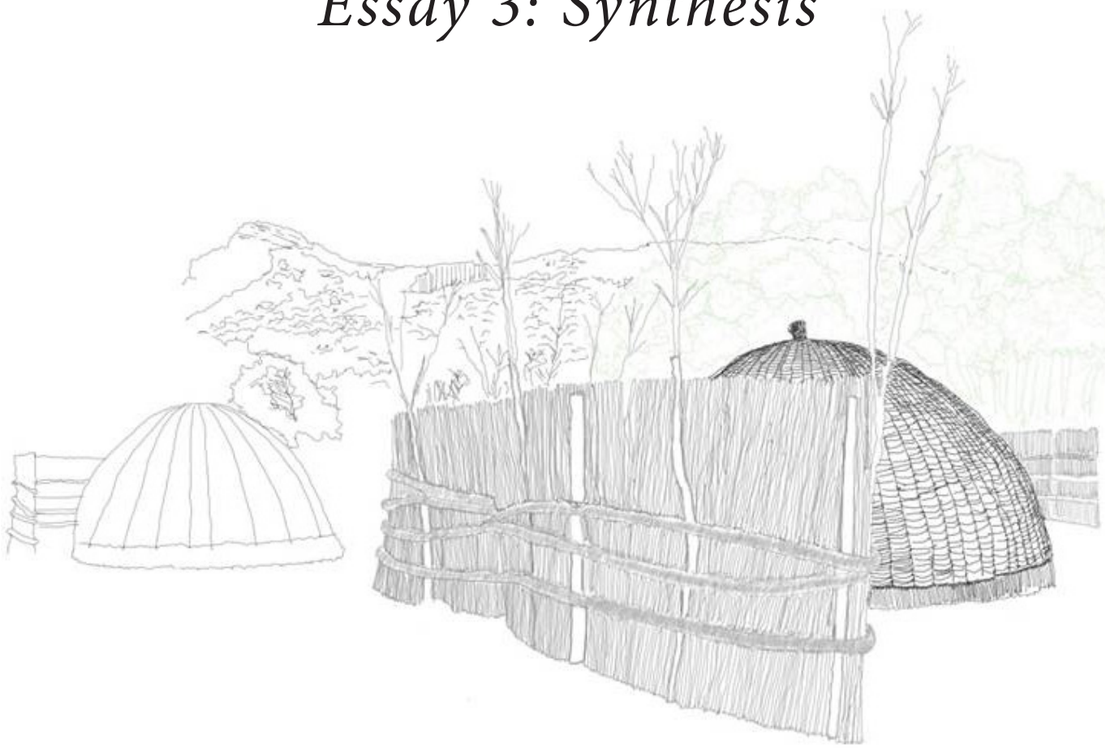
Essay 3: Synthesis



The following section explores the poetics of design and technology through an iterative process. In support of the previous two essays, critical design decisions are taken based on empirical and scientific evidence.

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Local vernacular as a main design language informant (Author 2021)

3.1 Contextual Analysis

3.1.1 Design Informants

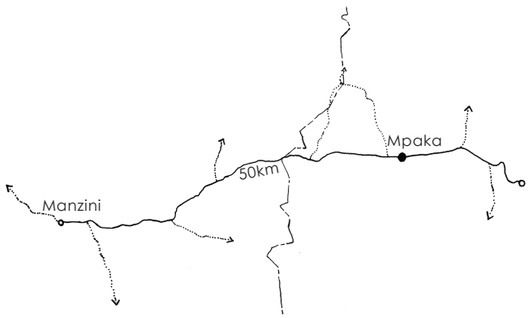

Figure 3.1: Distance between the site and major city

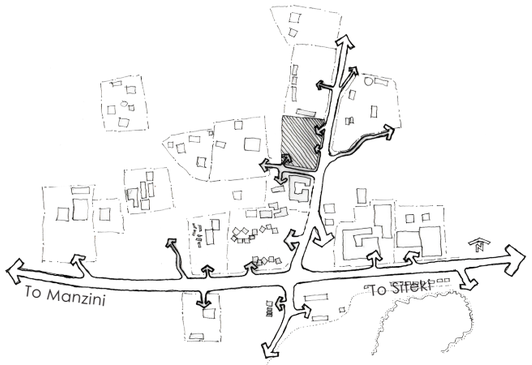

Figure 3.2: Agrarian Precinct location

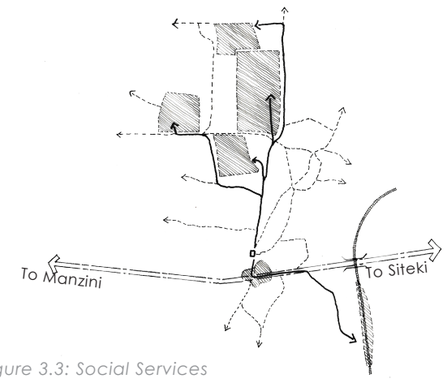

Figure 3.3: Social Services

SITE LOCATION:

The site is located next to the retail and commercial node, 155 metres (m) away from high traffic noise along the MR3 highway. Specifically, the chosen location is situated at an intersection between a new service road, located on the left-hand side, and the pedestrian boulevard on the right. As per the Matsapha Town Planning Scheme, the site's building line is set back 5m away from the road (Matsapha Municipality, 2019 , p. 82).

NEIGHBOURHOOD CONTEXT:

The location's immediate surroundings include a low-density residential zone with detached single-family dwellings on the northern side. These units provide accommodation for young entrepreneurs who intend to create start-ups on-site.

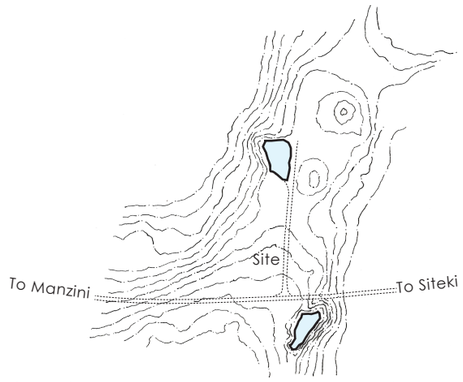

Figure 3.4: topography and two water bodies

SIZE AND ZONING:

The site covers a total area of 3 250m2 and is zoned for agricultural use; accessory buildings, offices, and structure ancillaries for commercial use are also permissible (Matsapha Municipality, 2019, p. 108). The building restriction is limited to 8m per storey (Matsapha Municipality, 2019, p. 115), with the currently presented building project having a maximum of two stories. The project's building is further provided with a maximum of five parking bays and a 50m2 on-street loading zone for delivery vehicles. This loading zone is required for the delivery of grain bags coming in from the maize fields. The presented taxi rank, in turn, caters for the additional parking of eight taxis per bay (City of Johannesburg, 2018 , p. 72).

LEGAL:

While the area is currently in the process of urbanisation, it still falls under the governance and leadership of Chief Ndlondlo and other inner-councilmembers, including the indvuna (governor), Sipho Cijwa Dlamini. The project will, therefore, have to abide by all traditional legalities before commencement (Dlamini, 2021 , p. 1).

NATURAL PHYSICAL FEATURE:

As indicated on the map in Figure 3.4, two existing water bodies provide drinking water for domestic animals. However, this water is currently unsuitable for human consumption. The map also shows 1m interval contour lines indicating the direction of the topographical slope that channels stormwater towards the retention dam for treatment.

MANMADE FEATURES:

The current street does not have any surface paving. Hence, the project intends to pave the street in order to maximise efficient rainwater collection.

CIRCULATION:

The current street is used as the main boulevard while a new service road will be constructed as part of the project in order to better access different areas of the transect. Furthermore, the main boulevard is pedestrian-oriented and has intersecting corridors that link to the main service road. These two streets intersect and lead to the main MR3 highway.

UTILITIES:

There are a limited number of public utilities in the area, including electricity supply and a telecom tower for cellphone connectivity. The project, thus, further introduces a water treatment plant at Node 3 that can supply fresh water for the development framework and which recycles wastewater for irrigation use. Its capacity is discussed further in Section 3.11: Services. For the purposes of the current discussion, however, it is sufficient to state that the installation takes place 2m underground with reinforced concrete stormwater service channels that run towards a water cistern.

SENSORY:

When initially mapping the site, it was discovered that during the weekend, the current market street becomes less busy and less noisy. There is also less traffic activity and fewer informal activities that take place. This lowering in 'busyness' over the weekend was found to be due to a lack of storage facilities, as vendors often have to transport their goods daily to sell on the market street.

SHUMAN AND CULTURAL:

Each homestead has at least one rondavel often roofed with thatch. This is because of the historic and cultural nature of the Swazi lifestyle, of building separate units according to their function. The sacred hut (Kagogo) for example, remains an important unit in each homestead (Malindzisa, 2021). In general, local materials and their technologies have the element of temporality. This is also revealed by national cultural practices such as the Umhlanga ceremony, which occurs annually. Maidens engage in a tradition of cutting reeds to revive 'emaguma' (huts) for the royal residents. This practice is not only limited to national cultural events but also practiced in rural communities, where thatched rondavel and adobe walled houses are constantly revived and maintained.

CLIMATE:

The climatic conditions of Mpaka indicate a maximum temperature of 30˚ C and a minimum of 20 ˚ between May and August. The graphs below indicate the average precipitation and north-south prevailing wind directions during the May and August month. These months have been selected to maximize the most effective design strategies of the project.

SITE WEAKNESS:

The site has a lack of public infrastructure such as the market area. It is not conducive for the community to conduct social and economic activities. As a result, people migrate to the cities leaving the area sparsely populated thus adding to the difficulty of providing efficient and integrated infrastructural systems such as water and electricity supply connections.

SITE STRENGTH:

the site has fertile land available for agrarian activities and open spaces for development. The site is adjacent to the MR3 highway which provides easy access to the KM111 International airport, an important entry point for tourists to visit the site. The site forms part of the circulation route to tourist destinations such as the Hlane nature reserve 7 km away from the site. The Mpaka railway also forms an important gate way that connects the site to Matsapha industrial site located in the Manzini region.

OPPORTUNITIES:

There is the opportunity to utilize the available land, animal, and human resources, through agrarian urbanism strategies, to boost the economic status of the community. Through NGO sponsorships, the build infrastructures can provide platforms for trading, educating, training, and empowering locals as well as asylum seekers at the refugee camp. Due to its geographic location, this framework has the potential to attract local and international markets.

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3. 2 Critical Questions to Derive the Development Framework

How can this proposal become a catalyst for developing a sustainable framework?

How will the infrastructure be maintained?

What policies are put in place to guide the development and protection of the infrastructure?

How will the locals and refugees in the area benefit from the development?

What is the hierarchy of services needed for the framework to attract tourist and international markets? (i.e., trading: market hub, education: indigenous knowledge skills training, arts & culture connectivity: taxi rank, radio station, Housing: residential development, recreational spaces, and parks, etc.)

3.3 Aim

To stitch the social and economic fragments together to enhance the lives of the local community.

To strengthen existing corridors that connect these strategic economic development nodes

To upgrade the transport facility hub that links the site to nearest cities and tourists destinations

To Integrate refugees and asylum seekers through the exchange of skills and knowledge and be part of the community

3.5 Technological Intentions

The following sections detail the investigation into the technical solutions present in this study, based on local and sustainable technologies, so as to create a sustainable agrarian development framework that responds to the socio-economic needs of Mpaka. The poetic intention of these solutions is to create a mediation where the permanent stereotomic and temporary tectonic architecture can meet.

Figure 3.1: Local vernacular (Author, 2021)

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3.6 Technological Responses

In respect to an aerial overview, the form and spatial arrangements of Mpaka seem to have appeared randomly; however, upon closer analysis of the socio-economic activities in this area, it is possible to see the meaning behind the seemingly organic spatial forms. Specially, this rural spatial context creates opportunities for establishing a dialogue between organic and orthogonal interfaces, where the relationship between local and modern technologies become more appreciated.

3.7 Structural System

Figure 3.2 shows the explored view of the transportation hub roofing system. The emphasis is on the three structural elements of the roof, the namely primary, secondary, and tertiary structures.

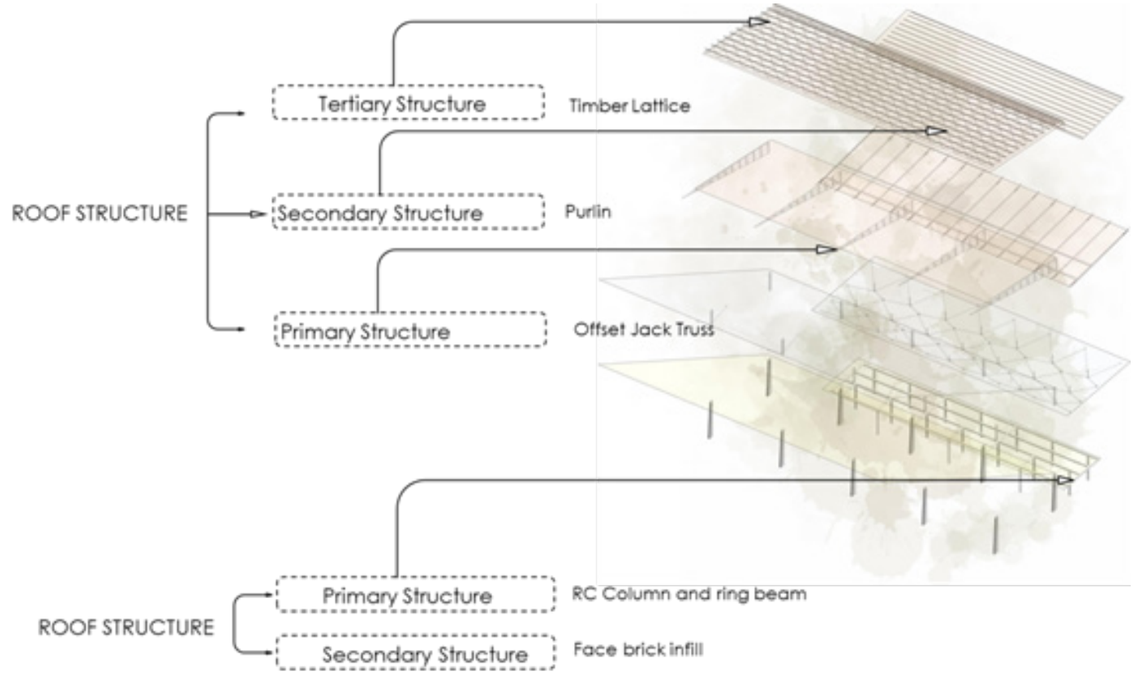

Figure 3.2: Primary, Secondary, and Tertiary Structure (Author, 2021)

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3.8 Structural Intentions

The taxi rank diagram presented in Figure 3.3 highlights the first concept of the project's structural intentions, namely to determine whether or not this principle could be applied in different iterations of the transect. These iterations focus on the wall (skin) and roof in terms of its primary, secondary, and tertiary structures.

3.8.1 SKIN:

The primary structure of the skin consists of a reinforced concrete column, along with a reinforced concrete ring beam, designed to act as tectonics in framing the trading market stalls. This technique allows the primary structure to be independent of the stereotomic face-brick, which acts as an infill.

3.8.2 ROOF:

The main structure of the taxi interchange is made of an offset jack truss, which allows for longer roof spans. The same principle applies to the butterfly steel struts covering the market stalls, which work to allow the roof sheeting to span longer distances. The secondary structure of the roof consists of purlins made of lightweight steel material. The tertiary structure, in turn, is made of local timber lattices that resemble local African patterns, as in line with Brown and Maudlin (2012, pp. 347-350).

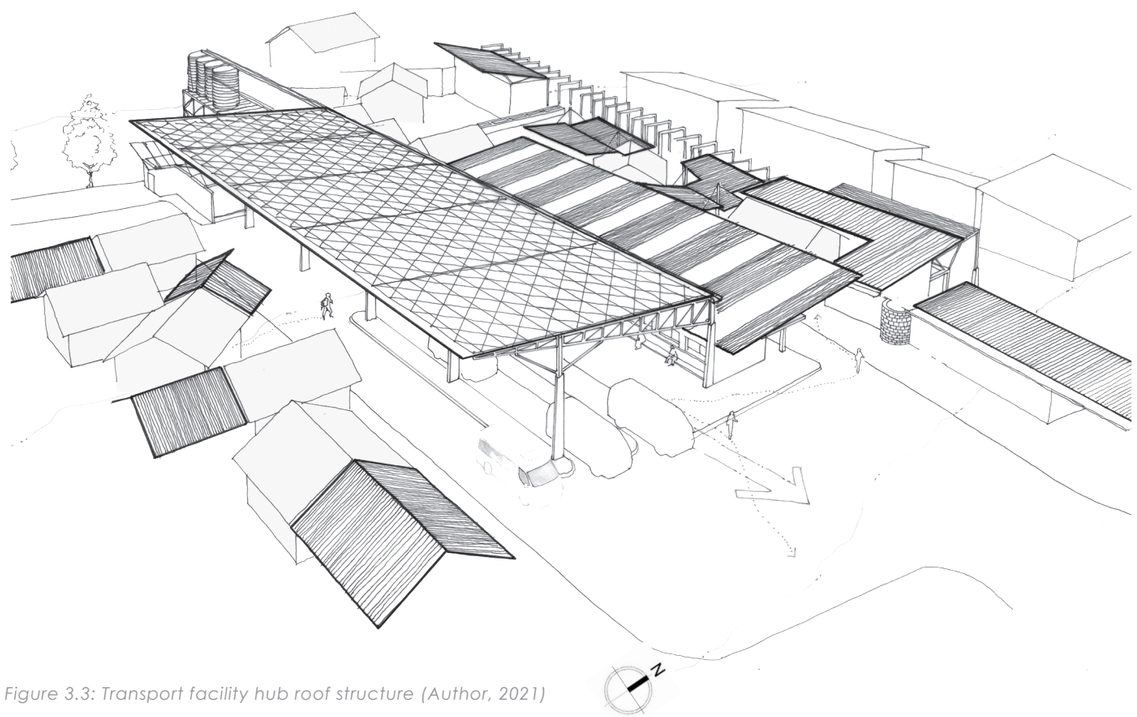


Figure 3.3: Transport facility hub roof structure (Author, 2021)

3.9 Materiality

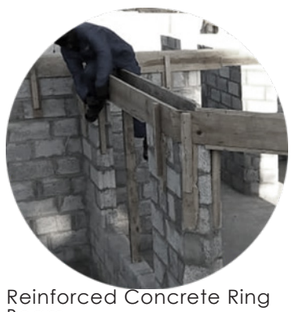
The use of local materials in a rural setting has always been a crucial factor in construction (Clifford, 2021, p. 58-63). This approach to building also involves a tactile method, where vernacular skills are transferred through gender socialisation in the preservation of cultural practices . The presented project, thus, aims to create a symbiosis between the temporary and permanent use of material in respect to specific parts of the urban transect.

The tectonics of the roof, for example, apply large roof overhangs that provide a permanent structure that allows for the temporary vernacular adobe wall to act as an infill in order to present a culturally expressive solution (CS Studio Architects, 1998, p. 1). Similarly, the large steel sheet overhangs protect the wearing out of the adobe wall against flood rains.

The agrarian precinct, furthermore, allows for the involvement of the project's contractors to collaborate with the local community in skill-sharing during project construction. This engagement can create a sense of authorship for the local user and may, thereby, foster a spirit to protect, maintain, and preserve these structures in the long run.

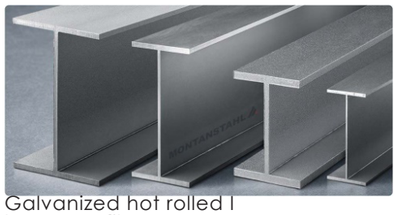

Clay Brick


Local produced hollow core concrete Blocks


Reinforced Concrete Ring Beam


Reeds and grass


Klip-lok 406 roof Sheeting


Galvanized hot rolled I beam profile


Adobe wall


Gum poles

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3.10 Sustainability – The Environmental System

There are a number of aspects to consider in respect to sustainability:

PASSIVE DESIGN:

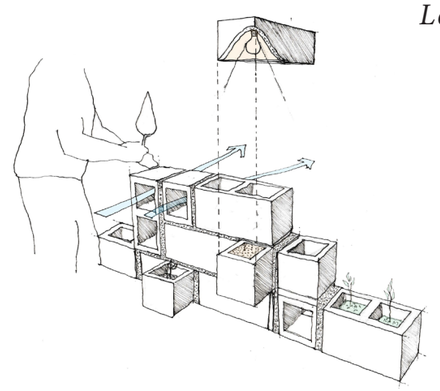
The design intentions are to limit the use of mechanical ventilation and, by association, limit maintenance costs. This is done through the playful use of local air bricks that allow the building skin to breathe during the hot summer season.

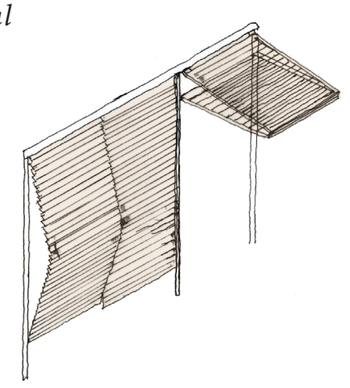
MATERIAL USE:

The project uses thatched roofing to insulate the grain and water storage facilities. This strategy is used to more creatively reduce energy consumption.

SERVICES:

The water storage facility is positioned in such a way as to allow water to flow through potential energy so as to reduce electrical and mechanical costs.


Local Material



Precedent Study


Seed bank: Local used concrete block by Paragon architects


Local vernacular

3.11 Systems

3.11.1 WATER

Due to the aforementioned lack of infrastructure, such as municipal water supply systems, the people of Mpaka tend to practice water conservation through means of rainwater harvesting, with the use of water tanks (Eslamian, 2021, p. 21). However, this water is never enough to support sustainable agrarian activities, as rainwater and streams remain the only source of water supply. The project, therefore, embarks on a process of creating sustainable water supply systems. The existing and complimentary light infrastructure are also further supplemented with rain storage tanks in order to collect water from smaller rooftops.

3.11.2 WATER SUPPLY

Agrarian urbanism requires an intensive water supply. As such, the 1km long spine connecting Nodes 1 and 3, according to the development framework, is paved with asphalt and recycled plastic material to allow efficient flow of stormwater. This flow follows the topographic slope towards the water catchment, as indicated in Figure 3.4. It should be noted that the benefits of rainwater harvesting involve commercial as well as domestic use, such as cleaning, cooking, and irrigation (Lancaster, 2010, p. 122).

3.11.3 WATER SUPPLY AND THE ECOSYSTEM

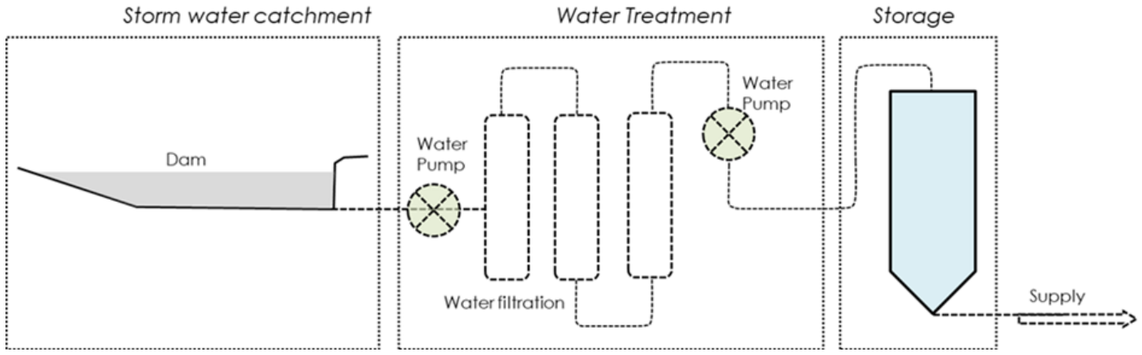
In times of changing weather patterns and unpredictable rainfall, water becomes a precious resource (Aleksandra, 2021, p. 713). Therefore, it is necessary for this design concept to indicate how water can be collected, purified, and stored. To that end, the existing topography, together with its habitat, is handled more conservatively so as to allow for the effective collection of wastewater for purification and irrigation purposes. A water management system also forms part of the programme in order to build strategic water catchment channels that collect the stormwater that supplies the farming endeavours.

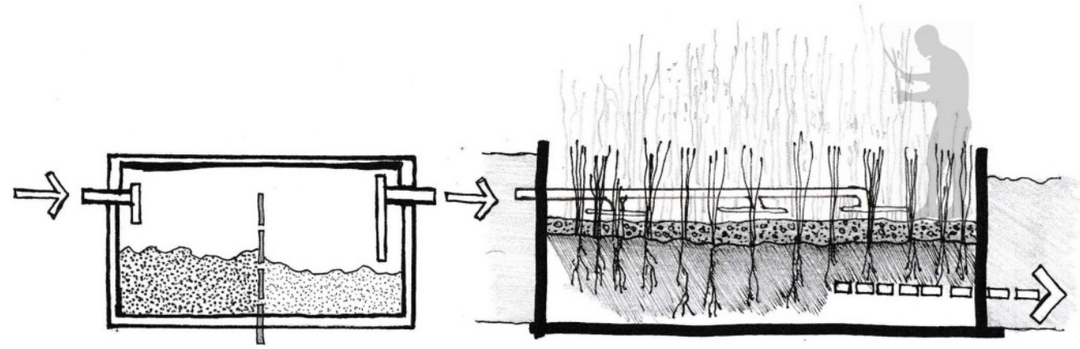
3.11.4 WASTE MANAGEMENT POLICY

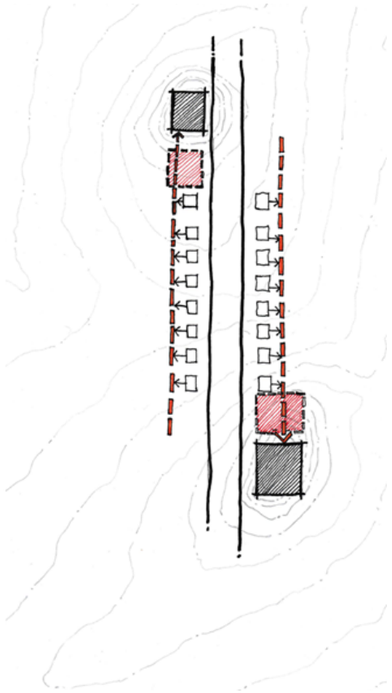
Policies are put in place to ensure that the aspects of water and waste management are effectively implemented and to protect the natural environment and its biodiversity.

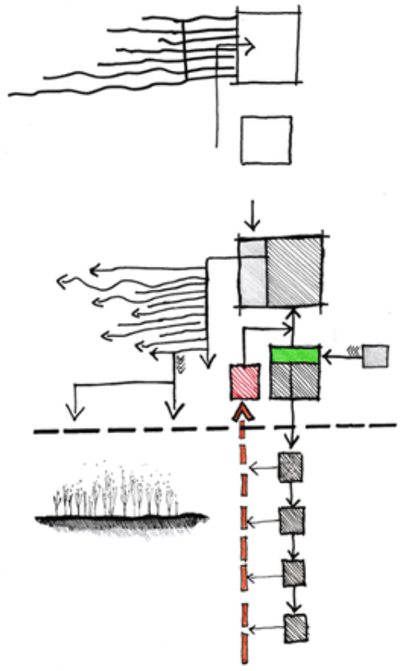
3.11.5 BIOGAS FACILITY AND SOLAR FARM

Organic waste is taken through several processes, including the creation of fertilisers that are supplied back into the fields. Animal and plant manure is also used as biogas for domestic use.









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3.12 Services

3.12.1 STORMWATER CHANNELS

The industrial section of the development framework involves the process of water harvesting, in conjunction with the establishment of the water treatment plant. After the stormwater has been collected and treated for domestic supply, wastewater can be collected and treated so as to form part of the general irrigation process.

3.12.2 WATER YIELD

Rainwater is collected through the large roof overhangs of the transport facility hub, as well as via the paved surfaces of the transect. According to the yield calculations in the table below , an annual average yield consists of approximately 6 085 251m3 of water, with an average of 4.2844m of precipitation per year.

Yield (m^3) = P x A x C

P = Precipitation (m)

A = Area of catchment (m^2)

C = Runoff coefficient, 0.8 to 0.9

The urban strategy further intends to harvest rainwater from hard surfaces (e.g., large roof overhangs and impervious paving) on an average of 80-90% efficiency. The precipitation diagram for Mpaka, thus, indicates how many days per month certain precipitation amounts might be reached.

The locally produced concrete block can also be used as an air brick for cross ventilation and cooling strategies. In addition, locally produced grass mats are used as sunscreens and shutters for passive ventilation. These elements create and maintain the relationship between locally available skills and materials while also introducing modern materials.

3.12.3 SYSTEMS LIGHT

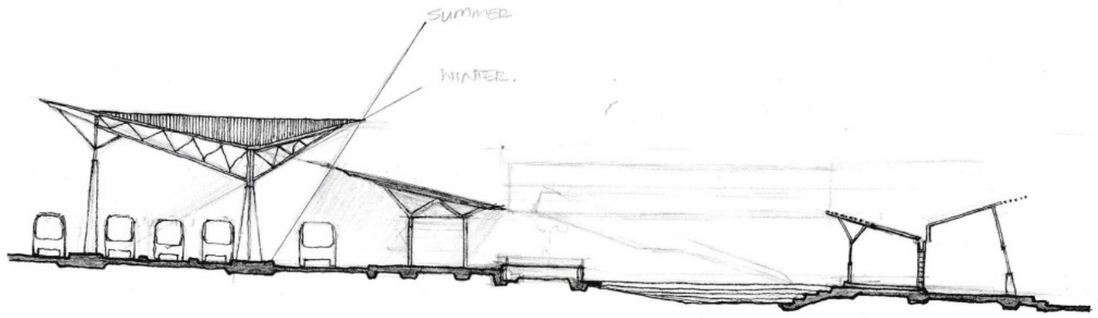
In addressing the issue of natural lighting that flows into the trading hub, Klip-Lok translucent roof sheets are used to allow diffused light into the space.

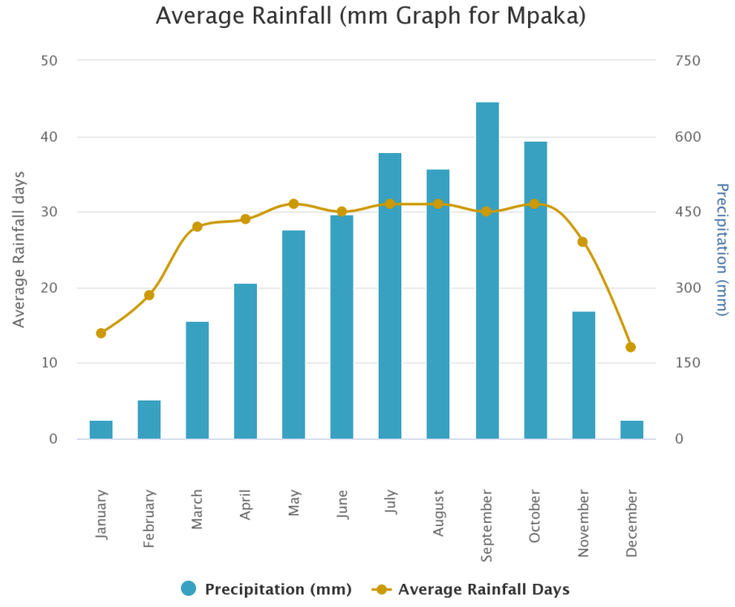
Month	Ave. Monthly Precipitation, P (m)	Yield (m^3) = P x A x C
January	0,0369	23645
February	0,0778	49853
March	0,2340	149944
April	0,3089	197939
May	0,4164	266824
June	0,4450	285151
July	0,5683	363968
August	0,5365	343783
September	0,6694	428944
October	0,5910	378706
November	0,25540	163657
December	0,0372	23837

Table 3.1: Monthly Precipitation and Yield (Author, 2021)

Catchment	Area (m^2)	Runoff Coefficient, C (Weighted)
Roof	33220	0,41
Paving	729625	0,43
TOTAL	762845	0,84

Table 3.2: Catchment Surface Area (Author, 2021)





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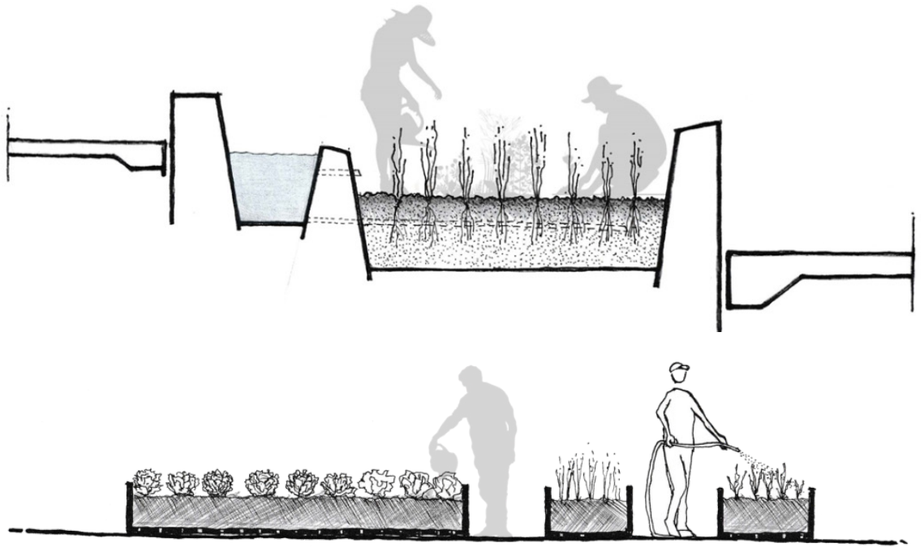
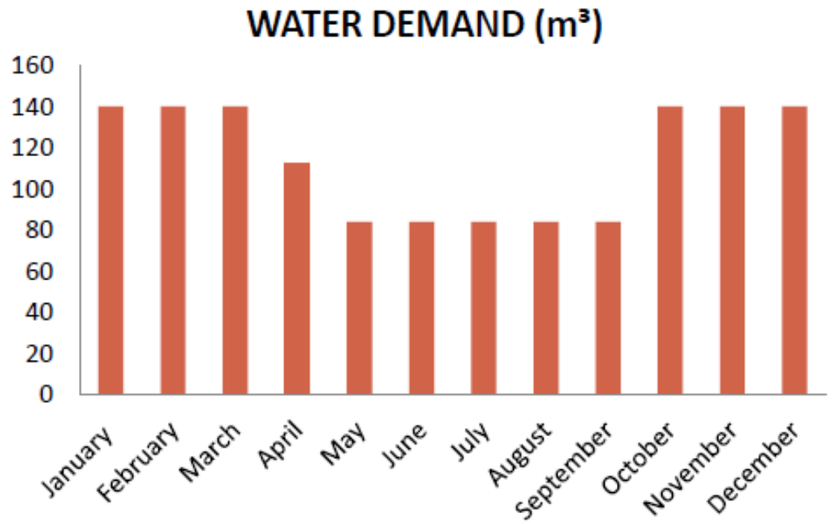
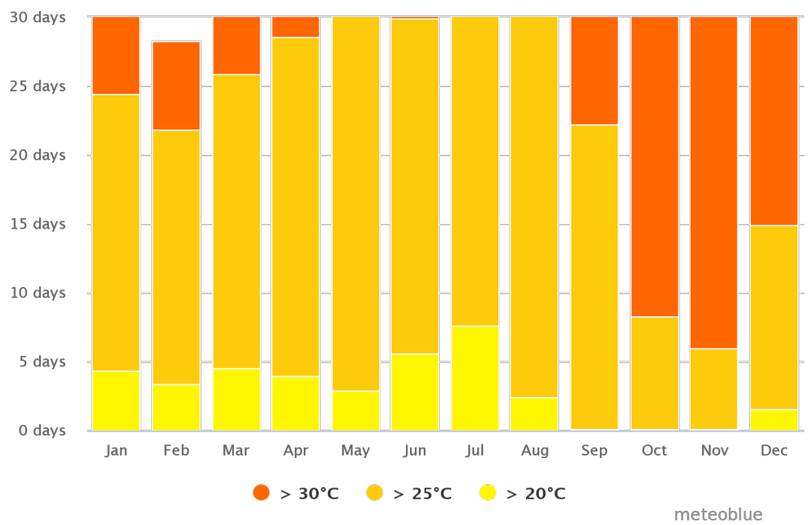
3.12.4 WATER DEMAND

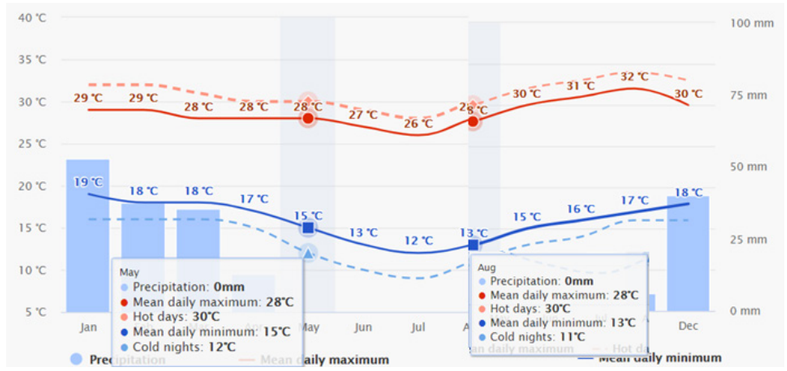


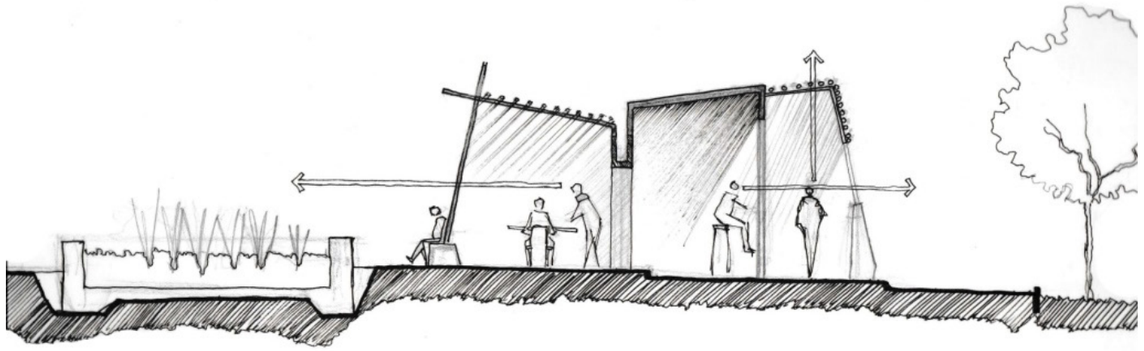
Irrigation Demand				
Month	Planting Area (m^2)	Irrigation depth /week (m)	Irrigation depth/ month	Irrigation demand (m^2/month)
January	10000	0,05	0,2	140
February	10000	0,05	0,2	140
March	10000	0,05	0,2	112
April	10000	0,04	0,16	84
May	10000	0,03	0,12	84
June	10000	0,03	0,12	84
July	10000	0,03	0,12	84
August	10000	0,03	0,12	84
September	10000	0,03	0,12	84
October	10000	0,05	0,2	140
November	10000	0,05	0,2	140
December	10000	0,05	0,2	140
				1372

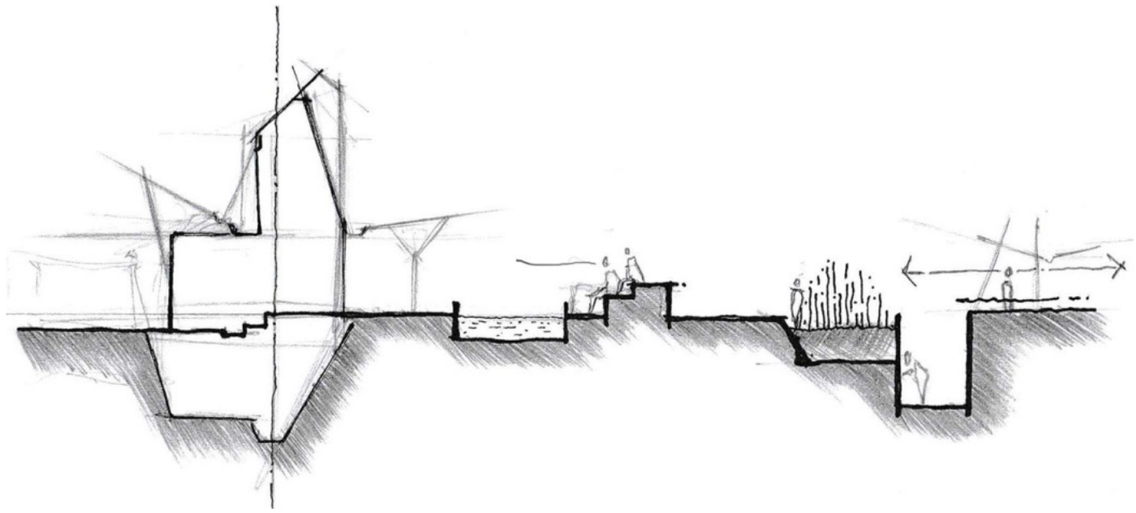
Table 3.3: Irrigation Demand (Author, 2021)

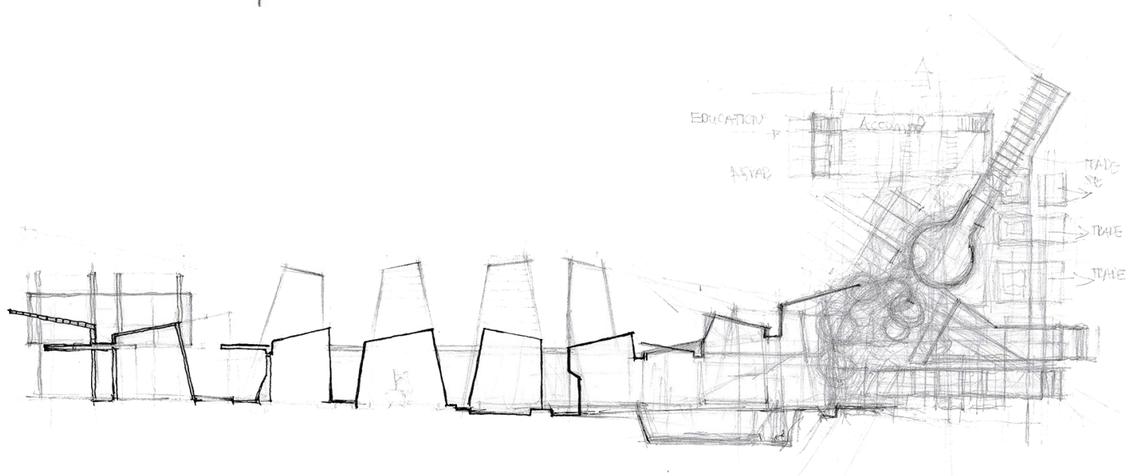












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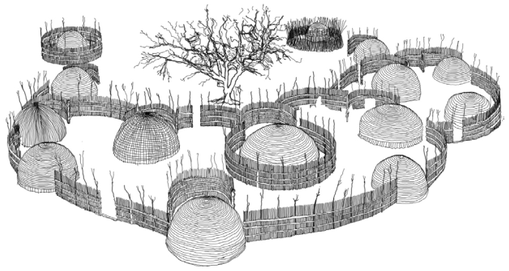
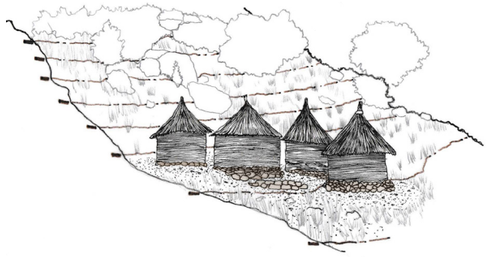
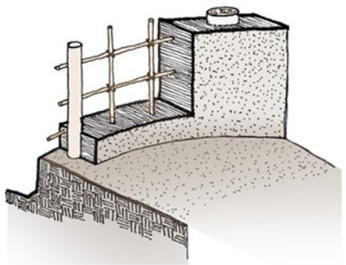
3.13 Technology

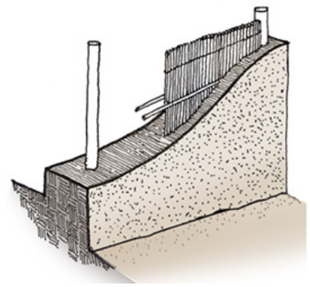
Learning from the local vernacular, the tectonic structure is essentially made of timber framing, while the mud cladding serves as skin in the protection and enclosure of the internal spaces.

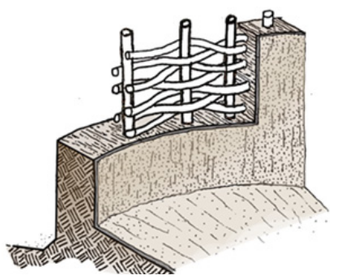
A similar technique is implemented in respect to the light infrastructure, where the tectonic concrete column/ring beam frames the structure and supports the roof with large overhangs. This strategy allows the stereotomic adobe wall to then act as an infill while still being protected against rainwater by the steel roof sheeting.







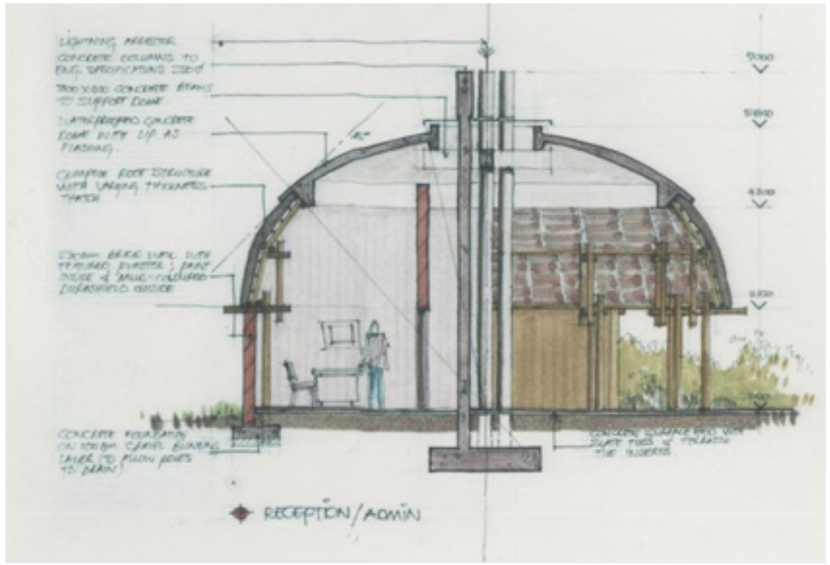


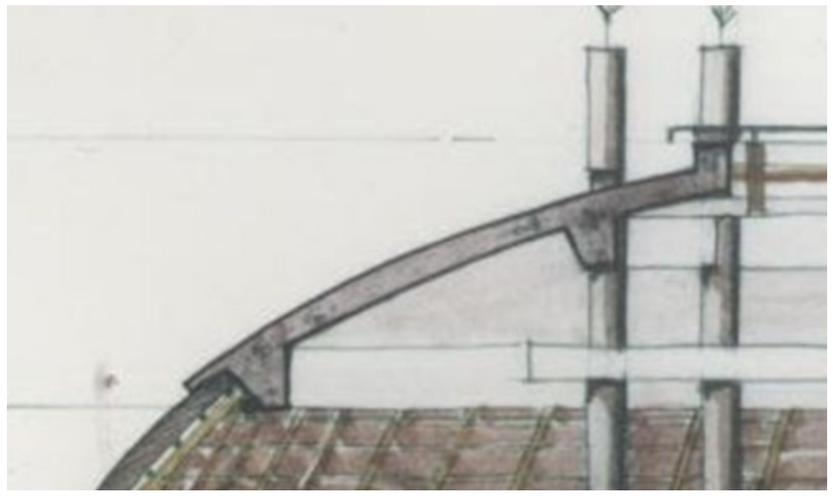


3.14 Precedent Study - Technology

3.14.1 ZULU SUN LODGE (DURBAN, SOUTH AFRICA)

AArchitect Niel Crafford demonstrates how vernacular material, such as thatched roofing, can be improved upon in terms of its durability by using more permanent material (Crafford, 2021). Crafford (2021) expressly details why the angle plays a key role in determining the lifespan of this roofing material. In particular, anything less than a 45˚ slope drastically deteriorates the grass and rots quicker than the rest of the thatch (Thatchers Association of South Africa, 2016, p. 30). In order to improve the longevity of the roofing in his design, Crafford thus opted to replace the grass that lies below the 45˚ degrees slope with a concrete roof cap.





3.14.2 NIKE FOOTBALL TRAINING CENTRE (SOWETO, SOUTH AFRICA)

Luyanda Mpahlwa and Mokena Makeke spoke about the playful use of public spaces using African architectural identity at the 2021 Design Indaba. As part of their address, they noted how the Nike Football Training Centre, located in Soweto, reveals how local timber louvers are used as cladding strips and solar shading (Gerin, 2008, p. 113). Such louver use is reminiscent of a regional reed beehive screen that defines private and public spaces and emphasises visual connection (ArchiDatum, 2021, p. 1).

3.14.3 CENTRE FOR EARTH ARCHITECTURE (MOPTI, MALI)

Kere Architecture demonstrates how a ring beam supported on a reinforced concrete column, functioning as a primary structure, can create independence between a roof structure and the local brick infill (Goodwin, 2021, p. 1). This principle is experimented on in respect to this current study's own transport hub, and is also replicated throughout the site in different iterations. The strategy has been found to be particularly useful in creating an opportunity to adopt stereotomic wall infill using local vernacular material such as adobe walls. This approach also allows the independent roof to have large roof overhangs that can protect the walls from rainwater.

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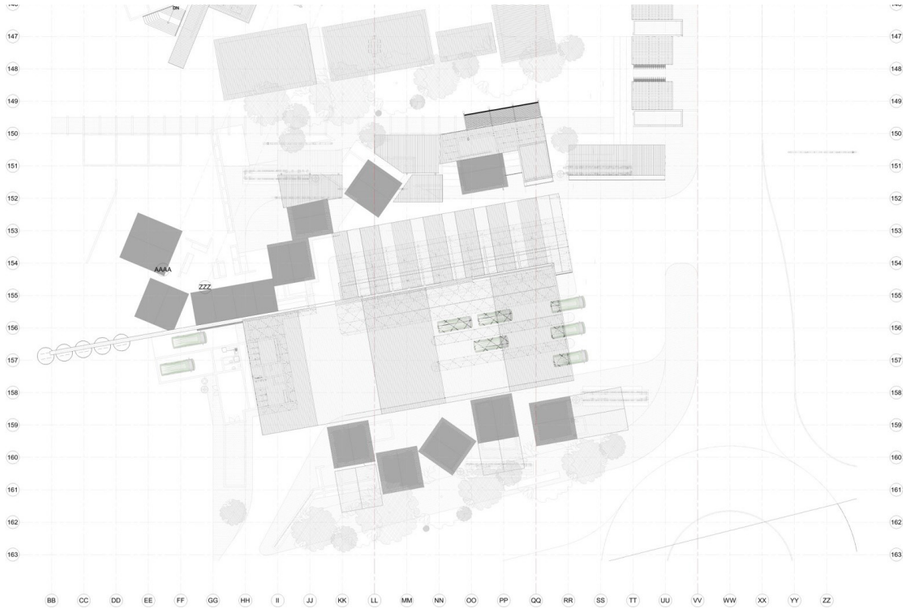
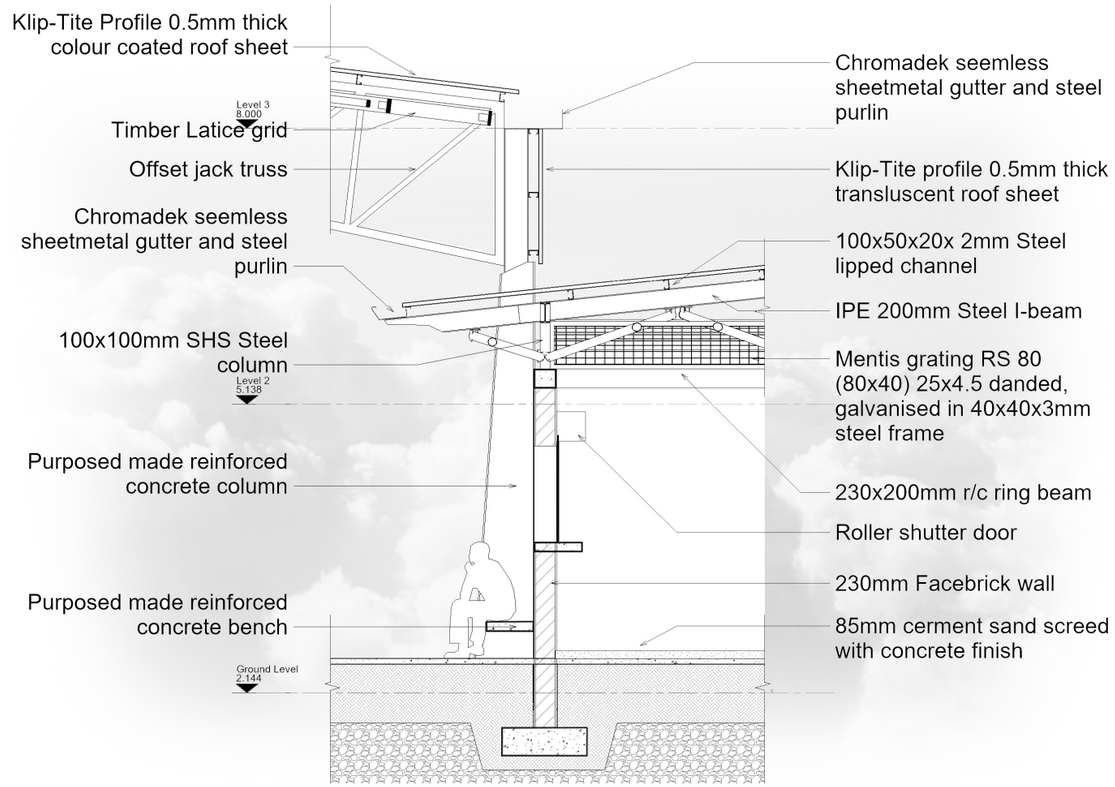
3.15.1 Transport Hub Plan

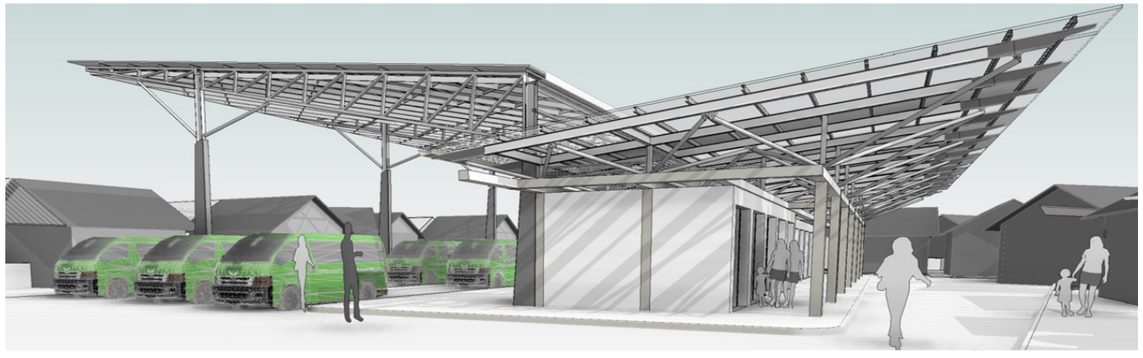
3.15.3 Transport Hub Roof Plan



3.15.2 Transport Hub Section



3.15.4 Transport Hub Pespective



CONCEPT INTENTIONS

Structural Intentions

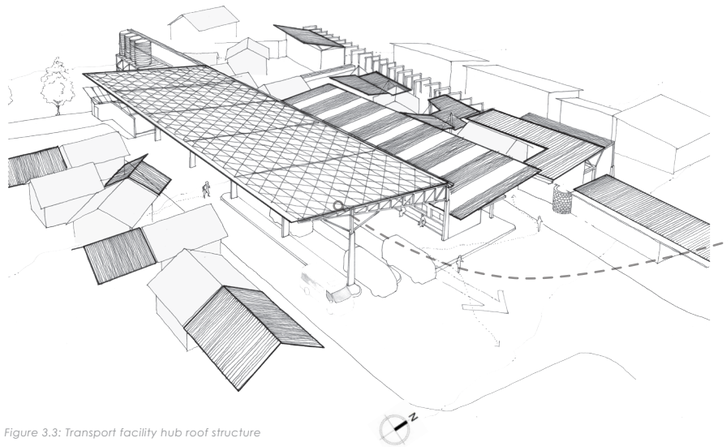
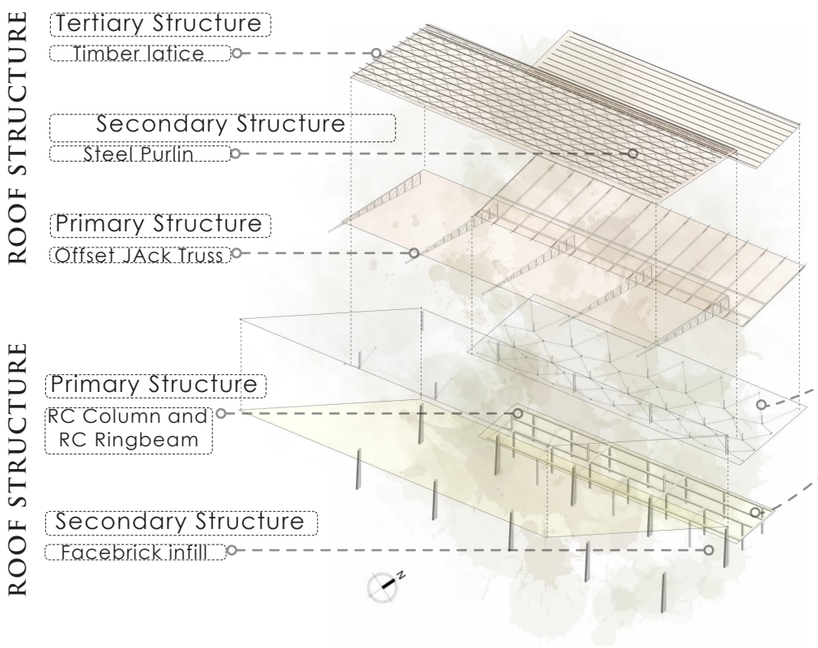
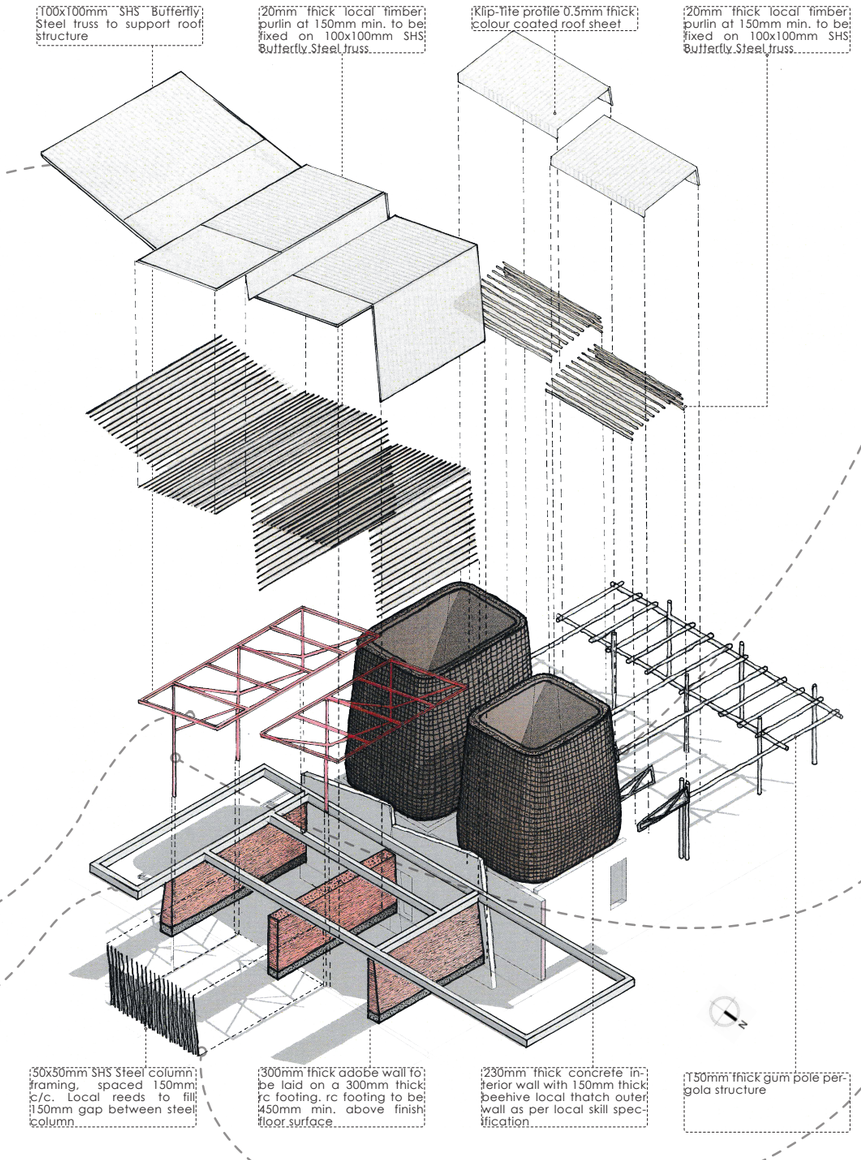


Figure 3.3: Transport facility hub roof structure

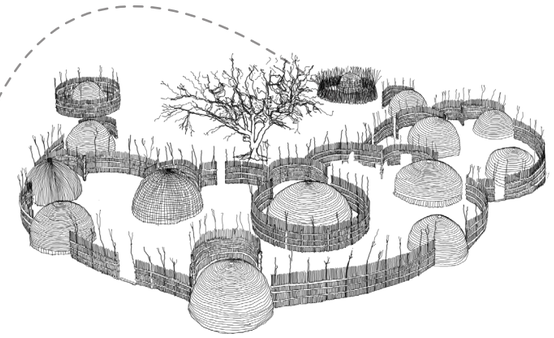
3.7 Structural System

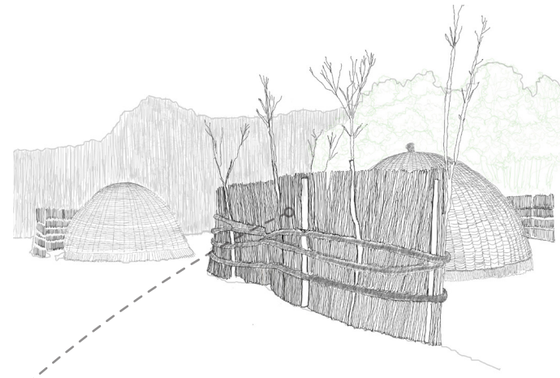


Technological Responses



Mantenga Cultural Village





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Elevations

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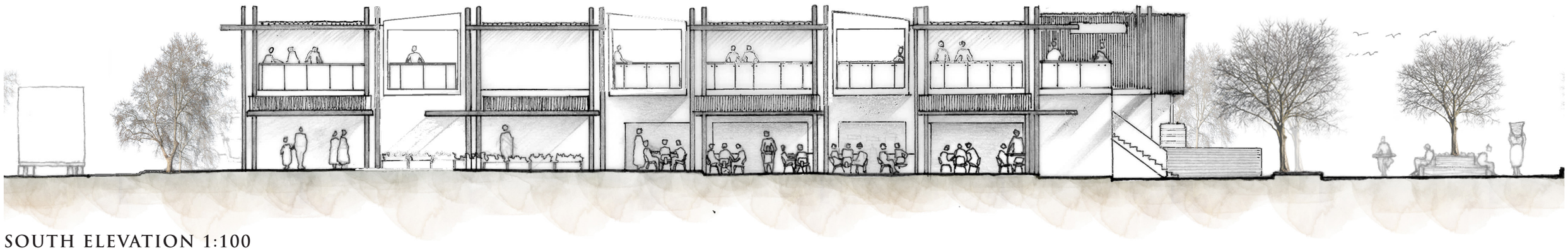
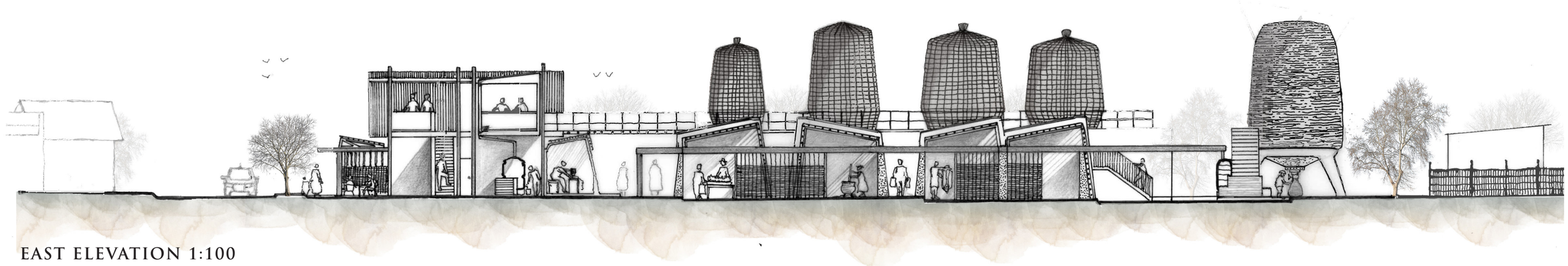
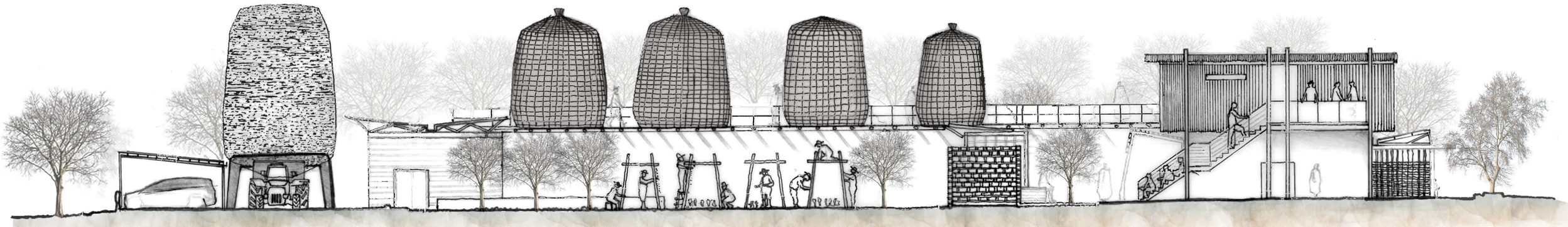


SOUTH ELEVATION 1:100



EAST ELEVATION 1:100



WEST ELEVATION 1:100

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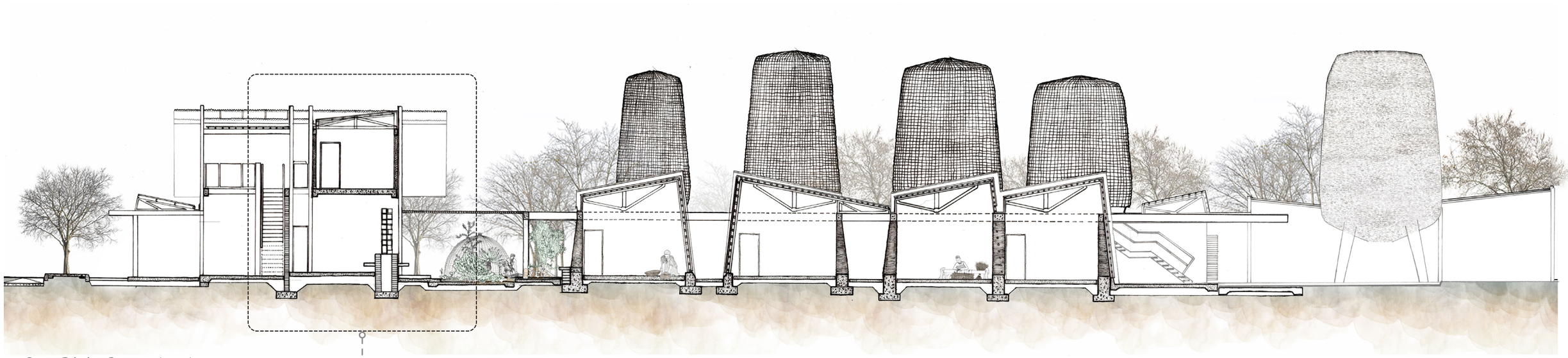
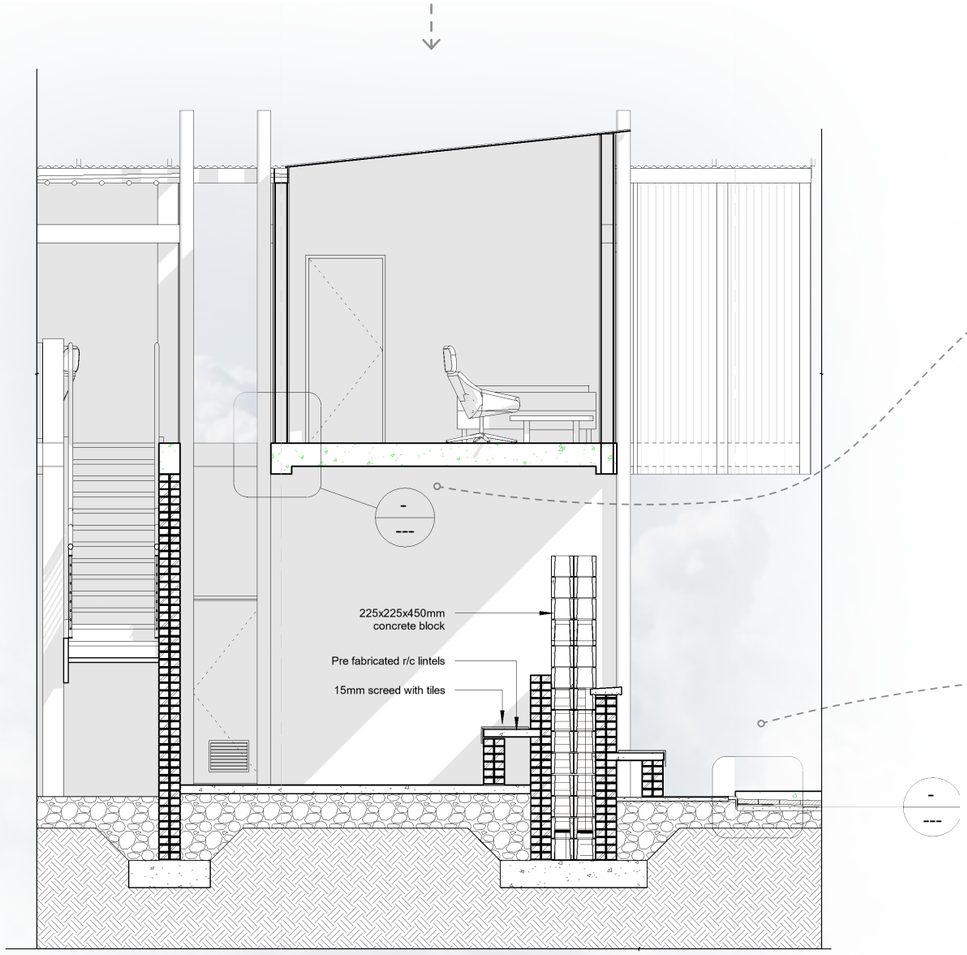
SECTION and DETAILS

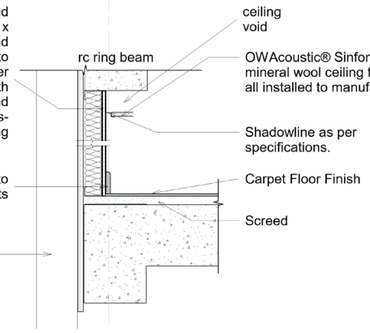


SECTION A-A



131

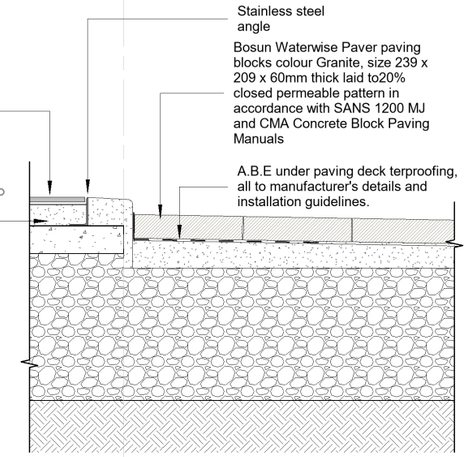
Gyproc 3000 high GypWall SoundBloc Ultrasteel Stud Drywall, consisting of stud and track system with 70 x 50mm studs at 600mm centres friction fitted into head track and floor track with 63mm insulation inserted into cavity of partitioning and cladded with an interior layer of 12,5mm thick Gyproc SoundBloc board fixed with 25mm and 42mm Screws at 220mm centres and resilient bars to one, external claddind wall consist of s-rib steel sheeting



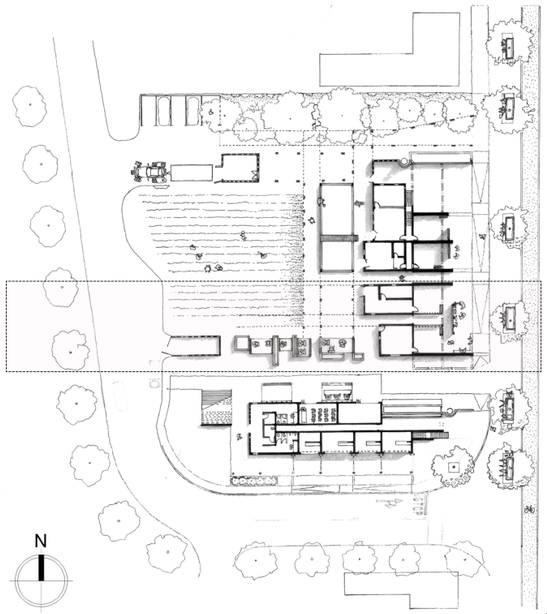
130

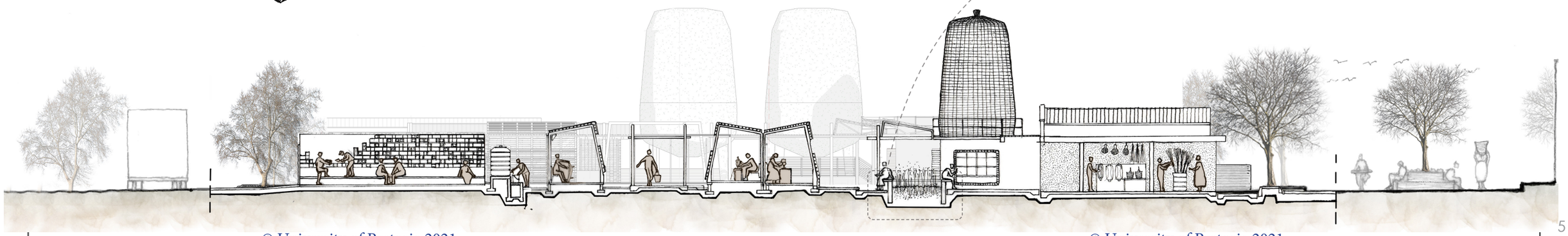
600x600mm full bodied porcelain tiles. Specs to be confirmed and approved.

60mm recess in rc surfacebe to with 45mm screed.



HEALTH FOOD PRODUCTION:





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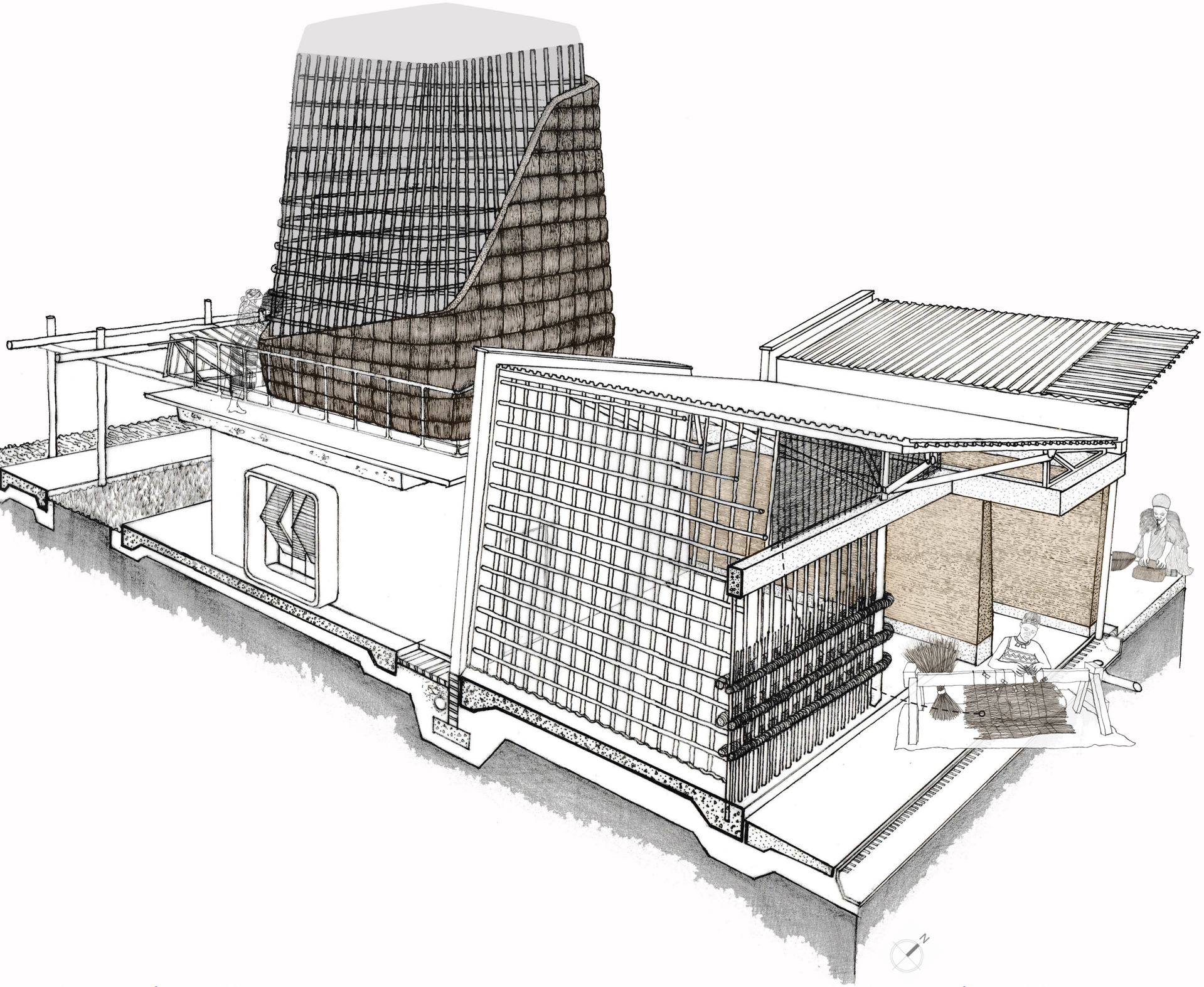
Local Skill+Contractor Interface



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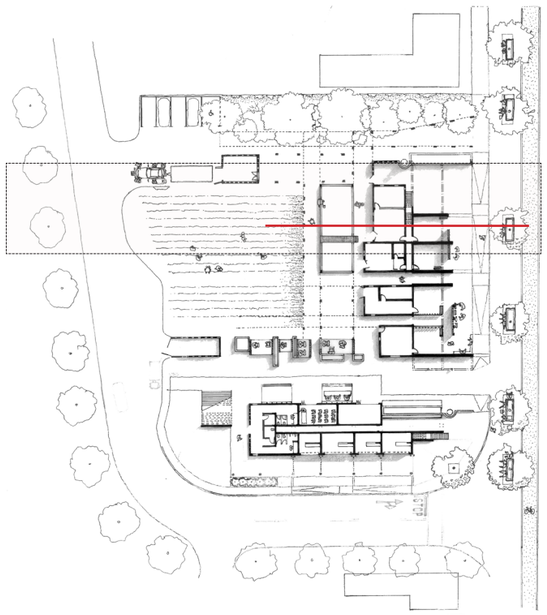
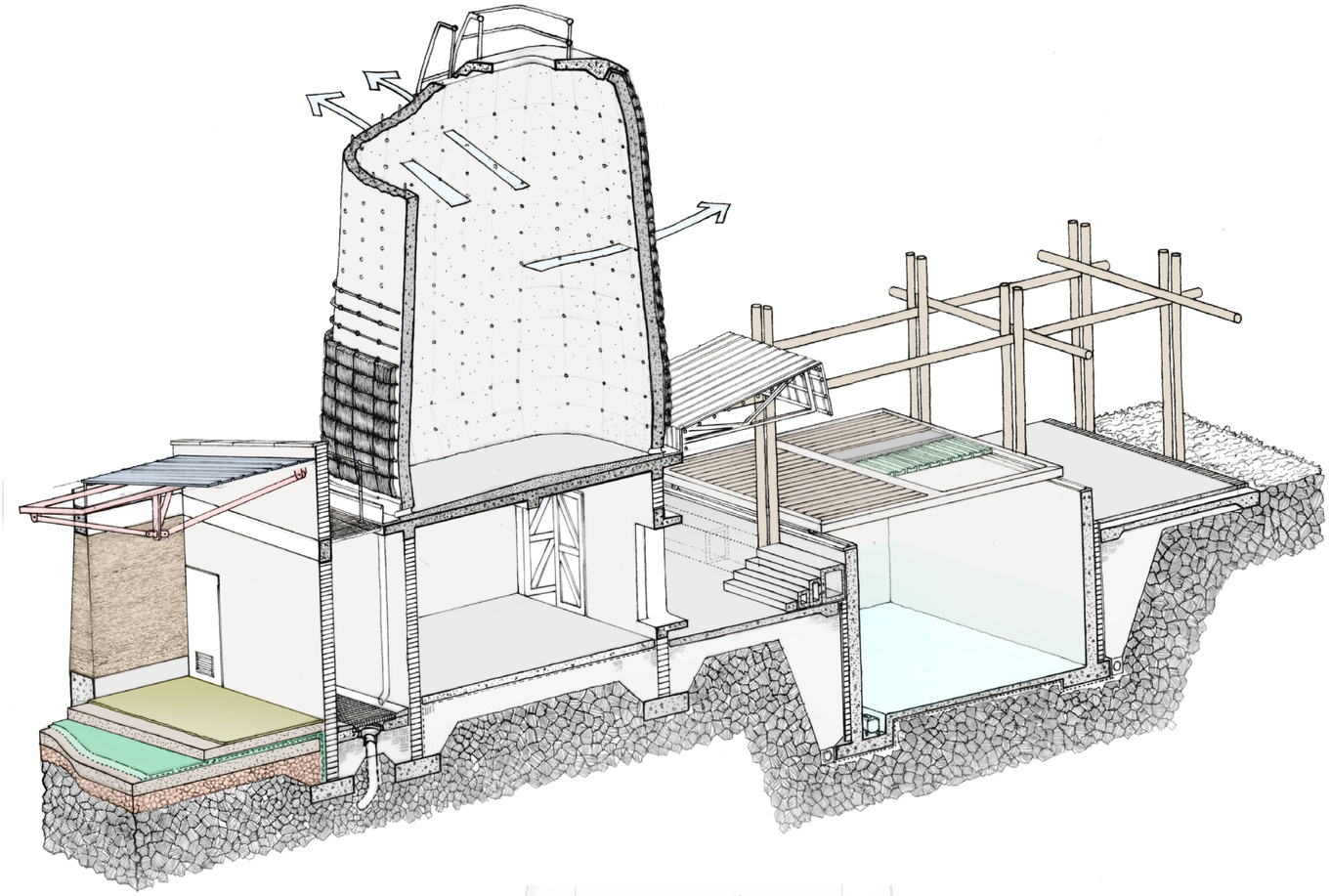
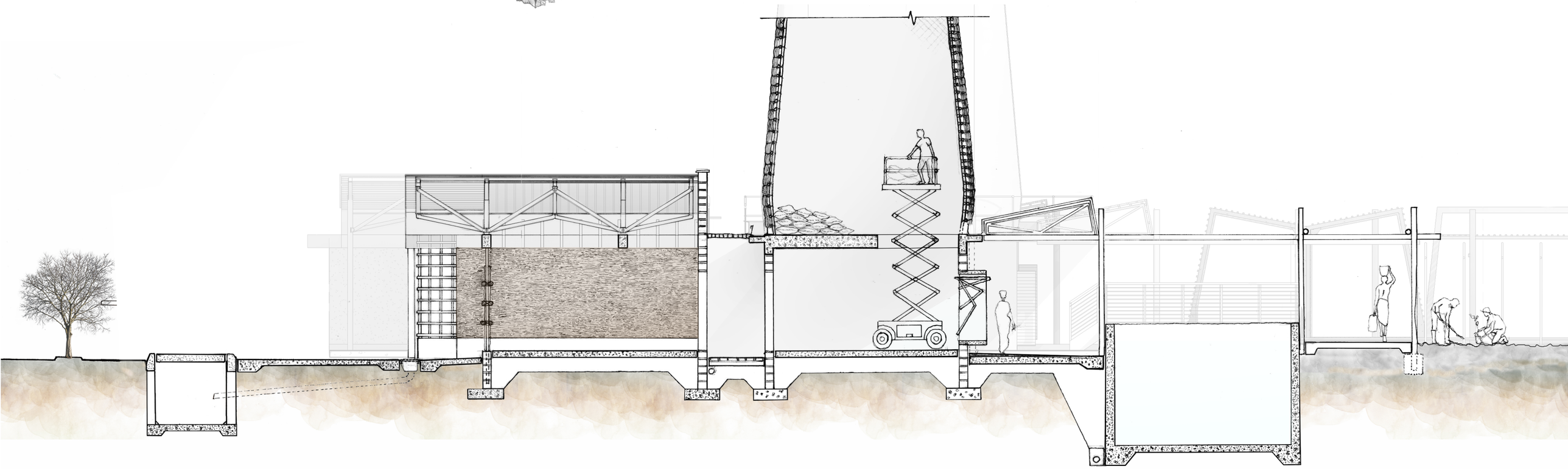
AGRO-ECONOMY:







3.16 Sefaira

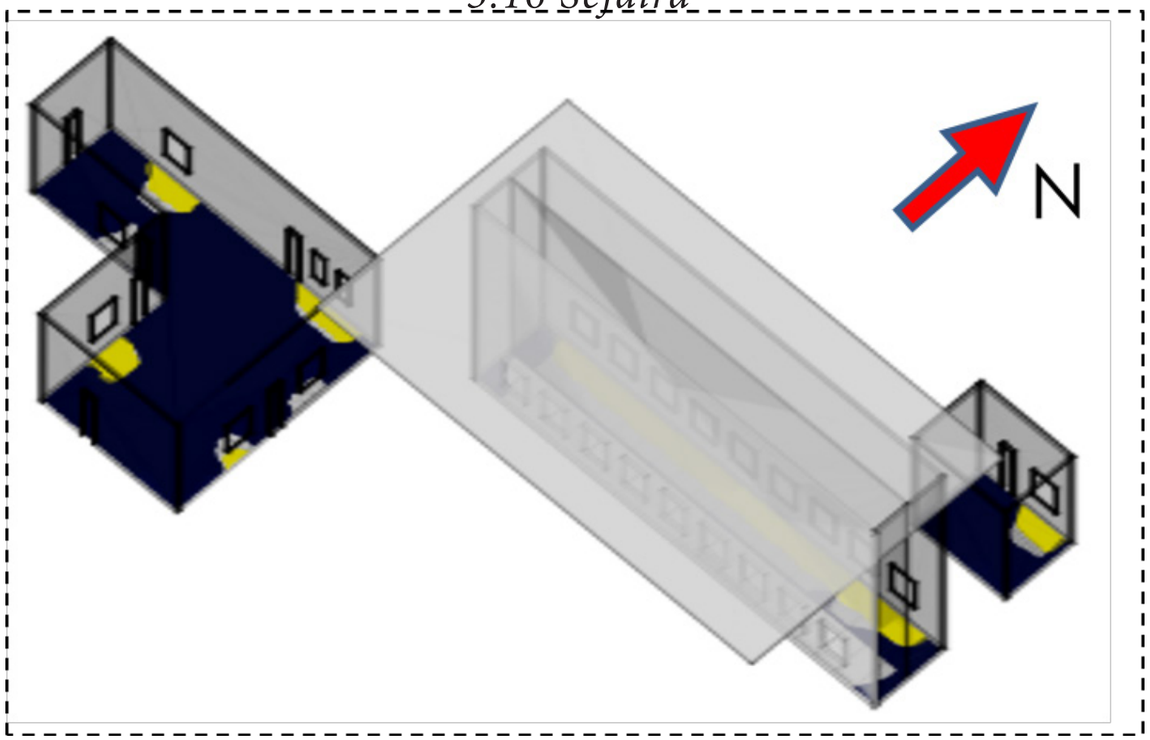
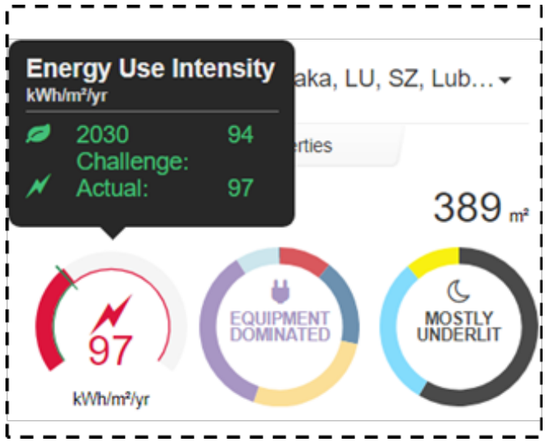
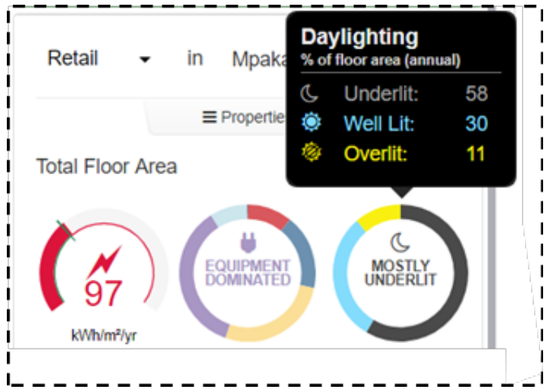
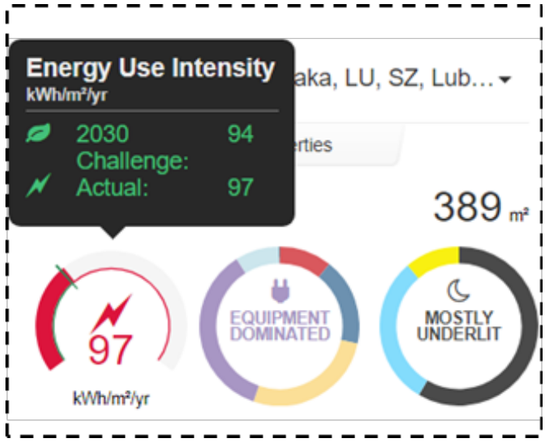
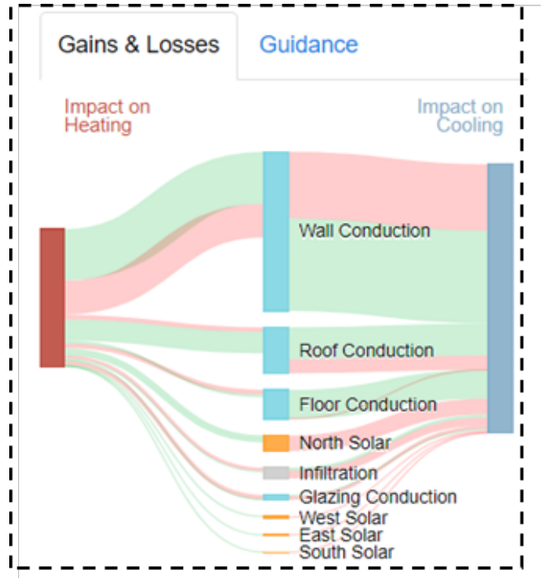


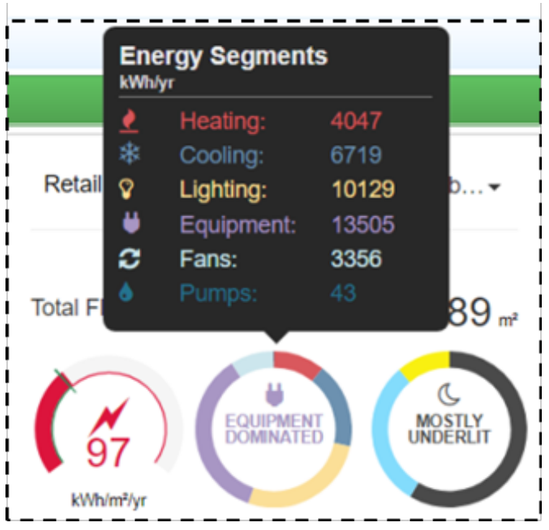
Figure 3.15.1: Solar heat gain (Author, 2021)











3.17 SBAT Rating

SUSTAINABLE BUILDING ASSESSMENT TOOL RESIDENTIAL

1,04

	Achieved
SB SBAT REPORT	**4,7**

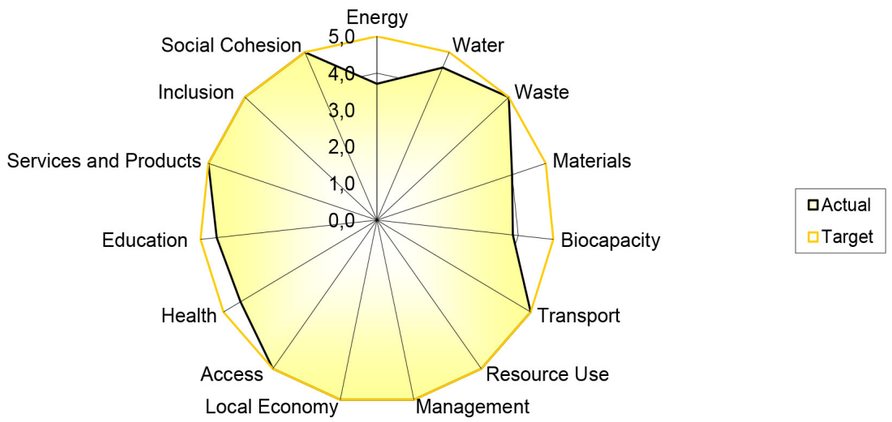
SB1 Project

Agrarian Precint	0

SB2 Address

Mpaka Eswatini	0

SB3 SBAT Graph



SB4 Environmental, Social and Economic Performance	Score
Environmental	4,2
Economic	5,0
Social	4,8
SBAT Rating	4,7

SB5 EF and HDI Factors	Score
EF Factor	4,5
HDI Factor	4,7

SB6 Targets	Percentage
Environmental	84
Economic	100
Social	96

SB7 Self Assessment: Information supplied and and confirmed by

Name	Date
Signature	

SB8 Validation: Documentation validated by

Name	Date
Signature	

SB9 Validation Report Version

IVR

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