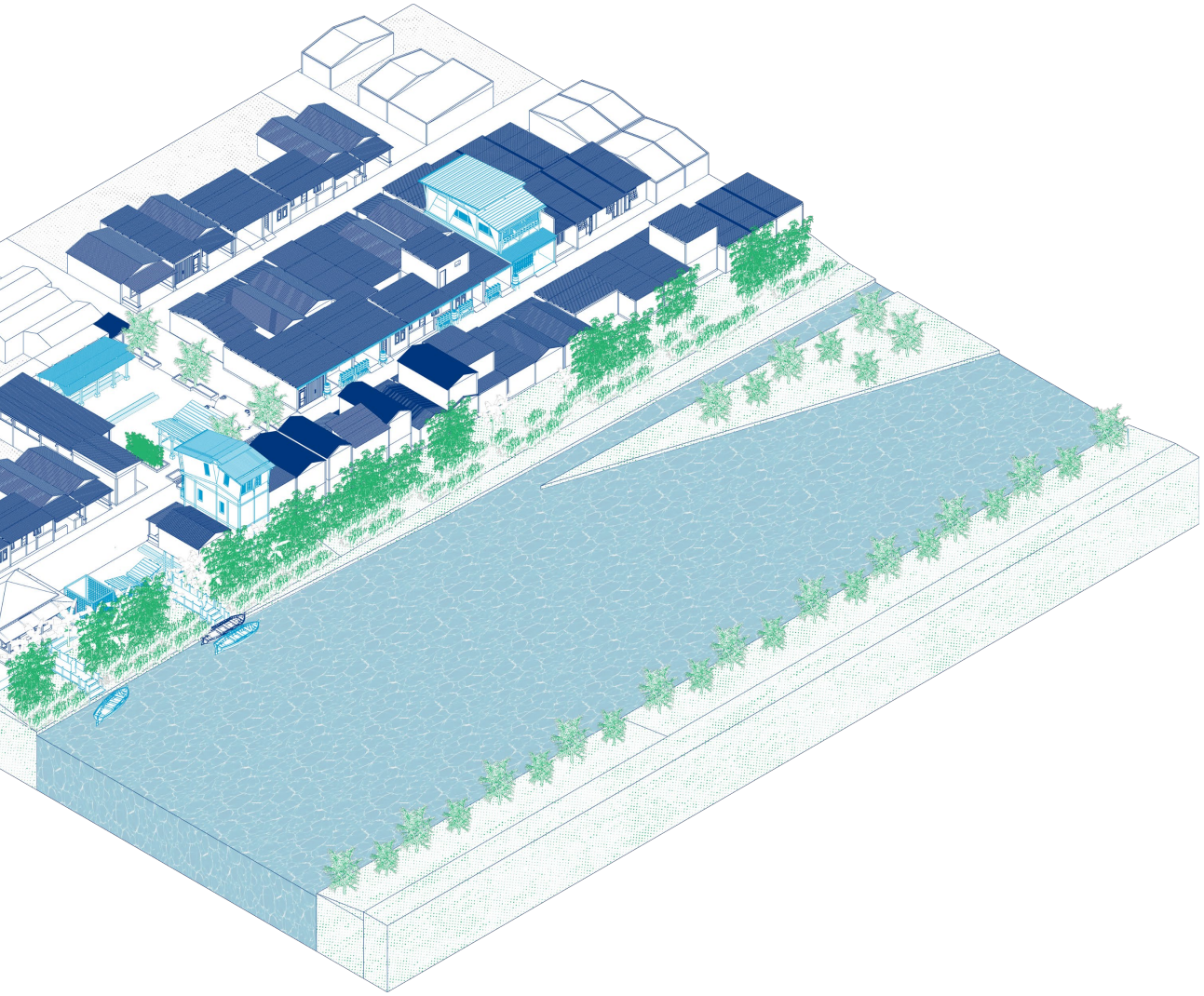


Architectural Engineering Graduation Studio
P5 Presentation

Recovering *The Water*

Enhancing the health and wellbeing of Indonesia's kampung system while contributing to the recovery of water ecosystem services

Aprisia Rasya Murran 5794781

Nico Tillie Research Tutor

Mo Smit Design Tutor

Paddy Tomesen Building Engineering Tutor

The Neighbourhood *Keputih*

Introduction

River in Surabaya

Soerabaja Kart, 1915

Surabaya, 2024

So, what are *the actual problems?*

Water *Scarcity*

Rising ***Water*** *Flood*

Polluted ***Water*** *& Drainage*

Water *Scarcity*

Water availability
How can I provide water?

Rising ***Water*** *Flood*

Protected from water
How can I protect residents from raised water?

Polluted ***Water*** *& Drainage*

Water Quality
How can I purify water?

Water is a **source of life**

Water is a **human right**

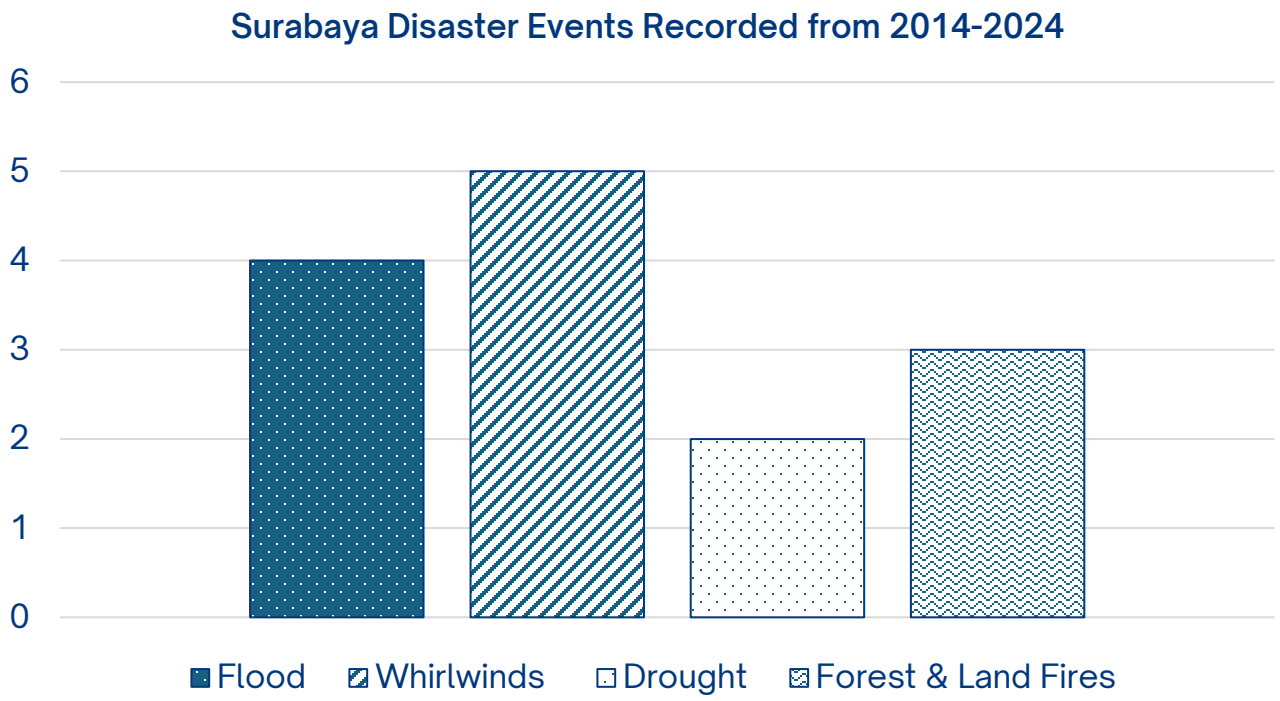
Water is a **nature right**

We've **broken** the water cycle, **destroyed** water ecosystems and **contaminated** groundwater.

UN's Chief António Guterres, World Water Day 2023


Rainfall
Flooding
River
Flooding

Disaster Events



Source: National Agency for Disaster Countermeasure

But, what happens *to*
the architecture of the houses?

Poor housing structure ; lack of proper ventilation; materials with higher CO2 emissions

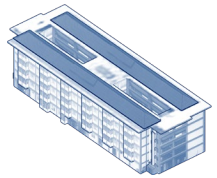
Again, what happen with the kampung residents
living informally and *build along the river*?

Forced Eviction

Surabaya's Resident Card holder

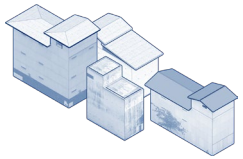
Financial compensation

or



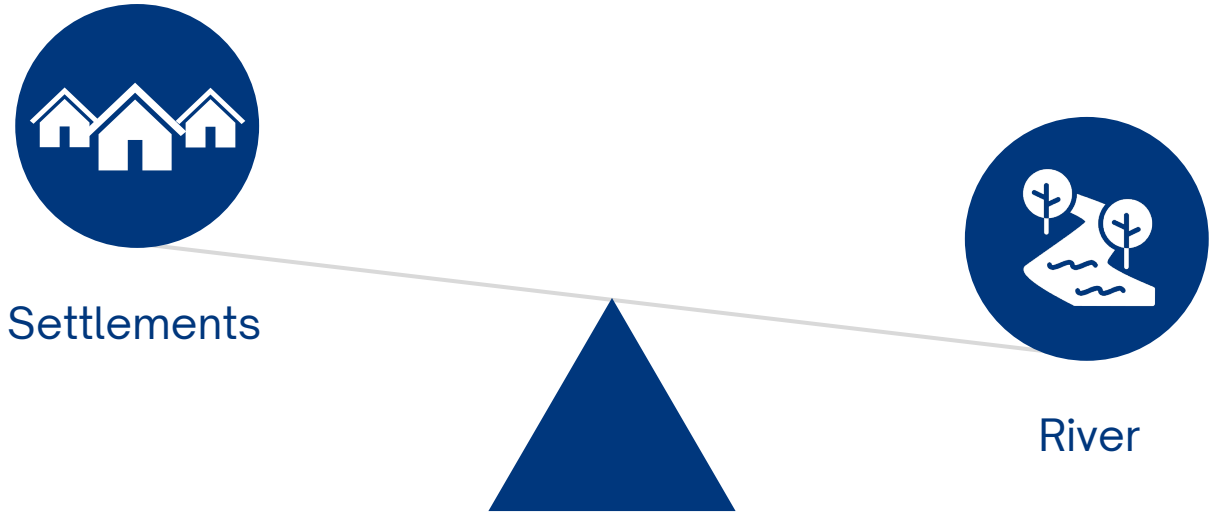
Relocation public housing/ Rusunawa

Non Surabaya's Resident Card holder



Simply displaced; in other informal settlements

What’s the goal?

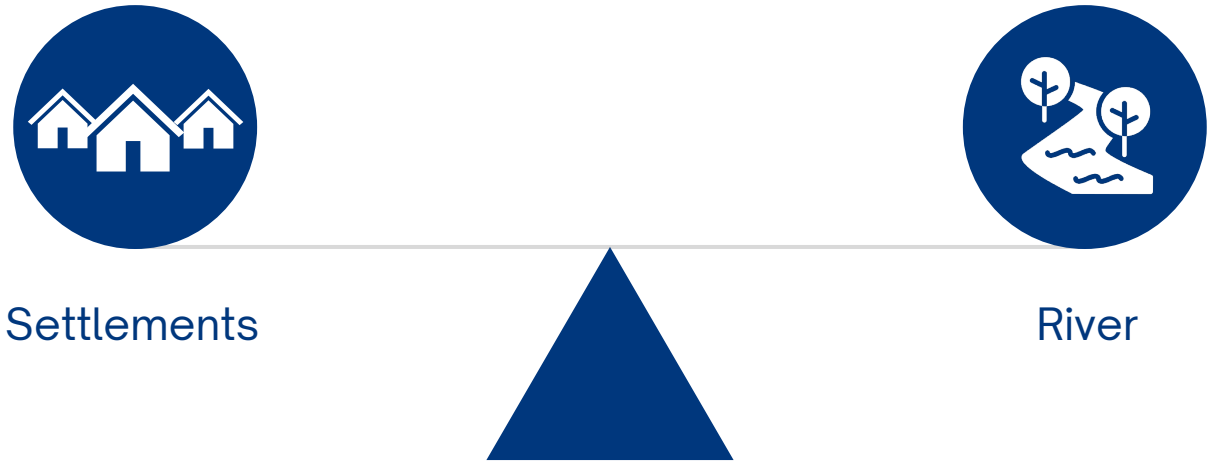


Imbalance function of urban infrastructure

What’s the goal?

Make it
Resilience

Restore its
Original Function



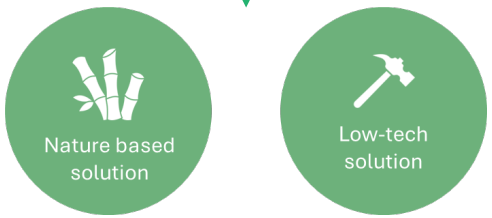
Settlements

River

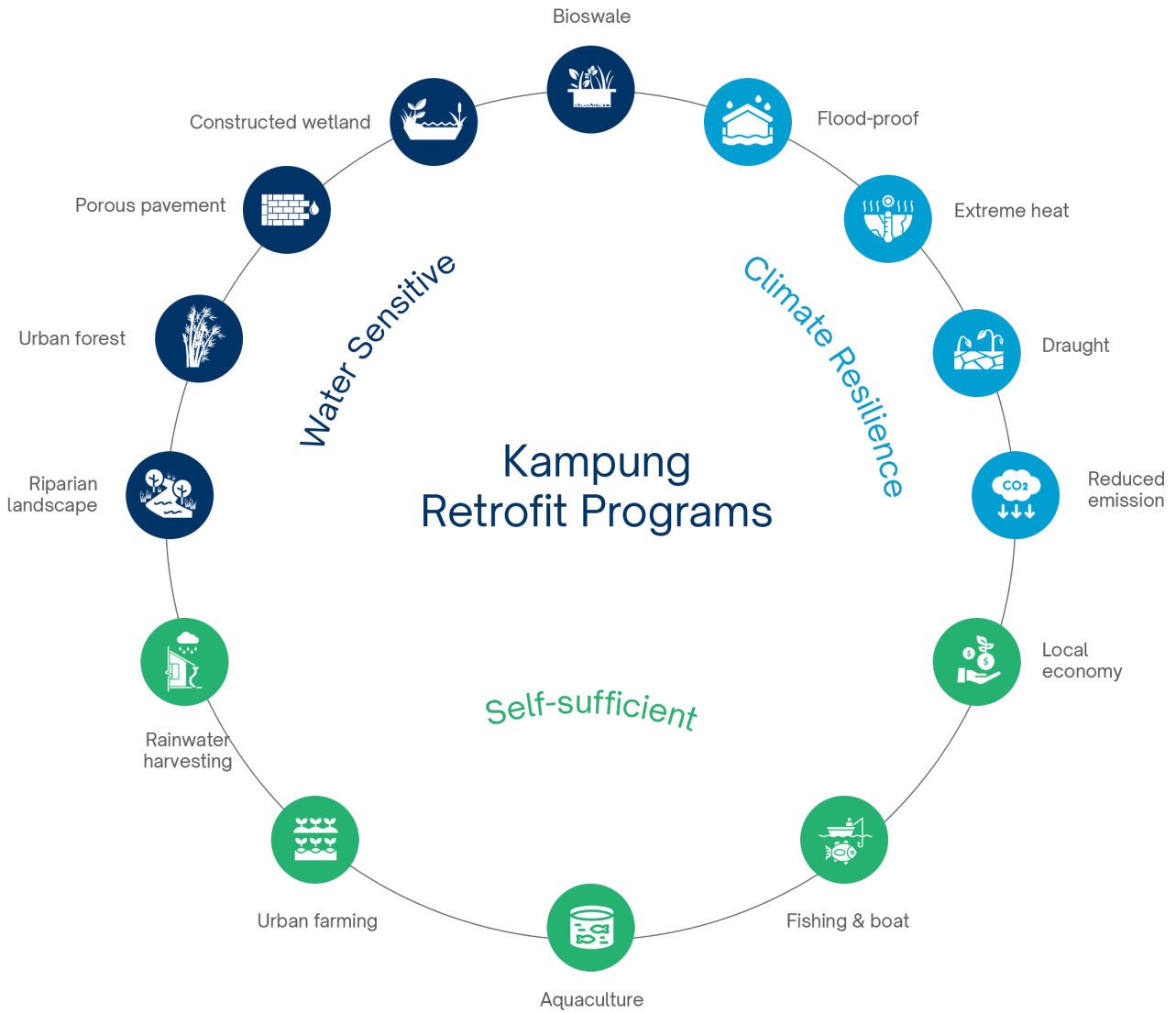
Imbalance function of urban infrastructure

Design Question

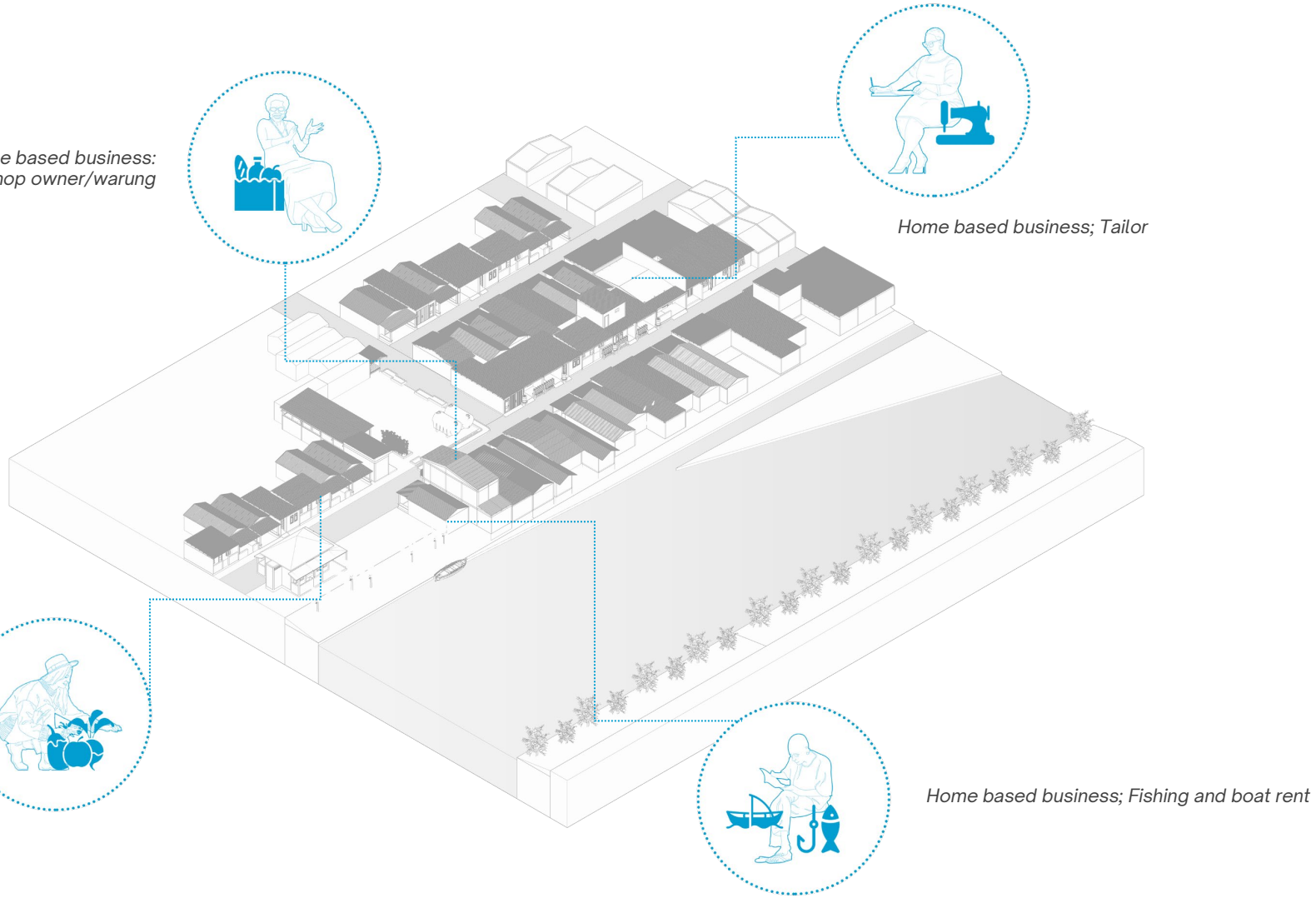
How can ***kampung*** **housing retrofit strategies** enhance the **system health and wellbeing** of *kampung* communities using nature-based and low-tech solutions to **restore ecosystem services**?



Program of Requirements



Residents & Activities



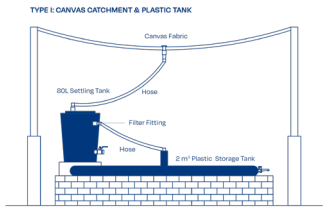
Technical Research

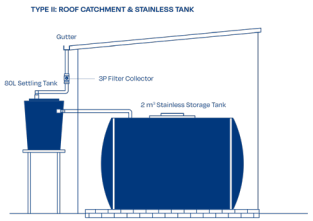
Technical Research

Water Provisioning

Suitable: irrigating plants and cultivating freshwater fish

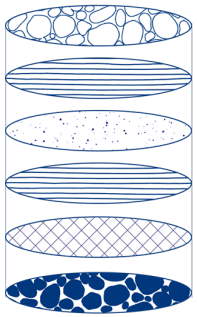
Suitable: household activities expect drinking water





Water Purification

FILTRATION MEDIA



30 cm Gravel

30 cm Palm Fiber / *Ijuk*

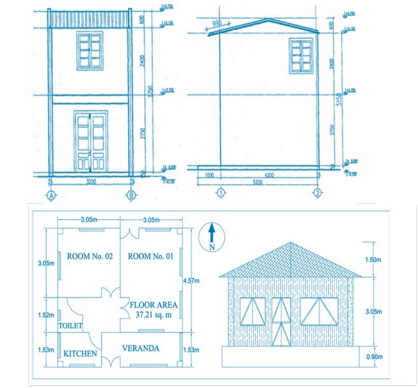
30 cm Sand

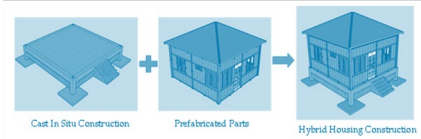
30 cm Palm Fiber / *Ijuk*

10 cm Sponge

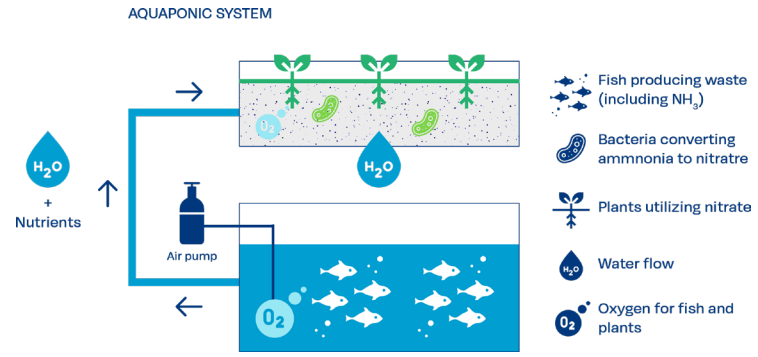
50 cm Activated Carbon (Charcoal or Banana Peels)

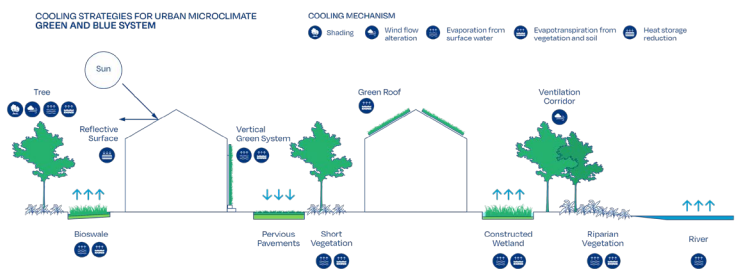
Flood Protection





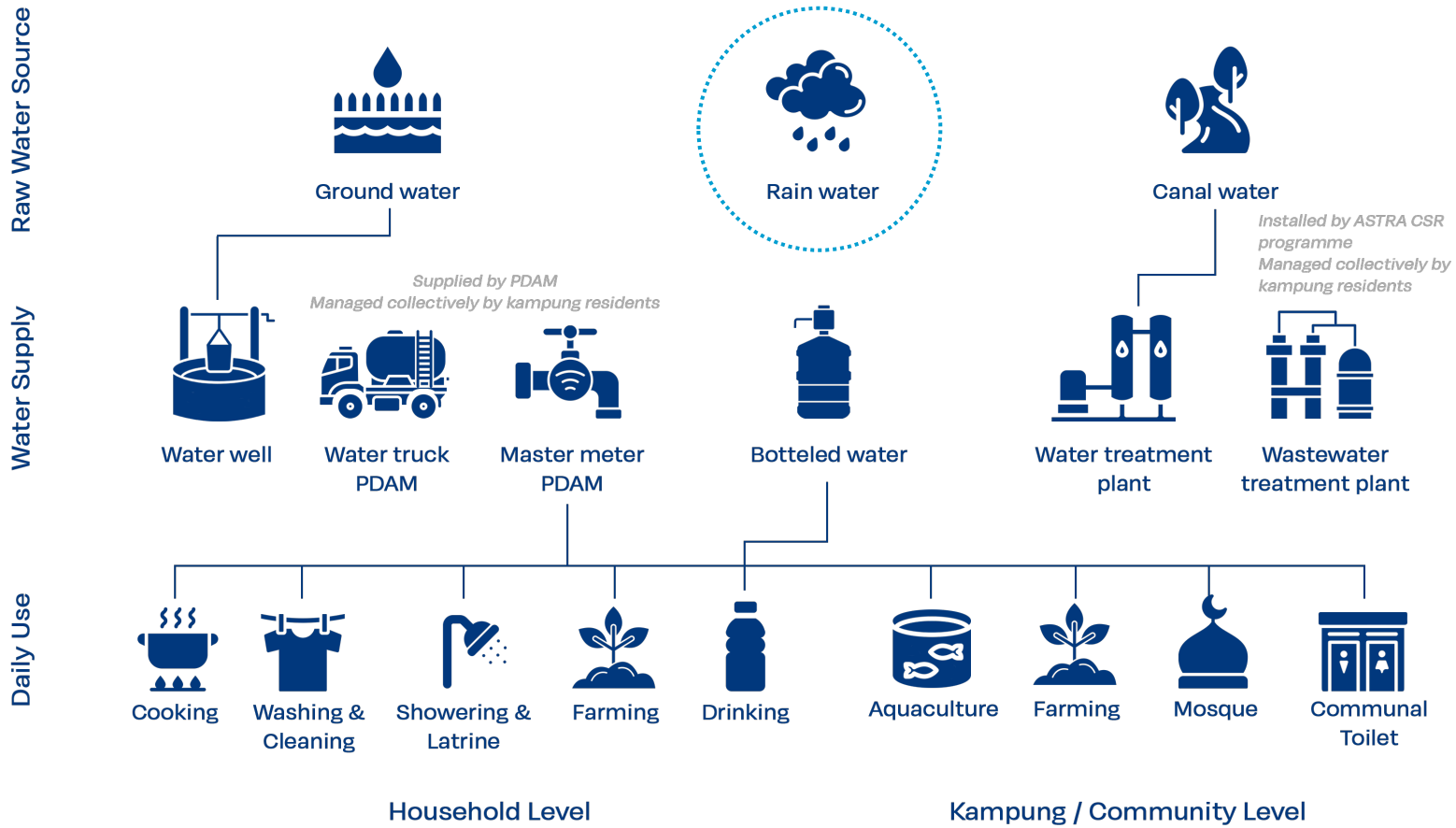
Local Climate Regulation



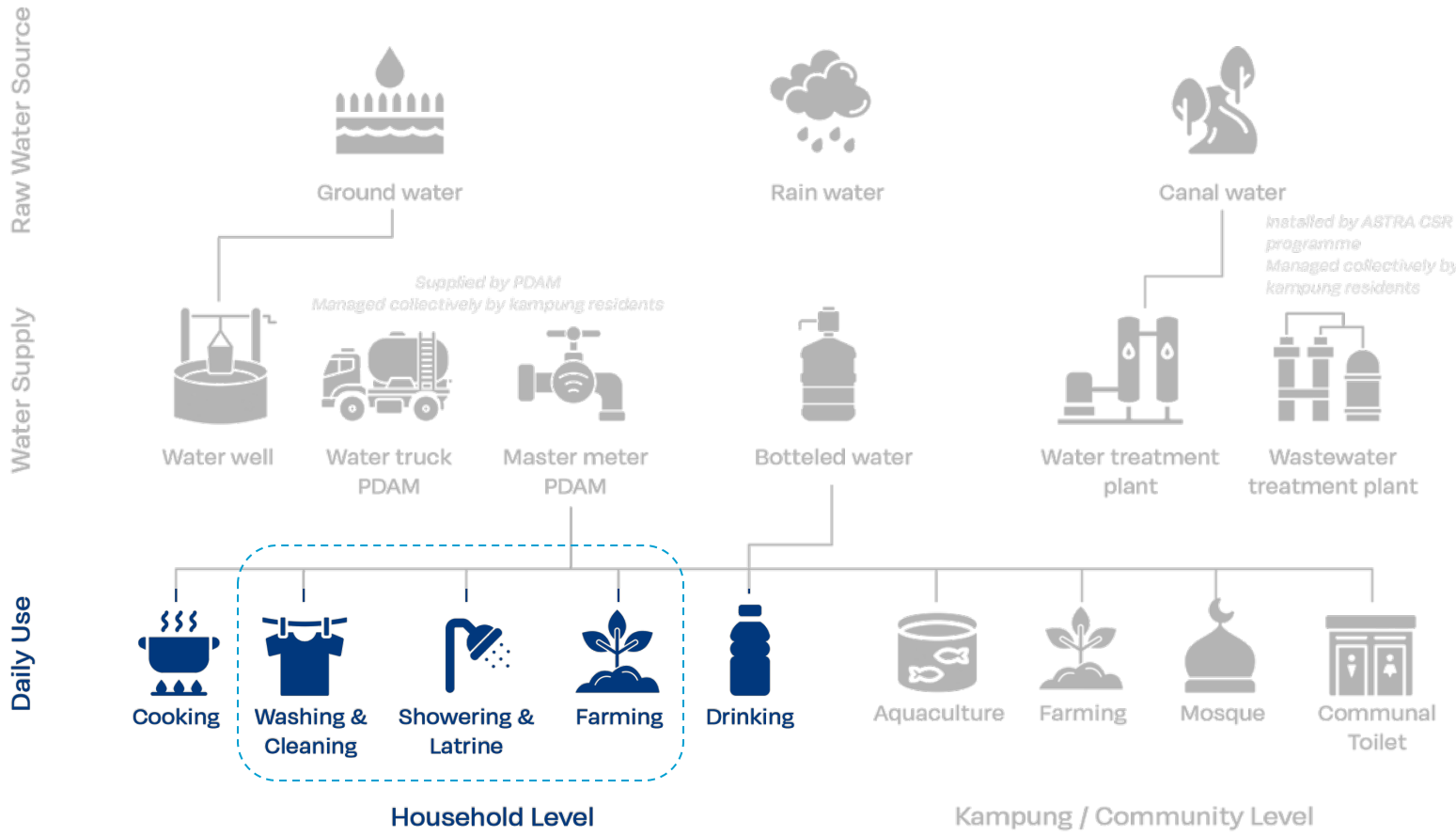


How is *the water system* in the kampung now?

Water Use in Kampung Keputih

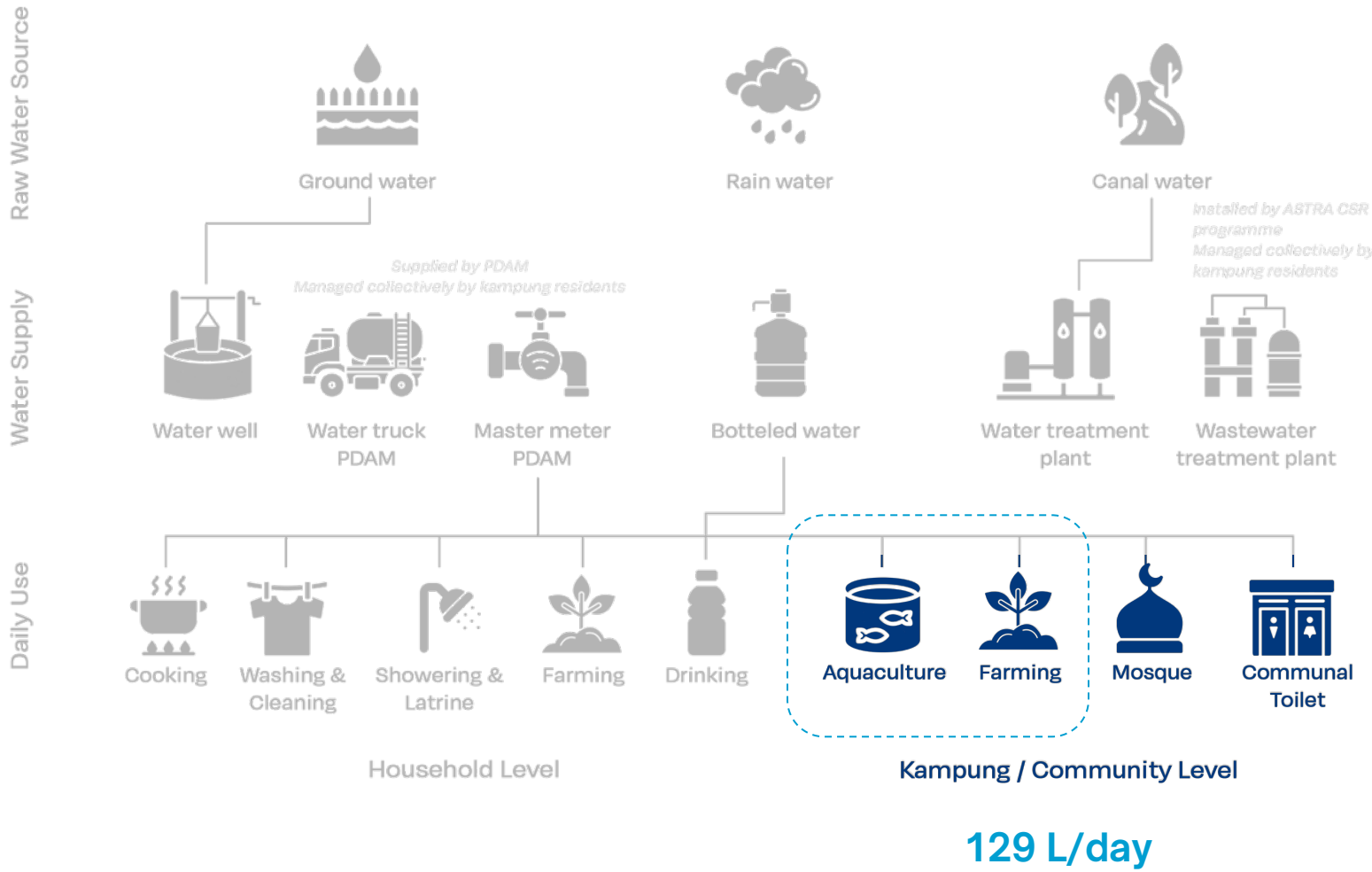


Water Use in Kampung Keputih



135 L/day

Water Use in Kampung Keputih



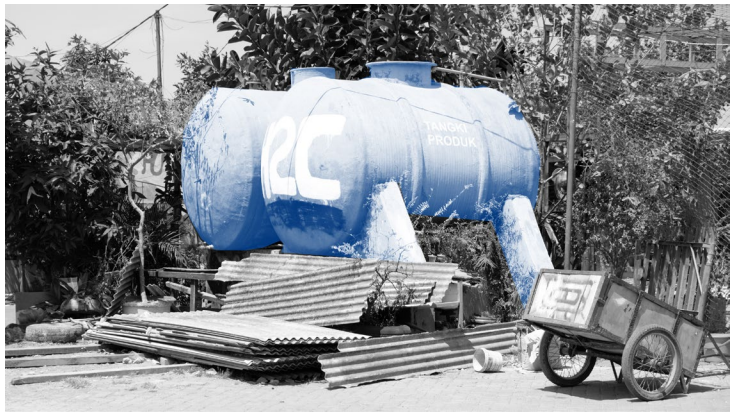
129 L/day

Existing Water Infrastructure

Water filter

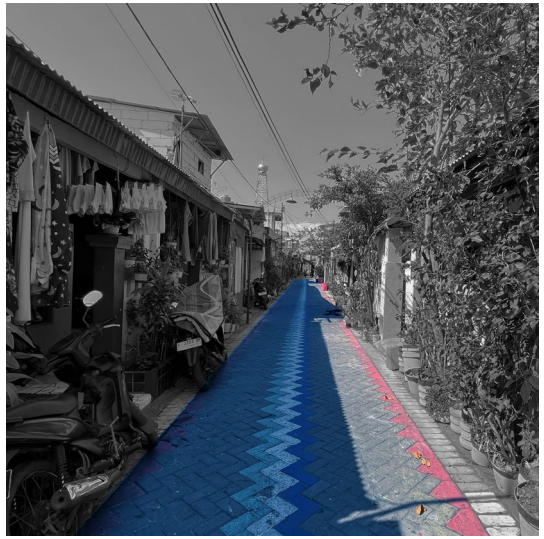
Communal toilet

Water tank



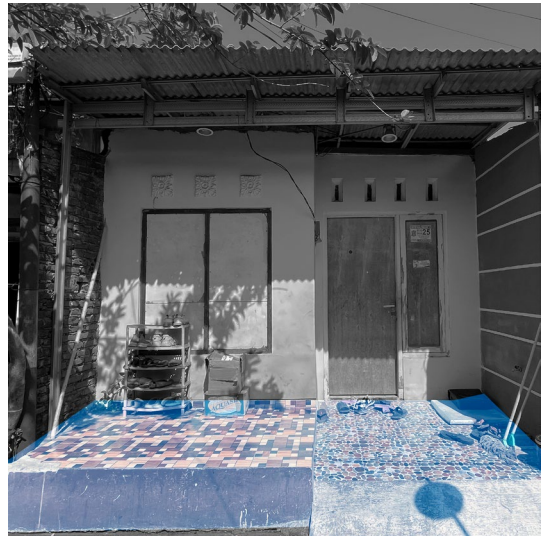
Catfish aquaculture

Current Flood Adaptation



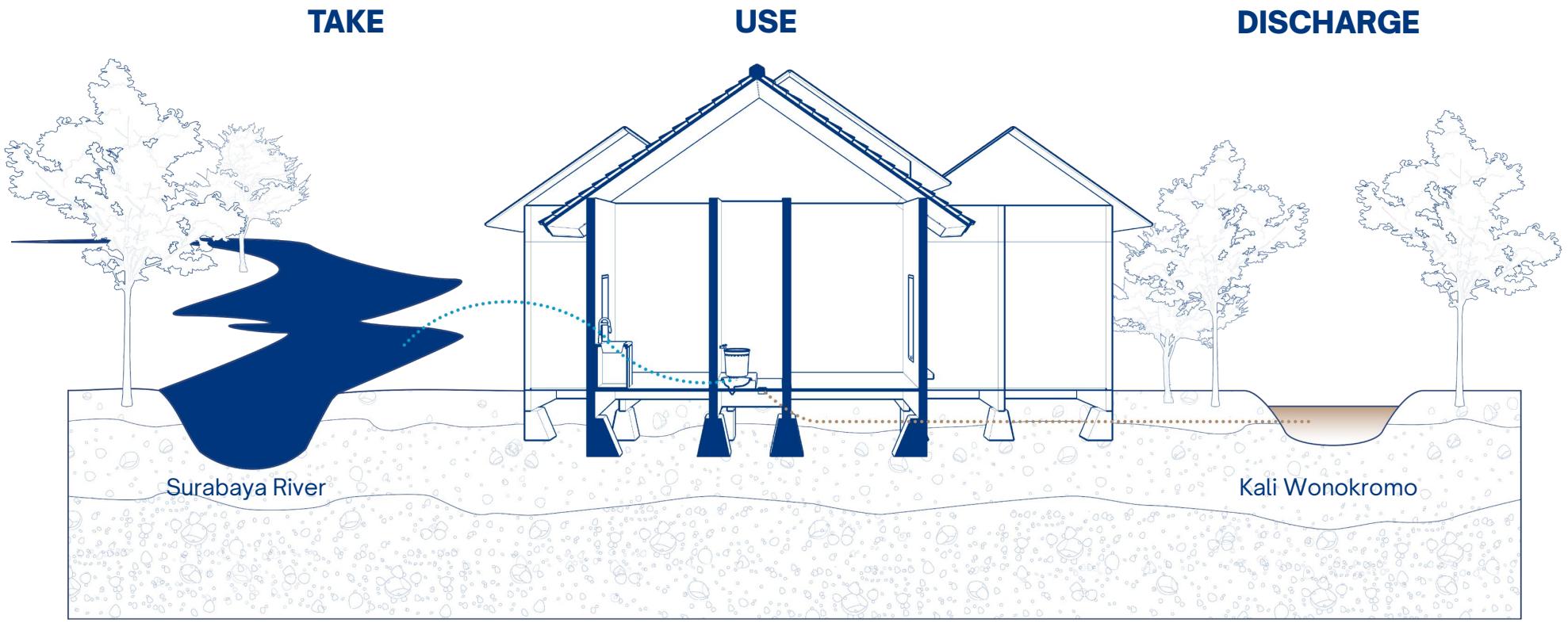
Elevated kampung street

Not elevated yet

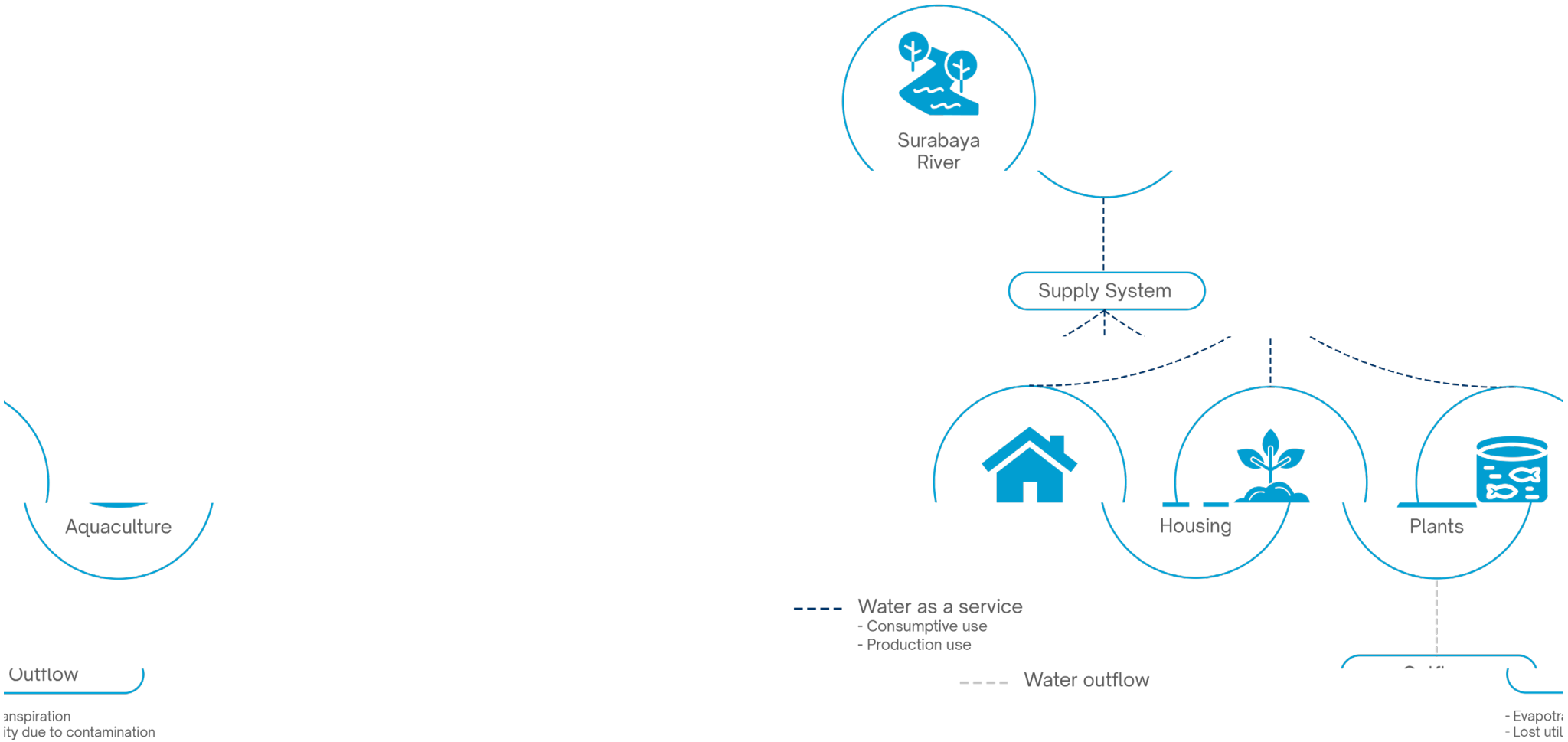


Elevated housing 20 cm

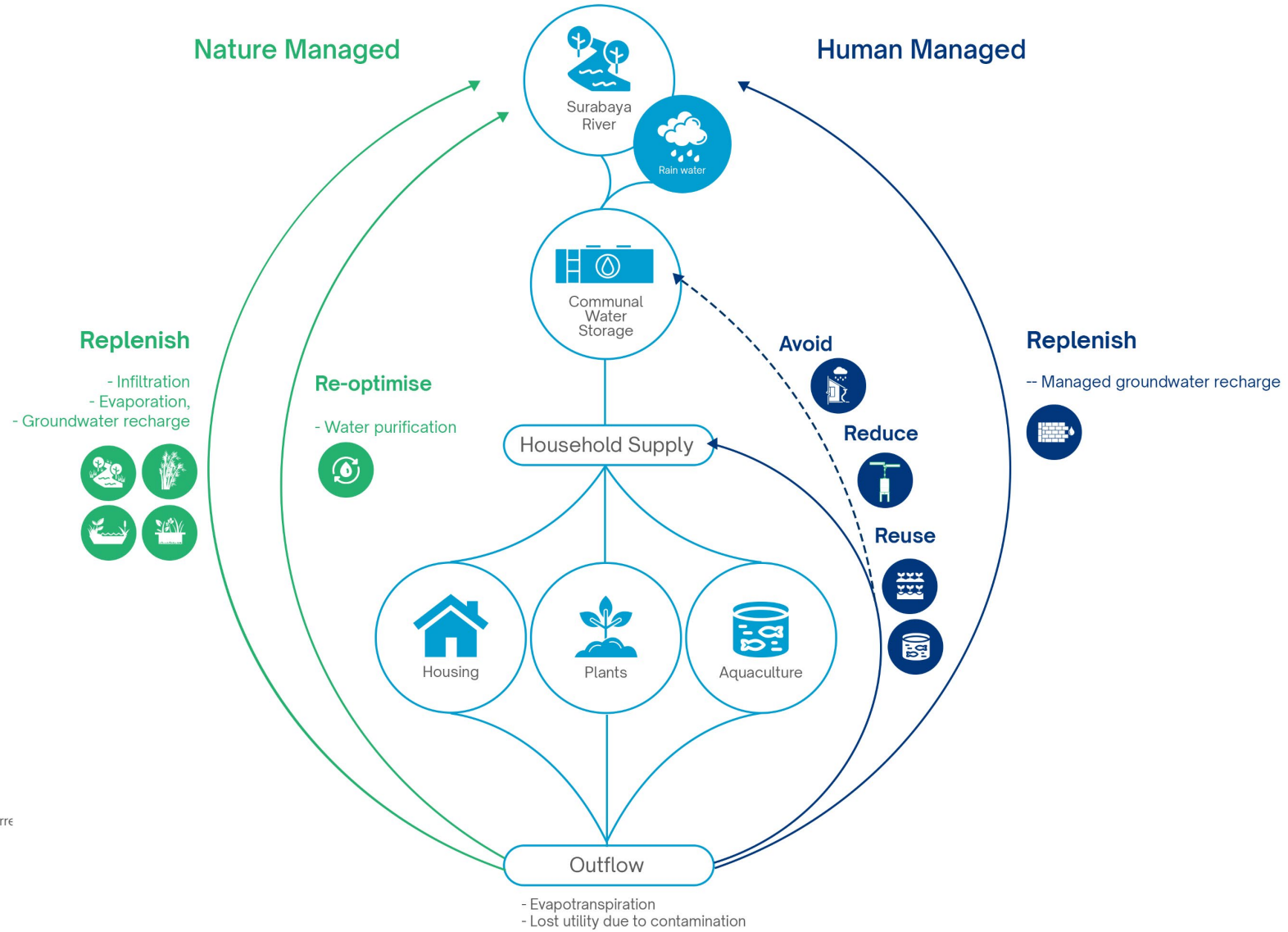
Linear Water System



Linear Water System



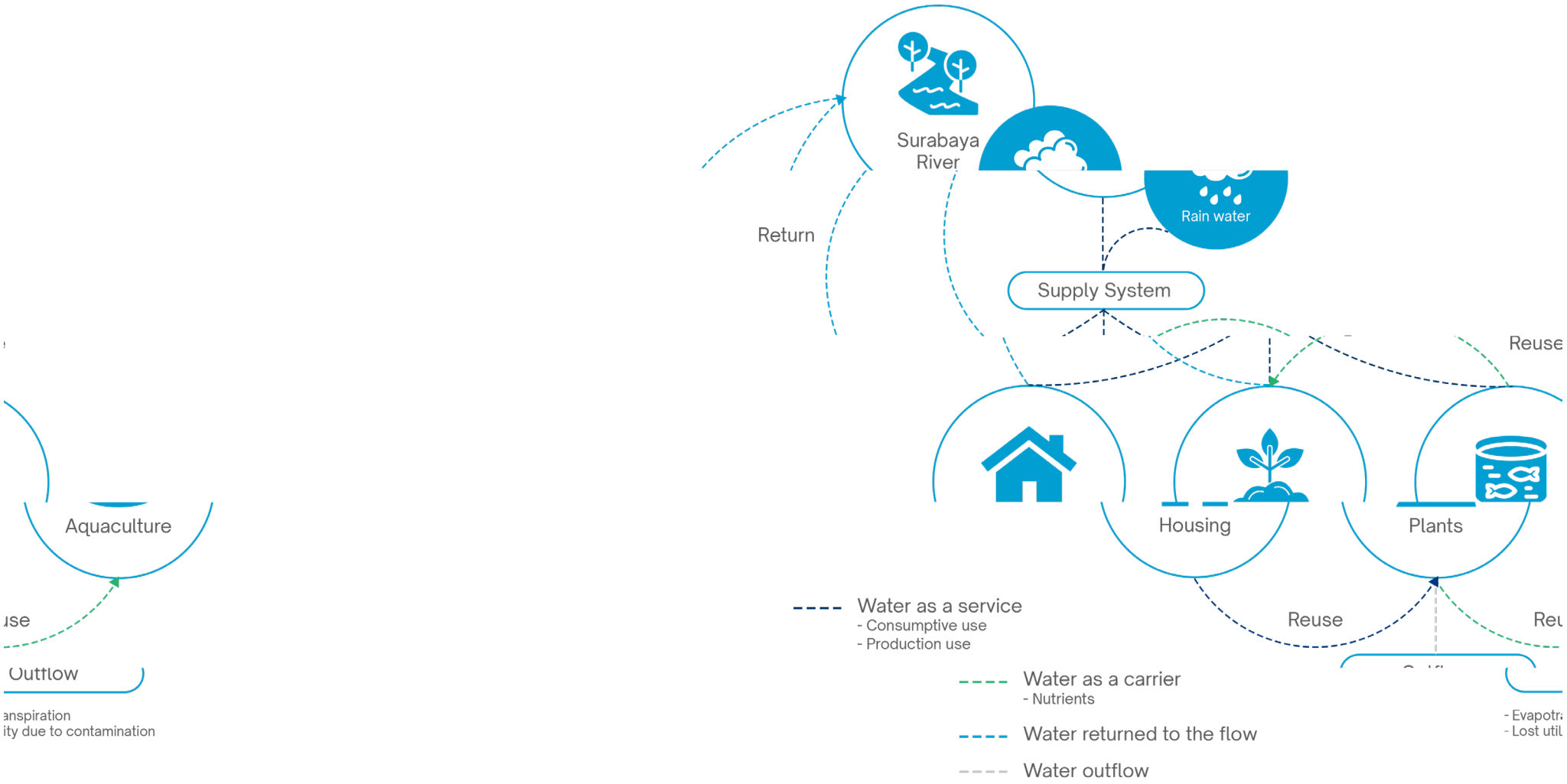
Butterfly Diagram on Circular Water Economy



Set of Tools

- Riparian landscape
- Urban forest
- Constructed wetland
- Bioswale
- Water purification
- Rain harvesting
- Shared rain gutter & barre
- Urban farming
- Aquaculture
- Porous pavement

Circular Water System



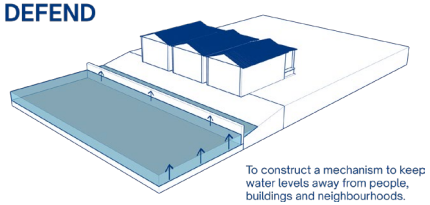
Urban Plan & Landscape

Water Tools

Seth McDowell

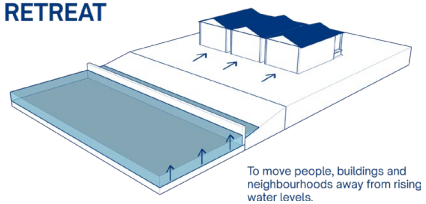
Flood

Act One
The Rising Water
DEFEND



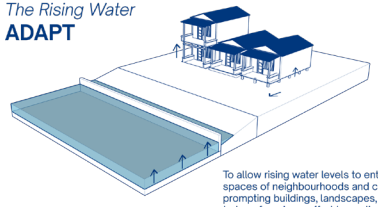
To construct a mechanism to keep water levels away from people, buildings and neighbourhoods.

Act One
The Rising Water
RETREAT



To move people, buildings and neighbourhoods away from rising water levels.

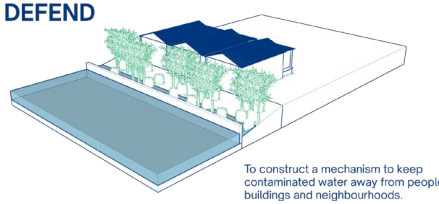
Act One
The Rising Water
ADAPT



To allow rising water levels to enter the spaces of neighbourhoods and communities, prompting buildings, landscapes, and people to transform in an effort to acclimate to the presence of water

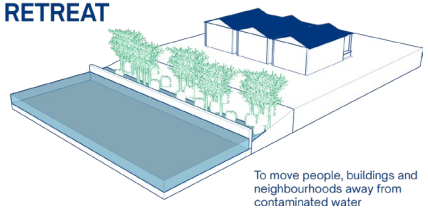
Polluted Water

Act Two
The Contaminated
DEFEND



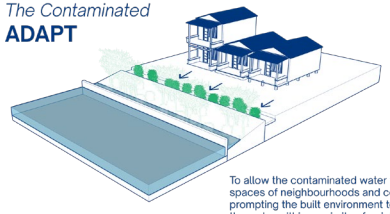
To construct a mechanism to keep contaminated water away from people, buildings and neighbourhoods.

Act Two
The Contaminated
RETREAT



To move people, buildings and neighbourhoods away from contaminated water

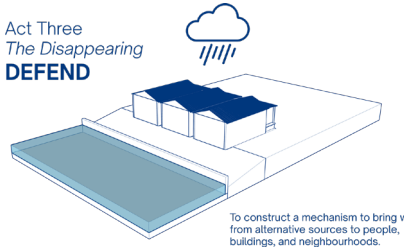
Act Two
The Contaminated
ADAPT



To allow the contaminated water to enter the spaces of neighbourhoods and communities, prompting the built environment to cleanse the water within proximity of point in use

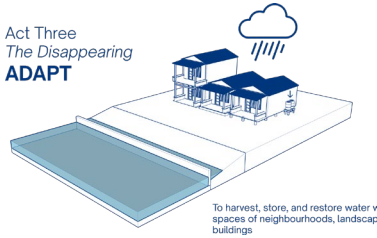
Water Scarcity

Act Three
The Disappearing
DEFEND



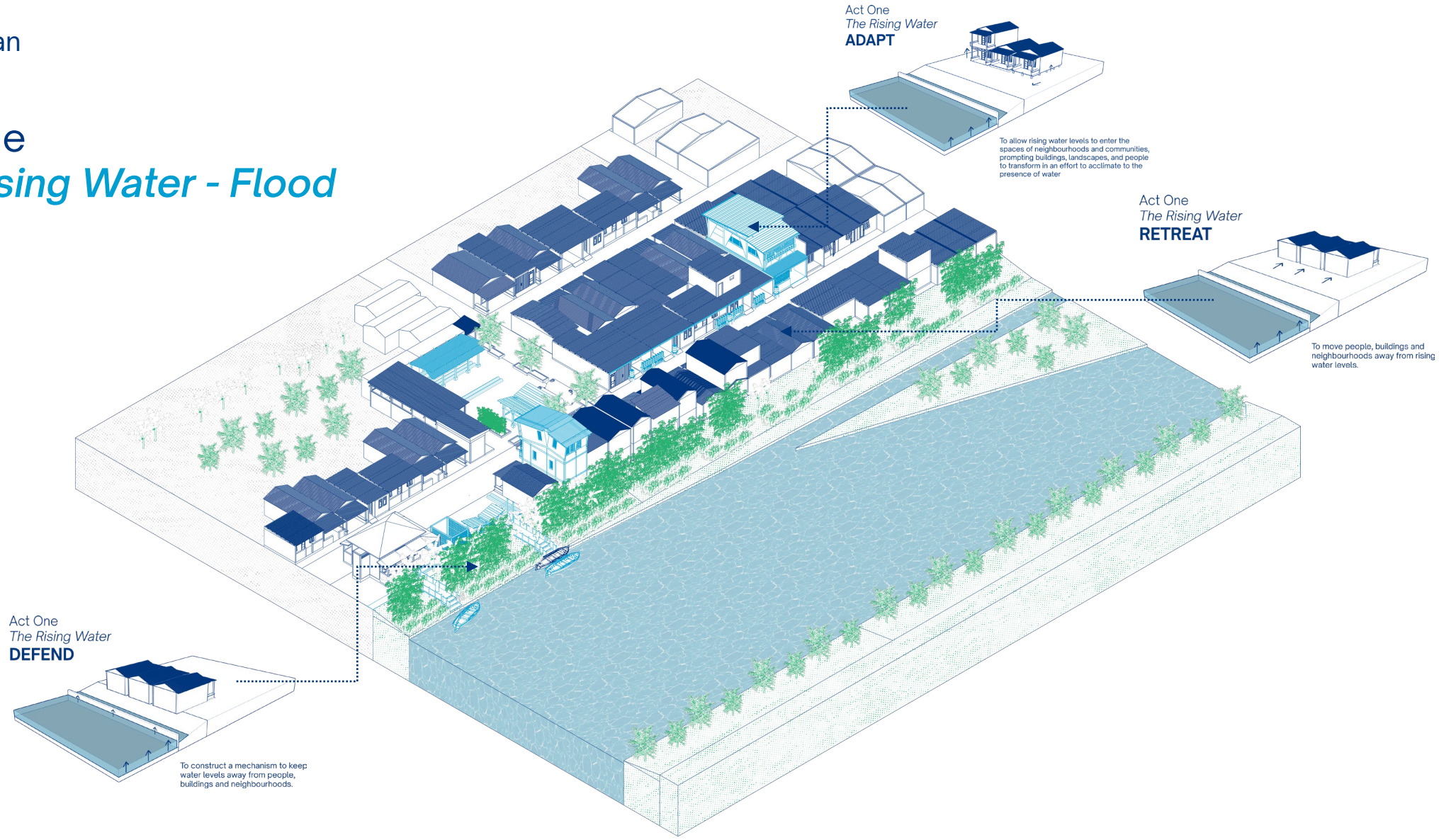
To construct a mechanism to bring water from alternative sources to people, buildings, and neighbourhoods.

Act Three
The Disappearing
ADAPT

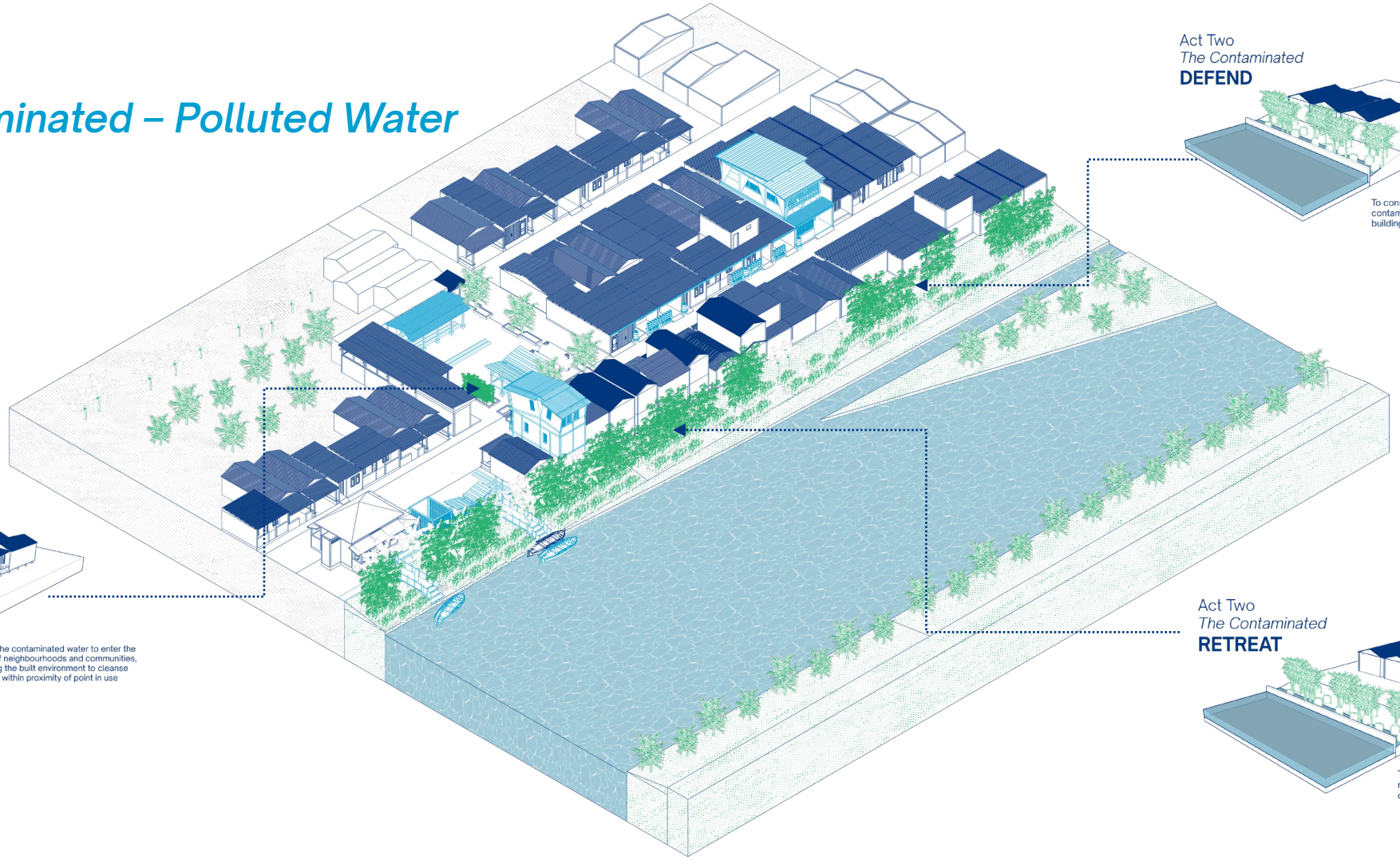


To harvest, store, and restore water within the spaces of neighbourhoods, landscapes, and buildings

Act One
The Rising Water - Flood



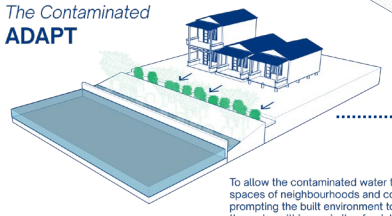
Act Two
The Contaminated – Polluted Water



Act Two
The Contaminated
DEFEND

To construct a mechanism to keep contaminated water away from people, buildings and neighbourhoods.

Act Two
The Contaminated
ADAPT

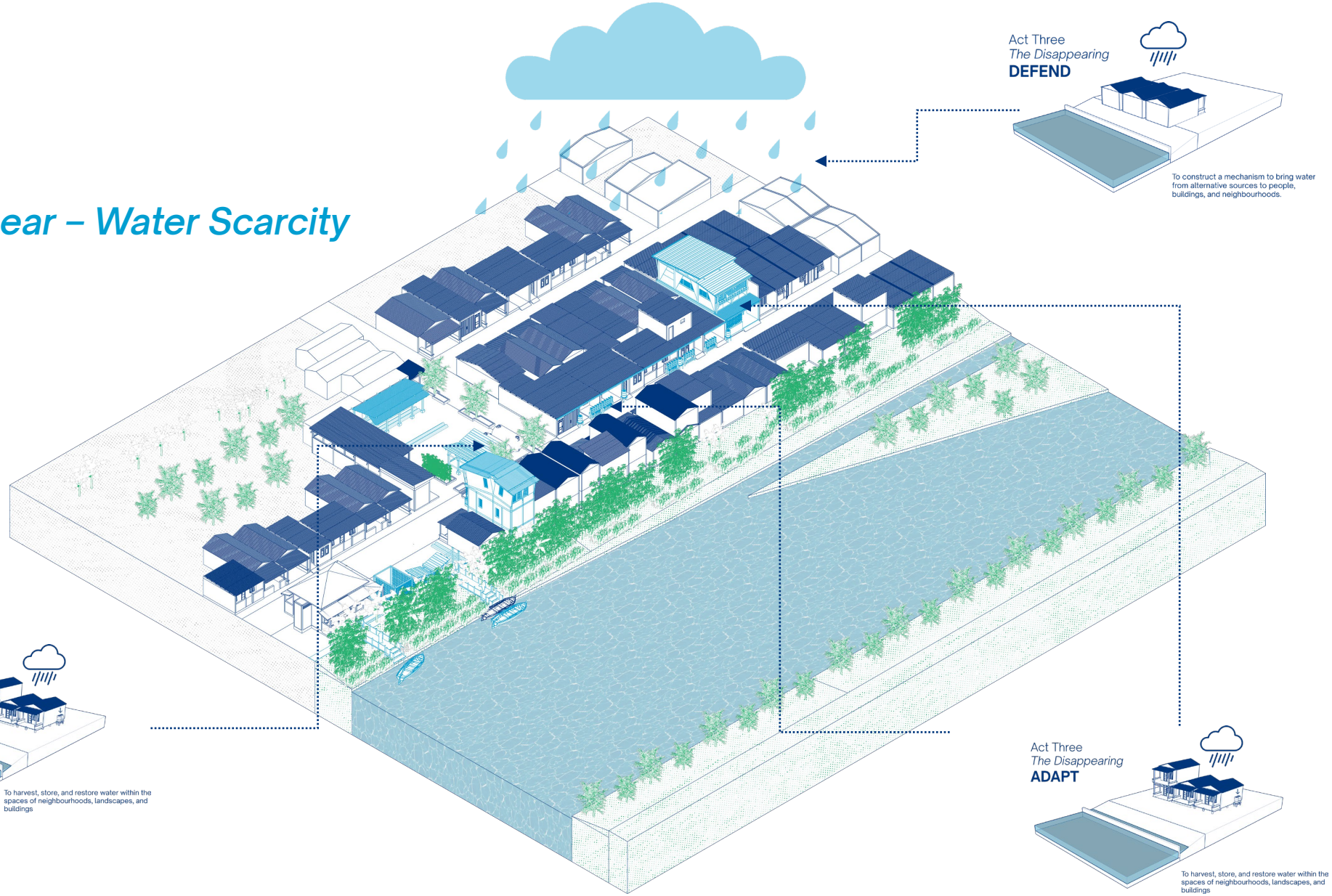


To allow the contaminated water to enter the spaces of neighbourhoods and communities, prompting the built environment to cleanse the water within proximity of point in use

Act Two
The Contaminated
RETREAT

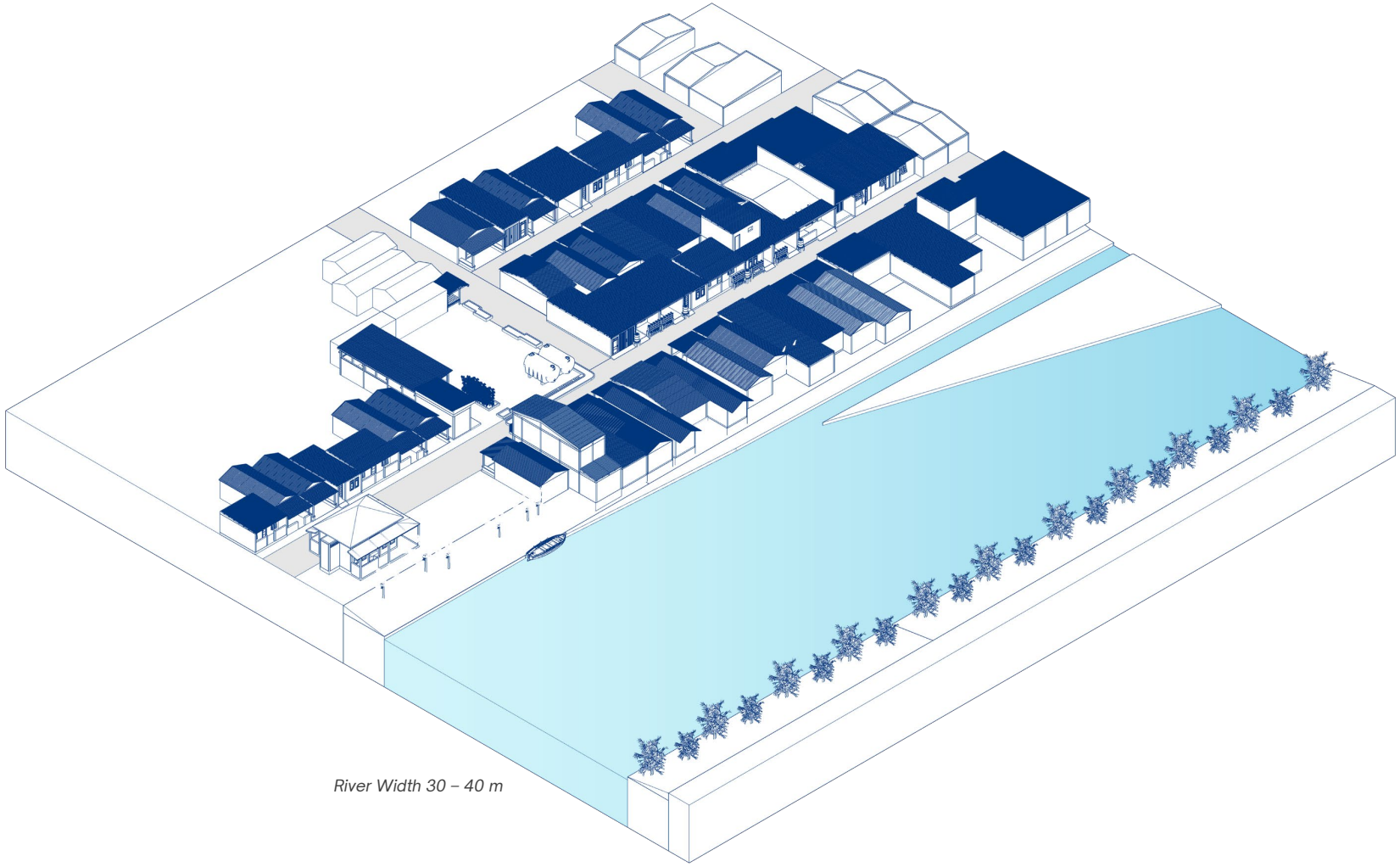
To move people, buildings and neighbourhoods away from contaminated water

Act Three
The Disappear – Water Scarcity



Masterplan

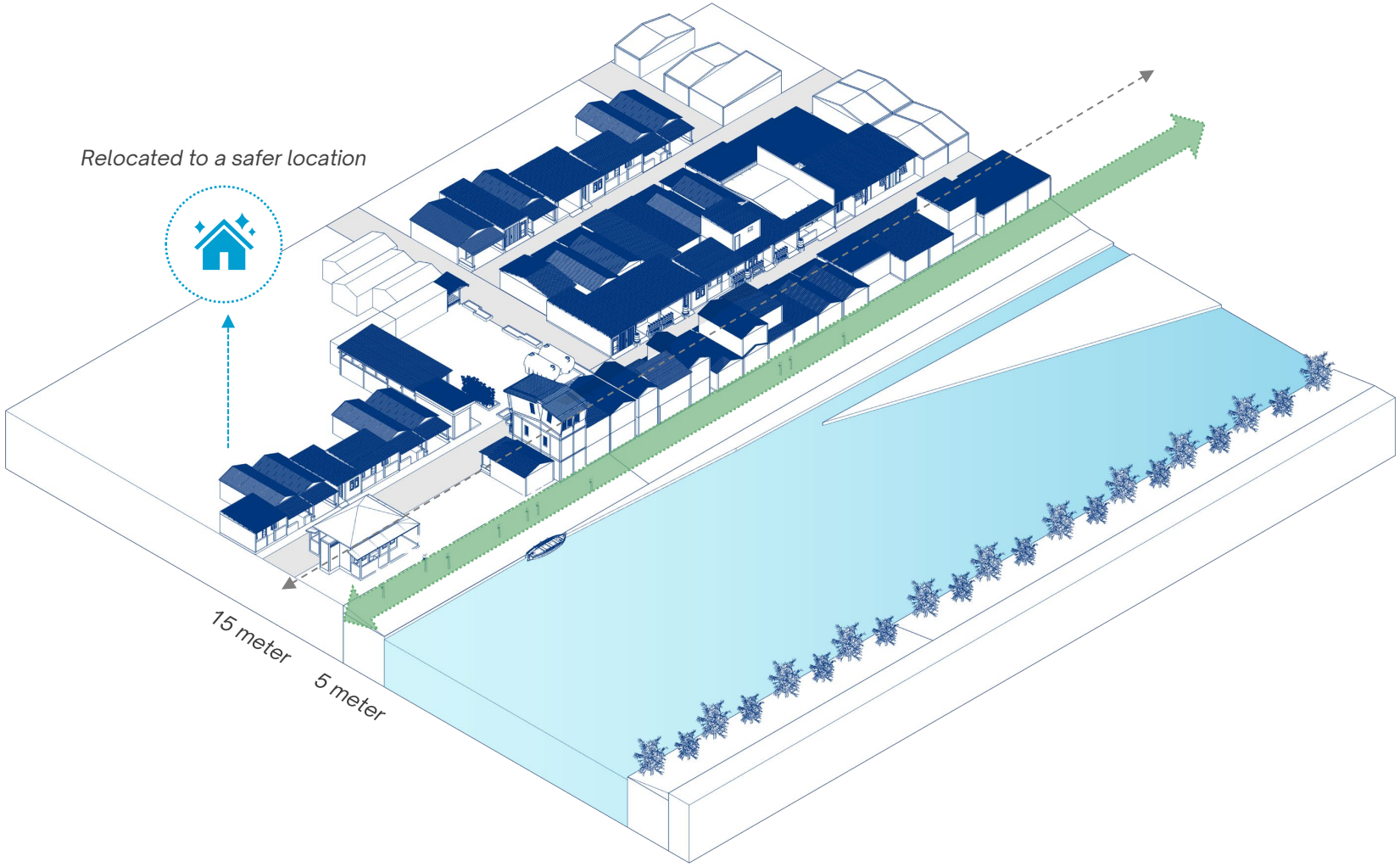
Existing Condition



River Width 30 – 40 m

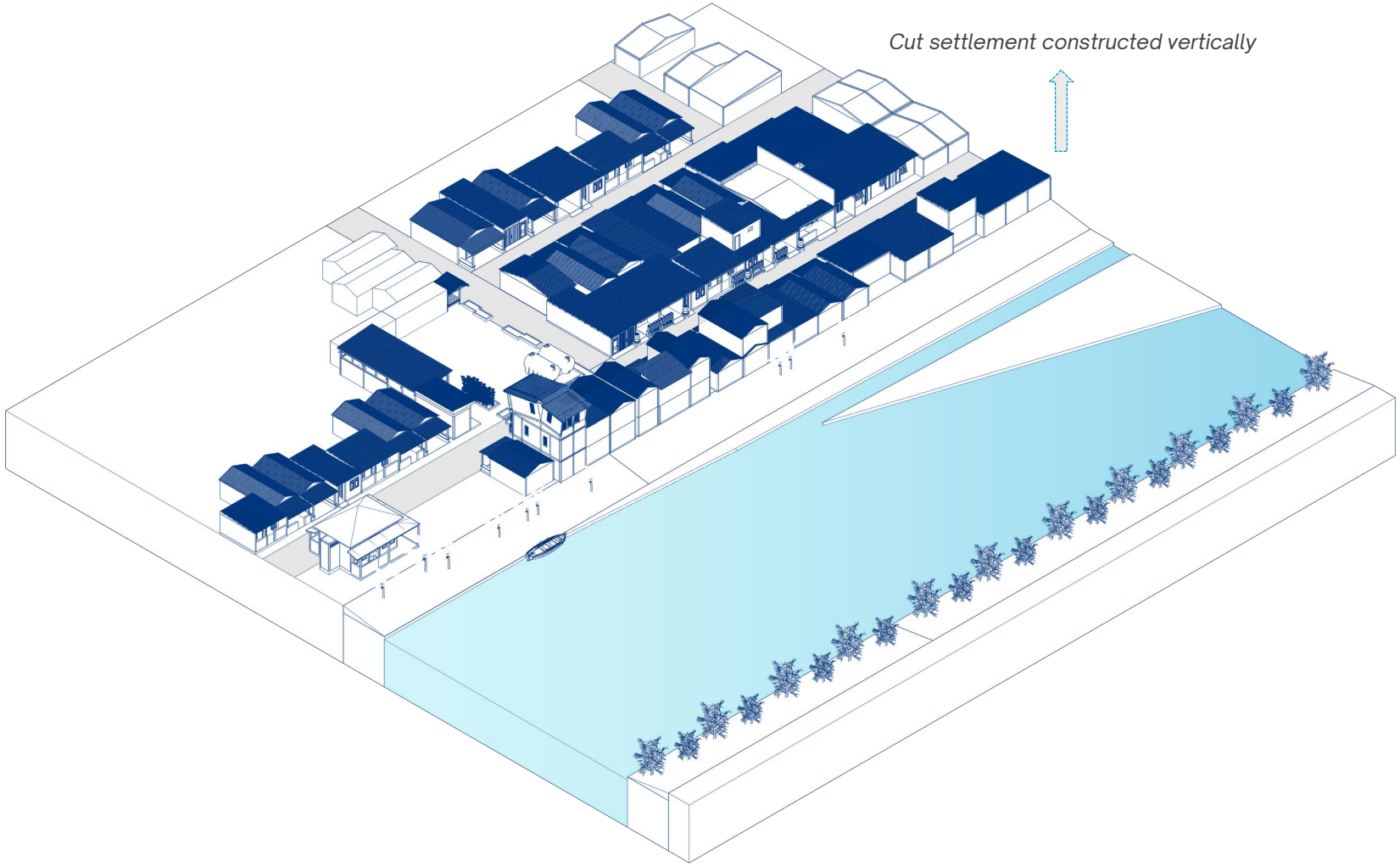
Masterplan

Clearing Riverbank Area (5 meter wide)



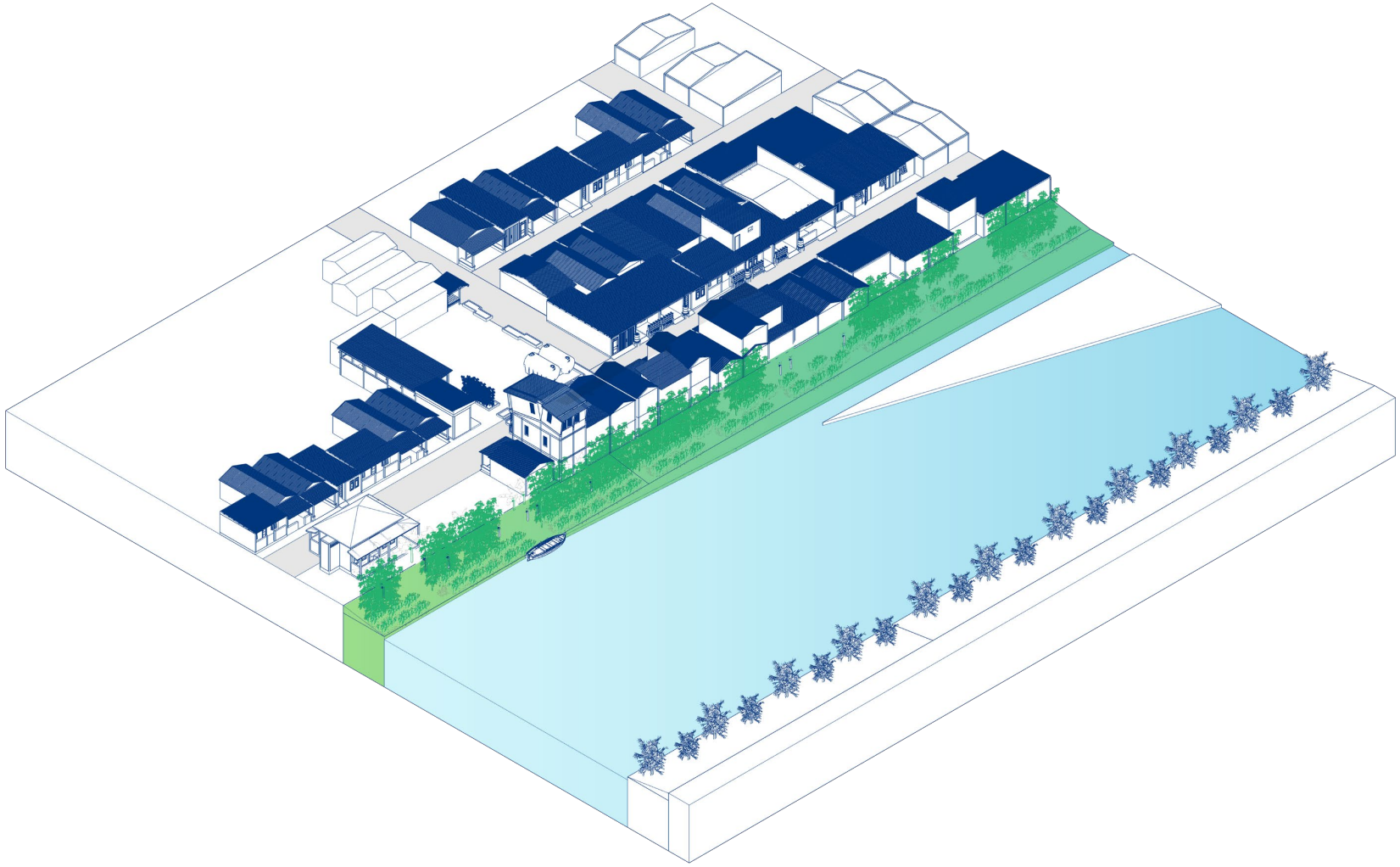
Masterplan

Clearing Riverbank Area (5 meter wide)

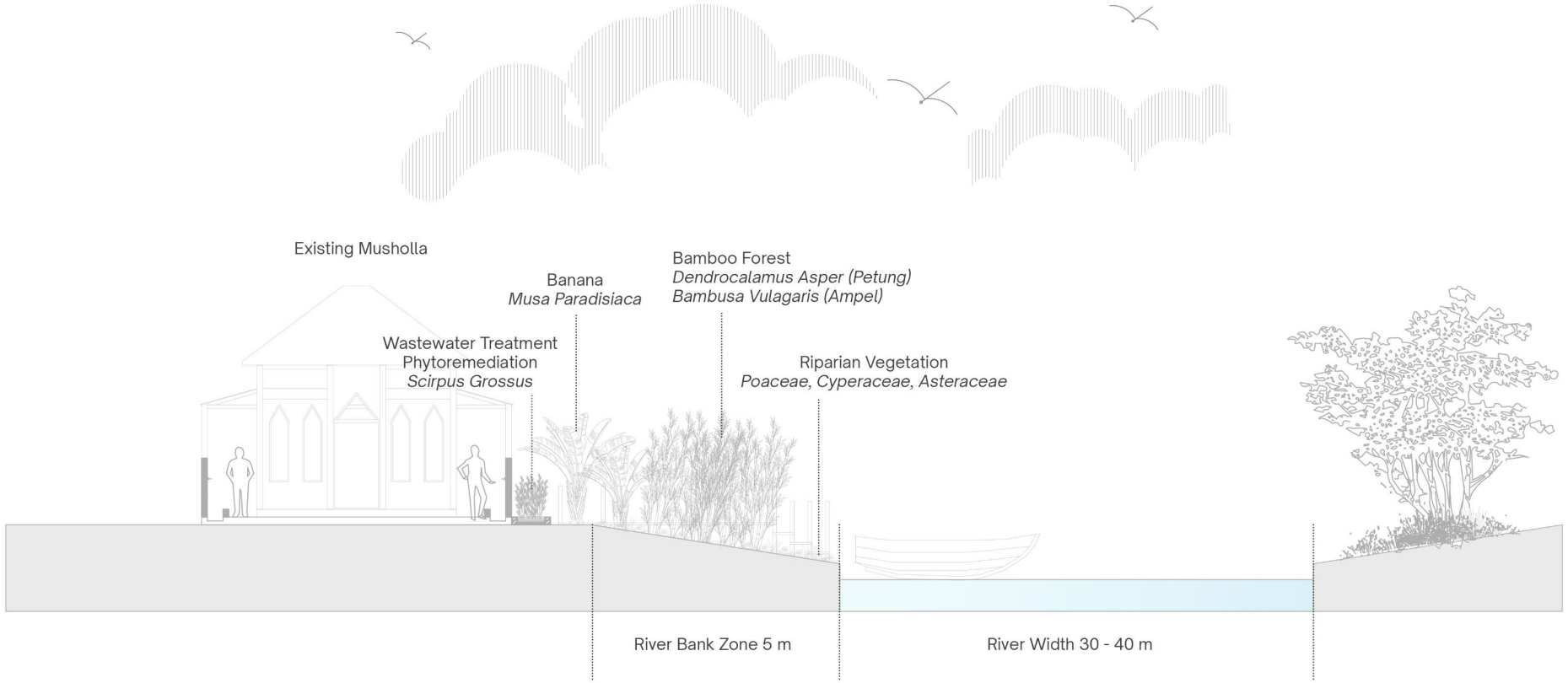


Masterplan

Riparian Restoration

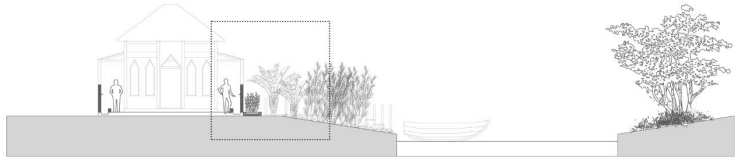


River Bank Area

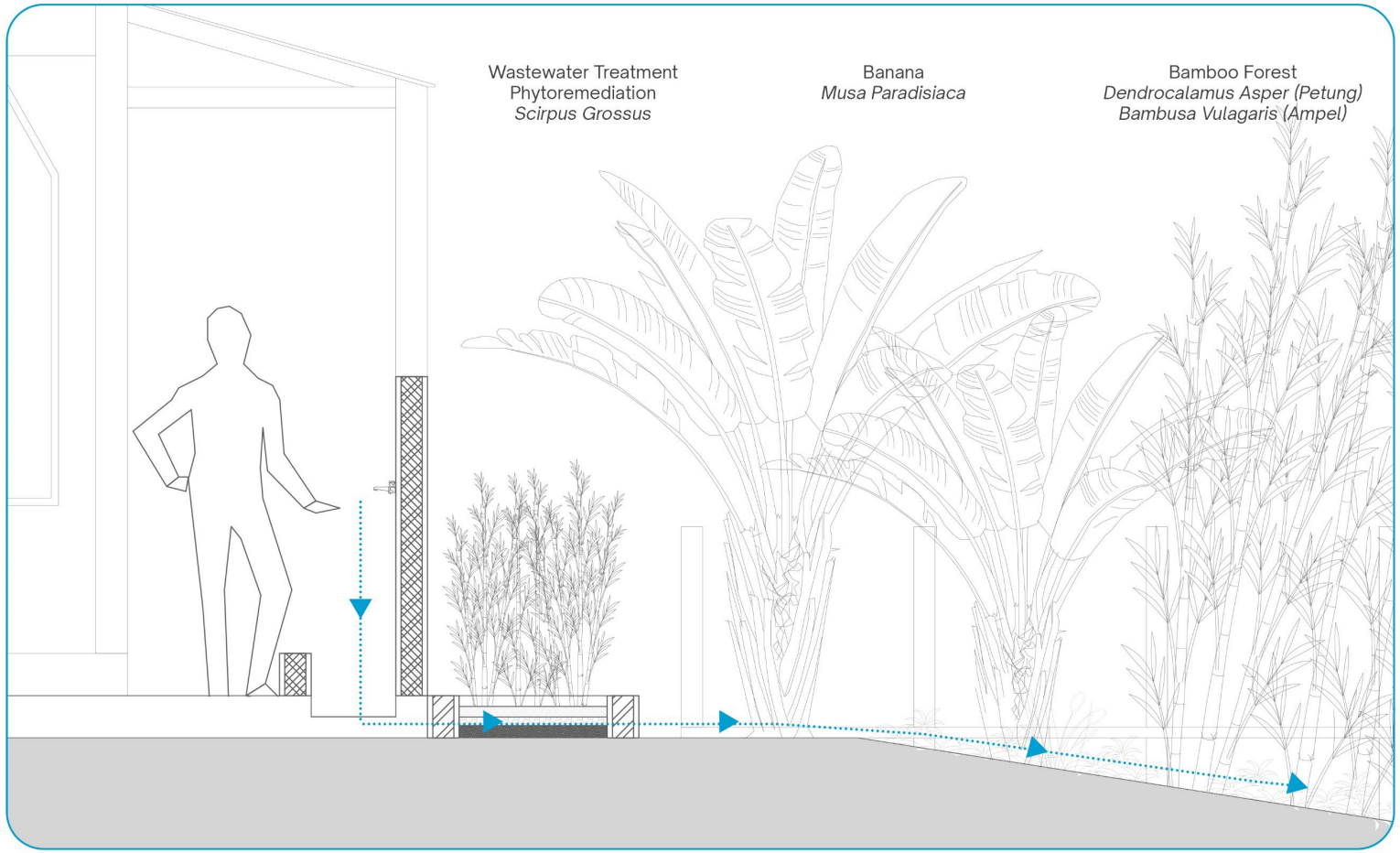


Riverbank Section 1:100

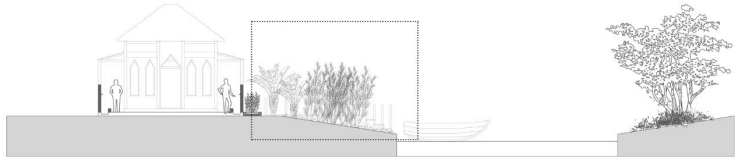
River Bank Area



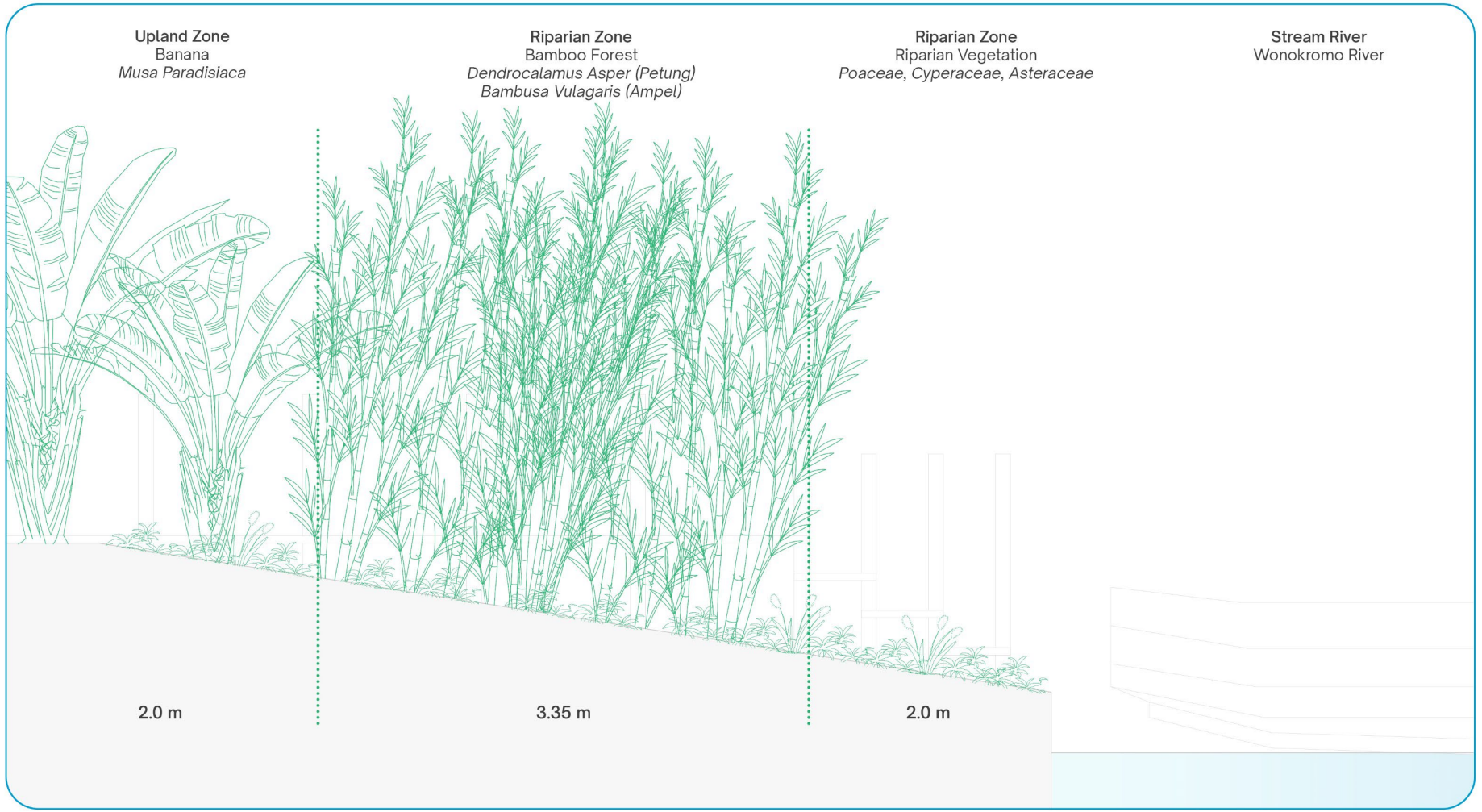
Riverbank Detail 1: 20



River Bank Area



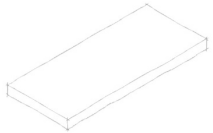
Riverbank Detail 1: 25




River Bank

Potential On-site Material

Material Flow

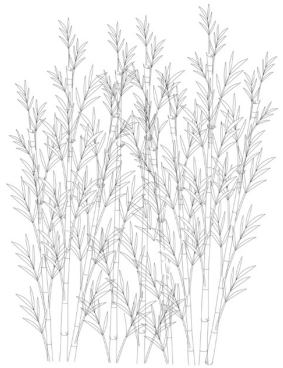


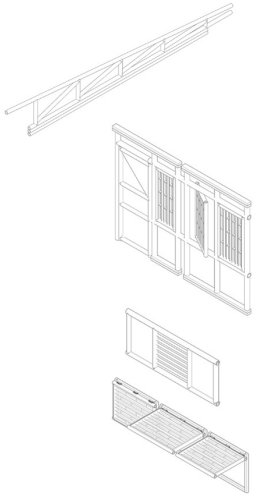
Banana Pseudostem
for roof insulation

Banana Peel
for charcoal in water filtration media

Banana
Musa Paradisiaca

Bamboo
Bambusoideae



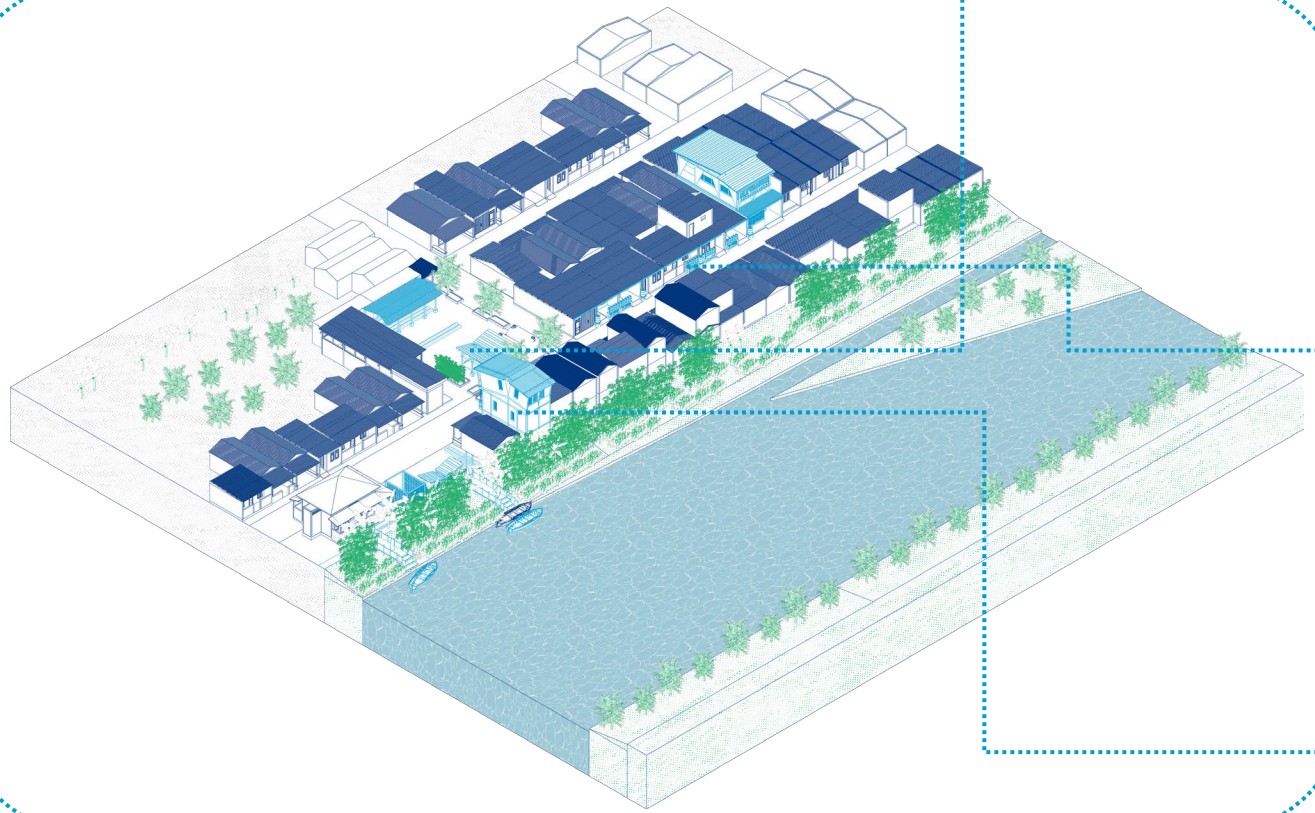


Bamboo Pole
for main structure

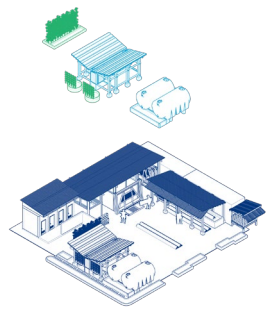
Landscape
Riparian restoration | Wastewater treatment | Soil erosion

Water Management

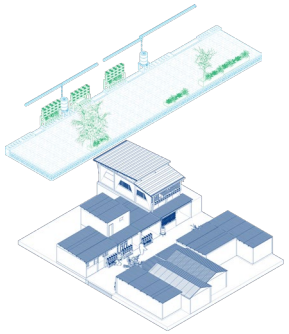
Macro Scale *Kampung Level*



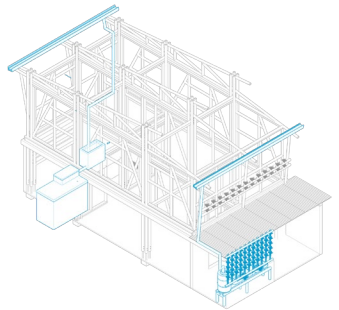
Meso Scale
Kampung
Communal Place



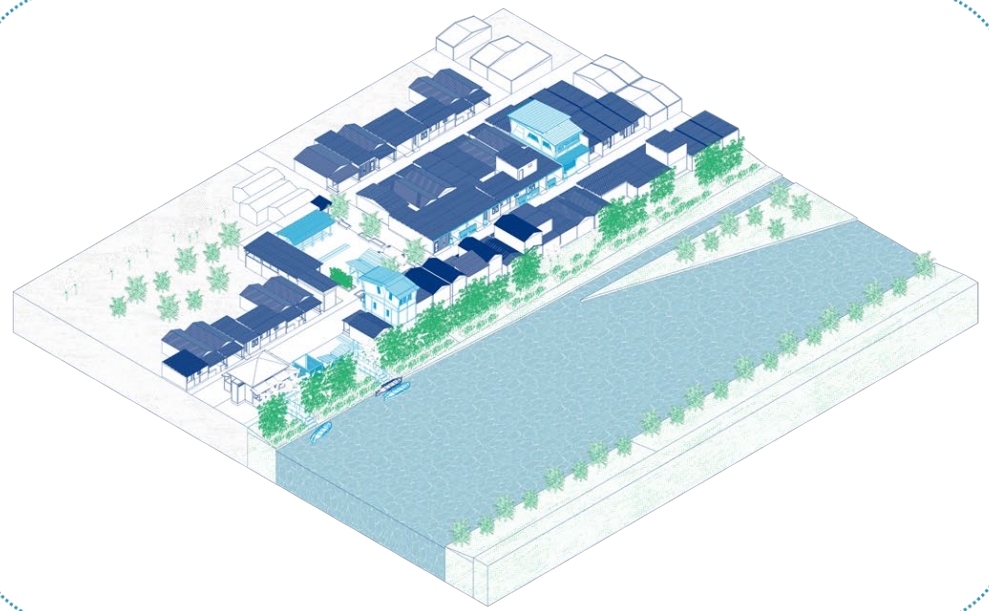
Meso Scale
Kampung
Street



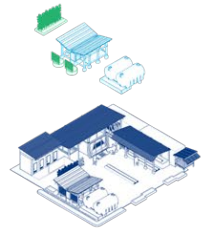
Micro Scale
Household



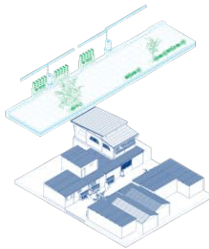
Macro Scale *Kampung Level*



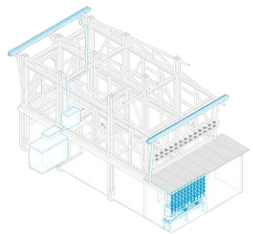
Meso Scale
Kampung
Communal Place



Meso Scale
Kampung
Street



Micro Scale
Household

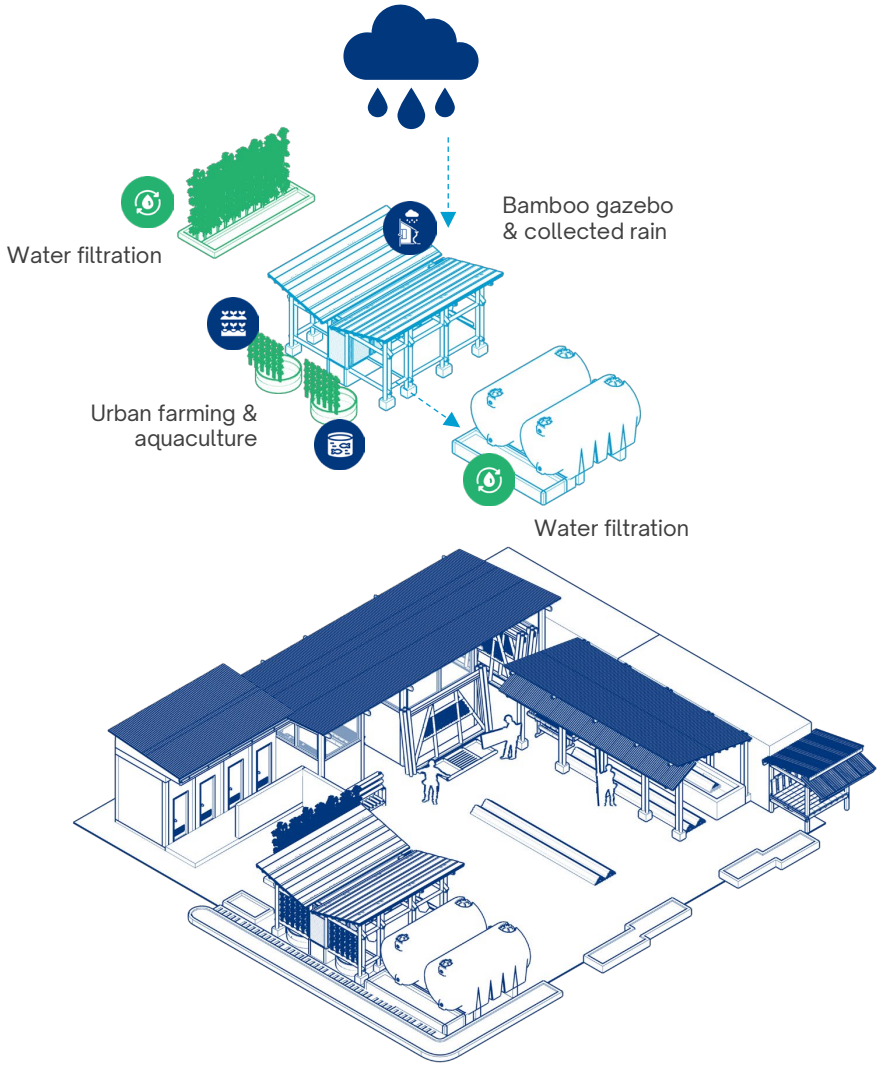


Set of Tools

- Riparian landscape
- Urban forest
- Constructed wetland
- Bioswale
- Water purification
- Rain harvesting
- Shared rain gutter & barrel
- Urban farming
- Aquaculture
- Porous pavement

Meso Scale

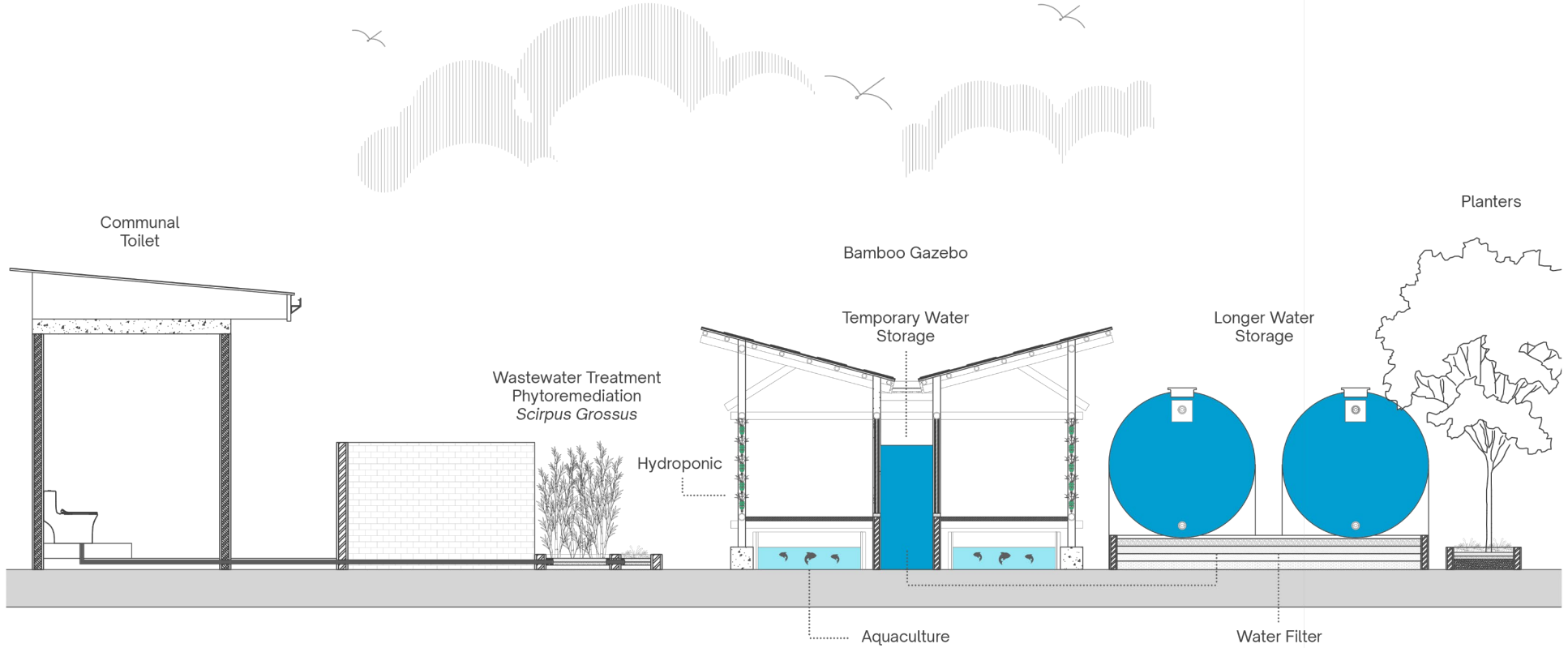
Kampung Communal Place



Set of Tools

- Riparian landscape
- Urban forest
- Constructed wetland
- Bioswale
- Water purification
- Rain harvesting
- Shared rain gutter & barrel
- Urban farming
- Aquaculture
- Porous pavement

Water Point & Communal Space

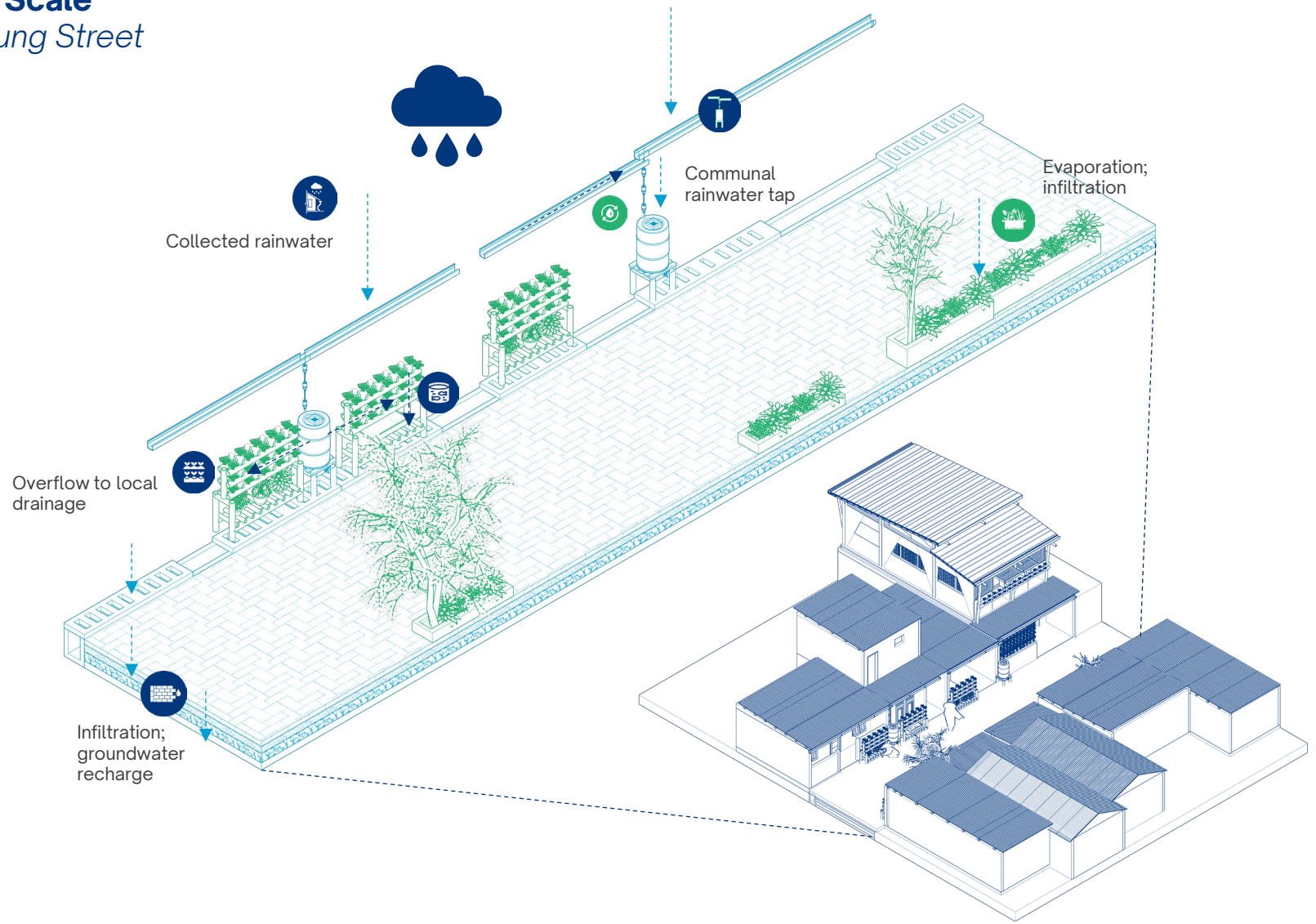


Water Point & Communal Space


Water Point & Communal Space


Water Point & Communal Space

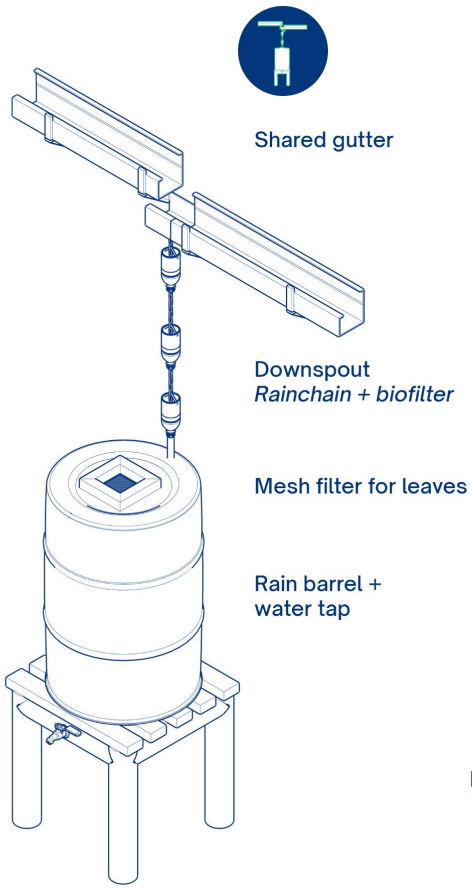
Meso Scale
Kampung Street

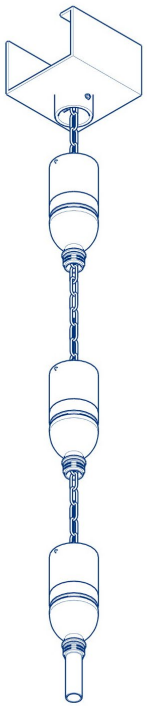


Set of Tools

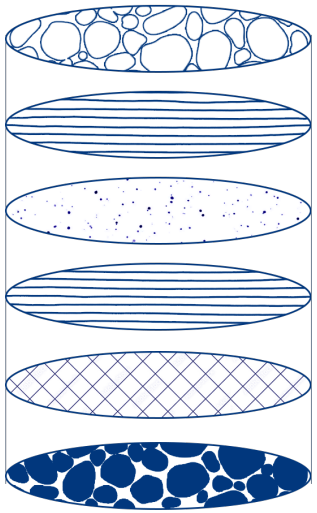
- Riparian landscape
- Urban forest
- Constructed wetland
- Bioswale
- Water purification
- Rain harvesting
- Shared rain gutter & barrel
- Urban farming
- Aquaculture
- Porous pavement

Kampung Street Level | *Shared Gutter*





FILTRATION MEDIA



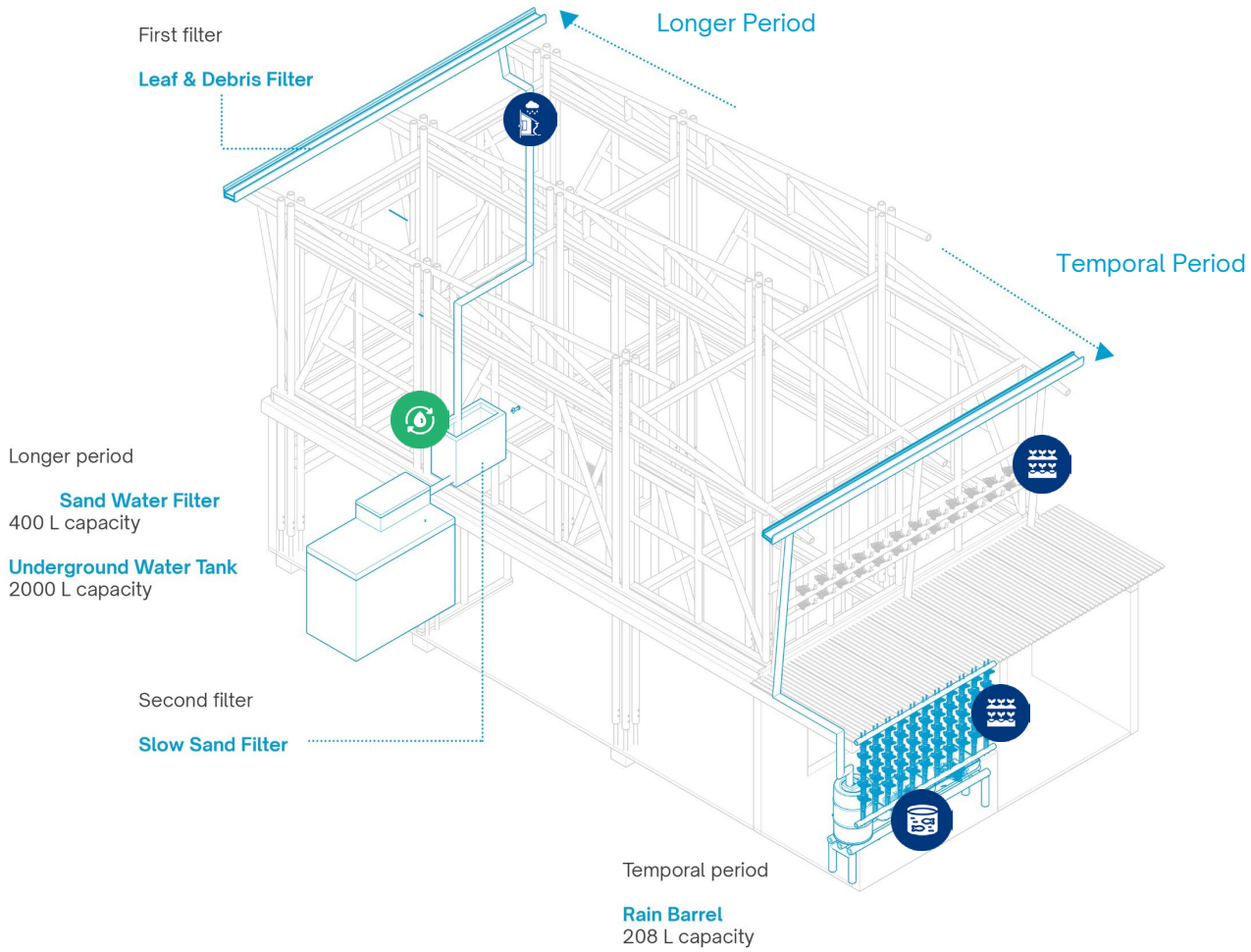
- 30 cm Gravel
- 30 cm Palm Fiber / *Ijuk*
- 30 cm Sand
- 30 cm Palm Fiber / *Ijuk*
- 10 cm Sponge
- 50 cm Activated Carbon
(Charcoal or Banana Peels)

Set of Tools

- Riparian landscape
- Urban forest
- Constructed wetland
- Bioswale
- Water purification
- Rain harvesting
- Shared rain gutter & barrel
- Urban farming
- Aquaculture
- Porous pavement

Kampung Street Level

Household Level | *Concept*

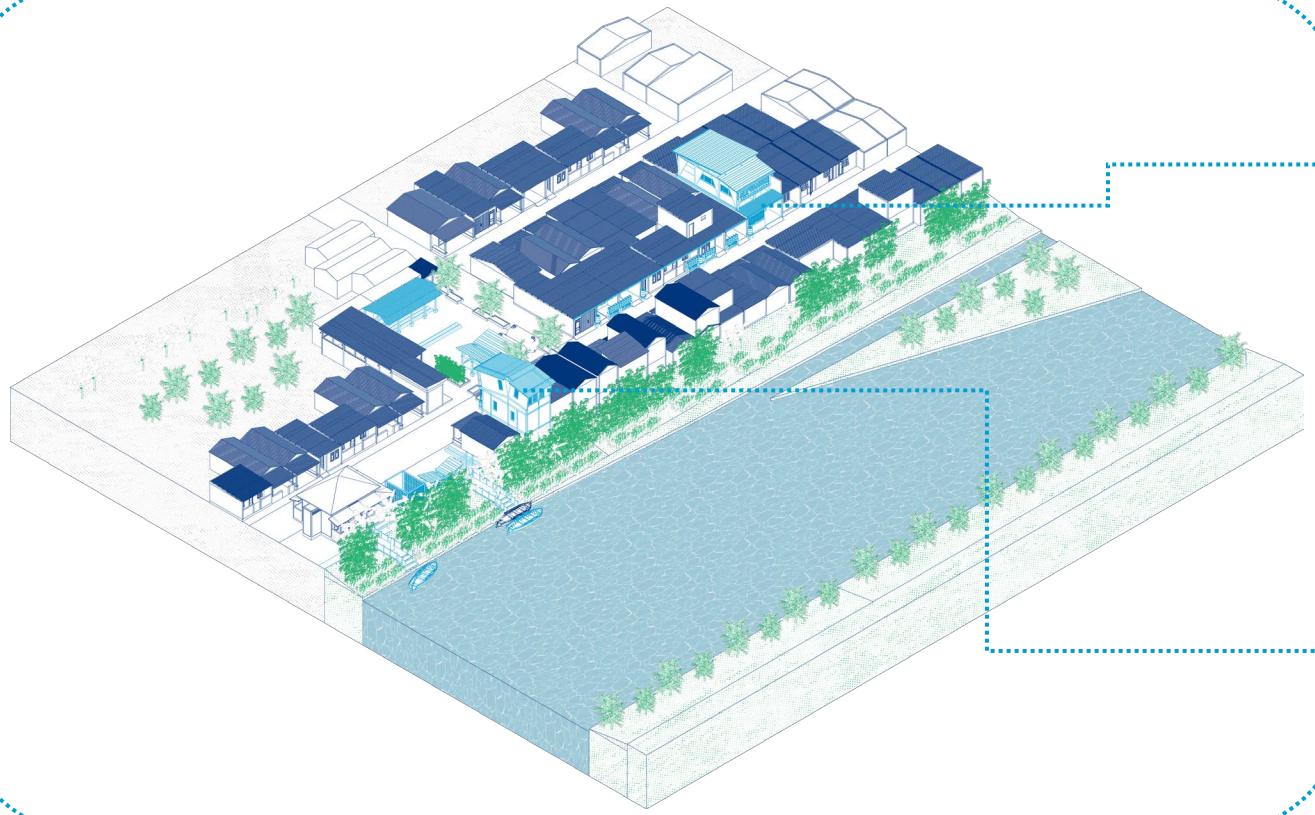


Set of Tools

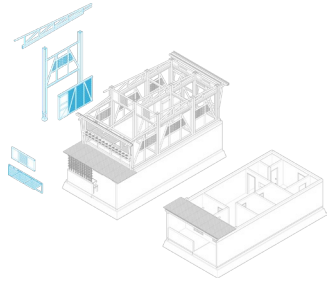
- Riparian landscape
- Urban forest
- Constructed wetland
- Bioswale
- Water purification
- Rain harvesting
- Shared rain gutter & barrel
- Urban farming
- Aquaculture
- Porous pavement

Architecture of the Housing

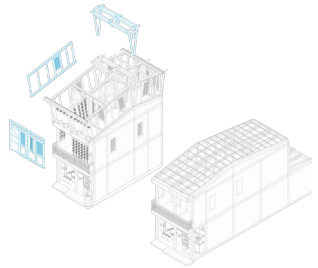
Type of Retrofit Housing



Retrofit Housing 1
Inner Kampung



Retrofit Housing 2
Riverbank Zone



But first, do you know that
the existing kampung housing structure
causes higher CO2 emissions?

Retrofit Home | Embodied Carbon

1.643,76
(KgCO2/Kg)

345,39
(KgCO2/Kg)

4.735,42
(KgCO2/Kg)

5.488,56?
(KgCO2/Kg)

6.207,30
(KgCO2/Kg)

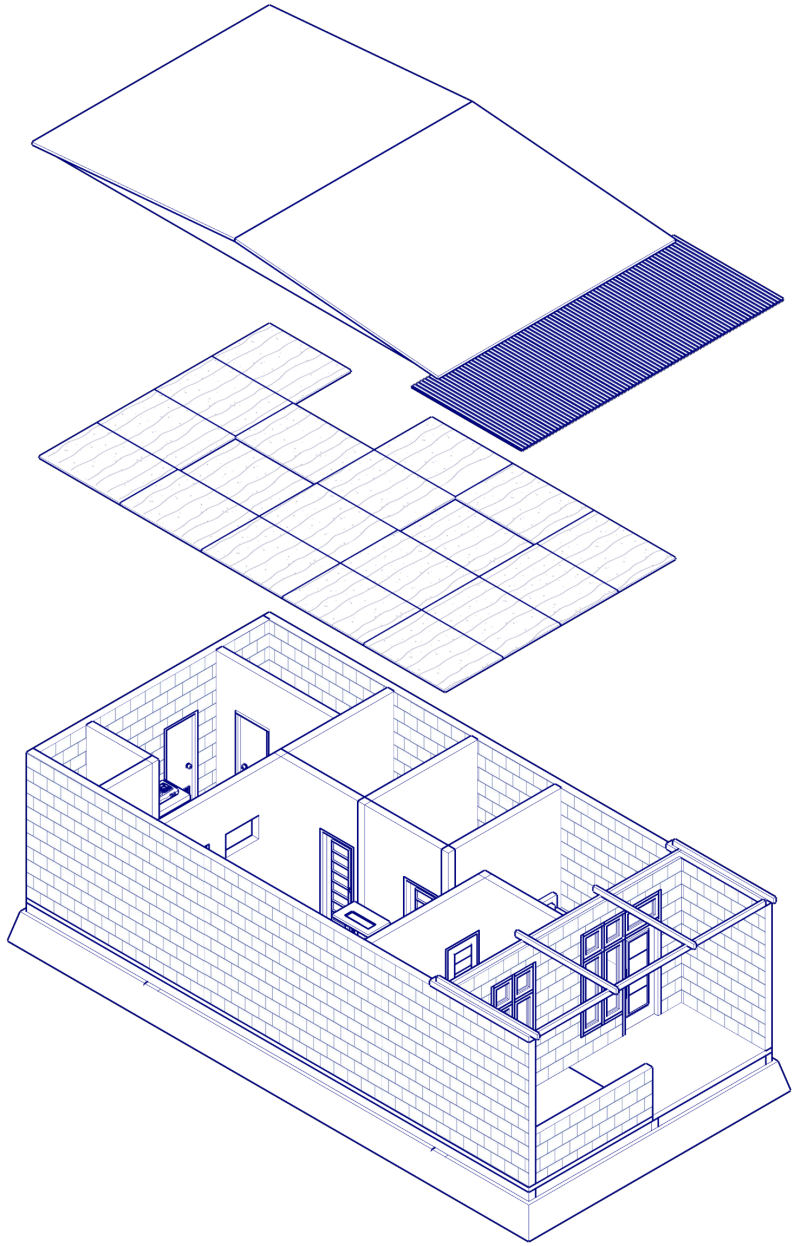
211,04
(KgCO2/Kg)

47,72
(KgCO2/Kg)

Kampung Example
Housing
5.5 x 12 m

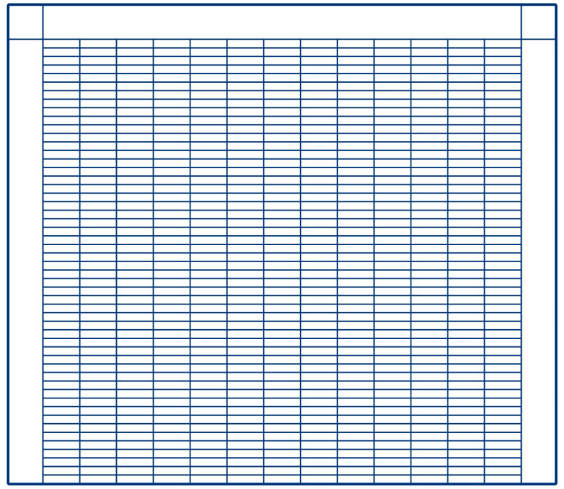
Embodied Carbon

18.679,32
(KgCO2/Kg)



Cost & Embodied Carbon Comparison

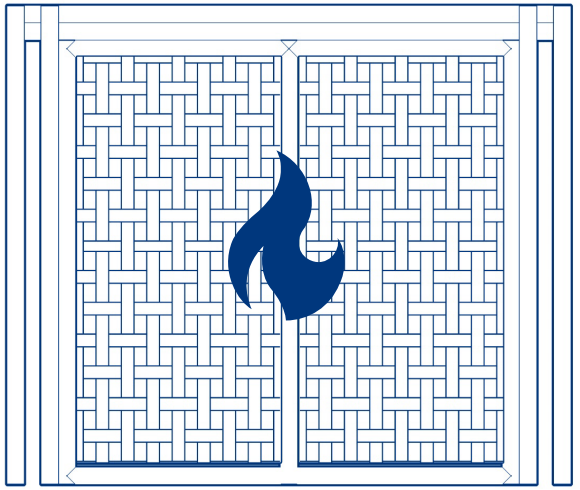
Wall Module 3 x 3 m



Clay Brick + Cement Plaster

Rp 532.772 (€30.20)

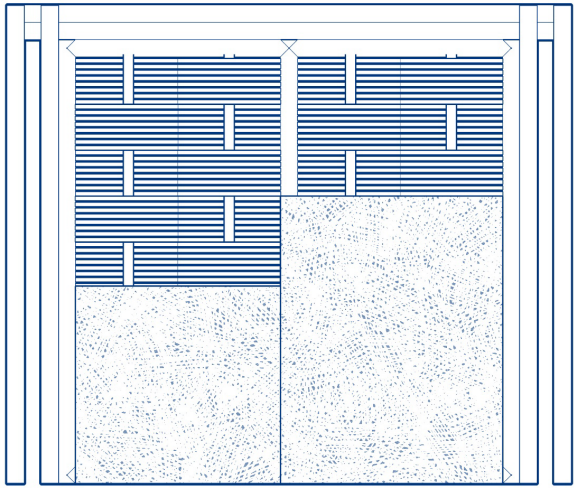
3,574 KgCO2/Kg



Bamboo Framing + Woven Matt

Rp 160.000 (€9.06)

0,426 KgCO2/Kg



Bamboo Framing + Earth Plaster

Rp 235.000 (€13.32)

0,438 KgCO2/Kg

Brick & Bamboo

Bamboo

Brick

Kampung Tongkol
Kamil Muhammad

Source of Material

Source of Material | Bamboo

Bambu Tali
Gigantochloa Apus

Growth 1 - 22 m
Diameter 5 – 13 cm
Flexible

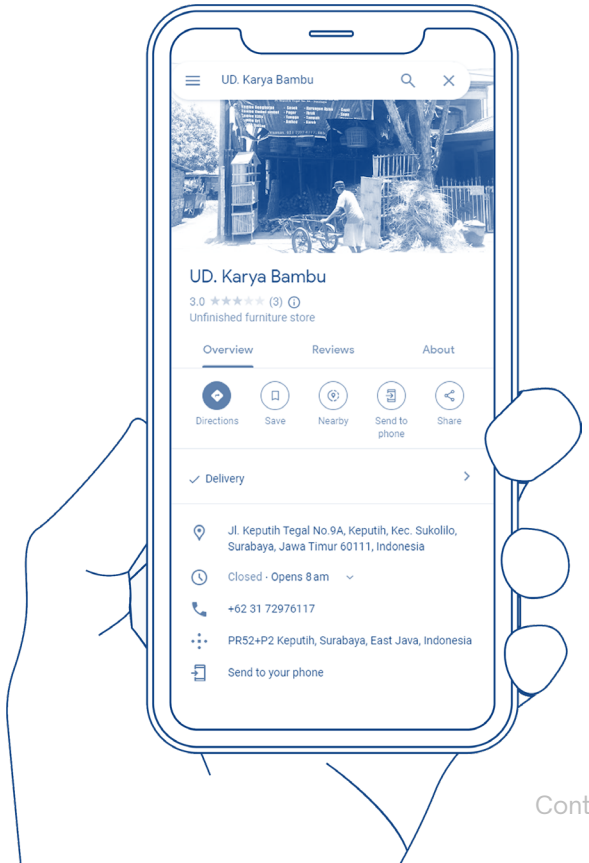
Bambu Petung
Dendrocalamus Asper

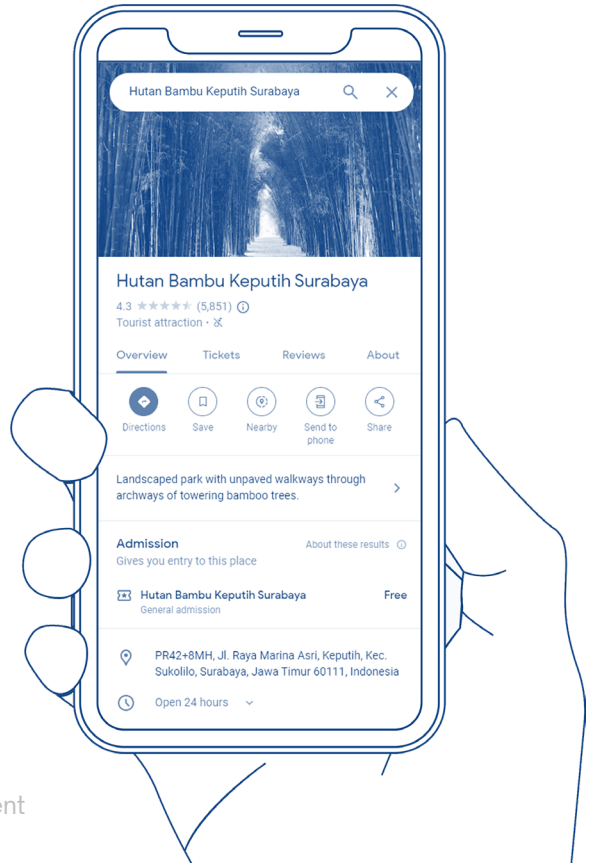
Growth 1-18 m
Diameter 8 – 20 cm
Strong - structure

Source of Material | Bamboo

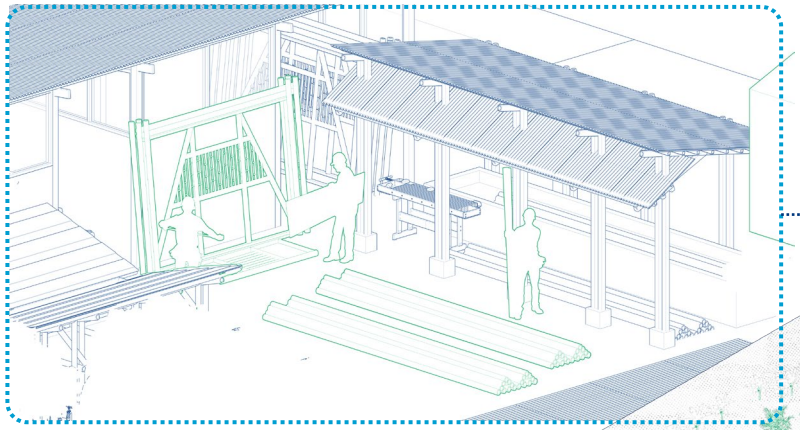
Local Bamboo Supplier
UD . Karya Bambu
± 1,8 km | 5 minutes driving

Bamboo Forest
Municipal-owned
± 1,3 km | 4 minutes driving

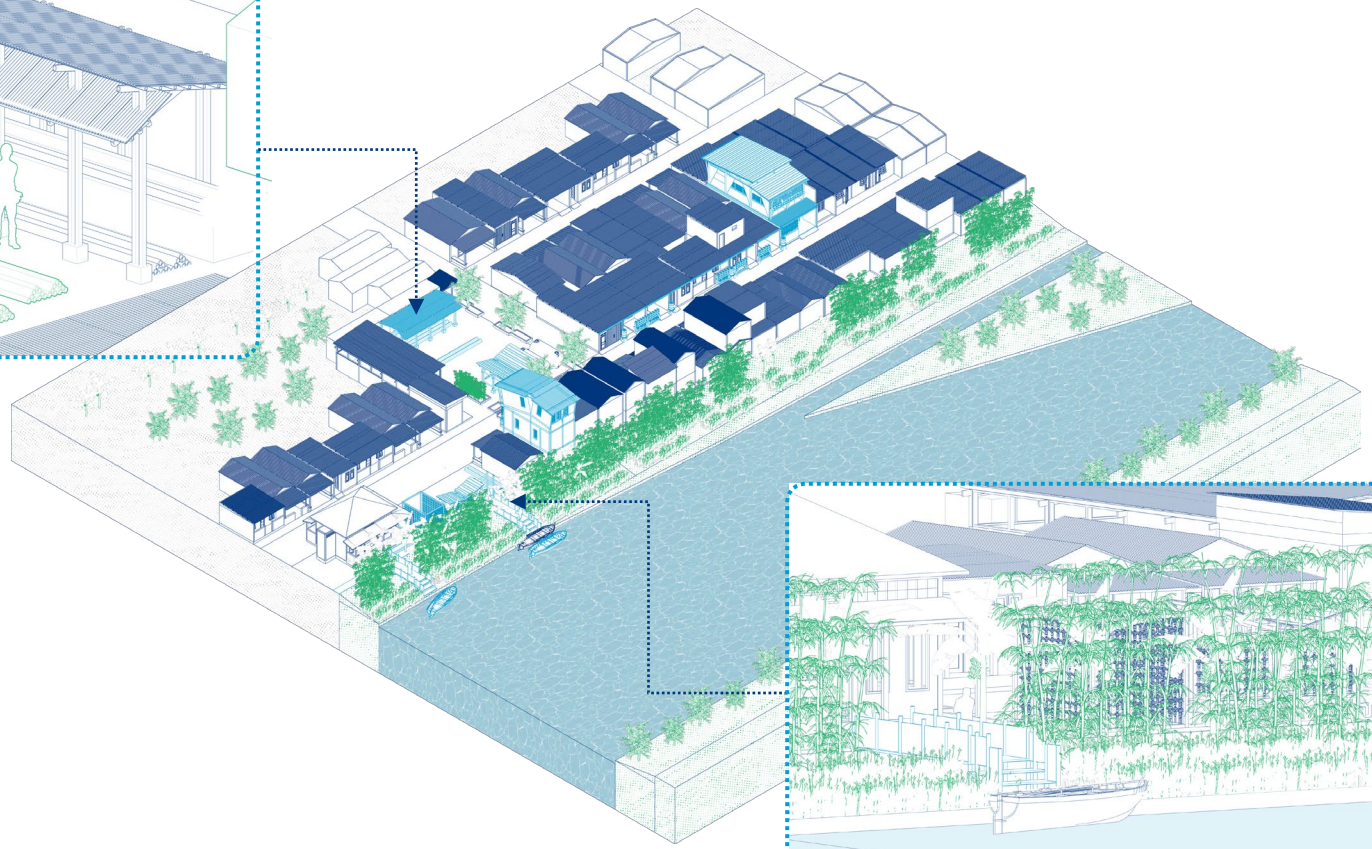




Bamboo Flow & Treatment



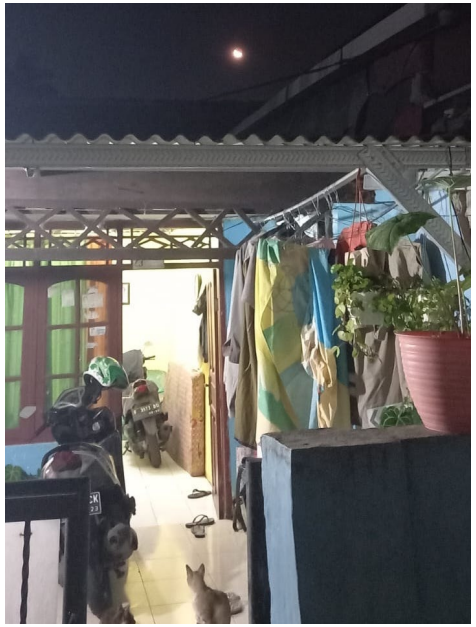
Treated *in Bamboo Workshop With chemicals, borax and boric acid*



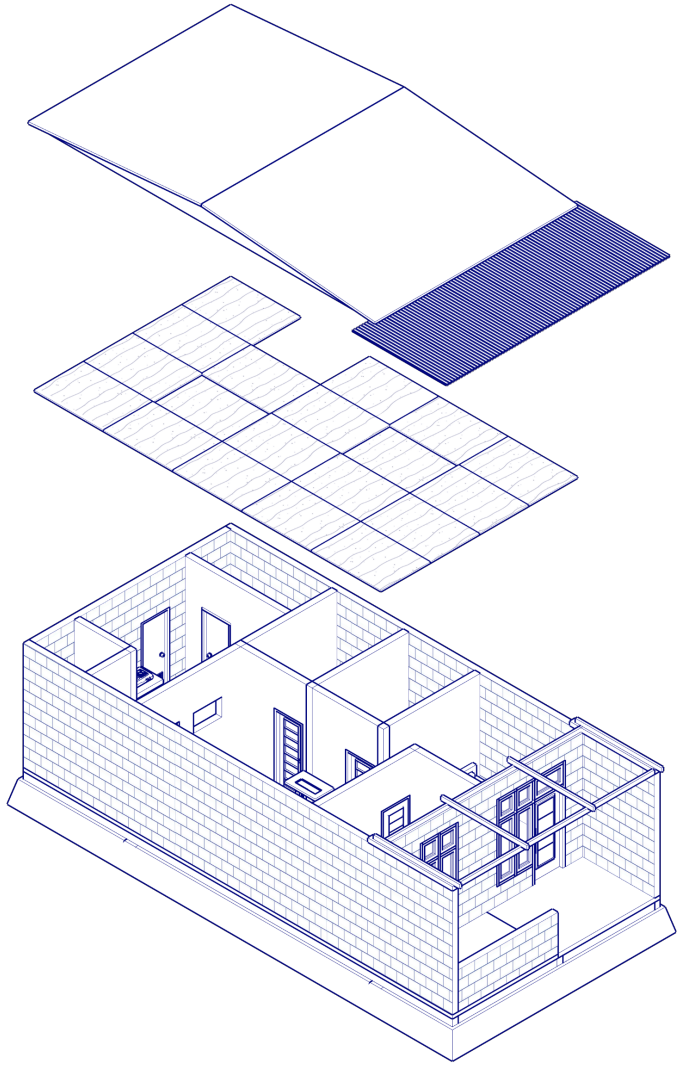
Harvest *from kampung-owned bamboo forest*

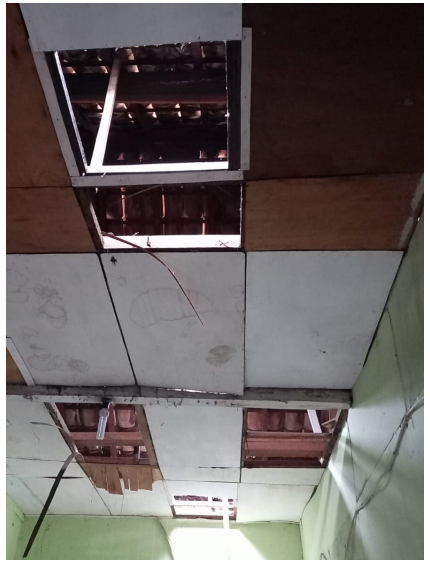
Bamboo Workshop

Retrofit Home | Existing Condition



Prone to flood
No rainwater equipment





Poor ceiling &
roof structure

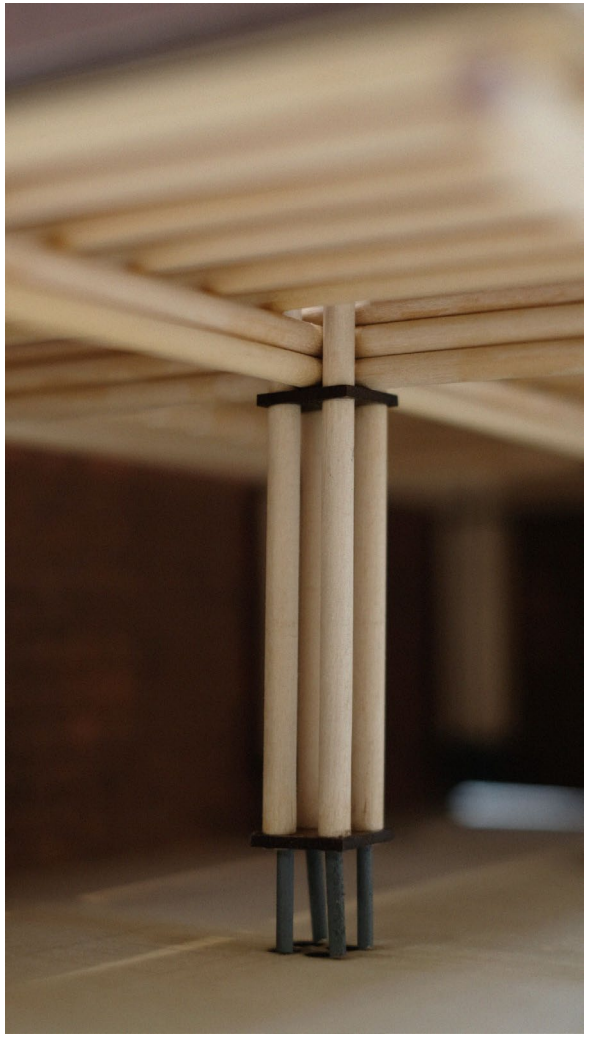
Lack of proper
ventilation

Structure

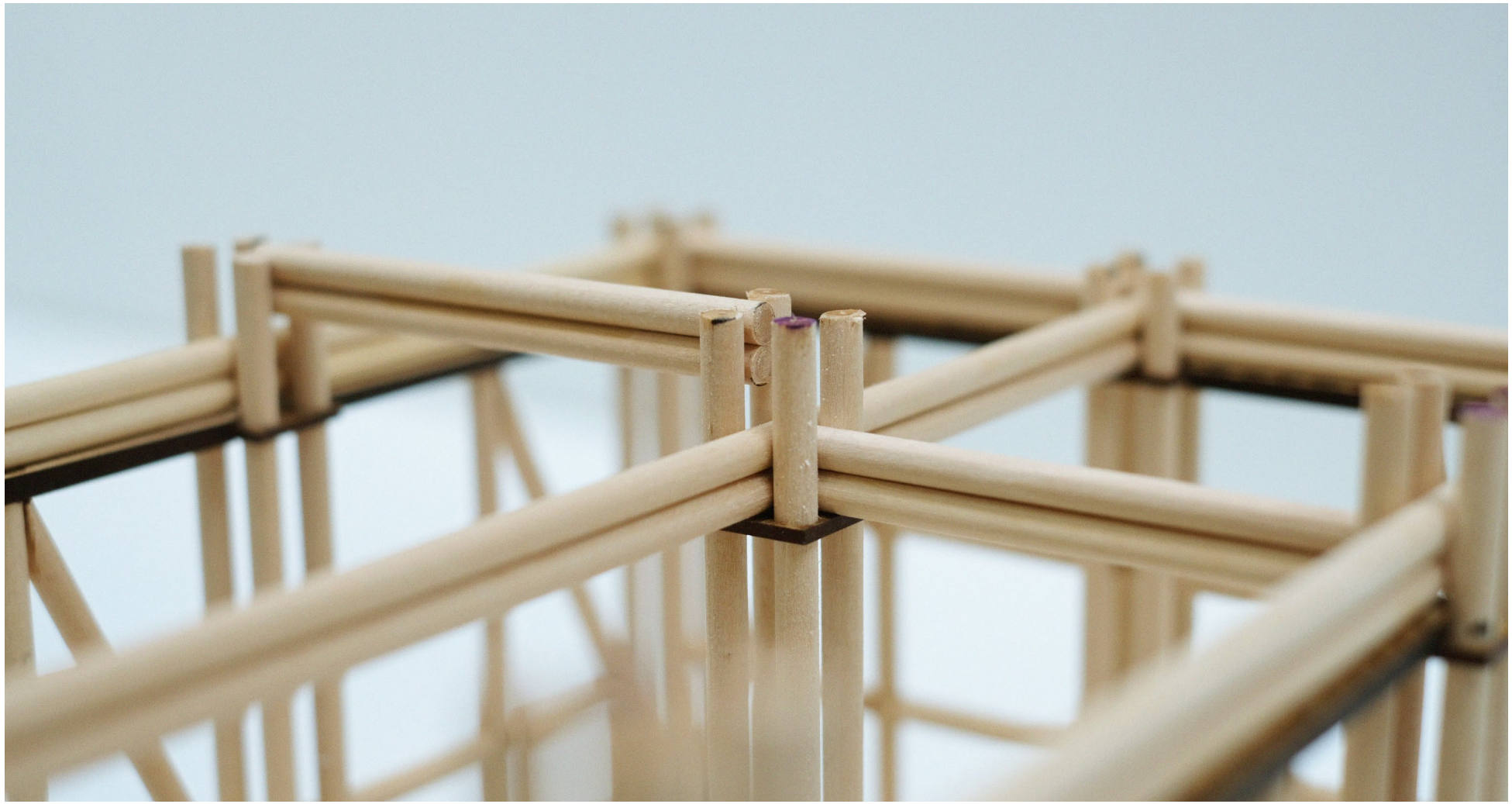
Structure | *Separated Structure*

Structure | *Lesson Learned*

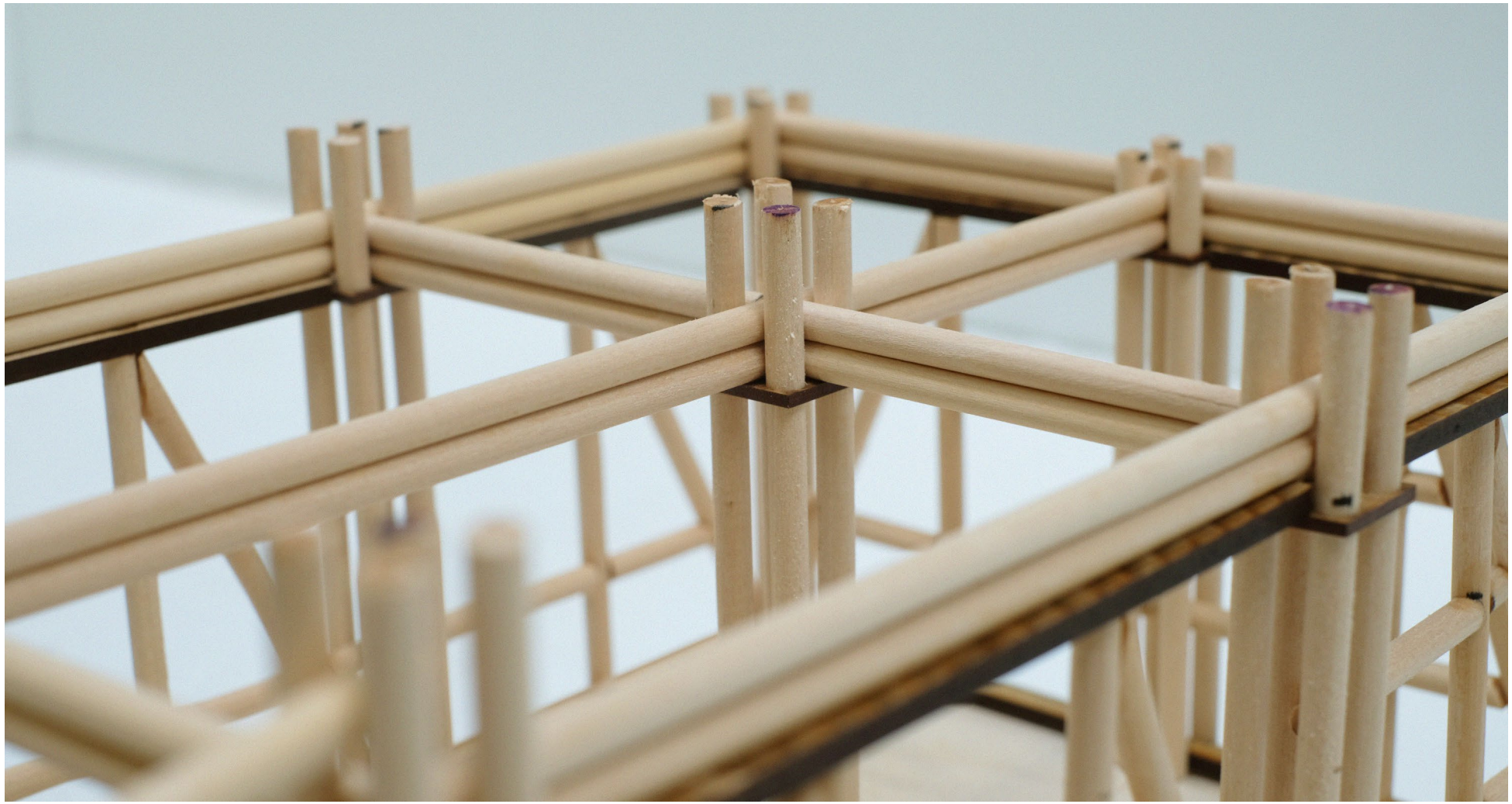
Structure | *Column*



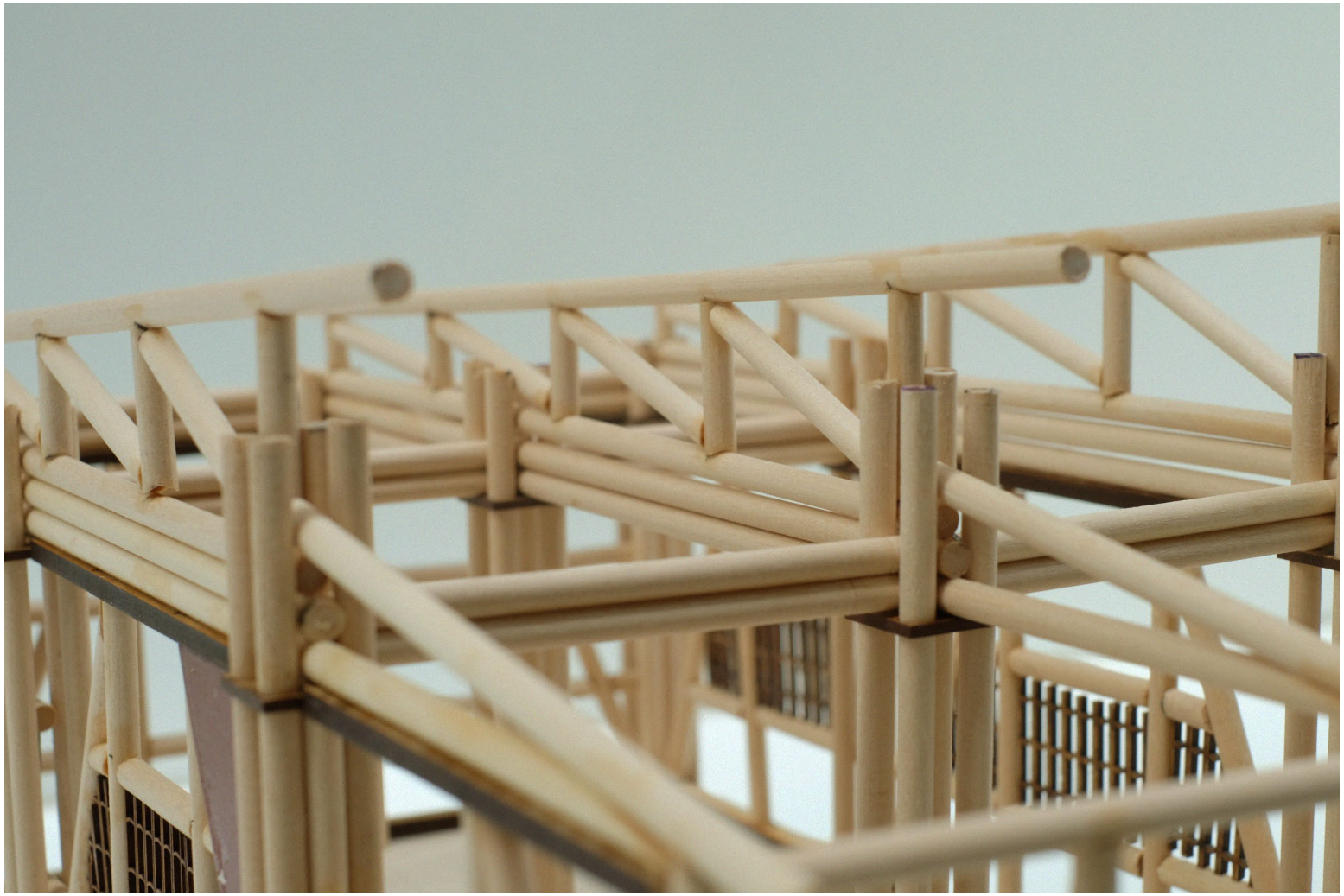
Structure | *Beam*

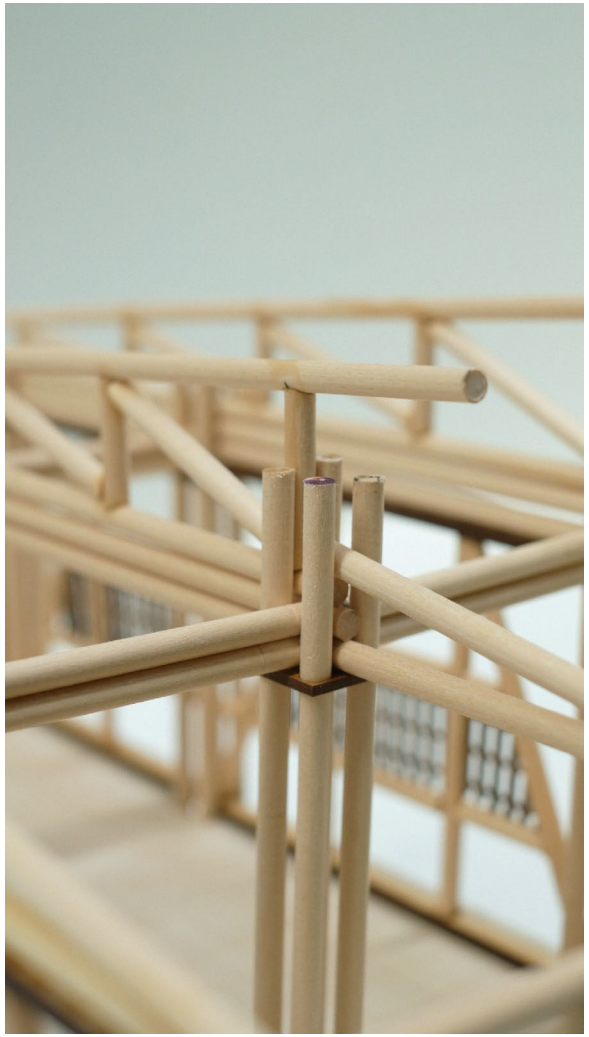


Structure | *Beam*

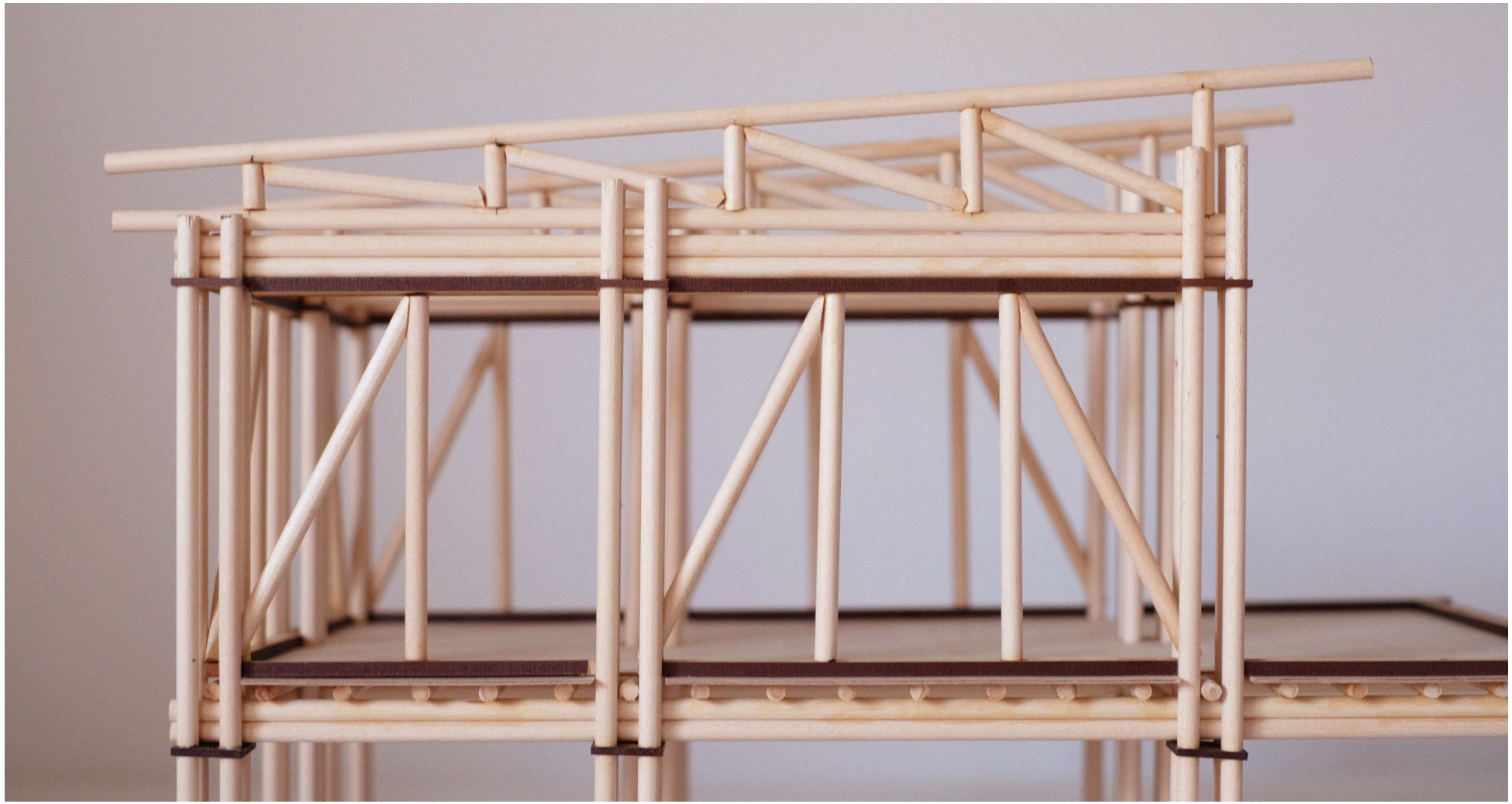


Structure | *Roof Truss*





Structure | *Disaster Proof-Bracing*



Structure | *Disaster Proof-Bracing*

Structure | *Clay Plaster*

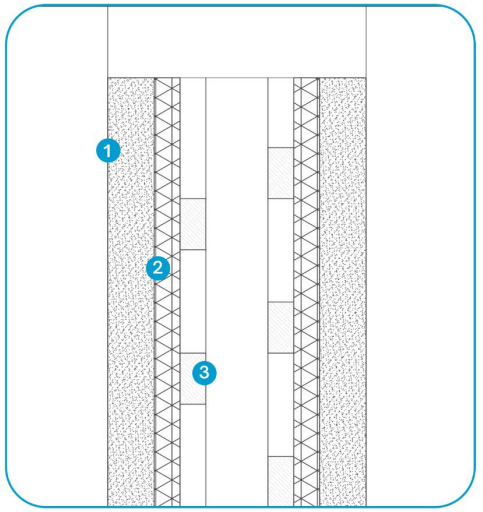
Structure | *Clay Plaster*

Structure | *In Between Construction*

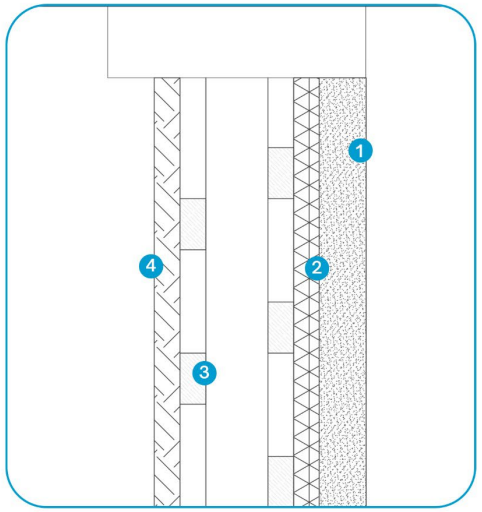
Structure | *In Between Construction*

Structure | *Fire Resistance*

Double Skin System
30 - 60 min FFR
20 - 25 mm thickness clay render

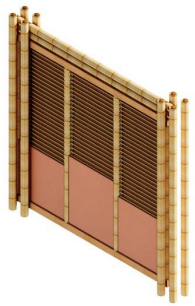


Single Skin System
10 - 15 min FFR
10 - 18 mm thickness clay render



1 Clay plaster thickness
Vary from 18 - 25 mm *based on wall position
2 Steel wire mesh
3 Bamboo slats
4 Bamboo woven for interior finishing

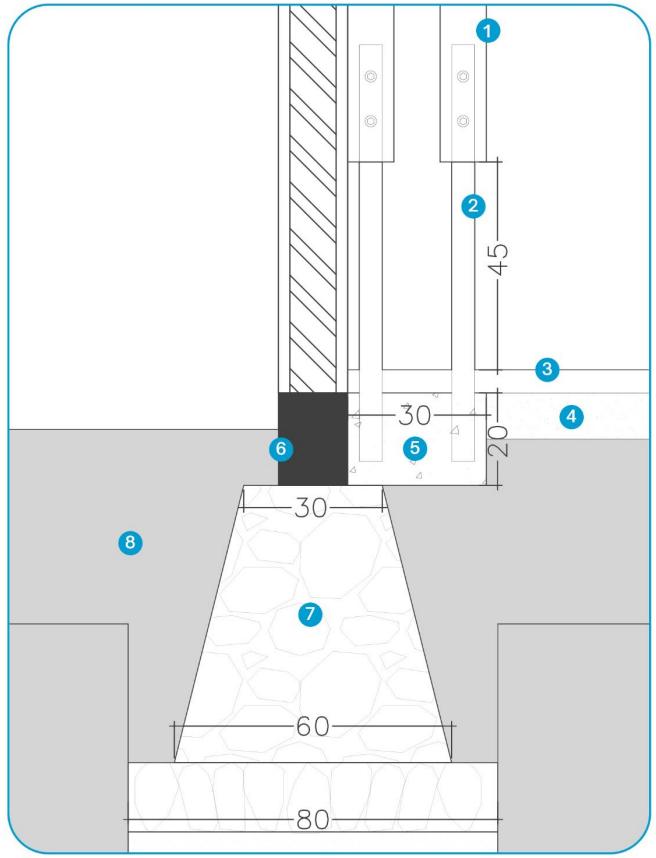
Wall Finishing
Exterior Clay Plaster



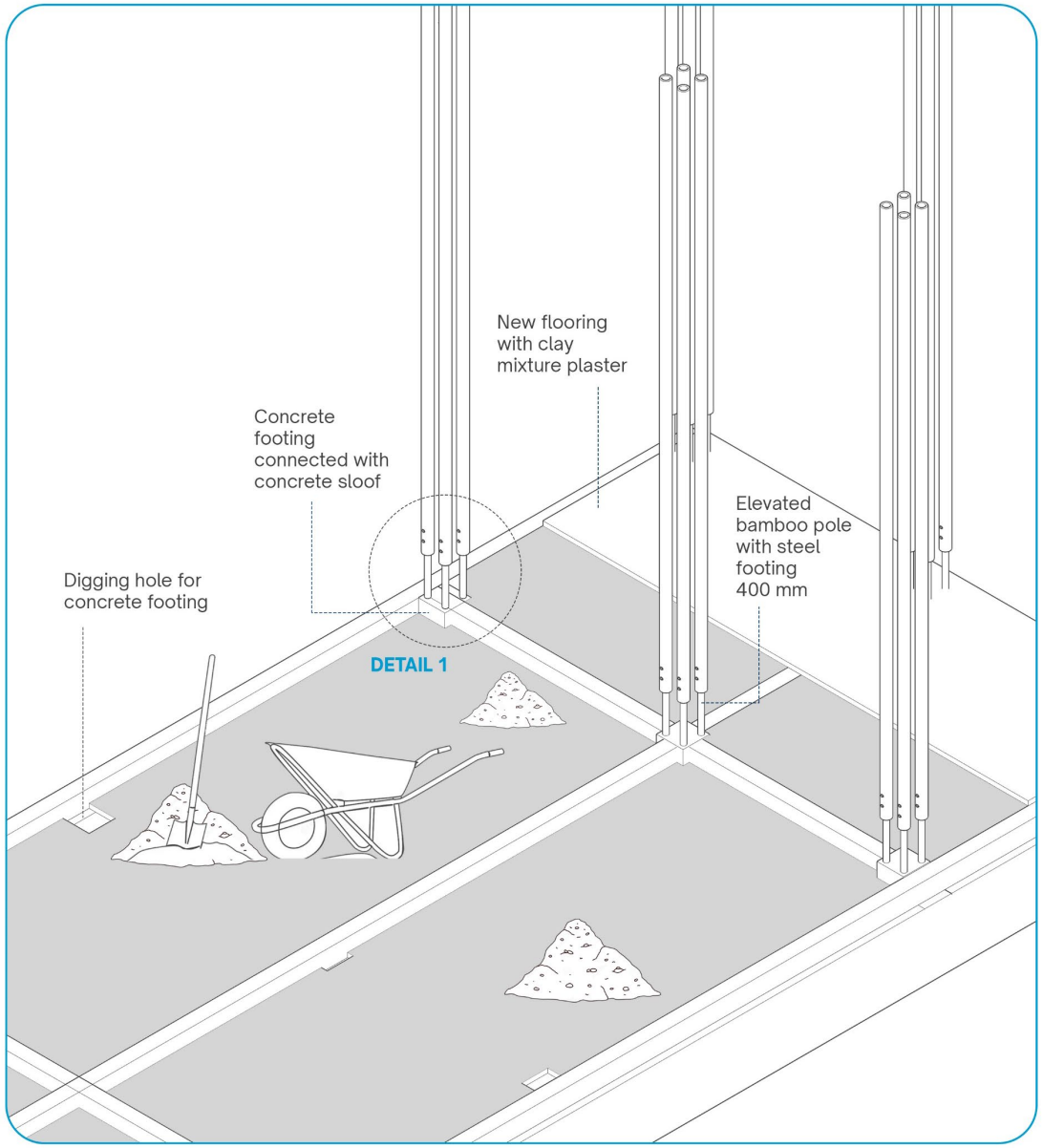
Wall Structure
Bamboo Slats

Wall Finishing
Interior Bamboo Woven

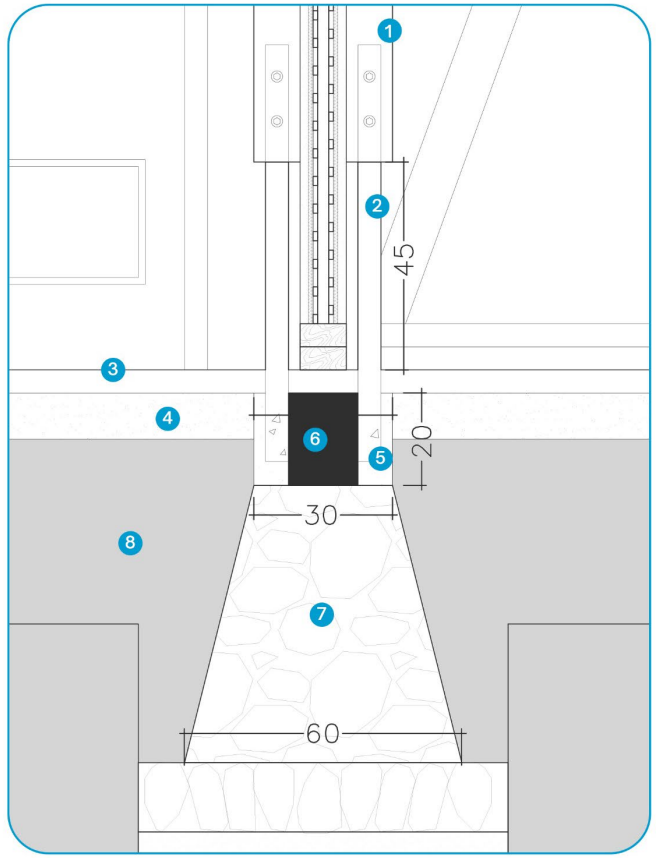
Structure | *Foundation*



1 Bamboo pole column d. 100 mm
2 Steel footing pole d. 70 mm
3 Clay mixture plaster with oil coating 5 mm
4 Earth rammed 100 mm
5 Concrete base 200 x 300 mm
6 Existing concrete sloof 150 x 200 mm
7 Stone foundation 300 x 600 mm



Structure | *Foundation*



1 Bamboo pole column d. 100 mm
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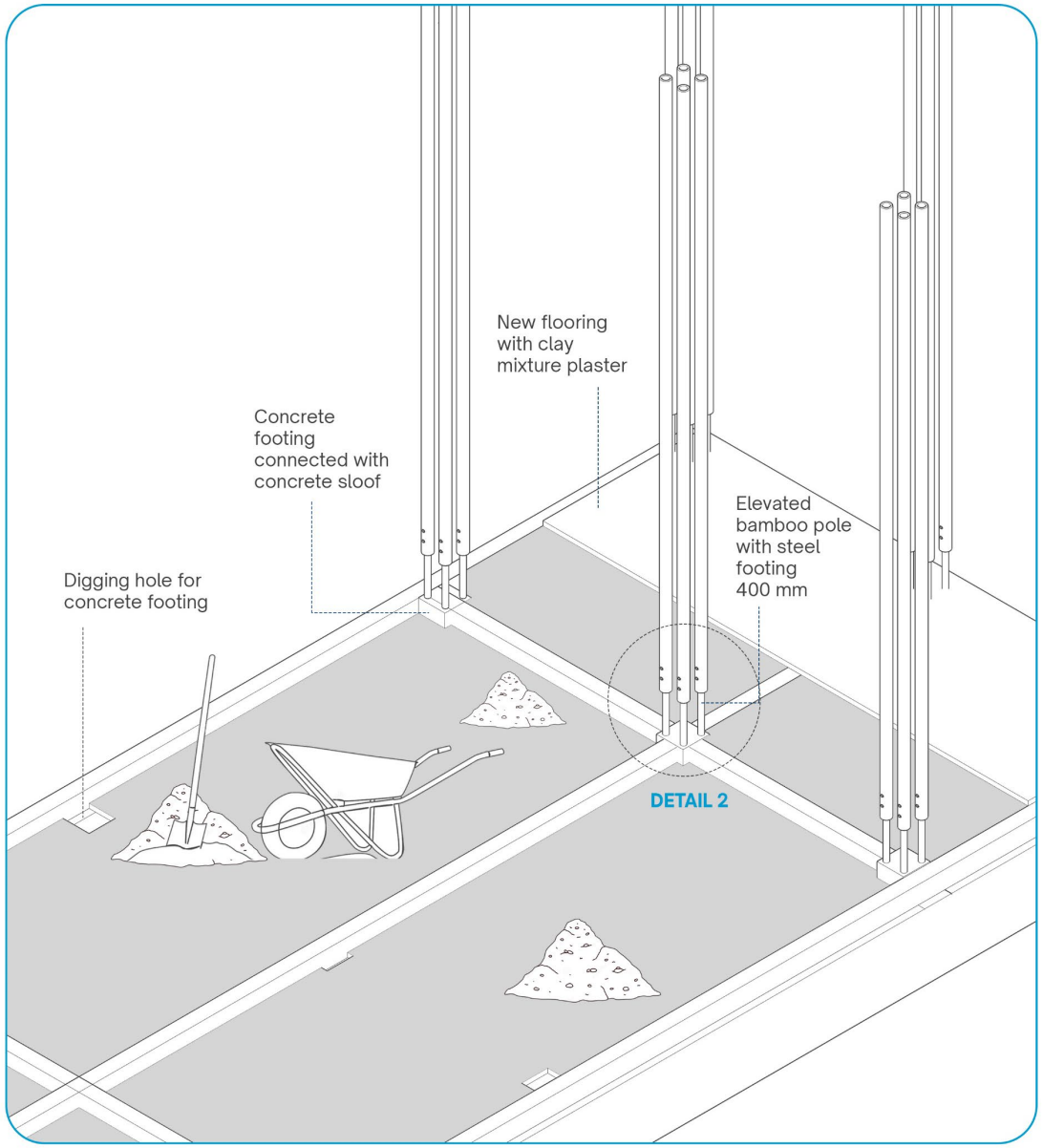
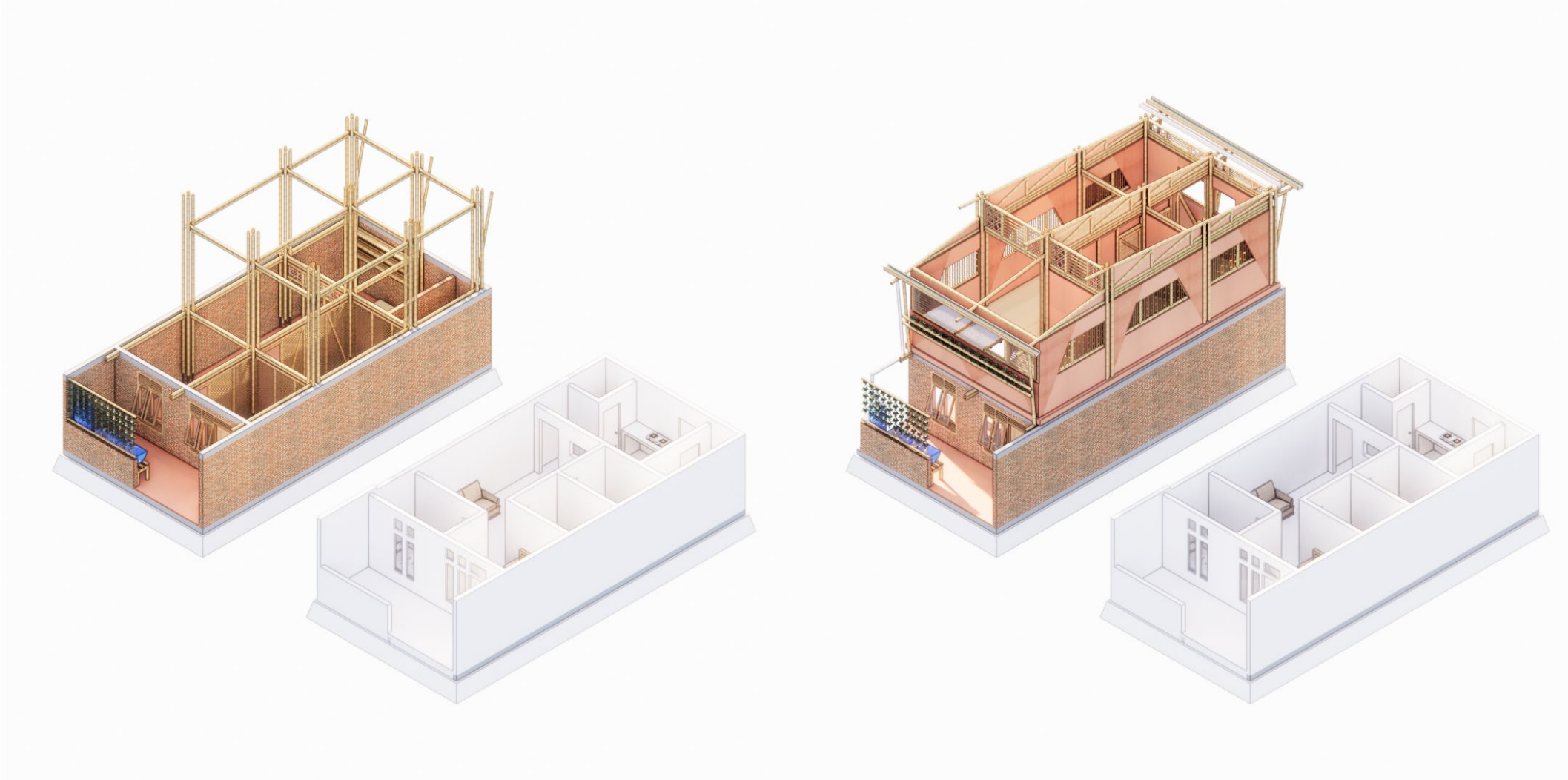
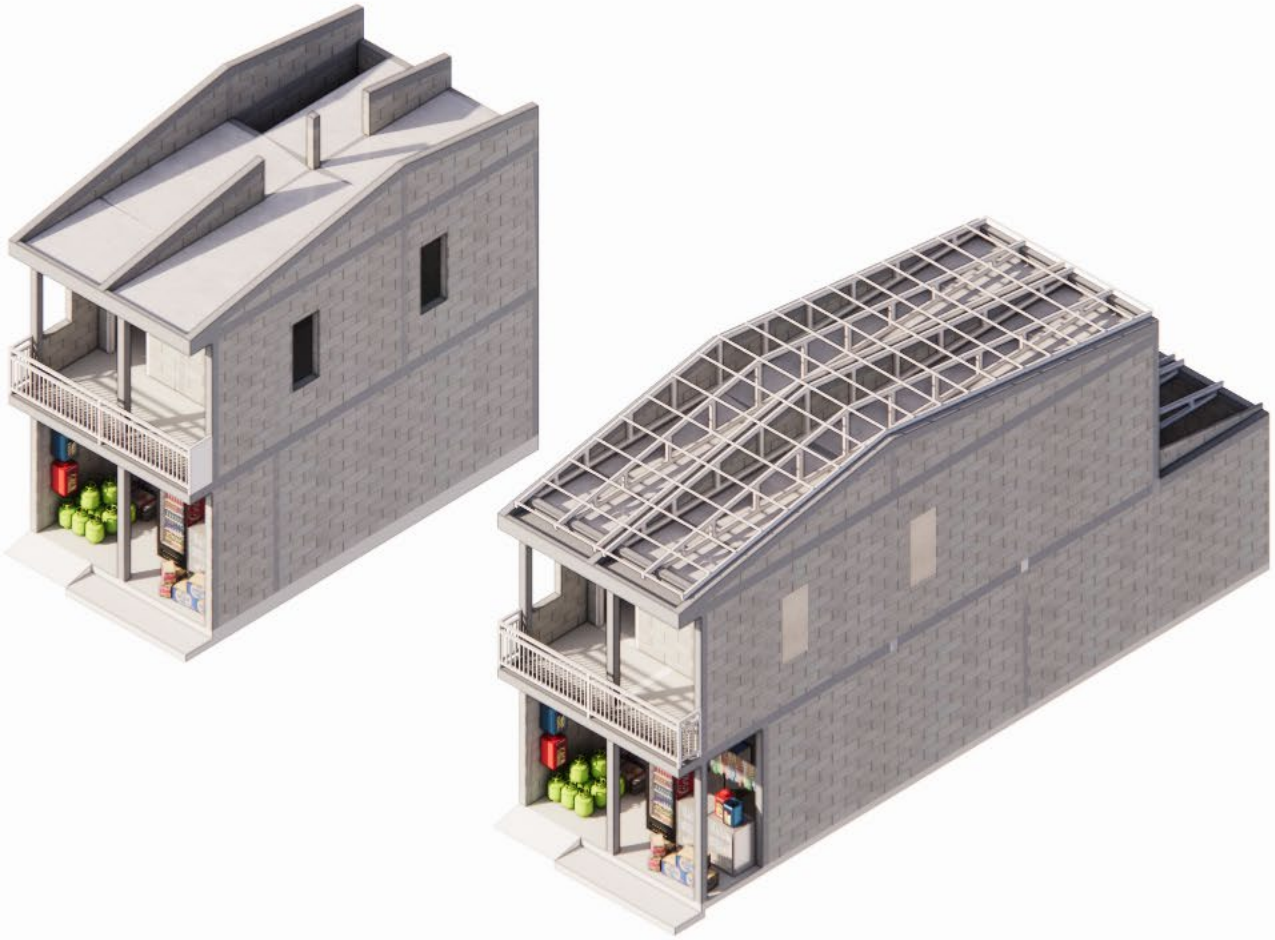
7 Stone foundation 300 x 600 mm



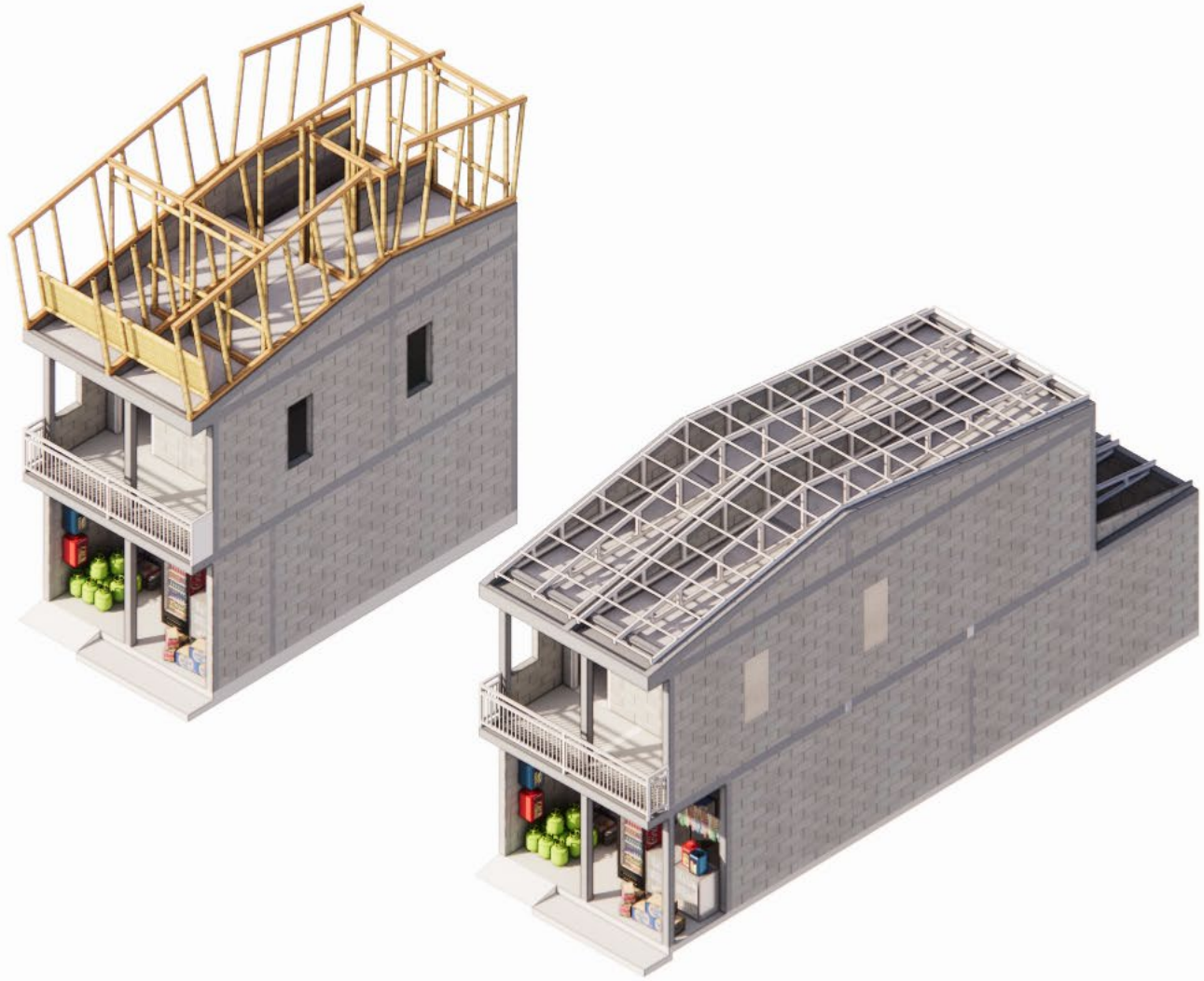
After Retrofit



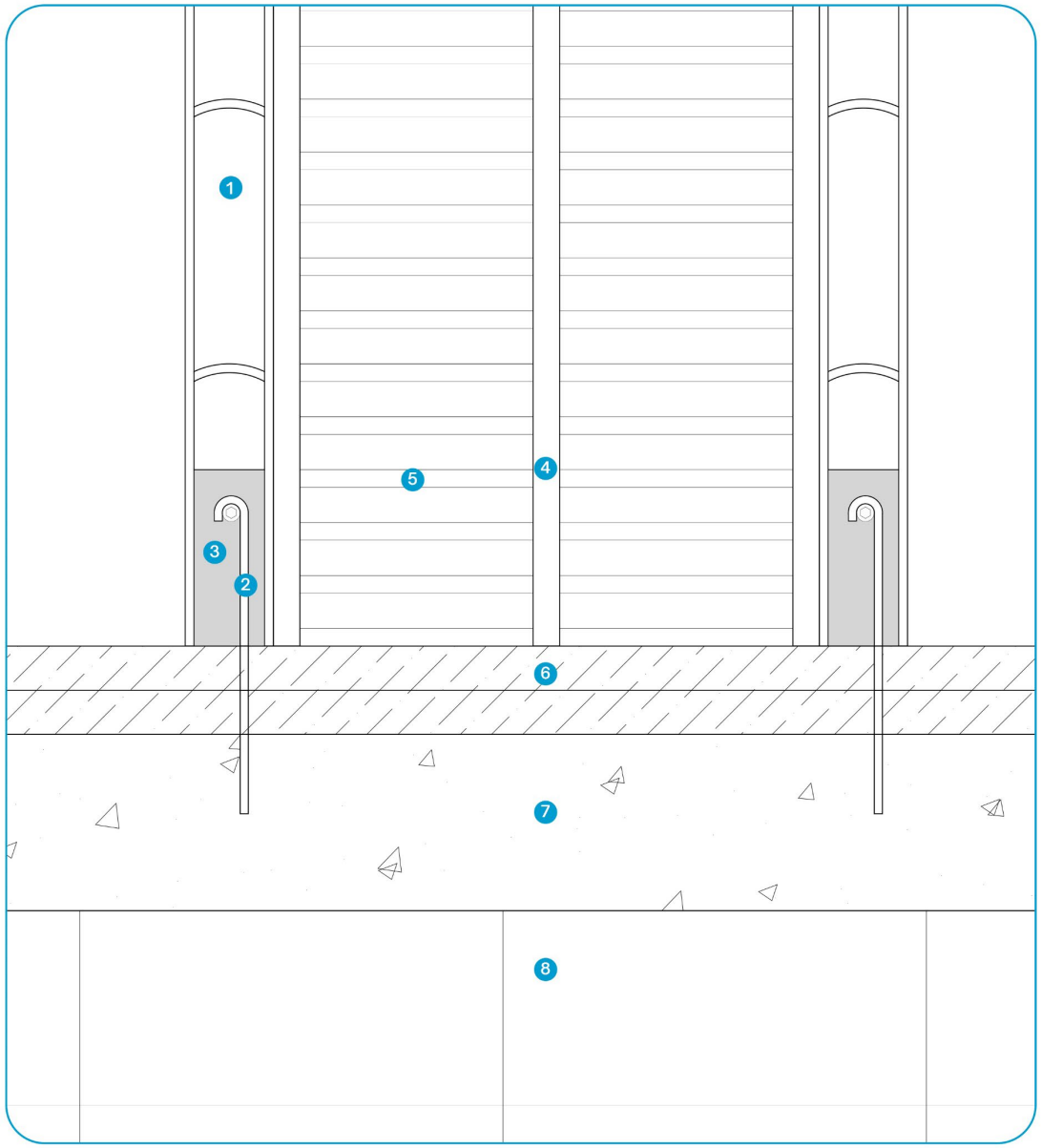
Construction | Housing 2



Construction | Housing 2

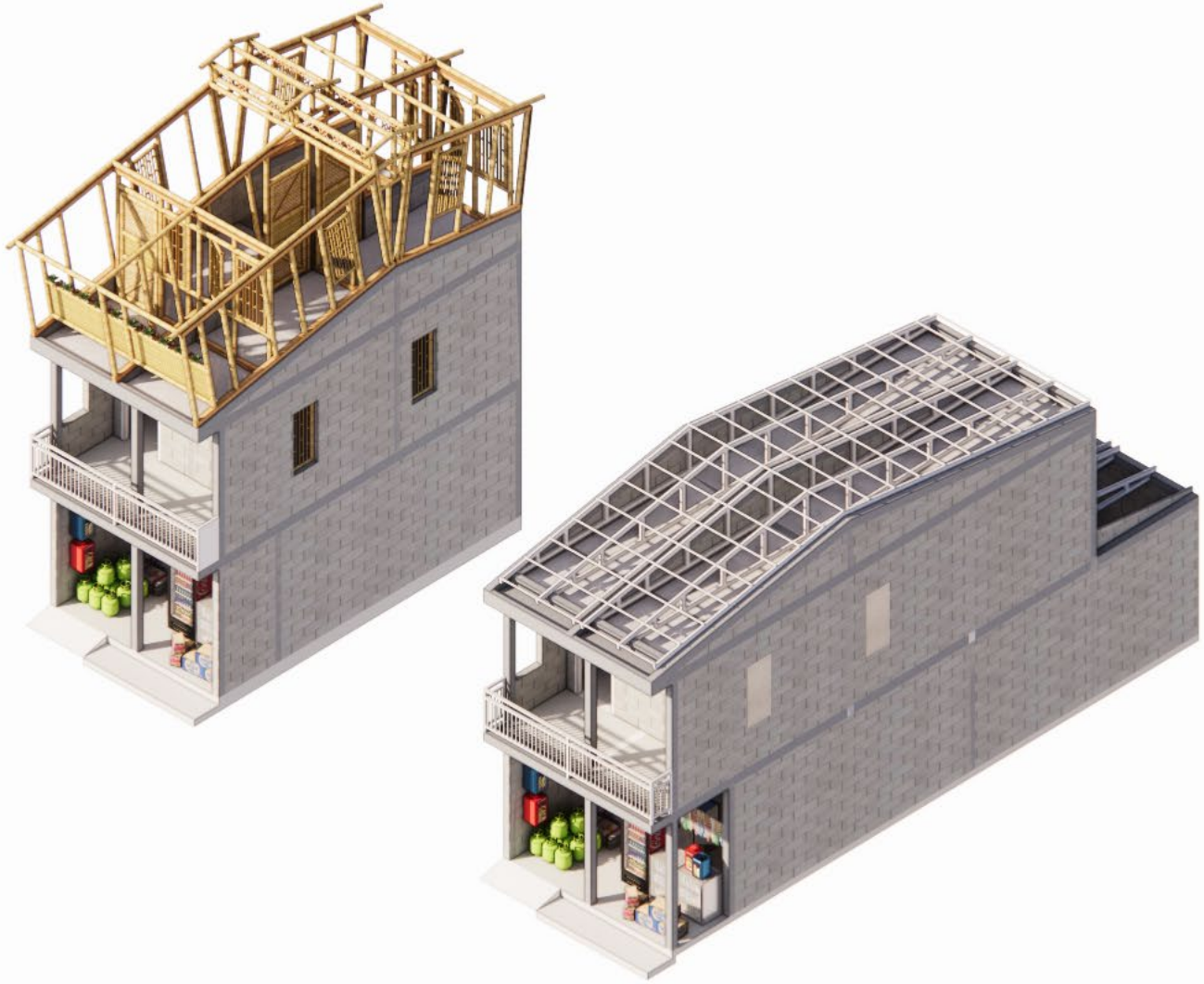


Structure | *Bamboo and Concrete Block*

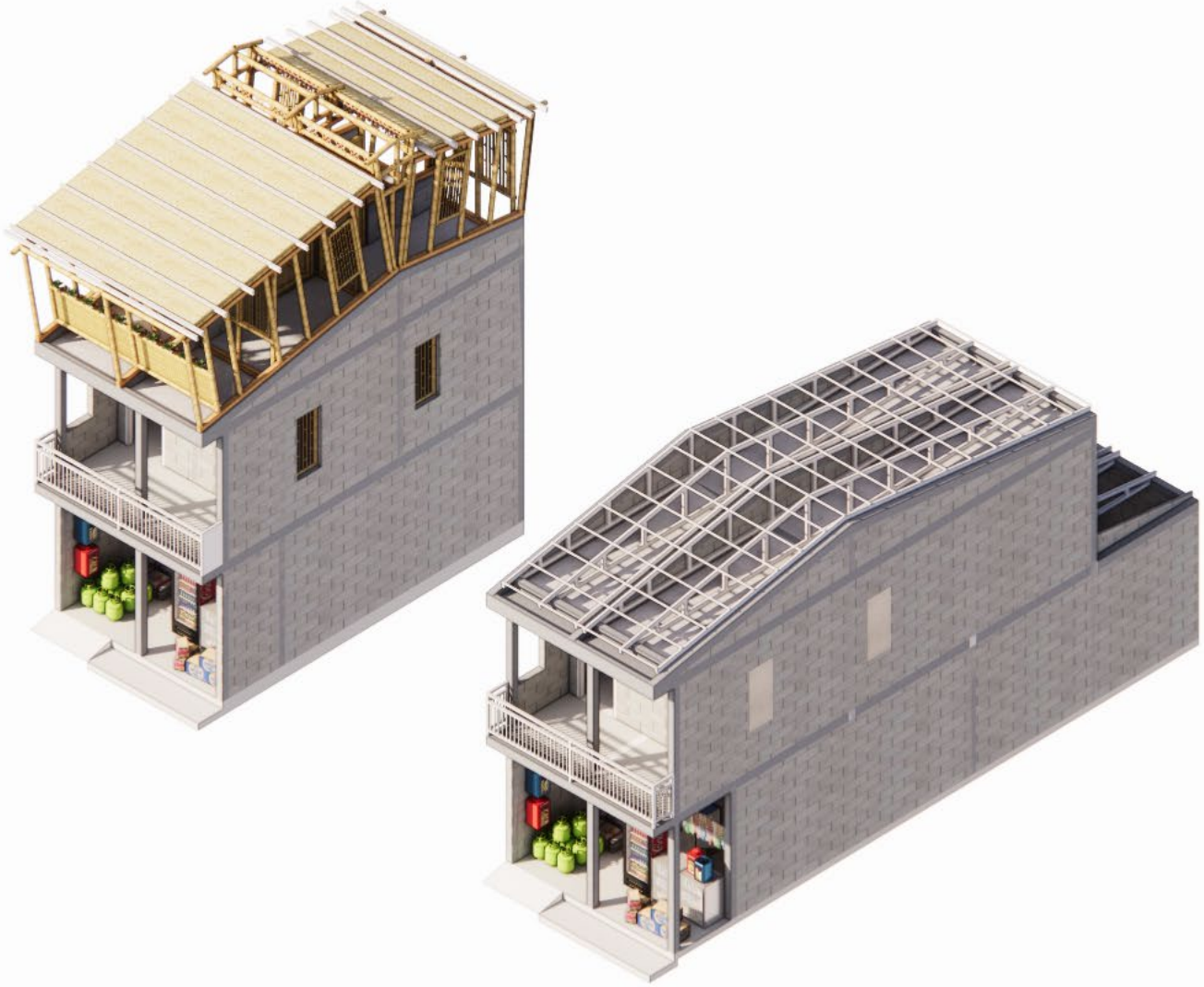


1 Bamboo pole column d. 100 mm
2 Steel rod & bolt
3 Mortar filling 200 mm
4 Timber stick/Bamboo d. 30 mm
5 Bamboo slat thickness 10 mm
6 Double timber plate thickness 50 mm
7 Existing concrete beam 150 x 200 mm
8 Concrete block 200 x 600 x 100 mm

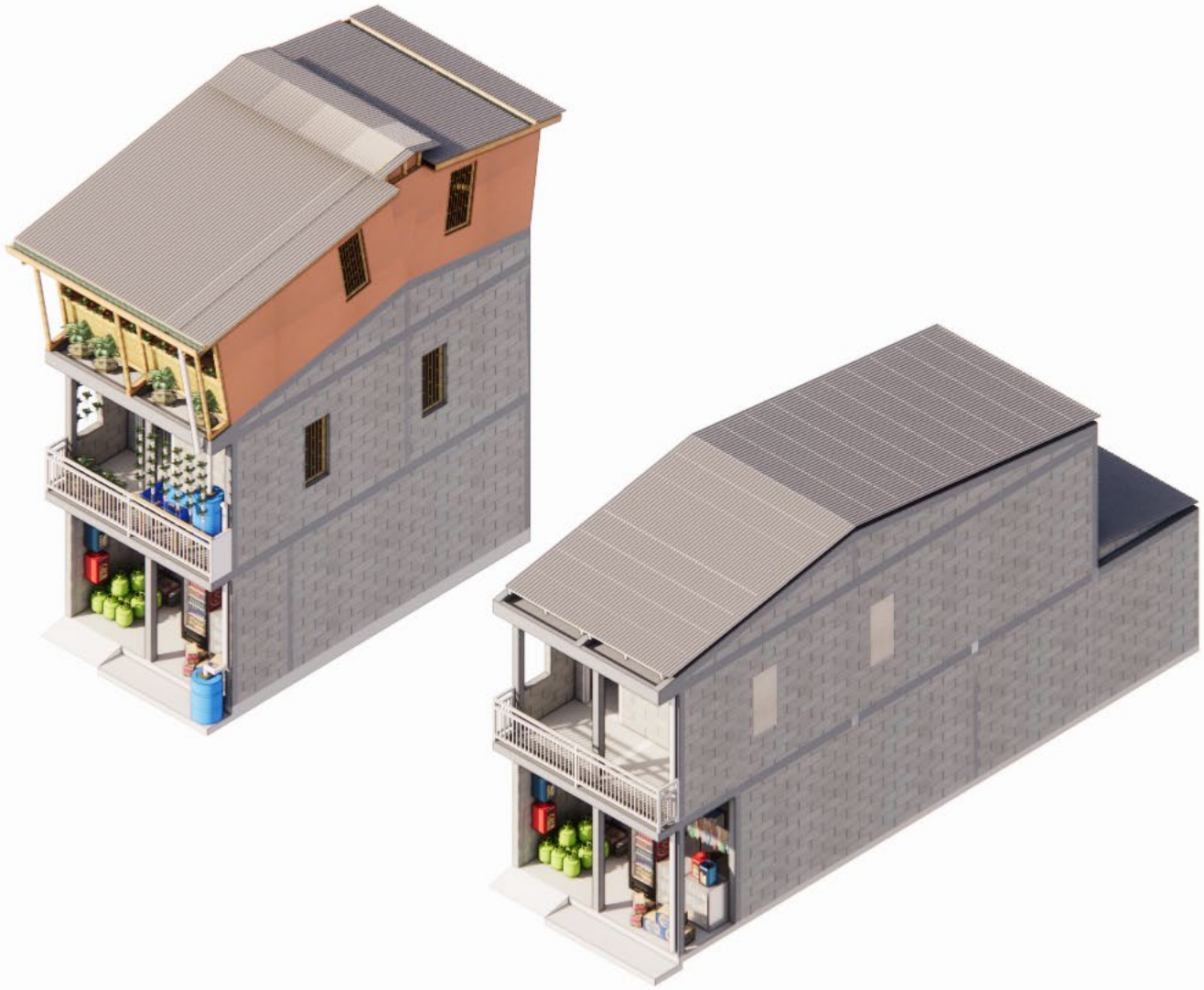
Construction | Housing 2



Construction | Housing 2

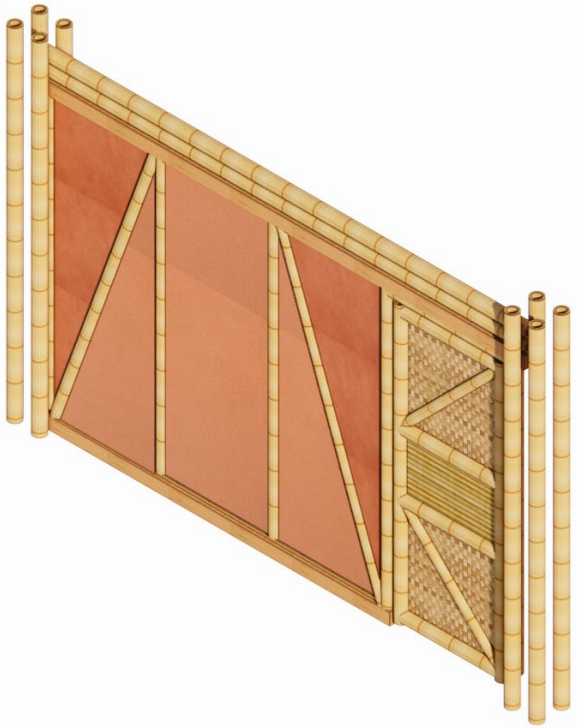


Construction | Housing 2

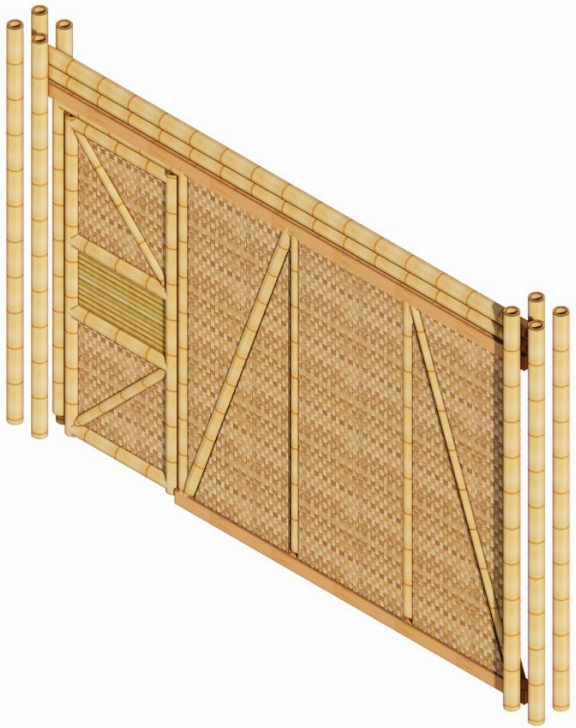


Housing Two

Element of Aesthetics



Interior Finishing
Wall + Door
Clay lime plaster



Interior Finishing
Wall + Door
Bamboo woven

Exterior Finishing
Wall + Window
Clay lime plaster, bamboo skeleton

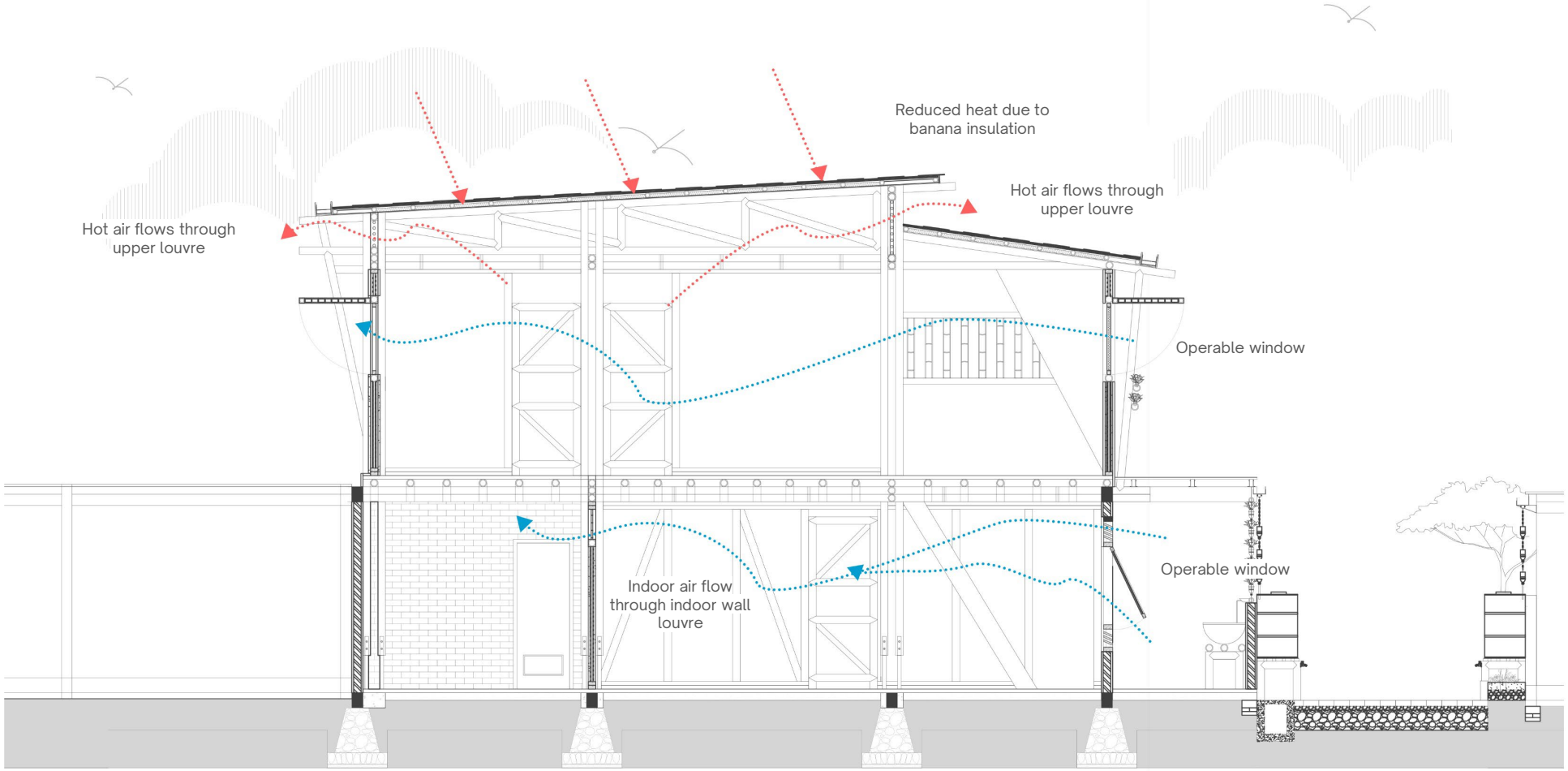
Interior Housing / *First Floor*

Interior Housing / *Second Floor*


Interior Housing / *Second Floor*

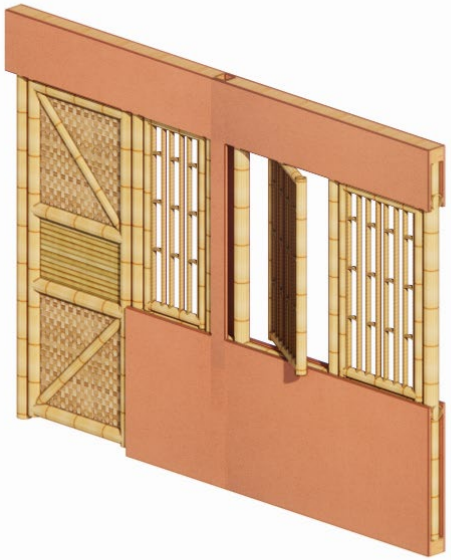
Climate

Climate


Reduced heat due to
banana insulation
Hot air flows through
upper louvre
Hot air flows through
upper louvre
Operable window
Indoor air flow
through indoor wall
louvre
Operable window

Element of Ventilation

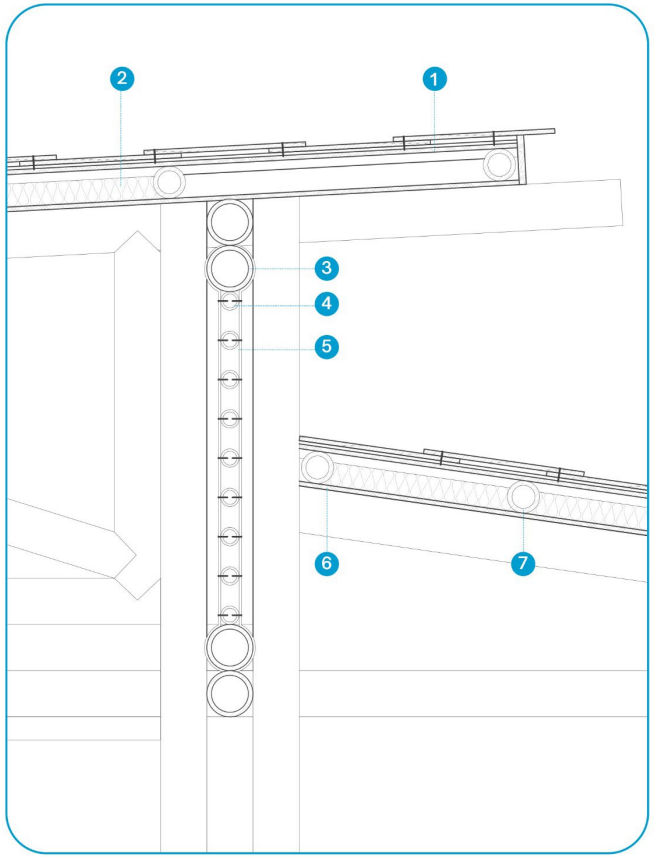
Fixed Window
+ Privacy
+ View
+ Airflow



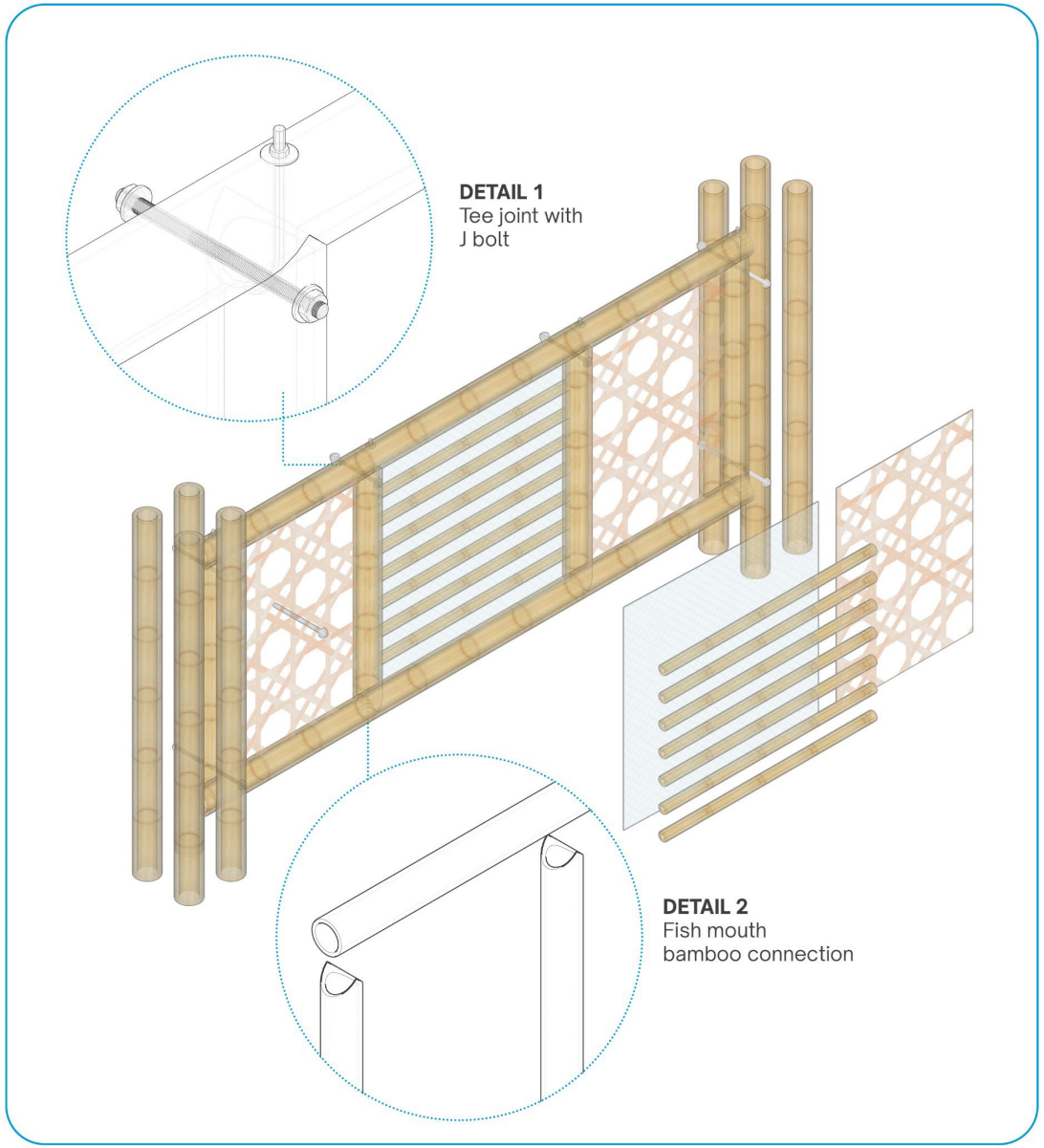
Operable Window
+ Privacy
+ View
+ Airflow

Indoor Louvre
+ Airflow

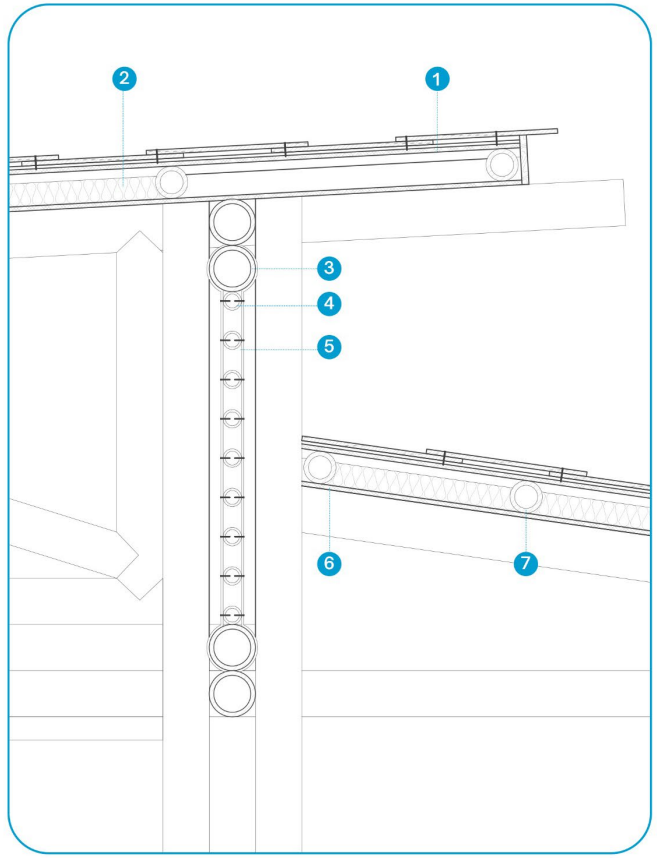
Climate | Bamboo *Louvre*



1 Bamboo *Pelupuh* roof cover
Waterproof membrane layer
Bamboo woven
2 Banana fiber insulation panel
3 Bamboo pole louvre frame d. 100 mm
4 Bamboo inner louvre d. 40 mm
5 Insect screen net
6 Bamboo woven ceiling
7 Bamboo rafter d. 70 mm



Climate | Bamboo *Louvre*



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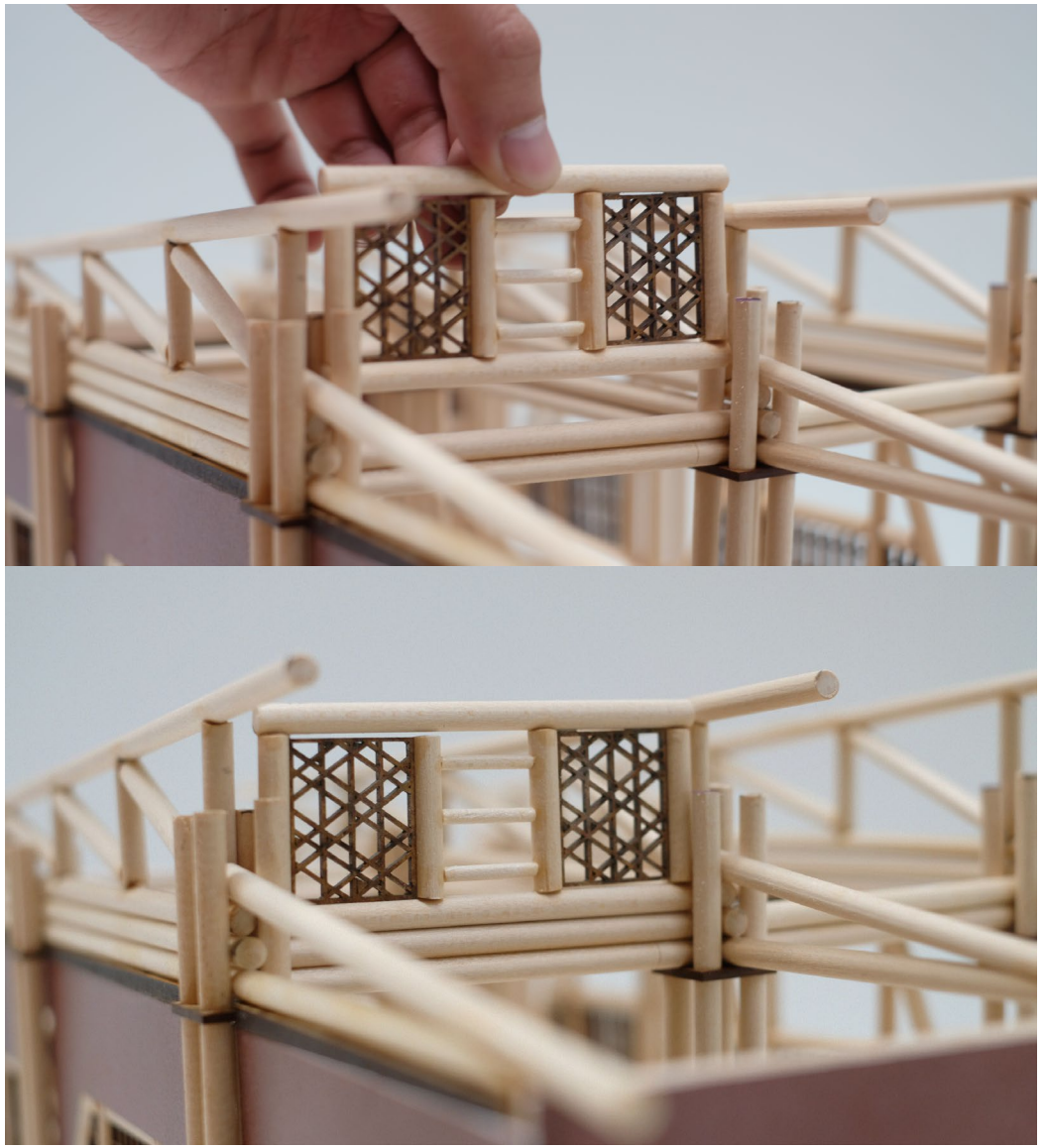


Flexibility in Hours

07.00 am / opening window

Flexibility in Hours

10.00 am / hanging clothes

Flexibility in Hours

12.00 am / half closed blind

Flexibility in Hours

14.00 am / fully closed blind

Flexibility in Hours

18.00 am / closed window

Management

Funding Scheme

Current Funding

Monthly community saving

Collect water bottle

Municipal Funding

Kampung improvement programme & housing rehabilitation

Revolving fund for housing retrofit

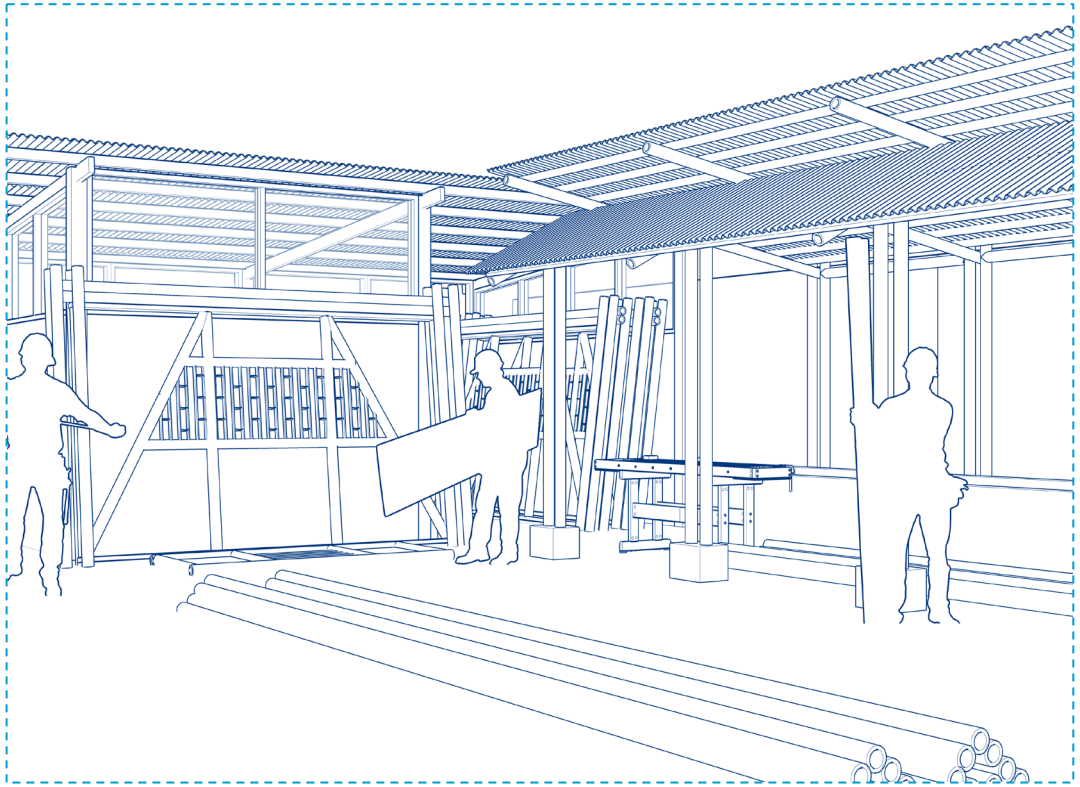
International Institution | Company | NGO

Cooperation (Credit system)

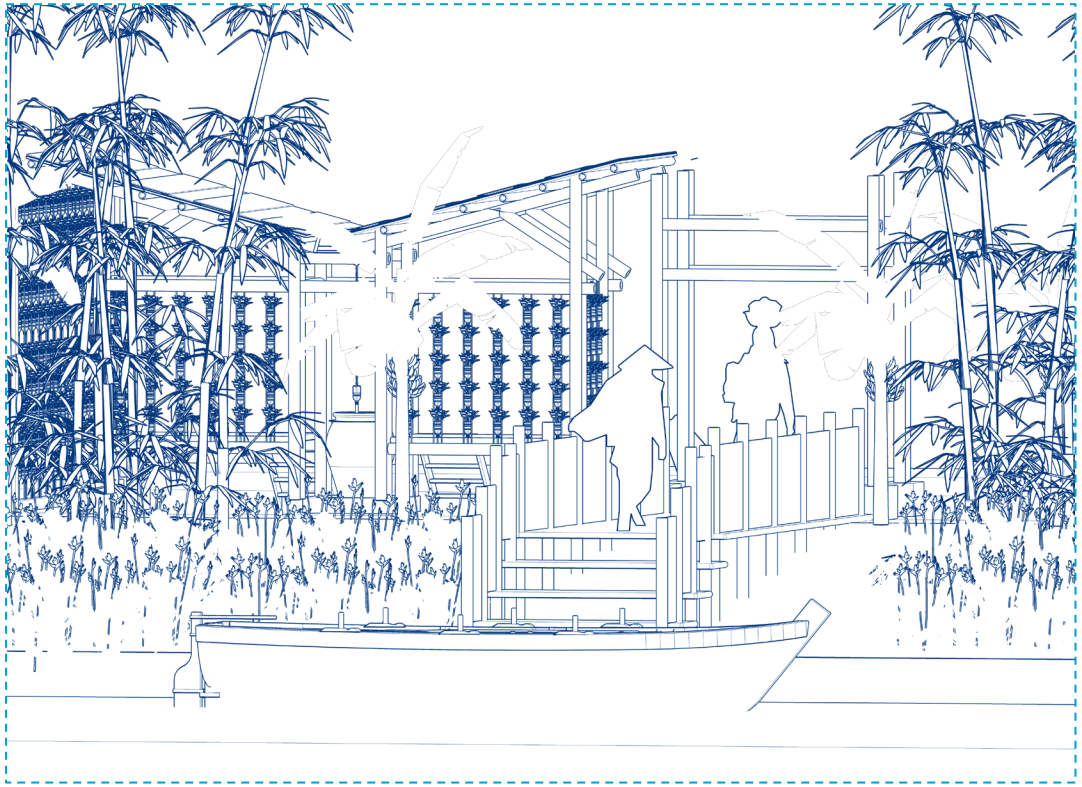
Home-based business assistance

Revolving fund for housing retrofit

Local Economy



Bamboo Workshop



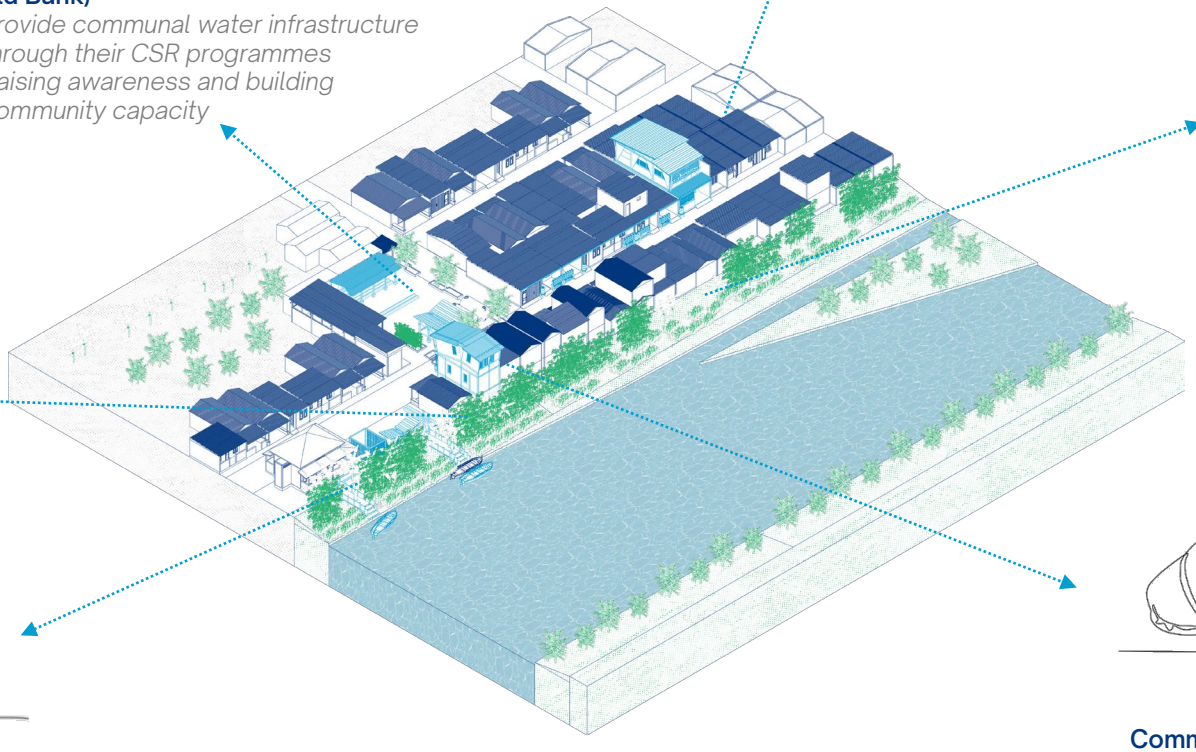
Fishing Boat Tourism

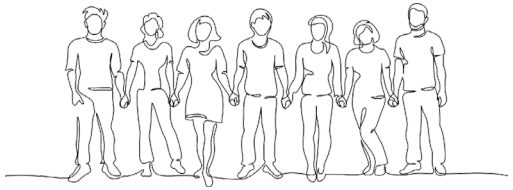
Actor & Stakeholder

Company
International Institution (UNEP, UNICEF, World Bank)
- *Provide communal water infrastructure through their CSR programmes*
- *Raising awareness and building community capacity*

Keputih Community
- *Deciding the planning and the available and suitable options*
- *Managing their existing infrastructure and funding*
- *Maintaining the overall infrastructure and kampung system*

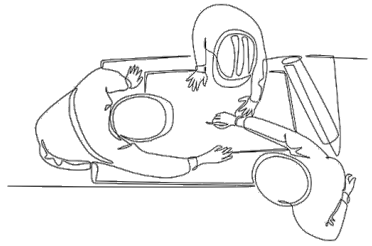
Surabaya Municipality
- *Formalising land ownership*
- *Clearing and restoring the riverbank zone*
- *Provide funding support, housing allowance and retrofit system*
- *Providing kampung improvement programme*





Riverbank Community
(Paguyuban Warga Strenkali Surabaya)
- *Advocating & strengthing the local community*

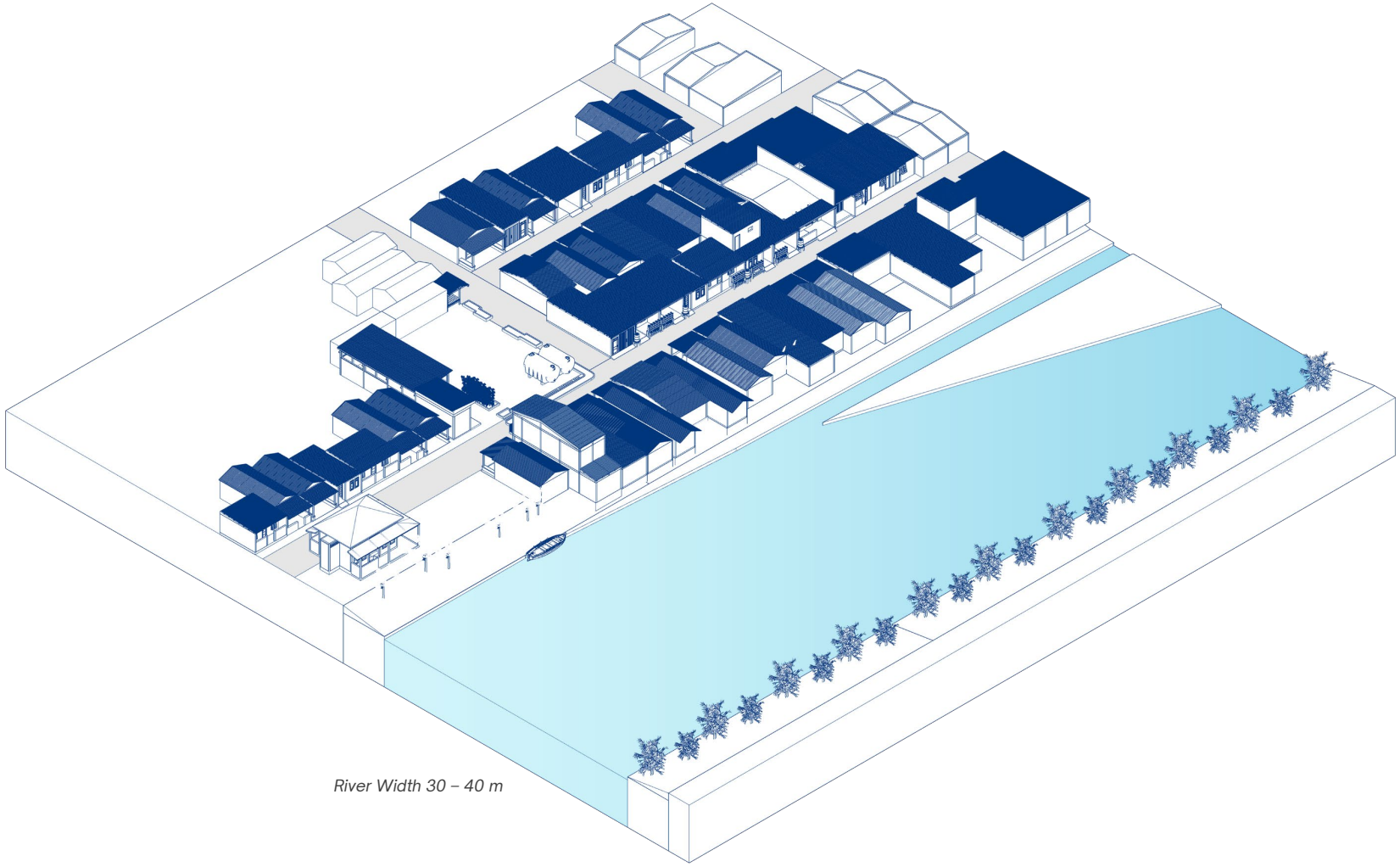
Local Educational Institutional
(ITS, Unair, UPN Veteran Jatim)
- *Provide technical research about water system & water quality*
- *Provide water infrastructure through their social projects/pilot projects*
- *Raising awareness and building community capacity*



Community Architect
(Arkom Jawa Timur)
- *Guided the kampung planning process & decision making*
- *Supporting technical drawings & insight*

Masterplan

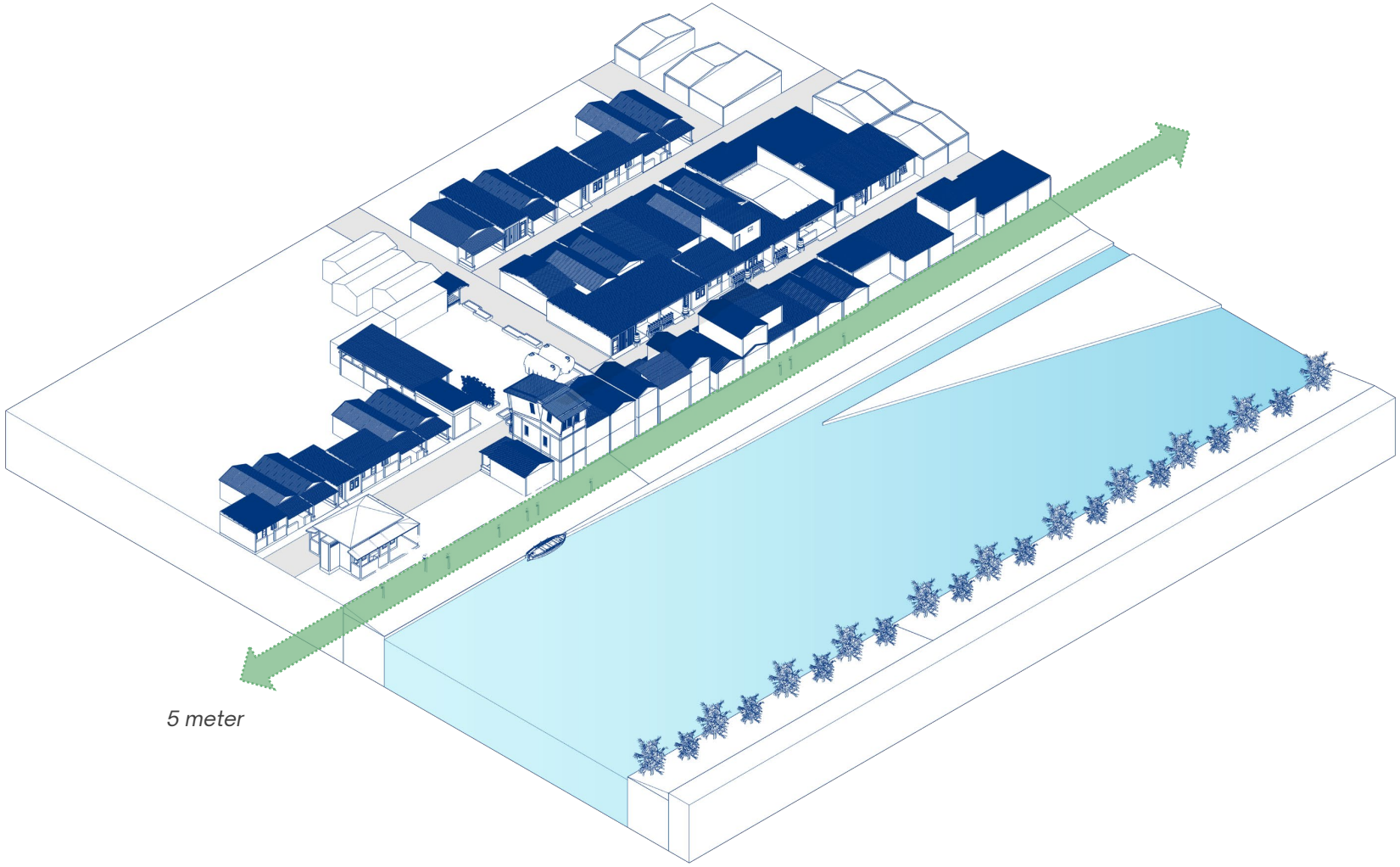
Existing Condition



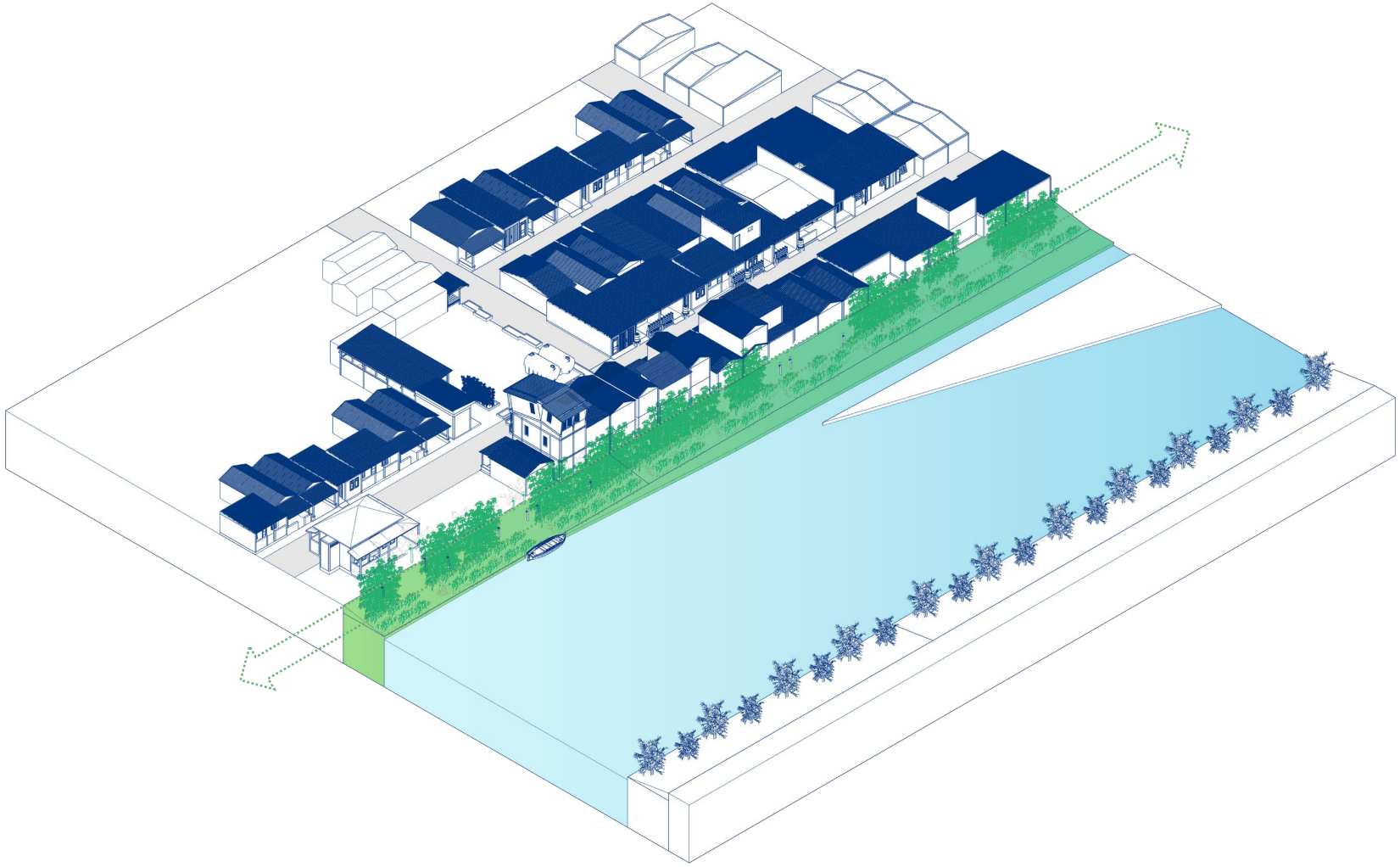
River Width 30 – 40 m

Masterplan

Phase 1 *| Clearing Riverbank Area & Land Formalisation*



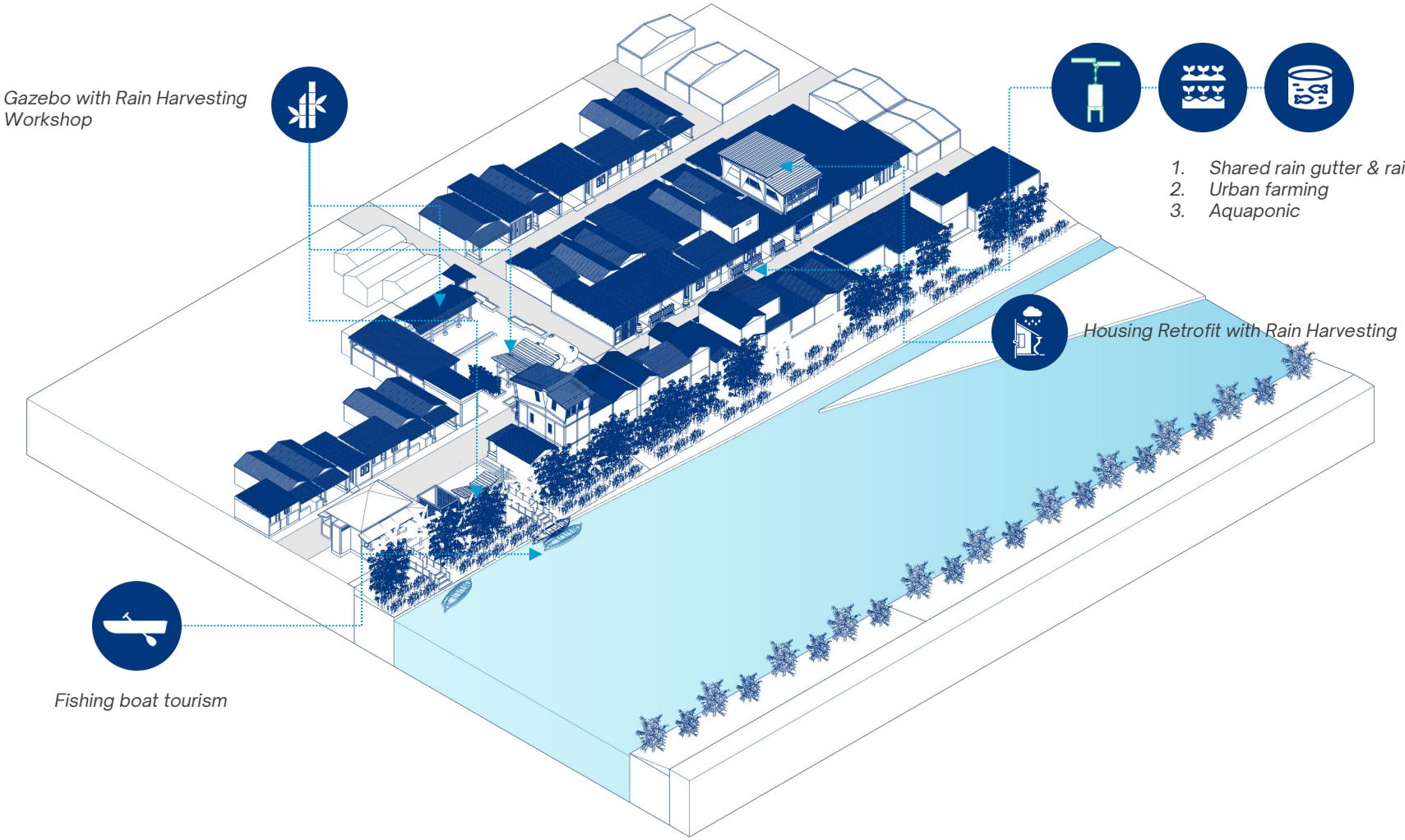
Phase 2 | *Riparian Restoration*



Masterplan

Phase 3 *| Kampung retrofit within communal & household level*

1. *Bamboo Gazebo with Rain Harvesting*
2. *Bamboo Workshop*

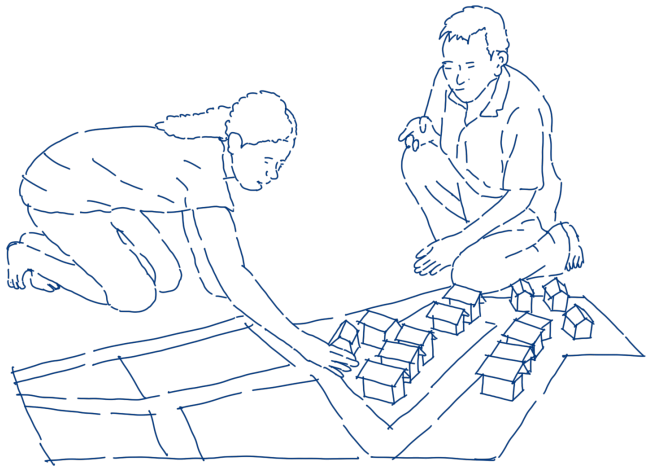


1. *Shared rain gutter & rain barrel*
2. *Urban farming*
3. *Aquaponic*

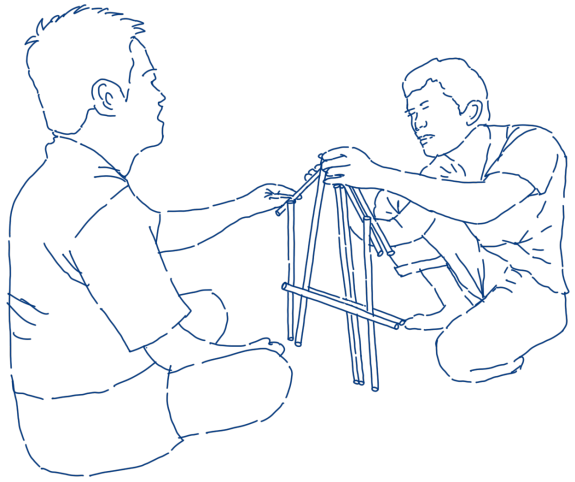
Housing Retrofit with Rain Harvesting

Fishing boat tourism

Planning

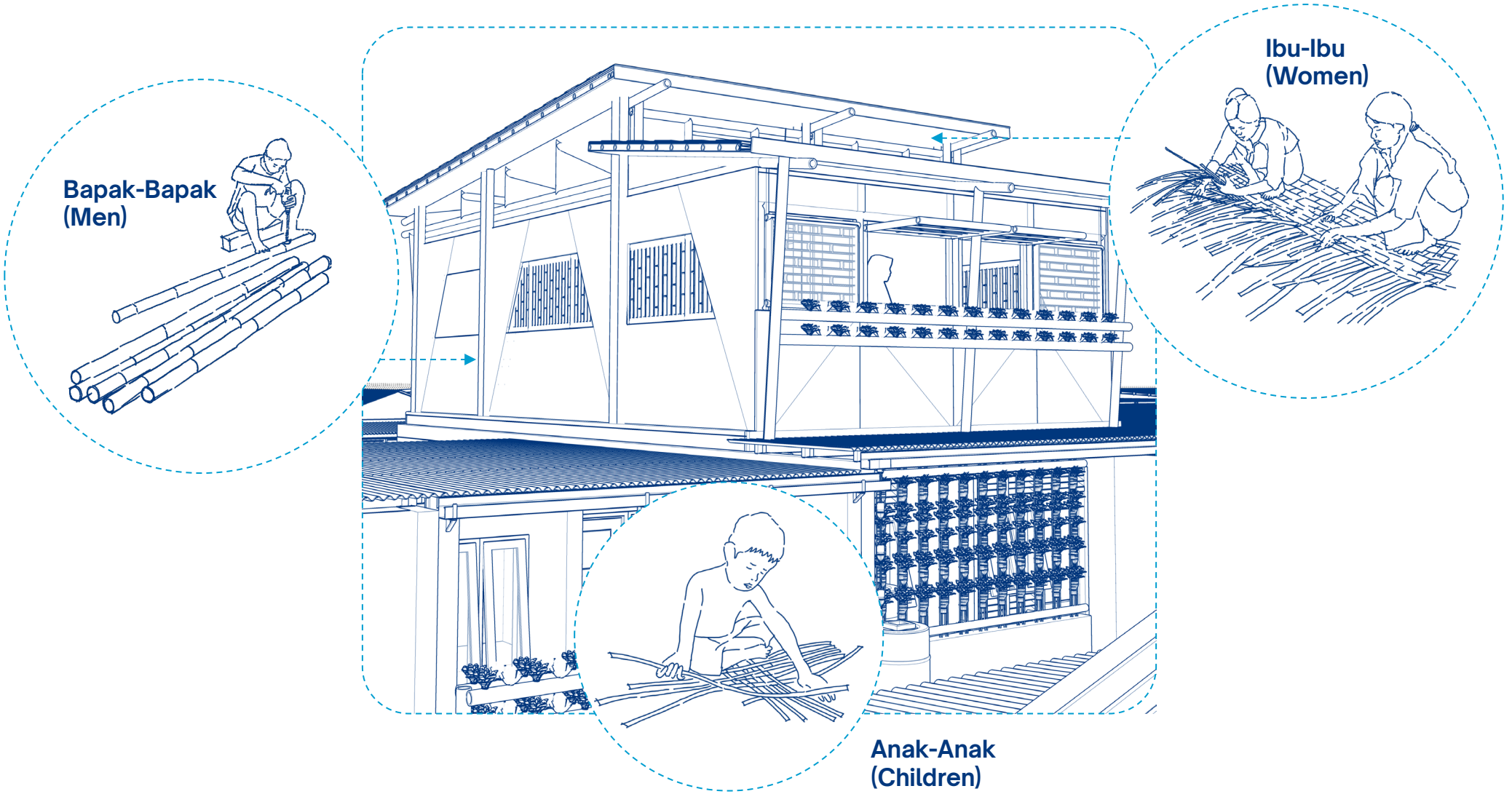


Community planning guided by community architect



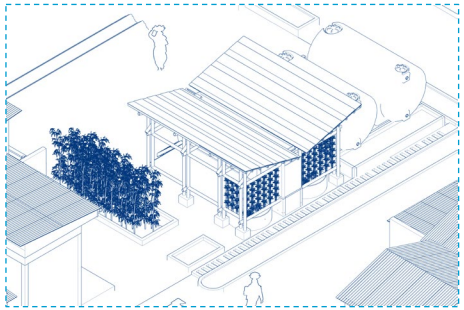
Residents trained with bamboo experts

Team of Builders

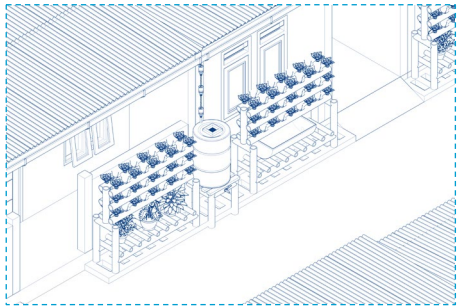


Food Production

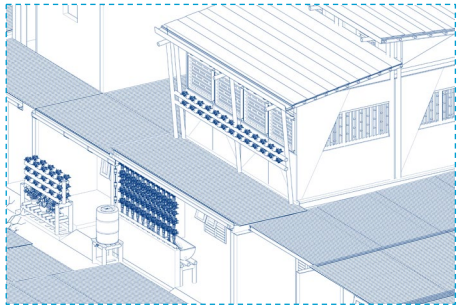
Scale



Kampung Level | *Bamboo Gazebo*

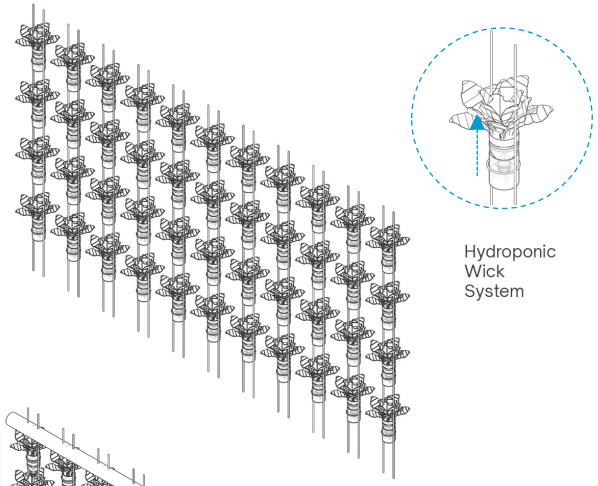


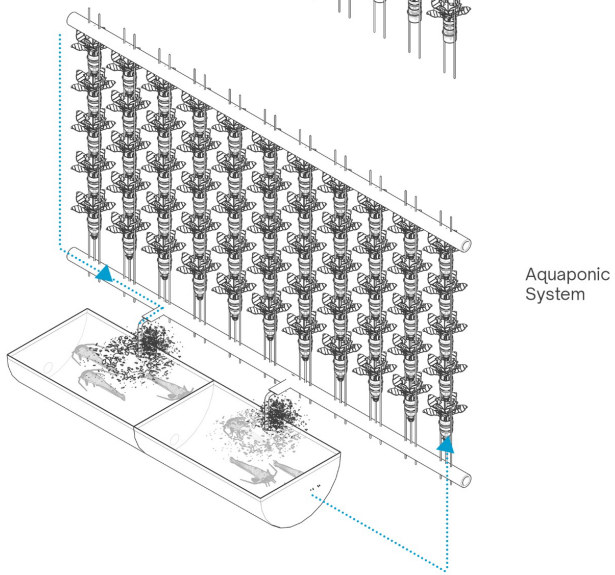
Kampung Street Level | *Shared Food*



Household Level | *Private Hydroponic & Aquaponic*

System





Food Option

Vegetable

Spinach
Spinacia oleracea

Lettuce
Lactuca sativa

Water Spinach
Ipomoea aquatica

Celery
Apium graveolens

Red Chili
Capsicum annuum

Tomato
Solanum lycopersicum

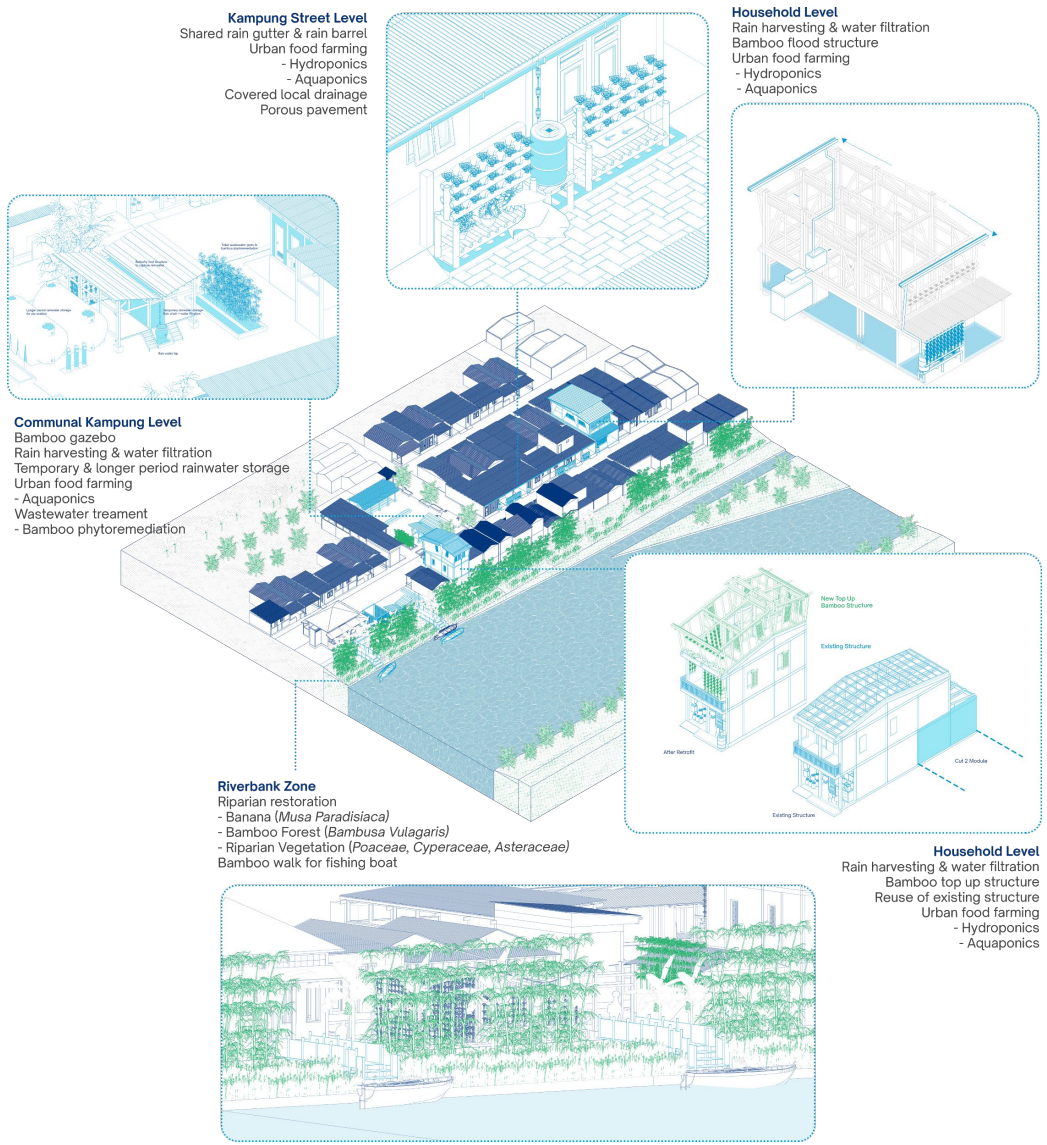
Fish

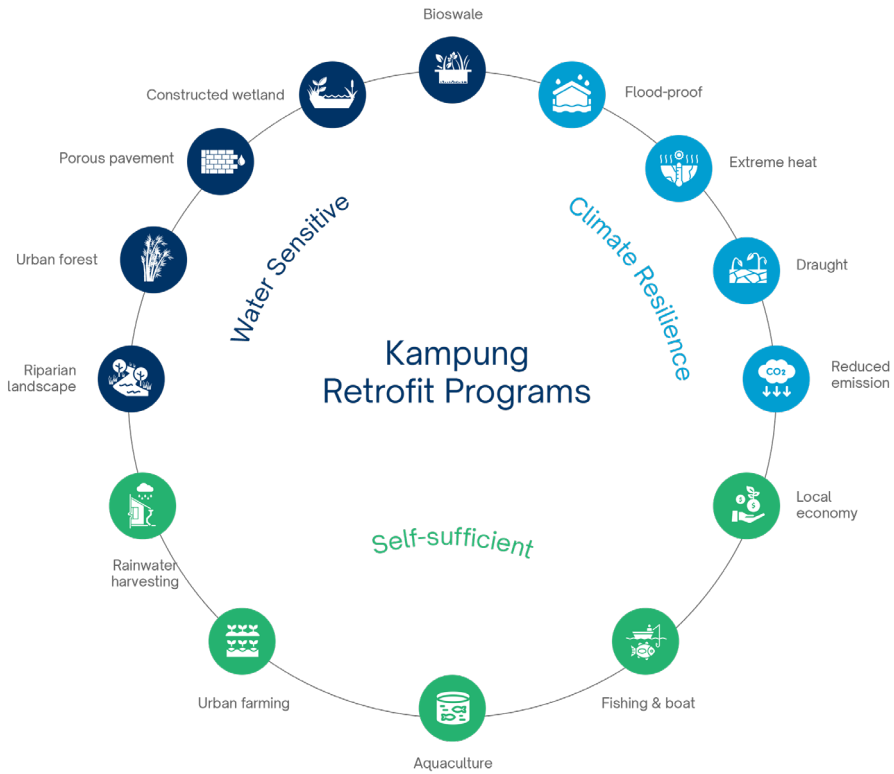
Catfish
Clarias scopoli

Nile Tilapia
Oreochromis niloticus

Gourami
Osphronemus goramy

Conclusion & Reflection





Terima kasih
Thank you
Dank je wel