STEP BY STEP

BUILDING A NEW EDUCATIONAL VILLAGE IN MOSHI'S GREEN OASIS

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Energie Effizienz Design
M09 Methodik des energieeffizienten Entwerfens

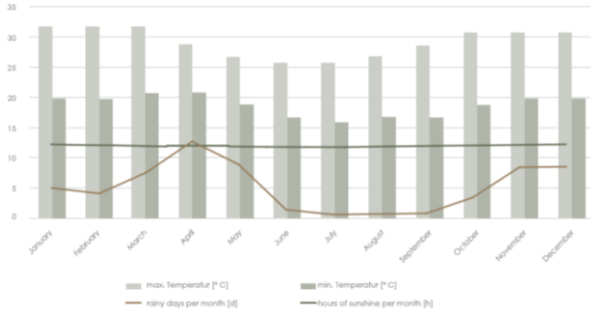
overview

01

ANALYSIS

project

This project focuses on the design of a training center in Africa, more precisely in Tanzania, Moshi. The central challenge is the conception and implementation of a new training center specifically designed to qualify future Montessori trainees. The importance of this project lies not only in the creation of infrastructure for a training center but also in the development of a place that brings Montessori to life through its architecture. Considering the special pedagogical approaches offered by the Montessori method, this project will help enrich the educational landscape in the region and promote the training of educators who can implement innovative teaching methods in their professional context. This introduction serves as the starting point for the detailed analysis, planning, and implementation of a training center that not only meets local educational needs but also makes a sustainable contribution to the pedagogical development of teachers.



Afrika, Tansania, Moshi

Tanzania is characterized by a wide variety of landscapes, resulting in distinctly different climatic zones and a temperate climate in the immediate vicinity of the Kilimanjaro region. The average daily temperatures range from 26.5 to 30° C. In the north-eastern and northern regions of Tanzania, there are two rainy seasons per year: an extended phase from March to May and a shorter period in October to November. During the short rainy season from October to November, it is warm, accompanied by high humidity. During the other periods, however, the conditions are pleasantly cool at around 22 ° C.

task definition / case study

Sisterhood Ushirika wa Neema,
Quelle: https://archive.lifeonearthpictures.com/image/I0000Y_Zk3TTIzOY

The subject of this study is the planning of a new Montessori school for the Montessori teachers in training in the Sisterhood Ushirika wa Neema.
The Ushirika wa Neema sisters are based in Moshi, in the northeastern region of Tanzania. They constitute a Lutheran sisterhood primarily engaged in the realms of education and agriculture. Since 1994, they have been providing training for Montessori educators at the Montessori Training Centre in Moshi. Numerous alumni from this training center secure positions within Lutheran congregations in the Moshi vicinity. Additionally, the sisters manage a Montessori kindergarten and oversee agricultural activities on a farm. The Ushirika wa Neema sisters were established in 1979 under the auspices of the Augsburg deaconesses. Sister Elistaha Mlay currently leads the community, comprising approximately 70 sisters.
Not only is the community of sisters growing, but the number of people interested in the trainee positions is also steadily increasing, creating a need for new classrooms. The existing classrooms are to be rededicated accordingly.

development of the sisterhood

In order to gain an understanding of the sisterhood and its vision, an exchange took place with the sisters. Sister Elista Mlay went into more detail about the development of the sisterhood. The community regularly receives enquiries and applications that cannot be accommodated due to limited spatial capacities. The clear goal is therefore the further development of the congregation and the sisterhood. The sisters are endeavoring to build up an independent financial basis. By running shops and farming, the head sister hopes to generate additional income alongside tourism. Another wish is to produce their own electricity with the help of photovoltaic systems. This would be used to operate the pumps for the water supply and thus ensure a continuous water supply. The use of grey water and the storage of rainwater are also part of the head nurse's vision.

Sister Elistaha Mlay

strengths / **w**eaknesses / **o**pportunities / **t**hreads analyse

S

Established institution: The Ushirika Wa Neema Sisterhood has a strong foundation and history.
Infrastructure: Self-sufficient organic farming on site & at the Great Farm provides a solid foundation for sustainability.
Interconnected pillars: The sisterhood has developed a network of mutually supporting pillars.
Generous Land: Having a large plot of green land provides opportunities for expansion and development.
Lecturers for Montesorri: Special further training opportunity for teachers.

W

Space Limitations: Inadequate space for trainees & small classrooms hinder effective teaching of the Montessori concept.
Limited Accommodation: Insufficient sleeping facilities for trainees restrict growth potential.
Unreliable Power Supply: Frequent power cuts hinder operational consistency.
Elderly Housing Needs: Lack of barrier-free housing for older sisters is a current deficiency.

O

Education Campus: Opportunity to establish an education campus to address space limitations &facilitate effective teaching.
Self-Sufficiency Goals: Potential to achieve self-sufficiency in energy, water, and food resources.
Institutional Restructuring: A restructuring initiative could significantly improve the living and learning environment.
Community Engagement: Engaging more with the local community can offer support and create communal spaces beneficial for both parties.

T

Shortage of space: Due to the limited accommodation available, no further interested sister can be accepted.
Unreliable supply: Due to frequent power cuts, the supply of fresh water is also limited.
Economic Instability: Reorganisation and expansion plans may be affected by economic fluctuations.

visions sister cristina

MONTESSORI IDEA

The new Montessori Trainee Centre should also be used for seminars and workshops, both in the evenings and during the holidays to spread the Montessori idea all over the country.

EDUCATION CAMPUS

In the new trainee center, we want to have sufficient space to learn to create a nice atmosphere. I think we should build a new education campus in the south of our property where we can have the MTC, our kindergarden and school together.

MONTESSORI EXPERIENCE

I don't just want to train good teachers. I want them to understand the Montessori concept. That's why the students should also produce the teaching materials themselves, just as Maria Montessori said: "help me to do it by myself".

MEDIA ROOM

We already have computers and laptops, but we would also like to have a room to give the students access to them.

visions sister Elista

GROWTH

Our sisterhood is expanding, aiming for 150-200 members in the future. A residence for our aging sisters is needed, and to secure our future, we're developing a "Great Farm" spanning 200 hectares as our primary income source. The growth may soon outpace our current kitchen and dining space.

COMMUNITY

We reside in a close-knit community, sharing daily activities. The church, our essential meeting place, is too small. Sisters desire amenities like a fitness room and on-site medical care. For our older sisters, incorporating accessibility features, including ramps, is of utmost importance.

SOURCE OF INCOME

Some of our sisters also come from poorer families. I could well imagine building three small shops on the road where the sisters could sell their own products or food for the tuktuk drivers to earn money themselves.

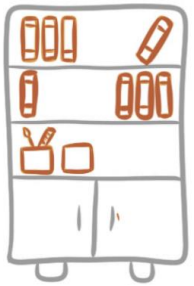
SUSTANIABILITY

In the area of energy supply, we are also thinking about the future. We already have some PV modules, but would like to expand this further in the future, for which we already have funds. I could also imagine collecting and storing rainwater so that it can be used in the dry season.

visions student

PLACE FOR EDUCATION/CREATIVITY

I would definitely like to have larger classrooms. Our rooms are currently quite overcrowded and the building is getting too small. We also need our own space to store the teaching materials



PLACE FOR SPORT

I would also like a sports field for the afternoon, a baseball field would be great!

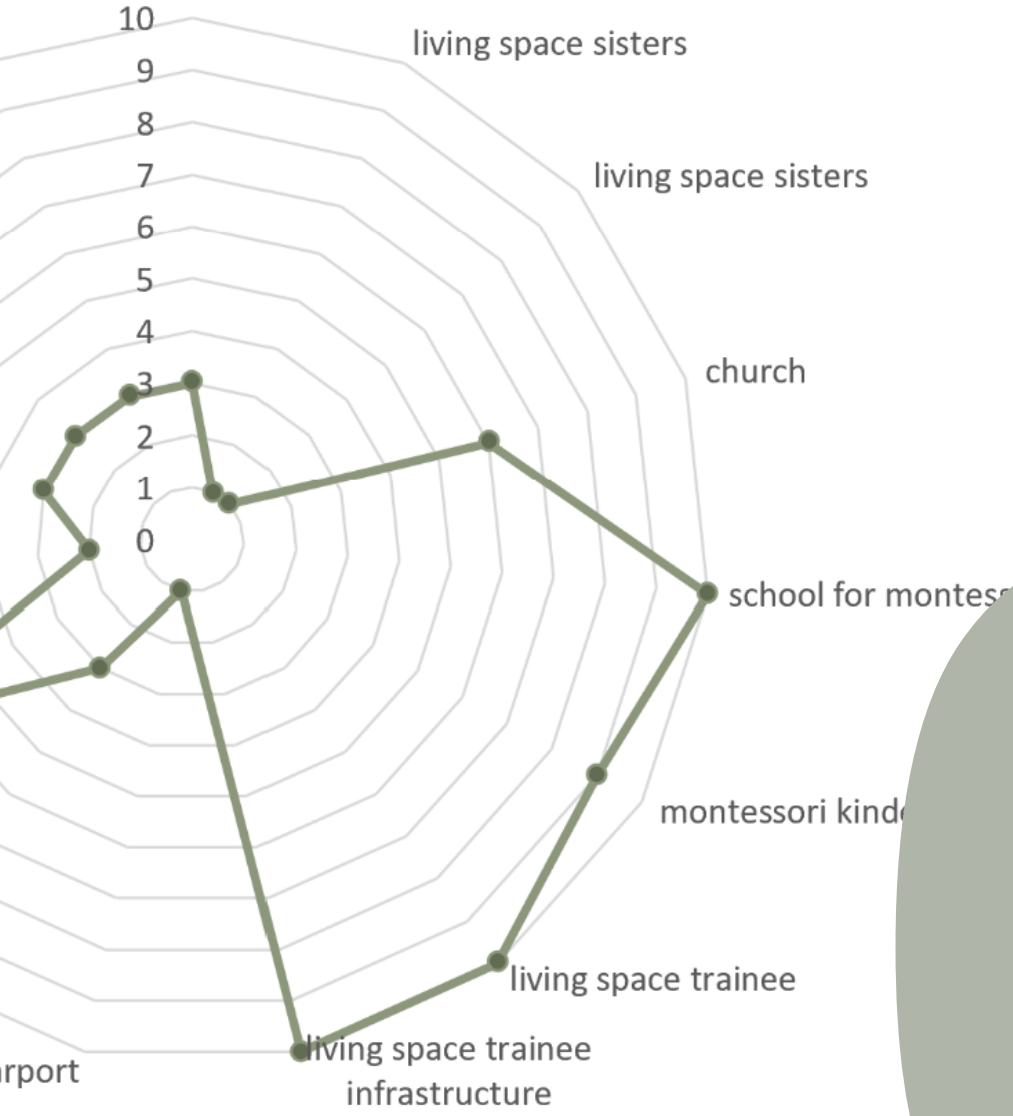
LEARNING ATMOSPHERE

It also gets quite hot in the summer, which we want to improve in our new building. And colourful would be nice!

Excursion nov'2023

zone sisterhood, ushirika wa neema

zones education campus, ushirika wa neema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living space sisters
living space sisters
church
school for montes
montessori kind
living space trainee
living space trainee
infrastructure
rport

02

CONCEPT

	living space sisters [2]	living space sisters [3, 9, 10, 11, 12]
existing situation		
category	sisterhood	sisterhood
use	living, community	sleep, live, eat
number of levels	2	2
constructed ground area	440[m²]	190[m²]
1 floor	380	190
total area [m²]	820	380
area roof [m²]	380	300
angle roof [°]	30	30
numbers of rooms	14	8
No. of sanitary rooms	11	4
max. number of persons	28	60
m²/ person	29	32
persons: who	sisters	sisters
days of use	365	365
main occupancy [h/d]	24/7	24/7
location	privat	privat
analysis and evaluation		
current situation/problems	water tank (2000l), solar thermal energy collector with hot water storage	kitchen with microwave (without stove, fridge), 1 floor 2 sisters share one room
requirements for location	Kilimandscharo, the inner courtyard is used as a meeting place for the sisters	sisterhood in neighborhood, shared sewage
Requirements->building		
need for new building/ extension/ renovation	new buildings for old sisters and for expantion of the sisterhood	new buildings for old sisters and for expantion of the sisterhood
urgency (10-urgent/0- not urgent)	1	1
needs assessment		
planned number of person	14	
m²/ person needed	0	0

sisterhood

The long-term housing situation within the community is undergoing a structural reorganisation. In this process, permanent sisters are assigned individual rooms, while older sisters move into the “Feierabendhaus”. At the same time, new sleeping areas will be created in the old training rooms, which will be available to temporary sisters. These adaptations are intended not only to improve the quality of living for the permanently resident sisters, but also to meet the changing needs and requirements within the community. The targeted remodelling enables the efficient use of existing resources and at the same time creates a balanced living space for the different groups of sisters in their respective phases of life.

Sisterhood visualcoding

canteen / kitchen / washingroom

With the continuing expansion of the sisterhood, the existing infrastructure of the community needs to be adapted and expanded. This increased need for space is particularly evident in the canteen area, which is why this is to be expanded. At the same time, the urgency of renovating the roof truss becomes clear.

	Canteen [13]	kitchen + washingroom [14]
existing situation		
category	sisterhood	food, cleaning
use	get food served	clean, cook, hygene
number of levels	1	1
constructed ground area [m²]	180	200
total area [m²]	180	200
area roof [m²]	270	270
angle roof [°]	30	30
numbers of rooms	1	3
numbers of sanitary rooms	-	2
max. number of persons	70	
m²/ person	3	
persons: who	sisters	sisters
days of use	365	365
main occupancy hours/days	24/7	7:00-16:00/7
location	privat	privat
analysis and evaluation	24	7:00-16:00
current situation/problems		rainwater tank
Requirements for location		between the farm and the cafeteria
urgency (10-urgent/0- not)	3	7
needs assessment		
area needed [m²]	300	0

Kitchen+washingroom/Canteen visualcoding

Canteen

church

The church plays a central role in the life of the sisters and the surrounding community, which is why it is designed as a building that is always open to the public. As the congregation grows, the amount of space required in the church also increases. In order to cover this additional space requirement of around 600 m², an innovative solution is being sought by converting the premises of the kindergarten.

	Curch [4]
existing situation	
category	sisterhood + public
use	sitting, singing together
number of levels	1
constructed ground area [m²]	250
total area [m²]	250
area roof [m²]	515
angle roof [°]	30
numbers of rooms	4
numbers of sanitary rooms	1
max. number of persons	60
m²/ person	4
persons: who	Sisters + neighbourhood
days of use	365
main occupancy hours/days	24/7
location	Public
analysis and evaluation	
current situation/problems	Not enough space, people standing outside
Requirements for the building	Need more space
urgency (10-urgent/0- not urgent)	6
needs assessment	
planned number of persons	150
m²/ person needed	4
area needed [m²]	600

Church visualcoding

Church, Quelle: https://www.arthur-waser-foundation.ch

living space trainee

The inventory shown was compared with inventory figures from German standard values. When comparing the current stock, it became clear that there is a considerable lack of space. Due to the desire for an educational campus, this campus was designed with a hall of residence. The school is intended to serve as accommodation for temporary visitors or sisters. This strategic reorientation not only enables efficient use of the available space, but also helps to better meet the needs of the community and establish the educational campus as a multifunctional center.

	living space trainee [7]
existing situation	
category	education campus
use	Sleep, living
number of levels	2
constructed ground area [m²]	240
total area [m²]	240
area roof [m²]	300
angle roof [°]	30
numbers of rooms	21
numbers of sanitary rooms	2
max. number of persons	84
m²/ person	3
persons: who	Students
days of use	365
main occupancy hours/days	24/7
location	Halfprivat
analysis and evaluation	
current situation/problems	Not enough: space, bathrooms & drying area
Requirements for the building	New building
urgency (10-urgent/0- not)	10
needs assessment	
planned number of persons	150
m²/ person needed	6
area needed [m²]	900

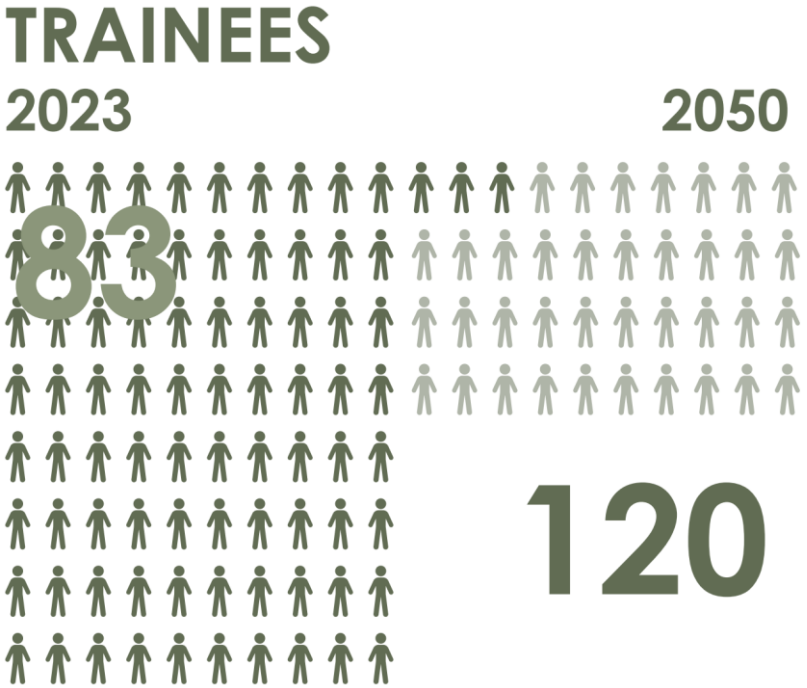
Living space trainee visualcoding

Students, Quelle: https://ushirika.se/gallery

montessori training center

The current school infrastructure was documented by means of a local inventory. In particular, the room sizes and the technical condition were recorded. It was determined that the electrical systems were in need of refurbishment. It is also clear that there is a lack of space in the classrooms, the staff room, the workshop and the materials storage area, which highlights the need for larger classrooms. The idea is to repurpose the school as a shop space in order to generate revenue.

Use	sit, lern
number of rooms	7
Floors	Partially 2
roofsystem	Wooden beams with corrugated iron

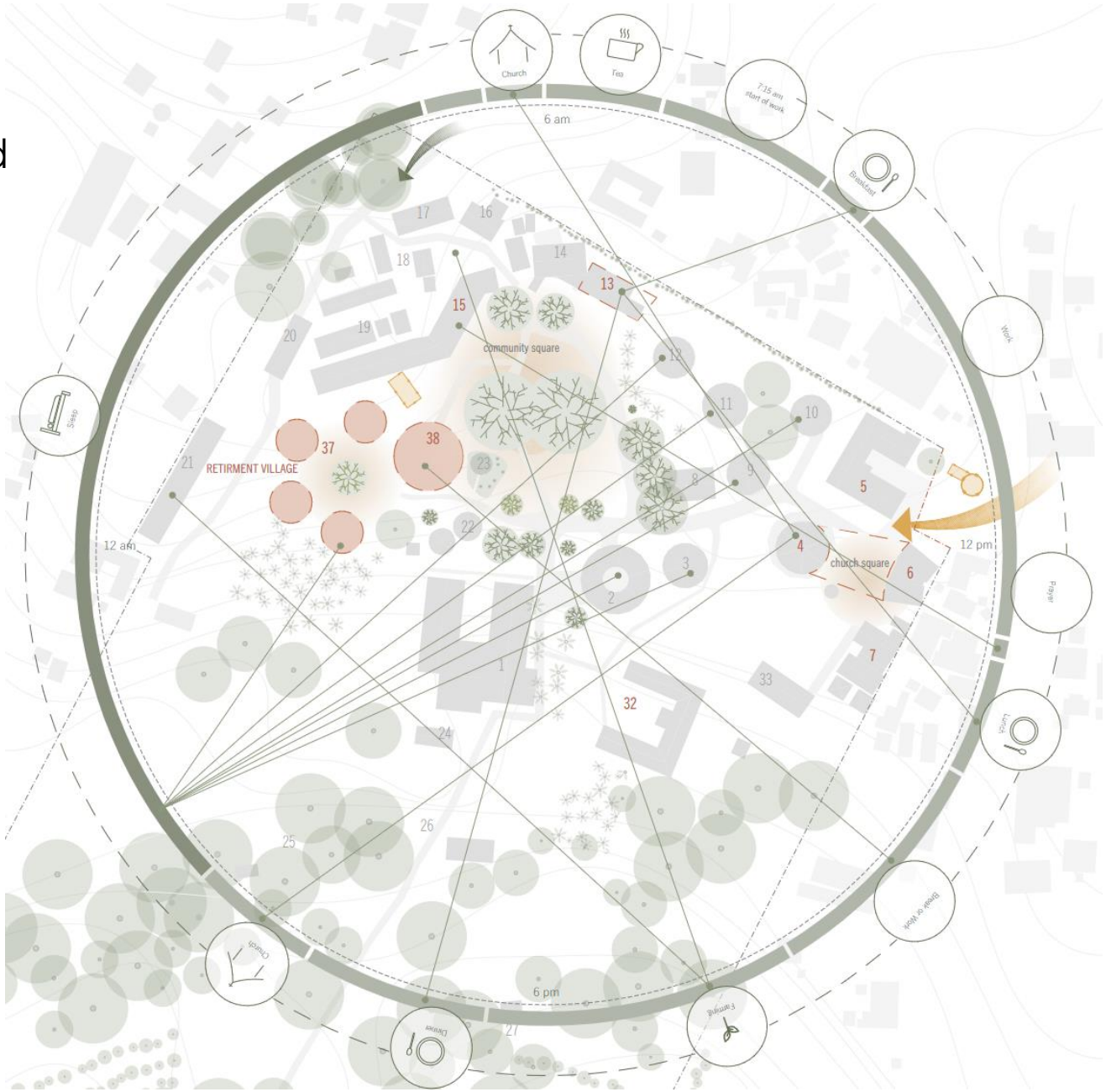


Classroom 1

03

MASTERPLAN

timetable sisterhood



entrances of the Ushirika wa Neema

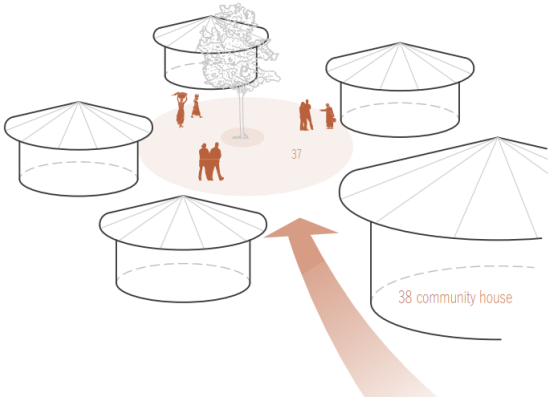
Reorganisation of entrances

The reorganisation will result in new room distributions, which will also result in the usage zones being adapted. This reorganisation leads to the creation of new entrances for the respective areas of use. The entrance to the church from the Sisterhood and the entrance to the farm for deliveries will remain. In addition, a separate arrival area will be created for the Education Campus.

new concept for the sisterhood

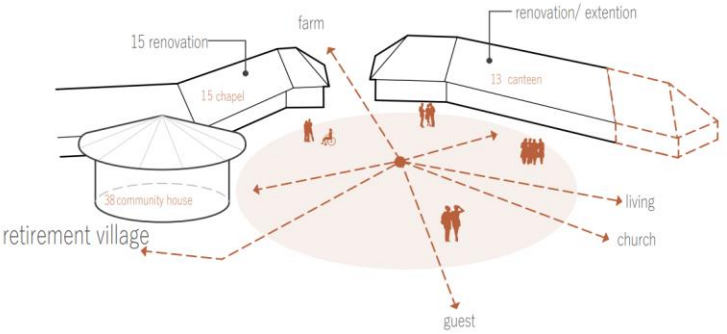
RETIREMENT VILLAGE

The older sisters will have their own retirement village, based on the previous roundhouse structure. Here, several sisters share a roundhouse and live in shared flats. The retirement village is located directly on the community square, so the older sisters are still integrated into the community but have
their own place of privacy. In the community house, young and old sisters can meet in common rooms,
there is a room for sports and a terrace with a view of Mount Kilimanjaro.



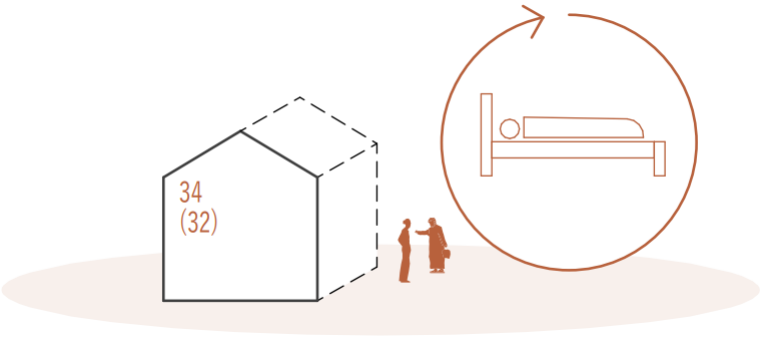
COMMUNITY SQUARE

The community square is to be established as a communal space. With its large trees, the square is particularly worth preserving. A number of community facilities are centered around this square, enabling encounters between old and young sisters, as well as with guests.



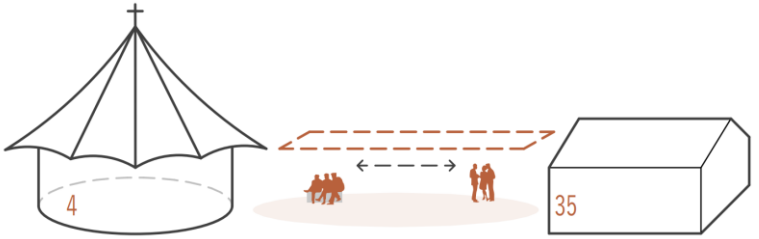
TEMPORARY LIVING

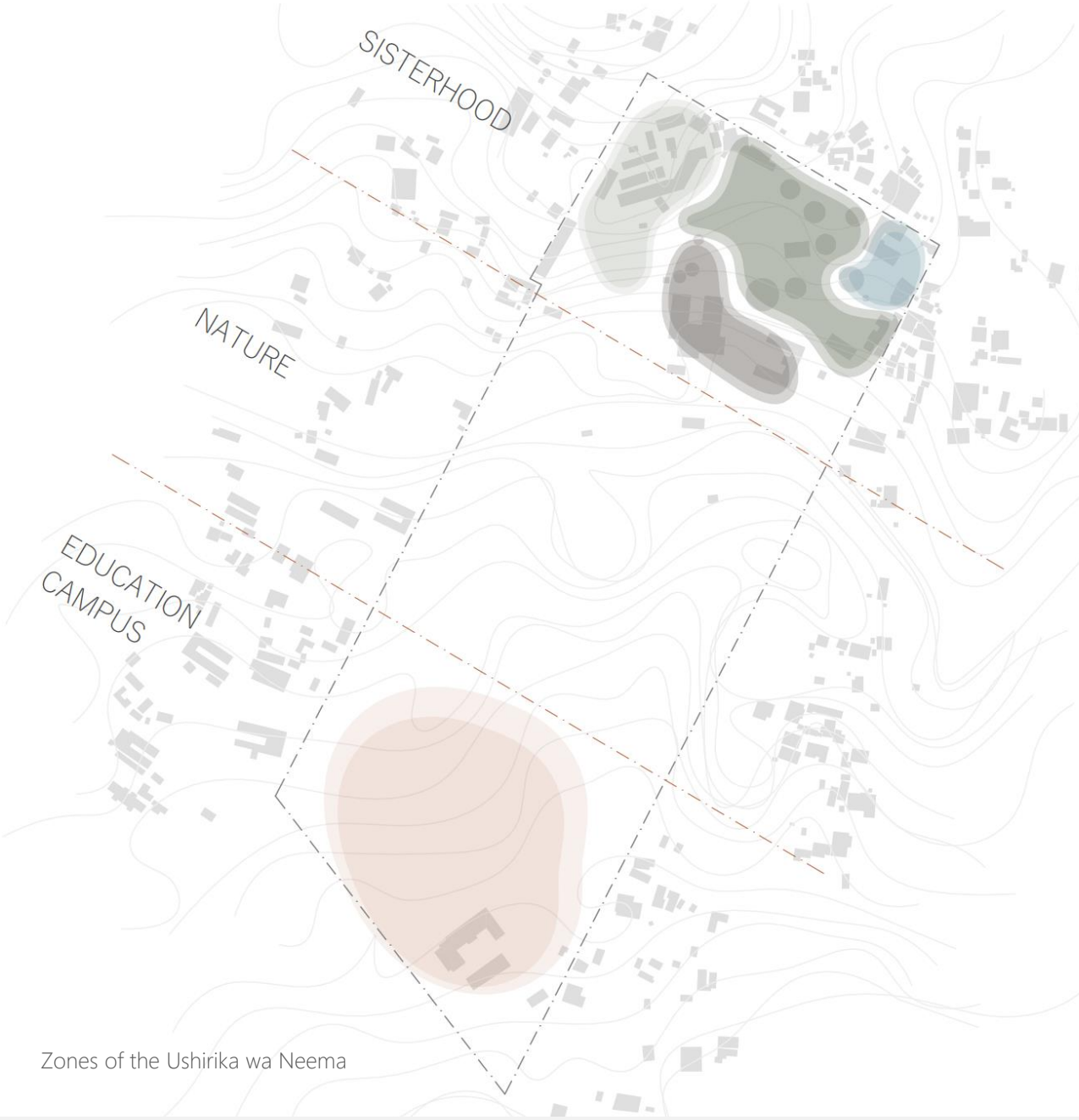
The MTC Livingspace can be adapted into temporary accommodation, so that sisters who do not work and live on site can sleep there when they come to visit occasionally. The current guest house of the korean organic farming project can be used after 10 years either as additional temporary accommodation or rooms for sisters on site.



CHANGE OF USE + EXTENTION

The old kindergarden can be used as a space for the church and congregation. The church can be extended by a roof, which creates a connection between the buildings and a covered outdoor space.





Zones of the Ushirika wa Neema

new zones

When planning a new educational campus, a detailed analysis of the division of the various uses for the individual buildings was carried out. In the course of this process, specific zones crystallised. The Education Zone in particular proved to be limited in terms of the space required for further expansion. Based on this realisation, the decision was made to reorient the lower part of the site, which led to a redistribution of the buildings.

In the upper section of the site, the sisterhood remains and includes both private and public areas. The Montessori Trainee Centre (MTC), the Trainee Living House, the kindergarten and the canteen will be located in the lower section of the site. This strategic reorganisation enables more efficient use of the available space and creates clearly defined areas for different functions within the educational campus.

04

EDUCATION CAMPUS

Ushirika wa Neema
Hochschule Augsburg, E2D, Jan 2024

Cekovic, Jürgens, Stickmann, Wicklein

Sister Christina

interview sister christina:

•My vision is to train Montessori teachers at Ushirika Wa Neema who can then work all over the country and spread the Montessori idea. I don't just want to train good teachers, I want them to understand the Montessori concept. That's why the students should also produce the teaching materials themselves, just as Maria Montessori said: "help me to do it by myself".

•Right now, our classrooms are too tight. In the new Trainee Center, we want to have sufficient space to learn to create a nice atmosphere. I think we should build a new education campus in the south of our property where we can have the MTC, our kindergarden and school together.

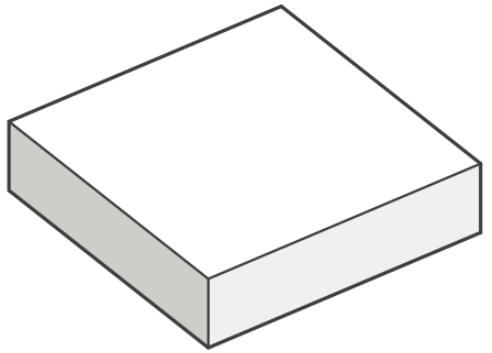
•The new Montessori Trainee Centre should also be used for seminars and workshops, both in the evenings and during the holidays to spread the Montessori idea to the public. For this we need seminar and conference rooms. We also need sufficient space for a workshop and storage facilities. The students should also have quiet places to relax, both indoors and outdoors.

•We already have computers and laptops, but we would also like to have a room to give the students access to them.

design process

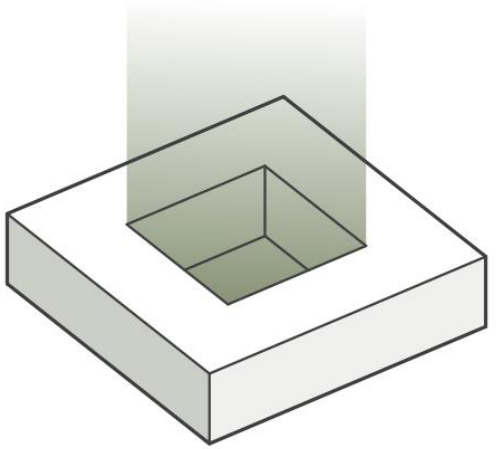
SHAPE

With the aim of designing an innovative training center, the first design step was to create a cube with the required volume in square meters.



INNER COURTYARD

In the next step, the idea of an inner courtyard was integrated into the planning in order to create a central, open space



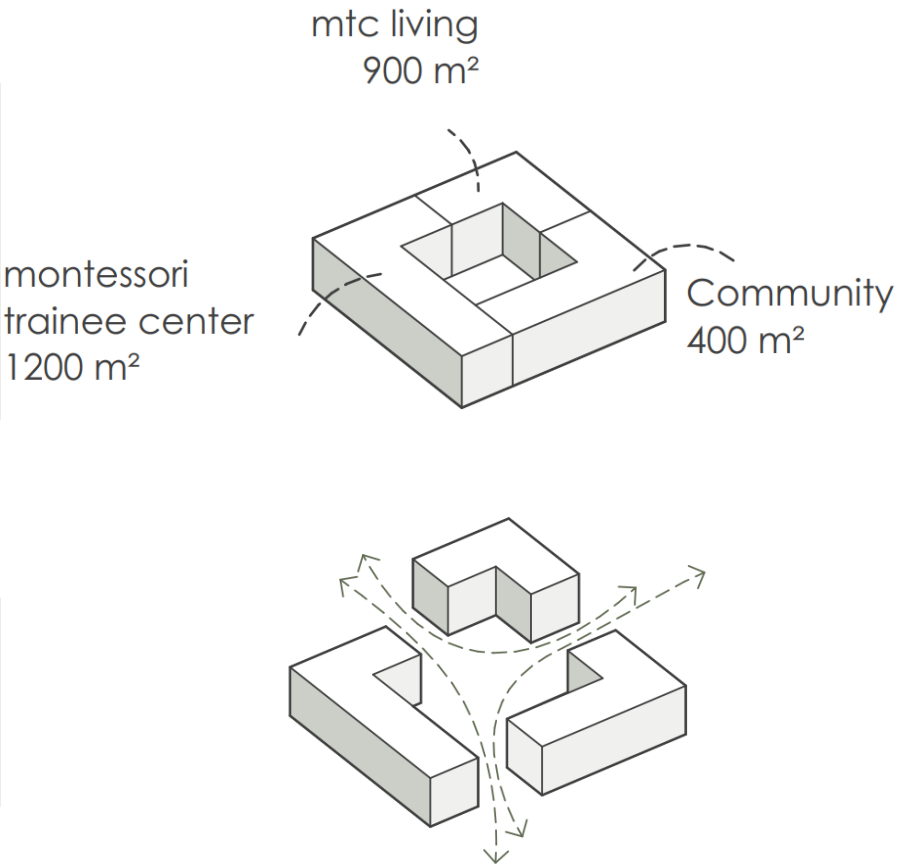
design process

INDIVIDUAL BUILDINGS

In view of the vision of a campus with several buildings, the decision was made to design several individual buildings from one cube. The aim was to enable a clear separation of the functions of the individual buildings. This allows the effective organisation of different subject areas in separate spaces, optimizing the functionality and structure of the educational campus.

OUTDOOR SQUARES

Particular attention was paid to the design of outdoor squares and courtyards in order to create a harmonious connection between indoor and outdoor spaces.



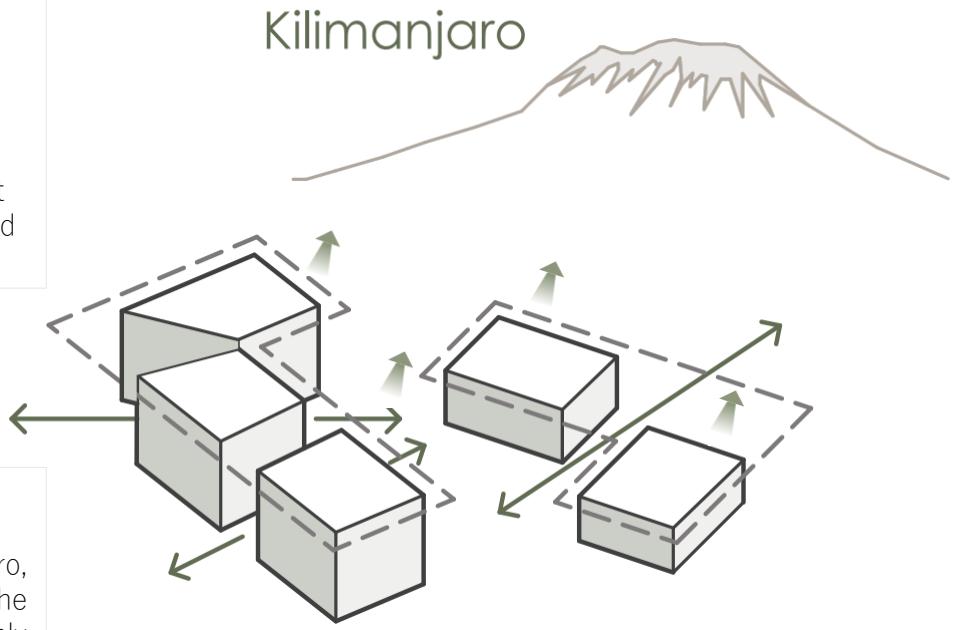
design process

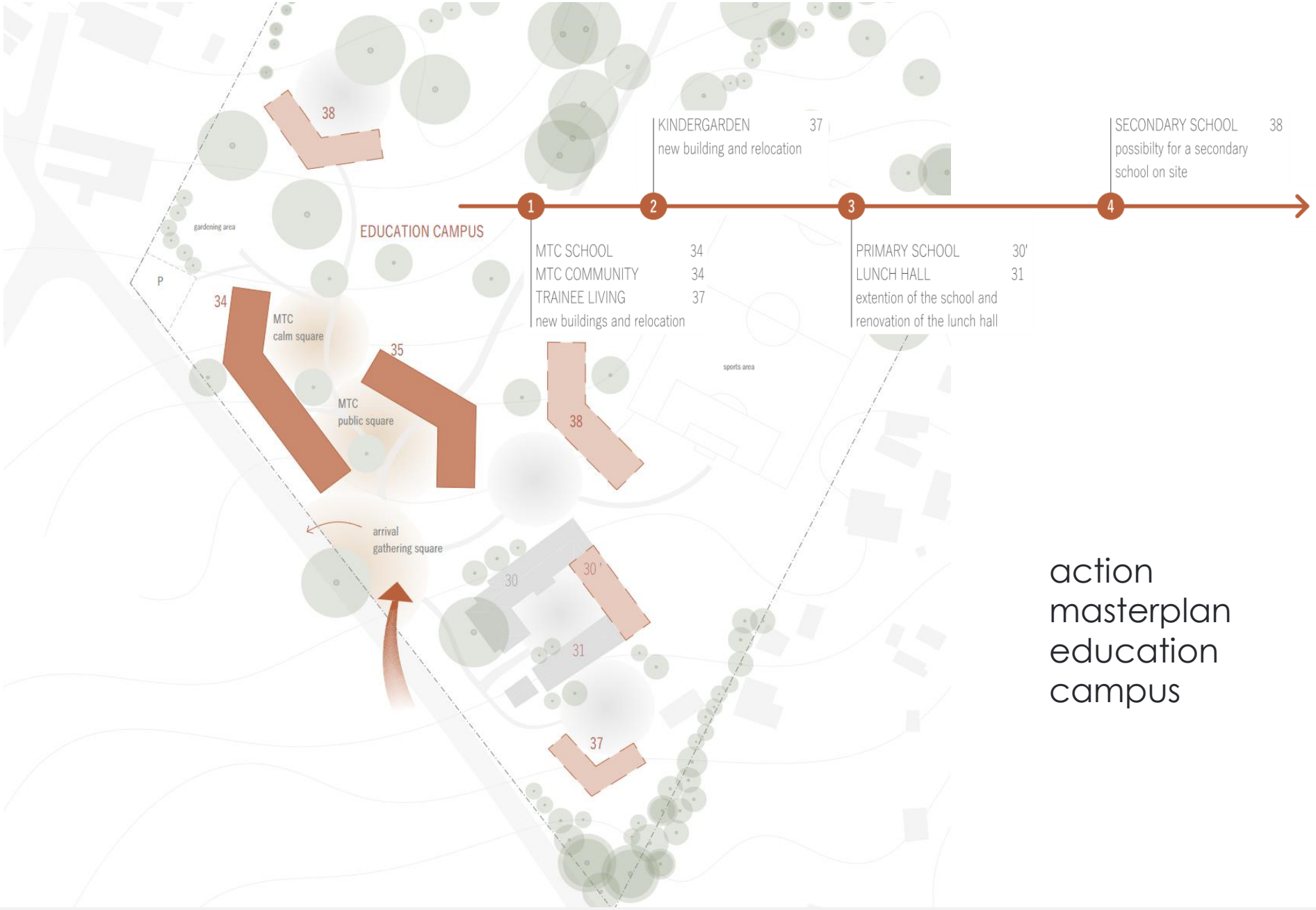
SUNLIGHT & WIND

In view of the vision of a campus with several buildings, the decision was made to design several individual buildings from one cube. The aim was to enable a clear separation of the functions of the individual buildings. This allows the effective organisation of different subject areas in separate spaces, optimising the functionality and structure of the educational campus.

ORIENTATION

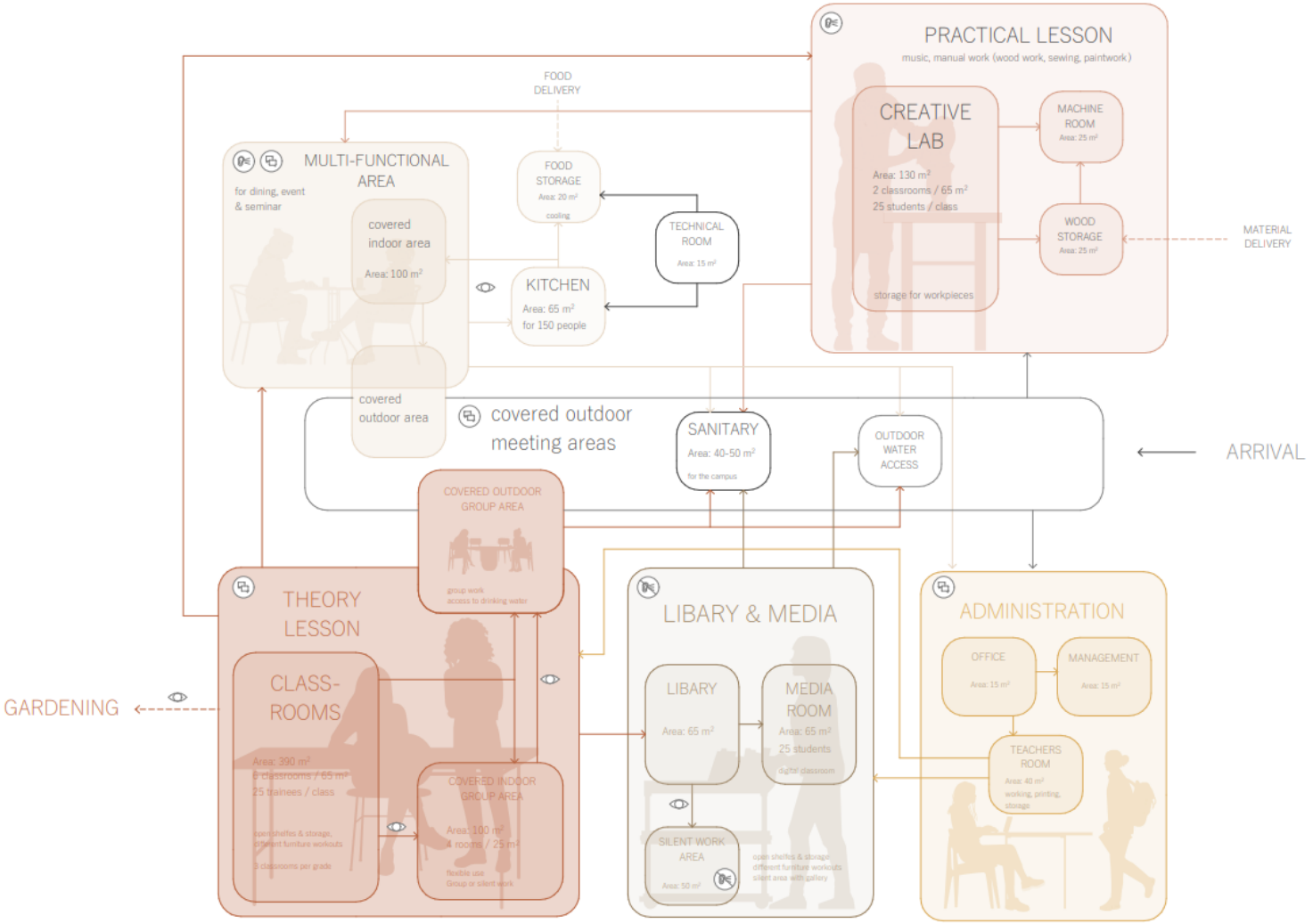
The campus is orientated towards Mount Kilimanjaro, creating an inspiring and symbolic connection to the natural environment. The covered areas created not only provide a pleasant lounge area, but also serve as protection from the sun and rain. Overall, these design considerations not only fulfil the functional requirements, but also create an inspiring, sustainable and harmonious place for education and community.

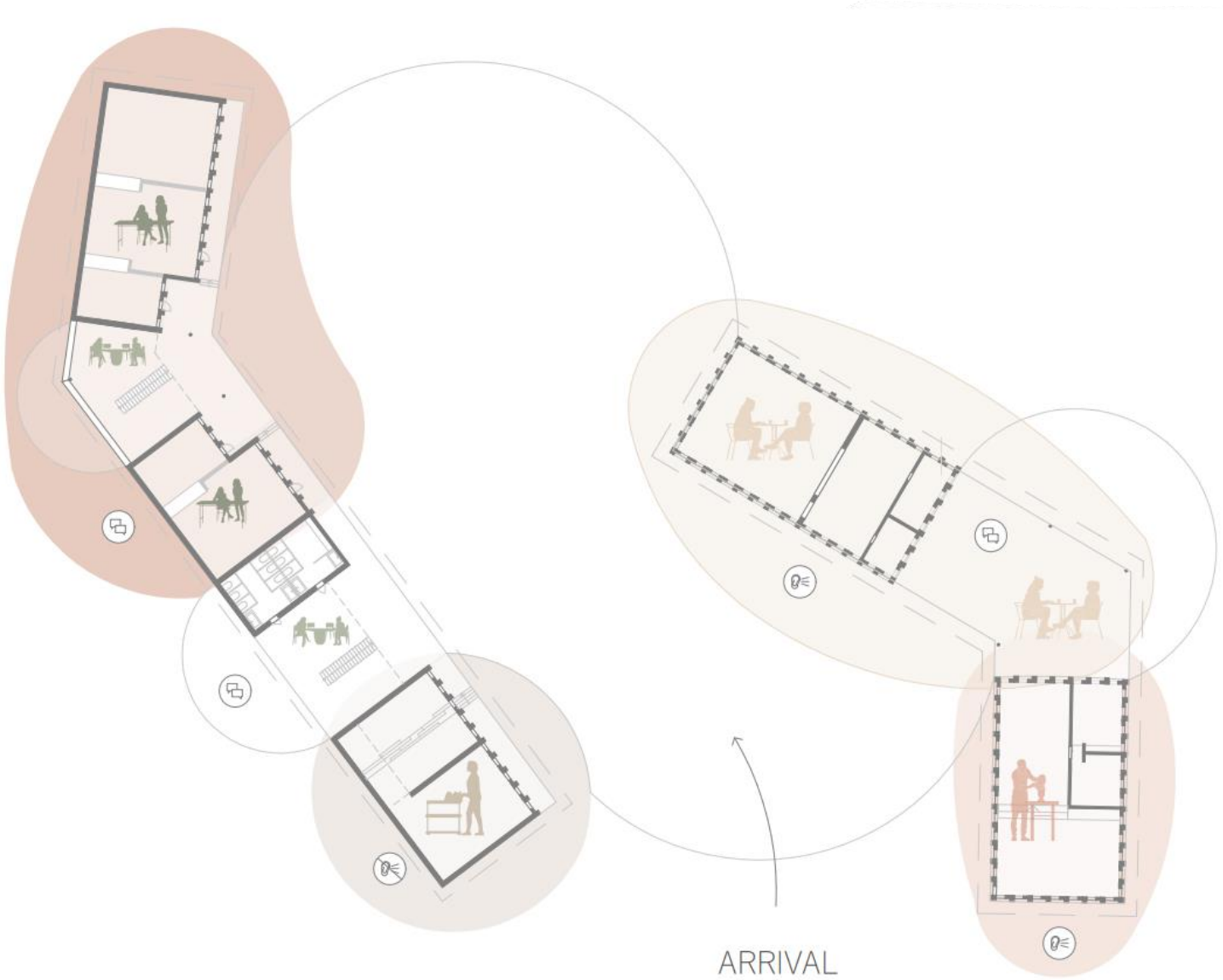




action masterplan education campus

analysis of needs – visual coding

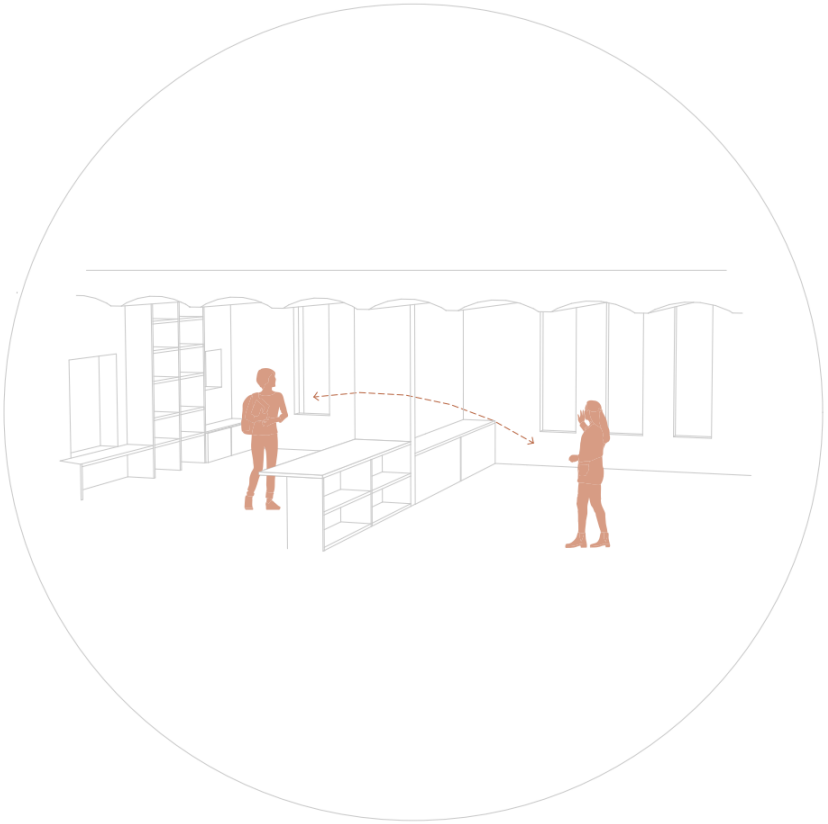



ARRIVAL

Floorplan

Floorplan
first floor

montessori principles



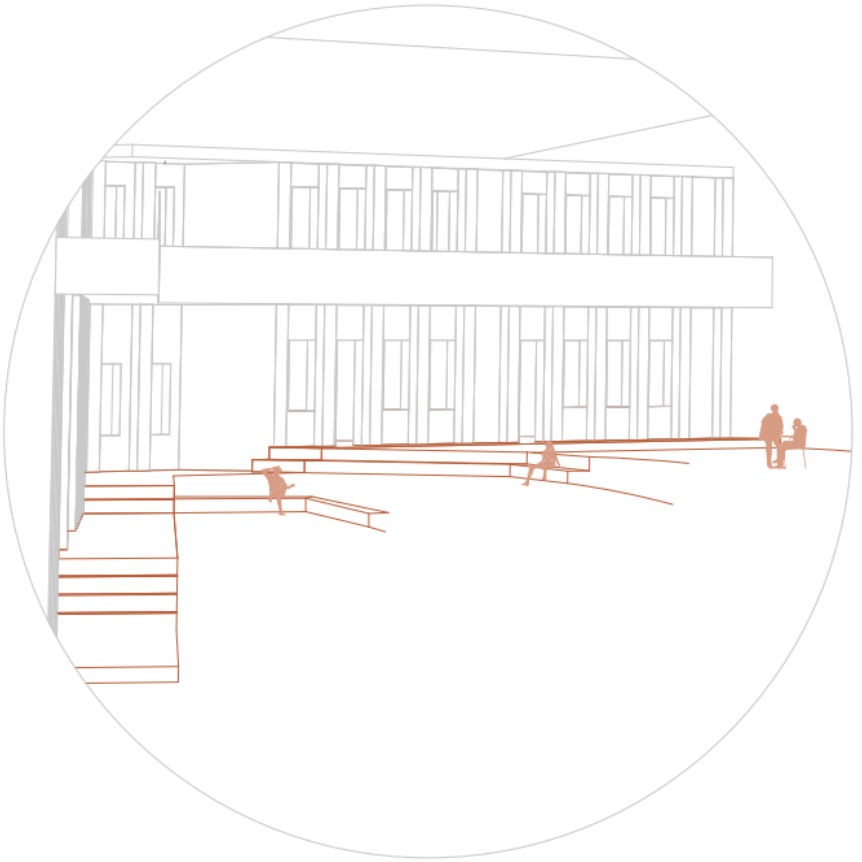
use of the walls and building fabric for storage space

Observation without intrusion

Creation of window seats ...
The psychological connection with the outside world

Transitional spaces between inside & outside ...
including shade

Workshop & material workshop

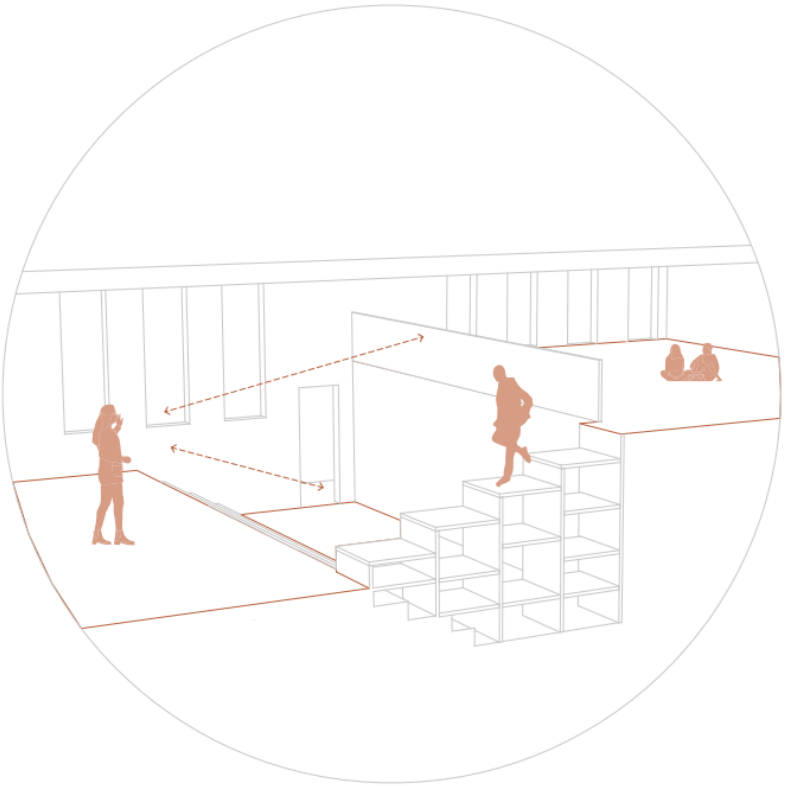


Transitional spaces between inside & outside ... including shade

everyday gathering spaces inside & outside

use of the walls and building fabric for storage space

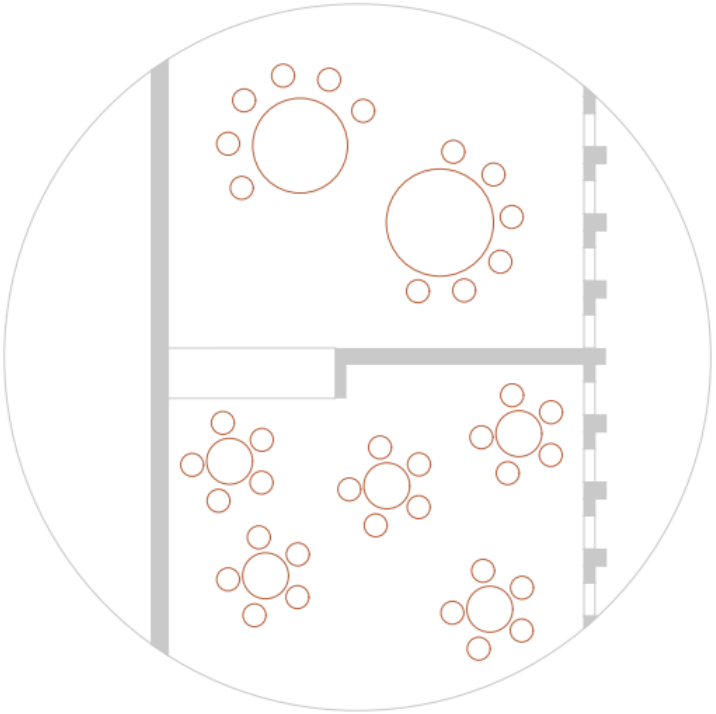
Open storage and display of learning materials



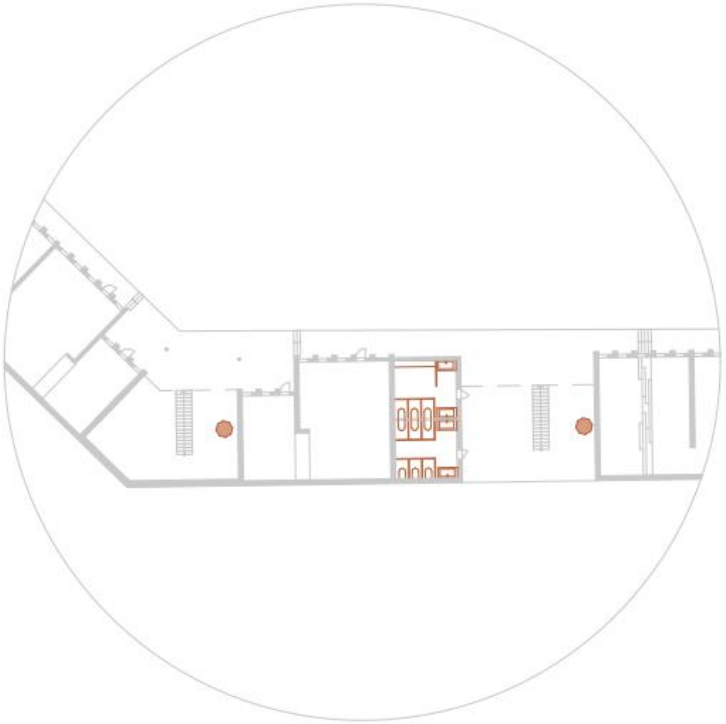
Different hights for floors and ceilings ...
even within a single storey

Offer of seculation ...
and respect of concentrated activity

Observation without intrusion



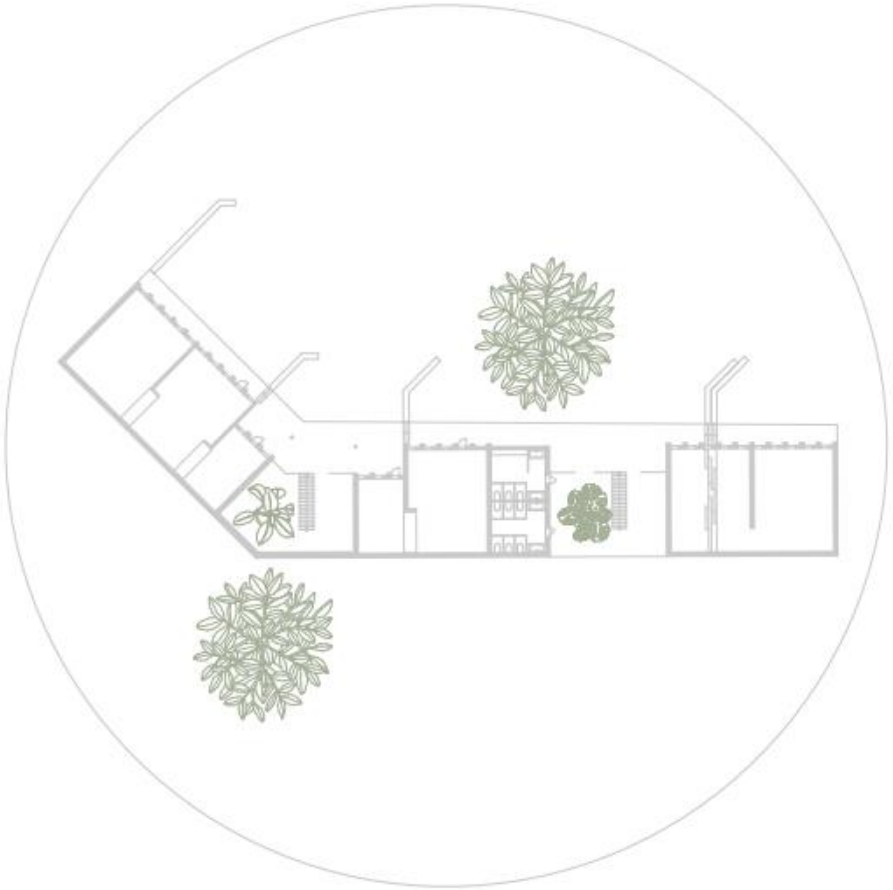
flexibility ...
in furniture workouts



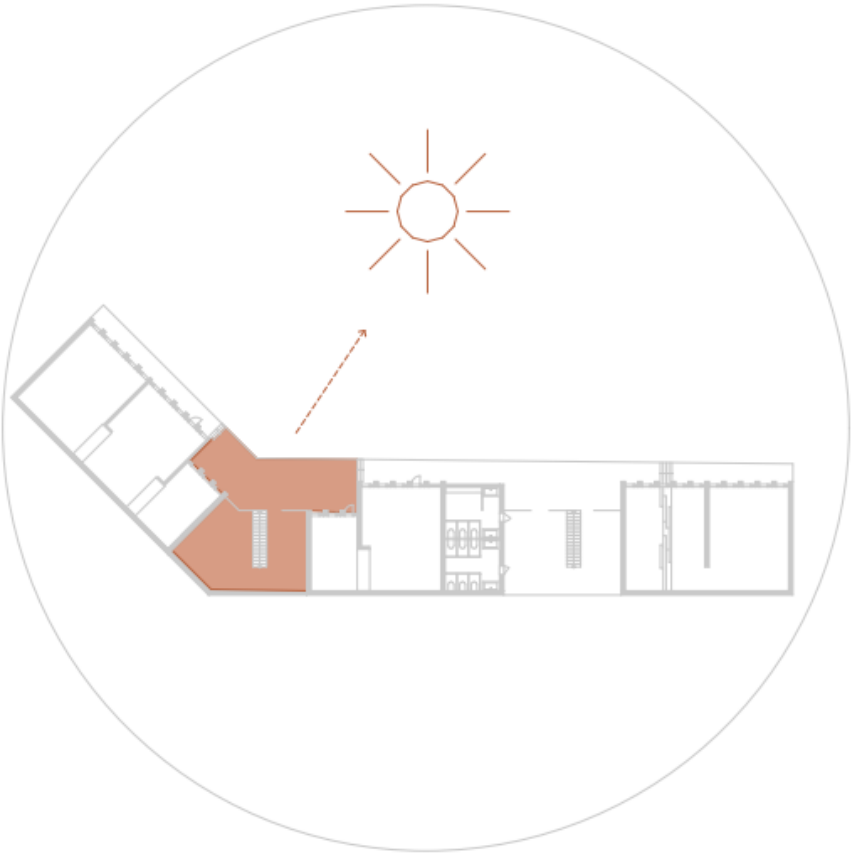
Meaningful access to water

Indipendent self-care ...
understanding of toilets and hygiene as part of education

montessori principles

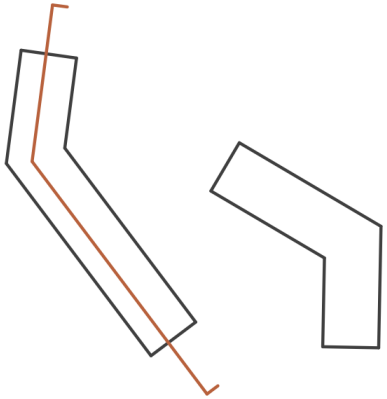


school and grounds as habitat
for animals and plants

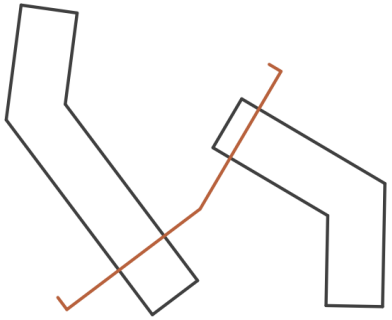


Orientation of the entrance area towards the
morning sun

section A



section B



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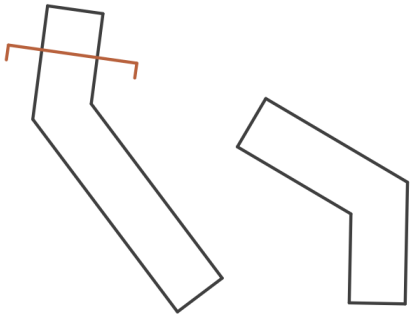
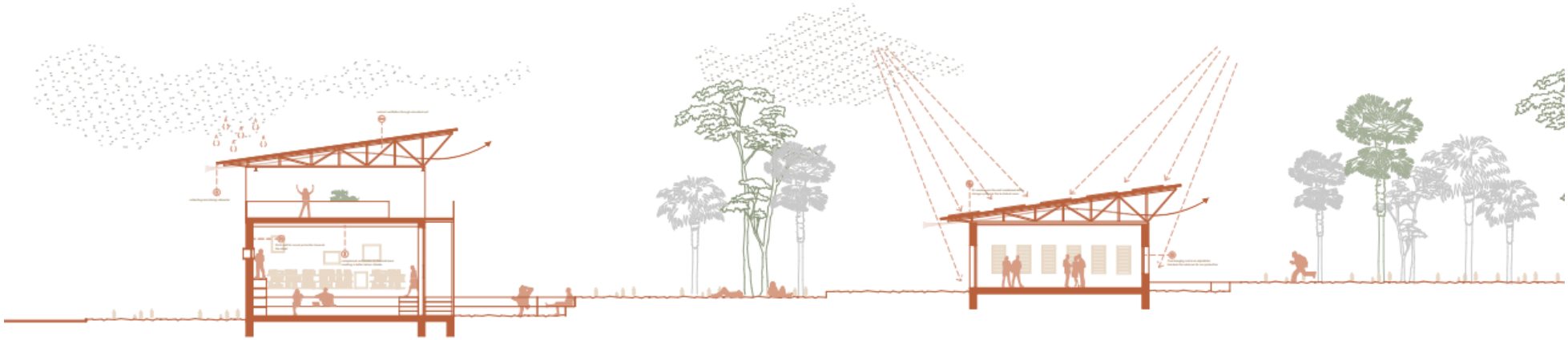


05 SECTION

section A

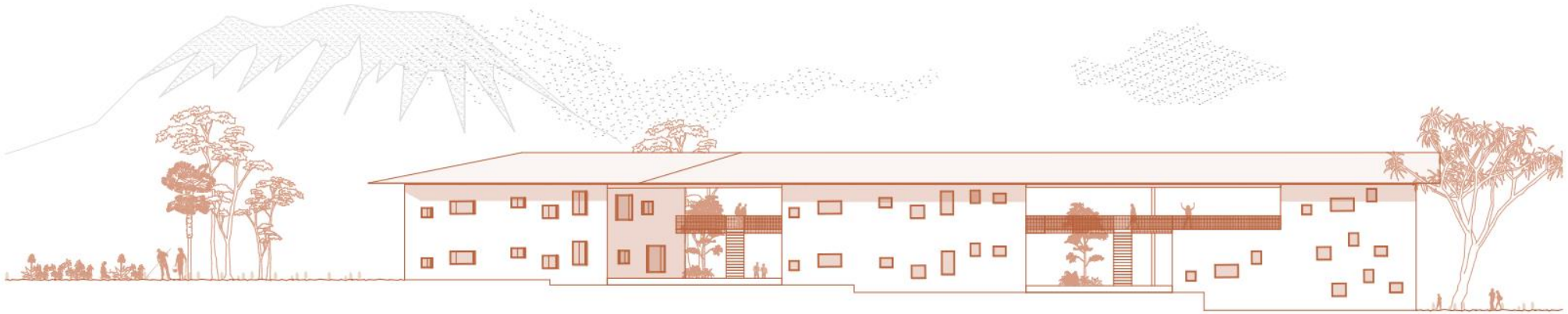
section B



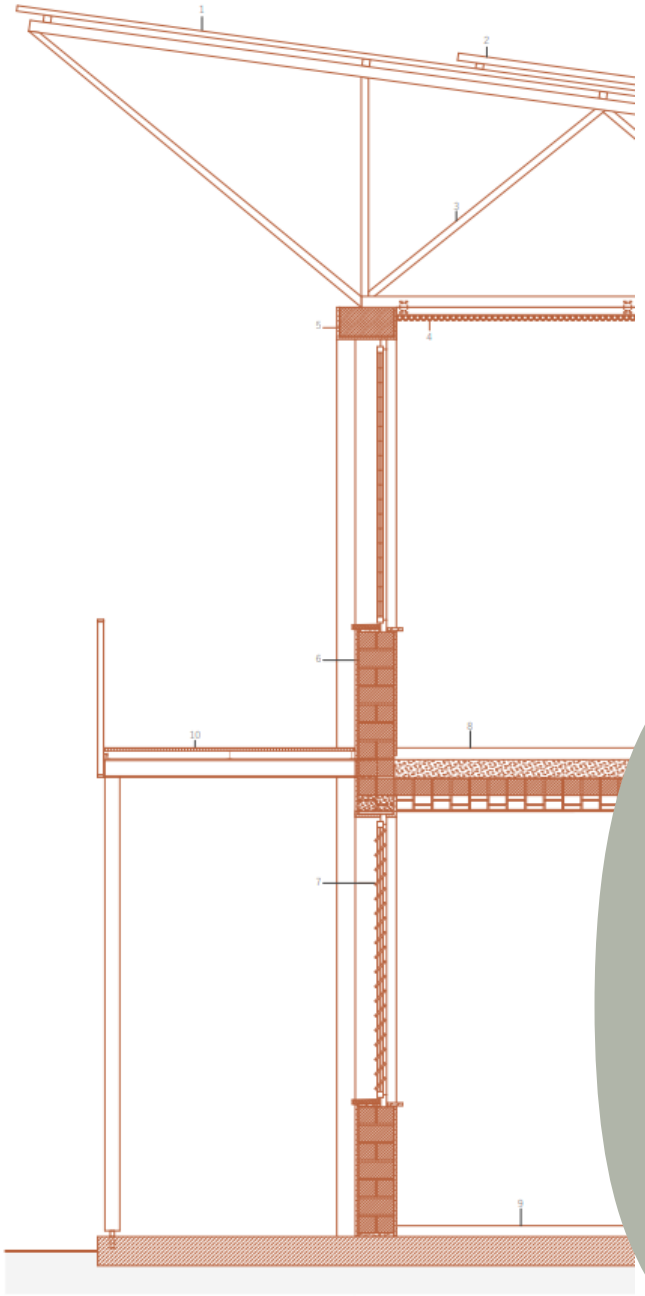
06

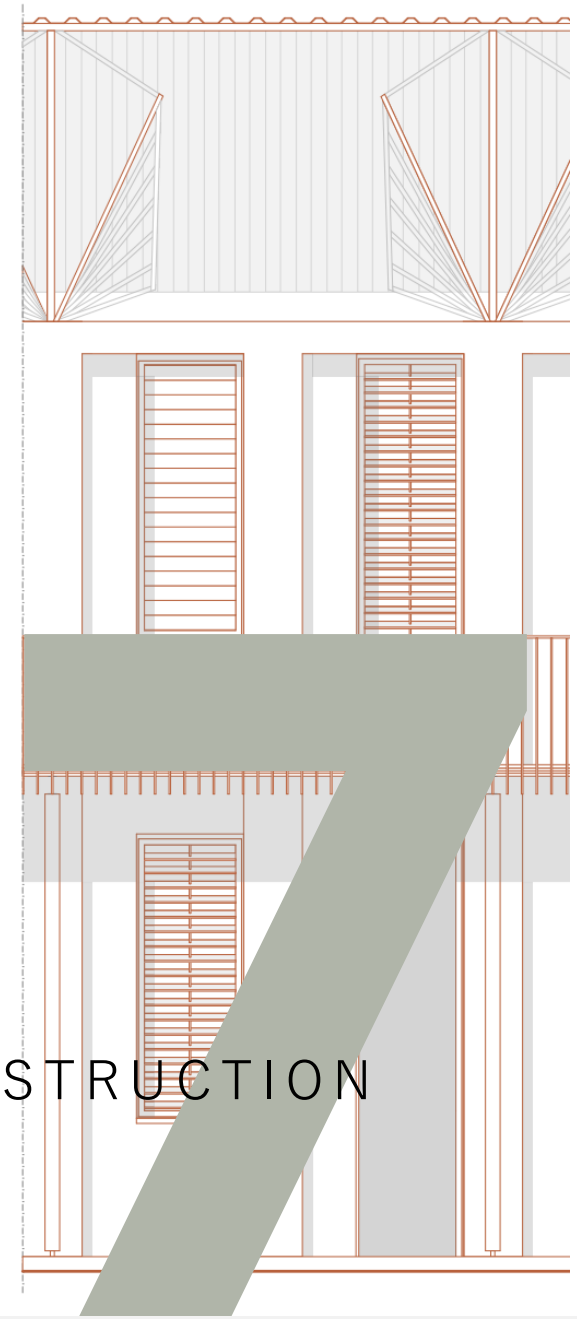
ELEVATIONS

elevation south



elevation north





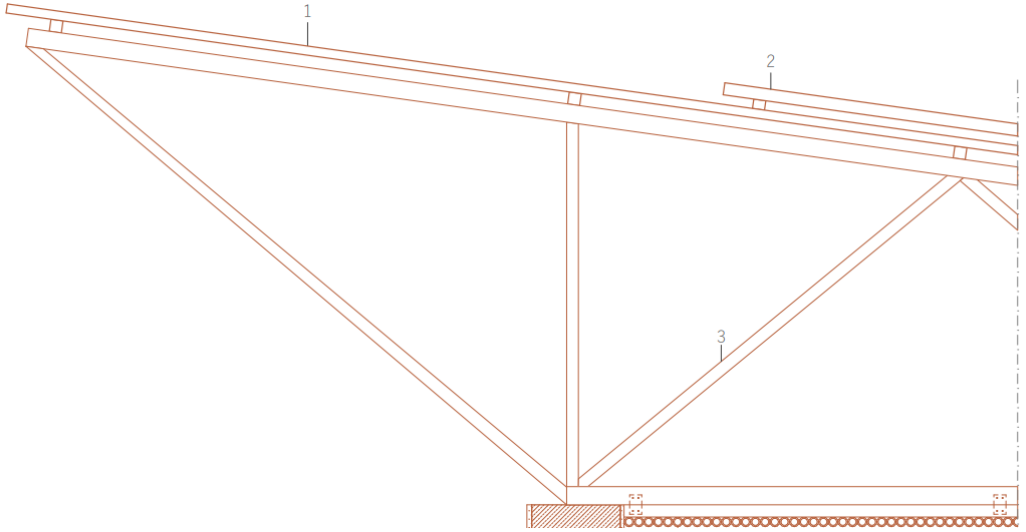
07

CONSTRUCTION

Ushirika wa Neema
Hochschule Augsburg, E2D, Jan 2024

Cekovic, Jürgens, Stickmann, Wicklein

materials: roof

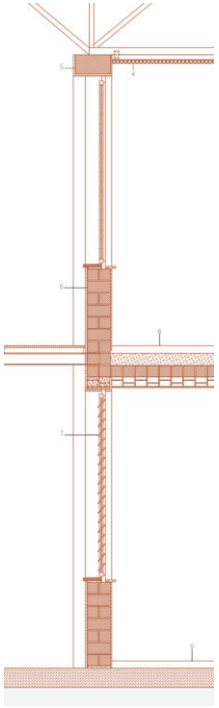


Constuction Roof

1 corrugated sheet metal
with white paint finish (8%)
2 mounting rail and
photovoltaic module
3 multi-dimensional steel
lattice girder

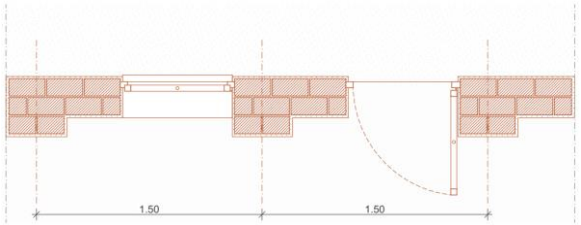
The campus buildings have a roof made of **corrugated sheet metal**, which is finished with a white coating (8%). The roof is supported by a multi-dimensional steel lattice girder. This careful selection of steel and metal not only guarantees a durable and low-maintenance solution for the roof, but also gives the campus a modern aesthetic that blends harmoniously into the overall appearance of the educational facility.

materials: wall

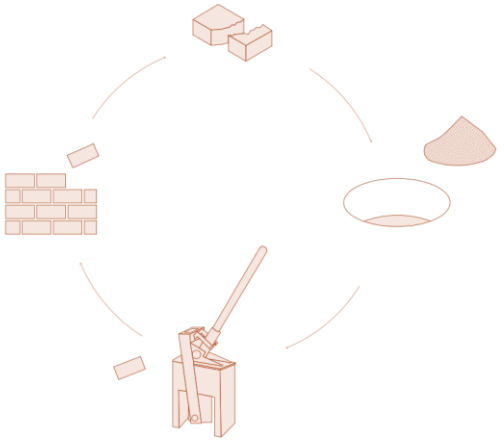


Constuction wall

The building's walls are constructed using natural materials, specifically self-made pressed **compressed earth bricks** (CEB) produced on-site, each measuring 240 x 115 x 115 mm. Following the bricklaying process, the wall undergoes plastering with a 2 mm thick clay layer and is finally coated with a 1.5 mm thick layer of white gypsum plaster.



The surface is given a neat appearance by an additional 1.5 mm thick gypsum plaster in white.
Steel was used for the **window frames**, which are fitted with horizontal louvres. These louvres give the windows an attractive appearance. The windows can also be mechanically locked.

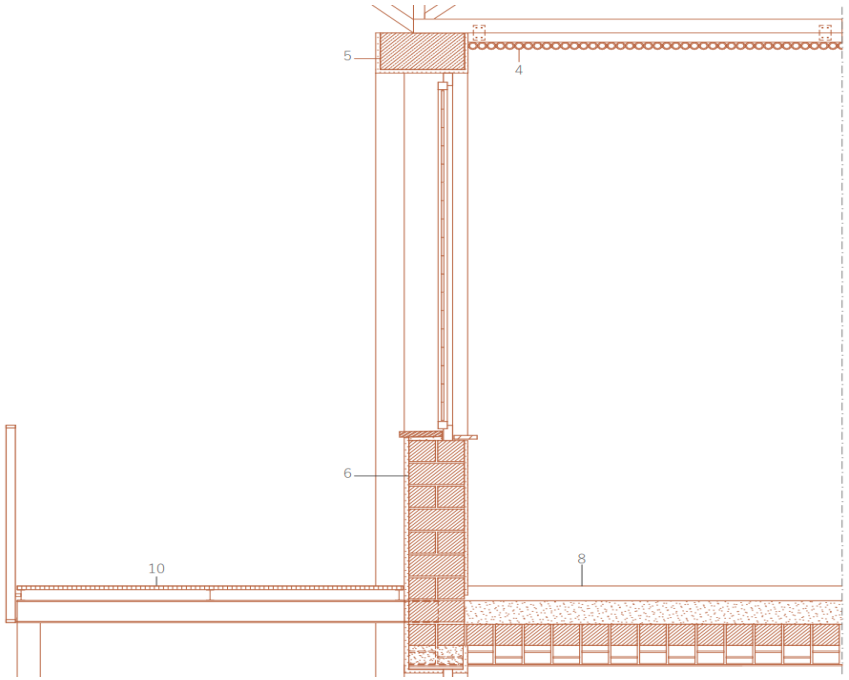


compressed earth bricks (CEB) produced on-site

6 clay plaster 2 mm
compressed earth brick (CEB)
240 x 115 x 115 mm
plaster 1.5 mm
white colour

7 steel window frame with
horizontal slats
mechanically/ lockable

materials: ceiling



Constuction ceiling, flor

4 false ceiling made of agave wood
subtructure timber
5 ringbeam concrete 360/200 mm

8 rammed earth 75 mm
levelling layer light clay
vaulted celling (CEB)
h-beam (IPE180)

A visible copress earth stone ceiling was chosen for the ceiling, which has a positive effect on the room atmosphere. The natural brown colour creates an earthy and protective atmosphere.

Ceiling formwork made of agave wood: The suspended ceilings are made of agave wood, a sustainable material with an attractive appearance. This wood is characterised by its exceptional lightness and strength. It has a light, often cream to yellowish colour and a fine, even texture. Agave wood is known for its sustainability, as the agave plant grows quickly and regrows well.

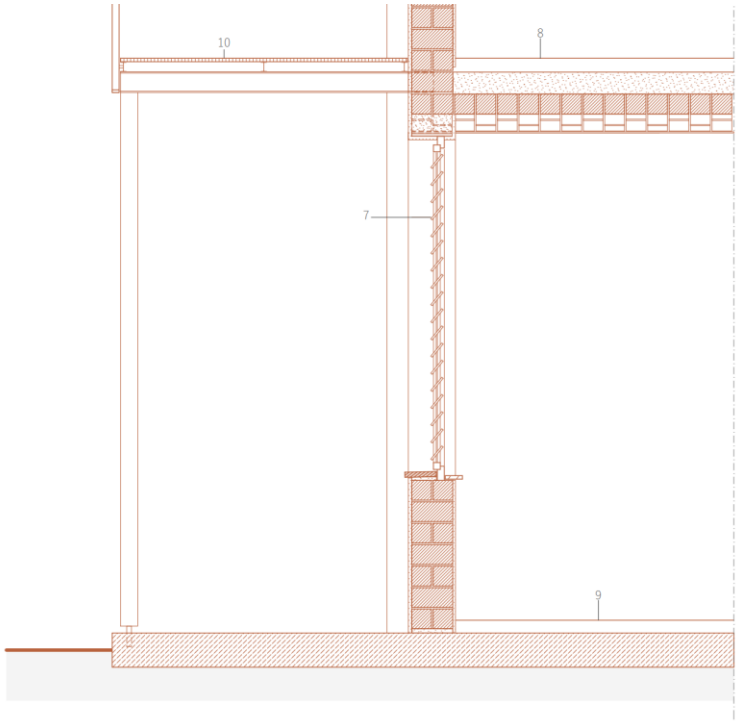
Wooden supporting structure: The wooden substructure provides a solid base for the ceiling

Concrete ring beams: concrete ring beams measuring 360/200 mm were installed to stabilise and support the structure.

Vaulted ceiling made of compressed earth brick (CEB): The ceiling is designed as an exposed cap ceiling and is made of compressed earth brick (CEB), which is not only an architectural feature, but also contributes to the room design.

Steel beams (H-Beam IPE180): The steel girders serve as structural support for the ceiling

materials: floor



Constuction floor

8 rammed earth 75 mm
levelling layer light clay
vaulted celling (CEB)
h-beam (IPE180)

9 rammed earth 75 mm
concrete foundation 200 mm
10 steel grating
steel underconstrcution
h-beam (IPE100)

Natural materials were selected for the floor slab and the floor, providing an aesthetic and functional solution:
concrete foundation: with a thickness of 200 mm, provides a stable and durable base for the structure
Rammed earth: The 75 mm thick layer of rammed earth forms the basis for the design of the floor and contributes to a natural and sustainable atmosphere.
Levelling layer of light clay: A levelling layer of light clay is placed on top of the pressed earth structure to ensure an even surface.
Steel grid: Overall, the design of the floor slab and the floor is a successful combination of natural materials, modern construction technology and aesthetic design.
Steel girders (IPE100): The steel girders serve as structural support for the floor.
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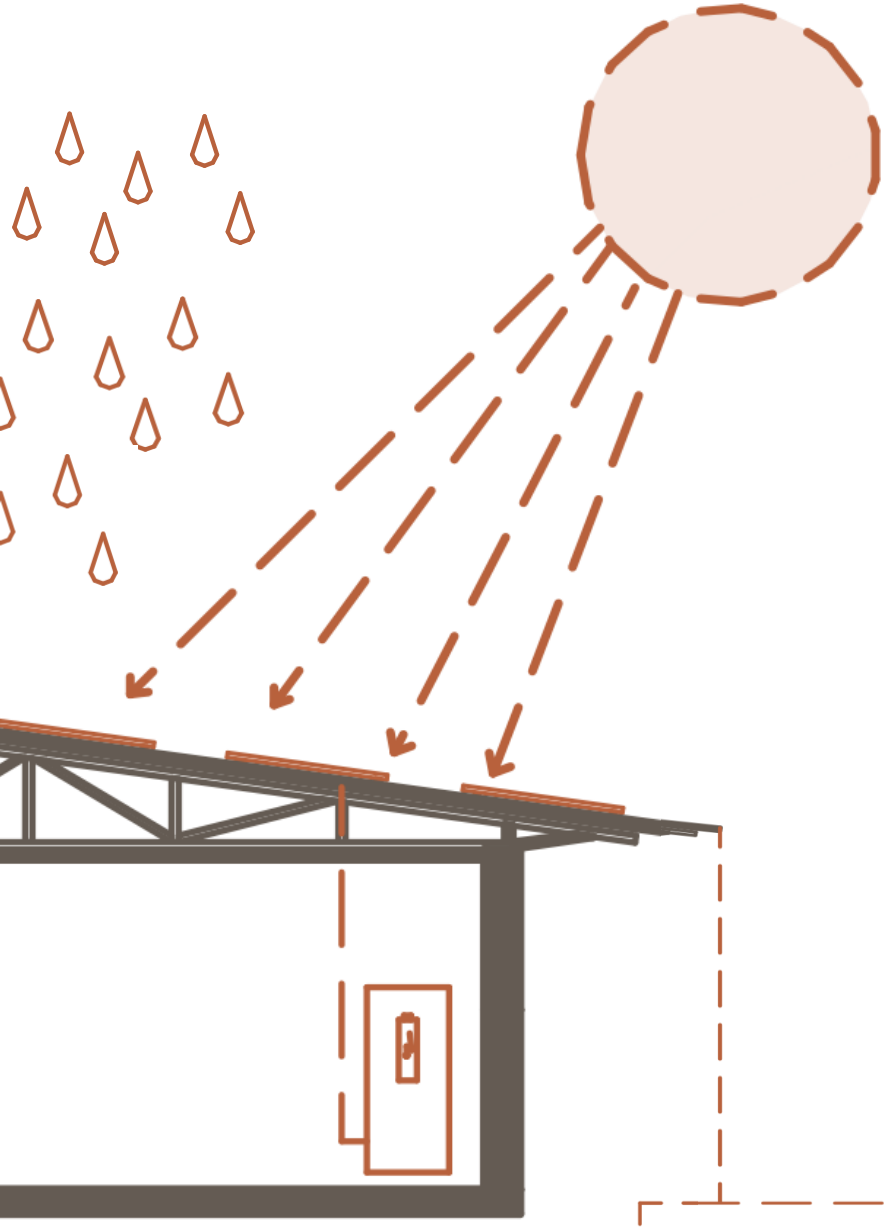
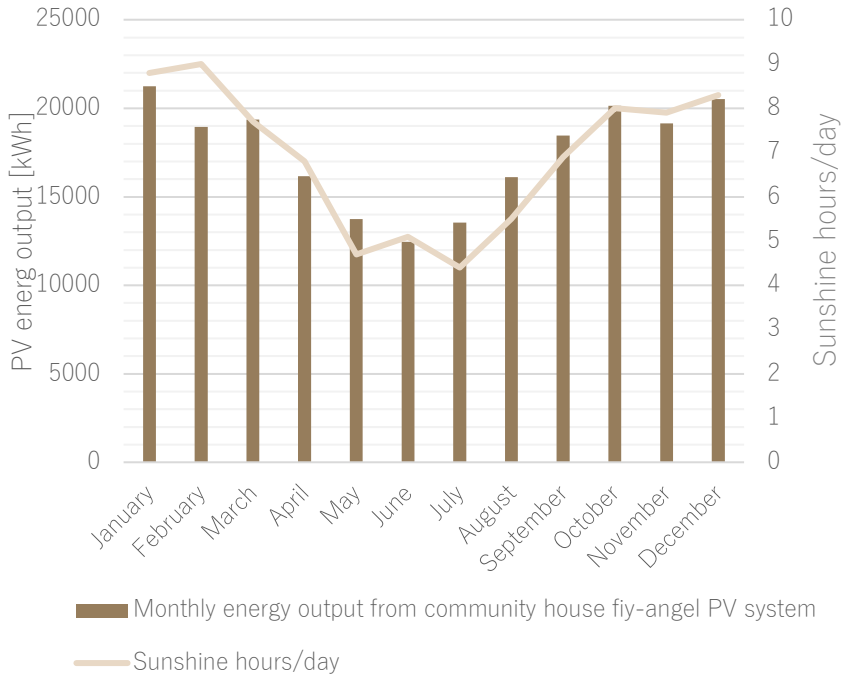


08

TECHNIC

photovoltaic

A photovoltaic system (PV system) is being installed on the roof of the Community Campus. The modules of this system are based on Monokristalline and have an inclination of 8 degrees. Each individual module has an area of 1.8 square meters and an output of 400 watts. The PV system therefore achieves a Efficiency level of 18% - 24%. In order to use the solar energy generated efficiently, a storage system is integrated in the technical room of the campus. This storage system enables the temporary storage and demand-orientated use of the electrical energy generated. The combination of the PV system on the roof and the storage system in the plant room helps to optimize the energy supply of the Community Campus.



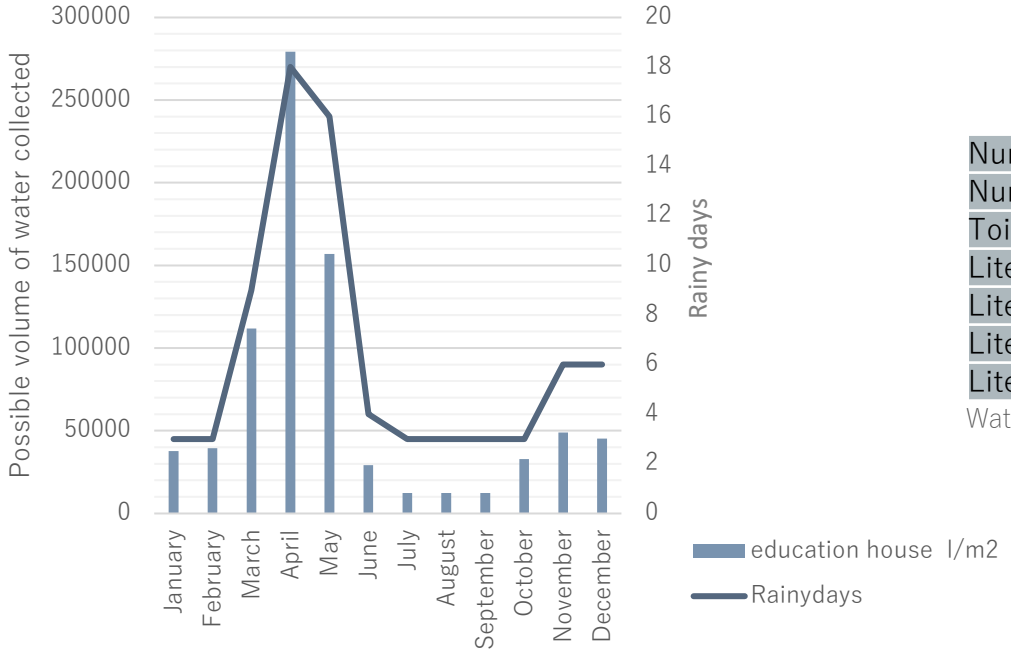
PV energy output [kWh] & Sunshine hours/day

Photovoltaic modules	Monokristalline
Efficiency level	18–24 %
Slope angle	8 °
Azimuth angle	0 °
Yearly PV energy production	209824.65 kWh

Simulation Input

water

By implementing a rainwater utilisation system, the Education Campus intends to collect rainwater from the roofs of the campus and store it in cisterns in order to use it specifically for flushing toilets. The amount of water is generally sufficient, except during the summer months, particularly in July, August and September. For the dry periods of the campus, the requirement of 31,200 liters per month for toilet flushing cannot be fully covered. A detailed analysis shows a demand of around 19,000 liters per month. Over a period of three months, the water requirement adds up to a total of around 57,000 liters. To meet this specific demand, the campus is planning to install five cisterns, each with a capacity of 12.5 m3, as well as a further cistern with a volume of 7.6 m3. The cisterns will be located underground. The implementation of these measures aims to utilise the campus's water resources efficiently and ensure a continuous flow of water for flushing toilets during dry periods.



Possible volume of water collected/Rainy days
https://www.wetter.com/reise/klima/klimatabelle/tansania-moshi-TZ0153209.html

Number of students	130
Number of toilet visits	2
Toilets used per day	260
Liters used per flush	4
Liters used per day Liters	1040
Liters used per month	31200
Liters used per year	379600

Water requirement for flushing toilets

Merisa Cekovic, Pia Jürgens, Rebecca Stickmann, Anne Wicklein

Energie Effizienz Design
M09 Methodik des energieeffizienten Entwerfens