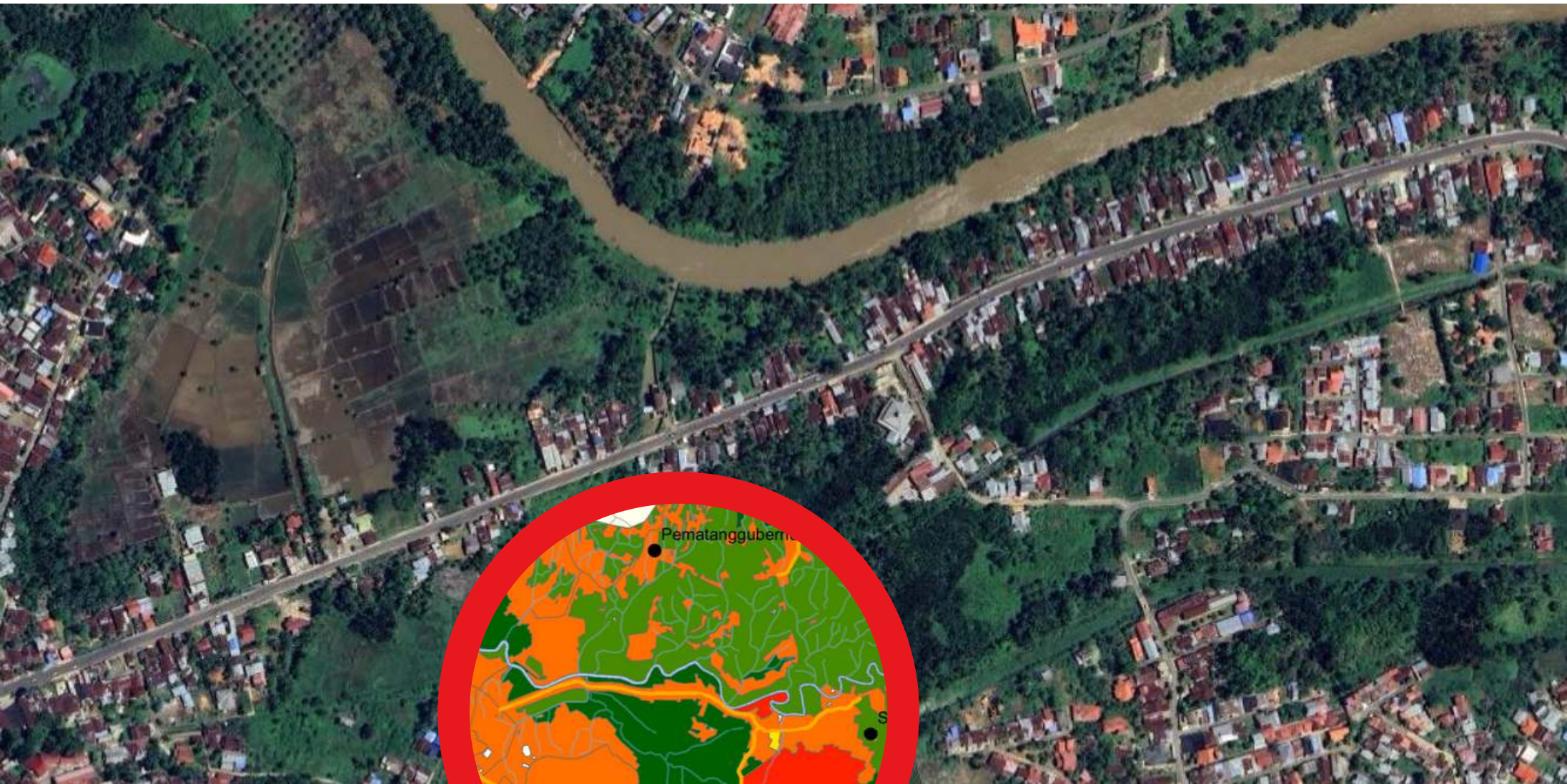
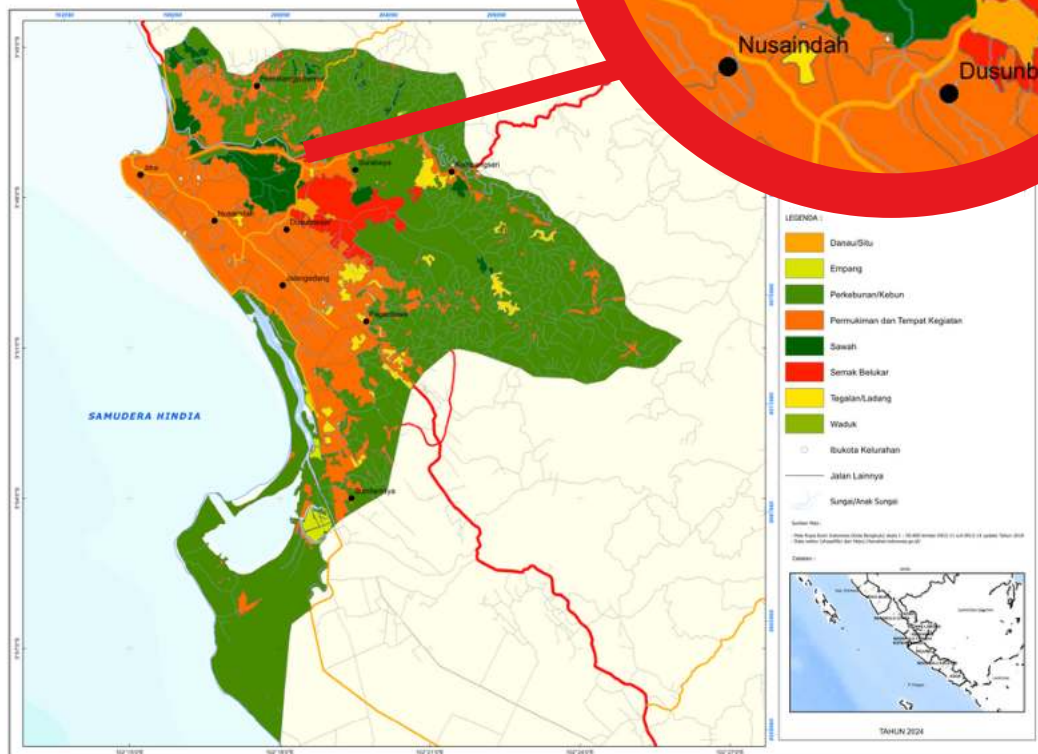
- **Site Location**

The area for the site is in the area of Rawa Makmur, Muara Bangkahulu and Suka Merindu, Sungai Serut, Bengkulu. These two locations are near each other and also is in the same proximity to the river. This location is being considered due to the flooding that occurred whenever there's a heavy rain. Rawa Makmur is a crowded residential area while Suka Merindu isn't as crowded, mostly filled with old houses. In Suka Merindu, the main road is higher than most of the houses, this caused a worse flood to the houses in the area.



Suka Merindu, Sungai Serut

- Site Area



The area of the site will be along the Irian street as this area is the area that is most affected by the flood and often get flooded especially in rainy season.

This area is right next to the main river in Bengkulu city, which is connected to the sea, thus whenever there is a high tide, the river volume would rise due to the high sedimentation which caused the water to unable to flow out smoothly. It is also the lowest area around the river, thus most rain water usually flowed towards this area.

- **Site Condition**



The road leading to this area is going down, thus the road is lower than the road before it. Not only that, the area of the houses are even lower than the road, which cause it to flood when there's heavy rain. During less intense rain, or rain that doesn't last a whole day, only some parts of the area is flooded.



- **Site Condition**



Once it rains heavily and in a long period of time, flooding will happen. Often times, it would also reach the road, submerging it in water. The water on the road might only seem to be around the height of the ankle, yet due to the difference of elevation of the road and the houses, the houses are most likely submerged deeper in water.



- Site Condition



- Site Context



The road is higher than the ground in either side of it. The height of the road from the houses varied. On the start of this road from the intersection towards Irian street, the ground on either side of the road is on the same level as the road.

Around 100 meter along the Irian street, it would descend. Despite this, the ground around the road is lower than before. In this part of the area, the height can be around 2 meters in difference.



- Site Context



More towards the middle area of this road, the difference of height is lessened. The ground height becoming $\pm 1,5$ meters and ± 1 meters respectively. By the end of Tanjung Agung area, which is Tanjung Jaya area, the road and ground is leveled with each other.



Ground level difference ± 2 meters



Ground level difference $\pm 1-1,5$ meter.

- Site Context



There are a lot of abandoned houses in this area. Most of them are old houses that were impacted by the flood and the owner or children of the owner cannot renovate it, thus leaving it abandoned.

There's also a former mosque that got damaged so bad in the flood that it is irreparable.

On the side that is right next to the river, there are around 10 abandoned houses that still looked habitable and around 8 that are already inhabitable.

- **Site Context**

The area of Tanjung Agung is roughly around 46 hectare and is the area that connected Bengkulu's city and its regency, also the main road used to go to South Sumatra or Lampung. This area is known for its specialty in Bengkulu's dish which is called pendap. Other than that, a lot of other Bengkulu's regional food are being sold for people that are going out of the city and wants to buy souvenirs.

In this area, there are around 100+ people living in the area, around 20-30% of them are merchants that sell Bengkulu's delicacies. Along the road of Irian street are around 45 houses in the northern side, around 13 of these houses are abandoned houses or houses that had been destroyed in the past flood thus unlivable. Around 5 houses are in the same elevation as the road, while the rest of them are still lower than the road.

One of reason for flood in this area is the contour of the area and the lack of drainage. The area of Tanjung Agung is like a bowl, so it is lower in elevation in the middle than the edge. Along with the lack of drainage, when heavy rain happen in the area, the water will begin to collect in the center.

In the center of this area is a road that connects the city and regency of Bengkulu. Usually, flood water will cover this road when it rain heavily, and

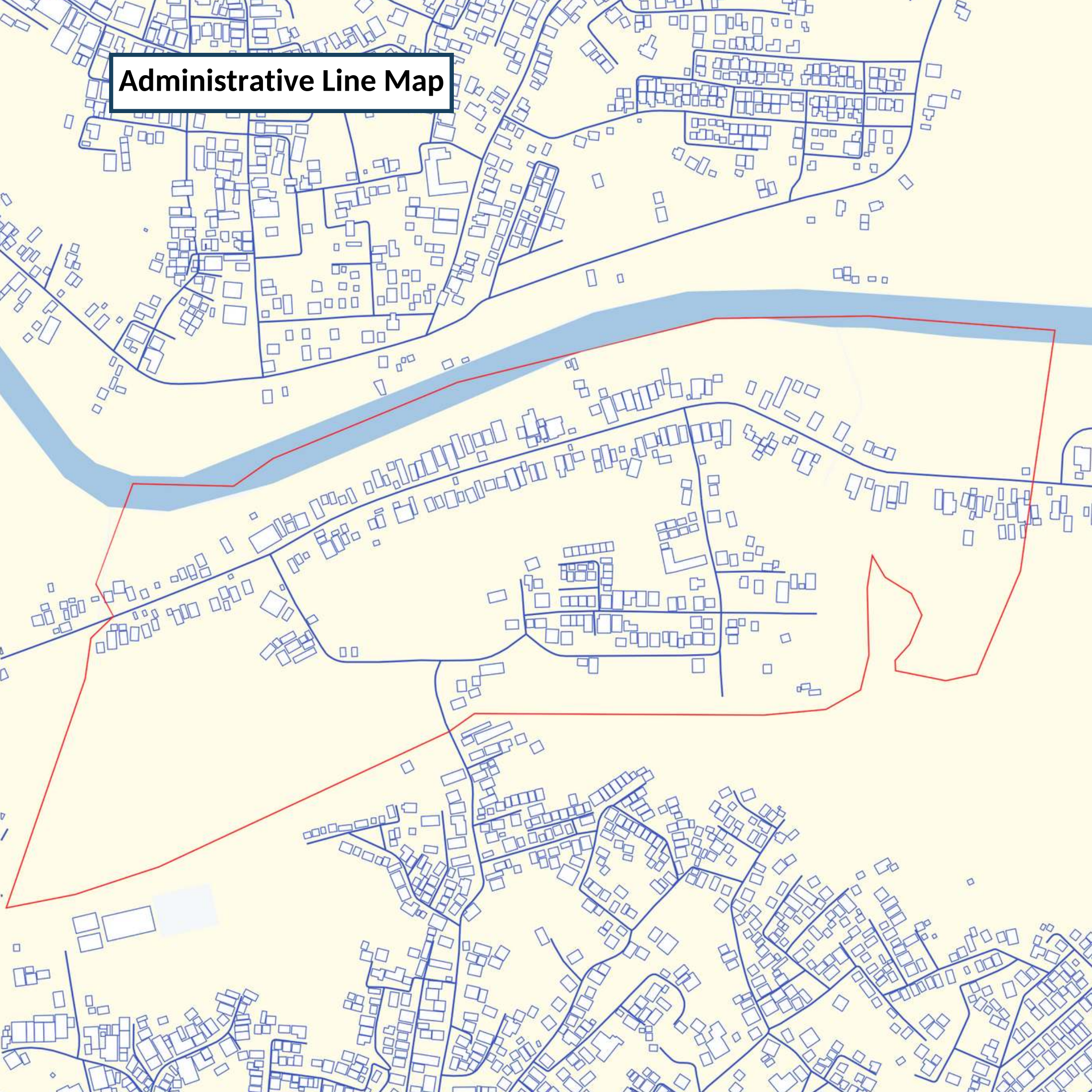
because of this, the government raised the road above its original elevation around 3-4 meters up.

Most of the building in this area are residential and mix-use. Most of the mix-use building are build in the same elevation as the road. The ground floor is usually used for parking space and/or storage. Inside of the ground floor, the storage is usually put on the back and higher than the parking lot. The floor is made slanted to prevent water from getting to the items in the storage room.

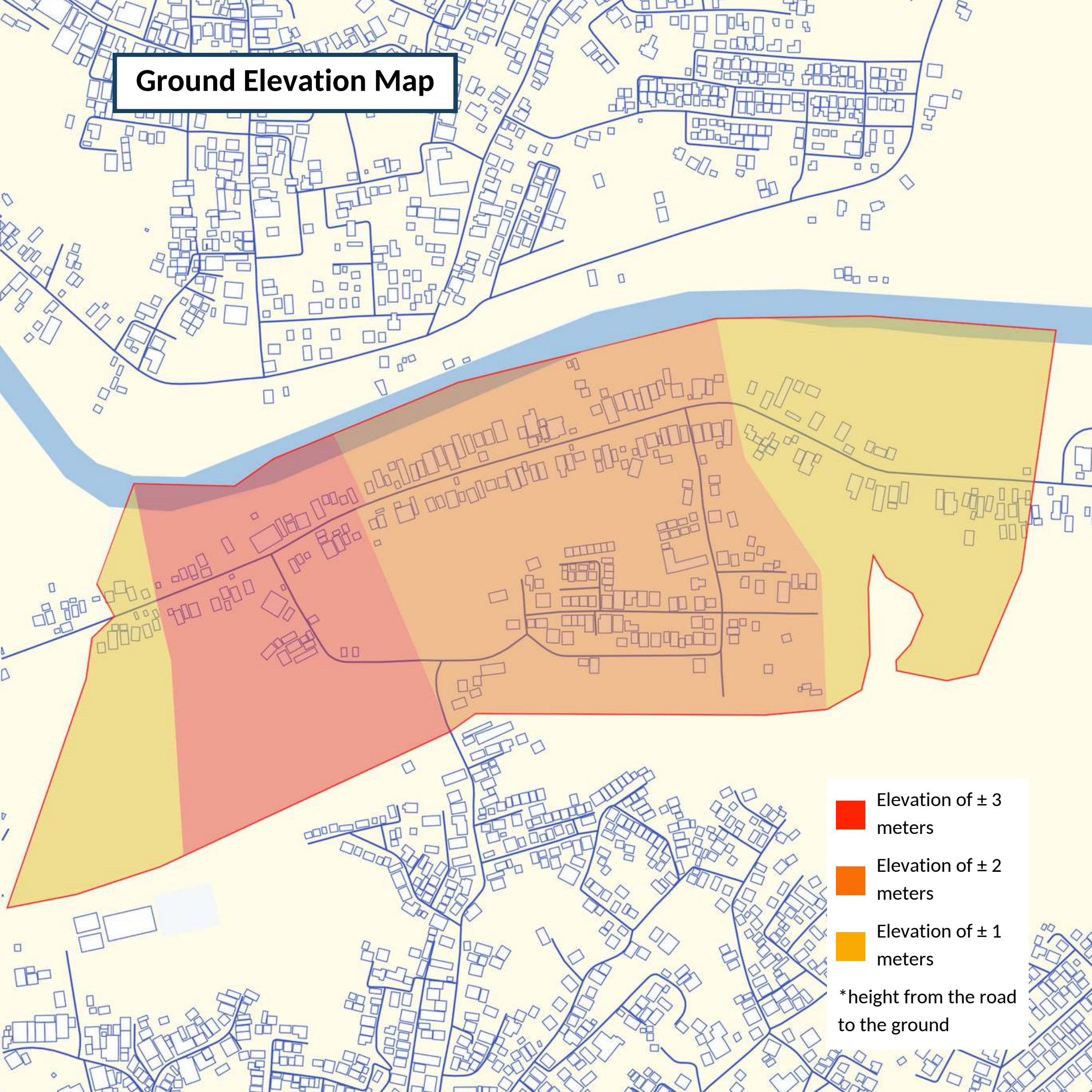
Other than the mix-use building, most houses are lower in elevation than the road. From around 45 houses available, only 10-15 houses are in the same elevation as the road. 6 of these are the mix-use building.

Right about now, most residentials have around 3-6 people living under one roof, this include grandparent(s), parent(s), and 2-3 children. Most of the ones that lives here are adults and children. The working adults in this residence are mostly working as merchant.

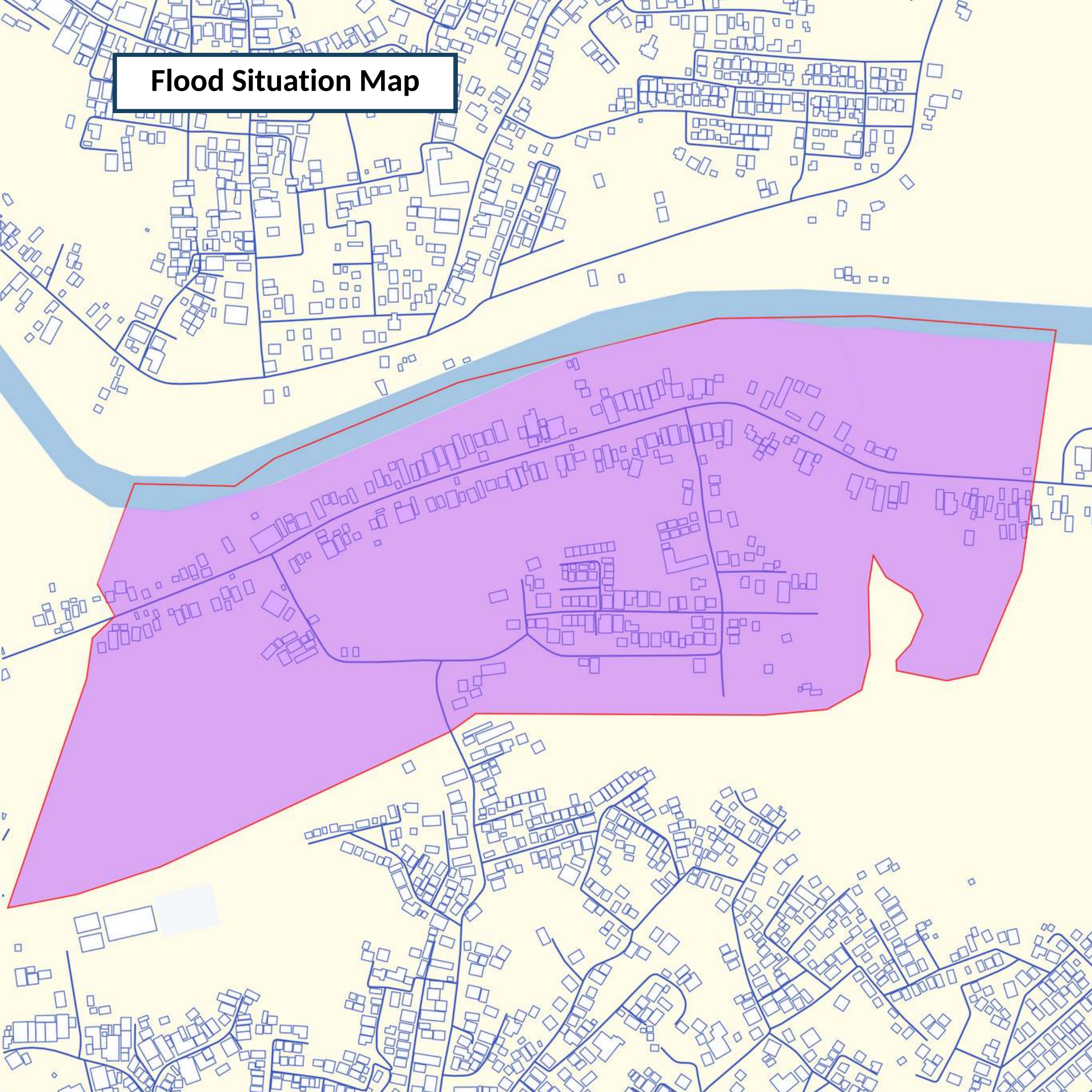
Administrative Line Map



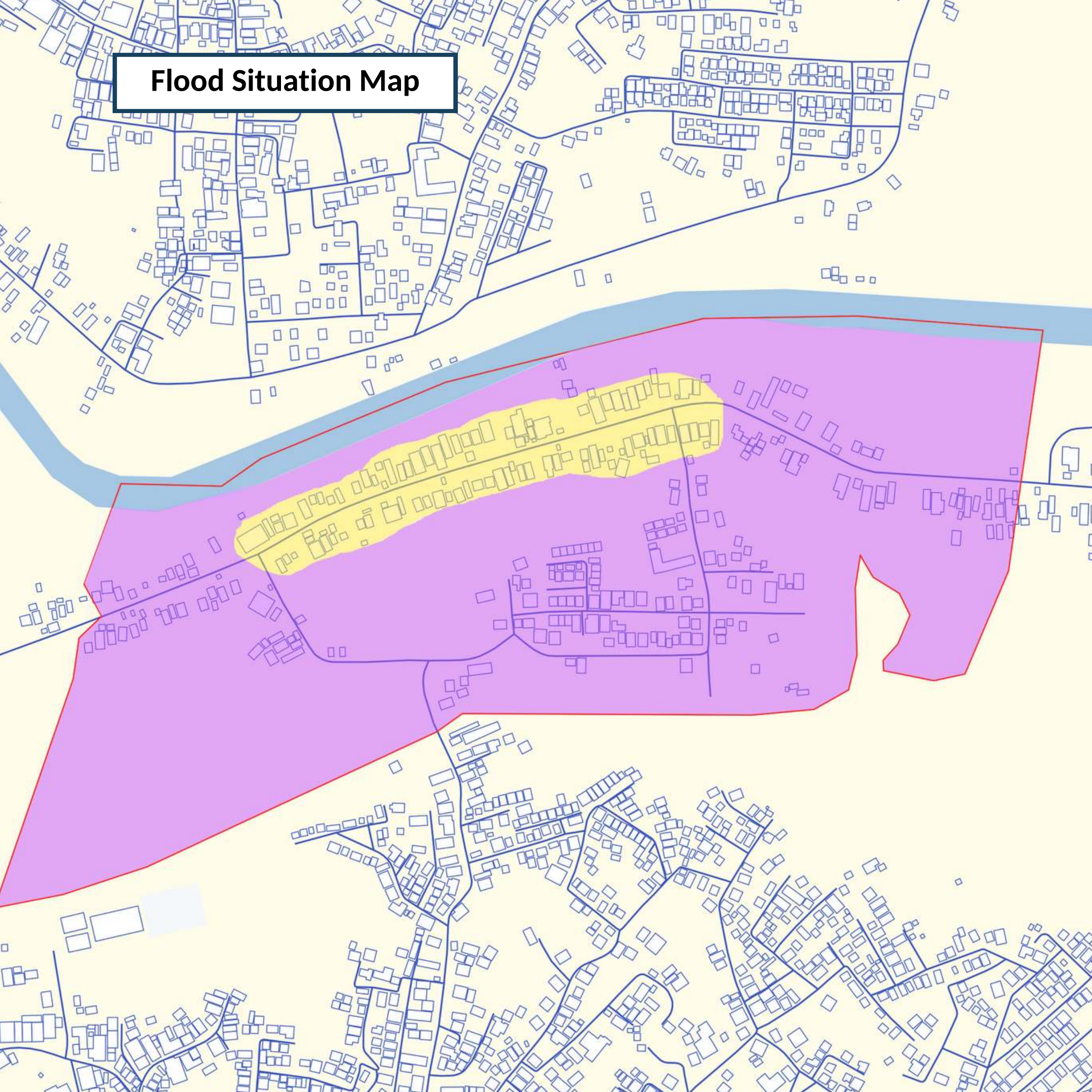
Ground Elevation Map



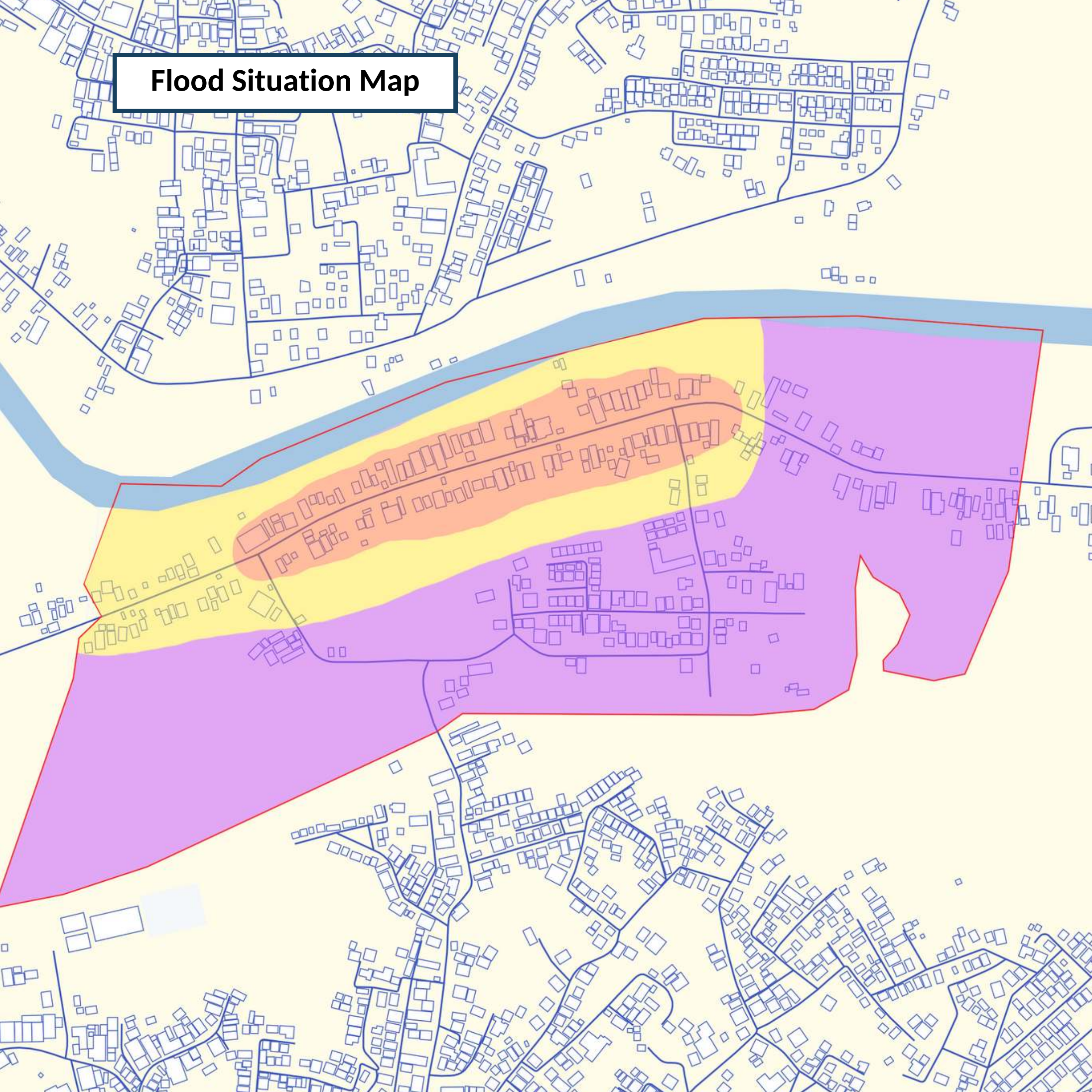
Flood Situation Map



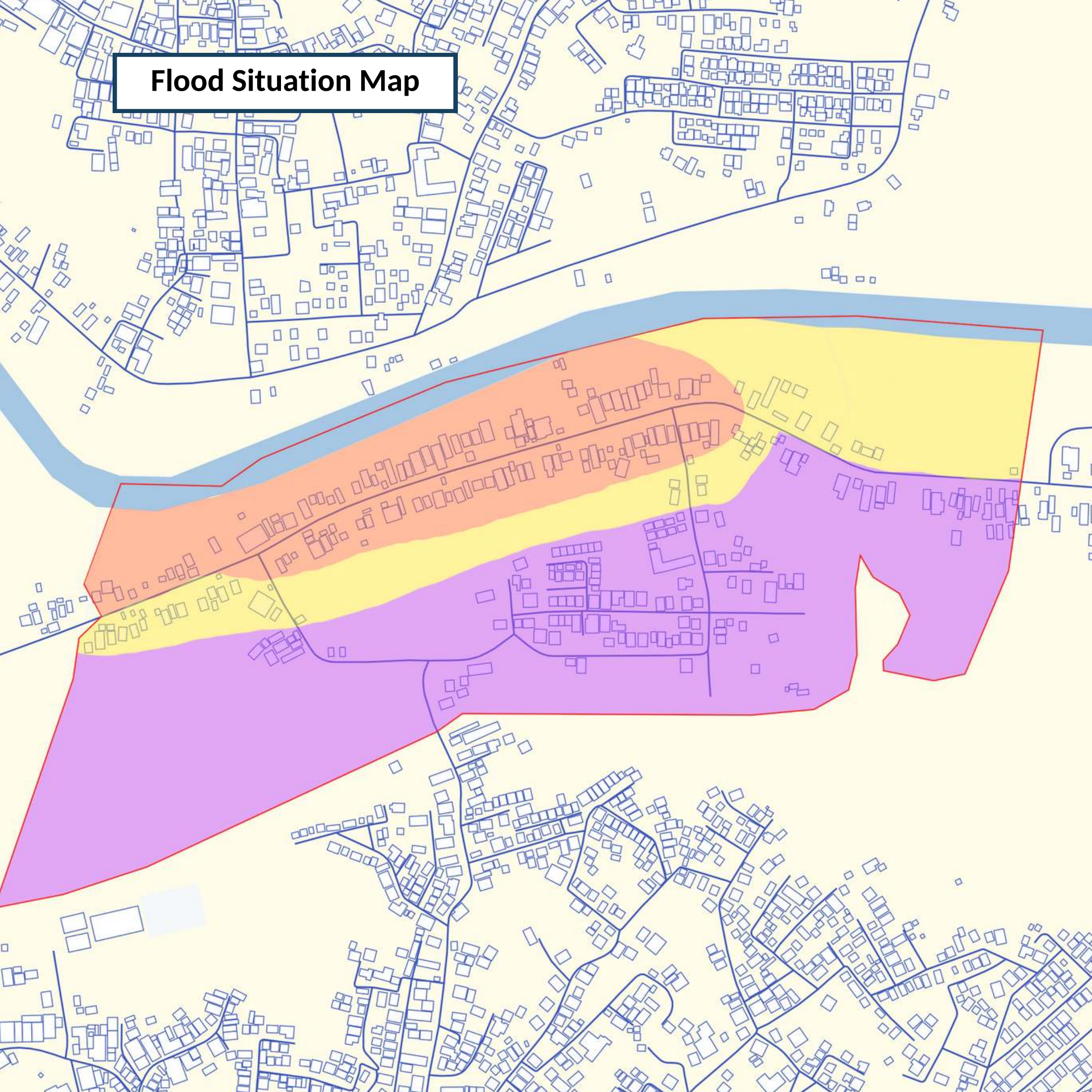
Flood Situation Map



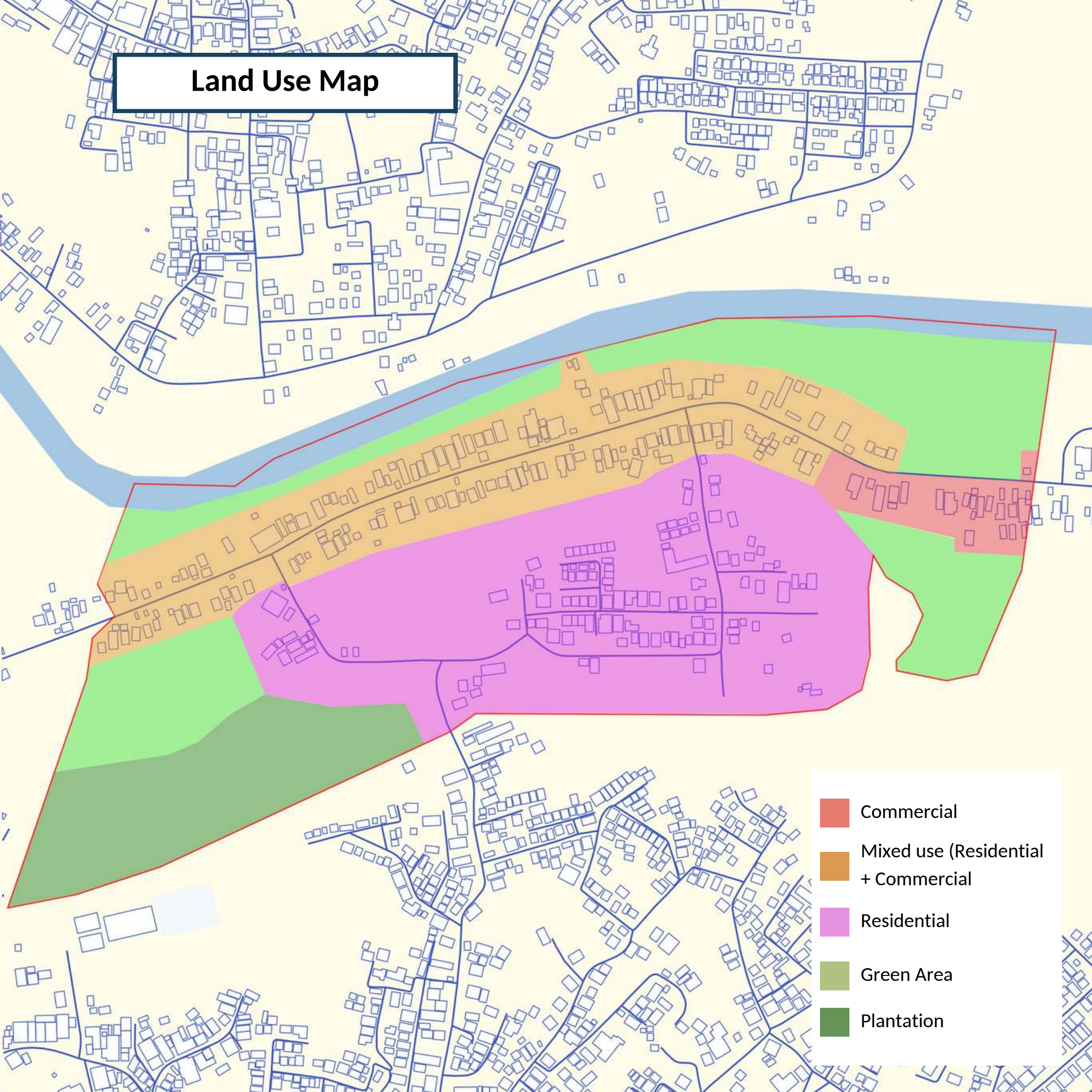
Flood Situation Map



Flood Situation Map



Land Use Map



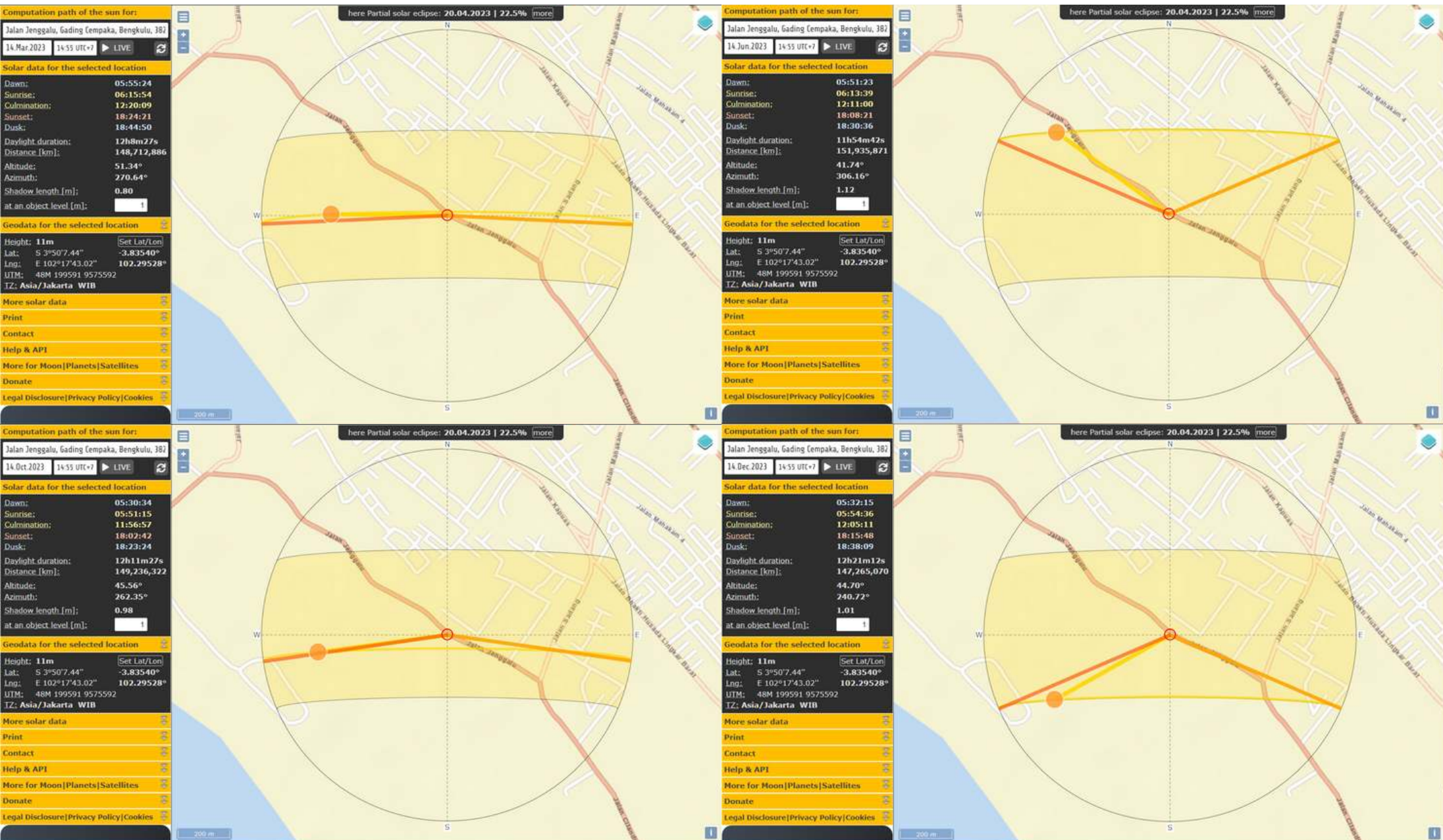
- Commercial
- Mixed use (Residential + Commercial)
- Residential
- Green Area
- Plantation

- **Client and User**

The client will be the government. The government had been planning to give solution to the flooding that often happen in Tanjung Agung without moving the people that lived there to another place.

The user will be residents and merchants that lives there and is using the place to sell local food and souvenir as their main source of income, local community that doesn't have any place other than their current house in the area, and local community that need house in the area.

• Sun Path Analysis



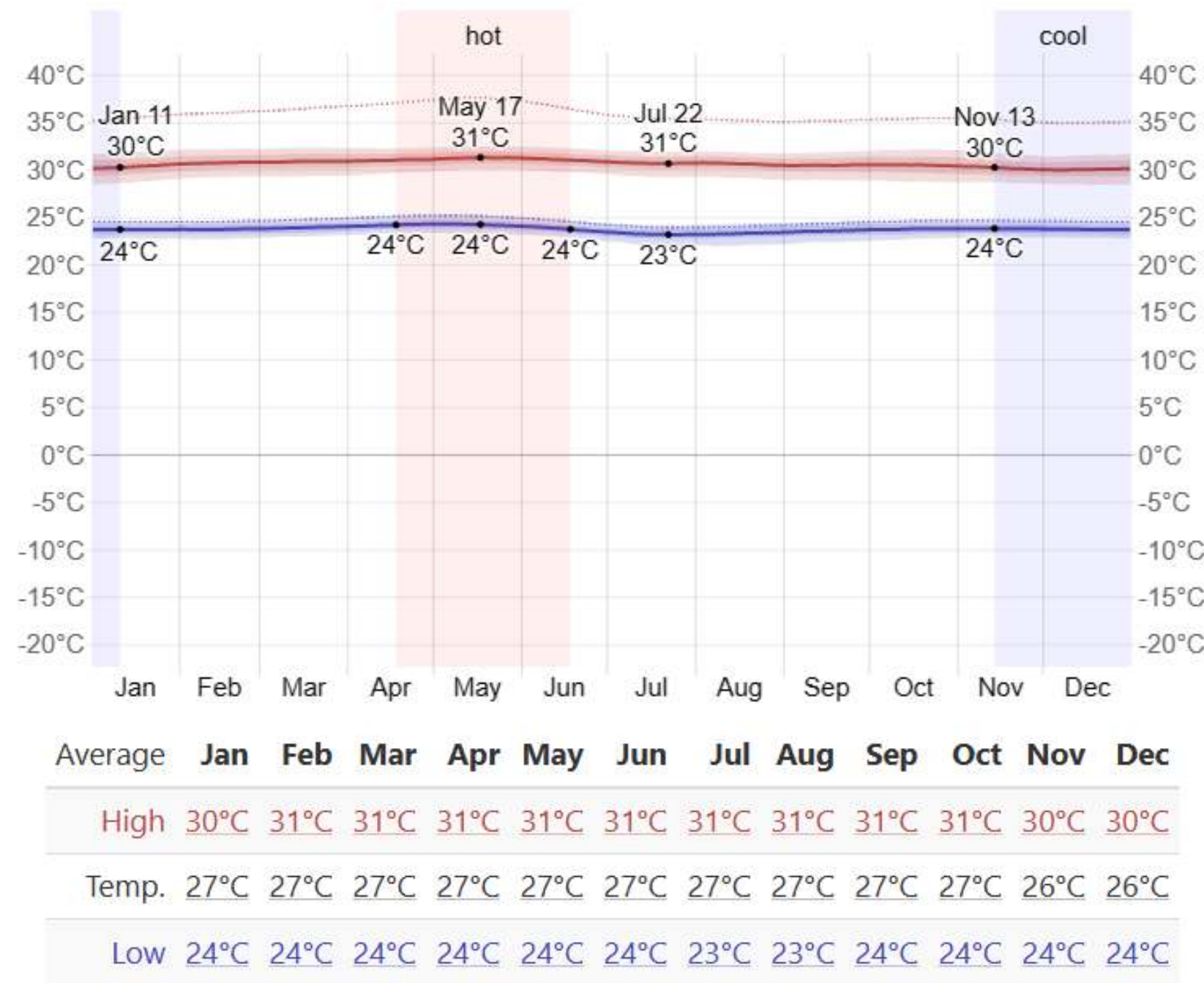
Source: <https://www.suncalc.org/>

The sun path throughout March till June is inclined towards southern area. While during the middle of the year, the sun is inclined towards northern area. In the later half of the year toward the end of the year, the sun is inclined towards southern area again.

The length of day is Bengkulu is relatively the same, more or less around 12 hours throughout the years.

• **Climate Analysis**

- *Temperature*



Source: <https://weatherspark.com/>

The average temperature in Bengkulu is 27°C, while the highest is 31°C for most of the year. The lowest temperature is around the middle of the year, which is 23°C.

- **Climate Analysis**
 - *Precipitation*

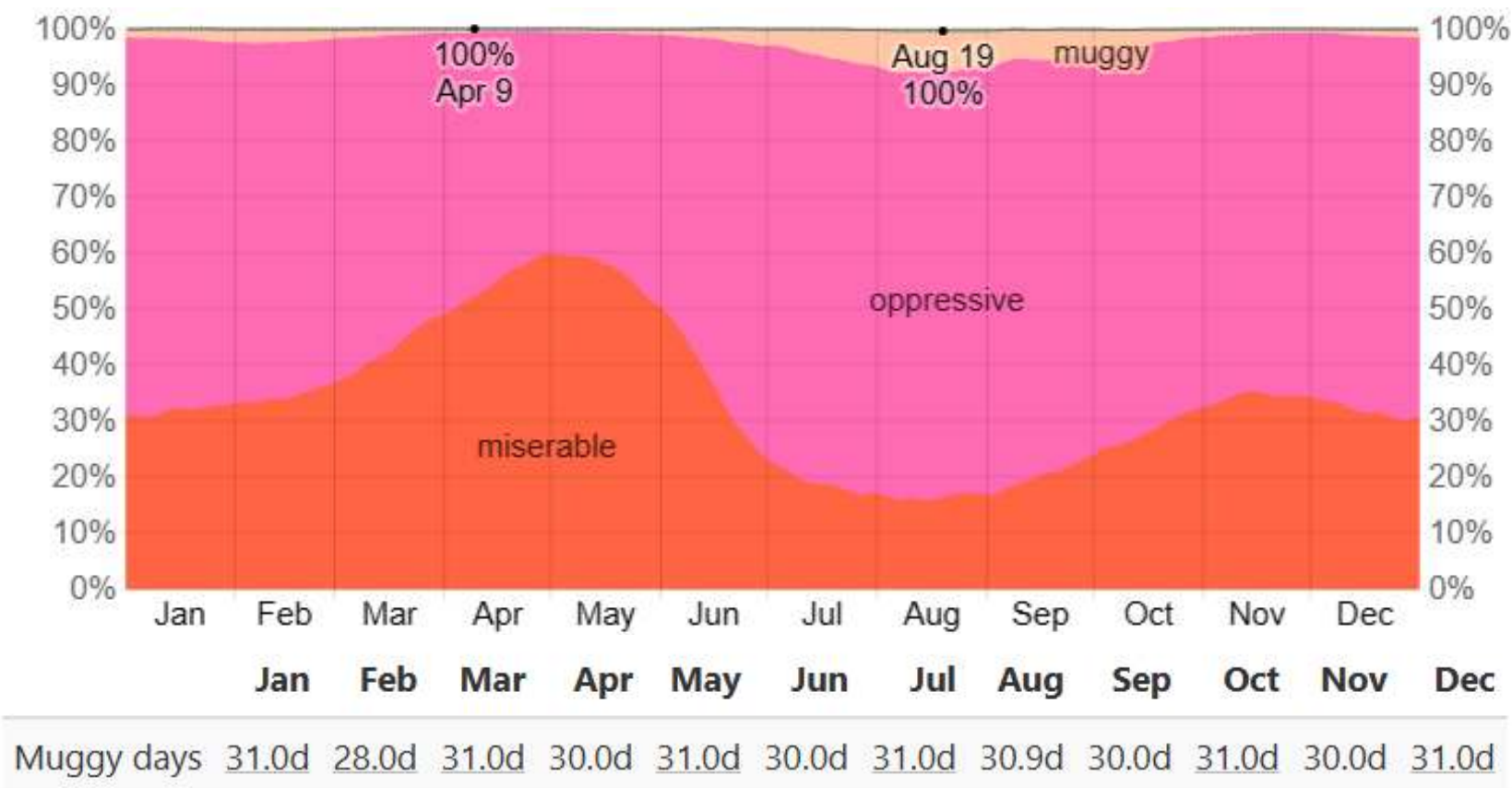


Source: <https://weatherspark.com/>

The precipitation in Bengkulu is pretty high around May and November, while the lowest is on August. Although, in these past years, when the rain would fall is uncertain,

- **Climate Analysis**

- Humidity

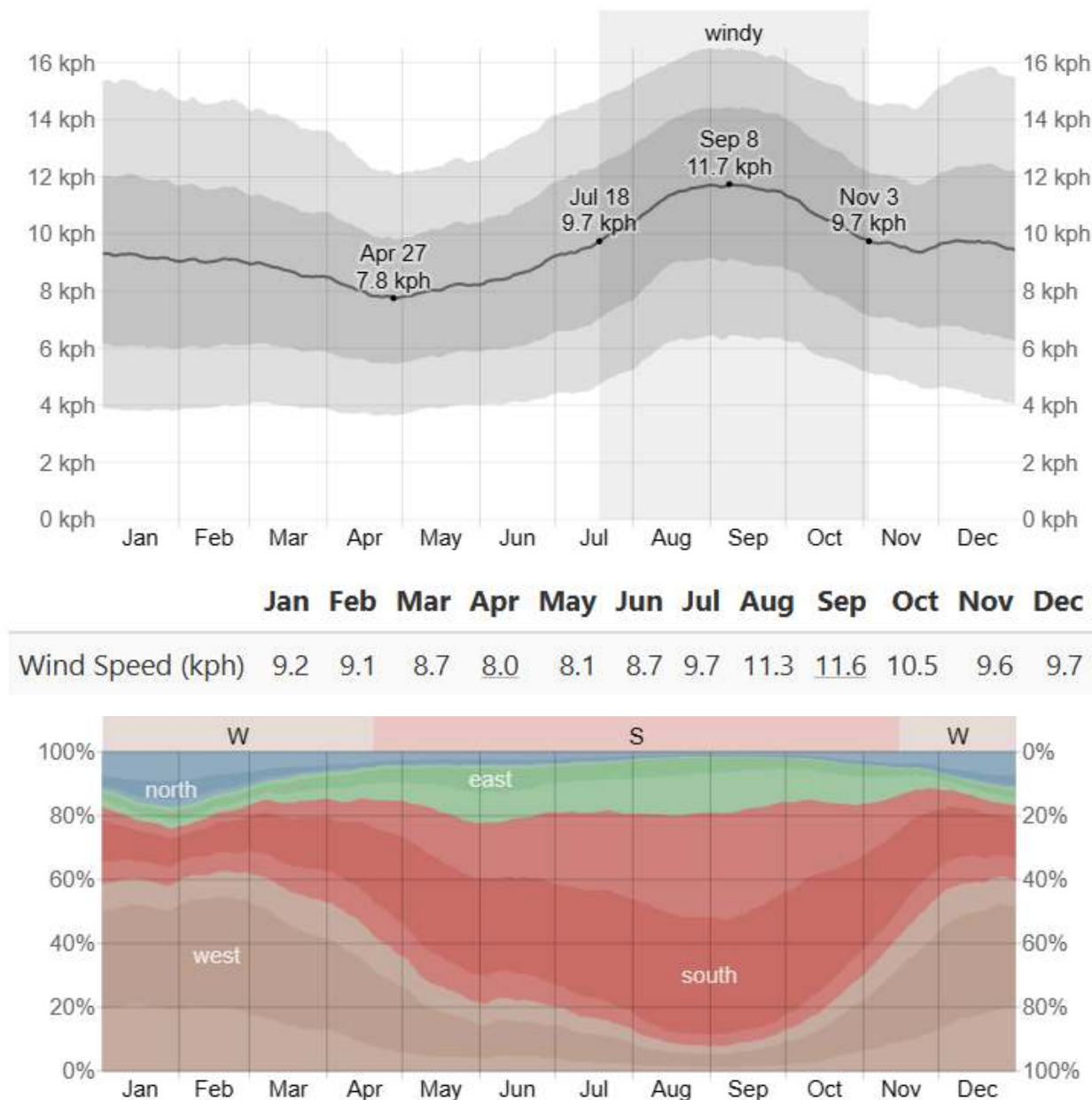


Source: <https://weatherspark.com/>

In Bengkulu, mostly it is muggy which peaked around the middle of the year, while some days is either oppressive or miserable.

- **Climate Analysis**

- *Wind Speed*



Source: <https://weatherspark.com/>

The wind speed in Bengkulu peaked during August until October with speed around 11,7 km/h, while the average wind speed is 8.0 km/h.

The wind direction in Bengkulu is towards the west in the beginning of the year, and shifted towards south during the latter half of the year.

PRECEDENT STUDY

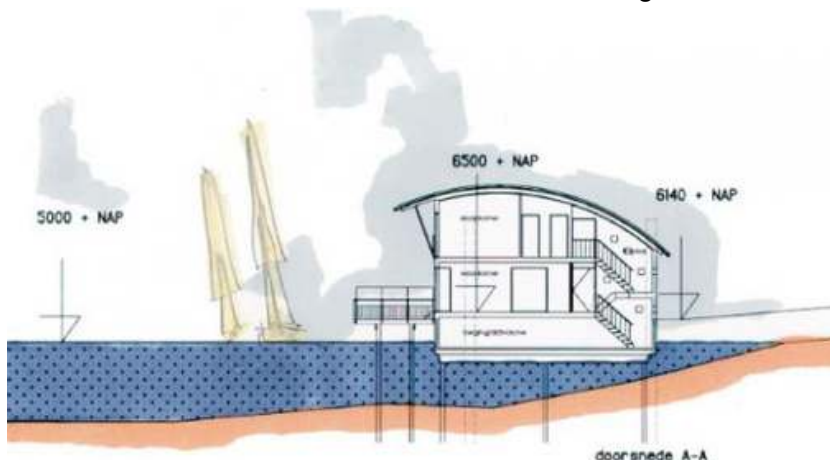
- **Maasbommel Amphibious Homes by Waterstudio and Dura Vermeer**



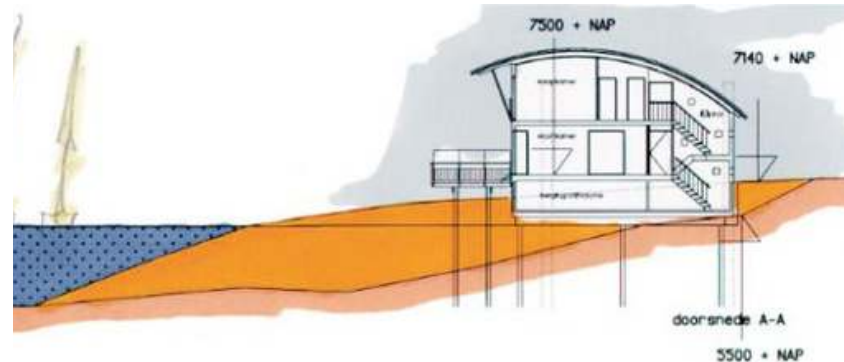
Maasbommel's Amphibious Homes by Waterstudio and Dura Vermeer is a collection of floating and amphibious houses that was made by the riverside of (river name). It was created to have a higher elevation so when the water rise, it won't hit the house.

Water level changes of as high as 5.5 meters are bearable for the residences. The construction of the semi-floating and floating housing is the same, consisting of a lightweight timber frame building atop a concrete barge. The barge's interior space could be utilized as basement storage.

The floating houses are constructed on top of the river with certain altitude to accommodate whenever the water is rising.



The semi-floating or amphibious houses are constructed on the ground by the riverside.



The semi-floating or amphibious houses are constructed on the ground by the riverside. These houses have mooring poles that allow the houses to shift in elevation in response to the water level. Thus, whenever the water level rises, the house would also rise up. The houses are connected to the mooring poles so it won't move along with the flow of the water and float away.

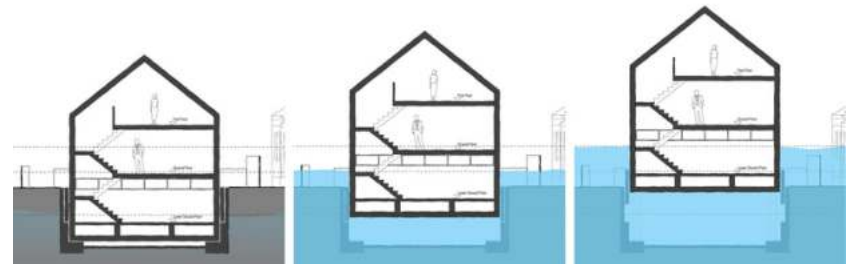
- **Amphibious house by BACA**



The amphibious house by BACA is a structure with permanent foundations that sits on the ground but rises in its dock during a flood so that it floats supported by the floodwater. The house is built to withstand floodwaters up to 2.5 meters deep, which is far higher than both the area's current and estimated future flood levels. It is built right by the riverside, around 10 meters from the river.

The architects also install sustainable features into the design, which are:

- high performance insulation
- double-glazing
- external blinds
- heat recovery ventilation system
- solar panels
- intuitive landscape



The home is buried, and from the outside, the floating base is hardly noticeable. Instead of being lifted nearly two meters above the ground as would be necessary if the house were not amphibious, the ground floor is raised less than one meter above the ground. By using this method, a three-story, 225 m², three-bedroom home might be built instead of a 90 m³, single-story home, without greatly raising the ridge height.

A thoughtfully designed garden serves as an organic flood warning system. Terraces with varying elevations are intended to flood gradually, warning residents far in advance of the floodwaters reaching a dangerous level. As BACA architects call it, an 'intuitive landscape'. Reeds cover the lowest terrace, while bushes and other plants adorn the other. At the highest point, directly below the living room, is the terrace; the lawn is situated one level above.

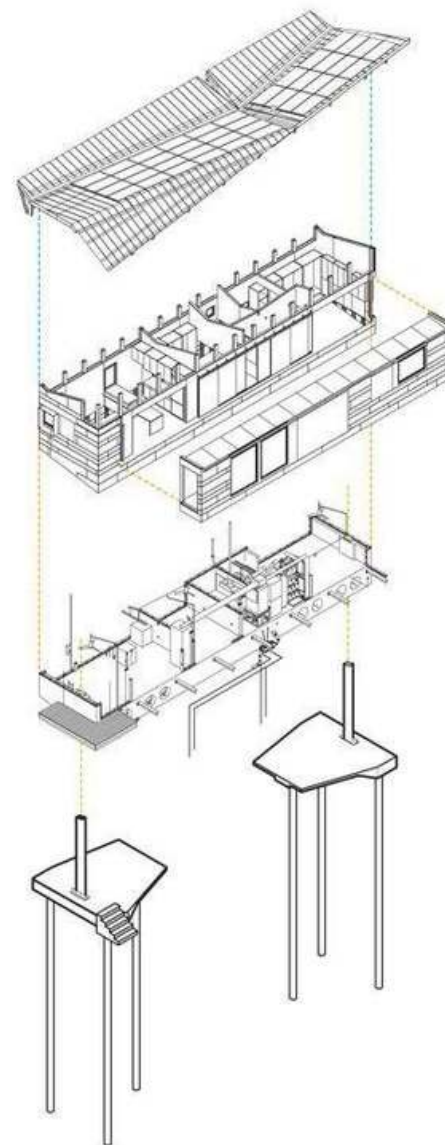
Elephant cabling is used to link the amphibious house's utilities. All of the services can stay clean and functional throughout any flood occurrence thanks to the flexible service pipes' 3 m extension design. Crucially, this maximizes the continuity of the tenants' everyday lives by enabling them to return to the house right away following a flood.

- **FLOAT house by Morphosis**



The FLOAT house is one that can meet its own energy and water demands, withstand floods caused by a storm the scale of Hurricane Katrina, and—perhaps most importantly—be produced at a low enough cost to serve as low-income housing.

The FLOAT House maximizes mass manufacturing efficiency while honoring the particular context and culture of New Orleans. The shotgun house typology, which is native to New Orleans and the Lower Ninth Ward, is the ancestor of the FLOAT House. The FLOAT House is perched on an elevated base, just like a conventional shotgun house. All mechanical, electrical, plumbing, and sustainable systems are integrated into this creative base, or "chassis," which also safely floats in the event of flooding. The chassis for the FLOAT House was inspired by General Motors' skateboard chassis, which is built to accommodate multiple car body styles. This allows for a wide range of customizable house layouts.



The house was built to be both affordable and flood-resistant, floating as the water level rose. It is constructed on a prefabricated polystyrene foam chassis covered in concrete reinforced with glass fibers. When fastened to stakes, this functions as a raft and raises the home to a height of 3.7 meters. The architects of this house expect that while not being intended for occupants to stay inside during flooding, the layout will enable them to return shortly after the storm.

CONCEPT STUDY

- **Amphibious Foundation and Buoyant Foundation**

Depending on the requirements of the site, there are three varieties of houses with buoyant systems. These three types of homes are amphibious, floatable, and floating.

A housing that is anchored in a fixed location and has a flotation foundation is called a floating house. It is not an inflatable for sailing. Either the floating residence's own self-sufficient functionality facilities or connections between it and the service station linked to the core urban supply systems provide the utility service lines (Moon, 2015).

Similar to the floating house, the floatable house also has a buoyant foundation system, but it differs in that it has a watercraft that allows the house to move considerably freely and independently in a direction perpendicular to the floodwater body (Winston, 1994). The main structure is supported by telescopic piers that are anchored in cement pedestals, while the buoyant component is made up of flotation cells beneath the platform. The house can rise above the flood level during a flood and will return to its original position when the flood level lowers (Moon, 2015).

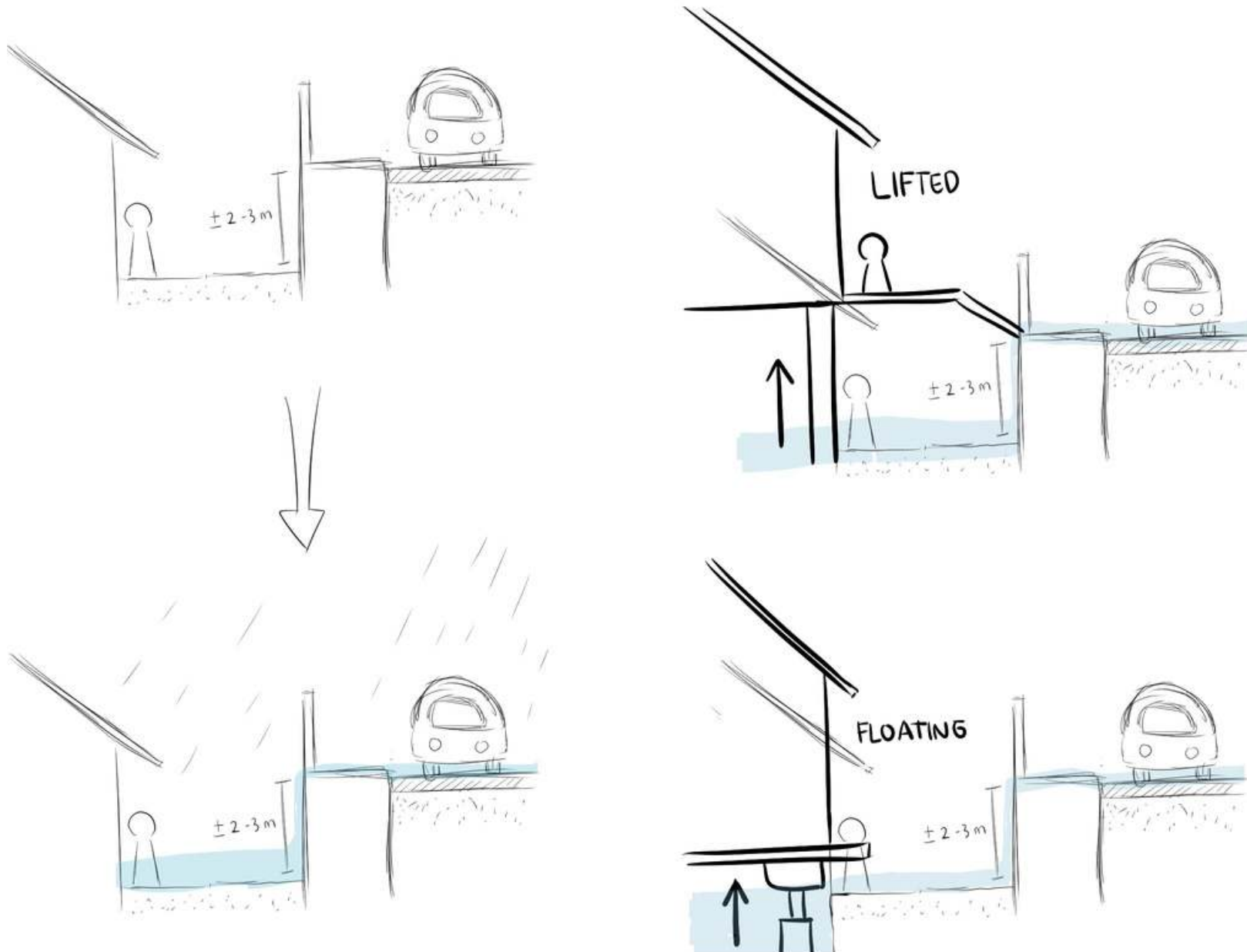
An amphibious house is one that, in the rainy season, can float with the flood level, but in the dry season, it remains grounded due to its buoyant foundation. Unlike the floating house, it is not permanently floating; instead, the house is kept in place by mooring pylons at the sides (Climate-ADAPT, 2015). This is a type of residence that is reachable by boat and automobile on the water. The floating housing and utilities infrastructure are offered in the same manner (Moon, 2015). It is a flood mitigation strategy that, rather than trying to thwart or impede the hydrological flooding cycle in the floodplain, synchronizes with it. Since it can employ the floodwater as the primary means of raising the superstructure to a predefined height during the inundation event, it effectively "lives with" the flooding event. When the water recedes, the house would settle back to its original place.

In short, floating house is a house that floats on top of a body of water and can freely move along with the water movements, it is not restricted to the ground below it and just floats on top of the body of water. Floatable house, is the same as floating house. The only difference is that floatable house is anchored to the ground with a

structure that enables it to move along with the rising volume of water where it sits on and able to return to its regular elevation whenever the water level decreases.

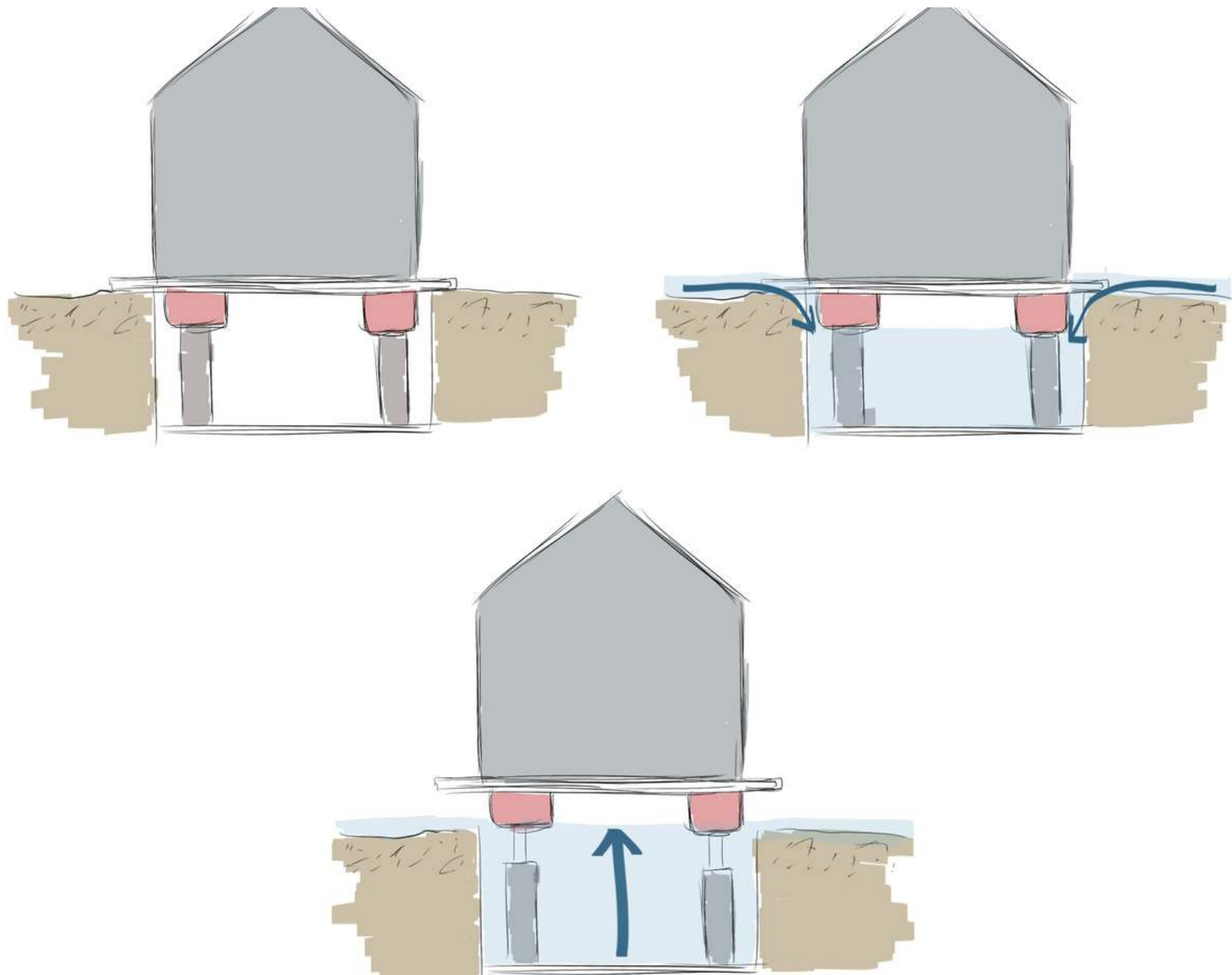
While amphibious house is a house that can sit on both ground and water. Usually amphibious house are made on the ground, but can rise and float on water if the water level rises. The same as floatable house, it is anchored to the ground thus preventing it to float away from its original place. Once the water level decreases, it can return back to its original place.

- Design Sketches

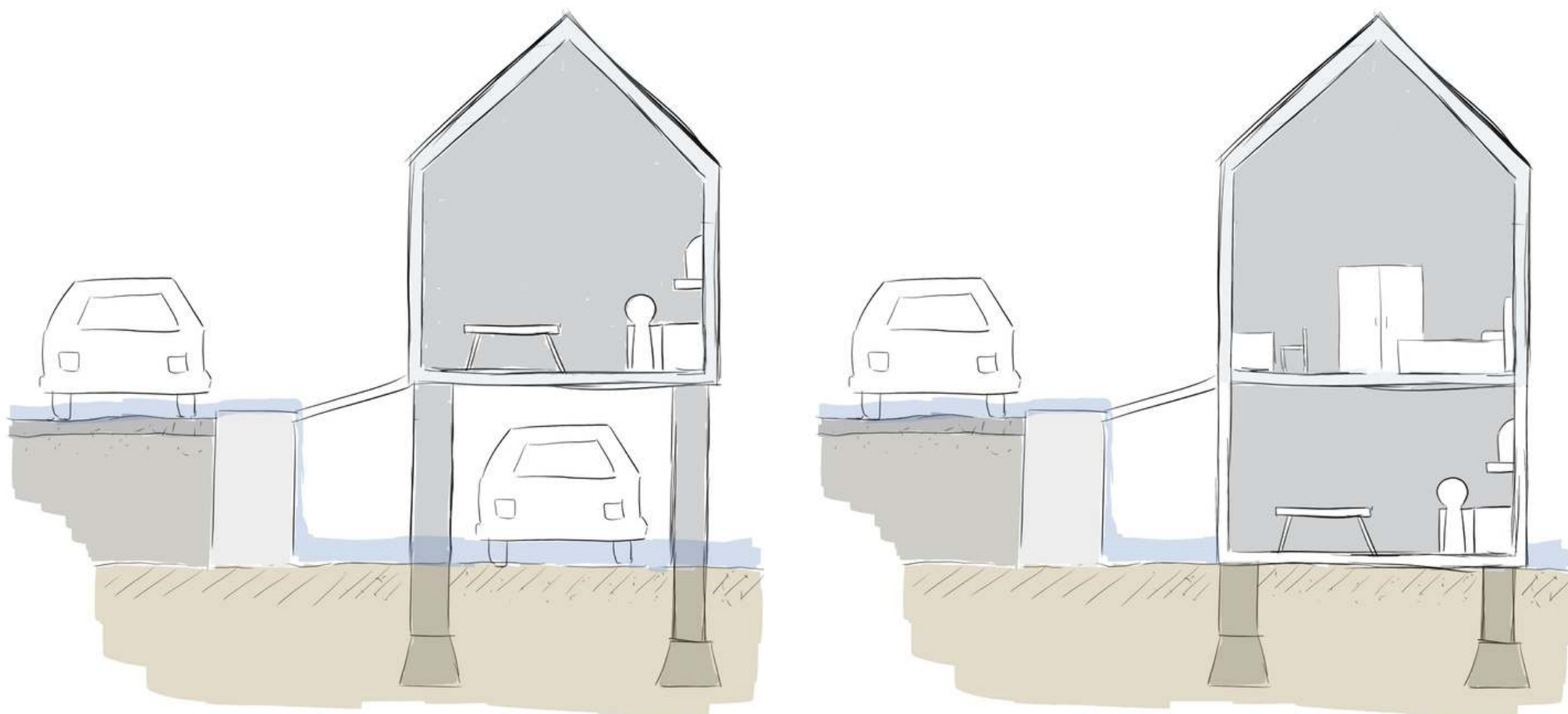


The elevation difference from the road to the ground is around 2-3 meters. During heavy rain, the excess water from the road would flow towards the ground level, causing flooding. Since there are also barely any catchment land, the houses got flooded easily.

Some solutions are either lifting the houses up to the road level, or make the floating houses thus minimizing the impact caused by the flood to the residence.



The floating house basically work like a boat. There would be several floats under the house, attached to a pole on the bottom so it won't float away. Once the flood subside, the house would float back down to its original place.



The lifted house is where the house is lifted up, creating an empty space below it, or in some cases, a full room which can be seen as a basement. If it's an empty space, it can be used for a parking space for the resident's vehicles. While a room can be used as a storage, or any other room needed in the house.

- **Building Materials**



WOOD

Wood is known by its durability, aesthetic value, and its strength. It is a common building material and is one of a locally sourced material.



PVC AND UPVC

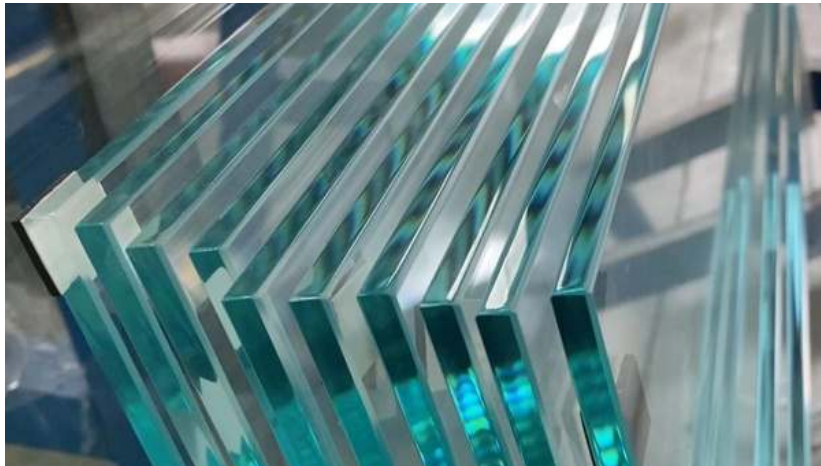
PVC and UPVC are plastic material that is very common in residential and commercial building, mostly for parts that are exposed to water.



CONCRETE

Concrete is a building material that is used very often. It is durable and is a good material for building structures.

- **Building Materials**



TEMPERED GLASS

Tempered glass is a strong material, unlike normal glass, it won't easily break.



EXPANDED POLYSTYRENE FOAM

Due to its closed-cell structure and low weight, EPS is utilized in the construction of houseboats, swim platforms, pontoons, rafts, and floating docks.



FIBERGLASS REINFORCED PLASTIC

A buoyant material with a high strength-to-weight ratio, fiberglass reinforced plastic (FRP) is frequently utilized for flotation-required applications like pontoon buildings, floating docks, and rescue boats.

SCHEMATIC DESIGN

SCHEMATIC DESIGN

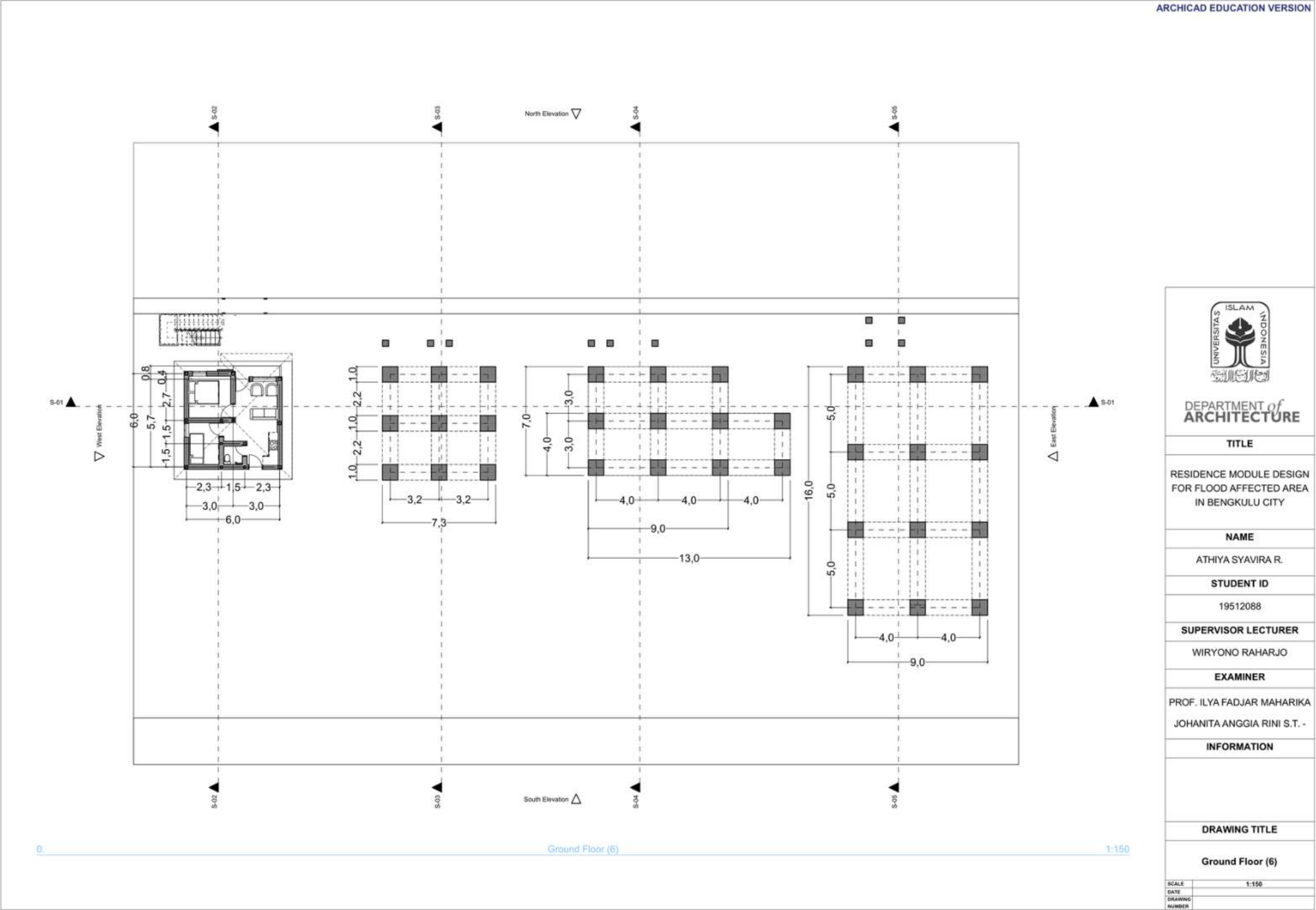
- Site Plan



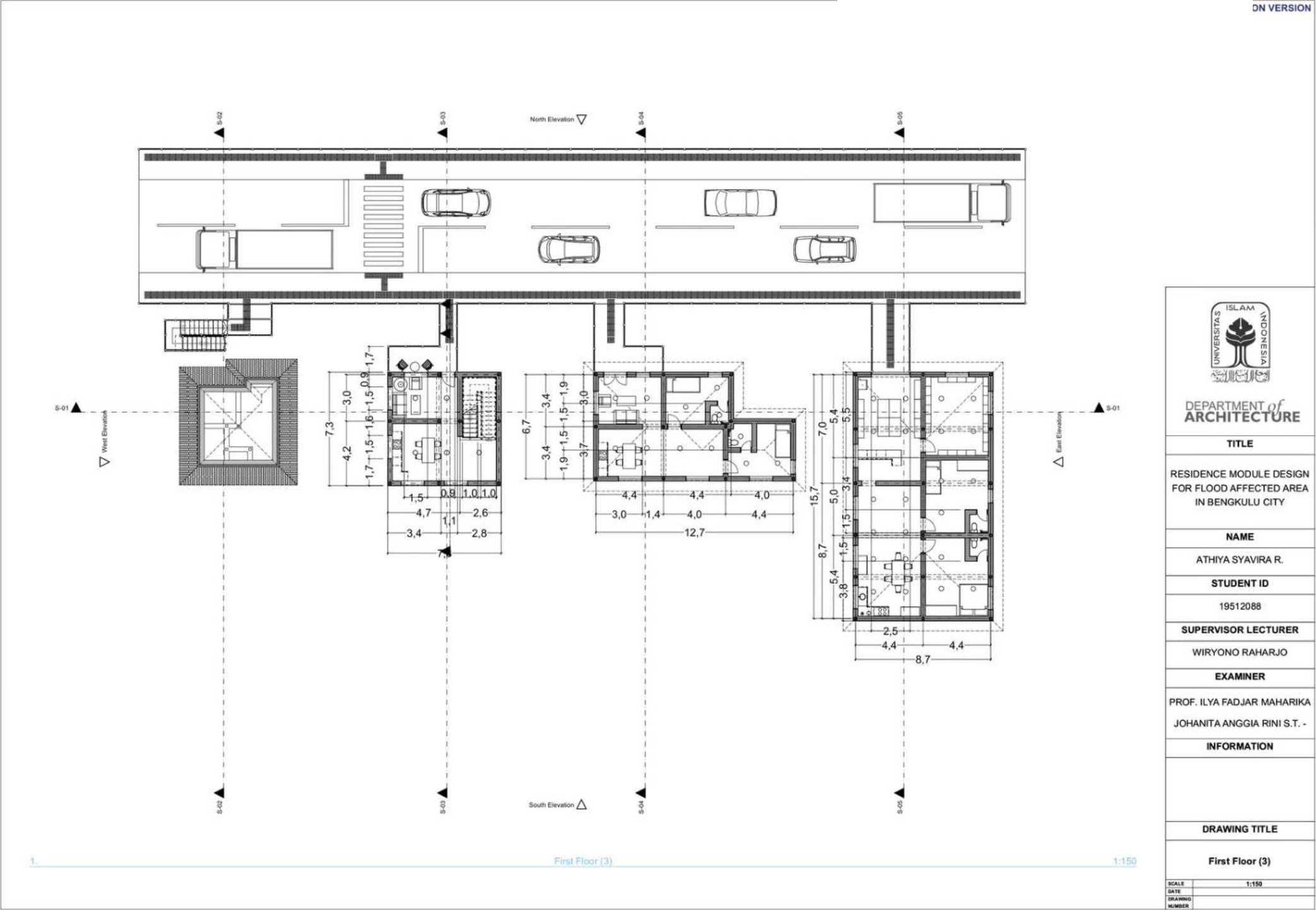
• Situation Plan



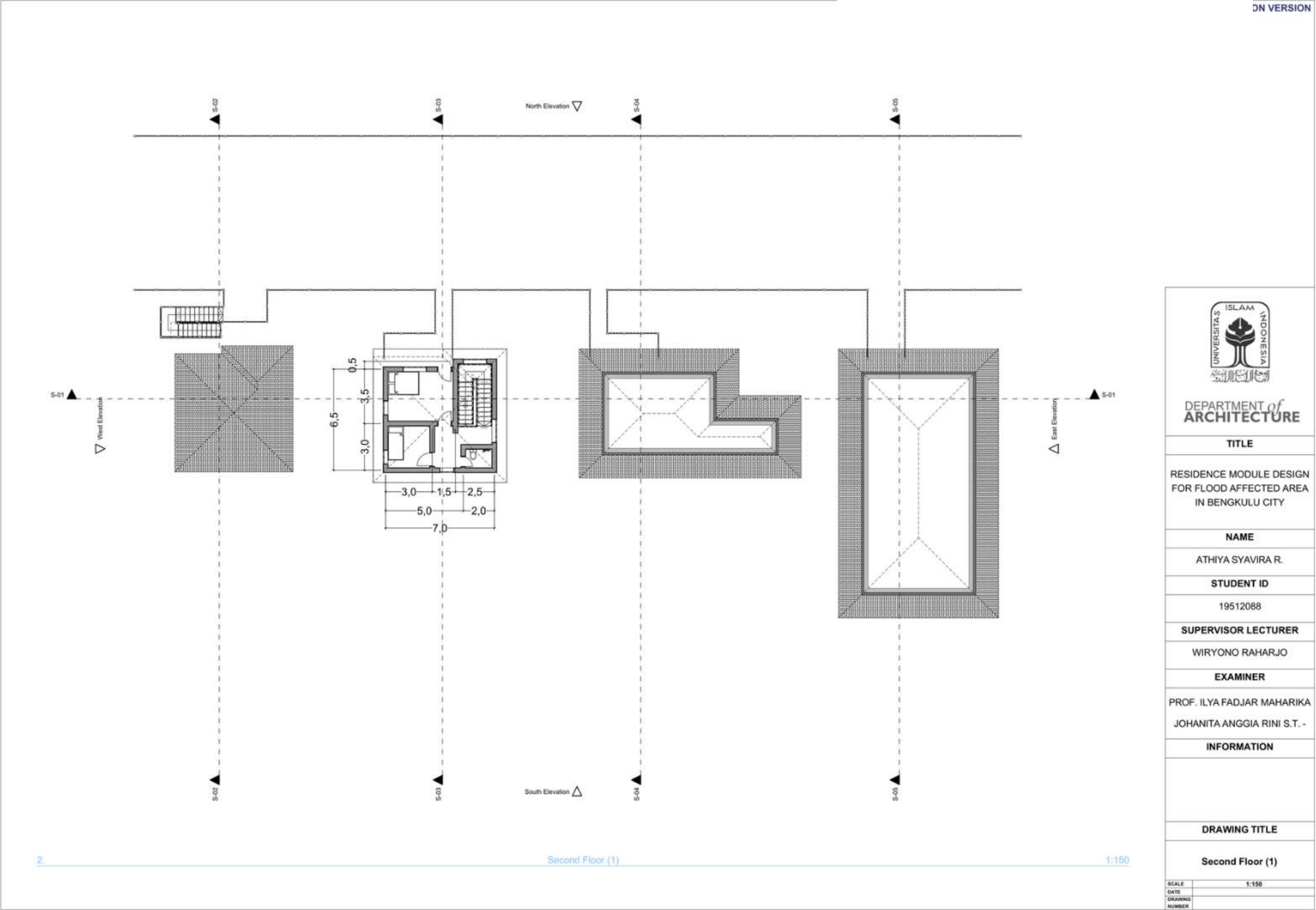
• Ground Floor Plan



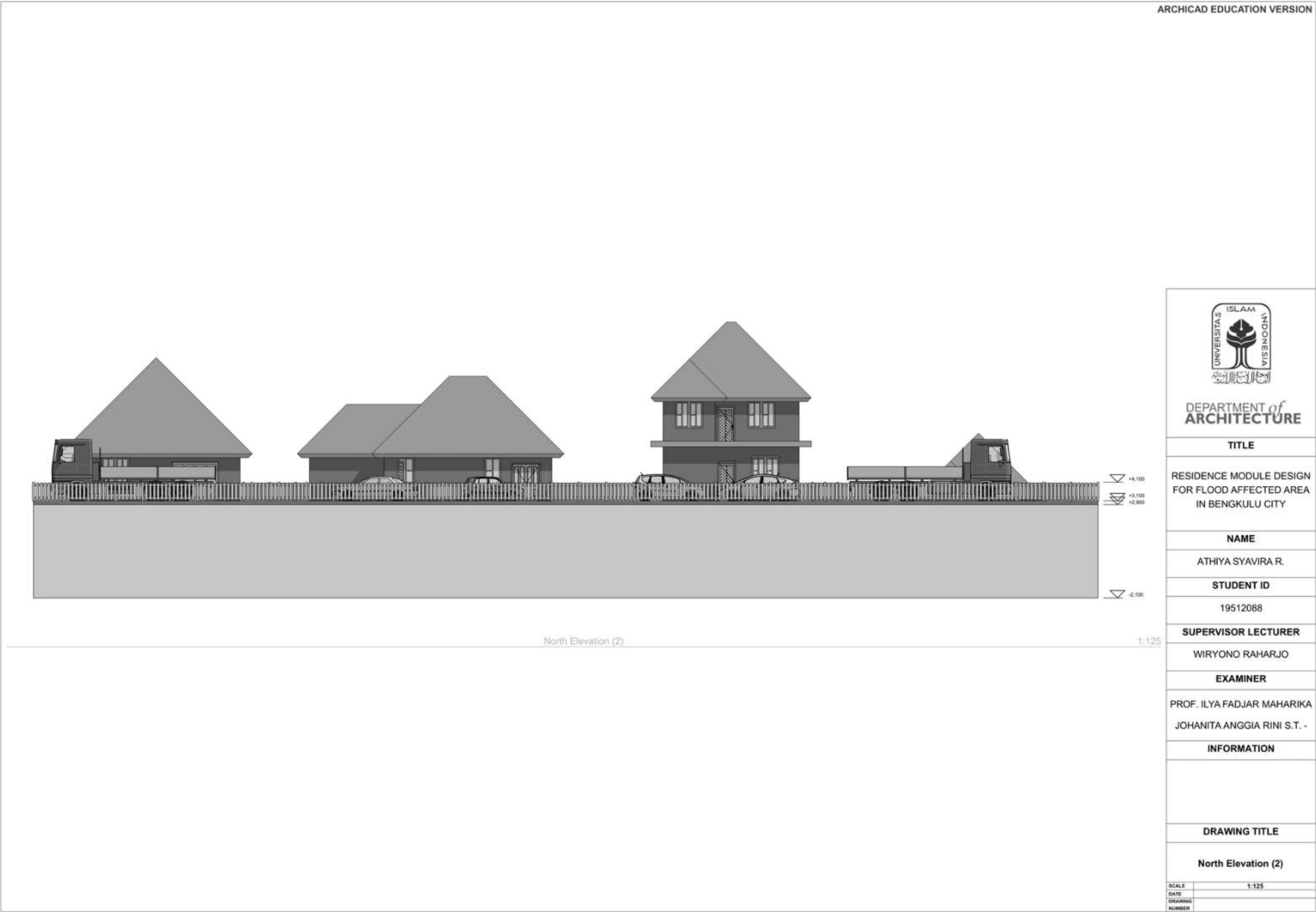
• First Floor Plan



• Second Floor Plan



- Elevation
 - North Elevation



- East Elevation

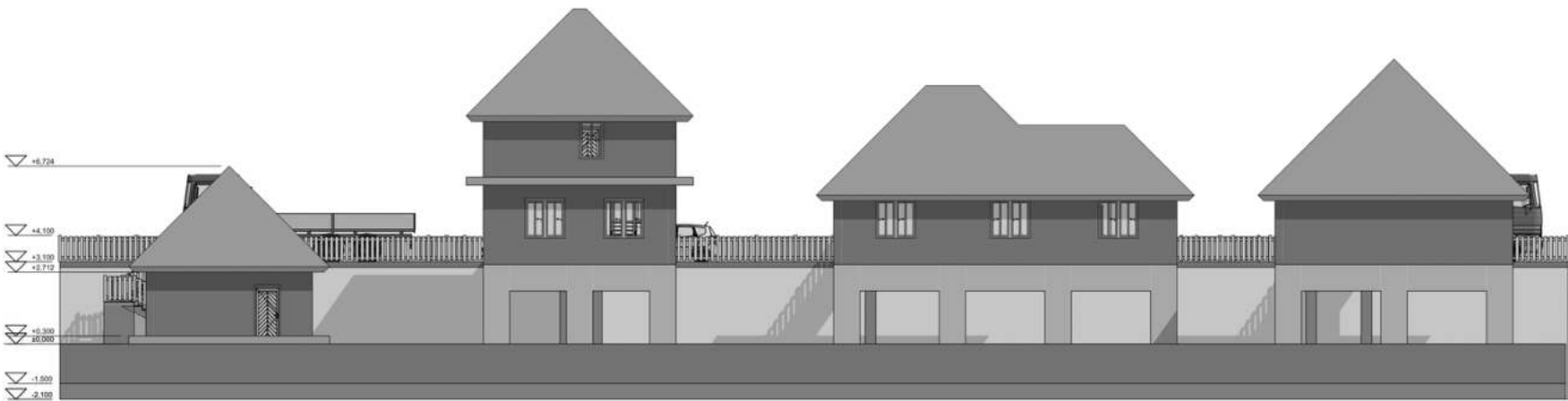
ARCHICAD EDUCATION VERSION



	
DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
East Elevation (2)	
SCALE	1:100
DATE	
DRAWING NUMBER	

- South Elevation

ARCHICAD EDUCATION VERSION



South Elevation (2)

1:125



DEPARTMENT of
ARCHITECTURE

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INFORMATION

DRAWING TITLE

South Elevation (2)

SCALE	1:125
DATE	
DRAWING NUMBER	

- West Elevation

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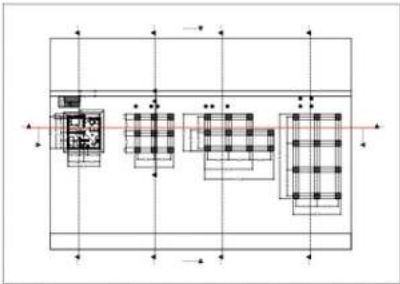
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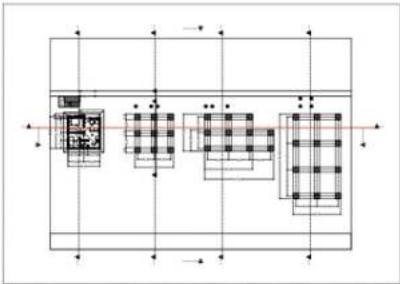
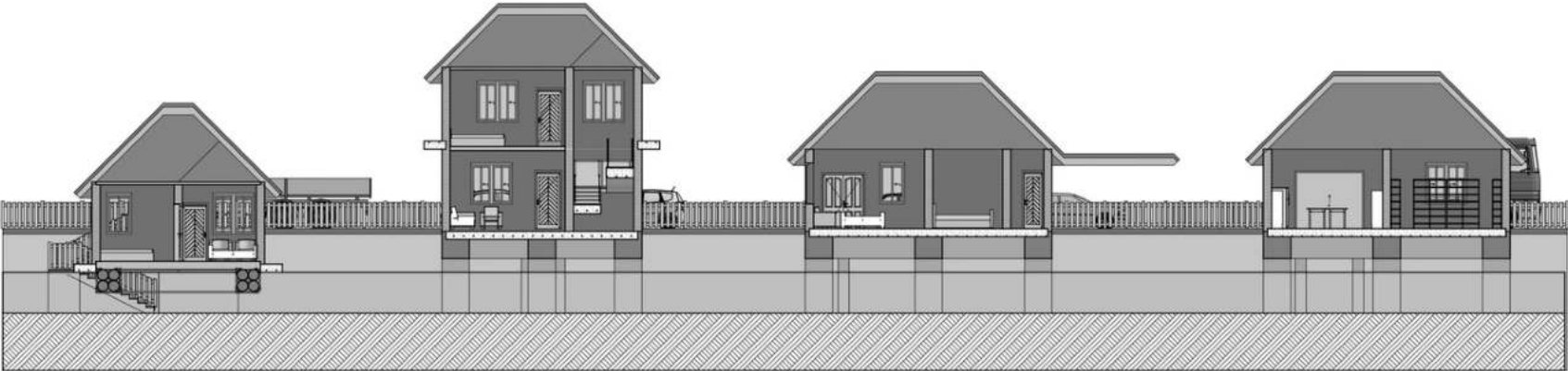
S-01

Building Section (1)

1:125

	
DEPARTMENT of ARCHITECTURE	
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WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
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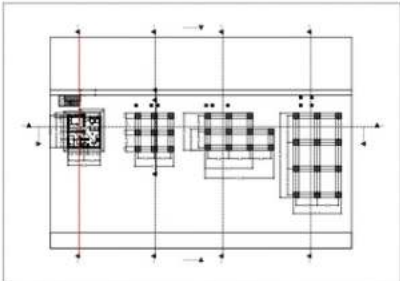
S-01

Building Section (1)

1:125

	
DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
Situation during flooding	
DRAWING TITLE	
Building Section (1)	
SCALE	1:125
DATE	
DRAWING NUMBER	

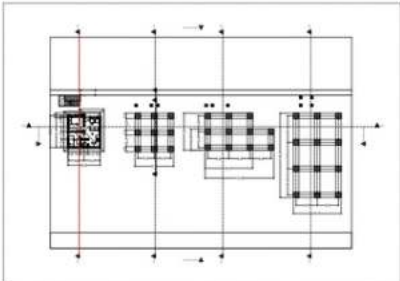
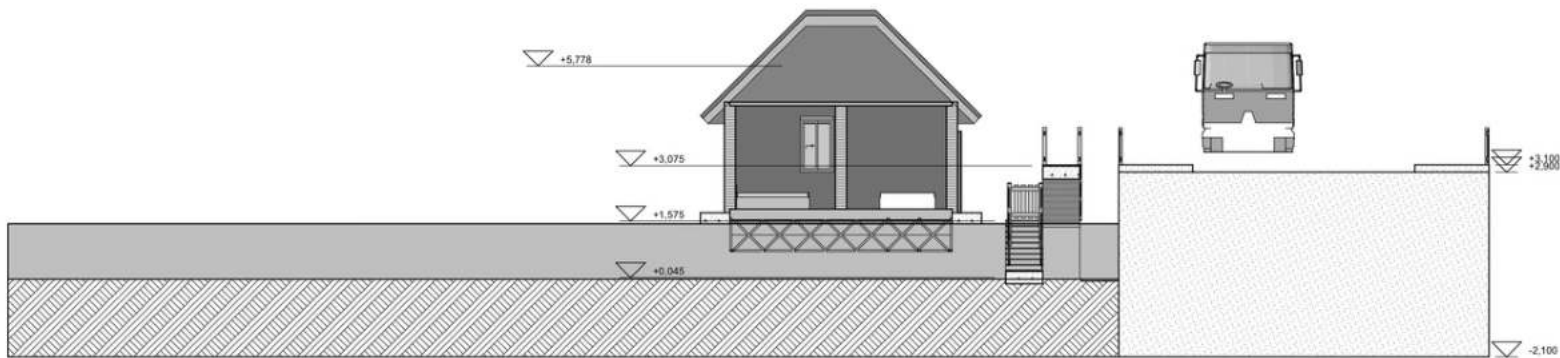
• Section



S-02 Building Section 1:100

	DEPARTMENT of
	ARCHITECTURE
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Building Section	
SCALE	1:100, 1:200
DATE	
DRAWING NUMBER	

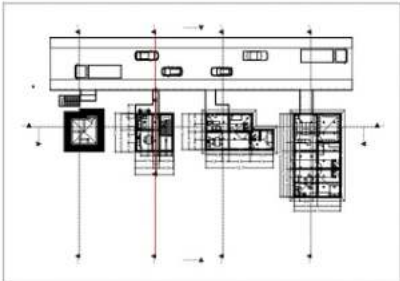
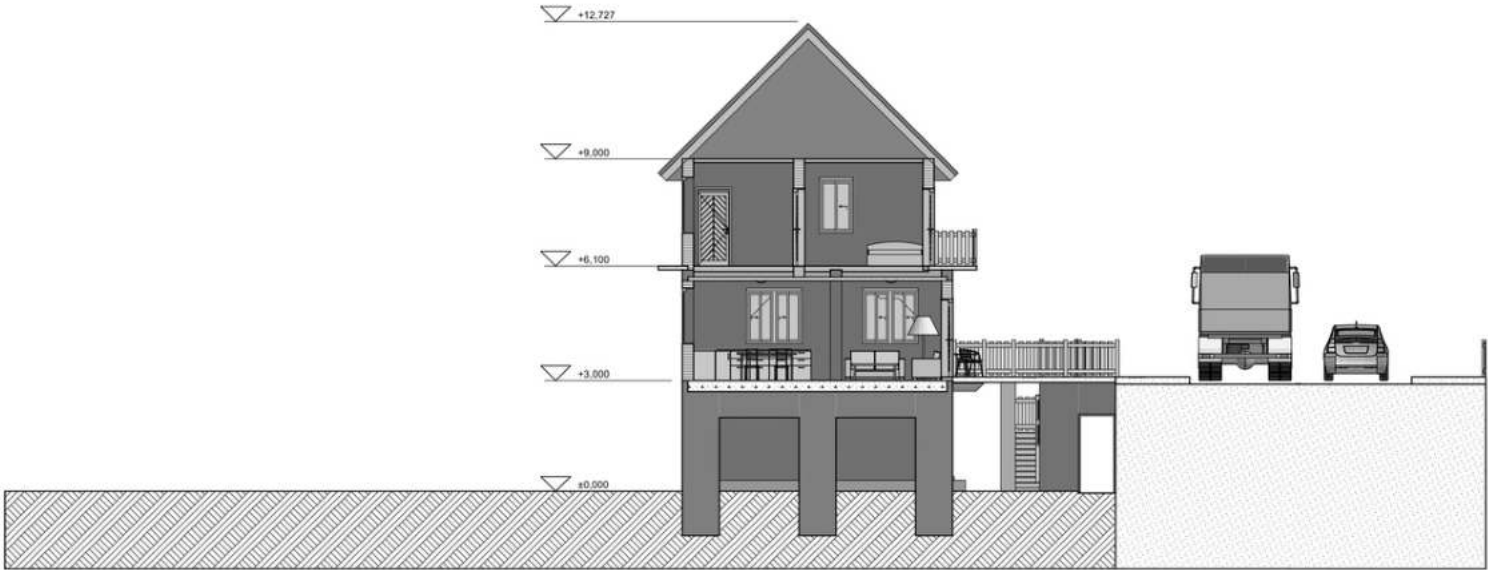
• Section



S-02 Building Section 1:100

 DEPARTMENT of ARCHITECTURE	
TITLE	RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY
NAME	ATHIYA SYAVIRA R.
STUDENT ID	19512088
SUPERVISOR LECTURER	WIRYONO RAHARJO
EXAMINER	PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -
INFORMATION	
Situation during flooding	
DRAWING TITLE	
Building Section	
SCALE	1:100
DATE	
DRAWING NUMBER	

• Section



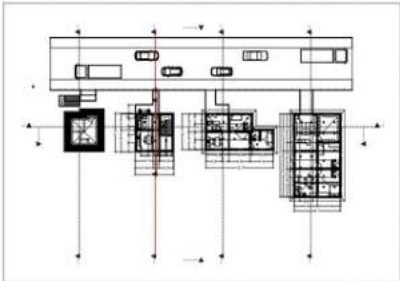
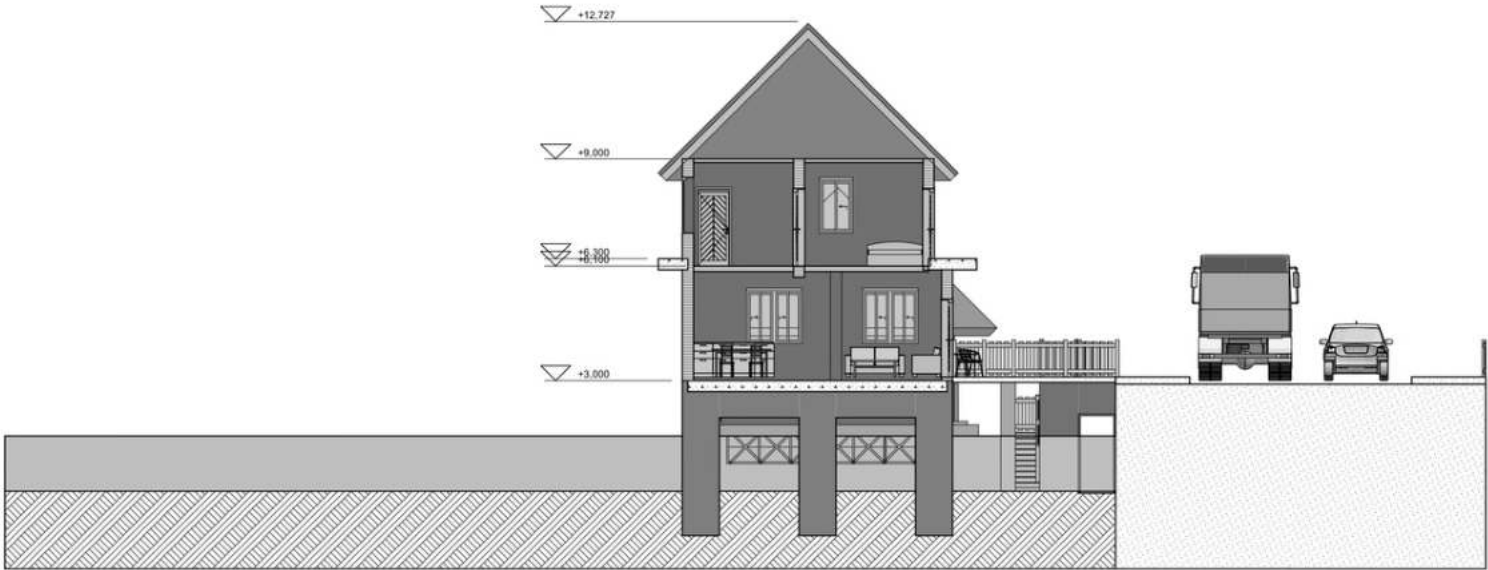
S-03

Building Section

1:100

 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Building Section	
SCALE	1:100, 1:700
DATE	
DRAWING NUMBER	

• Section



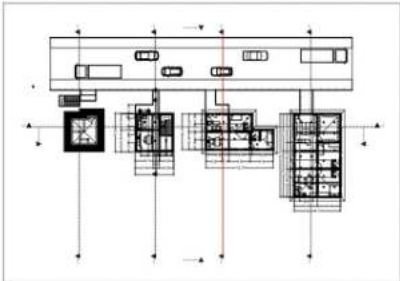
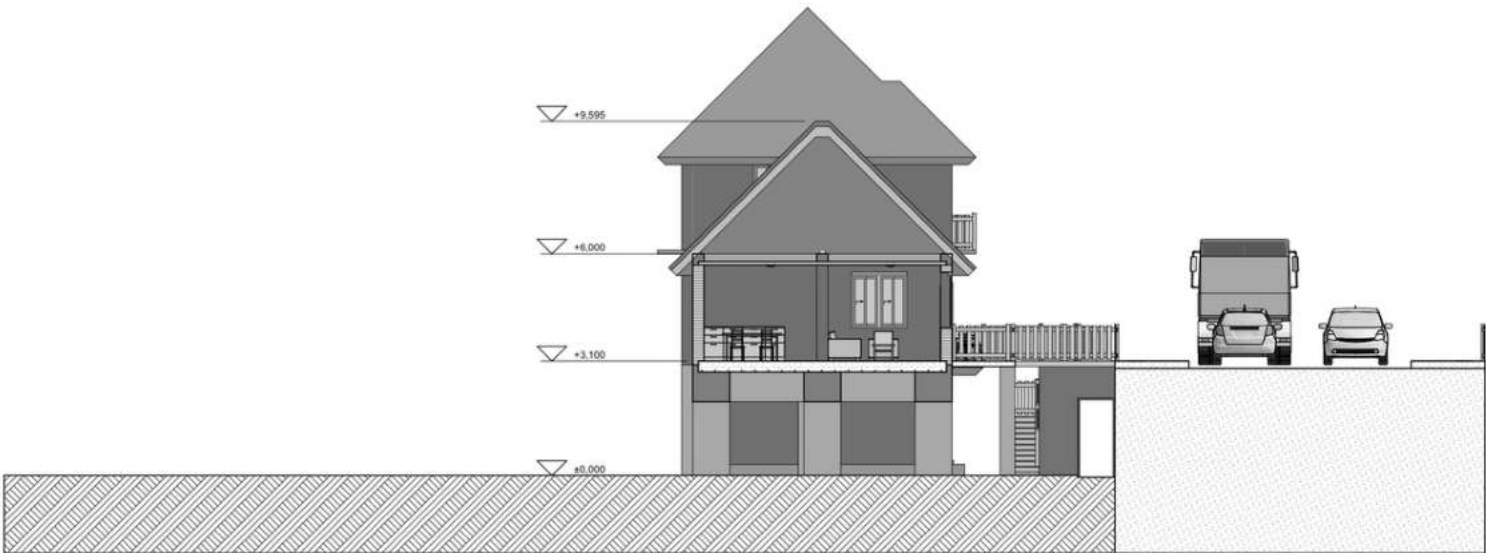
S-03

Building Section

1:100

 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
Situation during flooding	
DRAWING TITLE	
Building Section	
SCALE	1:100
DATE	
DRAWING NUMBER	

• Section



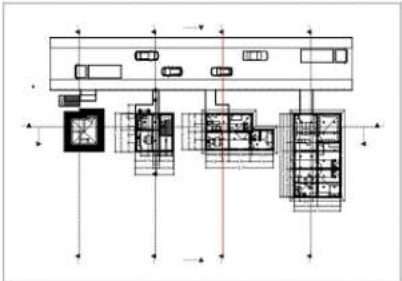
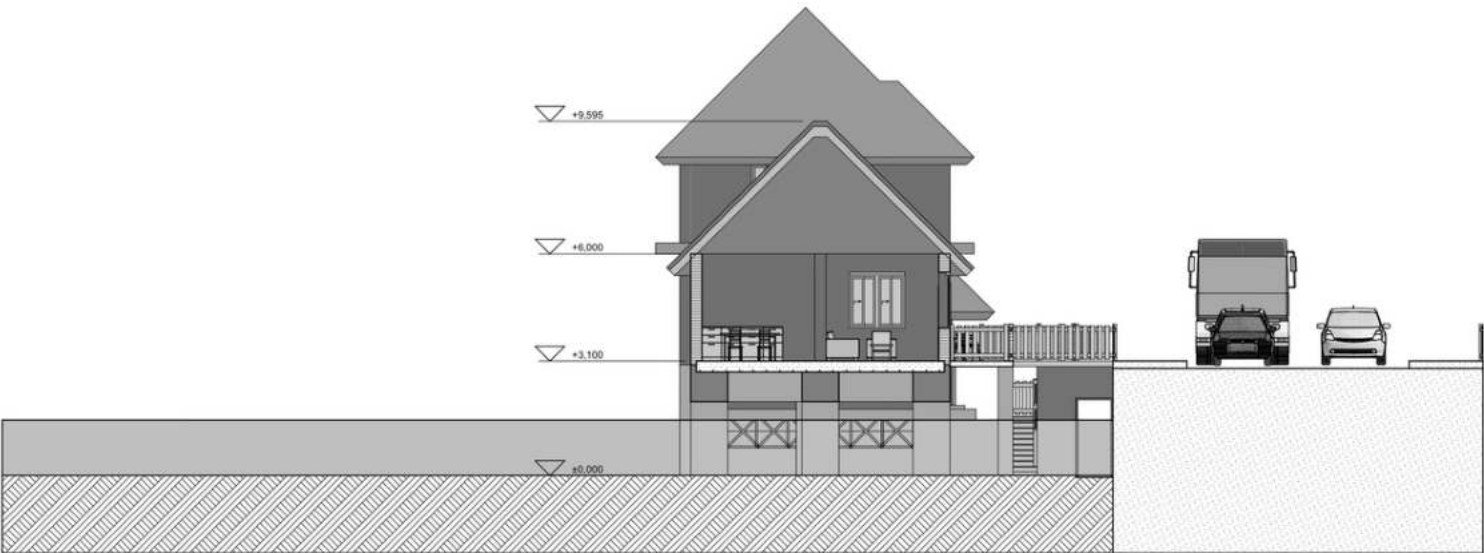
S-04

Building Section (1)

1:100


DEPARTMENT of ARCHITECTURE
TITLE
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY
NAME
ATHIYA SYAVIRA R.
STUDENT ID
19512088
SUPERVISOR LECTURER
WIRYONO RAHARJO
EXAMINER
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -
INFORMATION
DRAWING TITLE
Building Section
SCALE
DATE
DRAWING
NUMBER

• Section



S-04

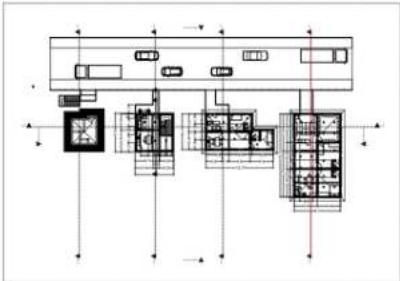
Building Section (1)

1:100

 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
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PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
Situation during flooding	
DRAWING TITLE	
Building Section (1)	
SCALE	1:100
DATE	
DRAWING NUMBER	

• Section

ARCHICAD EDUCATION VERSION



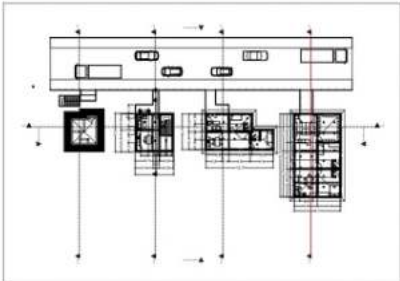
S-05

Building Section (1)

1:100

 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Building Section	
SCALE	1:100, 1:200
DATE	
DRAWING NUMBER	

• Section



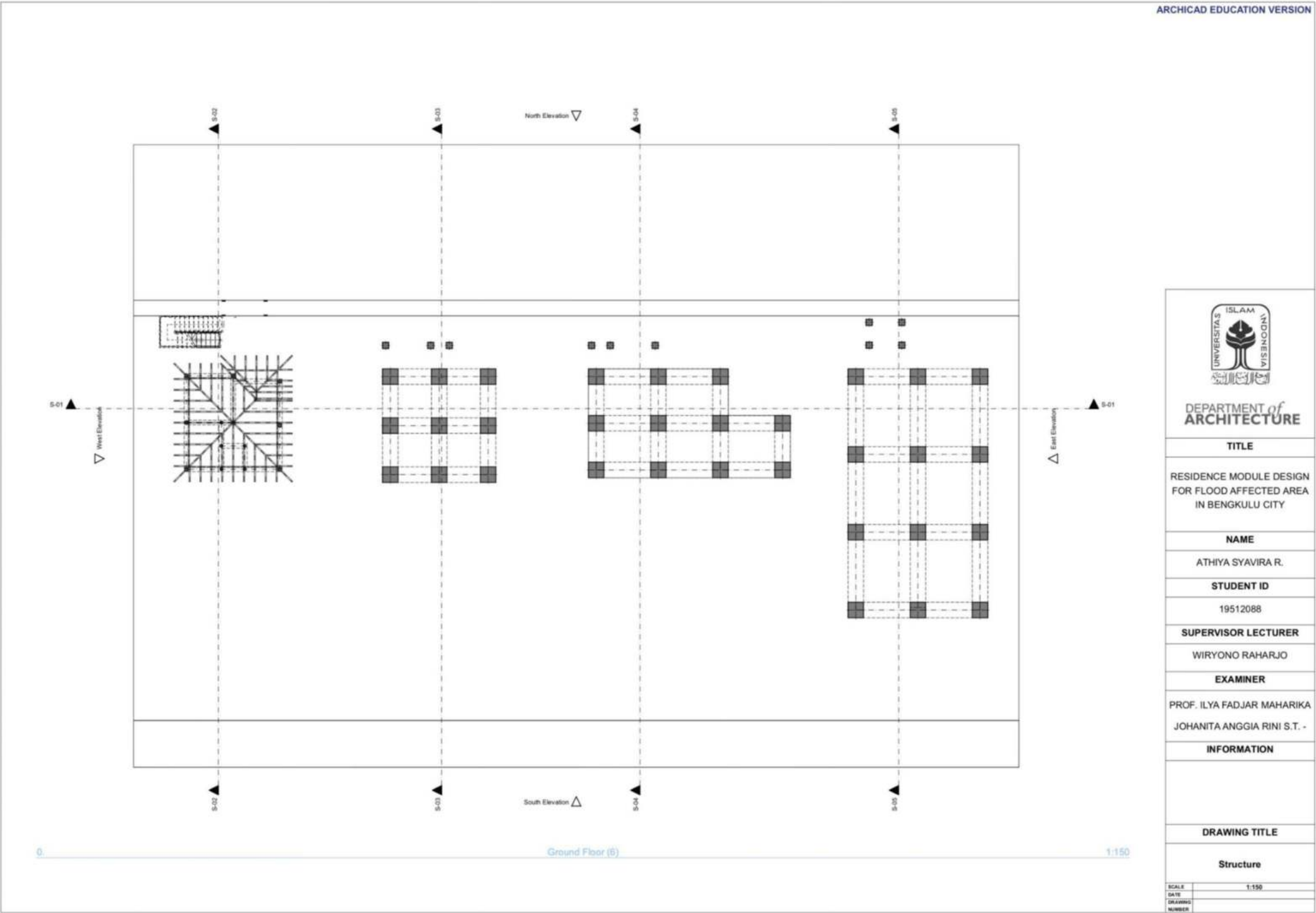
S-05

Building Section (1)

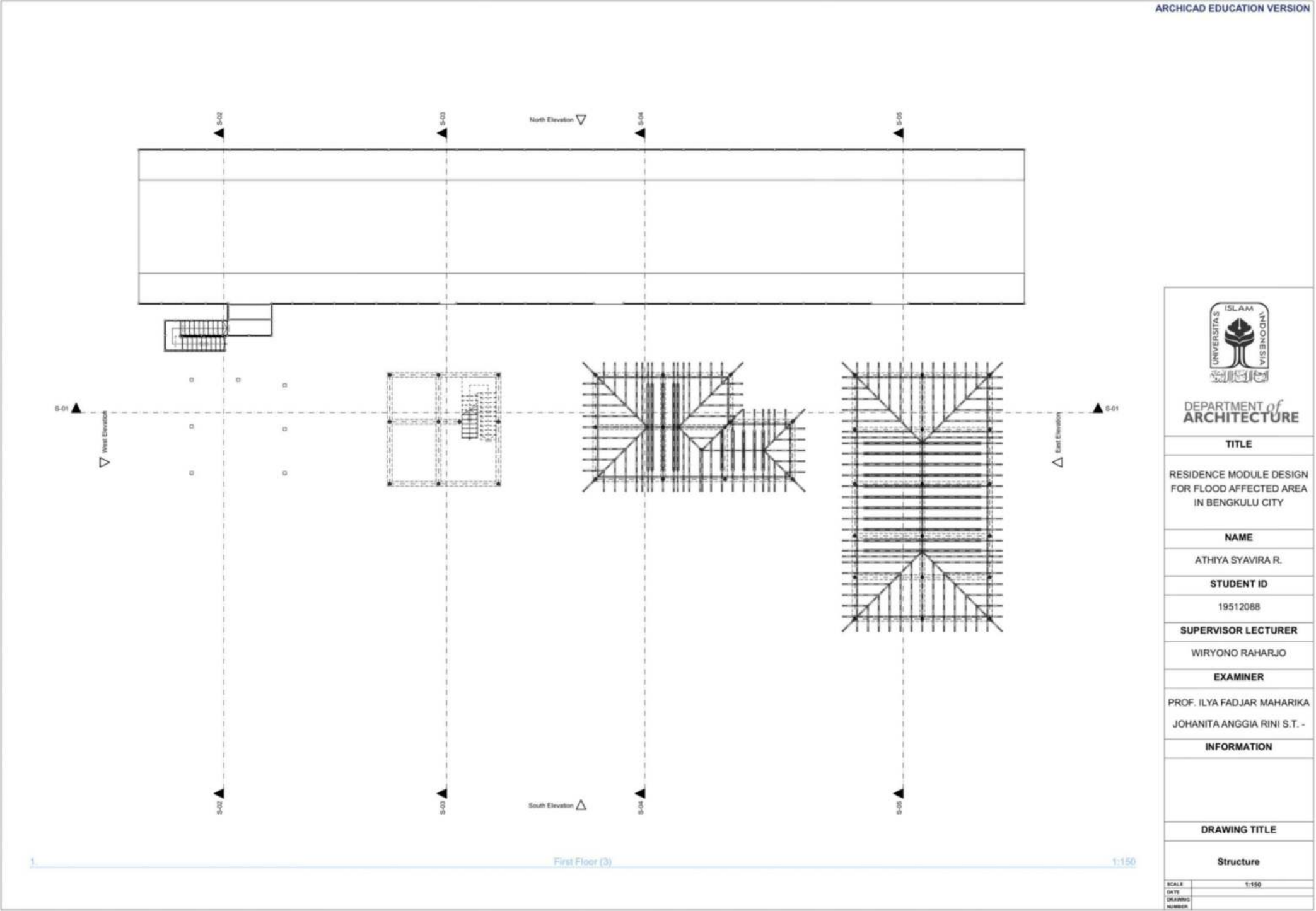
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 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
Situation during flooding	
DRAWING TITLE	
Building Section (1)	
SCALE	1:100
DATE	
DRAWING NUMBER	

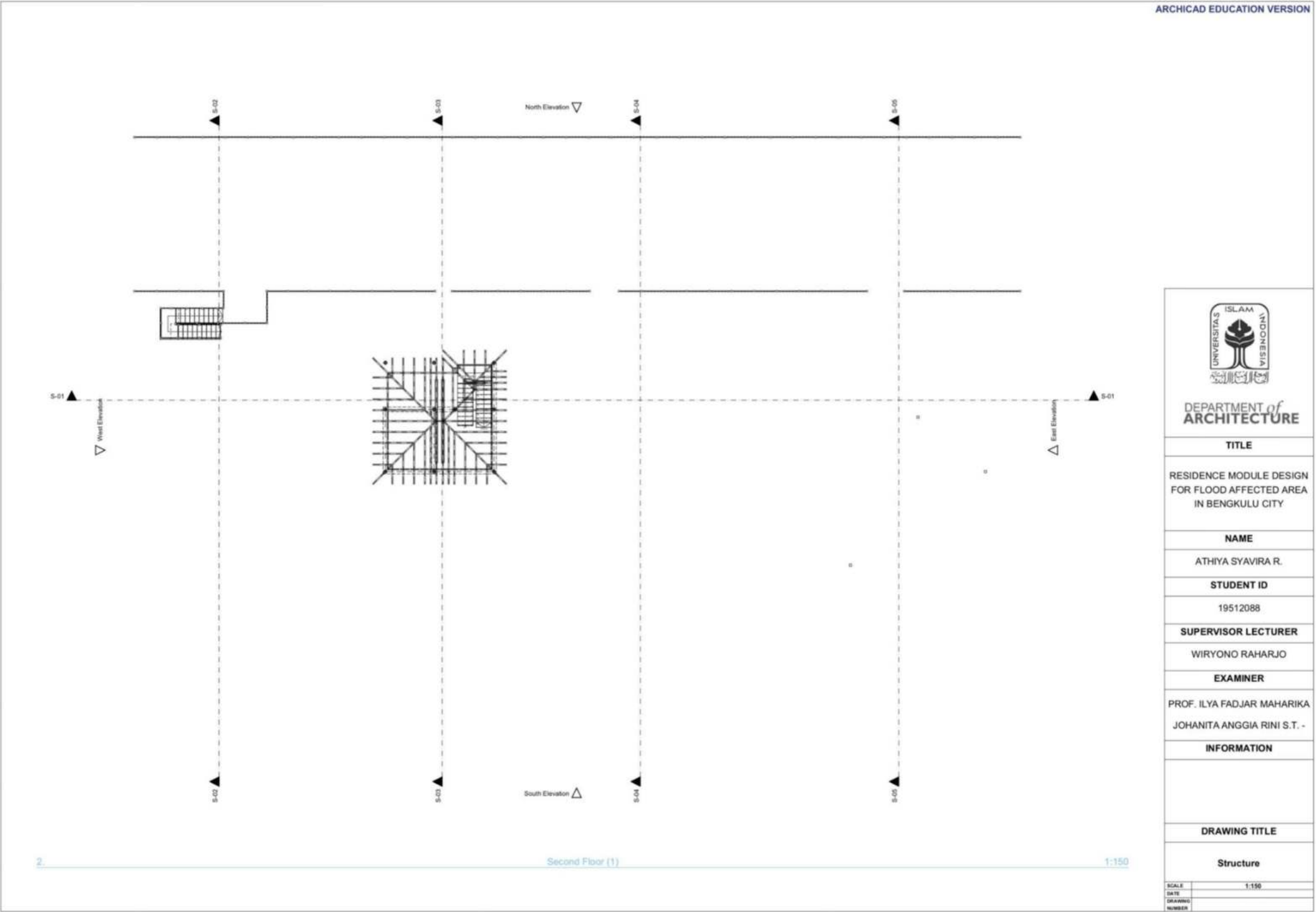
• Structure



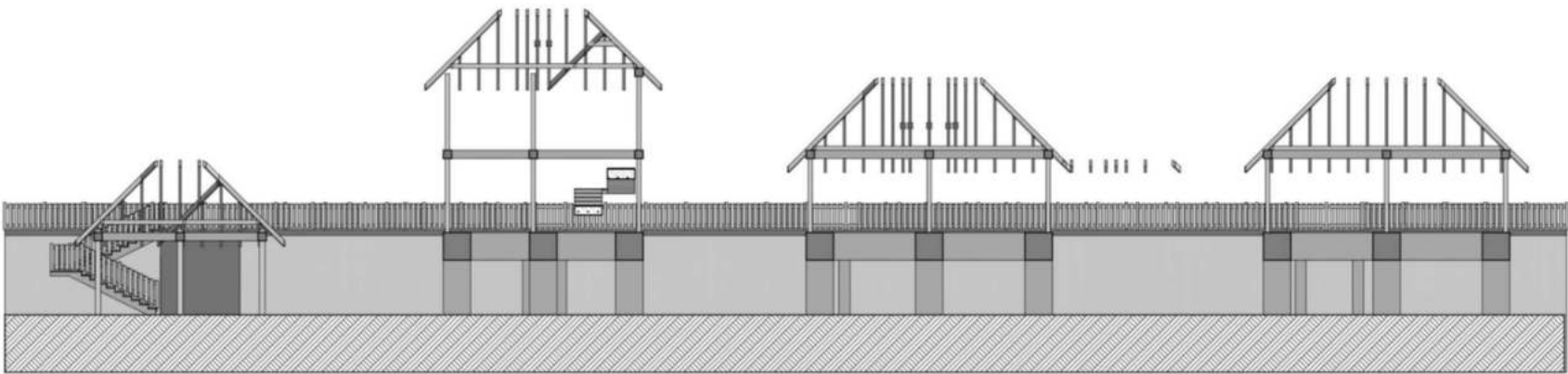
• Structure



• Structure



• Structure



S-01

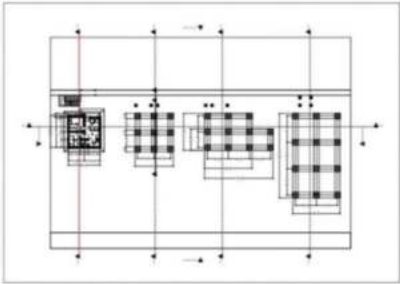
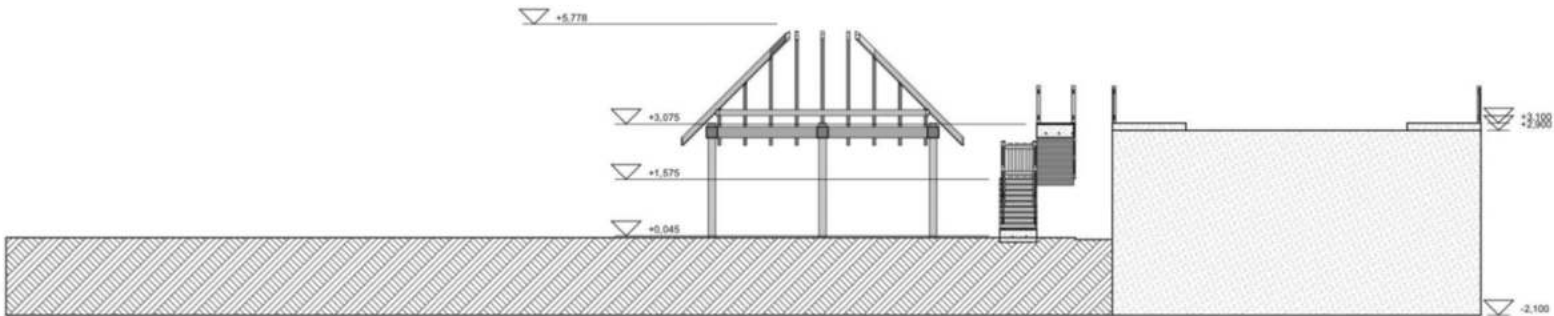
Building Section (1)

1:125

	
DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Structure	
SCALE	1:125
DATE	
DRAWING NUMBER	

• Structure

ARCHICAD EDUCATION VERSION



S-02

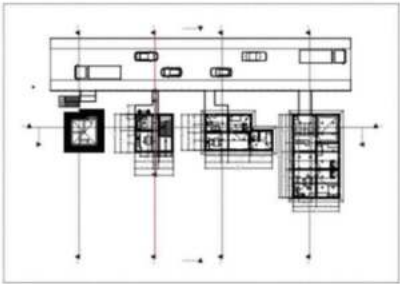
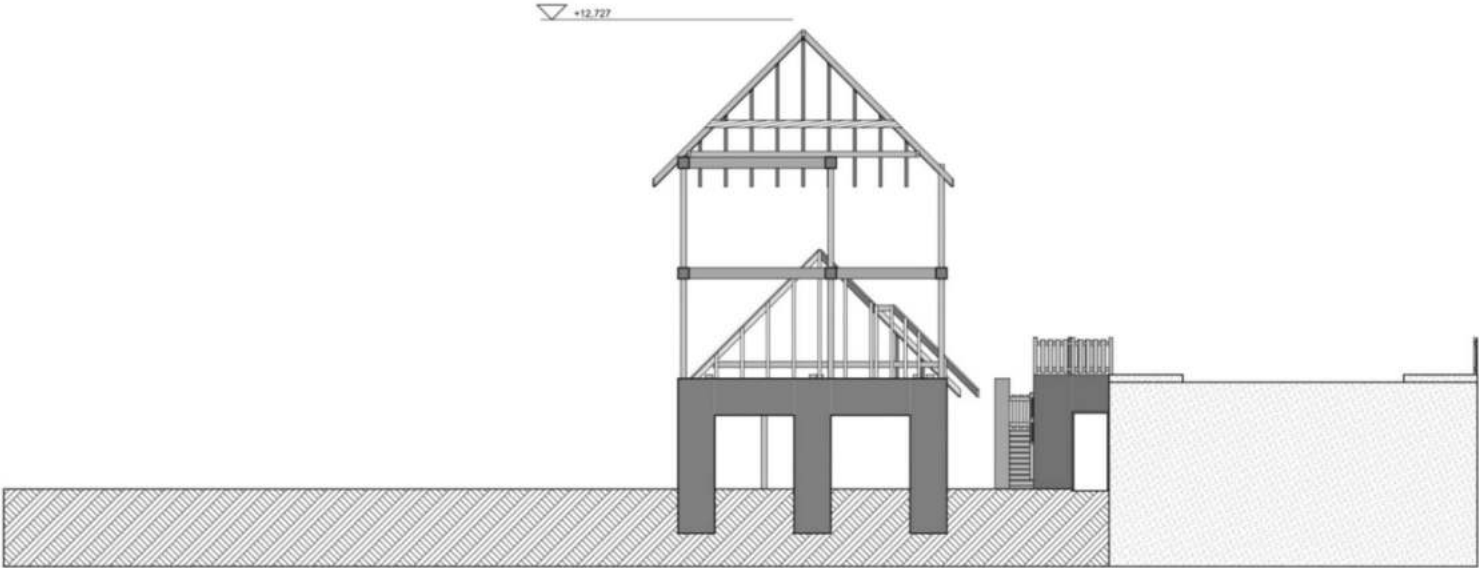
Building Section

1:100

	
DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Structure	
SCALE	1:100
DATE	
DRAWING NUMBER	

• Structure

ARCHICAD EDUCATION VERSION



S-03

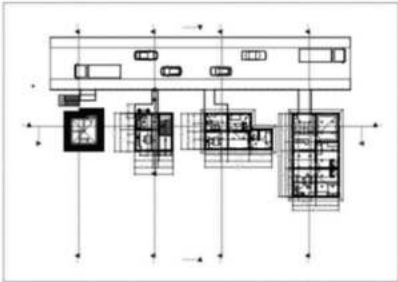
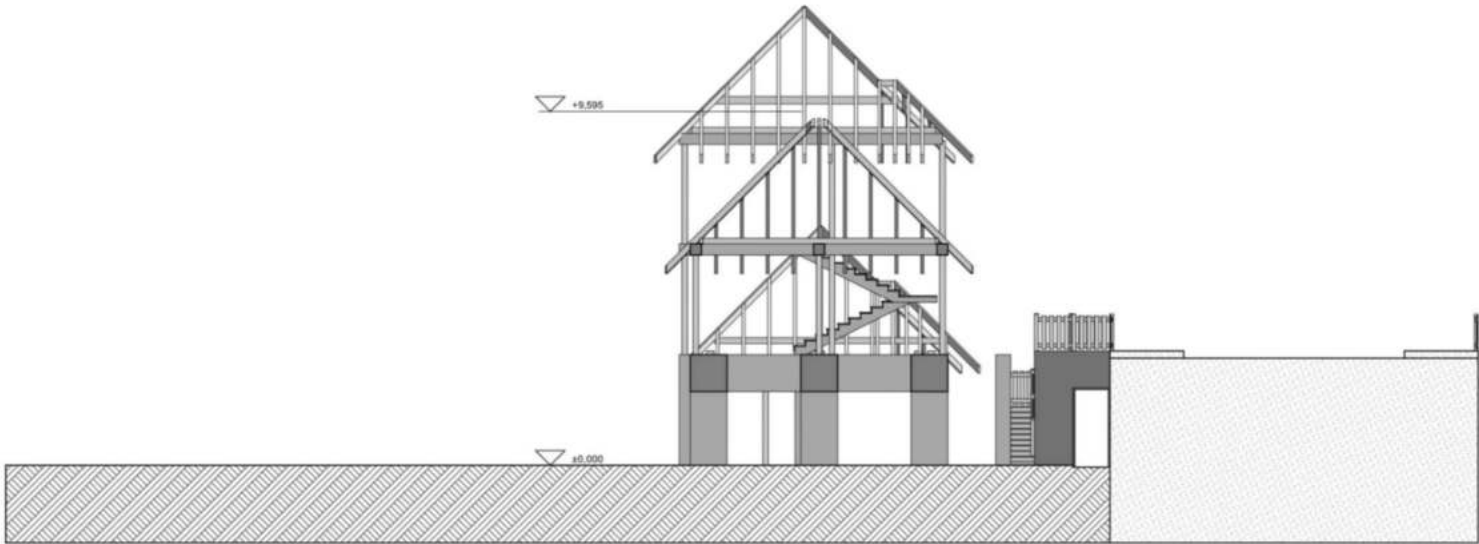
Building Section

1:100

	
DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Structure	
SCALE	1:100
DATE	
DRAWING NUMBER	

• Structure

ARCHICAD EDUCATION VERSION



S-04

Building Section (1)

1:100

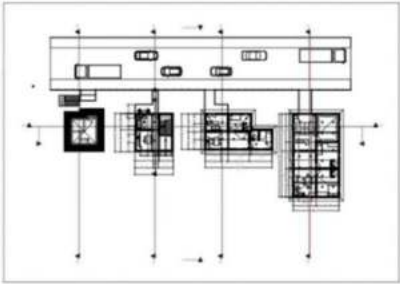
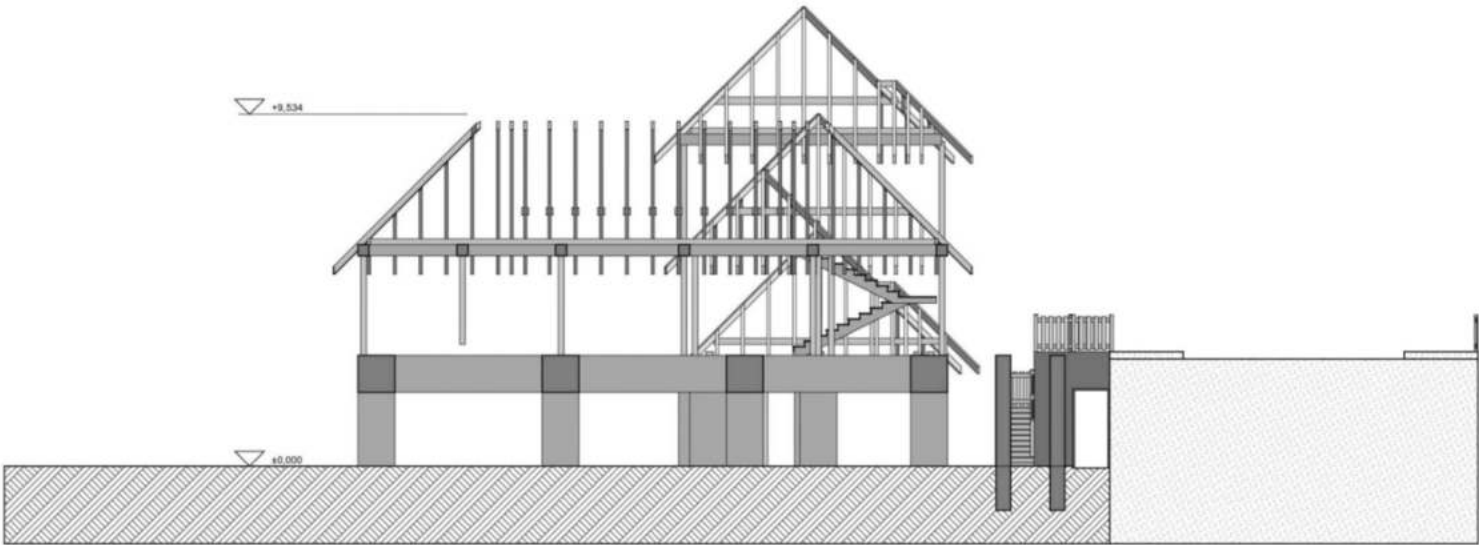


DEPARTMENT of
ARCHITECTURE

TITLE
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY
NAME
ATHIYA SYAVIRA R.
STUDENT ID
19512088
SUPERVISOR LECTURER
WIRYONO RAHARJO
EXAMINER
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -
INFORMATION
DRAWING TITLE
Structure
SCALE 1:100
DATE
DRAWING NUMBER

• Structure

ARCHICAD EDUCATION VERSION



S-05

Building Section (1)

1:100

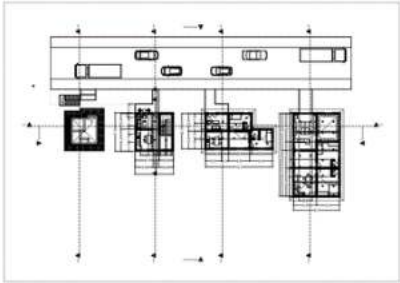
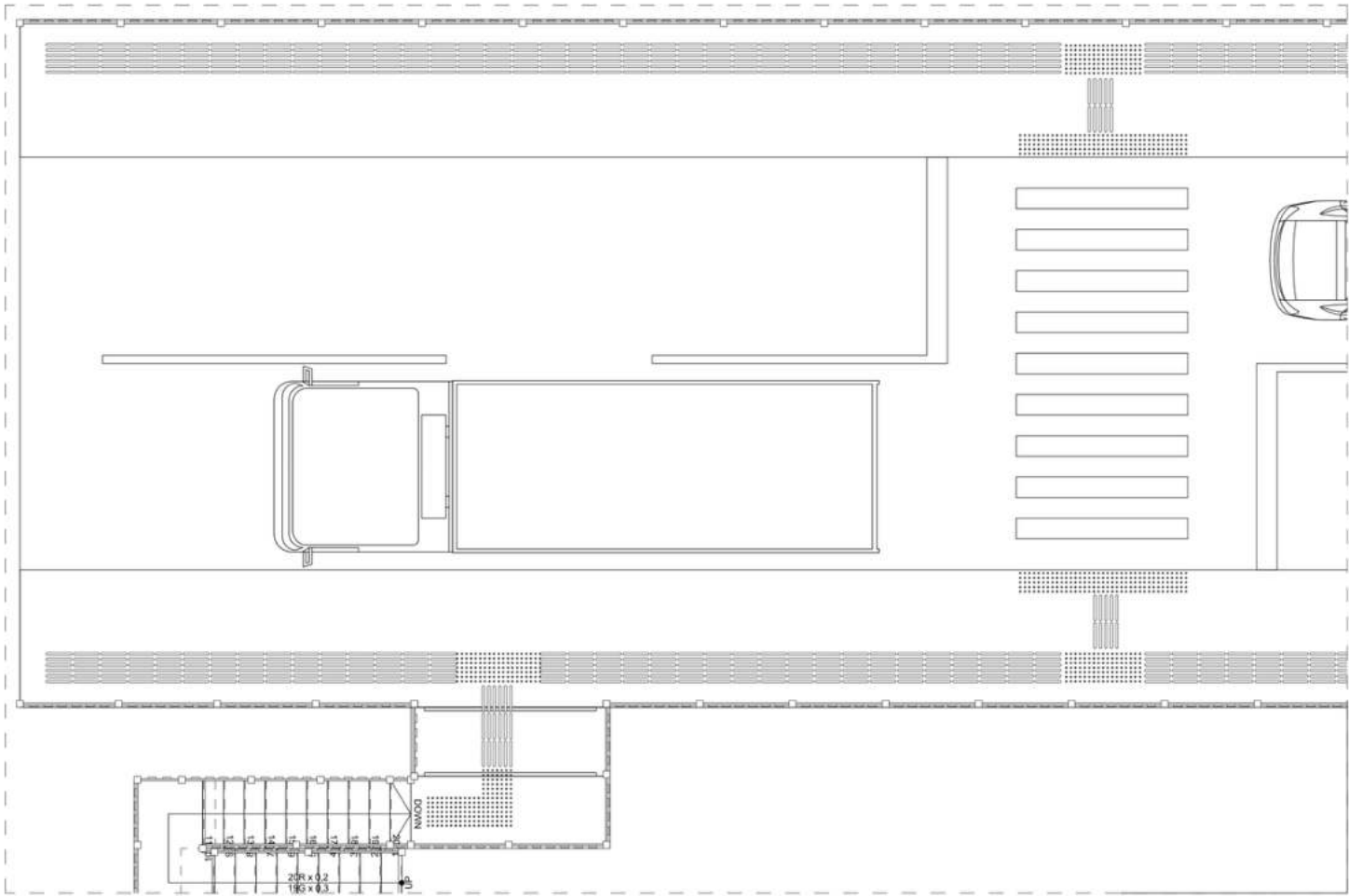


DEPARTMENT of
ARCHITECTURE

TITLE
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY
NAME
ATHIYA SYAVIRA R.
STUDENT ID
19512088
SUPERVISOR LECTURER
WIRYONO RAHARJO
EXAMINER
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -
INFORMATION
DRAWING TITLE
Structure
SCALE 1:100
DATE
DRAWING NUMBER

• Utility - Tactile Grounds Surface Indicators

ARCHICAD EDUCATION VERSION



D-01

Detail

1:50



DEPARTMENT of
ARCHITECTURE

TITLE

RESIDENCE MODULE DESIGN
FOR FLOOD AFFECTED AREA
IN BENGKULU CITY

NAME

ATHIYA SYAVIRA R.

STUDENT ID

19512088

SUPERVISOR LECTURER

WIRYONO RAHARJO

EXAMINER

PROF. ILYA FADJAR MAHARIKA
JOHANITA ANGGIA RINI S.T. -

INFORMATION

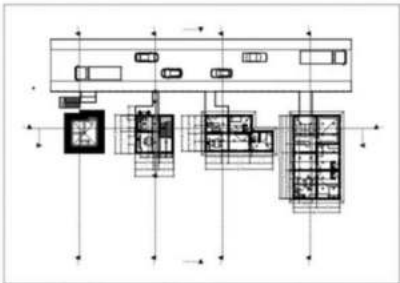
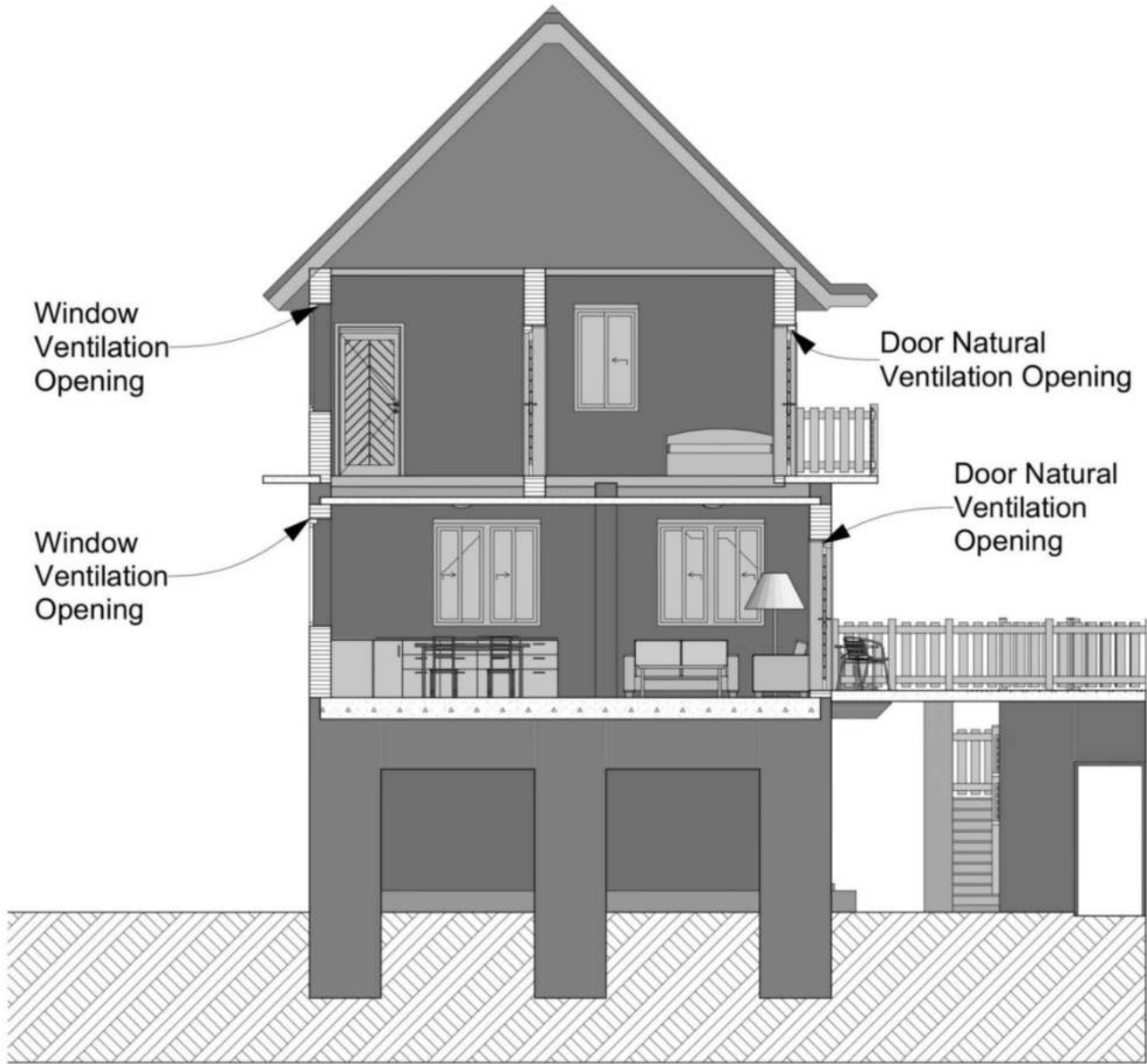
DRAWING TITLE

Detail, Worksheet

SCALE	1:50, 1:700
DATE	
DRAWING NUMBER	

• Utility - Natural Ventilation and Light

ARCHICAD EDUCATION VERSION



Ventilation

1:45



DEPARTMENT of
ARCHITECTURE

TITLE

RESIDENCE MODULE DESIGN
FOR FLOOD AFFECTED AREA
IN BENGKULU CITY

NAME

ATHIYA SYAVIRA R.

STUDENT ID

19512088

SUPERVISOR LECTURER

WIRYONO RAHARJO

EXAMINER

PROF. ILYA FADJAR MAHARIKA
JOHANITA ANGGIA RINI S.T. -

INFORMATION

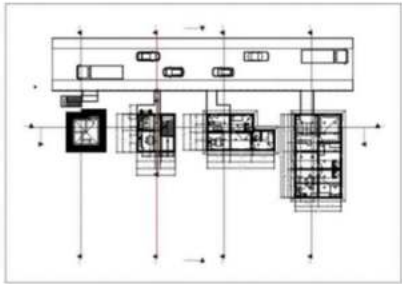
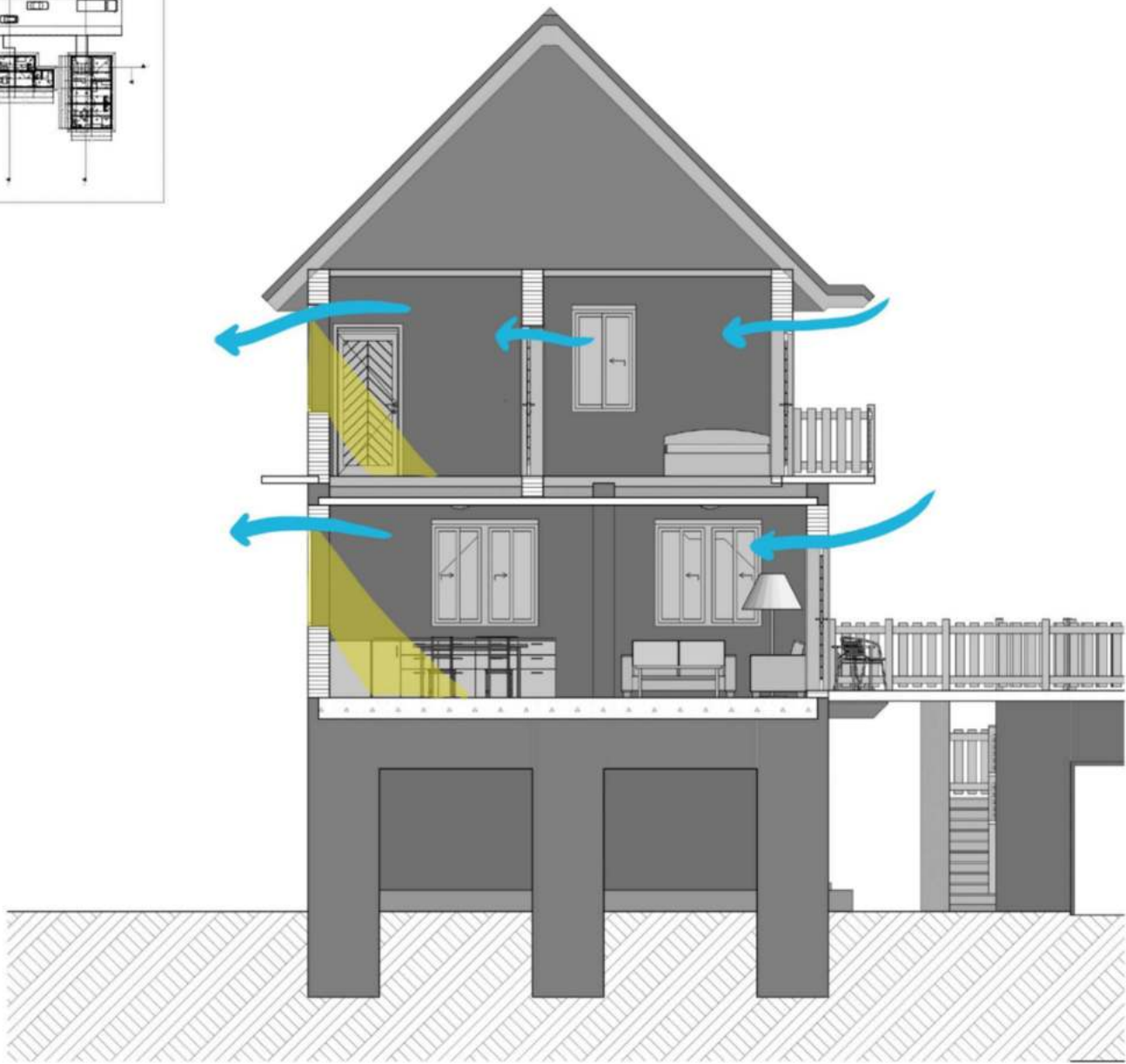
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Ventilation

SCALE 1:45, 1:700
DATE
DRAWING NUMBER

• Utility - Natural Ventilation and Light

ARCHICAD EDUCATION VERSION



Ventilation and Sunlight (1)

1:45



DEPARTMENT of
ARCHITECTURE

TITLE

RESIDENCE MODULE DESIGN
FOR FLOOD AFFECTED AREA
IN BENGKULU CITY

NAME

ATHIYA SYAVIRA R.

STUDENT ID

19512088

SUPERVISOR LECTURER

WIRYONO RAHARJO

EXAMINER

PROF. ILYA FADJAR MAHARIKA
JOHANITA ANGGIA RINI S.T. -

INFORMATION

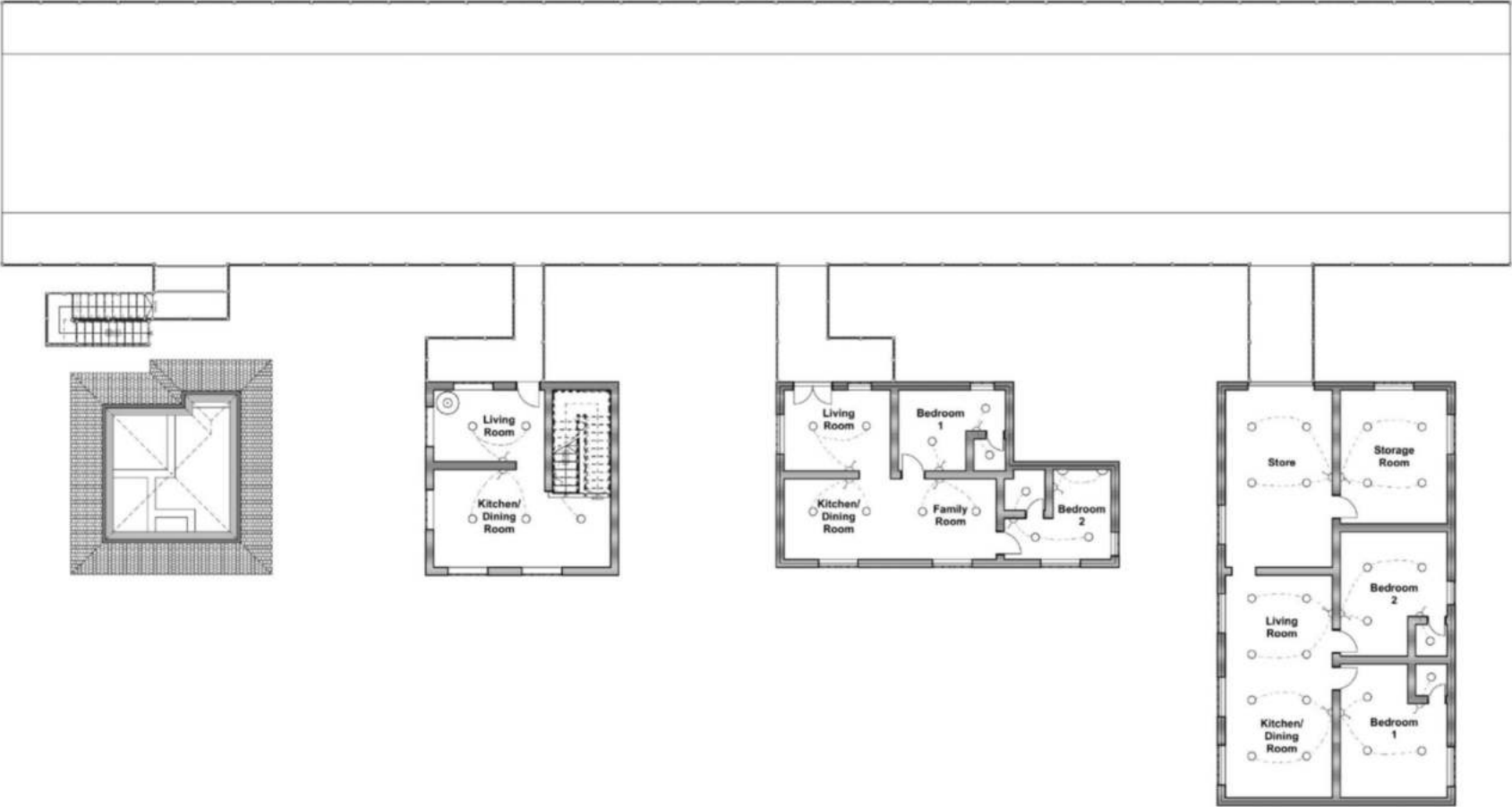
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Ventilation and Sunlight (1)

SCALE	1:45
DATE	
DRAWING NUMBER	

• MEP

ARCHICAD EDUCATION VERSION



DEPARTMENT of
ARCHITECTURE

TITLE
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY
NAME
ATHIYA SYAVIRA R.
STUDENT ID
19512088
SUPERVISOR LECTURER
WIRYONO RAHARJO
EXAMINER
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -

INFORMATION

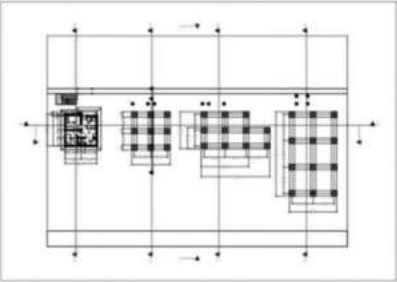
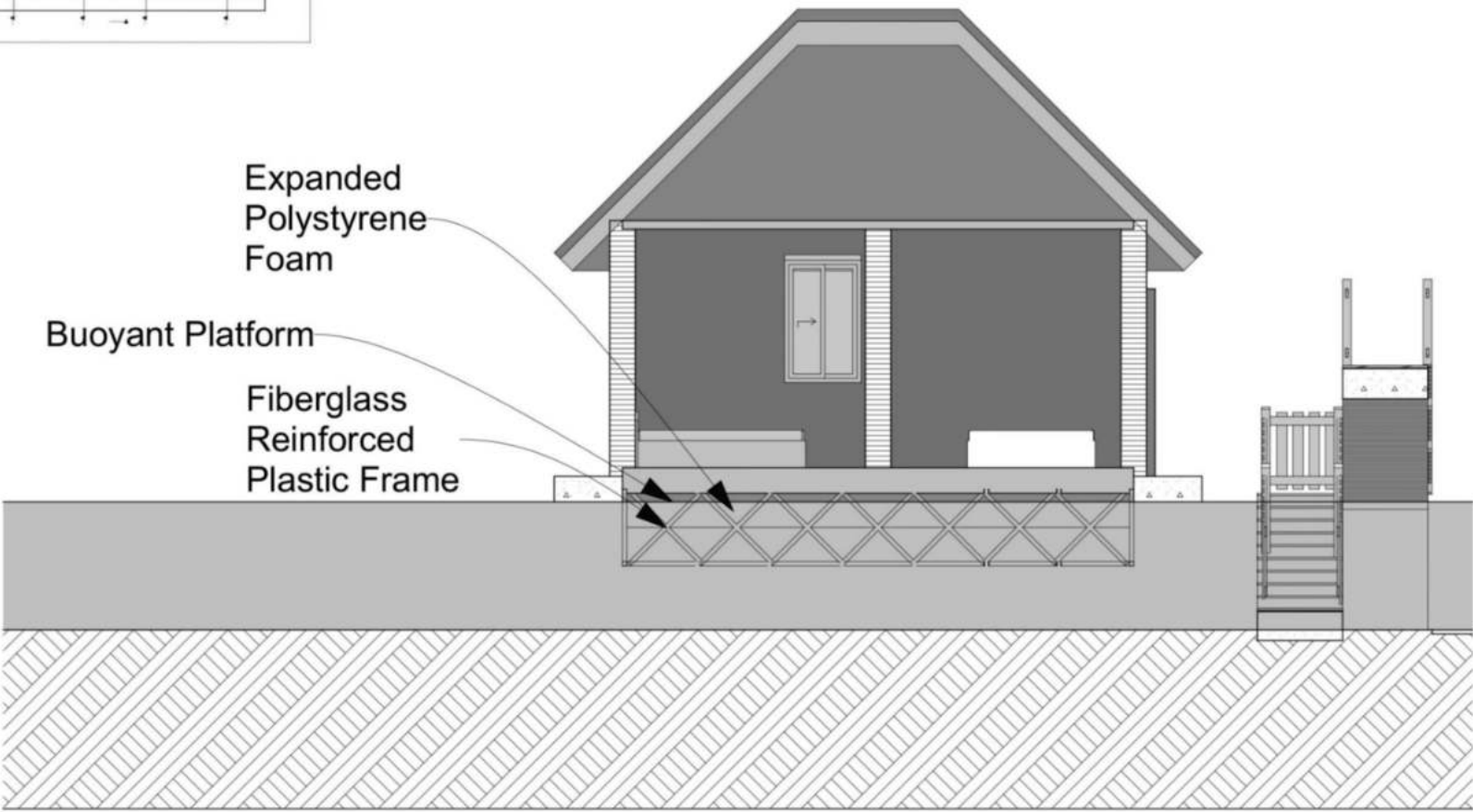
DRAWING TITLE

MEP (1)

SCALE	1:125
DATE	
DRAWING NUMBER	

• Details

ARCHICAD EDUCATION VERSION



Detail

1:40



DEPARTMENT of
ARCHITECTURE

TITLE

RESIDENCE MODULE DESIGN
FOR FLOOD AFFECTED AREA
IN BENGKULU CITY

NAME

ATHIYA SYAVIRA R.

STUDENT ID

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SUPERVISOR LECTURER

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PROF. ILYA FADJAR MAHARIKA
JOHANITA ANGGIA RINI S.T. -

INFORMATION

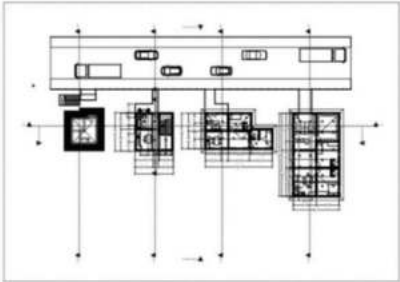
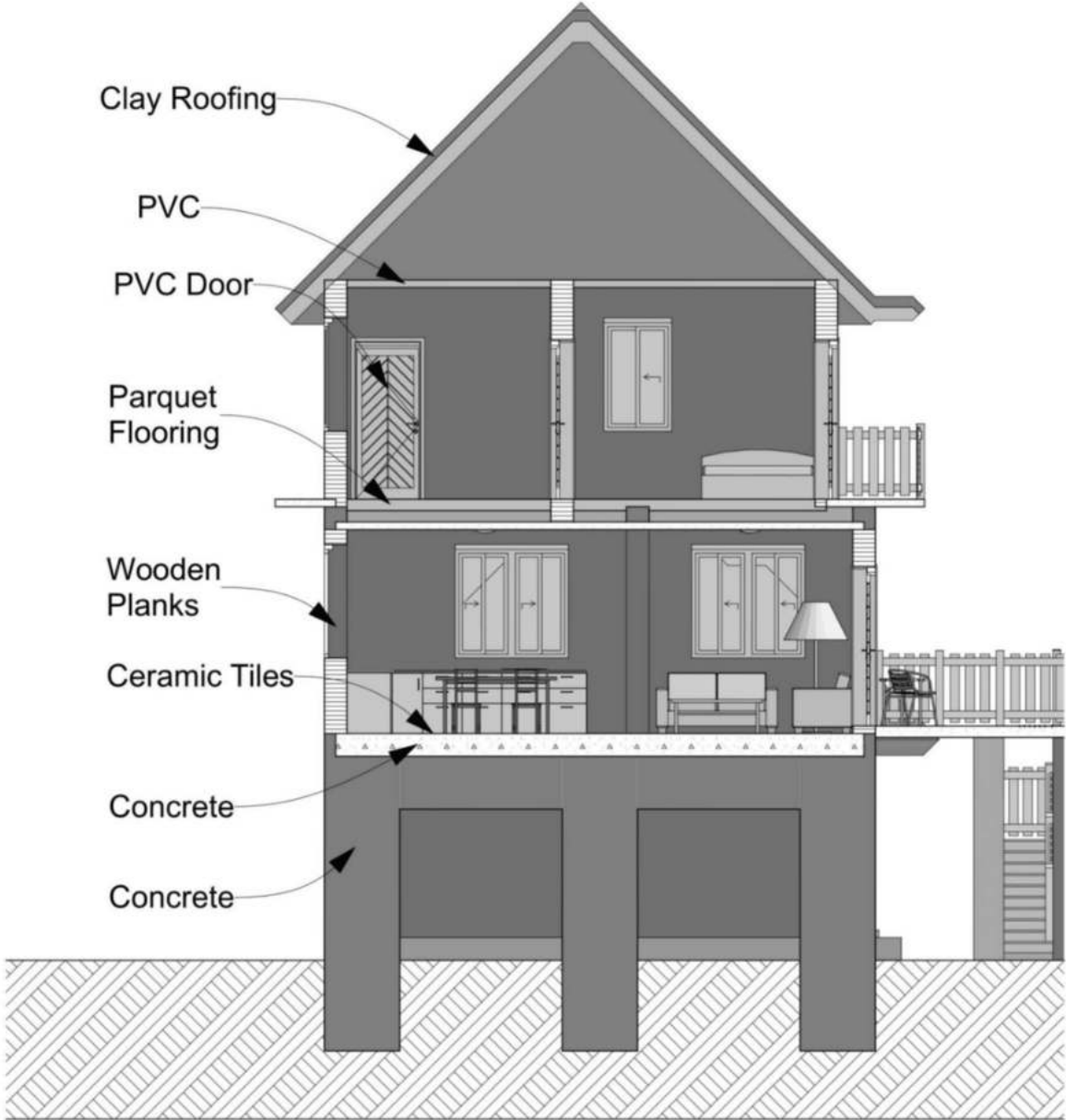
DRAWING TITLE

Detail

SCALE	1:40
DATE	
DRAWING NUMBER	

• Details

ARCHICAD EDUCATION VERSION



Detail

1:45



DEPARTMENT of
ARCHITECTURE

TITLE

RESIDENCE MODULE DESIGN
FOR FLOOD AFFECTED AREA
IN BENGKULU CITY

NAME

ATHIYA SYAVIRA R.

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JOHANITA ANGGIA RINI S.T. -

INFORMATION

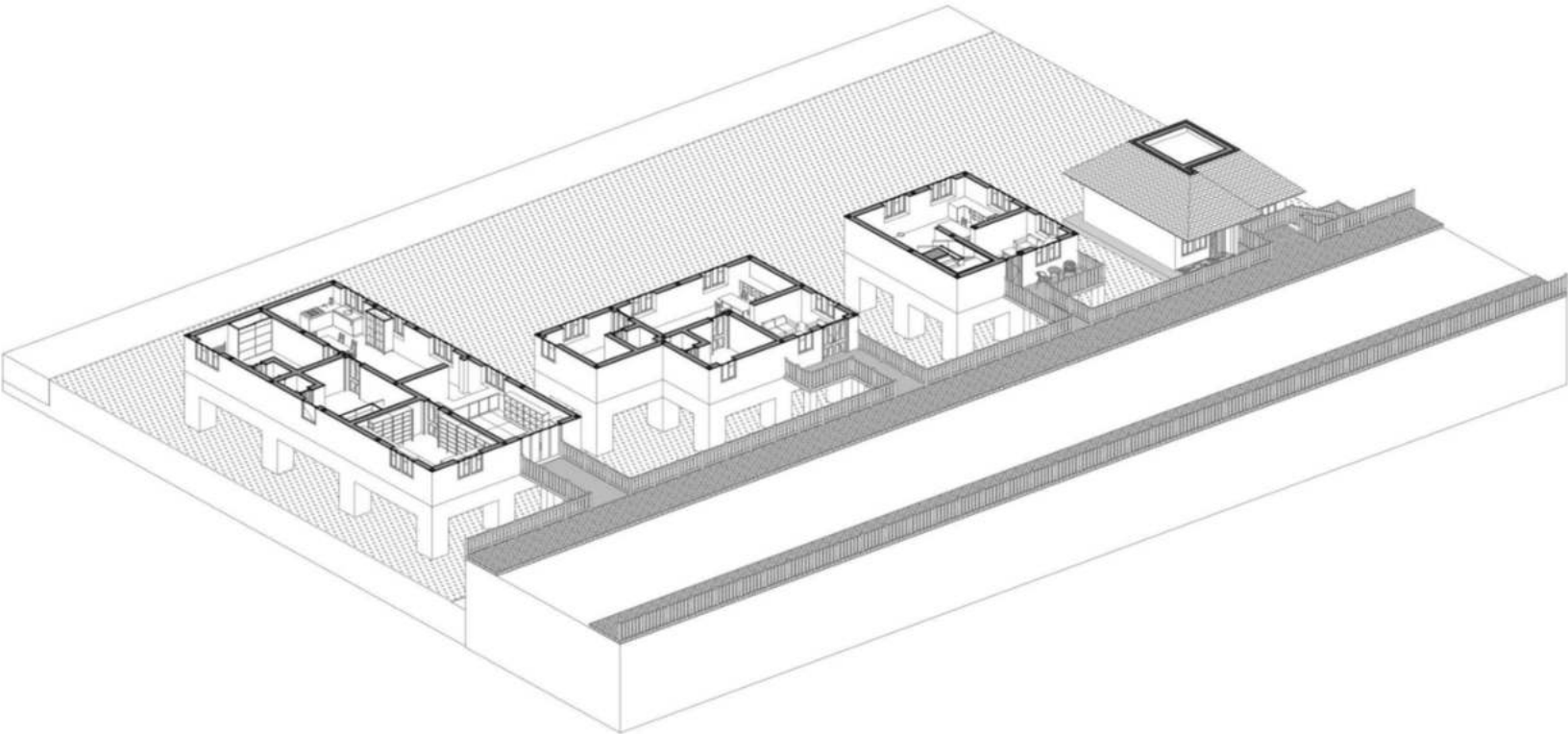
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Detail

SCALE	1:45, 1:700
DATE	
DRAWING NUMBER	

• Axonometry

ARCHICAD EDUCATION VERSION



DEPARTMENT of
ARCHITECTURE

TITLE

RESIDENCE MODULE DESIGN
FOR FLOOD AFFECTED AREA
IN BENGKULU CITY

NAME

ATHIYA SYAVIRA R.

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EXAMINER

PROF. ILYA FADJAR MAHARIKA
JOHANITA ANGGIA RINI S.T. -

INFORMATION

DRAWING TITLE

Axonometry

SCALE	1:200
DATE	
DRAWING NUMBER	

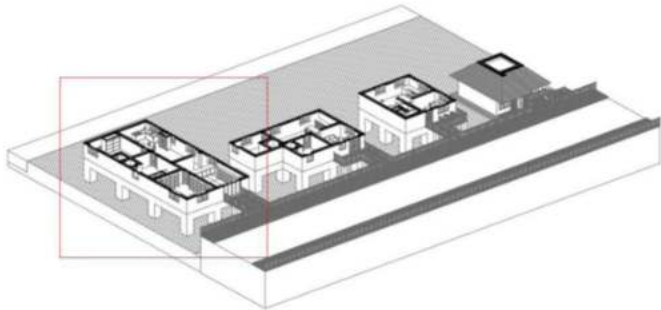
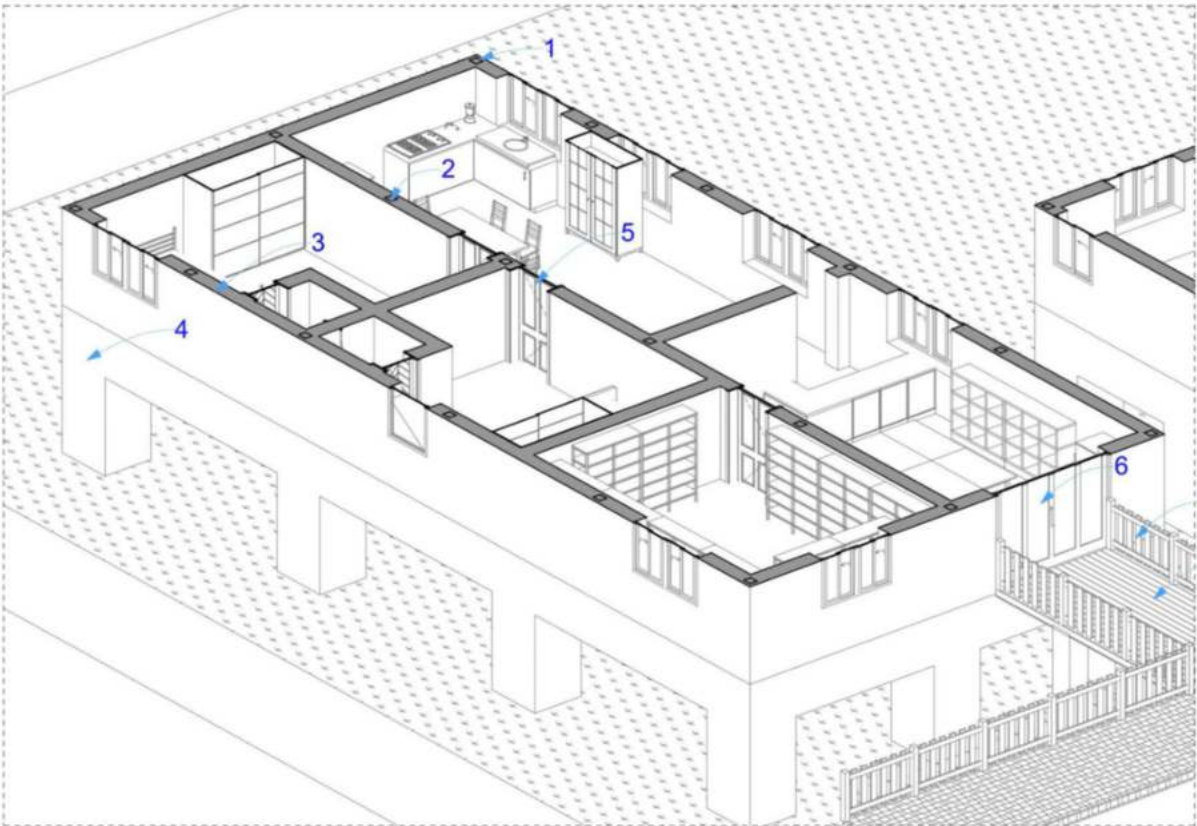
3D-01

Axonometry

1:200

• Axonometry

ARCHICAD EDUCATION VERSION



- Legend:
- 1. Main Column
 - 2. Practical Colum
 - 3. Wooden Plank Wall
 - 4. Reinforced Concrete Column
 - 5. PVC Door
 - 6. Glass Door
 - 7. Wooden Railing
 - 8. Reinforced Concrete Slab



DEPARTMENT of
ARCHITECTURE

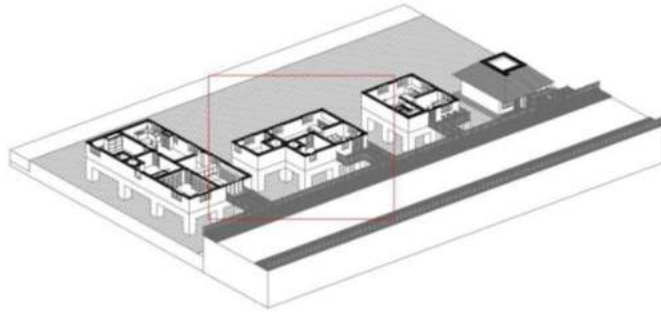
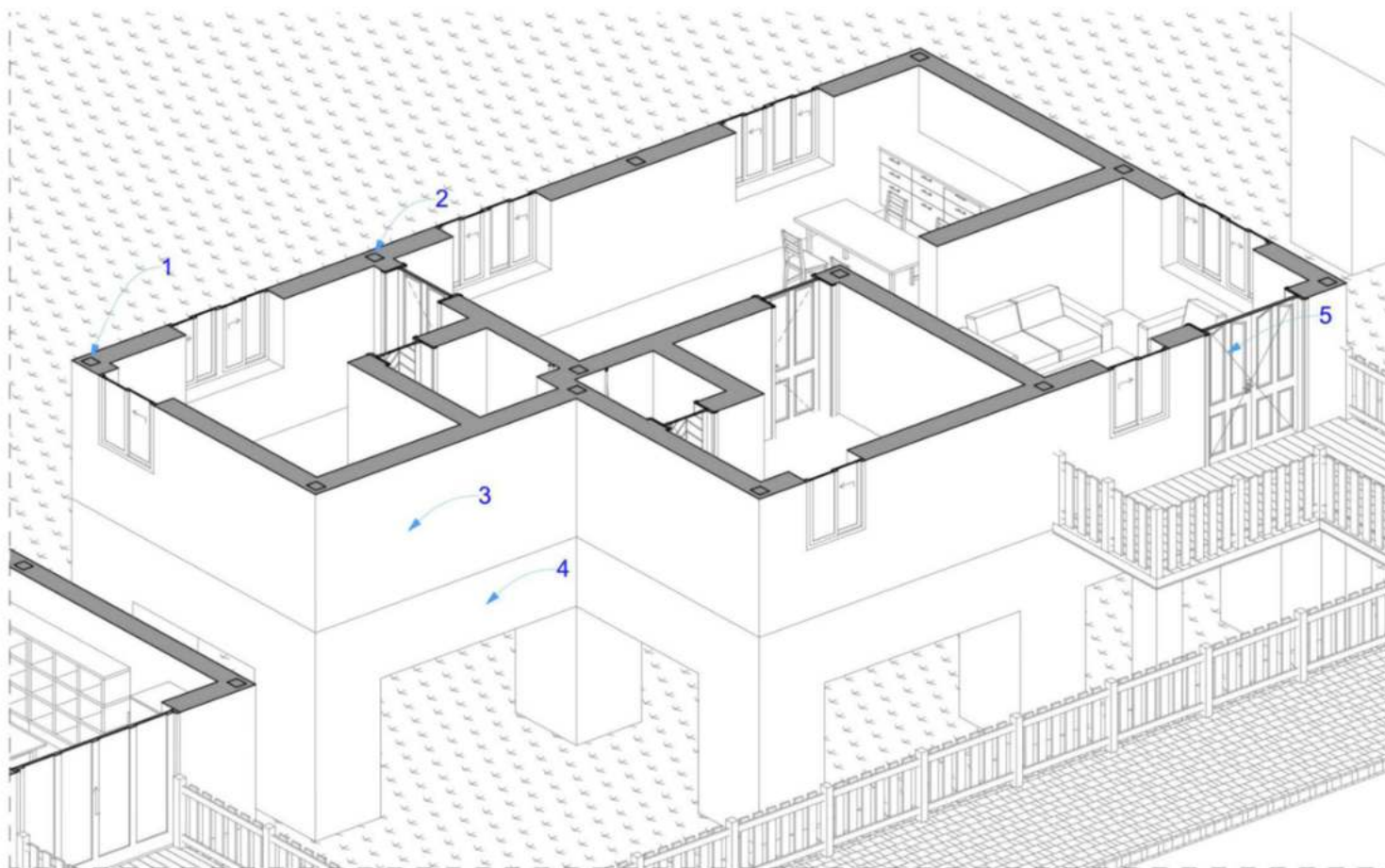
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Axonometry (1), Detail	
SCALE	1:500, 1:75
DATE	
DRAWING NUMBER	

D-02

Detail

1/75

- **Axonometry**



Legend:

1. Main Column
2. Practical Column
3. Wooden Plank Wall
4. Reinforced Concrete Structure
5. UPVC Door

DEPARTMENT of
ARCHITECTURE

TITLE

RESIDENCE MODULE DESIGN
FOR FLOOD AFFECTED AREA
IN BENGKULU CITY

NAME _____

ATHIYA SYAVIRA R.

STUDENT ID

19512088

SUPERVISOR LECTURER

WIRYONO RAHARJO

EXAMINER

PROF. ILYA FADJAR MAHARIKA

JOHANITA ANGGIA RINI S.T. -

INFORMATION

DRAWING TITLE

Axonometry (1), Detail

SCALE	1:500, 1:50
DATE	
DRAWING NUMBER	

• Exterior Perspective

ARCHICAD EDUCATION VERSION

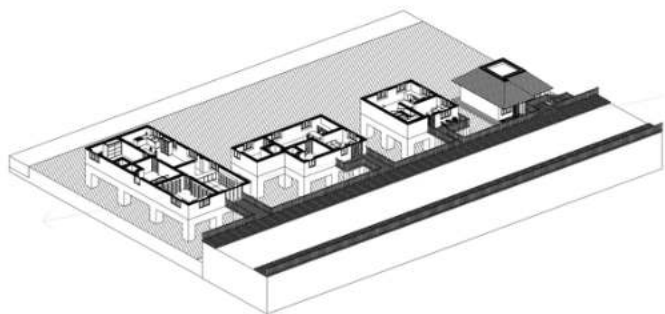


Image6

1:1,43



DEPARTMENT of
ARCHITECTURE

TITLE
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY
NAME
ATHIYA SYAVIRA R.
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SUPERVISOR LECTURER
WIRYONO RAHARJO
EXAMINER
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -
INFORMATION
DRAWING TITLE
Exterior
SCALE 1:1,43, 1:500
DATE
DRAWING NUMBER

• Exterior Perspective

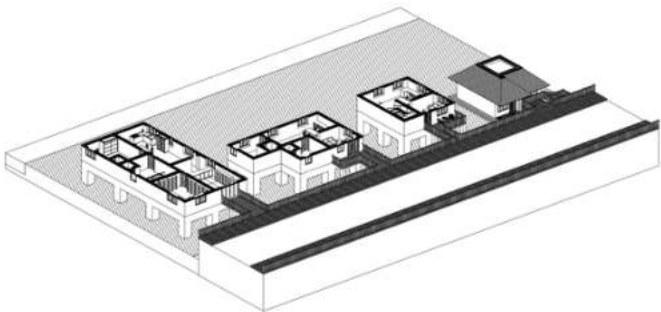


Image3

1:1,49

ARCHICAD EDUCATION VERSION

 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
19512088	
SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Exterior	
SCALE	1:500, 1:1,49
DATE	
DRAWING NUMBER	

• Exterior Perspective

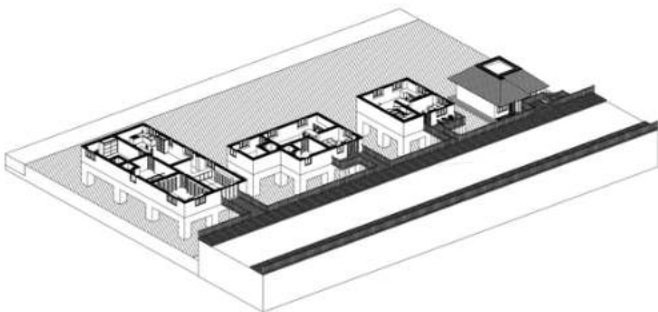


Image1

1:1,22

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 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
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SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Exterior	
SCALE	1:500, 1:1,22
DATE	
DRAWING NUMBER	

• Exterior Perspective

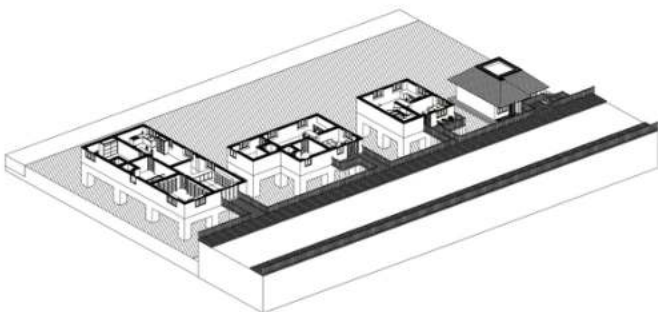


Image5

1:1,52

ARCHICAD EDUCATION VERSION

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TITLE	
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WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Exterior	
SCALE	1:500, 1:1,52
DATE	
DRAWING NUMBER	

• Exterior Perspective

ARCHICAD EDUCATION VERSION

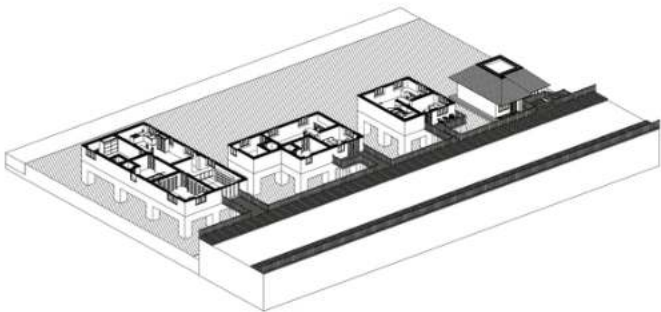
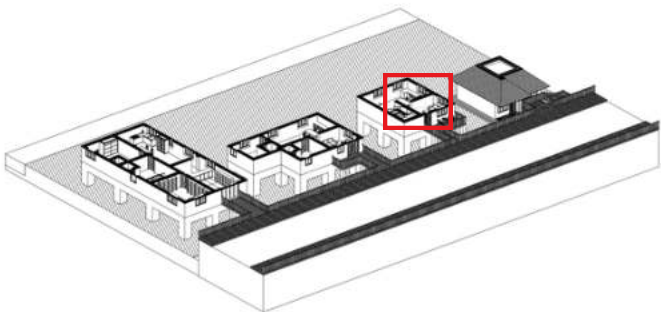


image4

1:1,51

 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
STUDENT ID	
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WIRYONO RAHARJO	
EXAMINER	
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INFORMATION	
DRAWING TITLE	
Exterior	
SCALE	1:500, 1:1,51
DATE	
DRAWING NUMBER	

• Interior Perspective



ARCHICAD EDUCATION VERSION



Image8

1:1,56

 DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
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ATHIYA SYAVIRA R.	
STUDENT ID	
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SUPERVISOR LECTURER	
WIRYONO RAHARJO	
EXAMINER	
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INFORMATION	
DRAWING TITLE	
Interior	
SCALE	1:500, 1:1,56
DATE	
DRAWING	
NUMBER	

• Interior Perspective

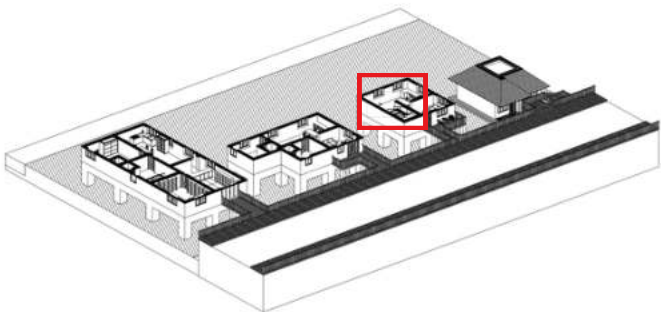


Image10

1:1,48

ARCHICAD EDUCATION VERSION

	
DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
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WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
DRAWING TITLE	
Interior	
SCALE	1:500, 1:1,48
DATE	
DRAWING NUMBER	

• Interior Perspective

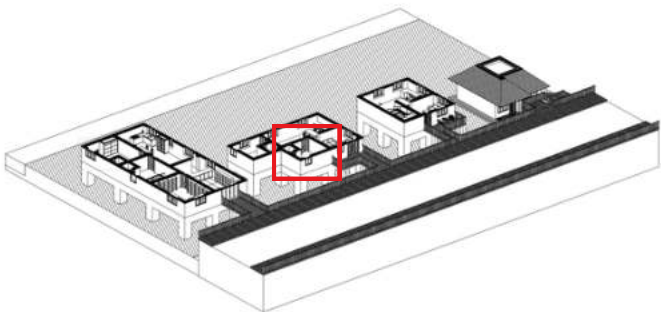


Image12

1:1,49

ARCHICAD EDUCATION VERSION

	
DEPARTMENT of ARCHITECTURE	
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INFORMATION	
DRAWING TITLE	
Interior	
SCALE	1:500, 1:1,49
DATE	
DRAWING NUMBER	

• Interior Perspective

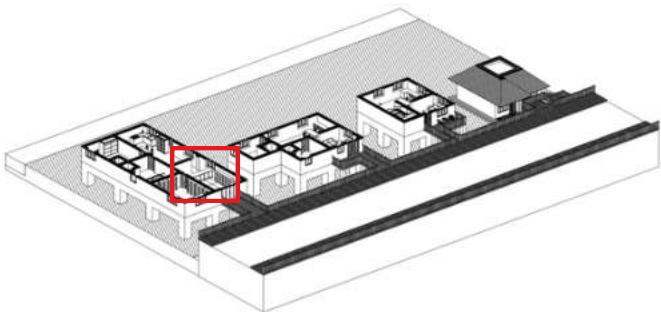


Image13

1:1,49

ARCHICAD EDUCATION VERSION

 DEPARTMENT of ARCHITECTURE	
TITLE	
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INFORMATION	
DRAWING TITLE	
Interior	
SCALE	1:500, 1:1,49
DATE	
DRAWING NUMBER	

• Interior Perspective

ARCHICAD EDUCATION VERSION

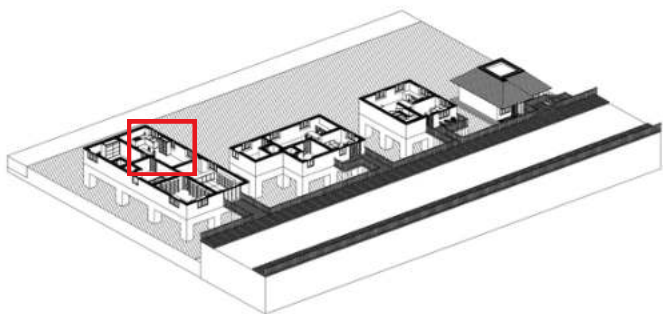


Image14

1:1.52

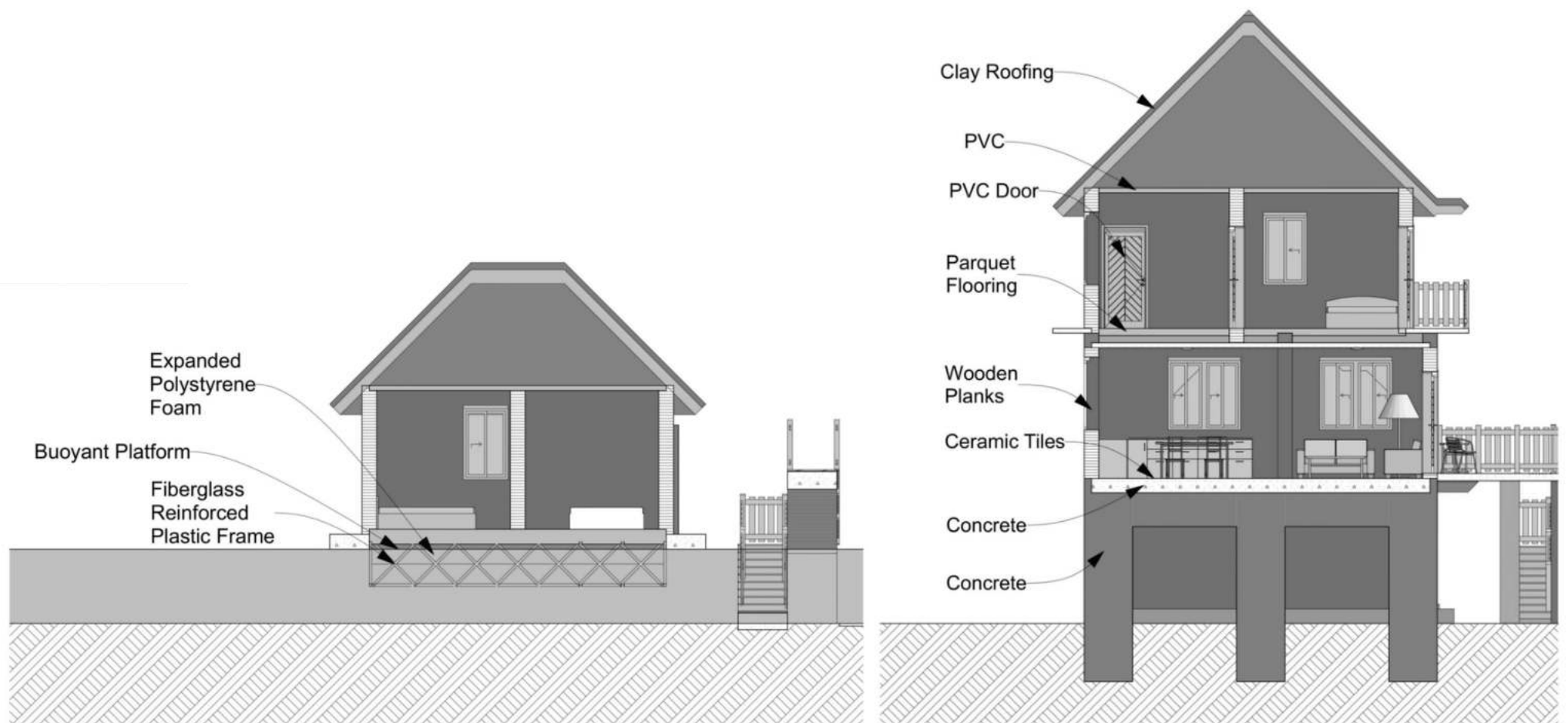
	
DEPARTMENT of ARCHITECTURE	
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INFORMATION	
DRAWING TITLE	
Interior	
SCALE	1:500, 1:1.52
DATE	
DRAWING NUMBER	

DESIGN REFLECTION

CRITICTS AND COMMENTS FROM EXAMINER

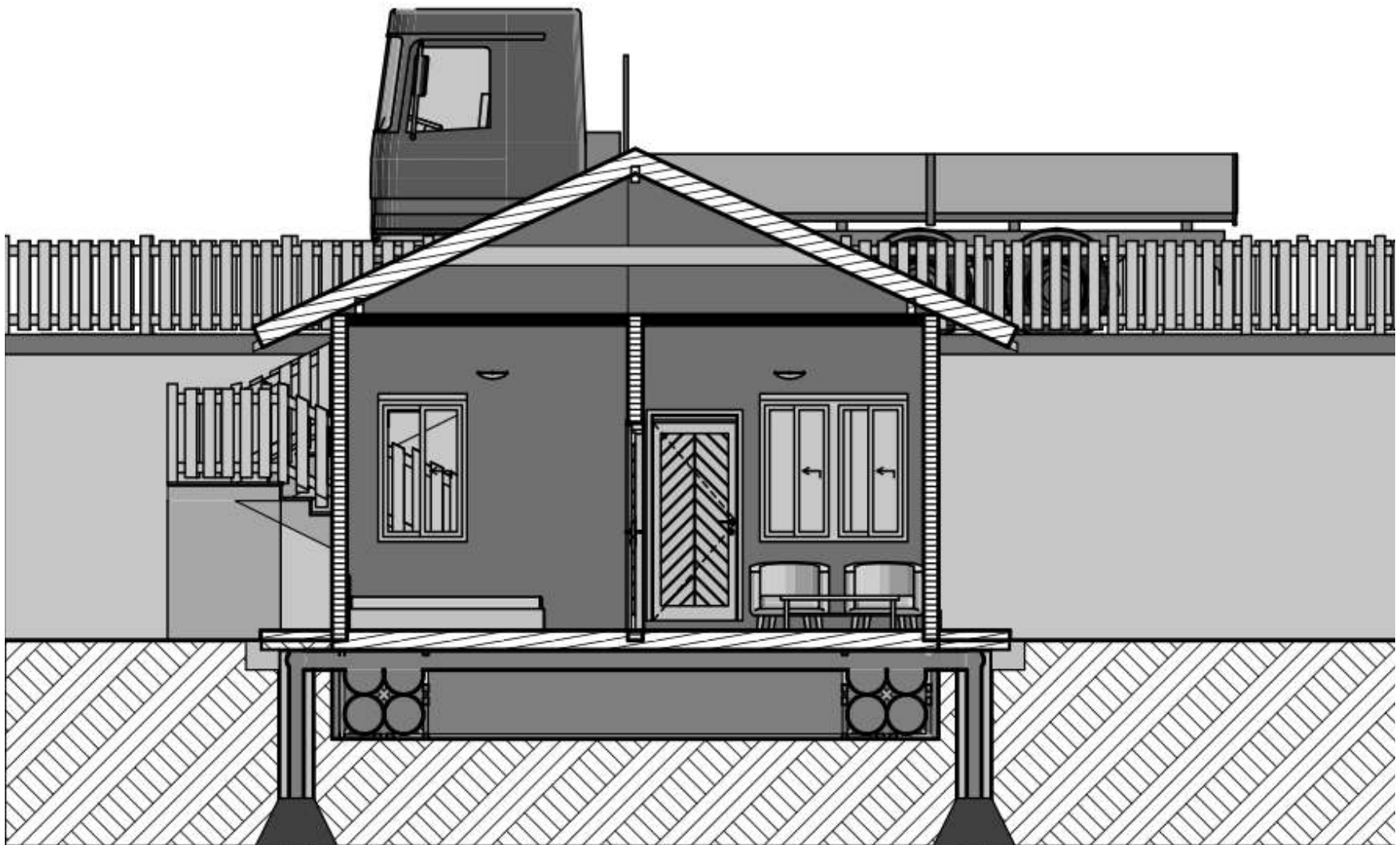
During the final defense evaluation, both the examiners have almost the same critics, which are about the size and weight of each building, especially the floating building. About whether the building can float or not using the buoyant mechanism and if the material type and size are lightweight enough for a floating house. There are also concerns about the size of the stilt, whether it's not too big to hold the buildings.

Another concern is about the infrastructure of the house, and ensuring the infrastructure won't be obstructed by the water during the flood.



REVISION

This page contains the evaluation that has been carried out by the examiner and the supervisor during the final defense evaluation where the most crucial thing that should be considered is the structure and materials used, especially on the floating house. The main concern is if the buoyant platform can hold and lift the house during flooding. To respond to the matter, the structure had been revised. The materials of the house had also been changed and fixed to be more lightweight.



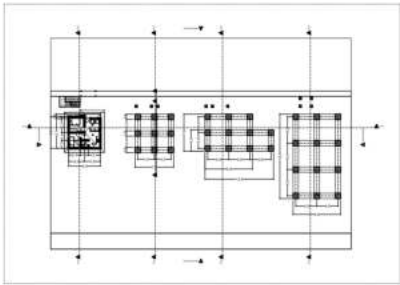
REVISION

Another critique was about the stilts being too big for the house. Thus, some changes are made. The size of the stilts structure are adjusted and re-simulate through RESIST to ensure that the structure is strong enough to hold the house. The materials used and the size of the structures of the house had also been changed to be more lightweight.



REVISION

ARCHICAD EDUCATION VERSION



S-01

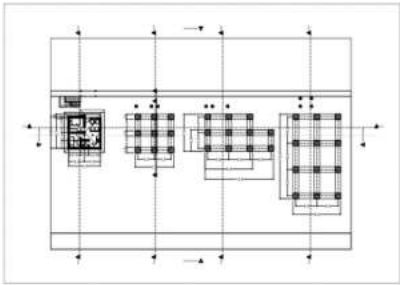
Building Section (1)

1:125

	
DEPARTMENT of ARCHITECTURE	
TITLE	
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NAME	
ATHIYA SYAVIRA R.	
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WIRYONO RAHARJO	
EXAMINER	
PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
REVISION	
DRAWING TITLE	
SECTION 1	
SCALE	1:125
DATE	
DRAWING NUMBER	

REVISION

ARCHICAD EDUCATION VERSION



S-20

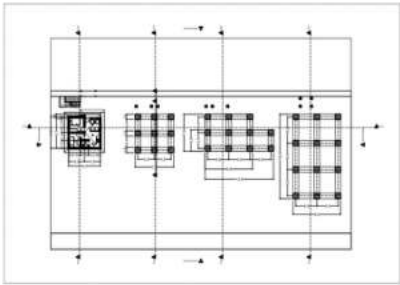
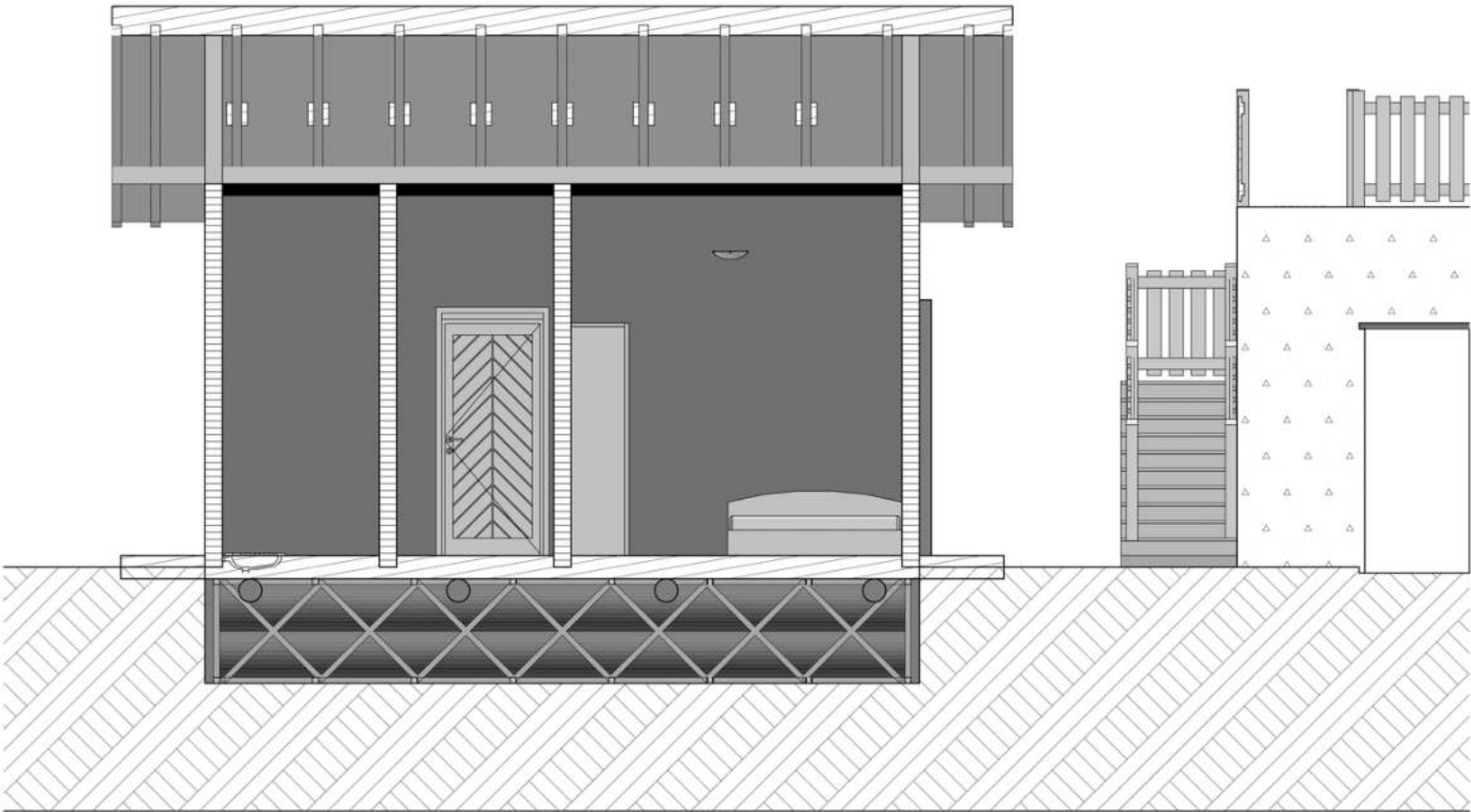
Building Section

1:125

	
DEPARTMENT of ARCHITECTURE	
TITLE	
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NAME	
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INFORMATION	
REVISION	
DRAWING TITLE	
SECTION 2	
SCALE	1:125
DATE	
DRAWING NUMBER	

REVISION

ARCHICAD EDUCATION VERSION

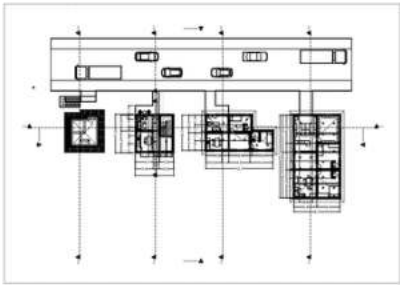
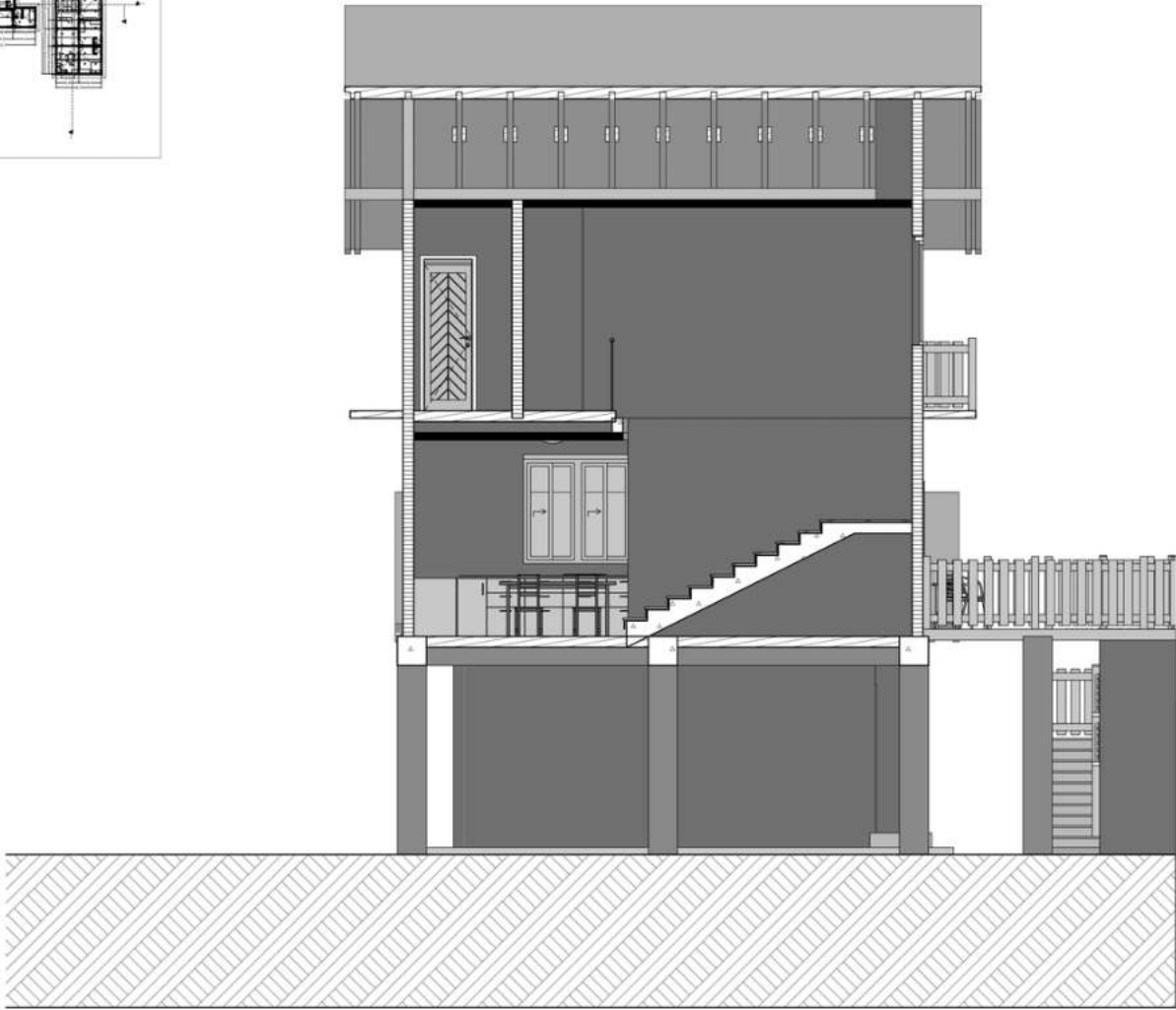


DEPARTMENT of
ARCHITECTURE

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PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
REVISION	
DRAWING TITLE	
SECTION 3	
SCALE	1:125
DATE	
DRAWING NUMBER	

REVISION

ARCHICAD EDUCATION VERSION



S-22

Building Section

1:50

	
DEPARTMENT of ARCHITECTURE	
TITLE	
RESIDENCE MODULE DESIGN FOR FLOOD AFFECTED AREA IN BENGKULU CITY	
NAME	
ATHIYA SYAVIRA R.	
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PROF. ILYA FADJAR MAHARIKA JOHANITA ANGGIA RINI S.T. -	
INFORMATION	
REVISION	
DRAWING TITLE	
SECTION 4	
SCALE	1:125
DATE	
DRAWING NUMBER	

CONCLUSION AND RECOMMENDATION

On the conclusion of this work, there are some things to note. This project is made in concern of the livelihood of the citizens in Bengkulu city that often got affected by flood, as one of the area used for this project was one of the most affected area by flood. This became the idea, concept and the design guideline of the design. There are a lot of considerations in design and development stage, moreover in the idea of the building typology. Due to the limitations of this projects, there are a lot of drawbacks and imperfections. However, hopefully this project can be an inspiration for others in creating something that can contribute to architectural development in the future.

ATTACHEMENT



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SURAT KETERANGAN HASIL CEK PLAGIASI

Nomor: 2522995975/Perpus./10/Dir.Perpus/XI/2024

Bismillaahirrahmaanirrahiim

Assalamualaikum Wr. Wb.

Dengan ini, menerangkan Bahwa:

Nama : ATHIYA SYAVIRA R
Nomor Mahasiswa : 19512088
Pembimbing : IR. WIRYONO RAHARJO, M.ARCH., PH.D.
Fakultas / Prodi : Teknik Sipil dan Perencanaan/ Arsitektur
Judul Karya Ilmiah : Modular Residence Module for Flood Affected Area in Bengkulu City

Karya ilmiah yang bersangkutan di atas telah melalui proses cek plagiasi menggunakan **Turnitin** dengan hasil kemiripan (*similarity*) sebesar **13 (Tiga Belas) %**.

Demikian Surat Keterangan ini dibuat untuk dapat dipergunakan sebagaimana mestinya.

Wassalamualaikum Wr. Wb.

Yogyakarta, 11/18/2024

Direktur



Muhammad Jamil, SIP.



Residence Module Design

for Flood Affected Area in Bengkulu City



Flood is a universal problem, and it has also becoming a national problem in Indonesia. Several places in Indonesia has different reasons on to why the area got affected by flood. It can be due to trash, overflowing of river, lack of absorption land, etc. In Bengkulu, flood is also a problem, and it is especially apparent in several specific spots. In one particular spot that has a bad history of flood and is still until today is the area that will be talked about in this paper. The cause of the flooding, the effect of the flood to residents and residentials, flood resilience and management, and how to create a safe and comfortable residential for the people affected by the flood in this area by using modular architecture.

Bengkulu is a province located on the island of Sumatra, Indonesia. The provincial capital of Bengkulu is located in the city of Bengkulu. This province is located in the southwestern part of Sumatra Island and the west coast in the southern part of Sumatra Island which is directly adjacent to the provinces of West Sumatra, Jambi, South Sumatra and Lampung in the surrounding area.

Bengkulu city is right by a sea shore and it has a river that went through its city. One of the area it went through is called Tanjung Agung. Tanjung Agung is an area near the center of the city. Along this road, there are a lot of people selling Bengkulu's specialty food like Pendap, Bai Tat, Lempuk, etc. Tanjung Agung is also an area that is lower than its surrounding. With its land lower in elevation than the surrounding area, and also due to it being next to the river.





Site Problem

Bengkulu had always suffered from flood, especially during rainy season. Although, there are hot spots for flooding in Bengkulu. The government had made water canals to control the flow of water in the area, yet flood would still occur from time to time. The flood height itself varied from only 1 meter to as high as 3 meters, although nowadays the highest flood is around less than 2 meters. It took several days for the flood to fully dried up, depended on the weather. If it's sunny for the whole day, the flood would dried up in 2-3 days. On the contrary, if it kept raining, even if it's only a drizzle, it could take up to a week to dried up.

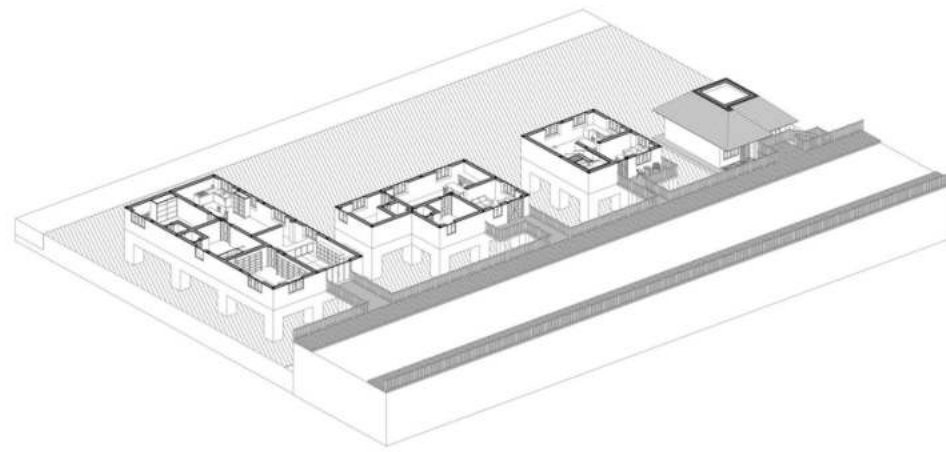


Concept

The floating house basically work like a boat. There would be several floats under the house, attached to a pole on the bottom so it won't float away. Once the flood subside, the house would float back down to its original place.

The lifted house is where the house is lifted up, creating an empty space below it, or in some cases, a full room which can be seen as a basement. If it's an empty space, it can be used for a parking space for the resident's vehicles. While a room can be used as a storage, or any other room needed in the house.



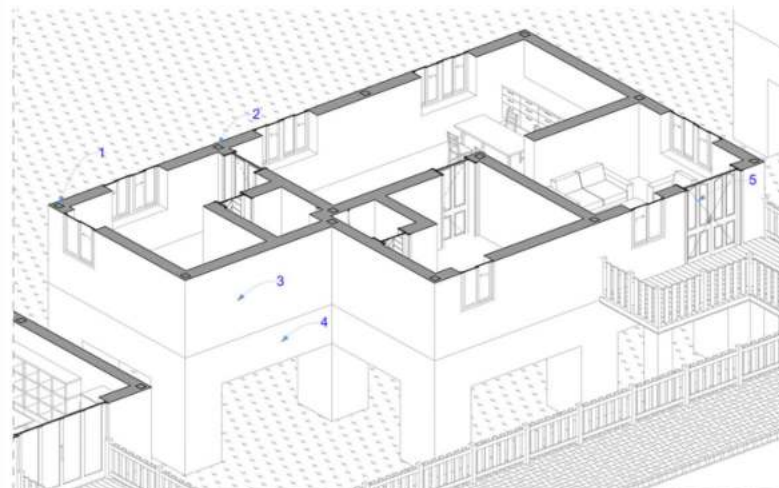


Legend:

1. Main Column
2. Practical Column
3. Wooden Plank Wall
4. Reinforced Concrete Column
5. PVC Door
6. Glass Door
7. Wooden Railing
8. Reinforced Concrete Slab

This shows the typology of the other building that use stilts to avoid flood. This typology doesn't use buoyant platform as it is a mixed use building, a store and a house. By using stilts, it will give easier access to the customer to go to the store.

This shows the typology of another building that use stilts to avoid flood. This typology doesn't use buoyant platform as it is a house for big family and is also thinking of the possibility of one of the family member being elderly and/or disabled. By having it an even level with the road, making it passable for the disabled.



Legend:
1. Main Column
2. Practical Column
3. Wooden Plank Wall
4. Reinforced Concrete Structure
5. UPVC Door





KITCHEN / DINING ROOM



BEDROOM



STORE



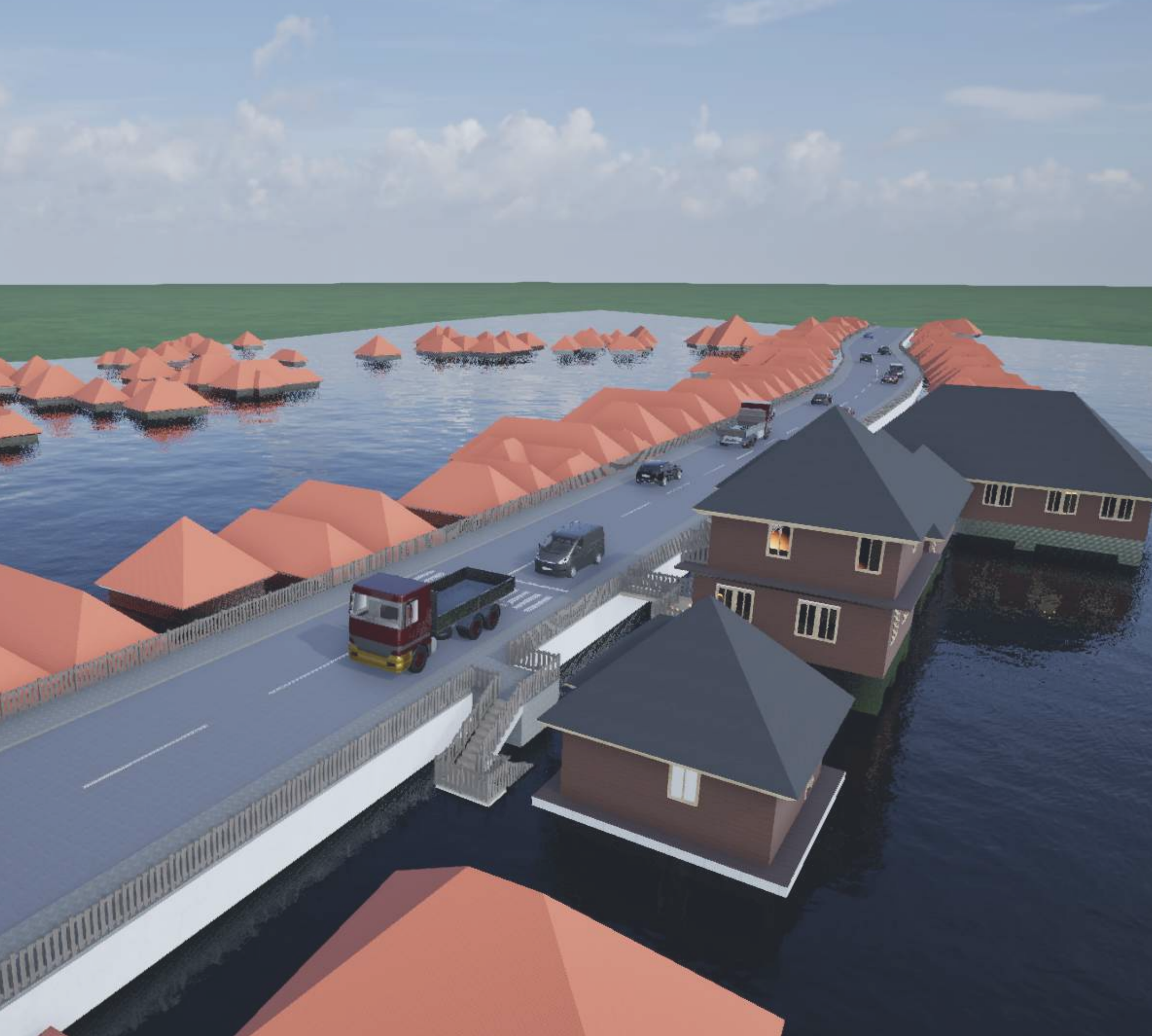
FAMILY ROOM



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Residence Module Design for Flood
Affected Area in Bengkulu City

Athiya Syavira Rinalson
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