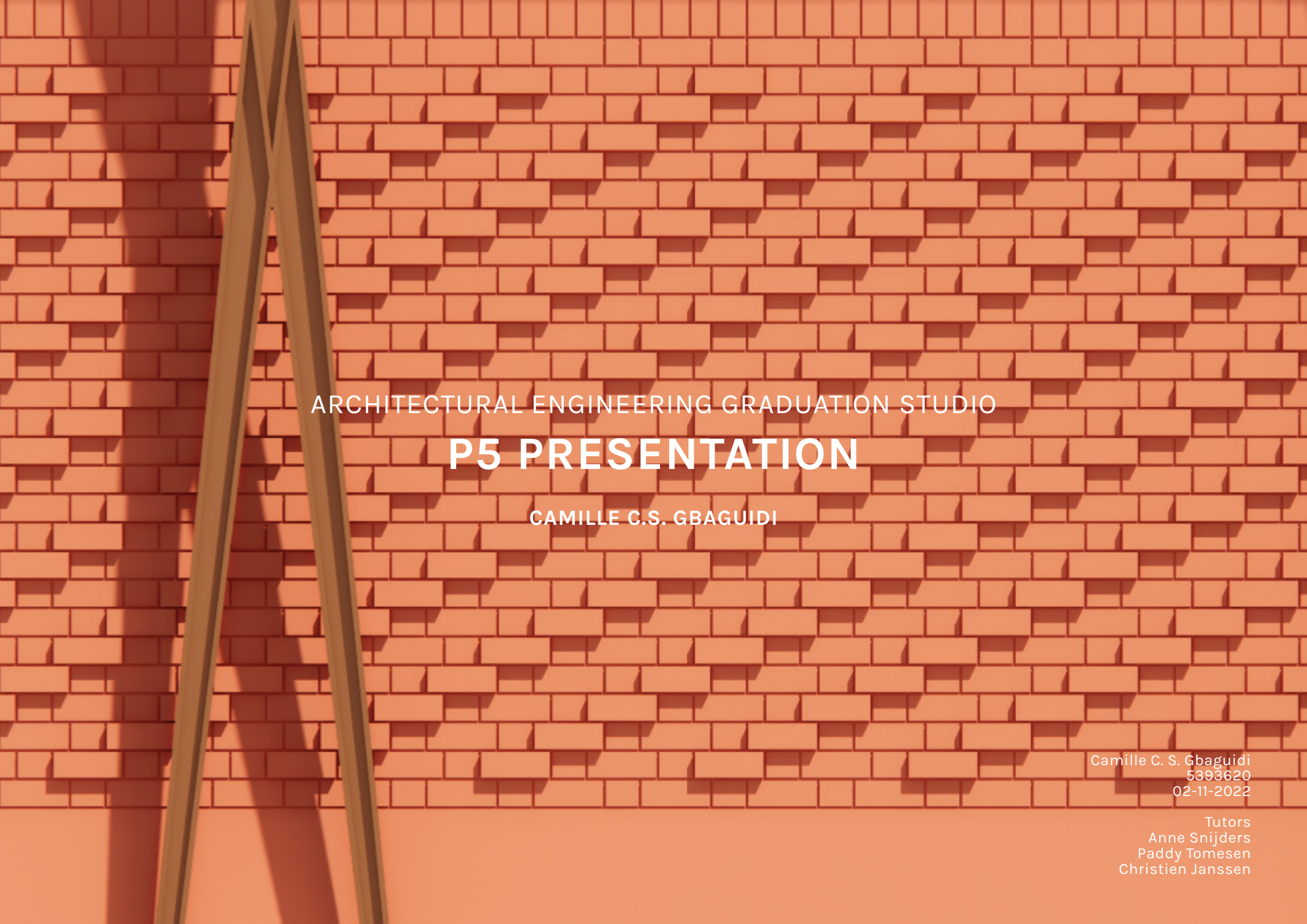

ARCHITECTURAL ENGINEERING GRADUATION STUDIO

P5 PRESENTATION

CAMILLE C.S. GBAGUIDI

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5393620
02-11-2022

Tutors
Anne Snijders
Paddy Tomesen
Christien Janssen

THE ROLE OF EMERGENT AND DEVELOPING COUNTRIES IN THE 21ST CENTURY

A VISION FOR SUSTAINABLE HOUSING DEVELOPMENT IN BENIN

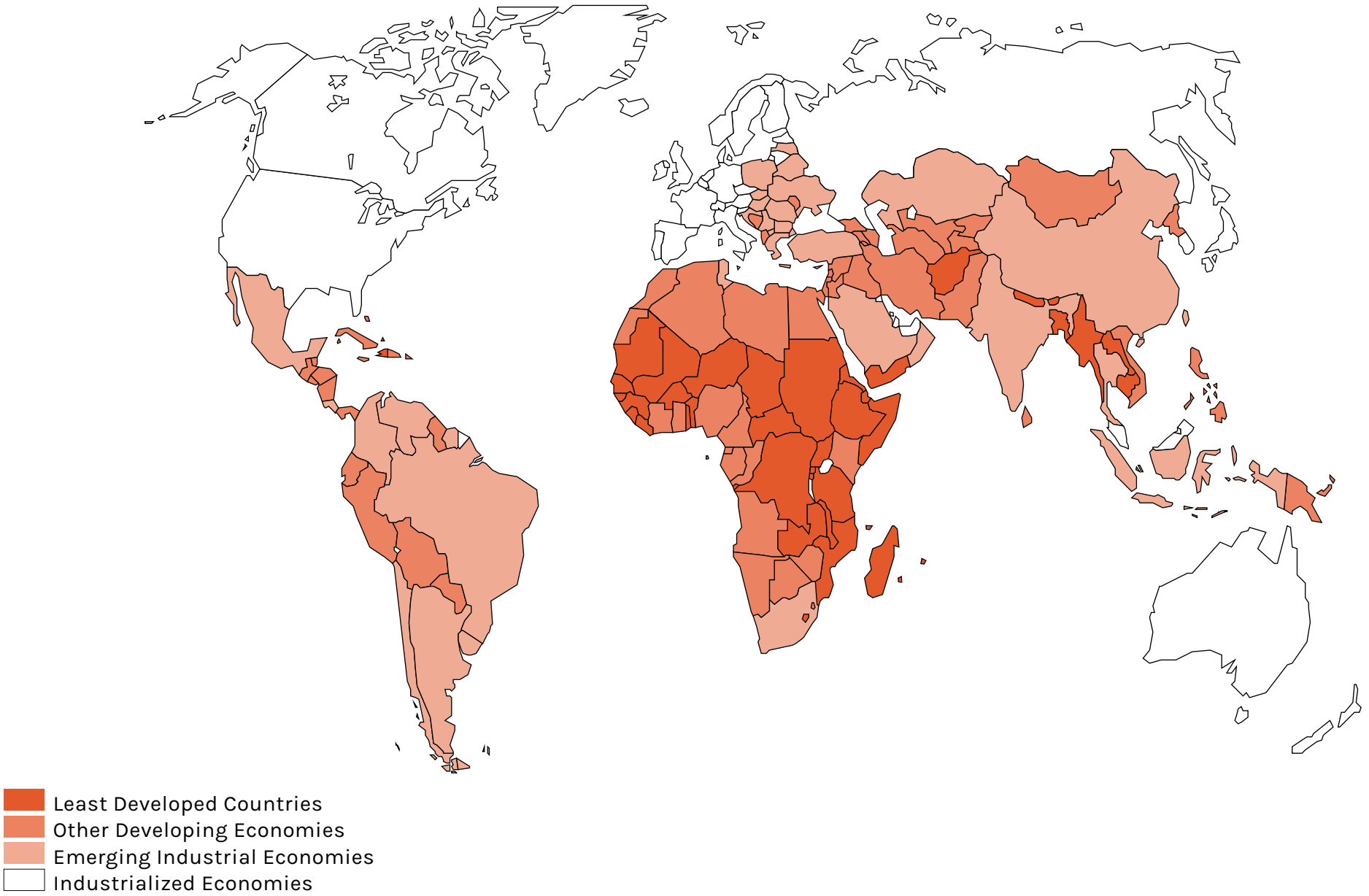
A VISION FOR SUSTAINABLE HOUSING DEVELOPMENT IN BENIN

CONTENT

MOTIVATION

HOUSING PRIORITIES

"The most extensive housing projects will take place outside the industrialised countries in the coming decades."



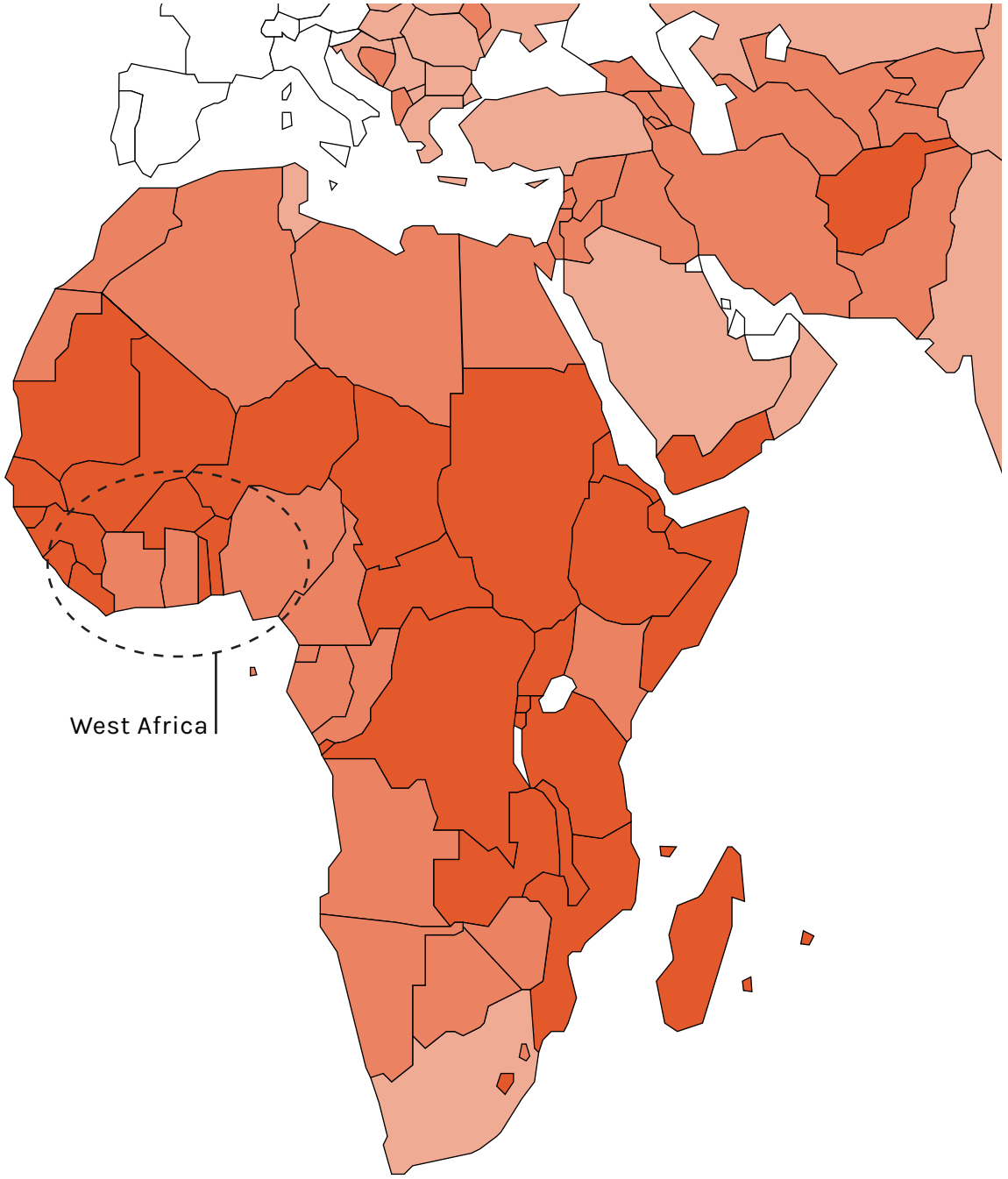
AFRICA BUILTS MORE

For Africa, UN-Habitat predicts that population and urbanization rates will increase more than 50% by 2040 . This also means that the number of **urban dwellings will triple** from 400 million to 1.26 billion by 2050.

80% of buildings in sub-Saharan Africa are not yet built, compared to 30% in Europe .

While it is difficult to generalise given the regional and intraregional disparities, it is clear that the areas concerned will be particularly vulnerable to the consequences of poorly managed massive urbanisation.

Today's choices will have an impact on the decades to come.



CURRENT HOUSING PROJECTS

"Copy-cat architecture that is outdated."

In West Africa currently there is a **housing shortage** estimated at **3.5 million units**. This housing deficit is growing with a yearly rate of approximately 3%.

West Africa is currently in a massive urbanization phase and the respective governments have established mass housing programs:

SENEGAL +100K

TOGO +20K

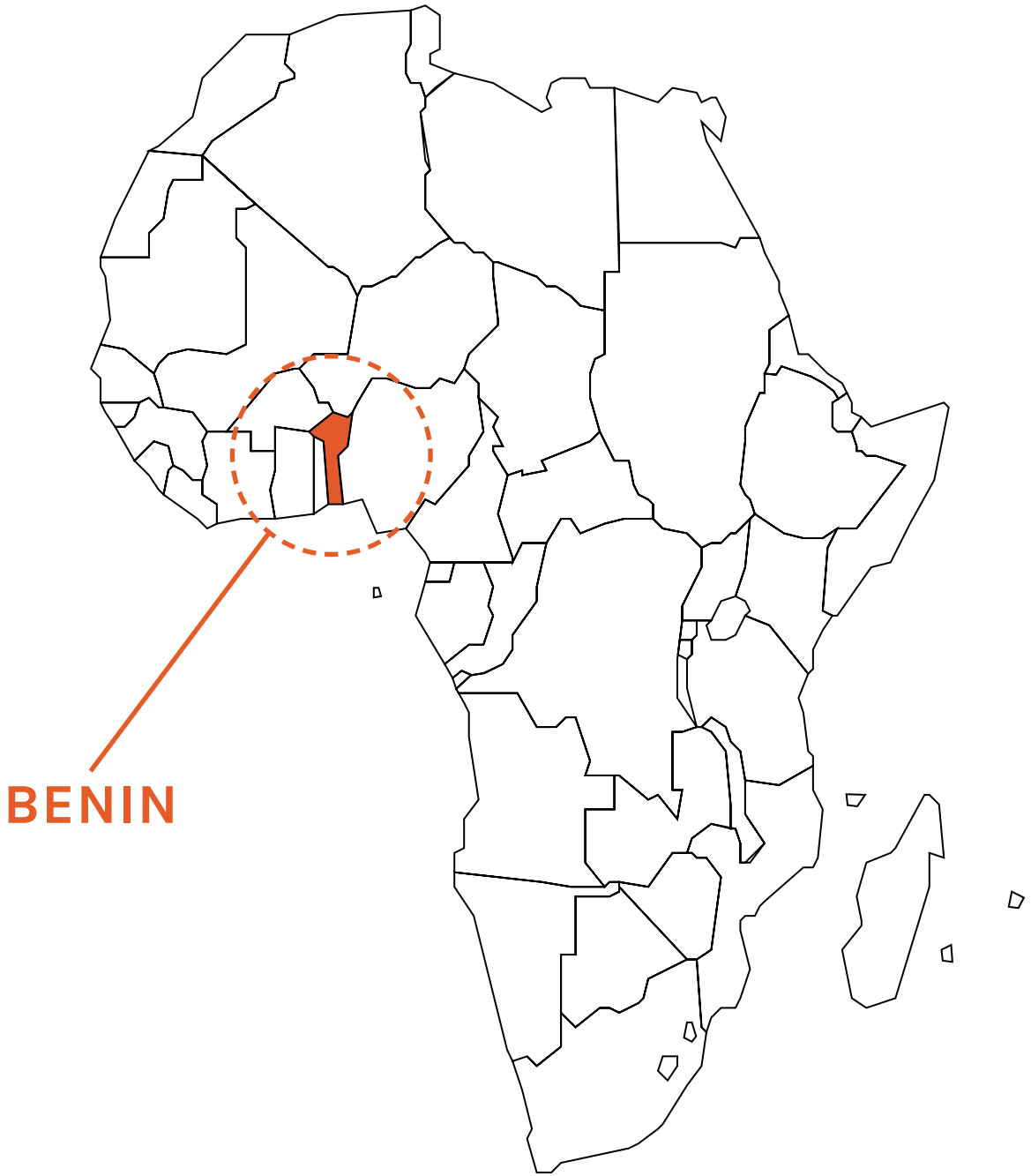
GHANA +100K

MALI +50K

NIGERIA +300K

CONTEXT

PLACE OF FOCUS

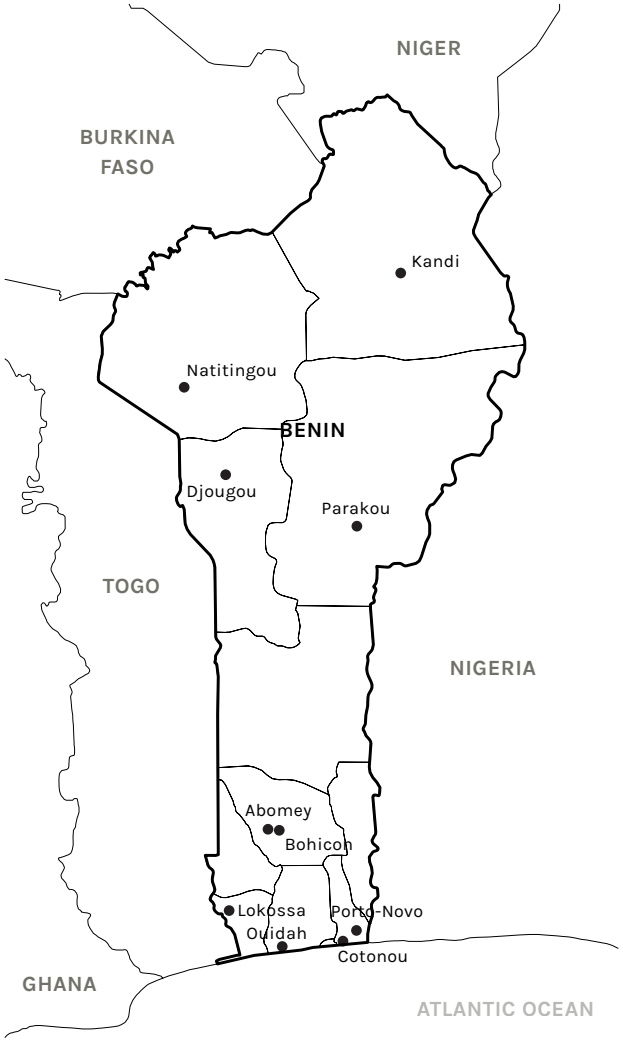


PLACE OF FOCUS

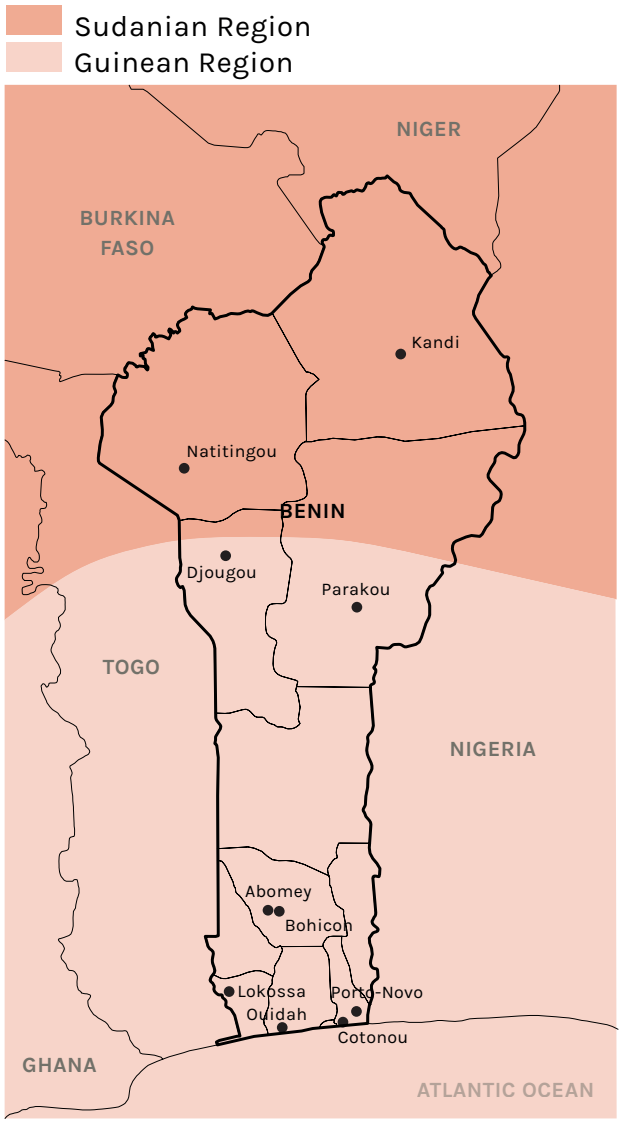
Area **114 763 km2**
Population **12.5 Mio**

Administrative Capital
Porto-Novo

Capital of Trade
and Largest City
Cotonou



PLACE OF FOCUS



PLACE OF FOCUS

Avg temperature 27.5 c with a very low amplitude between day and night = no nead for heating, no nead for insulation

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Avg precipitation 1245mm per year = 47% more then in the Netherlands

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8hrs of sunshine per day
Avg 1400 kWh per m2 oer year in the southern part of the country

PLACE OF FOCUS

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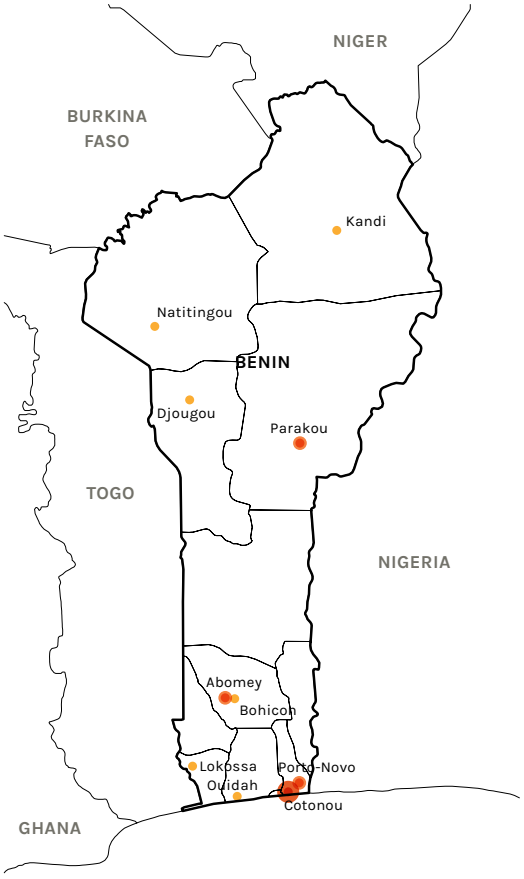
Avg precipitation 1245mm per year = 47% more then in the Netherlands

8hrs of sunshine per day
Avg 1400 kWh per m2 oer year in the southern part of the country

Avg humidty 84%, ventilation is key

PLACE OF FOCUS

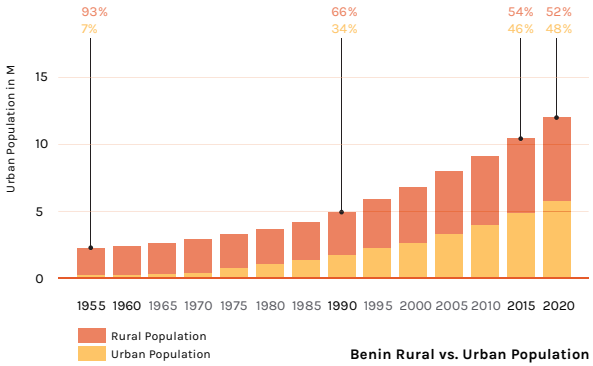


10 Largest cities

+ 500k
1. Cotonou

+100k-500k
2. Porto-Novo
3. Parakou
4. Abomey

<100k
5. Djougou
6. Bohicon
7. Kandi
8. Natitingou
9. Ouidah
10. Lokossa



Benin Rural vs. Urban Population

CURRENT CONSTRUCTION

Overdimensioned concrete construction

"In Benin, today, when we talk about new construction, we talk about concrete buildings and this, is a reality that we have to face. "

J.P. Houndeffo

CURRENT CONSTRUCTION

Overdimensioned concrete construction

No regard for climate design

CURRENT CONSTRUCTION

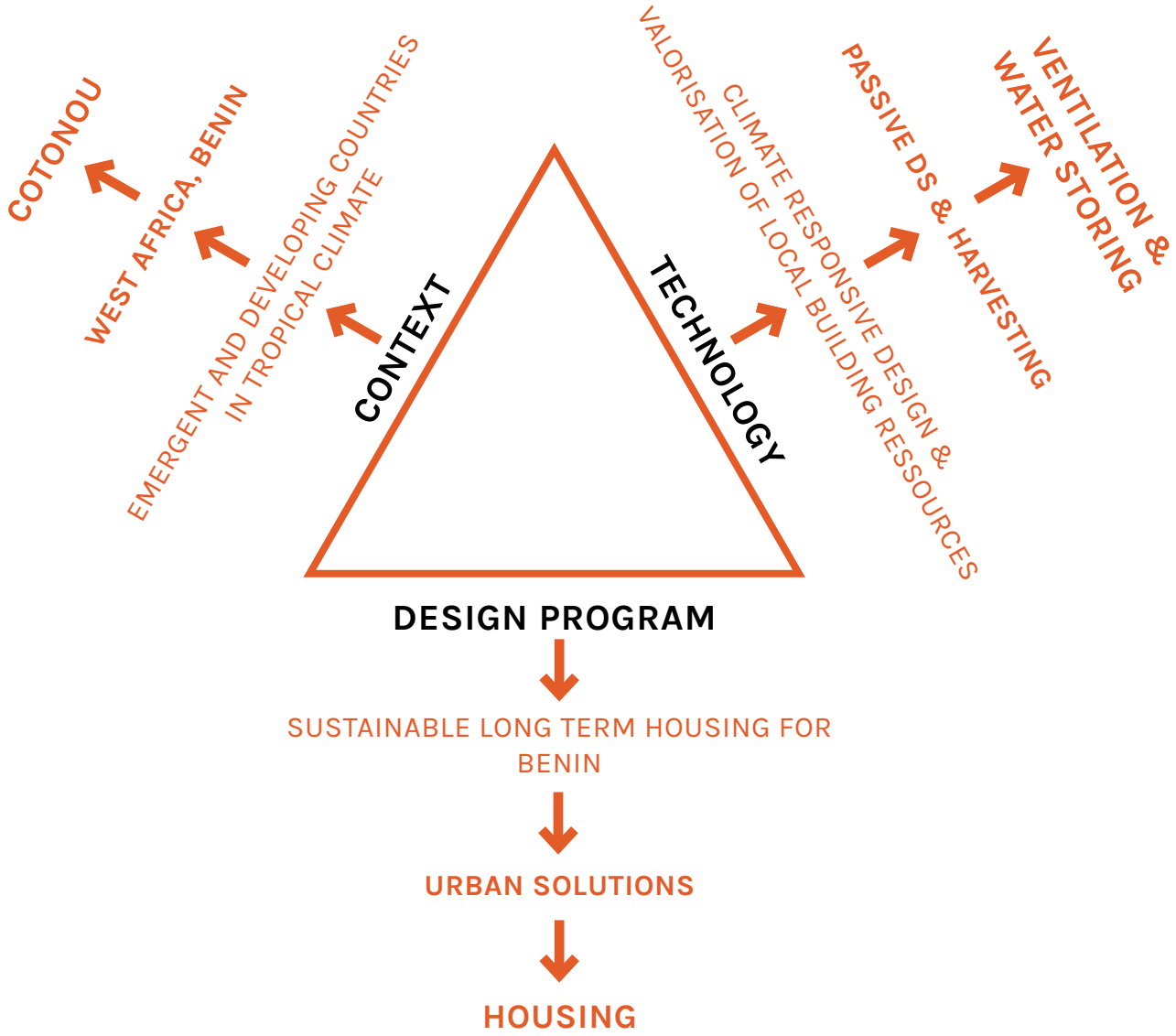
Overdimensioned concrete construction

No regard for climate design

Use of concrete at any scale and for all the building parts

PROJECT VISION

DESIGN METHODOLOGY



DESIGN METHODOLOGY

SYMBIOSIS BETWEEN SCIENCE & CULTURE

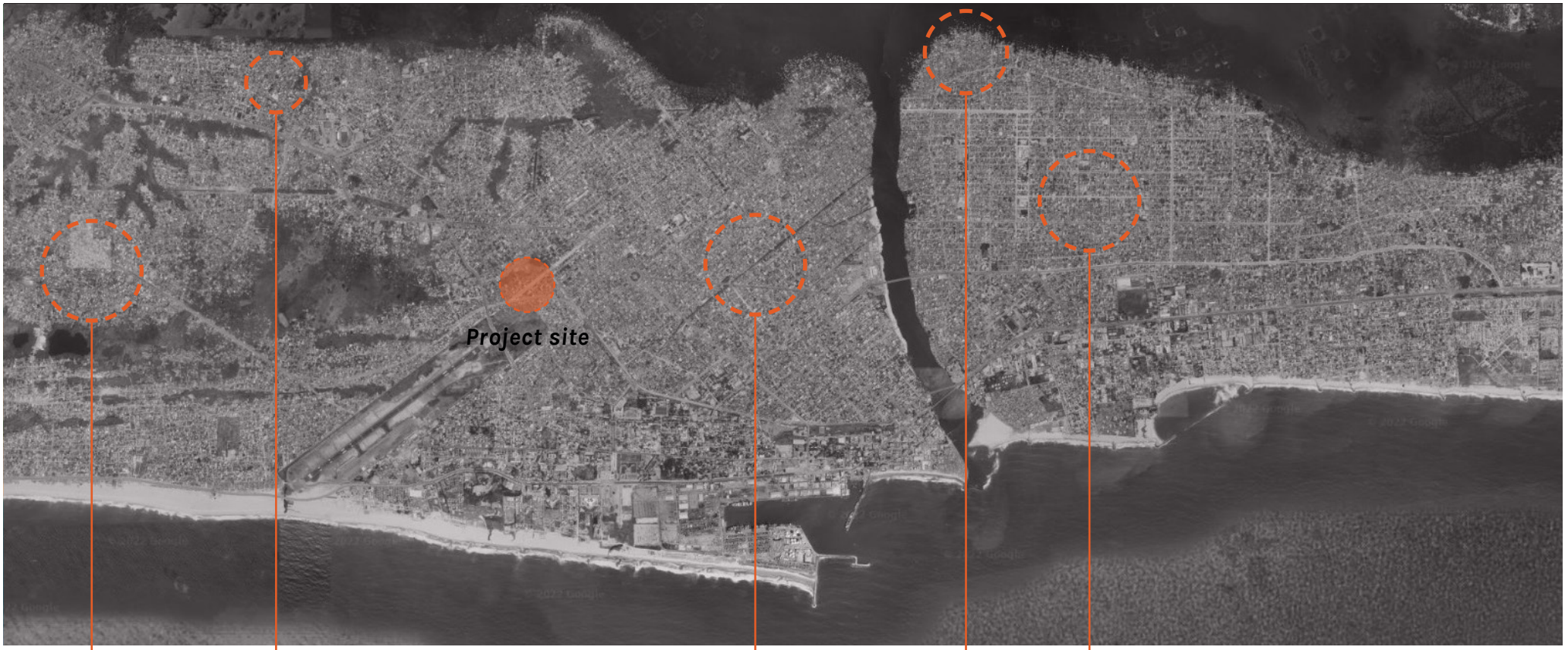
THE MEASURABLE & NON MEASURABLE

URBAN NARRATIVE

PROJECT SITE

PROJECT SITE

HOUSING BLOCK CONCEPT



Informally grown structure

Colonial structure

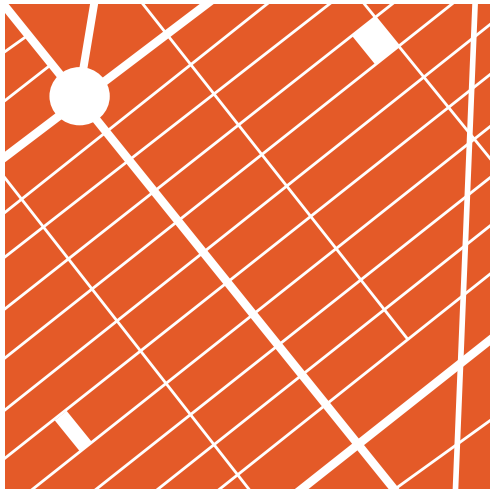
Informally grown structure on water

City growth grid

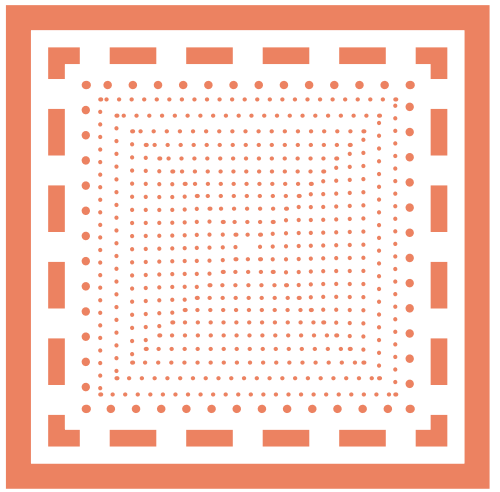
HOUSING BLOCK CONCEPT

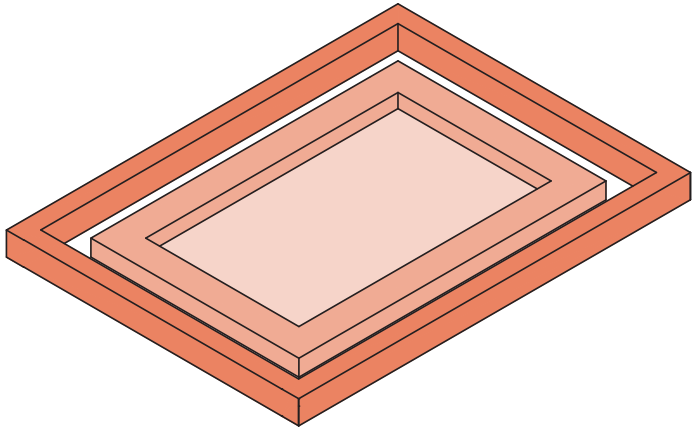
Grown Structure ***vs.*** ***Planned Structure*** **=** ***Hybrid Structure***

Expresses the needs of the users

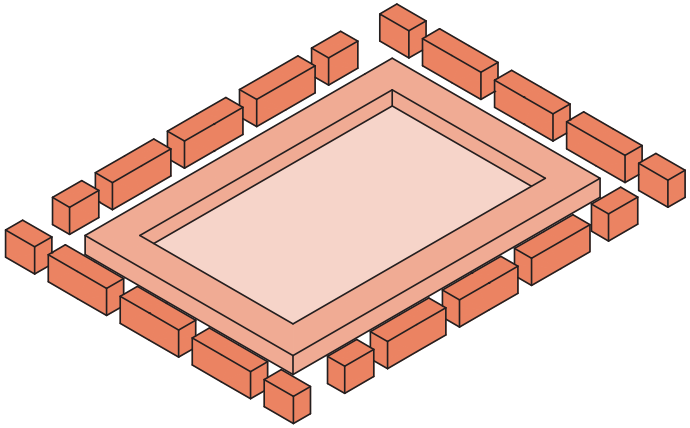


Meets the requirements of a modern city (technical development, traffic, orientation etc.)

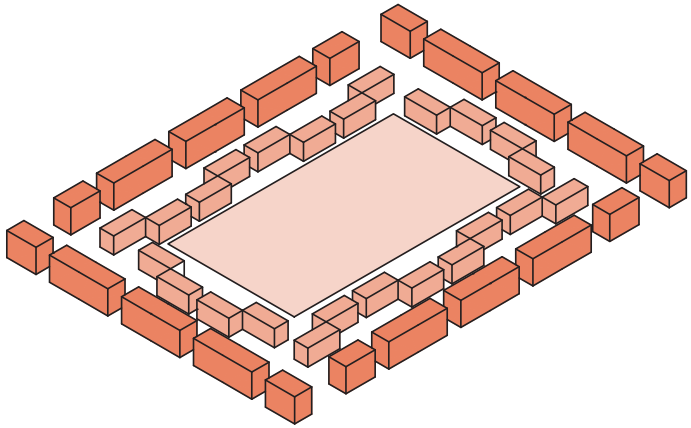




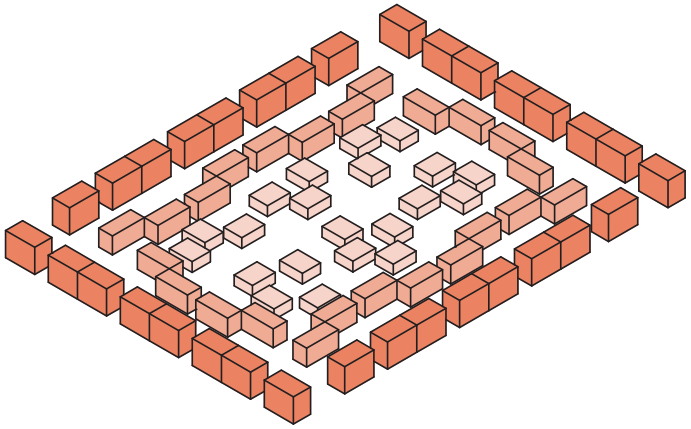
1. 3 Layers



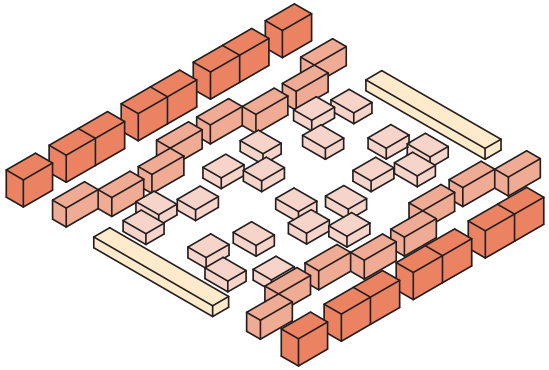
2. Divide for circulation and ventilation



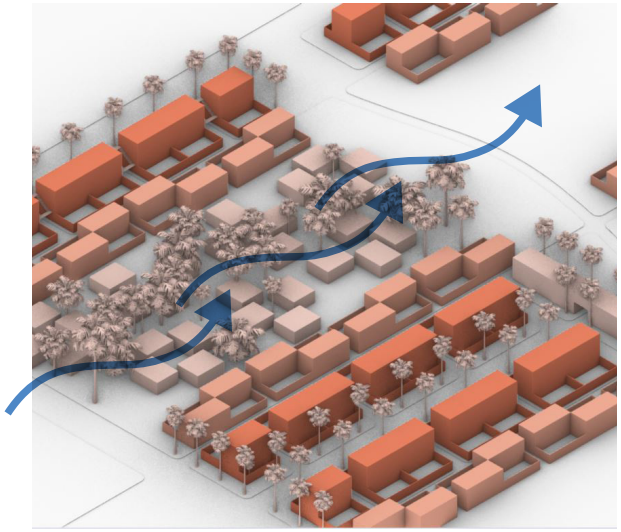
3. Shift for ventilation



4. Scater and cluster

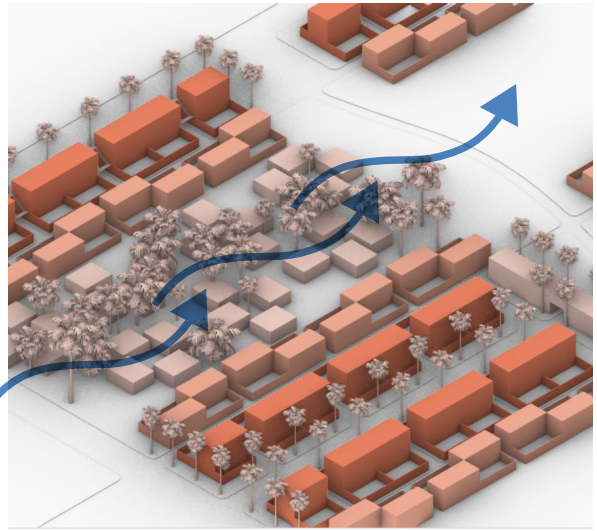


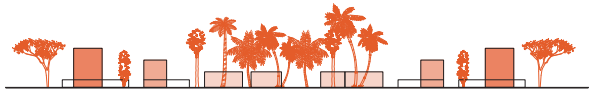
5. Lower the edges that are perpendicular to prevailing wind

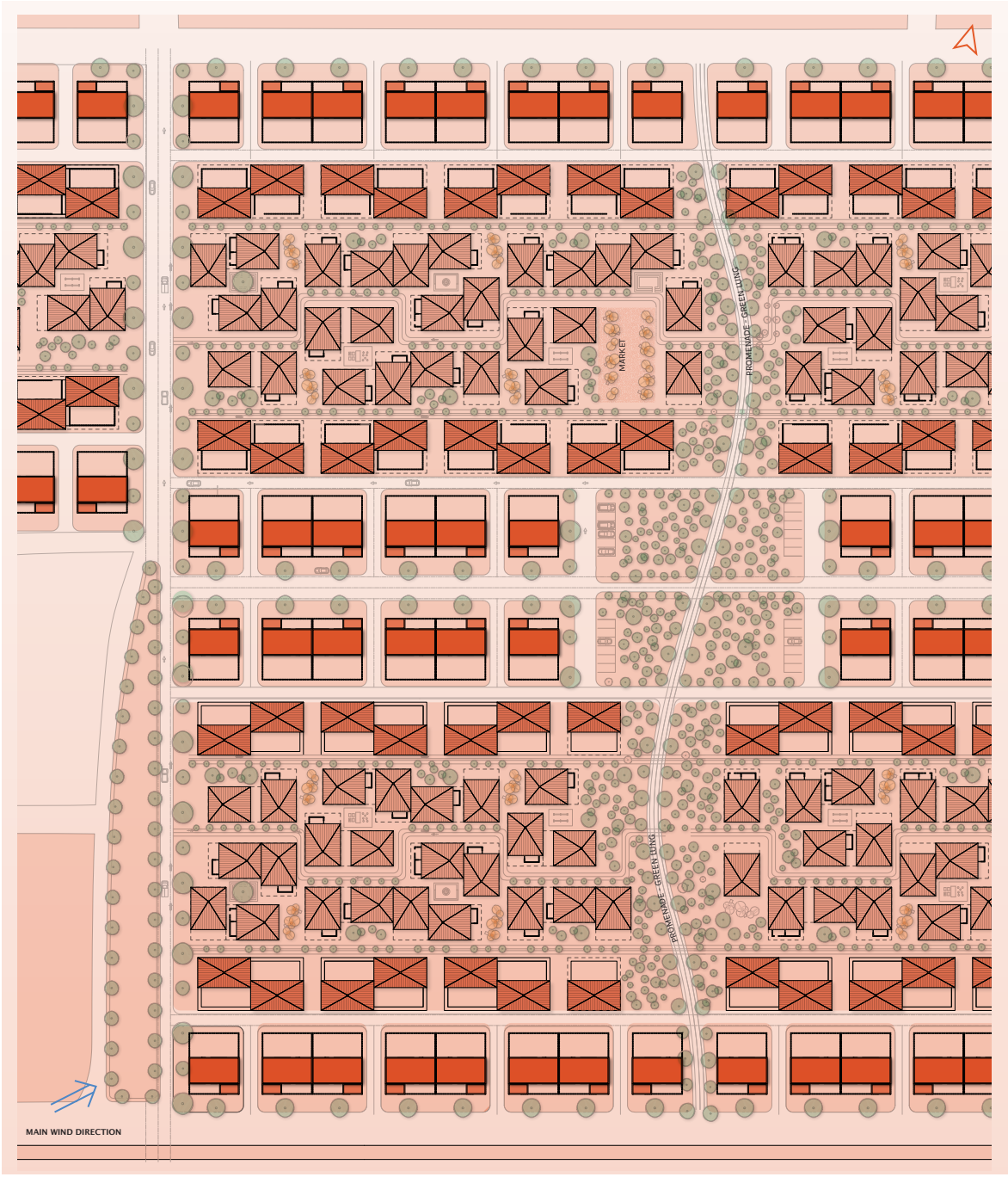


6. Add vegetation for green ventilation corridors

MASTERPLAN






MARKET
PROMENADE - GREEN LUNG
PROMENADE - GREEN LUNG
MAIN WIND DIRECTION

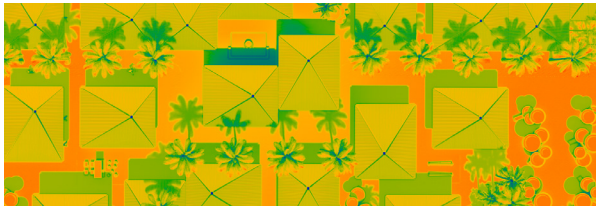
CREATING HIERARCHY

Climate Concept

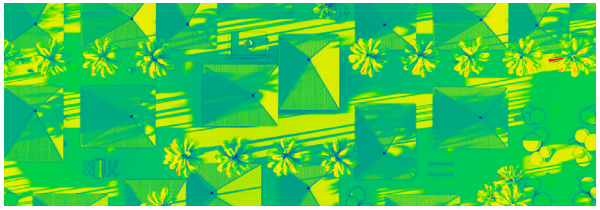
The horizontal streets of the overall housing block are oriented in Southwest. The block itself is structured as a valley to protect the neighbourhood from the noise of the street. At the centre of the block a green lung, or shadow umbrella is becoming a place for social activities, gathering or crossing the block shaded by the sun. The family house and generation house benefit of their own micro-climate within they property due to a garden.

Heat map

10am



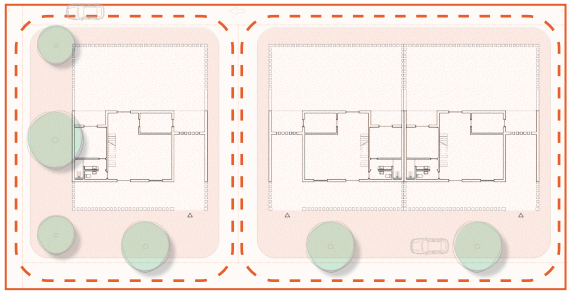
12am



5pm

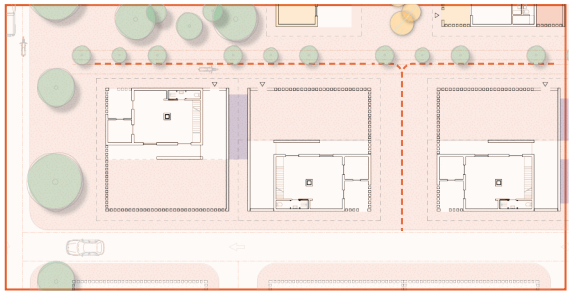
CREATING HIERARCHY

Access Concept



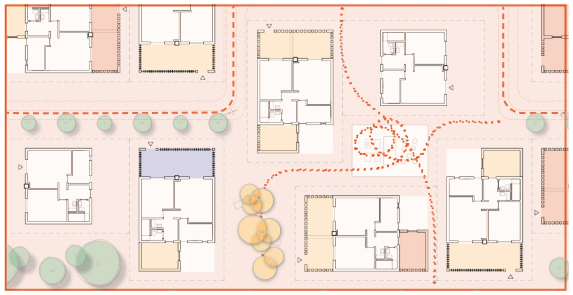
Access by Car

Generations House and Family House are fully accessible by car and are provided with a parking spot on their property.



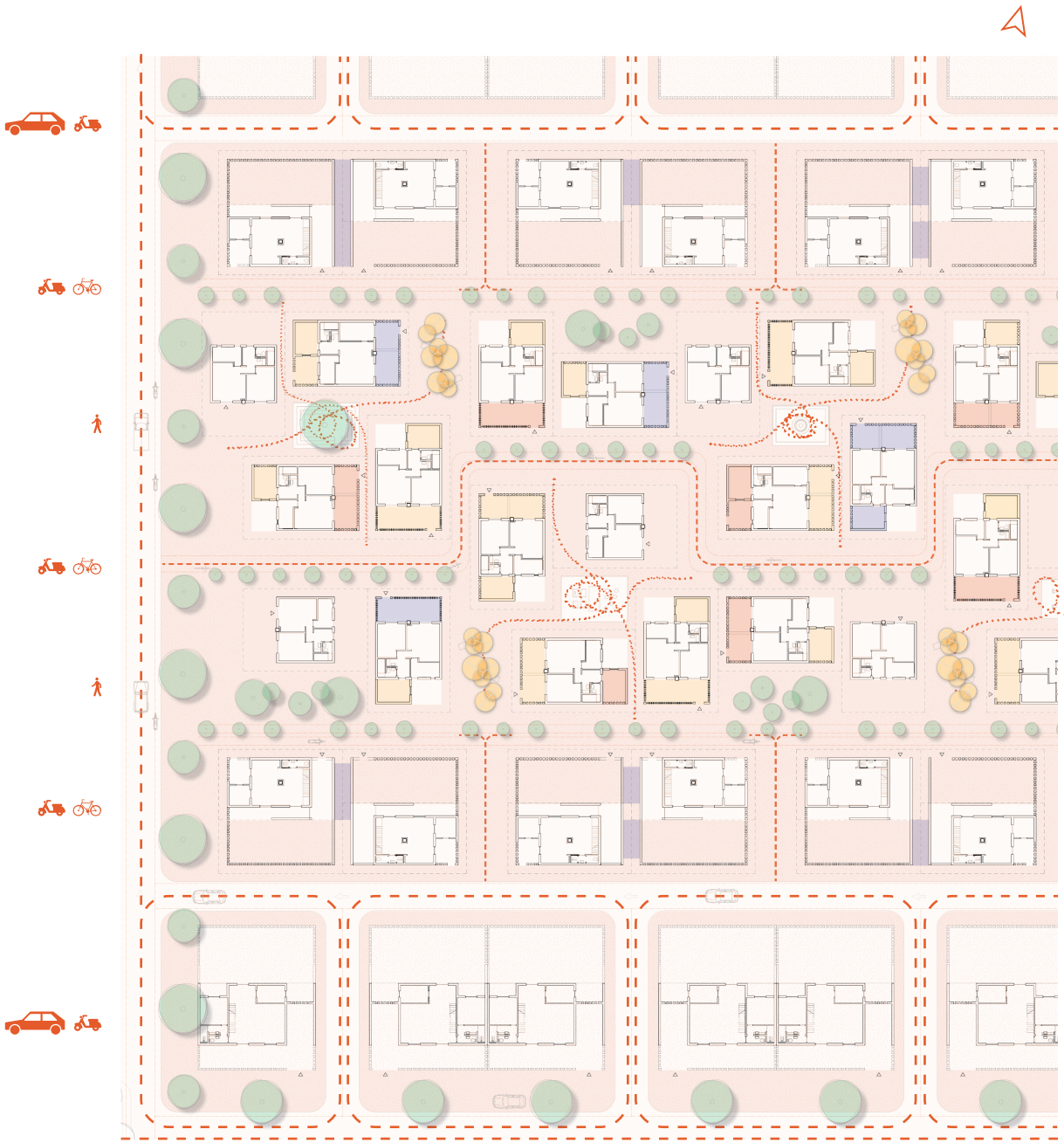
Access by Scooter

Beyond the point of family houses traffic is slowed down and we are entire a zone accessible by scooter and bikes, allow to easily access the flats in the inner part of the block.



Pedestrian zone

The centre part of the housing block is reserved to pedestrians. Here the residents can gather and children can play safely.



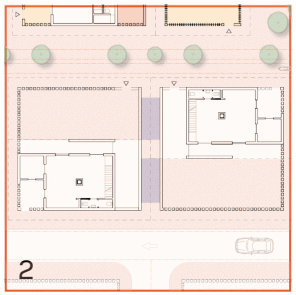
CREATING HIERARCHY

Housing Concept

People and families from different social classes live in the housing block. Accordingly, I have developped 3 different types of houses.

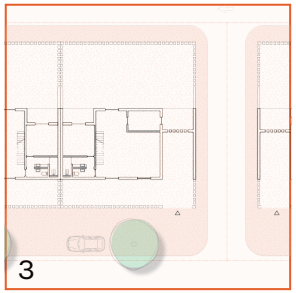
Starter family house

1 Floor
Type: 1 flat
Plot size: 100 m2
Habitable Space: max app 80 m2
Persons: 1-3



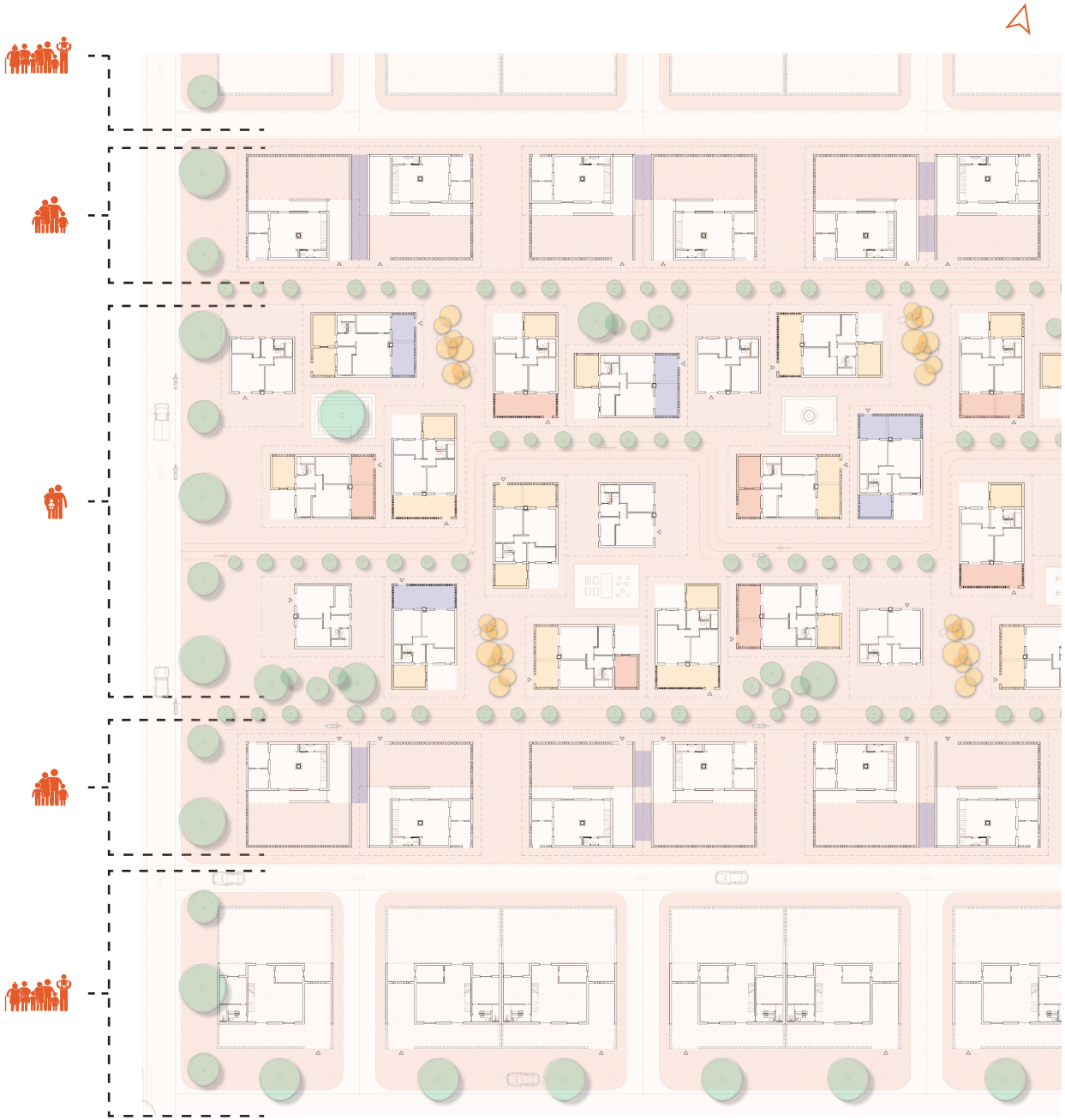
Family House

2 Floors
Type: 1 house
Plot size: 168 m2
Habitable Space: 84 m2
Persons: 4-6



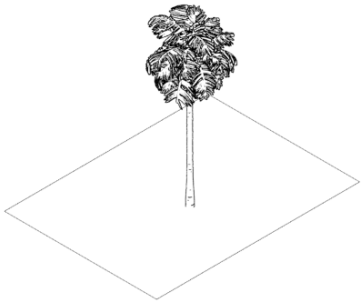
Generations House

3 Floors
Type: 3 flats
Plot size: 224 m2
Habitable Space: 240 m2
Persons: 10-12

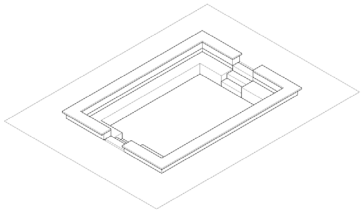


CREATING HIERARCHY

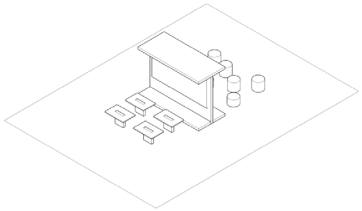
Social Concept



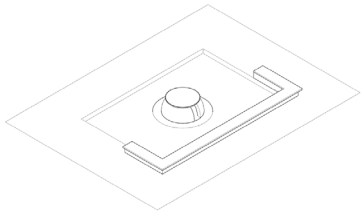
UNDER A TREE



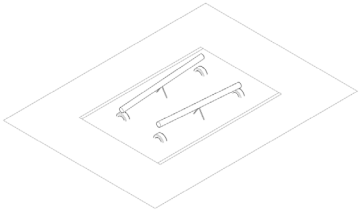
GATHER



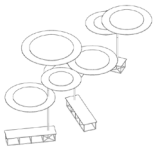
EDUCATION



OUTDOOR COOKING



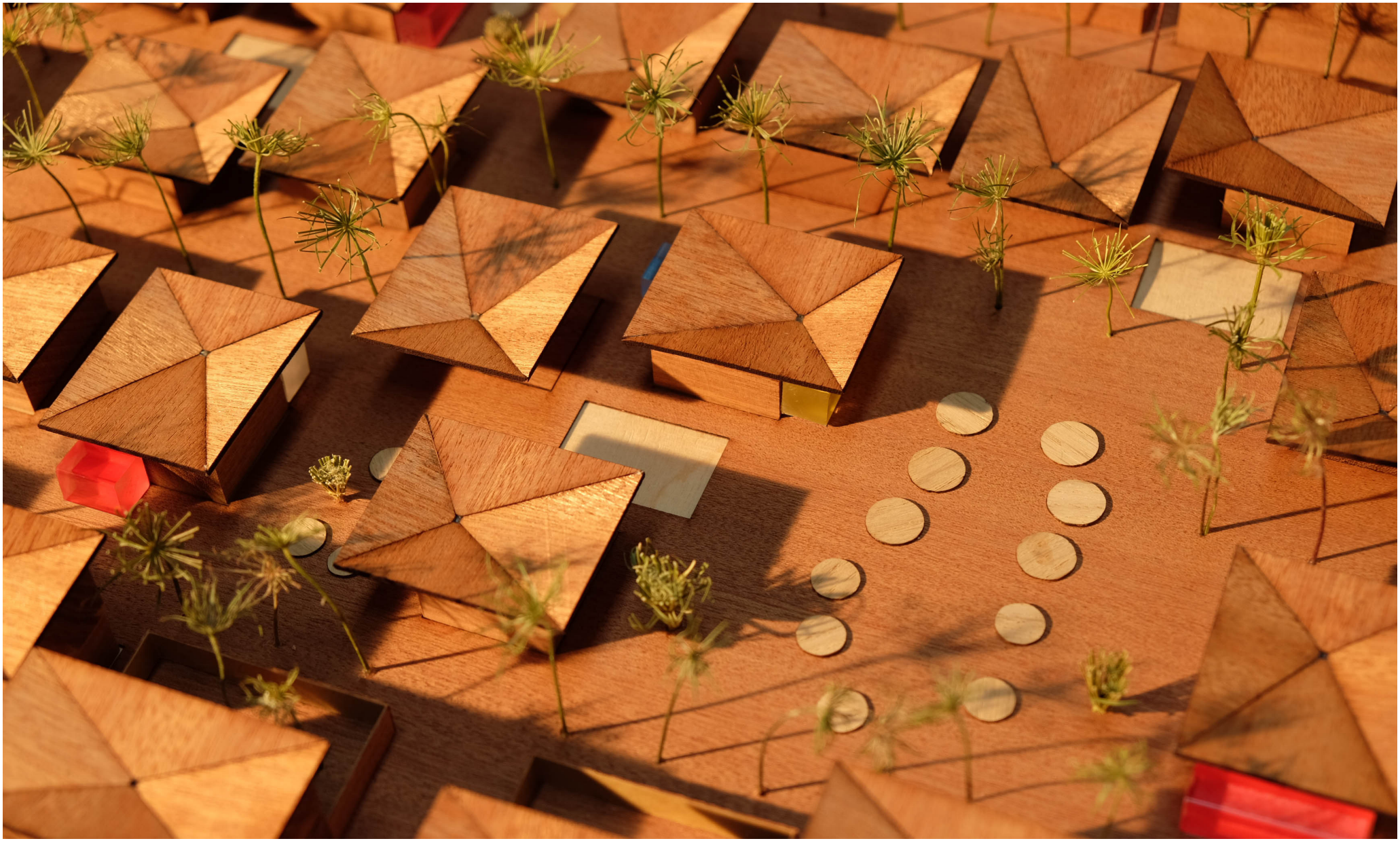
PLAYGROUND



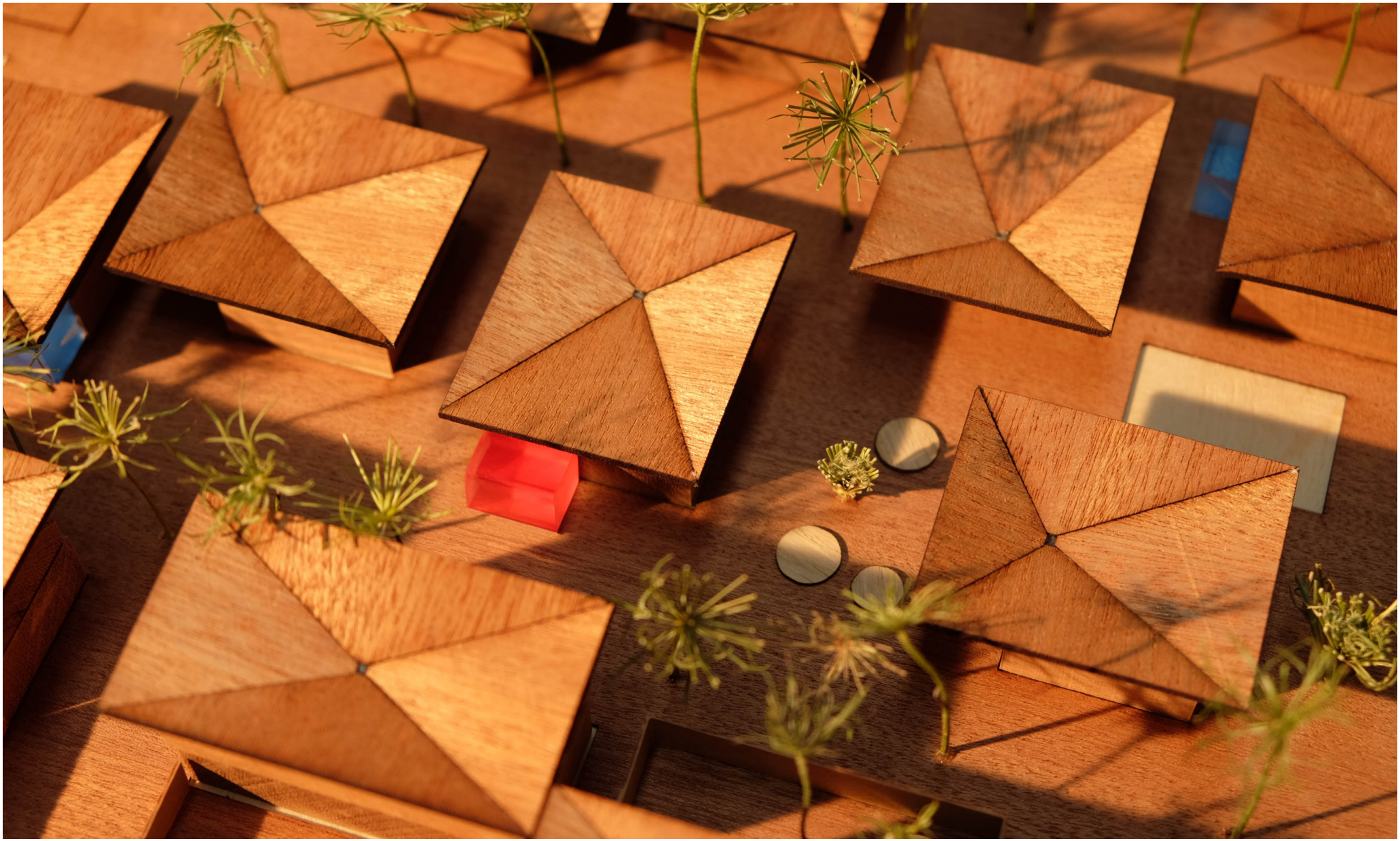
PUBLIC OBJECTS

GREEN LUNG

MARKET

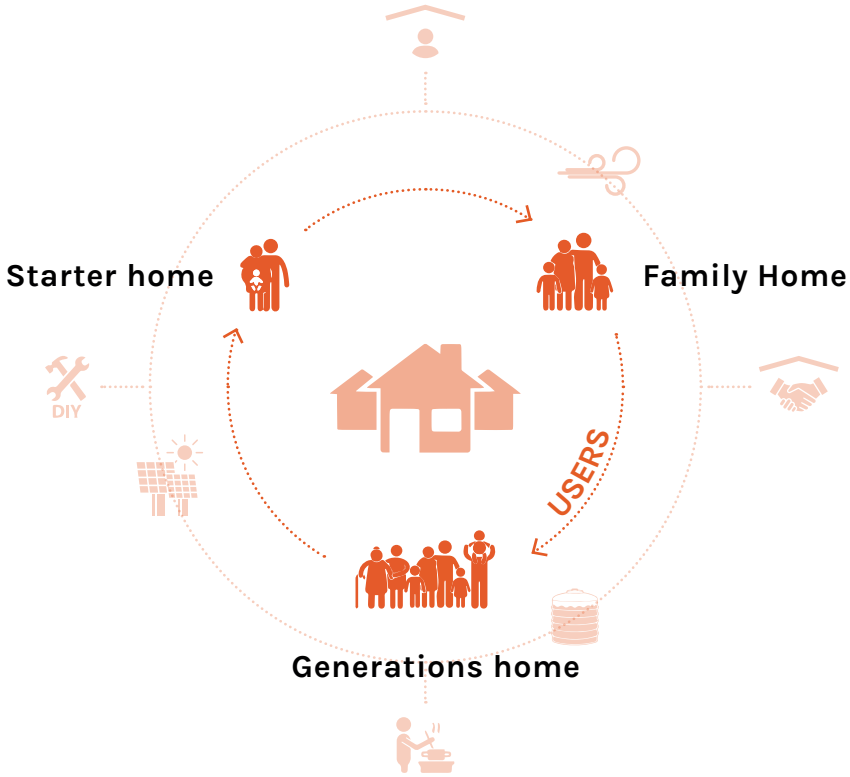


HOUSING & IN-BETWEEEN SPACES

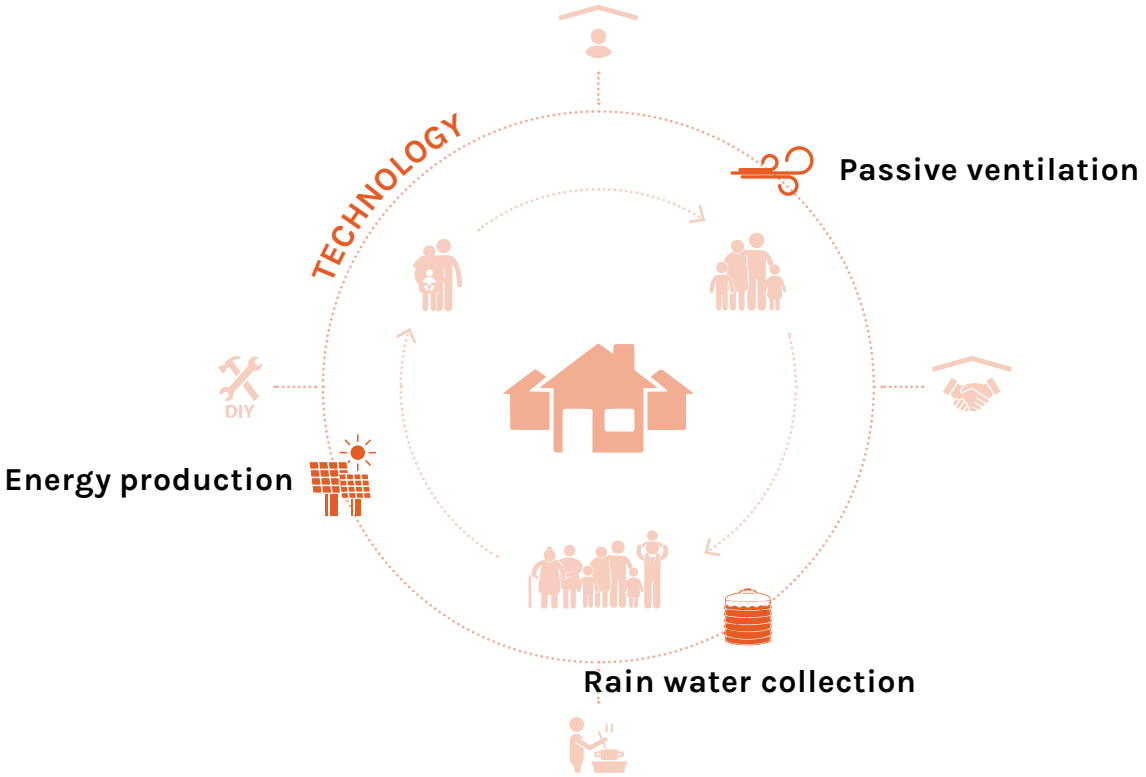


HOUSING NARRATIVE

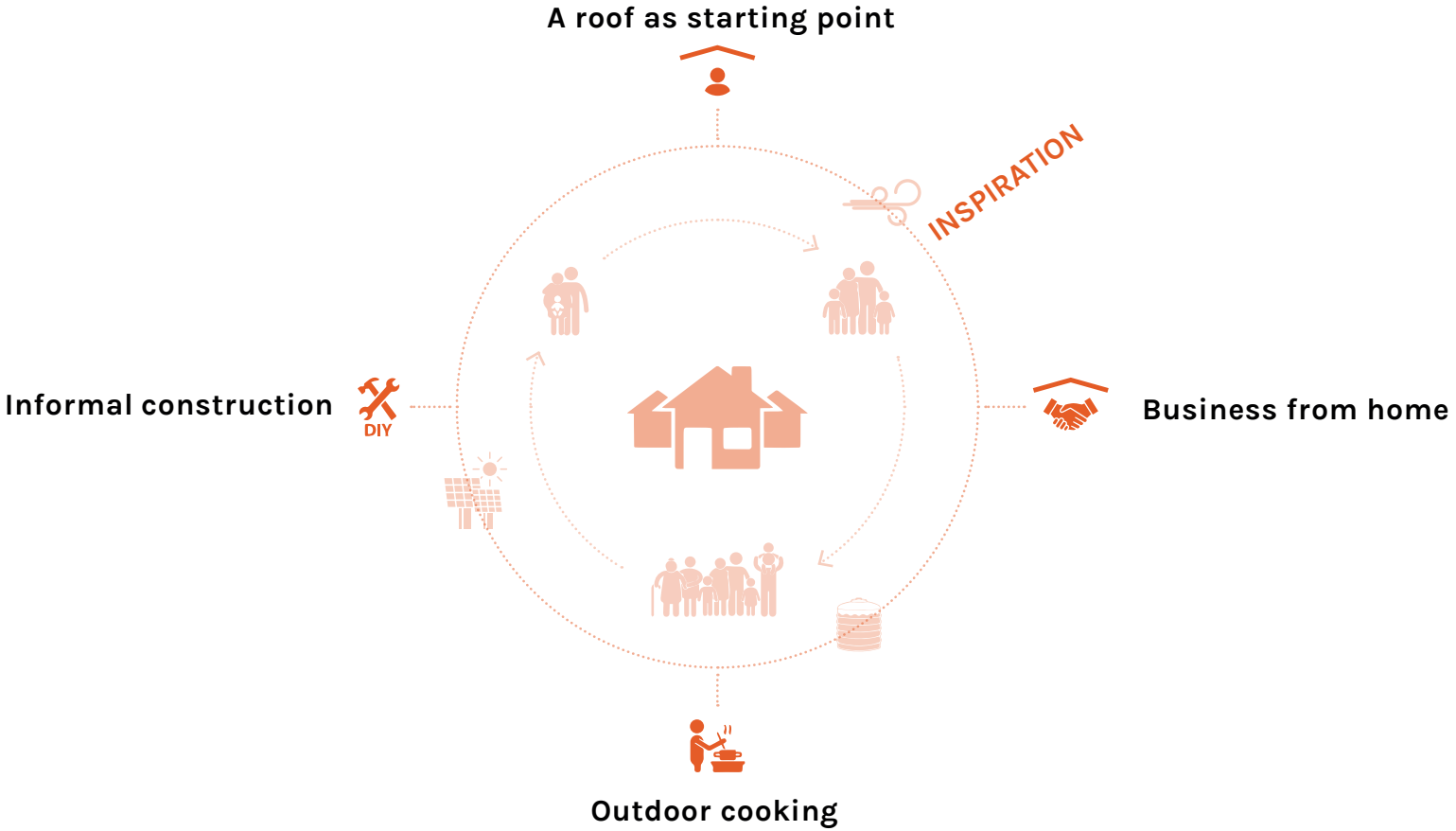
HOUSING CONCEPT



HOUSING CONCEPT



HOUSING CONCEPT



HOUSING INSPIRATION

Roof as starting point

HOUSING INSPIRATION

Roof as starting point

Informal construction

HOUSING INSPIRATION

Roof as starting point

Informal construction

Cooking Outside

HOUSING INSPIRATION

Roof as starting point

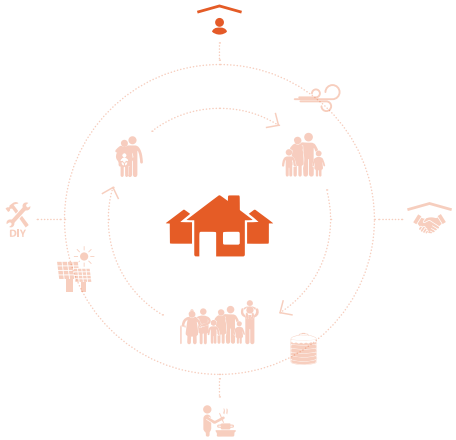
Informal construction

Cooking Outside

Business from home

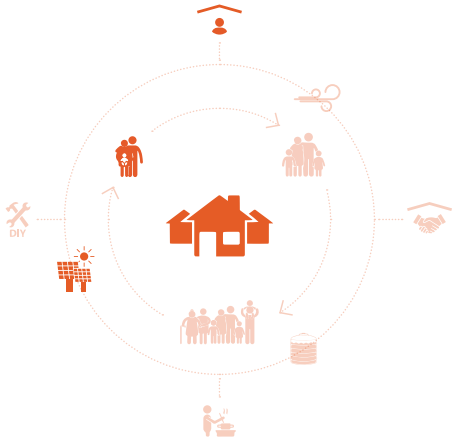
HOUSING CONCEPT

A ROOF AS STARTING POINT



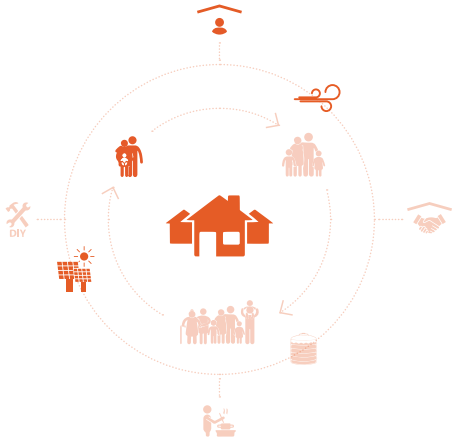
Roof and Ground

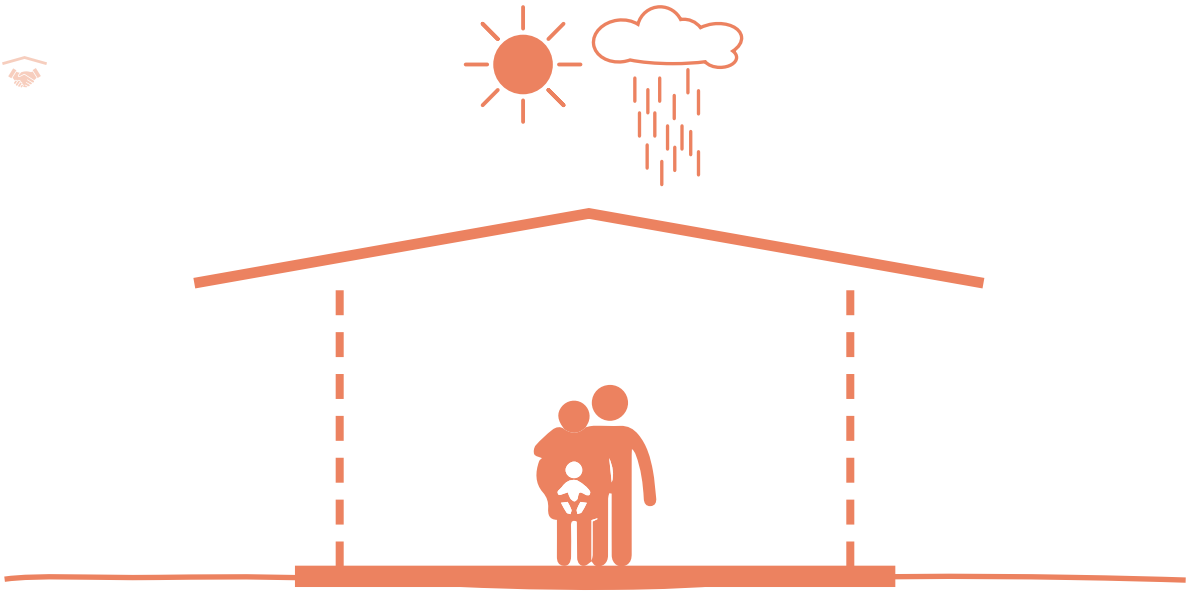
A ROOF AS STARTING POINT



Protect from Sun and Rain

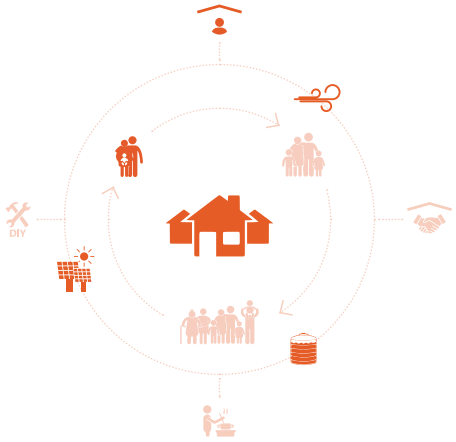
A ROOF AS STARTING POINT

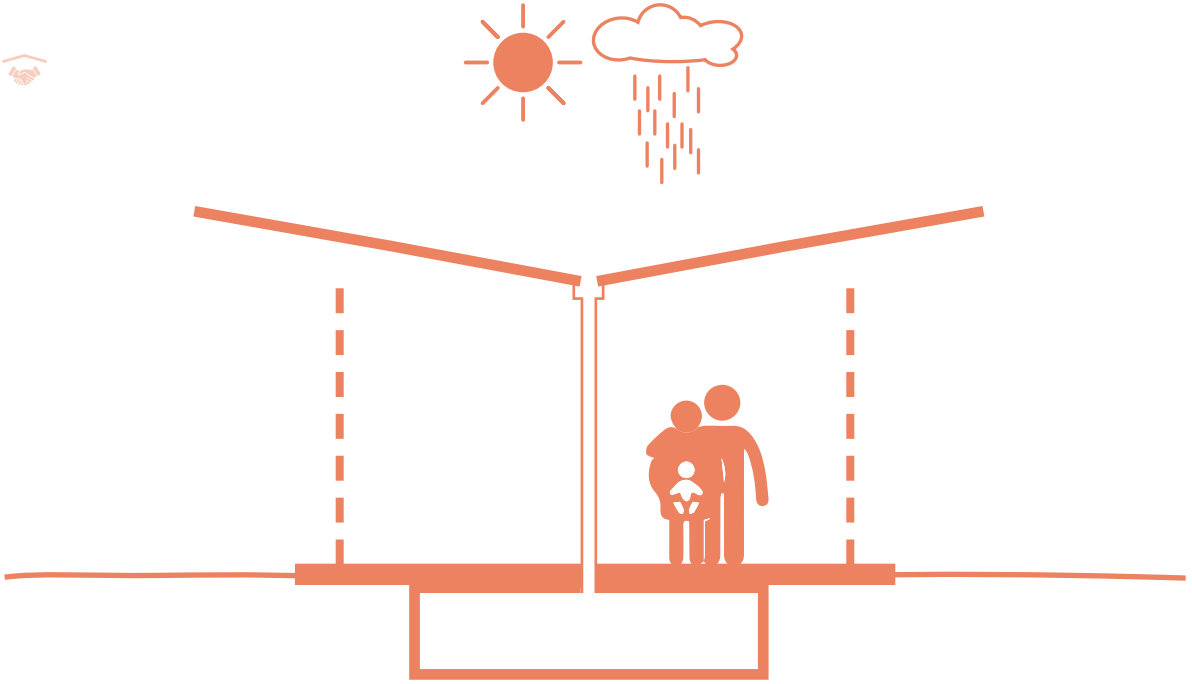




Enclose for Privacy

A ROOF AS STARTING POINT





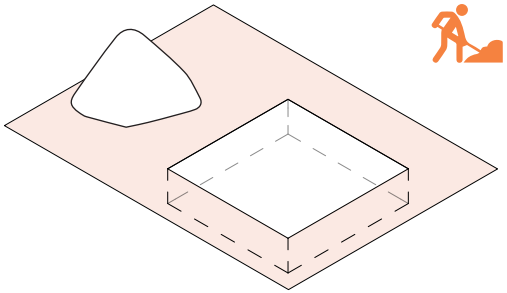
Roof and Water tank

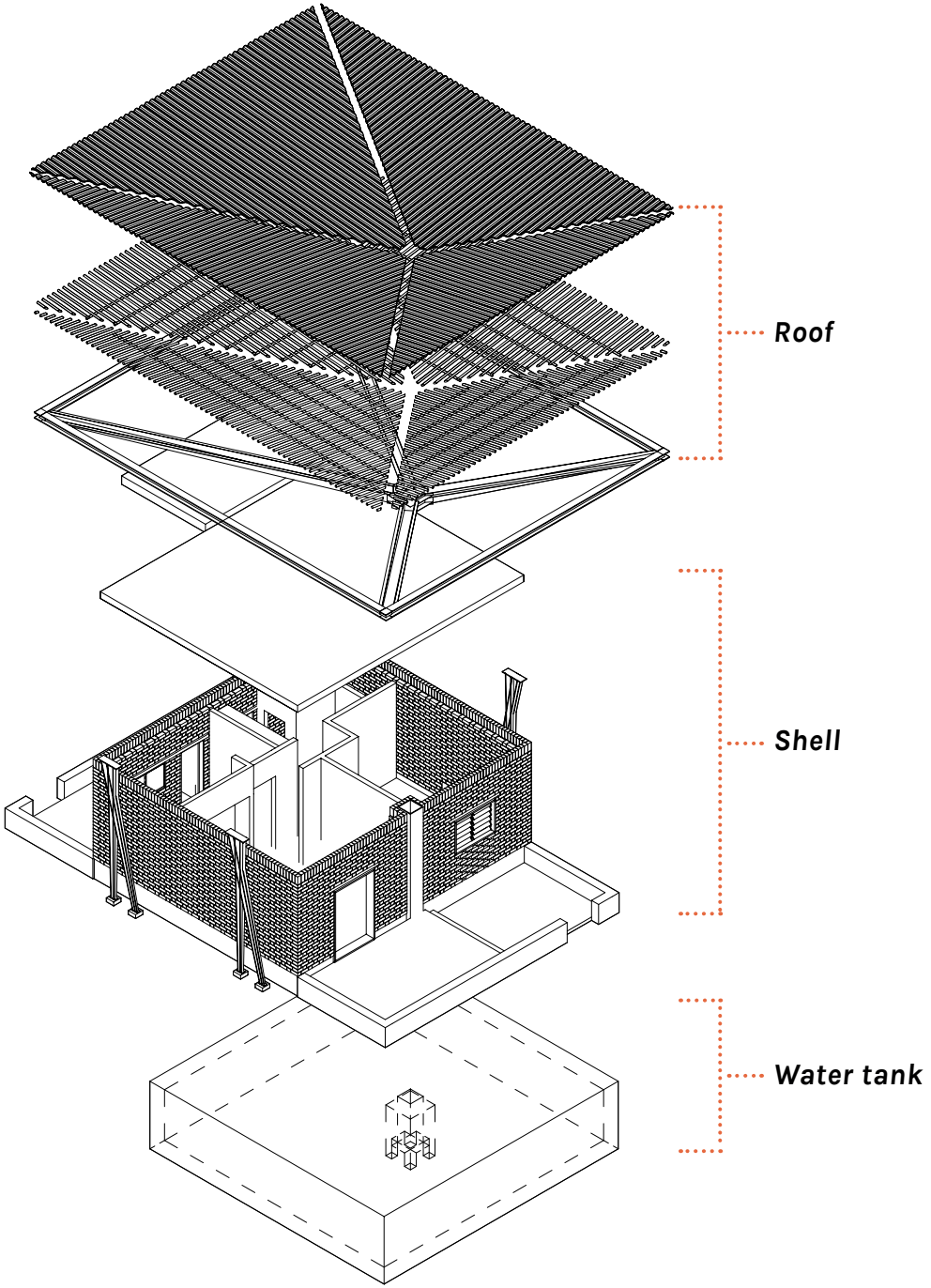
BUILDING NARRATIVE

CONSTRUCTION PROCESS

1. Excavate

Extract enough soil for the water tank. This also has as purpose to extract soil that can be used for the construction of the comporessed earth bricks.

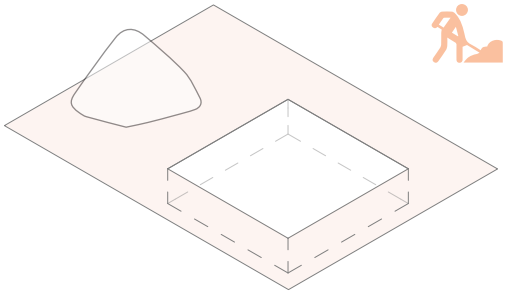


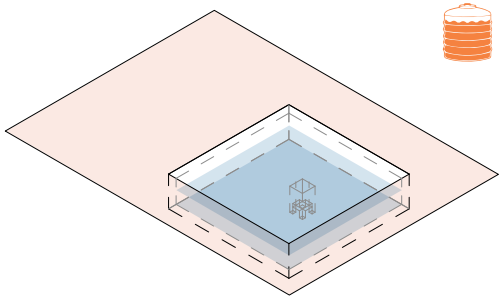


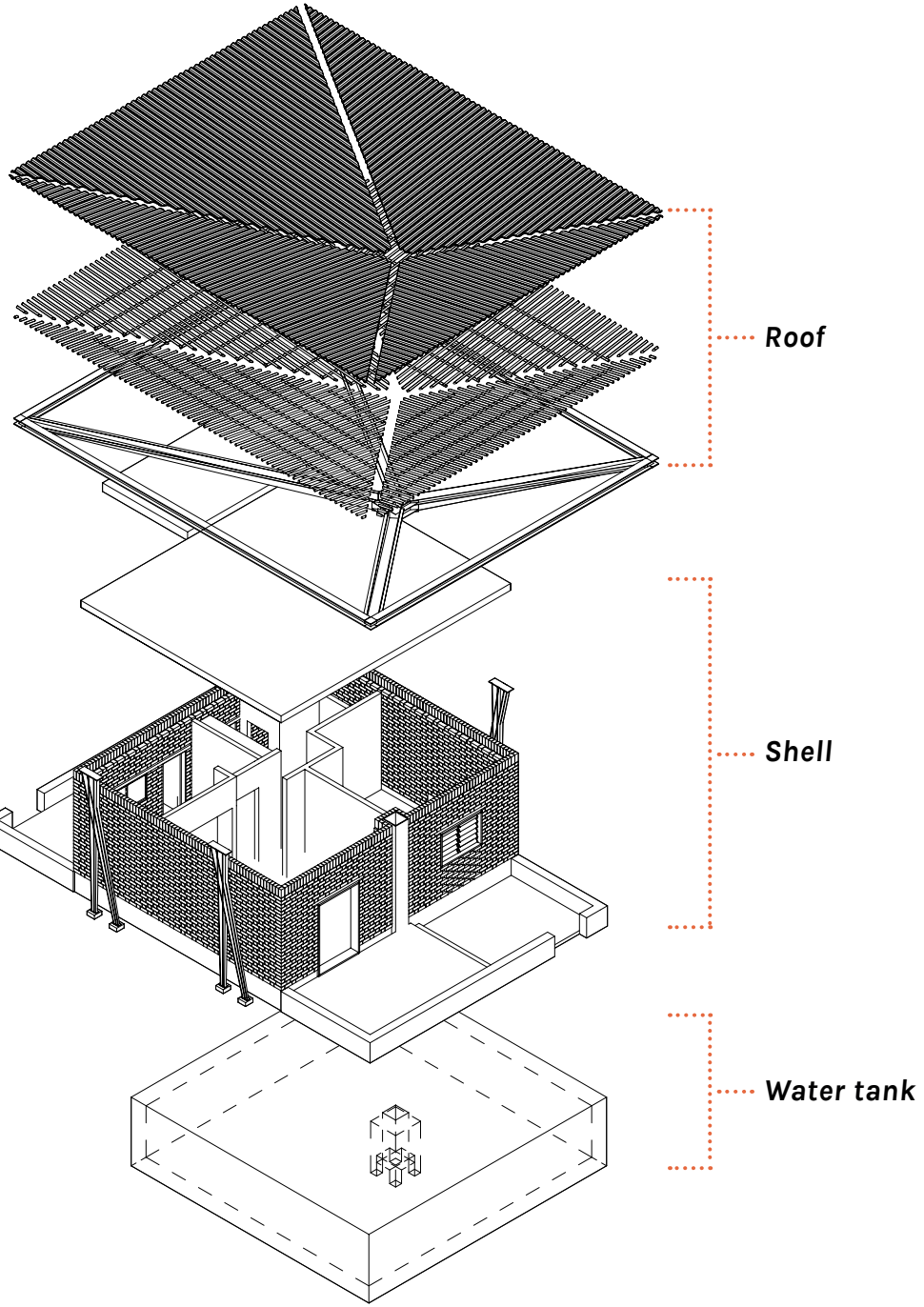
CONSTRUCTION PROCESS

2. Water tank

Build water tank that simultaneously takes the role of main foundation to the building.



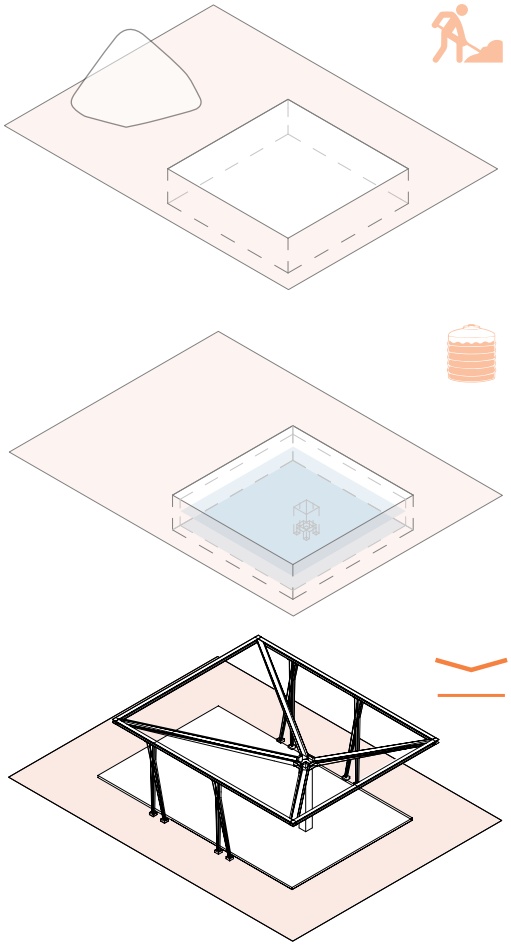


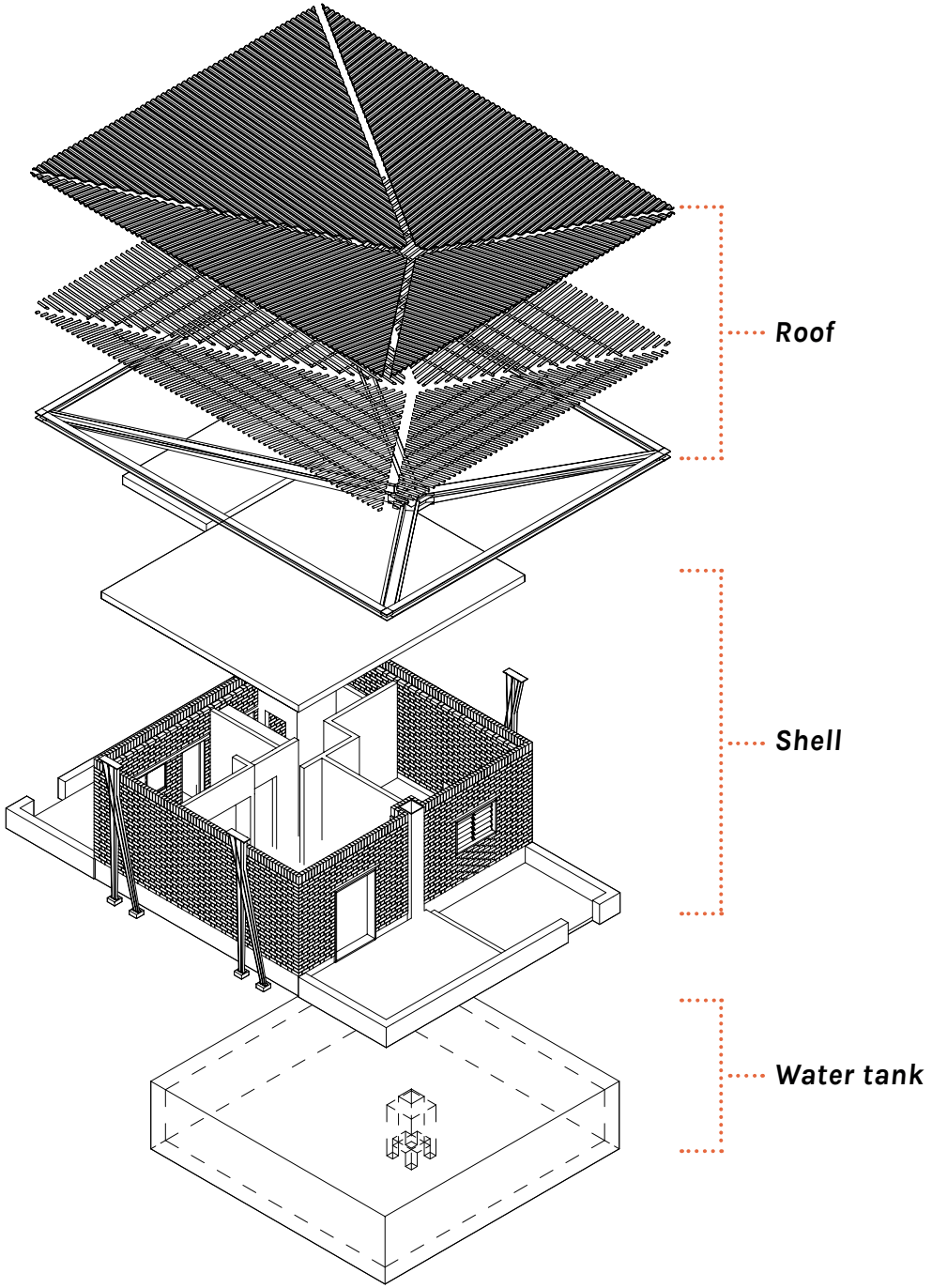


CONSTRUCTION PROCESS

3. Roof guter structure

Install the governement funded roof structure with integrated guter system.

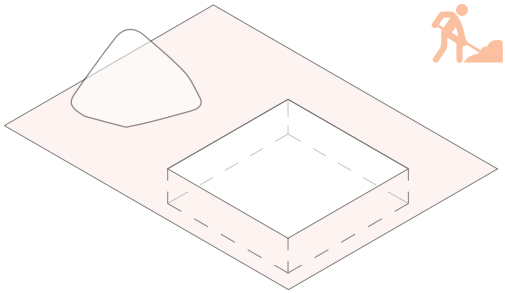


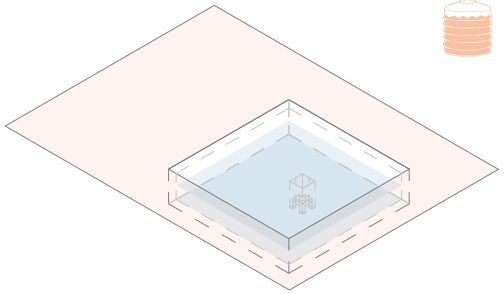


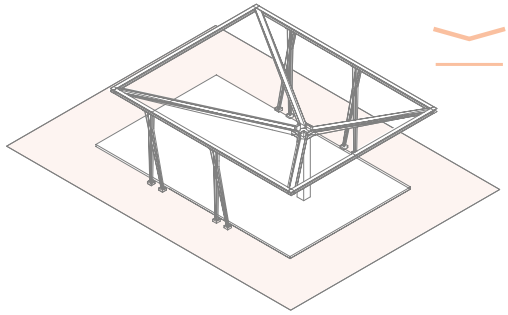
CONSTRUCTION PROCESS

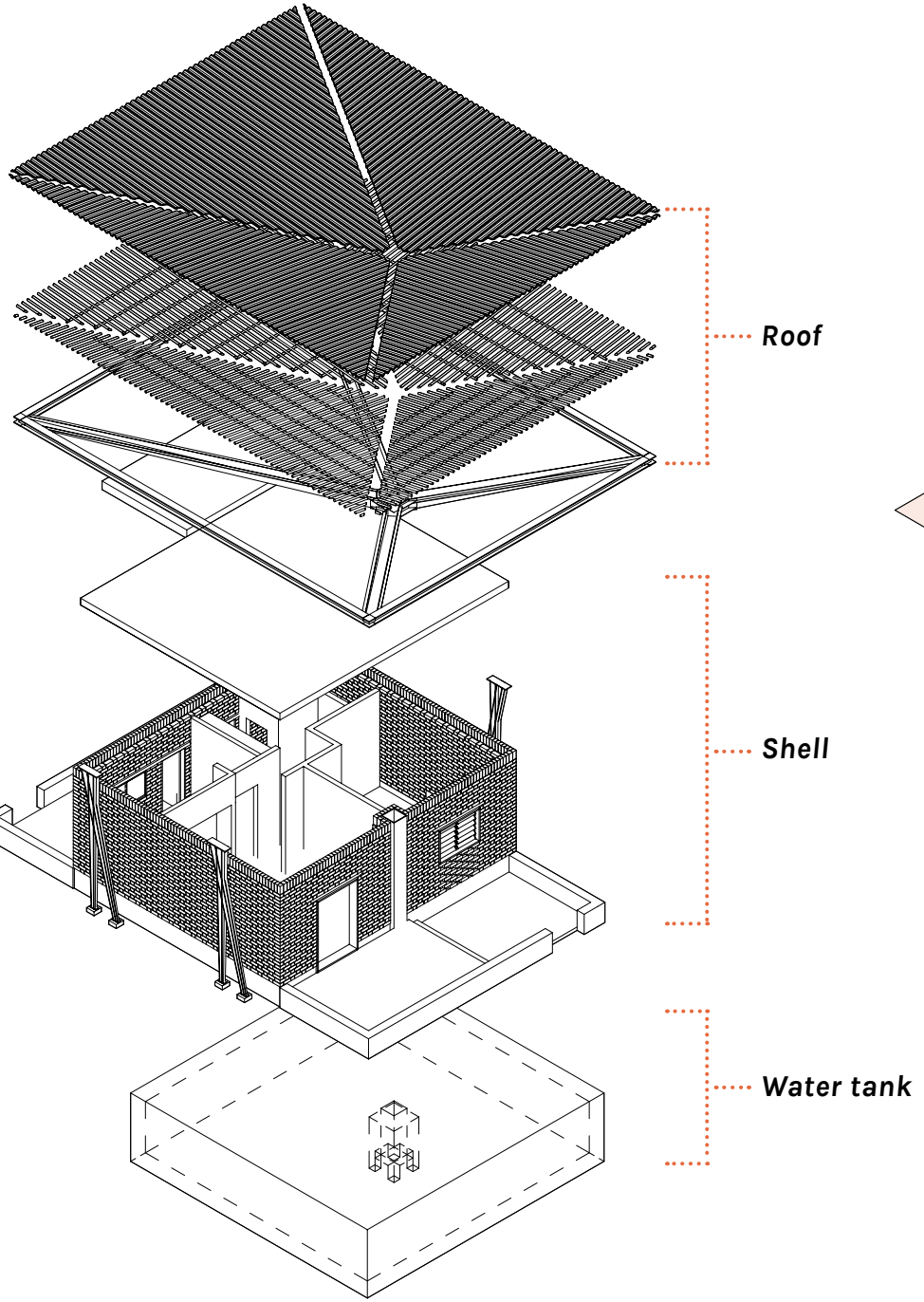
4. Roof sheating

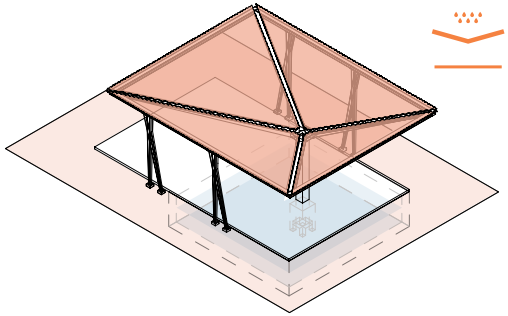
Install the roof sheating that will allow us to start collecting rain water that can be used on the construction site. Now the building structure is ready to be sold.







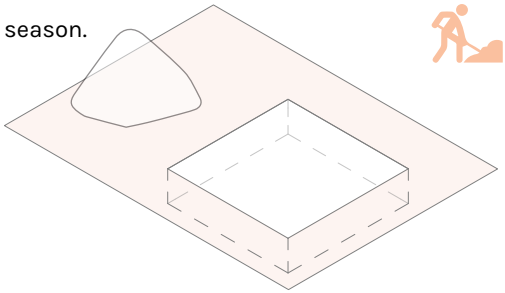


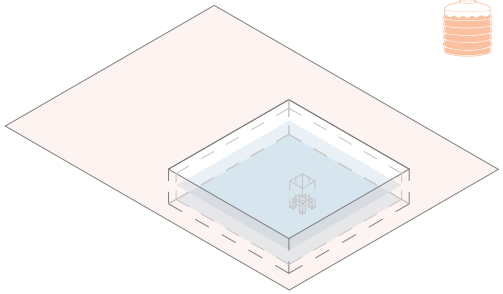


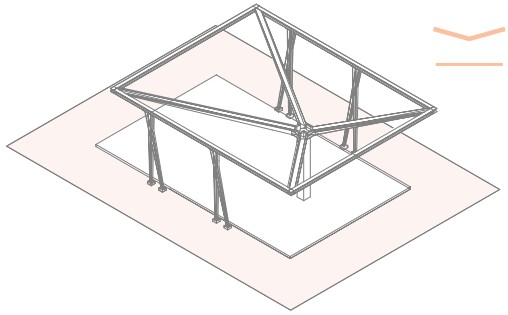
CONSTRUCTION PROCESS

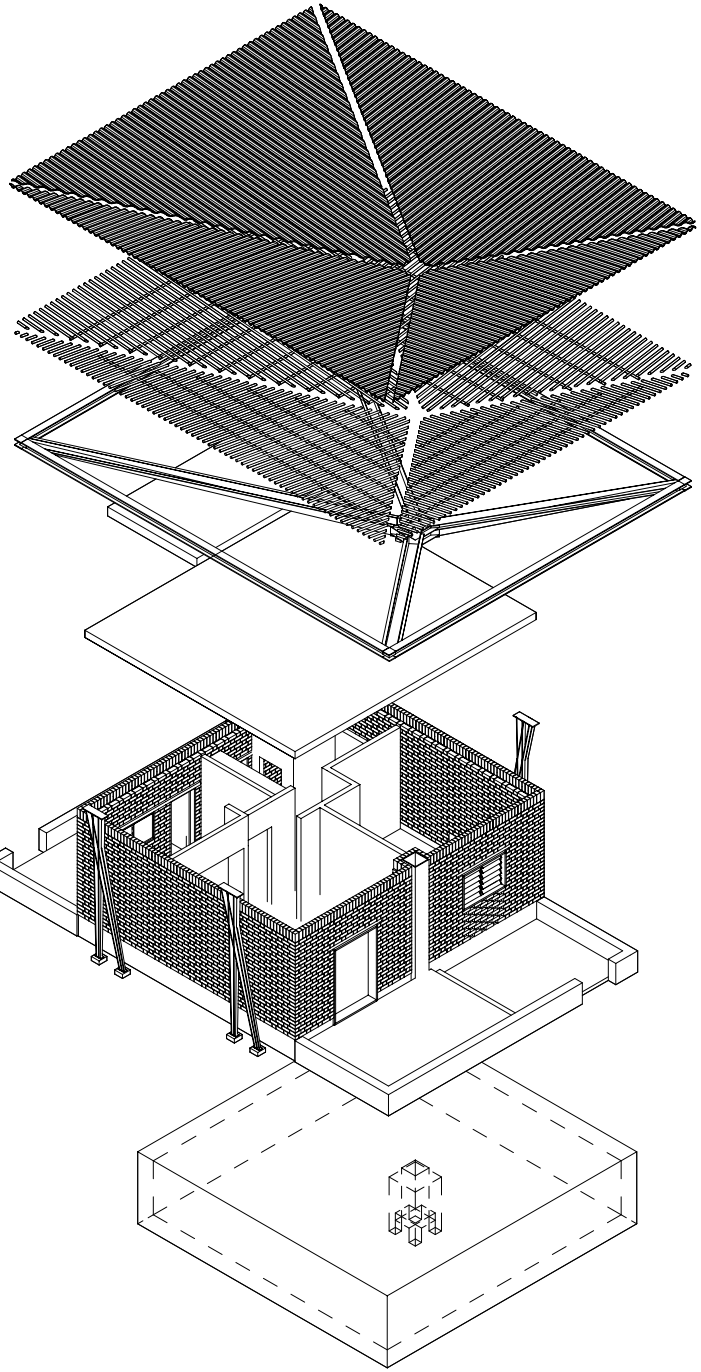
5. CEB manufacturing

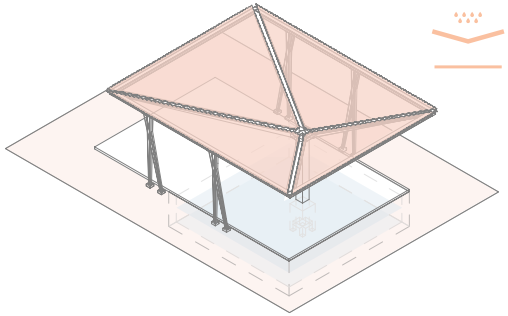
Production of the compressed earth blocks on site by small entrepreneurs or even the local community themselve. The bricks are then stored in the shade under the already present roof structure im order to prevent them drying to fast and cracking and to protect them from heavy rain if built during the rain season.

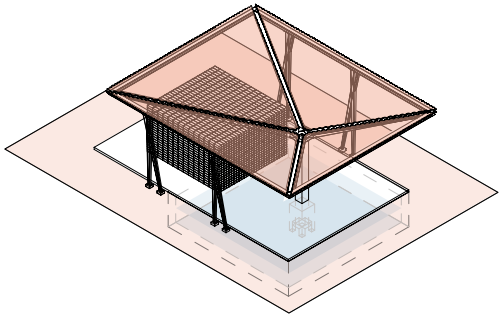








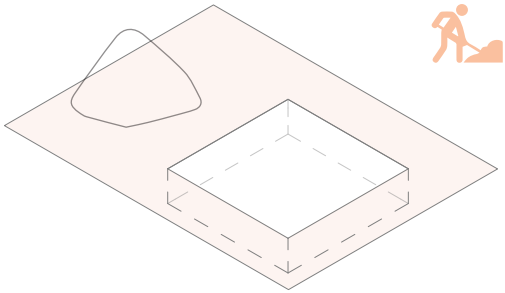


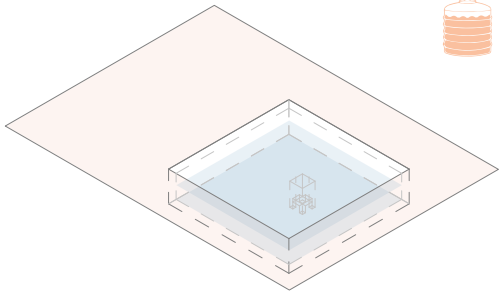


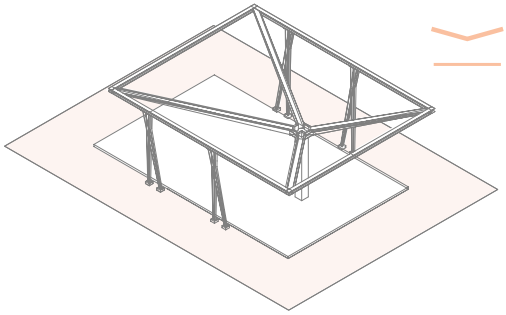
CONSTRUCTION PROCESS

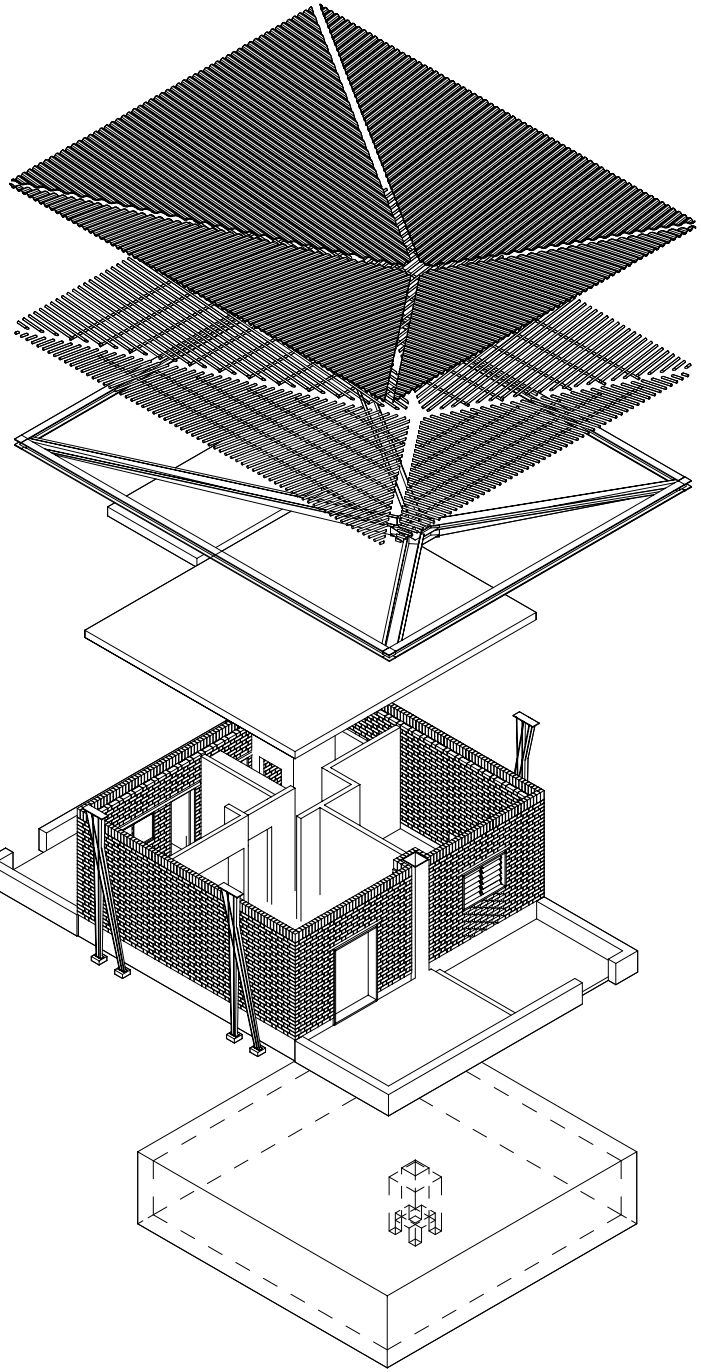
6. Main Building

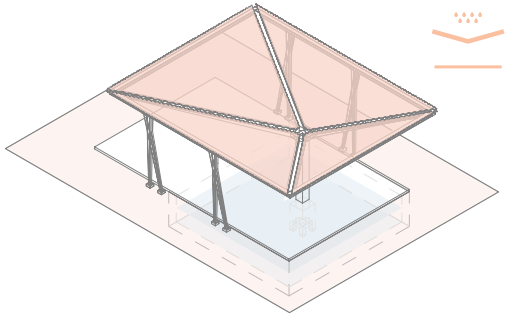
Use the produced compressed earth bricks to construct the main building shell.

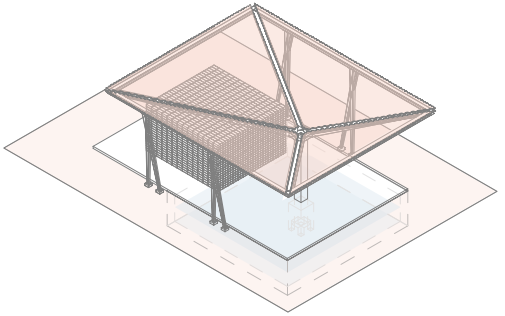


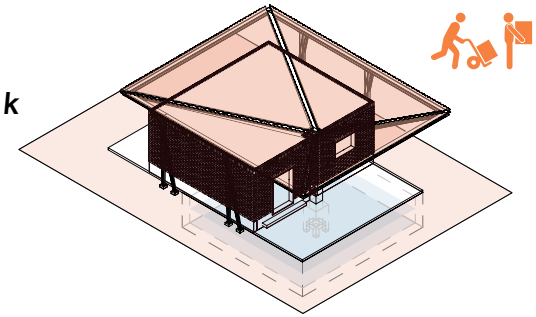






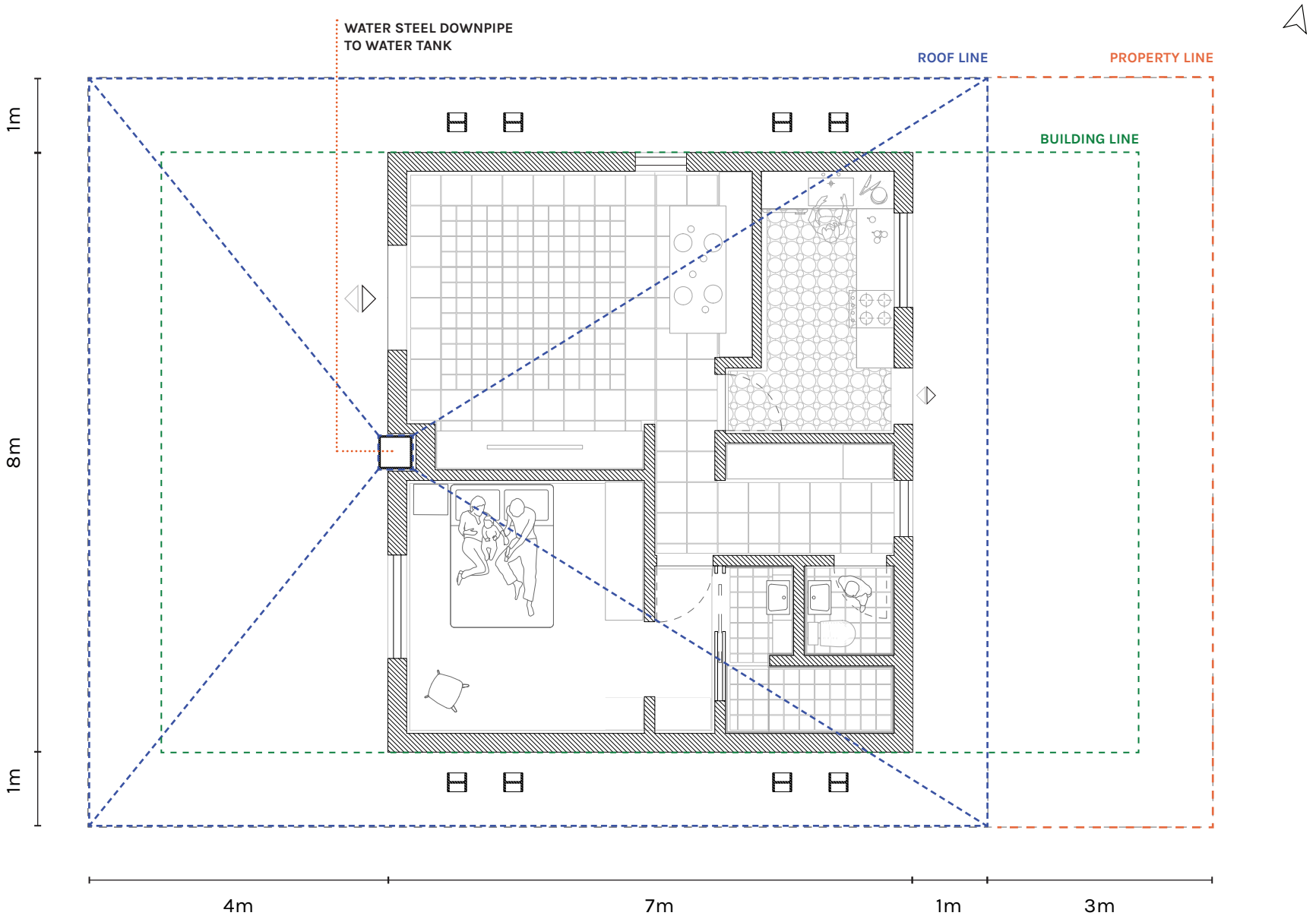






LIFE INSIDE

STARTER HOME



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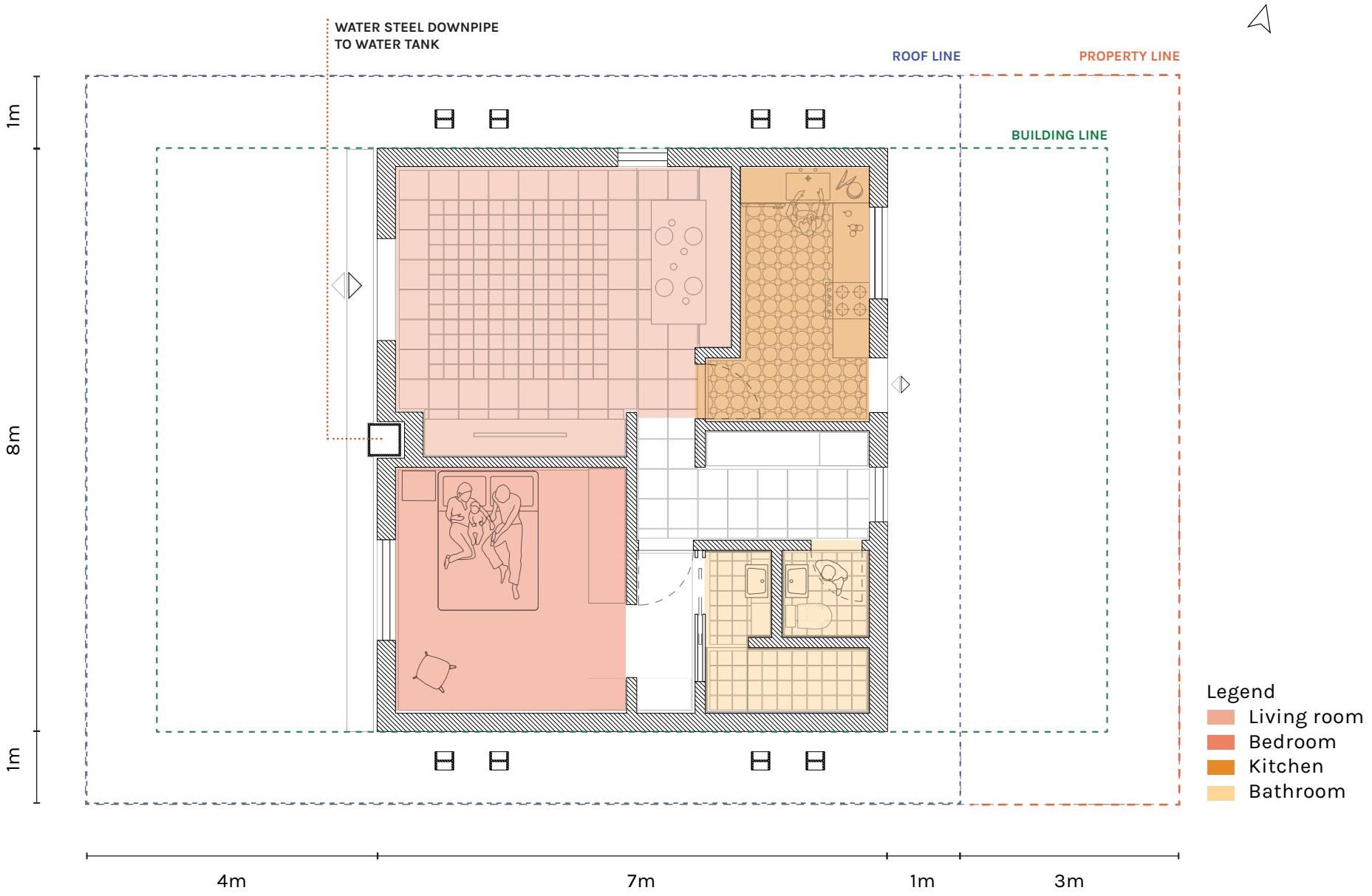

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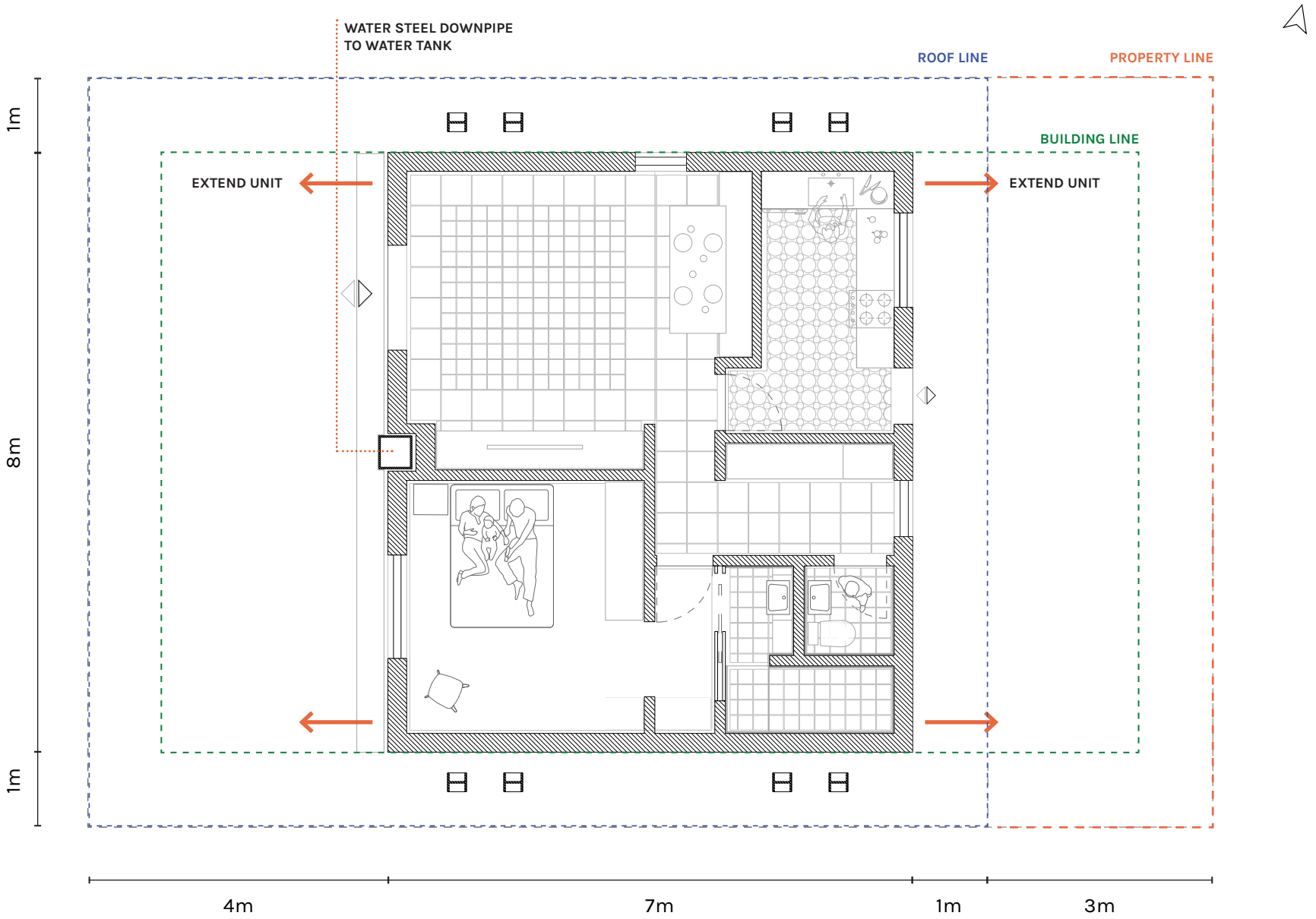

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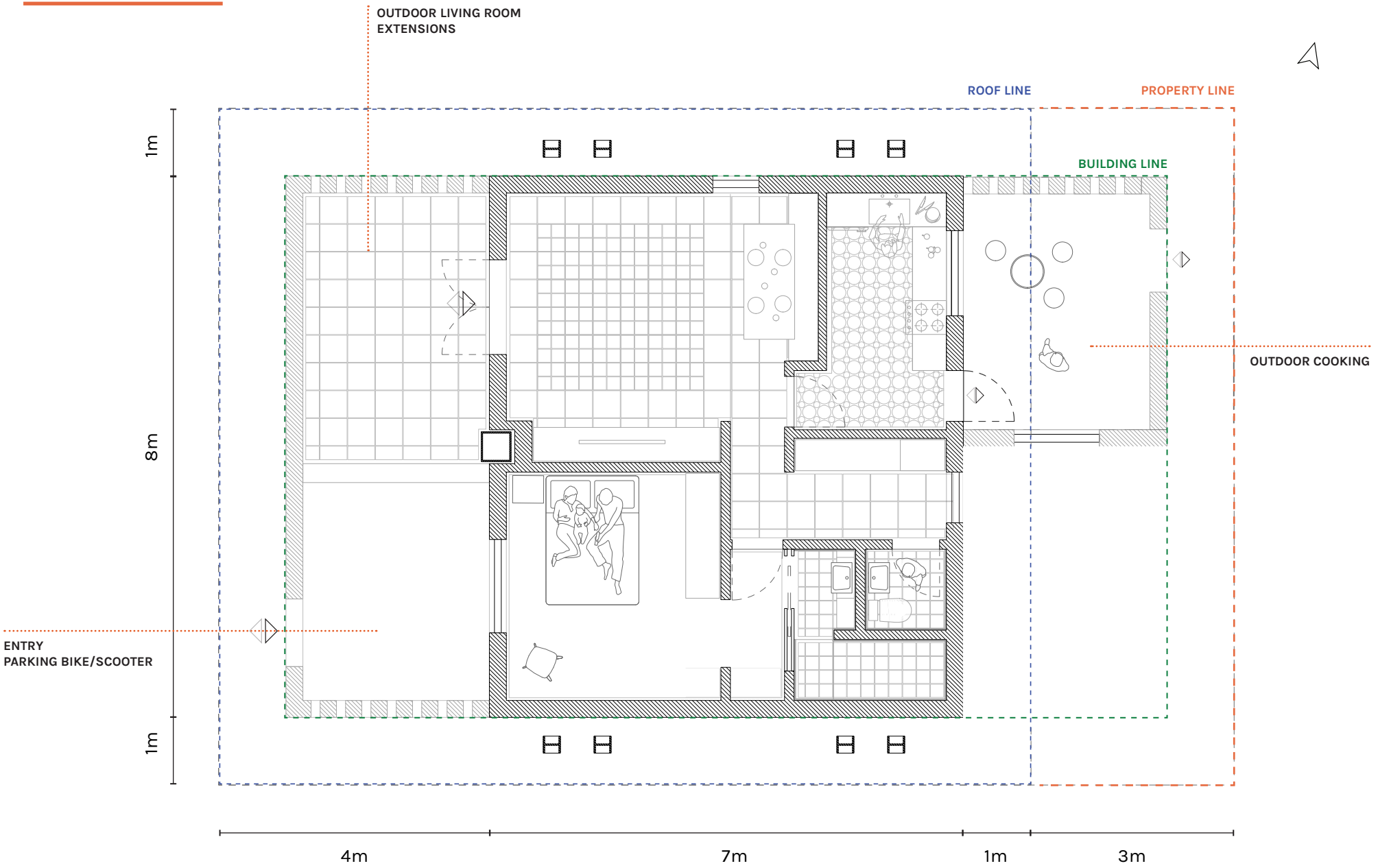

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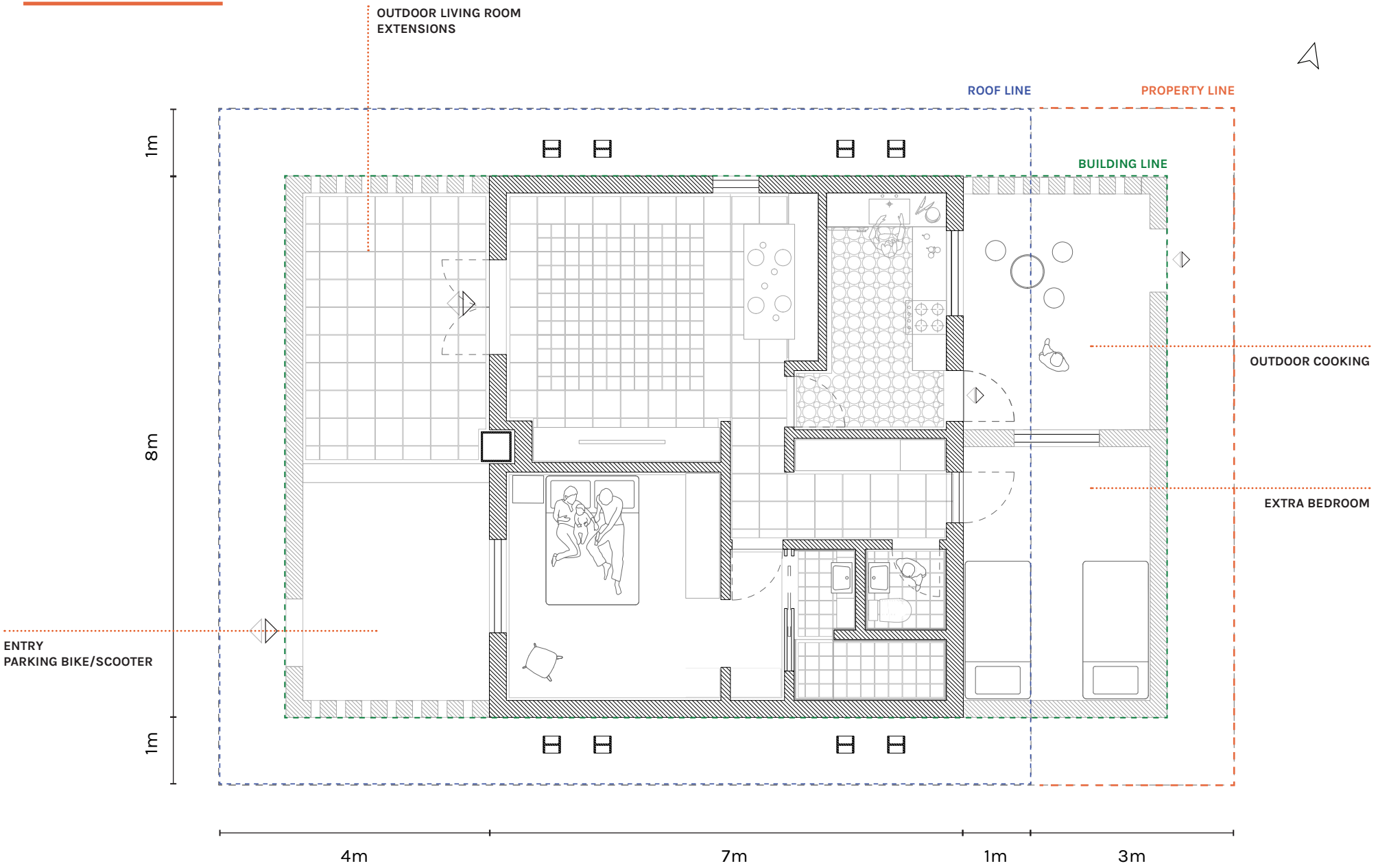

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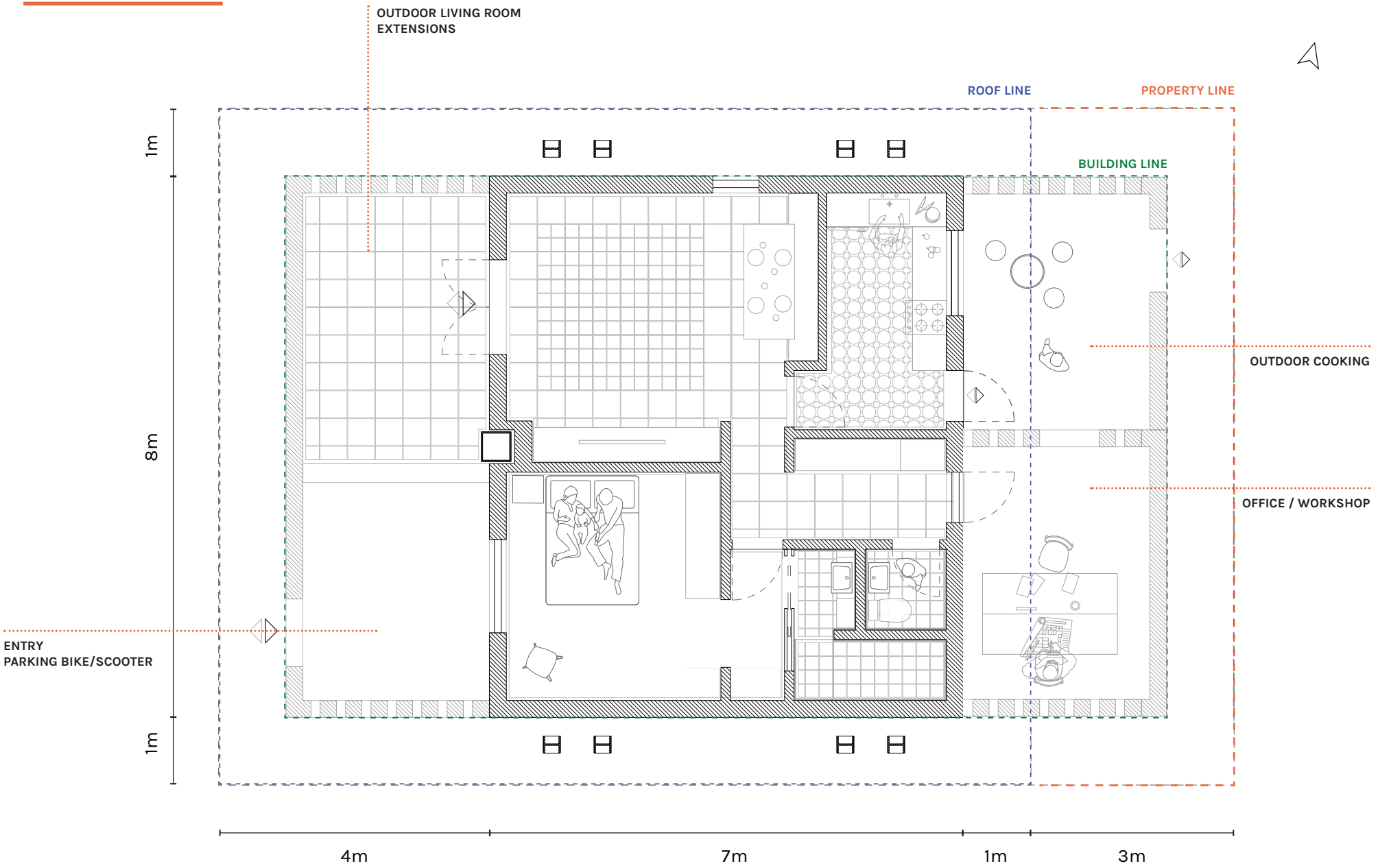

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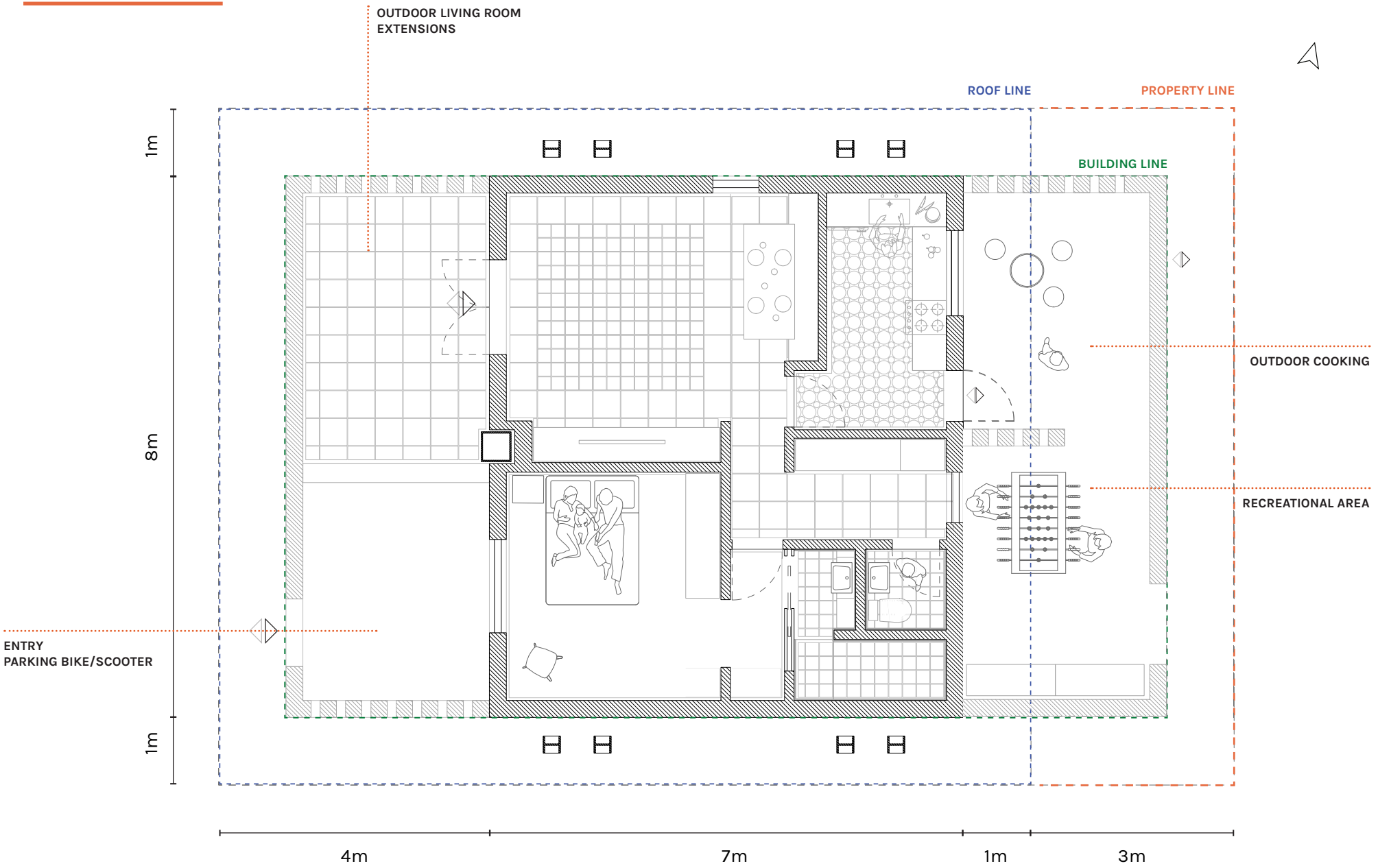

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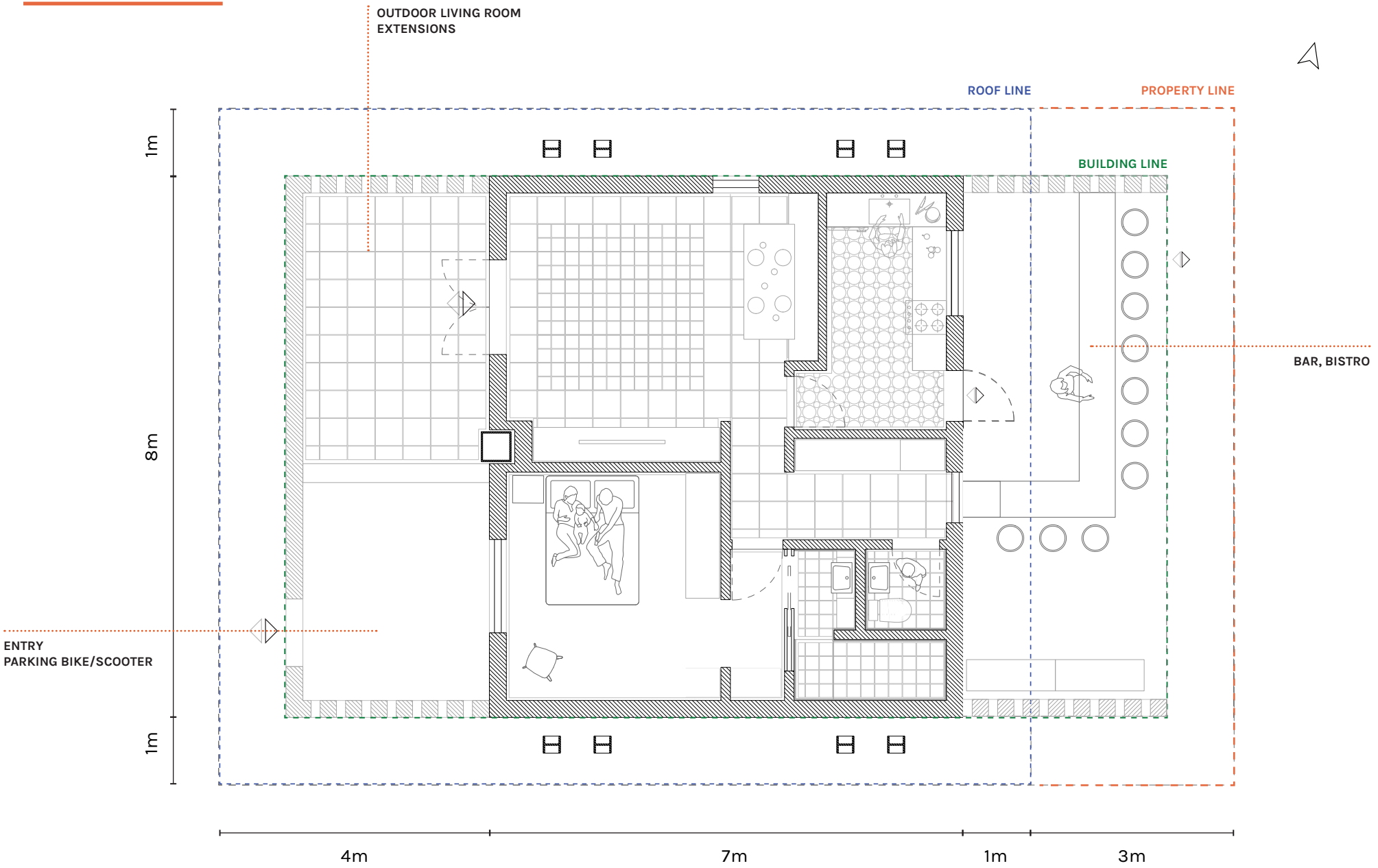
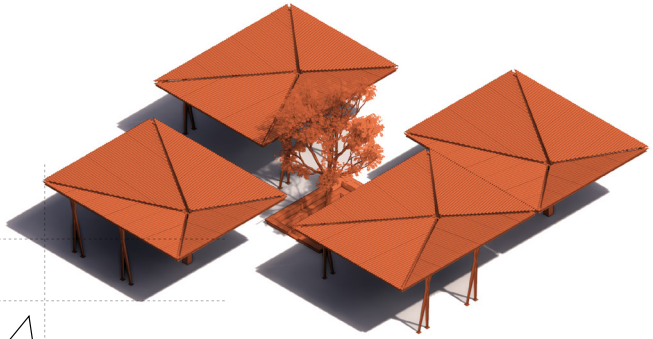
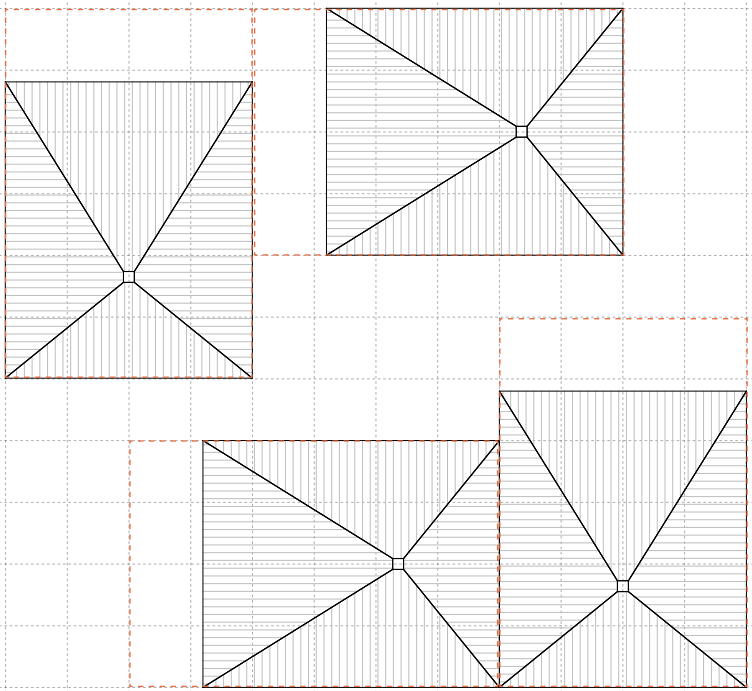


4 ROOFS 1 COURTYARD

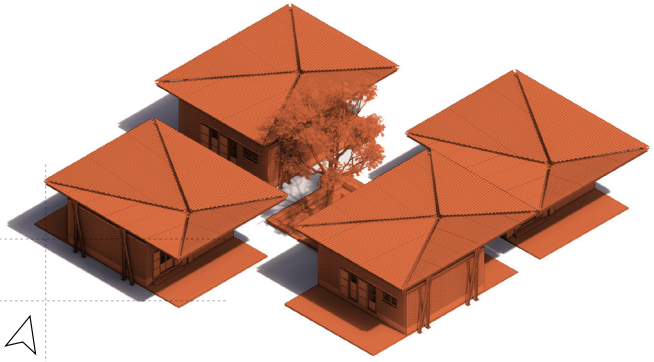


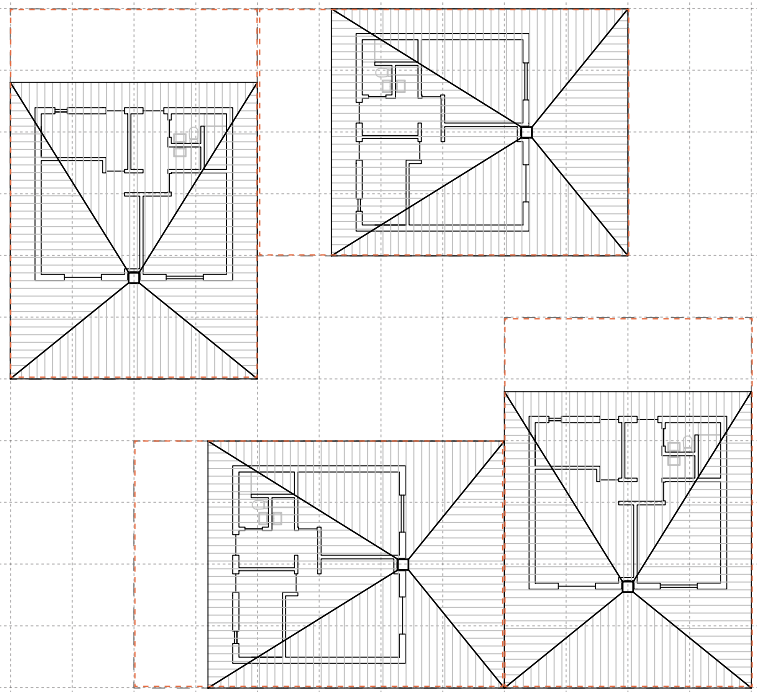
2,5m*2,5m grid



Organised Shelter

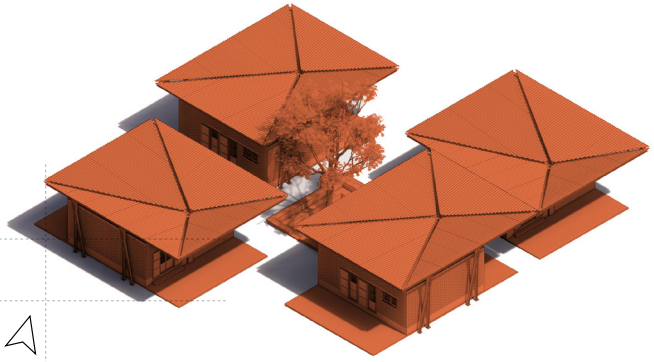
4 ROOFS 1 COURTYARD

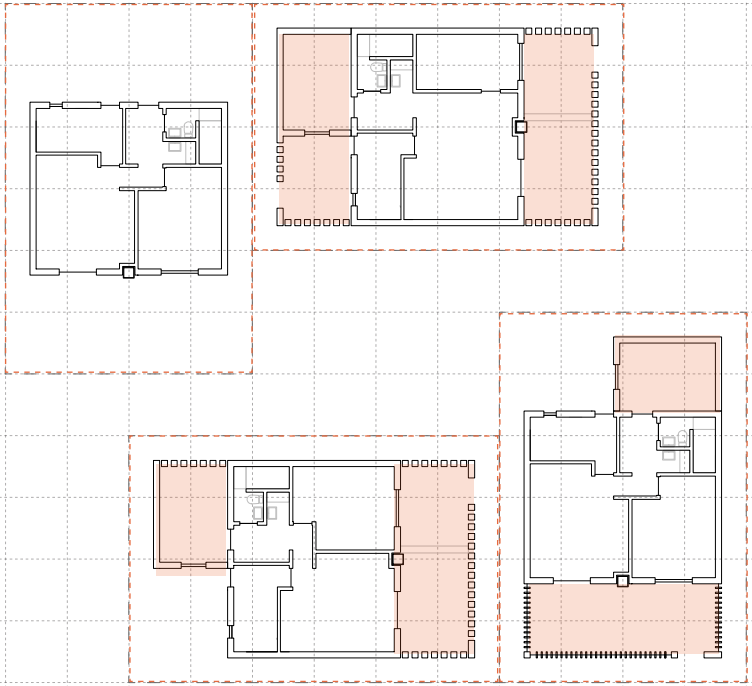




Proposed basic housing unit

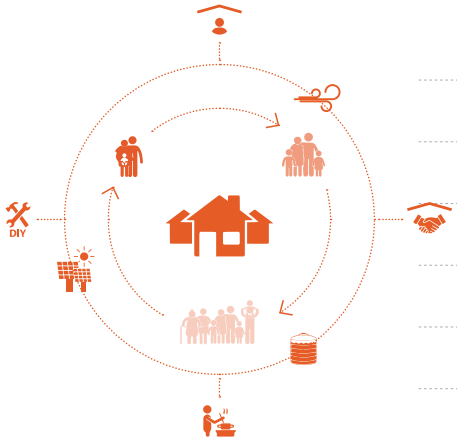
4 ROOFS 1 COURTYARD

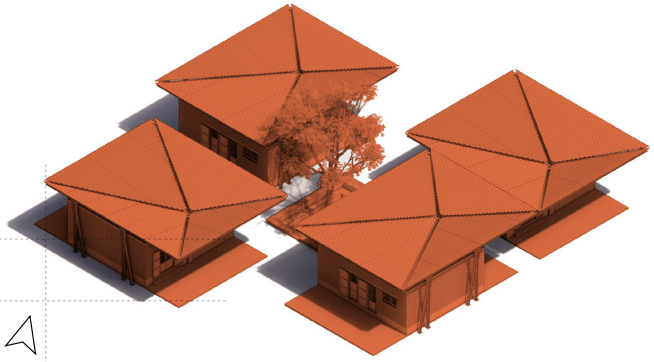


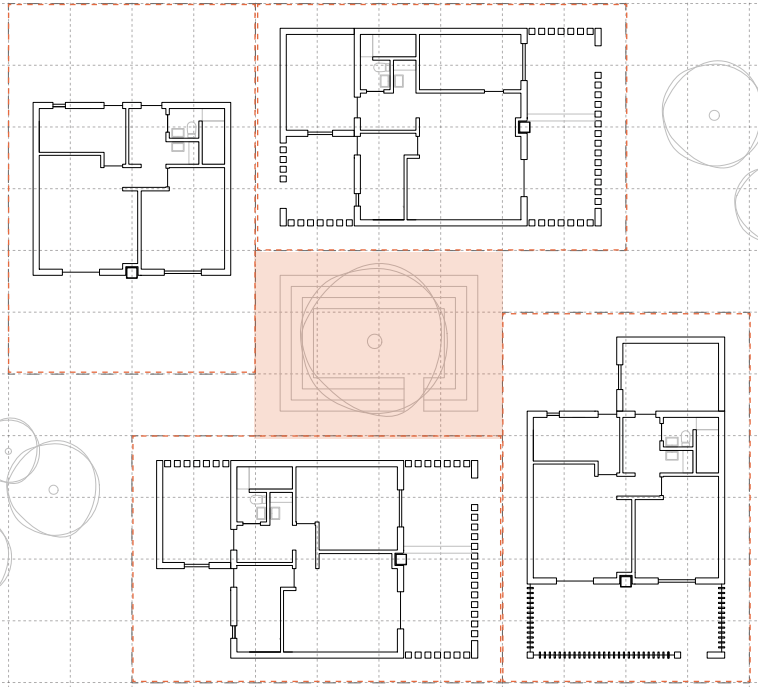


Added Extensions

4 ROOFS 1 COURTYARD

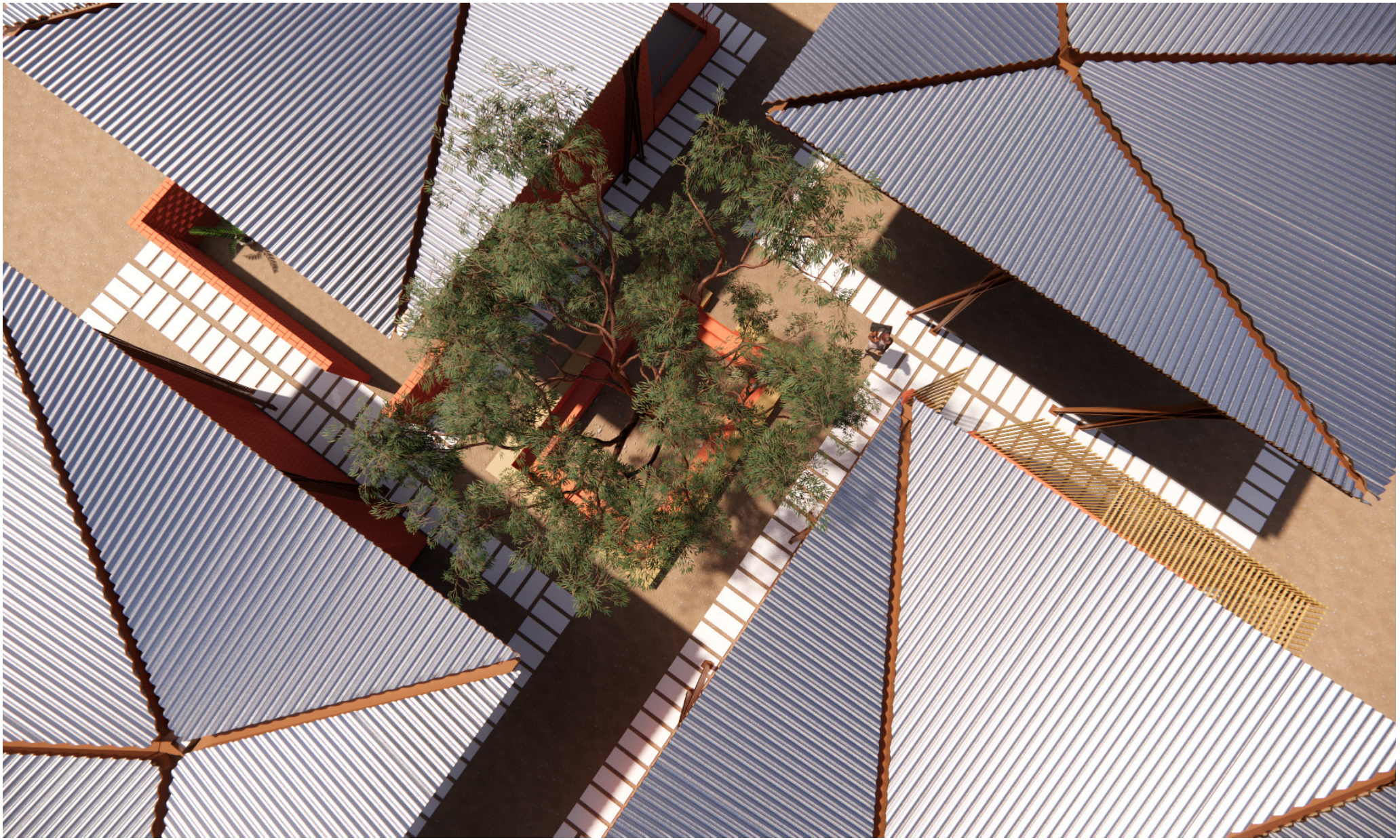




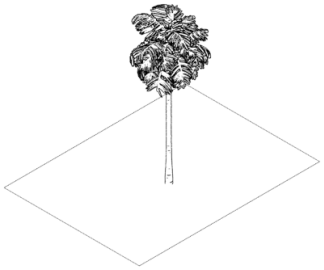


In-between spaces = social concept

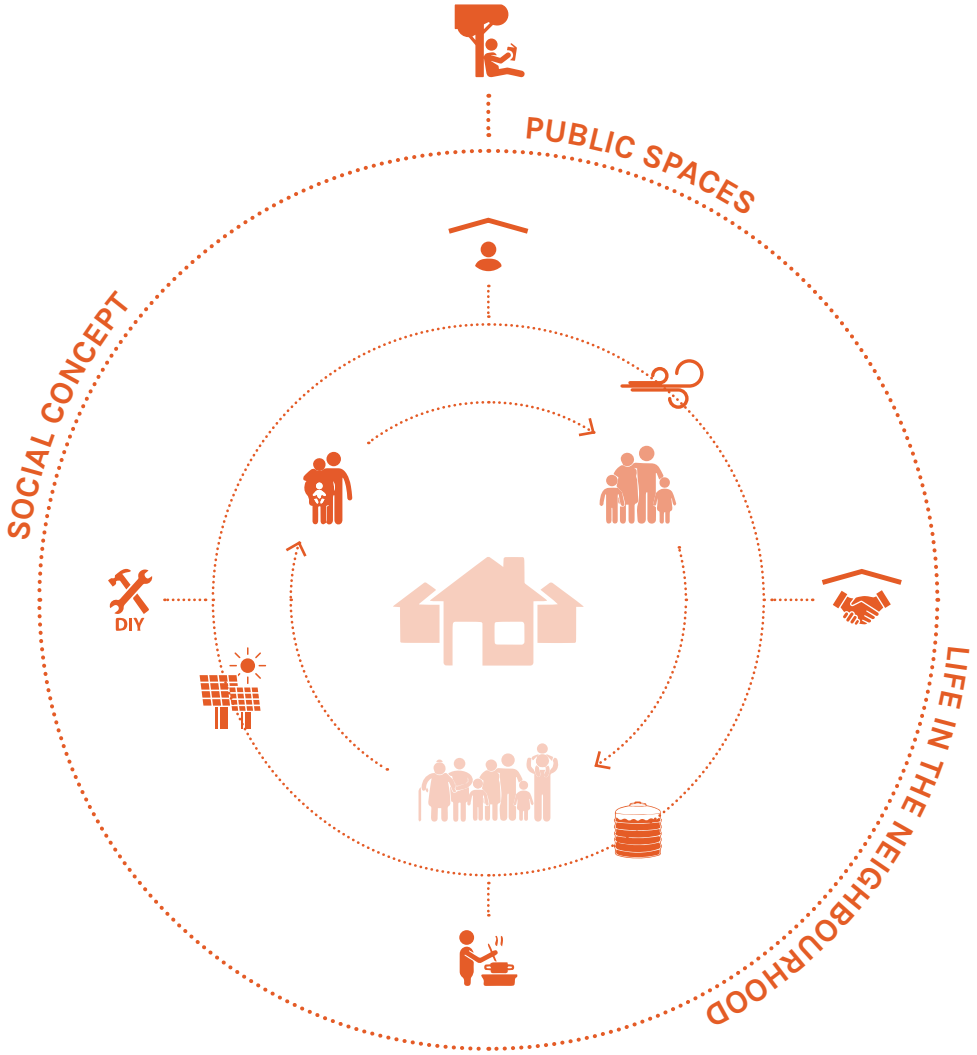
4 ROOFS 1 COURTYARD



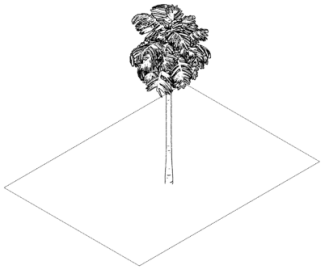
HOUSING + SOCIAL CONCEPT

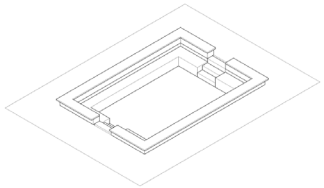


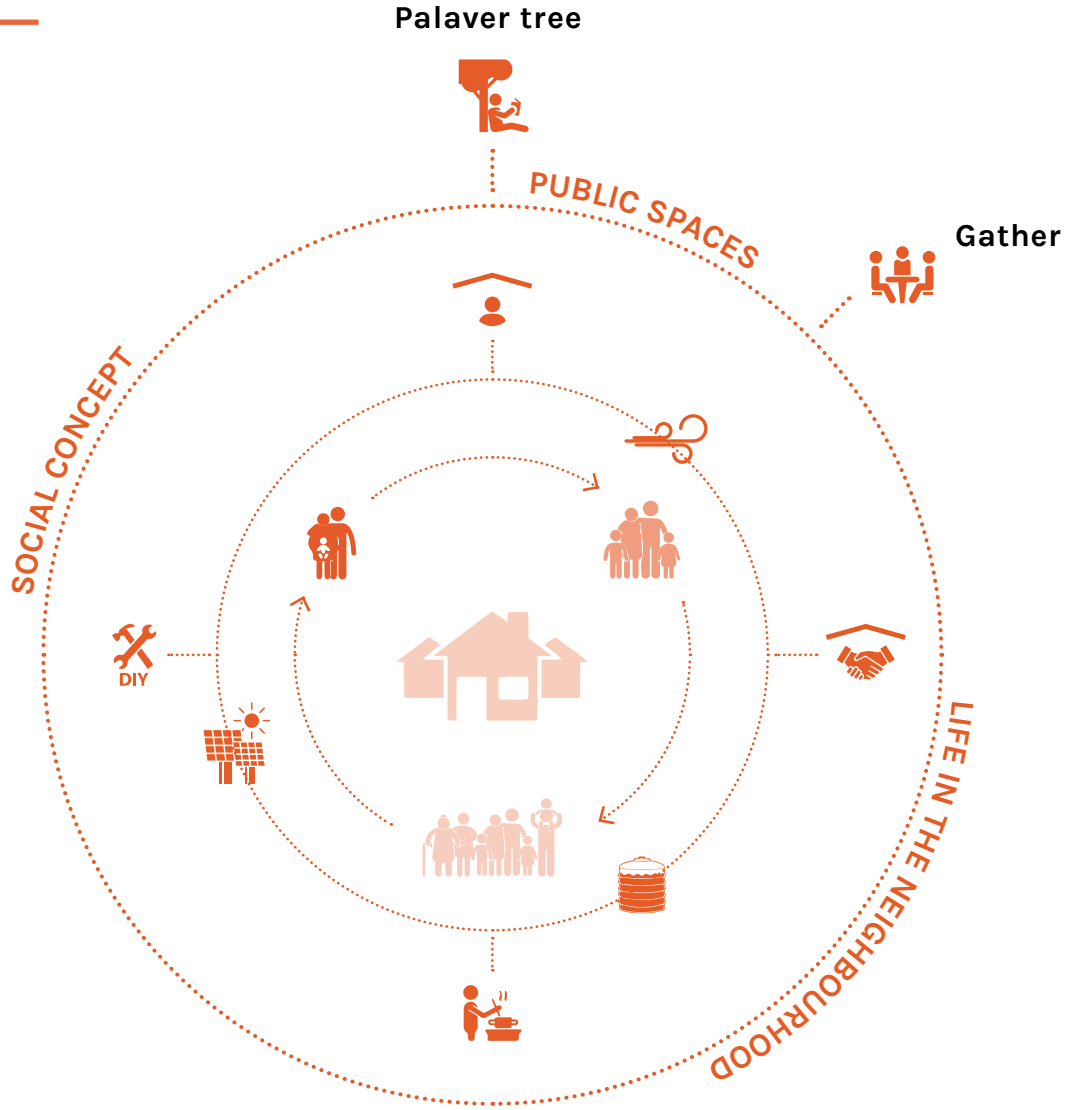
Palaver tree



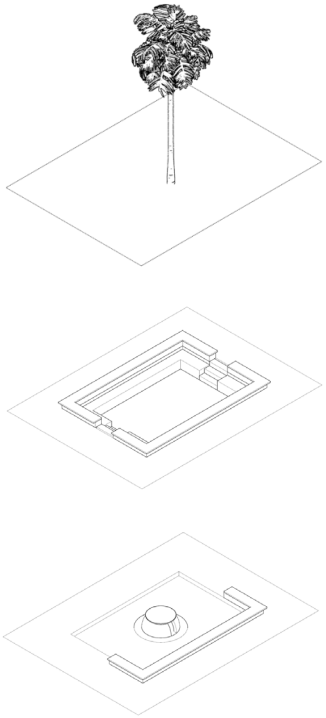
HOUSING + SOCIAL CONCEPT

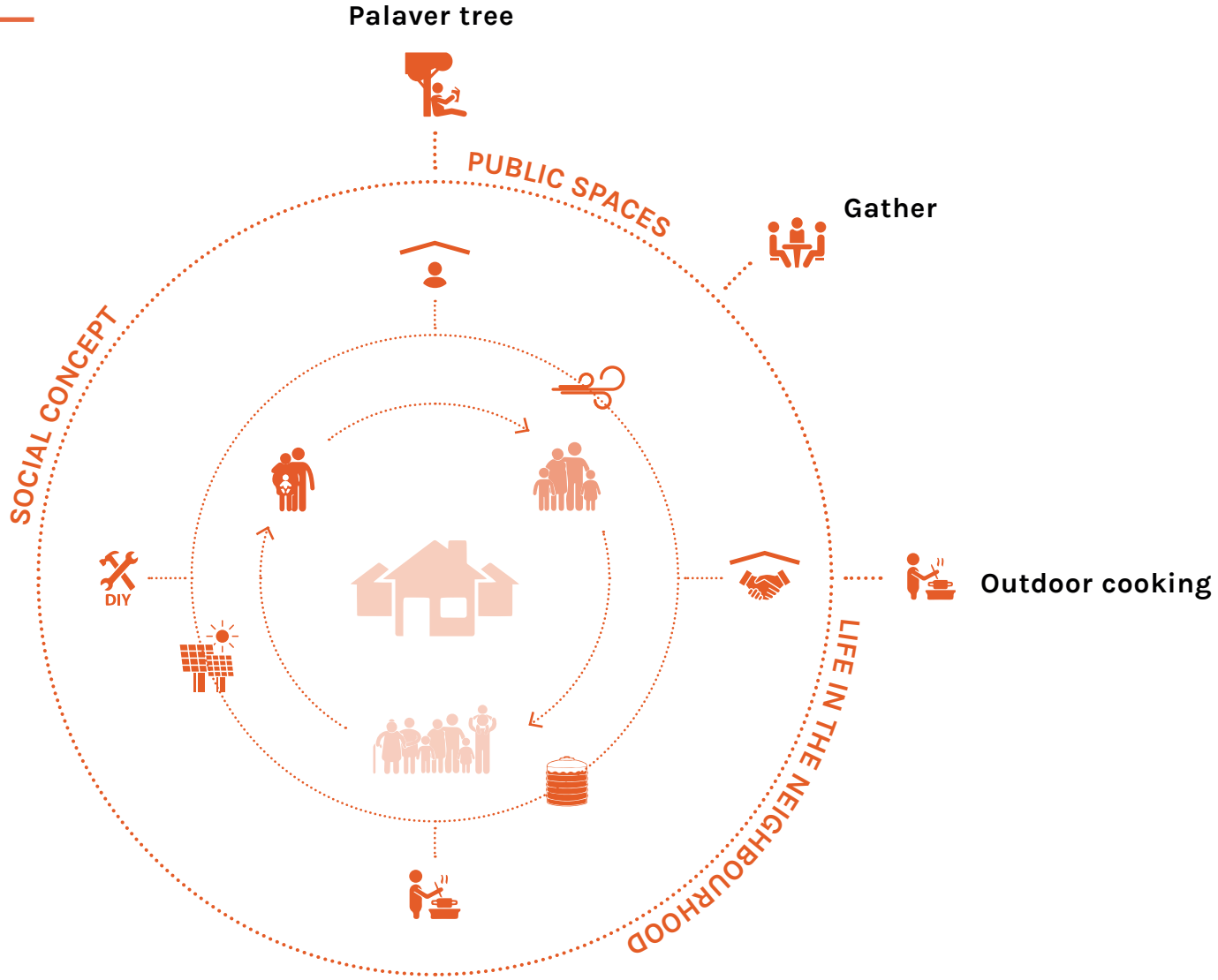




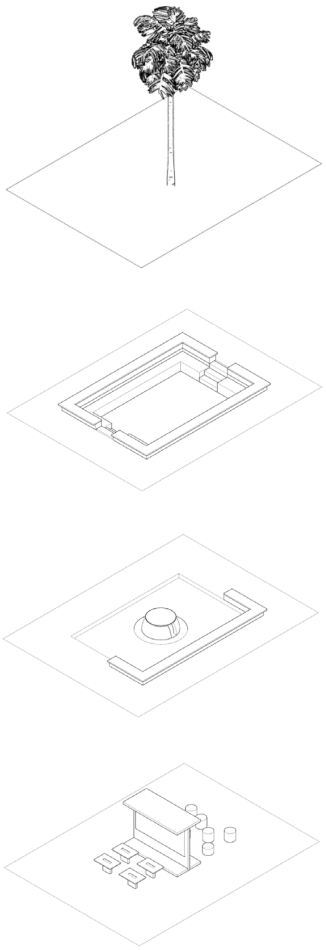


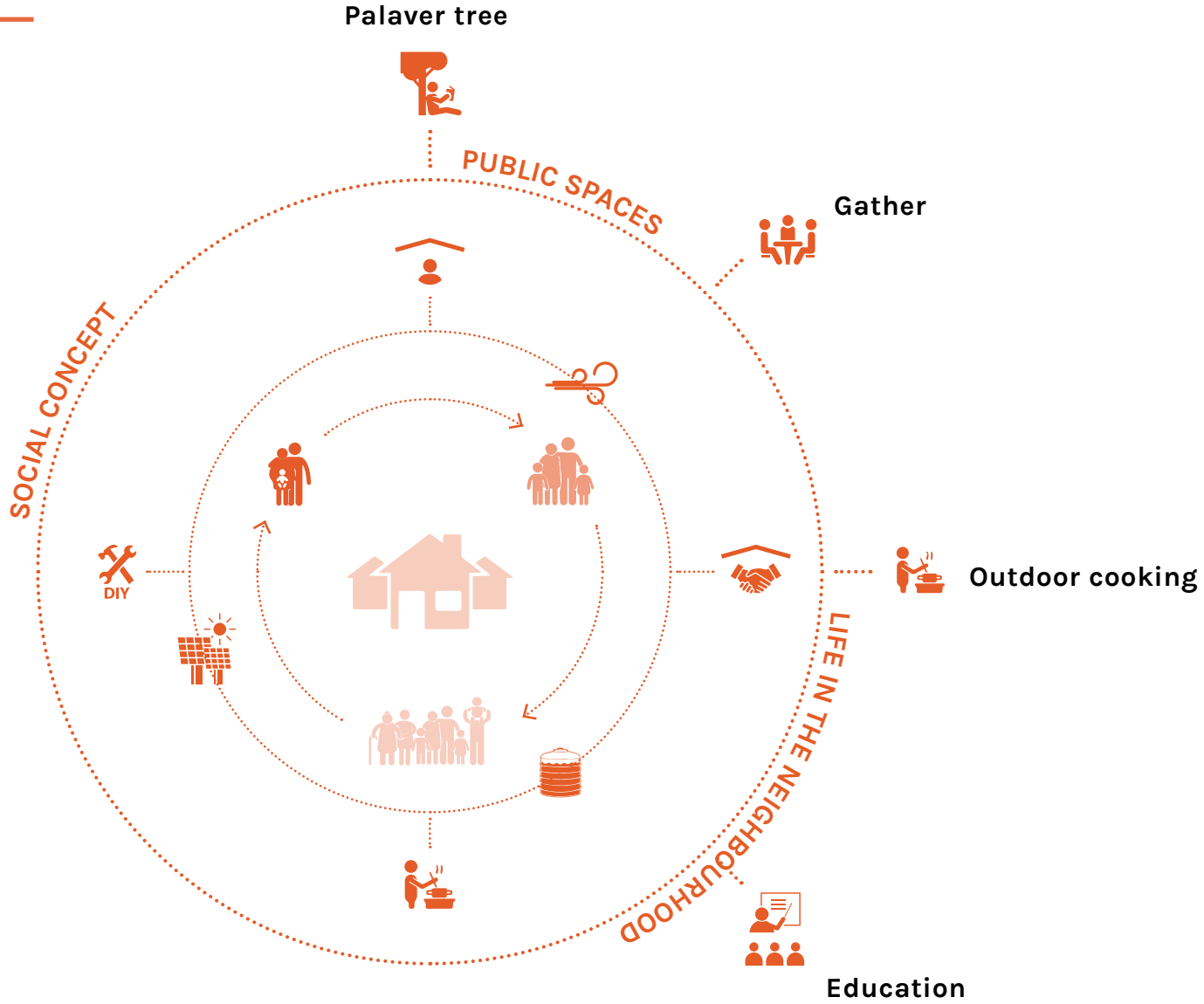
HOUSING + SOCIAL CONCEPT



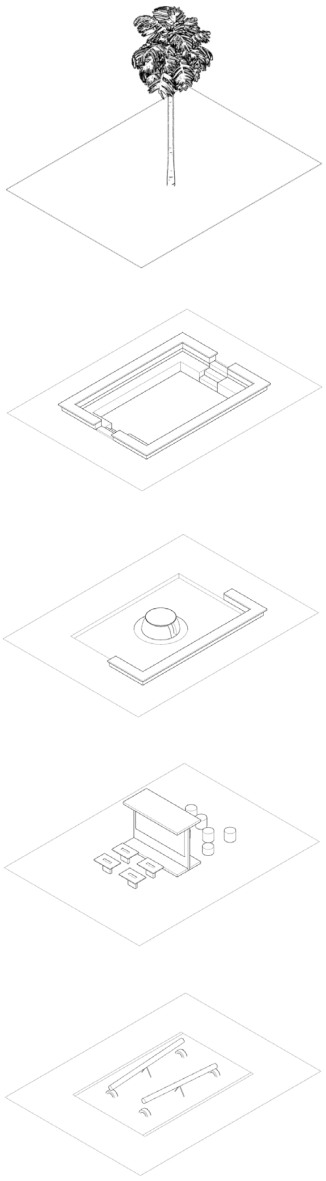


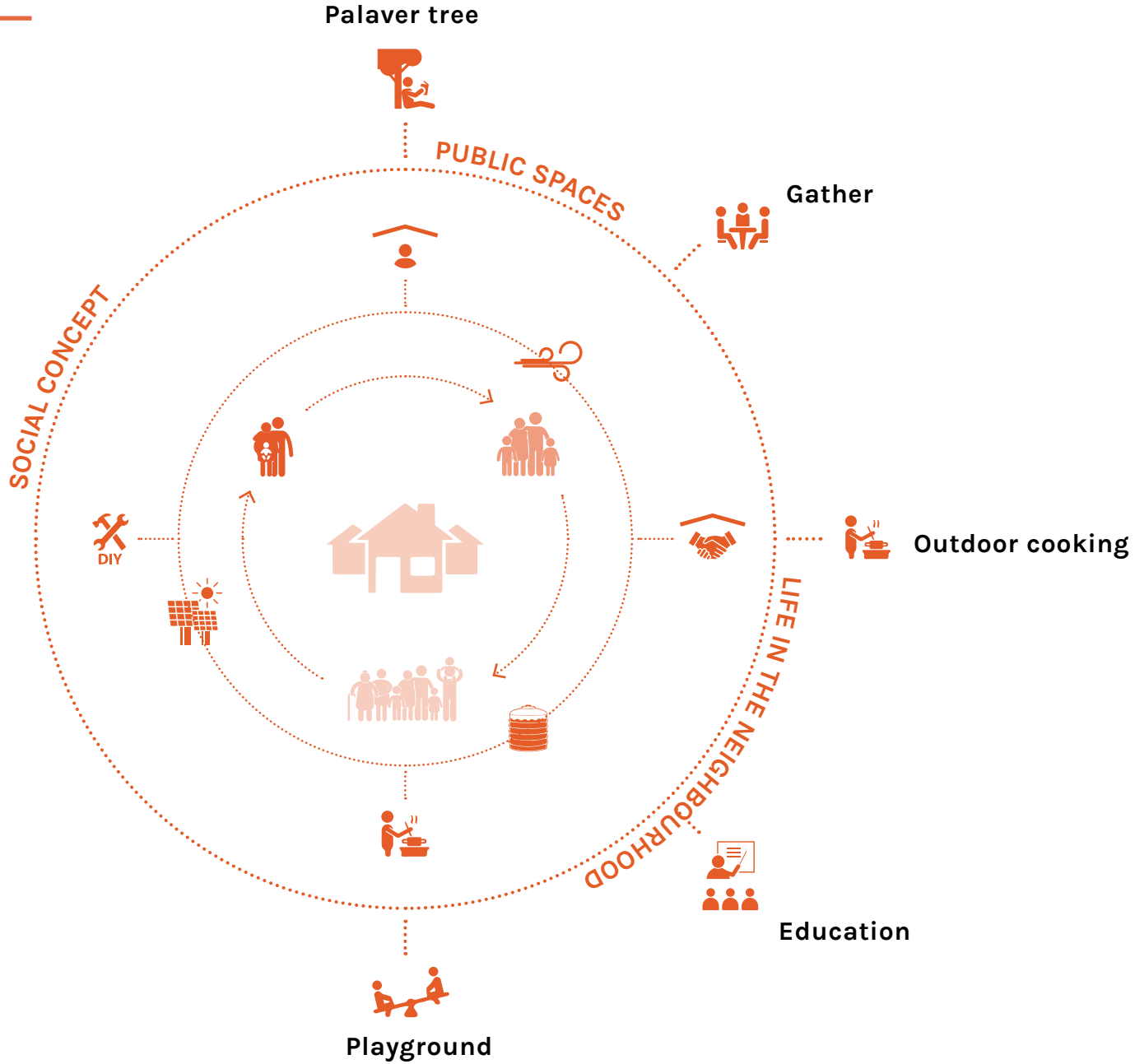
HOUSING + SOCIAL CONCEPT



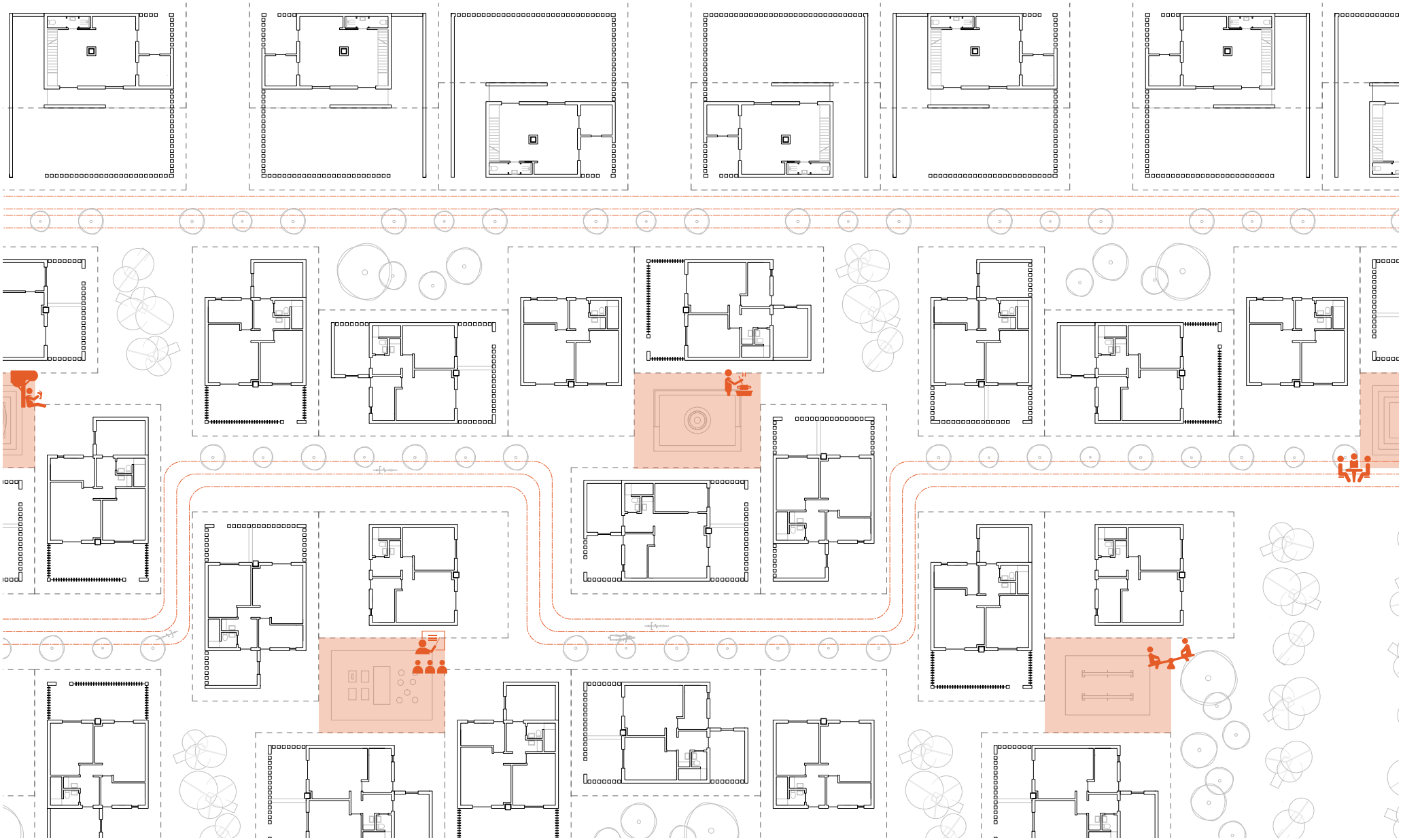


HOUSING + SOCIAL CONCEPT

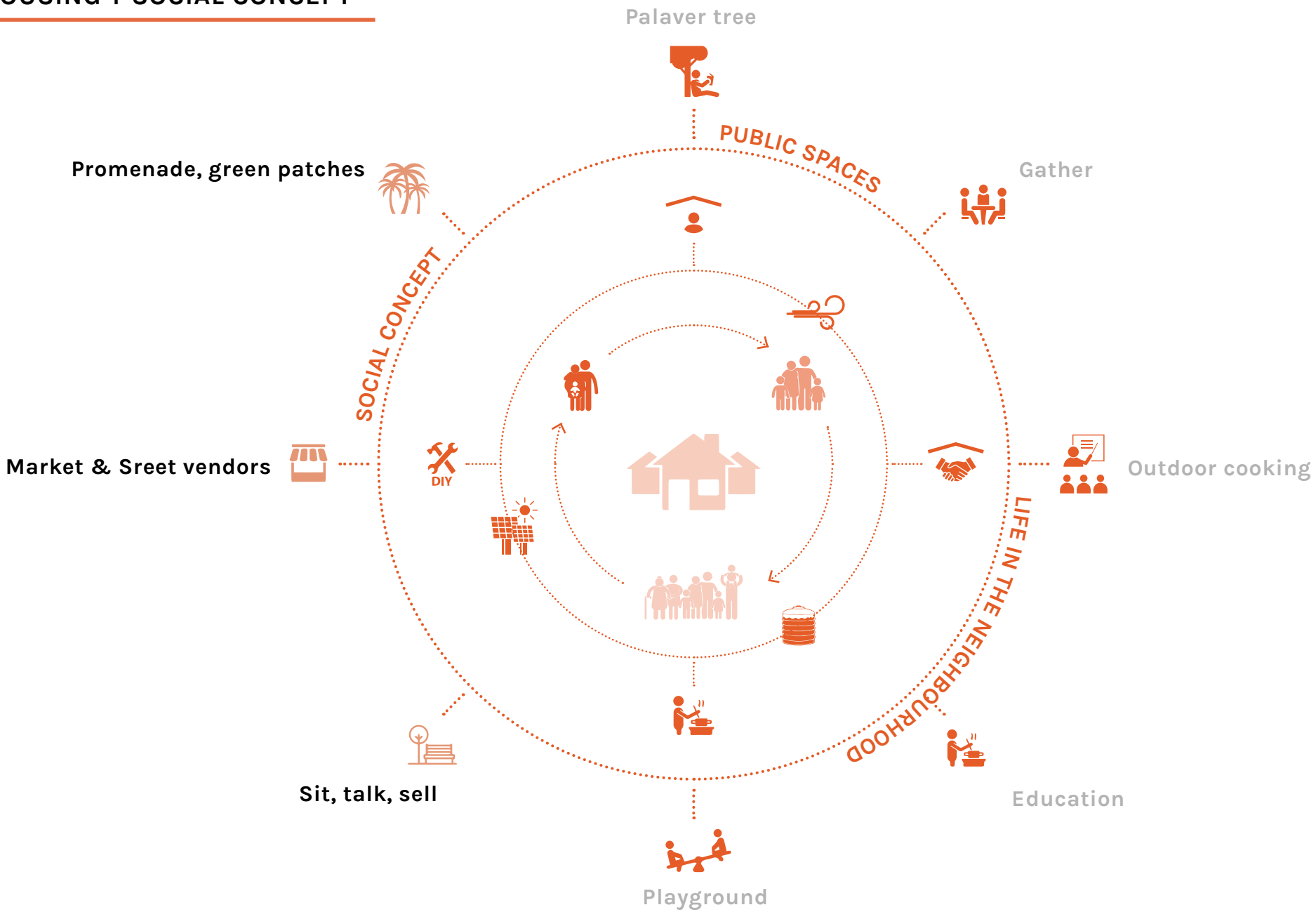




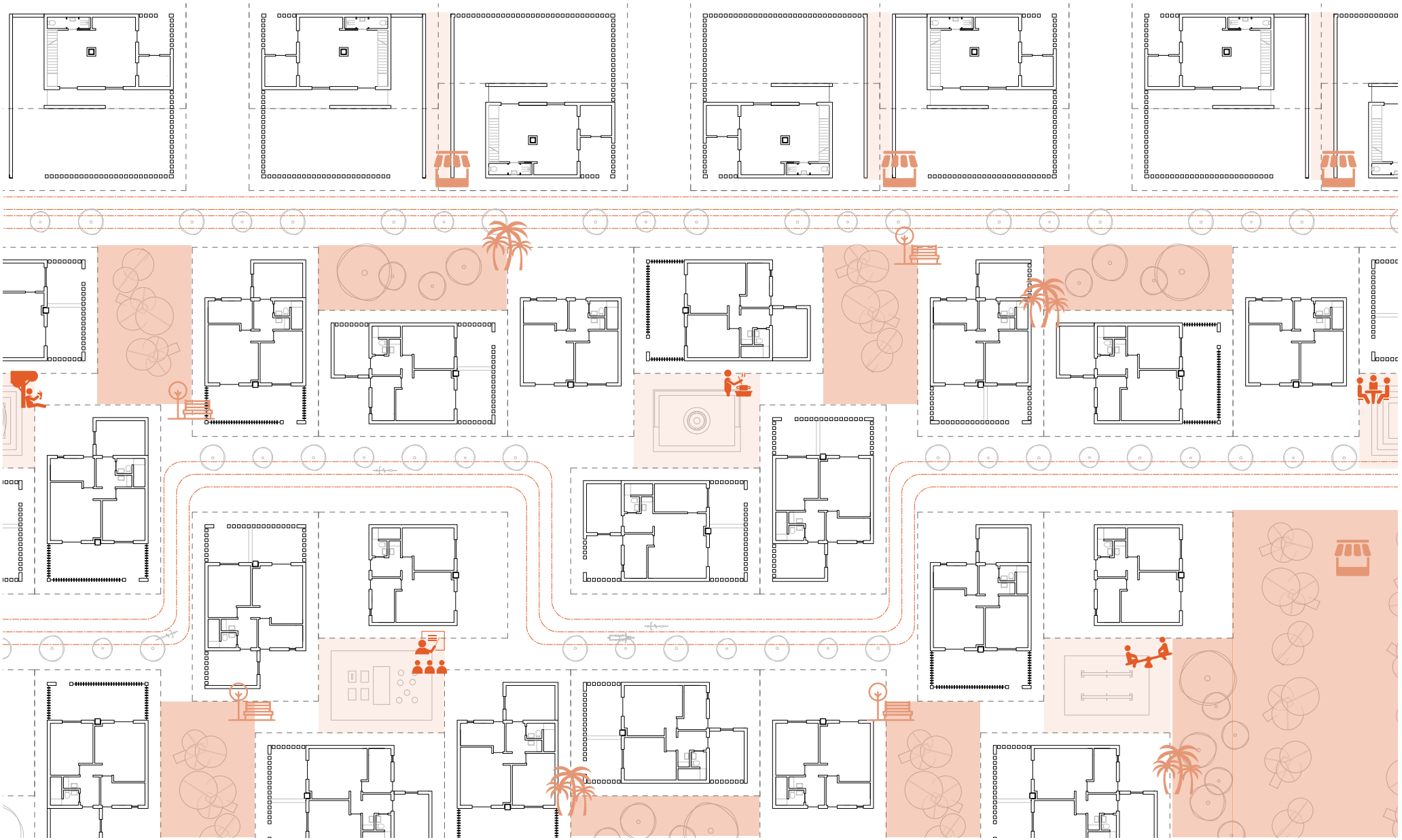
IMPLEMENTATION



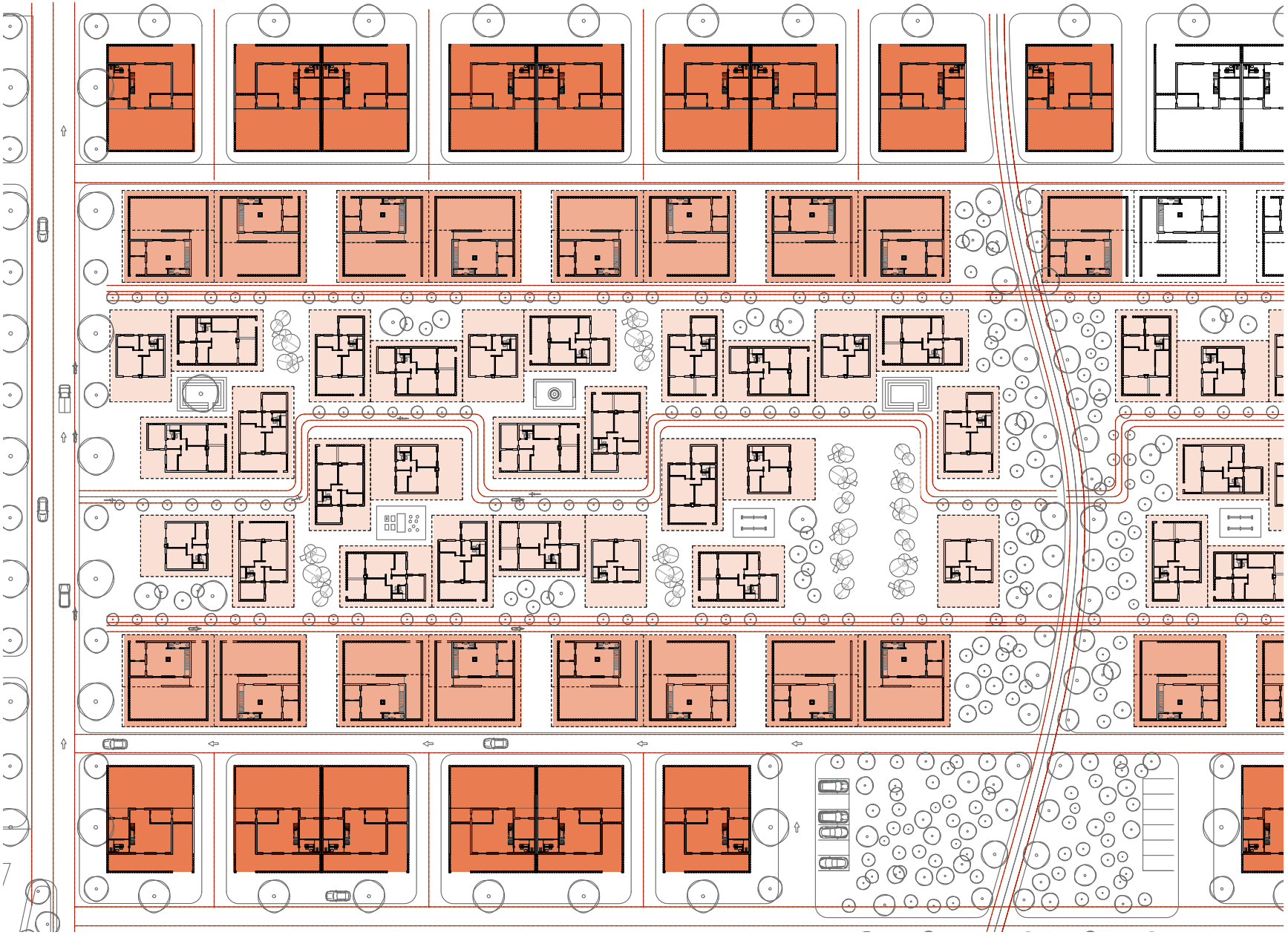
HOUSING + SOCIAL CONCEPT

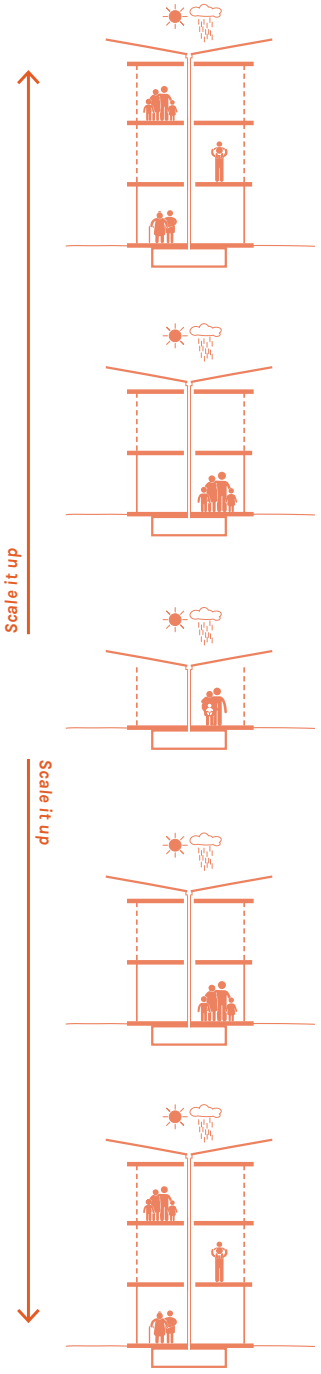


IMPLEMENTATION

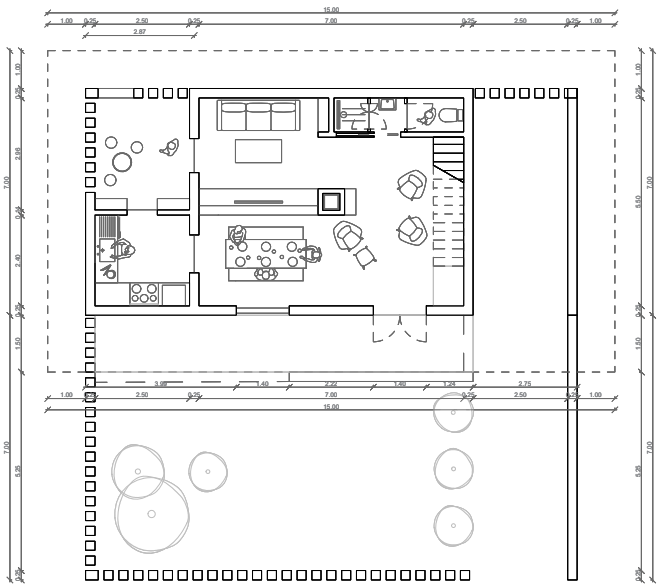


SCALE IT UP

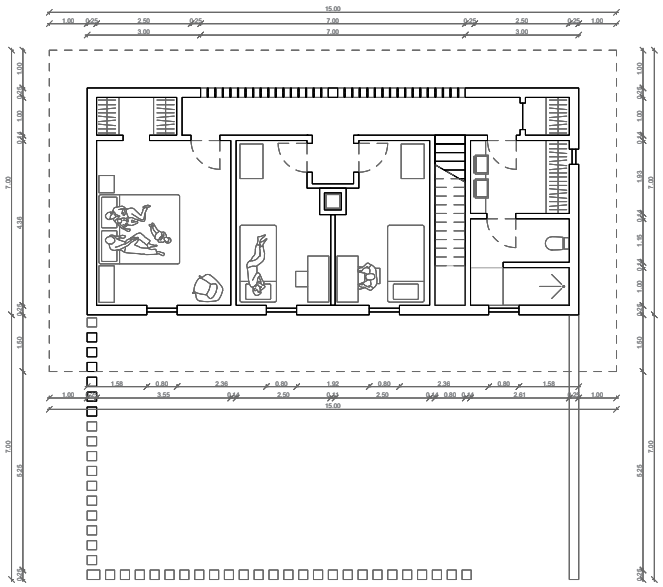




FAMILY HOUSE



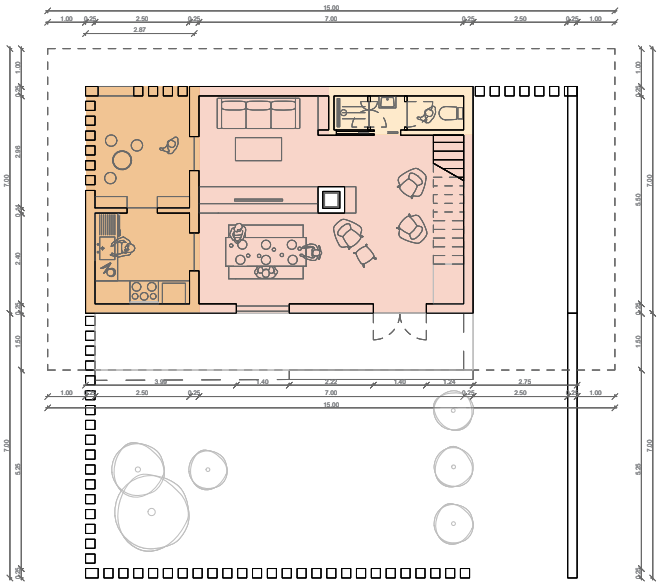
GROUND FLOOR
1:100



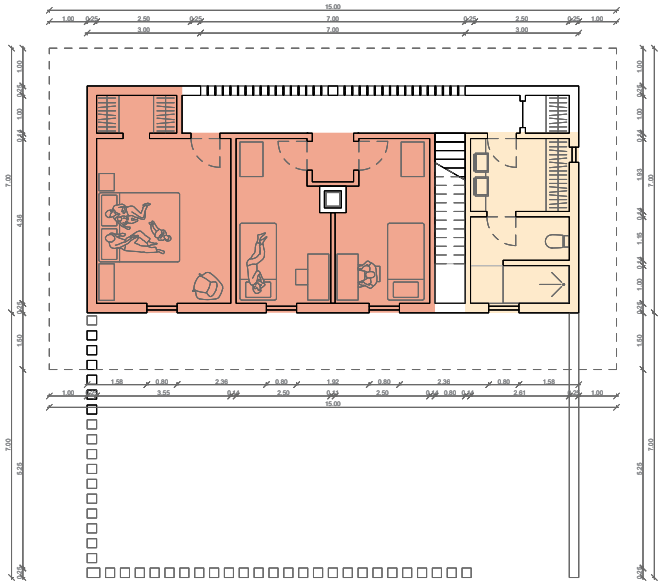
FIRST FLOOR
1:100

FAMILY HOUSE

Program



GROUND FLOOR
1:100



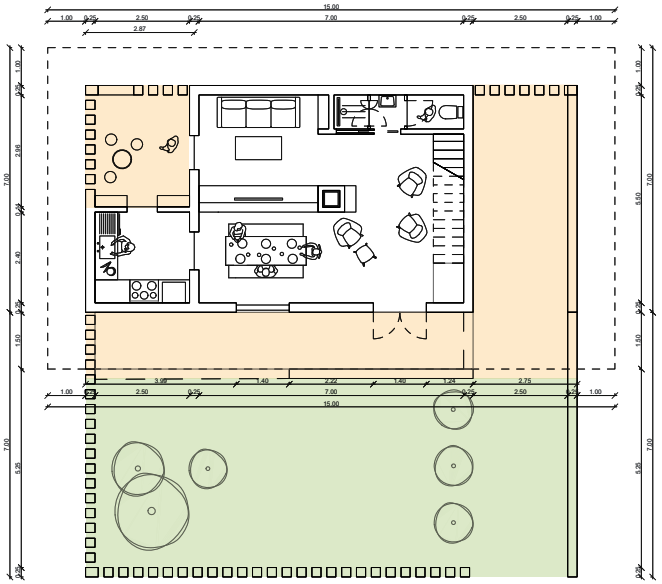
FIRST FLOOR
1:100

Legend

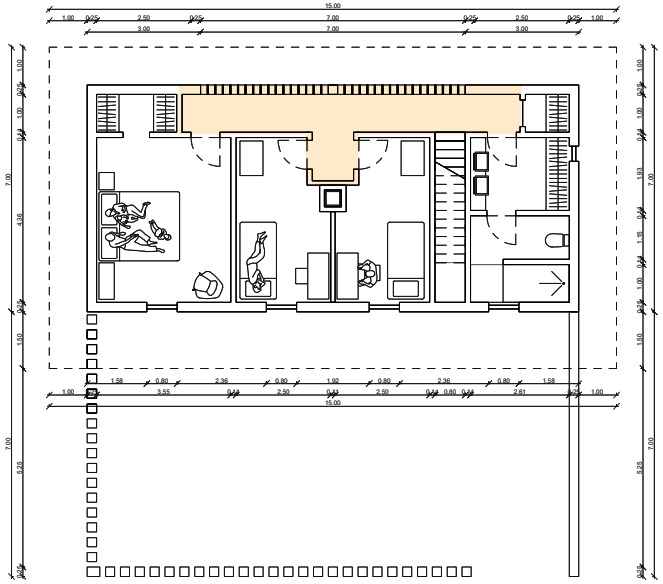
- Living room
- Bedroom
- Kitchen
- Bathroom

FAMILY HOUSE

Outdoor Living



GROUND FLOOR
1:100

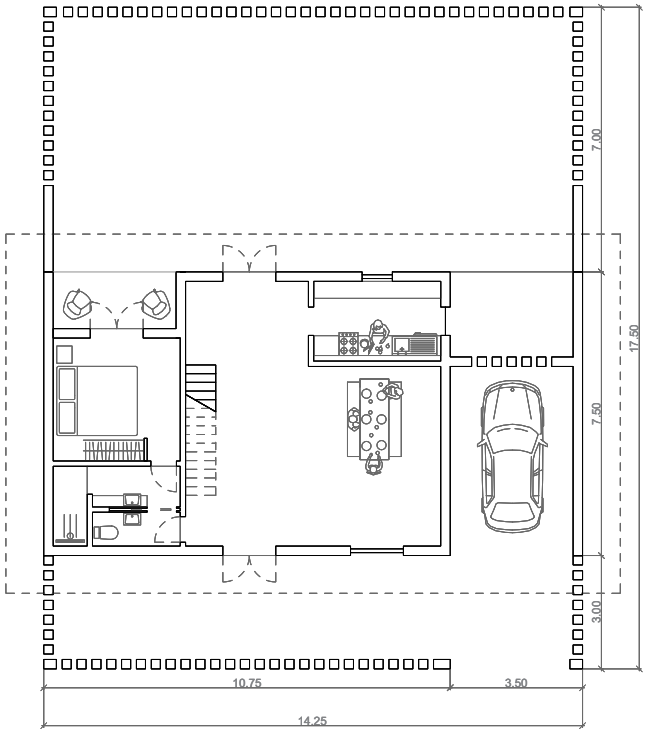


FIRST FLOOR
1:100

Legend

- Outdoor, garden area
- Outdoor, Terrace, Balcony, niche, corridor

GENERATIONS HOME



GROUND FLOOR
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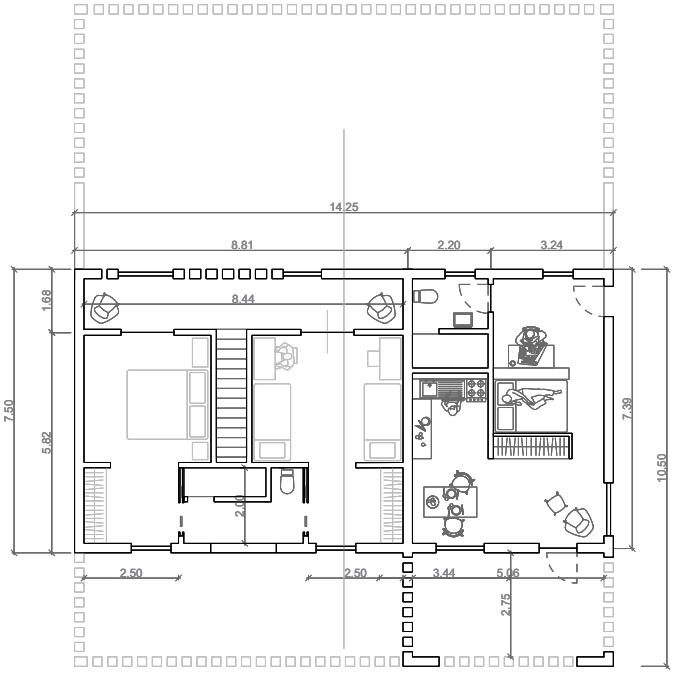

FIRST FLOOR
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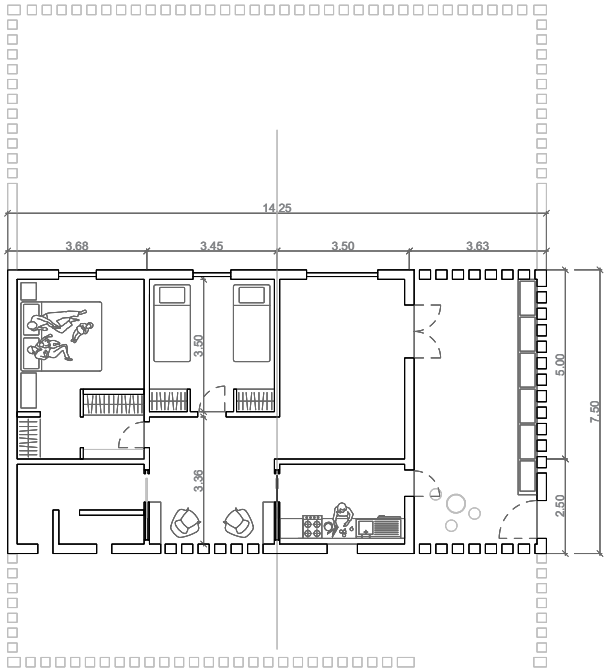
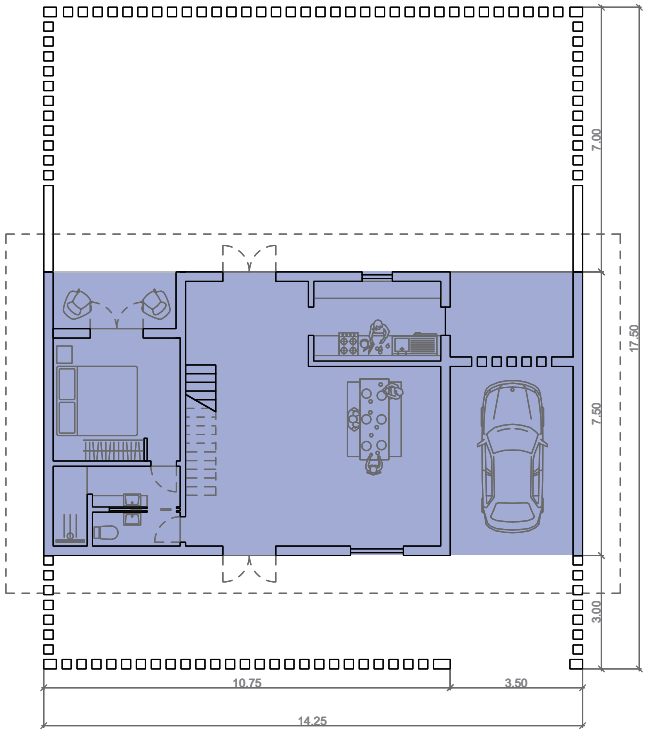


SECOND FLOOR
1:100

GENERATIONS HOME

1 House 3 Apartments



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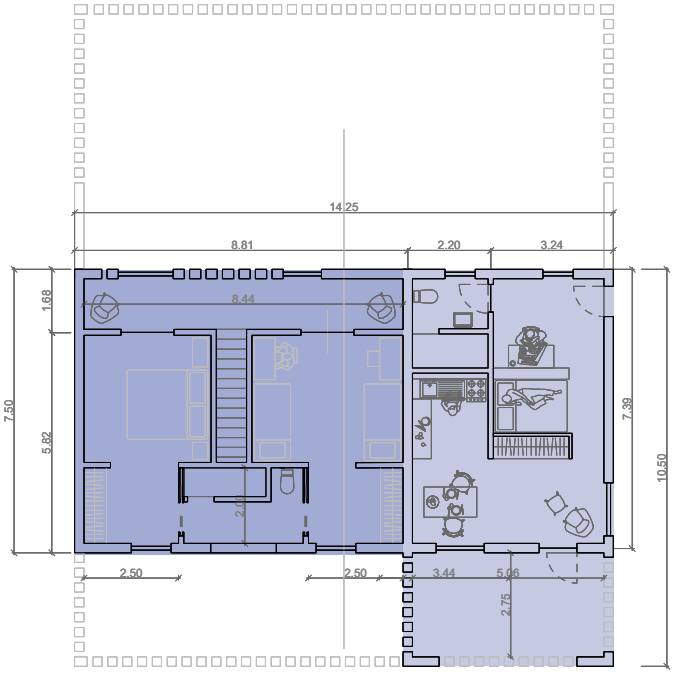
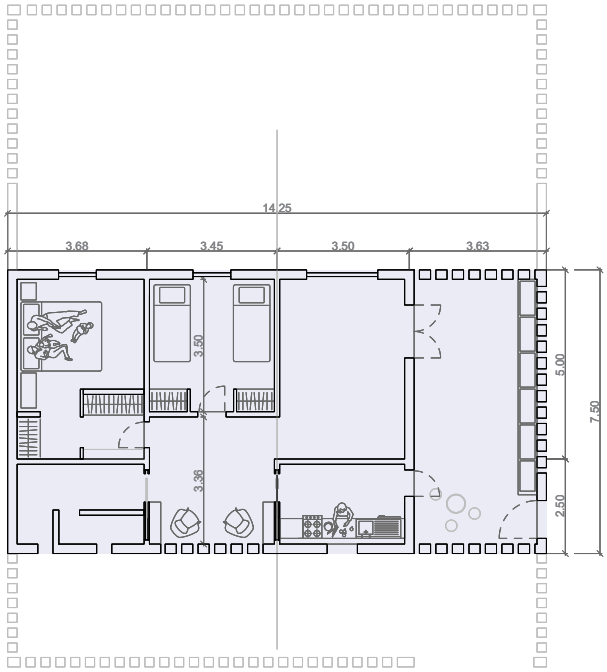


FIRST FLOOR
1:100



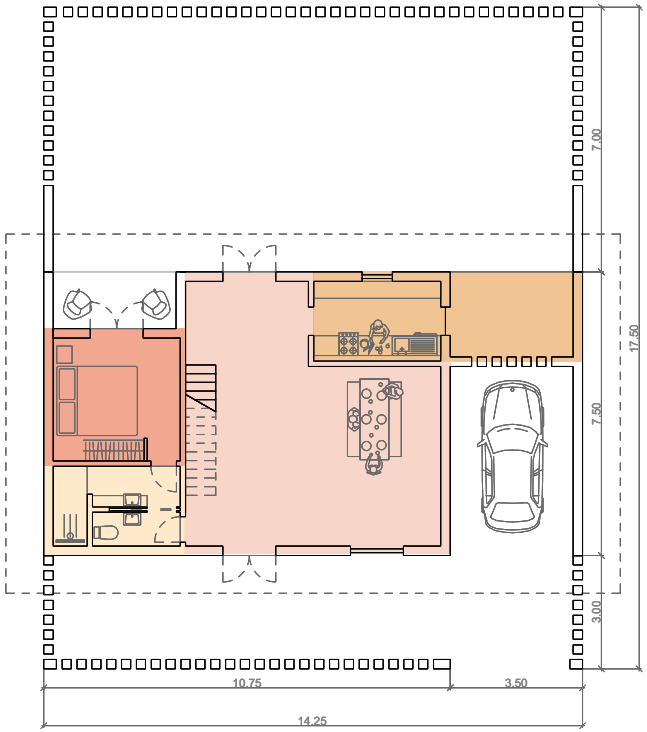
SECOND FLOOR
1:100

Legend

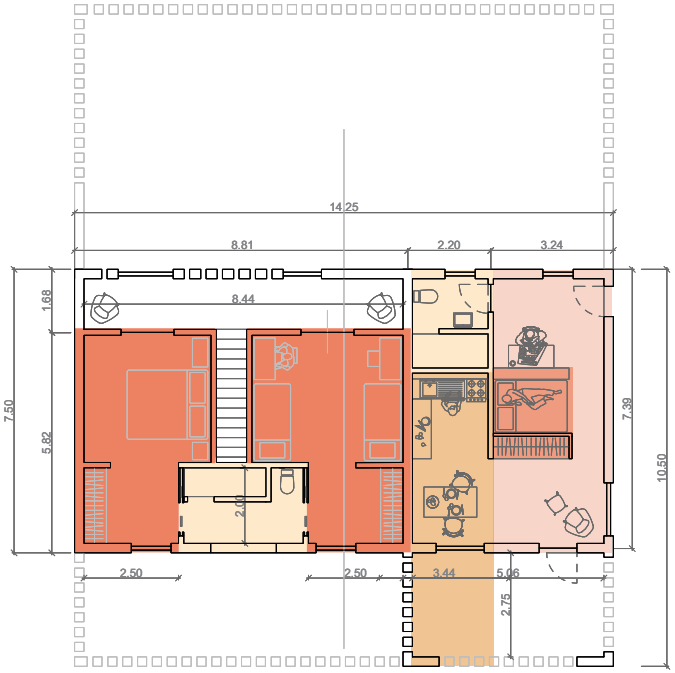
- Apartment 1 (app. 120m2 + garden)
- Apartment 2 (app. 35m2)
- Apartment 3 (app. 85m2)

GENERATIONS HOME

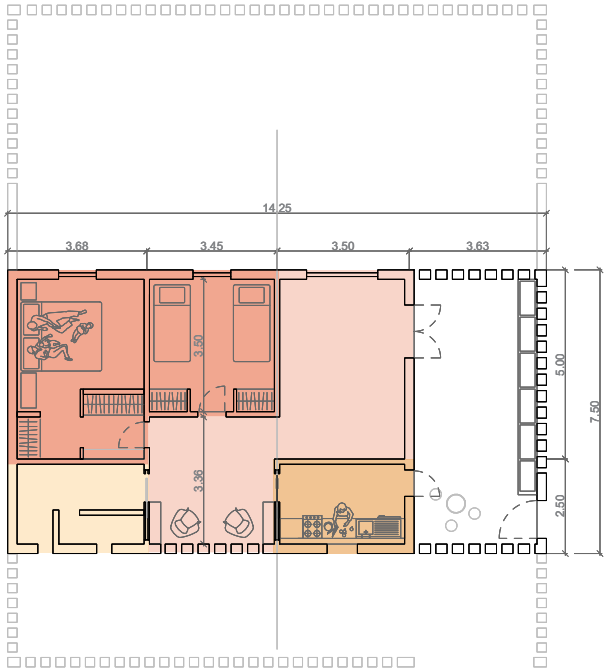
Program



GROUND FLOOR
1:100



FIRST FLOOR
1:100



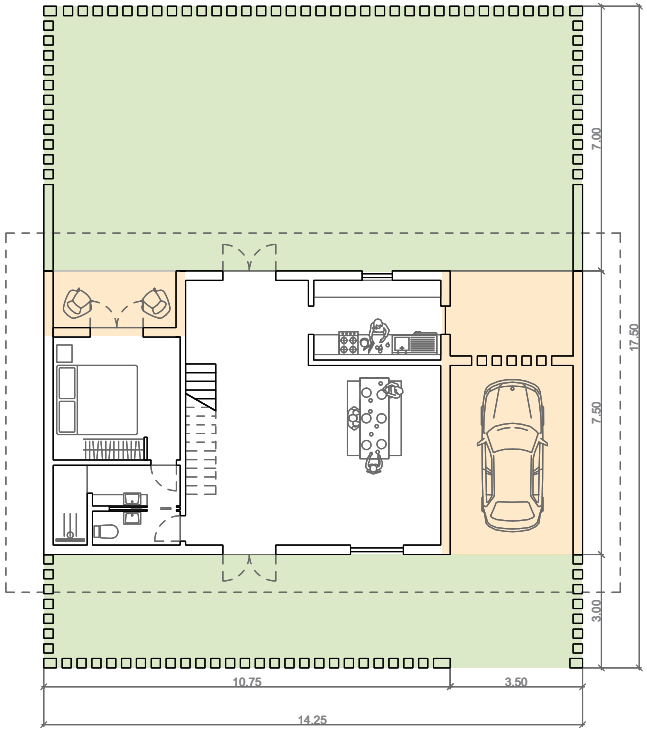
SECOND FLOOR
1:100

Legend

- Living room
- Bedroom
- Kitchen
- Bathroom

GENERATIONS HOME

Outdoor Living



GROUND FLOOR
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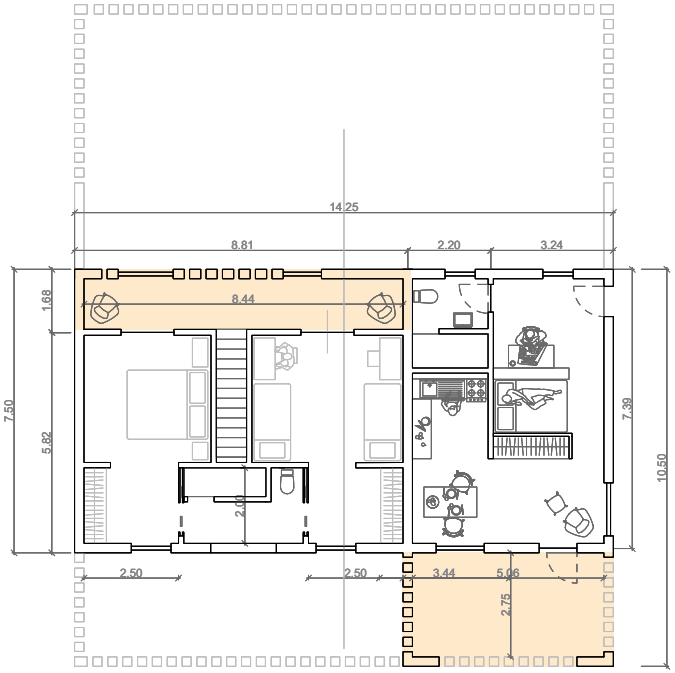

FIRST FLOOR
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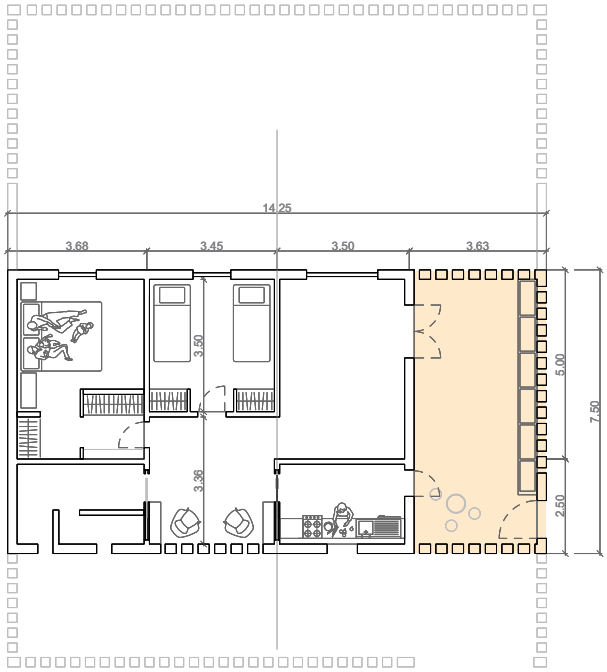


SECOND FLOOR
1:100

Legend

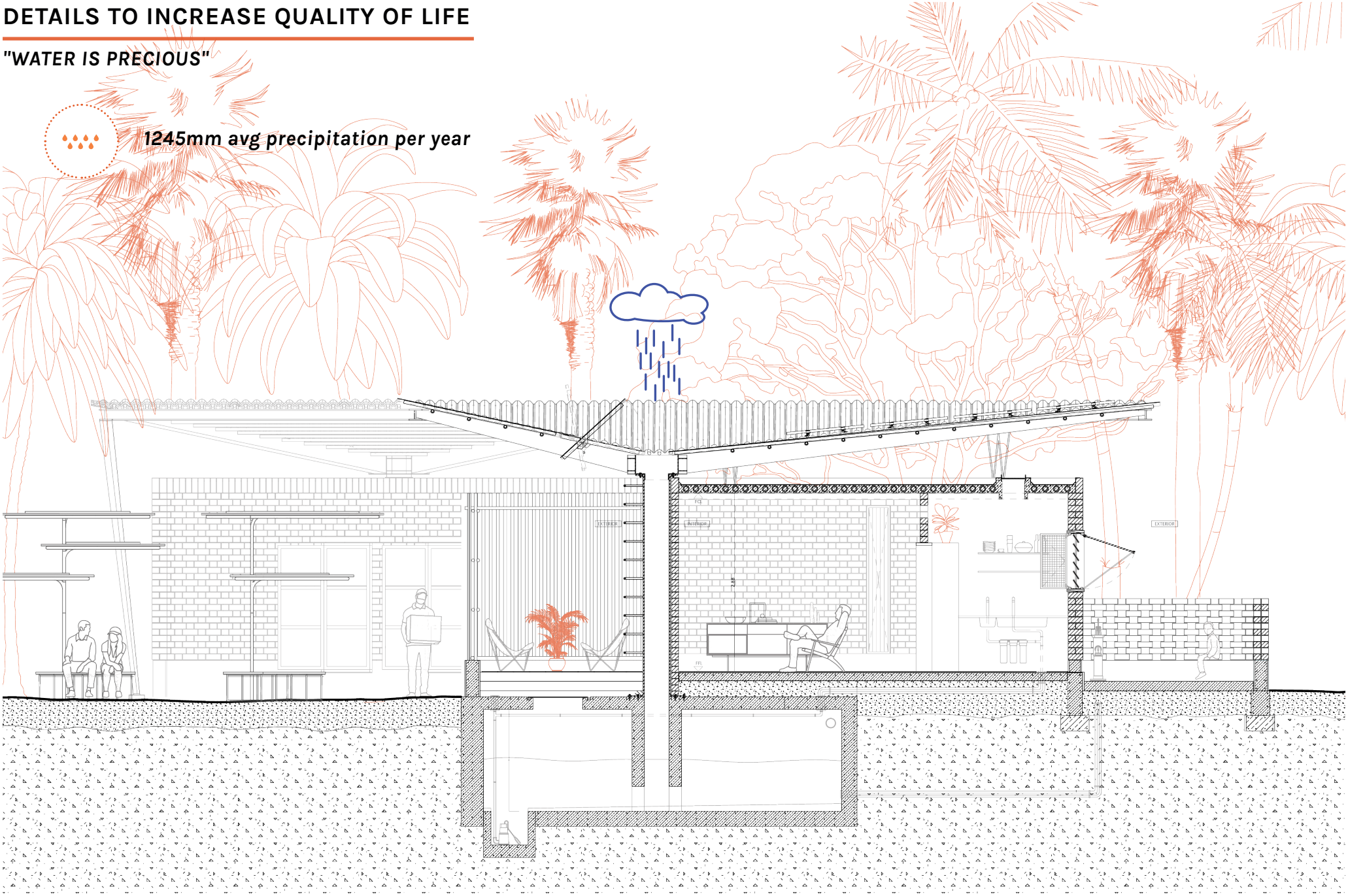
- Outdoor, garden area
- Outdoor, Terrace, Balcony, nich, corridor

NARRATIVE OF ELEMENTS

DETAILS TO INCREASE QUALITY OF LIFE

"WATER IS PRECIOUS"

1245mm avg precipitation per year



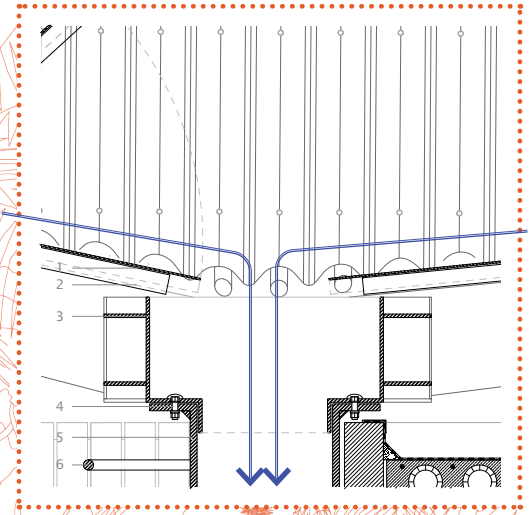
DETAILS TO INCREASE QUALITY OF LIFE

"WATER IS PRECIOUS"

1245mm avg precipitation per year

Funnel roof starter home surface = 120m2

STEEL DOWNPIPE DETAIL



STEEL DOWNPIPE DETAIL 1:10

1. Corrugated metal sheeting
2. Bamboo substructure
3. Steel gutter funnel head piece
4. Countersunk bolted connection
5. Steel downpipe
6. Maintenance ladder

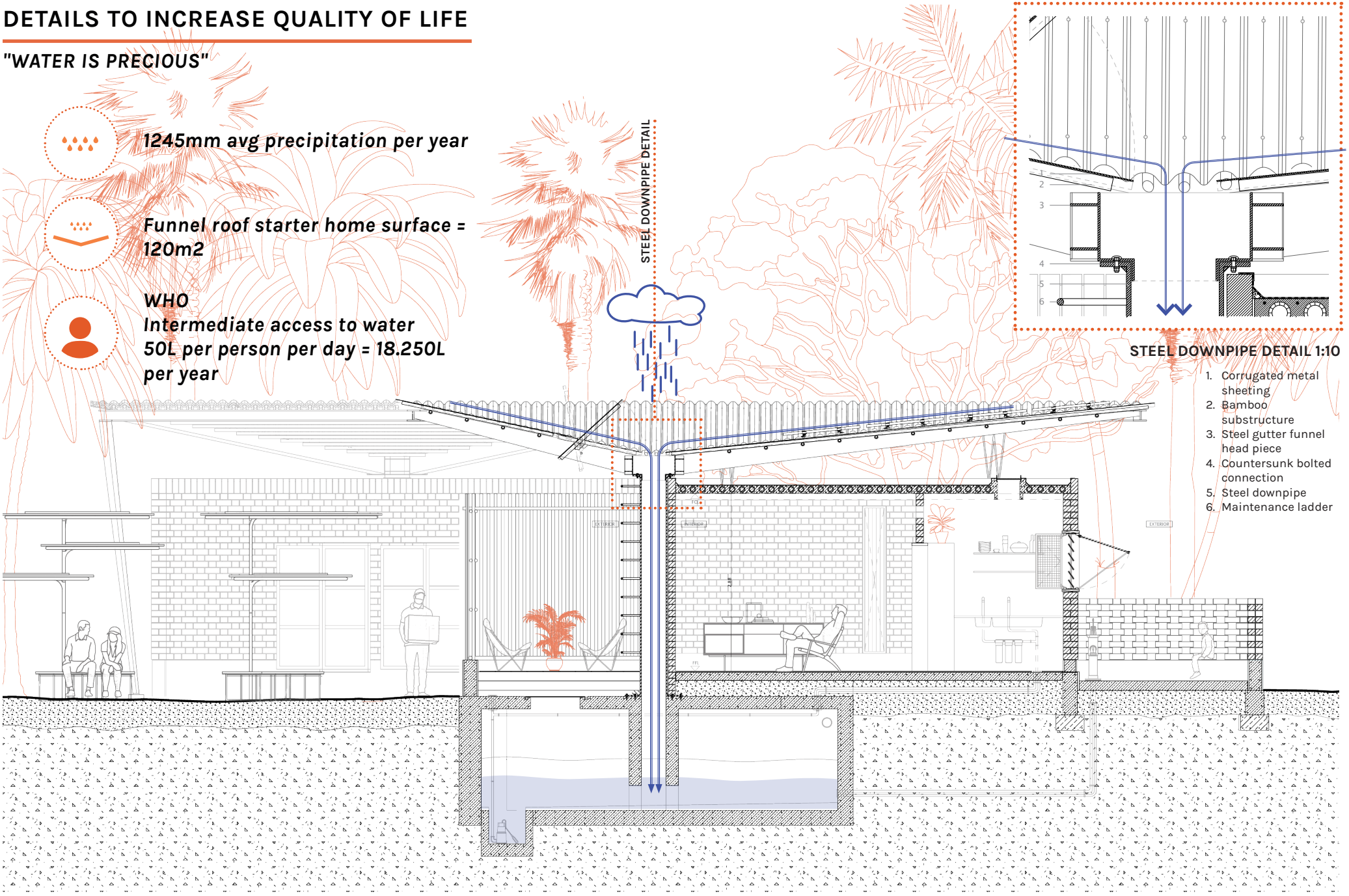
DETAILS TO INCREASE QUALITY OF LIFE

"WATER IS PRECIOUS"

1245mm avg precipitation per year

Funnel roof starter home surface = 120m2

WHO
Intermediate access to water
50L per person per day = 18.250L per year



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DETAILS TO INCREASE QUALITY OF LIFE

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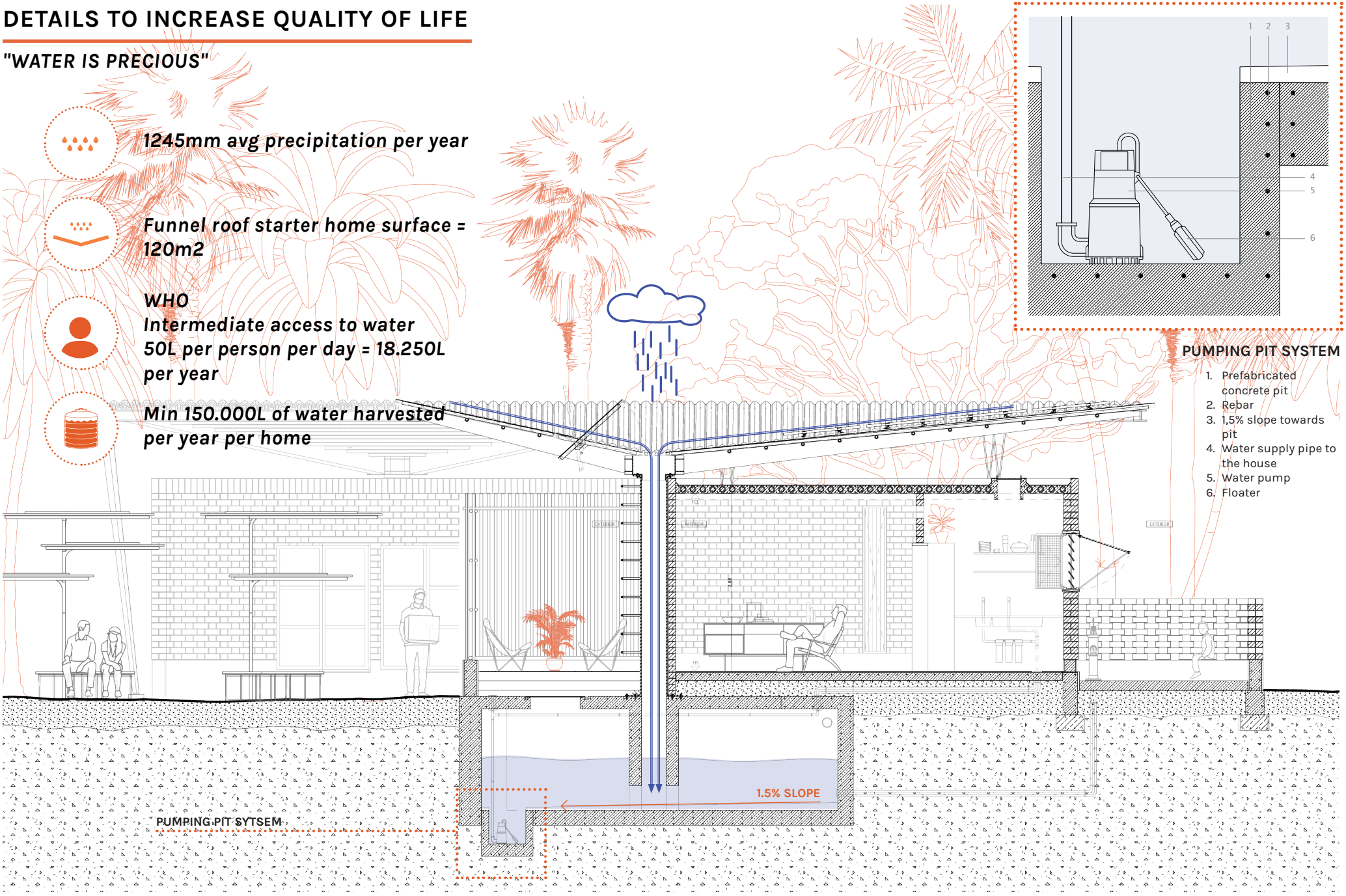

PUMPING PIT SYSTEM

1. Prefabricated concrete pit
2. Rebar
3. 1,5% slope towards pit
4. Water supply pipe to the house
5. Water pump
6. Floater

DETAILS TO INCREASE QUALITY OF LIFE

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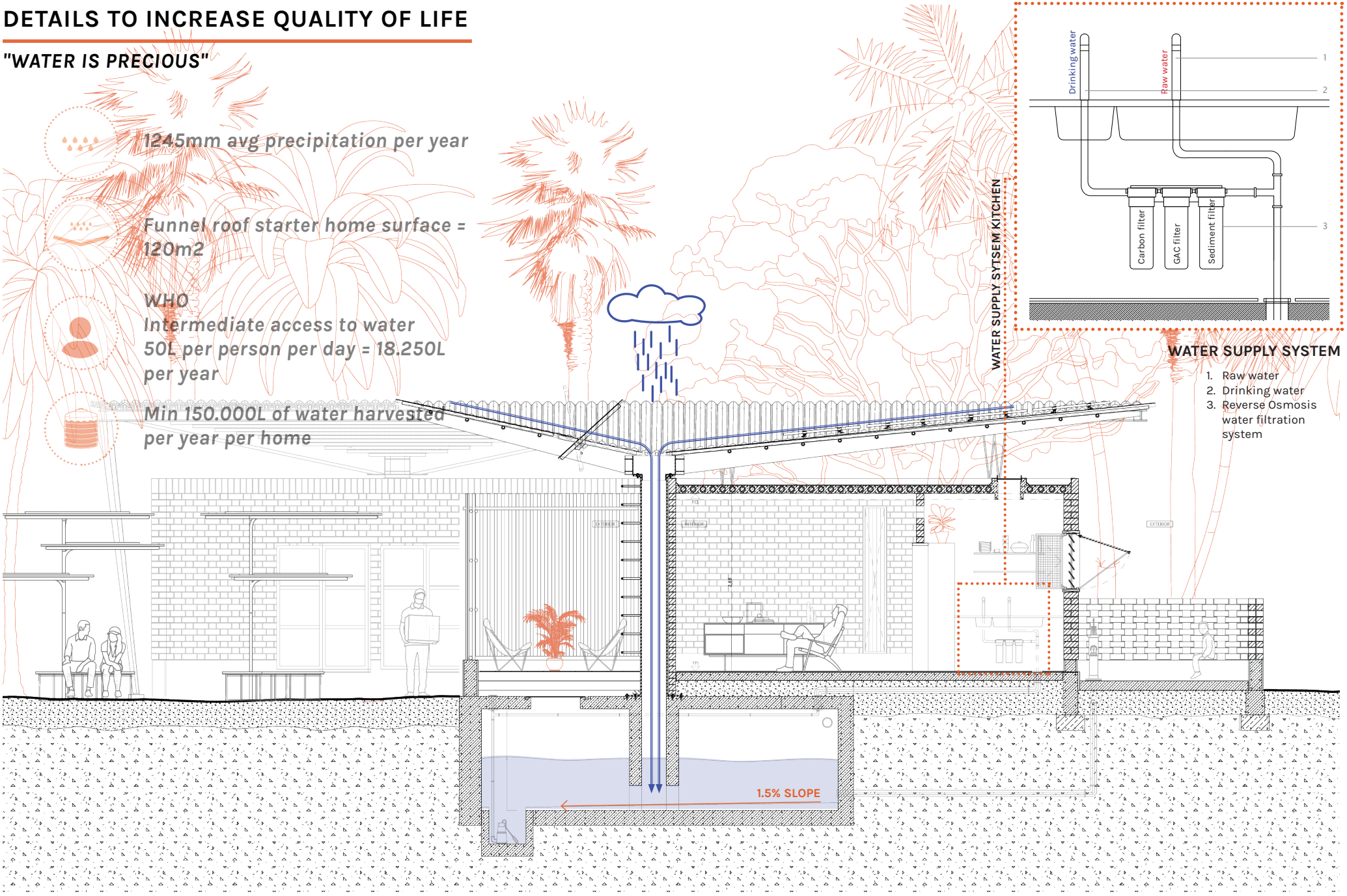

WATER SUPPLY SYSTEM

1. Raw water
2. Drinking water
3. Reverse Osmosis water filtration system

DETAILS TO INCREASE QUALITY OF LIFE

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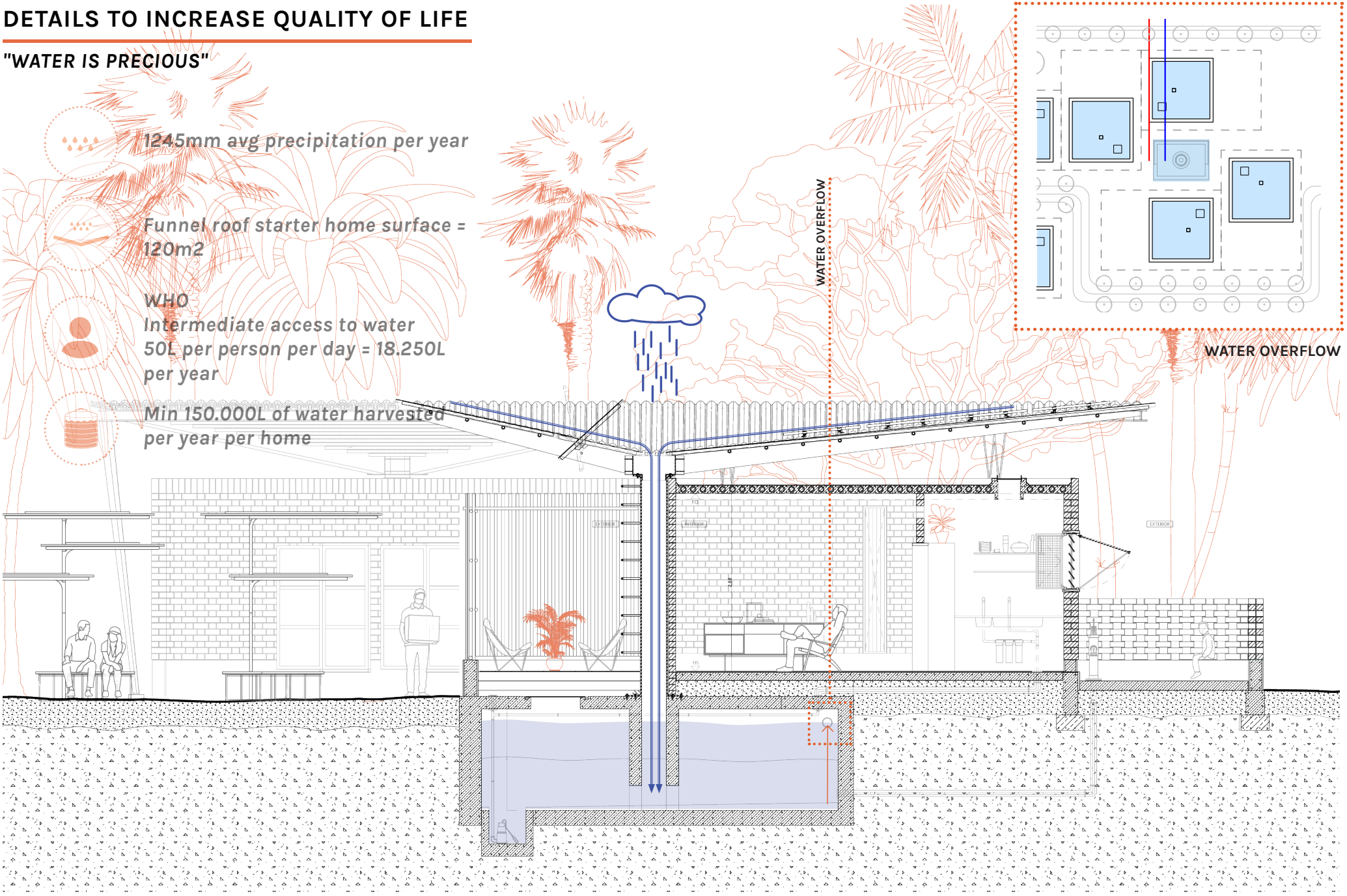

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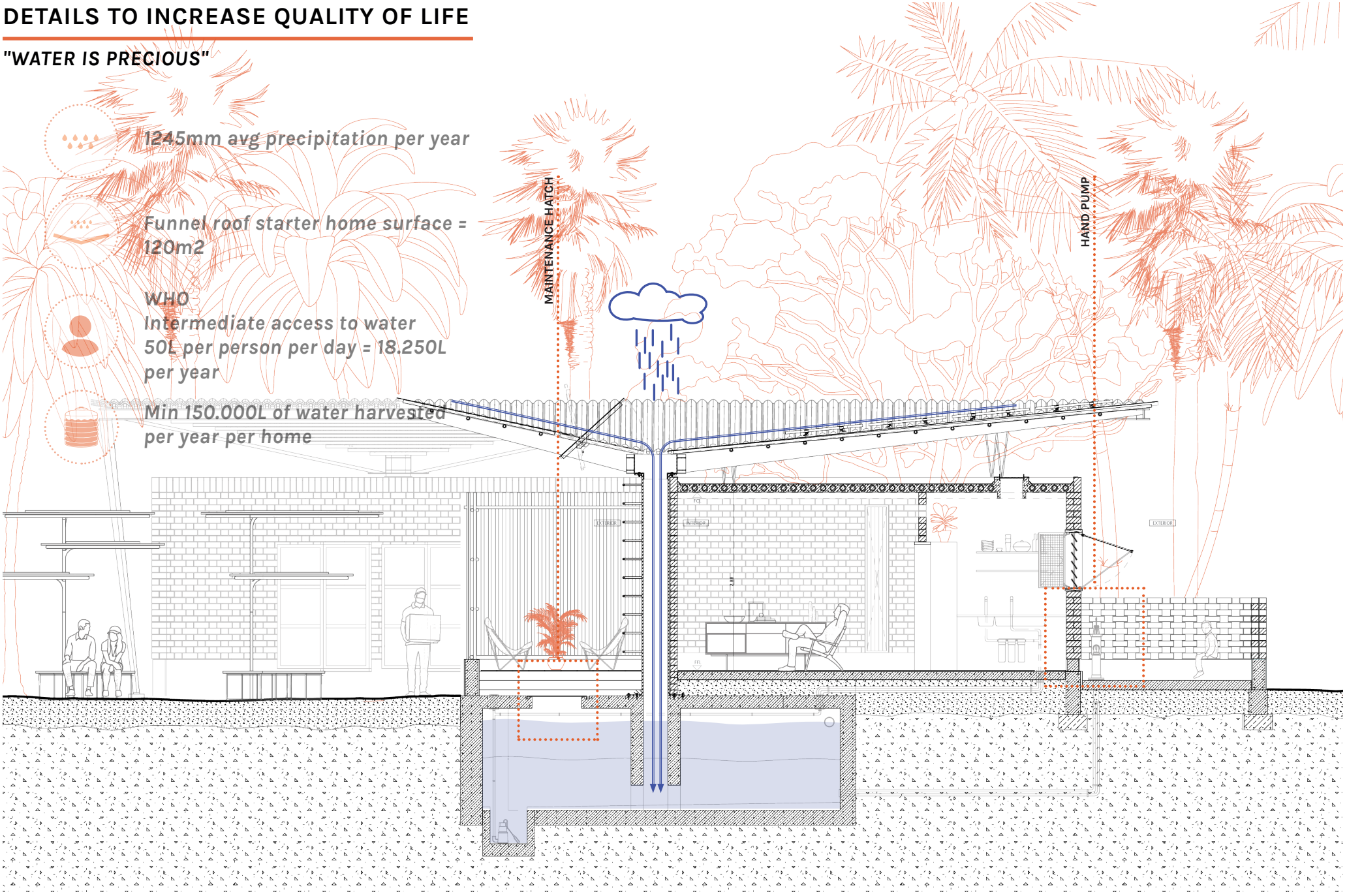
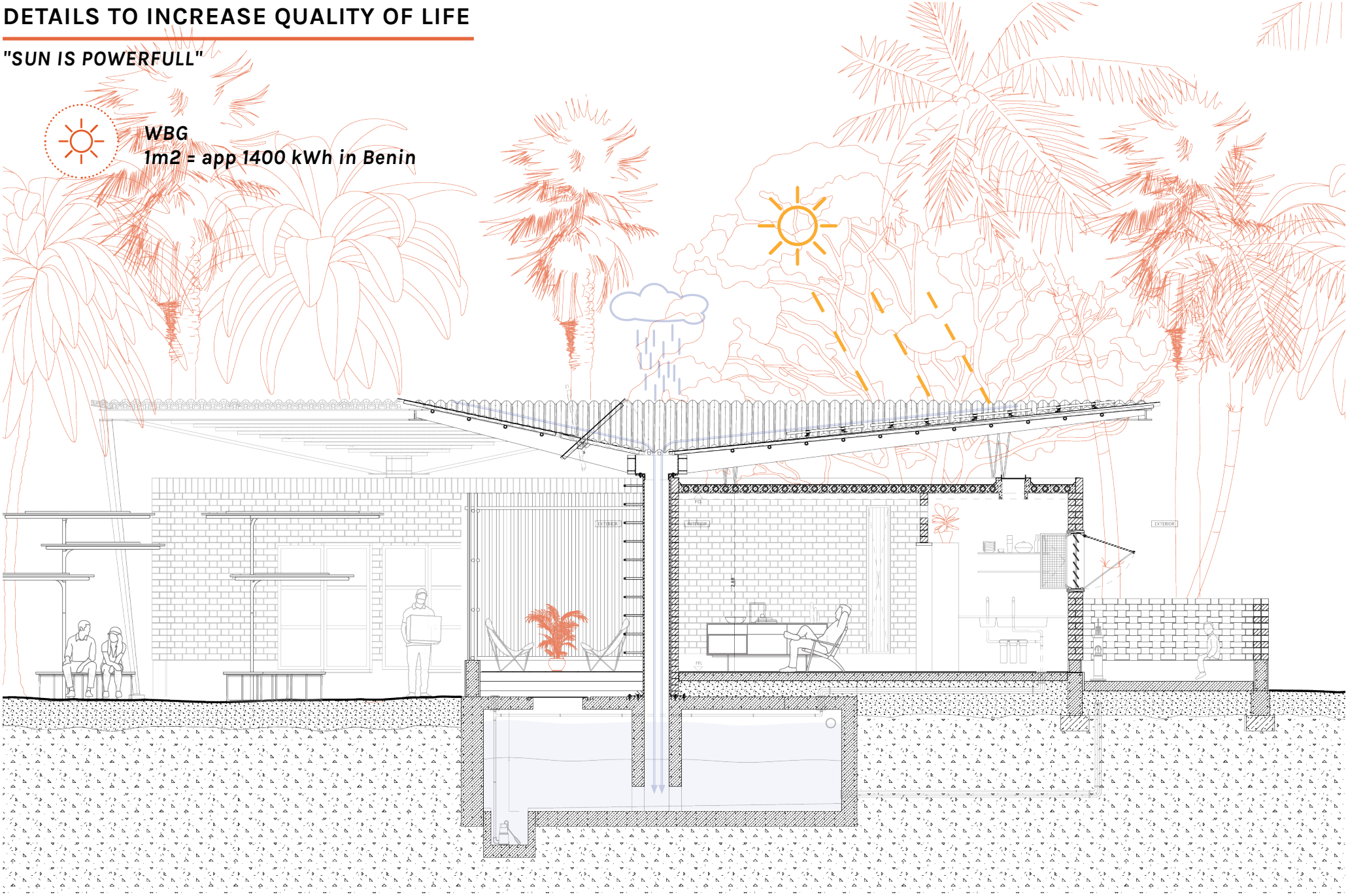


DETAILS TO INCREASE QUALITY OF LIFE

"SUN IS POWERFULL"

WBG
1m2 = app 1400 kWh in Benin



DETAILS TO INCREASE QUALITY OF LIFE

"SUN IS POWERFULL"

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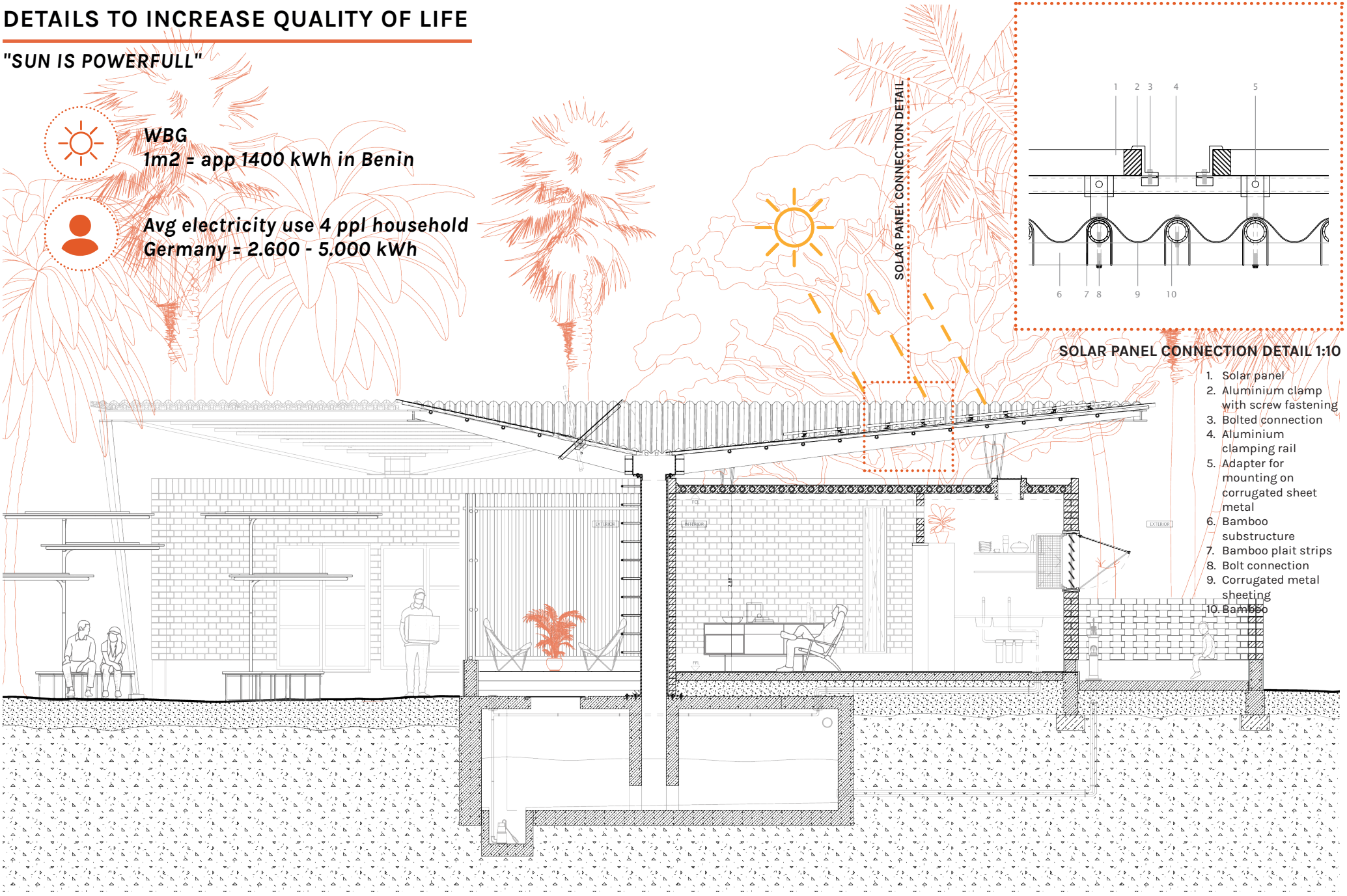
1m2 = app 1400 kWh in Benin

Avg electricity use 4 ppl household
Germany = 2.600 - 5.000 kWh



SOLAR PANEL CONNECTION DETAIL 1:10

1. Solar panel
2. Aluminium clamp with screw fastening
3. Bolted connection
4. Aluminium clamping rail
5. Adapter for mounting on corrugated sheet metal
6. Bamboo substructure
7. Bamboo plait strips
8. Bolt connection
9. Corrugated metal sheeting
10. Bamboo

DETAILS TO INCREASE QUALITY OF LIFE

"SUN IS POWERFULL"

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Avg electricity use 4 ppl household
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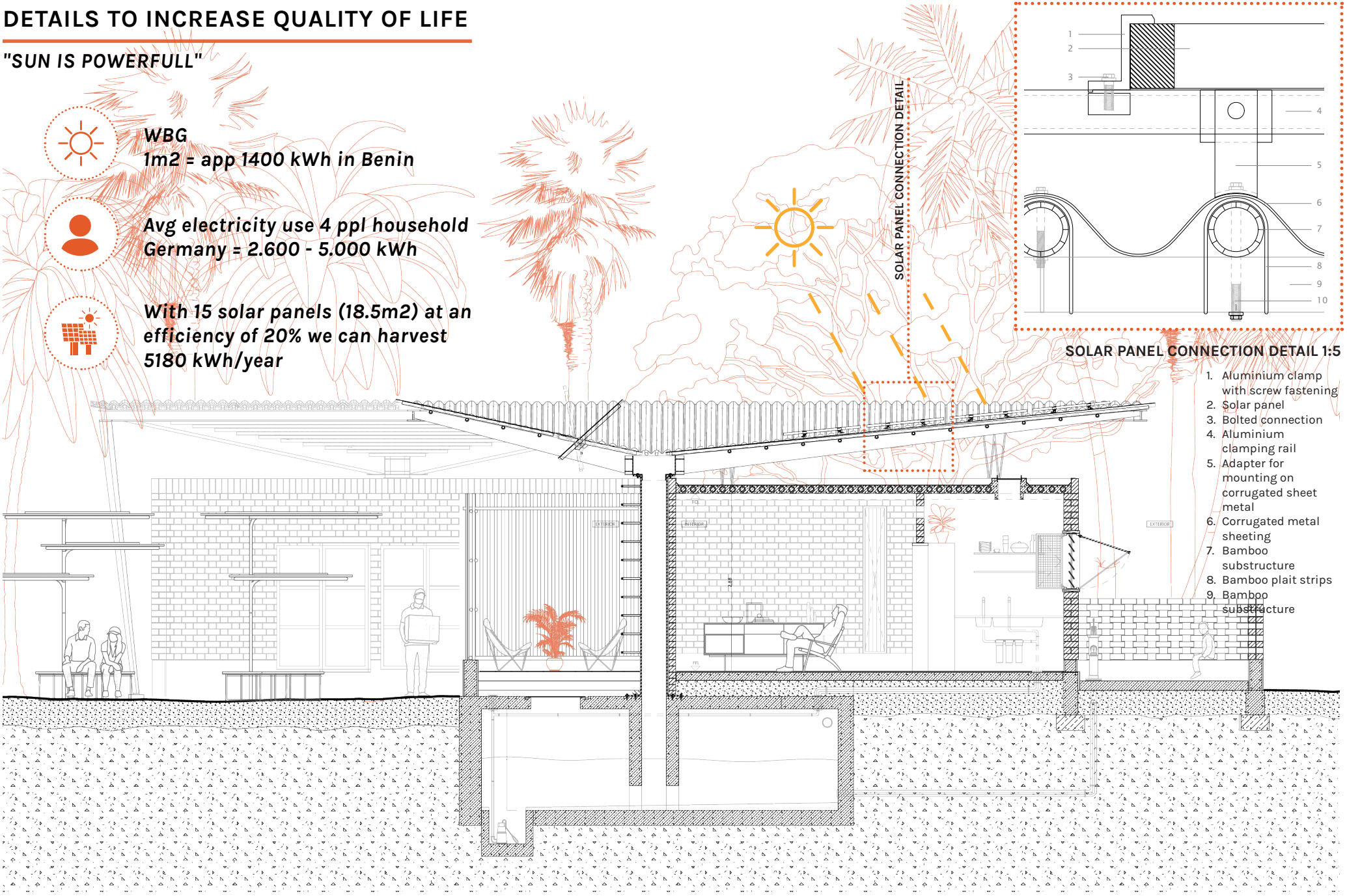
With 15 solar panels (18.5m2) at an efficiency of 20% we can harvest 5180 kWh/year



SOLAR PANEL CONNECTION DETAIL 1:5

1. Aluminium clamp with screw fastening
2. Solar panel
3. Bolted connection
4. Aluminium clamping rail
5. Adapter for mounting on corrugated sheet metal
6. Corrugated metal sheeting
7. Bamboo substructure
8. Bamboo plait strips
9. Bamboo substructure

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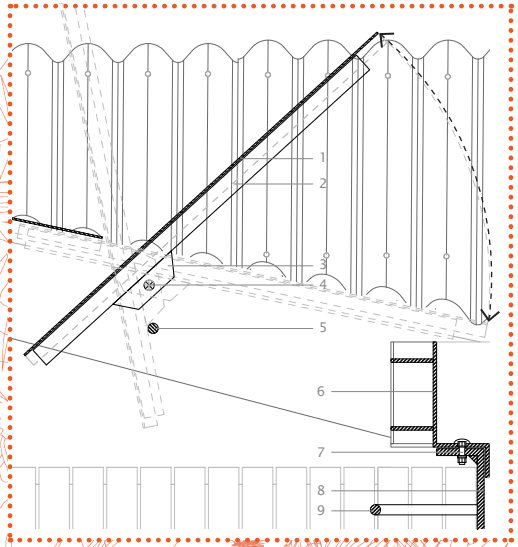
ROOF MAINTENANCE HATCH DETAIL



ROOF MAINTENANCE HATCH DETAIL 1:10

1. Corrugated metal sheeting
2. Metal round pipe substructure
3. Reinforcement
4. Bearing
5. Stop to limit opening
6. Steel gutter funnel head piece
7. Countersunk bolted connection
8. Steel downpipe
9. Maintenance ladder

DETAILS TO INCREASE QUALITY OF LIFE

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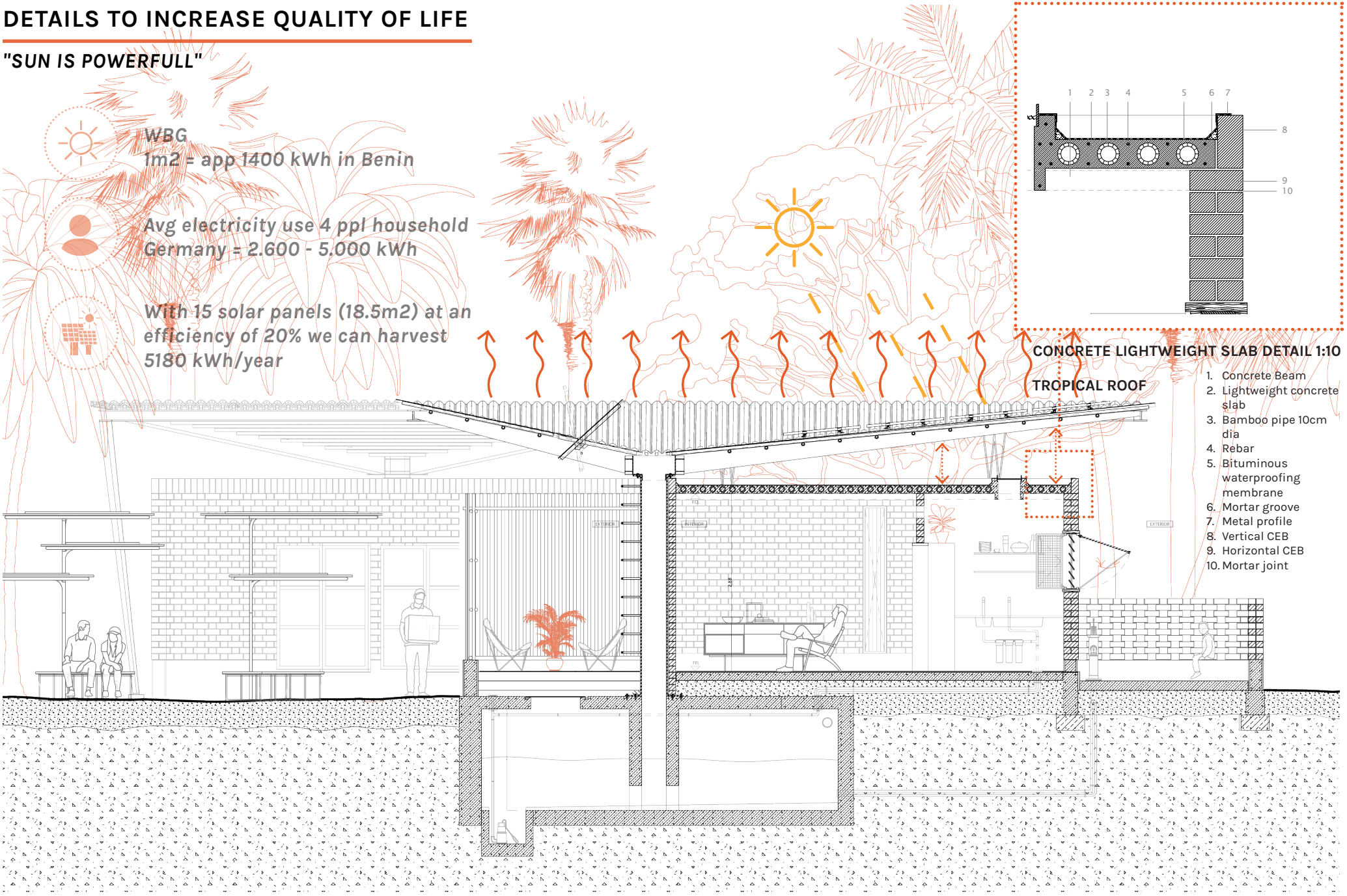


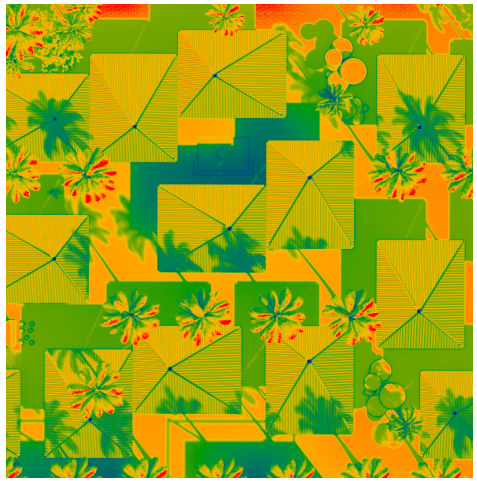
CONCRETE LIGHTWEIGHT SLAB DETAIL 1:10

1. Concrete Beam
2. Lightweight concrete slab
3. Bamboo pipe 10cm dia
4. Rebar
5. Bituminous waterproofing membrane
6. Mortar groove
7. Metal profile
8. Vertical CEB
9. Horizontal CEB
10. Mortar joint

DETAILS TO INCREASE QUALITY OF LIFE

"SHADE IS ESSENTIAL"

Roof overhang determined in relation to proximity to adjacent buildings



SHADING PRINCIPLE 10 AM - HEAT MAP

TROPICAL ROOF

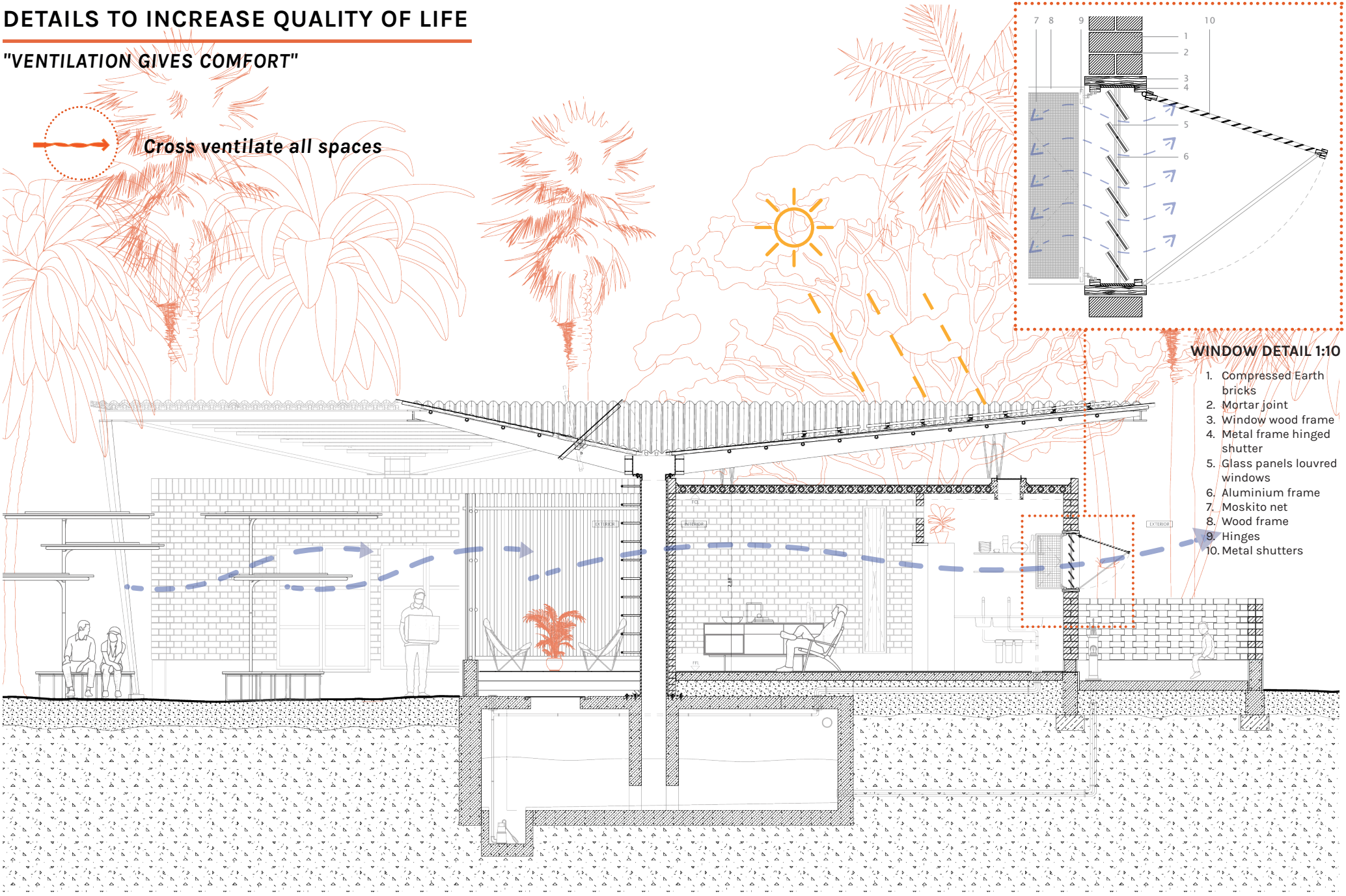
4m

1m

DETAILS TO INCREASE QUALITY OF LIFE

"VENTILATION GIVES COMFORT"

Cross ventilate all spaces



WINDOW DETAIL 1:10

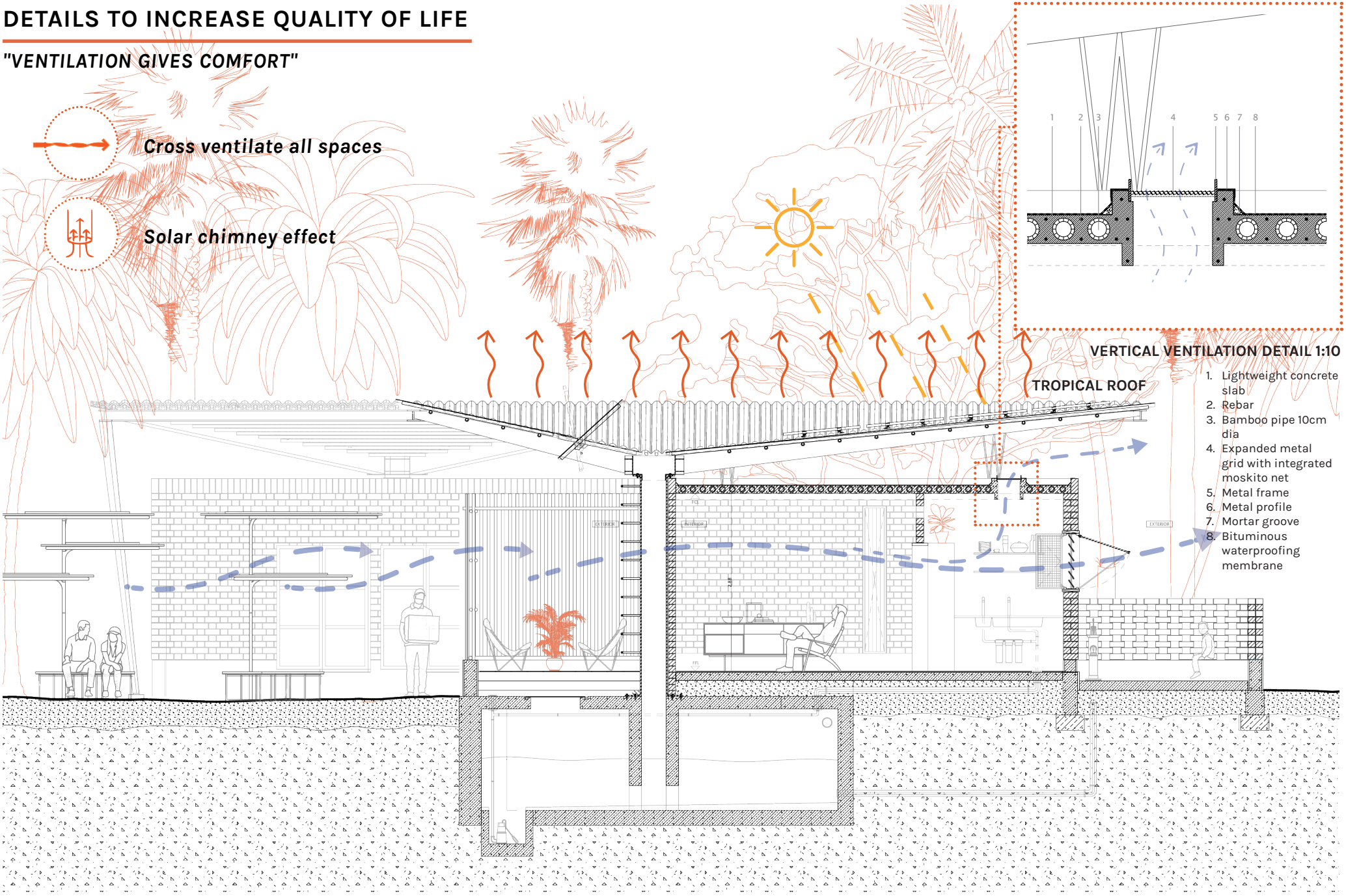
1. Compressed Earth bricks
2. Mortar joint
3. Window wood frame
4. Metal frame hinged shutter
5. Glass panels louvred windows
6. Aluminium frame
7. Moskito net
8. Wood frame
9. Hinges
10. Metal shutters

DETAILS TO INCREASE QUALITY OF LIFE

"VENTILATION GIVES COMFORT"

Cross ventilate all spaces

Solar chimney effect



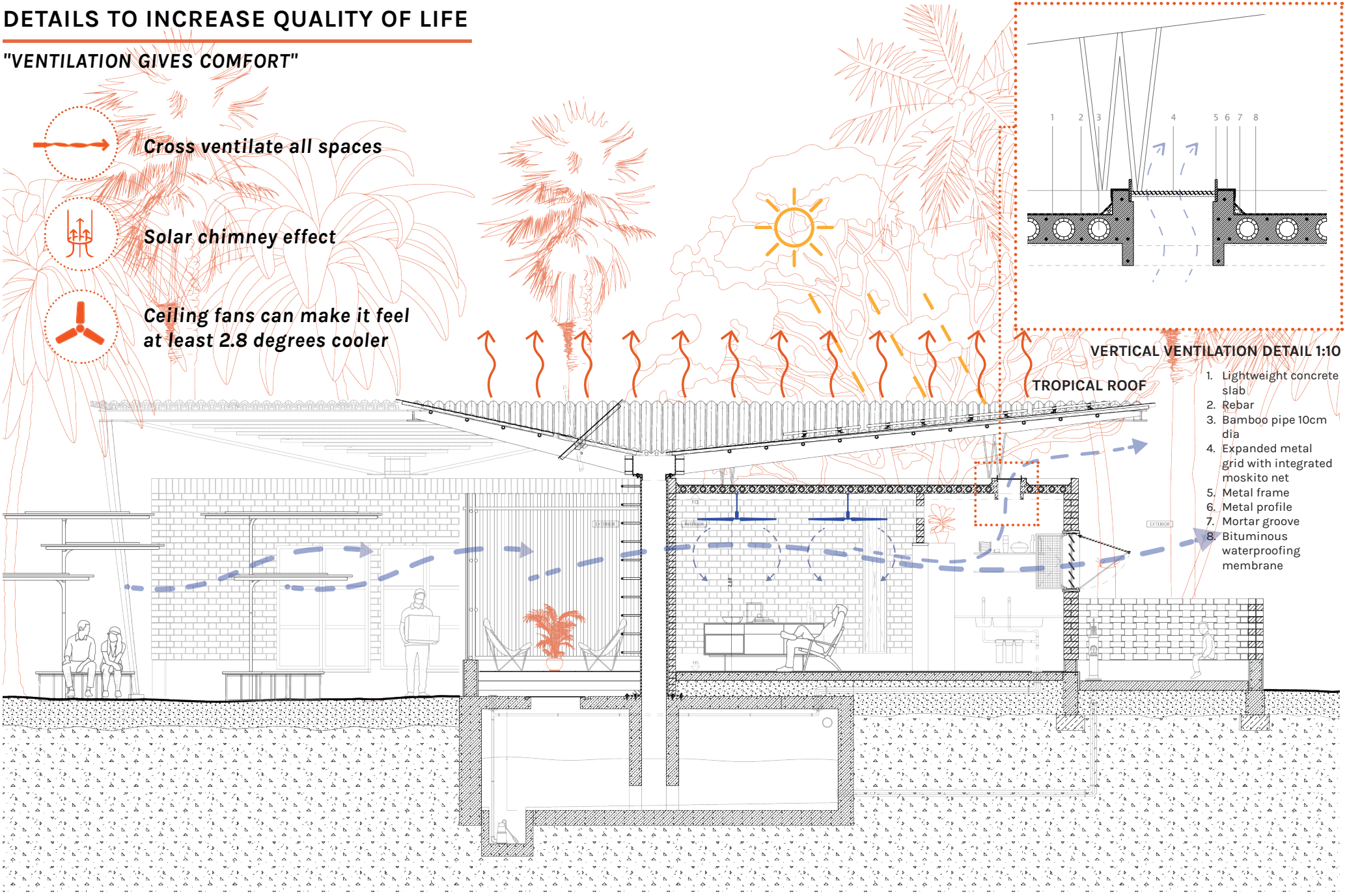
DETAILS TO INCREASE QUALITY OF LIFE

"VENTILATION GIVES COMFORT"

Cross ventilate all spaces

Solar chimney effect

Ceiling fans can make it feel at least 2.8 degrees cooler



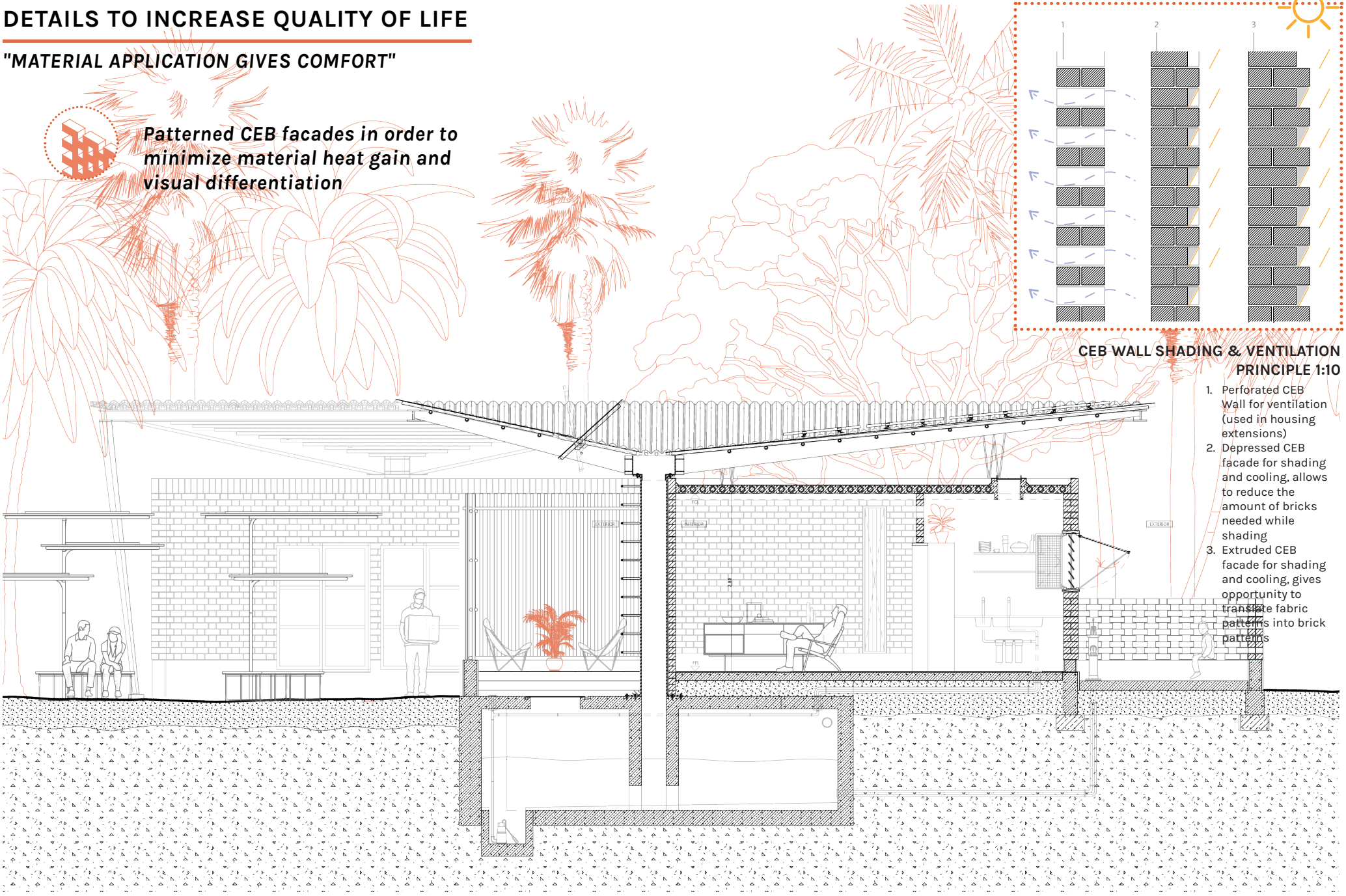
VERTICAL VENTILATION DETAIL 1:10

1. Lightweight concrete slab
2. Rebar
3. Bamboo pipe 10cm dia
4. Expanded metal grid with integrated moskito net
5. Metal frame
6. Metal profile
7. Mortar groove
8. Bituminous waterproofing membrane

DETAILS TO INCREASE QUALITY OF LIFE

"MATERIAL APPLICATION GIVES COMFORT"

Patterned CEB facades in order to minimize material heat gain and visual differentiation



CEB WALL SHADING & VENTILATION PRINCIPLE 1:10

1. Perforated CEB Wall for ventilation (used in housing extensions)
2. Depressed CEB facade for shading and cooling, allows to reduce the amount of bricks needed while shading
3. Extruded CEB facade for shading and cooling, gives opportunity to translate fabric patterns into brick patterns

DETAILS TO INCREASE QUALITY OF LIFE

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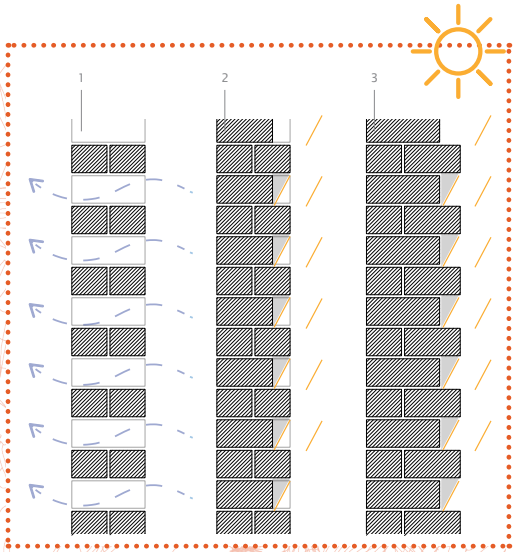
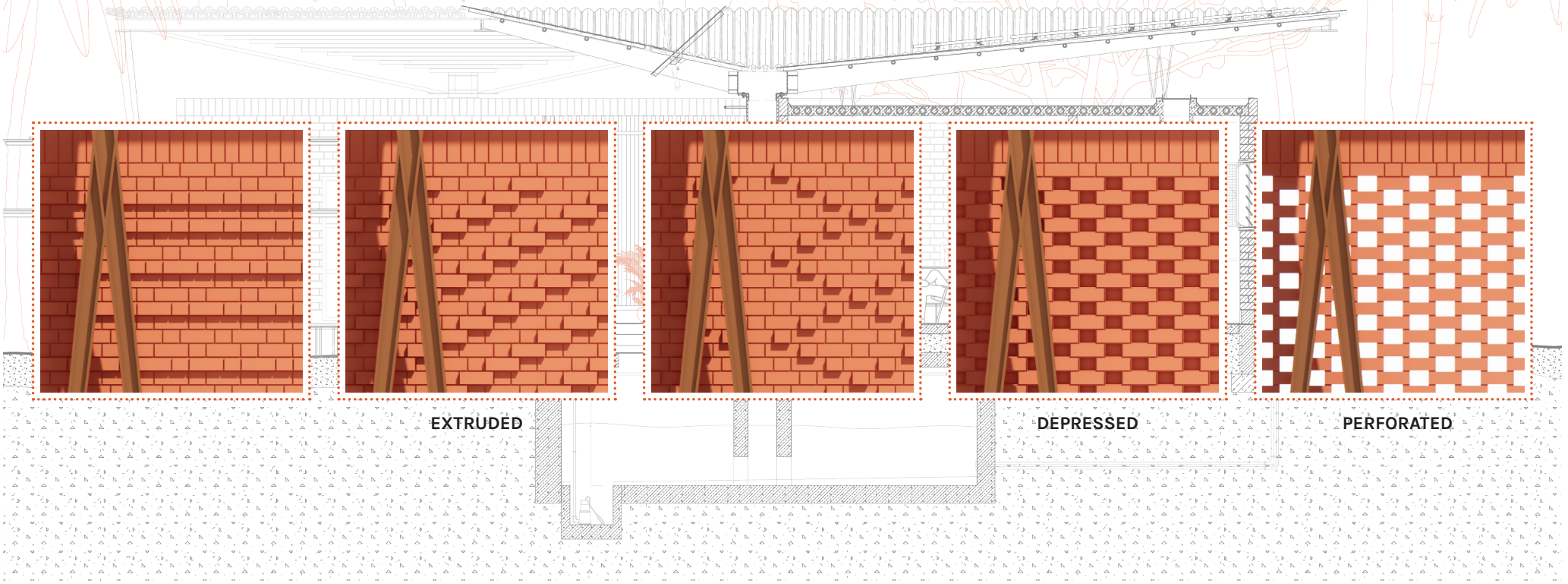
Patterned CEB facades in order to minimize material heat gain and visual differentiation



CEB WALL SHADING & VENTILATION
PRINCIPLE 1:10



LIFE IN THE NEIGHBOURHOOD

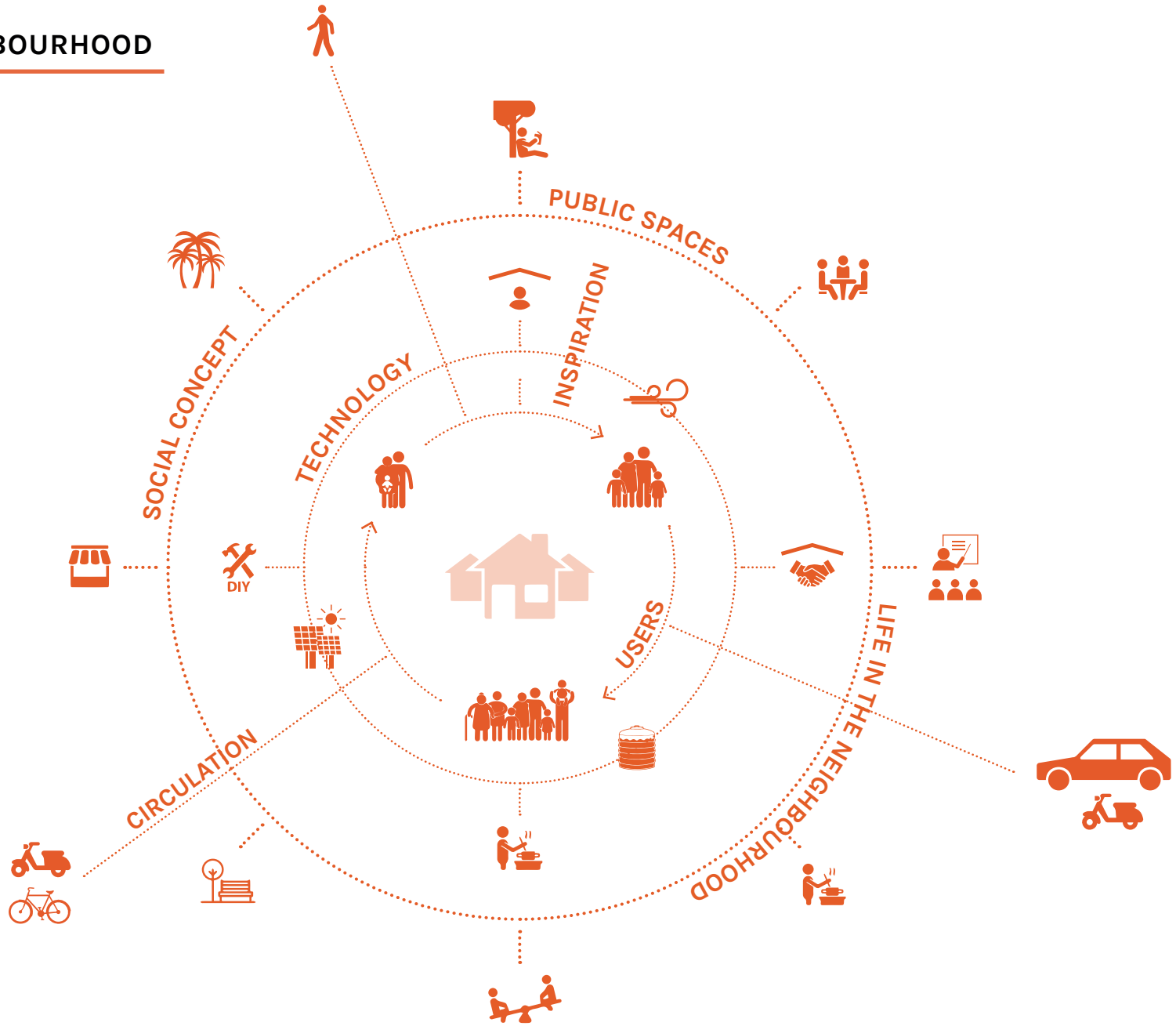
So whats life in the neighbourhood like?


LOCATION


GBEHANZIN
ETS LAJOIE PLUS
POISSONNERIE
AGONGLO
Ets HILLARY
VAS-Y-VOIR
HAN-KPETE


F. TORRES
9

LIFE IN THE NEIGHBOURHOOD



THANK YOU

CAMILLE C.S. GBAGUIDI