

REFUGEE RESILIENCE PROJECT

A new start towards a safe environment



MAHMOUD





PROBLEM STATEMENT



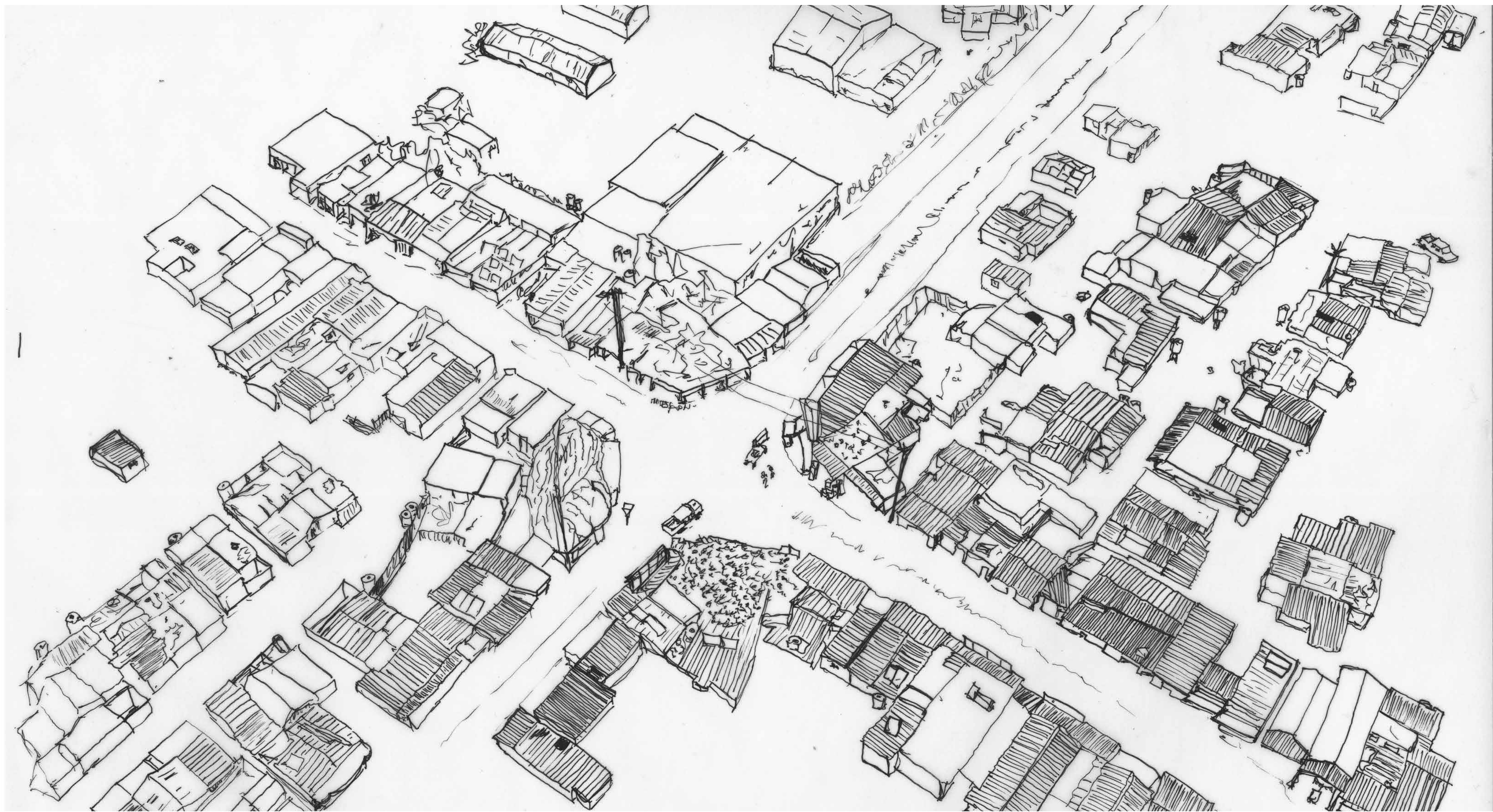
How can a framework for refugee shelter design address the physical, psychological, social, and cultural needs of displaced populations while ensuring safety, sustainability, privacy, and a sense of belonging?

- 1) What factors contribute to the physical safety and emotional well-being of displaced individuals in shelter environments?*
- 2) What are the tangible and intangible needs of displaced populations in refugee camps?*
- 3) How can principles of sustainability be effectively incorporated into the design of refugee shelters?*

ZA'ATARI CAMP | JORDAN



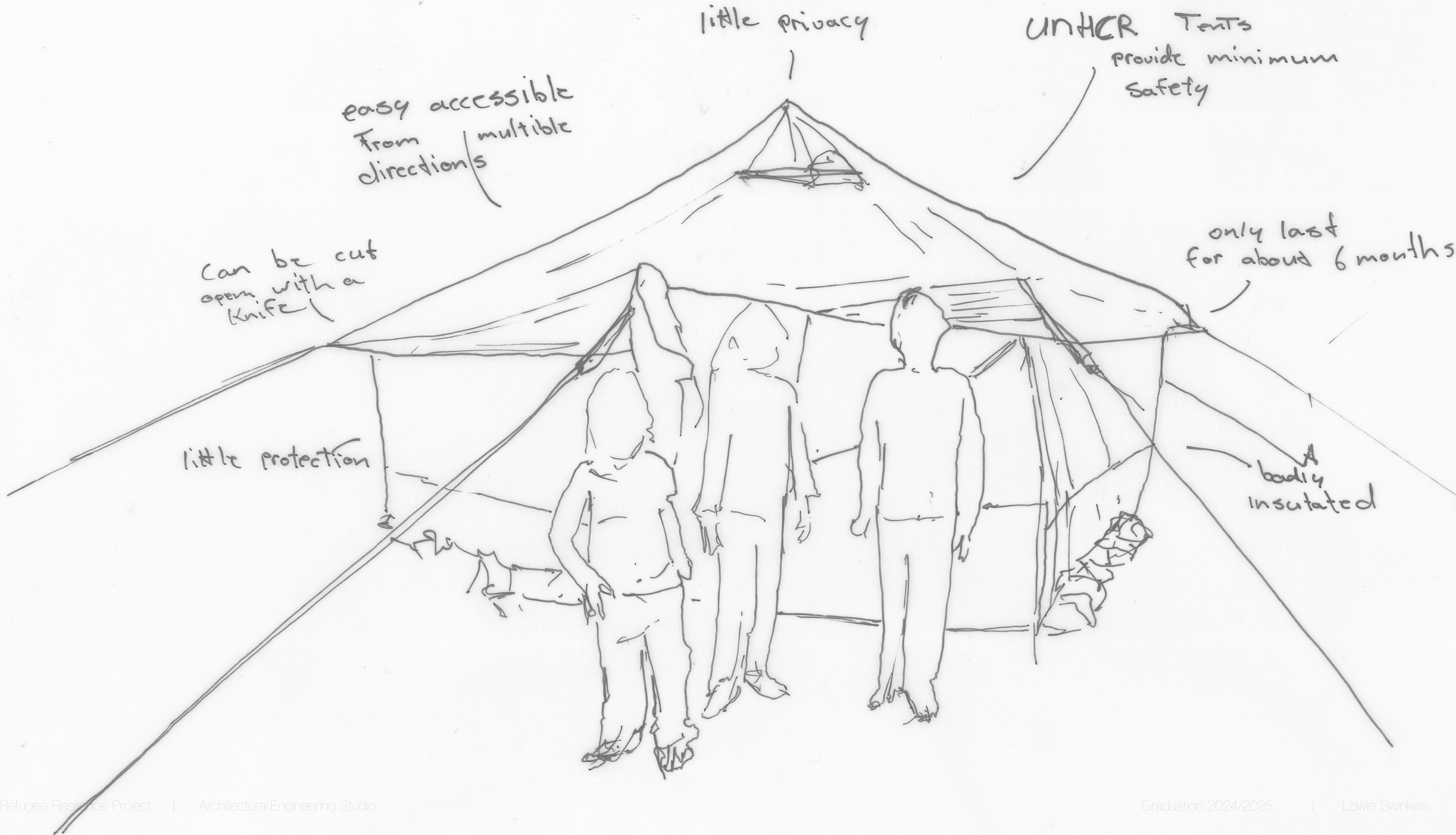






UNHCR 'MADE' CAMP





little privacy

UNHCR Tents
provide minimum
safety

easy accessible
from multiple
directions

can be cut
open with a
knife

only last
for about 6 months

little protection

badly
insulated

REFUGEE 'NEEDS'

Physical 'needs'

- Functional efficiency
- Shelter performance
- Modular and adaptability
- Integrating self-sufficiency

Social 'needs'

- Community-building opportunities
- Interconnected population structures/hierarchy
- Access to education, employment, and inclusion programs
- Communal spaces for shared activities
- Camp hierarchies for stability and cohesion

Psychological 'needs'

- Privacy needs
- Targeted protection
- Belonging and resilience
- Cultural integration



SHELTER STUDIES

EXISTING SHELTERS



Core Shelter
Design (Philippines)



DesertSeal



Shipping
Container



SCES
(Japan)



UNHCR
Standard Tents



Tuareg
Tents



Military
Foldable Materials



Yurts



IKEA
Shelter



Koryak
Chukchi
Scott Tents



Kyrgyzstan
Transitional
Shelter



Q-Brixx
Block

| Parameter | SCES (Japan) | Q-Brixx Block | Shipping Container Shelters | Military Foldable Materials | UNHCR Standard Tents | Koryak Chukchi Scott Tents | Yurts | Core Shelter Design (Philippines) | DesertSeal | Tuareg Tents | IKEA Shelter | Kyrgyzstan Transitional Shelter |
|------------------------|--------------|---------------|-----------------------------|-----------------------------|----------------------|----------------------------|-------|-----------------------------------|------------|--------------|--------------|---------------------------------|
| Structural Integrity | ✓ | | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ |
| Security Measures | ✓ | | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ |
| Health and Hygiene | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Thermal Comfort | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Use of Local Materials | | | | | | ✓ | ✓ | ✓ | | ✓ | | ✓ |
| Durability | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Energy Efficiency | | | | | | | | | ✓ | | ✓ | |
| Environmental Impact | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Rapid Deployment | ✓ | ✓ | | ✓ | ✓ | ✓ | | | | ✓ | ✓ | |
| Adaptability | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | |
| Ease of Maintenance | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Privacy | | | ✓ | | | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Community Integration | | | | | | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Aesthetic Appeal | | | | | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |



IKEA
Better Shelter

The Reaction

The day after the announcement of the prize I sensed a collective sigh of despair among my colleagues working on refugee issues, which was tangible in personal conversations, snarky asides, and exasperated emails.

The failures of the shelter were, for many of them, far too obvious. It was meager, limited, with no proper floor, no insulation, no natural light, and with a structure that let in drafts and dust. It had been oversold, under-ordered, and was described as sustainable when in fact it involved flying piles of metal and plastic around the world. It ignored established practice in the humanitarian shelter sector, which advocates the use of local materials and abundant local labor, and, above all, it was accompanied by an insistent triumphalism, with media reports pushing the narrative that an intractable problem had been solved. It had not. Managing refugee arrivals is a complex political issue that requires sustained political engagement, legal reform, and advocacy in host states to ensure investment in welfare and protection. Although these were not the aims of the IKEA refugee shelter, such lavish praise and attention, my informants felt, were a distraction. Many such “innovative designs” have become a fetish, creating a mistaken reassurance that circumstances can

MATERIAL RESEARCH

Potential material(s)



USED CIGARETTE
FILTERS



AMADOU
ORANGE PEEL



WOOD FOAM



RECYCLED
POLYPROPYLENE



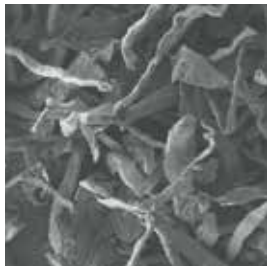
FLAX FIBRE



BAMBOO FIBRE



FABRIC FROM
COW DUNG



CELLULOSE-BA-
SED MATERIALS



GRASS 'LATEX'



BAMBOO SAND-
WICH CON-
STRUCTIONS



HYGROSCOPIC
WOOD



KENAF



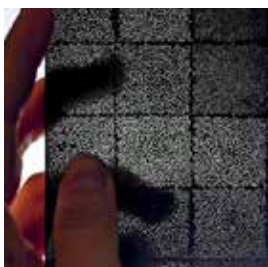
SISAL



MUSHROOM-BA-
SED MATERIALS



BIRCH BARK



LIGHTWEIGHT
RATTAN CON-
STRUCTION



TYVEK



HYGROSCOPIC
SHAPECHAN-
GING MATERIALS



HEMP FIBRE



ALGAE AND ALGAE
COMPOSITES



PAPER COMPOSI-
TE MATERIALS



TEXTILE-BASED
LIGHTWEIGHT



WOODEN
LEATHER



ARTIFICIAL CARTILAGE
RECYCLED DENIM FABRIC



COCONUT SEED-HAIR
FIBRE

Potential material(s)



USED CIGARETTE FILTERS



AMADOU ORANGE PEEL



WOOD FOAM



RECYCLED POLYPROPYLENE



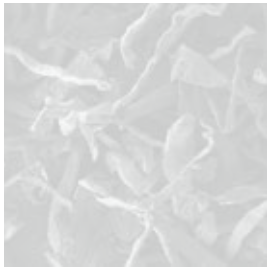
FLAX FIBRE



BAMBOO FIBRE



FABRIC FROM COW DUNG



CELLULOSE-BASED MATERIALS



GRASS 'LATEX'



BAMBOO SANDWICH CONSTRUCTIONS



HYGROSCOPIC WOOD



KENAF



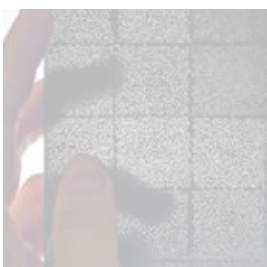
SISAL



MUSHROOM-BASED MATERIALS



BIRCH BARK



LIGHTWEIGHT RATTAN CONSTRUCTION



TYVEK



HYGROSCOPIC SHAPE-CHANGING MATERIALS



HEMP FIBRE



ALGAE AND ALGAE COMPOSITES



PAPER COMPOSITE MATERIALS



TEXTILE-BASED LIGHTWEIGHT



WOODEN LEATHER



ARTIFICIAL CARTILAGE



RECYCLED DENIM FABRIC



COCONUT SEED-HAIR FIBRE



FLAX FIBRE



BAMBOO FIBRE



HEMP FIBRE



MECHANICAL PROPERTIES

| FIBERS | relative density (G/cm3) | elongation at failure (%) |
|----------------|-----------------------------|-----------------------------------|
| carbon | 1.7-1.9 | 0.4-1.9 |
| glass | 2.5-2.7 | 1.8-5.4 |
| flax | 1.4-1.5 | 1.2-3.3 |
| hemp | 1.4-1.5 | 1.0-3.5 |
| jute | 1.3-1.49 | 1.0-1.8 |
| | | |
| oilbased resin | 1.1 | 7.0-10.0 |
| biobased resin | 1.09 | 5.0 |
| | | |
| | elastic modulus E (Gpa) | tensile strength (Mpa) |
| carbon | 230-250 | 2000-3000 |
| glass | 70-76 | 2000-3500 |
| flax | 27.6-103 | 343-2000 |
| hemp | 23.5-90 | 270-900 |
| jute | 26-43 | 320-800 |
| | | |
| oilbased resin | 3-6 | 60-125 |
| biobased resin | 3.2 | 67.5 |
| | | |
| | energy intensity (MJ/kg) | global warming potential (GWP) |
| carbon | 183-459 | 16.38 |
| glass | 13-51 | 2.95 |
| flax | 6.5-9.55 | 0.437 |
| hemp | 8.9 | 0.531 |
| jute | 9.6 | 0.57 |
| | | |
| oilbased resin | 76-80 | 4.7-8.1 |
| biobased resin | 49 | 4.08 |

mechanical properties flax fibers
Heider Vanessa. (2023).

LIST OF REQUIREMENTS

Physical ‘needs’

- Functional efficiency
- Shelter performance
- Modular and adaptability
- Integrating self-sufficiency

Social ‘needs’

- Community-building opportunities
- Interconnected population structures/hierarchy
- Access to education, employment, and inclusion programs
- Communal spaces for shared activities
- Camp hierarchies for stability and cohesion

Psychological ‘needs’

- Privacy needs
- Targeted protection
- Belonging and resilience
- Cultural integration



- Sense of belonging
- Social inclusion
- Gender-sensitive design
- Mitigate risks for vulnerable groups

- Integrating eco-friendly materials
- Promoting community-building opportunities

- Adaptable to various geographic and climatic conditions
- Strengthened social cohesion and mutual understanding.
- Inclusive and harmonious communities.

- Refugee camps must enable rebuilding of lives through:
 - Holistic management integrating health, education, and economic infrastructure.
 - Reduced control mechanisms to empower personal agency.

- Programs promoting:
 - Anti-discrimination and social inclusion.
 - Resident empowerment and dignity.
 - Balancing economic, social, and environmental dimensions

- Promoting Integration and Resilience
- Creating accessible healthcare systems.

- Low-tech
- Fireproof (30 min.)
- Waterproof

- Sturdiness
- Easy to maintain
- Durable (at least 15 years)

- Goal:
Transform camps into platforms for recovery, resilience, and hope starting with a livable and safe shelter

STORY TO DESIGN

Phase 1 to 4

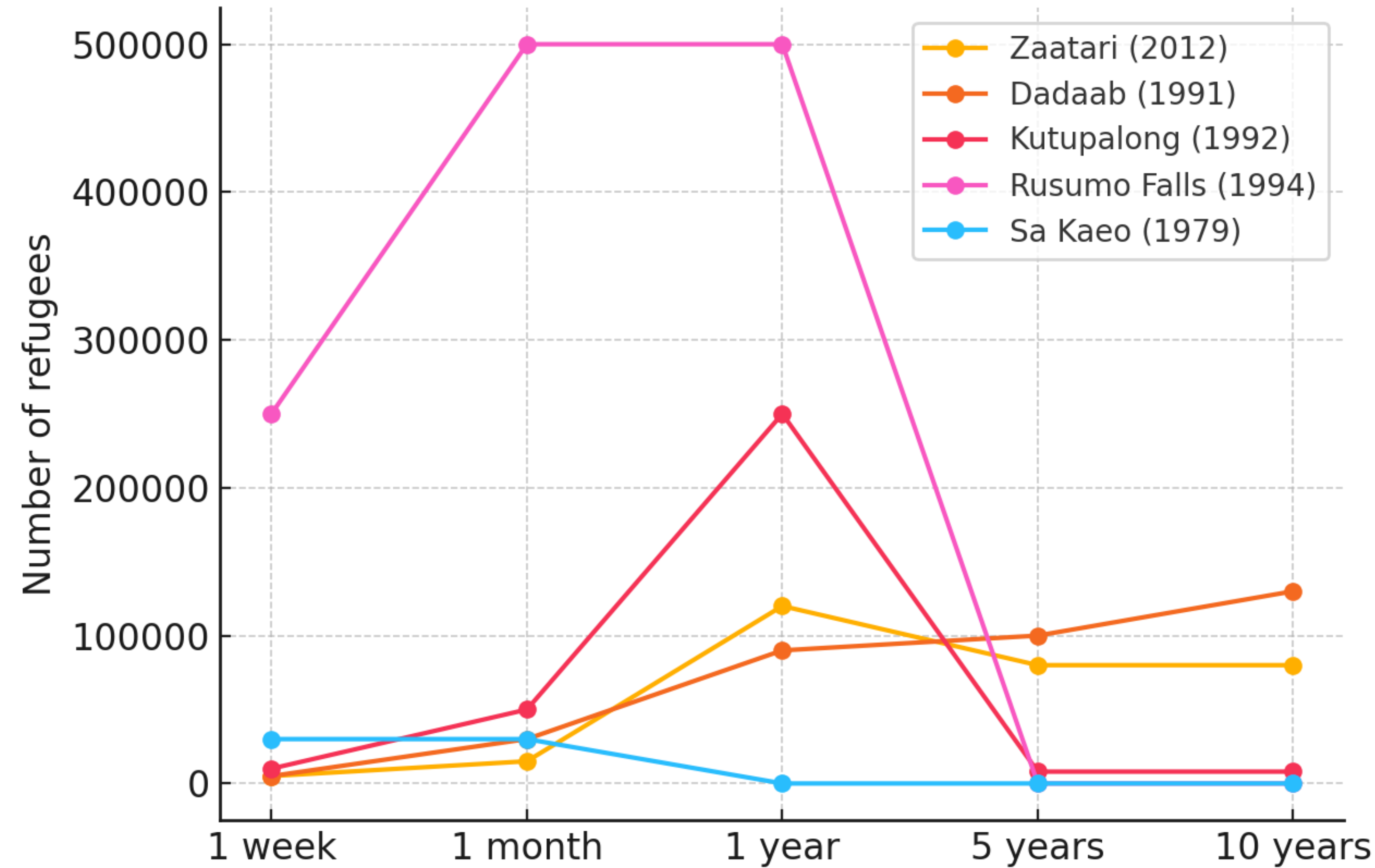




PHASE 1

TAKING IN REFUGEES

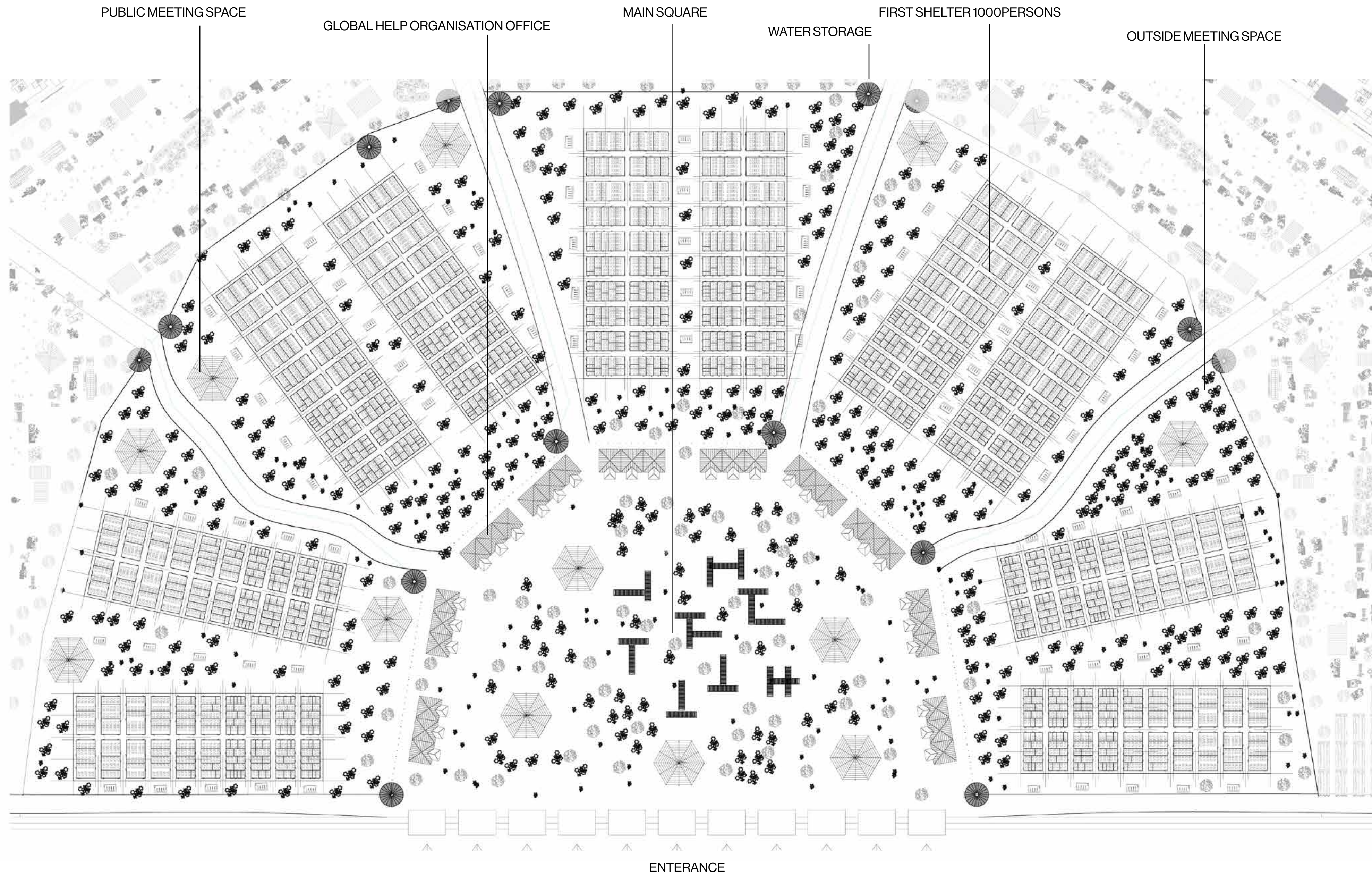
Refugee arrivals in camps over time



<https://www.unhcr.org/us/news/stories/jordans-zaatari-refugee-camp-10-facts-10-years#:~:text=Ten%20years%20ago%2C%20a%20group,newly%20opened%20Za%E2%80%99atari%20refugee%20camp>

<https://www.refworld.org/reference/annualreport/uscir/2001/en/15271#:~:text=Kenyan%20authorities%20required%20most%20refugees,resided%20in%20the%20Kakuma%20camps>

https://en.wikipedia.org/wiki/Great_Lakes_refugee_crisis#:~:text=The%20result%20was%20dramatic,had%20fled%20south%20into%20Burundi



1000 BEDS





20 February 2018

Kenya: Failure to register Somali refugees putting them at risk of starvation and abuse

Victor Nyamori

It has been a year since the Kenyan government's plan to shut down Dadaab refugee camp was scuppered. The High Co deemed the decision un-constitutional and ordered the government to continue giving asylum to new refugees. But if an thought the landmark ruling would herald the end of years of suffering for Somali refugees, they will by now be bitterly disappointed.

The government, while not overtly rejecting the ruling, has quietly disregarded it, mainly by denying refugees registration much-needed identity documents.



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9 February 2022 Author(s): Ms. Nusrat Khan

Involving Rohingya refugees in reforestation in Bangladesh to reduce disaster risks

Source(s): United Nations Office for Disaster Risk Reduction - Regional Office for Asia and Pacific



The New York Times

HURRICANE KATRINA: THE SUPERDOME

Superdome: Haven Quickly Becomes an Ordeal

📄 Share full article



By Joseph B. Treaster

Sept. 1, 2005

NEW ORLEANS, Aug. 31 - The sick and the disabled were the first to be let out. But late Wednesday afternoon, as the clamorous



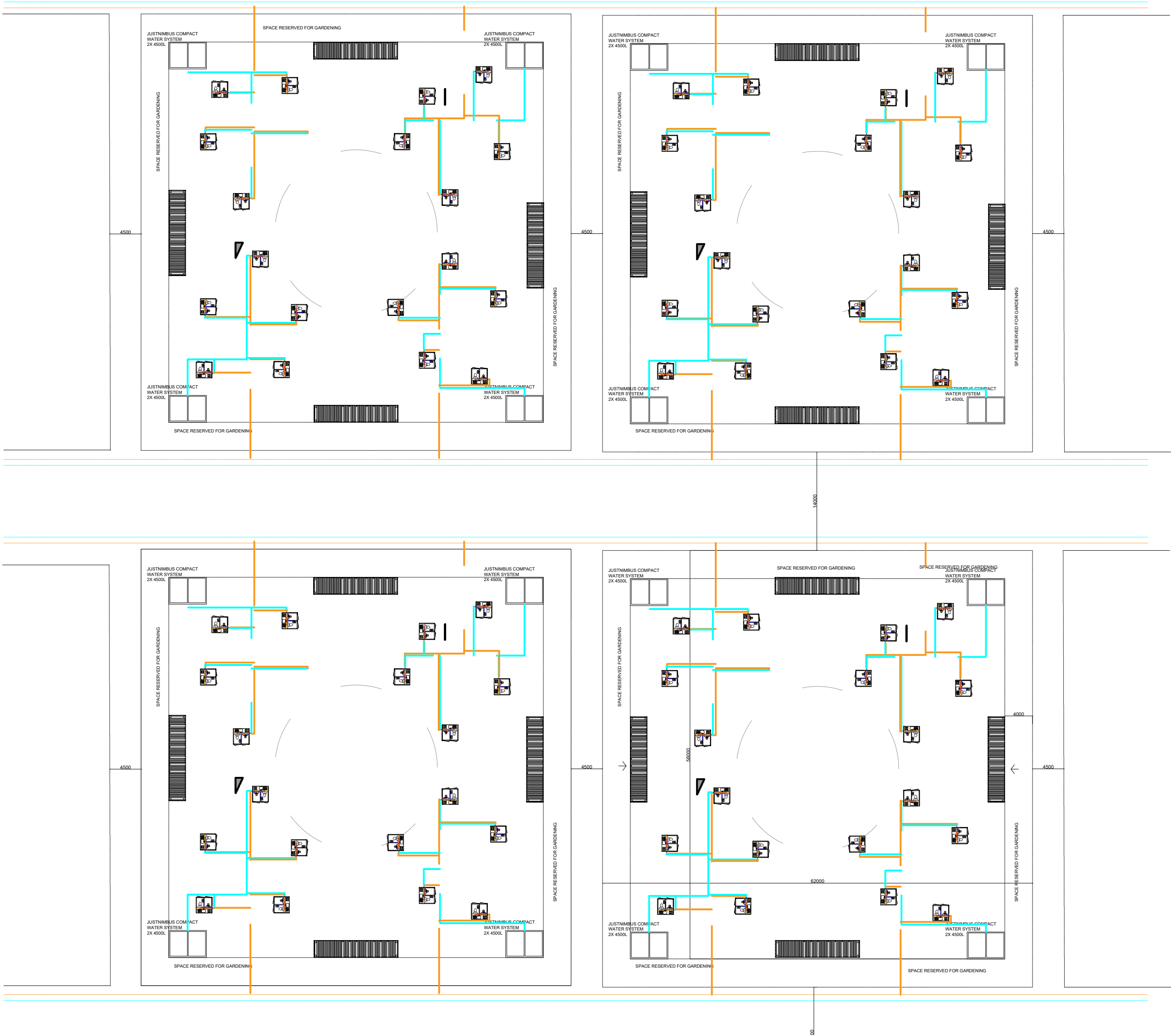
ia camp for displaced people are living on the streets of the Greek island
i has plenty of platitudes to offer, but not much else, DW's Bernd Riegert



PHASE 2

CONNECTING | DISTRIBUTING | SHARING

PHASE 2 ASSIGNING THE PLOT



PHASE 3

BUILDING | COURTYARD/COMMUNITY

‘RULES’

| | |
|---|------------------|
| Community-clusters (UNHCR) | ~80 personen |
| Dunbar’s number | ~150 persons |
| Number of persons per community: | ~80 - 150 |
| Space to turn/unload a truck | 14m |
| Width of the street | 4.5m |
| Amount of m² per person incl. veg. garden and kitchen (UNHCR) | 45m² |
| Fire brake every (UNHCR) | 300m |
| Between every structure | 2m |
| Water supply per person per day | 20L |

Dunbar's number

<https://www.psychologytoday.com/us/blog/out-of-the-ooze/202405/is-there-an-ideal-size-for-human-social-groups#:~:text=150%20is%20the%20Magic%20Number>

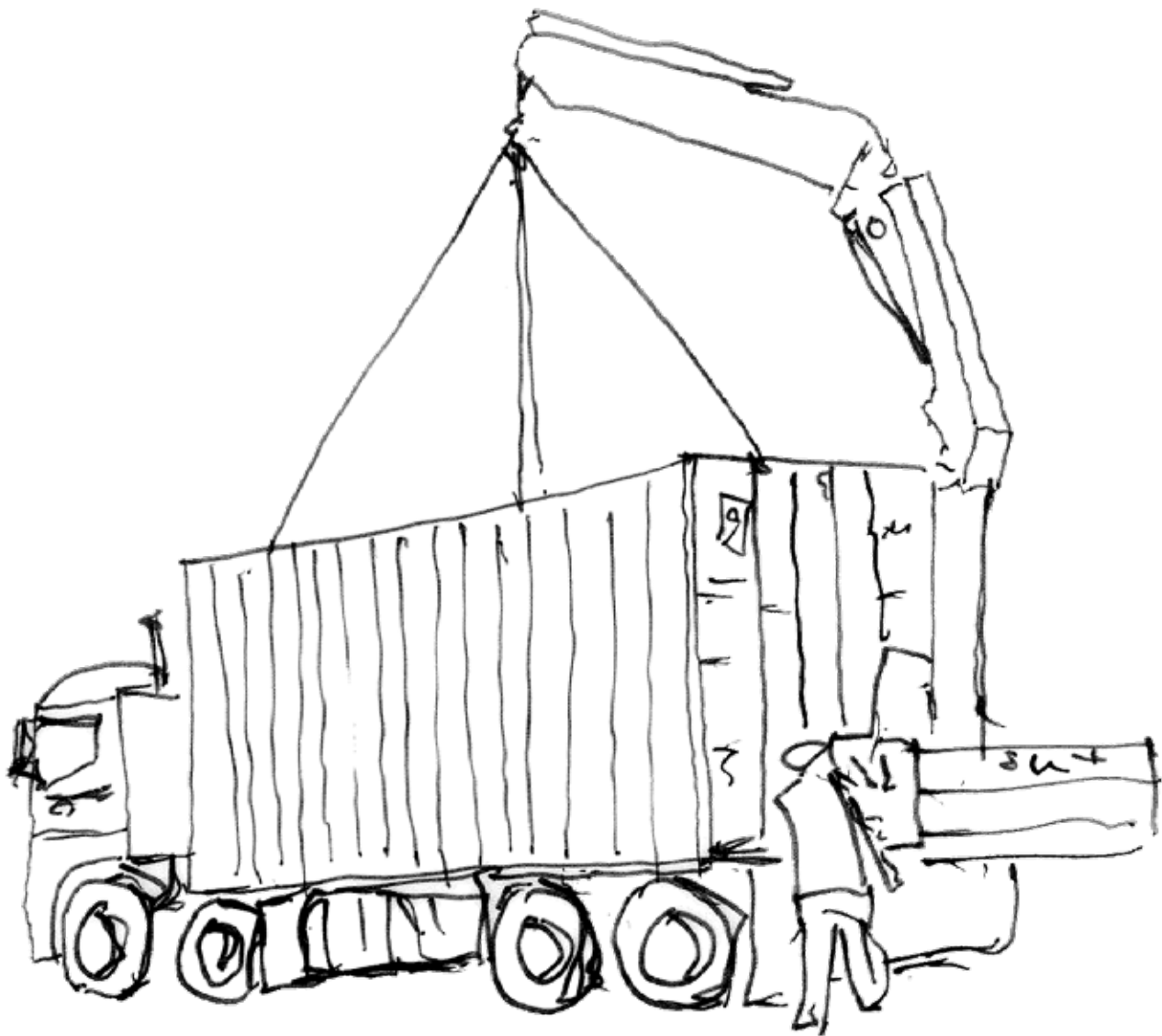
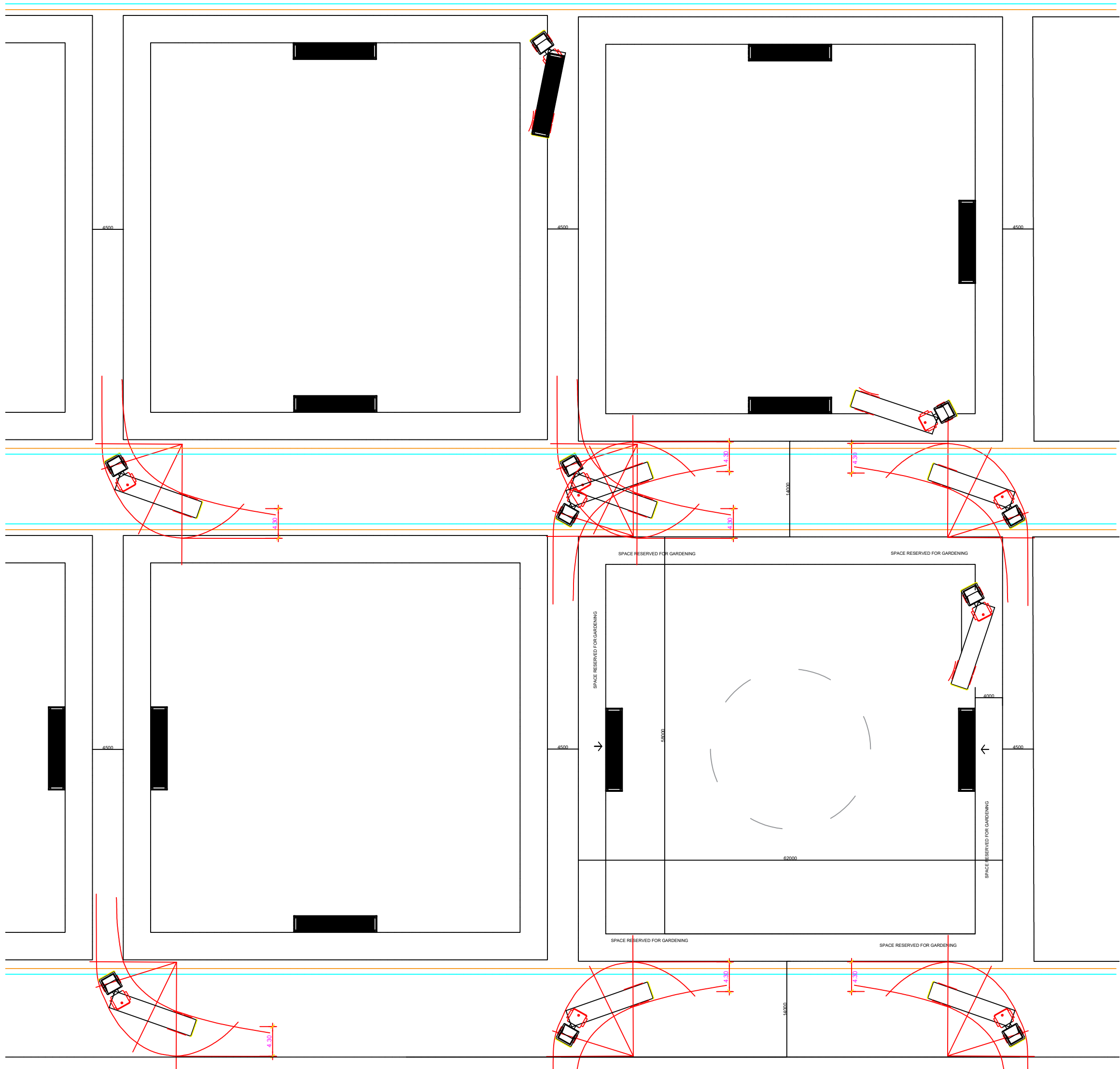
Community clusters

<https://emergency.unhcr.org/emergency-assistance/shelter-camp-and-settlement/settlements/principles-standards-settlement-planning#:~:text=Module%20Structure%20Approximate%20number%20Family,max>

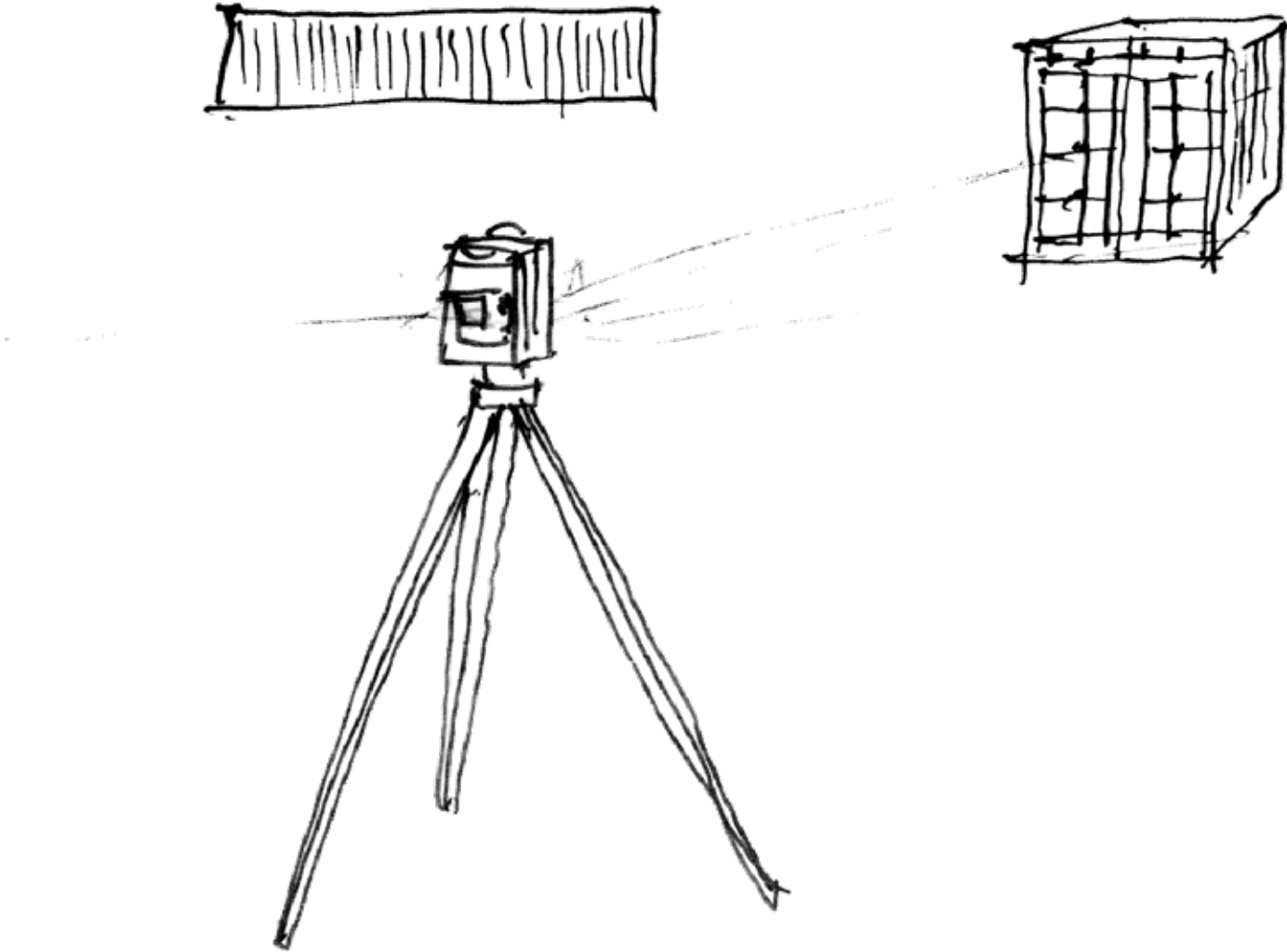
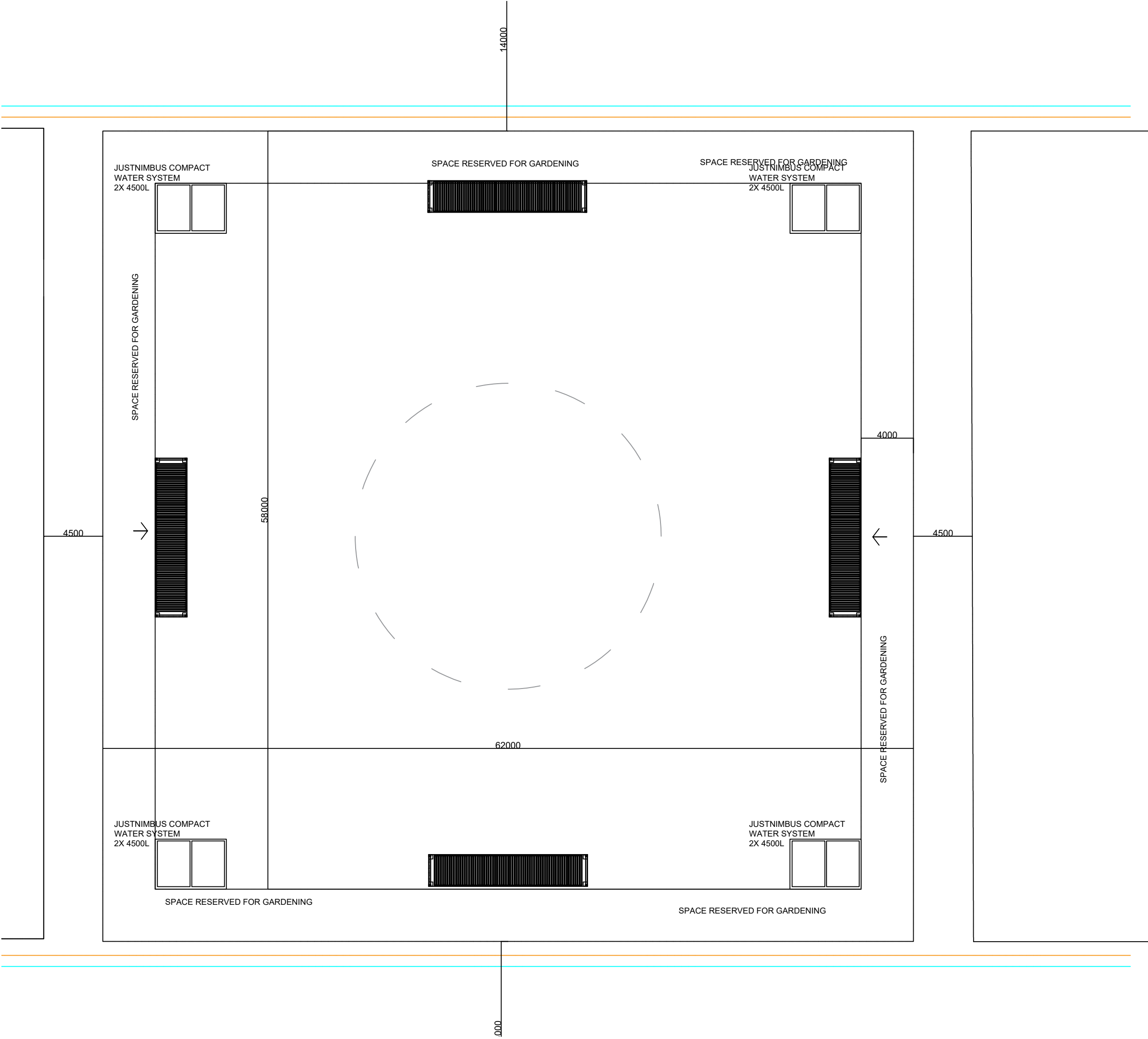
Fire brake

<https://emergency.unhcr.org/emergency-assistance/shelter-camp-and-settlement/safe-and-secure-settlements/safe-and-secure-settlements>

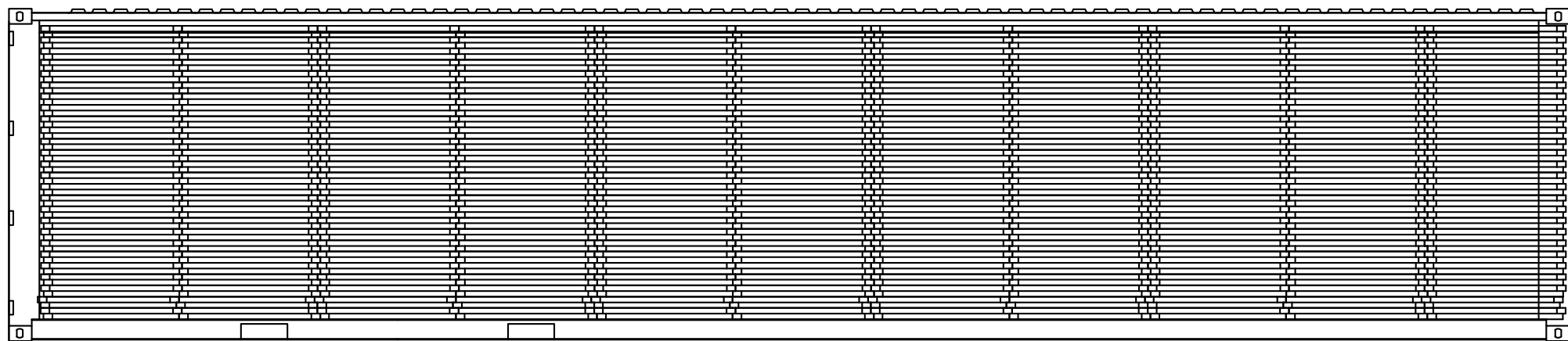
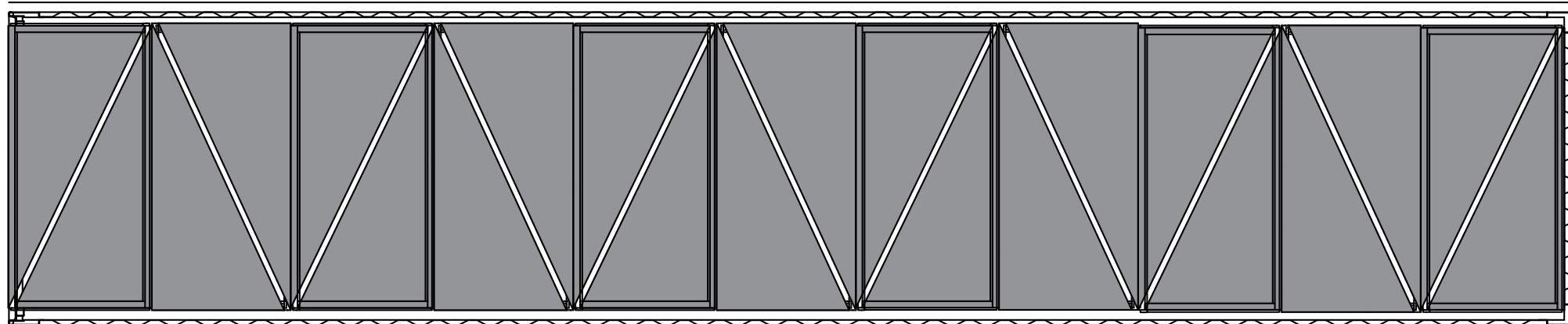
STEP1 'DETERMINING THE PLOT'



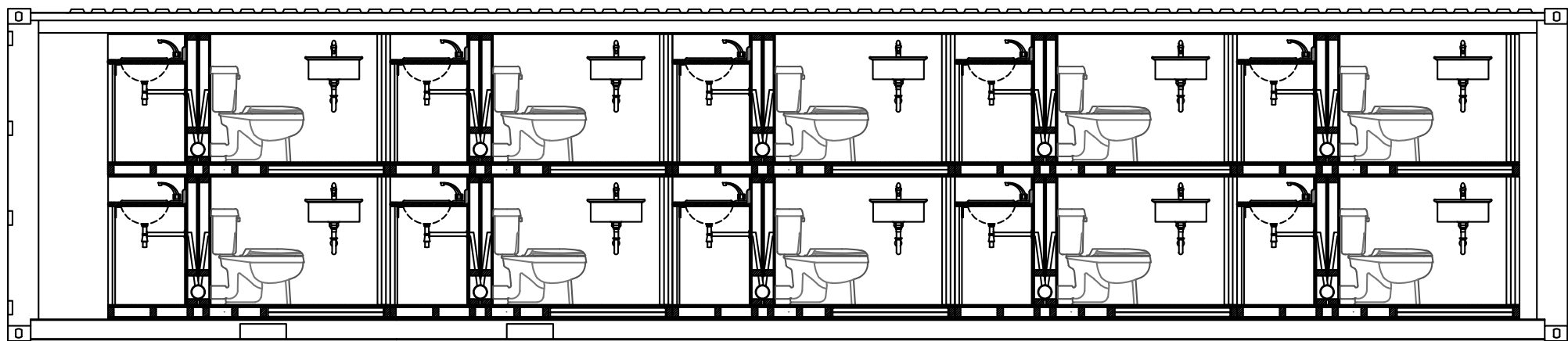
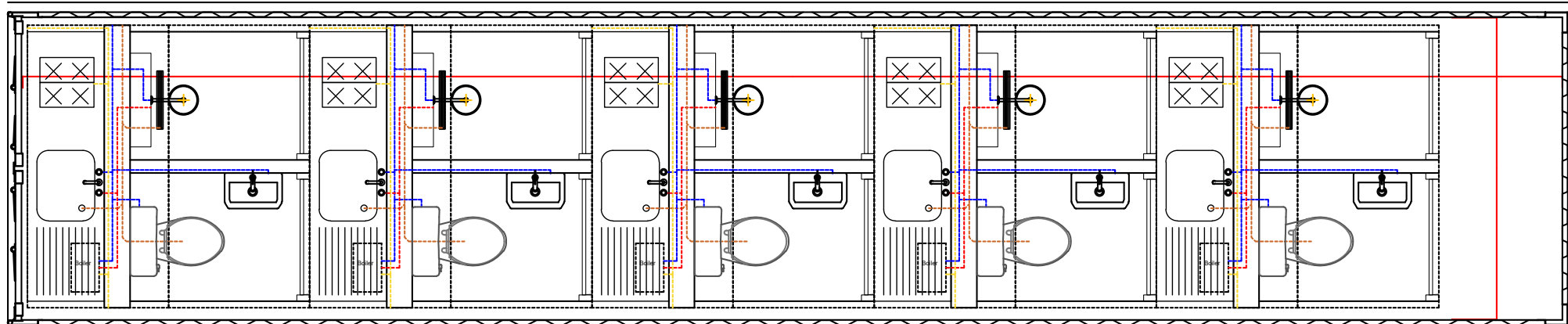
STEP 1



FILLED UP CONTAINER

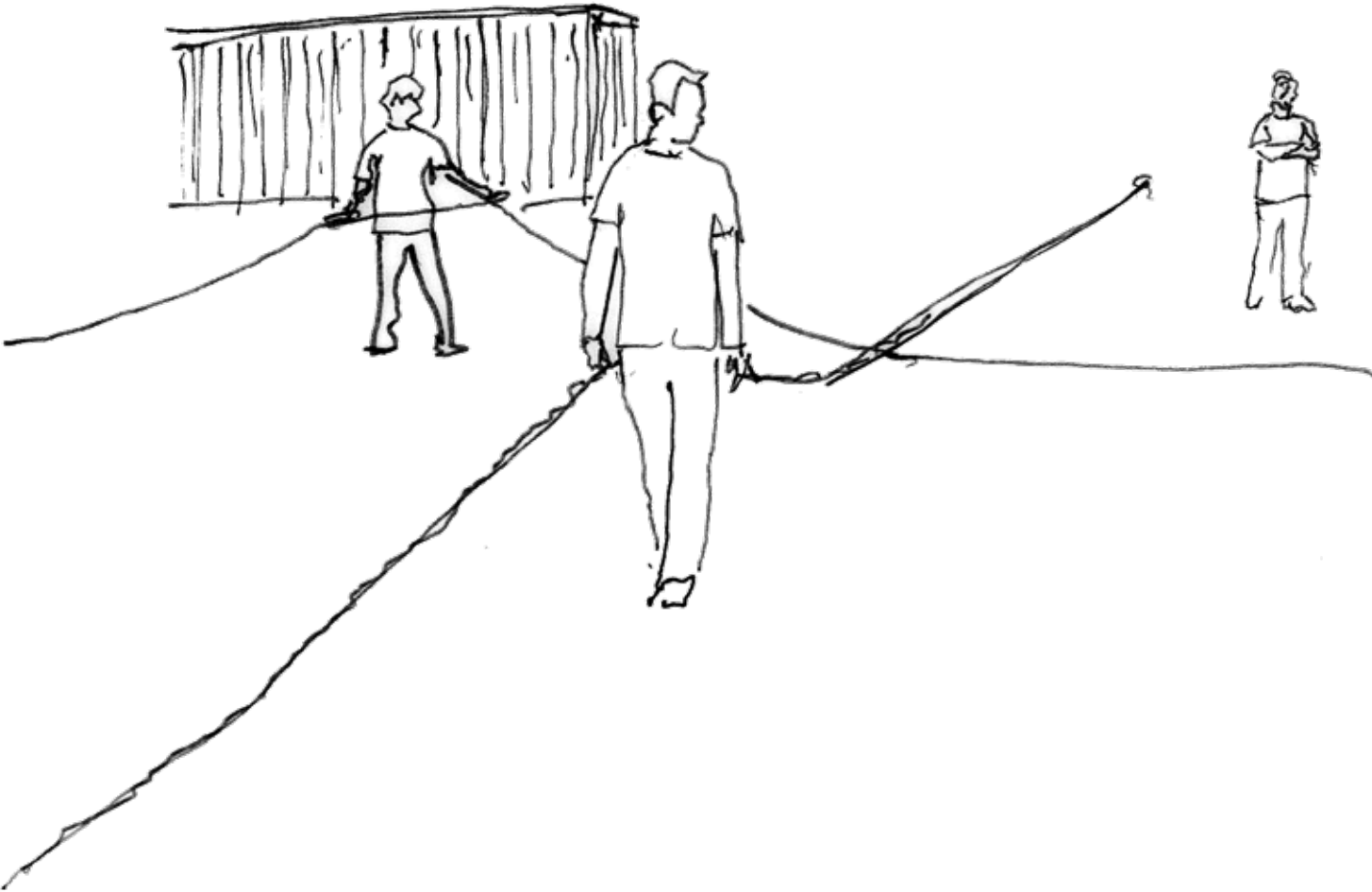
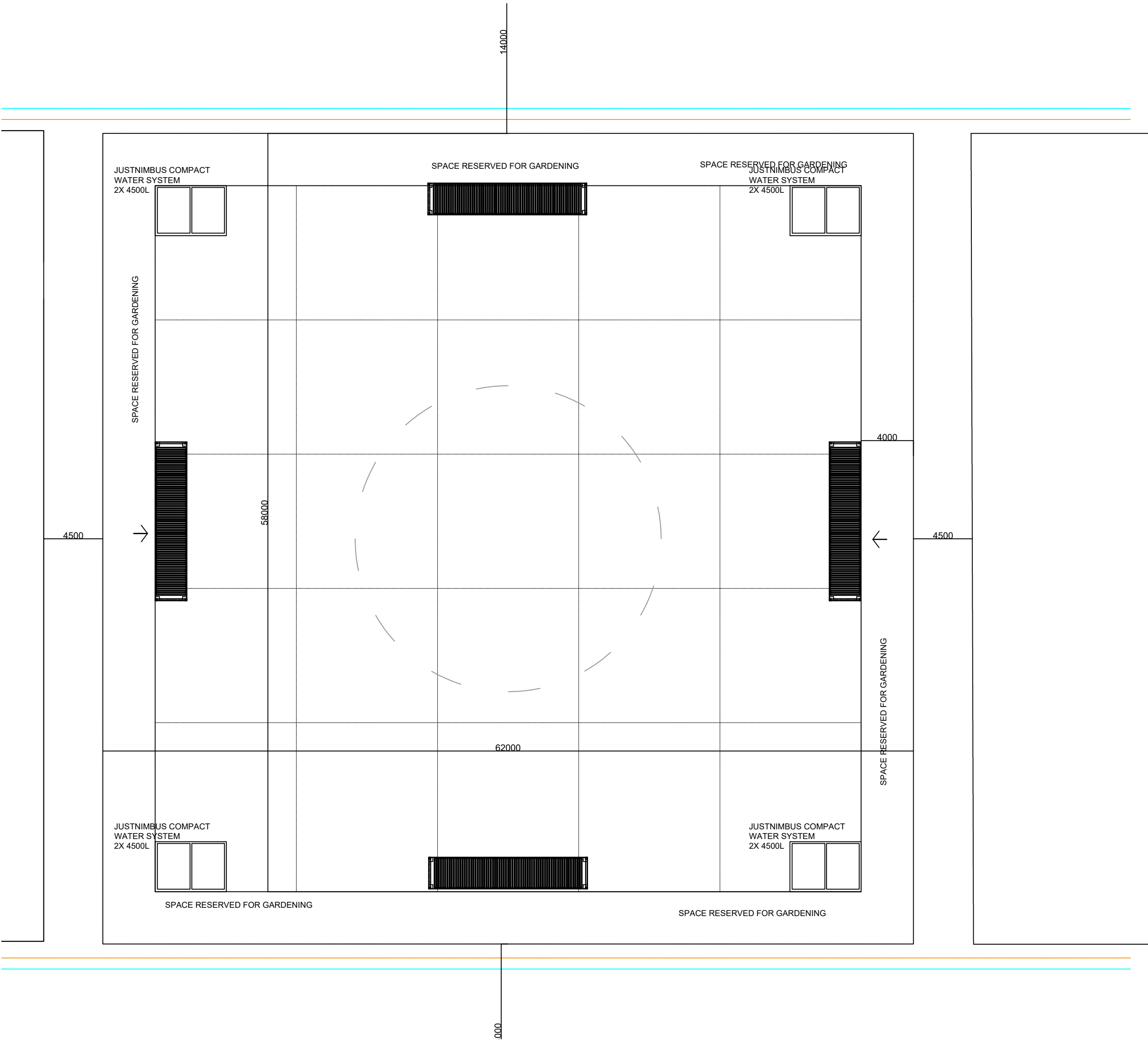


26 LAYERS
22 TRIANGULAR PANELS PER LAYER
TOTAL 572 PANELS PER 40FT. CONTAINER

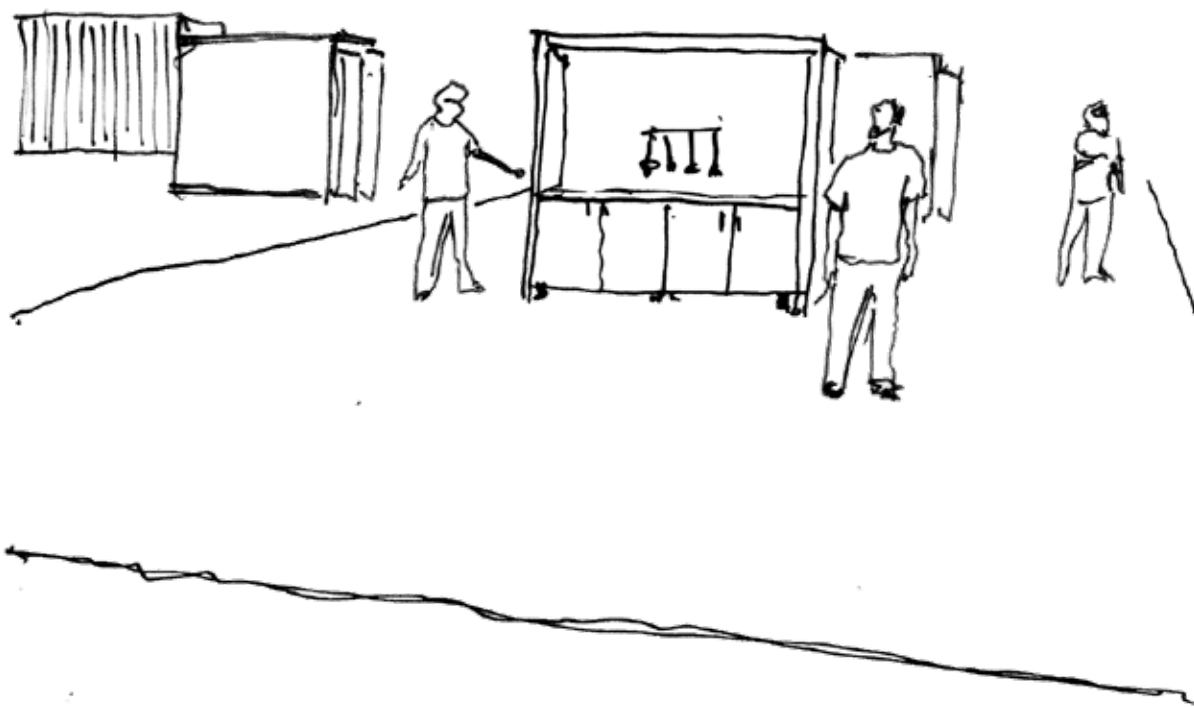
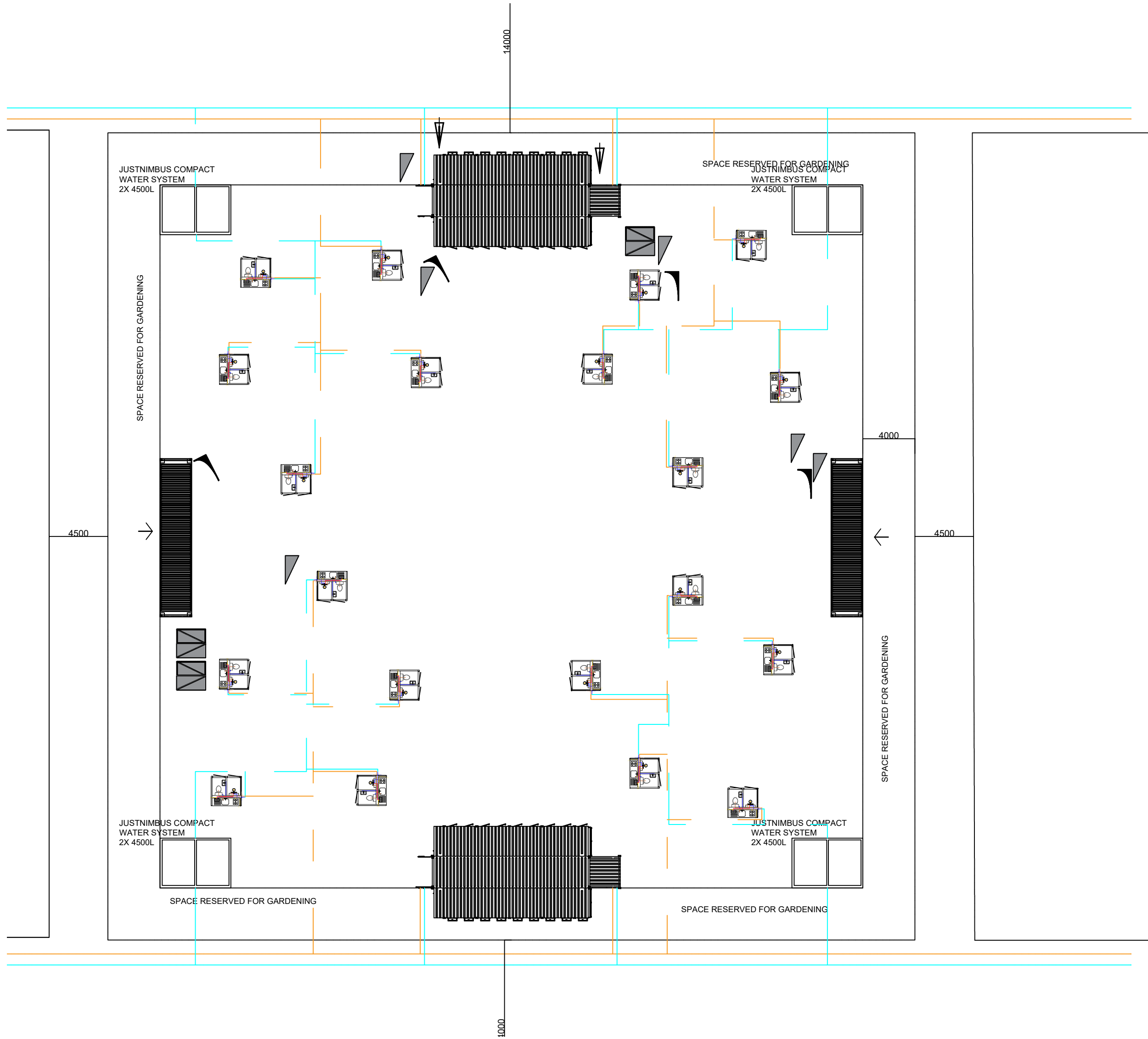


2 LAYERS
5 UNITS PER LAYER
TOTAL 10 UNITS PER 40FT. CONTAINER

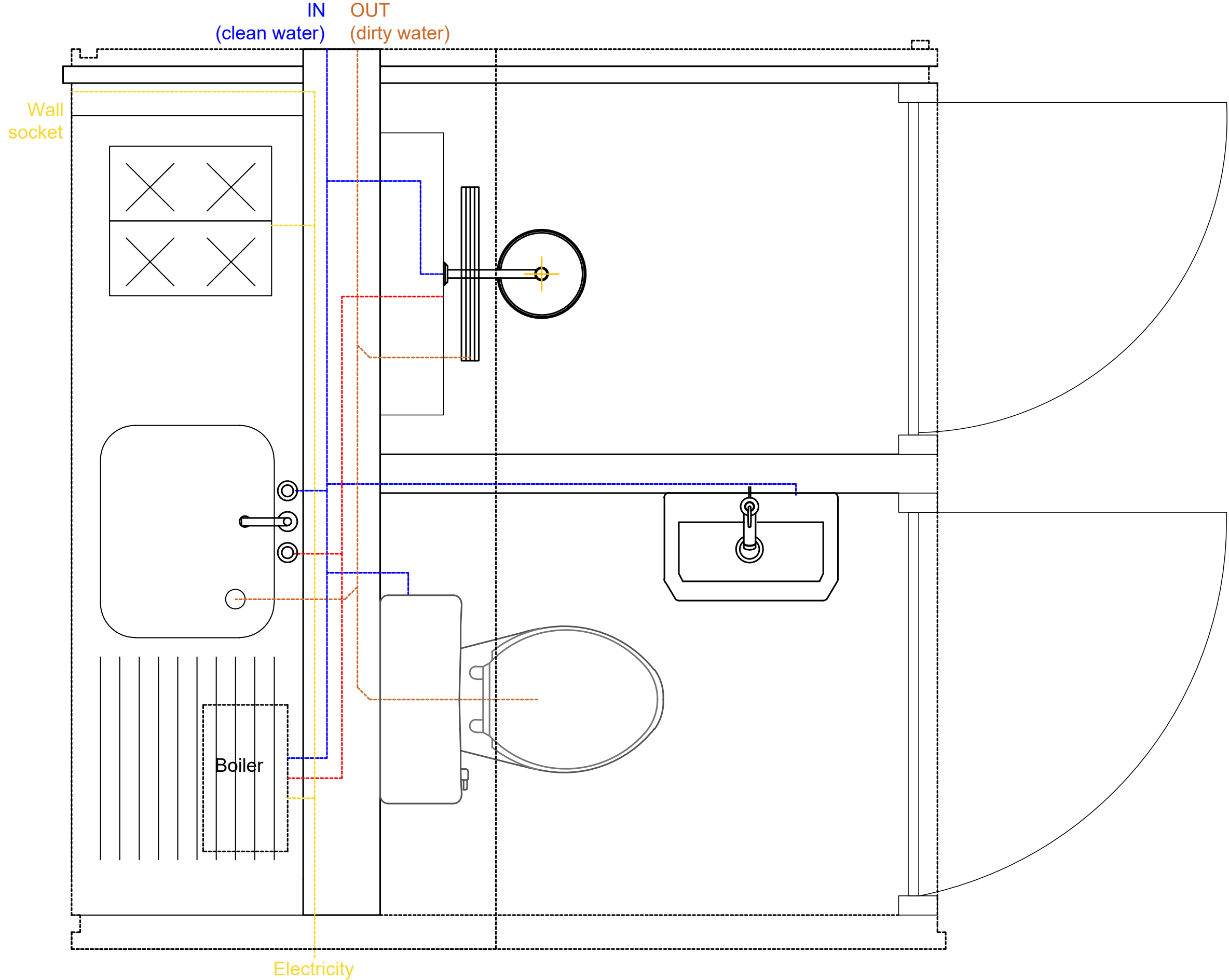
STEP 3 'BOUNDARY'



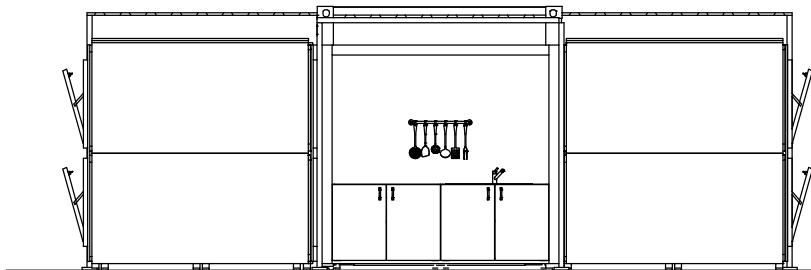
STEP 4 KITCHEN/BATHROOM UNITS



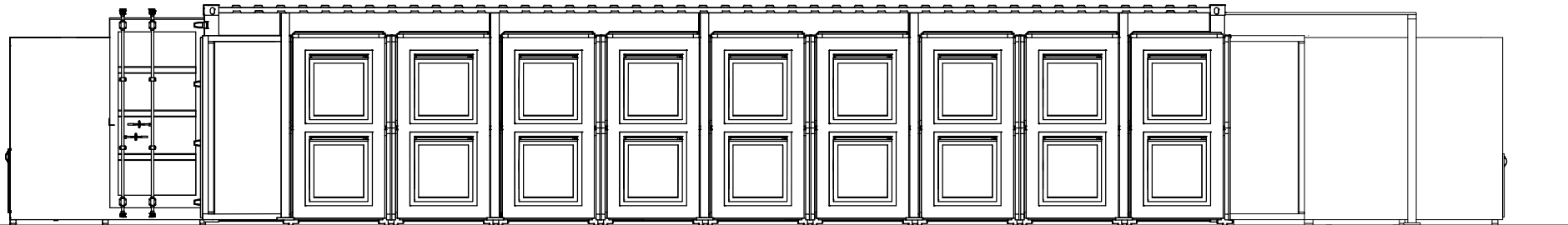
UNIT



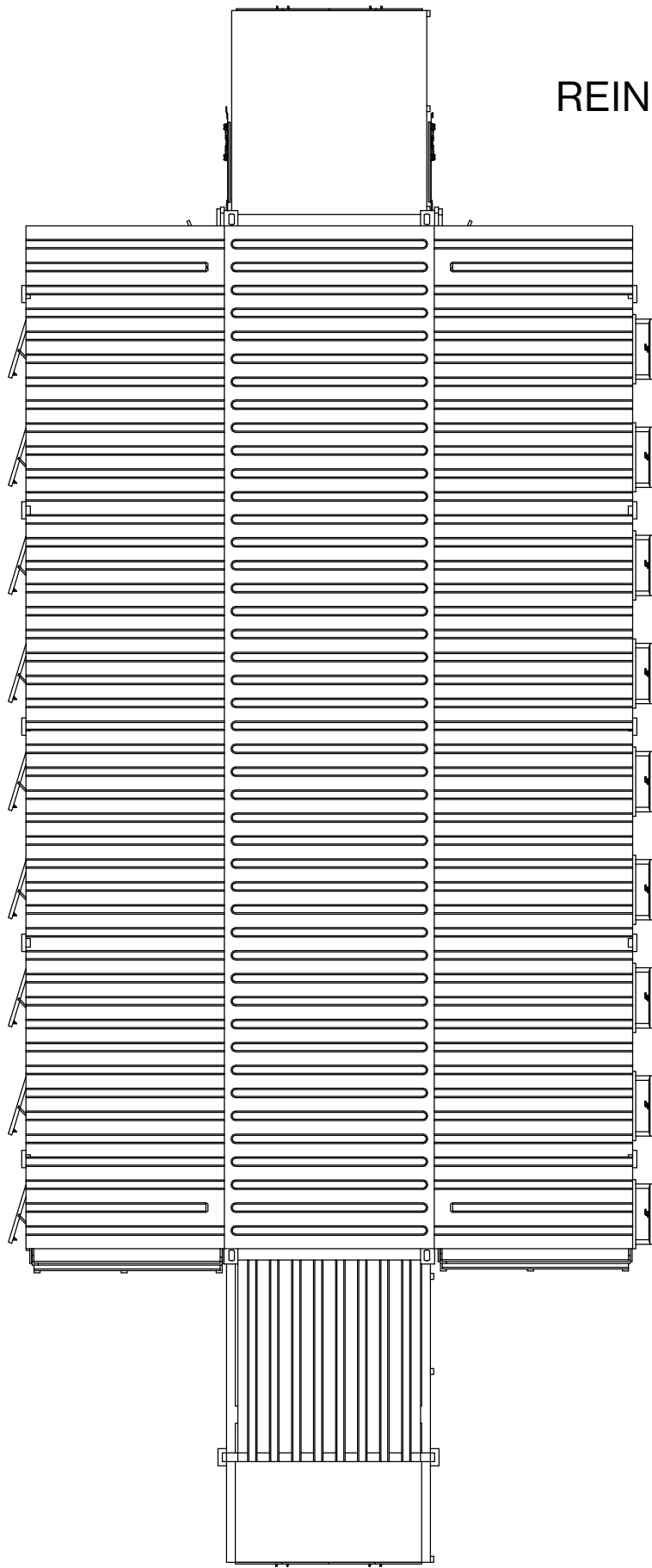
COCOONS



LEFT ELEVATION

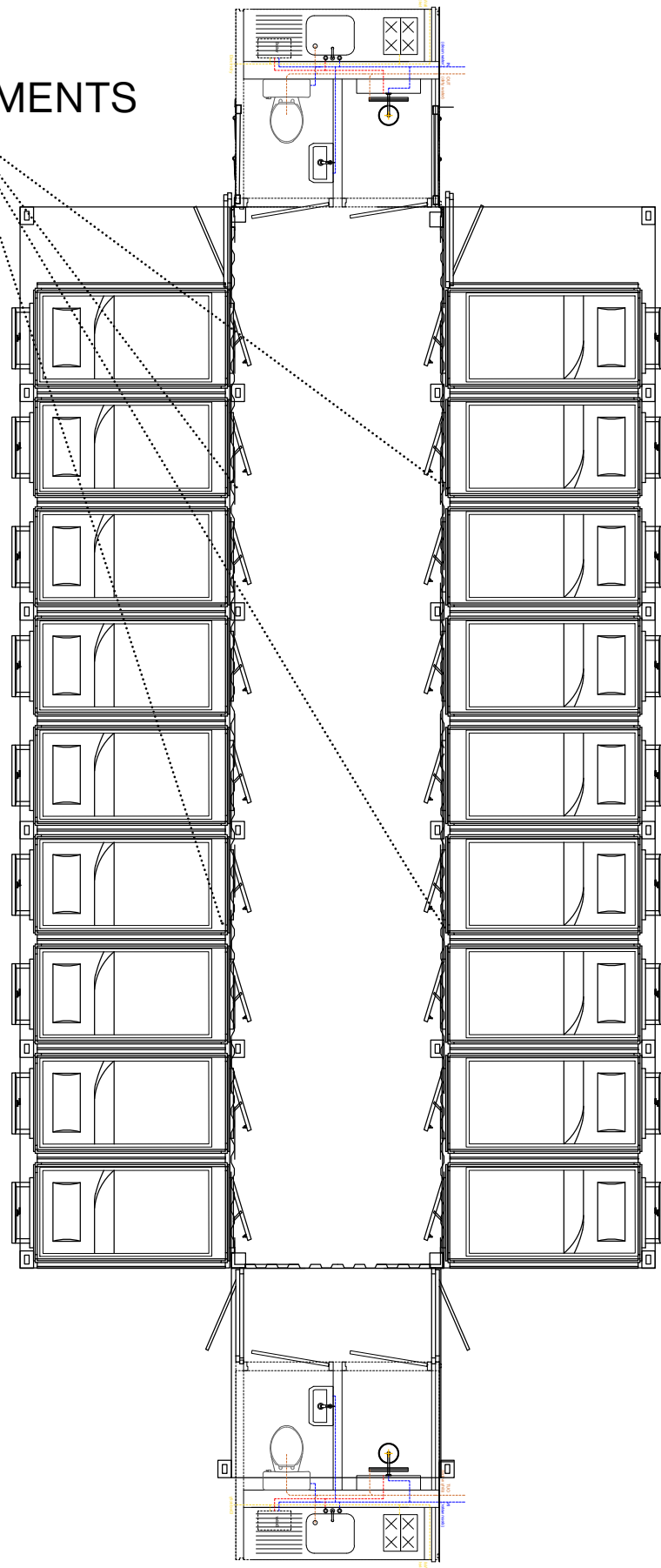


FRONT ELEVATION

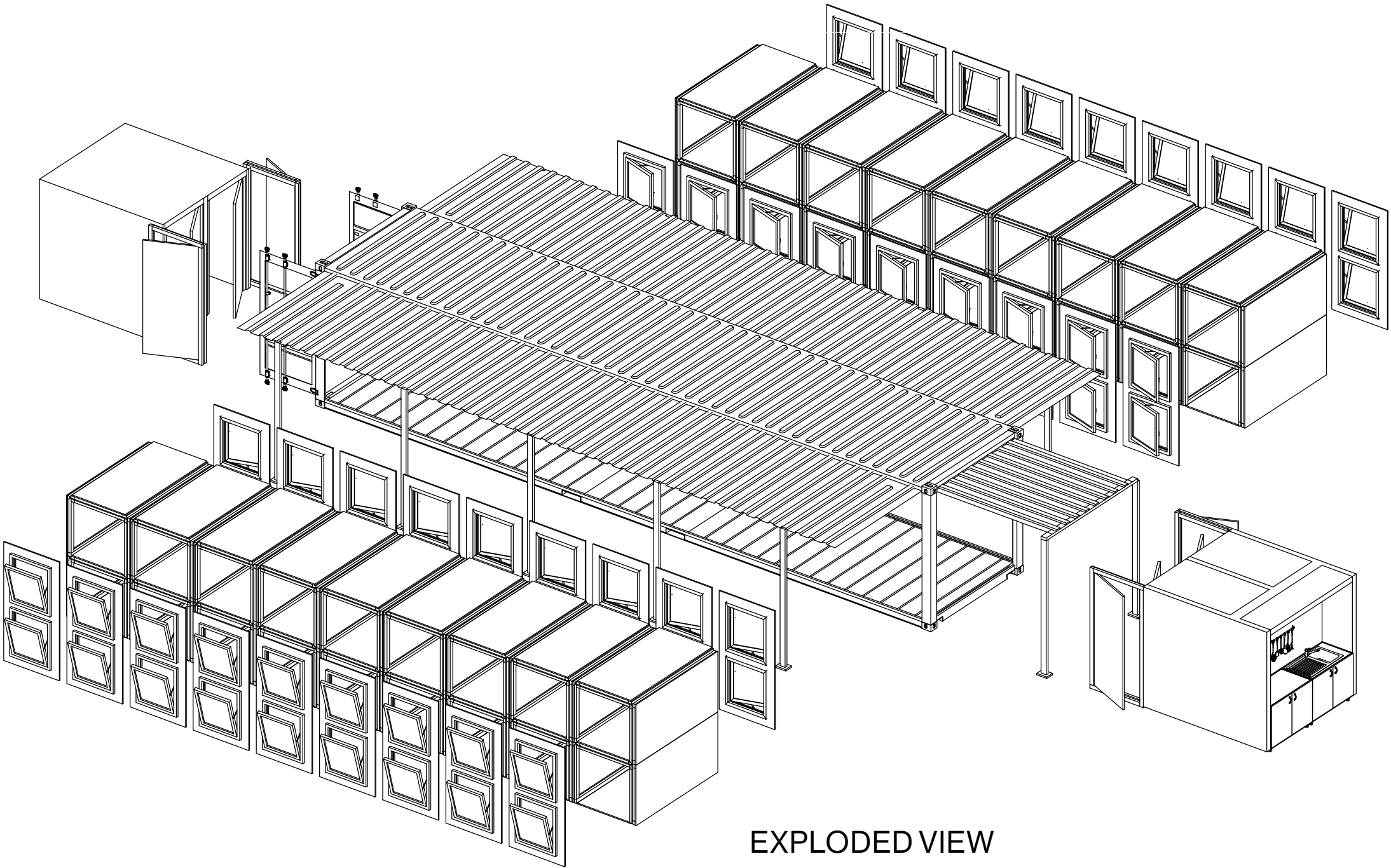


ROOFTOP PLAN

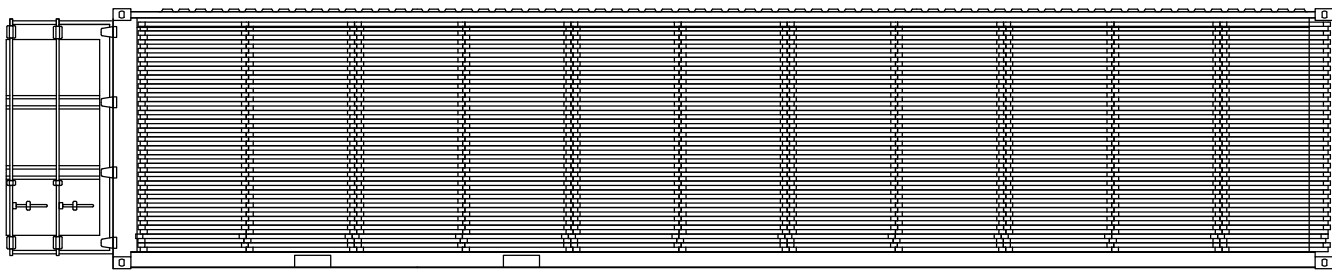
REINFORCEMENTS



FLOOR PLAN

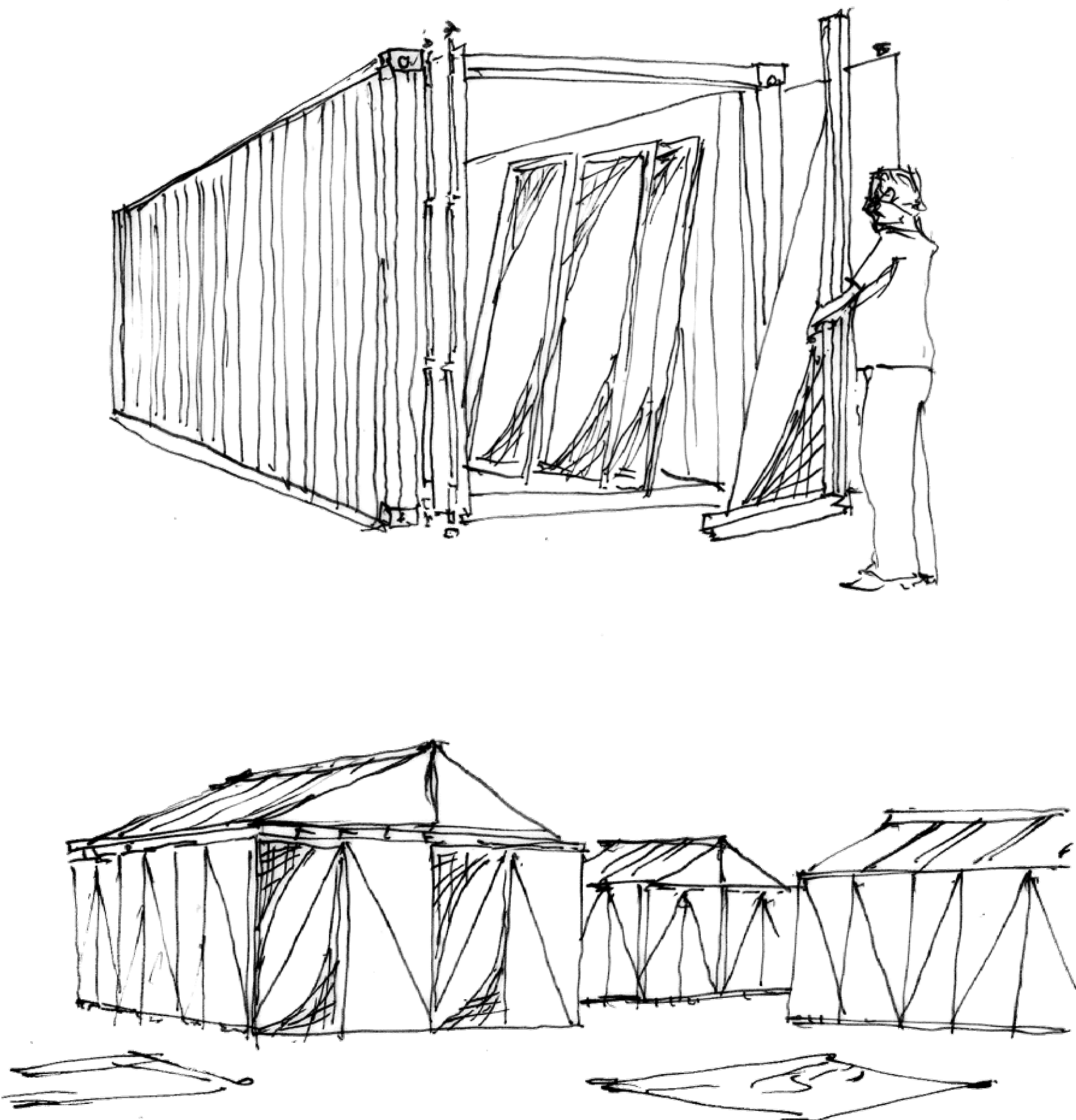
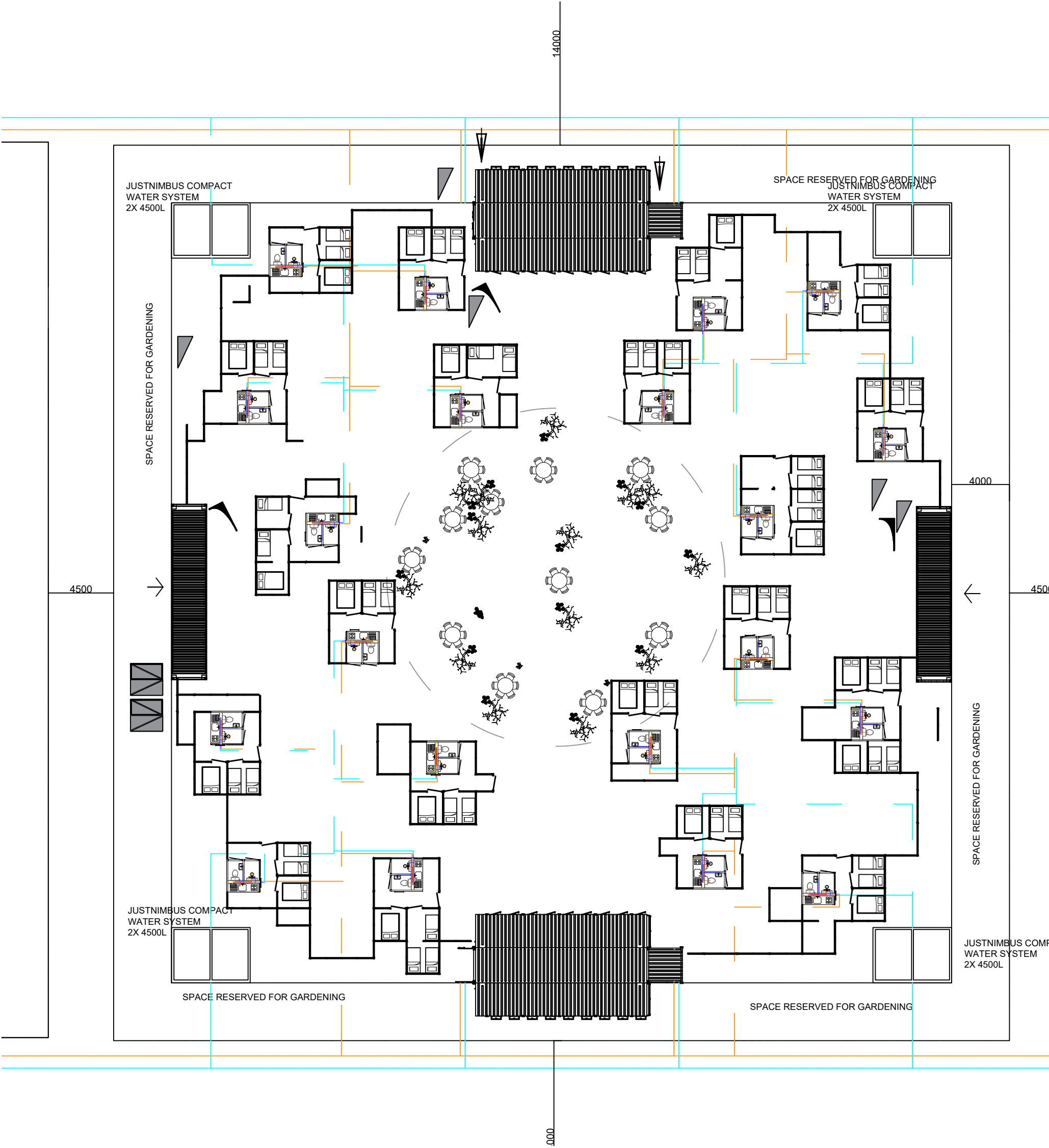


EXPLODED VIEW

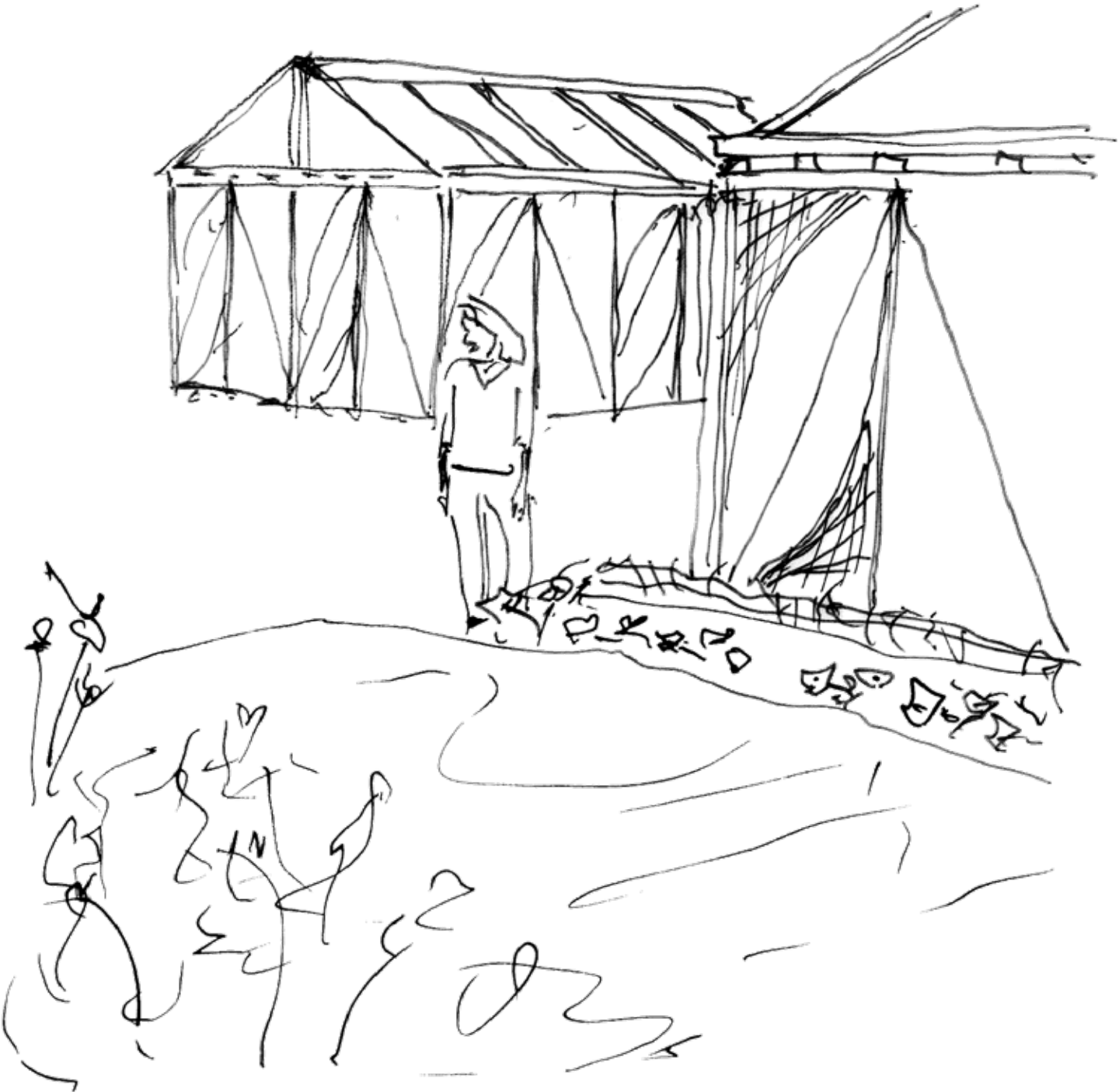
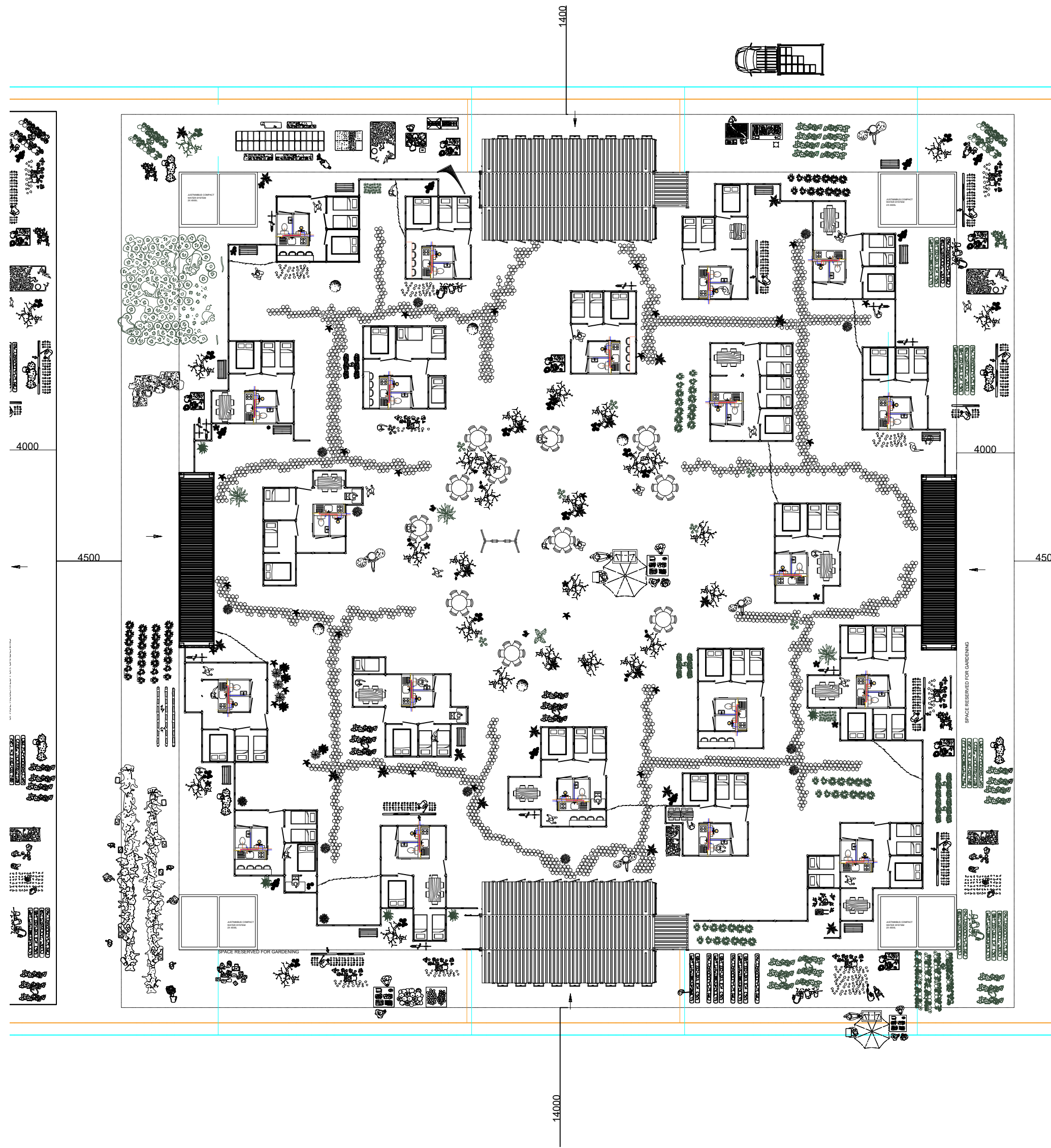


40FT CONTAINER FILLED UP

STEP 5 BUILDING THE SHELTER

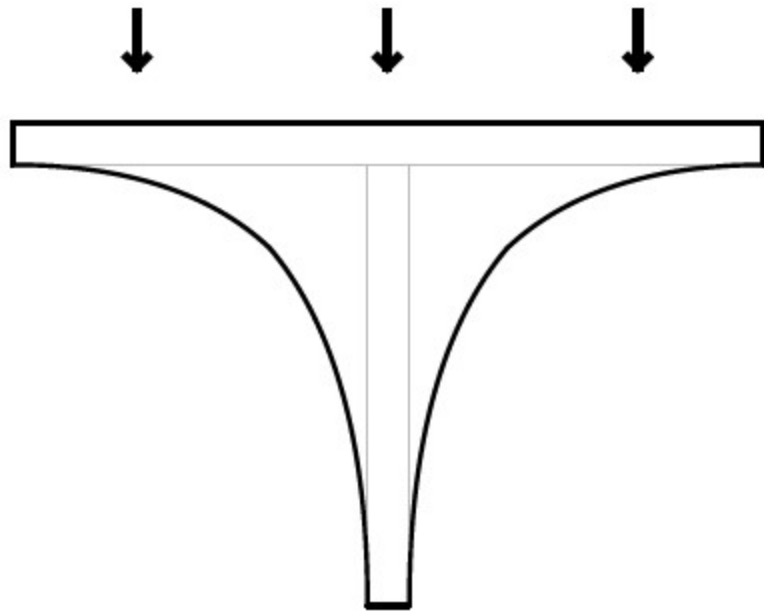
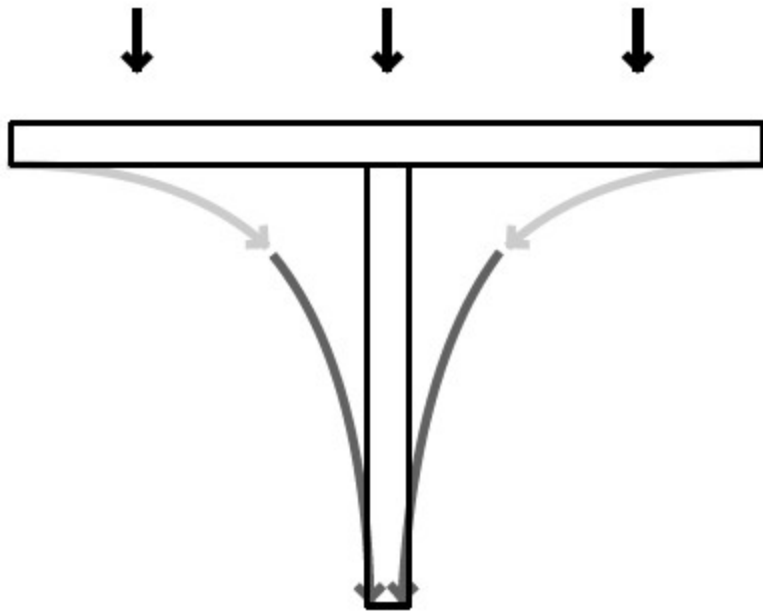
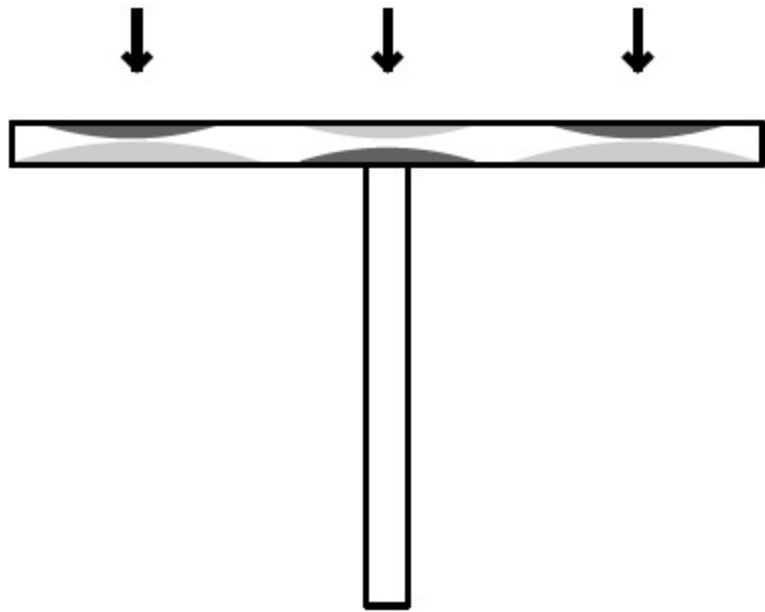
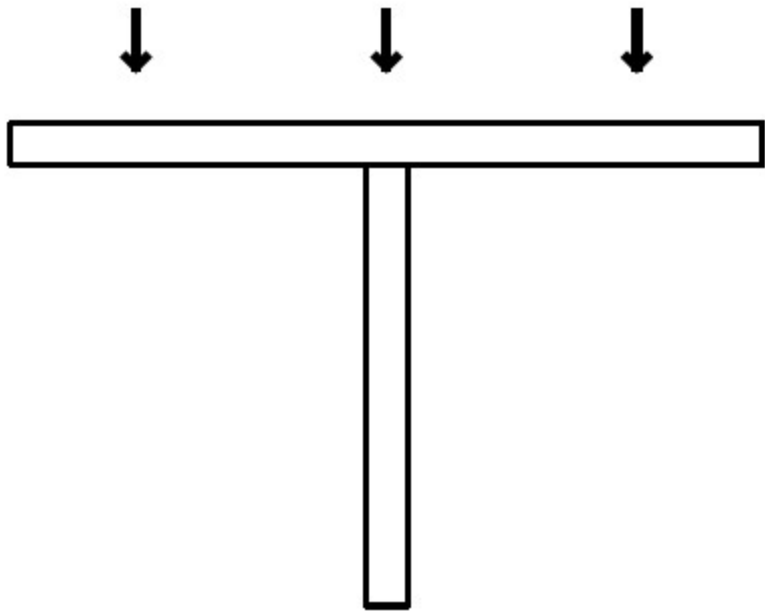


STEP 6 'GROWING'

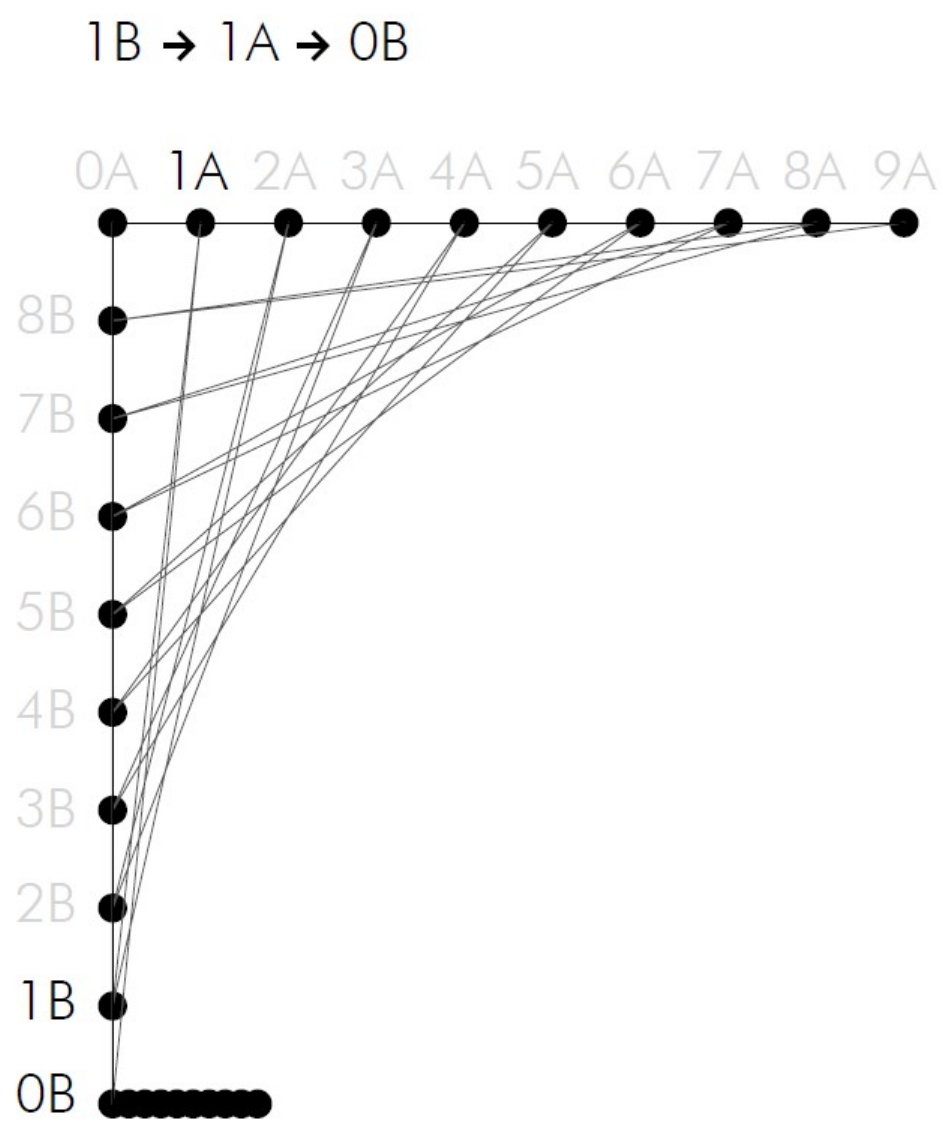
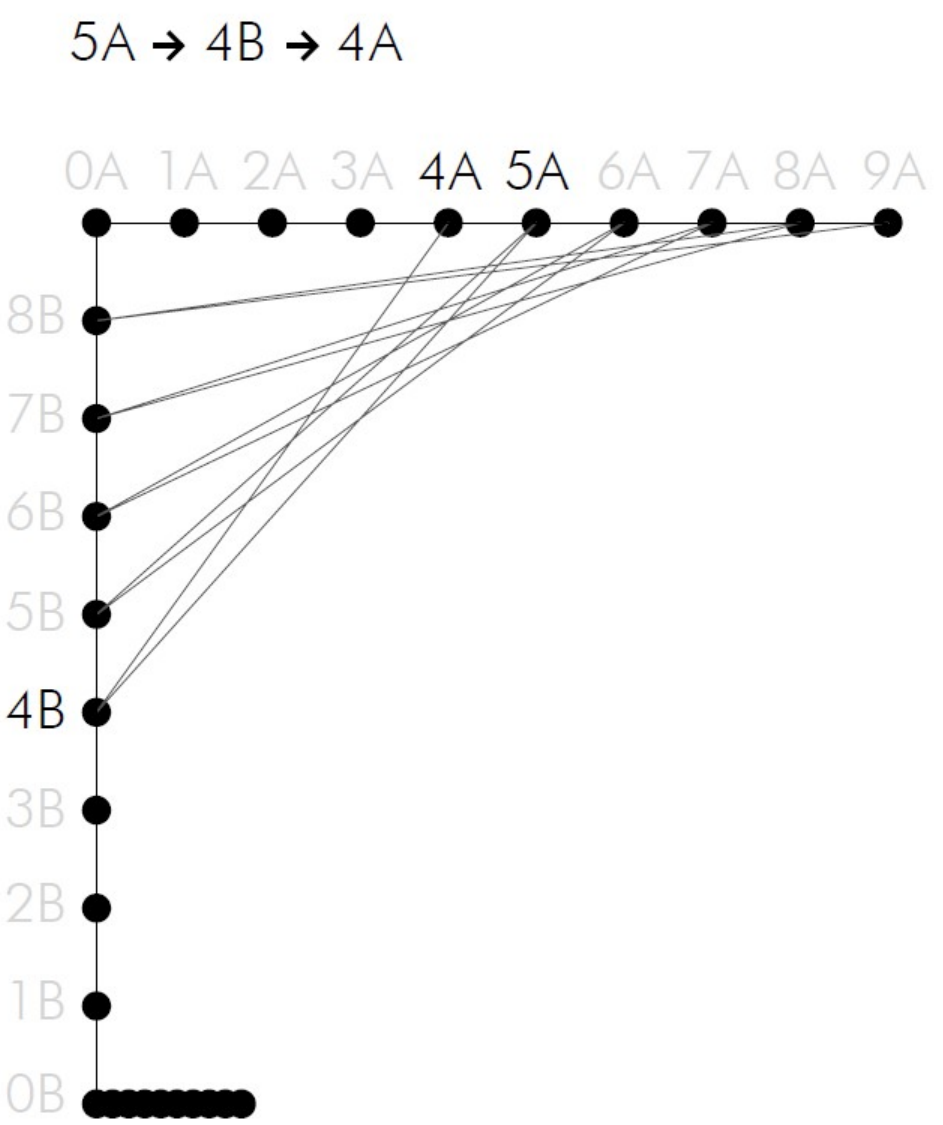
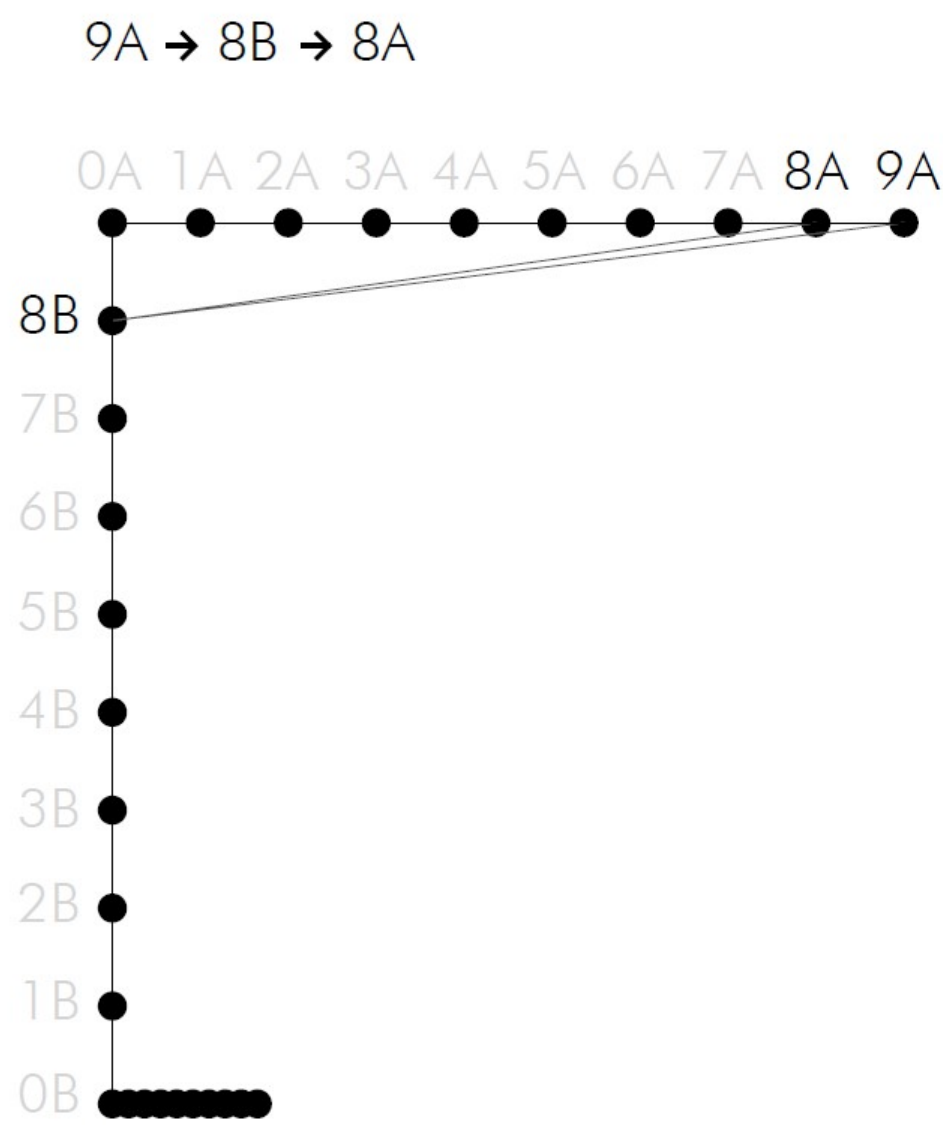


ASSEMBLY | PANEL

FORCES

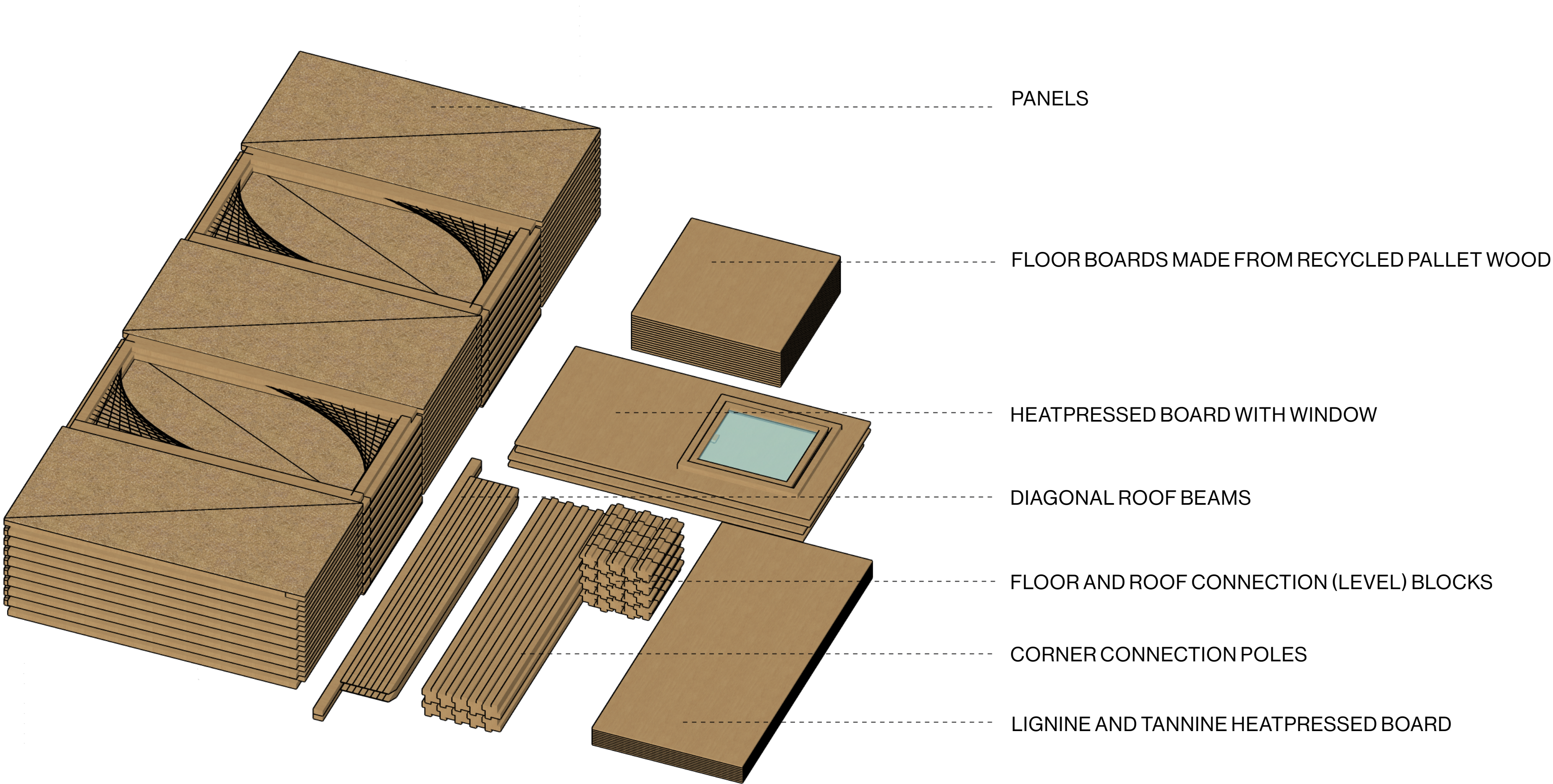


WEAVING

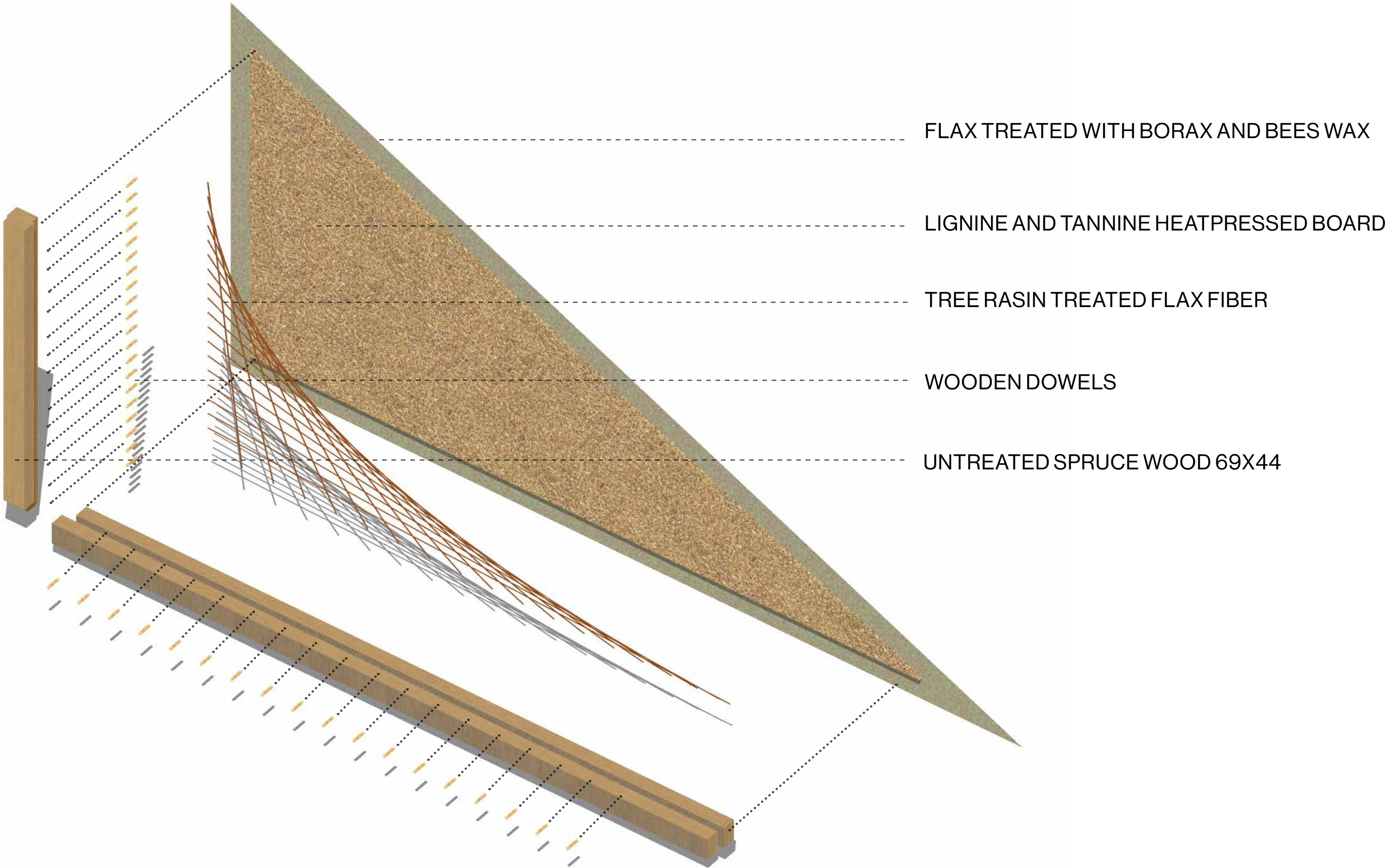


mechanical properties flax fibers
Heider Vanessa. (2023).

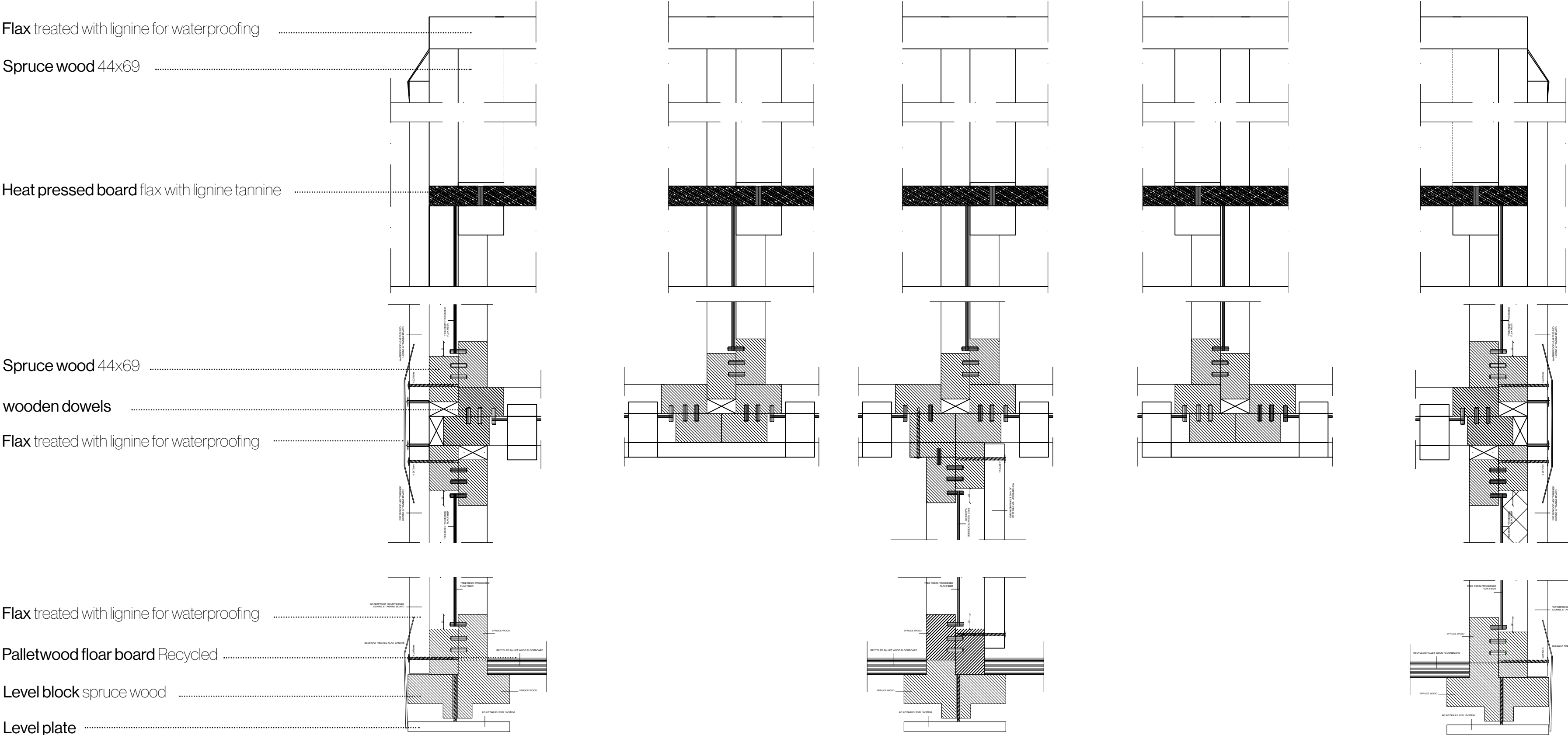
COMPLETE PACKAGE



PANEL



DRAWINGS FOR ARCHITECTS/ENGINEERS

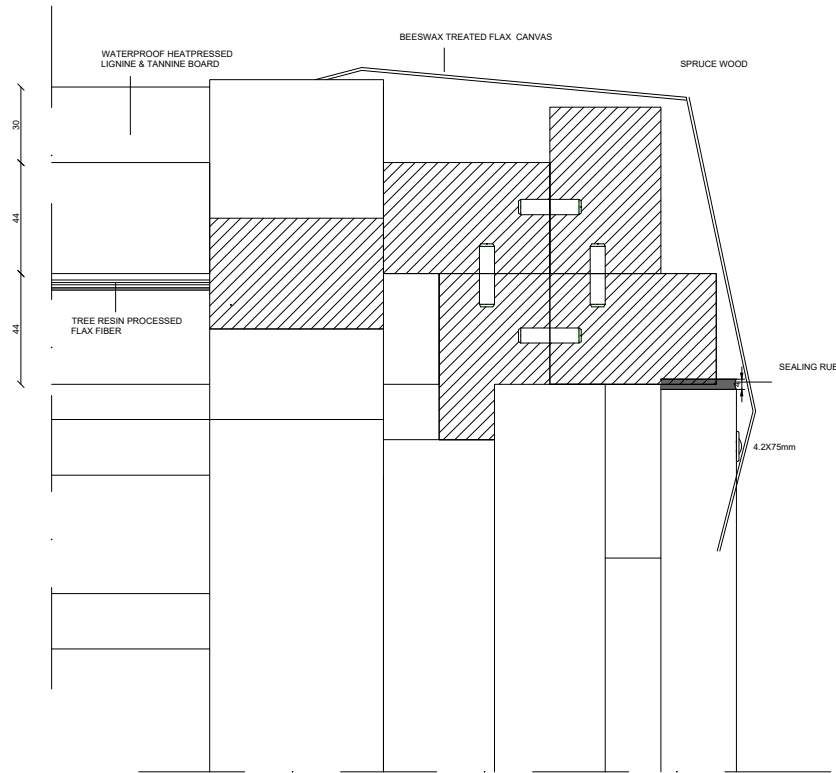
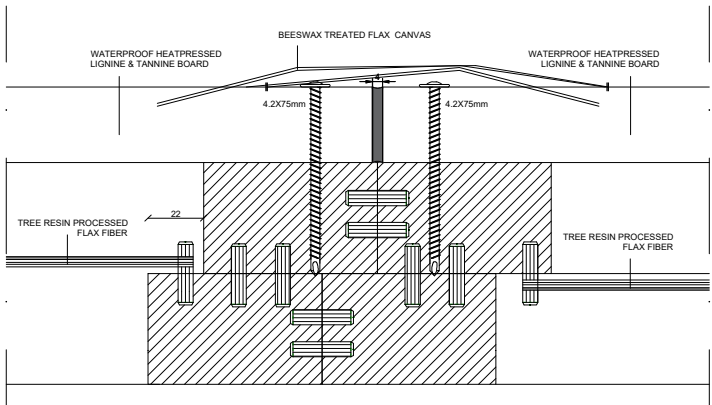
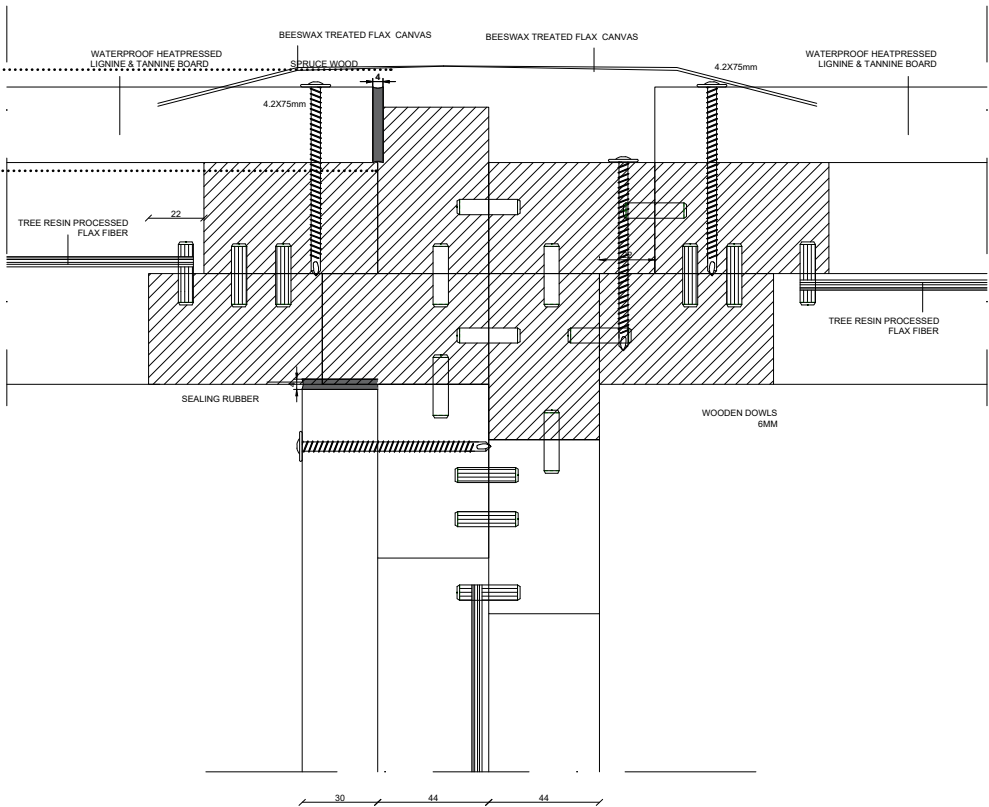


DRAWINGS FOR ARCHITECTS/ENGINEERS

Flax treated with lignine for waterproofing

Spruce wood 44x69

Heat pressed board flax with lignine tannine

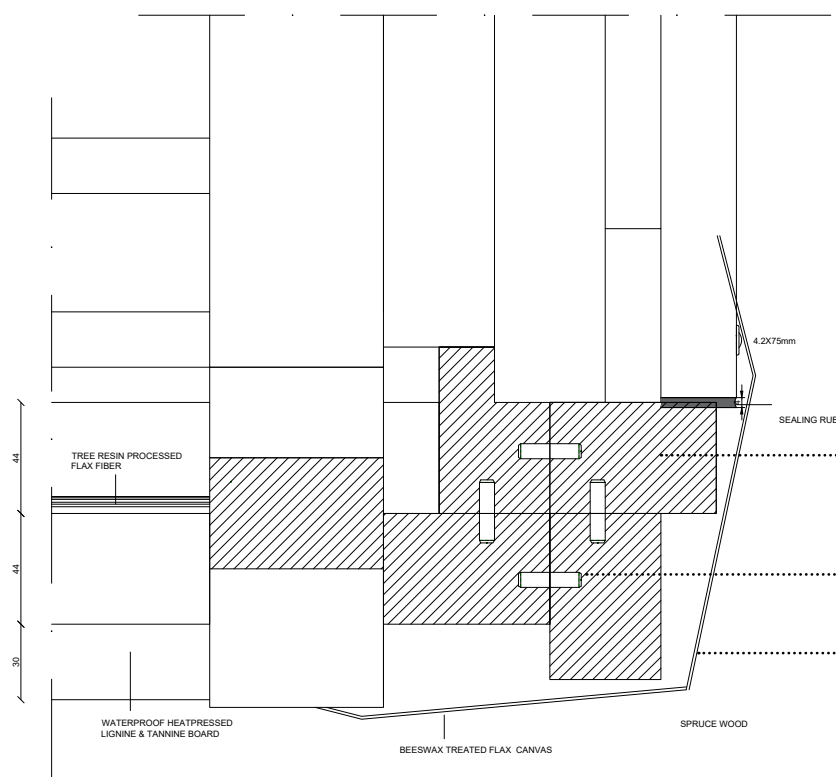
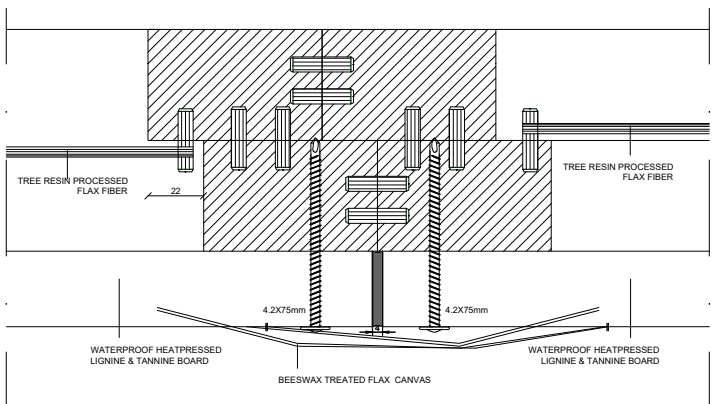
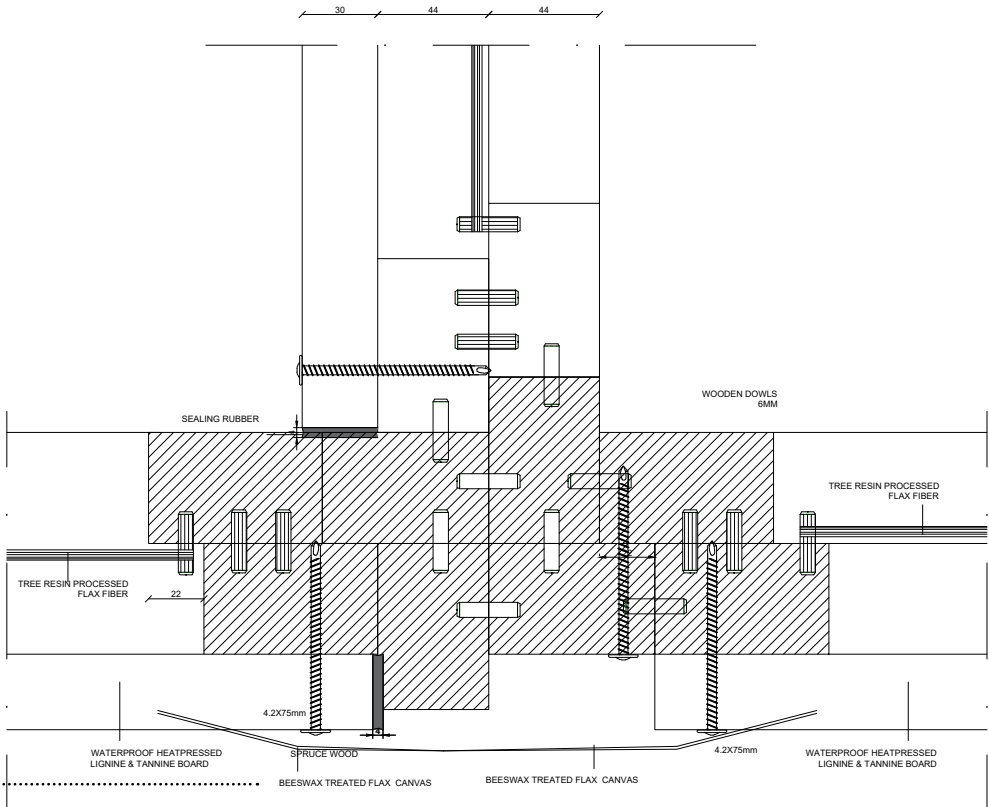


Flax treated with lignine for waterproofing

Palletwood floor board Recycled

Level block spruce wood

Level plate



Spruce wood 44x69

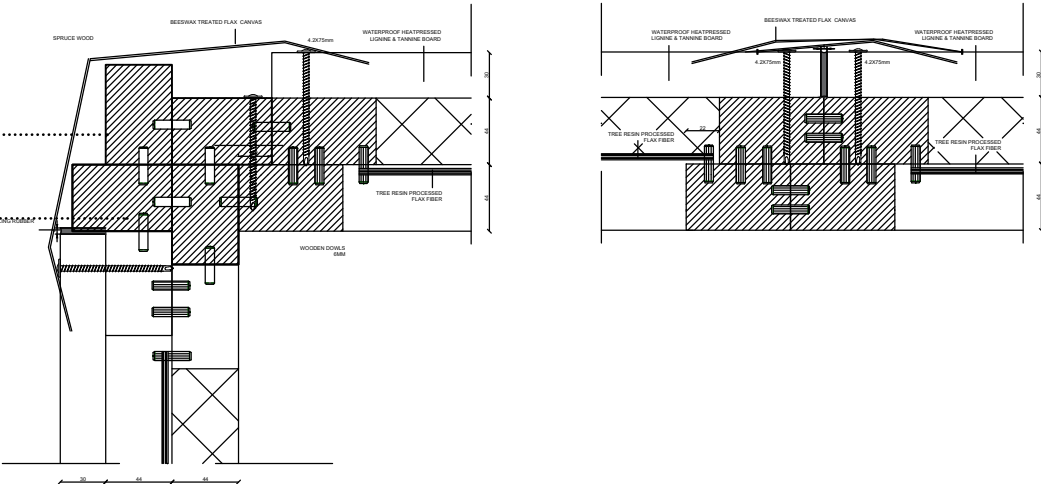
wooden dowels

Flax treated with lignine for waterproofing

DRAWINGS FOR ARCHITECTS/ENGINEERS

Flax treated with lignine for waterproofing

Spruce wood 44x69

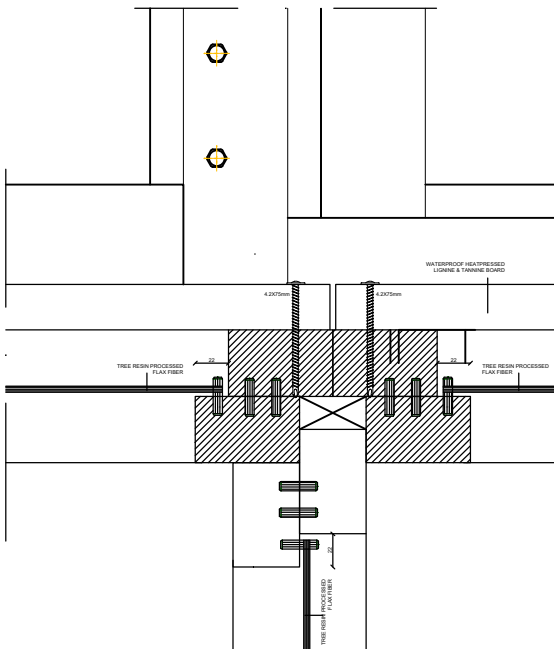
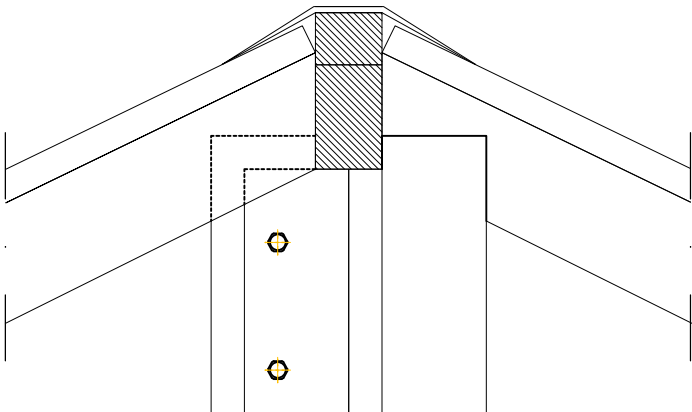
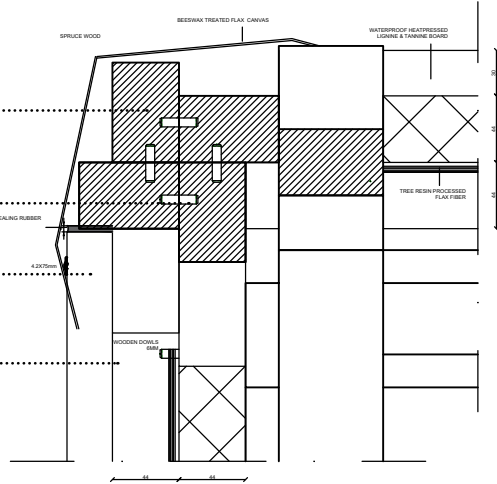


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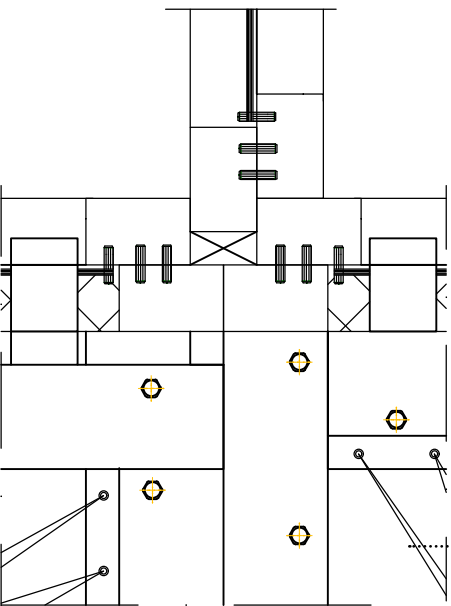
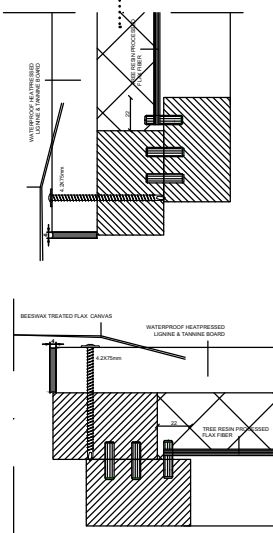
wooden dowels

Flax treated with lignine for waterproofing

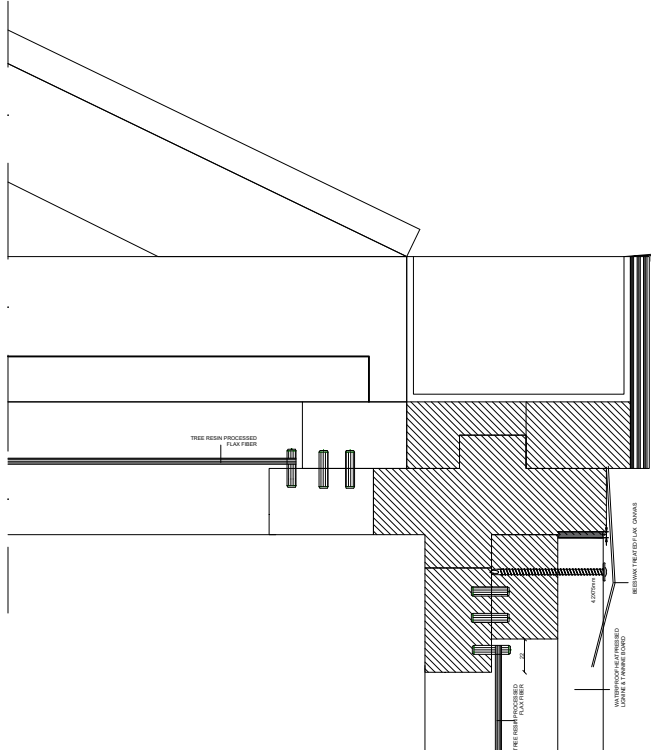
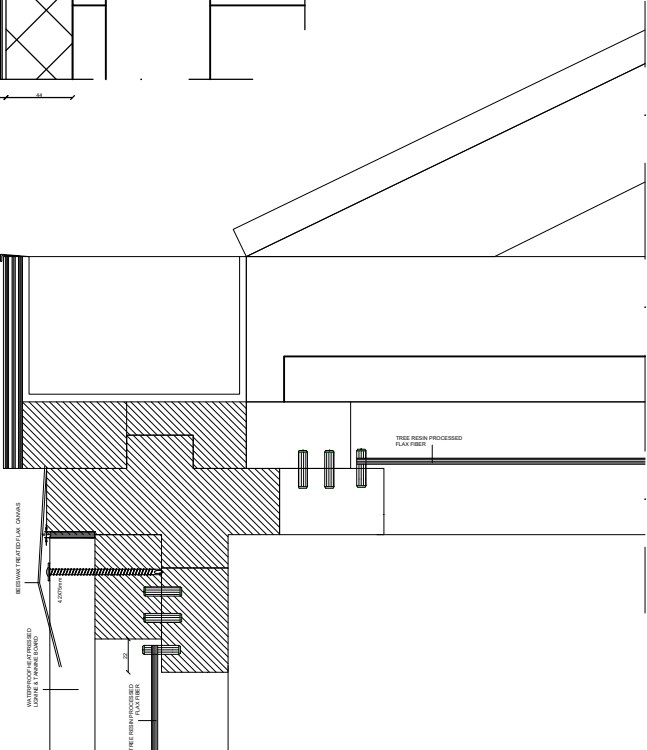
Heat pressed board flax with lignine tannine



Insulation (optional)



Flax fibre treated with natural resin

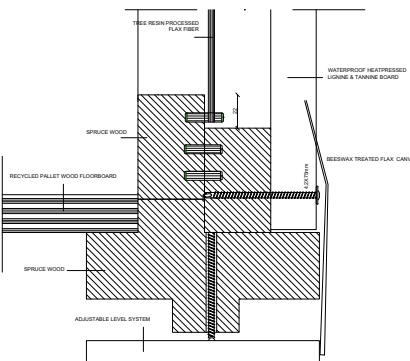
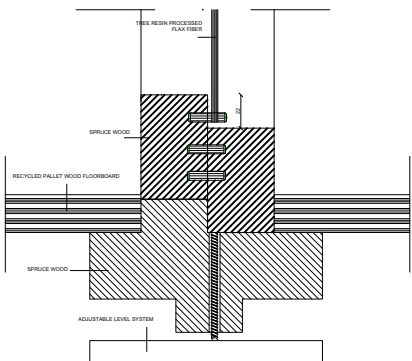
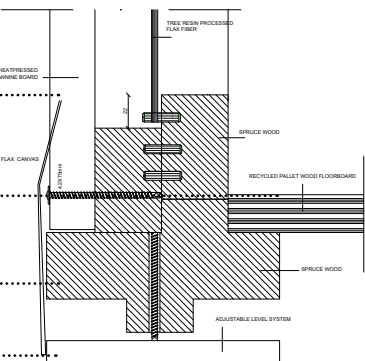


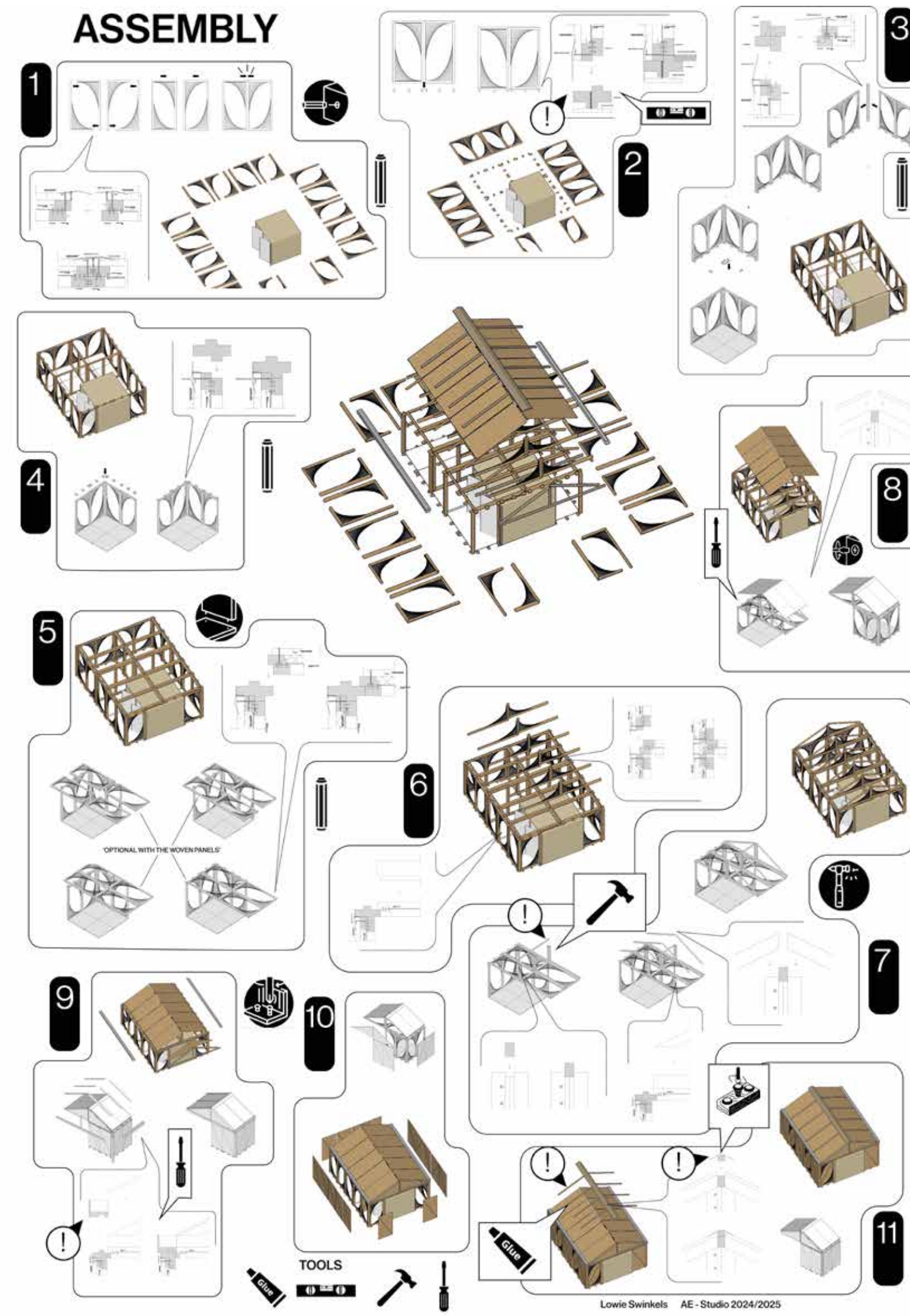
Flax treated with lignine for waterproofing

Palletwood floor board Recycled

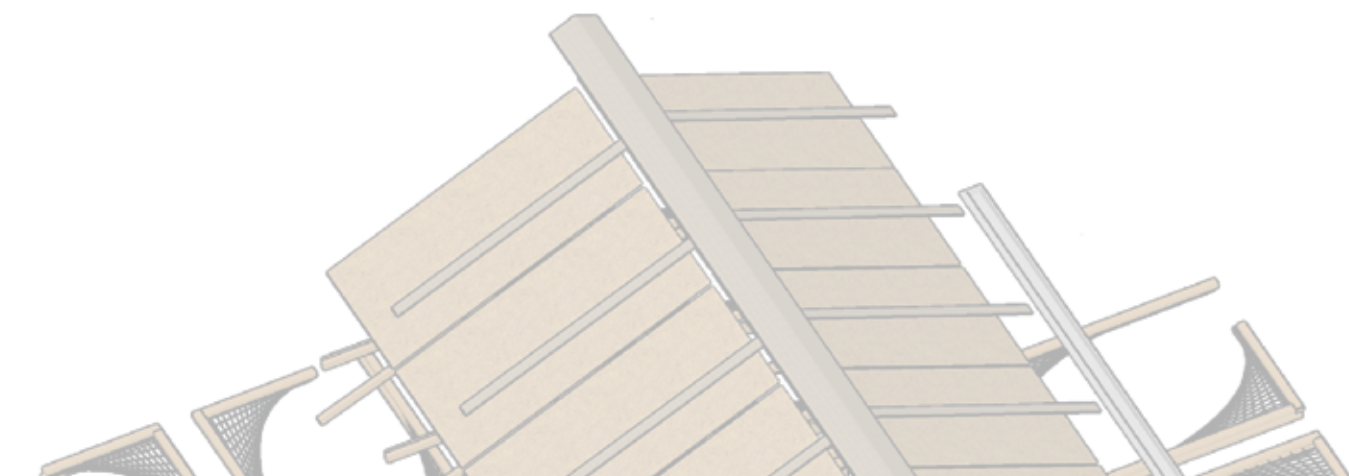
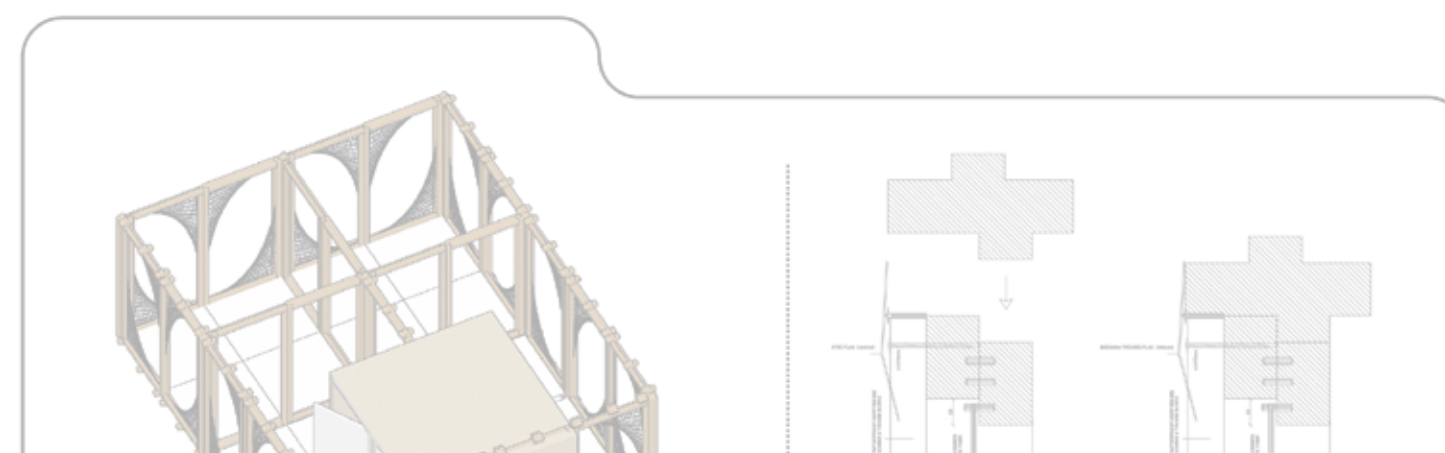
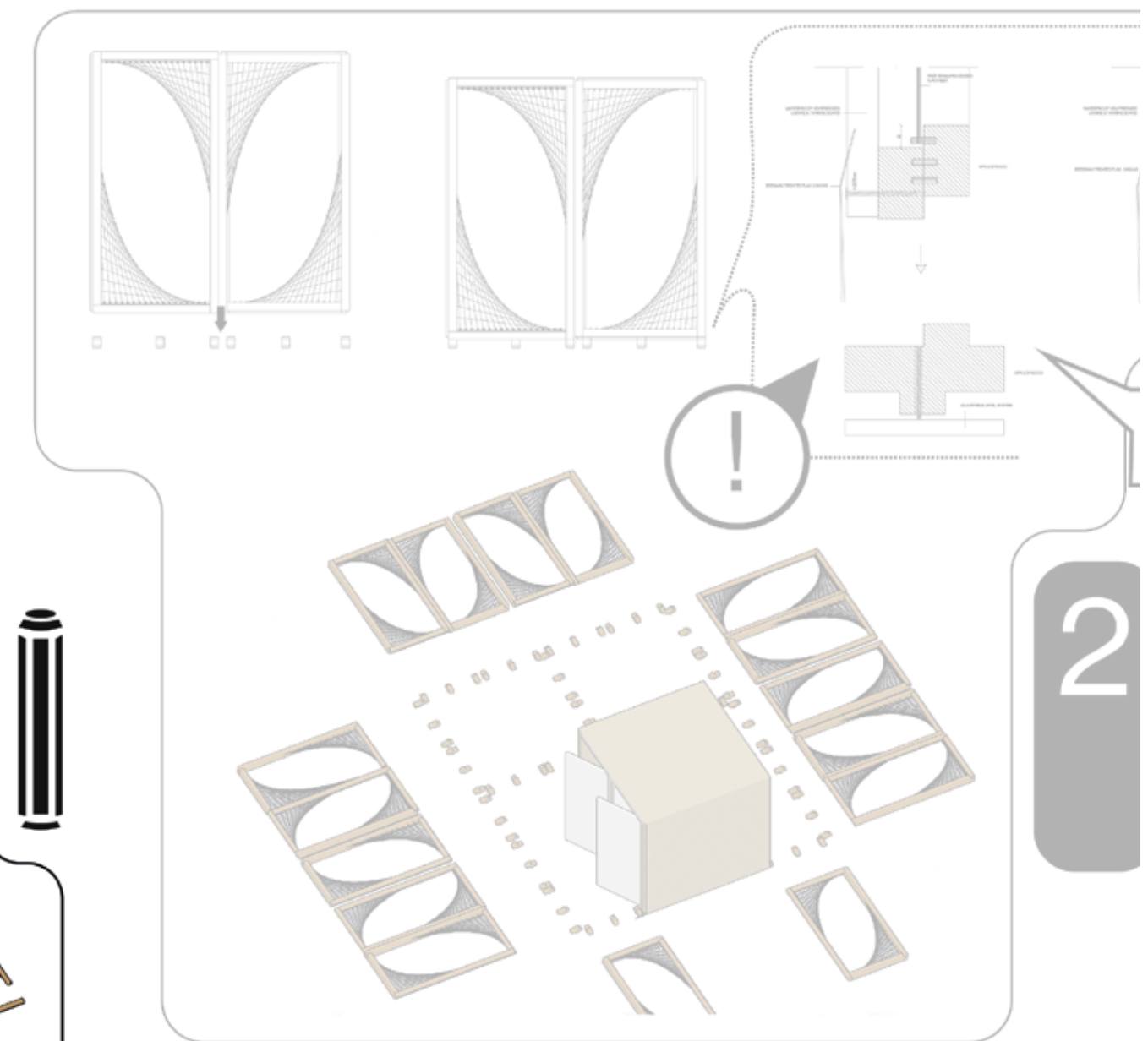
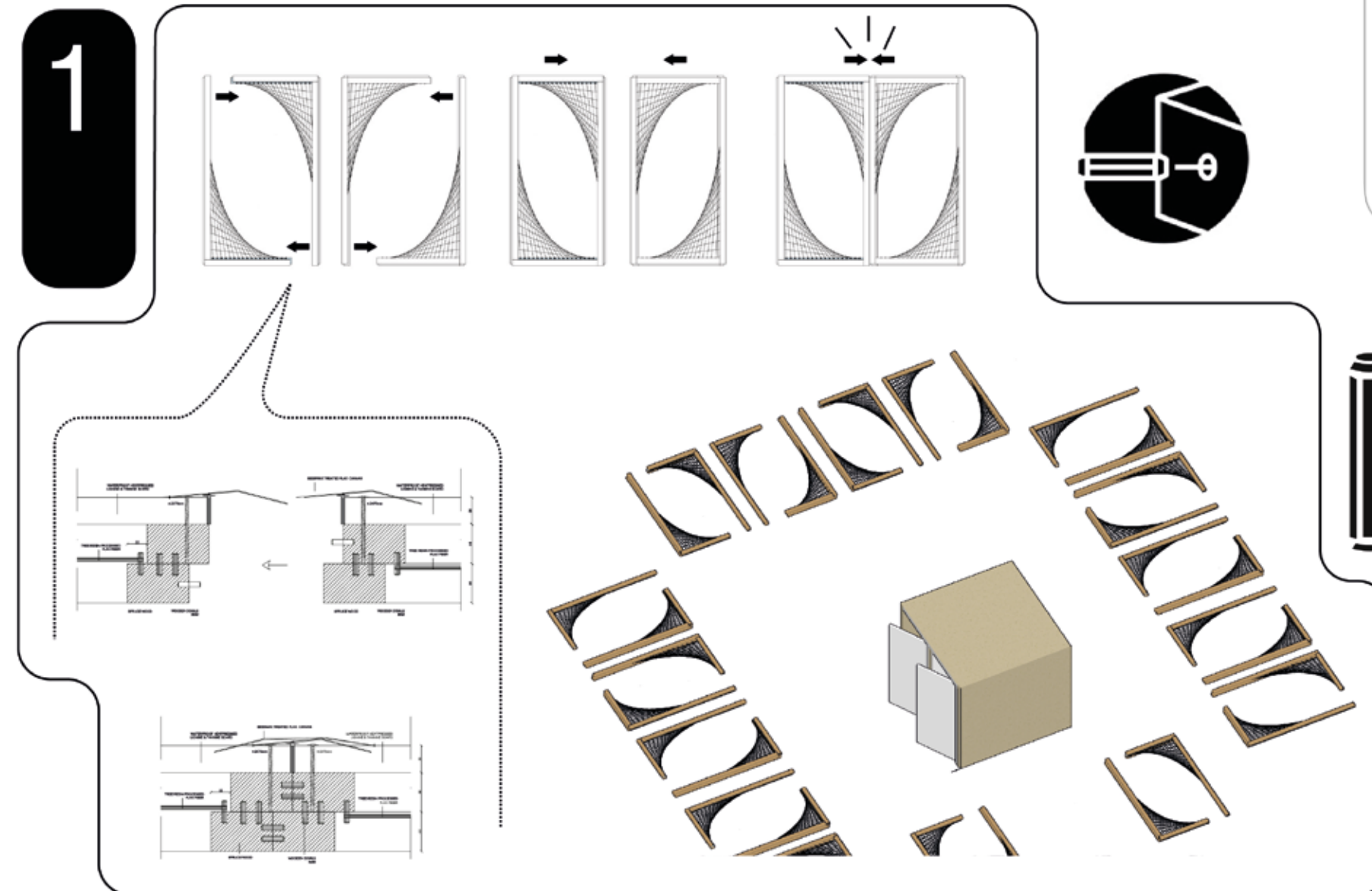
Level block spruce wood

Level plate

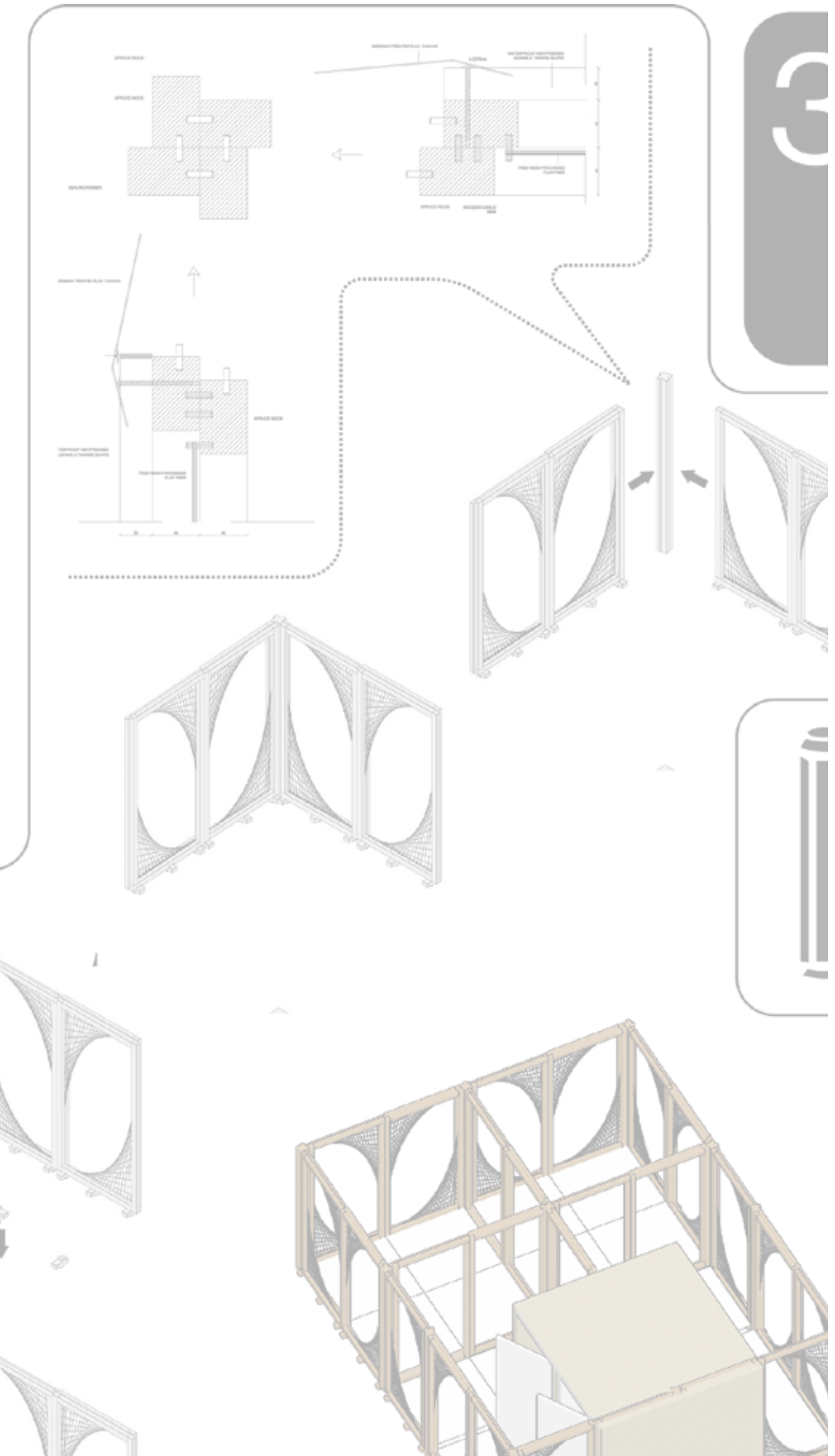
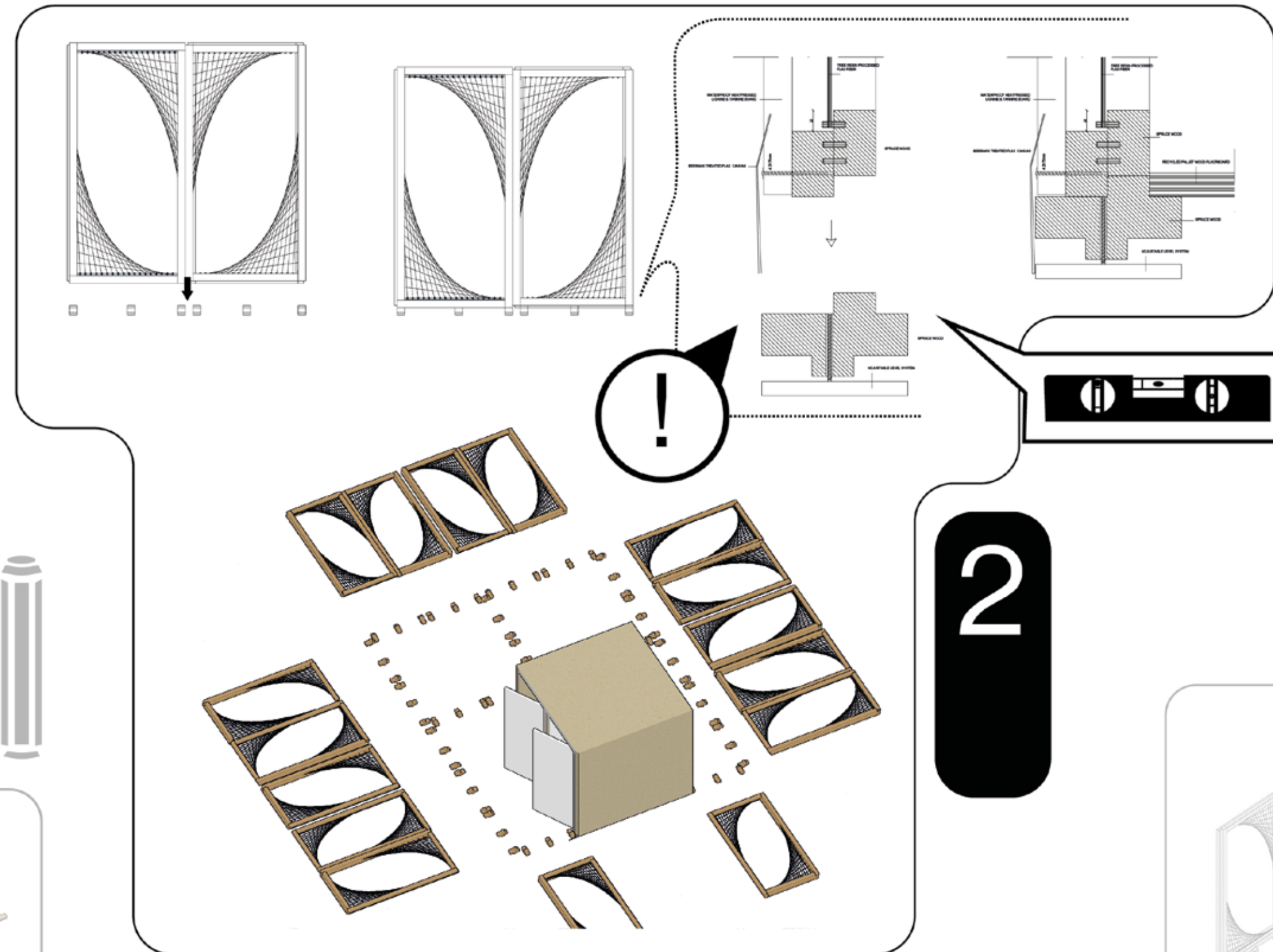
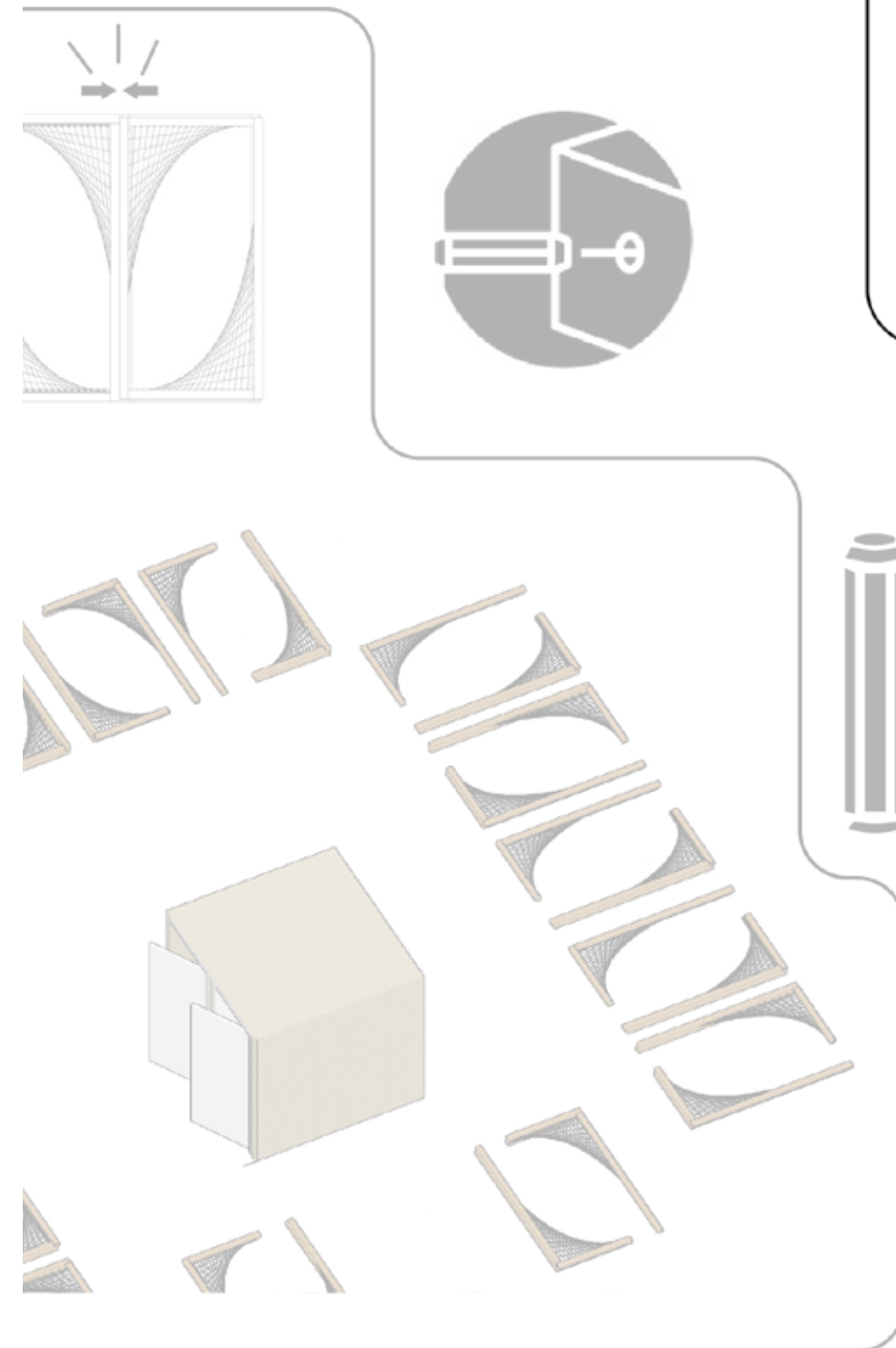


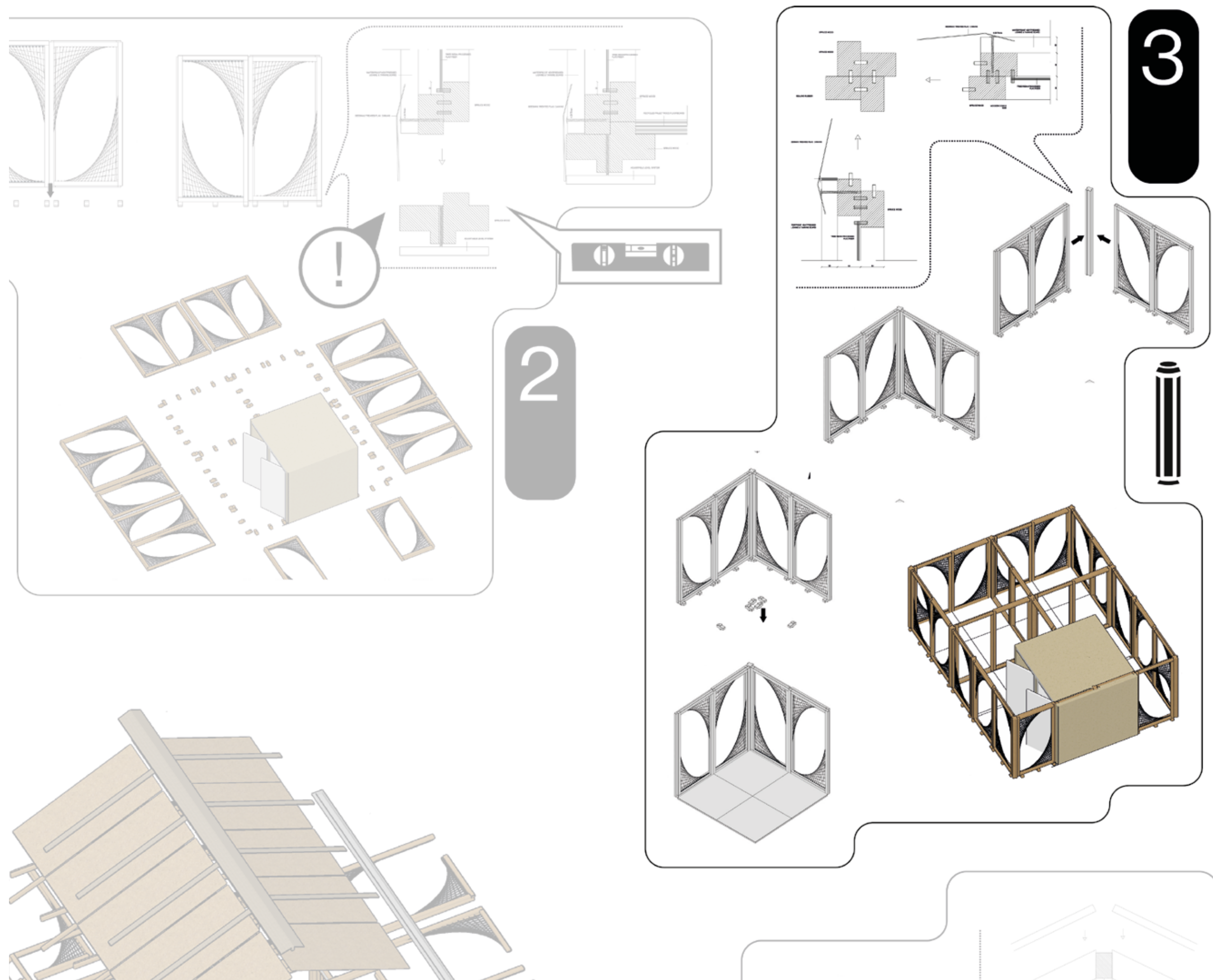


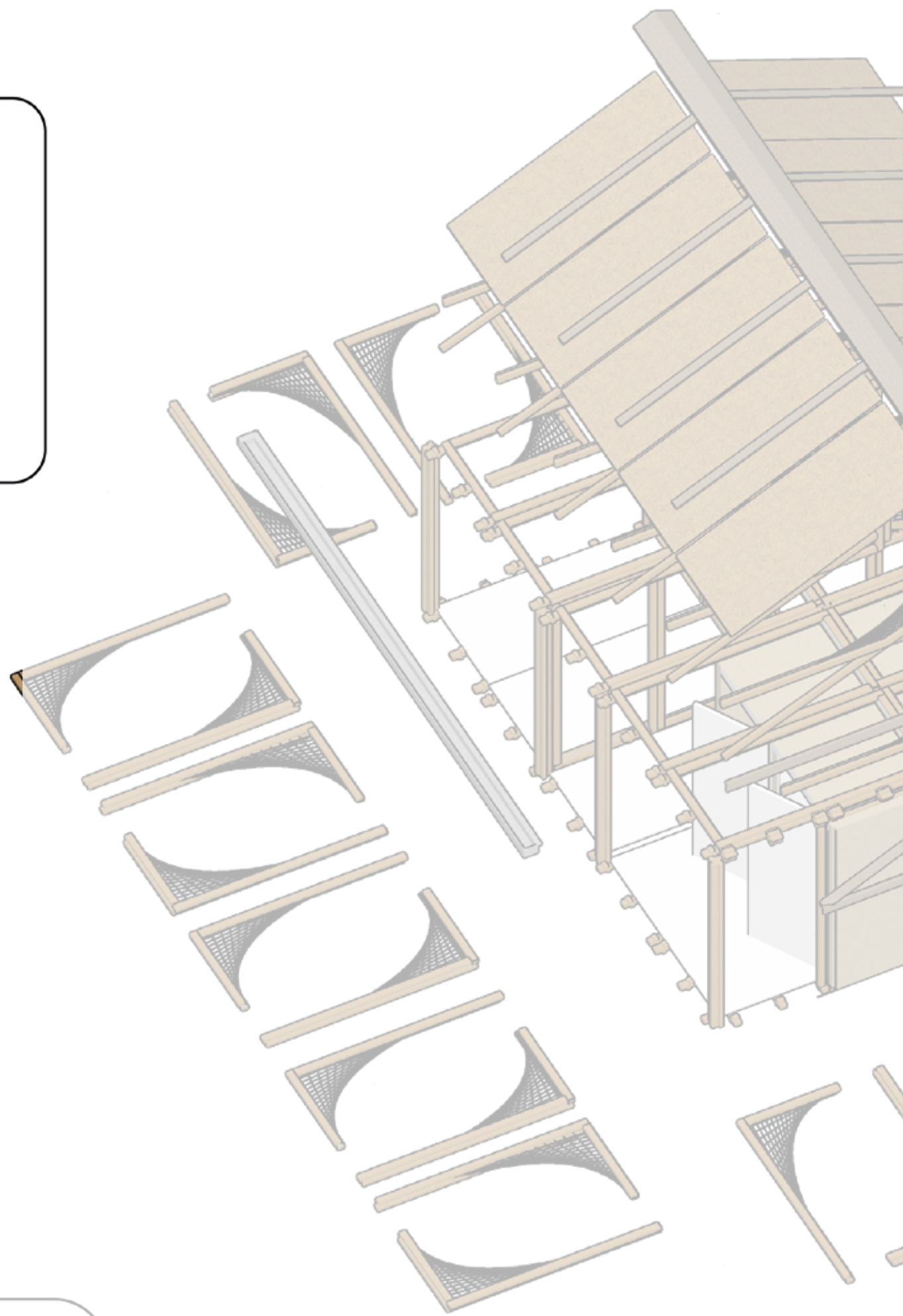
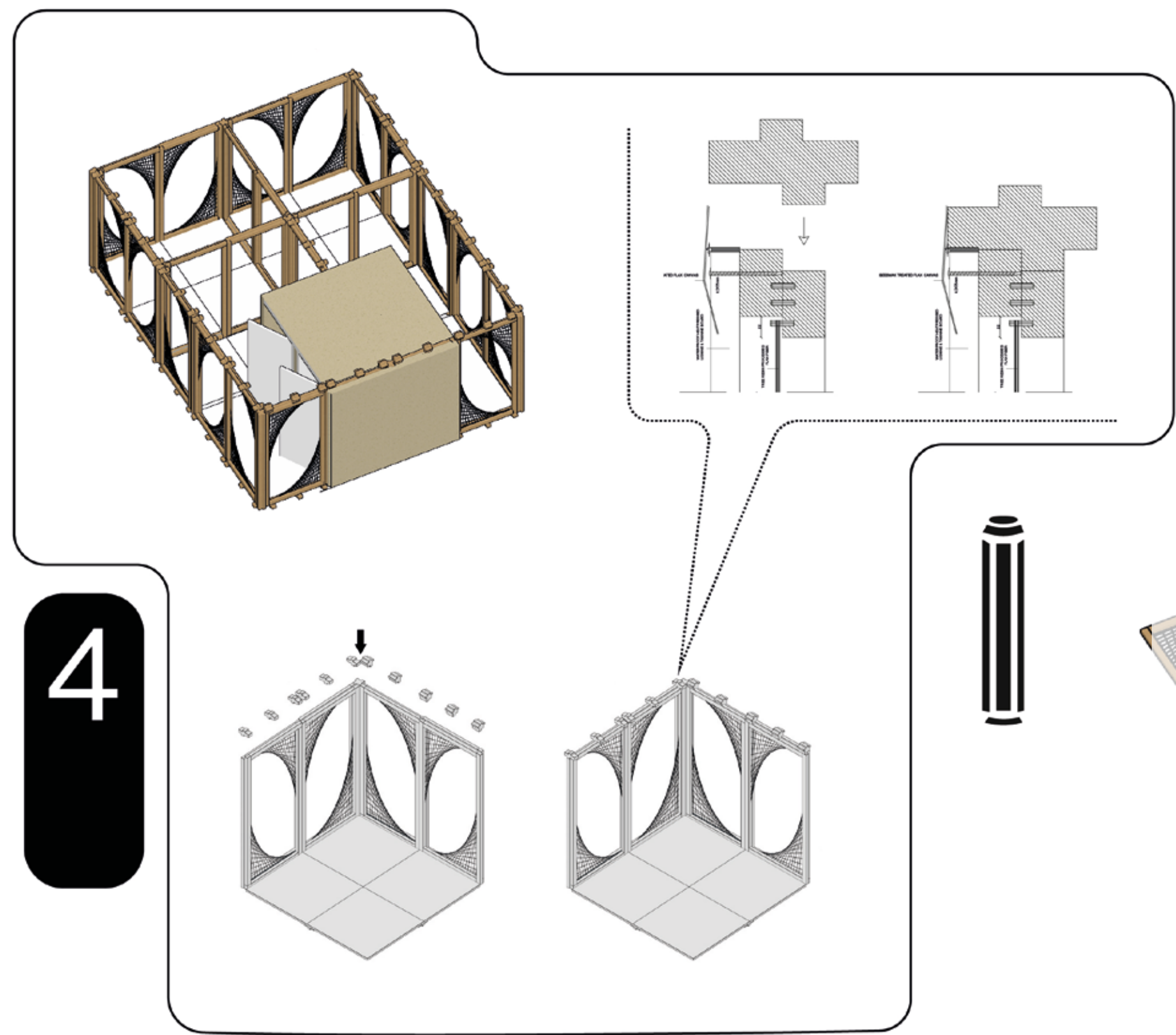
ASSEMBLY

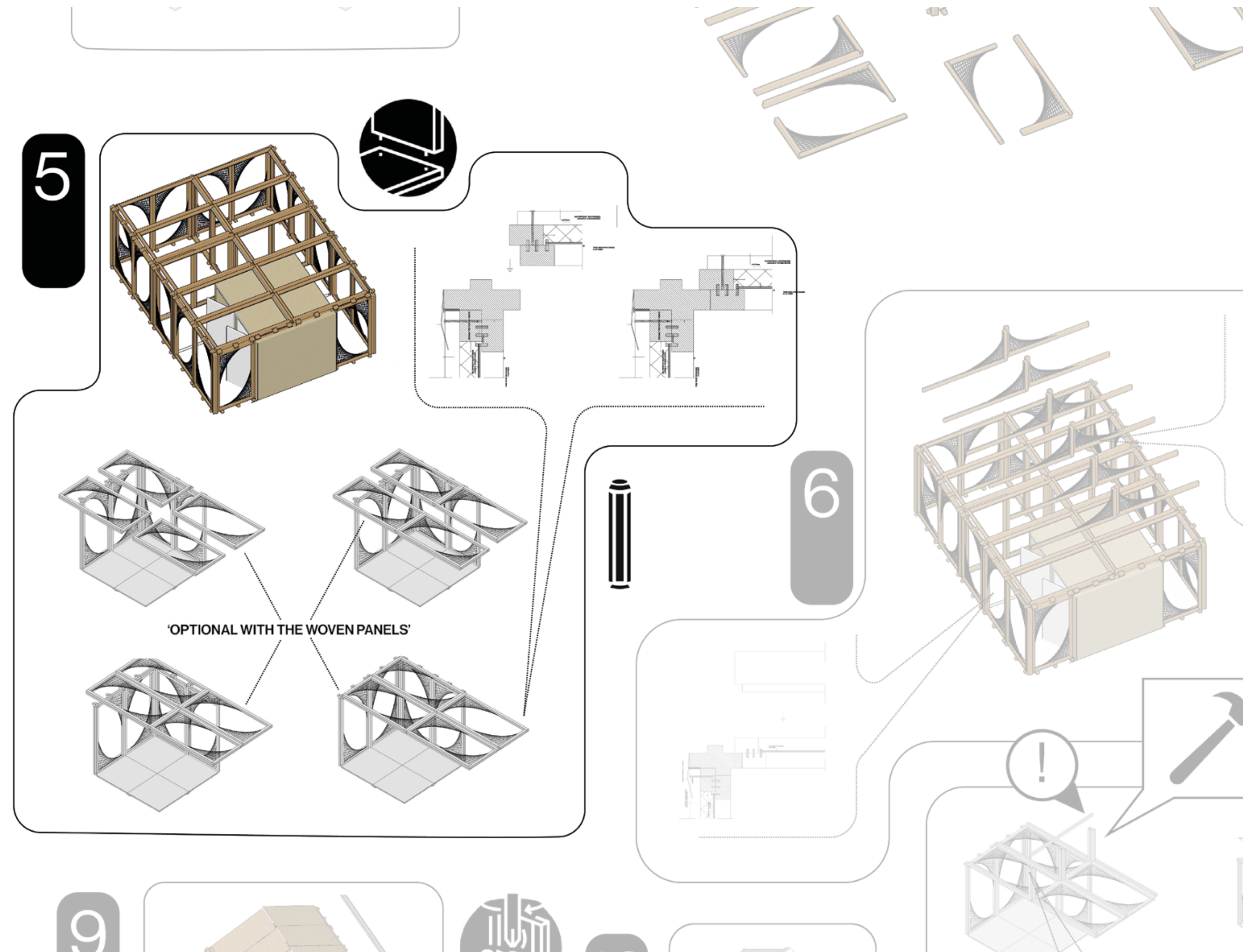


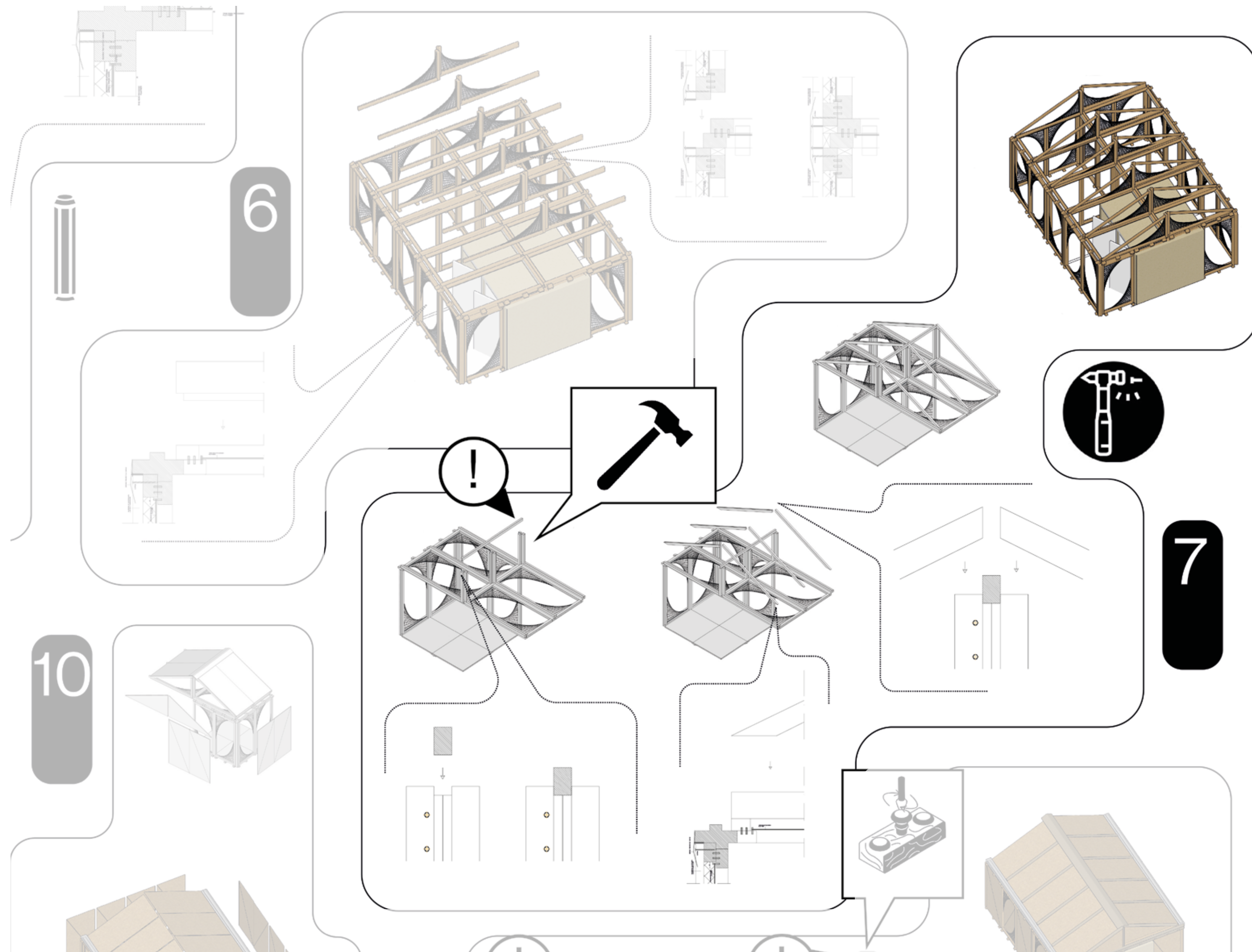
PLY

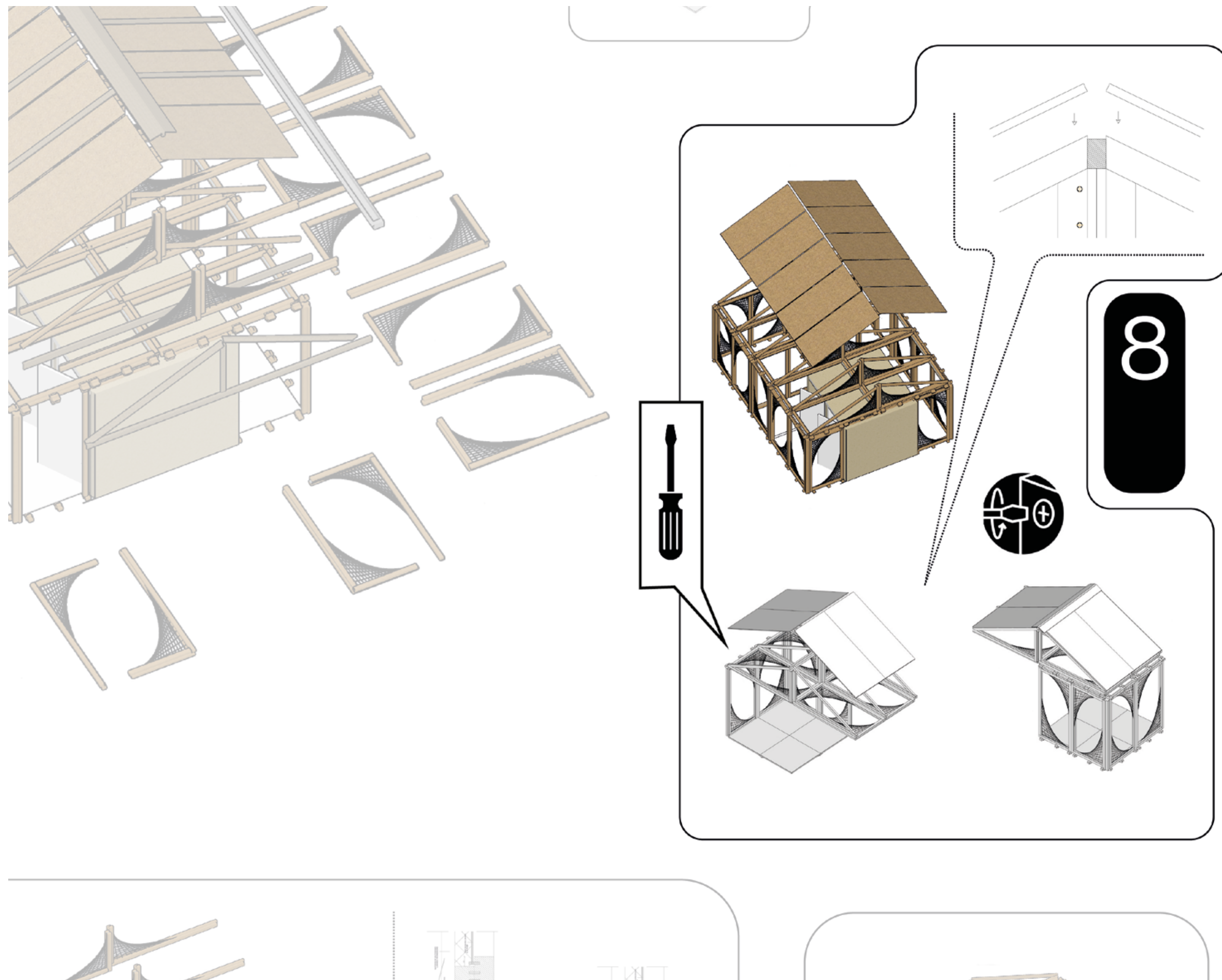


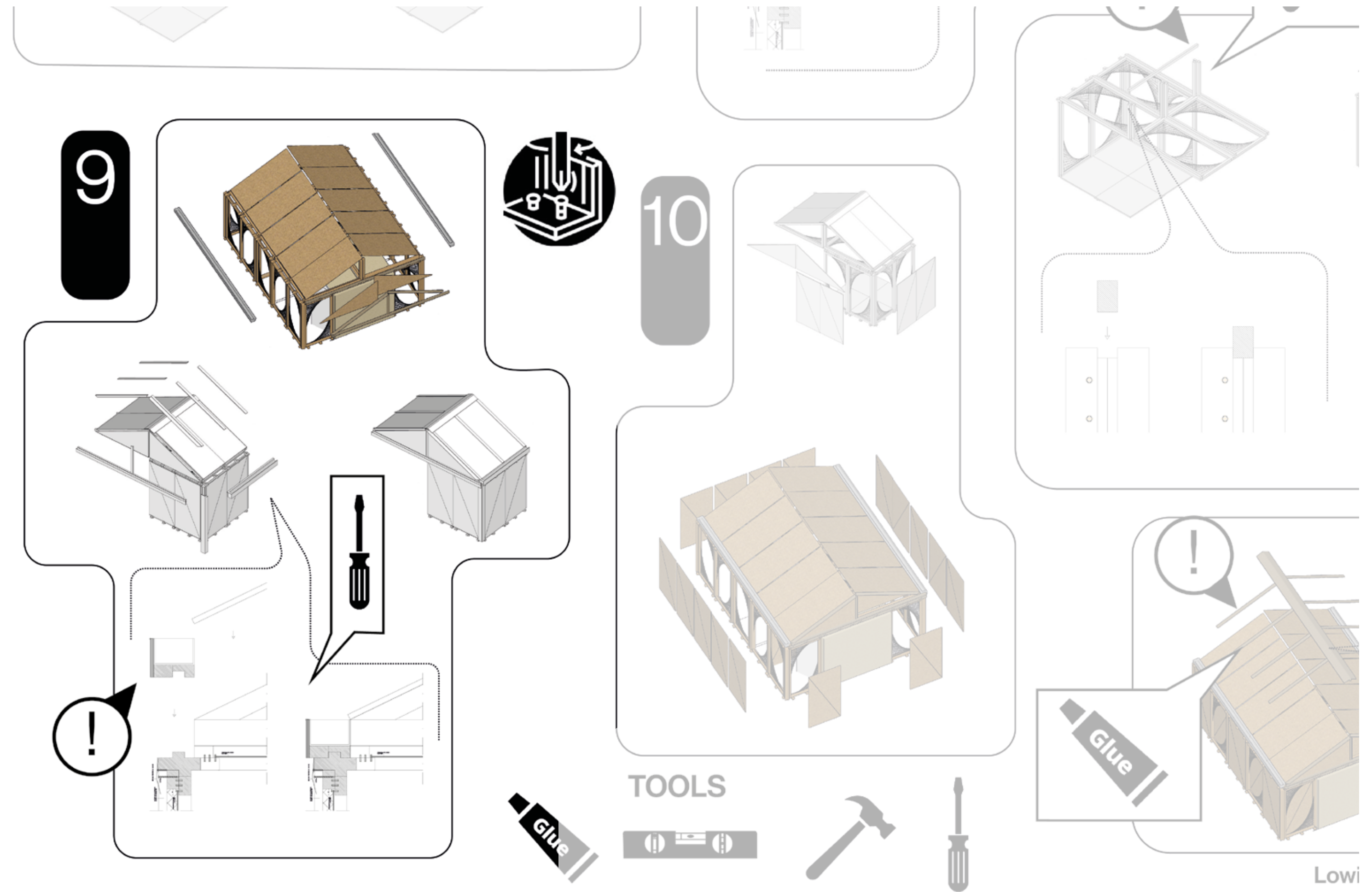




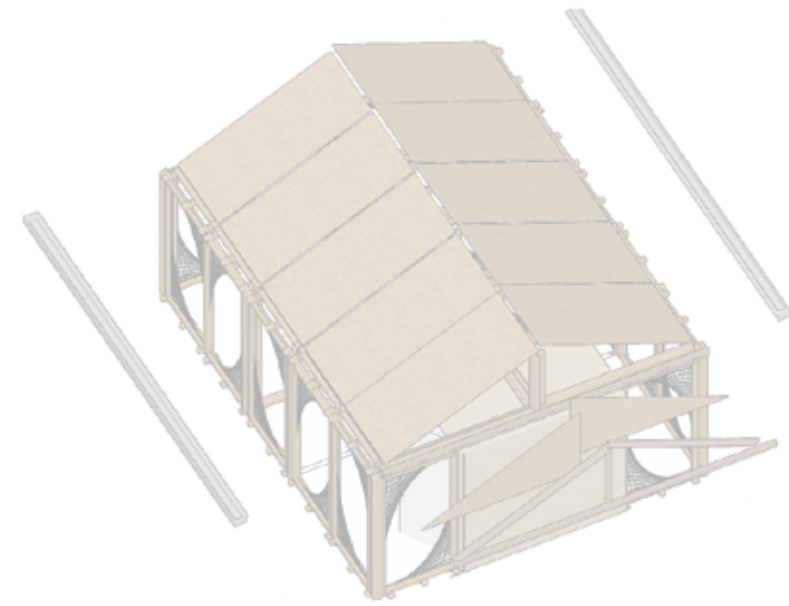




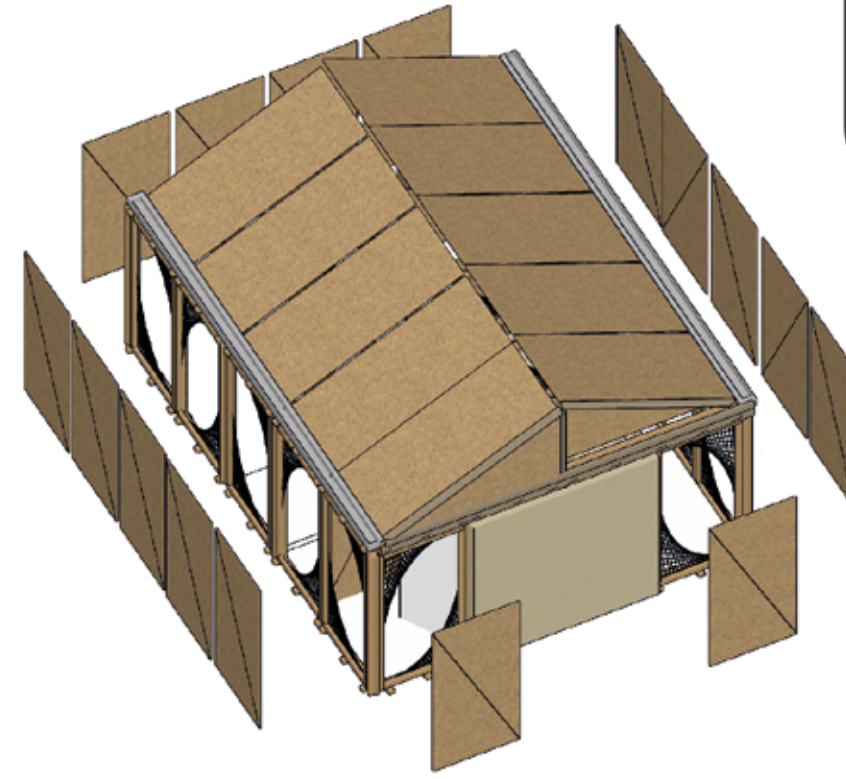
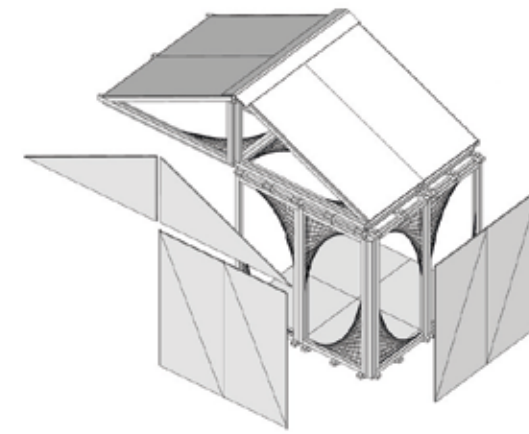




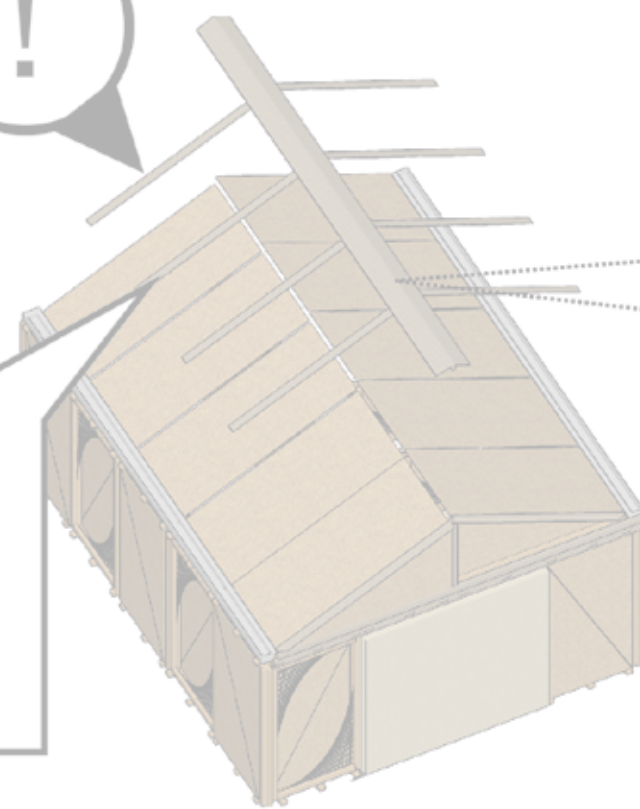
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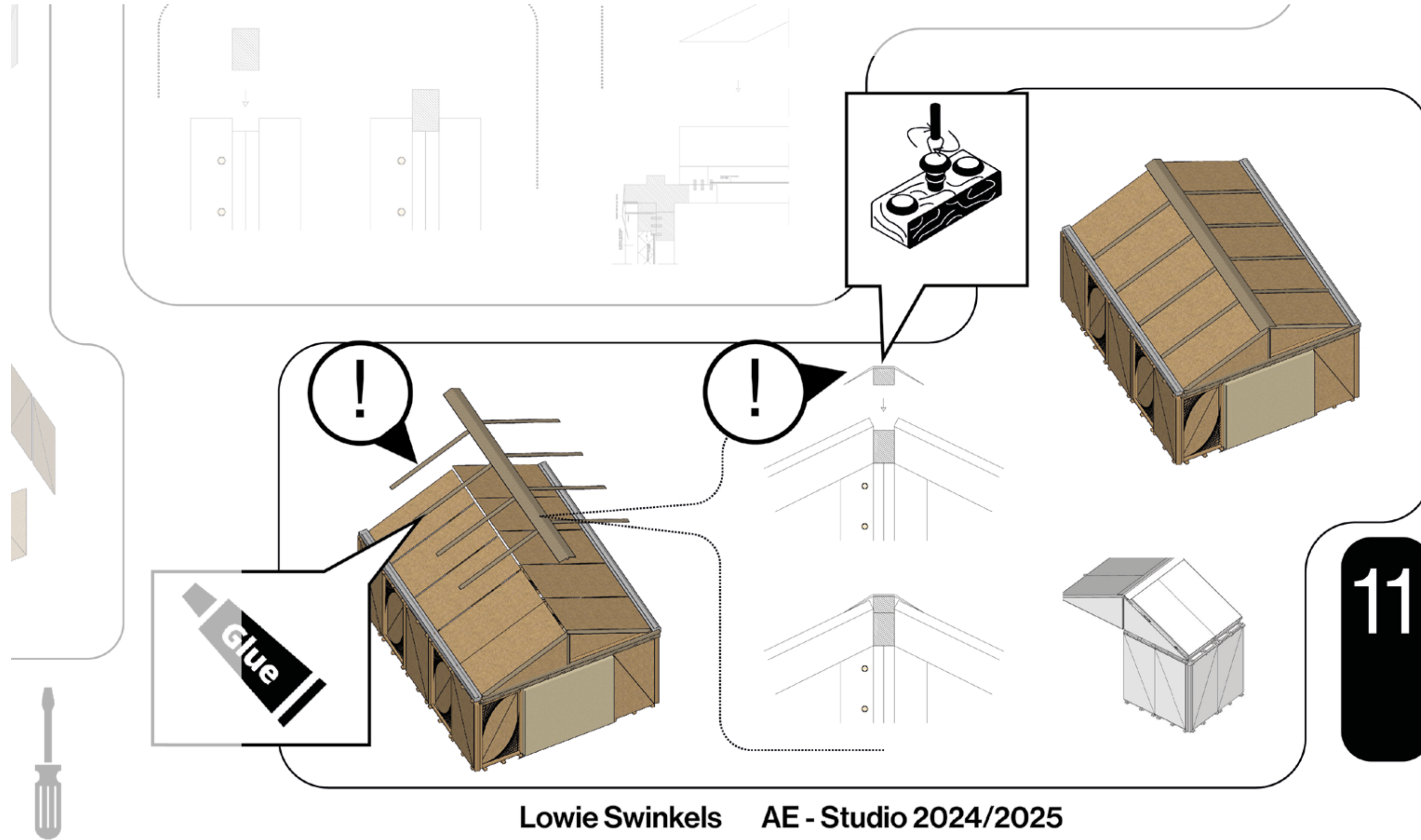


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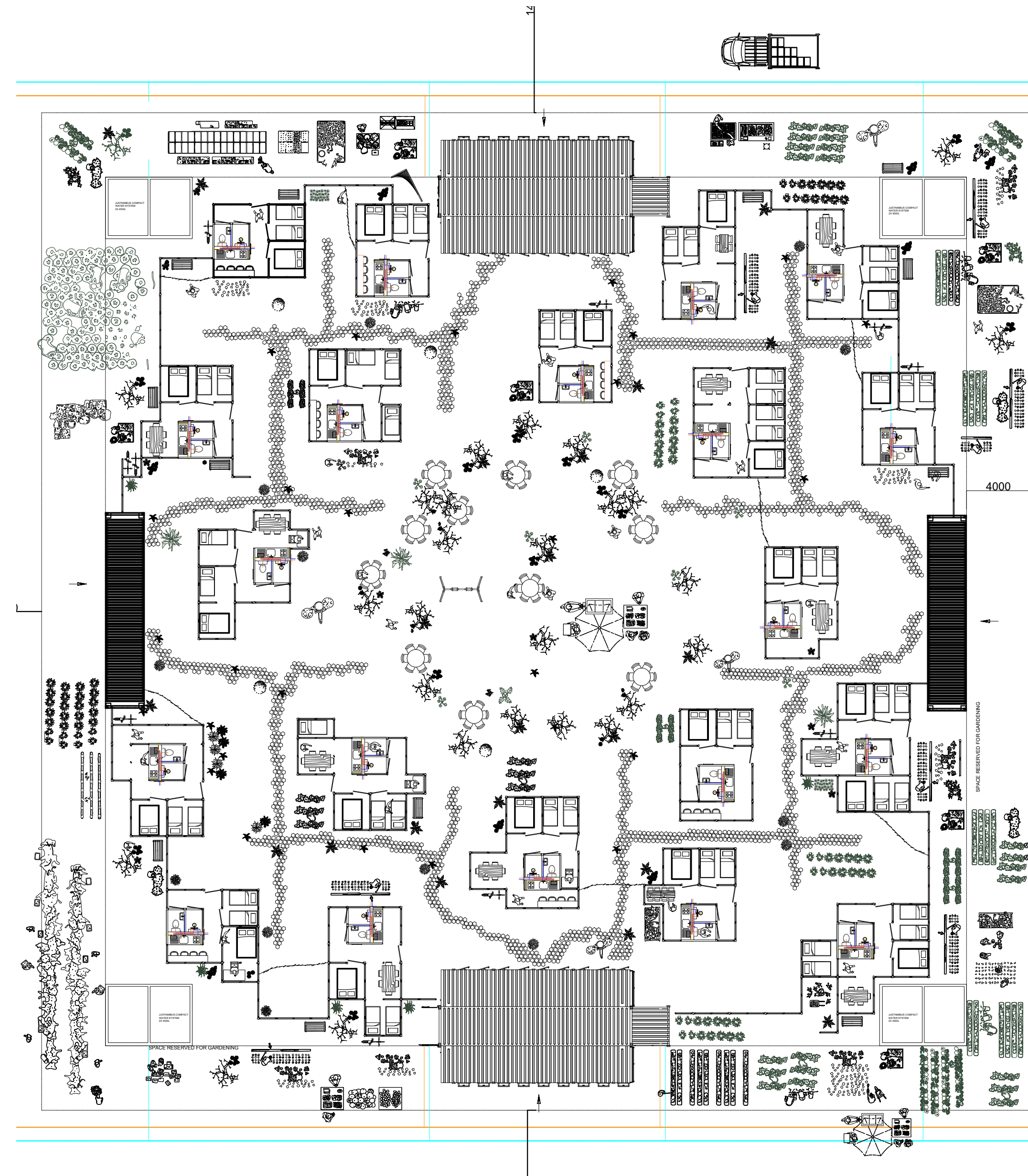
TOOLS

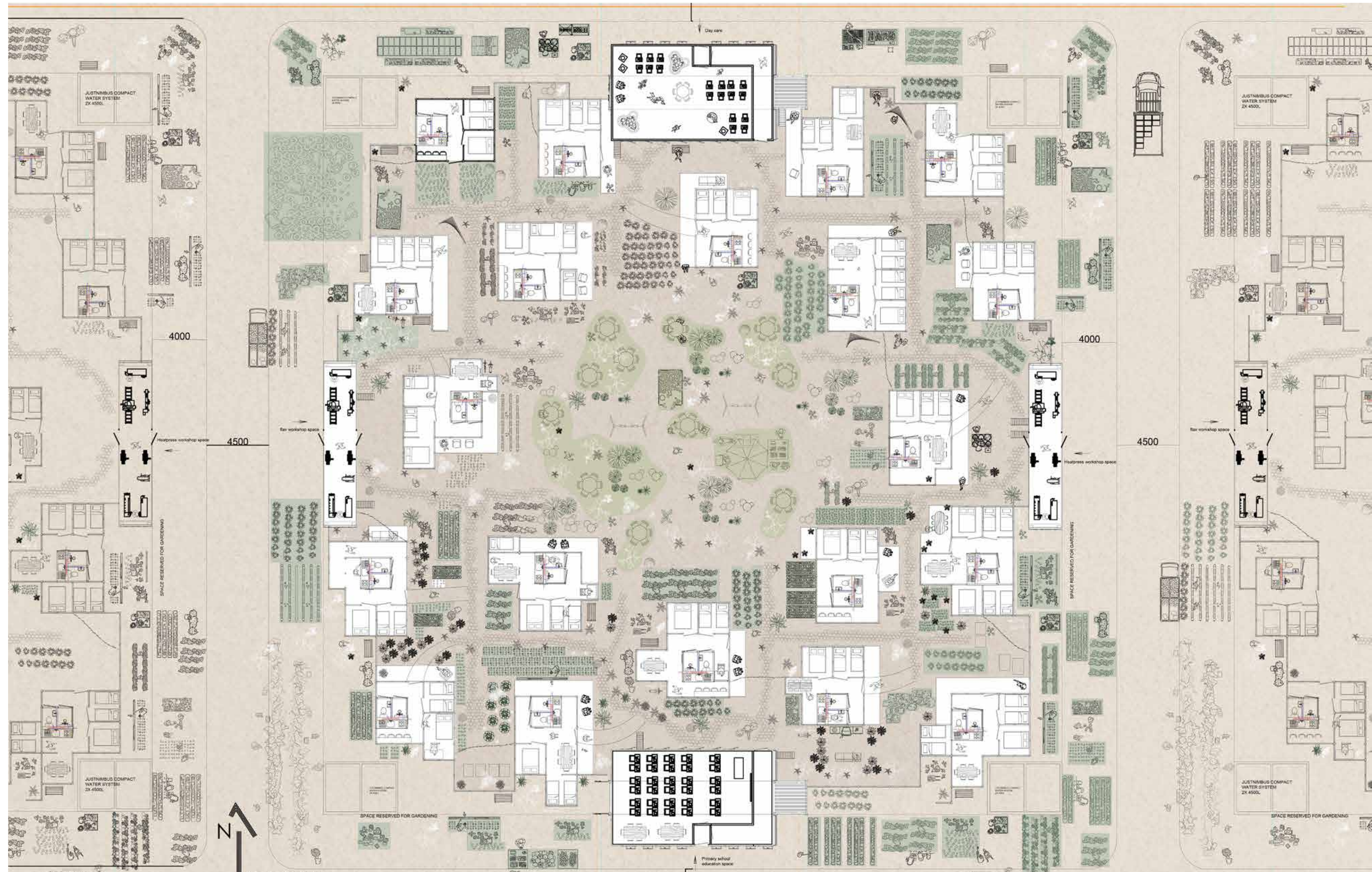


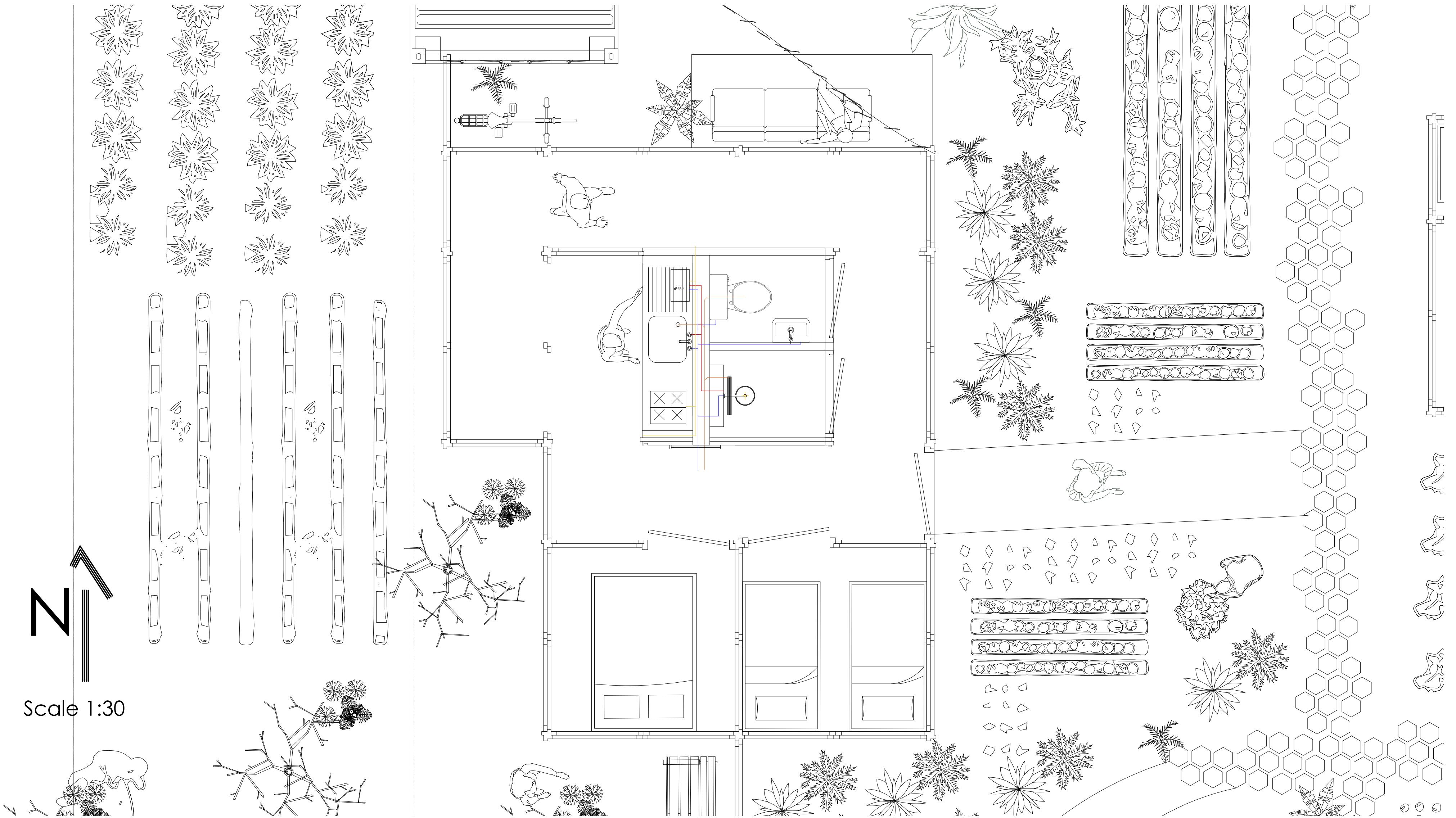


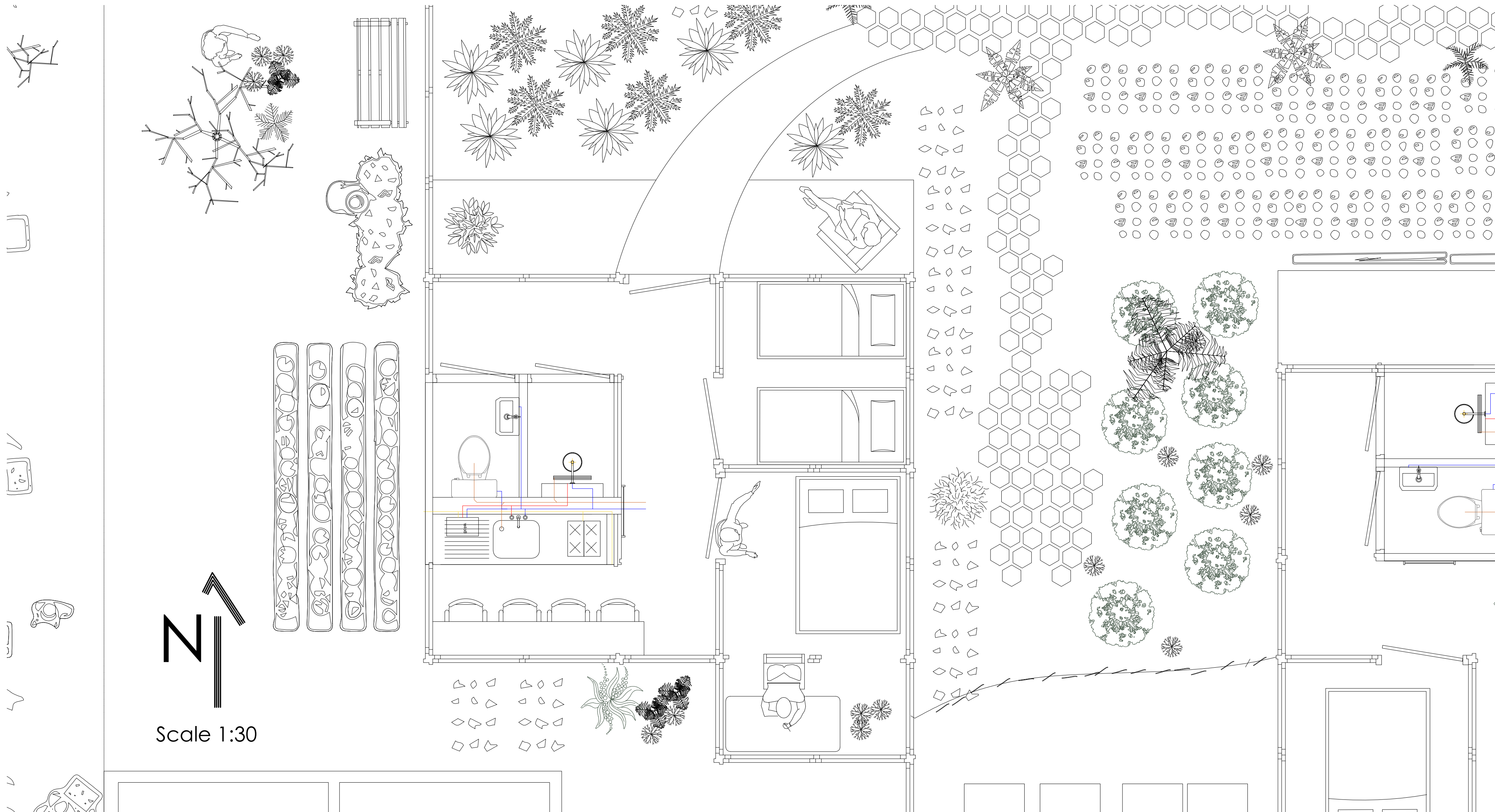
PHASE 4

GROWING | DEVELOPING | WORKING



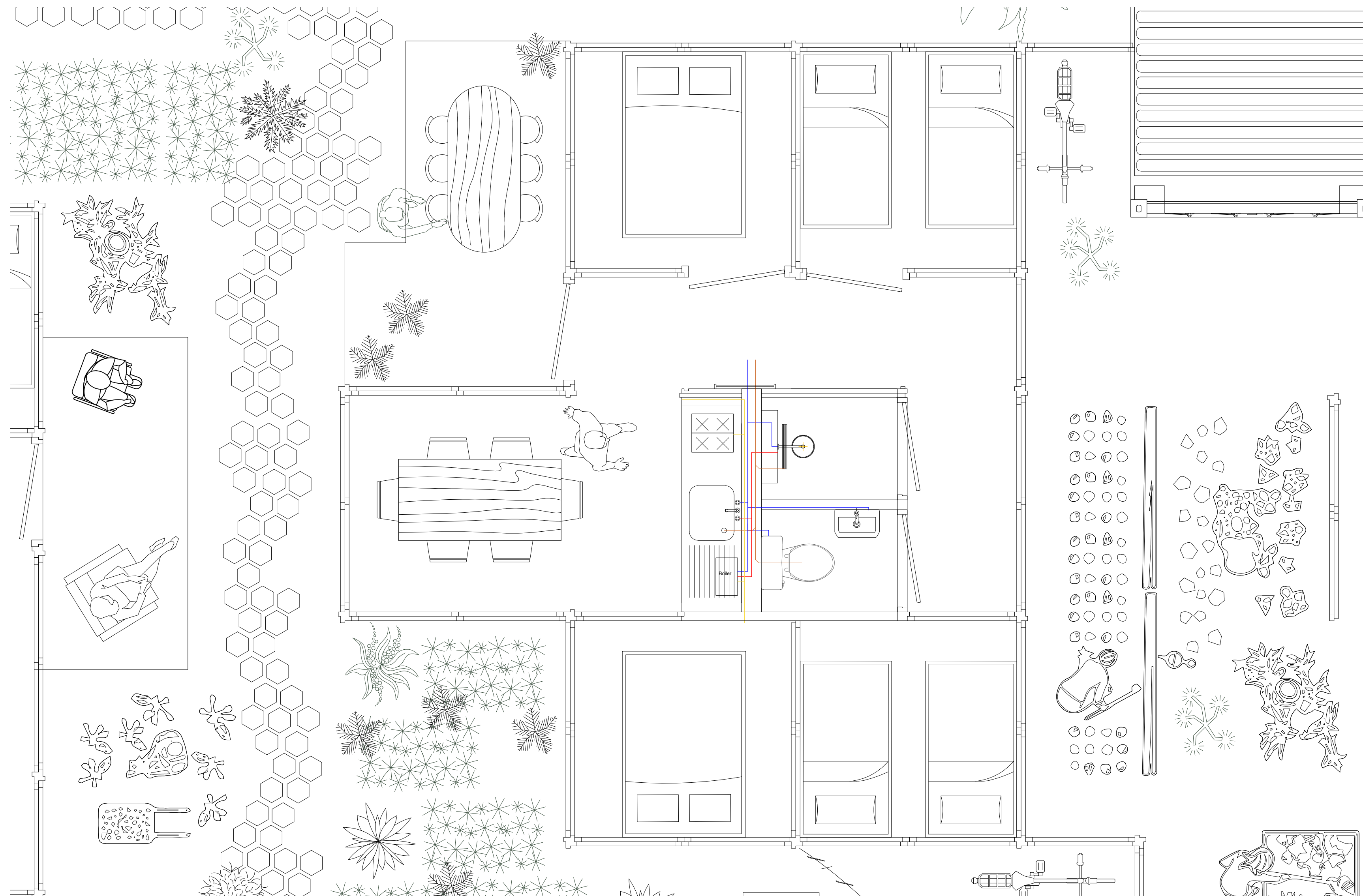


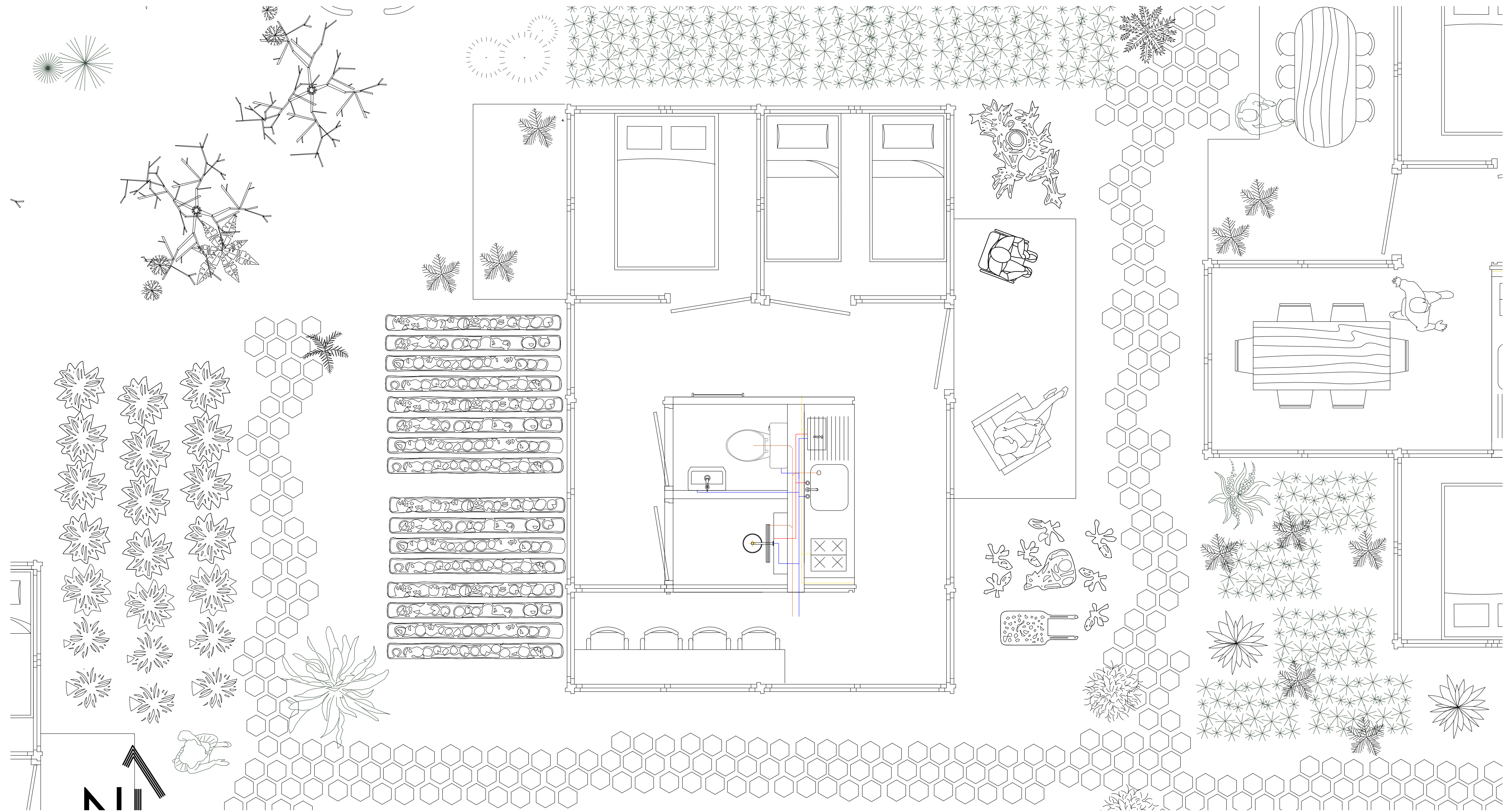




Scale 1:3

SPACE RESERVED FOR GARDENING















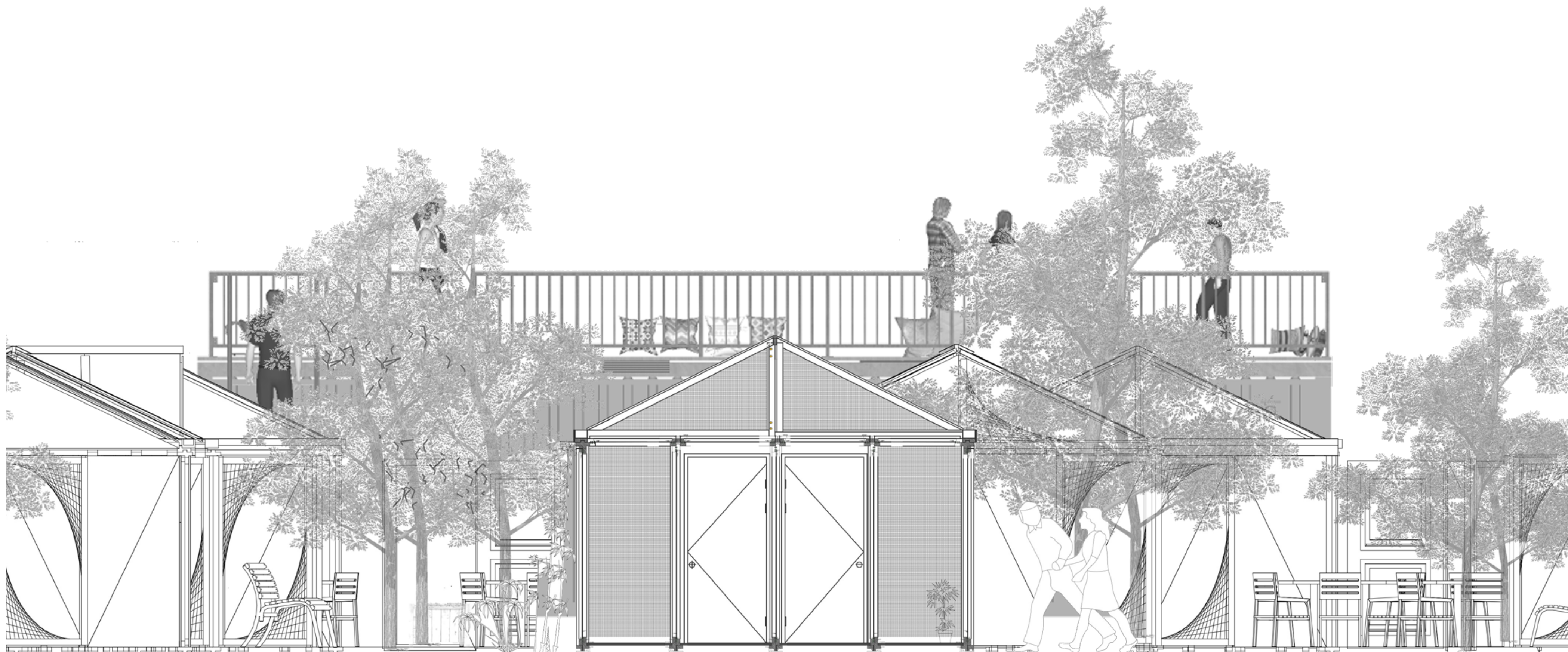




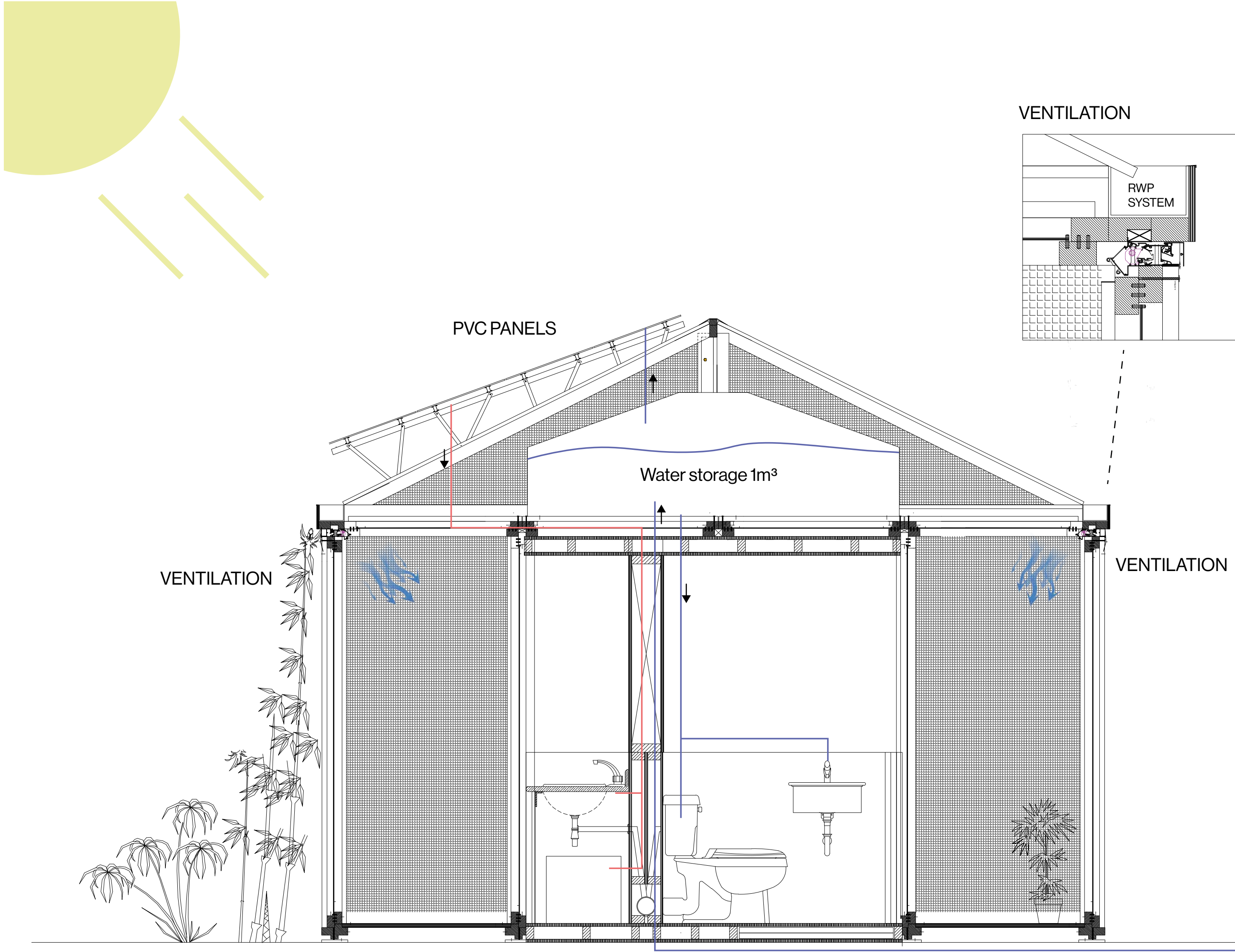
IMPRESSION



ELEVATION/SECTION



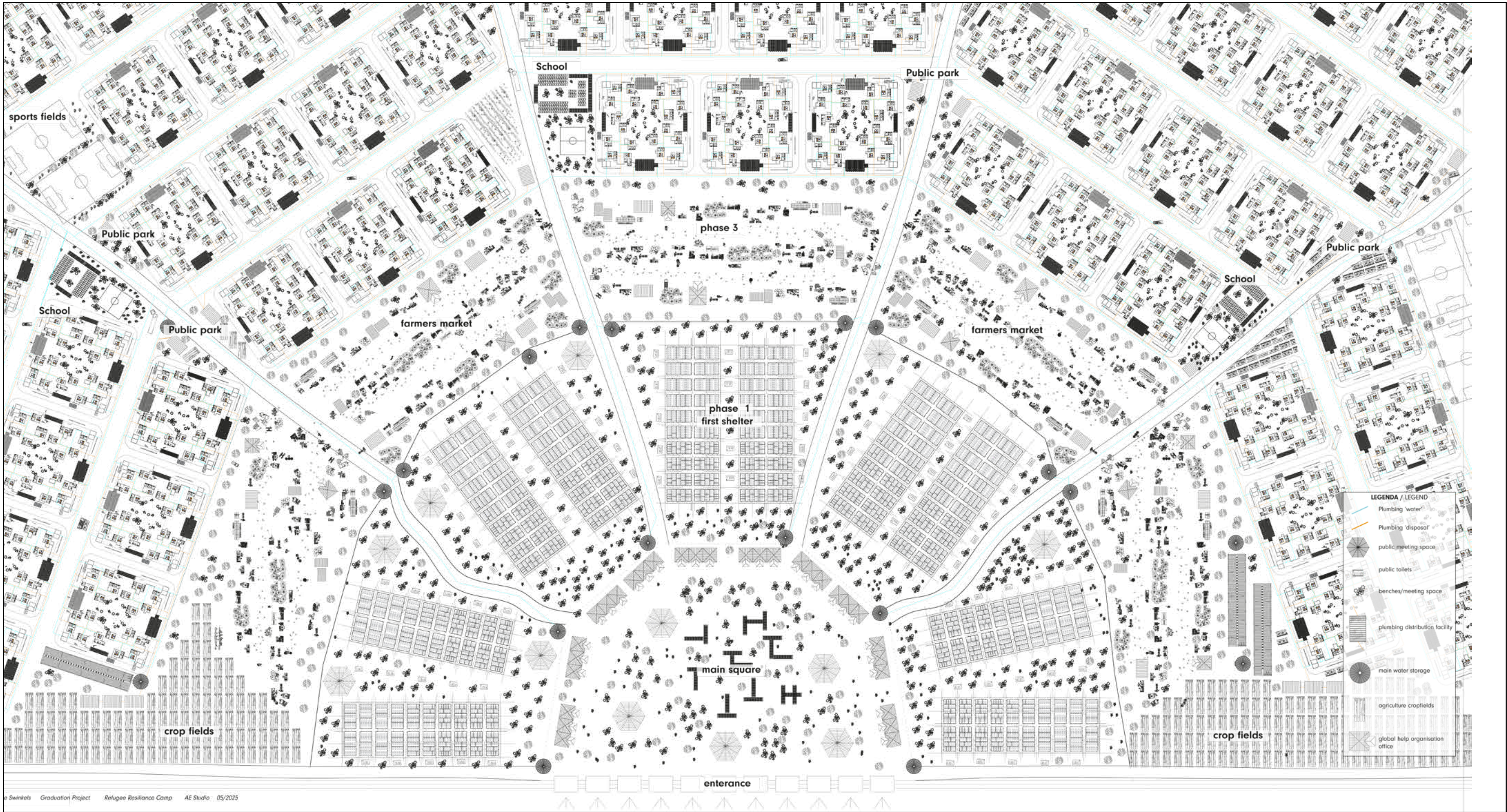
CLIMATE



PHASE 4 'WORKING'



OVERALL CAMP PLAN

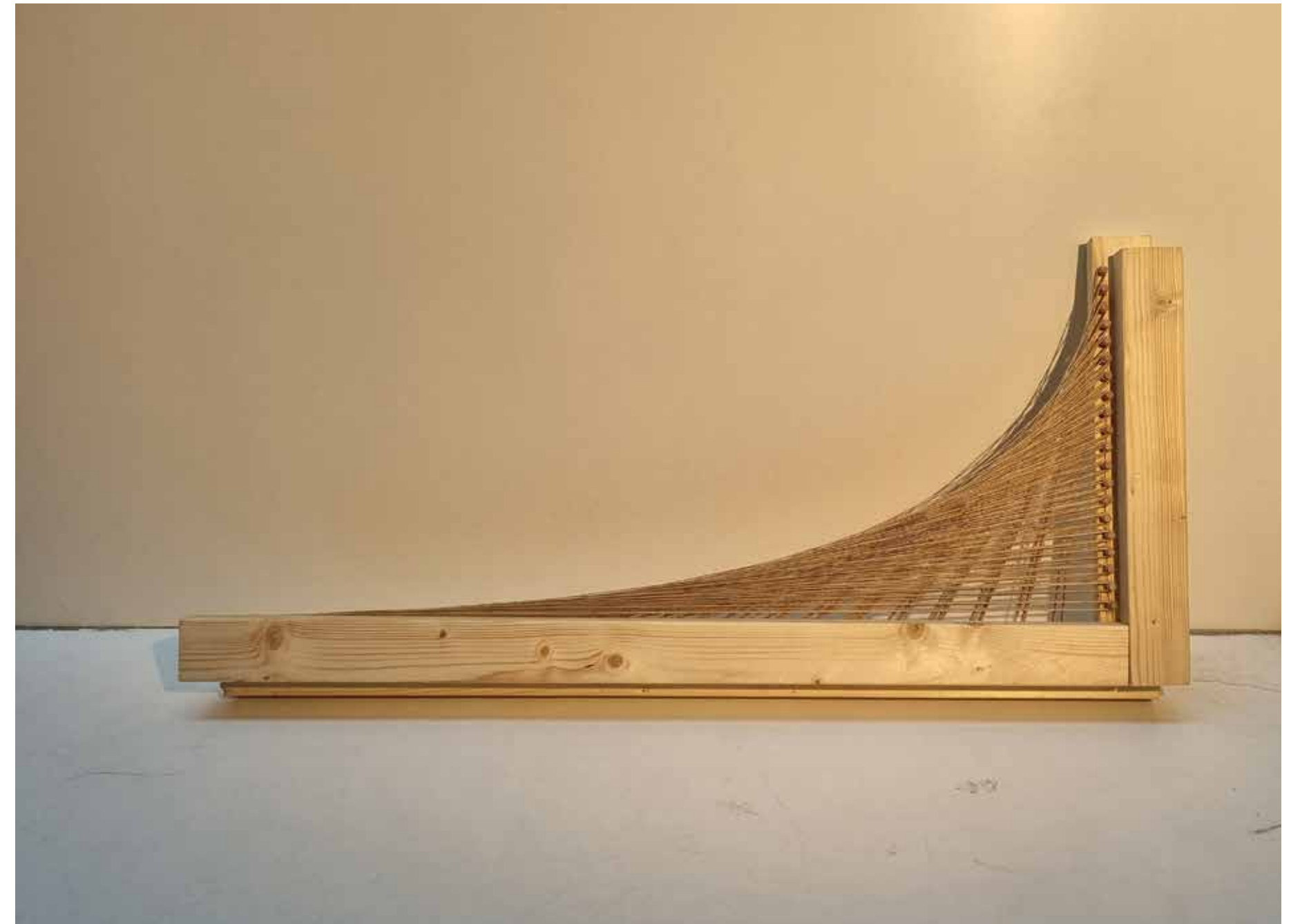




1:2 FLAX MODEL



1:2 FLAX MODEL

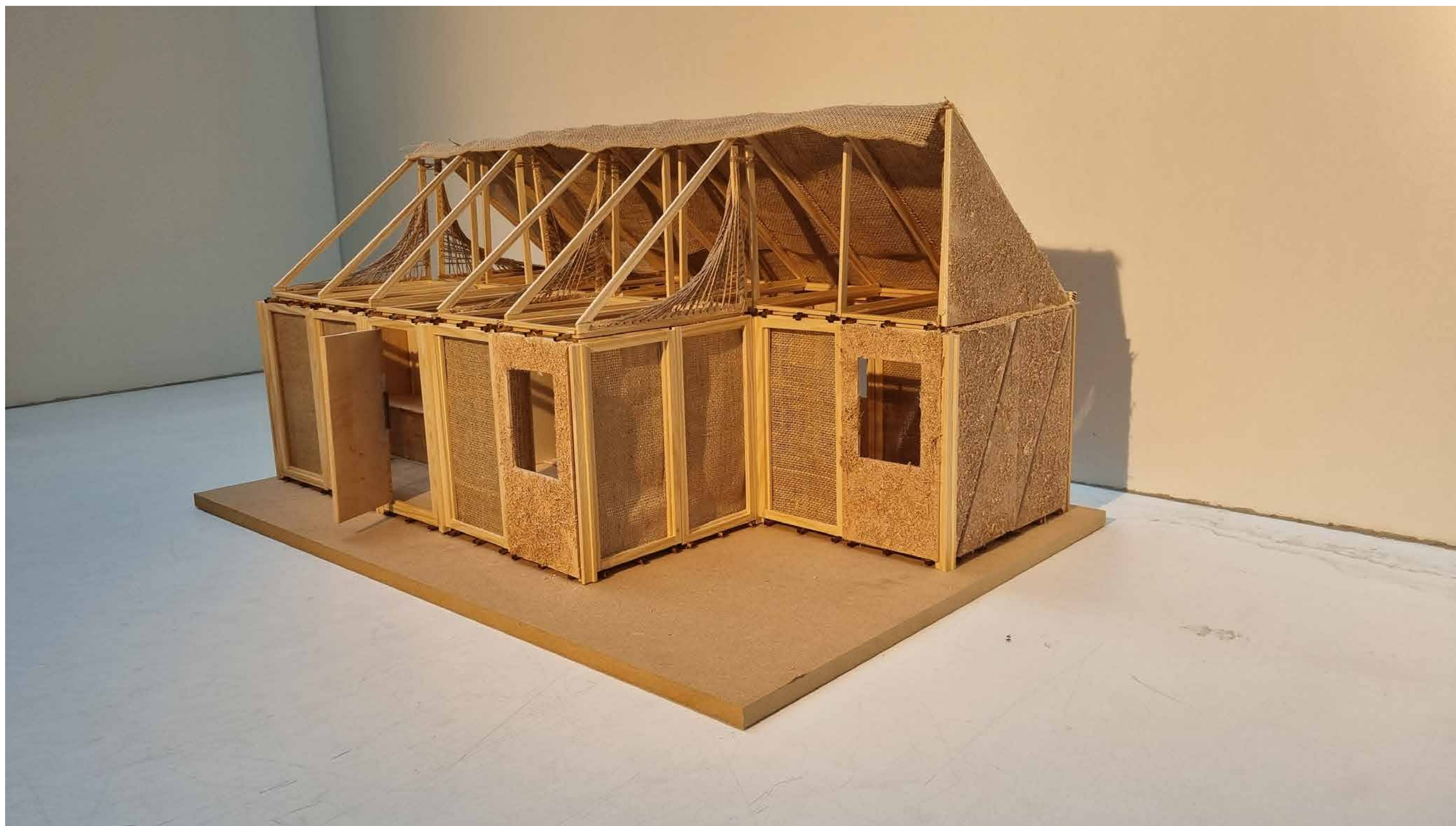


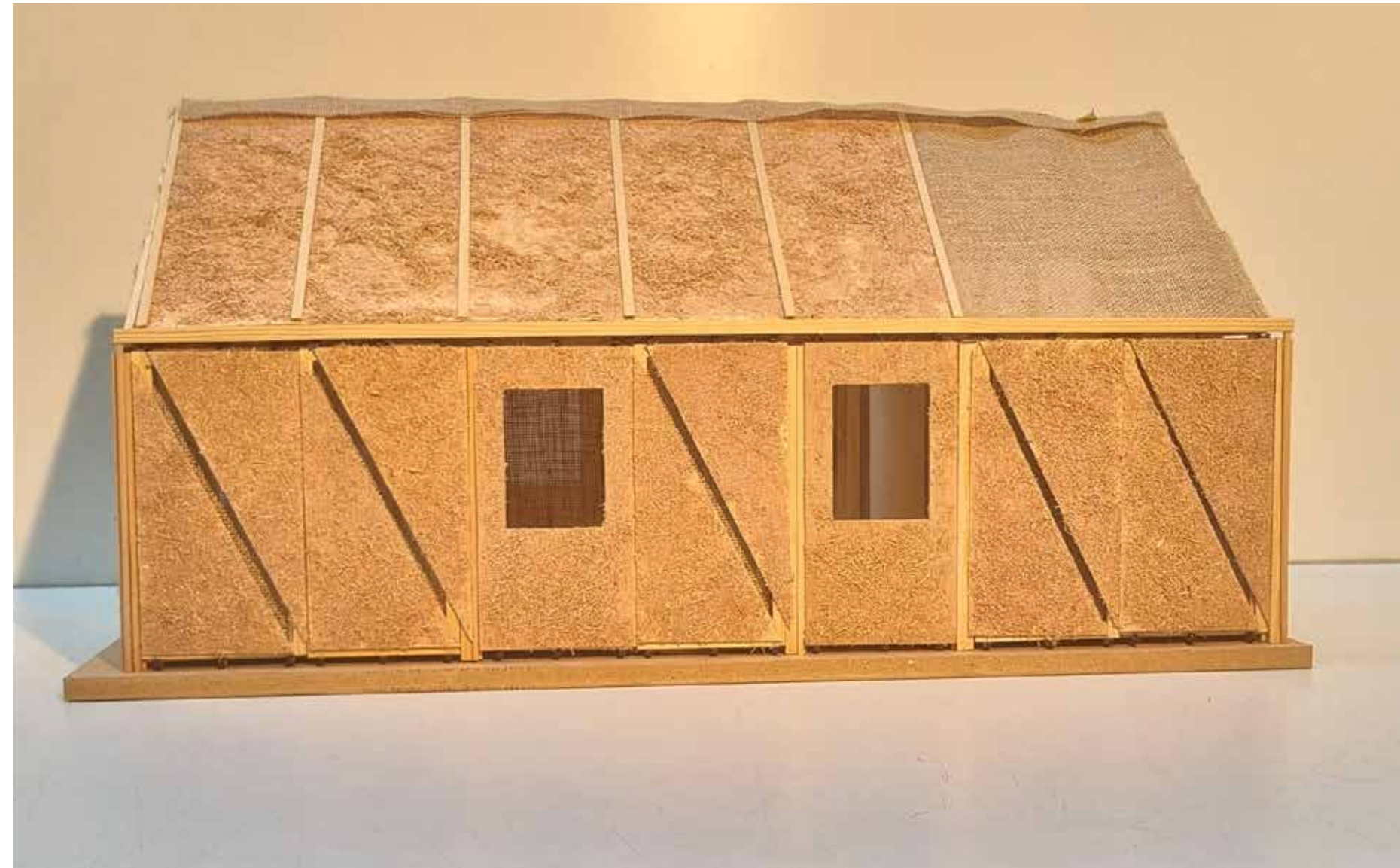
1:2 FLAX MODEL



1:10 MODEL



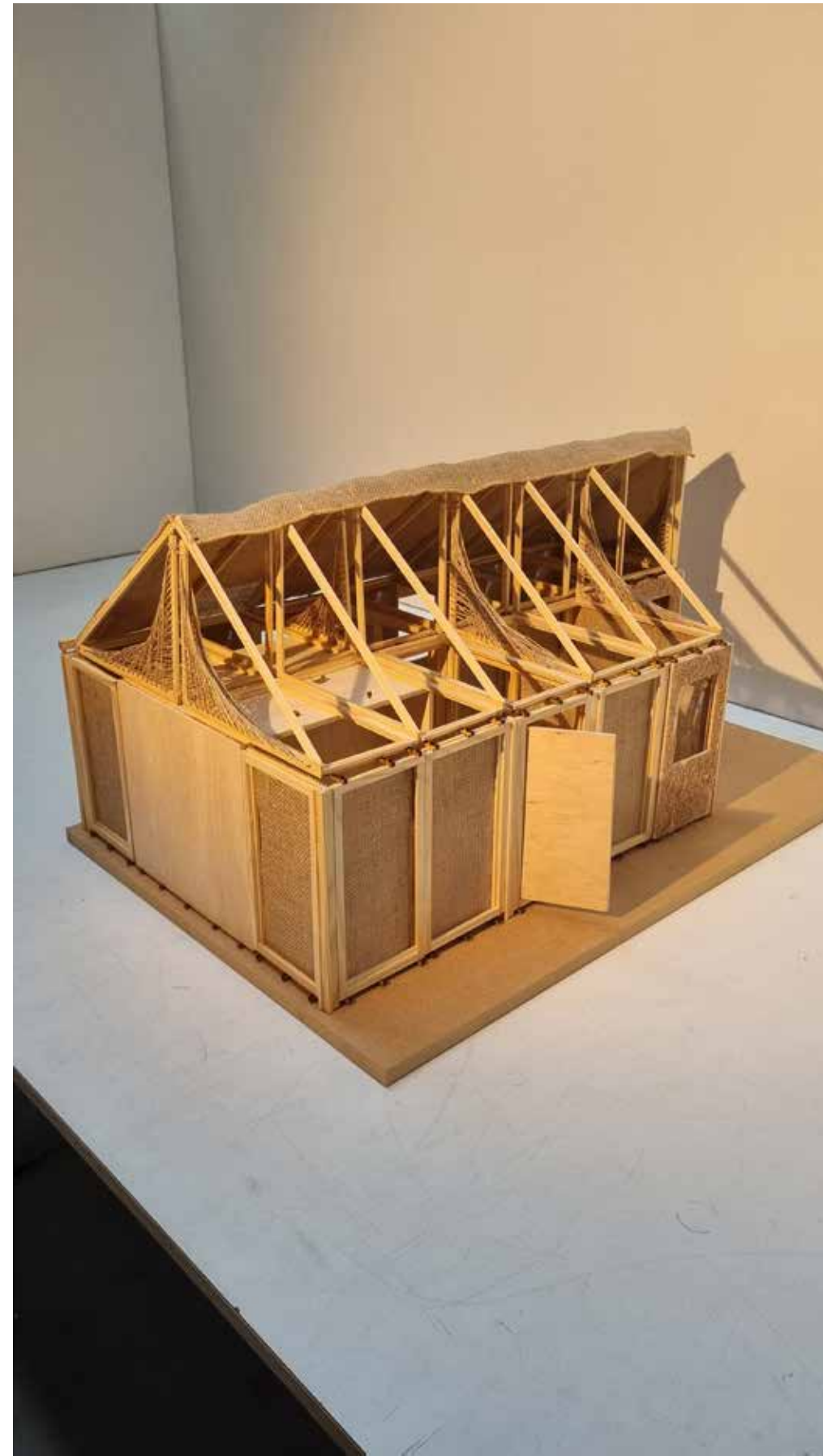






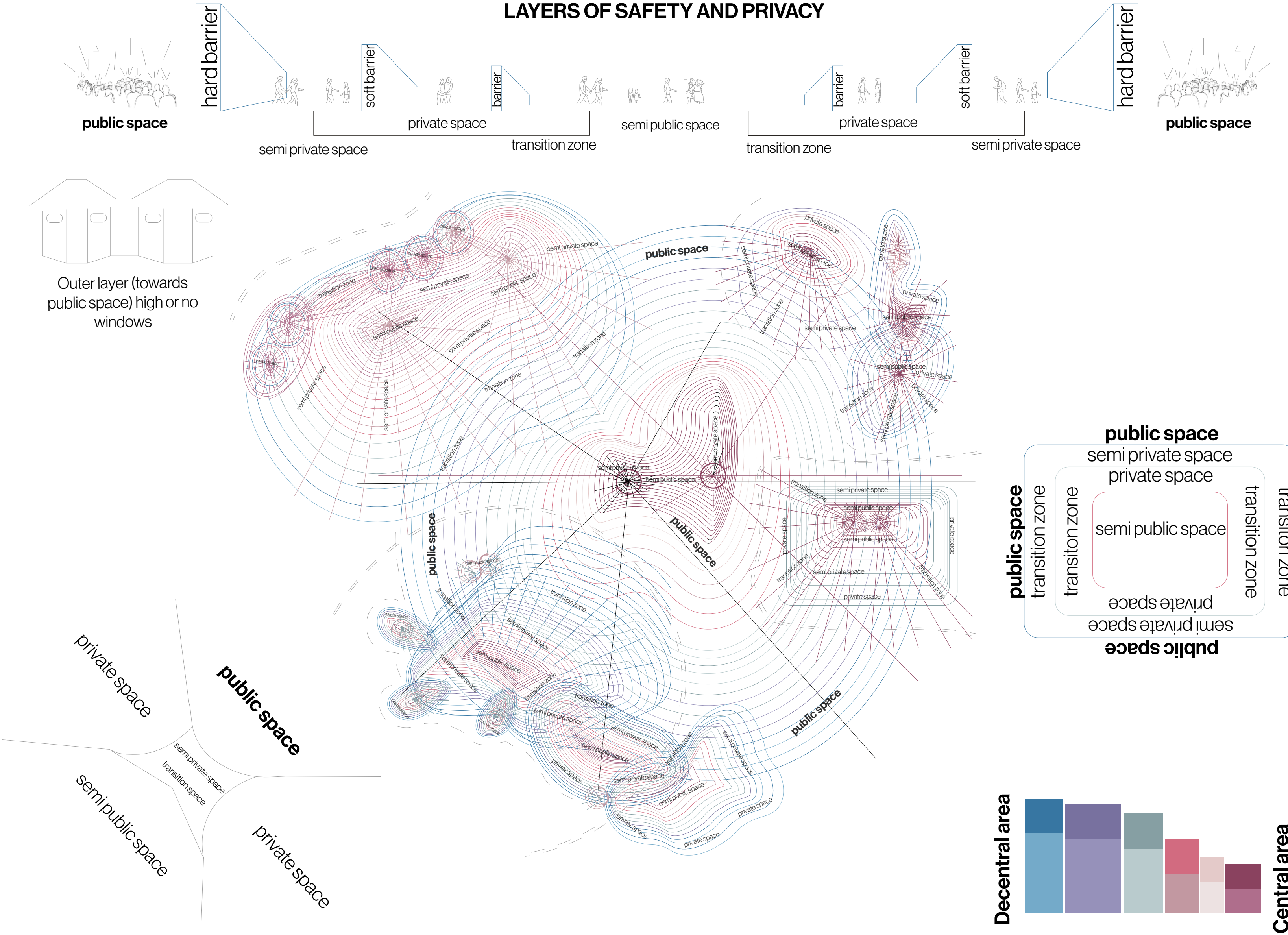








LAYERS OF SAFETY AND PRIVACY



RULES REFUGEE CAMP - UNHCR

| Description | Minimum Standard |
|------------------------|--|
| Covered living area | 3.5 sqm. Per person minimum In cold climates and urban areas more than 3.5 sqm. may be required (4.5 sqm. to 5.5 sqm. is more appropriate) Minimum ceiling height of 2m at highest point |
| Camp settlement size | 45 sqm. per person (incl. kitchen and vegetable garden) |
| Fire Safety | 30 m firebreak every 300 m Minimum 2 m between structures – use 2 times the height of the structure as an appropriate distance. |
| Gradient for camp site | 1 to 5 %, ideally 2 to 4% |
| Drainage | Appropriate drainage needs to be put in place, especially relevant in locations that experience a rainy season or flash floods. |

| Module | Structure | Approximate Number |
|------------|-----------------|--------------------|
| Family | 1x Family | 4-6 persons |
| Community | 16x families | 80 persons |
| Block | 16x communities | 1.250 persons |
| Sector | 4x Blocks | 5.000 persons |
| Settlement | 4x Sectors | 20.000 persons |

| Description | Standard | Further consideration |
|---------------------------------|---|---|
| Communal latrine | 1 per 20 persons - emergency phase | Separate latrine areas for men and women for long-term accommodation use one house hold latrine per family |
| Latrine distance | Not more than 50m from shelter and not closer than 6m | Latrines must be close enough to encourage their use but far enough to prevent problems with smells and pests |
| Shower | 1 per 50 persons | Separate, well drained, shower areas for men and women |
| Water supply | 20 litres per person per day | |
| Water tap stand | 1 per 80 persons | 1 per community |
| Water distance | Max. 200m from household | No dwelling should be further than a few minutes' walk from a water distribution point |
| Rubbish container of 100 litres | 1 per 50 persons | 1 per 10 families |
| Refuse pit 2mx5mx2m | 1 per 500 persons | 1 per 100 families |
| Health centre | 1 per 20,000 persons | 1 per settlement Include water and sanitation facilities |
| Referral hospital | 1 per 200,000 persons | 1 per 10 settlements |
| School | 1 per 5,000 persons | 1 per sector 3 classrooms, 50 Sqm. |

| Description | Standard | Further consideration |
|-------------------------|--------------------------------|---|
| Distribution centre | 1 per 5,000 persons | 1 per sector |
| Market place | 1 per 20,000 persons | 1 per settlement |
| Feeding centre | 1 per 20,000 persons | 1 per settlement |
| Storage area | 15 to 20 Sqm. per 100 persons | Refugee storage |
| Lighting | As appropriate | Consider priority locations such as latrine, wash areas, public service areas |
| Registration area | As appropriate | May include arrivals area, medical clearance, distribution, parking |
| Administration / office | As appropriate | |
| Security post | As appropriate | |
| Security fencing | Depending on the circumstances | |

SITE SELECTION CRITERIA

Site selection criteria:

Topography, drainage, soil conditions

The topography of the land should permit easy drainage and the site should be located above flood level. Rocky, impermeable soil should be avoided. Land covered with grass will prevent dust. Wherever possible, steep slopes, narrow valleys, and ravines should be avoided.

Ideally, a site should have a slope of 2%–4% for good drainage, and not more than 10% to avoid erosion and the need for expensive earthmoving for roads and building construction.

Avoid areas likely to become marshy or waterlogged during the rainy season. Consult national meteorological data and host communities before making a decision.

Soils that absorb surface water swiftly facilitate the construction and effectiveness of pit latrines.

Subsoil should permit good infiltration (permit soil to absorb water and retain solid waste in latrines). Very sandy soils may have good infiltration; but latrine pits may be less stable.

Pit latrines should not penetrate into the ground water. The groundwater table should be at least 3m. below the surface of the site.

Avoid excessively rocky or impermeable sites as they hamper both shelter and latrine construction.

If possible, select a site where the land is suitable for vegetable gardens or smallscale cultivation

Water resources

Choose locations that are reasonably close to an adequate source of good water, and ideally near high ground that has good surface water runoff and drainage. Once located, water sources should be protected. Ideally, no individual should have to walk for more than a few minutes. There should be at least one water point for every 250 people.

Ideally, hydrological surveys will provide information on the presence of water. A site should not be selected on the assumption that water will be found by drilling. Trucking water over long distances should be avoided if possible.

Land Rights

UNHCR neither purchases nor rents land for refugee settlements.

Refugees should enjoy exclusive use of the site in which they live, by agreement with national and local authorities.

Governments often make public land available.

Private or communal land (including unclosed pastoral land) may only be used if the Government has agreed a formal legal arrangement with the owner(s), in accordance with the laws of the country.

The status of land occupied for sites should be clarified in writing by the Government. In association with the Government and host community, agree and clarify the entitlement of refugees to carry out given activities (forage for food, collect firewood, collect timber and other shelter materials such as grass or mud, gather

Accessibility

Ensure the site has an adequate road infrastructure; access to it should be reliable, including during the rainy season.

Assess the site's proximity to national services, including health facilities markets and towns. Access to mainstream services is encouraged wherever possible and avoids the need to develop parallel services for the camp population.

Liaise with development agencies, including UNDP and related Government ministries, to secure improvement of access routes.

UNHCR should fund the cost of building short access roads connecting the site to the main road.

Security

The site should be located a sufficient distance from international borders (50km), conflict zones, and other potentially sensitive areas (such as military installations). Avoid locations that experience extreme climatic conditions, or present evident health (malaria), environmental or other risks.

High winds can damage temporary shelters and increase fire risks.

Evaluate seasonal variations. Sites that are ideal in the dry season may be uninhabitable in the rainy season.

Avoid locating refugees in places whose climate differs greatly from that to which they are accustomed.