HUMANITARIAN ARCHITECTURE, FROM ETHICS TO AESTHETICS

Construction of a secondary school in Malawi

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ABSTRACT

The thesis explores the field of humanitarian architecture within the context of extreme poverty through the design of a secondary school in Malawi, Africa.

The role of an architect goes beyond developing the built environment of the western world. Humanitarian architecture fills the need for architects working beyond their typical unwritten borders.

The introduction included here will explain the role of a humanitarian architect by expressing a common reason for designing and building in third world countries, with the values and limits of it being explored through the lens of ethics.

Certain general facts about Malawi are included, regarding the realities of the existing school system and mapping and works as a definition of the current challenges that are being faced there. The site where the proposed secondary school will be located will be presented, showing the values and the unrivalled character of the place.

A final, and crucial component of this thesis will focus on the design process of the school. It is a guide through the geographical background of the location and the overall concept and organization of the project. The technical issues, as a major challenge for designing in Malawi, are explored with regards to materiality, structural and construction techniques, water and sanitation, ecology, environmental and maintenance concerns. These are essential topics for development of a project located within such extreme poverty. All decisions have been made in order to reinforce the special character of the place, while considering the needs of the community and the realities of the project's location.

The final design proposal will be displayed through floor plans, sections, elevations and three-dimensional views and will defend the decisions made according to the completed analysis, with keeping in mind the rich unique aspect of the site.

CONTENT

INTRODUCTION

INTRODUCTION

The purpose of humanitarian architecture

Planet earth is home to a countless amount of accidents, natural disasters, human conflicts, famine etc. In 2010, approximatively 42 million people worldwide had to evacuate their lands because of natural disasters[1]. Local communities around the world often do not have the resources to face these hazards and to build or rebuild what they have lost. Aiding these communities in their daily struggles requires the support from sectors such as housing, education or health facilities. This is the truth that few architects have found ways to step in and make a difference.

> *"Human beings are at the centre of concerns for sustainable development, including adequate shelter for all and sustainable human settlements."*
> *UN Habitat Agenda, Chapter 1*

[1] World Bank, *"United Nations High Commissioner for Refugees"*, Global trends, 2010.

“Architecture as a tool to improve lives.”
Anna Heringer

Definition of the “Humanitarian Architecture” term

The global crisis in architecture in developing countries is related to catastrophic events due to the climate change and political events as the decolonisation of Africa. Humanitarian architecture is the building respond to this crisis. It can be seen as the help provided to improve the welfare of people in need and find durable solutions for their everyday lives. It is much more than drawing conceptual designs, resolving technical issues and building “well designed” structures for an informal client, it brings design solutions for a range of communities affected by life complications. Humanitarian architecture is about serving the alternative client, not the person that is asking to design or build but the person for who architects are designing or building for. It is the architecture for the people.

> *Humanitarian architecture is providing “safe, permanent, well-designed, and well-built solutions that would hopefully resolve these problems for all time.”*
> *Eric Cesal*

Architecture often loses its ethics. Leonardo Gonzales, a freelance architect, explains his thoughts about the current construction situation in La Paz, Bolivia, “as soon as the construction companies have their permission to build, they do not care- mas es mejor- the more flats you can build on one floor, and the more floors, the better, it is all about money.” Too often, constructors and even architects think according to the costs and not about what is important, the soul of architecture, why do we build in the first place. Humanitarian architecture has an answer to this question, it gives a real reason to build, by supporting local traditions and social and ethical values, that results in a moral design.

Examples of humanitarian architecture projects

MARY'S MEALS' KITCHENS
Orkidstudio
Eldoret, Kenya, 2015

GANDO TEACHERS' HOUSING
Diébédo Francis Kéré
Gando, Burkina Faso, 2004

SAFE HAVEN ORPHANAGE
TYIN Architects
Ban Tha Song Yang, Thailand, 2009

Images: 1 *https://orkidstudio.org/projects/marys-meals-kitchens/15*. (Accessed January 2019).
2 *http://kere-foundation.com/en/our-work/teacher-houses*. (Accessed January 2019).
3 *http://www.tyinarchitects.com/works/safe-haven-bathhouse*. (Accessed January 2019).

Humanitarian design is an effort that can be linked to a variety of contexts. Firstly, in the natural disaster context, the objective is to provide infrastructure and rebuild what people have lost. Post-disaster architecture is the challenge of providing safe, healthy and resilient housing and infrastructure as a form of relief following a major disaster. It works, at its core, to restore basic Human Rights, such as Food and Shelter for All, or the Right to Education. The aim of humanitarian architecture is to achieve a dual outcome: a long-term solution utilizing conventional construction that respects a country's customs, combined with an innovative approach. For instance in 2010, there was a devastating earthquake in Haiti where approximatively 7000 people died. According to the Bureau de Monétisation des Programmes d'Aide au Developement (BMPAD), in Delmas 32, the most affected neighbourhood in Haiti, 29% of the housing in the neighbourhood was destroyed, 12% had damage, and 36% needed repair before that the local population could inhabit their homes once again. The architects that took part in the rebuilding efforts had to understand the needs of the population and take them into account in order to improve the living conditions for those who have lost their homes. Currently, the most important phase for a designer is to listen to the concerns of local residents and to provide them the help they need as fast as possible. The goal is to educate and include the population in the design and construction process, to make them aware of how to react in a similar event. Help the population help themselves.

Humanitarian architecture helps populations to improve their living conditions all year long. Some countries are very different from what we know in the global North, where vast areas of the world contain people who do not have access to basic services: no potable water, no electricity, poor health with little to no health services, and inadequate education systems. The main focus of building within areas of extreme poverty are ethics, cost, materiality, sanitation, ecology and sustainability.

Humanitarian architecture also plays a role in the context of human migration. As an increasing amount of people in the world are forced to leave their homes because of various unfortunate events, a question arises of how can we provide acceptable accommodation for these refugees? For this condition, conscious urbanism and architecture are essential tools that must be used to respond to the housing, slum and refugee camp crises of today.

In all of these cases, architecture has become a tool to build, rebuild and relocate the people who, against their will, were forced to give up their livelihoods as well as those who are in need of refuge, for those who do not have access to basic human needs and continuously have their human rights violated.

This thesis will focus on the condition of extreme poverty in developing nations. It will act as a guide on how to build in a unique climate utilising particular local construction techniques that will develop an affordable, buildable, energy efficient, and sustainable product. This research will result in a resource-saving secondary school that would serve as a safe learning environment for the children of Malawi, in Africa.

GENERAL FACTS

GENERAL FACTS

Education in Malawi

In this thesis, the attention will be paid on developing countries in general and principally on Malawi's educational and building methods. What is the reality in this country? How do people live their everyday lives? What are the challenges in the construction field?

A large amount of educational facilities are unsafe and unsuitable for teaching and learning due to a lack of resources, planning methods, inadequate construction technologies and an ineffective construction management process. According to the statistical yearbooks of the Ministry of Education of Malawi, the number of classrooms per year is only growing half as needed. The quality of the existing school facilities is also extremely bad: the durability and functionality are both abysmal, the school furniture is often broken or simply missing and there is often no potable water and a bad sanitation system. These conditions result in a lack of attendance for both students and teachers.

According to UNESCO, in Malawi, 4.5 million children are aged to attend primary schools, 83% of these children are enrolled, which means that only 17%, which represent 765 000 children are not attending school at all. This category concerns the poorest children in Malawi. Moreover, 11% of the students aged between 15 and 24 years old succeed primary school, 7% succeed secondary school and only 1% of the students study beyond secondary school. The illiteracy rate represents 50% and is mostly due to the lack of connection between the villages, only few school infrastructures and a high cost of education.

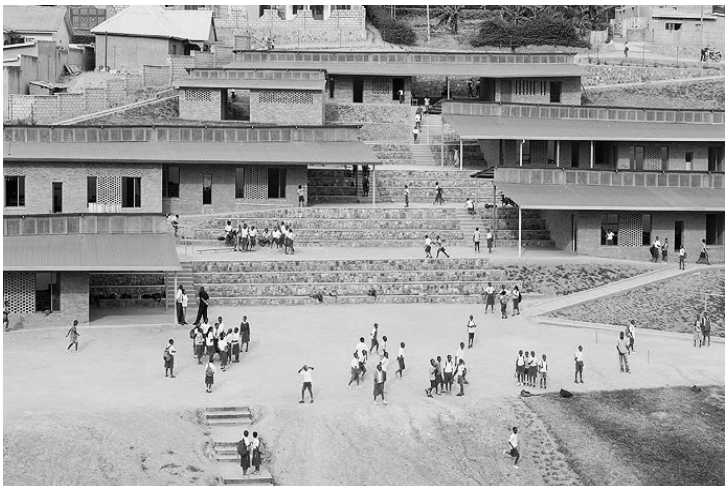
Access to education is a real chance in this type of country, it is a place where students are respected and encouraged to change the situation in their country. In fact, it gives them the tools to fight against poverty and diseases. A school should be a safe place where children can get food, drinkable water, and life-saving vaccines, but often it is not.

> *"Education is the most powerful weapon which you can use to change the world."*
> *Nelson Mandela*

Examples of schools projects

AGRICULTURAL SCHOOL BELLA VISTA
CODE Architecture
Cochabamba, Bolivia, 2014

SECONDARY SCHOOL IN GANDO
Diébédo Francis Kéré
Gando, Burkina Faso, 2008



UMUBANO PRIMARY SCHOOL
MASS Design Group
Kigali, Rwanda, 2018

Images: 1 *https://www.archdaily.com/875095/agricultural-school-bella-vista-code*. (Accessed January 2019).
2 *http://kere-foundation.com/en/our-work/primary-school*. (Accessed January 2019).
3 *https://massdesigngroup.org/work/design/umubano-primary-school*. (Accessed January 2019).

Many African countries provide primary school infrastructures. Regarding secondary education, its cost is often higher and its location is further away from home. Therefore, transportation may be needed. Families generally do not have the money to cover the expenses, so children do not attend secondary schools. Furthermore, keeping an adolescent at school when he could learn job skills and work, stays a dilemma for a family.

"Better school, better future."
WAYAiR Foundation

PRE-SCHOOLS

The government of Malawi does not give assistance to pre-schools. It strongly invites people living in villages to create their own. Pre-schooling is an important foundation for the development of children. With no funds, most of the pre-schools are not registered. However, they work because of the help of volunteer teachers and mothers from the neighbourhood. They usually also do not have their own building: churches share their facilities with pre-schools.

PRIMARY SCHOOLS

Primary schools concern children aged between six and thirteen years old which count eight grades in total. Since 1994, primary schools are free of charge for all students, but they still must purchase their own uniforms and school supplies, which can be difficult for many families. Moreover, there are not enough teachers and school facilities to deal with the increasing number of students attending primary schools. A lot of primary schools are built with simple shelter structures or no structure at all. In this case, classes are given outdoor.

Regarding furniture, Malawi offers furniture made of concrete, which is favourable against vandalism since it is very sturdy but is difficult to move. In fact, flexibility has become more suitable for the modern classroom teaching strategies that allow multigrade classes. Therefore, teachers should be able to move the furniture easily, in order to organize the classrooms in different ways.

Primary school's teachers are paid by the government, but they do not employ enough of them, especially in rural areas. The ratio is approximatively 96 pupils per teacher, whereas the recommendation is 60 pupils per teacher[2].

[2] World Bank, *"School Census data"*, Group 5 2005, World Bank project documents 2005, UNESCO 2005.

“Knowledge is on the pages of books, and with knowledge comes the power to dream.”
Barkissou from Taga, Burkina Faso, Build on the non-profit organization

SECONDARY SCHOOLS

Secondary schools concern adolescents aged between fourteen and seventeen years old, which represent a total of four years of study. The percentage of female and male attending secondary school without necessarily graduating, are respectively 28.8% and 29.7%. It is the worst education statistics in Sub-Sahara Africa. Students in secondary schools must pay a tuition fee to attend classes, which goes from $20 (€17) for public schools to $700 (€622) for private ones. It represents a lot of money for some families that already fight to raise their children. Sending them to secondary schools might become an additional burden. Many children choose not to continue studying in secondary school to help their families in daily activities such as farming, fishing, cooking, or looking out for their younger siblings.

Most of the secondary schools have more resources than primary schools, but they still deal with the same problems, such as teacher's ratio, classrooms facilities, learning material, school supplies, etc. There is a huge lack of secondary school facilities in Malawi. Students must commute great distances to reach them, affecting the attendance and the probability of dropping out. There are only 76 secondary schools in Malawi, for a country 3.5 times more populated than Finland, which has 3257 secondary schools. Moreover, there is a real issue in the distribution of facilities according to students in the country[3]. Urban children have more chance to access to education than children in rural areas because the schools are closer to one another.

Furthermore, students must study biology and physics which require a laboratory that needs direct access to electricity. Many Malawi's secondary schools do not have the necessary recourses to have one.

UNIVERSITIES

Only few students make it to tertiary education (1% of the primary school's children). In Malawi, there are four public universities and 21 private ones. The goal of the University of Malawi is to grant "relevant, world-class education, research and services for the sustainable development of Malawi and the world."[4]

In general, school facilities should all have the basic requirement of accessibility, durability, functionality, safety and health. They represent a real challenge for architects who work in the humanitarian field, where most of these requirements are often set aside.

[3] World Bank, *"Analysis of school census data in Malawi"*, 2004.
[4] University of Malawi, *https://www.sarua.org/?q=uni_University%20of%20Malawi.* (Accessed February 2019).

School Mapping

The school mapping strategy was initiated in France in 1963 and gives information on the implementation of primary and secondary schools across the country. It has been a model used everywhere in the world ever since.

Firstly, it describes the accessibility issue, which sets a maximum distance that children should except to travel from home to school. In 1970, a distance norm of three kilometres between primary schools has been established by the International Institute for Education Planning (HEP) in Paris. However, some research has shown that three kilometres is a too long way for young children and a solution would be to imply smaller scattered and multigrade schools rather than larger facilities away from each other. Multigrade teaching is a strategy combining children from two or more grades together in one classroom with a single teacher. This strategy provides basic education in a efficient way in rural areas, where the population is dispersed. School buildings must be flexible in order to convert a one-classroom building into a two-classrooms building in case the population increases.

Secondly, schools must provide a positive and healthy learning environment, with a good water and sanitation system, including disable systems, in order to attract both students and teachers. In Malawi, the rate of physically disabled children represents 3% of the overall population and school facilities must have the necessary equipment such as accessible routes, wider doors openings and building ramps. The latrines must also be disabled-friendly with a larger internal area and handles on the inner walls. The cost of these improvements is very low compared to the overall cost of latrines.

Thirdly, the school mapping strategy includes the construction technology, combining materials, engineering and workmanship characteristics, resulting in functional, durable and cost-effective facilities. These technologies listed below help understanding the decision in the design of the secondary school, according to the social, economic and safety aspects.

CLASSIC CLASSROOM

The classic classroom is the most common type of educational facility found in Malawi. It is made of three main materials: the floor and the ring-beam, essential to avoid bracing, are made of concrete. The roof cover is either made of corrugated metal on wood or metal trusses, or made of dry grass placed on top of a wooden structure. The classic classroom has a similar construction system than the housing industry, which represent 80% of the overall constructions in the country. Therefore, there is a wide range of contractors who can provide the labour. It is a solid and durable model, following the national and international technical norms, that displays effectiveness with inexpensive materials. Globally, it is the most accepted model in the society. Citizens build their own house this way, thus, they would easily accept school facilities built likewise.

SCHOOL SHELTER

The school shelter is often used in African countries in general. They represent 21% of the classrooms listed in Malawi. It is a favourable solution for emergency situations, when a large number of classrooms are rapidly needed. It is also an easy and cost-effective way of building, that can be directly built by the community. On the contrary, a complete solid structure would rather require a construction company because of its complexity.

School shelters have also many disadvantages. They necessitate heavy maintenance due to the limited durability of the materials, it is an open structure that makes the school impossible during the rainy season or in case of heavy wind or sandstorm.

The school shelter is built in the simplest possible way, with only a concrete slab and corrugated iron sheets on metal trusses for the roof, standing on metal columns.

“In the world Ban wants to build, steel is not always cold, and paper can last longer than concrete.”
Stephen Phelan

PREFABRICATED CONSTRUCTIONS

Prefabricated materials are a portion of building produced in an off-site factory, delivered and assembled on-site. It is a modular, cost and time-saving method that can be partly realised by volunteers, with very little building skills or experiences. However, the cost of prefabricated constructions per square metre is higher than the cost of the construction of classic classrooms per square meter.

The main issue remains the delivery issue. In Madagascar, only 45% of the pieces of a school project were delivered within a three-year delay, due to the lack of usable roads leading to the site. Some parts of the construction also require specific construction skills, not available everywhere in the country, thus, people must be trained, or these special skills must be imported. Therefore, prefabricated constructions have absolutely no impact on local employment.

Moreover, the durability of prefabricated classrooms is very low and the maintenance very heavy. It also does not allow improvements through the years; a prefabricated building will stay as it is planned to be. In the beginning of the construction process, the costs seem to be lower, but the previous requirements make the final building costlier. It is also impossible to coordinate the delivery of the prefabricated pieces with the availability of the community labour, as delivery can sometimes encounter many problems before reaching the site.

Furthermore, the prefabrication represents a waste of material in the developing countries. The design often does not suit to the climate, culture, community and economy of the city or the region where it is implemented. It results in a project that does not respect the land and its traditions.

> *"We cannot make a universal prototype for temporary shelter like the universal solutions that the medical profession has for diseases. That's why I think it's easier to send a doctor over there to help the people but, in architecture, there are no universal solutions."*
> *Shigeru Ban*

Moreover, it encourages the nearby market, the craft workers and favour the construction with a local entrepreneur that results in a cost-efficient project.

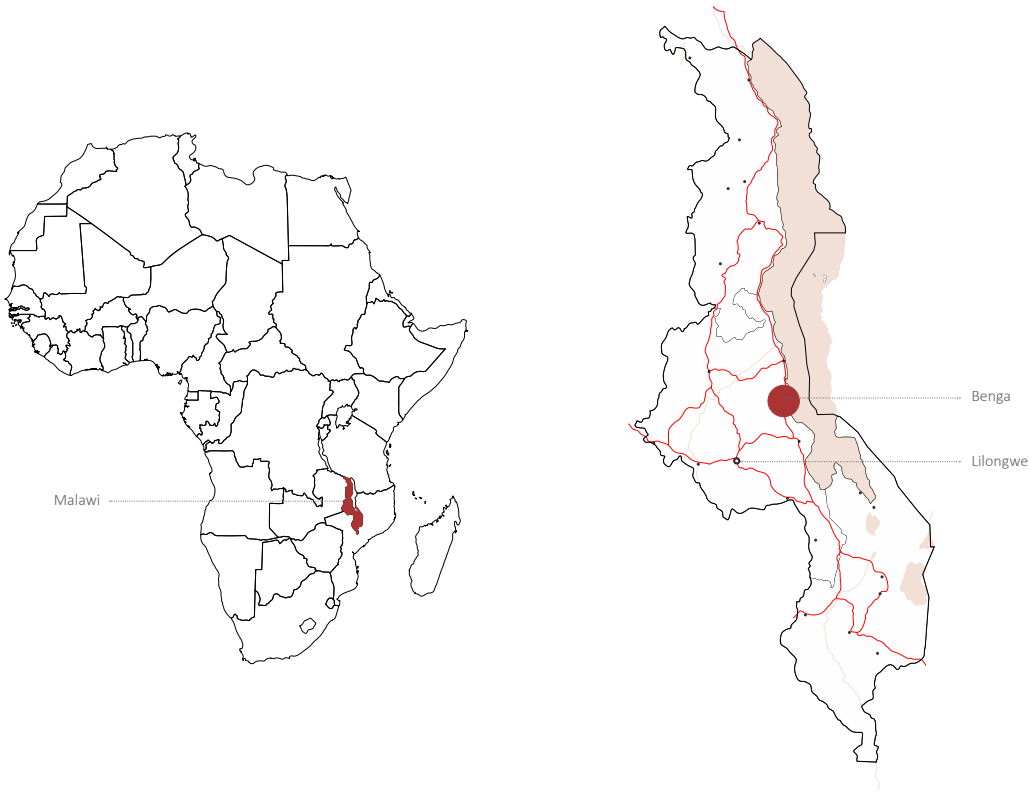
The most appropriate building technology in Africa nowadays is the solution that allows large production of low-cost and simple buildings using local enterprises and materials, promoting a low-carbon solution by cutting down the transport. The industrialized prefabrication and short-term solutions are not viable in developing countries. A good building depends on the strong cooperation with local industries and basic choices of construction technologies financed by supportive donors.

The designed project will follow these consideration elements according to the materials available on site, the transportation distance and the overall construction system.

SITE AND CONTEXT

SITE AND CONTEXT

Location



Malawi is a sub-Sahara country situated in the southeast of Africa with a population of 18 million (2016). Capital and largest city is Lilongwe with 640 000 inhabitants[5]. It is one of the least developed countries in the world (6th poorest in 2018). It was a former British colony and became independent in 1964. The country is described as the "Warm heart of Africa" due to the generosity and hospitality of its people, its songs and dances. The main problems, which the country is facing are diseases such as HIV/AIDS and a lack of education. Moreover, approximately 85% of the population is living in rural areas which causes an agricultural dependency. The life expectancy is given as 67 years for females and 61 years for males[6]. Main reasons for the low life expectation can be found in the underdeveloped health care system and high infant mortality.

[5] World Population Prospects, "*United Nations Department of Economic and Social Affairs*", Population Division, Revision 2017, September 2017, ESA.UN.org. (Accessed January 2019).
[6] World Health Organization, *"WHO Country Cooperation Strategy Malawi"*, 2018-2013, 2.

The country has a subtropical climate with two main seasons: a warm-wet season in summer and a dry season in winter. In summer, which last form November to April 95% of the precipitation of the year takes place. The average temperature during this period is around 27° C and 30° C. During winter the average temperature drops to 17°C to 23°C[7]. This typical sub-Sahara climate allows populations to cultivate a various number of crops such as tea, coffee, sugar, tobacco, cotton and groundnuts. Other secondary but very popular crops are maize, cassava, sweet potatoes, sorghum, bananas, rice, and Irish potatoes. The climatic condition also makes it possible to grow fruits like citrus, mango, guava, papaya, avocado, and banana[8]. Agriculture not only covers Malawi's needs, it is also the main export good. Cattle, sheep and goats are raised for the personal consumption.

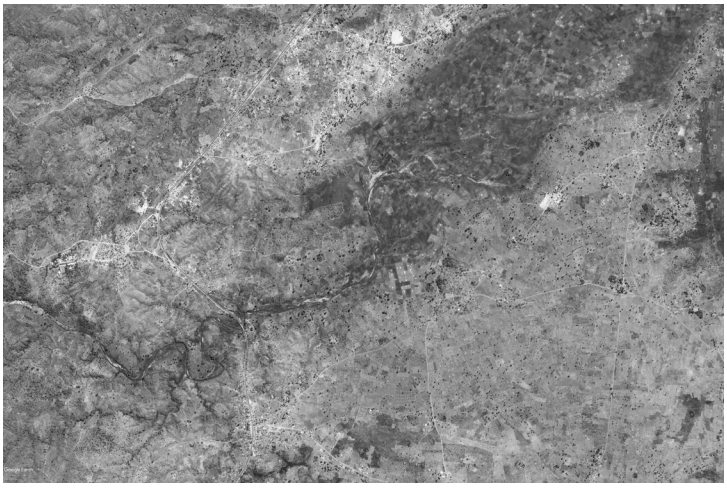
Malawi is home of the 9th biggest freshwater lake in the world, Lake Malawi[9]. The main natural vegetation is the savannah woodland and is situated in the heights of the country. It has been altered by human activities and deforestation has become one of the main problems in the country. People do not worry about it because they do not see its effects. Education will make them aware of the real risks. In fact, cutting down trees has direct impacts on the climate. It exposes the soil to rainfalls, washing away the soil into rivers, leading to Lake Malawi, which becomes more and more polluted.

One of the objectives of education would be to make the people aware of these risks and teach them how to solve the problems. A solution could be to grow trees in order to use them for several purposes, food, environmental protection and used material replacement used in the construction field. For example, in Norway, for each felled tree, two trees are planted, in order to replace and renew the former forest. The goal is to teach local communities to help themselves. In the architecture field, a solution would be to teach the basics of Computer-Aided Design (CAD) to the citizens, to empower them in the design of their own buildings and participate themselves to their recovery.

For populations living in countries like Malawi, each day is a fight to survive. It is a habit to skip the least important things compared to food and drink. Long-term architecture is a critical corner often cut, but it also has a double power: it creates both homes and jobs, such as transportation, craft, construction, manufacture jobs etc.

[7] *Cutter*, Africa 2006, 142.
[8] Food and Agriculture Organization of the United Nation, *"Nutrition guidelines and standards for school meals"*, FAO Malawi, report from 33 low and middle-income countries, Rome, 2019.
[9] Largest Lakes (Area), *http://www.worldlakes.org/lakeprofiles.asp?anchor=area*, retrieved 3 March 2013. (Accessed February 2019).

The project site is situated in Benga, in the Nkhotakota district, ten kilometres east of Lake Malawi. The main tar road leads to two major cities of the country: Nkotakota on the north and Salima on the south.



CITY OF BENGA

PROJECT'S SITE

IMAGE GALLERY

The site has a unique atmosphere, very different of what we usually know in the western world, influenced by a variety of typical elements of the place. Even though, the ground seems rather arid, the fauna and flora are rich, with many species of fruit trees and wild vegetation.

The place has never been altered by human activities, therefore, the vegetation is abundant. A few tiny shelters can be found on the site, probably built by the children from the nearby primary school, who seem to often use the place as a playground.

Images: Archstorming team, *https://www.archstorming.com/info-asp.html*. (Accessed January 2019).

Pictures of schools and constructions in Malawi

Thatched roof house ▶
▼ Primary school

▲ Covered space between the buildings

◄ Secondary school
Classroom ▼

◄ Inside of a church
Outdoor classroom, under a mango tree ▼

Pictures of the construction site, Benga, Malawi

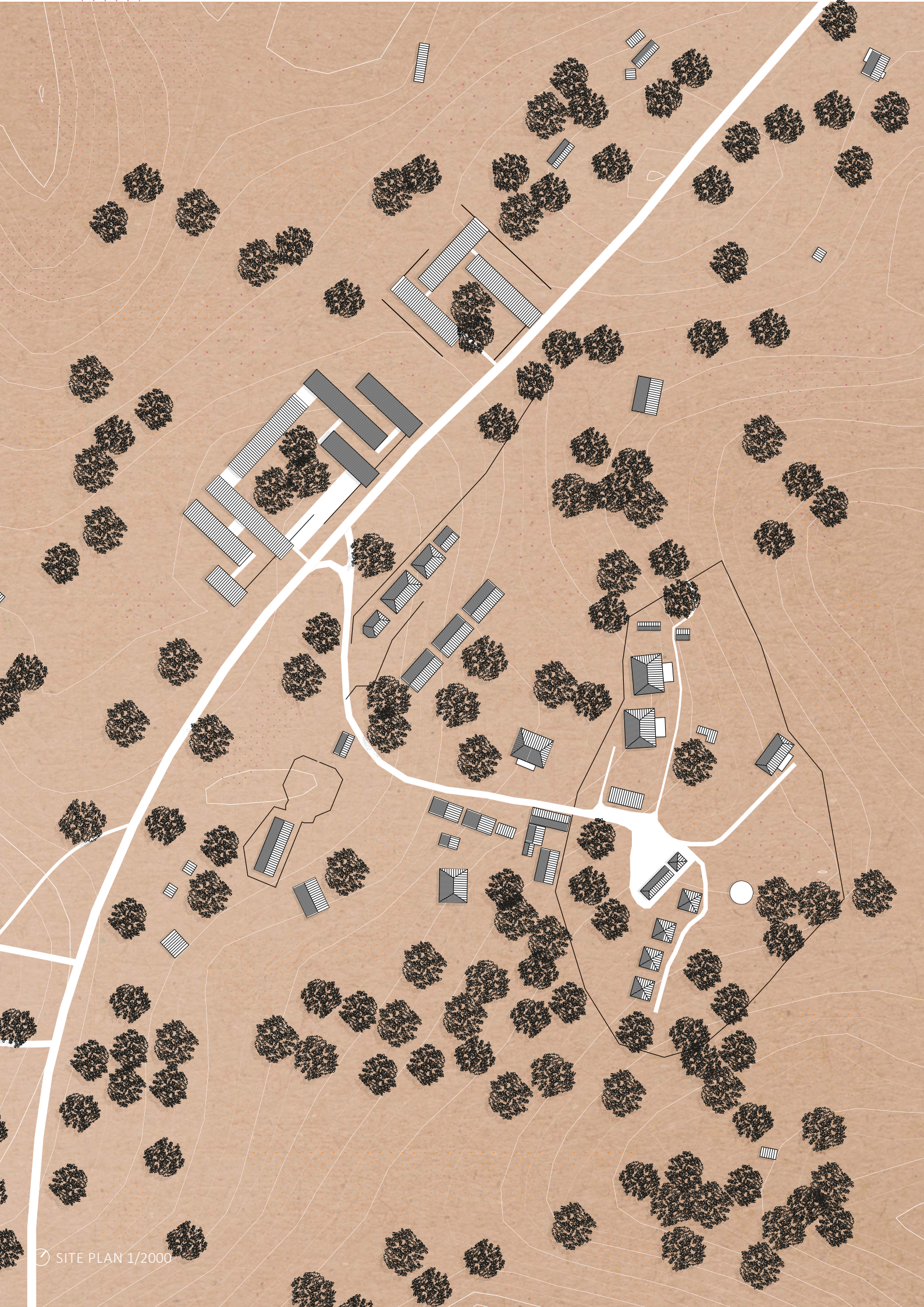
Benga parish ▶
▼ Construction site

Benga parish

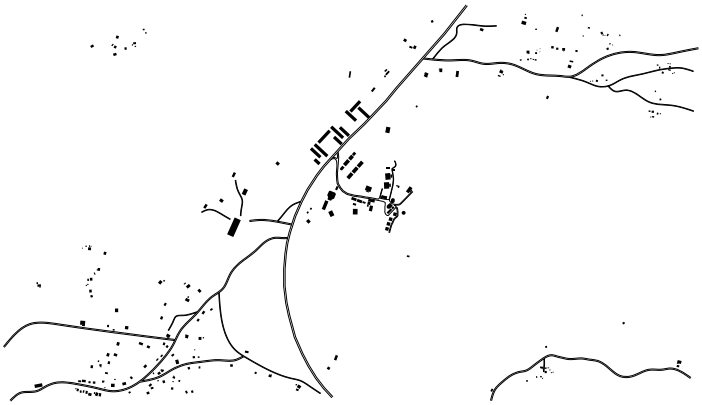

Benga Parish.
Mary Mother of the
urch Catholic Parish,

“Architecture is bound to situation. And I feel like the site is a metaphysical link, a poetic link, to what a building can be.”
Steven Holl

▲ Construction site

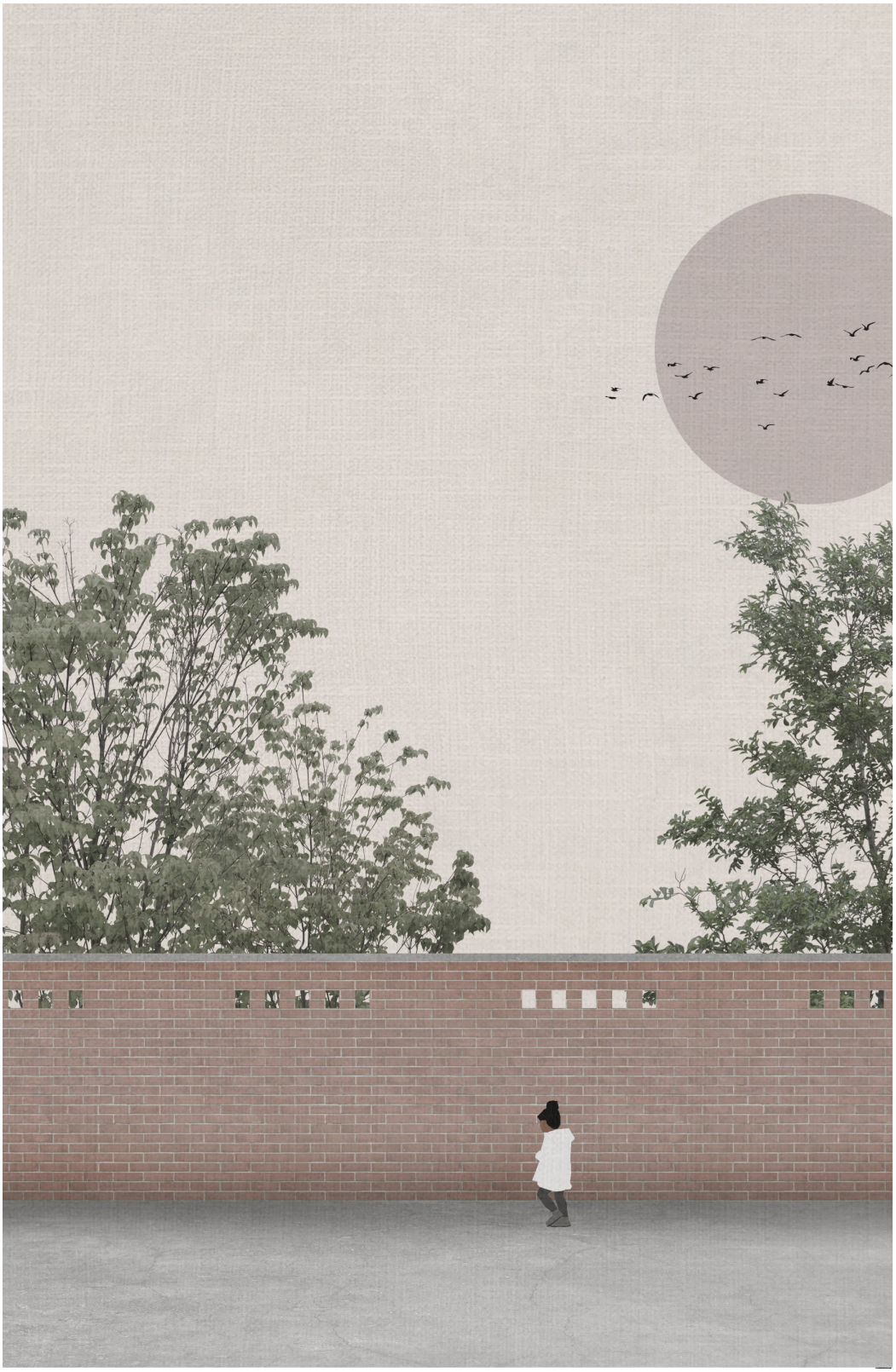

SITE PLAN 1/2000

Site plans



GRANULATION MAP 1/10000

DESIGN PROPOSAL

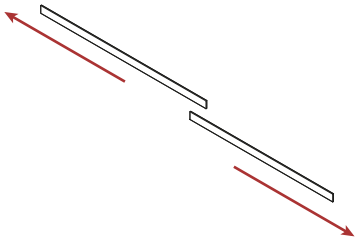


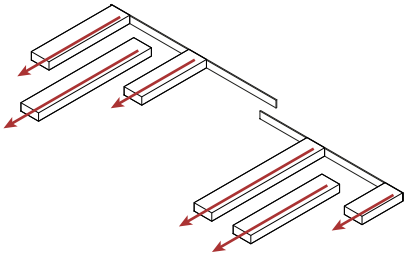
“I think of architecture as a piece of clothing to wrap arround human beings.”
Toyo Ito

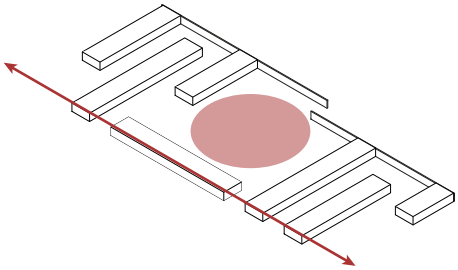
DESIGN PROPOSAL

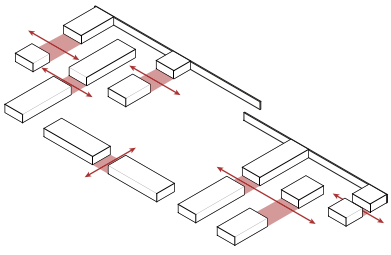
The following design of the secondary school in Benga, Malawi, will present a thoughtful and respectful concept regarding the environment where it takes place. It will preserve the atmosphere already present on the site and stimulate the fragile economic sector of the area. The project proposal will offer the students, the opportunity to study in a safe and healthy environment.

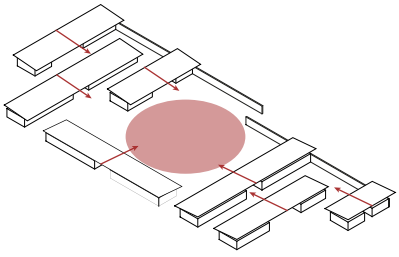
The challenge is to provide all the required elements necessary in the secondary school design, while using simple and reasonable construction techniques, adapted to the real situation of the location.











General organization

The project of the secondary school is situated on the west side of a main north-south tar roads, ten kilometres east from to Lake Malawi. There is a primary school on the opposite side of this road. It creates an educational complex, to provide a complete primary and secondary educational path.

1. Wall concept

In the site plan, we notice that the parish and the primary school are enclosed or semi-enclosed by long walls. Similarly, in the entrance of the secondary school's site, two 2.50 m high walls extend from each other to create a physical barrier between the school facilities and the street. The walls have multiple purposes. They act as a noise protection against the abundant traffic noises, secure the students from this main road, and give a single access to enter in the school.

2. Organization of the buildings

For most of the countries in Africa, including Malawi, one-story buildings are the most common type of constructions. It is a cost-effective and simple way of building and the maintenance is easier than with two stories or more. All school buildings are oriented perpendicular to the main walls.

3. Enclosure

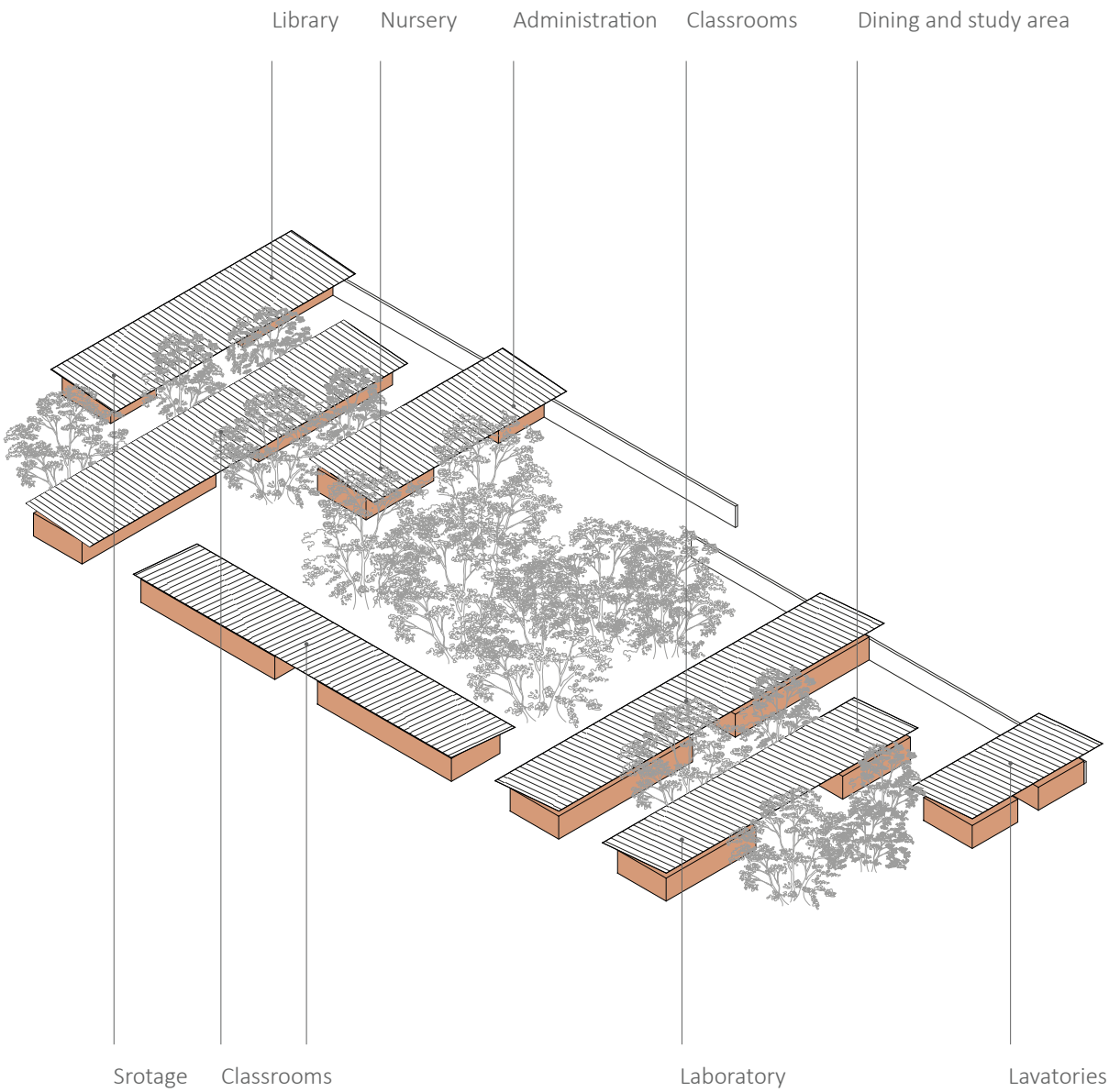
In the west edge of the site, a single building encloses the school. This building is parallel to the main walls and perpendicular to all other buildings. A main square is created in the middle of the school. The square is dominated by a concrete platform which is directly connected to the entrance of the site.

4. Creation of a block model

Each block combines two buildings on both sides of a covered space. This covered space protects the students from the sun and the rain. It can also be used in various ways, for example a multipurpose area, an outdoor classroom, a meeting room, or a simple shelter. The concrete paths leading from one building to another always leads to this covered space situated in the middle of each block.

5. Roof direction towards the yard

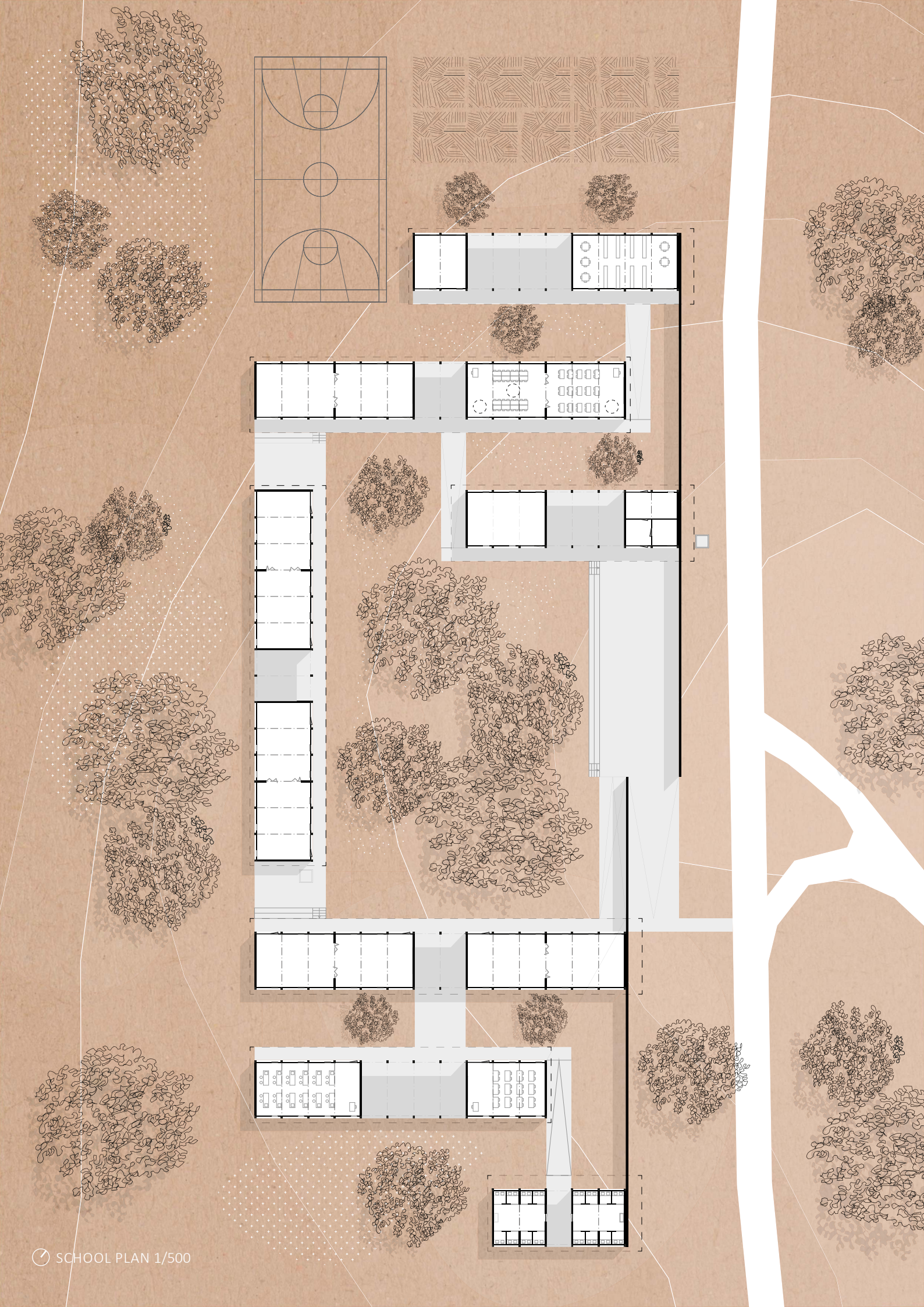
Each building has a shed roof pointing at the main courtyard in the middle in the middle of the area. It shows distinctly the school area from the surroundings.


Library
Nursery
Administration
Classrooms
Dining and study area
Srotage
Classrooms
Laboratory
Lavatories

The first building facing the entrance is the administration building with the headmaster's office, the secretary's office and the teachers' office. There is also a nursery available on site, for both primary and secondary schools. Often, children aged to go to school do not attend classes because they must stay at home and take care of their younger siblings. Therefore, with a nursery available on site, students can drop their younger brothers and sisters at the nursery and attend classes. The complex of primary and secondary schools becomes a place to gather all ages in order to support one another. The nursery can be organized by mothers or fathers from the neighbourhood, or students during their free time. For instance, the Comprehensive Rural Health Project (CRHP), in Jamkhed, India, trains rural women to provide health care and maintain a nursery, that benefits the entire community.

In Africa, most of the classroom buildings are too small for the number of students that it receives and the teacher ratio is not respected. Currently, the World Bank for Education for all (EFA) in African countries, the ratio is 40:1 for primary schools and 25:1 for secondary schools. This model shows high performances on students learning experiences. The World Bank also set 1.2 m² area, corresponding to a minimal space per student in a classroom, necessary for air and people flows and rapid exit in case of emergency. However, it does not provide enough space for storage or special classroom organization for multigrade classes. With all these improvements related to the students-teachers ratio, classrooms would necessitate a 1.4 m² norm per student. The ideal classroom size is around 48/56 m². Some school projects have shown ideas as learning aid without additional cost and extra space. The Building as a Learning Aid (Bâlâ) approach uses physical elements of the building as a learning material. For instance, a door opening can become a way of explaining the degree and radiant in mathematics[10].

[10] Bâlâ approach, *"Building as a Learning Aid"*, Vaipeyi, 2005.



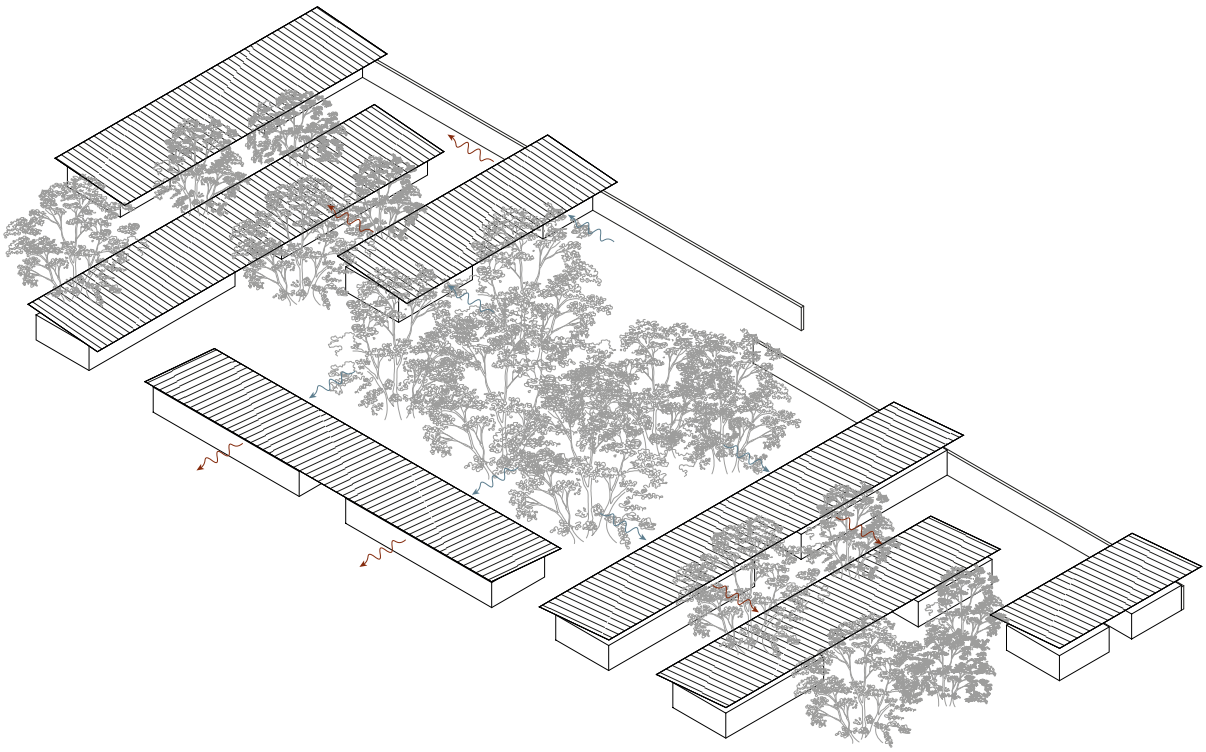
SCHOOL PLAN 1/500

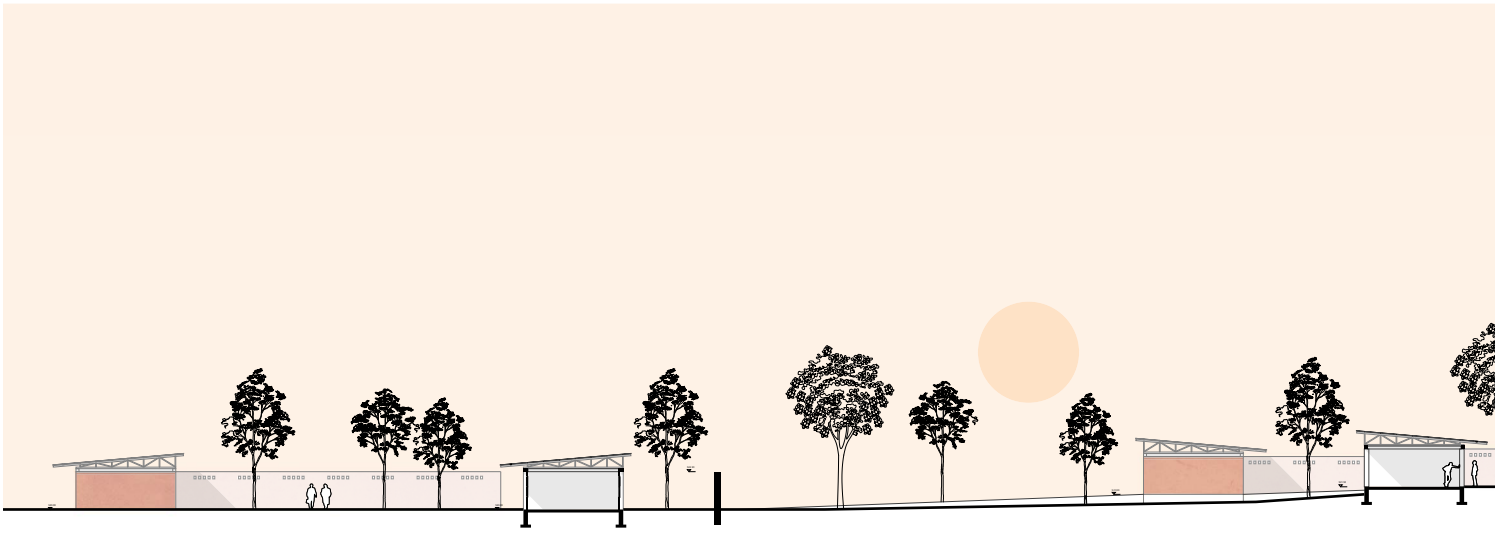
Students will not only learn about mathematics, history and languages but also about everyday activities such as livestock, agriculture and healthcare prevention (malaria, dysentery, respiratory infections, and nutrition-related illnesses). Education provides stability, a structure in the country society and hope for the future. Providing a safe environment for children also makes them less vulnerable to exploitation, kidnapping and recruitment by militant groups.

In the project, there are three classroom buildings with four 50 m^2 classrooms for 32 students. It is an average between the World Bank data and the real situation in Malawi. Each building contains two classrooms on one side of the covered space and two classrooms on the other side. These two classrooms are connected to each other with movable panels, that can either be closed, to have two separate spaces, or open to have a large 100 m^2 area. Each four-classroom block is placed around the courtyard in three different buildings to allow a construction in phases. In fact, in developing countries, the construction must be done this way according to the money collected before and during the construction. One building is built after another and the construction can take some years to end. School sometimes starts with only a few classrooms built, even if all the required buildings are not constructed. During the first phase of construction, there will be only one building with four classrooms, and after completion of construction, a total of twelve classrooms. Each building is separated from another to allow natural ventilation, phasing construction, and rainwater evacuation from the site.

The school has a library to allow the storage of books and a laboratory indispensable to study sciences. It also offers a dining and study block, required to study after the classes and during the exam period, where most of the students stay at school overnight.

The project also includes an agriculture area, since it is the biggest income of the country, it is important for students to learn about plants and the cultivating system as a part of the science classes. Students can learn how to cultivate and cook their own food in order to prepare the daily meals at school. A multi-purpose sports-field is also set for sports session for both primary and secondary schools. Near the agriculture and sports-fields, a storage building can be found in order to store the necessary equipment.



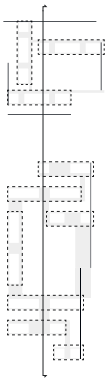


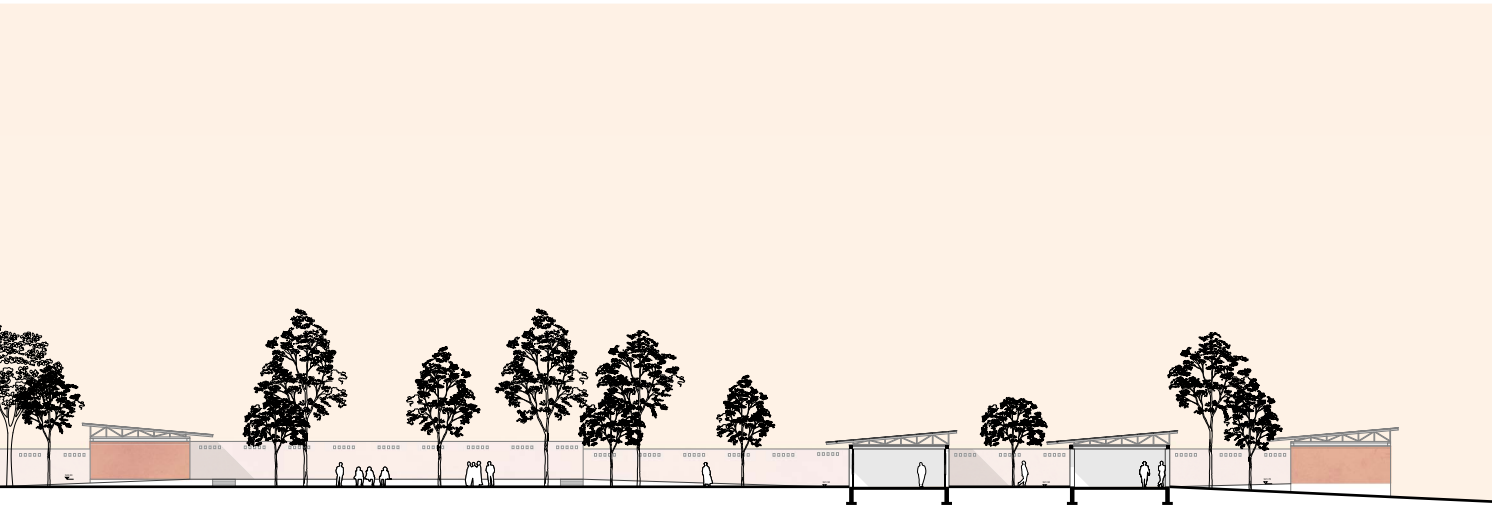
LONGITUDINAL SECTION 1/500

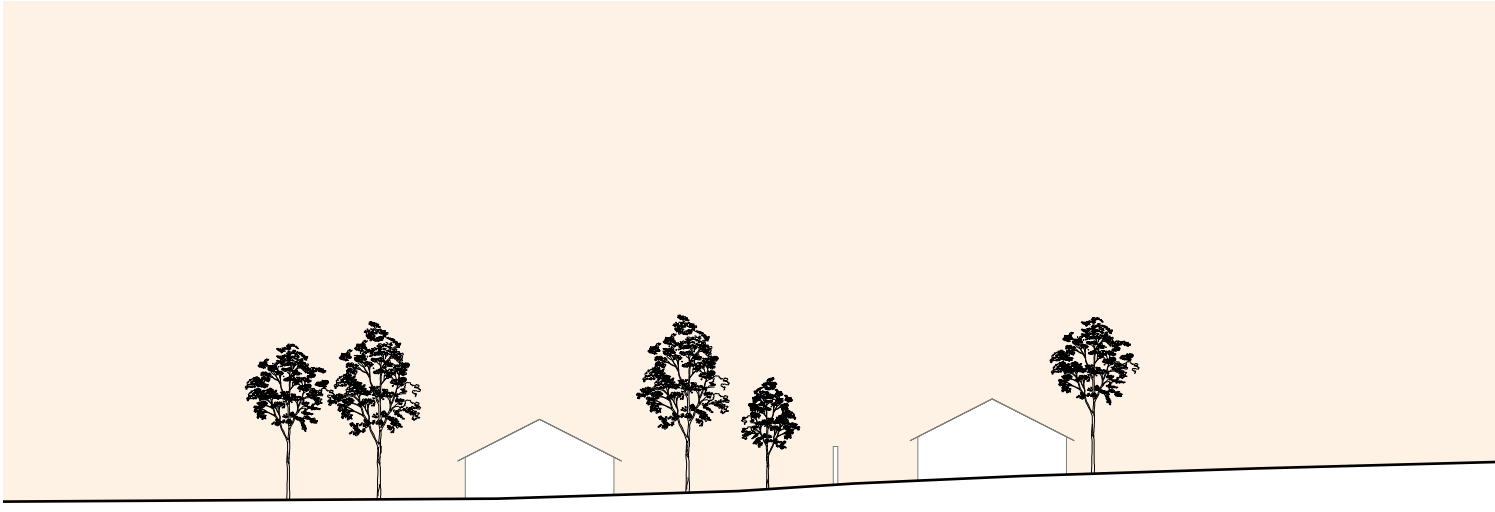
Ventillation system

The courtyards, situated in the middle of the school or housing area, are covered by trees, that have many effects on the welfare of people and on buildings. They have a large foliage that can act as a parasol during the dry season, providing shadows on the main courtyard and allowing outdoor classes. In fact, in African countries, teachers often teach outside in summer because of the high indoor temperature. For instance, the WAYAiR's school project in Ulyankulu, Tanzania provides outdoor classes during the dry season, under mango trees, that also provides mangos for six months (from October to January).

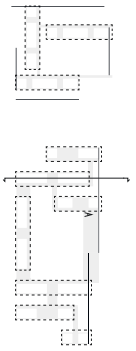
Trees can also support the natural ventilation system for the buildings around. It allows the fresh air, coming from below the foliage, to cool the surrounded buildings, because of the presence of an air gap between the top of the walls and the roof cover. The hot air is spreading out on the other side of the buildings.

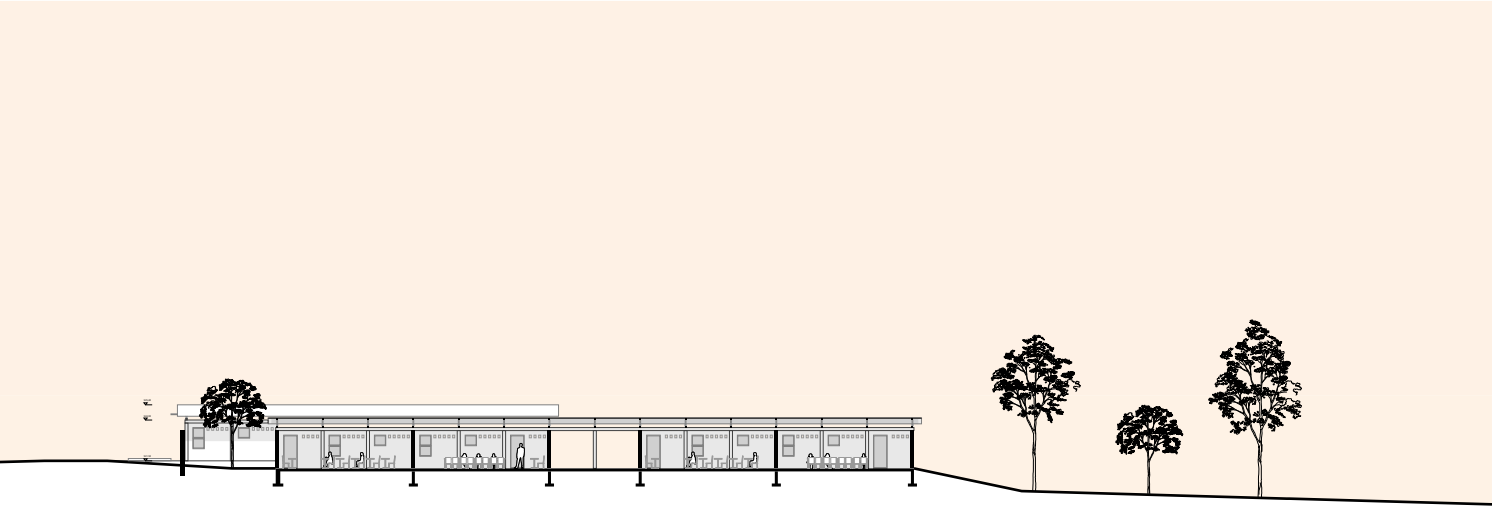


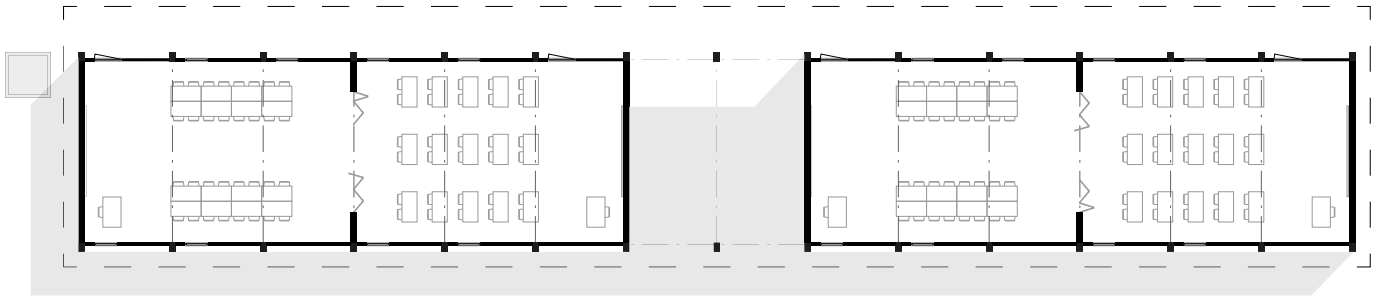




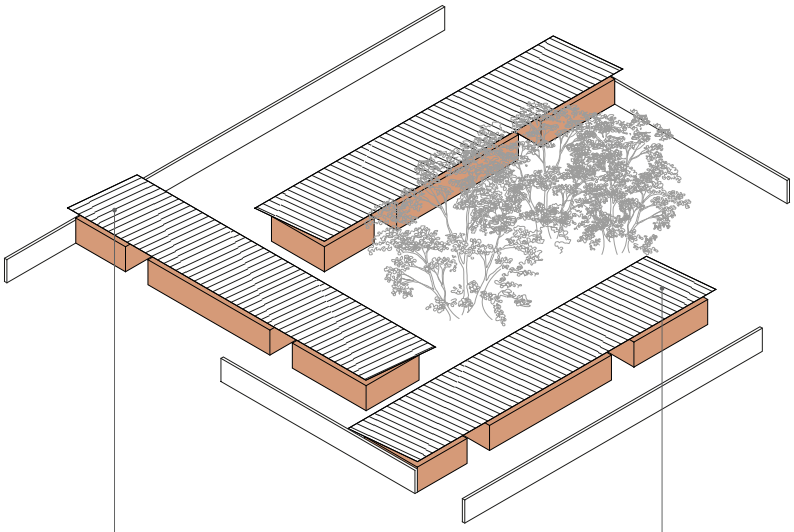
SCHOOL TRANSVERSAL SECTION 1/500





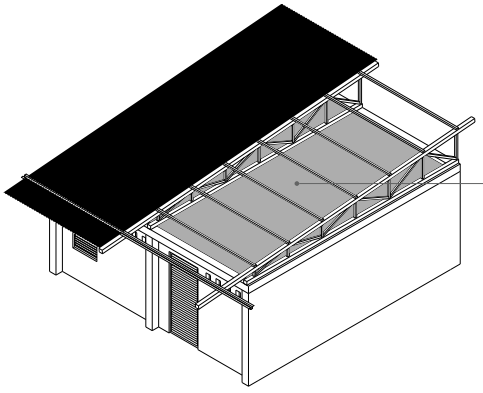


CLASSROOM PLAN 1/250



One-bedroom house

Two-bedrooms house



Wooden pannels

Housing desgin

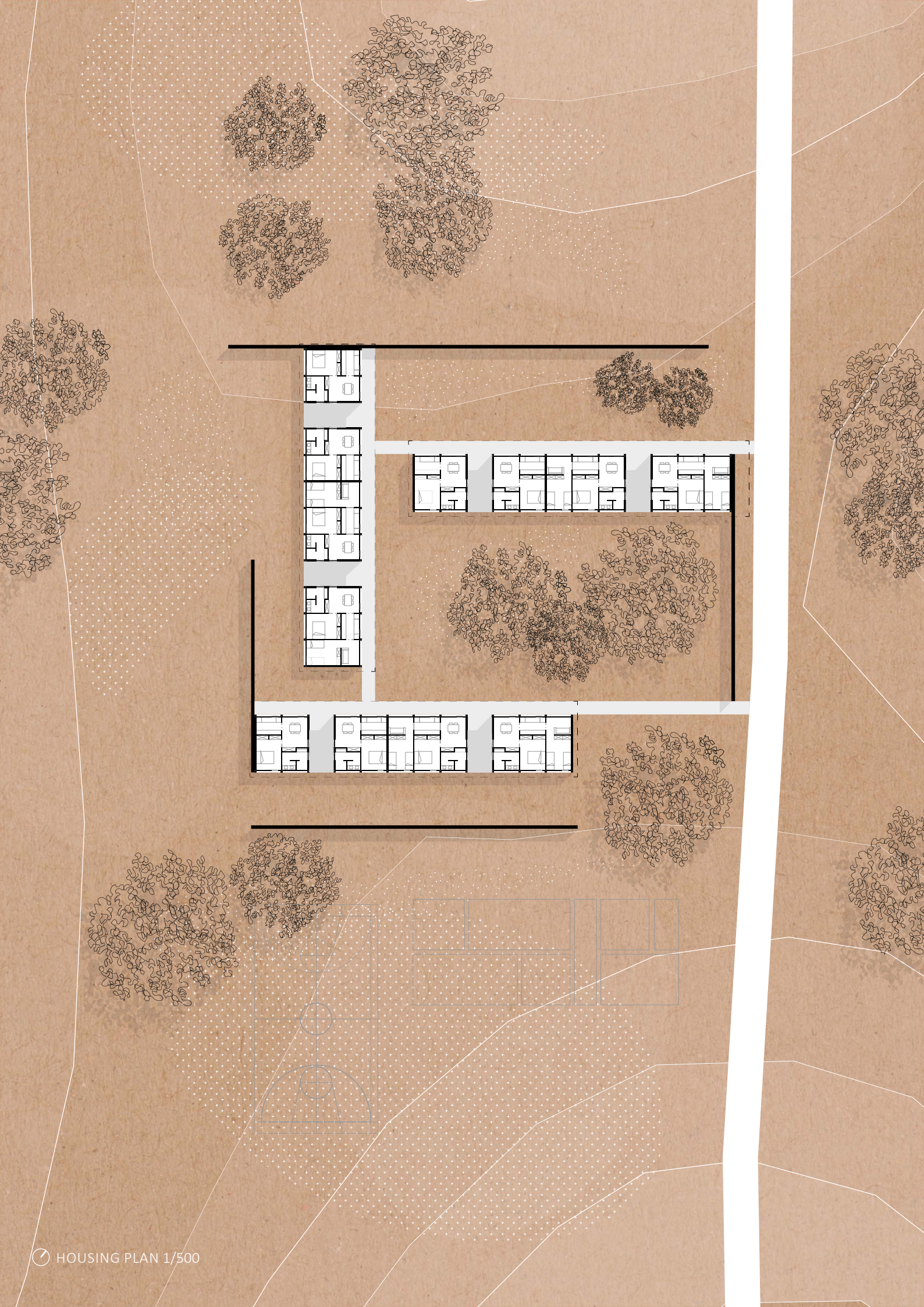
In Malawi, as in most of the African countries, the schools must provide houses for teachers and their family to attract new ones, especially in rural areas. Teacher housing is costly and should not be considered as a necessary part of the minimum standard for school infrastructures but plays a very important role in the education provided to the children. A lot of NGOs or local organizations help paying the teachers salaries, provide desks, and school supplies to make a school project possible.

The teachers housing would involve the same phasing system than the classrooms construction. When four classrooms are built, four new teacher's houses are built. In the end of the construction, twelve houses for twelve classrooms would be built

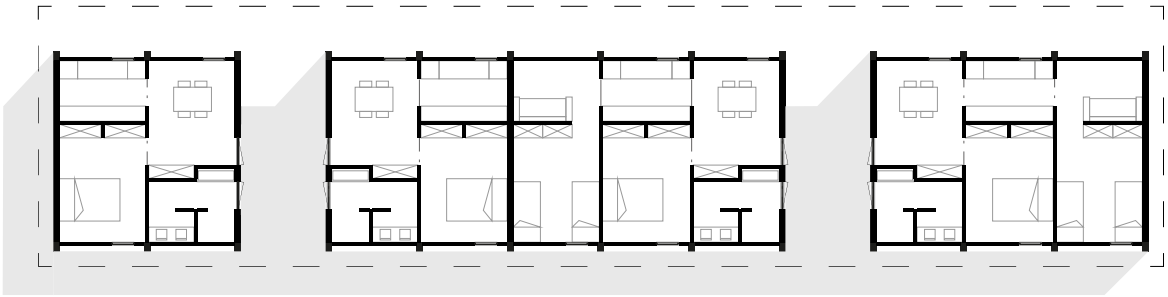
These houses are built on the same model and construction system as the school, with a covered empty space between two houses. There are two different types of houses: a one-bedroom house, for a couple or single volunteer teachers who would come from abroad and a two-bedrooms house for the teacher and his family of one or more children. Each house also includes a living and dining area, a kitchen and a bathroom with dry toilets and showers. The bathroom is separated from the living area because of the dry latrines. It is still attached to the house but accessible from outside, under the covered space. Usually, in African countries, the bathroom is a complete separate building as it is in the school project, but it is important to keep a direct access when it comes to family houses.

The housing area is separated from the school buildings by the agriculture and the sports fields. It is enclosed by the same wall system as the school, to allow a certain privacy for the families. The buildings are placed in a way to create a small courtyard in the middle, with planted trees to allow a natural ventilation system inside the houses.

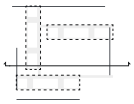
The only difference between the school and the housing construction is the presence of a primary roof, a light wooden panelling system nailed on the wooden beams, below the secondary iron sheets cover. It makes the space more confined, as people want to feel inside a house compared to a public space.

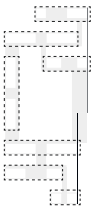


HOUSING PLAN 1/500

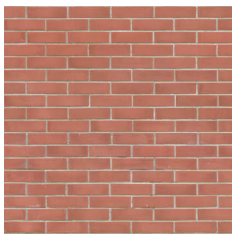


HOUSING PLAN 1/250





HOUSING SECTION 1/500



Compressed Earth Block (CEB) wall and column

Concrete slab and ring beam

Kiaat lumber

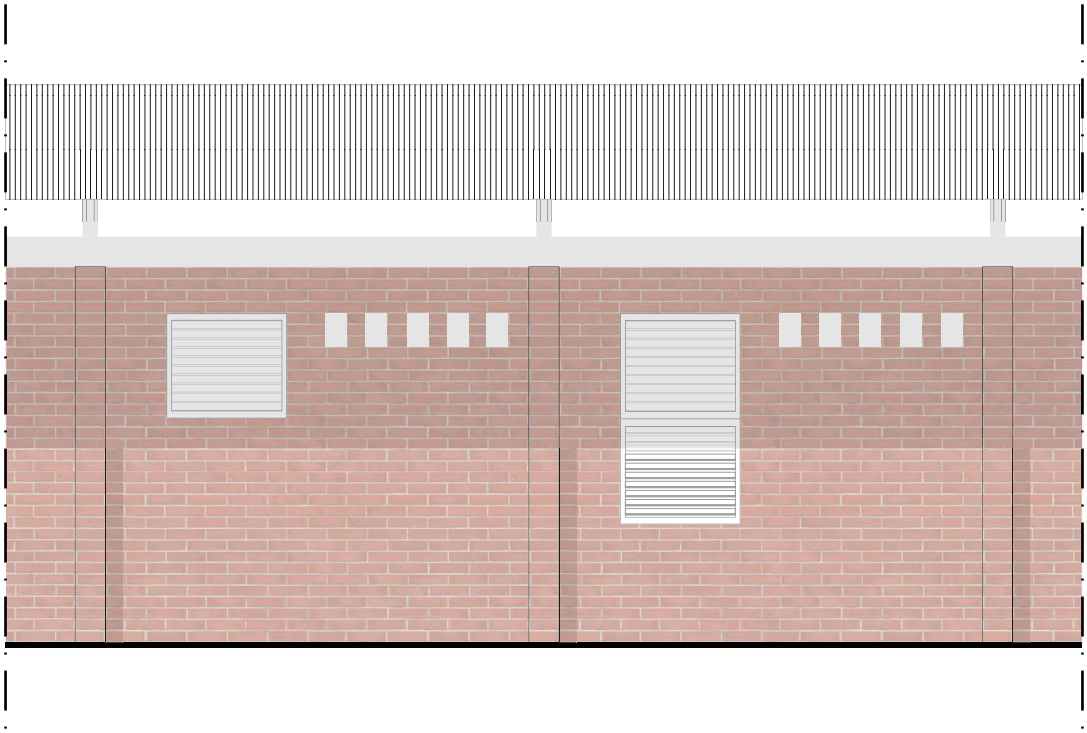
Corrugated iron sheet roof cover

Materials and construction

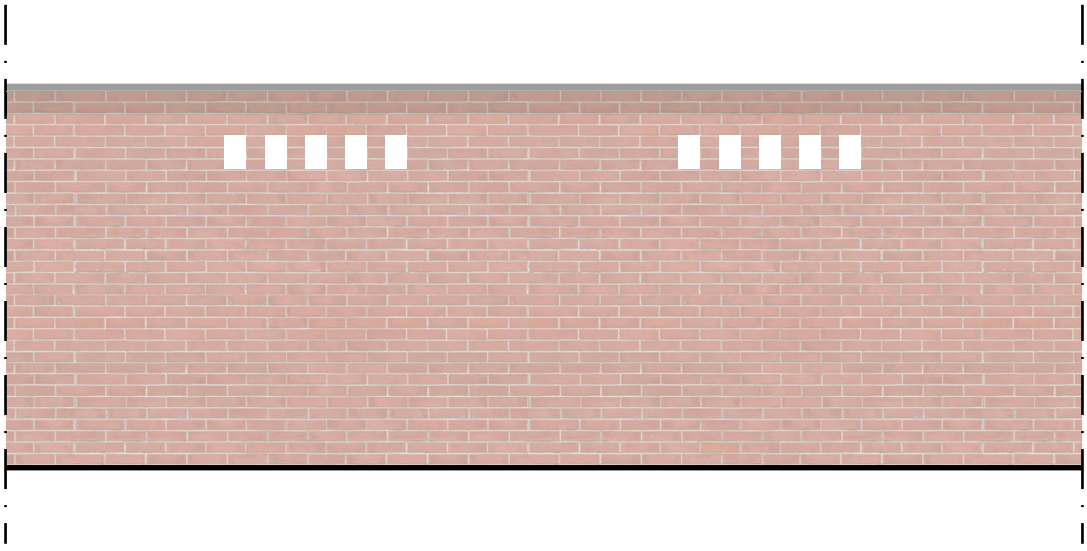
One of the main themes in humanitarian architecture is materiality. It is important to use the resources of the area, either in tools, crafts, materials, people's abilities and construction techniques. The new construction must reflect the traditional aspects of the country and bring innovative elements giving the available materials. Each material has its own advantage.

The material decision has a great influence on jobs creation (labour for production, assembling, transportation and installation). It is a question of which economy is wanted to be stimulated. If the decision is to use metal studs in the design, the manufacturing industries, transport and installation of metal stud, foundries are going to benefit from a metal design. If the decision is to use wood, the wood producing and processing industries, nurserymen are going to profit from this choice. The architecture process should include the whole economic picture while designing.

On the site, there are many different types of materials used for the constructions. There are bricks and stones buildings, wood and metal structures, and iron sheets, dry grass and straw for roof covers. It is used as an alternative for thatched roofs in developing countries. It is a very breathable material, allowing natural ventilation in the building and guarantying a comfortable indoor climate.



SCHOOL FACADE DETAIL 1/50



WALL FACADE DETAIL 1/50

Compressed earth as main material

One of the main materials used in the construction field in Malawi is earth. It is a widely available, malleable and economical material that has a variety way of usage. It can either be used raw, transformed, or simply mixed with water and straw to reduce its general cost.

Earth can generate bricks (29.5x14x9cm). They are water resistant and compensates the fluctuation of temperature which allows a comfortable indoor climate. Almost all the buildings on the site are built with bricks, and the new secondary school is following this construction typology. A very typical technology is used to build these buildings, the Compressed Earth Block technology (CEB). It was originally invented by François Cointereau during the 18th century, using a wine press. A brick making machine has been invented since, called the Compressed Earth Block (CEB) machine[12], designed to create bricks on site. It is a common solution used in African countries because of its cost and simplicity. The purpose is to heavily compress the earth instead of firing it, which also reduces the need for cutting down trees to make fires. These bricks can be made with all types of soil, compared to fired bricks that are done with clay, taken from the fertile valley, therefore, it saves these valleys from excavation and leaves them to food production.

These bricks are load-bearing which means that they can be used for the construction of columns, reducing the number of brick material in the overall construction. In general, it makes the building less complicated, it reduces construction time and the material needed and cost can be reduced by 20%.

[12] Hubert Guillaud, Thierry Joffroy and Pascal Odul, *"Manual of Design and Construction"*, Compressed Earth Blocks (CEB), Volume II, 1985.

Regarding structure, Wood and metal are the main materials used in the country and both have been used for the construction of the surrounding buildings on the site. Wood is an economical and widely available material compared to metal and is energy saving in terms of transformation. The negative point of using wood in Malawi is the deforestation problem. An alternative is to plant trees on site to be equivalent to the trees cut for the construction. It will have an educational purpose to raise awareness of students on the climate problem. Kiaat is one of the main wood used in construction because of the proximity of Kiaat and Umbila forests[13]. A wood company will produce the Kiaat lumbers and bring them on site to build the framework supporting the roof.

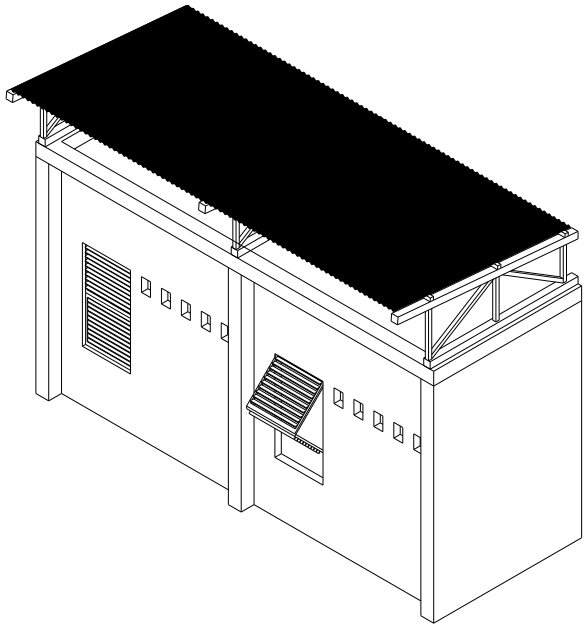
Metal has many advantages when it comes to roof covers. It consists of iron sheets nailed on the wood structure. This material is light, highly flexible, reusable, and low cost. However, iron sheets are subject to corrosion and have cutting edges, which can become a danger for the people. They also heat up quickly and a hot indoor, without a proper ventilation system, means the proliferation of diseases. An air gap between the structure and the main cover material can prevent such an indoor climate.

The window frames are also made of metal: it does not have any glass or plastic material because it would act as a greenhouse, therefore, the windows are just simple holes in the walls, keeping a constant air flow, with metal louvred shutters that can be completely closed, partially open or completely open according to the amount of sun wanted.

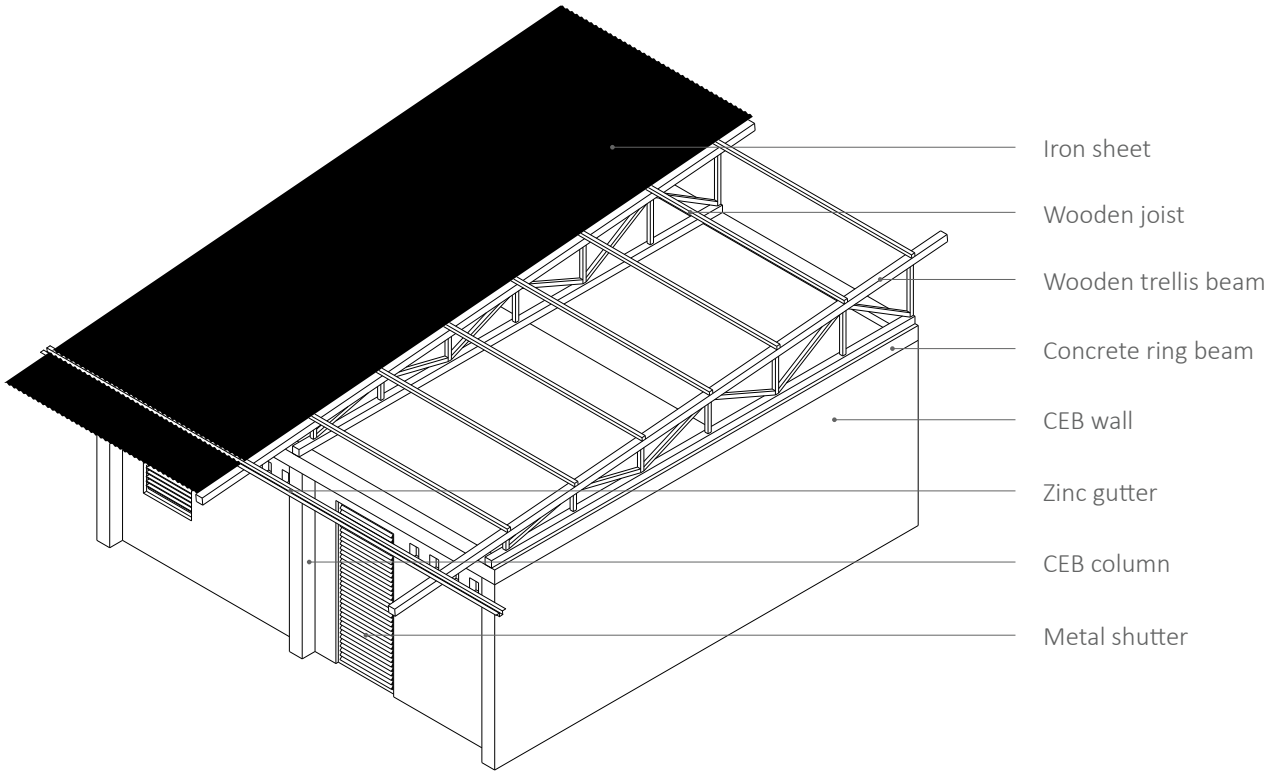
Additional items and waste materials such as bags, tires that can become seats, bottles filled with sand are used to build walls, fabrics to make curtains, wood can be recycled to various functions. All these elements are normally set on fire and generate pollution or washed away in rivers and can be fundable on the dumps next to villages around Lake Malawi. Therefore, recycling materials could also become a part of the education strategy, to make people aware of recycling as a cost-effective solution in the building process.

[13] Lumber product in Africa, *https://www.woodbois.com/products/lumber.* (Accessed April 2019).

Bamboo is another widely available material in central Africa. It is a low energy consumption material and has real advantages such as its lightweight, strength and water resistance. Its speed of growth is spectacular, about one meter per day, which makes it environmentally friendly and sustainable[14]. Bamboo can be cultivated locally if the climate conditions are suitable for its growth, which makes it completely cost-free concerning transportation. Bamboo is also a very strong material, approximatively ten times stronger than steel, according to HE Glenn, engineer at Clemson Agricultural College of South Carolina experimented the tensile strength of bamboo and demonstrated that it can be used as a substitute for steel reinforcing in concrete[15].

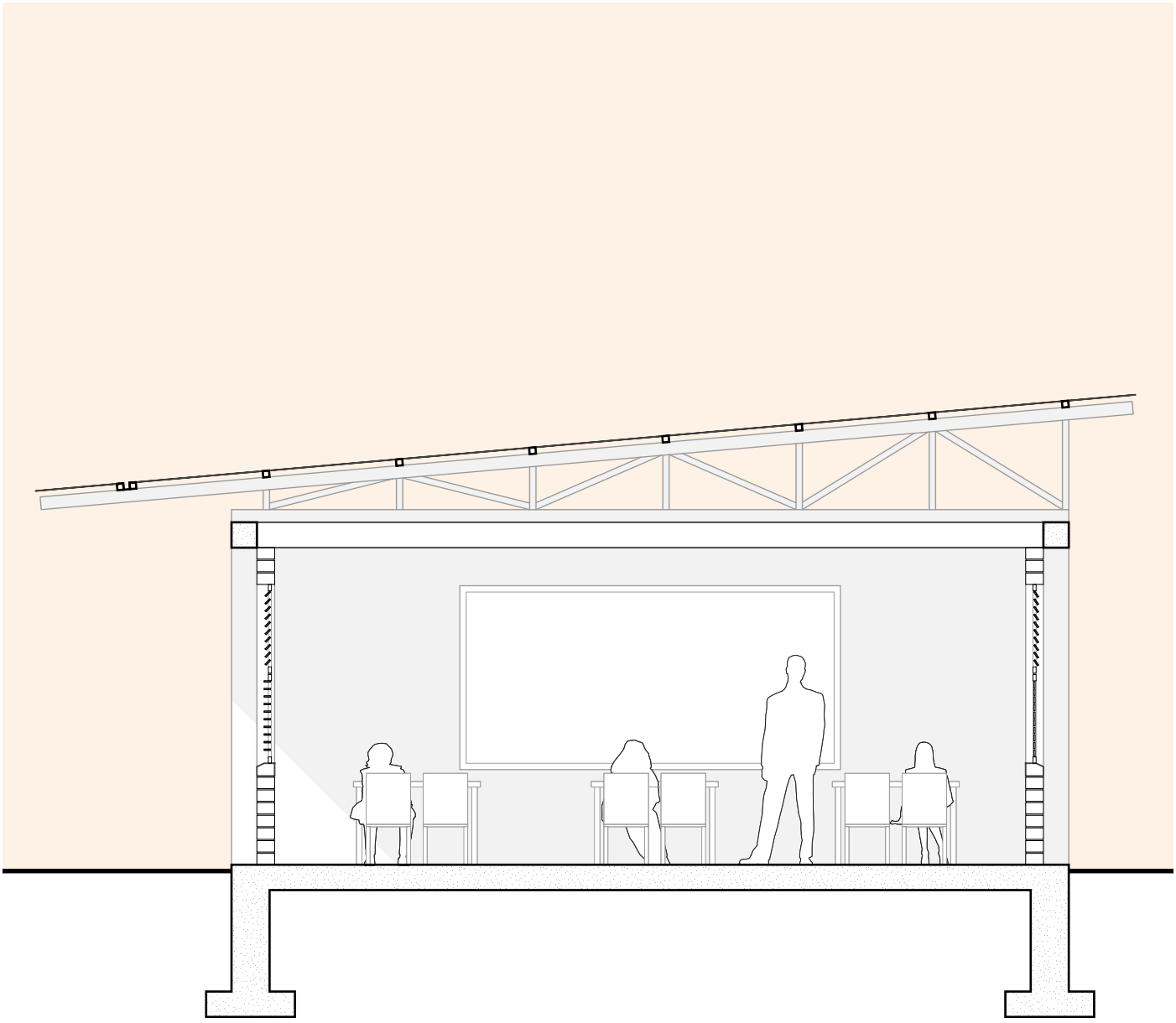


[14] David Farrelly, *"The Book of Bamboo"*, Sierra Club Books, San Francisco, 1984, 40.
[15] He Glenn, *"Bamboo Reinforcement in Portland Concrete"*, Engineering Experimental Station Bulletin n°4, Clemson Agricultural College, Clemson, South Carolina, 1950.

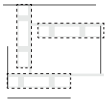

Iron sheet
Wooden joist
Wooden trellis beam
Concrete ring beam
CEB wall
Zinc gutter
CEB column
Metal shutter

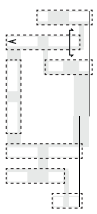
Construction method

The construction of an entire block (two buildings and one roof) will begin with the foundations and slabs, built with two essential materials, concrete and bamboo, used as reenforcement in concrete. Then, the 29.5x14x9cm compressed-earth-blocks (CEB) are added on top to create 20x30cm columns every three metres, and a single brick layer walls in between the columns. The mortar used to attach the bricks together is made of soil, aggregates and water. The fact of building columns instead of a double brick layer bearing wall reduces considerably the number of bricks used in the overall construction and become less costly. A concrete ring beam is placed all around one building to avoid bracing. On top of this ring beam and aligned with the columns are set Kiaat wood lumbers. They are creating a 5% slope trellis beam in order to hold perpendicular wooden joists, nailed on the structure. The concrete ring beam and the wooden beams are joint together with metal clips, preventing the structure to move. Finally, iron sheets are nailed on top of the wooden joists, to create the final roof cover. The wooden structure and the metal cover stretch each other from the edge of each side of the building to prevent water to enter inside the building in case of rainy weather.



CLASSROOM SECTION 1/50





“You have two hands. One to help yourself, the second to help others.”
Audrey Hepburn

Sense of community and maintenance

The durability of a building comes from the quality of the construction but also from the maintenance accorded to the building after its construction. The lack of maintenance has shown a need and costly rehabilitation process. Communities often do not assume the responsibility of maintaining the buildings and rely on the government, but the budget of a school construction does not include the resources for maintenance. A solution would be to directly involve the local communities in the construction. It is cost-saving and develops a great sense of empowerment for respecting and maintaining the buildings, which naturally leads to sustainability.

The choice of the materials for the design also depends on its maintenance process. Choosing good and resistant materials for the construction guides to durability. Compressed earth blocks need practically no maintenance. In fact, earth is the most resistant material that can be found on the market, it resists to water, by absorbing it and releasing in dry weather. When the blocks are damaged, it can easily be repaired with surrounding earth to fill the broken parts. Moreover, to produce 145 compressed earth blocks, it only requires one litre of diesel for the CEB machine, which makes this material one of the least energy consuming material during its production. Iron sheets are simply nailed next to each other. It is easy to replace one and nailing another instead. Wood is more complex to maintain through the years, especially for an exposed structure. It must be treated every year for fire protection, dimensional stabilization and fungal or insect attacks with chemical products.

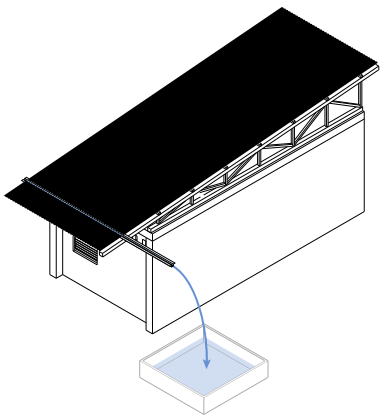
Another way of maintaining and involving people in the construction of facilities are the Non-Governmental Organizations (NGOs). The World Bank defines them as “private organizations that pursue activities to relieve suffering, promote the interest of the poor, protect the environment, provide basic social services, or undertake community development” (World Bank, 1989). Architectural NGOs are usually from developed countries and take actions in all kind of subjects with one common goal: offering architectural services to people in need.

People living in an area can also create community-based organizations or parents-teachers associations to collect private funds, use government funding, crowd-funding, or donor’s money to develop their environment. In Zambia, the Minister of education has delegated the construction of educational buildings to communities, that increases the mass production, and decreases the overall cost of the construction, compared with government approaches. On average, costs are lower, the result is more satisfactory and more accepted by the community.

Water and sanitation

In the very south edge of the site, the students can have access to the dry latrines, indispensable in extreme poverty countries, where there is no plumbing system. The same situation can be encountered after major disasters or in slums, where people often do not have sanitary systems or even access to water at all. Humanitarian designs deal a lot concerning water, which can be a powerful threat.

Two third of the planet's surface is covered by water, but only 0.01% is available for use. According to UNICEF/WHO, 780 million people drink water from unimproved sources such as rivers, ponds or open wells[16], 1.2 billion people contract diseases due to the lack of access to clean water, and approximatively 3.4 million people die each year[17]. The issue of water cleanness is essential for survival. Water can be a problem when there is too much and when there is not enough. It can result in floods or it can destroy an entire culture and famine becomes a major cause of death. In fact, in 2005 in Malawi, 4.7 million people, out of a population of 12 million people, suffered of food deficiency[18], because the rainy season was too short, and the soil was not enough irrigated to provide enough food during the growing season. A solution could be to collect the rainwater during the rainy season to be prepared during the annual droughts. For instance, PITCHAfrica designed the WaterBank school in Laikipia, Kenya. They collect the rainwater during the rainy season, clean and store it for later use in the dry-season[19]. The same system will be used in the project, rainwater will be collected from gutters on the roofs and container on the ground will store this water. It can later be used for cleaning or watering the agriculture fields.



[16] World Health Organisation (WHO), *"Guidelines for drinking-water quality"*, 4th edition, incorporating the 1st addendum, 2017.
[17] Annette Prüss-Üstün, Robert Bos, Gore Fiona and Jamie Bartman, *"Safer Water, Better Health: Cost, Benefits and Sustainability of Interventions to Protect and Promote Health",* World Health Organization (Geneva), 2008.
[18] Frank Phiri, *"Challenges 2005-2006: A Difficult Year Ahead for Famine-Hit Malawi"*, IPS Terraviva Online, 4 January 2006.
[19] The Rainchute Campain, PITCHAfrica, *www.pitch-africa.org.* (Accessed February 2019).

In Malawi, the sanitary system, in general, is very poor. There is just one hospital in the central region with only some operating rooms, which has major consequences on infant mortality and life expectancy. A lack of hygiene and the fact of drinking non-potable water is the main consequence of diseases' proliferation. The country does not have a proper plumbing system, therefore, to have access to drinkable water, the provisions must be covered by water tanks. Currently, it exists five water technologies for potable water access: rainwater tanks, wells, boreholes, water streams, and pipe connection to the communal water.

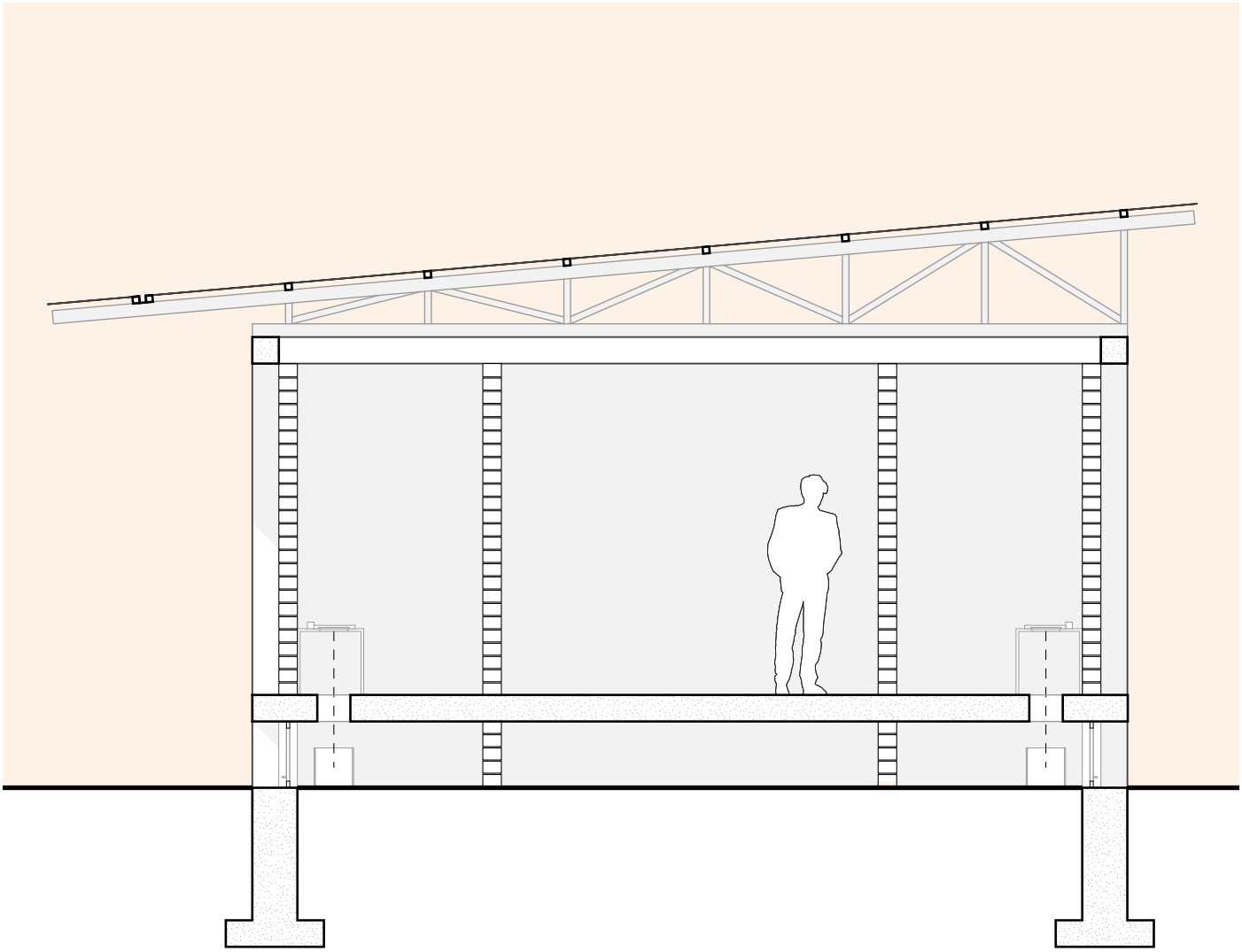
Some regions do not have access to the communal water, and sometimes it is difficult to access the aquifers, the last solution available is to fill tanks and bring them on site. Another solution is to fill the tanks with rainwater during the rainy season, but it has real health risks because of water stagnancy. A solution can be to use Household Water Treatments and Storage technologies (HWTS). It includes firstly, a physical filtration via ceramic, porous membrane, or bio-sand, then, a chemical filtration, via chlorinating disinfection, and finally, a heat treatment called SOIDS system, aiming to reduce the number of bacteria in the water by exposing plastic bottle to UV radiation, boiling or pasteurising water[20].

> *"HWT technology has the potential to have rapid and significant positive health impacts in situations where piped water systems are not possible and where people rely on sources water that may be contaminated, or where stored water becomes contaminated because of unhygienic handlingduring transport or in the home"*
> *WHO's Guidelines for Drinking-Water Quality (GDWQ)*

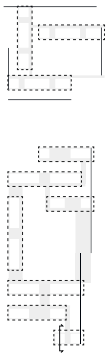
People can take water from wells by hand or with a pump system, that can be shared for both villages and schools in the neighbourhood. This solution is often supported by NGOs because it is the most efficient concerning cost and health issues. When the aquifer is too deep for wells, the borehole is an answer to the problem that is more sanitary than open wells because of the depth, but costlier.

African schools, that are not necessarily inside the villages, are far from having the resource to build such water systems, therefore, tanks stay the most common solution and will be the one used in the project as well.

[20] CAWST, The Centre for Affordable Water and Sanitation Technology, *www.cawst.org*. (Accessed February 2019).



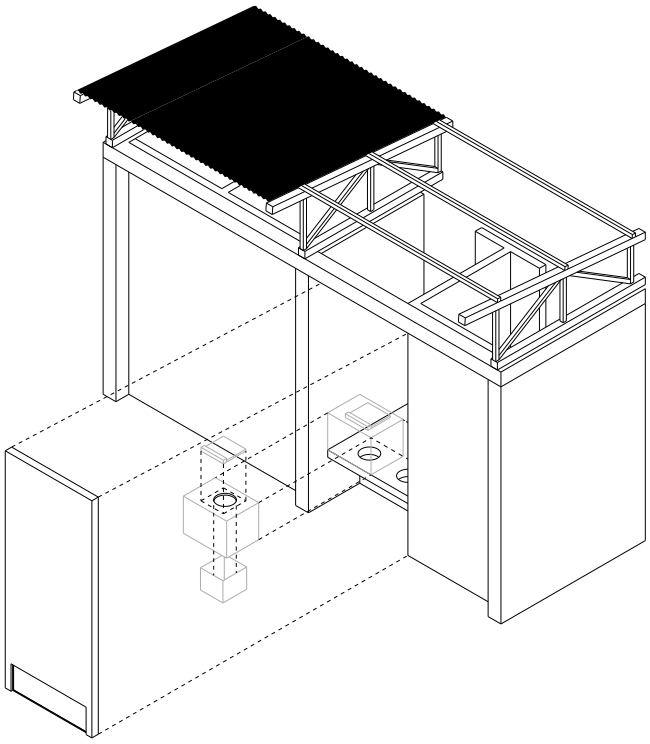
LAVATORIES SECTION 1/50



Regarding lavatories, dry toilets are the most frequent model present in Africa because of the absence of sewerage system. Therefore, it is necessary to create a cheap, simple and efficient construction to combine a healthy sanitation system in a sustainable building.

The lavatories designed in the project will follow the common sanitation system in Malawi. The separated male and female dry toilets buildings are placed in the extreme south edge of the site to have a certain distance from the other blocks. The building is 70 centimetres elevated to allow a compost system below. It is called a two-pit system toilets. It has two toilet chambers in one block. When the first chamber is full, students can use the other one, before emptying the first one and use the compost for agriculture purposes. It is very important to provide natural ventilation inside the chambers in order to make the composting system happening.

In general, latrines are very costly, therefore, some schools do not have latrine blocks at all. However, the lack of availability of latrines and potable water have considerable effects on the students' and teachers' health, and results in a lower attendance for both.



Ecology and environment

Ecology is the study and the understanding of the relation of organisms with their environment. Building ecologically leads to sustainability. Africa is the continent least responsible for climate change but it is very susceptible to its effects[21]. The global warming can reduce agricultural production, worsen the food security situation, and increase the number of floods and droughts[22].

Approximatively 1.6 billion people worldwide do not have electricity and use kerosene for lightning[23]. It causes 2 million children deaths every year due to the poor indoor air. Malawi does not have a spread electricity system; therefore, it is necessary to create one. A solar power system is the most frequent solution used by the NGOs to provide electricity where there is non. In the project, solar panels are fixed on wooden trusses on the roof of the science and study building, facing north, since both require electricity. This solar power system directly redirects the money saved in buying kerosene, to food production, or education..

The choice of materials, reuse of materials, waste recycling, water saving, and composting have considerable impacts on the environment. The use of wood is also directly linked to ecology and economy. For instance, in Africa, people usually cook with wood, and often on open fires. In Malawi, wood charcoal is the main cooking fuel and this situation results in 95% of the land's deforestation. In a poor country with a large unemployment rate, there is not enough money to have an alternative fuel to cook. However, solutions are available to change the situation. Firstly, cooking on closed fire makes already a big difference regarding energy savings. The wood burns slower, and a ceramic envelope contains the heat to focus it on the recipient above. Other bio-materials can also be used as an alternative for charcoal wood such as coconut shells, bamboo, almond shells and all kind of biowaste can be burned to make fire, replacing wood and reducing the deforestation issue.

Carbon is also a current issue in our society. Concerning the compressed earth block used in the project, they are very low carbon materials. They are made of earth, silt, sand and 5% lime. Half of the carbon dioxide released during its production is then reabsorbed by the lime during its life.

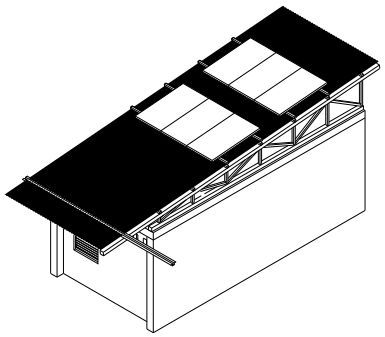
[21] Shreeshan Venkatesh, *"Africa: the least responsible, but most vulnerable to climate change"*, in Down To Earth, May 2018, 2018.
[22] Andrew Steer, *"Special Envoy for Climate Change"*, World Bank, 2012.
[23] World Energy Council, World Energy resources, 2016.

The minimisation of material waste should be a responsibility in every architectural design, regardless of building in a developed or developing country. The reuse of material or existing building is part of the circular economy system that is a major topic is our current society. Since 2005, there has been a great interest in ecological architecture, eco-friendly materials and green design practices. It increases the number of eco-literacy movements, whose interest is to educate people about how their actions affect the environment.

Changing its behaviour can have a great impact on energy use, and it is sometimes even more important than any energy technology improvements, for example, waste or water reduction. In the undeveloped nations, because of a bad waste management system (especially in slums where there are none), wastes are often left in the streets, thrown down ravines or burned if there is no efficient way of collecting them. It has serious effects on the environment and health, spreading diseases or toxic smokes in the atmosphere. An alternative has been found in Haiti where local organizations are offering money for each pound of plastic collected and brought to recycling centres. This small amount of money can make a great difference in people's life in order to feed their families or to pay the school fee.

Regarding water consumption, water can also be recycled, cleaned and reused for different purposes. For instance, BaO architects created a self-sustaining bathhouse with hot water, a greywater filtration and dry toilets. The water from the showers is first passing through basins filed with bamboo to filter the wastewater before it flows back underground[24]. These solutions, in addition, to be environmentally friendly, allow to reuse consumed water and keep the clean for drinking.

Environment, ecology and climate have been a powerful subject in the developed countries but left away in the developing countries, where the main problems regarding this subject are. The construction field has great effects on the environment and basic changes can be made to improve the current situation.



[24] BaO Architects, Shanmen Public Bathhouse, *www.bao-a.com/gansubathhouse.html*. (Accessed February 2019).

CONCLUSION

CONCLUSION

The goal of this work is to inform the reader of an alternate reality and to call awareness to the moral and humanitarian goals of architecture that go far beyond the typical borders within which architects typically work. It reflects the moment when architecture and ethics converge.

This proposal for the design of a secondary school in Benga, Malawi, reflects the reality of building in an environment where various issues and concerns must be considered. The various challenges of building in such an environment requires the understanding of the economic, social and technical aspects of the specific location.

As there is a lack of accessible information regarding documented history and architecture in certain developing countries, and particularly in Africa, a great challenge and opportunity for future research and development is created. The outcome of the design contains informed decisions where possible, and personal synthesis of the existing built environment where corresponding information could not be ascertained.

Would the outcome of such a school in this location indeed result in a positive impact on the local community? Would it attract local youth and their families to pursue an education? Would twelve classrooms be sufficient for the growing population of the community? Would it in fact be possible to involve the residents of the community in the building and maintenance process? Answers to these questions, among others, requires an understanding of the impact, value, and need for such a project, and requires additional research and outreach with the community.

Working on humanitarian projects challenges the typical way of seeing the impact, need, and challenges of architecture. This thesis is the first step in developing a new architectural course of direction, dedicated to improving the lives of people across the world who are less fortunate and who have access to fewer basic services than ourselves. The new responsibility for architects is thus to develop an environment where the global population haw access to health, security and comfort.

This project, through the study of humanitarian architecture within the context of extreme poverty, offers each space a reason to exist while supporting the current situation in the region. It also convinces the reader of another perspective in architecture that directly affects ethics.

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