

HOUSING FOR THE TEA GARDEN COMMUNITY

Architecture of Transition in the Bandlagesh Delta

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HOUSING FOR THE TEA GARDEN COMMUNITY

Global Housing Graduation Studio 2024/2025

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Figure 1

GENERAL PROBLEM

The existence of social inequality and minorities is a global phenomenon, which has historically resulted in the formation of segregated social structures. The term ‚segregation' is used to describe the unequal spatial distribution of population groups, whereby a particular group may be concentrated in a specific area while appearing less frequently in other locations.[1] The issue of social exclusion is a global phenomenon that has become a concern for many countries.[2] The three principal forms of segregation are ethnic segregation, spatial segregation, and social segregation, which are inextricably linked.

In the historical development of numerous countries, social segregation has been a consequence of ethnic and spatial segregation. It is evident that the majority of segregated individuals are from socio-economically disadvantaged backgrounds or have a migration history. In numerous European countries, the United States or Bangladesh, the phenomenon can be traced back to the migrant workers and immigrants who required housing.In order to accommodate the migrant workers, for example, public housing estates were constructed in Europe or in the United States, as well as workers' camps in the tea gardens in Bangladesh.[4] The locations of these accommodations are typically poorly served with regard to the availability of public facilities, transportation, and commercial establishments. The aforementioned developments resulted in the formation of neighbourhoods characterised by concentrated poverty and a high degree of racial and ethnic diversity. This has led to the creation of spatial segregation between the working class and the urban population.[5] In addition to the inadequate public facilities, there is a lack of accessibility to job opportunities and educational institutions.[6] The subsequent consequence of the isolation and ethnic segregation was the emergence of social segregation.

1 Boschmann et al., Mixed Neighbourhoods, 135
2 Calavita and Mallach, Inclusionary Housing in International Perspective, 5-6
3 Md Nazrul Islam & Md Al-Amin,Life behind leaves, 578
4 Fuster-Farfán et al., Social mix or social integration
5 Calavita and Mallach, Inclusionary Housing in International Perspective, 6
6 Galster, Neighbourhood Social Mix, 19, 20

Figure 1: "Mumbai." n.d. Unequal Scenes. Accessed June 26, 2025. https://unequalscenes.com/mumbai.



IN BANGLADESH

A similar dynamic can be observed in Bangladesh, where there is a pronounced segregation between different communities and religions. The historical experience of religious minorities in Bangladesh has been characterised by discrimination and segregation. The largest religious minority in Bangladesh is the Hindu community, which represents 8.5 per cent of the total population.[7] With the partition of the Bengal province of India in 1905, the Hindu population became a minority in the predominantly Muslim eastern area. This demographic shift was met with considerable approval by the Muslim population, who perceived it as a political, social, and economic advancement that would benefit them. However, the Hindu population was subjected to particularly intense targeting during the Liberation War. This was due to the accusation of the secession, which resulted in a series of targeted executions, sexual violence and other human rights violations. Today, Hindus continue to be attacked, marginalised and discriminated against.[8] They often live isolated in remote rural settlements or segregated in urban colonies and are excluded from many areas of employment.[9]

7 Minority Rights Group International, Under threat, 3,7
8 Minority Rights Group International, Under threat, 7
9 Minority Rights Group International, Under threat, 9



TEA GARDEN COMMUNITY

An example of these excluded groups living apart from the wider population is the tea garden community. A total of approximately 360,000 labourers are employed in the gardens, since Bangladesh is a significant global exporter of tea, with 164 tea gardens.[10] This group is among the most impoverished and marginalised in the population, with the majority of them belonging to the Hindu community.[11]

The lack of access to employment, education, socio-cultural activities and government services experienced by tea garden communities in Bangladesh as a result of exclusion makes it challenging for individuals to leave these communities.[12]

The tea garden workers earn just €1.50 a day, which is not enough to feed the whole family.[13] In addition to the salary, permanent workers are provided with a plot of land and a single room for their family. The free accommodation is an essential resource, as their income is often insufficient to cover housing costs. However, the quality of the neighborhoods often does not meet the needs of the inhabitants, due to their size, lack of sanitation and the quality of the housing. [14]

10 Md Nazrul Islam & Md Al-Amin, Life behind leaves, 571
11 Al-Amin et al., Social Exclusion & Poverty,21
12 Al-Amin et al., Social Exclusion & Poverty,21
13 Md Nazrul Islam & Md Al-Amin,Life behind leaves, 583
14 Md Nazrul Islam & Md Al-Amin, Life behind leaves, 576



LAKKATURA TEA GARDEN COMMUNITY

Most tea gardens in Bangladesh are located in rural areas. However, there are some tea gardens that are closer to the city. One such garden is the Lakkatura Tea Garden in Sylhet. The garden and the housing of the tea garden communities act as a transitional zone between the urban and the rural. This, compared to most tea gardens, gives them the opportunity to be more closer to city life.

The population of the Lakkatura tea garden is divided into two distinct communities, one of which is Hindu and the other Muslim. The Hindu community constitutes a smaller part of both and is situated closer to the gardens.

There are only a few houses, and these are of a good quality with fairly large courtyards. However, the Hindu community is constrained in their employment opportunities, primarily limited to tea gardens, due to language and religious barriers. This situation is further compounded during periods of salary shortages, as these communities lack
alternative sources of income.
The Muslim community is located to the east of the Hindu community. While there is no significant difference in size of the site, the density is considerably higher.

The population of the Lakkatura tea garden is increasing due to its proximity to the city. Its location provides employment opportunities, particularly for Muslims, outside the garden, including jobs as CNG drivers, private drivers and rickshaw puller. Consequently, the garden is an attractive place for the relatives of the wokers to live in. However, the area is already highly densely populated, which limits the possibility for further expansion and results in overcrowding in the houses.

Furthermore, some of the workers requiring accommodation were placed on the hilltop due to spatial constraints, thereby increasing the risk of landsliding. The workers have expressed concerns regarding the safety of children walking along these steep paths, and they also face difficulties in transporting resources.

The density of the housing development has a significant impact on the level of privacy available to residents, both within their own homes and in outdoor areas. In some cases, the creation of a courtyard, an important space for this community, is not feasible, thereby reducing the quality of life and the security of children wanting to play outside. In the event of illness, the overcrowding in the house makes it impossible to maintain a distance from other family members.

The quality as well as the density of housing has been found to have a negative impact on the living conditions of the inhabitants.

01 research

02 methodology & research question


UN Multi-Partner Trust Fund Office

NEWS

Exploited and marginalized, Bangladeshi tea wo

Tea garden workers in Bangladesh, who are mainly women, are one of the most marginalized groups in the country, with limited access to education for their children and prone to dire health risks. A programme supported by the UN's Joint SDG Fund, which funds initiatives focused on sustainable development, aims to boost social protection for these works, helping them access their rights and

"During my pregnancy, my family planned to help me deliver my baby at home, following in the footsteps of m
there were alternative, safe methods of childbirth delivery, in health care facilities with clinical specialists."

"My husband, Sunil, is also a tea garden worker, and we were never introduced to modern medicine or midwi

Deep-seated challenges

Ms. Munda's story is an example of the health challenges faced by tea workers, most of whom have more thar
planning services. However thanks to the programme, couples can improve their knowledge and take advant

"One day, I participated in an awareness session, which is where I learned about prenatal care, birth planning,
the information with my husband and family, we decided to seek health care from a secure clinic.

"As a result, I visited the facility for prenatal care, and they made me aware of what to expect and how to tend

"During the delivery, I was aided by a tea garden volunteer who transferred me to a health facility where I deli
strong advocate for the Rajghat tea garden maternal health care for all expecting mothers, so they know they

Approx. 360,000 workers and their families in 166 commercial tea gardens, especially women and girls who r

Figure 2

articles
literature



photographic
and videographic
documentation



interviews

METHODOLOGY

Literature Review

The initial phase of the research constitutes a literature review, the objective of which is to identify preliminary information regarding tea garden workers in Bangladesh. A number of reports by NGOs have been published on the living conditions, working conditions and social exclusion of these workers. In addition, there is literature concerning the history of the workers and the factors that led to their migration to Bangladesh. The literature review thus facilitates the identification of research gaps and the extent of existing studies.

Ethnographic research and fieldwork

However the informations available in literature and online is severely limited. Consequently, the central investigation of the daily lives of the workers and architectural and urban patterns will be conducted through ethnographic research conducted on the field trip. The data will be documented through the use of video and photographic methods. In order to redesign and improve the tea garden workers' accommodation and neighbourhood, it is first necessary to gain an understanding of the workers' needs. This can be achieved through ethnographic research, which involves conducting interviews and surveys. The objective is to ascertain which spatial patterns should be retained and which additional spatial needs the workers have. The findings of this study will serve as the basis for the design of a housing solution for the workers employed in the tea garden.

Figure 2: United Nations Development Programme, "Exploited and Marginalized, Bangladeshi Tea Workers Speak Up for Their Rights."

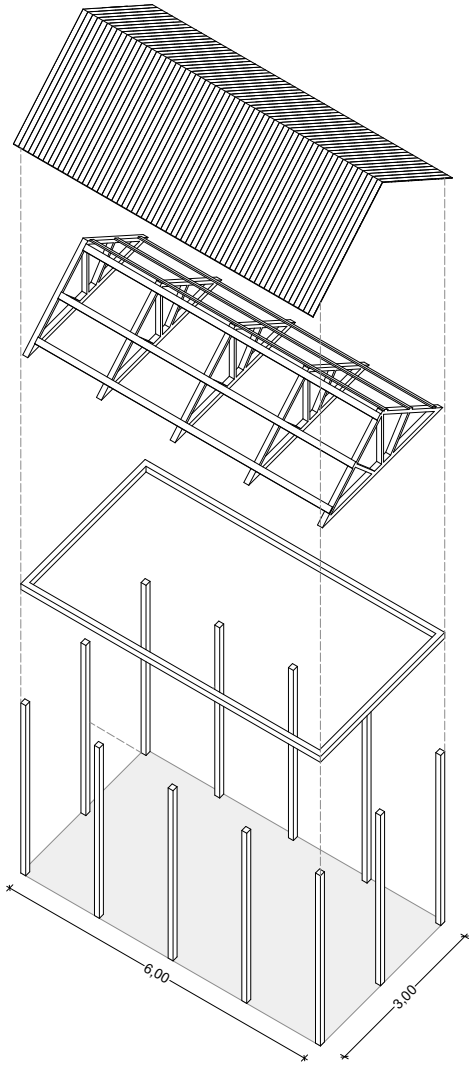

ভাড়া দেয়া হয়।

RESEARCH QUESTION

how can strategies for housing densification be designed
to preserve spatial and social structures
of tea garden communities?

01 research

03 analysis & ethnographic research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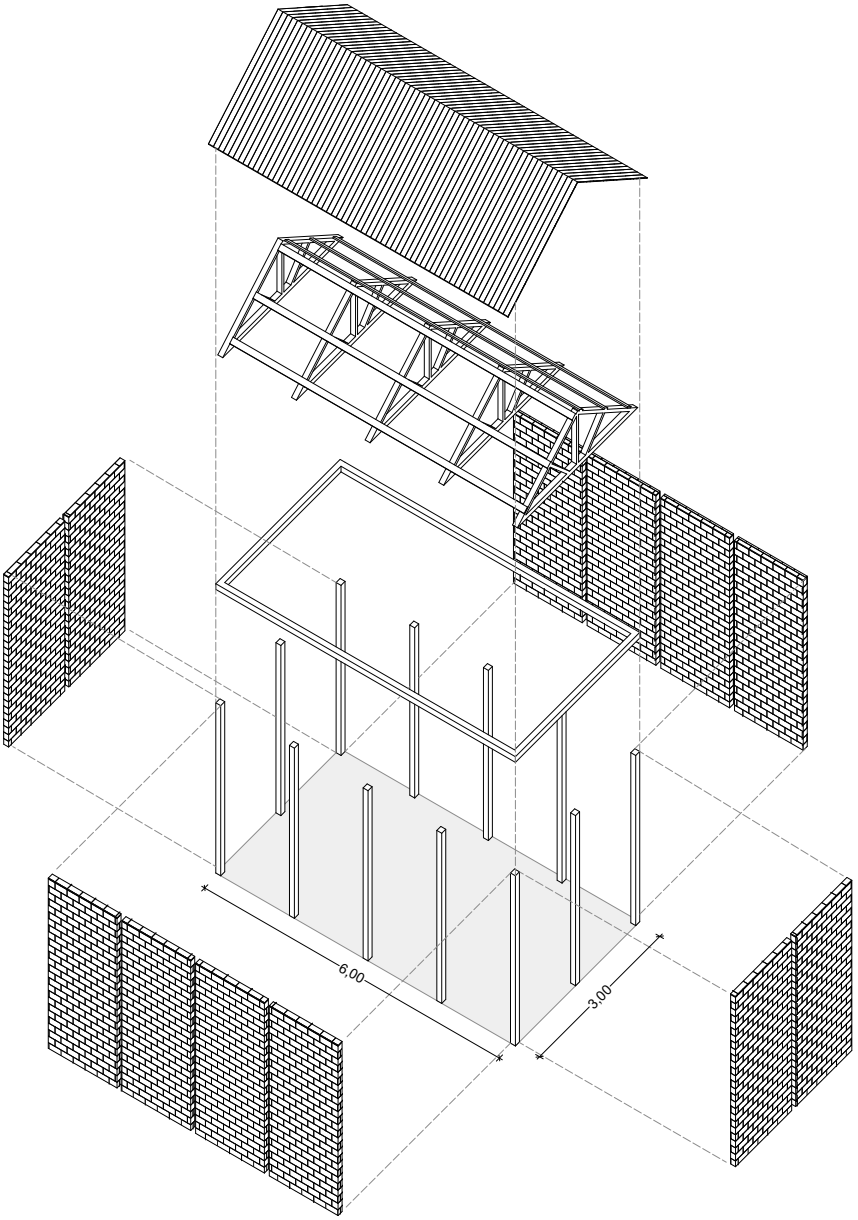
HOUSING

As permanent tea garden workers, families are provided by the tea garden company with a basic structure consisting of concrete columns and a wooden frame for the roof. Each family is allocated one plot, with a structure measuring 3 meters by 6 meters (18 square meters). However, the cladding for both the roof and the walls must be purchased and constructed by the families themselves.

The most commonly used material is corrugated metal sheeting, primarily due to its affordability. Despite its low cost, this material poses significant drawbacks: it causes excessive heat buildup inside the dwelling during the summer months and is prone to leaking during the rainy season. Some families who can afford a higher investment opt for brick walls, which offer greater durability and weather resistance, though at a substantially higher cost.

In tea gardens with predominantly Hindu communities, many families construct their homes with mud walls. Mud provides excellent thermal comfort in the hot season but lacks resistance to rain. As a result, mud houses require frequent maintenance, including the regular reapplication of mud to maintain structural integrity and protection.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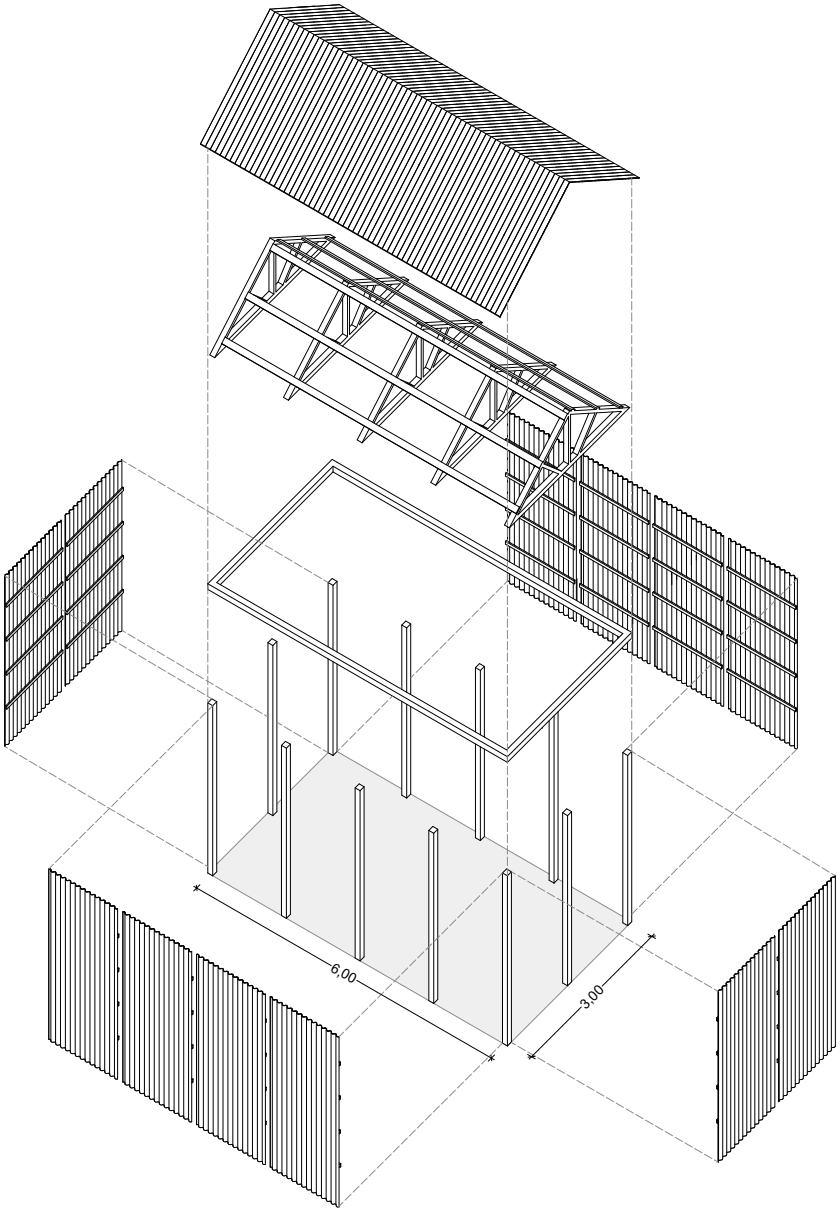
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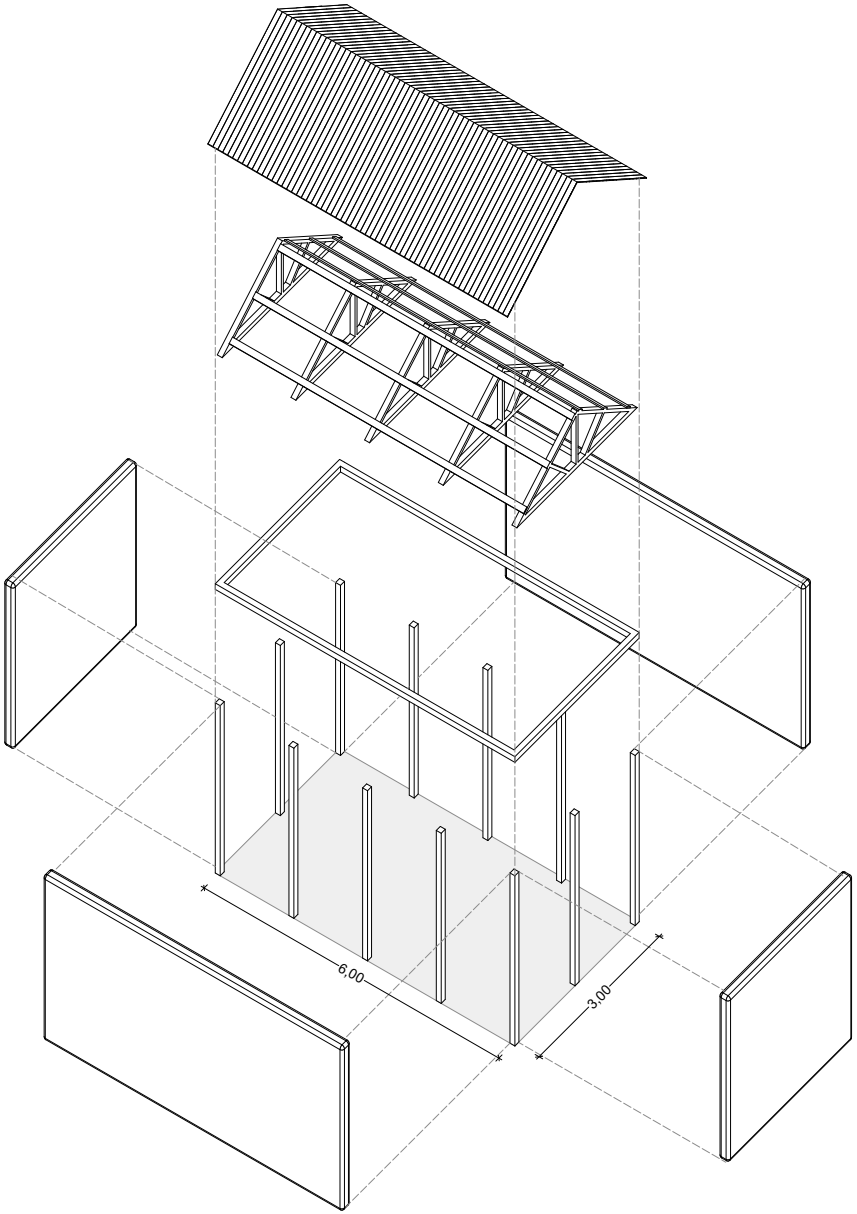
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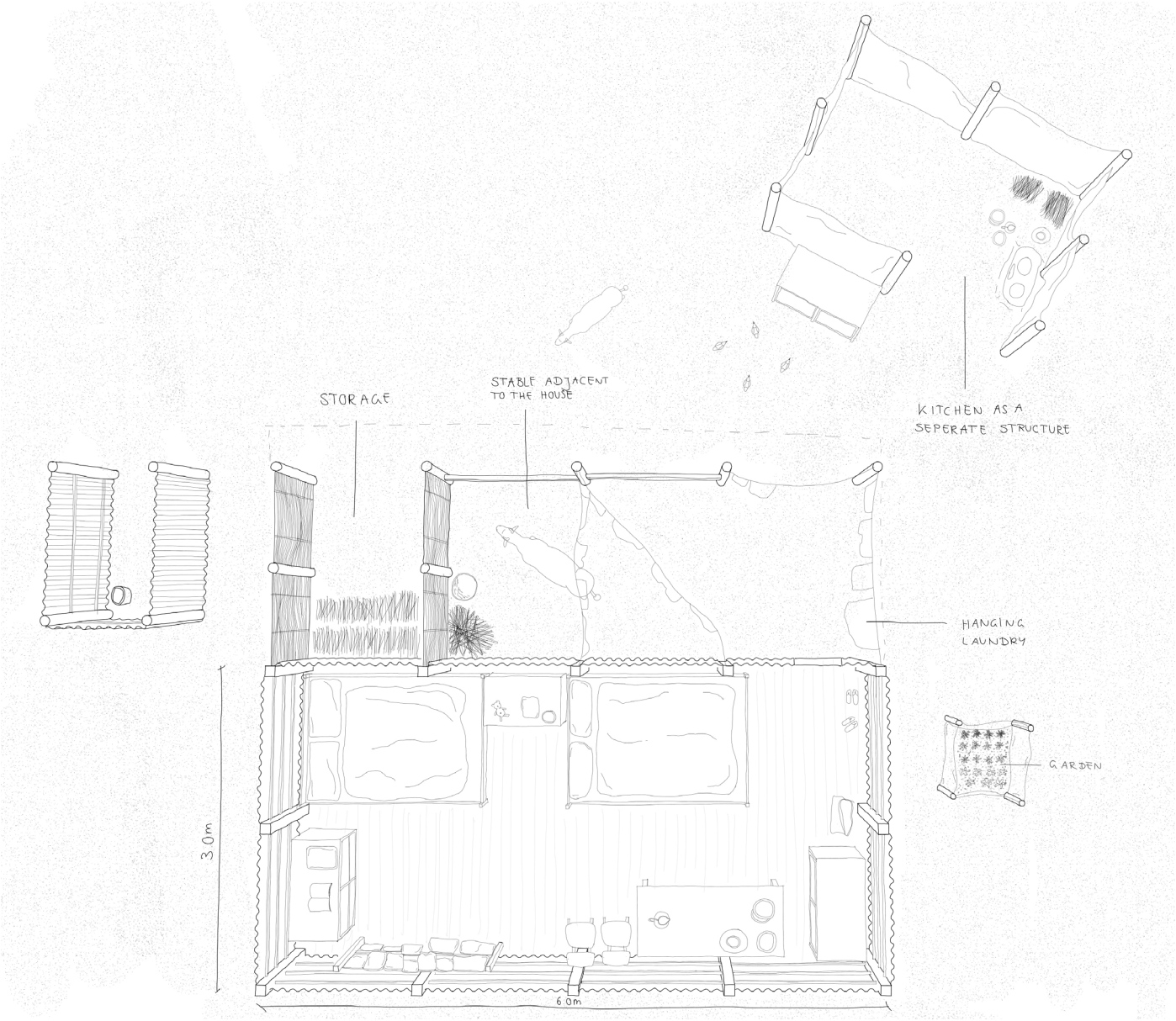
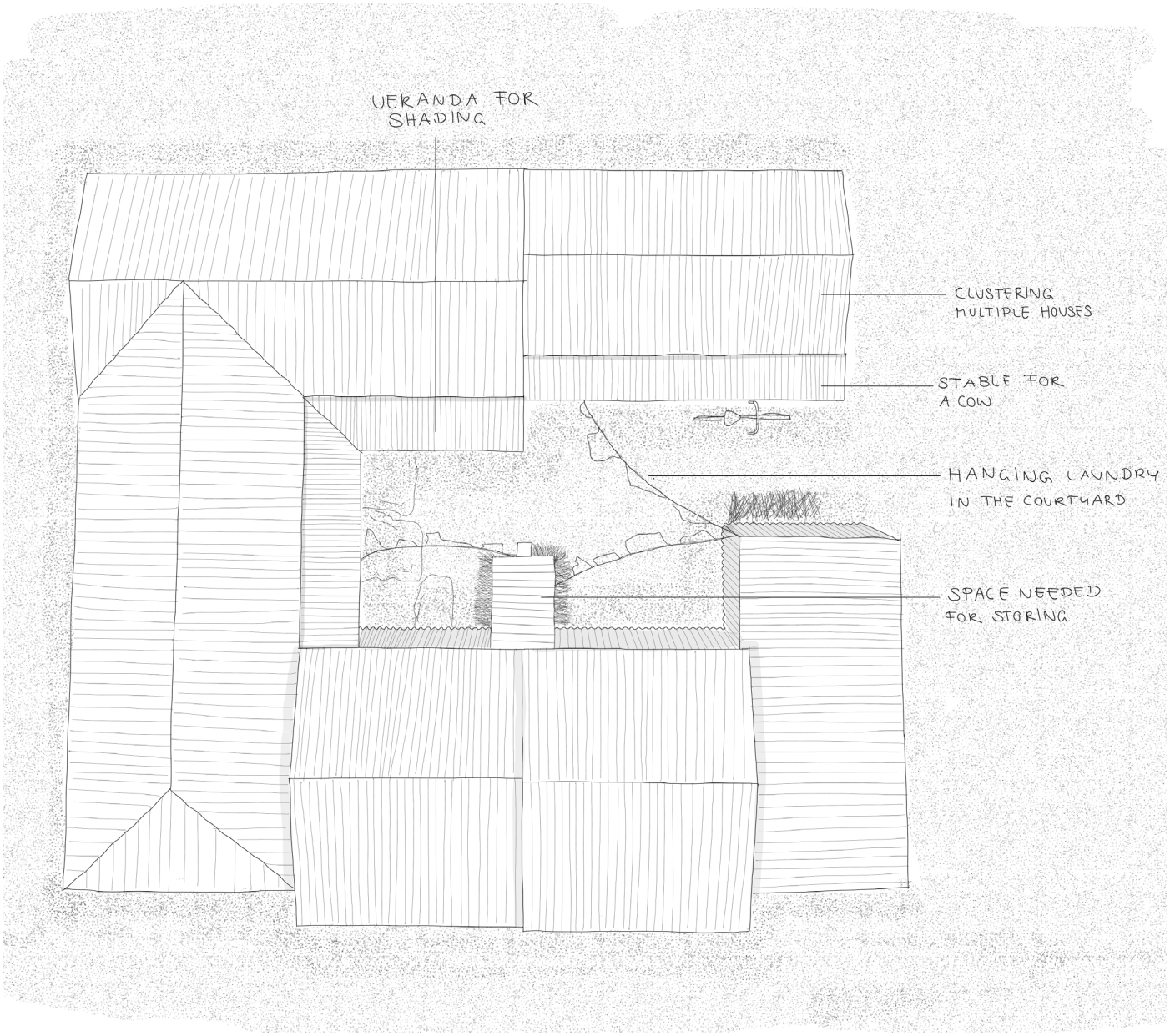
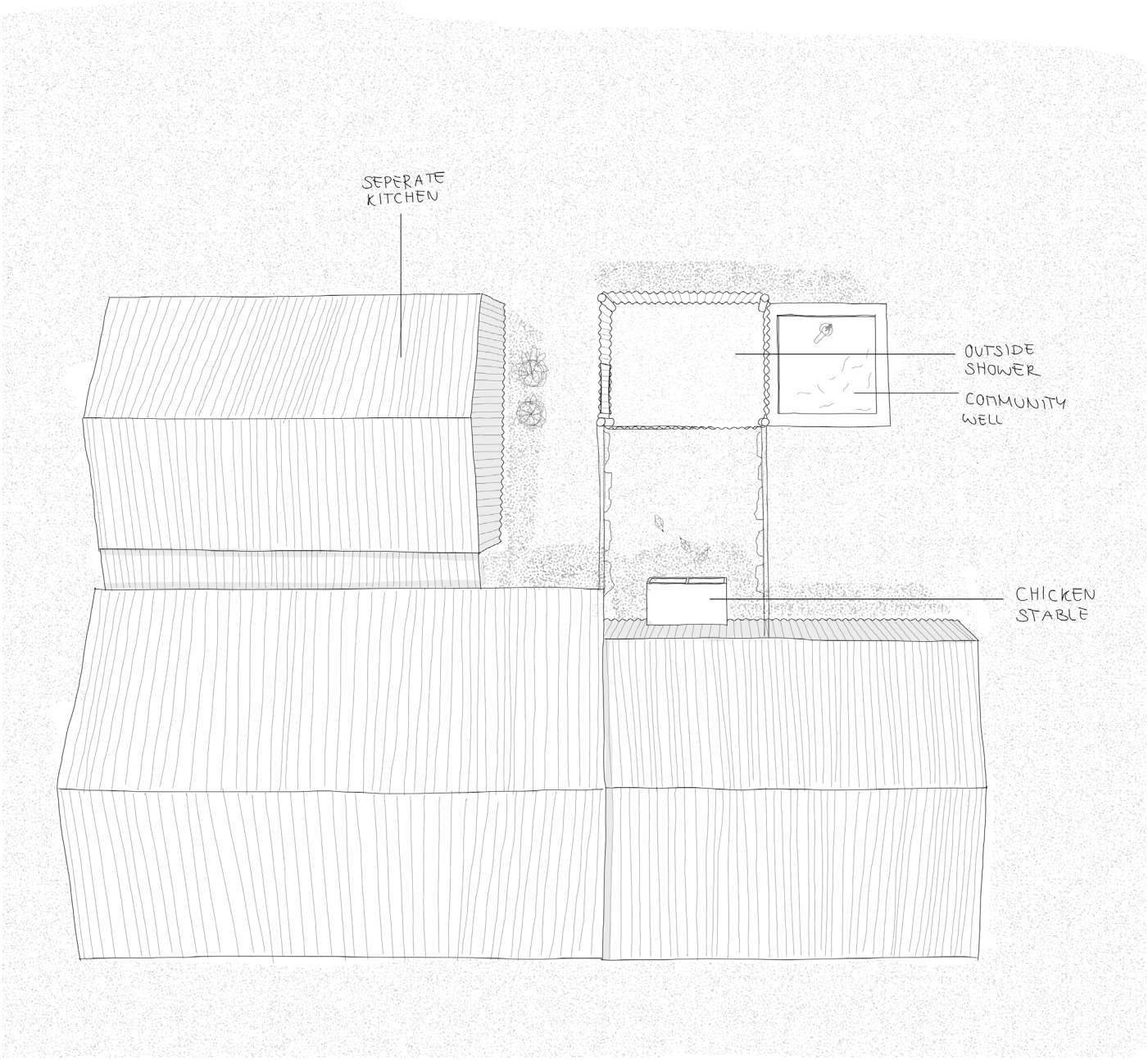

STORAGE
STABLE ADJACENT TO THE HOUSE
KITCHEN AS A SEPERATE STRUCTURE
HANGING LAUNDRY
GARDEN
3.0m
6.0m

INCREMENTAL HOUSING

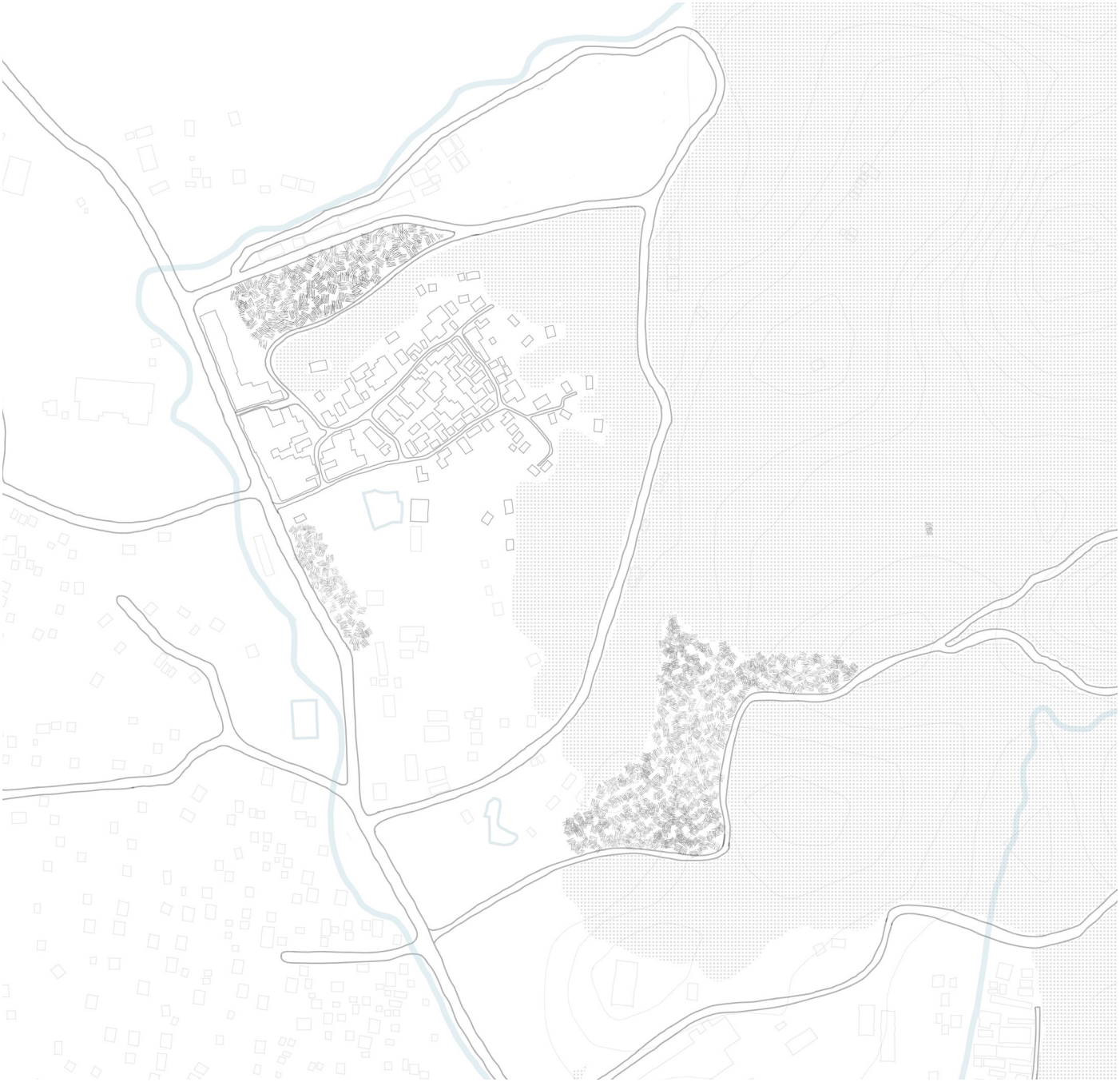
The basic structure, measuring 3 meters by 6 meters, does not provide sufficient space for families of five to ten people. As a result, residents often expand their living areas by adding separate kitchens, sanitary facilities, gardens, or sheds for their animals. However, with the population having grown rapidly in recent years, the available garden space has become increasingly limited, leaving little room for further expansion. Each family adapts and extends their home differently, depending on their specific needs, family size, and the dimensions of their plot.


VERANDA FOR SHADING
CLUSTERING MULTIPLE HOUSES
STABLE FOR A COW
HANGING LAUNDRY IN THE COURTYARD
SPACE NEEDED FOR STORING


SEPERATE
KITCHEN
OUTSIDE
SHOWER
COMMUNITY
WELL
CHICKEN
STABLE





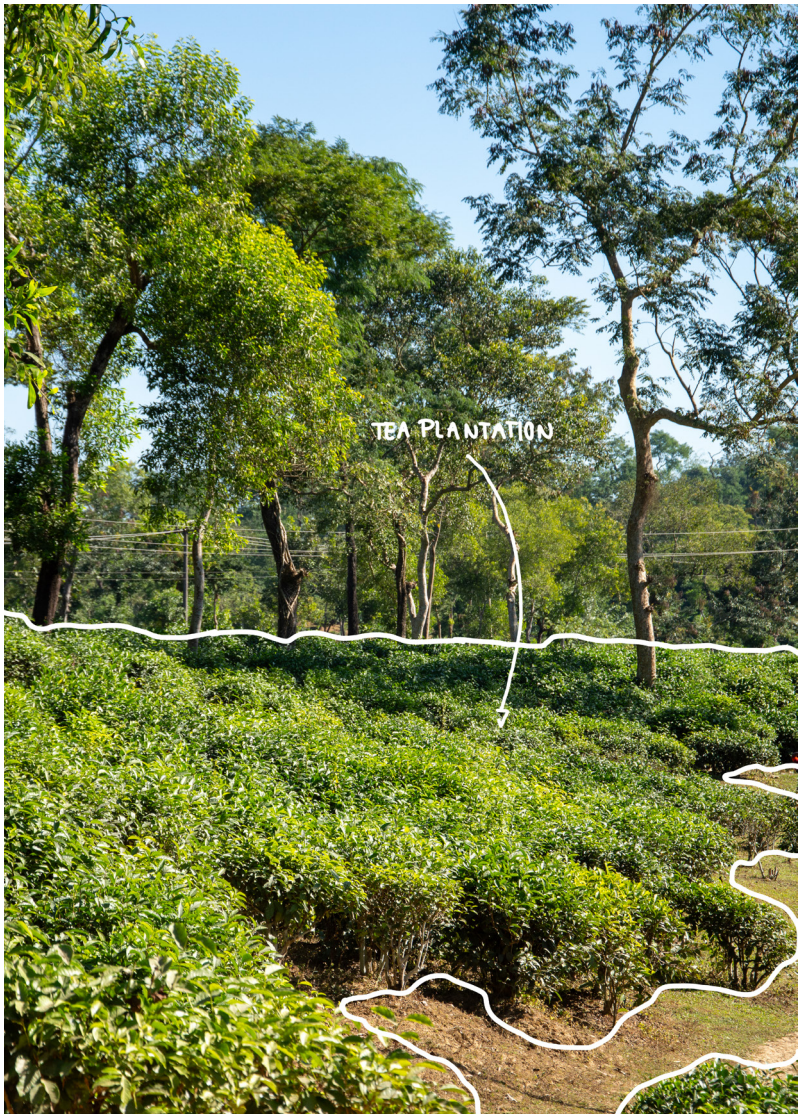


LANDSCAPING

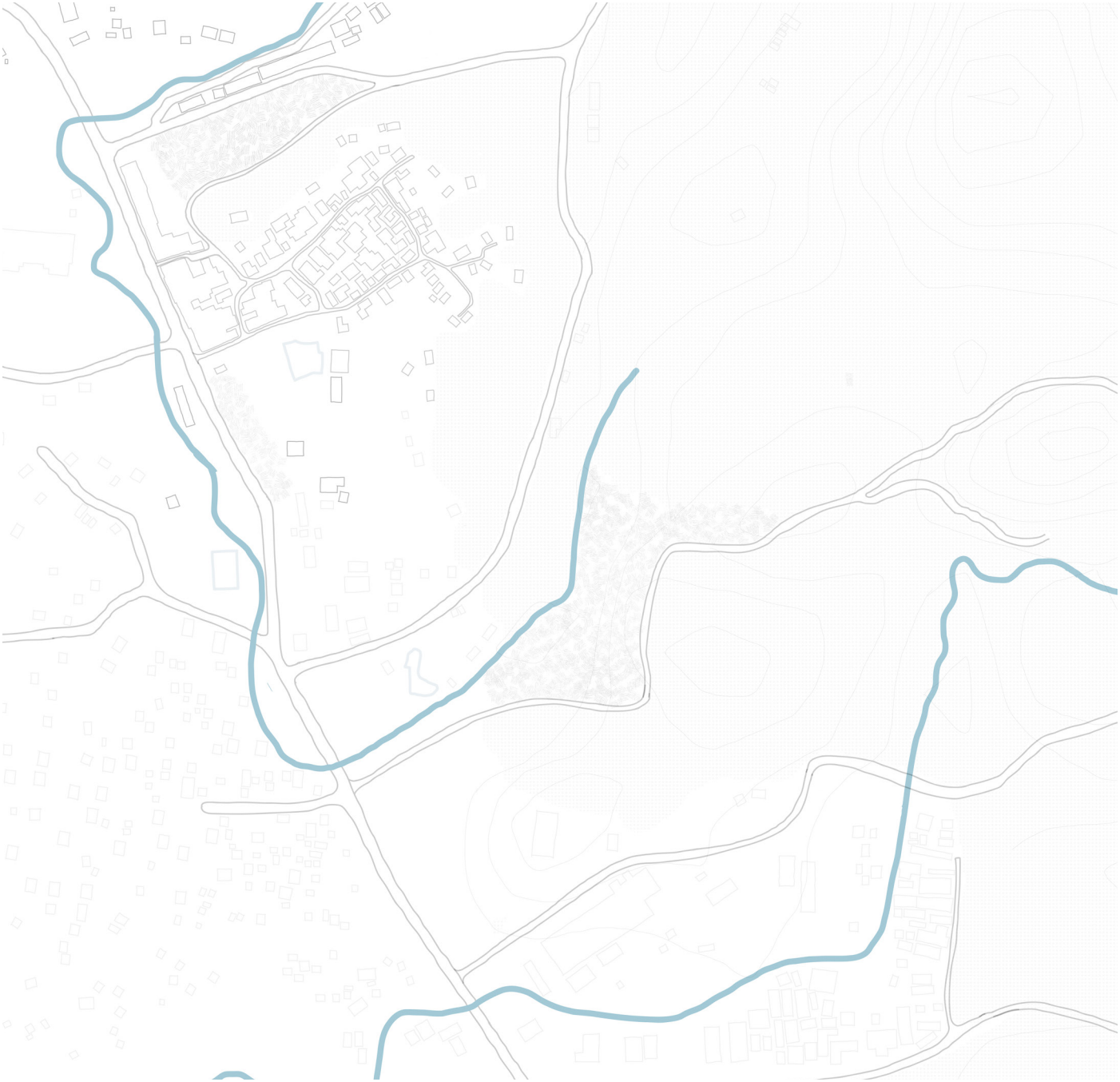
The village of the tea garden workers is situated in the valley, surrounded by the tea estate. It is located along the main road leading to both the airport and the city.

Behind the village, the tea gardens begin—where women work, picking tea leaves. In addition to tea plants, there are also rubber trees, which serve both as shade for the tea and as a source of rubber.

Adjacent to the village and within the boundaries of the garden are also agricultural fields, supporting local farming activities.


TEA PLANTATION


RUBBER TREES
FOR SHADING /
RUBBER PRODUCTION



WATER

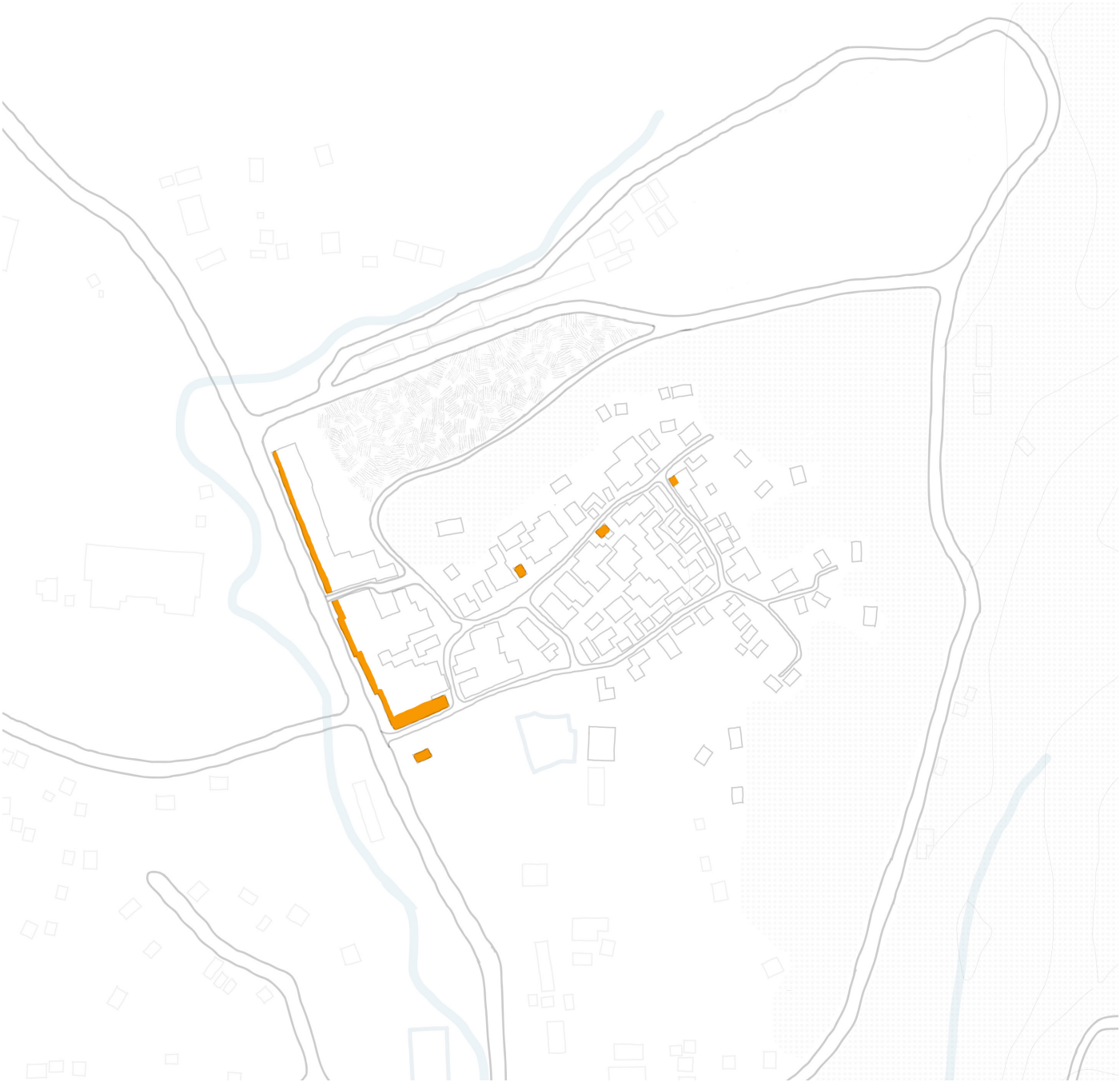
The site is bordered by a canal that flows into the nearby river. Canals play an essential role in regulating local water systems by channeling water into the river and preventing stagnation or overflow. The canal itself extends into the garden area, where residents commonly bathe and wash their clothes.

In the village, adjacent to the mosque, there is a pond that serves a similar function, primarily used by men for bathing and washing.

Within the site, residents have access to shared community wells that reach deep into the groundwater. These wells provide a general supply of water and are of sufficient quality to be used for drinking. However, the wells are communal, and individual households do not have direct access to water within their homes.


RIVER FOR
DOING
LAUNDRY


PUMP FOR
DRINKING WATER/
WASHING /
LAUNDRY
COMMUNITY
WELL



AMANETIES

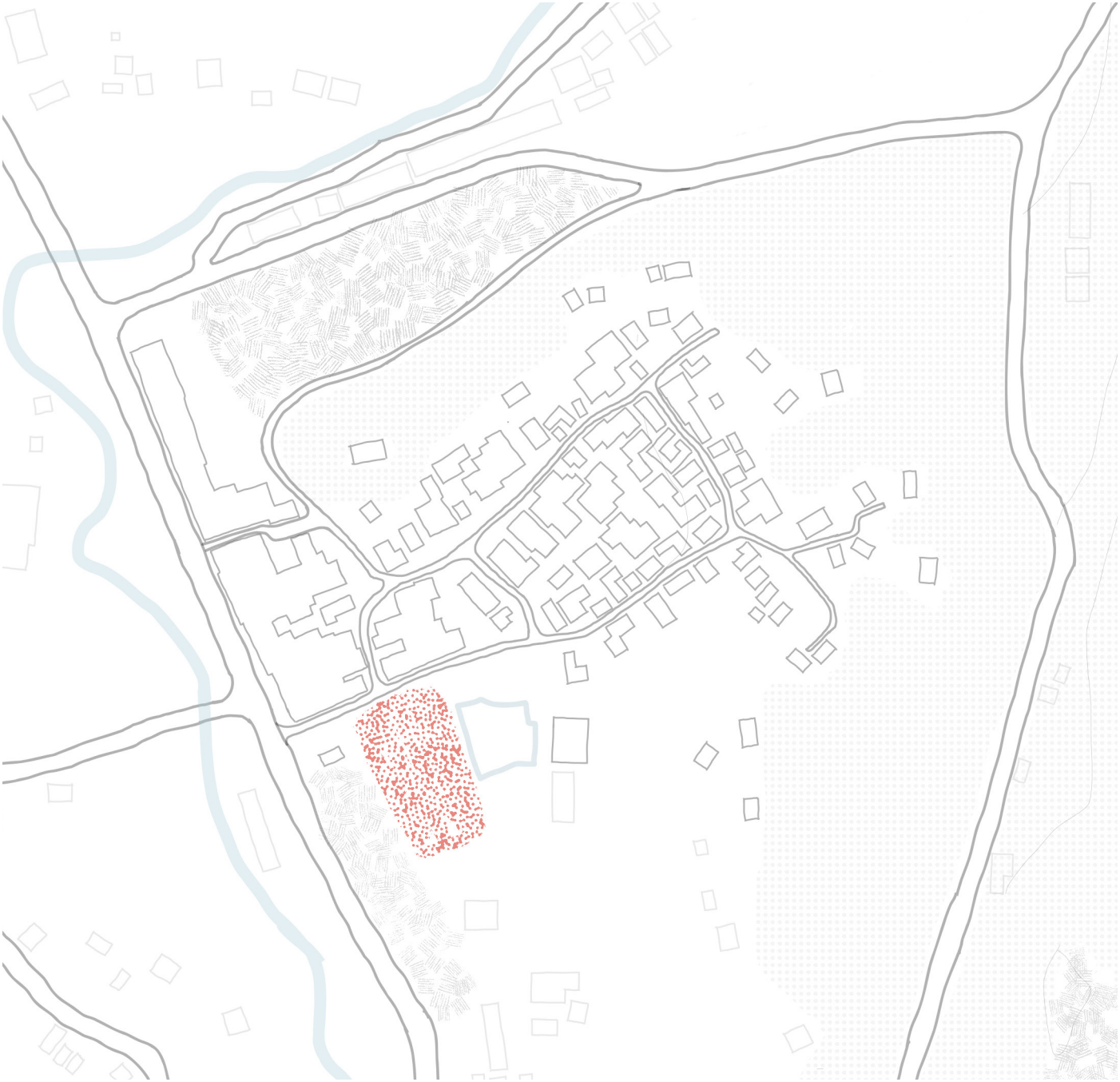
The Lakkatura tea garden has multiple spaces for mini markets, tea stalls and amenities.

Different shops, such as a CNG repair shop, a barber and a tailor, are located on the edge of the site towards the street, as well as at the entrance.

There are also some shops scattered around the site. Some people generate a second income by making bread, selling tea, running a mini market and selling dried sticks for cooking.


SHOP ON SITE
INBETWEEN
DWELLINGS


BREAD
STALL



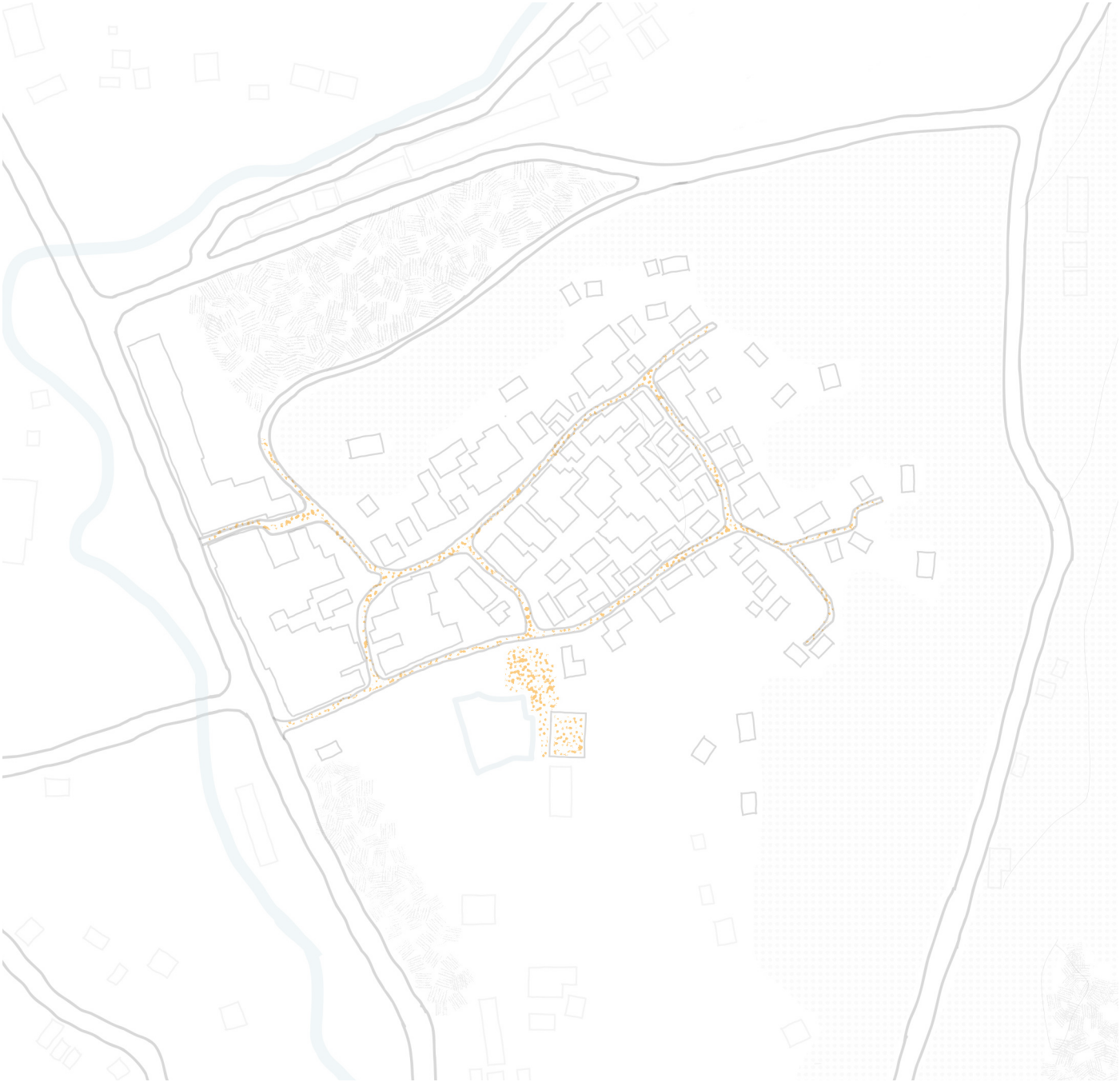
COMMUNITY SPACE

The community in the Lakkatura Tea Garden village is notably strong and cohesive. While there are some communal spaces available, access and use of these areas are not equally distributed among different groups, such as children, women, and men.

At the entrance of the site, near the main road, there is an open field that serves as a multifunctional space. It is commonly used by residents for playing cricket or football, and children often use it as a general play area. This field also serves as a venue for community celebrations, during which a temporary stage is erected for musical performances and other festivities.


STAGE FOR CELEBRATION
OPEN SPACE FOR SPORTS AND CELEBRATION


SPACE FOR
CRICKET

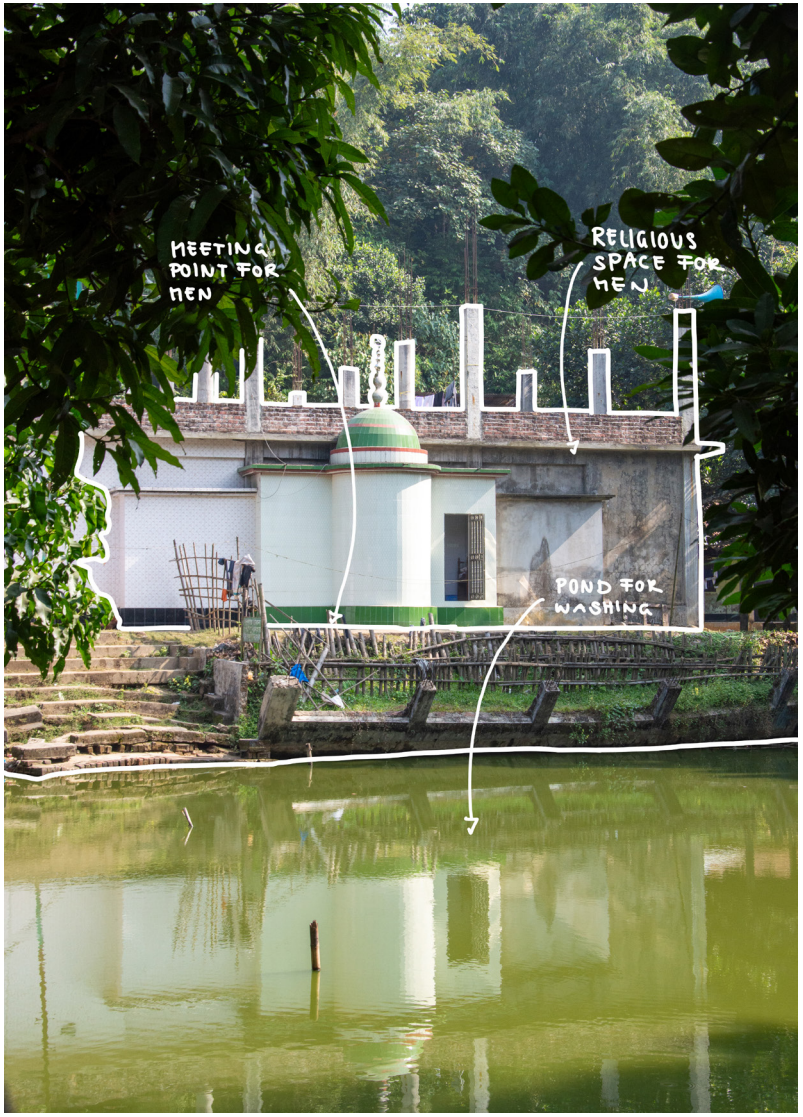


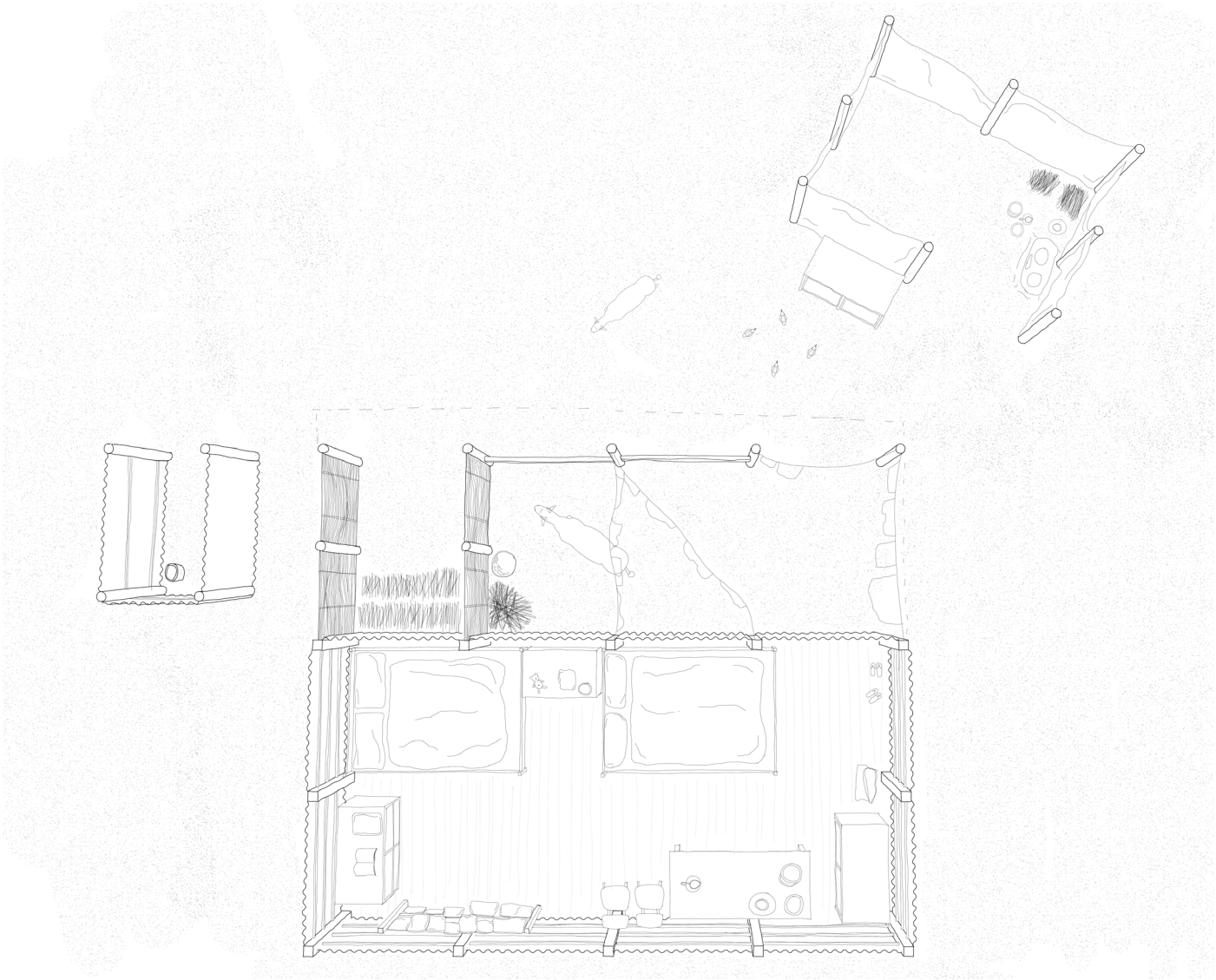
SPACES FOR MEN

As Bangladesh is a predominantly Muslim country, cultural and religious norms often influence gender roles and spatial practices. Women, in particular, frequently face restrictions in their movement, especially in public spaces, limiting their presence and participation in communal areas.

In contrast, men are more visibly present in the public realm within the village. They commonly occupy the streets and gather informally to socialize. The mosque plays a central role in male communal life—not only as a place of worship and religious practice but also as a social hub. The square in front of the mosque serves as an important gathering space where men meet, converse, and engage in community life.


MEN GATHERING
ON THE STREET


MEETING POINT FOR MEN
RELIGIOUS SPACE FOR MEN
POND FOR WASHING



SPACES FOR WOMEN (COURTYARD)

In the village, women primarily engage in daily life within the domestic sphere, with the courtyard serving as a central and multifunctional space. It is where much of their everyday work and social interaction takes place.

Courtyards are used for a range of household tasks, including cooking, washing, drying clothes, and storing materials such as firewood or sticks used for fuel. These materials are often dried in the sun and kept in the courtyard for convenience. Beyond their practical functions, courtyards also act as important social spaces, where women gather to talk, connect, and support one another within a culturally accepted environment.

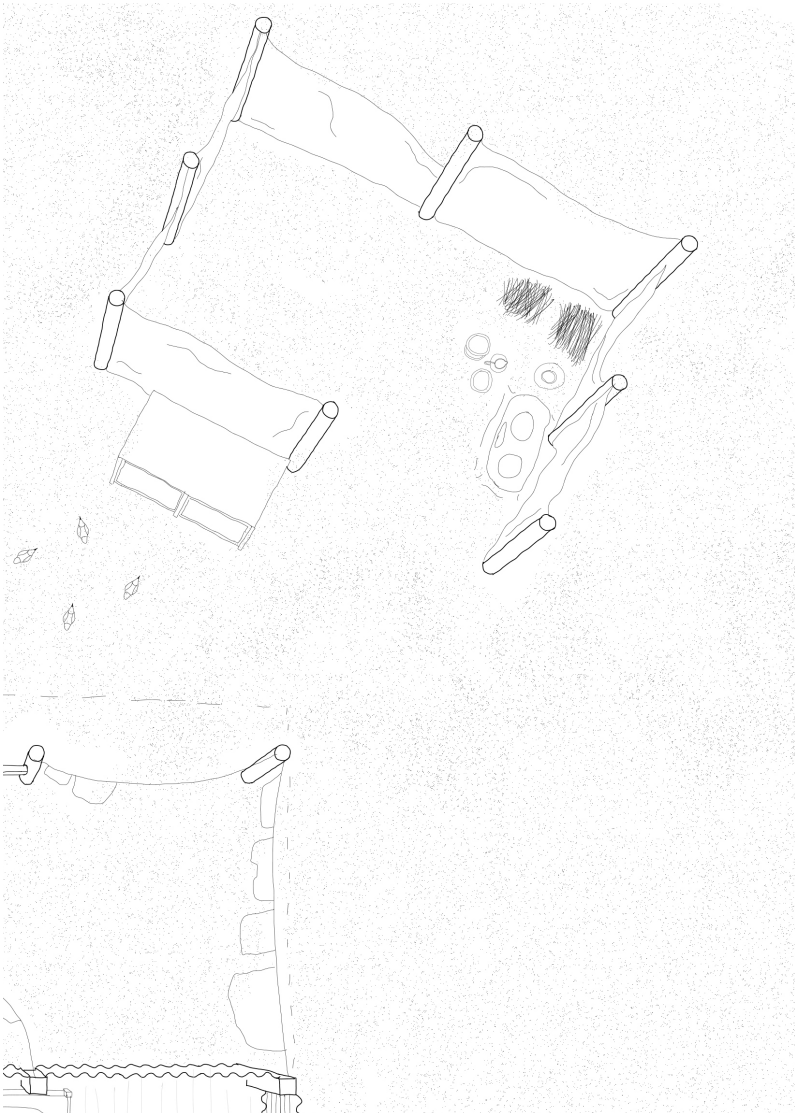
For children, the courtyard offers a secure and familiar environment in which to play, often under the supervision of their mothers or other family members. This makes it not only a functional space for domestic work but also a vital setting for everyday family life and informal caregiving.


WOMEN GATHERING IN THE COURTYARD


WOMEN DOING
CHORES AND HOBBIES
IN THE COURTYARD


DRYING
WOOD FOR
FIRE


FIREWOOD
HANGING LAUNDRY
MATERIAL STORAGE

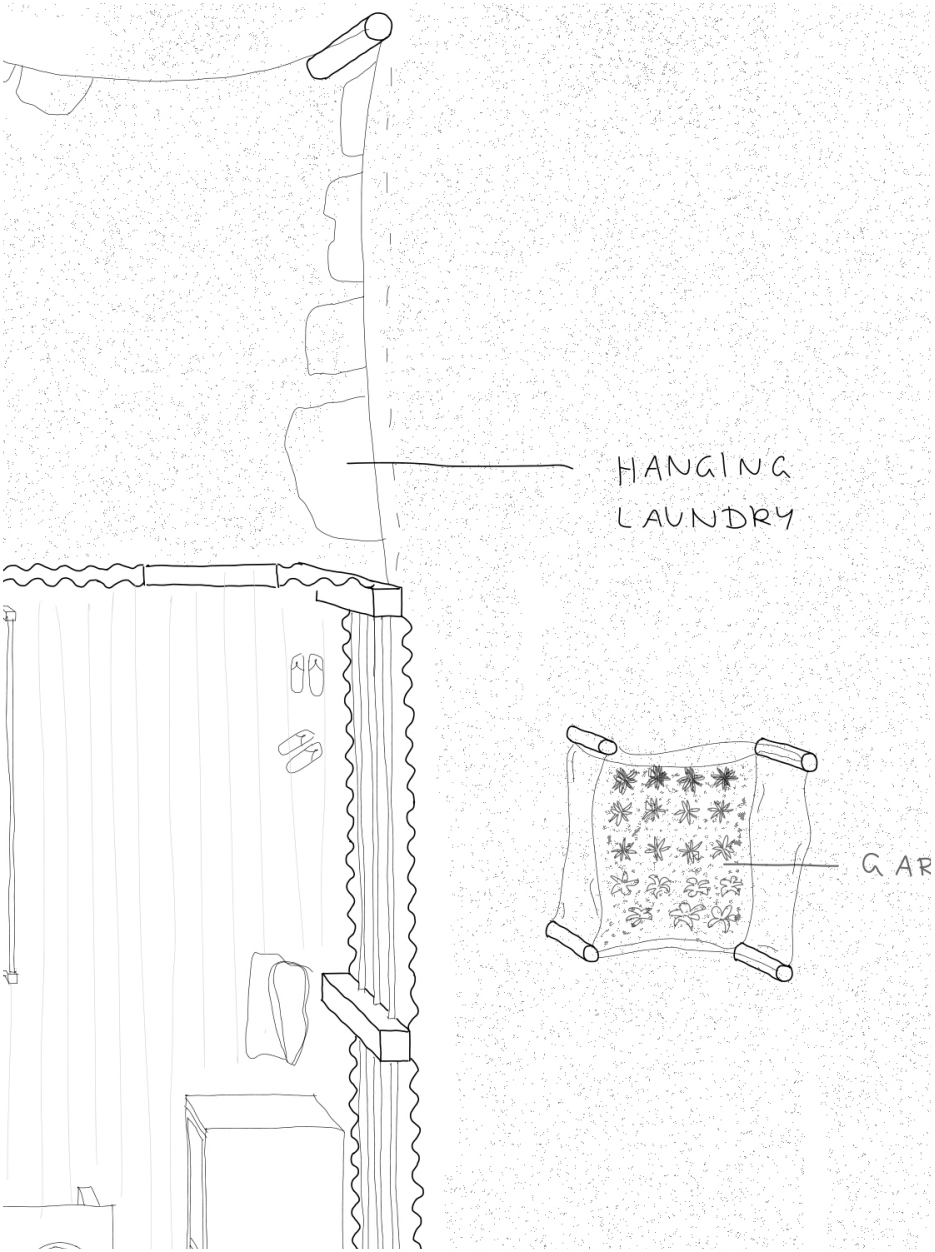


COOKING HABITS

In the villages, women typically cook using traditional open stoves. To prevent smoke from entering the living spaces, the kitchen is often located in a separate area or structure. These stoves, usually made from mud, are wood-fired and positioned directly on the ground. As part of local tradition, women cook while sitting on small stools, a method passed down through generations. This seated posture is not only shaped by the stove's design but also by cultural norms, and many women are not accustomed to cooking in any other way.


WOMEN COOKING ON LOW STOOL
OPEN FIRE STOVE


THE HIGHT IS VERY CONVENIENT TO STORE COOKING
WE NEED SPACE FOR STORING STICKS FOR COOKING
A SEPERATE KITCHEN IS GOOD FOR NOT HAVING THE SMOKE IN THE HOUSE
WE ARE USED TO COOK WHILE SITTING


HANGING
LAUNDRY
GAR

GARDENING

The tea garden company provides permanent workers with rice in addition to their salary. However, the salary is insufficient for families to regularly afford vegetables and fruits, resulting in an unbalanced diet.[1] [5]

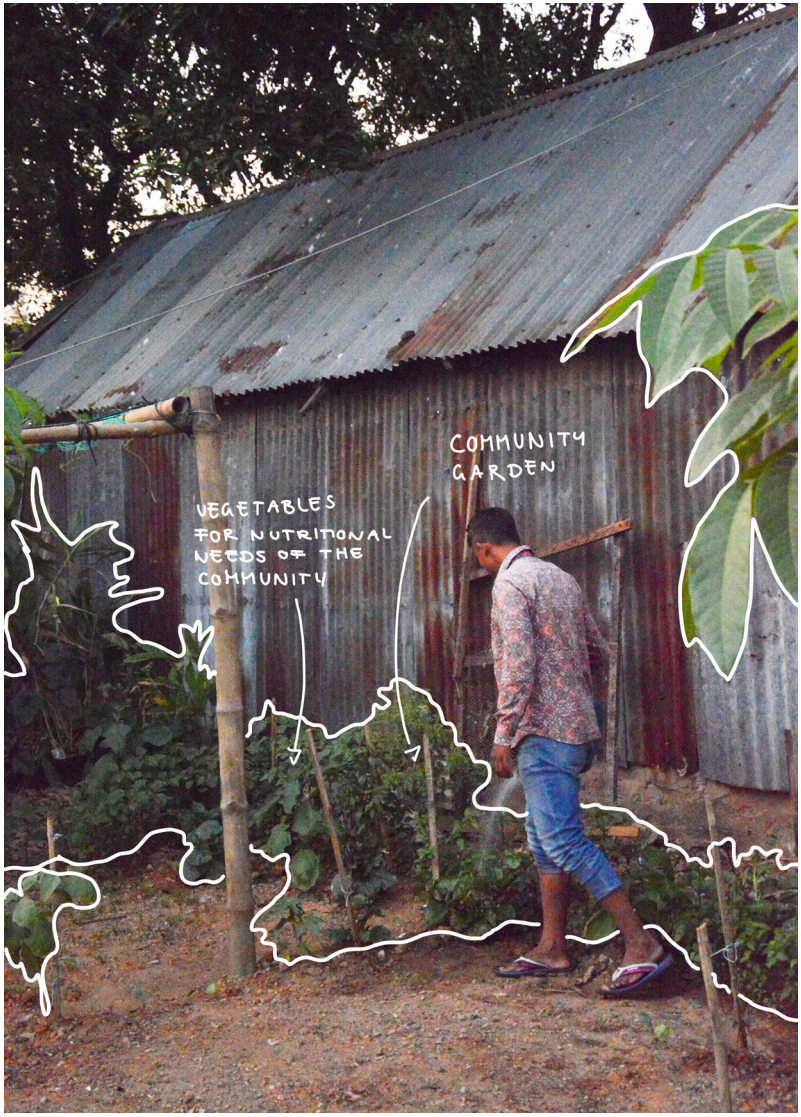
It is therefore essential for families to have access to land where they can grow herbs, vegetables, and fruits to meet their nutritional needs. Unfortunately, in this area, there is not enough space for individual homestead gardens or even a shared community garden.

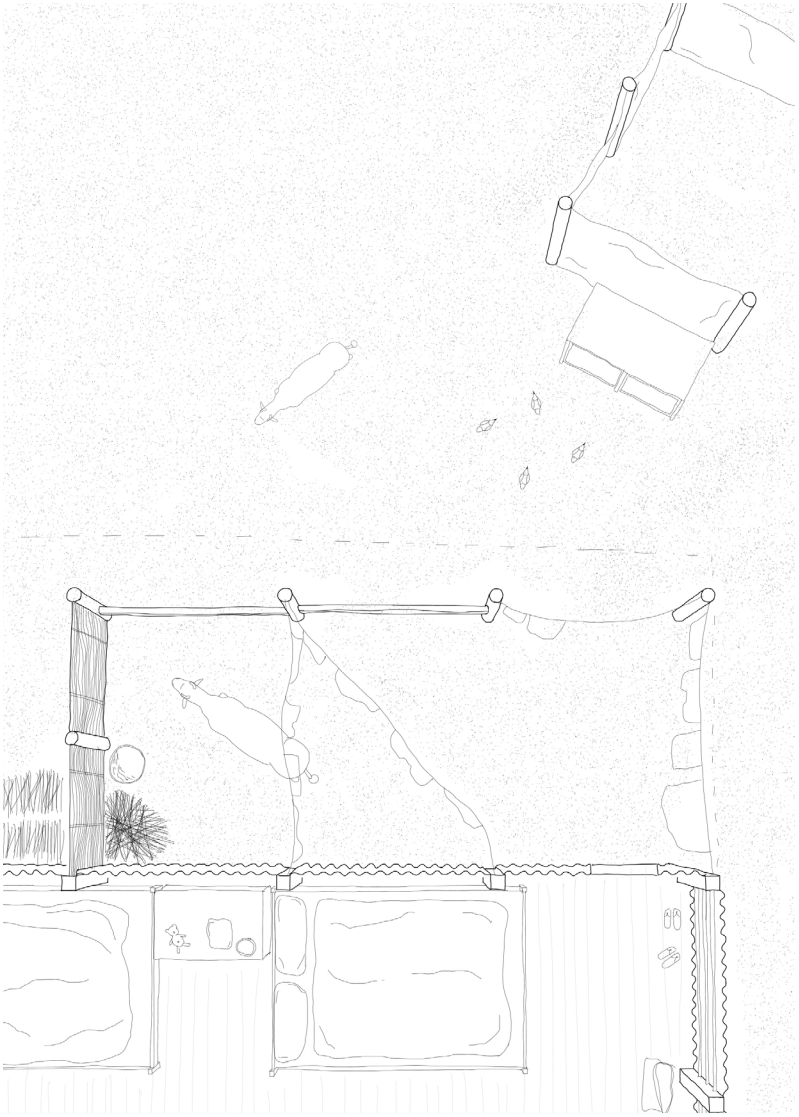
In contrast, other villages have successfully established community gardens, which enable families to grow their own food, improve daily nutrition, and reduce household expenses. These gardens also give people control over how their food is grown, increasing confidence in its safety and quality.

Organizations such as the East-West Seed Knowledge Transfer Foundation (EWS-KT) support the development of home gardens in Bangladesh. EWS-KT is a non-profit initiative that provides hands-on training in sustainable vegetable farming. Their work not only helps improve food security and agricultural skills but also plays an important role in empowering women by actively involving them in home gardening and decision-making processes.[16]

15 Ahmmed et al., A Study Report, 9
16 Knowledge Transfer Foundation | High-Quality Tropical Vegetable Seeds for Smallholder Farmers"


GARDENS
FENCED
OFF
HOME
GARDENING

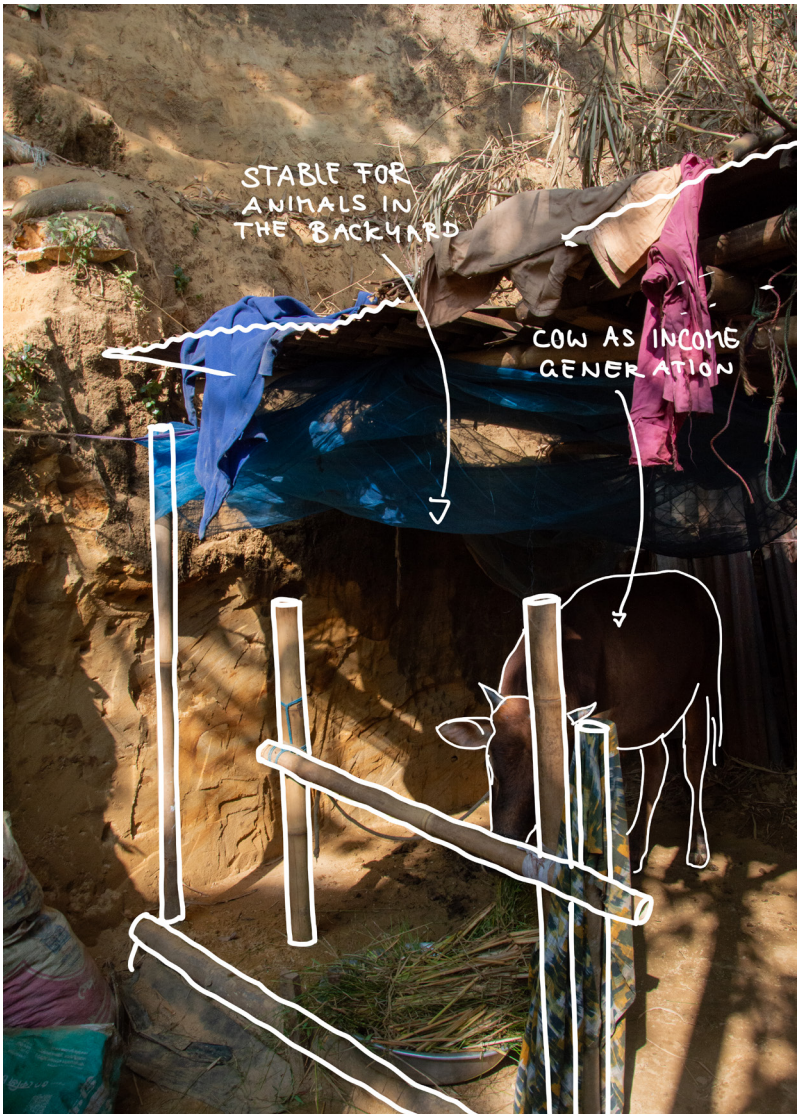

COMMUNITY
GARDEN
VEGETABLES
FOR NUTRITIONAL
NEEDS OF THE
COMMUNITY



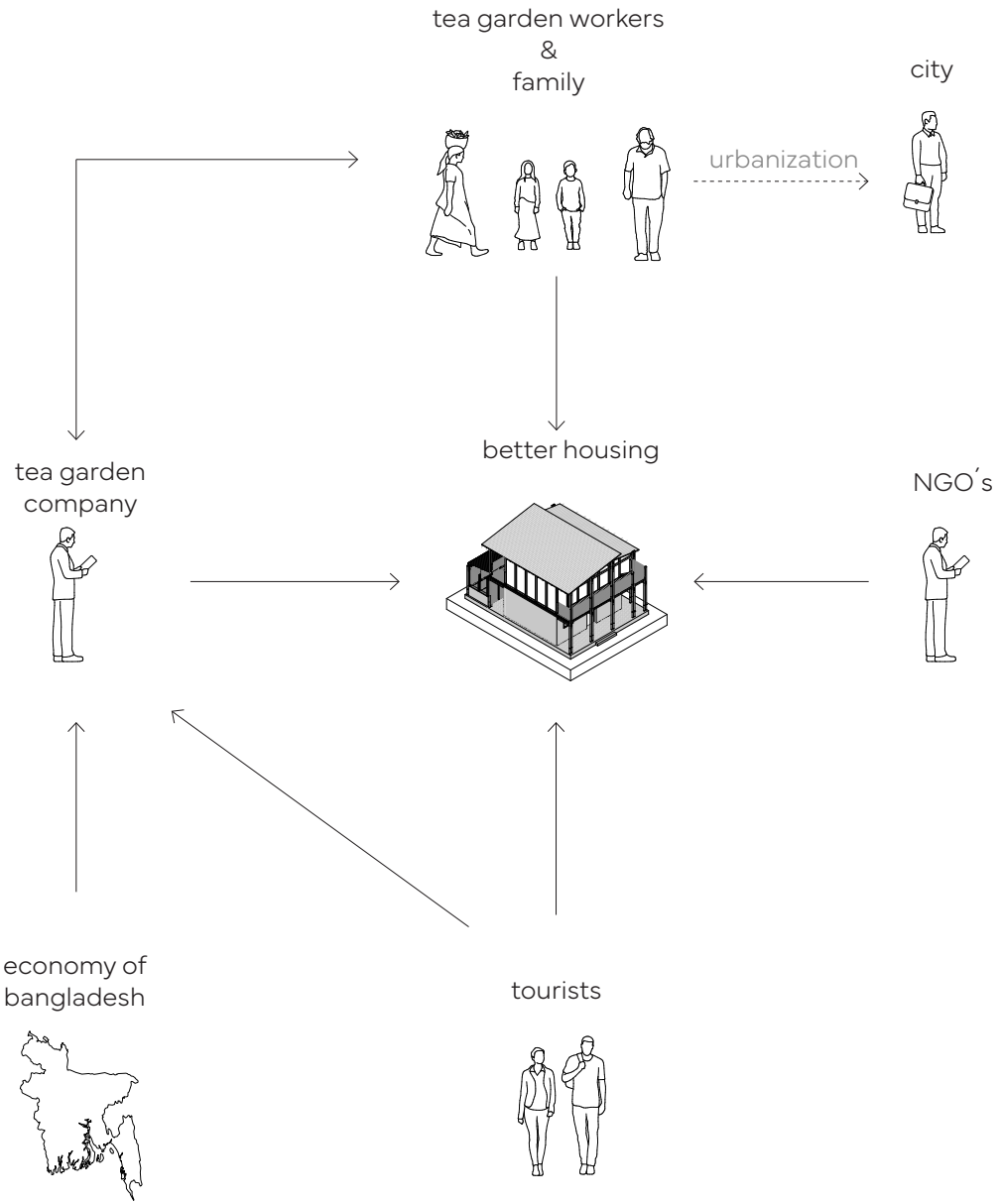
ANIMALS

In the tea garden communities, livestock play a vital role in supporting household livelihoods. Cows, in particular, are highly valued due to their high cost and are carefully protected as significant long-term investments. Because the wages of tea garden workers are very low, many families keep animals such as cows, goats, ducks, and chickens to supplement their income and ensure food security. These animals provide essential resources like milk and eggs, contributing both to daily nutrition and to the economic stability of the household.


INCOME
GENERATION
CHICKEN/
DUCK
STABLE


STABLE FOR ANIMALS IN THE BACKYARD
COW AS INCOME GENERATION

01 approach


tea garden workers
&
family
city
urbanization
tea garden
company
better housing
NGO´s
economy of
bangladesh
tourists

RELEVANCE & STAKEHOLDERS

The project addresses the critical housing challenges faced by tea garden communities in Bangladesh, focusing on the Lakkatura tea garden. These challenges include overcrowding, substandard housing conditions, and the lack of privacy.

From a social perspective, the project aims to improve the living conditions of marginalized tea garden workers. By addressing overcrowding and enhancing privacy and housing quality, the design fosters better quality of life, stability, and community cohesion. Furthermore, the focus on preserving traditional social and spatial structures ensures that cultural identity and communal ties remain intact, even as densification strategies are implemented.

From a professional standpoint, the project engages with complex architectural and urban challenges, such as designing for high-density settlements in a resource-constrained environment. The emphasis on integrating financing solutions into the design process makes the project a practical model for tackling similar housing crises globally. Moreover, the work contributes to the field of architecture by developing strategies that balance immediate needs with long-term sustainability, aligning with the principles of future-proof urban development.

As the world's ninth-largest tea producer, Bangladesh's tea industry is a major contributor to the national economy.[17] The industry relies heavily on tea garden companies for production, which in turn depend on the labor of tea garden workers. However, the extremely poor living and working conditions of these workers have led to frequent strikes, posing a significant threat to production.[18] Another challenge faced by the industry is increasing urbanization.[19] For instance, the Lakkatura Tea Garden, located near the city, has already seen many workers' family members employed in urban areas. Without improvements in working conditions, there is a growing risk that workers will leave the tea gardens for better opportunities elsewhere, which would negatively impact the companies. Providing improved housing could be one means of enhancing workers' quality of life, thereby encouraging them to remain employed in the gardens. Furthermore, by incorporating tourism into their development plans, companies could diversify their revenue streams. Given that tea garden workers are among the most marginalized groups in Bangladesh, non-governmental organizations (NGOs) are already engaged in supporting them and could potentially invest in such initiatives.[20]

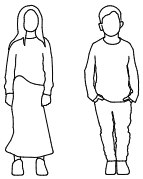
17. Mila et al., "Modelling and Forecasting of Tea Production."
18. Gain, „Tea workers' strike ends What's next?"
19. Lipi, Urbanization in Bangladesh, 39
20. United Nations Development Programme. "Exploited and Marginalized, Bangladeshi Tea Workers Speak Up for Their Rights."



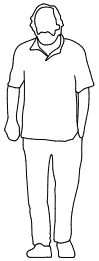
tea garden workers



city workers



children



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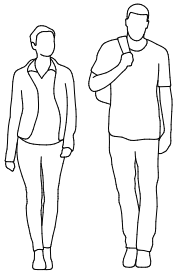


tourists

external

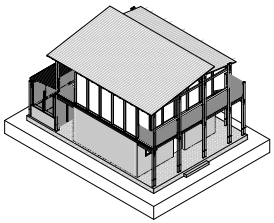
TARGET GROUP

The inhabitants of the Lakkatura Tea Garden represent a diverse population with varying needs. Women are predominantly employed as tea pluckers in the gardens while also managing household responsibilities and caring for children. In contrast, many men are engaged in work either within the tea processing factories or in the nearby city. Additionally, the community includes a significant number of children and elderly individuals. The project aims to address the needs of all these groups by creating inclusive spaces that promote equality and well-being for every member of the community.

In addition to serving the needs of local inhabitants, the project also seeks to incorporate tourists. Examples from other regions demonstrate that integrating tourism into tea gardens can promote the tea industry, revitalize local cultural heritage, and generate diverse sources of income.[21] This can be achieved through the development of tea houses, guided tours of the gardens and factories, and home-stay opportunities with tea garden workers.

21 Su, Wall, and Wang, "Integrating Tea and Tourism."

better housing



community

different needs

adaptibility

DESIGN PRINCIPLES

„The most beautiful thing here in the village is the sense of unity. It is truly wonderful how everyone helps one another."

- inhabitant of Lakkatura

The three main design principles emphasize the creation of spaces that serve the community and foster social cohesion. The project seeks to address the diverse needs of all community members, including workers, their families, and visitors. Additionally, the design is intended to be adaptable and replicable across other tea gardens.

02 masterplan

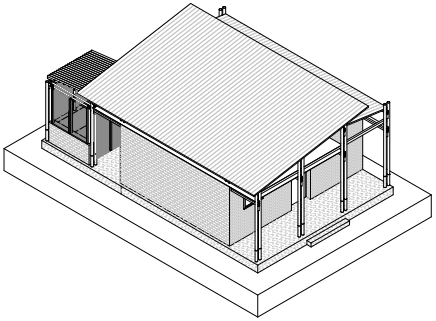


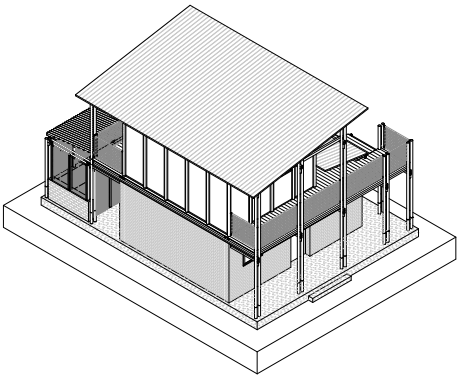
PRINCIPLES
MASTERPLAN

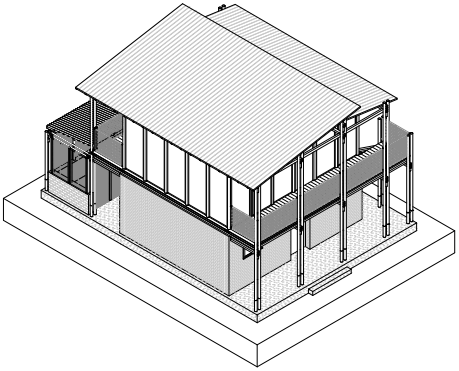
The masterplan is structured around a mix of dwellings, community spaces, a women's center, a school, various open public areas, and tourist accommodations. Its design is informed by the daily life patterns of tea garden workers and responds to their needs both within and beyond the home.

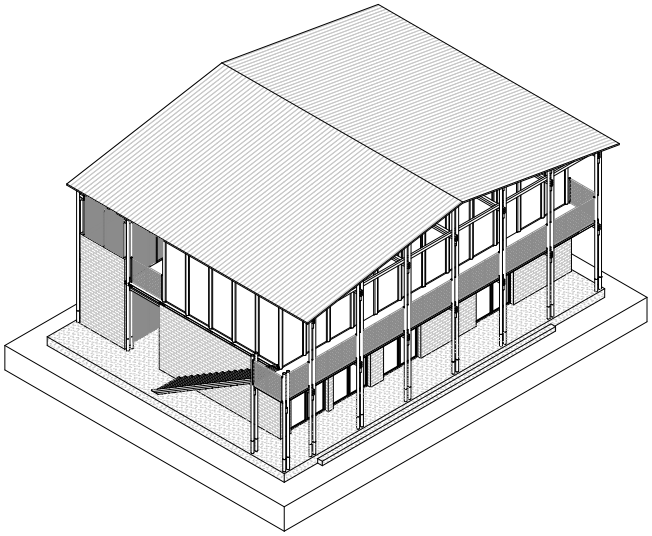
The dwelling types range from single-storey houses to expandable two-storey units. Designed with flexibility in mind, they allow for extension and adaptation based on family size and evolving needs. The houses are clustered in various configurations to respond to different site conditions, as the new housing will be integrated into the existing village fabric. This adaptable system ensures that the housing model is not only appropriate for this particular site but can also be applied to other tea gardens in the region.

A core principle of the masterplan is to foster community life for all residents, women, men, children, and animals, through a carefully considered hierarchy of public spaces. These include neighbourhood streets, semi-public community pockets, and more private, enclosed courtyards. The design of these communal spaces seeks to promote inclusivity, encourage social interaction, and nurture a strong sense of belonging.



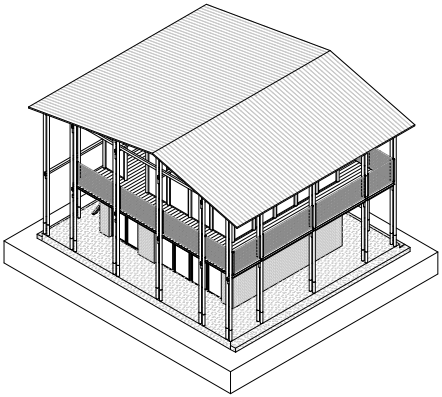


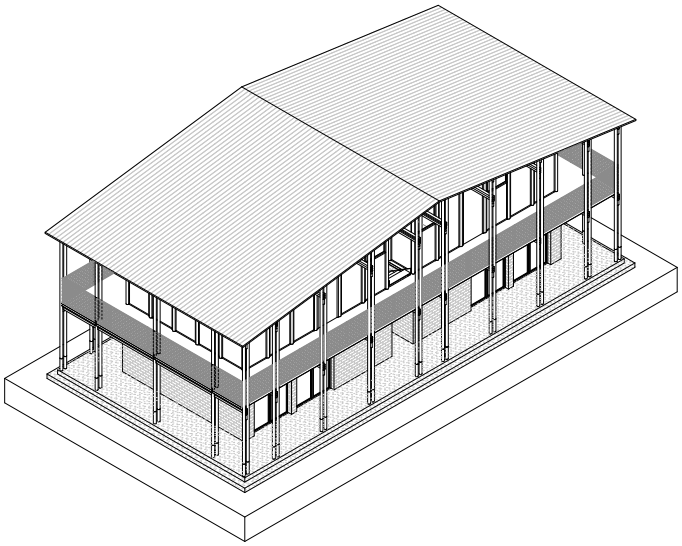




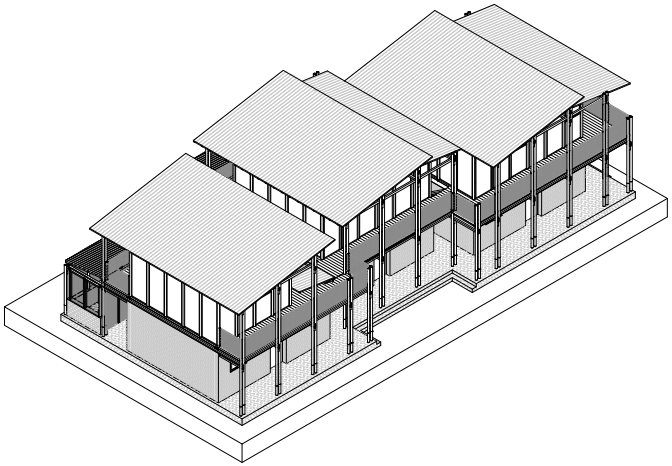
DWELLING

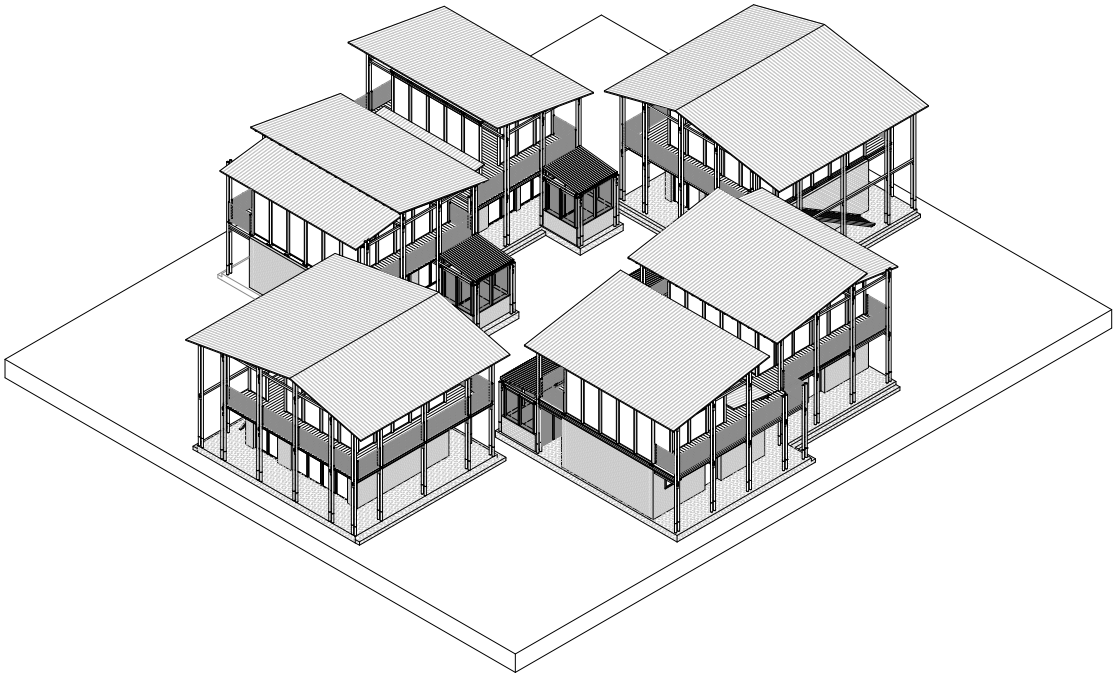
COMMUNITY





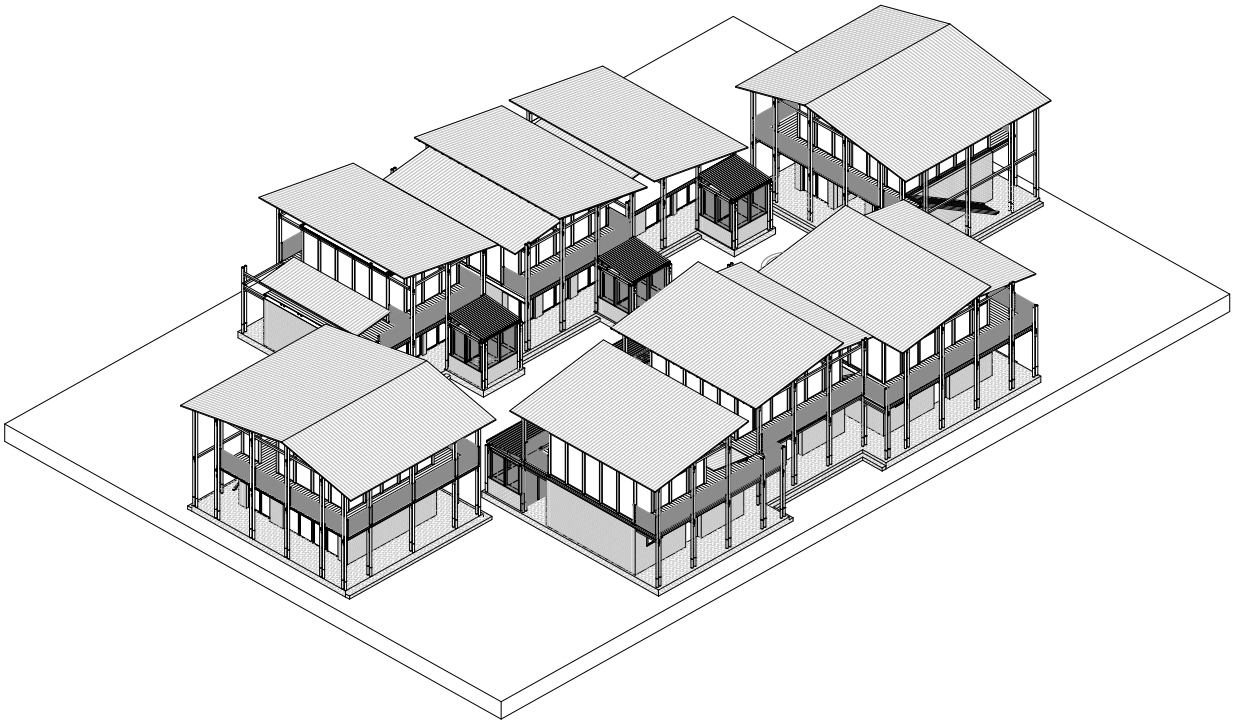
ROW HOUSES

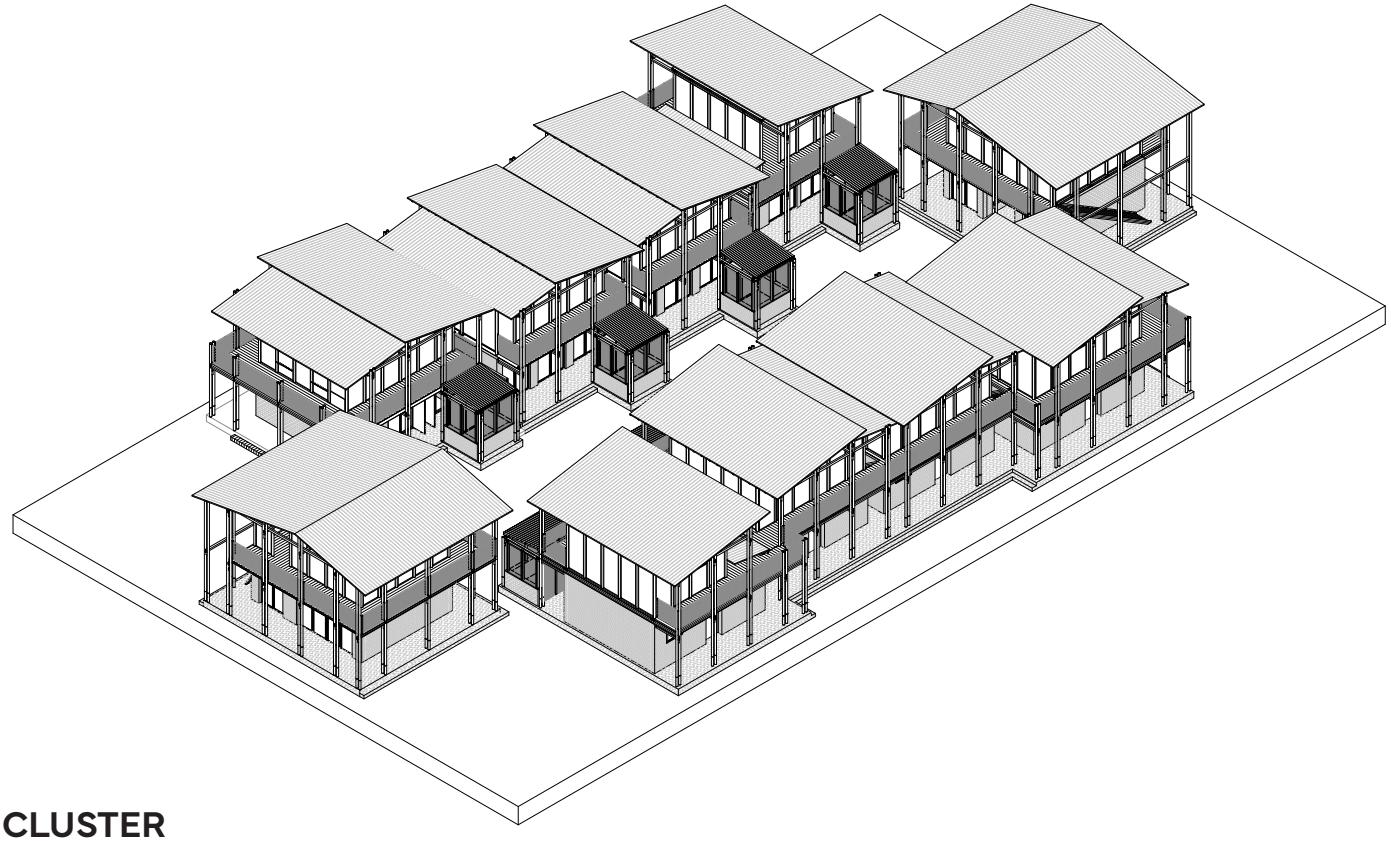




CLUSTER
4 DWELLINGS

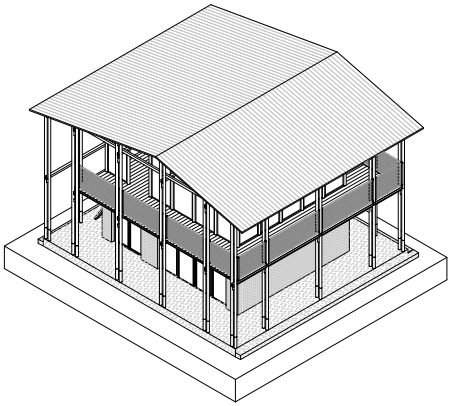
CLUSTER
6 DWELLINGS

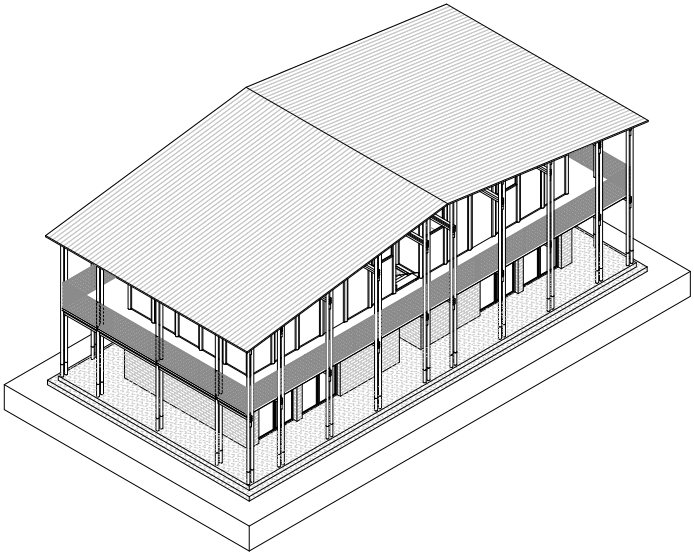




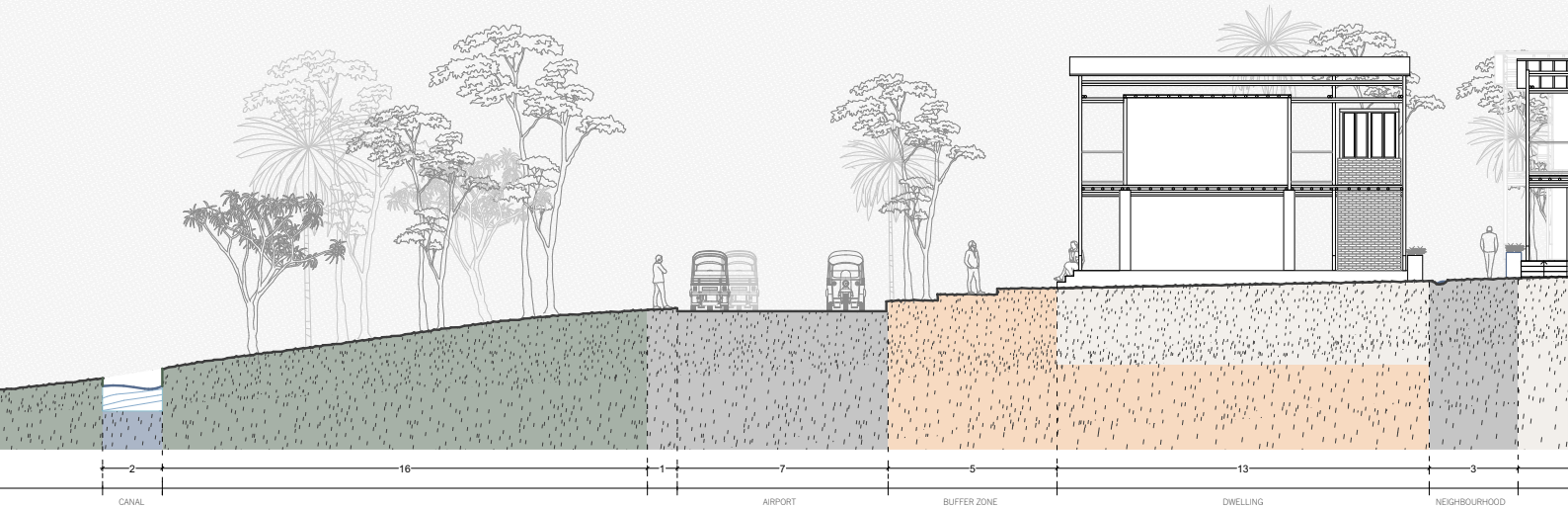
CLUSTER
8 DWELLINGS

COMMUNITY HOUSE
TOURIST ACCOMODATION





TEA HOUSE
WOMEN CENTER & SCHOOL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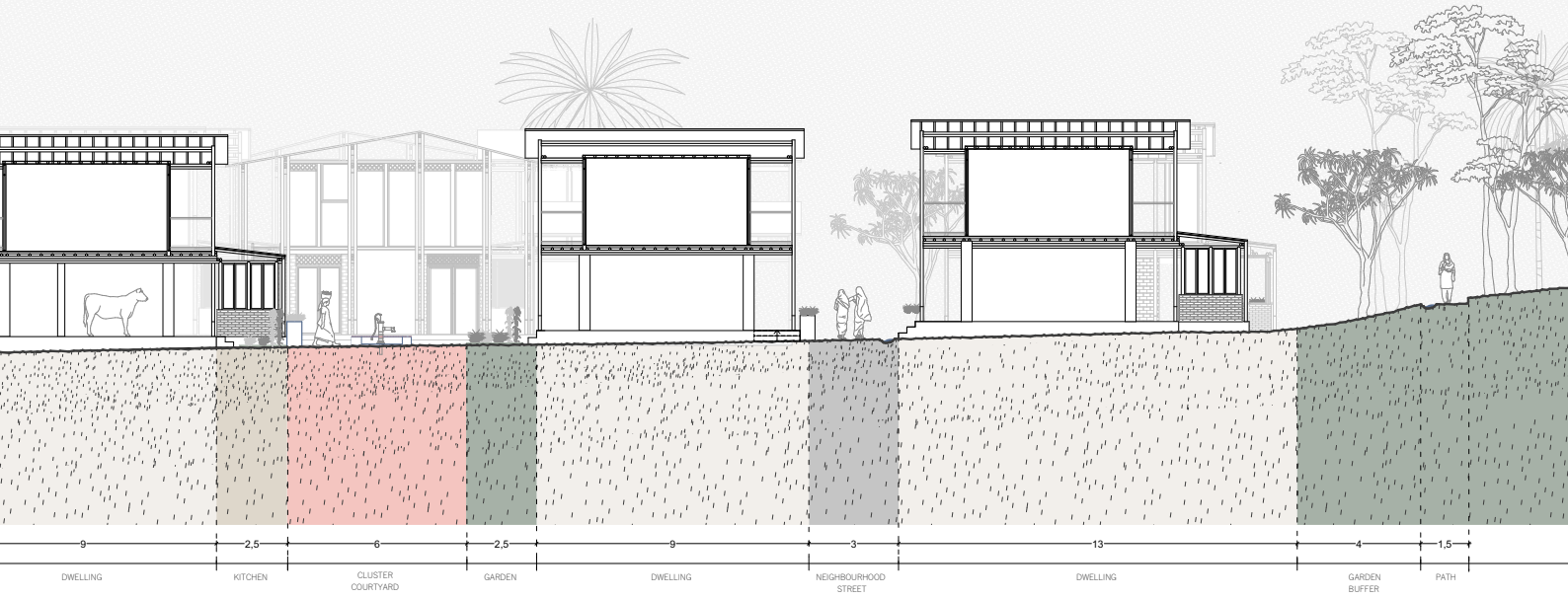
STREET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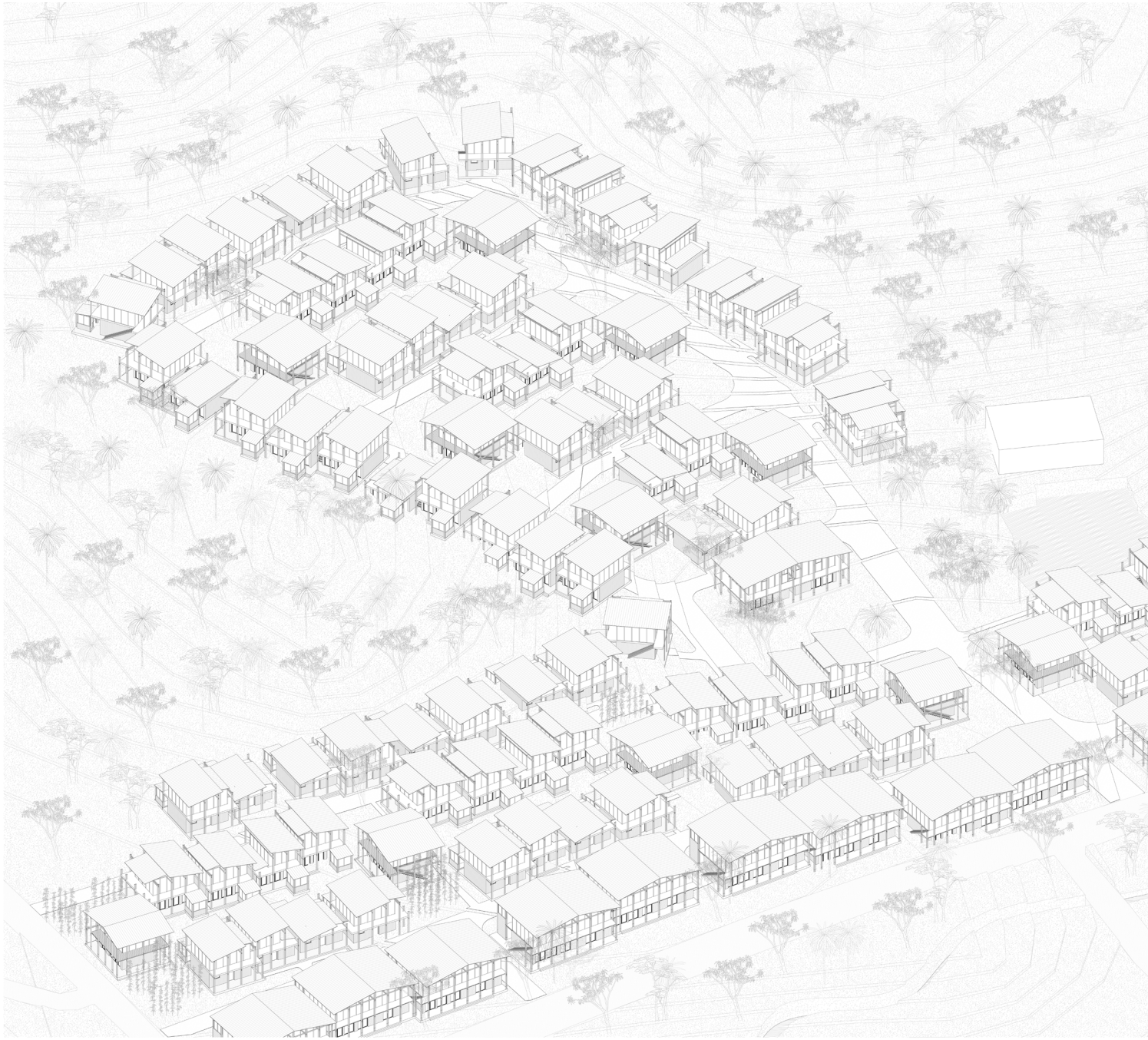
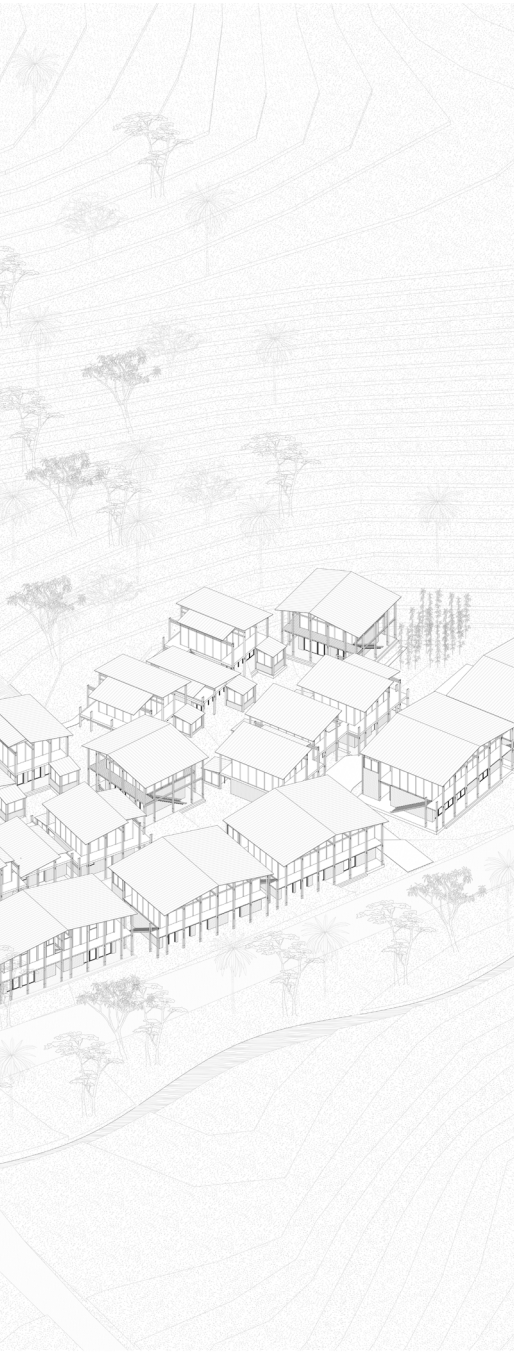
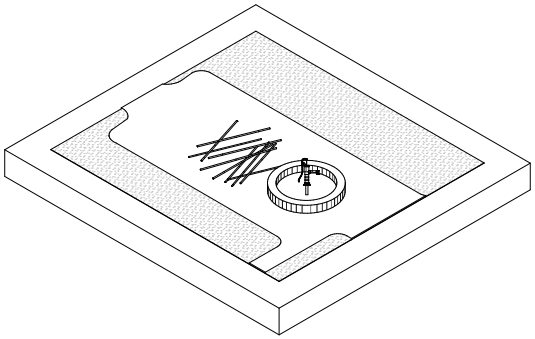
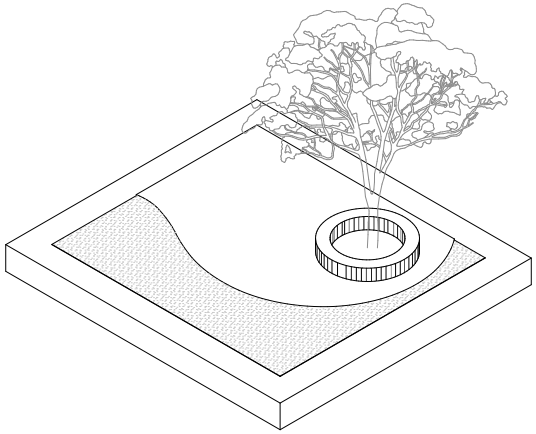
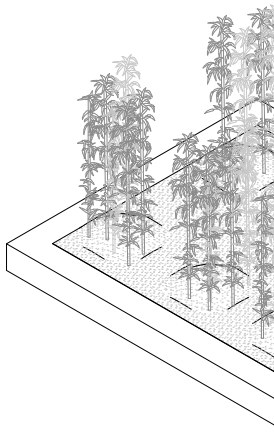
KITCHEN
CLUSTER COURTYARD
GARDEN
DWELLING
NEIGHBOURHOOD STREET
DWELLING
GARDEN BUFFER
PATH

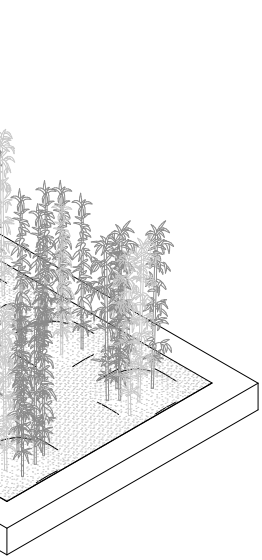


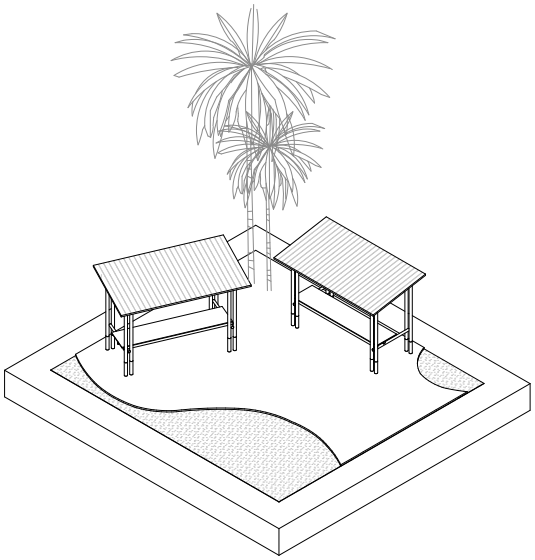


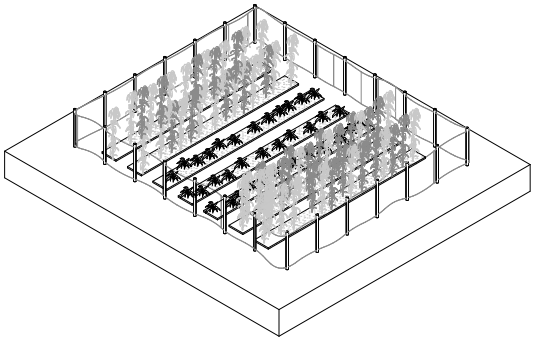










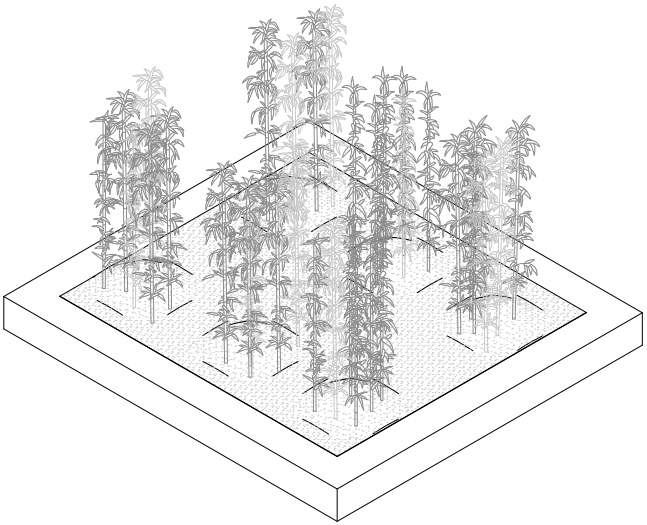






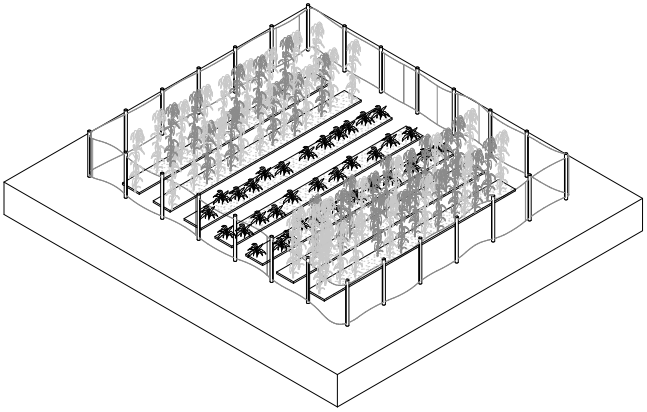


BAMBOO PLANTATION



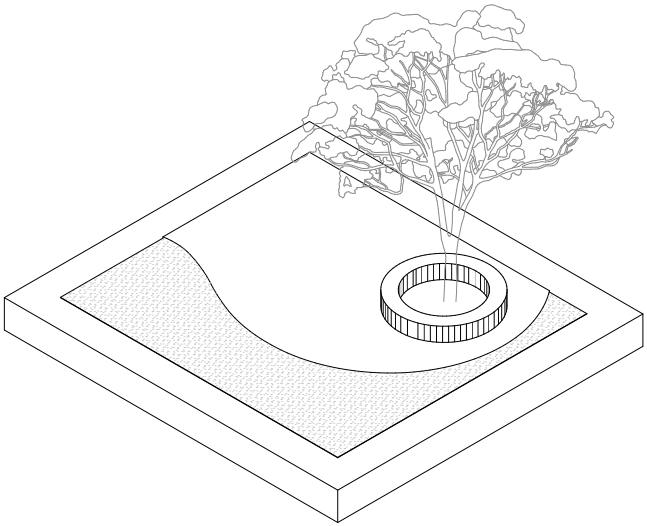


COMMUNITY GARDEN



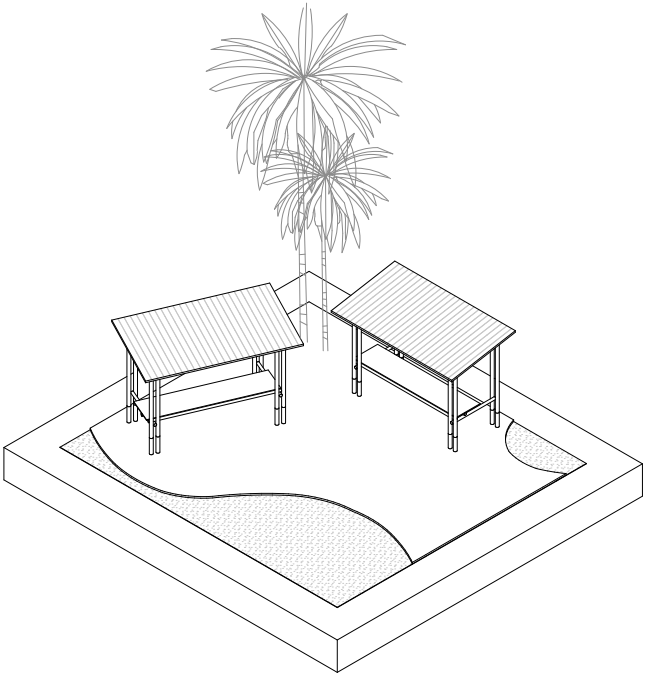


MEETING POINT



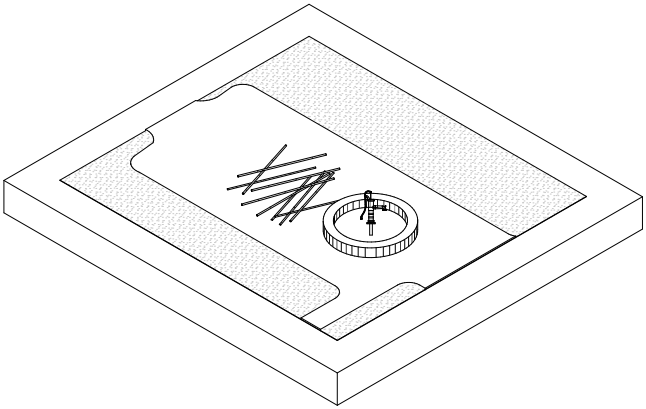


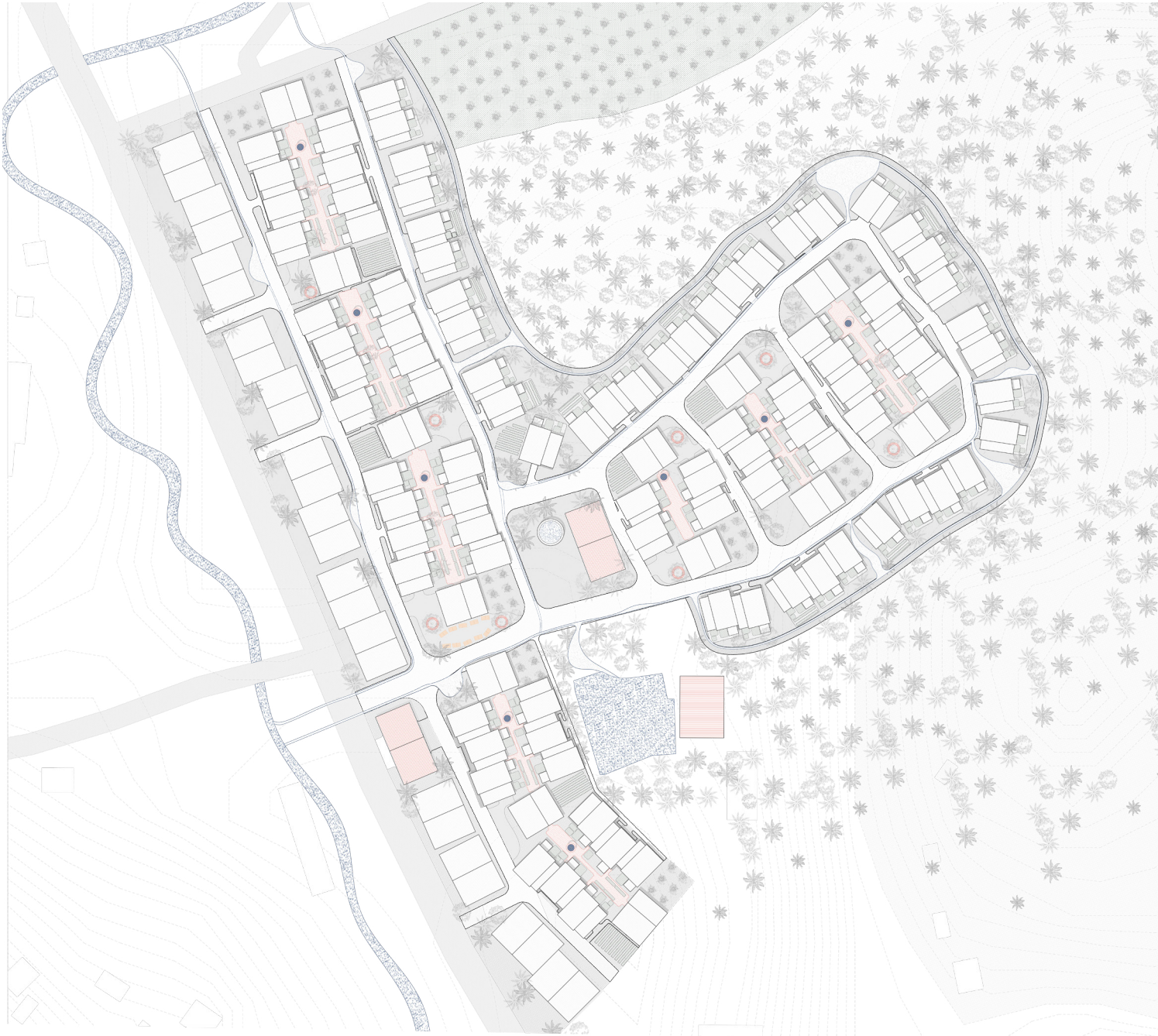
MARKET SQUARE





TUBE WELL COURTYARD





03 cluster & unit



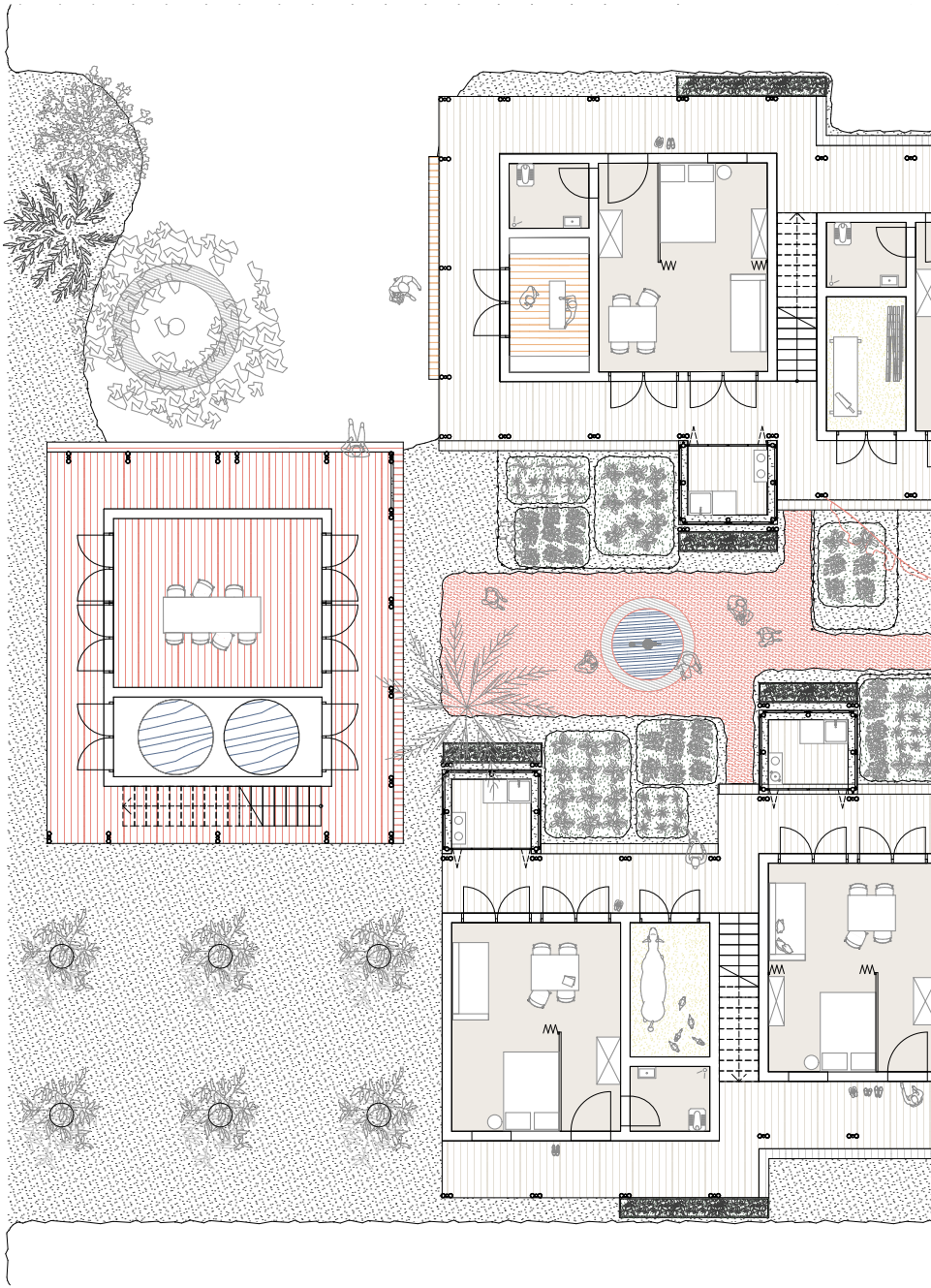
PRINCIPLES
CLUSTER & UNIT

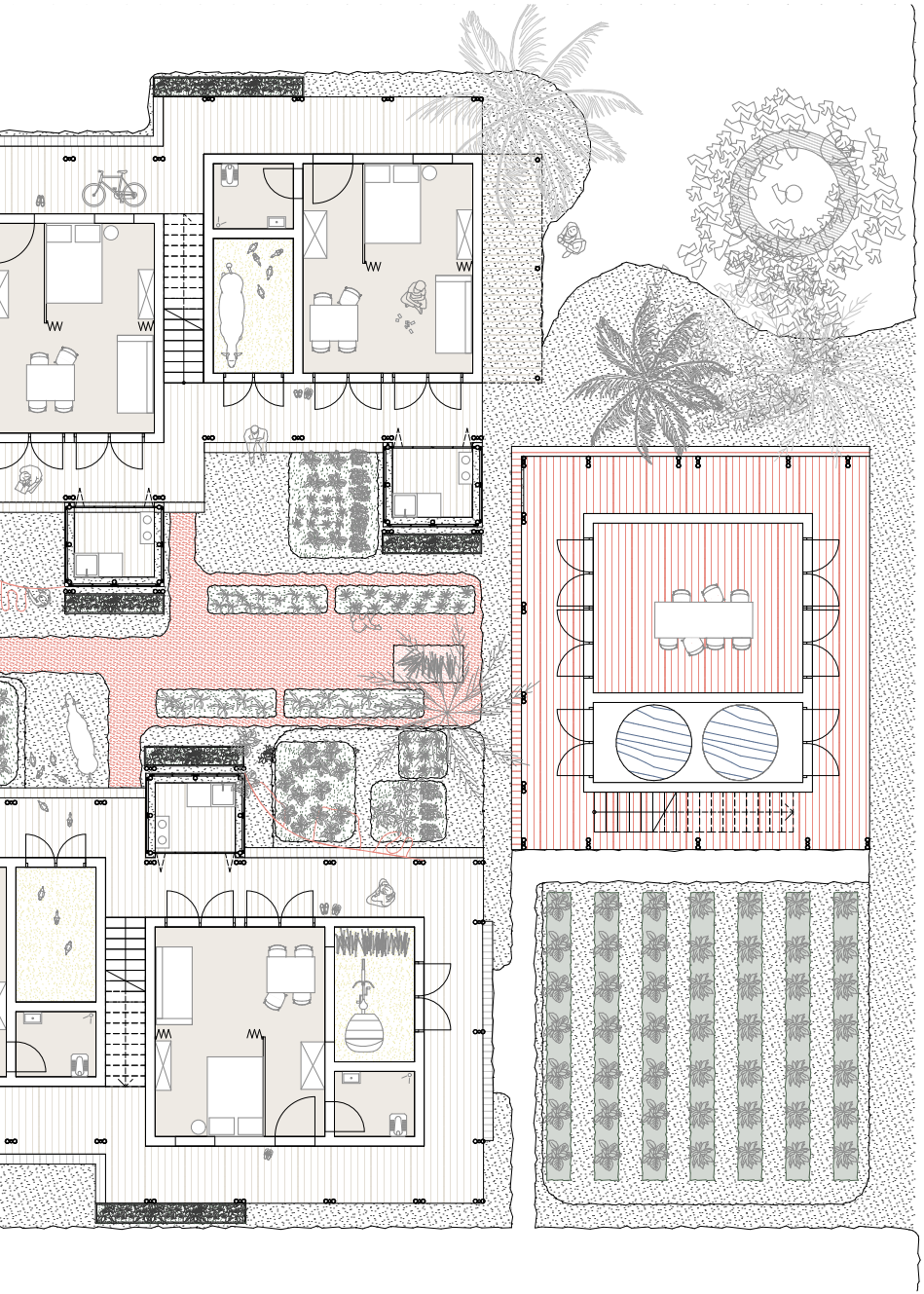
At the cluster and dwelling level, the design emphasizes a layered spatial experience that supports daily life, social interaction, and flexibility.

The spatial sequence, from the elevated entrance, through the veranda with its adjoining kitchen and garden, to the central courtyard, establishes a series of thresholds that mediate between public, communal, and private realm.

Each dwelling includes a small garden space for personal cultivation, keeping livestock such as cows, and supporting traditional outdoor kitchen activities. Shared staircases, open kitchens, and garden spaces foster a communal atmosphere, encouraging interaction among residents. The courtyard, carefully scaled to feel intimate without being constrictive, serves as the social heart of the cluster.

Type A is designed with the possibility of extension. Each unit includes one multifunctional space on the ground floor, which can be configured as a stable, storage room, corner shop, or garage, depending on the household's requirements. Type B integrates residential use with ground-floor public activation, allowing residents to operate shops, small restaurants, or other services. This combination of domestic and economic functions strengthens the local economy and reinforces the social life of the neighbourhood.







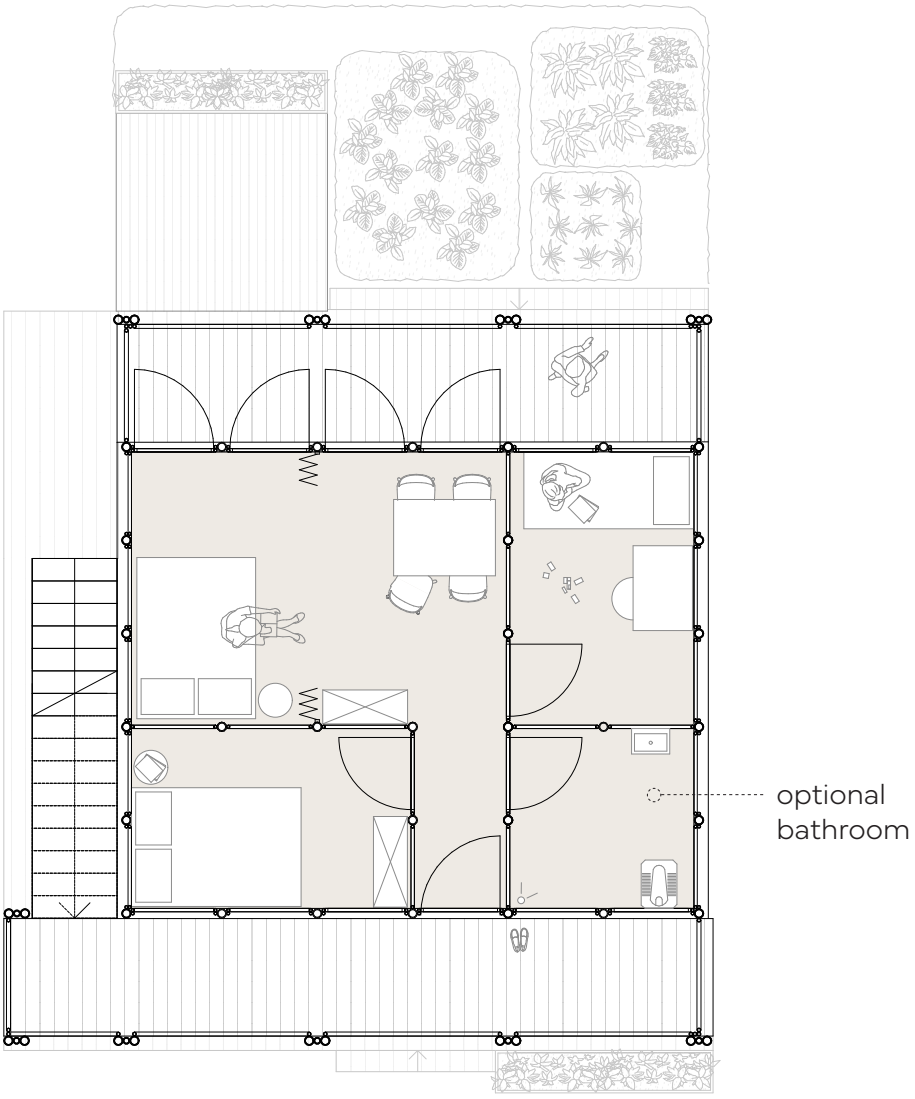












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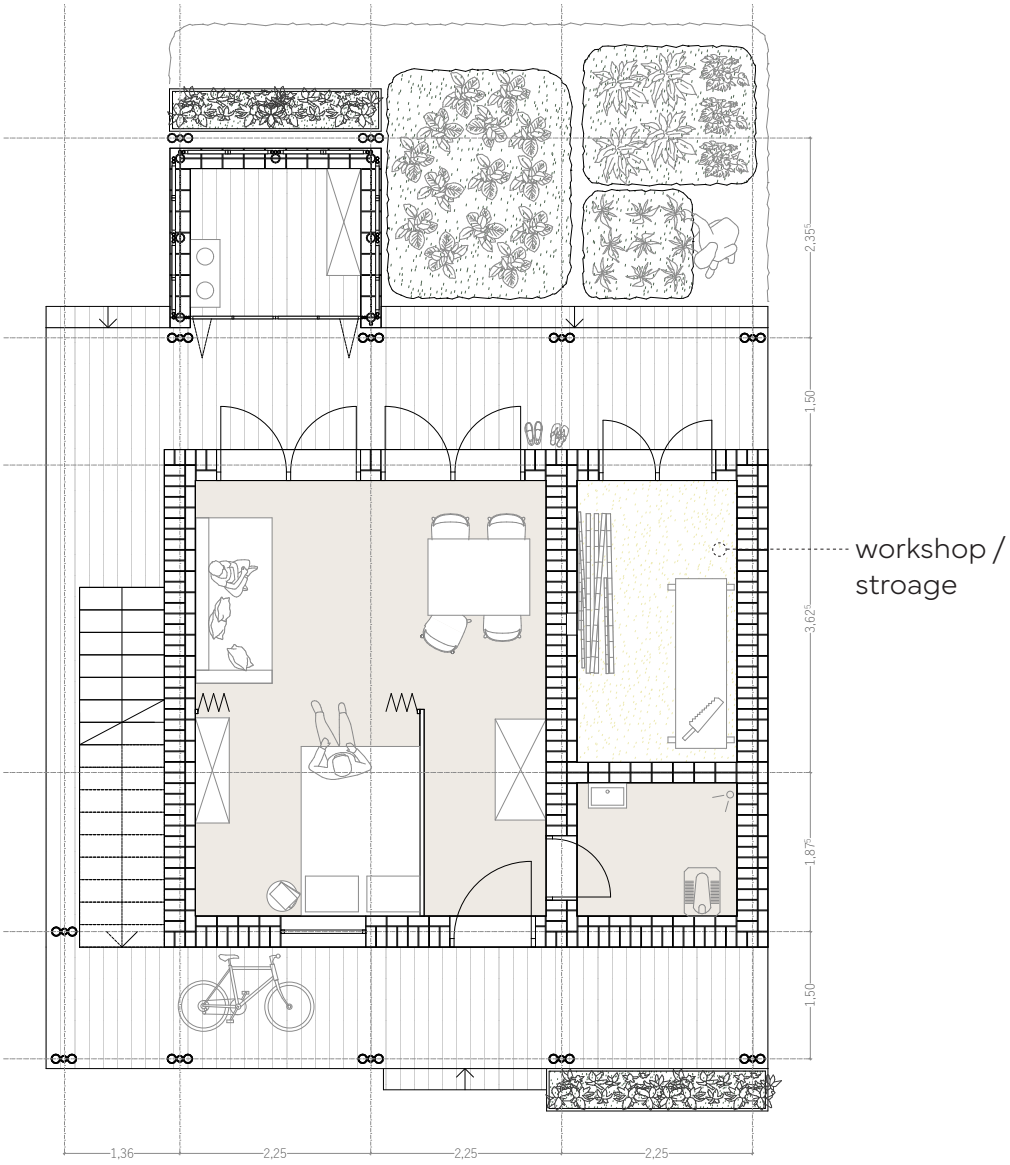

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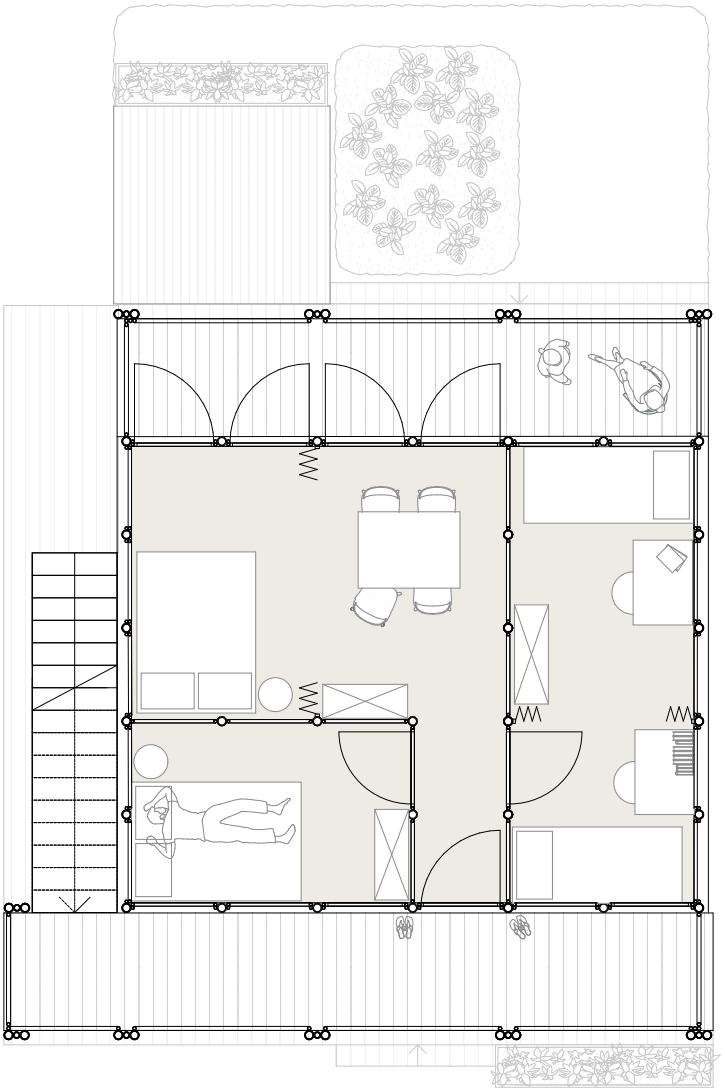

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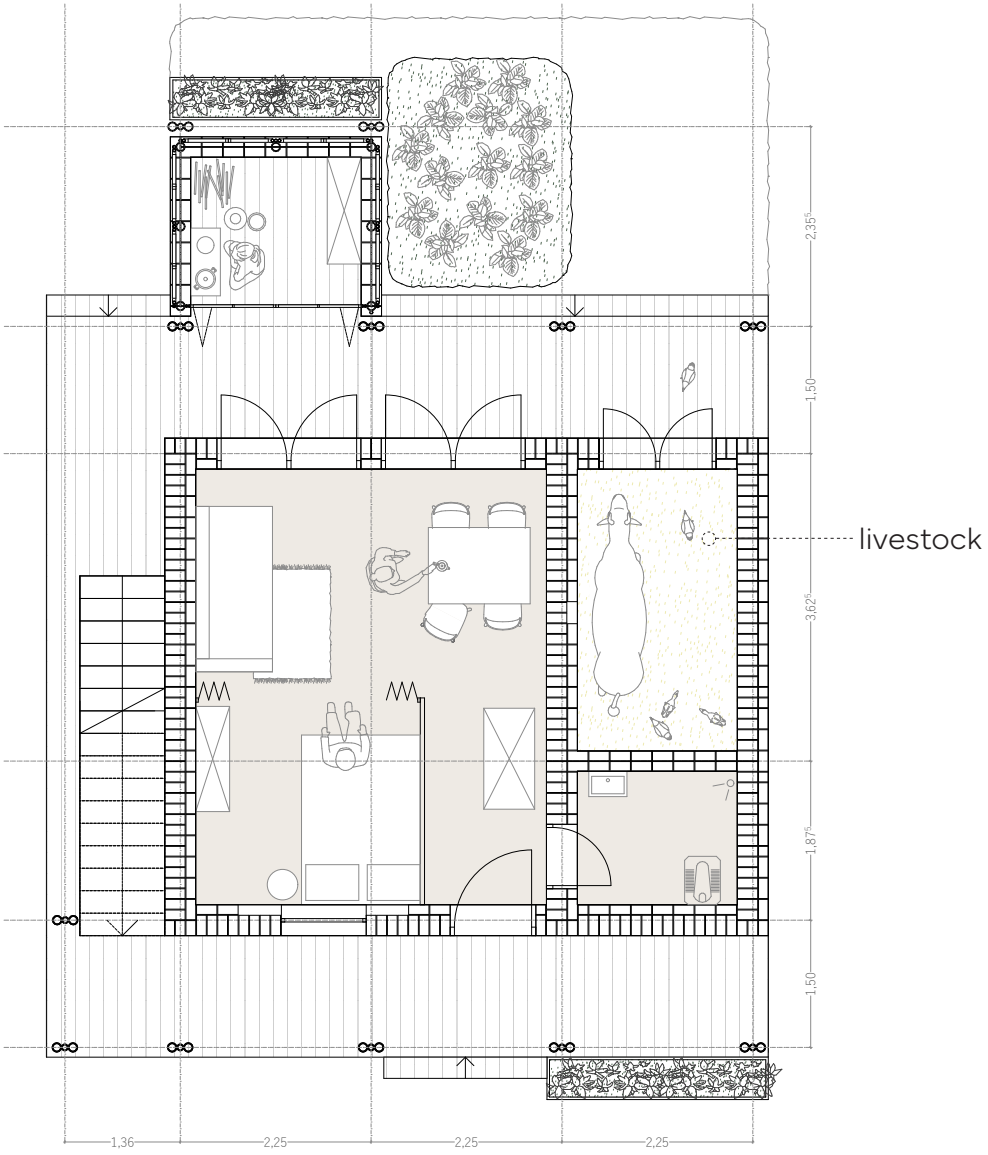

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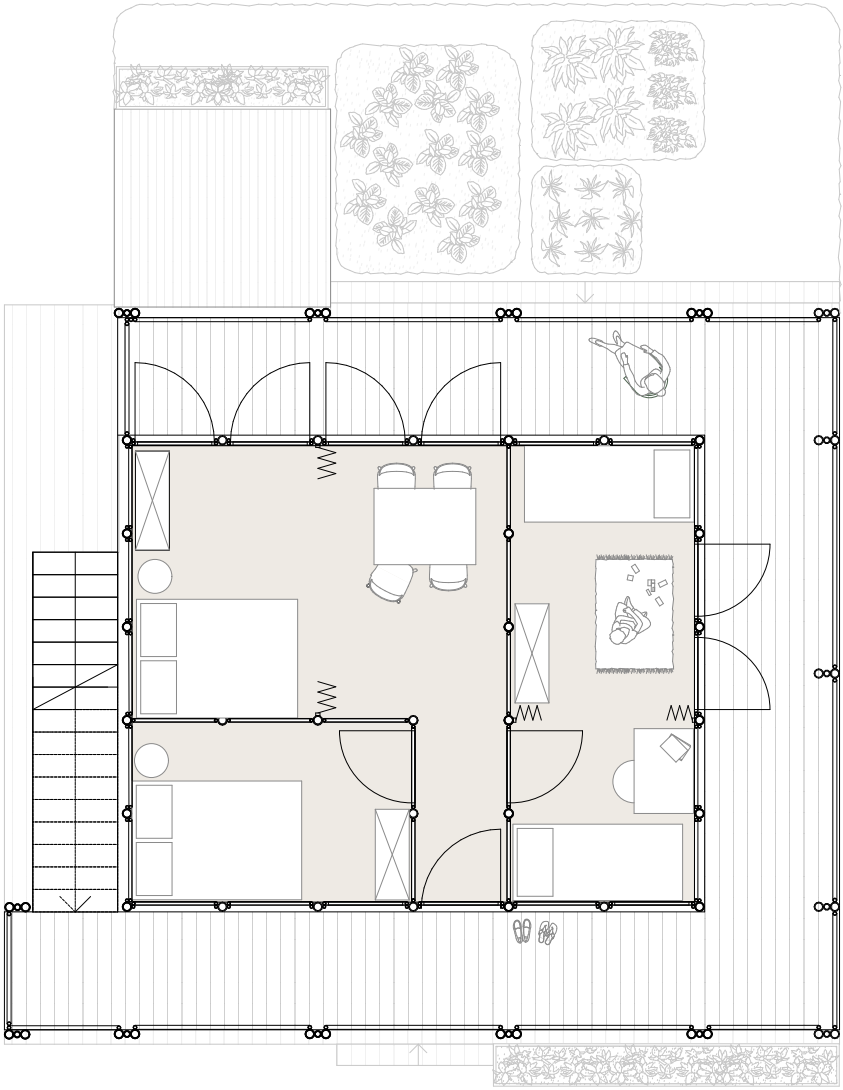

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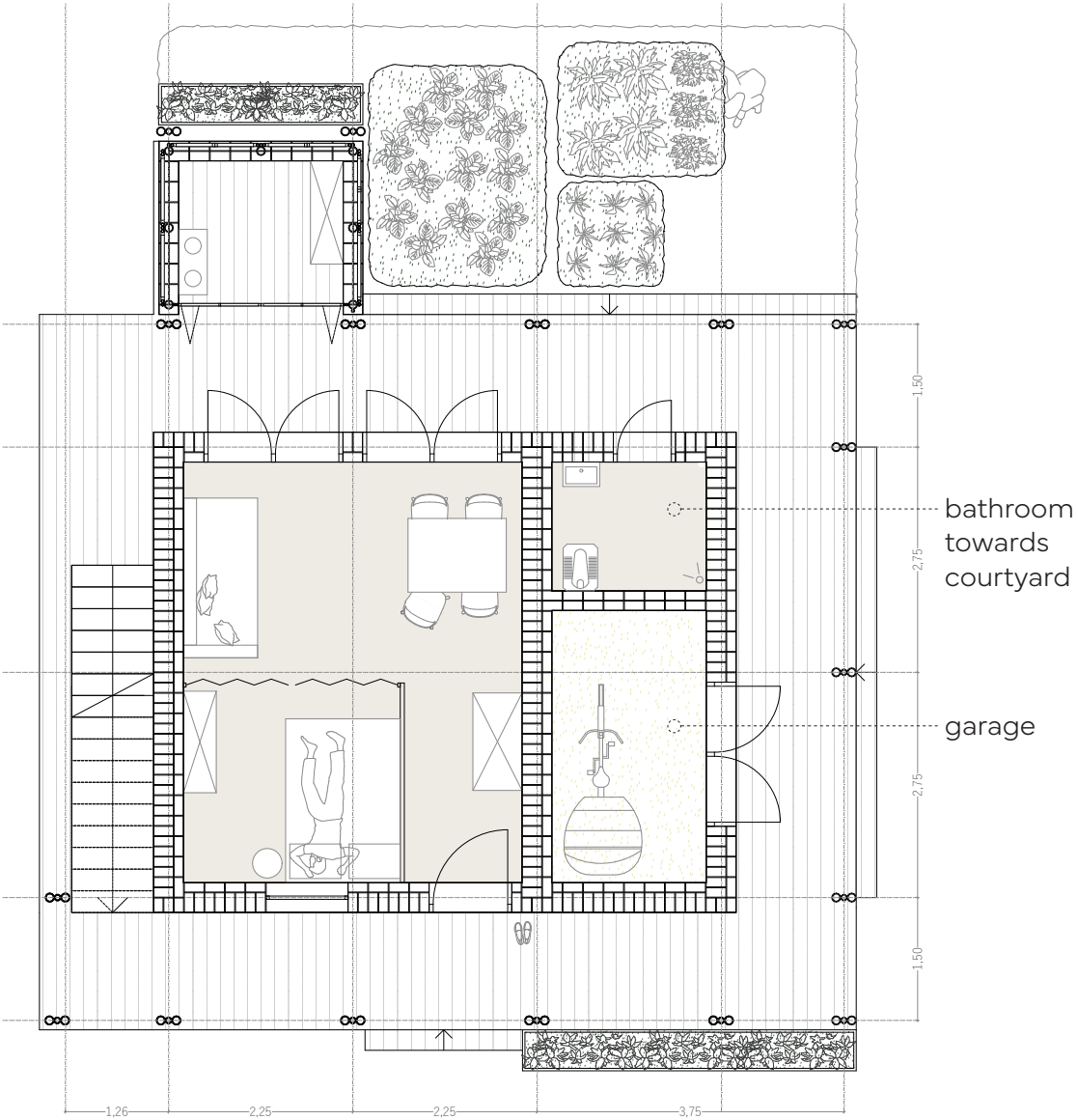
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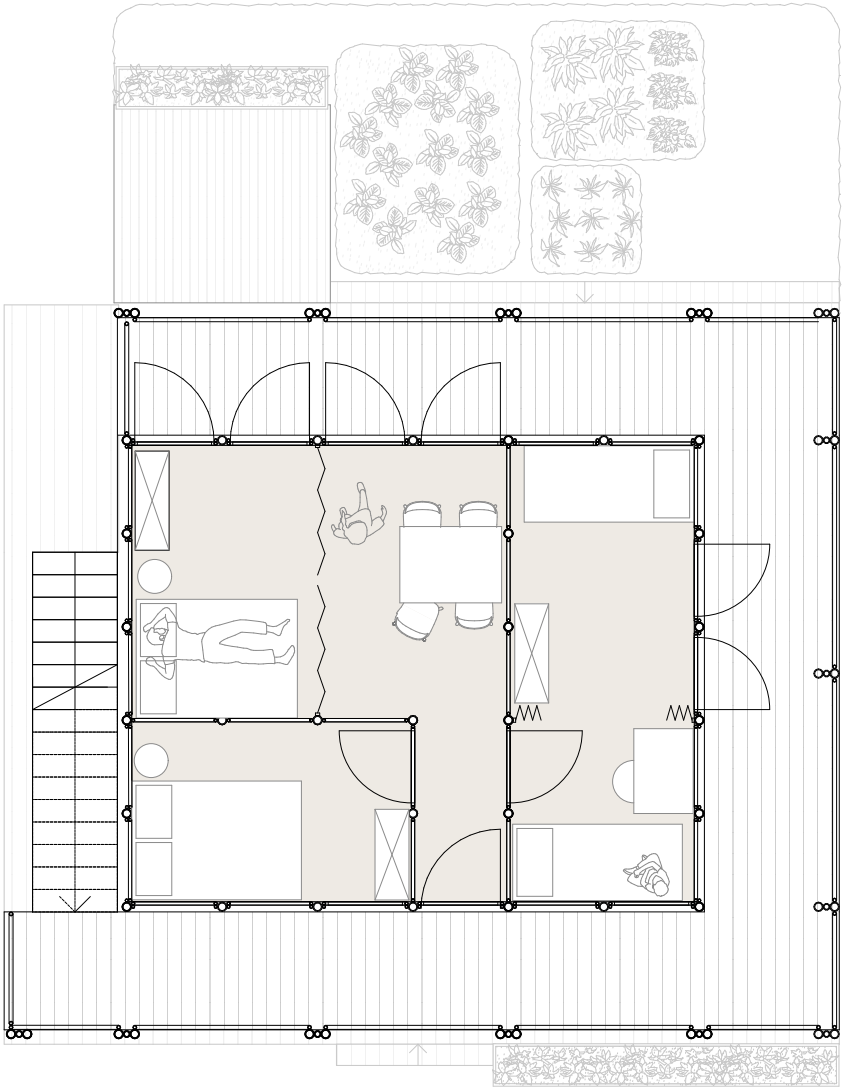

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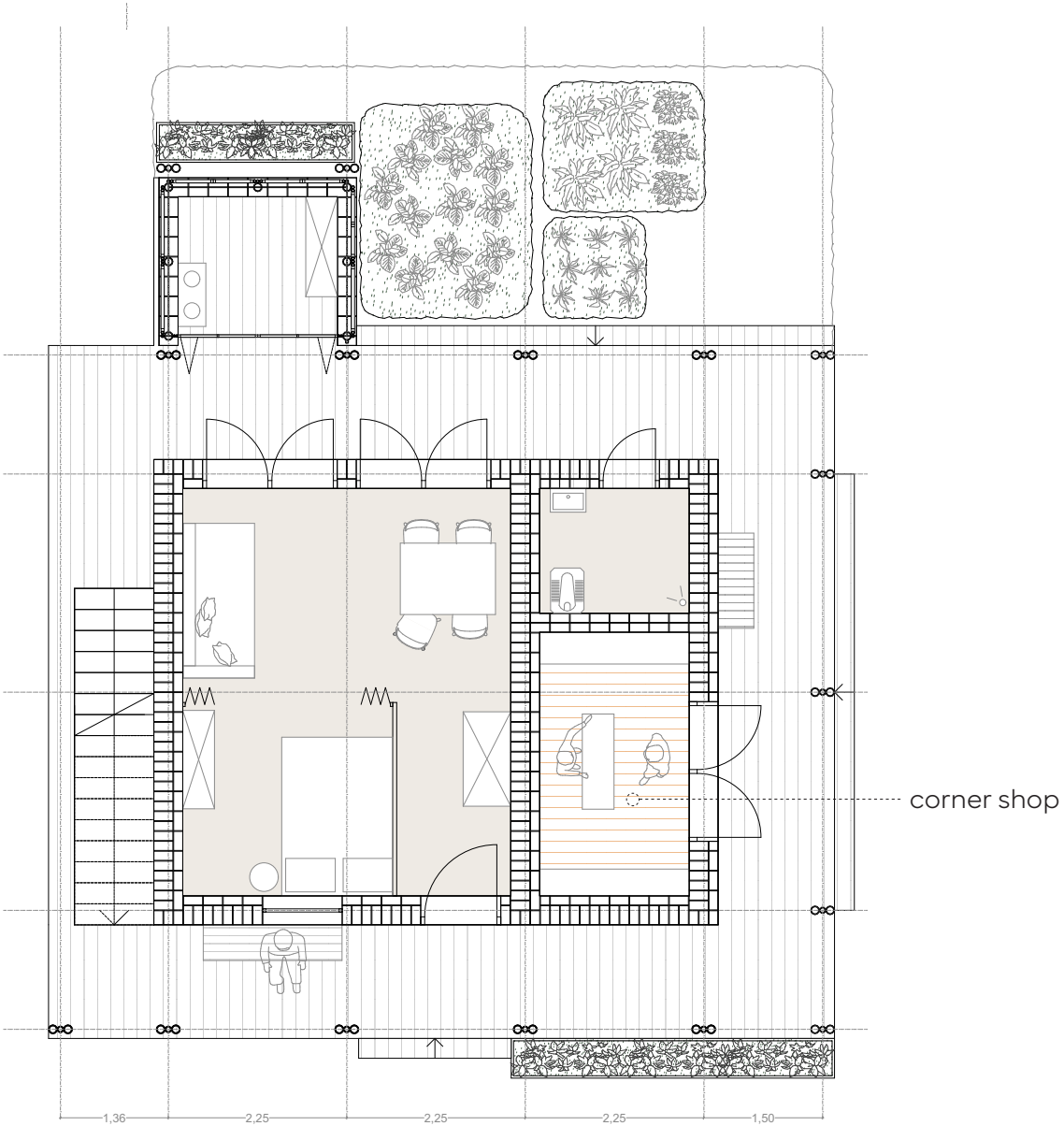

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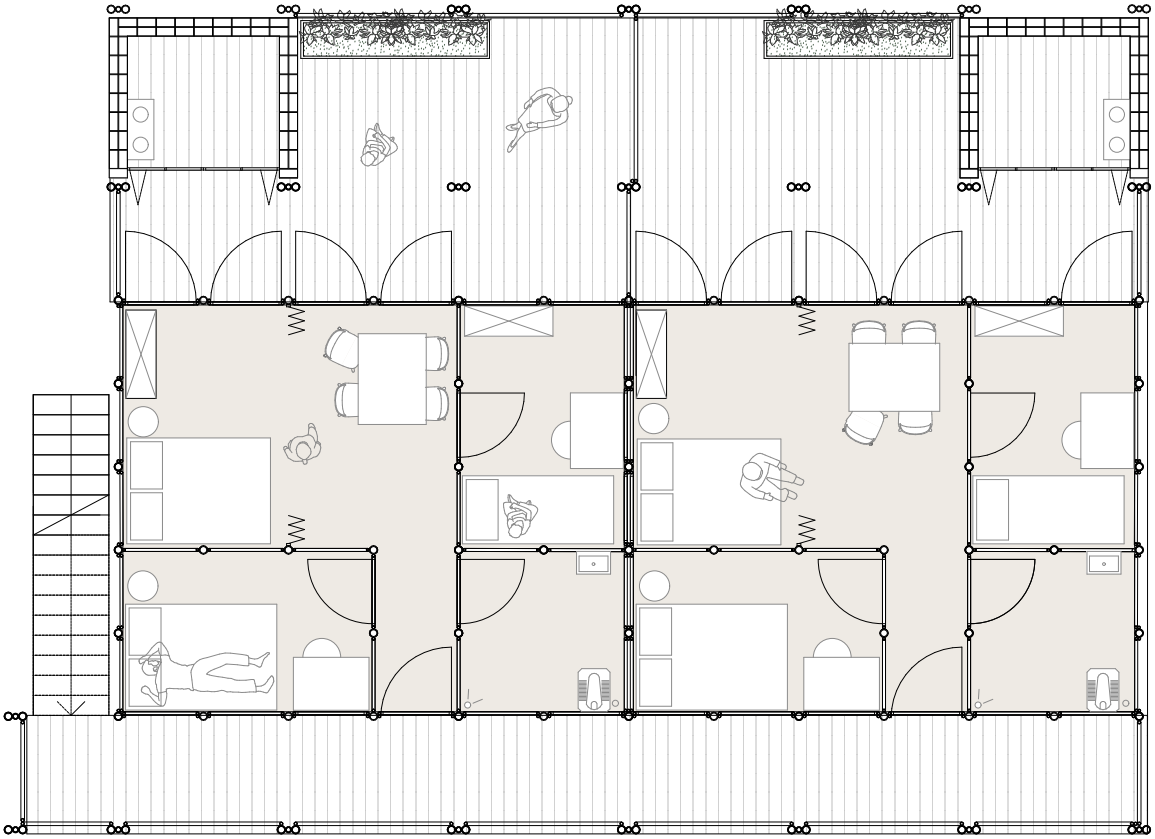

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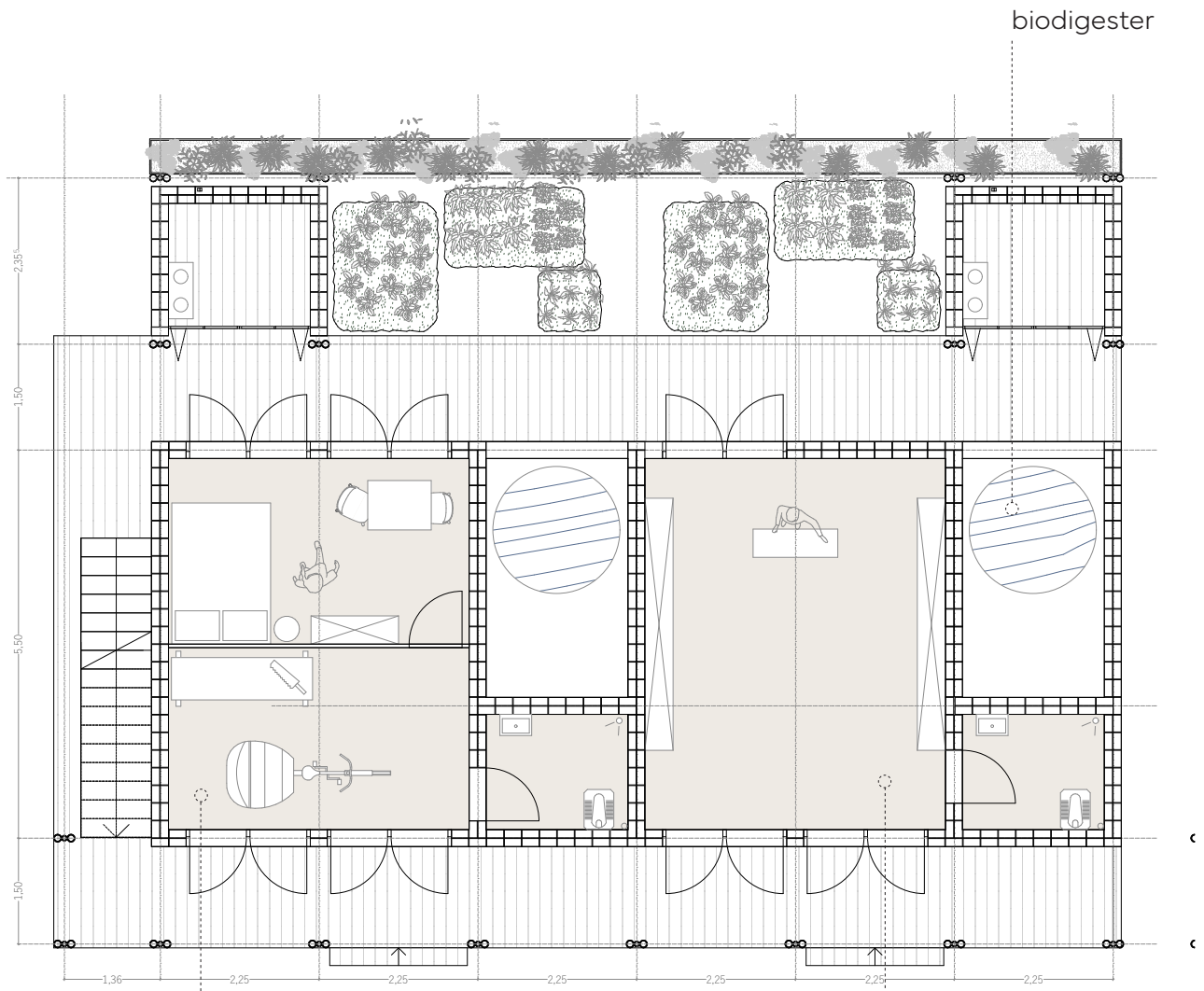
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shop (half size)
shop (full size)

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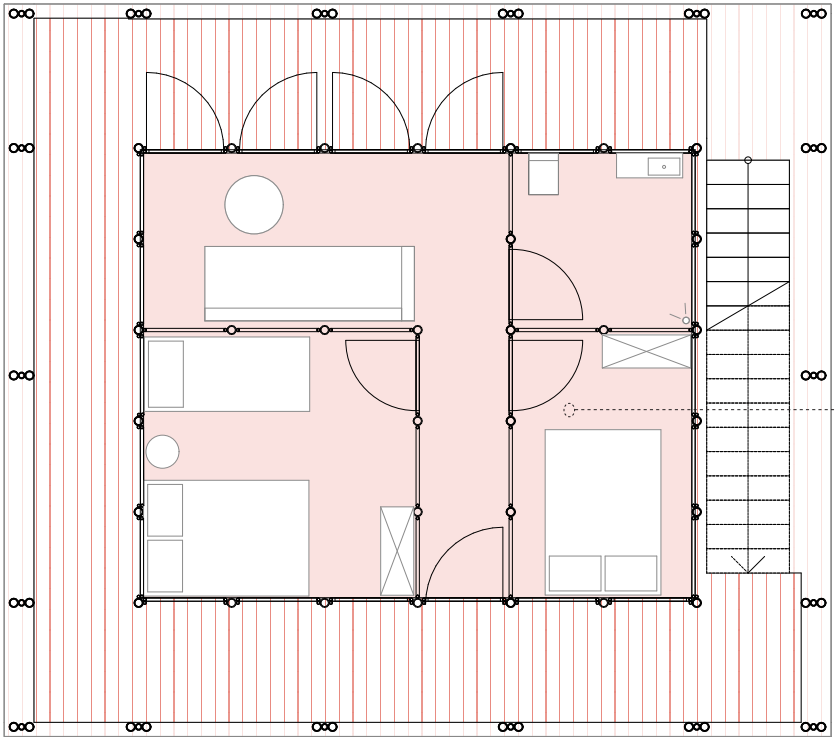

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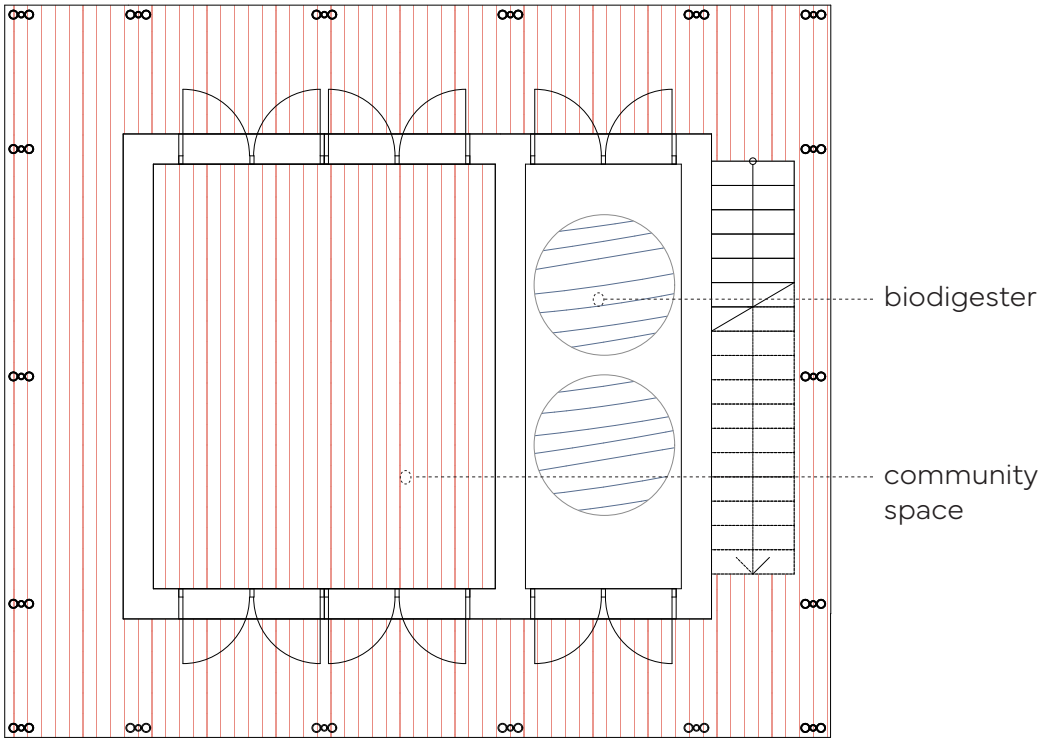

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04 materials



EARTH

There are various techniques for building with mud. One of the oldest methods is cob construction, where walls are built up in layers using a soil mixture. It is an affordable and simple technique that requires no specialized tools and only basic skills.[22]

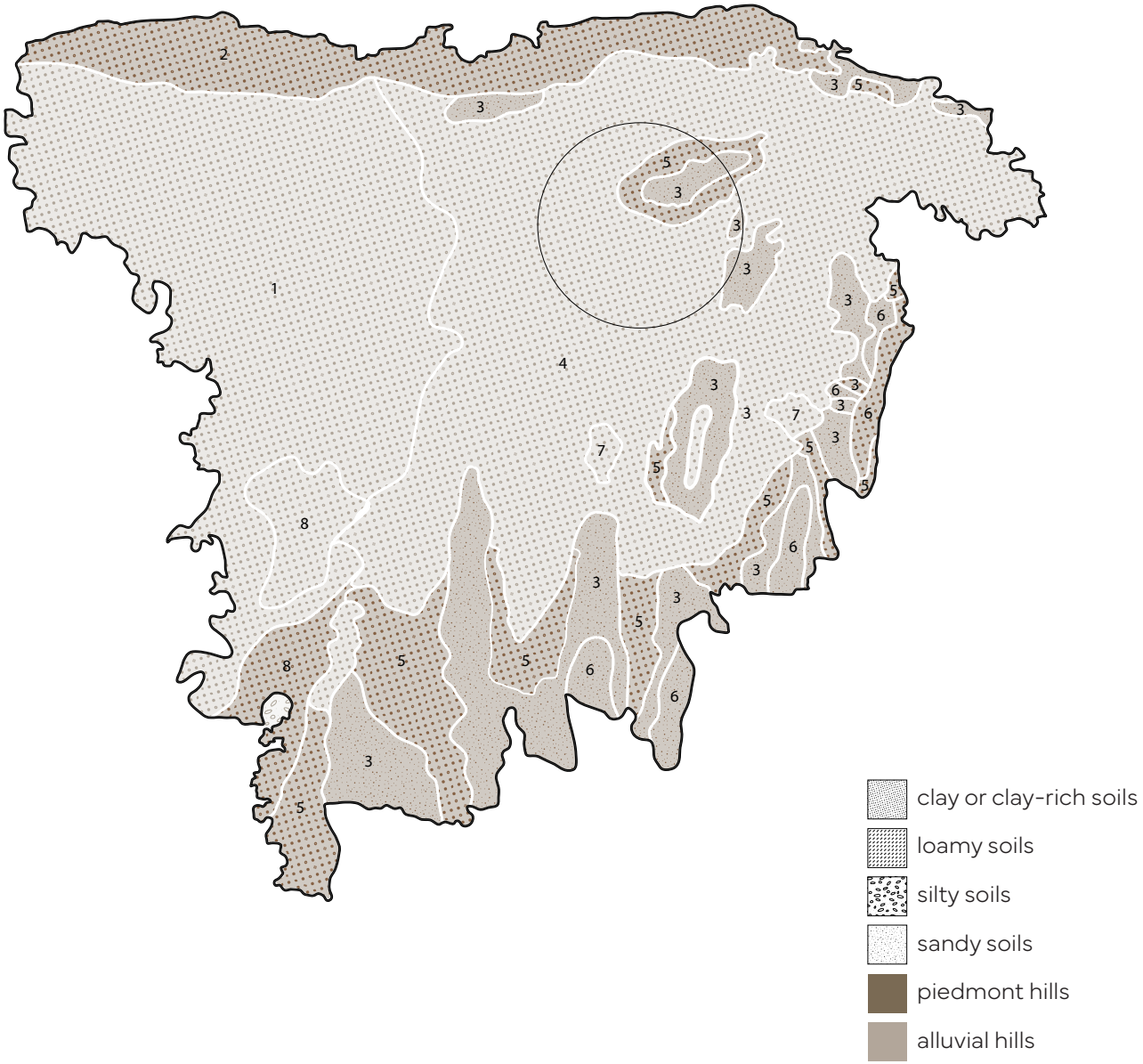
One of the most common techniques used in Bangladesh for exterior and partition walls is the wattle and daub method. In this technique, a frame made of woven bamboo or wood is coated with layers of mud. To improve elasticity, fibers are added to the mud mixture, and lime can be used to increase water resistance. However, this method is not suitable for load-bearing walls.[23]

Another widely used method is Compressed Earth Block (CEB) construction. Although increasingly popular worldwide, this technique is not a modern innovation;it is rooted in the traditional adobe block method. By compacting the earth, the structural performance and durability of the material are significantly enhanced. With proper quality control, CEBs can achieve performance levels comparable to those of sand-cement blocks or fired bricks. [24]

In comparison to fired bricks or sand-cement blocks, Compressed Earth Blocks (CEB) can be produced using a simple manual press, enabling local communities to manufacture the blocks on-site.[25] The low level of technical expertise required for production significantly reduces costs, making CEB an economically accessible building material. Furthermore, the absence of a firing process substantially lowers the carbon footprint associated with CEB production, enhancing its environmental sustainability.[26]

Compressed Earth Blocks (CEB) are composed of soil, sand, clay, and water. [27] In their unstabilized form, without additives such as lime or cement, these blocks must be carefully protected from water exposure. Only when stabilized, producing Compressed Stabilized Earth Blocks (CSEB), can they be used for multi-story construction. The Vikas Community serves as an example of this approach, featuring a three-story building constructed with CSEB.[28]

22. material research (global housing), chapter 6, 324
23. material research (global housing), chapter 6, 350
24. Rigassi, Compressed earth blocks, 6
25. Rigassi, Compressed earth blocks, 12
26.material research (global housing), chapter 6, 314
27. material research (global housing), chapter 6, 328
28. material research (global housing), chapter 6, 356


clay or clay-rich soils
loamy soils
silty soils
sandy soils
piedmont hills
alluvial hills

EARTH

When building with earth, the basic ingredients remain consistent: sand, which provides stability; clay, which acts as a binder; and water. The ratios of these components vary depending on the specific technique and the desired properties of the construction. To enhance elasticity or improve stabilization, additives such as lime, cement, or natural fibers can be incorporated into the mixture.[29]

The local conditions in Sylhet are highly favorable for the production of Compressed Earth Blocks (CEBs). Clay-rich soil and sandy soils are locally available, and nearby riverbeds provide an accessible source of river sand.

29. material research (global housing), chapter 5, 320

map of soil types in Sylhet devision



TEA WASTE IN EARTH CONSTRUCTION

In earth construction, a secondary material often plays a crucial role. Fibers are commonly added to adobe bricks, compressed earth blocks (CEBs), rammed earth, or earth plaster to strengthen the material and provide properties that the earth alone lacks. These fibers act as reinforcement due to their high tensile strength. Additionally, the inclusion of fibers reduces material density and helps to minimize shrinkage cracks.[30]

Since the site is adjacent to a tea plantation there are many plants, so also fibers awaylable. The tea plant itself is used for the tea plantation. However there are fibers that are sorted out during the production.

For tea production, only the leaves and buds of the plant are required. However, during harvesting, stems and twigs are often collected along with them. These materials are sorted out during processing and could potentially serve as reinforcement in Compressed Earth Blocks (CEBs), enhancing their tensile strength. Additionally, tea dust, fines, and fine tea fibers, which are not used in tea production, could be incorporated into CEB mixtures or earth plaster to increase porosity. This would reduce density, improve insulation properties, and help minimize shrinkage cracks.[31]

30. Laborel-Préneron et al., Plant aggregates and fibers in earth construction materials, 732
31. Kumar et al., Tea byproducts biorefinery for bioenergy recovery and value-added products development , 2-4



BAMBOO

Bamboo is a traditional building material in Bangladesh, valued for its lightweight properties, rapid renewability, and strength. It is a type of grass and an exceptionally fast-growing plant, capable of reaching heights of up to 25 meters within six months.[32,33] Once the culms have fully grown, they require three to five years to mature and achieve their full structural strength, although smaller-diameter culms reach maturity in a shorter period.[33]
Bamboo can be harvested through various methods. One source is natural bamboo forests, such as those found in the Sylhet Division. In addition, bamboo plantations are established, typically by commercial enterprises that process bamboo as a raw material. Once the bamboo reaches maturity, these plantations can also provide an important source of income. Furthermore, bamboo is cultivated on a smaller scale within homesteads, where it is primarily grown for subsistence use by the households that maintain it.[34]

Bamboo serves not only as a valuable construction material but also offers significant environmental benefits. Its rapid growth and extensive root system help stabilize the soil, effectively preventing erosion during periods of heavy rainfall, an important characteristic given the extreme weather conditions in Bangladesh. In addition, bamboo cultivation positively influences groundwater levels. The dense canopy reduces evaporation, while fallen leaves slow surface water runoff, allowing more water to infiltrate the soil and remain in the area.[35]

32. material research (global housing), chapter 5, 320
33. Kaminski et al., Structural Use of Bamboo, 3
34. Janssen, Designing and building with bamboo, 34-38
35. Janssen, Designing and building with bamboo, 39


JSC/ SSC/ HSC
MSE
HSE
MSE

BRICKS

Bricks are one of the most important materials in the building industry in Bangladesh. With approximately 7,000 brick fields, this sector plays a crucial role in construction. The abundance of clay along riverbanks has supported the long-standing development of the brick industry. Bricks are typically fired in kilns, which are predominantly fueled by coal, resulting in high levels of carbon dioxide emissions and raising significant environmental concerns.[36]

Air pollution in Bangladesh is steadily increasing, with the brick industry being one of the main contributors. In particular, Dhaka suffers from poor air quality, largely linked to the 1,000 kilns operating within and around the city. In 2018 alone, the brick sector consumed an estimated 7 million tonnes of coal and emitted over 21 million tonnes of carbon dioxide. As a result, more sustainable solutions, such as eco-friendly kilns or alternative building materials, urgently need to be explored.[37]

The materials used for brick production in Bangladesh are all locally sourced. Clay, sand, and water form the primary components of bricks.[28] Besides the local sourcing of these materials, bricks remain widely used throughout the country due to their durability, structural strength, and favorable thermal properties.[39]

36. material research (global housing), chapter 1, 10
37. Taylor, "Could Bangladesh's 'Eco-Bricks' Do More Harm Than Good?"
38. material research (global housing), chapter 1, 17
39. material research (global housing), chapter 1, 49

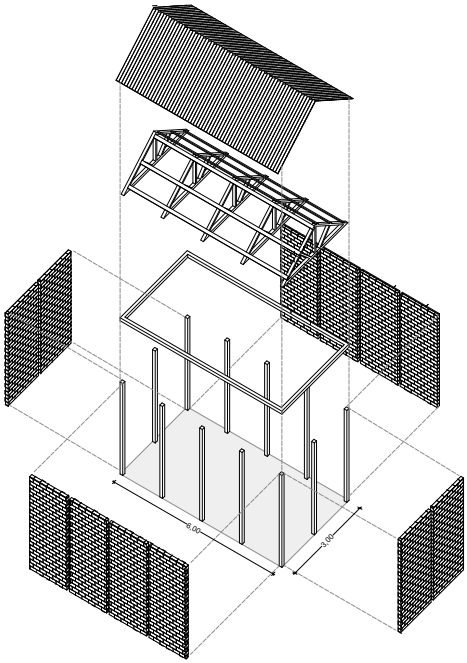
05 building technology

MATERIAL STRATEGY

The Material selection in the project was guided by four key criteria: cultural familiarity, social sustainability, financial feasibility, and ecological responsibility. The design draws from local building traditions, using materials already familiar to the community, but introduces new tecniques.

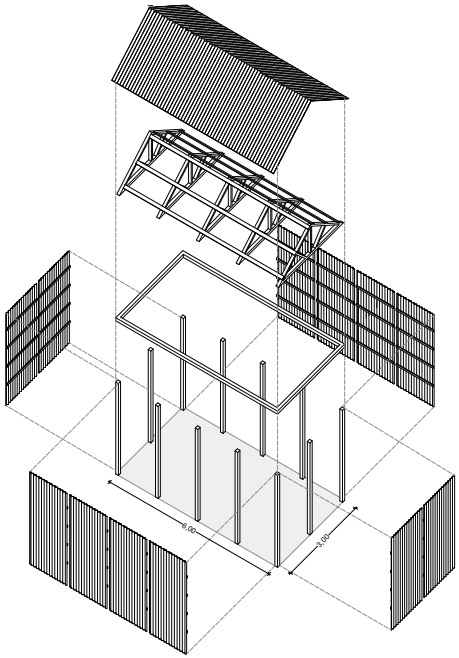
All dwelling types share a set of components to streamline planning and construction. The material palette includes a fired brick plinth, compressed earth blocks (CEB) for the ground floor, and a bamboo structure for the upper floor and veranda. This layered approach responds to spatial, structural, and climatic needs: the heavier CEB base provides privacy and separation from street-level activities (such as shops or animal enclosures), while the lightweight bamboo upper structure is modular and easily extendable. Bamboo panels are used for external and internal walls, with elevated roofing allowing for passive cooling and cross ventilation.

The Joints are designed for flexibility, using bolted connections, enabling easy assembly, disassembly, or future adaptation.



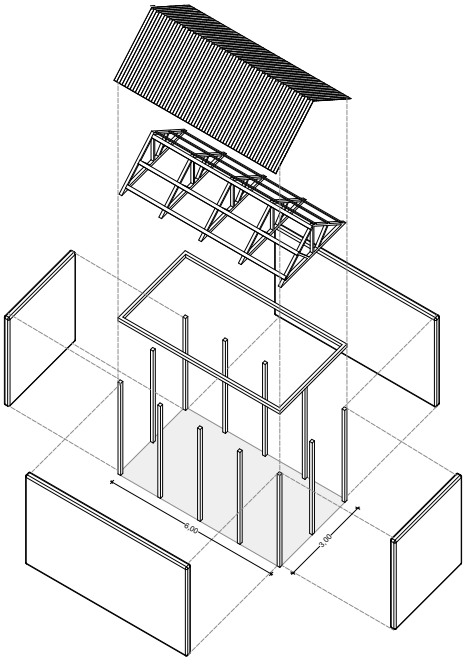
brick

exterior walls

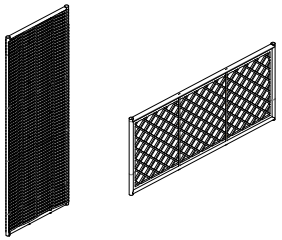


CI - sheets

roof
exterior walls
partition walls



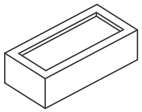
mud



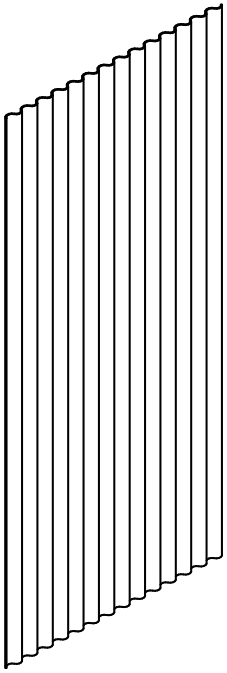
bamboo

foundation
floor
exterior walls

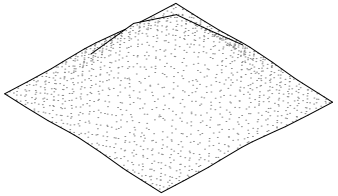
partition walls
fences
details
column



brick



CI - sheets



mud



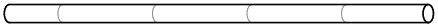
bamboo



tea waste

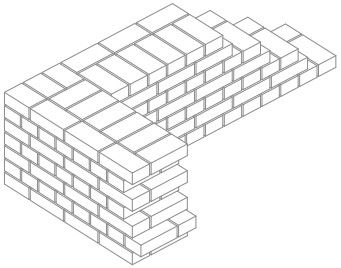


bamboo - column

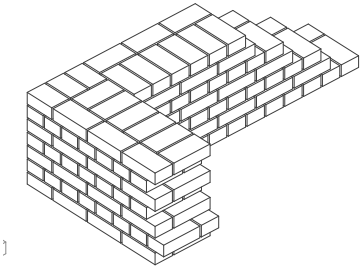


bamboo - beam

STRUCTURAL

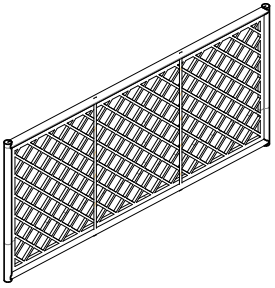


fired brick

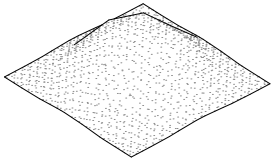


CEB

FINISH

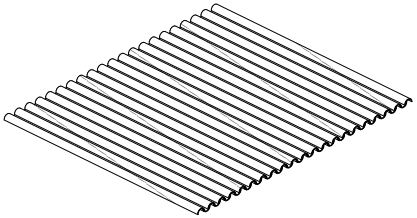


bamboo - railing

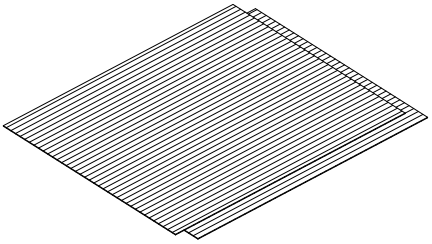


earth/ lime plaster

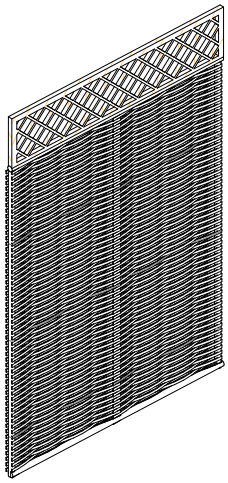
NON LOAD-BEARING



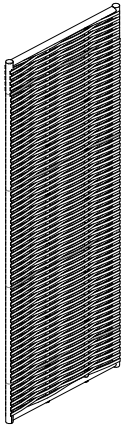
bamboo -roof



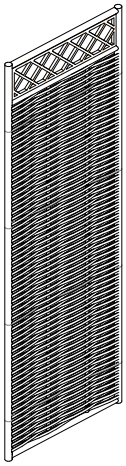
bamboo mat



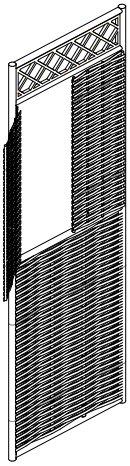
bamboo panel
double door + VG



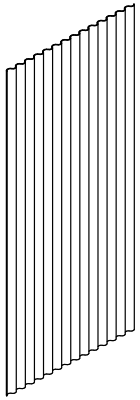
bamboo panel
closed



bamboo panel
closed + VG



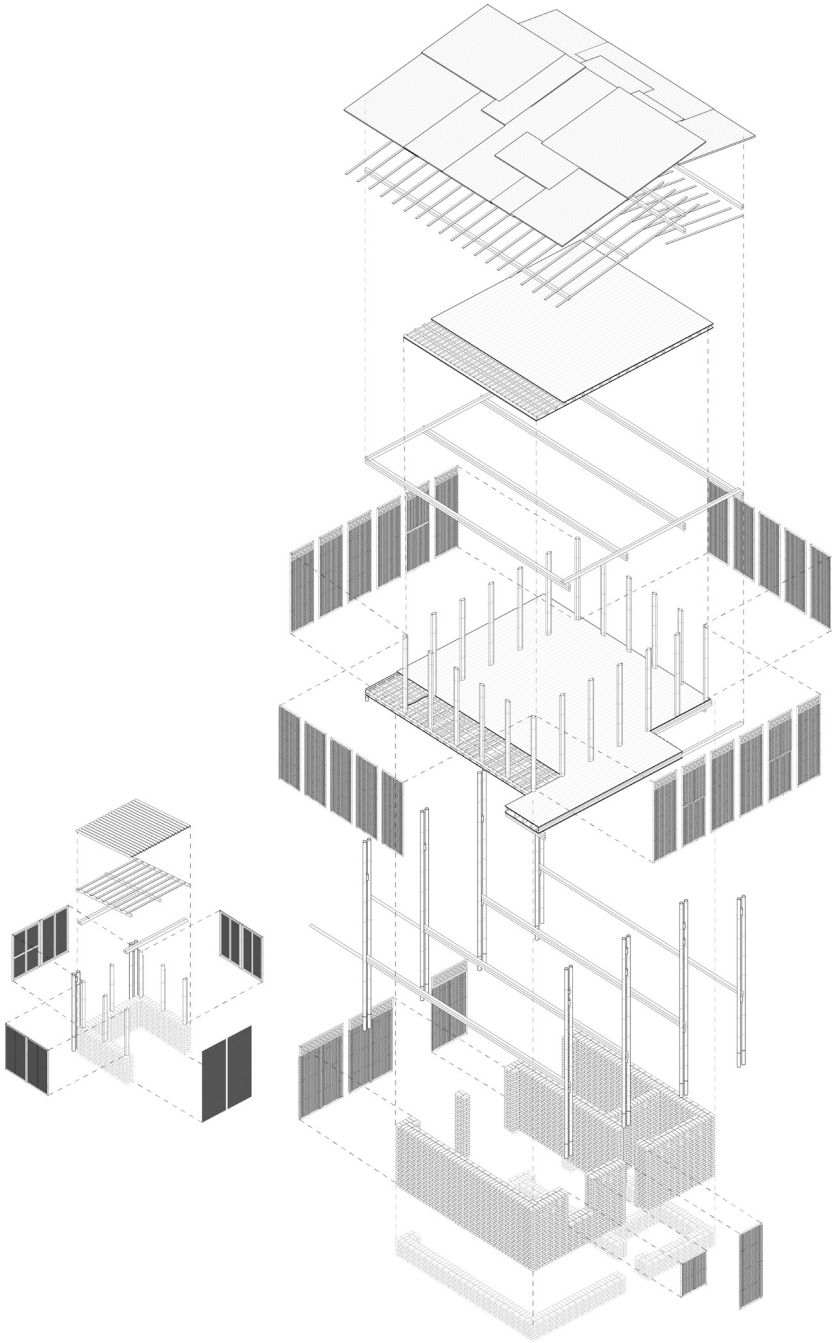
bamboo panel
window + VG

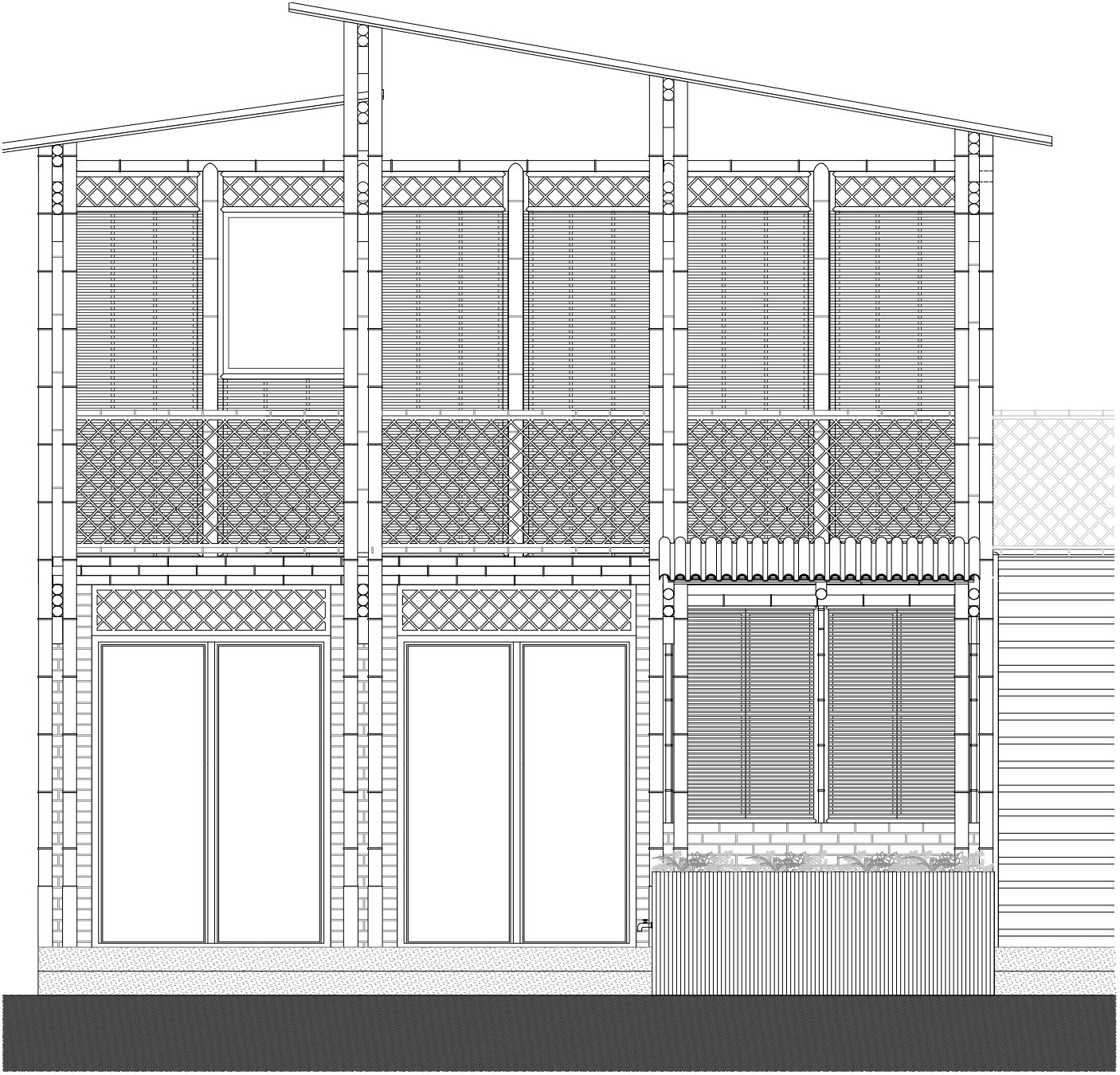


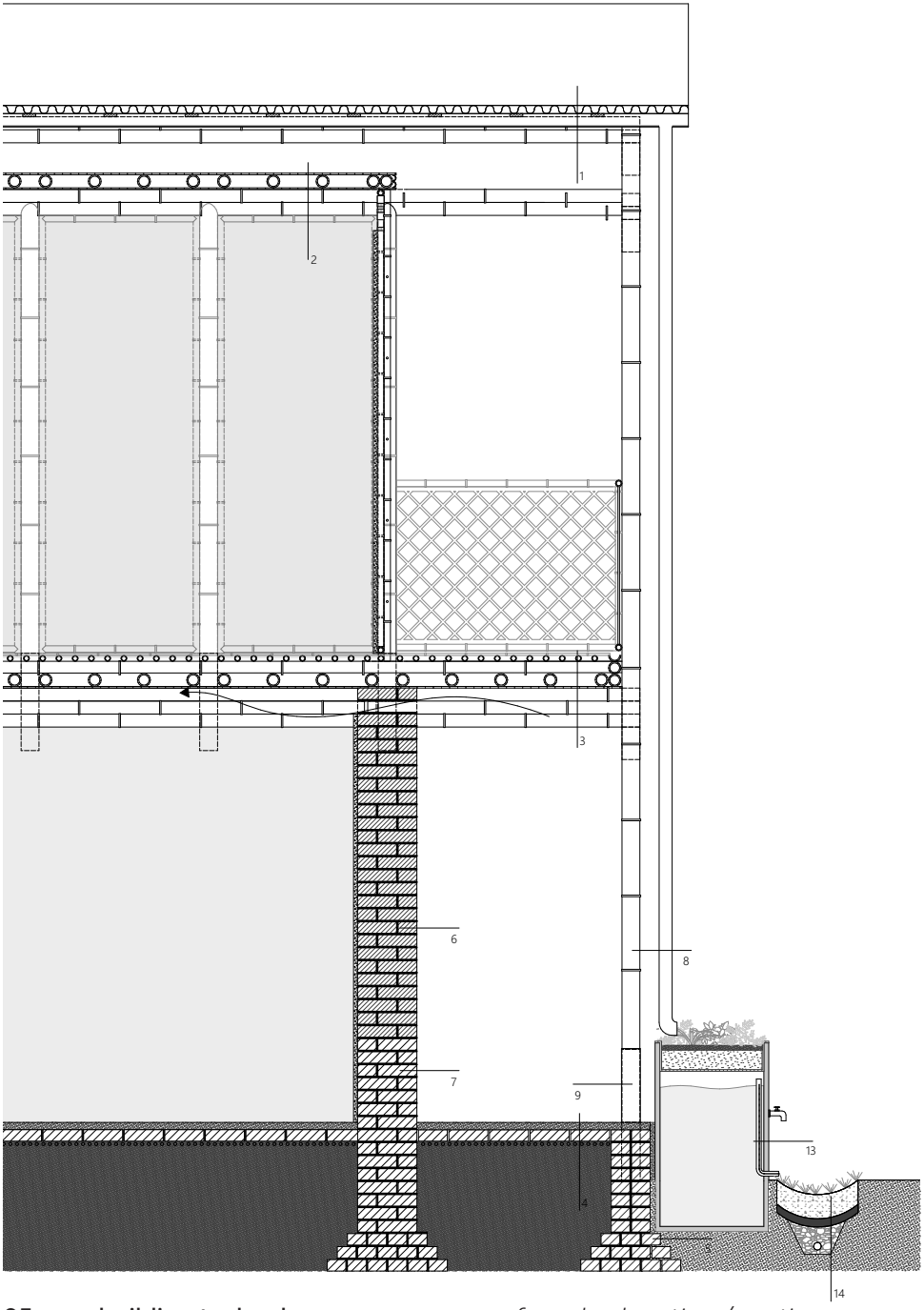
reused
CI - sheets


>50km
>40km
>70km

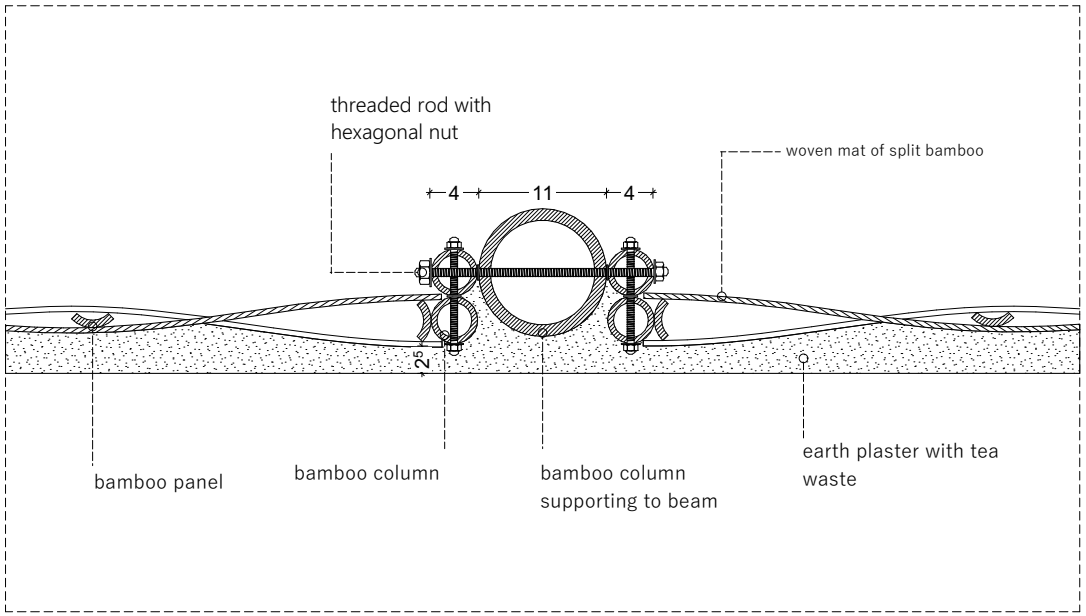

clay/silt/sand
lime
tea byproduct
CI - sheets
fired brick
import
on site





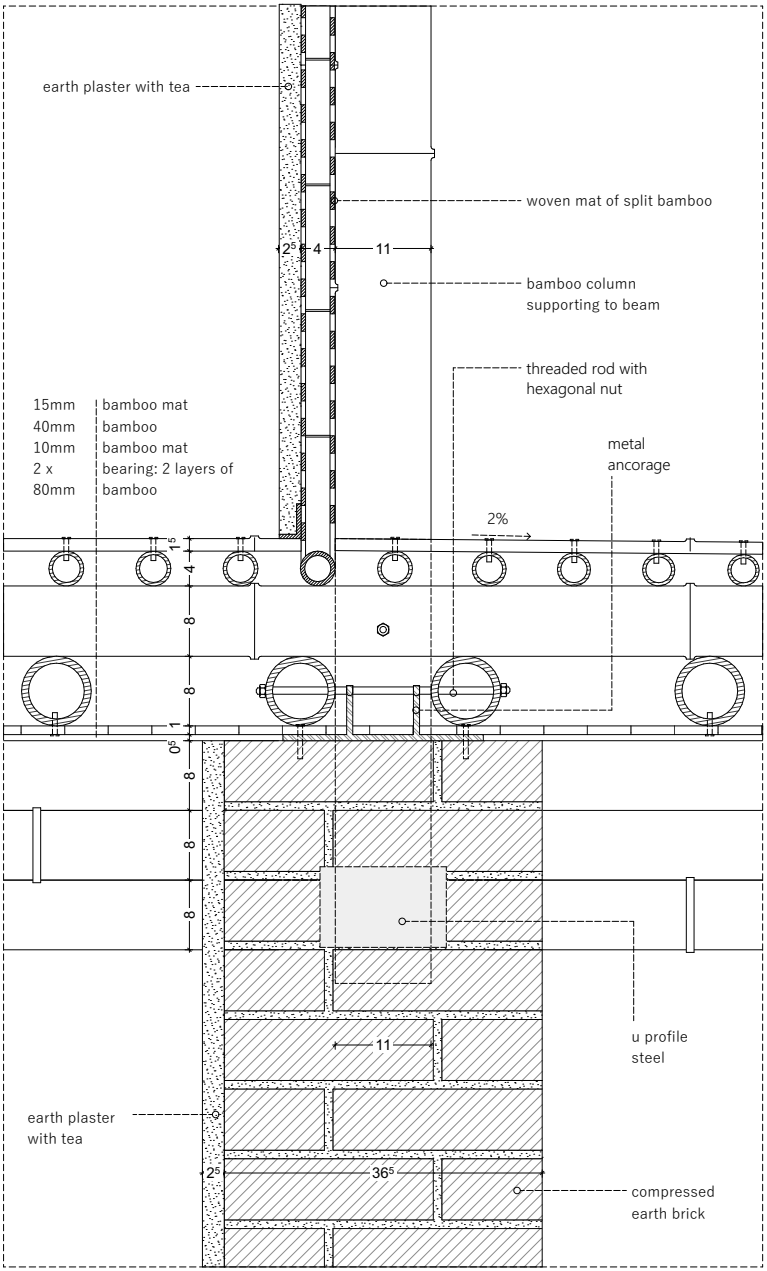


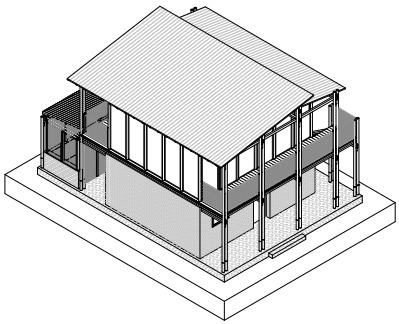
1mm 2x 80mm	corrugated iron sheet bearers: bamboo canes	1
10mm 40mm 80mm 10mm	bamboo mat bamboo cane bamboo cane bamboo mat	2
15mm 40mm 80mm 10mm 3x80mm	bamboo mat bamboo cane bamboo cane bamboo mat bearers: bamboo canes	3
40 mm 70 mm 80 mm 800mm	lime plaster fired brick fired brick chippings sand bed, compacted	4
560mm	fired brick strip foundation	5
20mm 240mm	Earth Plaster Compresses earth blocks 240x115x70mm	6
240mm	Plinth: fired brick 240x115x70mm	7
110mm	bamboo column	8
110mm	steel tube embedded in fired brick	9
240mm	fired brick 90cm	10
30mm	bamboo window frame	11
	bamboo halved bearers: 1x80mm bamboo canes	12
	planter with integrated water tank	13
	soil planting bed thick sand layer gravel layer perforated underdrain pipe	14

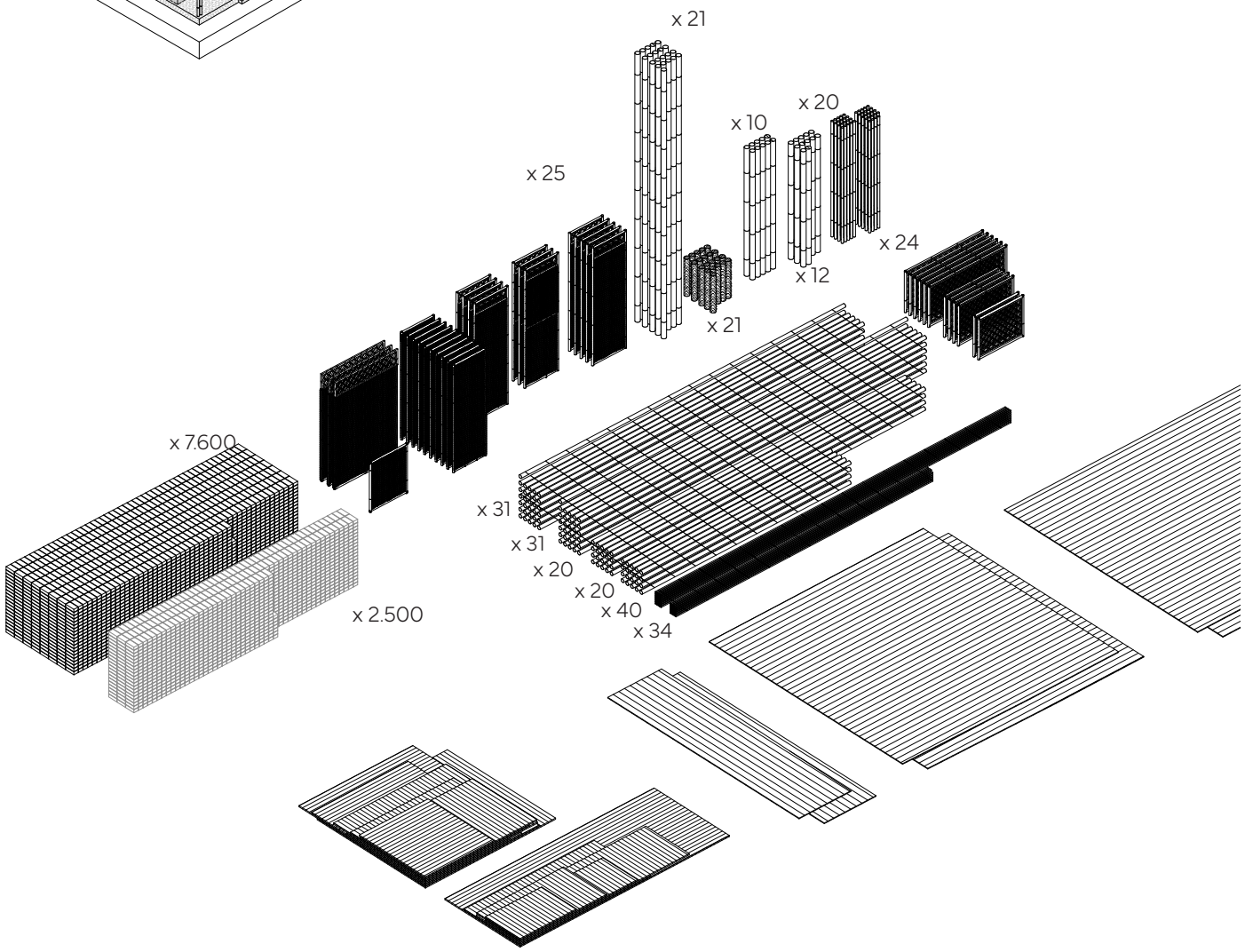


BAMBOO PANEL JOINT

BAMBOO CEB CONNECTION






x 21
x 10
x 20
x 25
x 24
x 12
x 21
x 7.600
x 31
x 31
x 20
x 20
x 40
x 34
x 2.500

COSTS

The building is composed of several different elements, combining materials to balance durability, flexibility, and cost. The lower portion of the structure is built from brick and compressed earth blocks (CEB), which provide a more permanent and solid base. This enhances privacy, particularly to the adjacent street, stable or shop.
The upper section consists of bamboo panels, that can be premade, supported by a bamboo frame. These panels are lightweight, easily replaceable, and can be modified or extended as needed.
The roof is constructed from a mix of new and reused corrugated iron sheets.

The choice of materials reflects considerations of affordability and the availability of local resources.

The costs of constructing the building are broken down as follows:

Bamboo[40] :
1m bamboo with the Ø 12cm = 60ct
197m (Ø 11cm) = 118€ (~60ct/m)
838m (Ø8cm) = 419€ (~50ct/m)
118m (Ø5cm) = 47€ (~40ct/m)
800m (Ø2cm) =240€ (~30ct/m)
In total: **824€**

Brick[41]:
1 x Manual (bangla) brick first class = ~7ct
Foundation: 4.000 bricks = 300€
Plinth: 2.500 bricks = 200€
In total: **500€**

CEB:
Since the earth is sourced directly from the site and surrounding area, it is difficult to accurately estimate the cost of the CEB.

7.600 CEB = **200€**

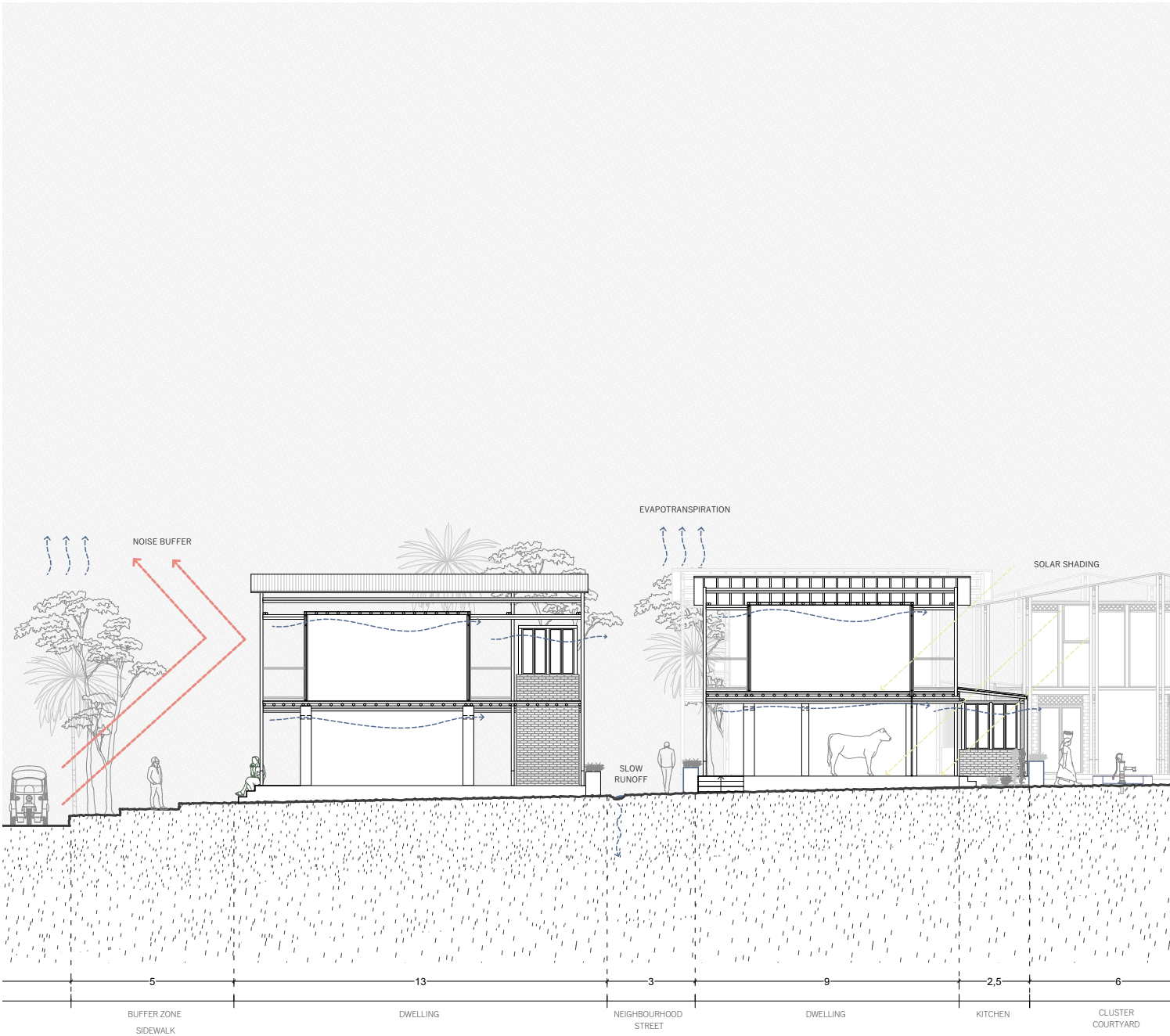
Corrugated CI-Sheets:[42]
The roofing will be a combination of reused materials and new elements, with approximately half being reused

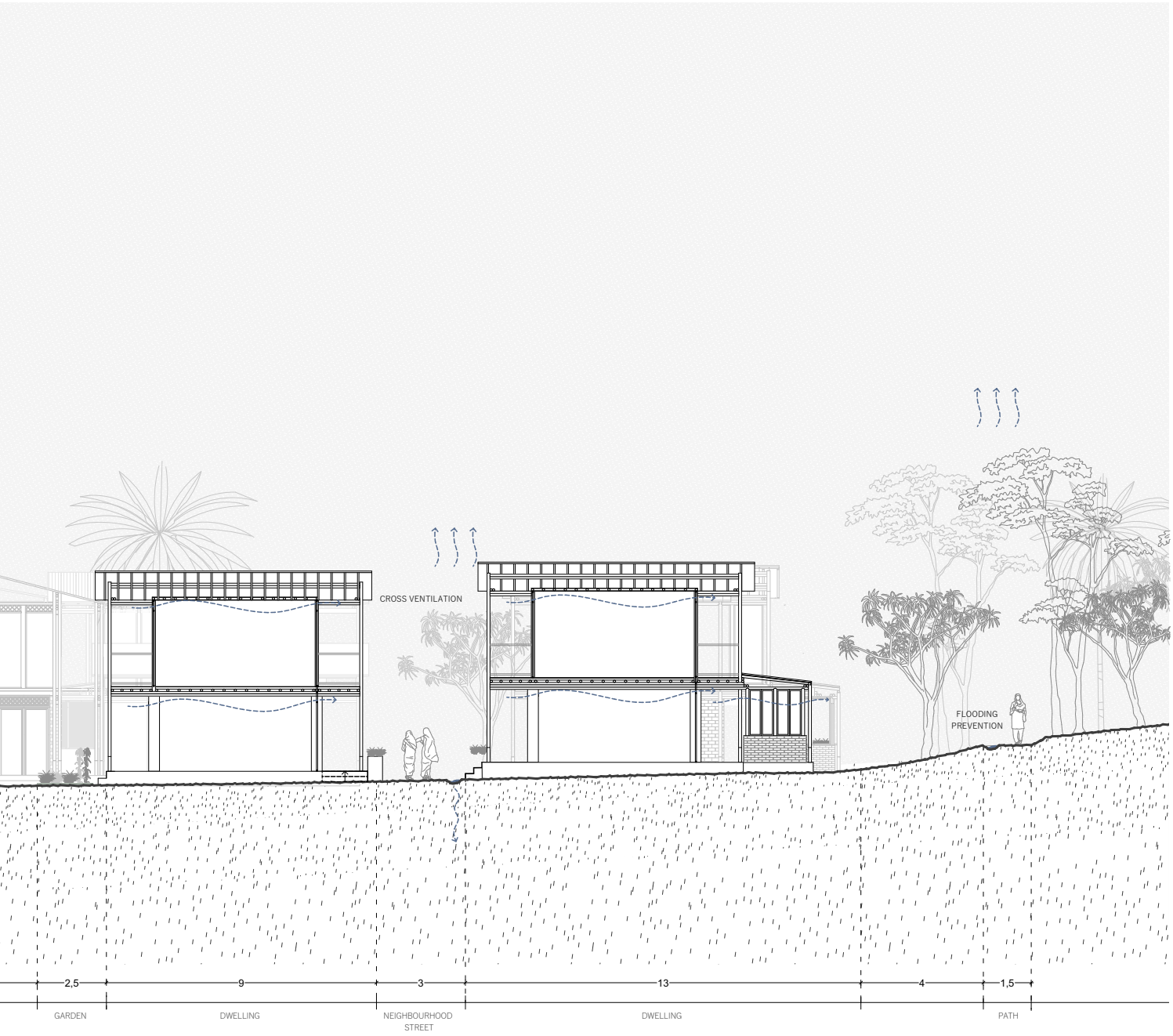
30m² (reused) = 0€
30m² (new) = **5€**

Total cost estimation of the materials:
(transportation and labour costs are not taken in account. However all materials are from local recources closeby)

1.529€

40. information from a loal in bangladesh
41. material research (global housing), chapter 1, 49
42. material research (global housing), chapter 7, 384


EVAPOTRANSPIRATION
NOISE BUFFER
SOLAR SHADING
SLOW
RUNOFF
5
13
3
9
2,5
6
BUFFER ZONE
SIDEWALK
DWELLING
NEIGHBOURHOOD
STREET
DWELLING
KITCHEN
CLUSTER
COURTYARD


CROSS VENTILATION
FLOODING
PREVENTION
2,5
9
3
13
4
1,5
GARDEN
DWELLING
NEIGHBOURHOOD
STREET
DWELLING
PATH



WATER MANAGEMENT

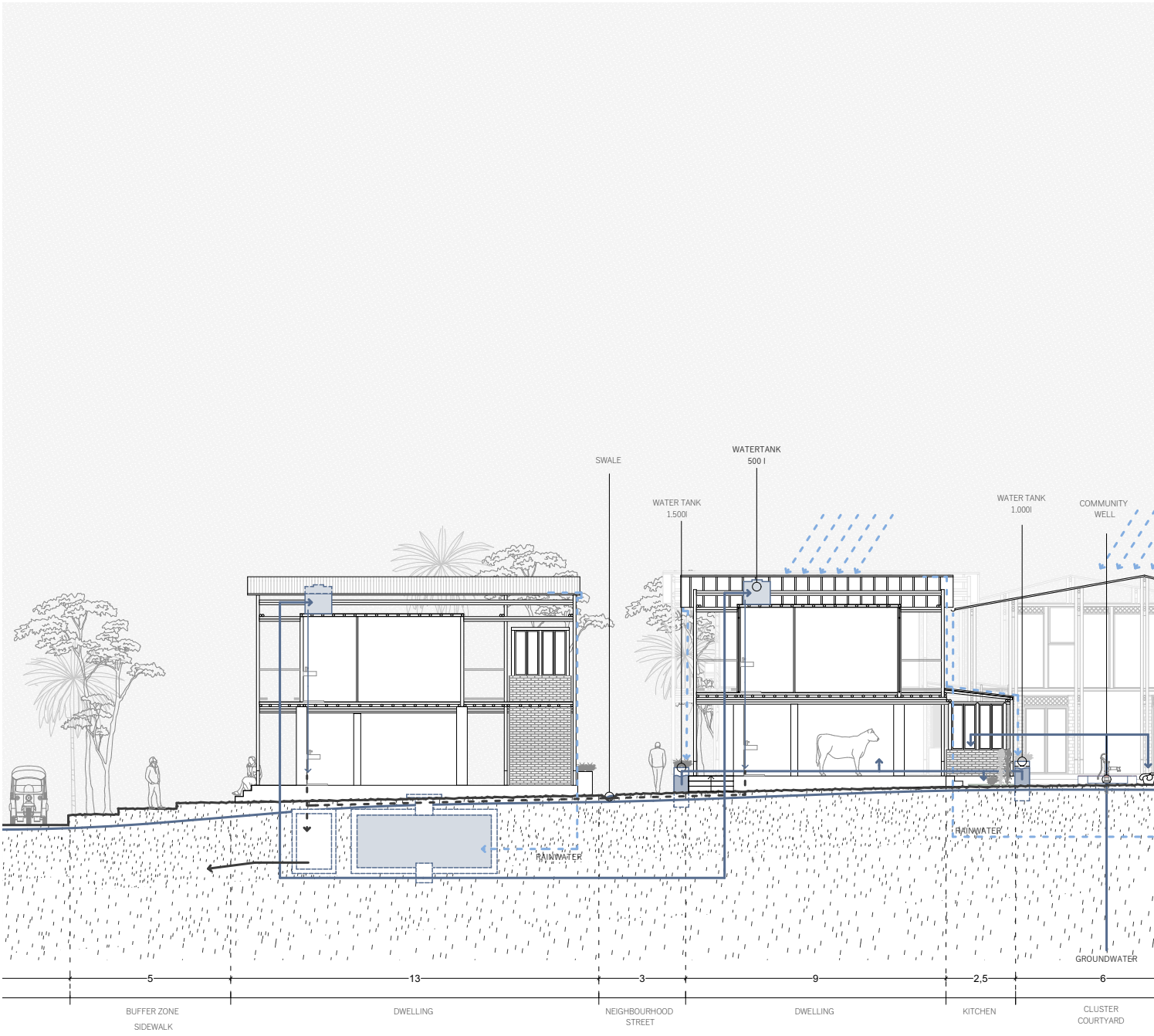
Bangladesh is one of the countries most vulnerable to the impacts of the climate crisis, particularly due to increasingly severe rainfall patterns and frequent tropical cyclones.[1,2] The rainy season extends from April to September, with an annual precipitation of approximately 2,200 mm. Following the monsoon, the region experiences a pronounced dry season lasting about six months.[1]

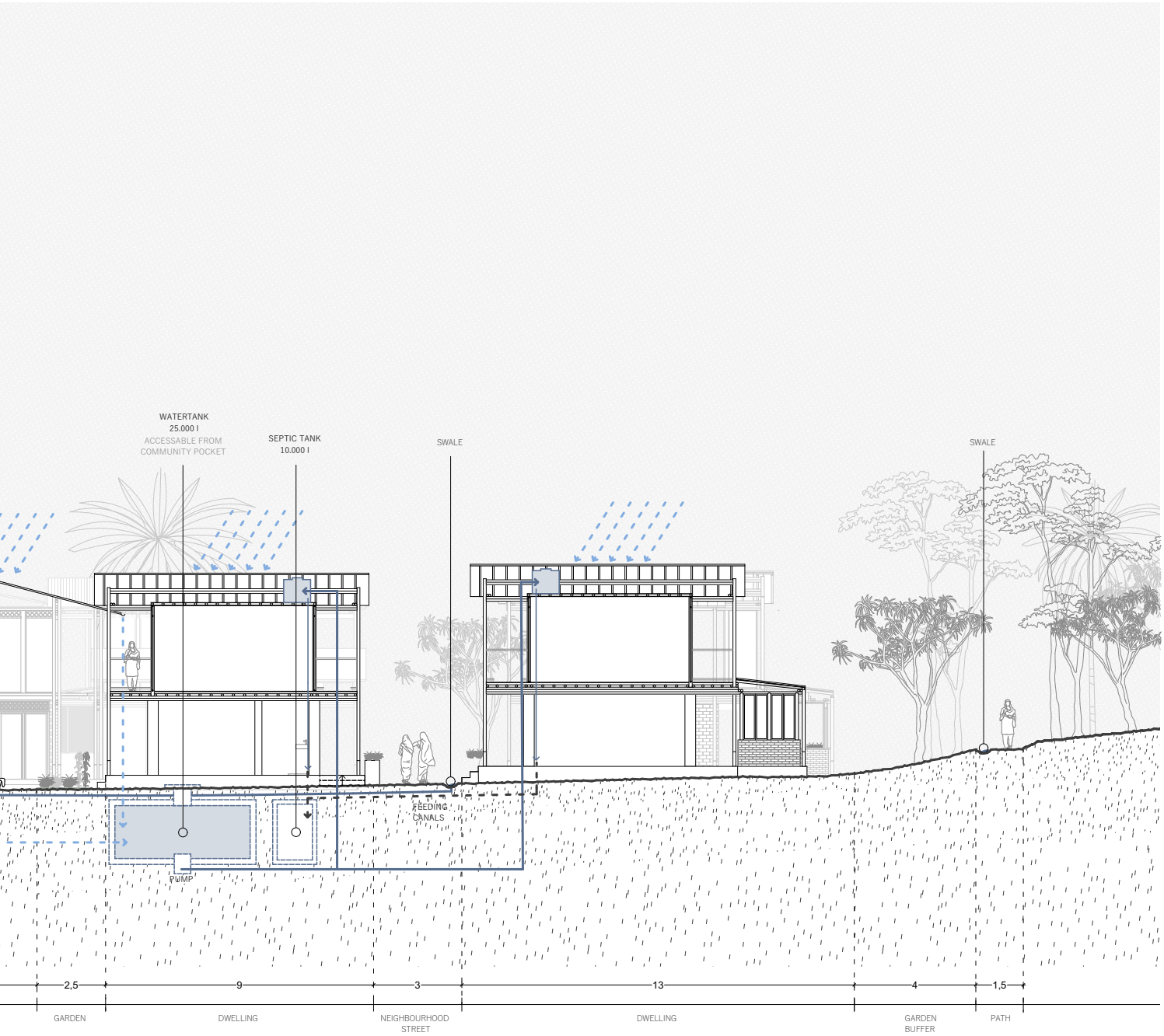
Given the significant rainfall during the monsoon season, there is an opportunity to capture and store water, rather than allowing it to simply run off. By using appropriate storage methods, rainwater can be conserved and made available for use during the dry season. For example, a roof of approximately 70 m²—the typical size for standard housing in the project—has the potential to collect up to 1,400 liters of water per day during the monsoon period

Since it is not possible to store all of the rainwater, various methods are employed to facilitate the gradual infiltration of excess water into the soil, thereby contributing to the natural replenishment of groundwater reserves and preventing from floodings, erosions.[3] One such method involves the use of swales, which support infiltration, retention, and the purification of stormwater.[4] In addition, retention ponds aid in the removal of pollutants through sedimentation, further enhancing the quality of water.[5]

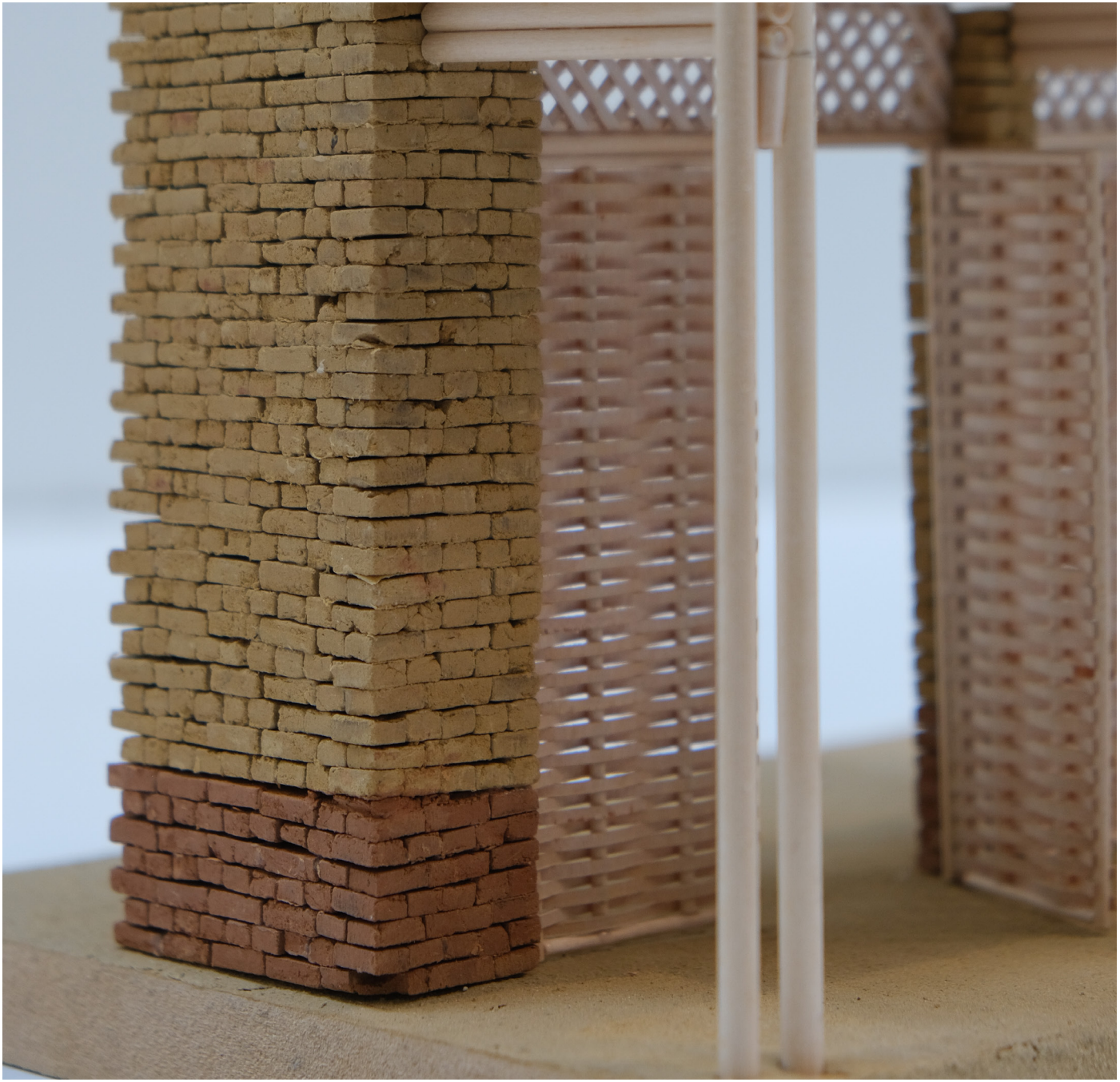
In rural Bangladesh, an adult requires approximately 70 liters of water per day, with an average household consumption of around 200 liters per day.[6] Given that the dry season lasts for roughly 150 days, a comprehensive water storage strategy was developed within the project. Groundwater is utilized for laundry, cooking, and drinking purposes. Small above-ground water tanks are used to provide water for livestock and irrigation of plants, while underground storage tanks supply water for sanitation facilities.

43. Bangladesh - Climatology | Climate Change Knowledge Portal
44. Rojas, How the Climate Crisis Is Impacting Bangladesh
45. 5 Effective Methods of Managing Urban Stormwater Runoff, 2024
46. Wang et al., Assessment of the Hydrological Performance of Grass Swales for Urban Stormwater Management
47. Retention Ponds
48. Milton et al., Water consumption patterns in rural Bangladesh, 434


SWALE
WATERTANK
500 l
WATER TANK
1.500l
WATER TANK
1.000l
COMMUNITY
WELL
RAINWATER
RAINWATER
GROUNDWATER
5
13
3
9
2,5
6
BUFFER ZONE
SIDEWALK
DWELLING
NEIGHBOURHOOD
STREET
DWELLING
KITCHEN
CLUSTER
COURTYARD


WATERTANK
25.000 l
ACCESSABLE FROM
COMMUNITY POCKET
SEPTIC TANK
10.000 l
SWALE
SWALE
FEEDING
CANALS
PUMP
2,5
9
3
13
4
1,5
GARDEN
DWELLING
NEIGHBOURHOOD
STREET
DWELLING
GARDEN
BUFFER
PATH

06 physical model



BRICK / CEB

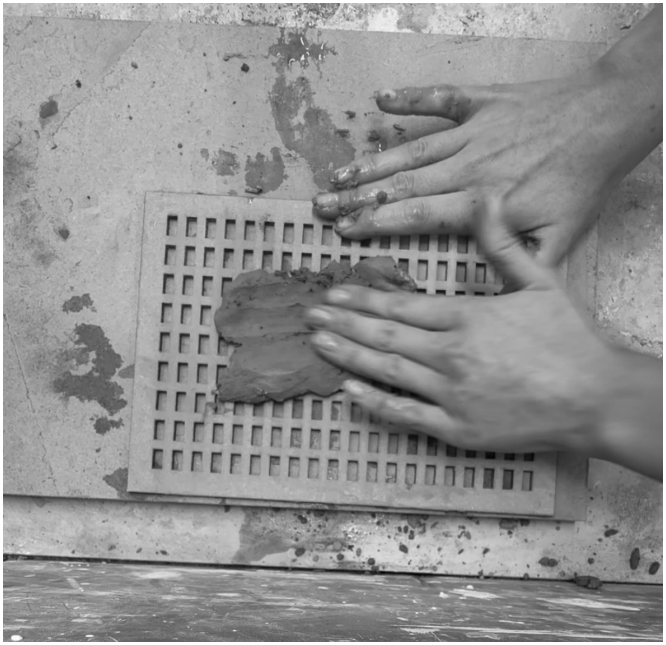
For the physical model, both bricks and compressed earth blocks (CEBs) were produced using a mixture of clay, sand, and water. While the materials used were sourced from Belgium rather than Bangladesh, the resulting earth blocks closely resemble the color of those typically seen in Bangladeshi earth constructions, as observed in photographic references. The variation in color seen in the model is due to the use of two different types of clay, no pigments were added.

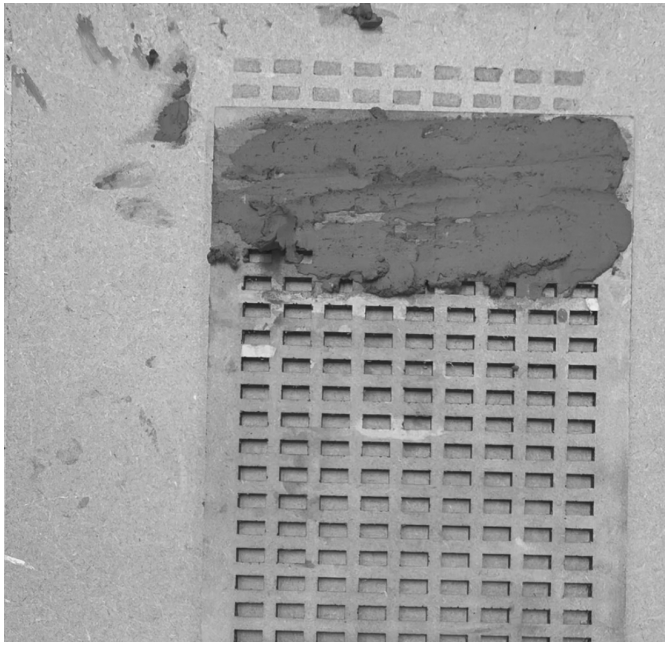
The recipe used for the model bricks differs slightly from that of standard-sized earth bricks. Since the model was built at a scale of 1:20 (with individual bricks measuring 1.2 cm × 0.6 cm × 0.3 cm), a higher proportion of clay was used to ensure cohesion at the smaller scale. The mixture consisted of:

- 1 part sand
- 3 parts clay
- water (added gradually to achieve the desired consistency)

The mixture was hand-pressed into an MDF mold. Due to the small size of the bricks, significantly less pressure was required compared to full-scale earth bricks. Once filled, the surface was smoothened using a wooden block. After approximately one hour of drying within the mold, the bricks were gently removed and left to dry for an additional hour before they were ready for use in the model.


clay
sand
water
mold



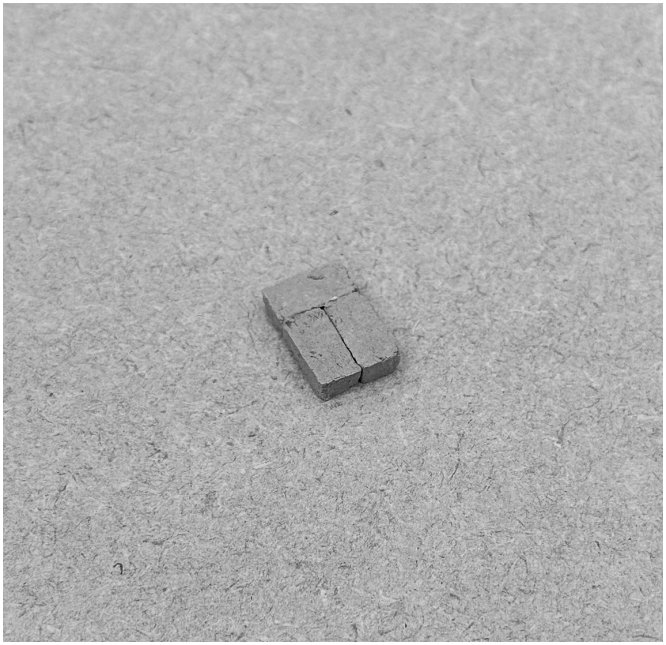


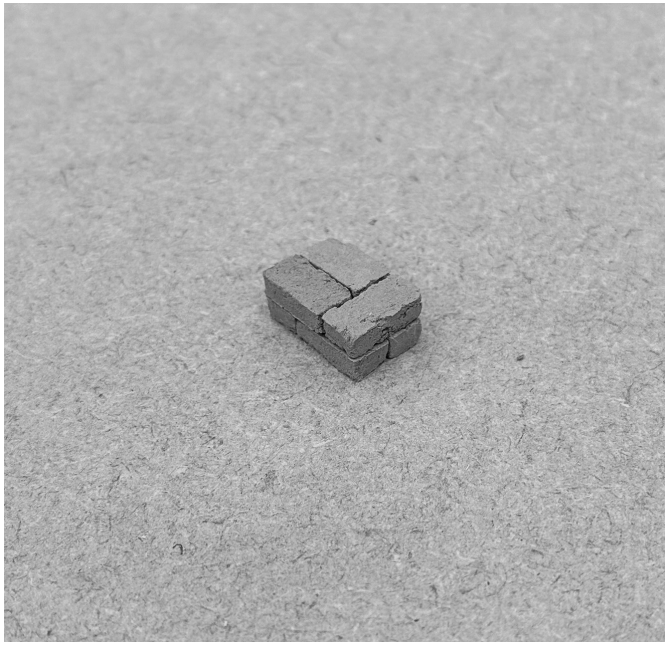


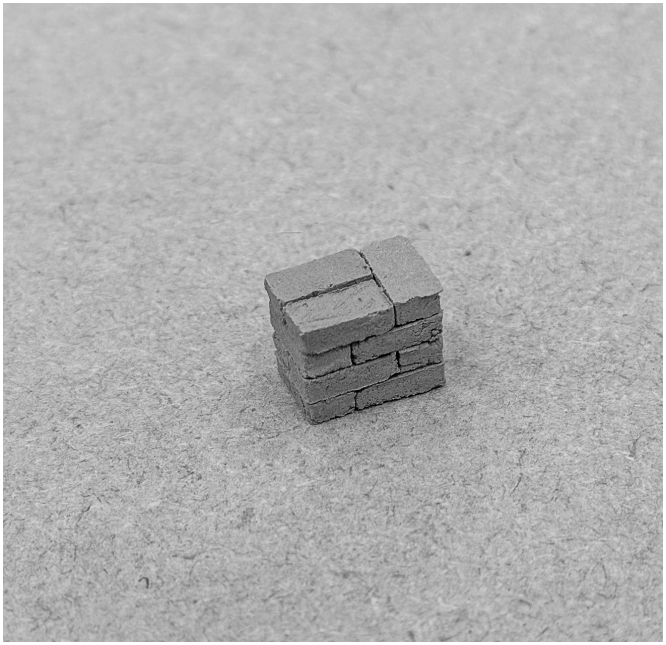


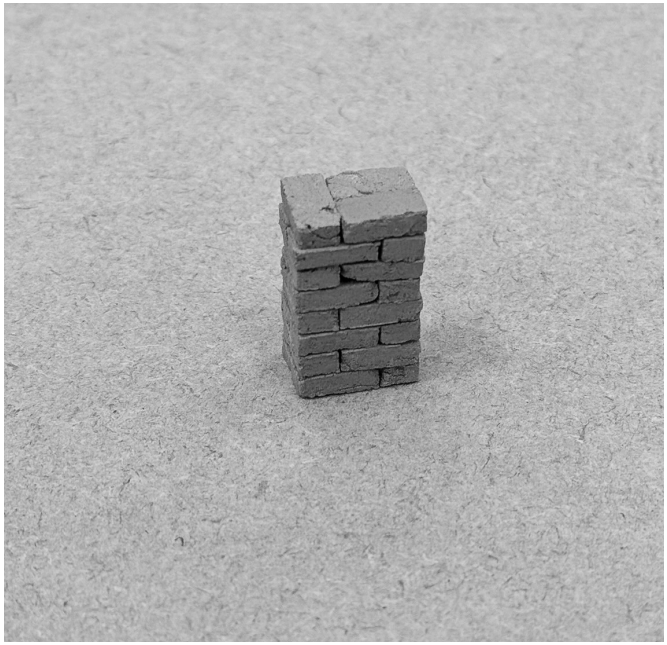


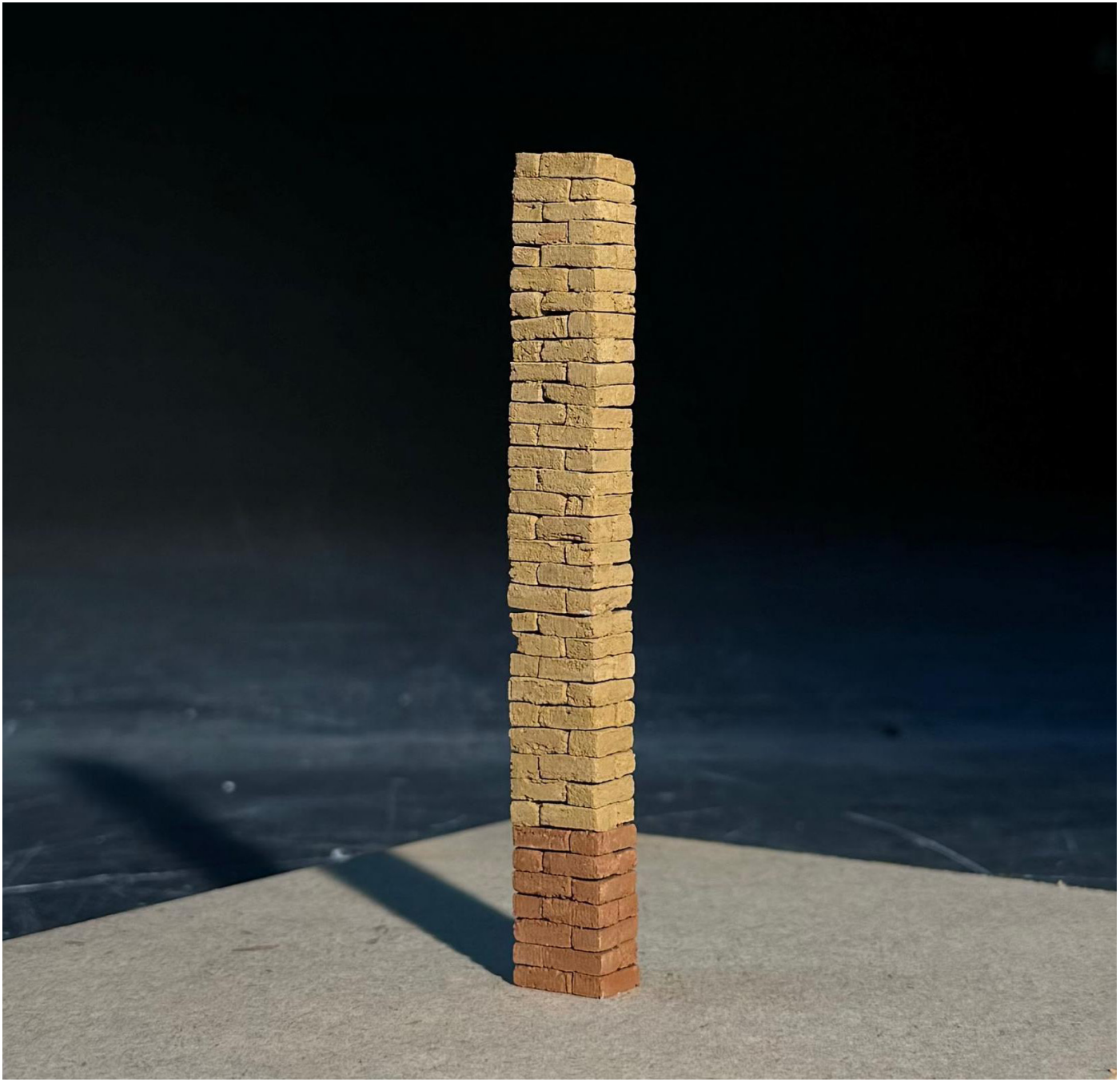


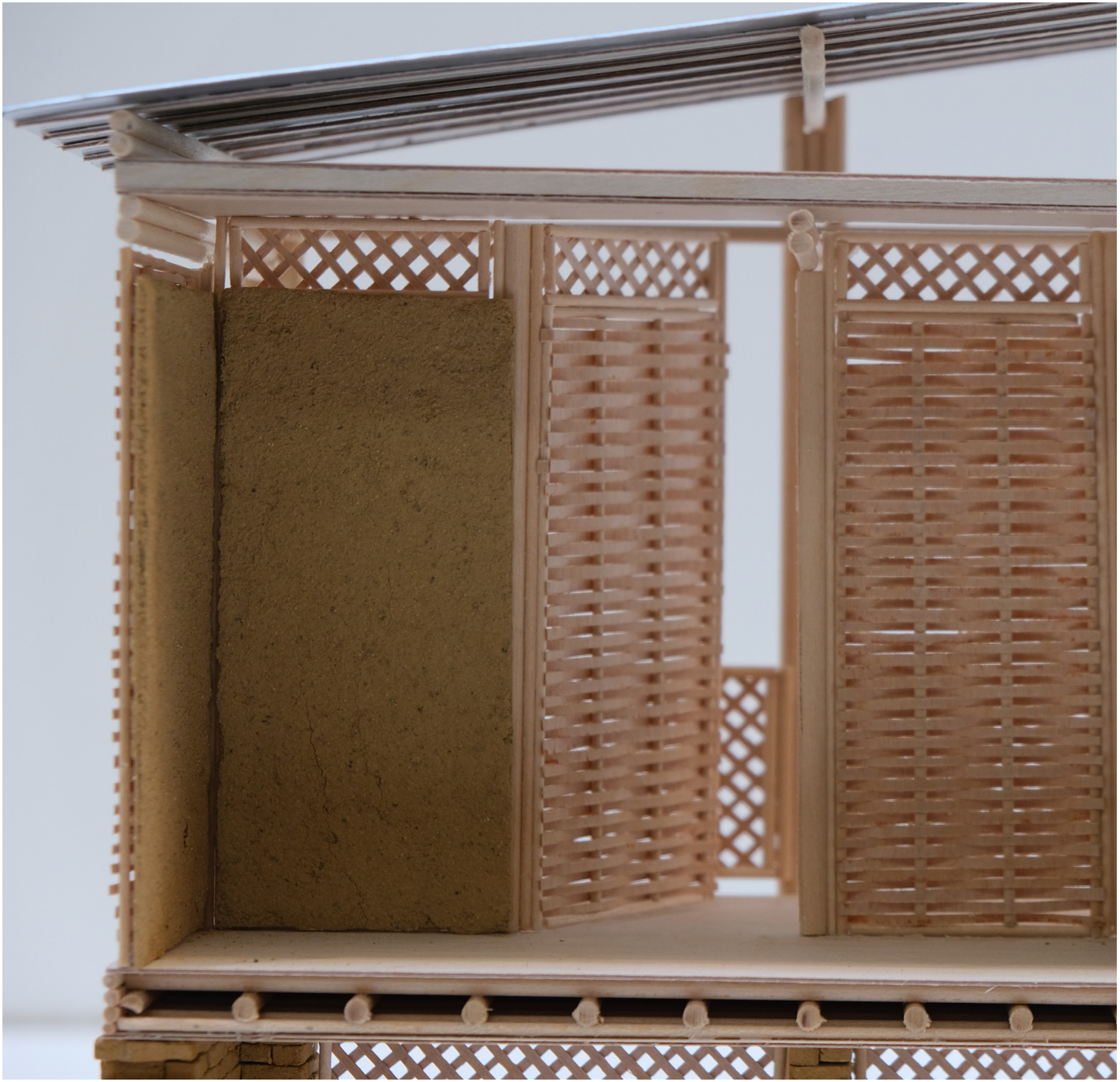












EARTH PLASTER WITH TEA BYPRODUCTS

For the earth plaster, a mixture of sand, clay, used tea, and water was prepared. The tea used in the mix consisted of dried, previously brewed black tea leaves from Bangladesh repurposed for this process.

The composition of the plaster was as follows:

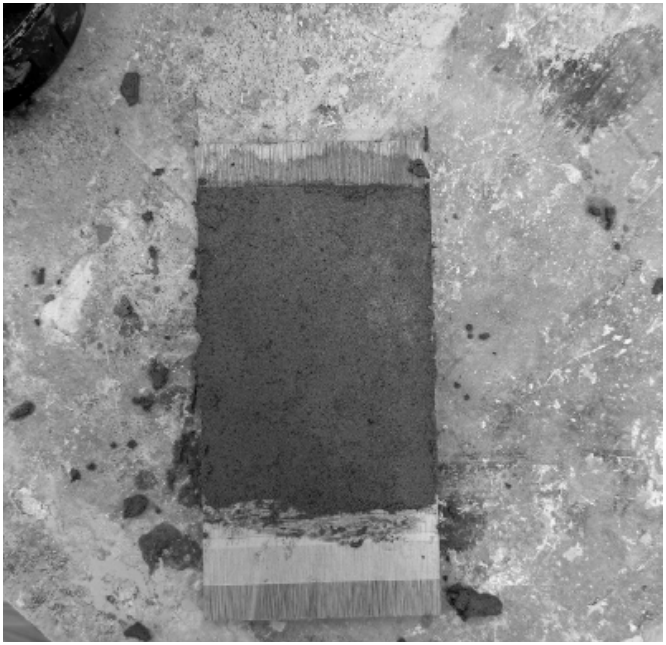
3 parts sand
1 part clay
1/2 part dried tea
water (added as needed for consistency)

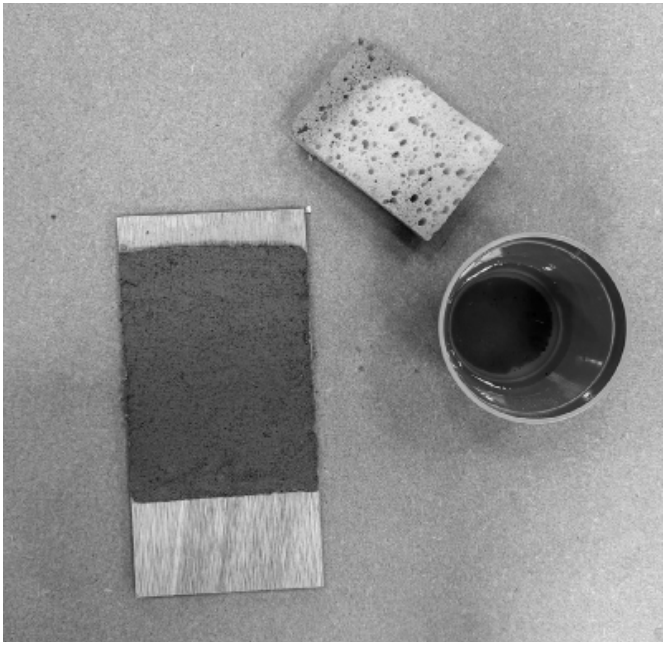
The plaster was applied onto a wooden board. After partial drying, a sponge was used in circular motions to gently bring the tea particles to the surface, enhancing the texture and visual quality of the finish. After several hours, the plaster was fully dry.


clay
sand
tea
water







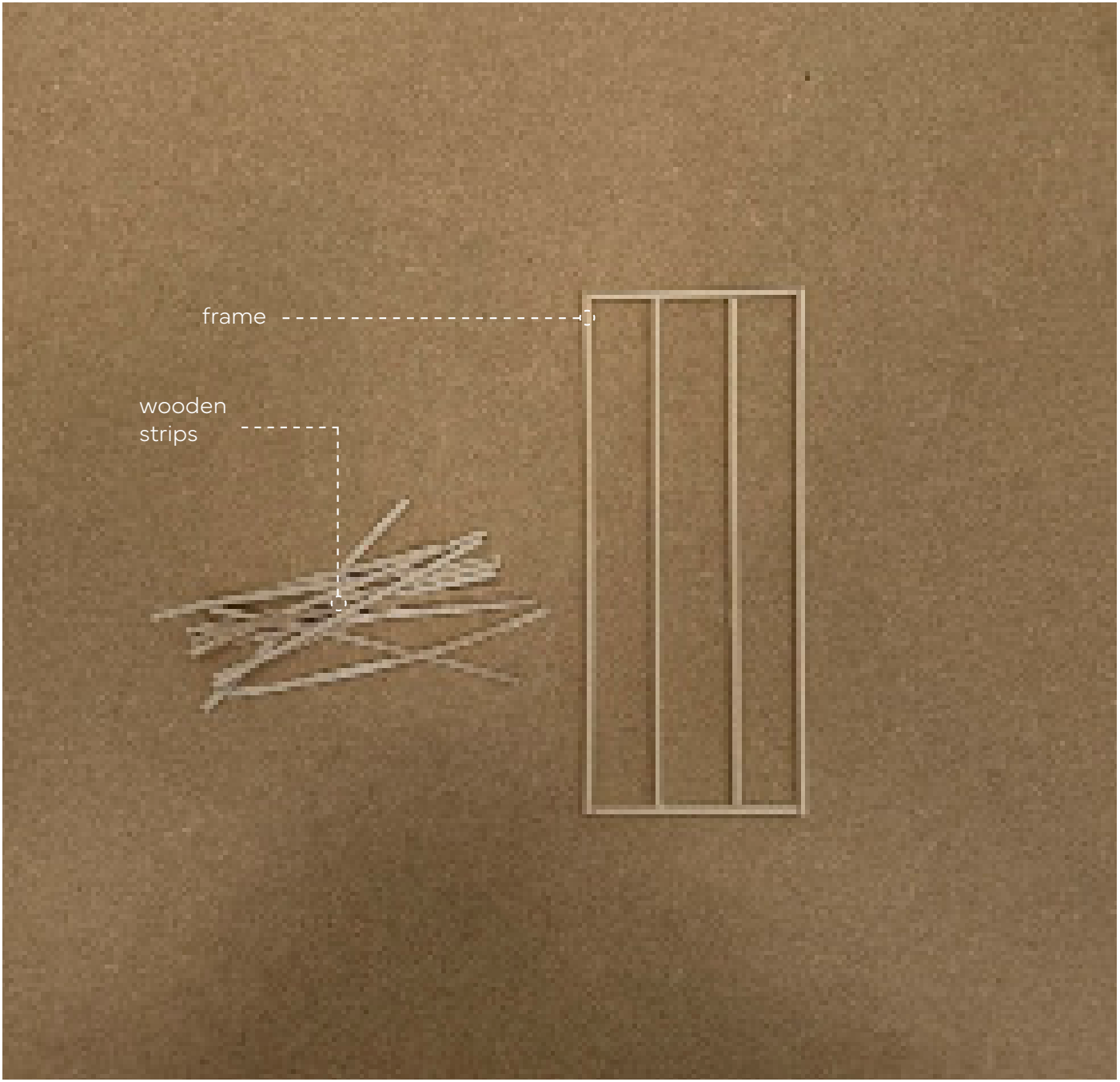


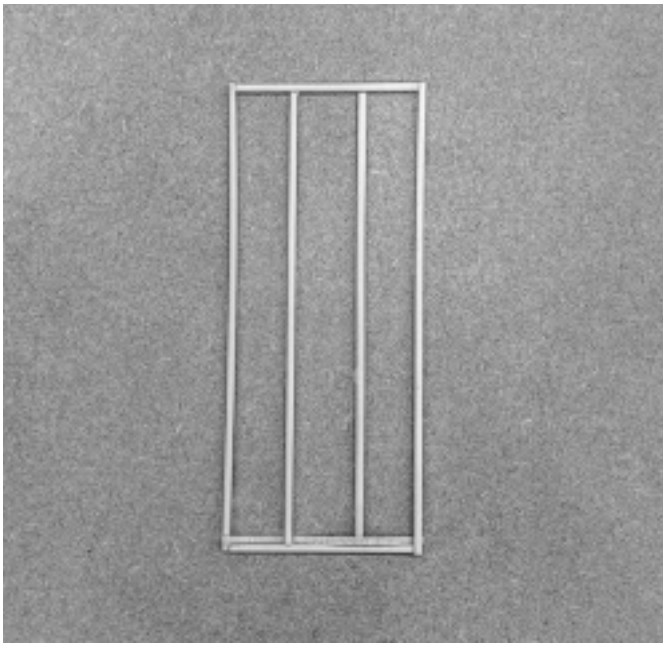


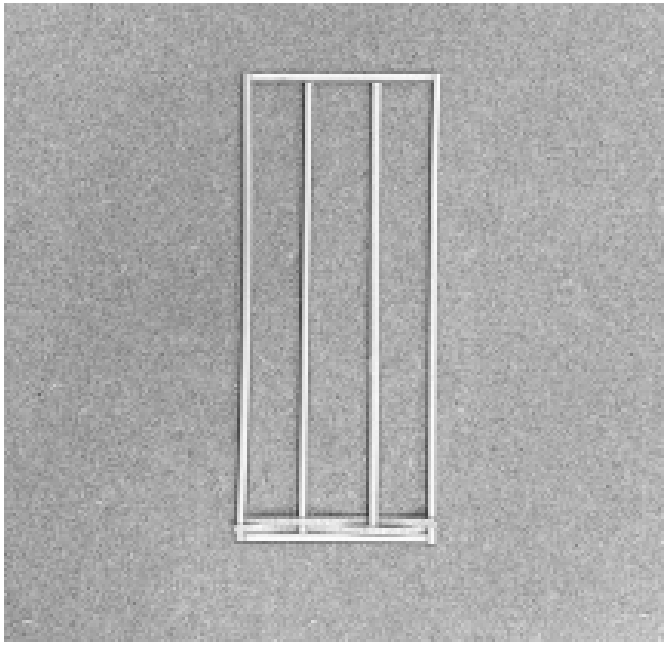
BAMBOO PANELS

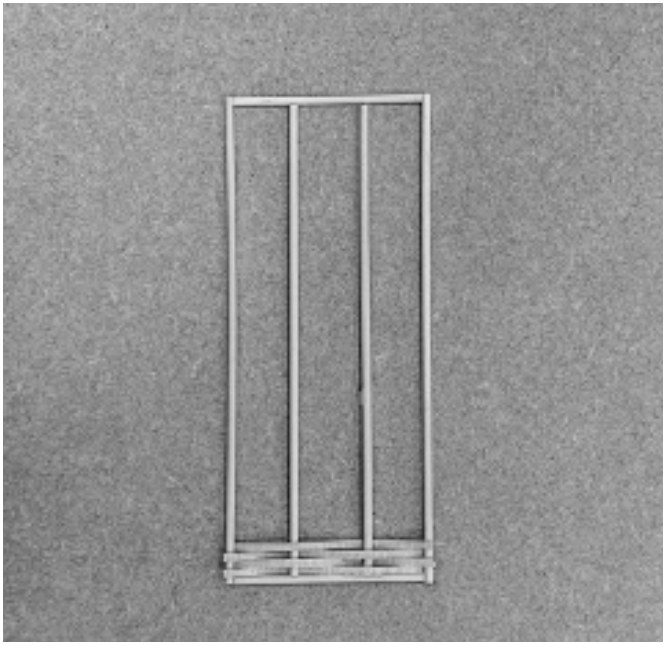
The facade of the building model was constructed using woven bamboo panels.

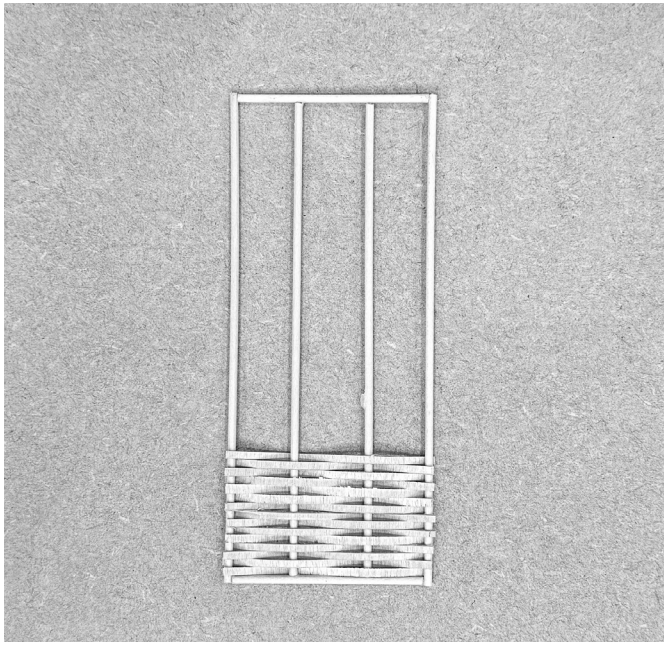
The process began with the creation of a simple frame with two support sticks in the center. Very thin plywood was cut into narrow strips and woven into the frame. The weaving technique involved alternating the direction of the strips with each row.


frame
wooden
strips









01 final reflection

1.

What is the relation between your graduation project topic, your master track (A, U, BT, LA, MBE), and your master programme (MSc AUBS)?

The graduation studio Global Housing is focusing on the issue of housing in Bangladesh. It is evident that Bangladesh is one of the most vulnerable countries to extreme weather conditions and significant levels of poverty. Moreover, Bangladesh has experienced rapid urbanisation in recent years, resulting in housing unaffordability, overloaded infrastructure, and considerable human displacement.

The central theme of my graduation project is the tea garden community, a group that is among the most marginalised in Bangladesh. It has been observed that such people are habitually marginalised and isolated in remote rural settlements or segregated in urban colonies. Such a community is found in Sylhet, in the Lakkatura tea Garden, which is located on the periphery of the city.

The research on tea garden workers is strongly connected to architecture, given that the living conditions in these villages are inadequate. The residential properties have been constructed to a substandard quality and do not offer the possibility of expansion. Additionally, it should be noted that the exterior area is inadequate for the purposes of gardening or socialising. Nevertheless, the majority of people would be hesitant to relocate, given the profound sense of community unity that prevails.

The project involves an investigation into the current living and building patterns of the existing settlement, with the objective of formulating a design for its redevelopment. The design is oriented towards flexibility in order to accommodate the diverse requirements of individuals, with a view to potential expansions and the creation of spaces for the community of all target groups, including children, women and men.

2.

How did your research influence your design/ recommendations and how did the design/ recommendations influence your research?

Understanding the tea garden community required multiple site visits to the Lakkatura Tea Garden and other gardens in the region. I conducted interviews with workers and their families to gain insight into their daily lives, spatial needs, and the social dynamics that shape their communities. These conversations helped uncover the values they hold, their challenges, and the traditions embedded in their living patterns. This research laid the foundation for my design decisions and was critical in ensuring that the project responded to real conditions, rather than assumptions.

The design process was deeply shaped by these findings, from the structure of the masterplan to the layout of individual dwellings and public spaces. For example, the communal lifestyle of the residents influenced the creation of shared courtyards, while traditional construction practices informed my choice of materials. At the same time, as the design progressed, it raised new questions that led to further investigation, such as researching the use of local materials like earth and bamboo, and exploring how to integrate water management systems appropriate for monsoon climates.

This dynamic, iterative relationship between research and design allowed the project to evolve continuously. Each informed the other, resulting in a more grounded and context-specific architectural proposal that acknowledges both tradition and the need for future resilience.

3.

How do you assess the value of your way of working (your approach, your used methods, used

The design process began with comparative analyses of housing projects, both at a global scale and within the specific context of Bangladesh. While the global case provided a broad perspective, it was the local analysis that deeply informed my understanding of housing in the Bangladeshi context, particularly how it differs from European models in terms of density, informality, and social structure. The second phase constituted a pilot project, the objective of which was to gain an understanding of density and to create a „collage" of existing projects on an unoccupied 1-hectare plot. The exercise facilitated the formulation of a masterplan, including considerations such as infrastructure, amenities, public space, private space and dwellings. The excursion to Bangladesh marked a turning point. Observing rural and urban conditions firsthand and engaging with diverse communities helped me move beyond abstract assumptions. Because of the limited literature on tea garden communities, I relied heavily on qualitative methods such as interviews and on-site observation. These methods were essential in understanding the nuanced realities of local life, though they also presented challenges, especially when different accounts contradicted each other or when informal knowledge couldn't be easily verified.

4.

How do you assess the academic and societal value, scope and implication of your graduation project, including ethical aspects?

My graduation project addresses the critical housing challenges faced by tea garden communities in Bangladesh, focusing on the Lakkatura tea garden. These challenges include overcrowding, substandard housing conditions, and the lack of privacy.

From a social perspective, the project aims to improve the living conditions of marginalized tea garden workers. By addressing overcrowding and enhancing privacy and housing quality, the design fosters better quality of life, stability, and community cohesion.

Furthermore, the focus on preserving traditional social and spatial structures ensures that cultural identity and communal ties remain intact, even as densification strategies are implemented.

From a professional standpoint, the project engages with complex architectural, urban, and landscape challenges, such as stormwater management, affordable housing or possibilities of expanding. The emphasis on integrating financing solutions into the design process makes the project a practical model for tackling similar housing crises globally.

Moreover, the work contributes to the field of architecture by developing strategies that balance immediate needs with long-term sustainability, aligning with the principles of future-proof urban development.

Scientifically, the project contributes to the knowledge on housing design in vulnerable and rapidly urbanizing contexts. The exploration of strategies for preservation of social and cultural patterns, and integration of sustainable practices provides valuable insights for addressing global housing challenges.

5.

How do you assess the value of the transferability of your project results?

The project was developed with flexibility, reuse, and replicability in mind. All housing types are based on a shared modular system, enabling various spatial configurations that can be adapted to different plot sizes and site conditions. Depending on the context, the layout can shift between row houses or clusters that form communal courtyards. This adaptability allows the project to respond to different spatial and social needs.

In addition to housing, the project includes amenities and public functions, making it suitable not only as a residential solution but also as a community hub that could be implemented in other contexts. While the design draws on the specific living patterns of tea garden workers, its core principles are transferable to similar rural communities.

However, it is important to note that the original site is not prone to flooding, so the current design does not address flood resilience and may require adjustments for regions with such risks.

6.

Did your research focus or design direction change after the excursion, and if so, how did the visit influence your thinking?

One of the most significant challenges I faced during the design process was working within a cultural and social context that was entirely different from what I was familiar with in Europe. The living patterns, spatial expectations, and community dynamics in the Lakkatura Tea Garden were unfamiliar, and I often struggled with questions such as: How large should a dwelling be? What defines comfort or privacy in this context? These uncertainties highlighted the risk of projecting my own assumptions onto a reality I didn't fully understand.

To address this, I learned that direct engagement with the context was not just helpful, but essential. Visiting the site, speaking with residents, and observing everyday life provided crucial insights that helped ground my design decisions in lived realities. These interactions taught me to listen more and design with cultural sensitivity. They also highlighted the importance of flexibility—both in the project itself and in my own thinking.

Having tutoring sessions with Marina Tabassum was also invaluable. Her architectural sensitivity and understanding of the local culture helped challenge and refine my approach, offering guidance where I lacked cultural familiarity. Through this process, I came to understand that designing in unfamiliar contexts requires not just technical skill, but also empathy, openness, and the willingness to adapt.

In the end, the challenge of navigating cultural distance became one of the most important learning experiences of the project, shaping me into a more context-aware and reflective designer.

7.

Did your research focus or design direction change after the excursion, and if so, how did the visit influence your thinking?

Initially, my research plan focused on fostering integration between tea garden workers and urban populations, with the aim of addressing the social exclusion these workers often face. This exclusion is largely driven by language barriers and religious differences. While most tea garden workers in the region belong to the Hindu community, I chose to work in a specific site where the residents are predominantly Muslim, which presented a different social dynamic than I had anticipated.

Prior to the excursion, I envisioned a project centered on bridging the gap between tea garden communities and city dwellers. However, during the site visit and through direct conversations with local residents, I gained a deeper understanding of their values and social structures. The community emphasized a strong internal cohesion, often describing themselves as "like a family," and expressed a clear preference to maintain their close-knit environment without external influence from urban migrants.

As a result of these insights, my project direction shifted significantly—from a focus on integration to a new emphasis on strengthening village life through the lens of community and tradition. This change allowed the design to be more grounded in the lived experiences and desires of the people it was intended to serve.

02 p1



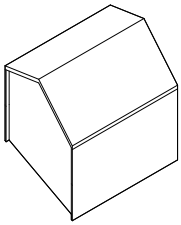
REFLECTION P1

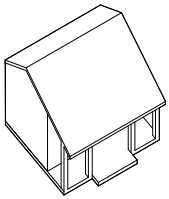
The task of Pilot Project P1 was to extract elements from a selected case study and apply them to a vacant 1-hectare plot, working within the constraints of a Floor Space Index (FSI) of 2.0 and limiting the design to low-rise buildings.

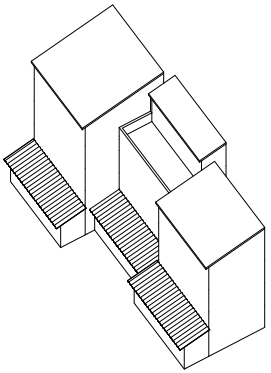
Through the case studies, various approaches to affordable housing were introduced and explored. Different strategies were examined to understand how to address density, cost, and livability.

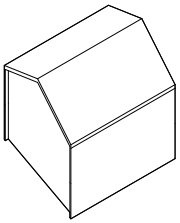
Particularly under the given density and low-rise limitation, it proved challenging to incorporate not only housing but also infrastructure such as streets and a community square. However, by strategically shifting the orientation and placement of the buildings, I was able to develop a masterplan that balances open space, maximizes sunlight exposure, and responds effectively to the constraints of the site.

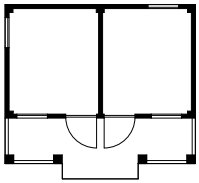
In conclusion, the task provided a first insight into the studio process, requiring us to address design challenges at both the masterplan and dwelling scales.

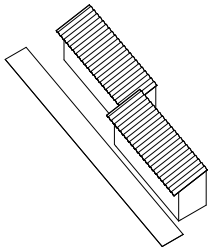










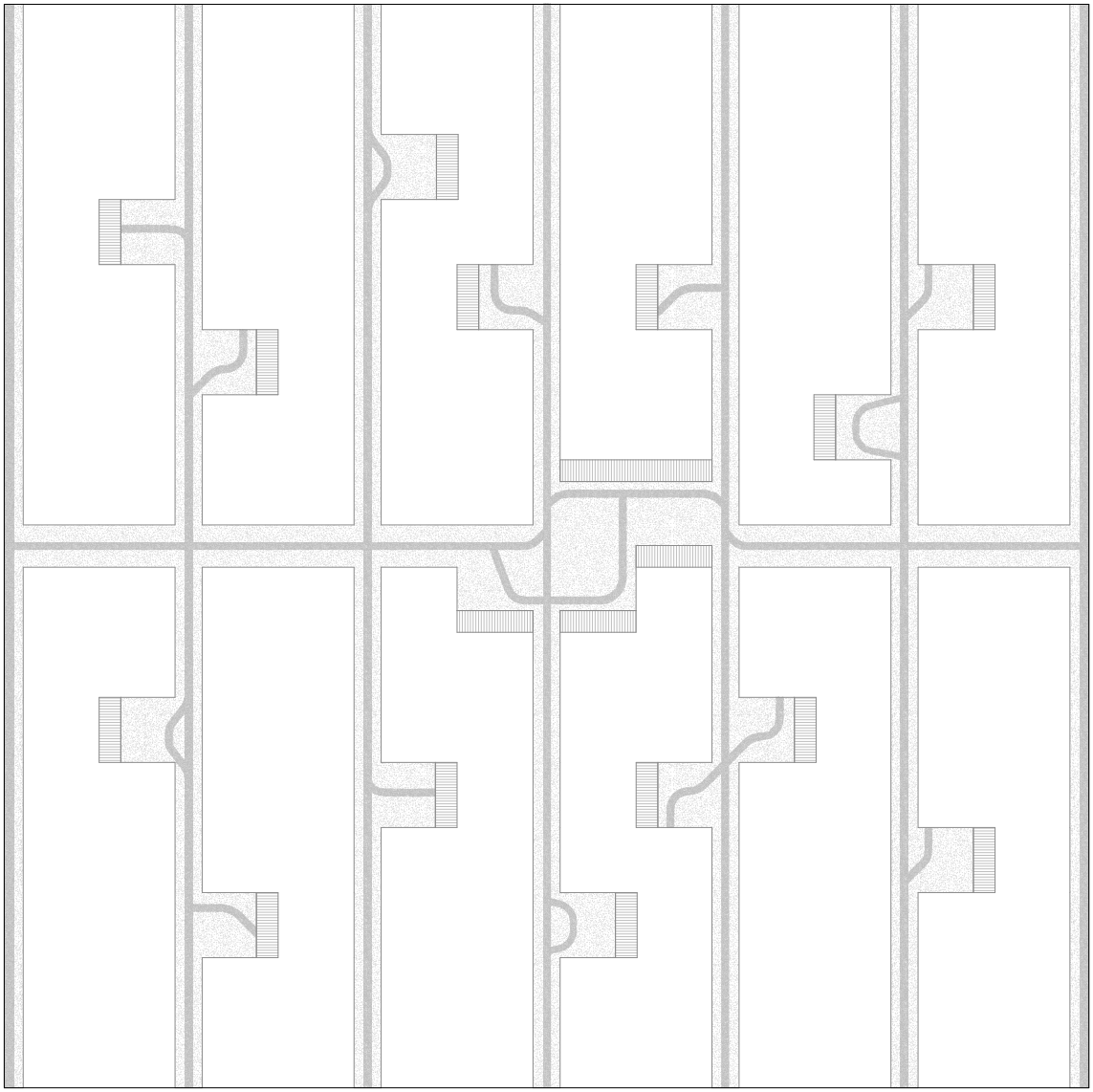


volume

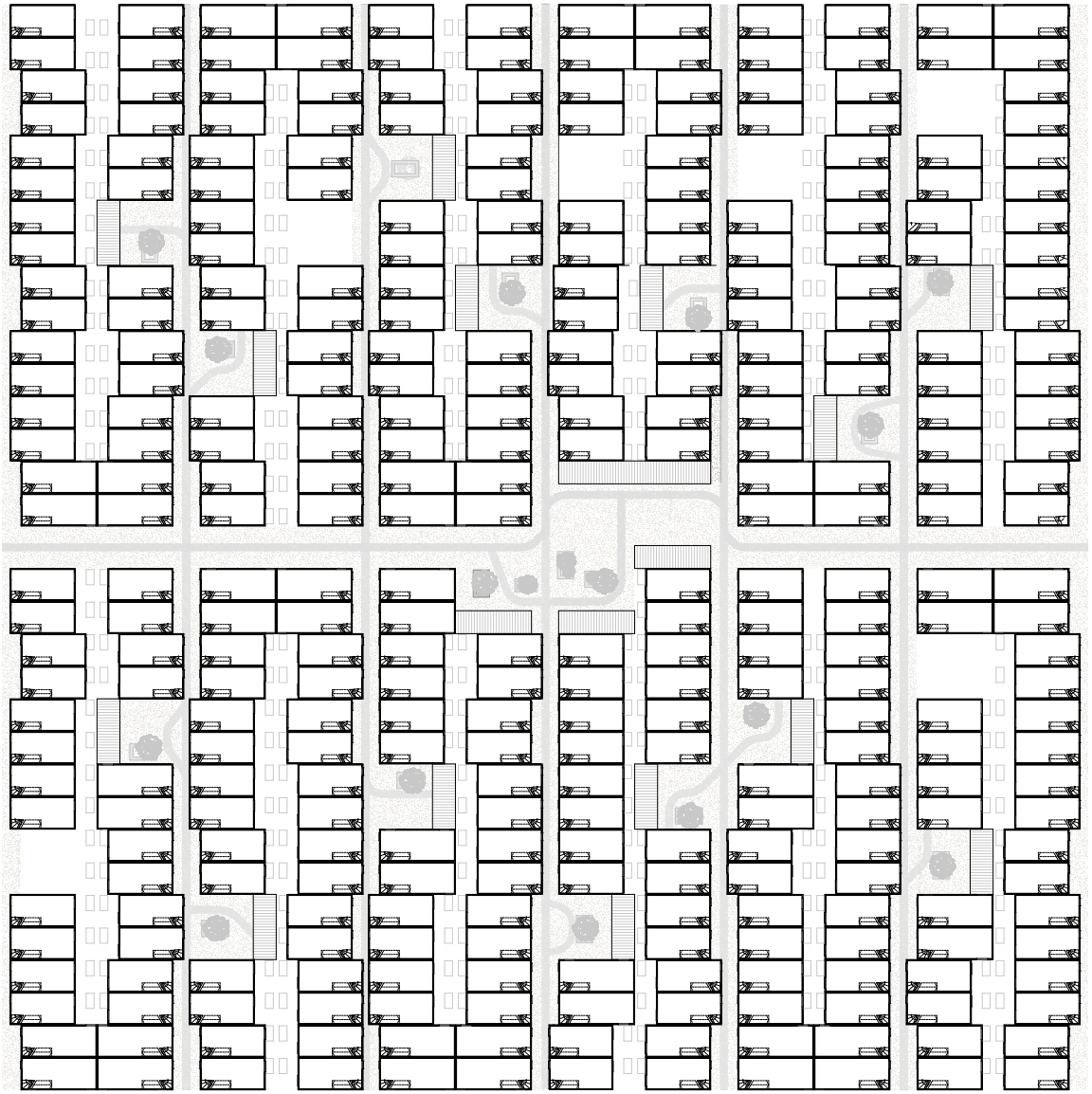
floorplan

sheds
amenities

CASE STUDIES



OPEN PUBLIC SPACE



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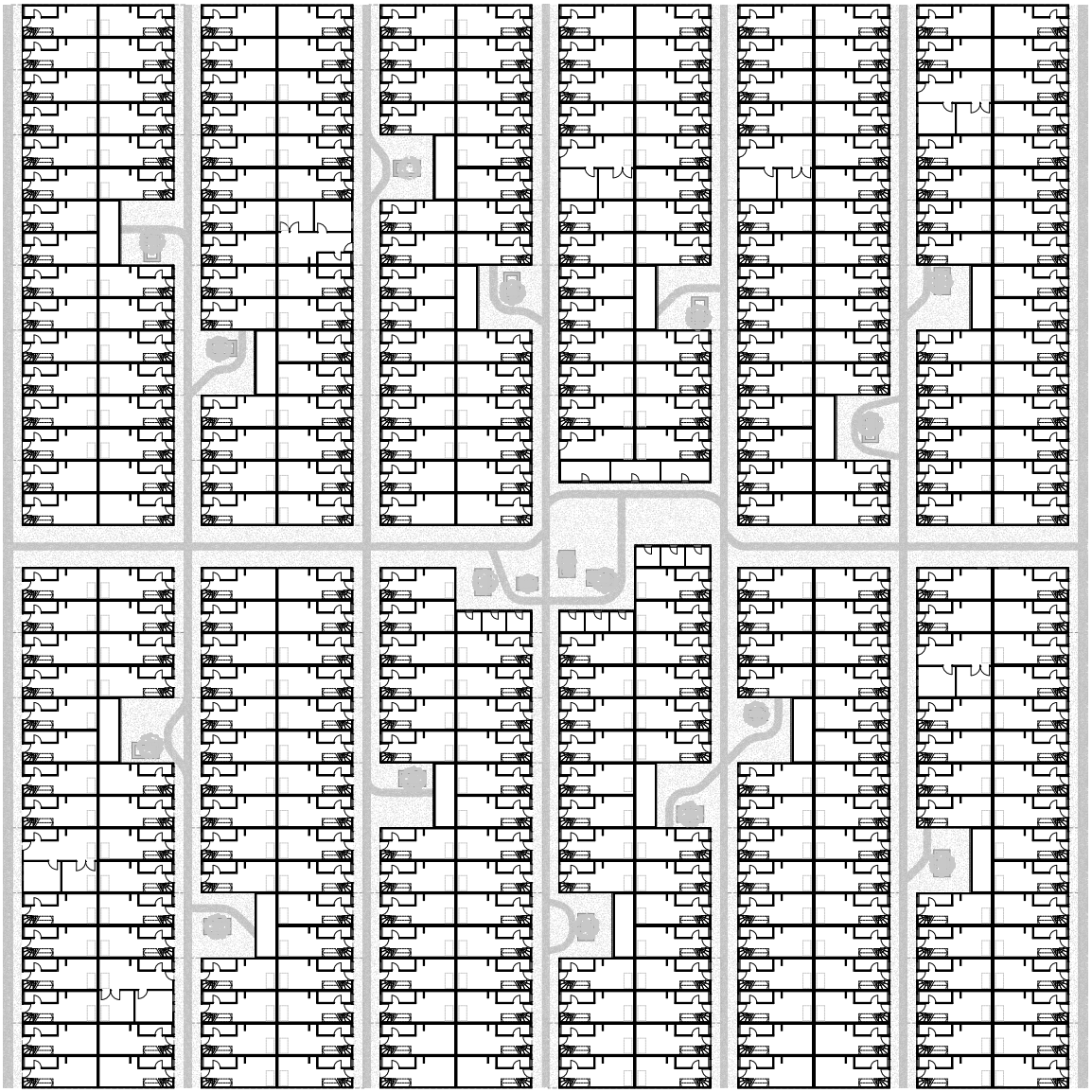

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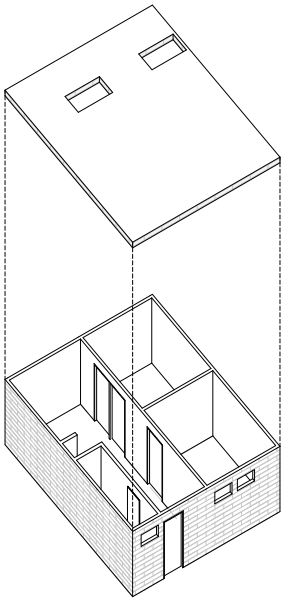
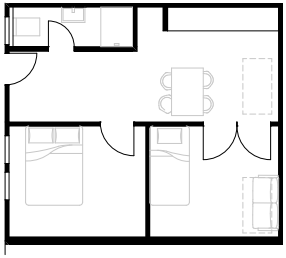
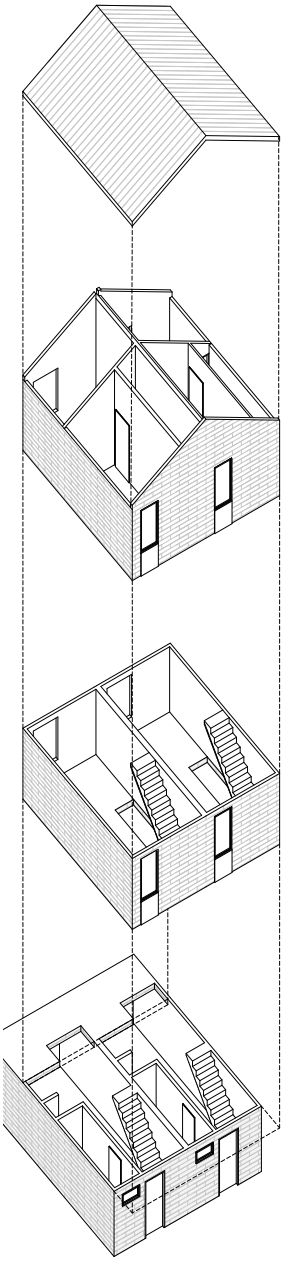
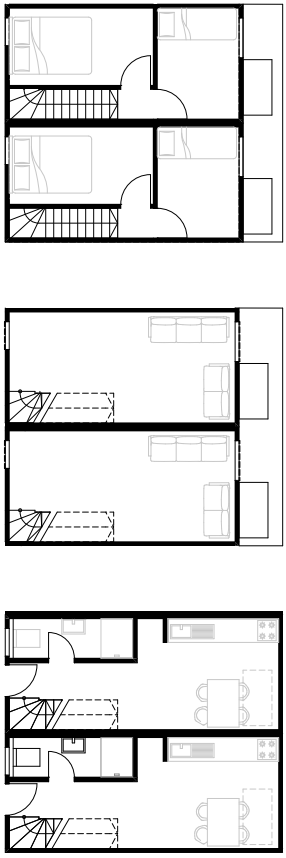
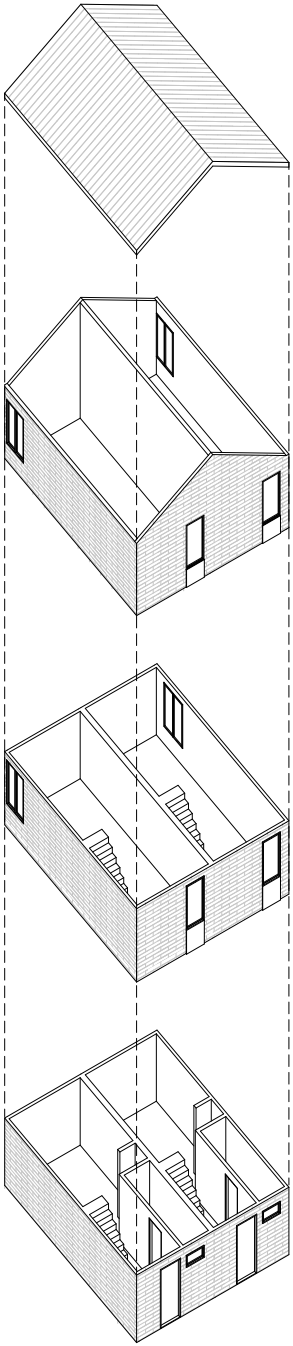
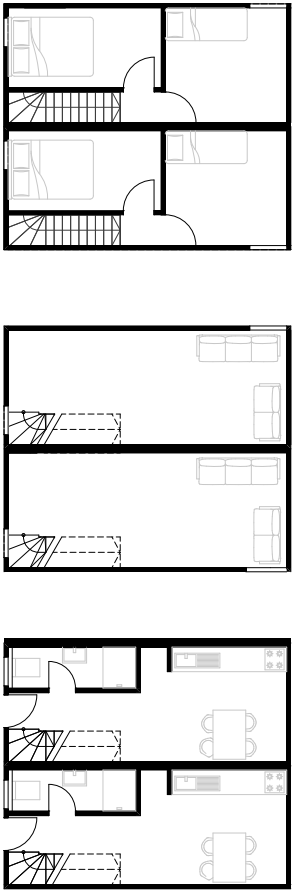




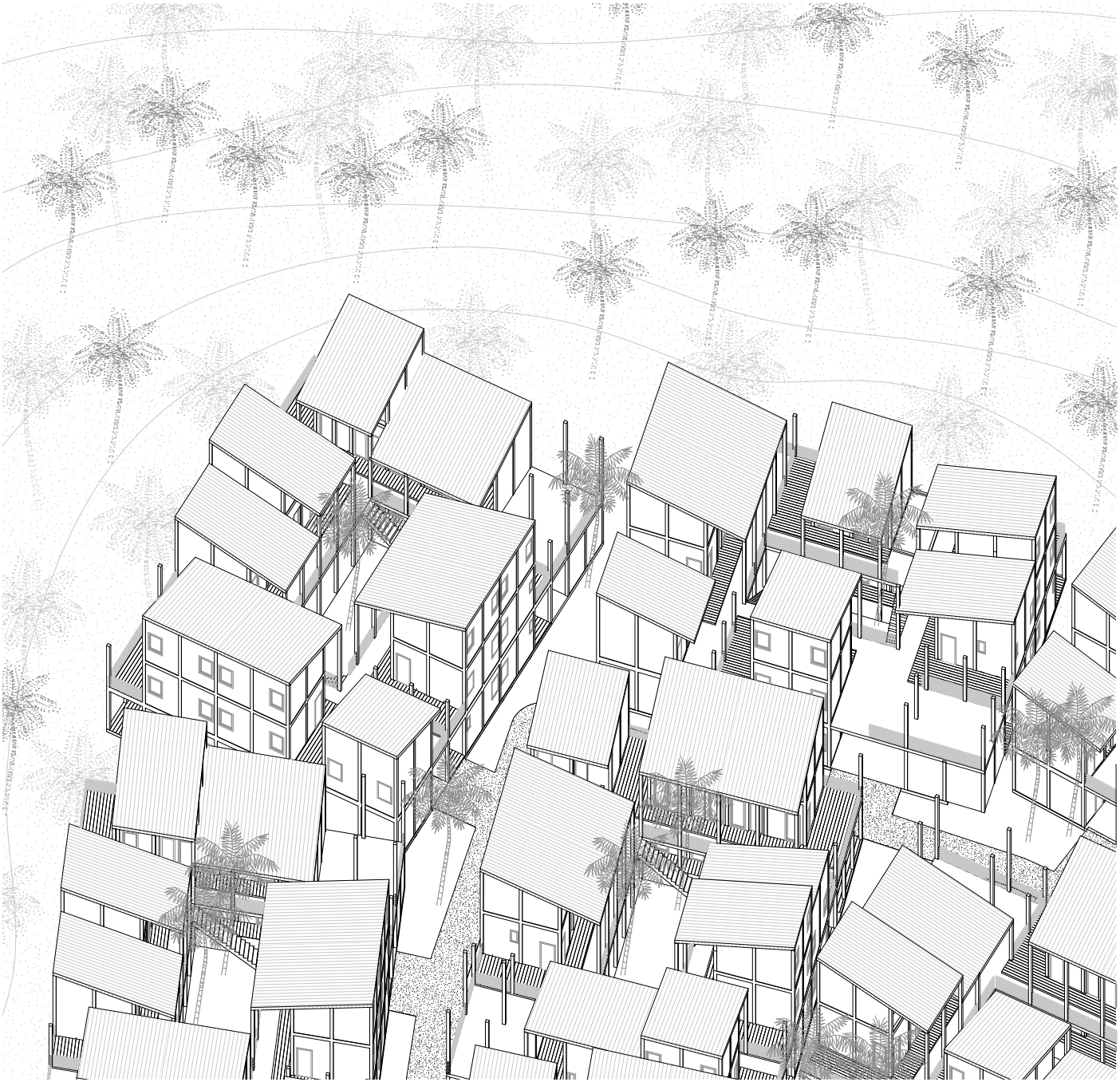








03 P2

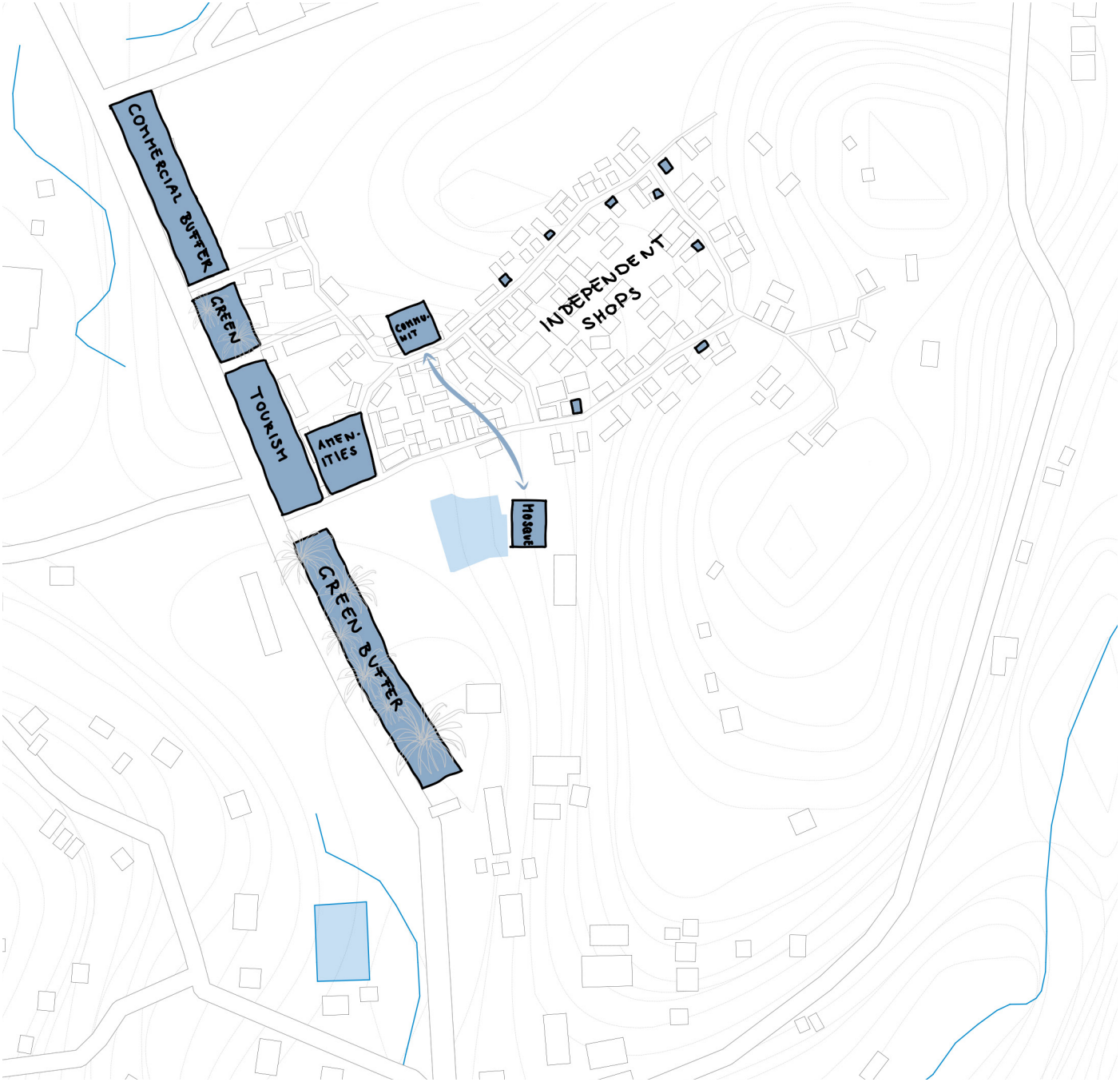


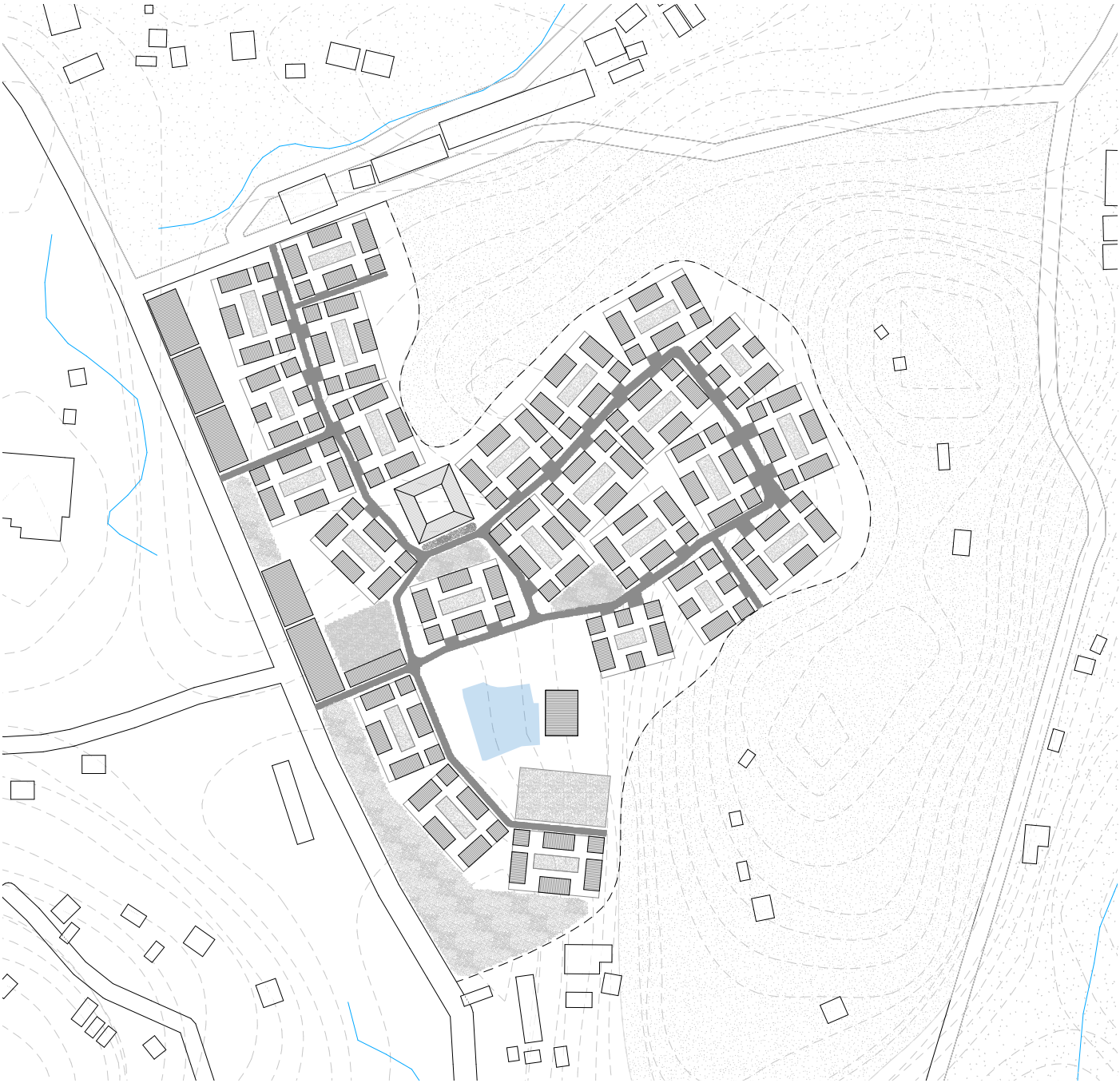
REFLECTION P2

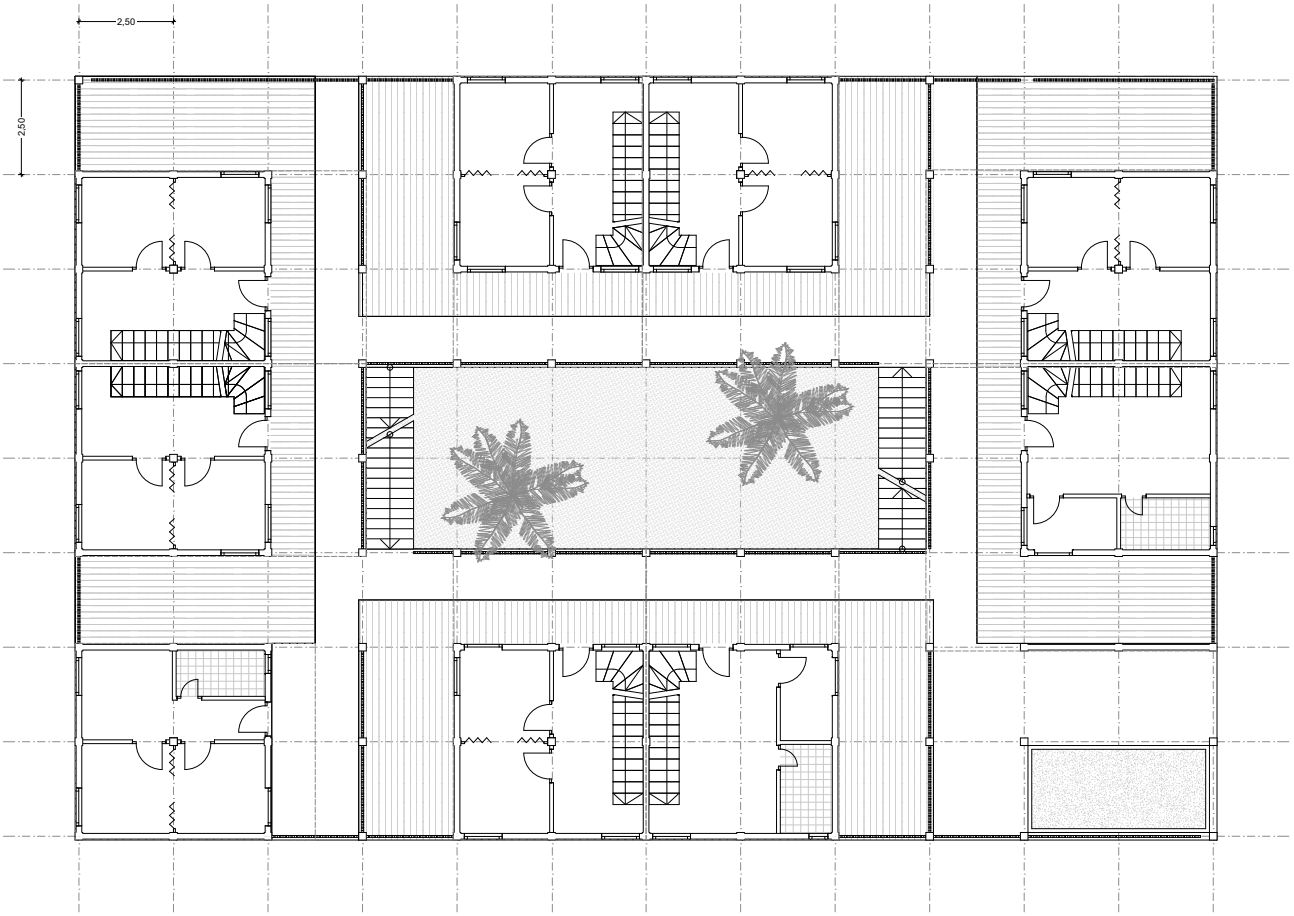
The core concept from Project P2—single-family houses combined with flexible ground-floor spaces—was carried forward into the graduation project.

However, the houses were reduced from three storeys to a maximum of two. This decision was based on the aim to simplify construction, and with a larger structural grid, the spatial needs of each dwelling could still be adequately met.

The idea of clustering homes around a shared courtyard and creating connections between clusters was partially retained. In the P2 design, all clusters were identical in size, which limited diversity and resulted in a rigid masterplan. One key takeaway from this was the importance of designing clusters of varying sizes to promote a more organic and adaptable urban layout.


COMMERCIAL BUFFER
GREEN
TOURISM
AMEN-ITIES
COMMU-NITY
INDEPENDENT SHOPS
HOSTEL
GREEN BUFFER





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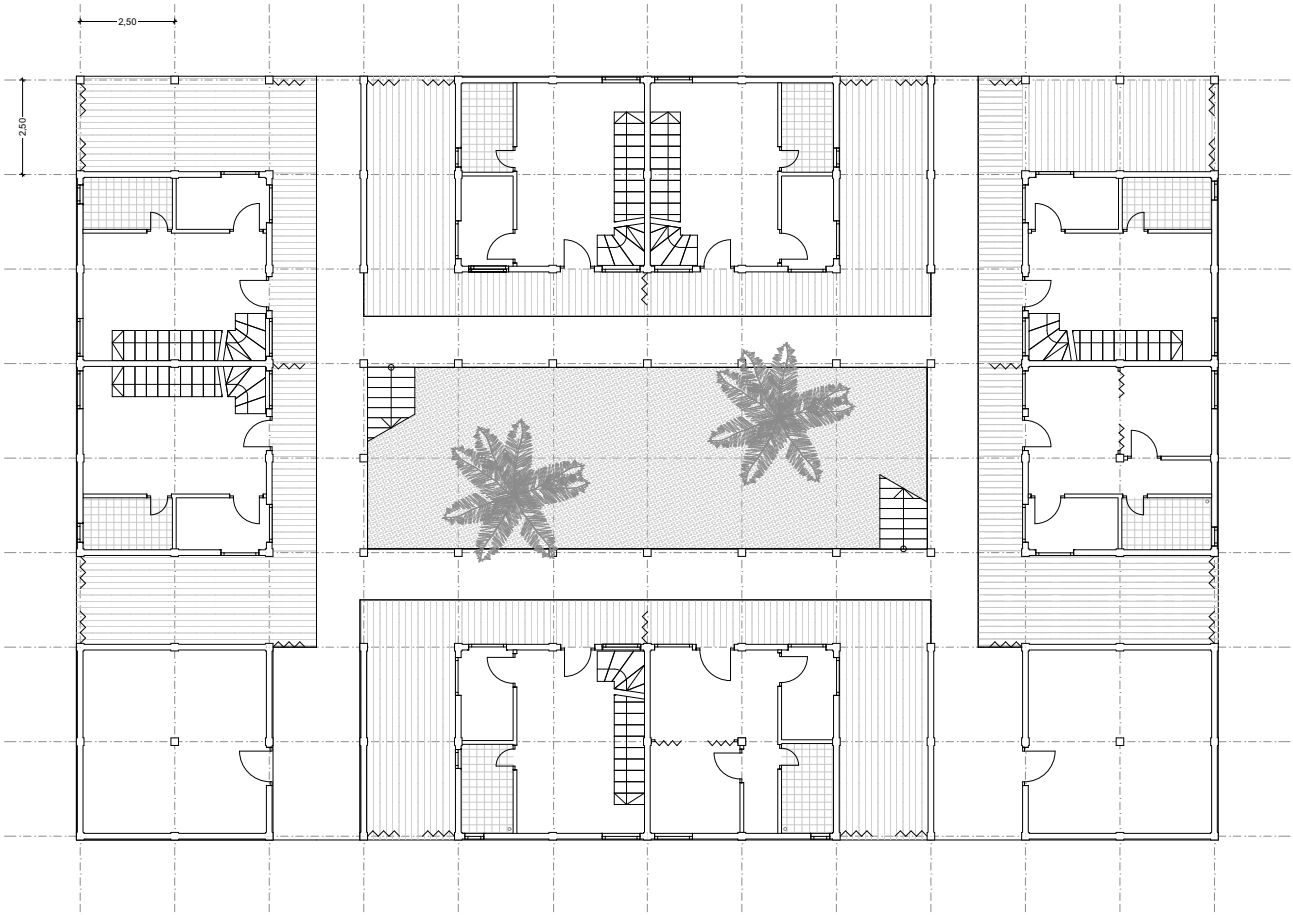

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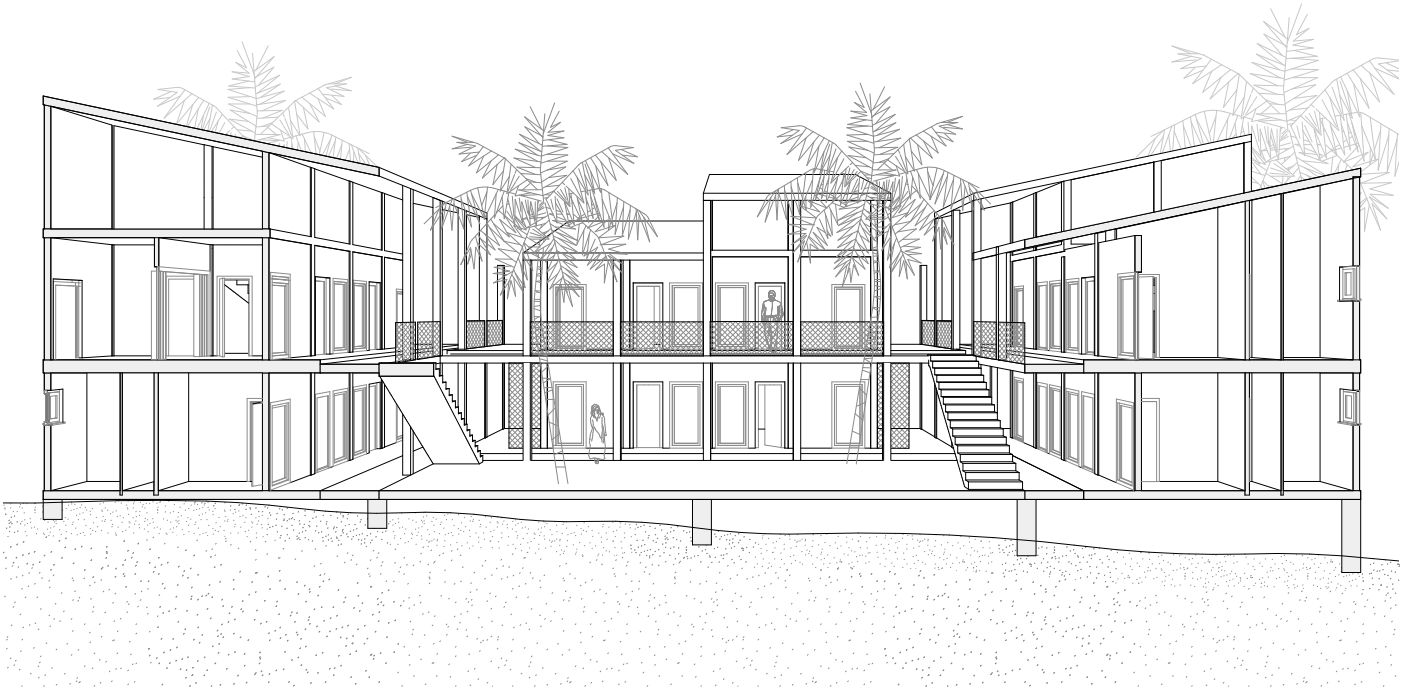
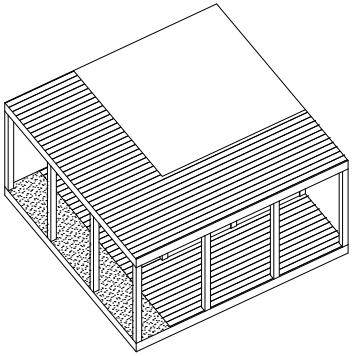
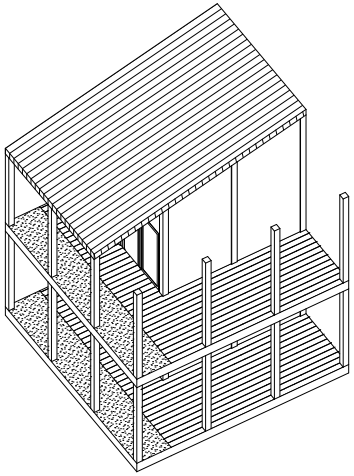
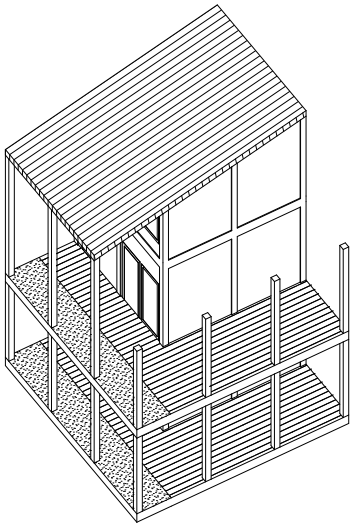




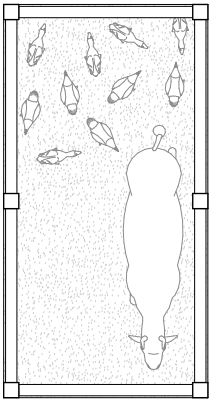
type a
2/3 people
dwelling 25m² +
extra space 12,5m²



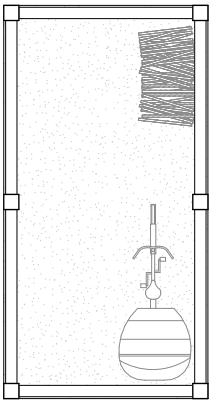
type b
4/5 people
dwelling 50m² +
extra space 25m²



type c
8 people
dwelling 75m² +
extra space 25m²



stable



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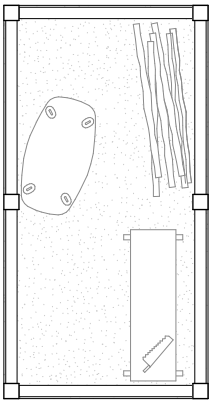
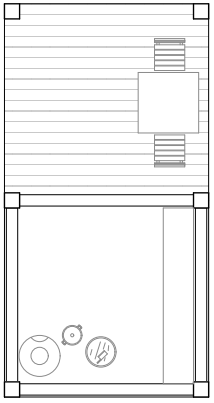
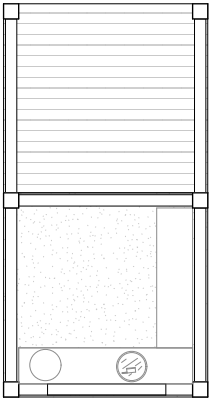


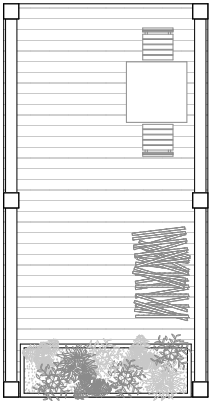
workshop



kitchen



shop



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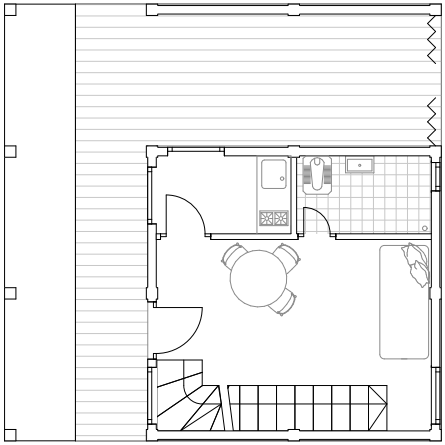
garden



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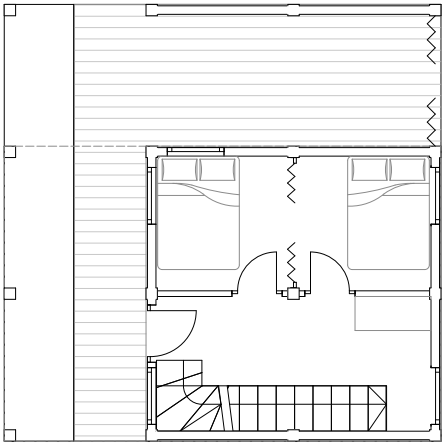

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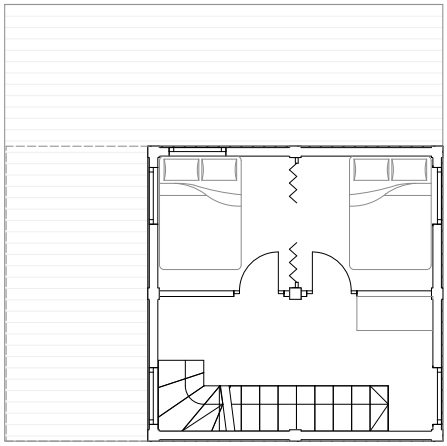

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Figure 1: "Mumbai." n.d. Unequal Scenes. Accessed June 26, 2025. https://unequalscenes.com/mumbai.

Figure 2: United Nations Development Programme, "Exploited and Marginalized, Bangladeshi Tea Workers Speak Up for Their *Rights."*

All drawings and photographs are by the author, Sara Seifert, unless otherwise stated.

