

2021

Levitating Well

*Architectural Well to Prevent Ground Subsidence in Jakarta
Thesis Project*

Location Jakarta, Indonesia
Type Urban Infrastructure
Instructor Sung-Taeg Nam (namst@hanyang.ac.kr)
Category Graduation Thesis Project
Role Individual Work

1st Prize Hanyang University Graduation Exhibition
2nd Prize Tamayouz International Excellence Award
Grand Prize Architectural Institute of Korea
Thesis Paper *Journal of the Architectural Institute of Korea* (2022)

Keyword: Jakarta, Ground Subsidence, Well, Rainwater Purification, Kampung, Amphibious Structure, Prefabricated DIY Structure

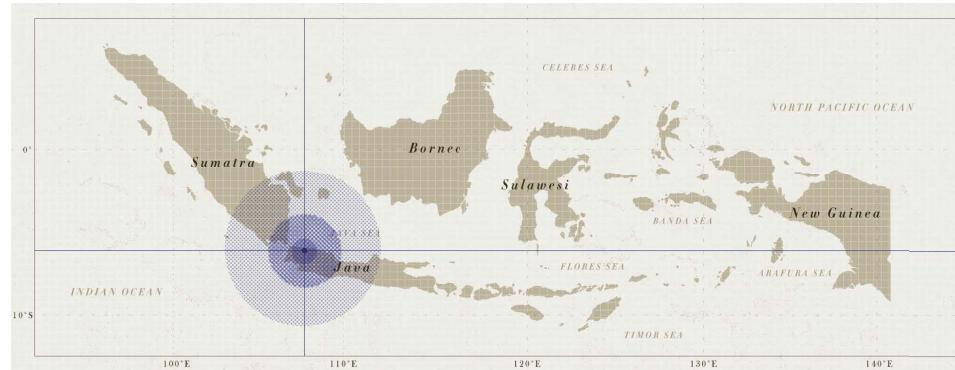
Jakarta, Indonesia's capital, is the fastest-sinking city in the world. Ground subsidence is the main cause of the city's sinkage; most of Jakarta's residents depend on wells for water, and the overwhelming extraction of water from Jakarta's lands continues to exacerbate the city's subsidence. Recently, flood-induced water contamination in Jakarta has rendered the usage of traditional wells dangerous not only for the city's survival, but also for the residents' well-being.

Using structures that float during floods, this project's new water system would purify rainwater in one of North Jakarta's villages, *Kampung Muka*. By using urban and constructive approach, Levitating Well aims to help people to live in balance with nature without harming the daily life or culture of the residents. Not only would this new water network preserve community life, but it would also reduce the ground subsidence of Jakarta in the long run.

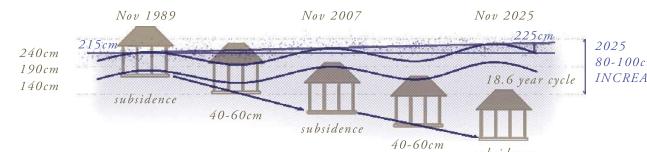


Jakarta, the fastest sinking city in the world

The Indonesian capital, Jakarta is home to 10 million people but it is also one of the fastest-sinking cities in the world. Not only does floods happen frequently, but this massive city is disappearing into the ground. Jakarta is sinking by an average of 1-15cm a year and almost half the city now sits below sea level.



Jakarta's Ground Subsidence and Sea Level Rise



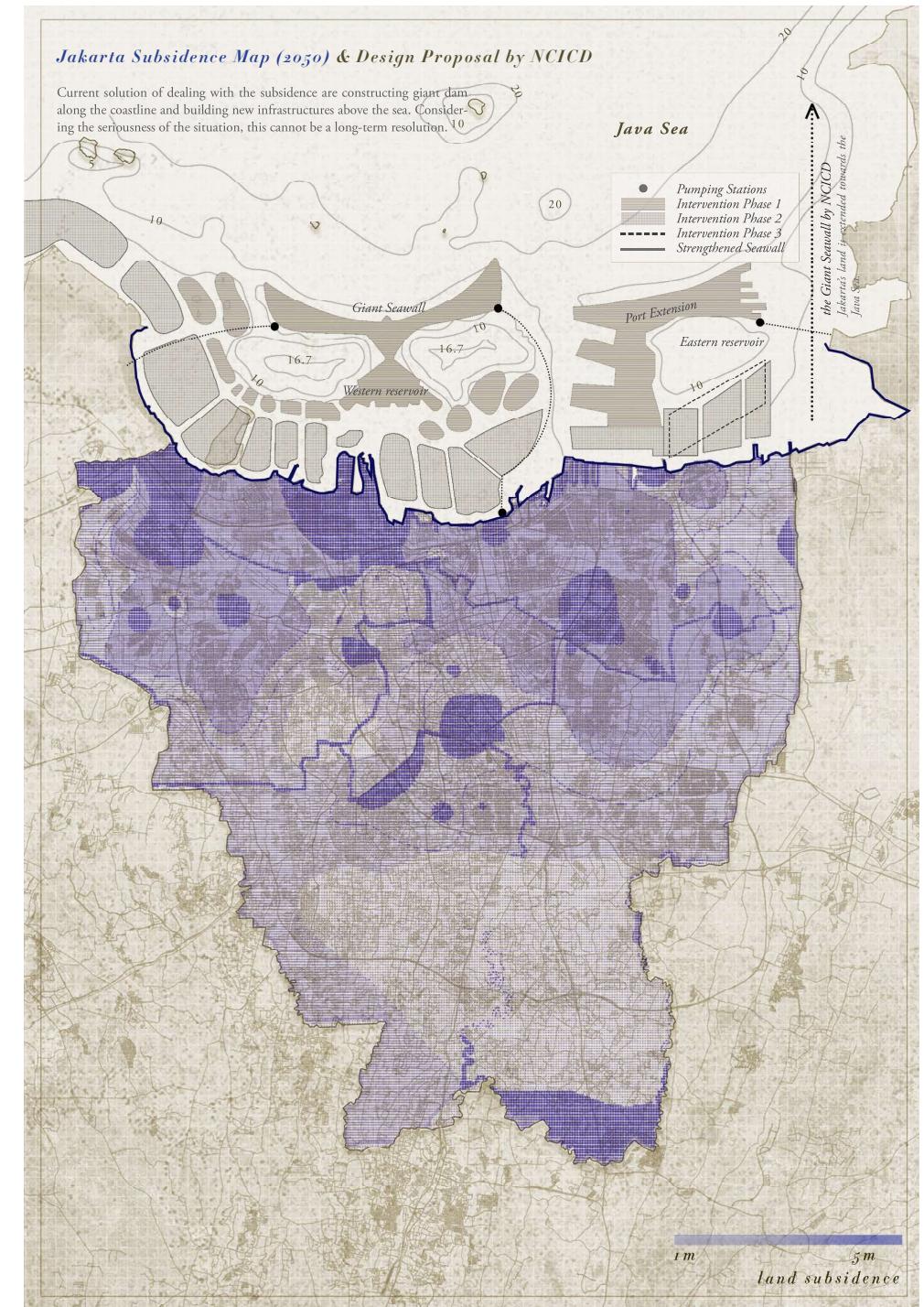
Contemporary Concrete Buildings that Worsen Ground Subsidence

Contemporary buildings that are built with heavy concretes are worsening the subsidence. It is easily affected by floods and ground subsidence, as shown in the picture below. Vernacular high-rise houses that are built with light bamboos are less affected by the environment. It also does not harm the natural ecosystem.



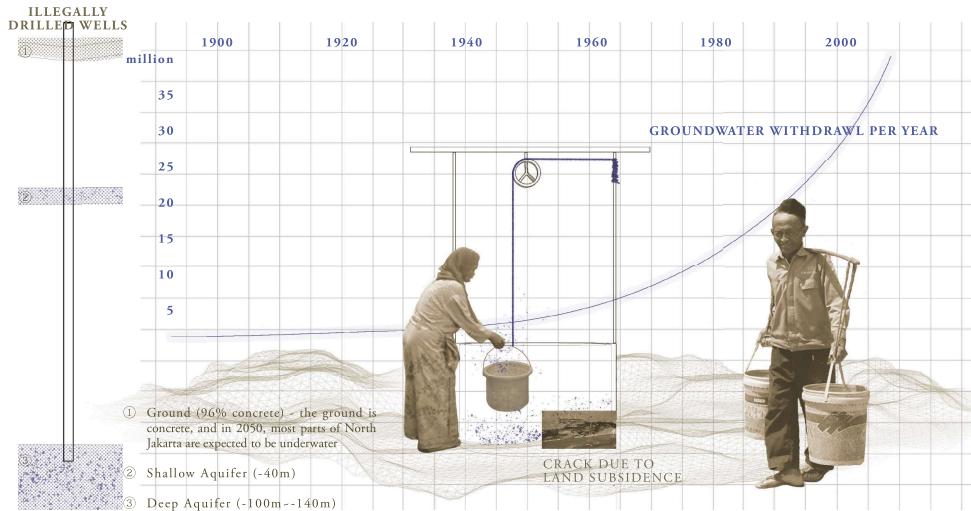
Indonesian Traditional Wood Architecture : Unaffected by the Environment

Indonesian Contemporary Concrete Architecture : Sunk Groundfloor



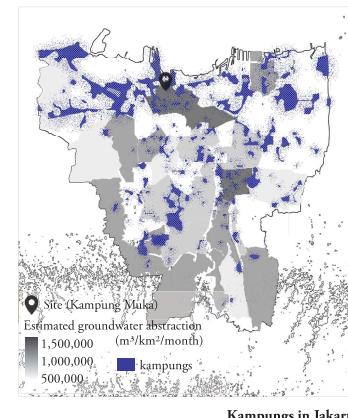
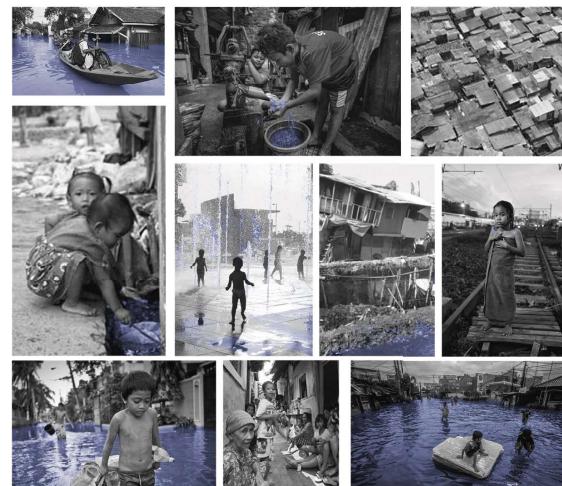
The Cause of Land Subsidence: "Wells"

In Jakarta, more than 40% of people use wells to gain water. However, these spots are in jeopardy because the government has decided to remove wells as a lot of investigations indicate that this is the cause of subsiding lands.

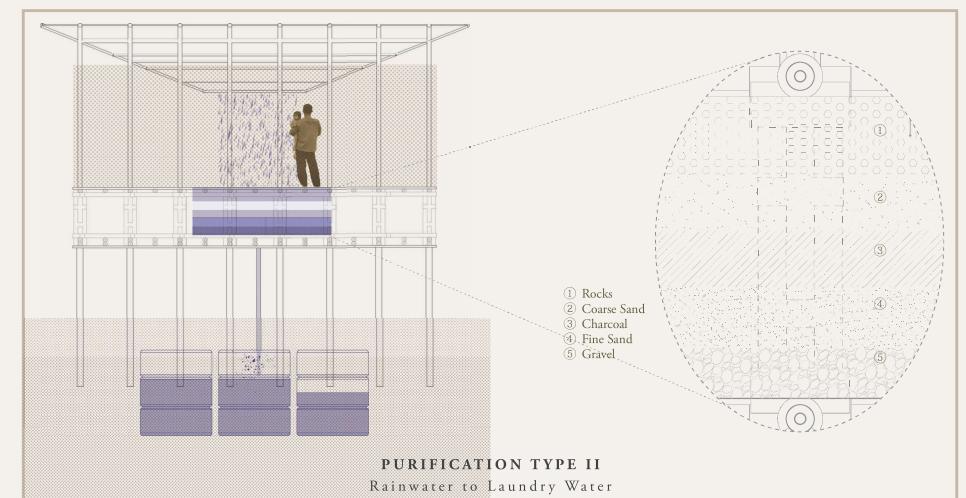
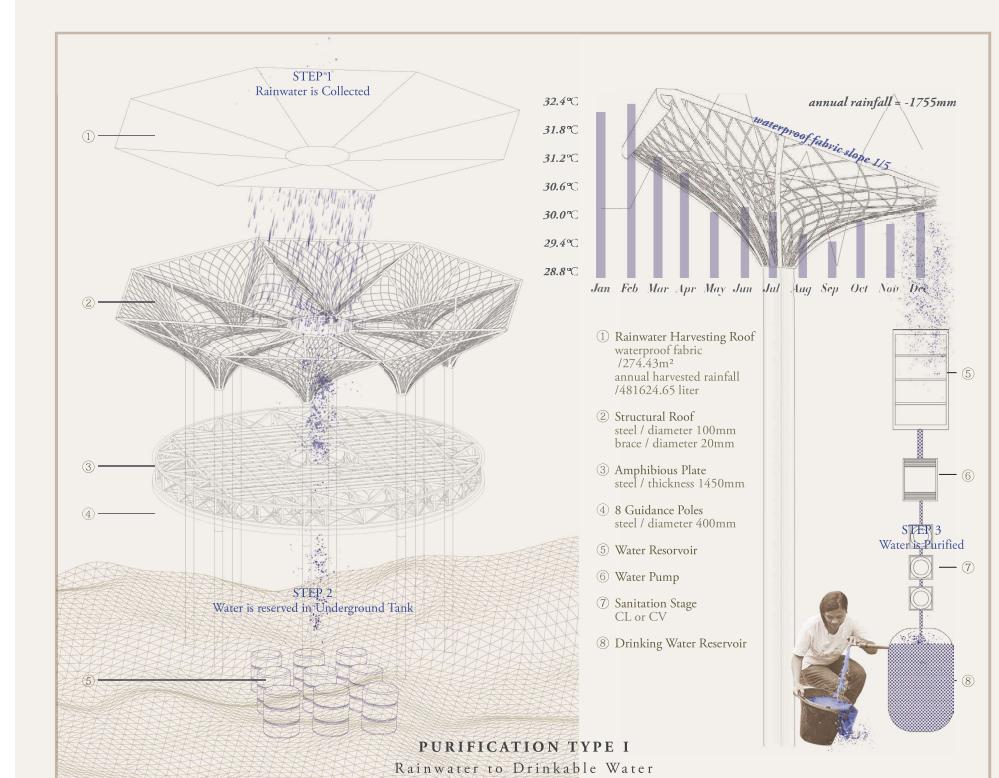


Water Wells in Kampungs (villages) : the Only Available Water Source & Community Bonding Spaces

In Jakarta, water is part of their living. It is a huge problem for them during floods, but it also can be a playground for children and an important resource for living. Due to a lack of water infrastructures in Kampungs, people still rely on wells to drink water. Because groundwater extractions happen everyday, they lead to more subsidence, threatening the local communities.



'Kampung' means 'Village' in Indonesia. About half of the people in Jakarta live in Kampungs. There are various Kampungs scattered all over Jakarta, but the ones in North Jakarta are especially facing more disastrous environmental issues. The kampungs are colored in blue on the map.

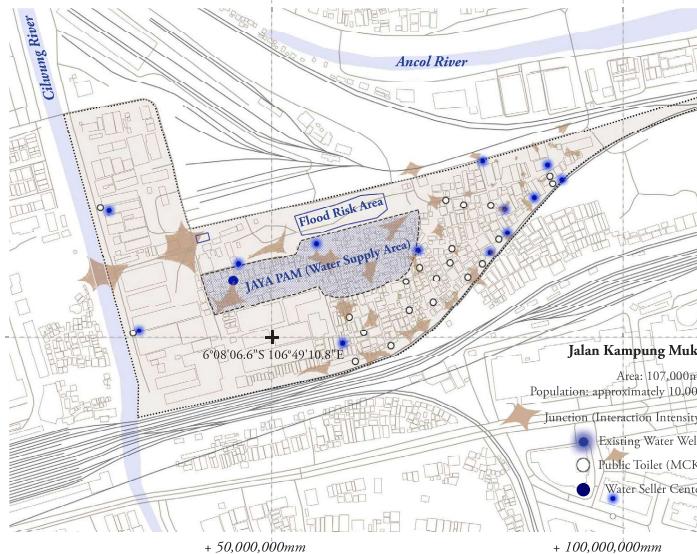


Strategy: Substituting Contaminated Wells by Purifying Rainwater

Rainwater purification system would substitute contaminated wells. Frequent rain no longer becomes a weakness, but rather opens opportunities. Rainwater purification is divided into two types. Type 1 deals with massive amount of rainwater purification. Type 2 consists of natural resources, and is a smaller volume than type 1.

Replacing 3 Problematic Places in Kampung Muka

Over the last century, Kampung Muka (one of kampungs in North Jakarta) has become synonymous with environmentally hazardous zone due to water crisis. This project attempts to gain control of the region's water infrastructure by proposing a sustainable water network that would substitute contaminated wells.



3 Problematic Zones in Kampung Muka



Current Situation → *"Levitating Well"*

a. Existing Water Well

A. Water Pavilion

Almost half of the Jakarta people use wells to gain water for their living. Wells act as a community bonding space. Also, flood-induced water contamination is threatening the residents' well-being.



b. Existing Alley

B. Water Road

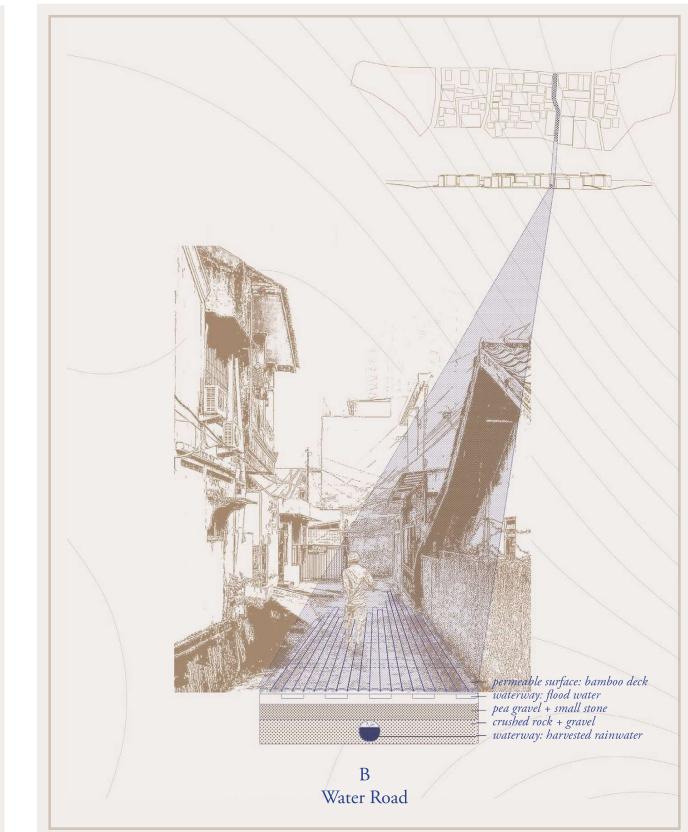
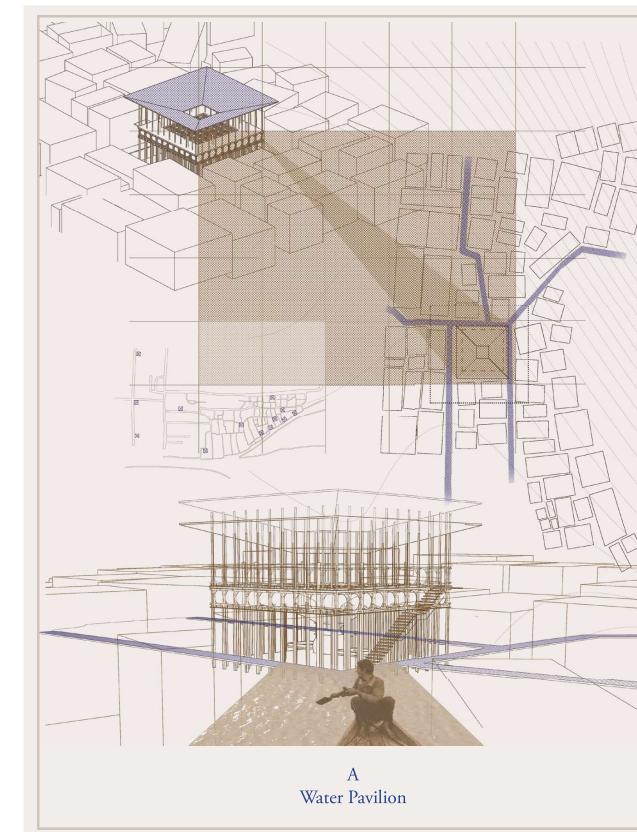
Most alleys are covered up with concrete. This blocks the rainwater to naturally seep into the ground, causing more floods and worsening land subsidence.



c. Existing Wetland

C. Main Building

A lot of lands are wetlands in North Jakarta. The site is often flooded due to the height of the land. Currently, this land is covered with garbage, and is a dangerous playground for children.



Programs Inspired by Neighbor's Daily Lives

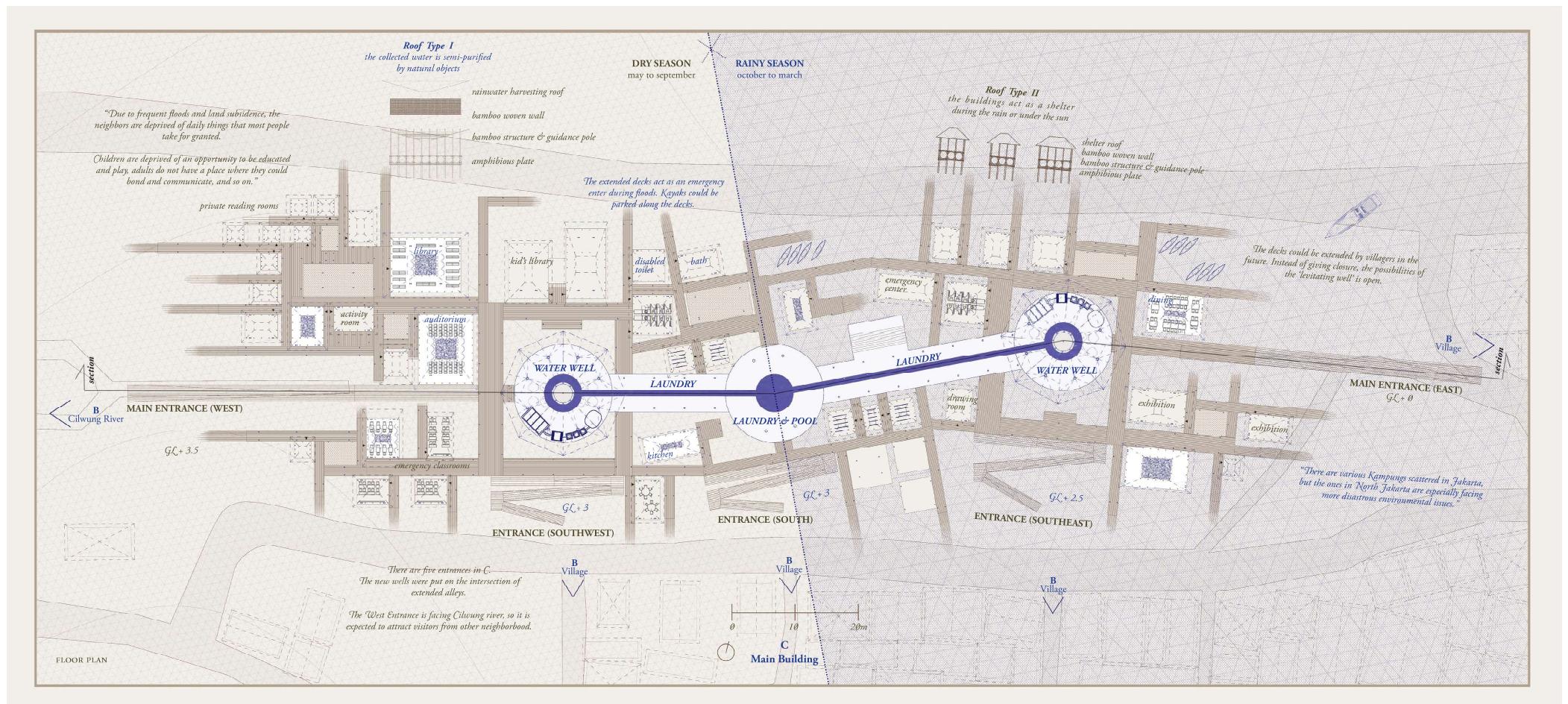
No longer under control of contaminated wells, this new water network will see locals bonding in a new type of well that are filled with programs that the locals need. This project aims to give basic enjoyments in life that all people should have. The architecture becomes part of their living, providing a space to live daily lives no matter what environmental crisis may occur.



C architecture model U1100

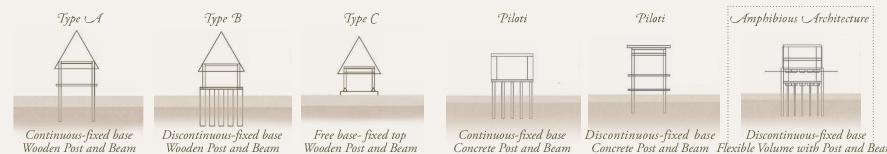


Rendered view from Laundry

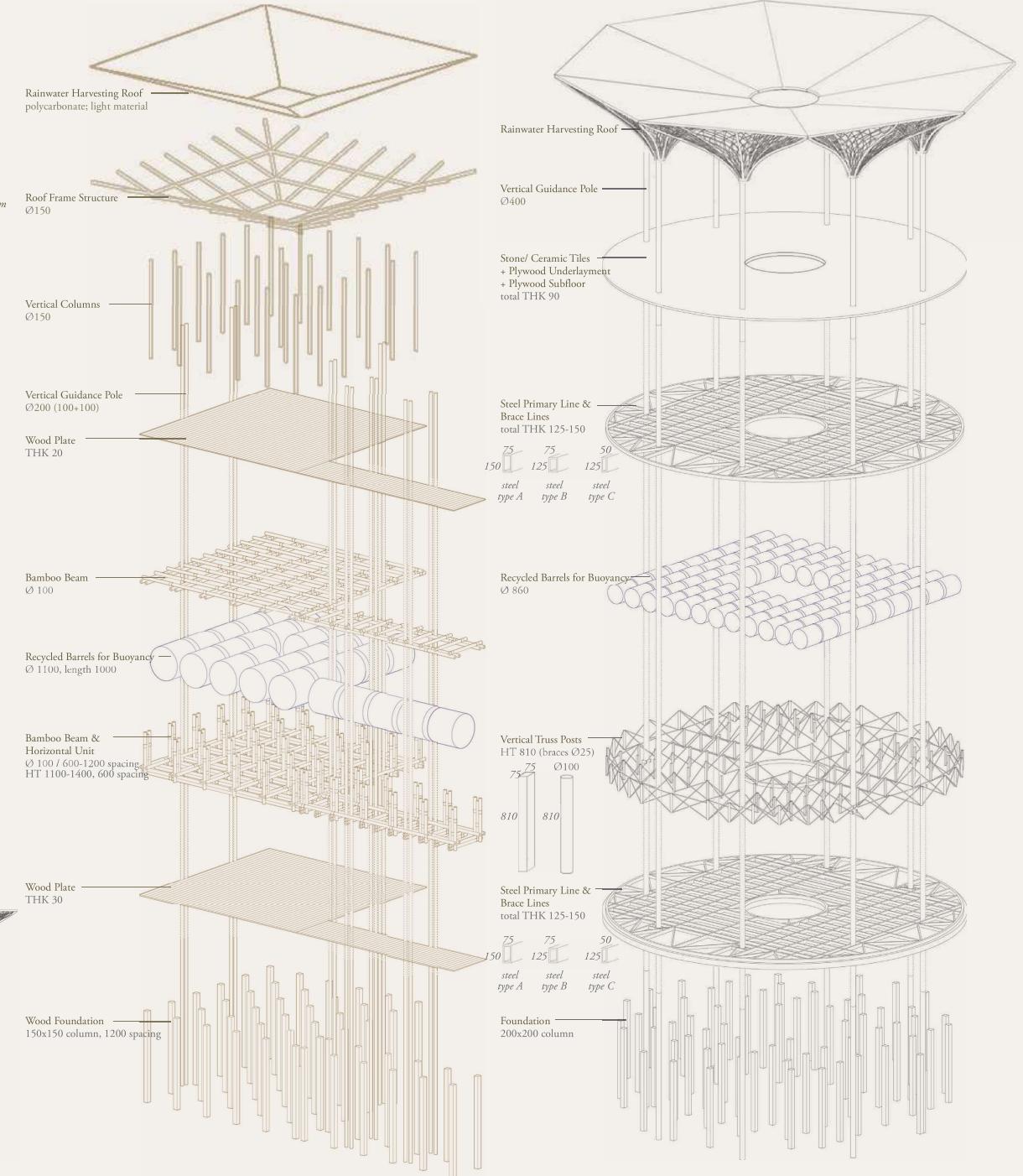
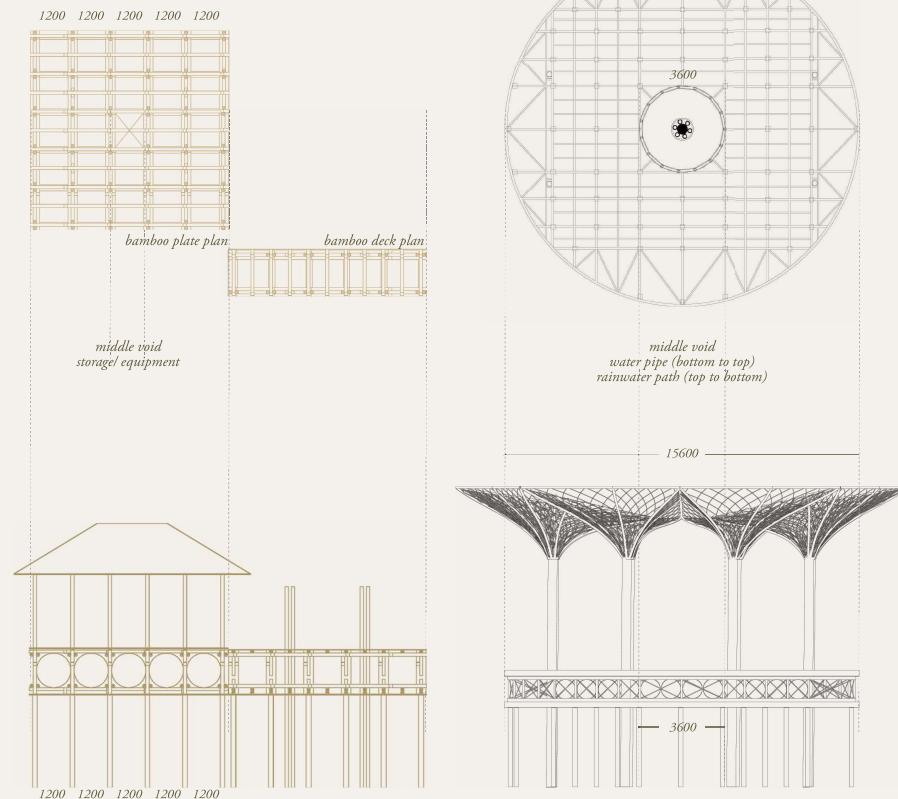


Amphibious Structure Inspired by Indonesian High-rise Houses

These are structural details that float during floods. Unlike Jakarta's traditional high-rise houses, which are in a fixed state, this is a structural system that can respond to the changing environment. The structure is built with light 'bamboo', and the same structural principle was also applied with iron. The structure, which floats from the foundation during flooding, moves freely along vertical rails.

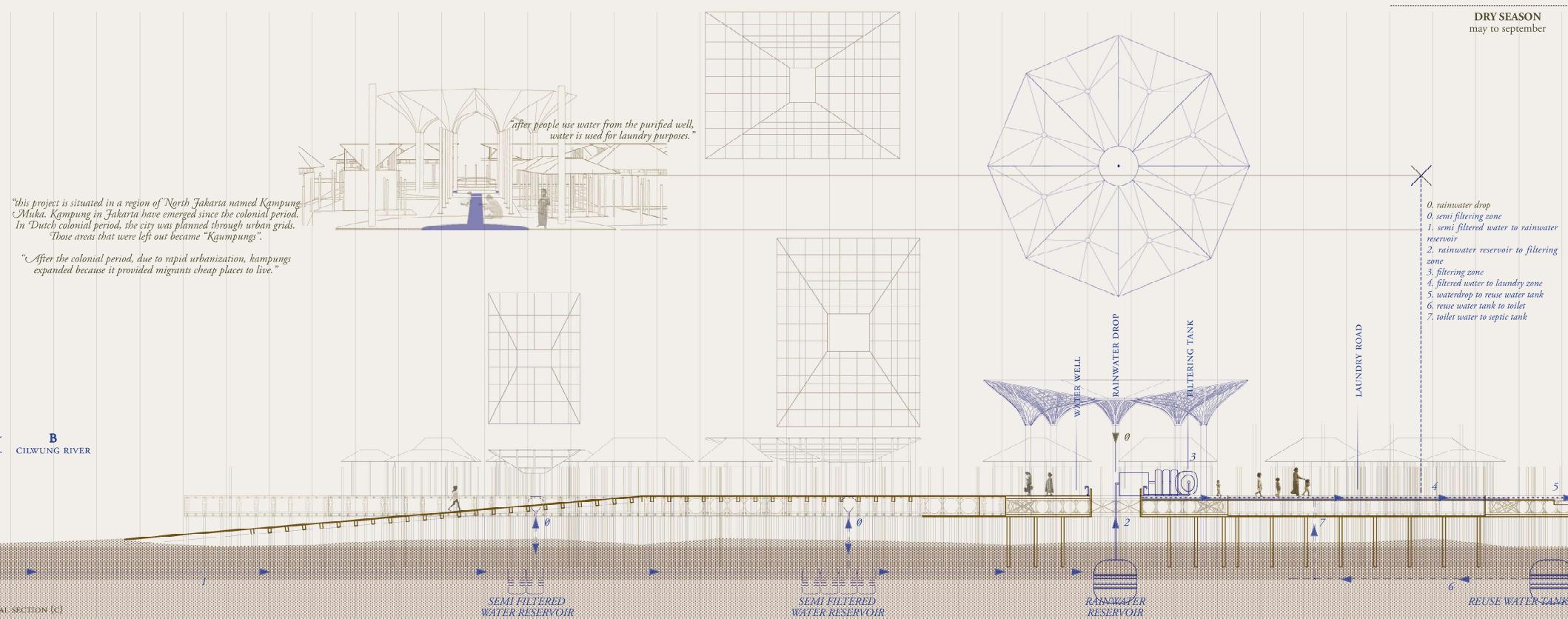
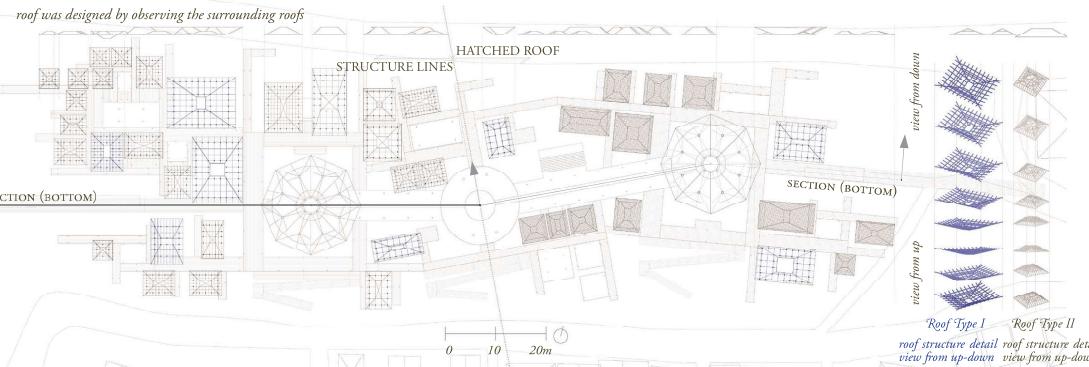


amphibious bamboo structural detail model 1/20



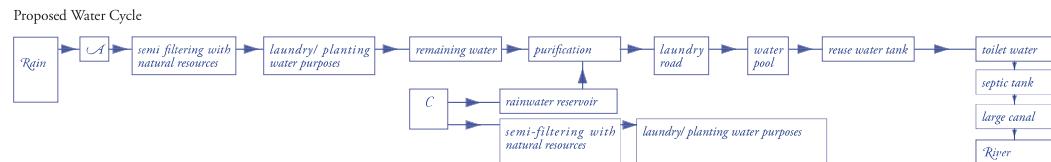
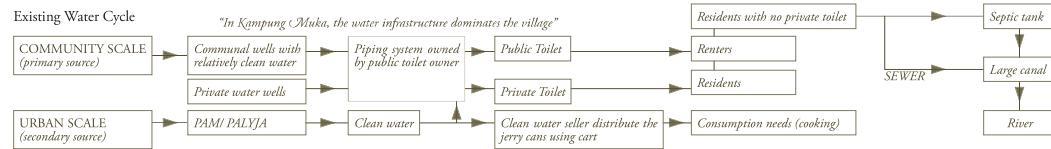
Water Wells that Float during Floods

Instead of manipulating the environment to fulfill our needs, the "Levitating Well" proposes a way to coexist with our planet while preserving it. This project is finished with the decks stretched out to the village so that the people could freely add decks and buildings. To make the construction process easier, as the architecture stretches out from the high-tech wells, it is built low-tech and with local materials. All the dimensions are a multiple of 1200mm, which is a human scale inspired by local decks around the Java Sea.



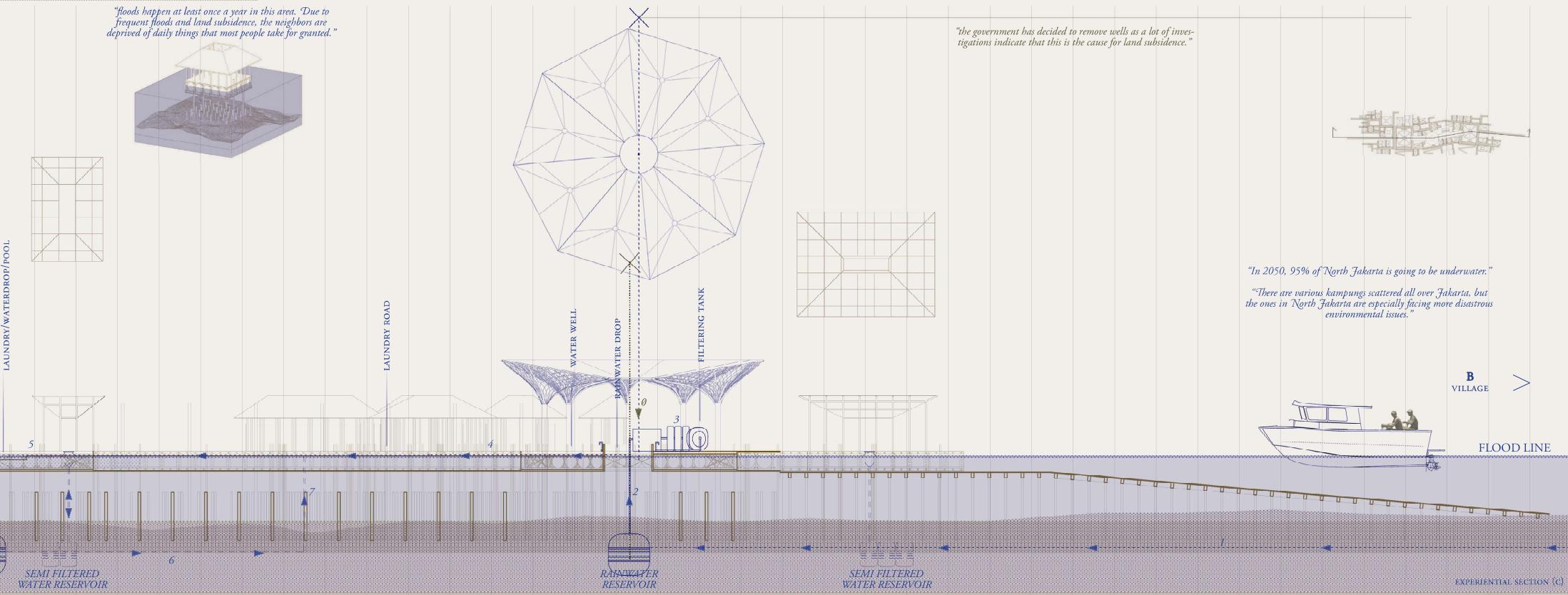
New Sustainable Water Cycle in Kampung Muka

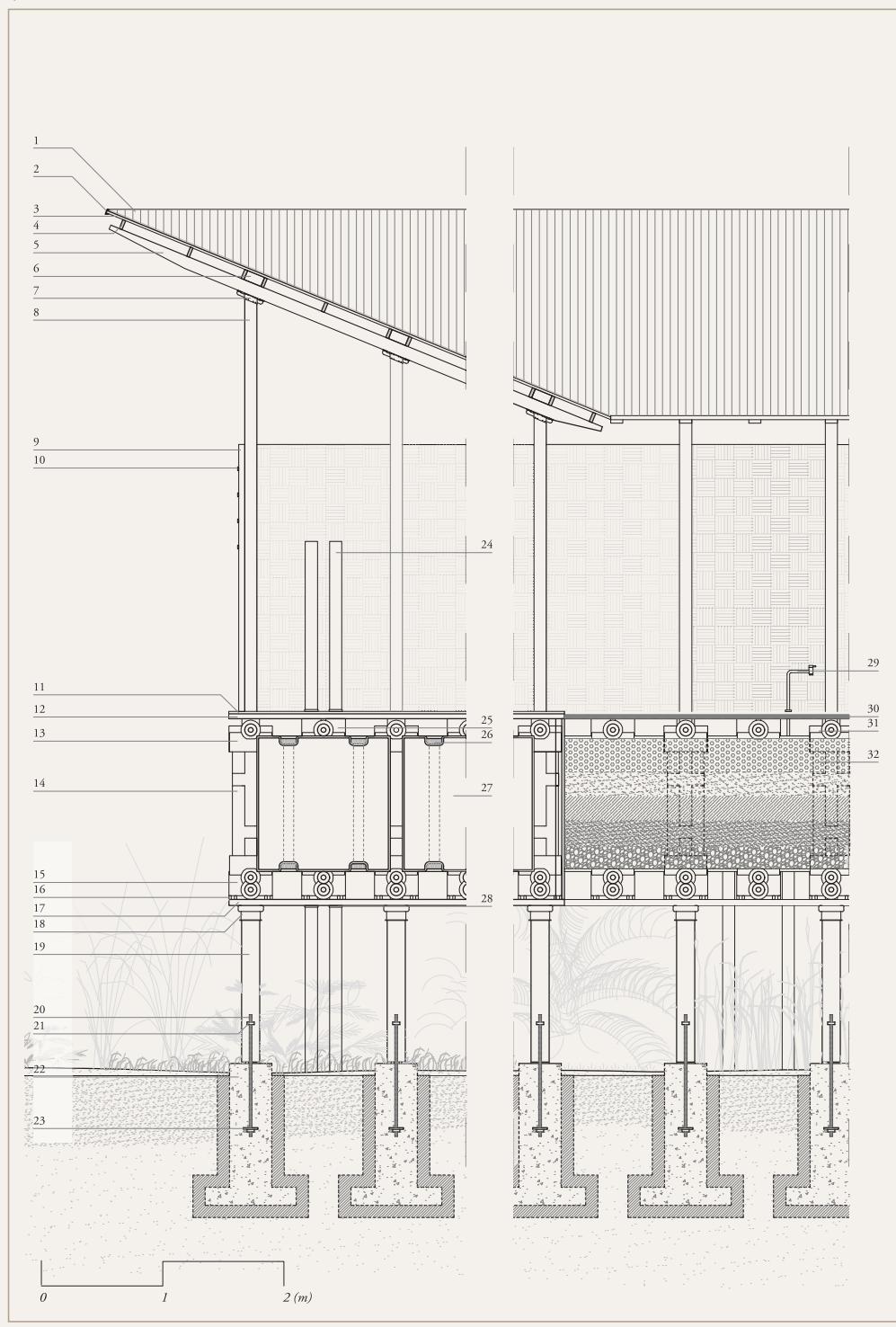
By 2050, most of North Jakarta's lands is expected to be underwater. Kampung Muka is no exception. Luckily, the proposed architecture will float even in the worst scenario. Also, the study of existing water cycle in Kampung Muka showed a way to apply rainwater purifying system into the village.



RAINY SEASON october to march

"floods happen at least once a year in this area. Due to frequent floods and land subsidence, the neighbors are deprived of daily things that most people take for granted."





Amphibious Structure Detail

Since all the buildings are small, light, and modularized, amphibious structures could be easily applied. To appropriately apply the structures, detailed plans were required. All of the details are written below.

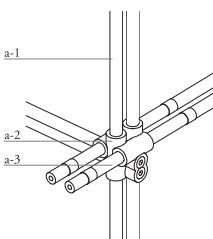


- 1 Sandwich steel sheet with 48kg/m³ density, corrugated sheeting with powder coating
- 2 Metal support device for sandwich panel
- 3 Soundproofing, rockwood #63.5
- 4 20x80 FG Metal duct, with flashing
- 5 Autoclaved eucalyptus glulam beam, 3-coat osmocolor finish, THK 150x80 (horizontal)
- 6 Autoclaved eucalyptus glulam beam, 3-coat osmocolor finish, THK 150x80 (vertical)
- 7 Prefabricated metal joint for autoclaved eucalyptus glulam beam and bamboo pillars
- 8 Sustainable bamboo pillar, 3-coat colorless varnish finish, Ø100
- 9 Sustainable bamboo weaving, THK 50
- 10 Metal joint for woven wall and bamboo pillar
- 11 Water proofing, lacquer or oil, THK 20
- 12 Wood flooring, THK 40
- 13 Prefabricated joint type #03, top anchoring joint for pillars-beams
- 14 Sustainable bamboo pillars, 3-bundle, Ø100
- 15 Prefabricated joint type #02, bottom anchoring joint for pillars-beams
- 16 Metal support device for bamboo pillars
- 17 Wood flooring, THK 45, waterproofing, lacquer or oil, THK 5
- 18 Metal support device for anchoring, 120x15, 60x20
- 19 Recycled barrels for buoyancy, diameter 1100, length 1000
- 20 Shock absorber, prefabricated rectangular rubber cap, THK 50
- 21 Metal support for railing, 3-coat waterproof finish
- 22 Reinforced concrete structure, cast-in-situ
- 23 Metal support device for anchoring, 120x15, 60x20
- 24 Steel railing, 3-coat waterproof finish, diameter 100
- 25 Prefabricated joint type #01, frictionless joint for railing
- 26 Eco-friendly natural twisted rope
- 27 Recycled barrels for buoyancy, diameter 1100, length 1000
- 28 Metal support for railing, 3-coat waterproof finish
- 29 Water tap, powder coating
- 30 Steel mesh, 3-coat waterproof finish, THK 30
- 31 Water pipe
- 32 Rainwater channeling box, rocks/ coarse sand/ charcoal/ fine sand/ gravel



Architecture Expanded by the Neighbors

DIY prefabricated joints allow the villagers to add and build masses. The distance between the columns is 1200mm. It is the same in every decks and buildings. This is a strategy to make the construction process easier. The decks and buildings could be separated and then be merged again. Villagers can participate in the construction process.

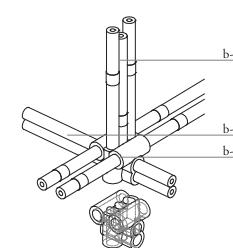


Prefabricated Joint Type #1

a-1 Steel railing, 3-coat waterproof finish, Ø100

a-2 Prefabricated metal joint type #1, frictionless joint with rollers for railing

a-3 Sustainable bamboo beams, Ø100

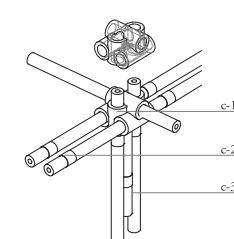


Prefabricated Joint Type #2

b-1 Sustainable bamboo pillars, 3-bundle, Ø100

b-2 Sustainable bamboo beams, Ø100

b-3 Prefabricated metal joint type #2, for anchoring bamboo pillars and beams



Prefabricated Joint Type #3

c-1 Prefabricated metal joint type #3, for anchoring bamboo pillars and beams

c-2 Sustainable bamboo beams, Ø100

c-3 Sustainable bamboo pillars, 3-bundle, Ø100

