

mudLIBRARY

Designing a Library in Ghana

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DIPLOMARBEIT

mudLIBRARY

Designing a Library in Ghana

Planung einer Bibliothek in Ghana

ausgeführt zum Zwecke der Erlangung des akademischen Grades

eines Diplom-Ingenieurs / Diplom-Ingenieurin

unter der Leitung von

Ao.Univ.Prof.in Dipl.-Ing. Dr.in phil.

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Fakultät für Architektur und Raumplanung

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Wien, am 30.05.2023



This thesis concerns planning and constructing a school library in Nsutam, Ghana. The core of the work is the on-site research, the user-oriented design and further, the implementation.

This project was developed in cooperation with the Non-Governmental Organisation *ArchiFair - sustainable planning and building*. In its work, *ArchiFair* focuses on social and ecologically sustainable architecture and is specialised in earth as a building material. Earth as a building material, local and resource-friendly construction and close cooperation with local partners were essential parameters for developing the *mudLIBRARY* project. This thesis is accompanied by the diploma thesis *mudLIBRARY - Architecture in a Development Context* by Luisa Zunft and *mudLIBRARY - Construction of a library in Ghana* by Manuel Obermoser.

Die vorliegende Arbeit befasst sich mit der Planung und Umsetzung einer Schulbibliothek in Nsutam, Ghana. Dabei ist der Kern der Arbeit das Eruiere der Bedürfnisse vor Ort, der daraus resultierende nutzerorientierte Entwurf und in weiterer Folge die Umsetzung vor Ort. Entstanden ist dieses Projekt in Zusammenarbeit mit dem Verein *ArchiFair - nachhaltiges Planen und Bauen*. *ArchiFair* fokussieren sich in ihren Projekten auf soziale und ökologisch nachhaltige Architektur und sind auf den Baustoff Lehm spezialisiert. Lehm als Baustoff, lokales und Ressourcen schonendes Bauen und die enge Zusammenarbeit mit den Partner*innen vor Ort waren somit für die Entwicklung des Projektes *mudLIBRARY* essenzielle Parameter. Ergänzt wird diese Diplomarbeit von den Arbeiten *mudLIBRARY - Architektur im Entwicklungskontext* von Luisa Zunft und *mudLIBRARY - Umsetzung einer Bibliothek in Ghana* von Manuel Obermoser.

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INTRODUCTION

- HOW IT STARTED
- ARCHIFAIR
- A VERY AMBITIOUS SCHEDULE



Fig.1: Sang , Ghana 2017 | mudCAFETERIA

HOW IT STARTED

In retrospect, the project kick-off was my first trip to Ghana in July 2017, when I volunteered for a construction project in the north of the country. I was on-site for three weeks and discovered my enthusiasm for earthen construction. The workshop was organised by Anna Schweiger and Jaap Willemsen, who in 2017 launched their non-profit organisation *ArchiFair -Nachhaltiges Planen und Bauen*. It was founded after their design for a school cafeteria won an international architecture competition. They raised about €35.000 through the association in order to fund their pilot project, the *mudCAFETERIA*. The project's main focus was building with local and sustainable materials, especially rammed earth.¹ At the beginning of summer 2019, it was time for me to search for a master thesis topic, and as luck would have it, I met Anna and told her that I would love to work with earthen construction and, at best, abroad. She told me that *ArchiFair* would like to support a project again and asked if I could imagine planning and implementing a project in Ghana. In August 2019, I received a message from Anna:

ArchiFair had received a request from its partners in Ghana and was asked whether it was interested in implementing a school library. I was on board immediately.

For its first project, *ArchiFair* worked closely with the Vienna University of Technology and gave a lecture in collaboration with Ao.Univ.Prof. Dipl.-Ing. Dr.phil. Andera Rieger Jandl. The finale of the lecture was the trip to Ghana, where the *mudCAFETERIA* was implemented within 12 weeks. Three years later, the same process was planned for the new library project. Before planning the project, I had to clarify whether I could find a supervisor for my thesis – and so step one was to get Andrea Rieger-Jandl on board. Luckily this was no problem, and she immediately agreed to supervise the thesis. She also supported the idea of organising an excursion and a lecture about the project.

This was the kick-off for the *mudLIBRARY!*

1) ArchiFair, 2023



Pilot Project ArchiFair: „mudCAFETERIA“
Built area: 200 m²
Construction period: 16 Weeks
Building costs: 20.000 Euro
Financed: Sponsors and Donations

Fig.2: mudCAFETERIA

ARCHIFAIR

Before I could leave for Ghana, I met again with Anna and Jaap so they could tell me more about *ArchiFair* and their methodology, assign tasks and set up a schedule for the library project. .

ArchiFair is a non-profit association that aims to „network, create awareness and provide an impetus for sustainable, affordable and social projects through the development and promotion of environmentally friendly earthen construction methods“. ² Their association is located in Vienna and is based on three guiding principles:

Sustainable Building: The goal is to build with local materials, respect resources and avoid using cement as a building material as much as possible. *ArchiFair* also strives for systematisation in order to optimise construction costs and time. ³

Multi-stakeholder approach: Through cooperation with local partners, universities, international experts and volunteers, *ArchiFair* wants to promote intensive knowledge exchange. The most important focus here is the cooperation with local partners. Projects can operate more sustainably through partnerships with local experts and bring added value for all involved. ³

Self-help: The projects are developed and implemented in close cooperation with future users and future operators. Experts pass on their knowledge to local workers and vice versa. Learning from each other and knowledge transfer are central factors. After the buildings are completed, they get handed over to a local administration.

For projects in which they are involved, *ArchiFair* takes over the financing through sponsors and donations, the planning of the building and the implementation. ⁴ These were also the tasks for the new library project. Before I could start with the design and we could start the search for sponsors, my first task was to travel to Ghana.

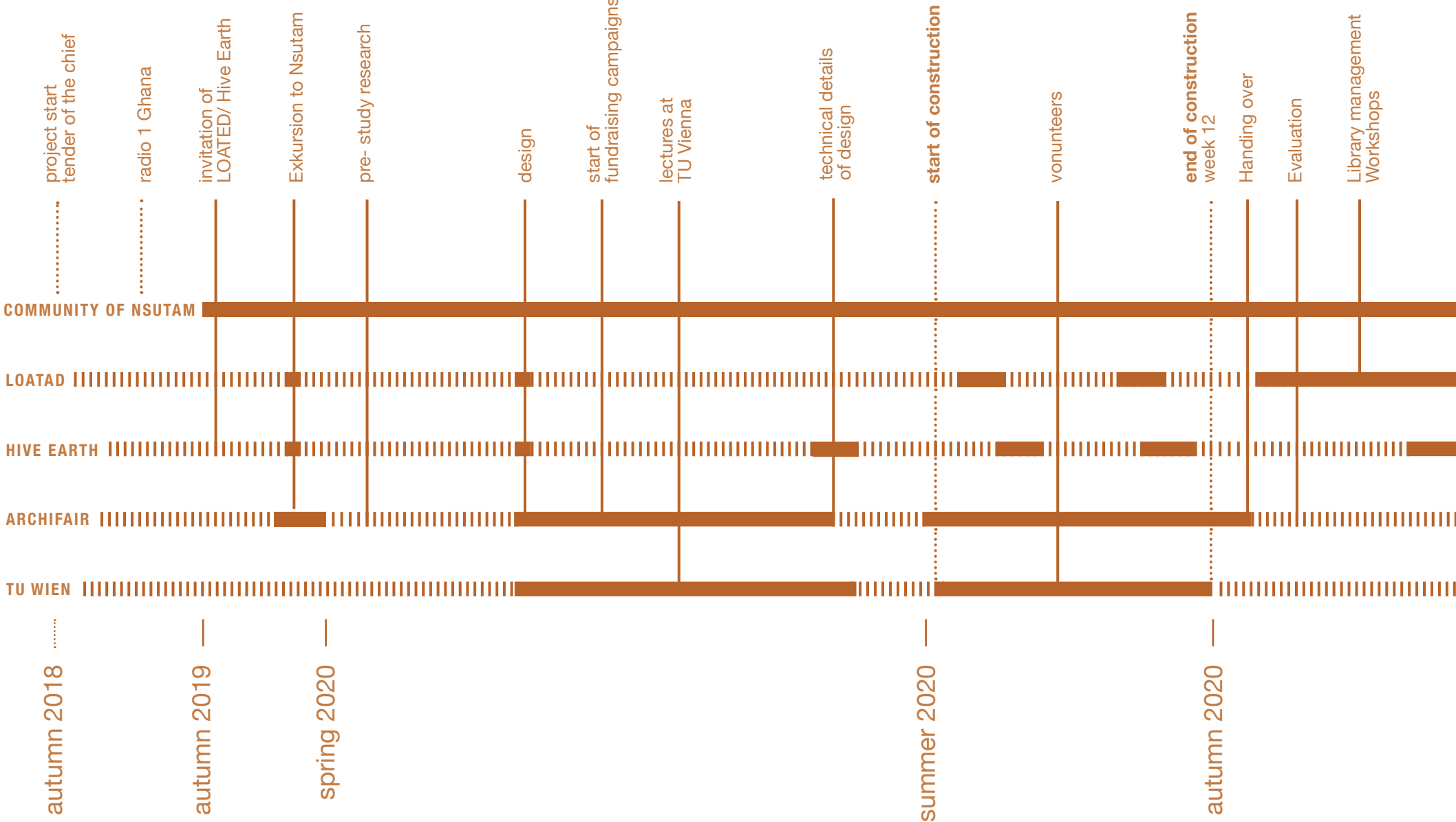
2) cf. Schweiger A., Willemsen J. 2019, pp.16

3) cf. Zunft L., 2023, pp.118

4) *ArchiFair*, 2023

A VERY AMBITIOUS SCHEDULE

After I agreed to the project in autumn of 2019, I planned my trip to Ghana for the end of January 2020. I stayed on site for a month and met all the partner organisations, visited the construction site and talked to the community and the future users of the library about their wishes and visions. The most crucial aspect was clarifying whether we all wanted to work together. At that time, I was still convinced that I would return to Ghana in June 2020 at the latest to discuss the final details and that the library construction would start in July 2020. However, due to the COVID-19 pandemic, everything went differently than expected.



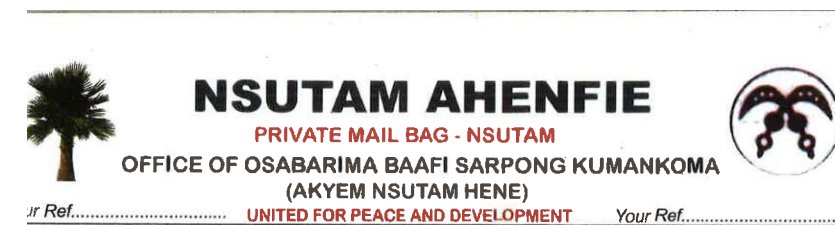
mudLIBRARY PRE-STUDY

- PREPARATIONS
- GHANA
- GET TO KNOW THE TEAM
- WELCOME TO NSUTAM

PREPARATIONS

Before the trip could start, *ArchiFair* connected me with Joelle Eyeson. She is one of the co-founders of *Hive Earth Studio* - an earthen construction company in Accra, Ghana. *ArchiFair* also worked with them on their first project. Joelle was the primary contact person to the community in Nsutam, where the library was planned to be built. She also introduced me to the NGO *Bookdrop Ghana*, which would furnish the library and help manage it with a local library committee.

On the other hand, she told the community and *Bookdrop Ghana* about our interest in the project and clarified whether they wanted to cooperate with us. We received a letter from the Chief of Nsutam and Sylvia Arthur, one of the founders of *Bookdrop Ghana*, that they are interested in cooperating with us.^{5,6} Three weeks later, I was on a plane to Accra.



9th January, 2020

Dear Sir/Madam,

REQUEST FOR SETTING UP PUBLIC LIBRARY

On behalf of the residents of Akyem Nsutam in the Fanteakwa South District of the Eastern Region of Republic of Ghana, I write to request you to set up a Public Library facility in our community.

Reading is the most essential skills that helps children develop many other skills such as reasoning, imagination, focus, consideration, discipline, etc.

Most of the children and school going pupils living here belong to families who have instilled reading and writing habits in their children. Besides, ours is a colony of avid readers.

Unfortunately, there is no library in our community. Meanwhile there are many basic schools and one senior high school in the community. Furthermore, the community contains pupils and students of all levels of education to whom the facility will be of great benefit. However, financial constraint has made the realization of this project impossible to some extent, through land is available.

After completion of the library its management shall be the council of elders, under the patronage of the chief of the community.

The community with the support of philanthropists shall generate funds to cater for maintenance as well as working personnels' remuneration all under the management of the library committee, and the strict supervision of the council of elders and the chief.

Kindly grants us this facility as early as possible as we don't want our children to waste their precious time in watching television or doing unnecessary things to affect their future.

All the residents are expecting a prompt response from your side. We hope you will look into this matter and do something in this regard.

Counting on your favourable consideration.

Thank you.

Truly Yours,

Osabarima Baafi Sarpong Komakuma
(Nsutam Hene)

CONTACT: 0244939063/0208191394

E-Mail: sarpkumankoma63@gmail.com

Fig.3: Letter from the Chief of Nsutam to ArchiFair

5) Email from the Chief of Nsutam Osambarima B. S. K., 9.1.2020

6) Email from Sylvia Arthur, 9.1.2020

GHANA

The Republic of Ghana is a West African country bordered to the west by the Ivory Coast, to the north by Burkina Faso, to the east by Togo and to the south by the Gulf of Guinea. Ghana has a total area of 238,533 km² and a population of about 31.3 million. The country is most populated in the coastal region. Half of the population lives in cities alone, with 2.3 million in the capital, Accra. The second largest city of Kumasi inhabits 1.8 million people.⁹ The median age in Ghana is 21.7 years. For comparison, Austria has a median age of 43.2.¹⁰

Ghana has a complex history, with many different cultural groups, empires and kingdoms playing a significant role in shaping the country's identity. In the 15th century, Europeans began to arrive in the region, including the Portuguese, Dutch and British. They established trading posts and colonies in the area, leading to the transatlantic slave trade and the exploitation of Ghana's natural resources. In 1821 the British established a colony in today's Ghana called the Gold Coast. In 1957 Ghana became the first sub-Saharan country to gain independence, with Kwame Nkrumah becoming its first president. Since 2020, there have been 16 regions, each having its own regional capital.¹¹

Due to its history, the official language in Ghana is English. Nevertheless, there are more than 100 ethnic groups with over 80 languages and dialects.¹² About half of the Ghanaians belong to the cultural and linguistic group known as Akan, who historically lived in the central and

southern parts of Ghana. Most people in Nsutam also belong to one of the Akan groups.¹³ Other cultural and linguistic groups are Ewe, Ga, and Dagbon, historically settled in the north and southern coastline.¹⁴ Of course, these cultures are not fully separated, and many overlaps exist between them.

Ghana is one of the leading countries in cocoa export. Other essential export goods are gold and mineral fuels. The coastal region in Ghana around the capital Accra is one of the wealthiest areas. The regions in the north are the least wealthy. This difference between the south and north of the country has to do with the fact that many factories are located in the coastal region and is also due to the colonial history: In colonial times, the seaside around Accra was the central trading point of Europeans and the economical impact exists until this day.¹⁴

In Ghana, in addition to the democratically elected political system, traditional structures play a significant role, especially in rural areas. Each community has a chief who gets supported by a council of elders. This council discusses concerns and wishes within the community.¹³ The traditional system is also very present in Nsutam, and the relationship with the Chief and the elders was significant during the design and construction phase. The Chapters *The Chief and the Council of Elders* explain this in more detail.



Fig.5: Ghana's 16 regions

9) Central Intelligence Agency

10) Worldometer

11) cf. Ghana Web, 2023

12) Ghana Web, 2023

13) Conversation with the Chief of Nsutam Osambarima B. S. K., 3.2.2020, Nsutam

14) cf. Konadu K., Campbell C.C. 2016, pp.6

FACTS AND FIGURES



Accra



Ghana-Cedi GHS

13¢ = 1€



English



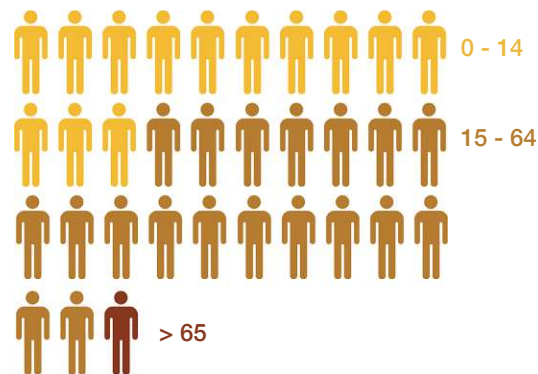
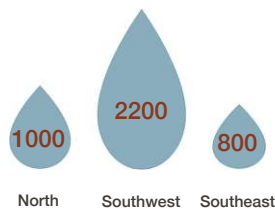
since 1957



79,1% Literacy

83,5% male 74,5% female

Rainfall mm l year

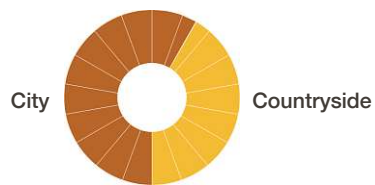


Average age

21.7

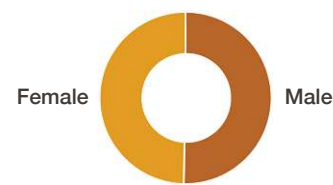
population

31.394.000



City

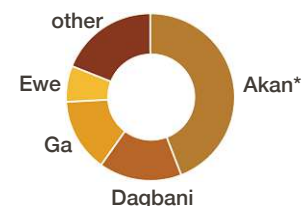
Countryside



Female

Male

Local languages



other

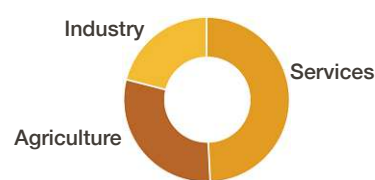
Ewe

Akan*

Ga

Dagbani

Employment

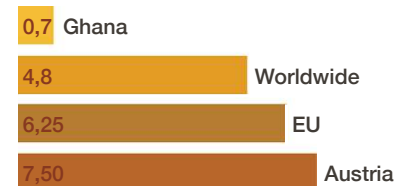


Industry

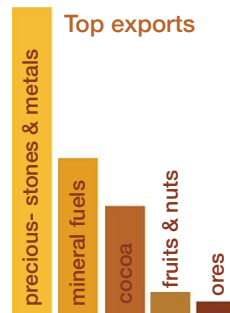
Services

Agriculture

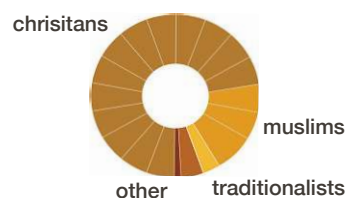
CO2 Emission t l resident



Top exports



Religions



christians

muslims

traditionalists

other

Inflation rate

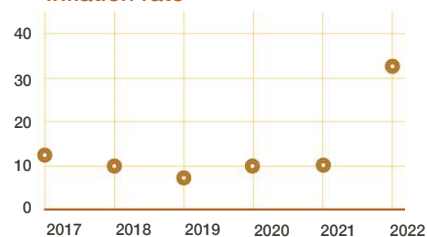


Fig.4: Ghana map

TOPOGRAPHY

Roughly, Ghana can be divided into three topographic zones. These zones have different characteristics regarding climate, soil, and vegetation.

Coastal savannah zone: This is a 535km long flat coastal zone located in the south of the country on the Gulf of Guinea. It stretches from the border with the Ivory Coast to Togo. It is primarily flat, with beaches and lagoons.

The forest zone: This zone is characterised by hills, rivers and plateaus. It covers the central part of the country. Evergreen and tropical semi-deciduous forests predominate the vegetation. The soil is very fertile, which is especially suitable for agriculture. The main crops in this zone are cocoa, oil palm and timber. Nsutem is located in this zone.

The Northern Savannah: This zone is located in the north, occupying two-thirds of the country.

Its characterised by flat, open grasslands and shrublands. Ghana's topography, generally, is hugely low. Half of the country is at most 152 meters above sea level. The highest point is Mount Afadjatol, which is 885 meters high and located at the border with Togo. The Volta Lake defines the Volta Basin in the north-central part of the country. Evergreen mountains and hills surround the basin. The most outstanding one is Kwahu Plateau in the south.¹⁵

Volta Lake is one of the largest artificial lakes in the world, covering an area of 3275 m². Through the Akosombo Dam electricity gets generated for Ghana, Togo, and Benin. Ghana's only natural lake is Lake Bosumtwi.¹⁶

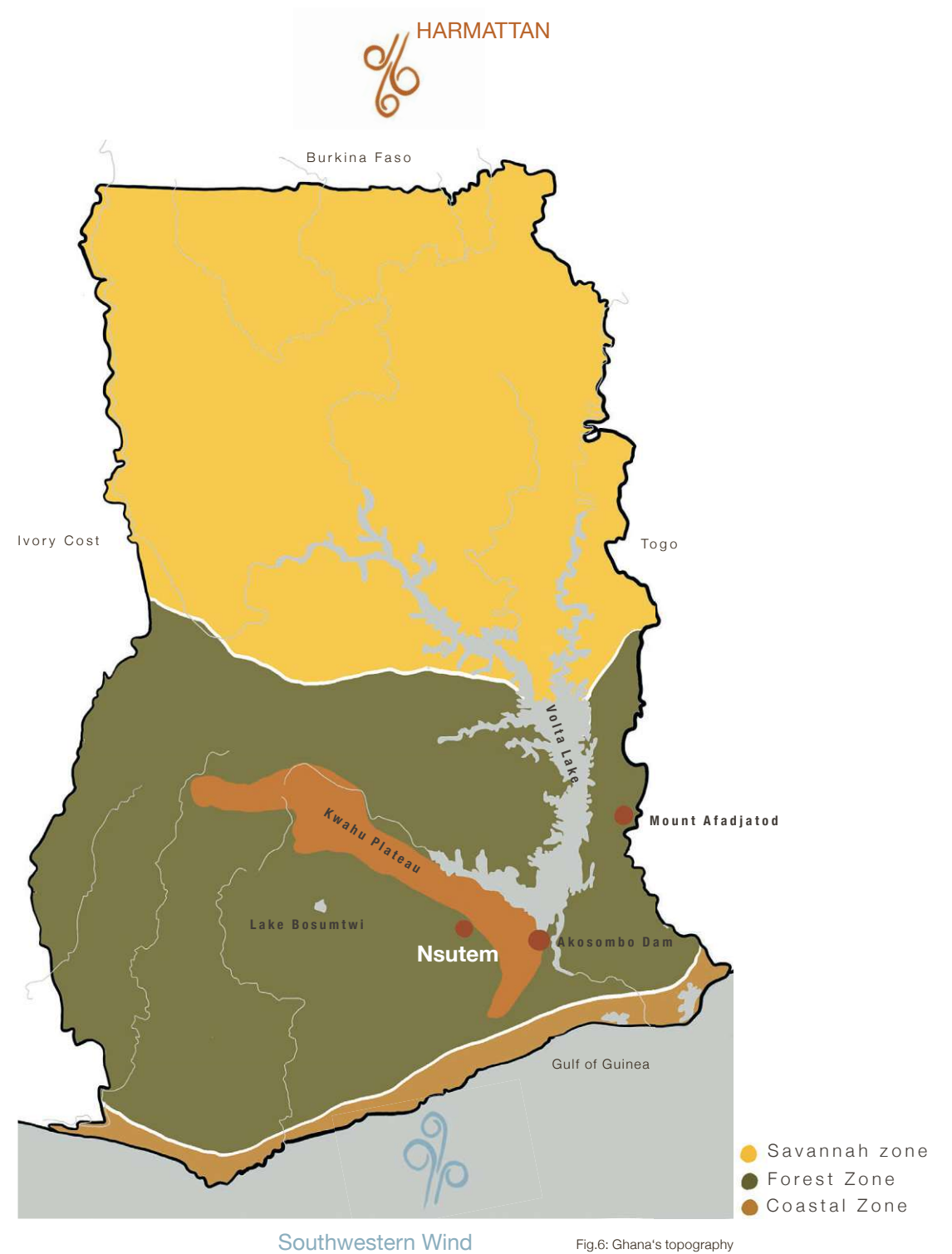


Fig.6: Ghana's topography



Fig.7: Coastal savannah zone

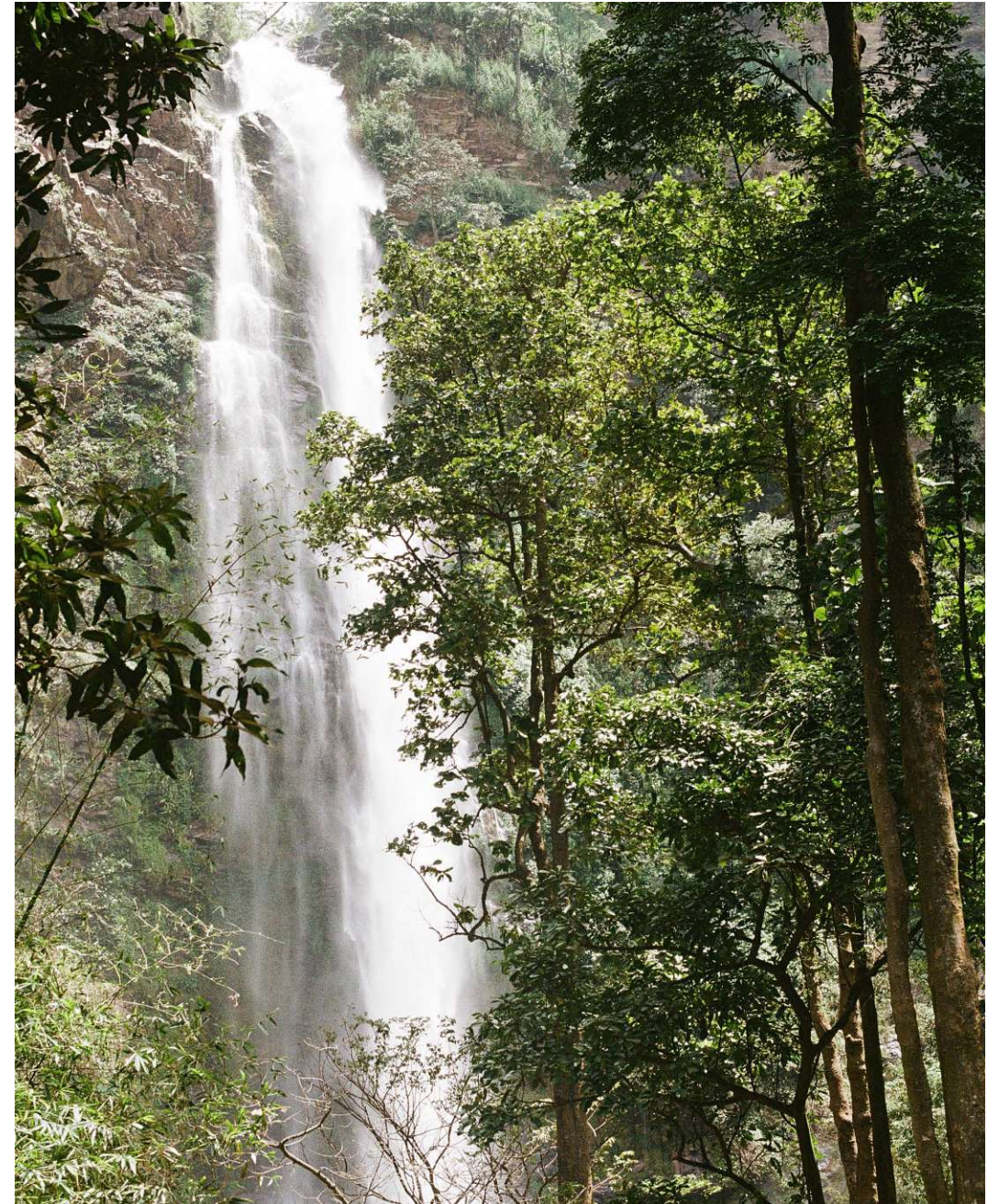


Fig.8: Forest Zone



Fig.9: Accra



Fig.10: Cape Coast



Fig.11: Forest zone

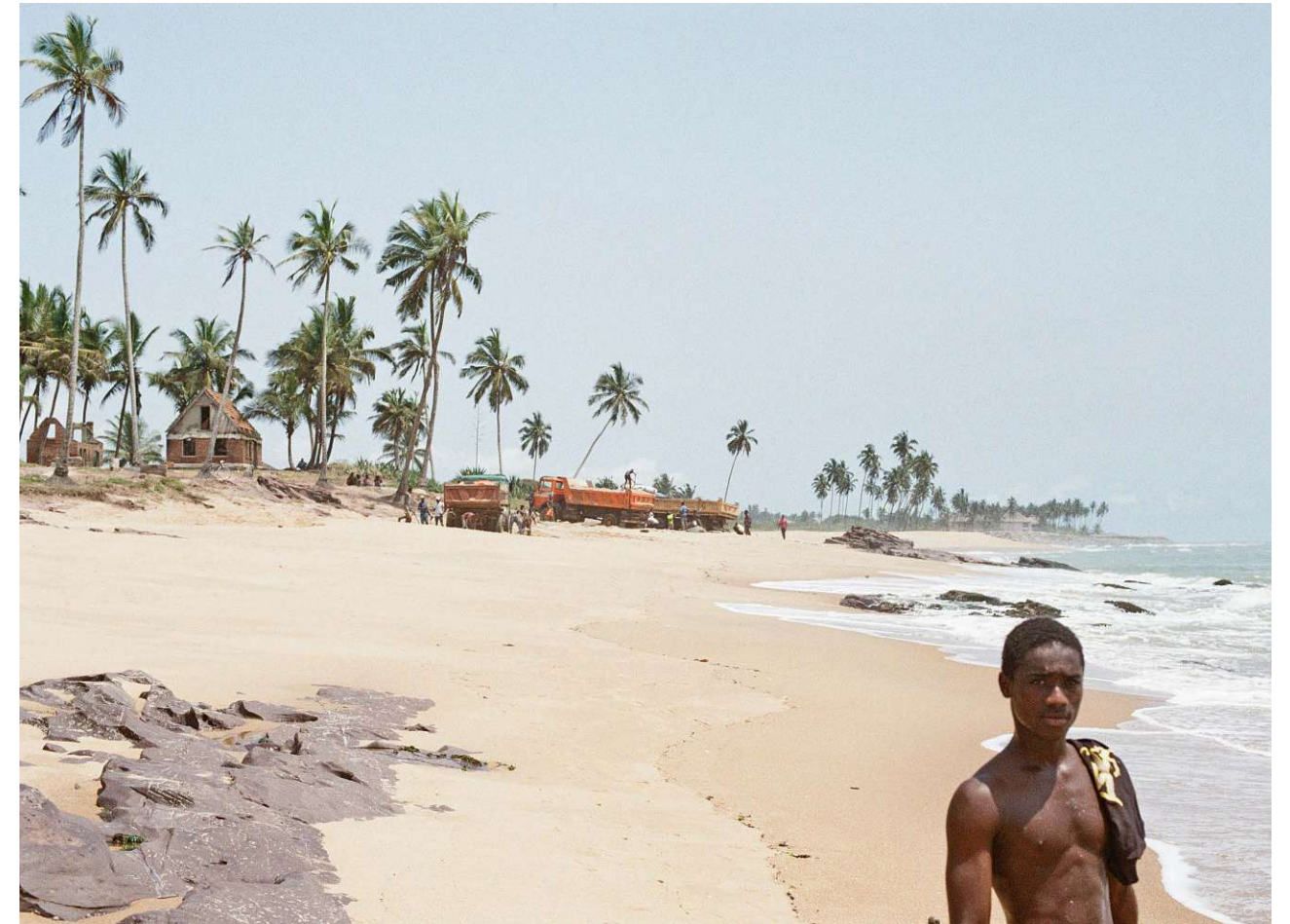


Fig.12: Coastal savannah zone

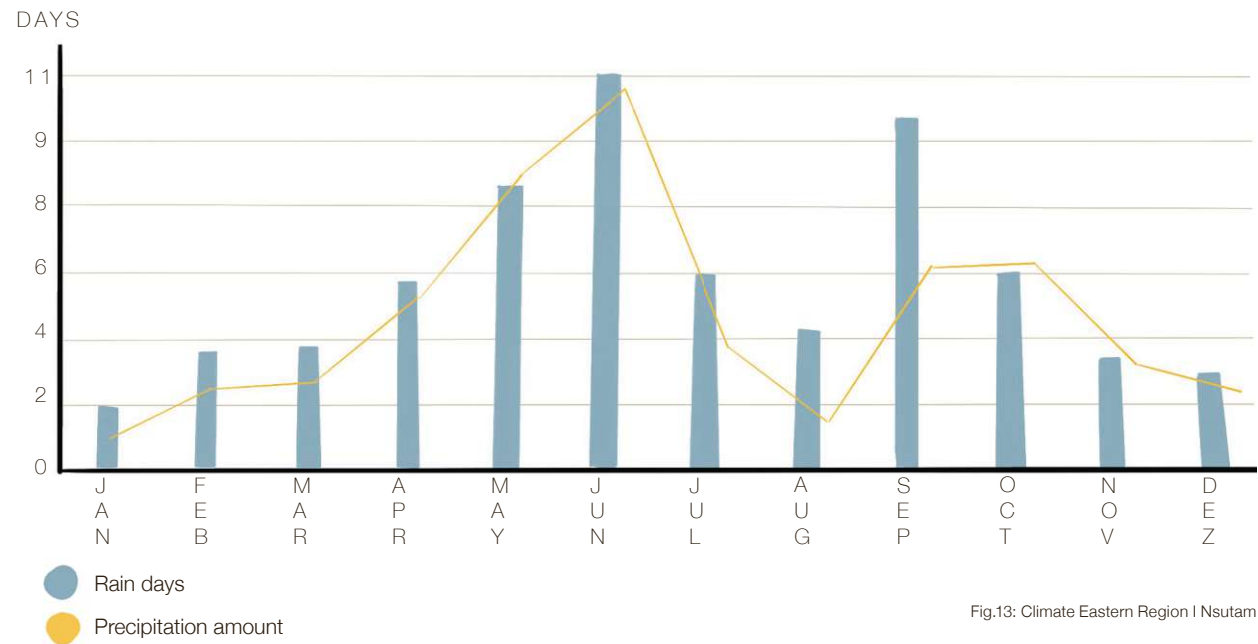


Fig.13: Climate Eastern Region | Nsutam

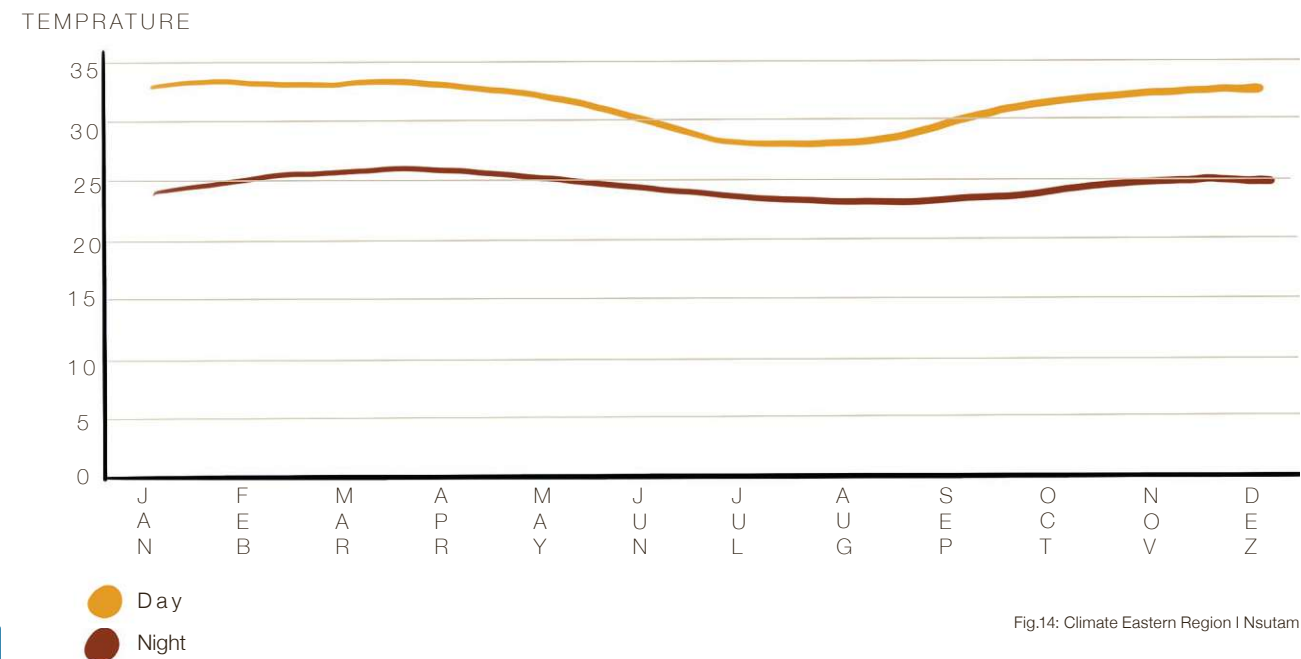


Fig.14: Climate Eastern Region | Nsutam

CLIMATE

Ghana is only a few degrees north of the equator. The climate is tropical, warm and humid throughout the year. There are two main seasons, the rainy and the dry season.¹⁷ Two air masses dominate these seasons. One is a moist southwesterly wind that forms over the Atlantic, and the other is a dry northeasterly wind that blows from the Sahara Desert over West Africa to the Gulf of Guinea.

The rainy seasons starts when the wind coming from the Atlantic dominates. The Sahara wind, also called Harmattan, brings the dry seasons. Typically, Harmattan lasts from December to February and can impact daily life in Ghana. During this time, there is often a large amount of dust and haze in the air, which can affect visibility and is especially noticeable when the sky appears dusty.¹⁸

The coastal regions are generally more humid and experience more rainfall than the northern regions, which are generally drier and hotter. In the savannah part north of the Kwahu Plateau, there is one dry season from November to March and one rainy season with the rainiest days in August and September. The annual precipitation here is up to 1,400 mm.¹⁸ In the forest part of the country, there are two rainy seasons. There is a long rainy season from April to July and a shorter one from September to November. In this zone, the annual precipitation is up to 2,180 mm.¹⁹ Thus, there are also two dry seasons—the first during the Harmattan and the second in August.

Nsutam is located in the forest part of the country. So usually, there are two of each season. Conversations with the people in Nsutam made it clear that predicting heavy rains in recent years has become challenging. During our second stay in 2022, they waited in vain for heavy rains in June and July. Although it would be typical for this time, it only rained very little, negatively impacting harvest and agriculture.²⁰

17) Länderdaten . Info

18) cf. Davids O., Fage J.D., Donna J.M., 2023

19) World Bank Group, 2021

20) Conversation with Richard Oppong, July 2022 , Nsutam



Fig.15: Nsutam on a rainy day in August 2022



Fig.16: Nsutam on a sunny day in July 2022

GET TO KNOW THE TEAM

BOOKDROP - LOATAD

Syvia Arthur and Seth Avusuglo from *Book Drop Ghana*, the NGO we will work closely with, were the main initiators of the *mudLIBRARY* project. When I arrived in Accra, I first met with them. They told me how the whole idea for this community library started: In an interview with the Chief of Nsutam on Radio 1 Ghana, the local radio station in Nsutam, he asked for support for a new school library.²¹ A friend of Seth, Richard Oppong, was working there. He heard the interview and thought BookDrop might be the perfect fit, so he contacted them. They were on board immediately but needed support regarding the financing and construction. That is why they contacted Hive Earth, and Hive Earth then asked ArchiFair for support.²²

At our meeting, Sylvia told me that *BookDrop Ghana* completed its campaign. They were now operating under the name of their library, *LOATAD - Library of Africa and The African Diaspora*. With *BookDrop Ghana* they had started a campaign to encourage Ghanaians living in the diaspora and anyone visiting Ghana to bring a culturally relevant book and drop it in one of the containers at high-profile locations like the Accra airport. These collected books then got distributed to schools and communities across the country. The campaign's motto was 'bring a book - leave a legacy'.²²

With *LOATAD*, Sylvia started a private library in Accra, Ghana, in 2017. Their focus is on books by authors of African descent. They want to be more than a library and see themselves as a movement.

²¹We are:

A decolonised library

An activist library

An African library

The library's mission has evolved to help address the serious literacy challenges that many across the country and the continent face. We believe in literacy and literature for all, and we strive to make both accessible regardless of geographic location, gender, age, disability, or religious or sexual orientation.'

To achieve this, *LOATAD* organises events to strengthen Ghana's literary and arts scene, invites authors from other countries to network, and launches the *Little LOATAD* project to support literacy and digitisation in disadvantaged regions of Ghana.²³



Fig.17: The LOATAD team in front of the secretariat in Nsutam | Sylvia in the middle and Seth on the far right

21) Radio One Ghana, 2018

22). Conversation with Sylvia Arthur, Seth Avusugulo, 30.1.2020, Accra

23) Library of Africa and the African Diaspora



Fig.18: Strategic Pillars of LOATAD

Little LOATAD are small libraries, often housed in schools, to provide relevant, high-quality books to children in rural, disadvantaged communities in Ghana that would otherwise not have access to them. *LOATAD* provides books, experience, and expertise, ranging from reading and writing workshops to advice and guidance on library management.²⁴

Sylvia told me they had already set up two small libraries in other regions. One, in Ashaiman in Greater Accra, has been a big success because the community is engaged and committed to the project. The other one, in Kumawu in the Ashanti region, could be doing better since the school administration is not supporting the project as it should. As for the library in Nsutam, Sylvia believes it could be a big success because the Chief personally asked for the library and many people are motivated to make it happen in the long run - like Radio 1 Ghana, where many young people work. Seth believes it is essential to have these key persons like the radio people and the Chief on board because they influence and motivate the community.

LOATAD's plan for Nsutam is 'to create Ghana's first Community of Literacy by involving all people in the community from the top down in a program aimed at improving literacy skills in the

community as a whole.' They want to include as many people as possible from the community and hand over responsibility. They have partnered with *Radio 1 Ghana* to run several campaigns to make people aware of the library. One of those campaigns is a reading competition called *Generations*. Children from different schools take part in this. They each have to read one book in English and one in Twi, and the children go to the radio station every week and read live on air. There they get asked questions about the books, and various other competitions occur. They have also initialised video interviews with community elders about their lives and recent changes in the village. For this, they have trained teenagers to conduct these interviews. The interviews are in Twi, the local language, so everyone from Nsutam can understand them. They will also be available in the library. *LOATAD's* philosophy is that 'everyone has something to teach and a story to tell.'

²⁵

²⁴ Library of Africa and the African Diaspora

²⁵ cf. Conversation with Sylvia Arthur, Seth Avusugulu, 30.1.2020, Accra



Fig.19: The LOATAD team at a workshop in Nustam on the topic „What is a library?“

They also started consulting people who wanted to be on the library committee after the project got finished. These community members will be responsible for keeping the library open and will be working closely with LOATAD for workshops and events.

Concerning the design, it is essential to them that the library should not be considered a classic library but that the building must offer space for more in order to make it a long-term success. It should be able to host film nights, exhibitions, meetings and celebrations to attract as many people as possible and to make those who cannot read feel welcome too.²⁶

At the end of our meeting, Seth told me that he had already announced my arrival to Richard Opong and the Chief of Nsutam. They told Seth that they would like all the organisations involved to come to Nsutam together to discuss and present the project. Before we said goodbye, we talked about me going to Nsutam in three days and them joining me after a week to do the presentation for the community together.²⁷

HIVE EARTH STUDIO

The next day, I met with Kwame Deheer from *Hive Earth Studio*. He and Joelle Eyeson run the Accra-based construction company *Hive Earth Studio* together. While Kwame is in Accra running the construction sites, Joelle is currently based in England doing the organisational and marketing tasks. They describe the company as follows:

'Hive Earth Studio is a multidisciplinary space. We specialise in using locally sourced and environmentally friendly materials for construction, interior design, art and design.'²⁸

They experiment with various earthen building methods and specialise primarily in rammed earth. They would be the rammed earth construction specialists for the library project and provide consulting during the design phase. After finishing the library, *Hive Earth Studio* will continue to take care of ongoing maintenance and be the long-term contact on-site if there are any problems with the building.²⁹



Fig.20: Kwame from *Hive Earth Studio* with ArchiFair | Nsutam 2022



Fig.21: Atelier of Hive Earth Studio | Accra 2020

I visited Kwame at his house, where he welcomed me in his garden and his atelier, where he experiments with different earthen products. He told me that his love for earth started over ten years ago when he recognised the potential in earth as a building material after seeing a rammed earth wall for the first time. He intends to: 'change the narrative around earth as a building material by using rammed earth in high-end architecture. Through this; the material gets valuable and attractive for everyday use again.'³⁰

Therefore *Hive Earth Studio* follows the philosophy: 'to learn from our past and how our forefathers used eco-friendly materials from the earth. We aim to use that knowledge to continue to innovate, push boundaries with what can be achieved from Africa, and share with the world.'³¹ Kwame tries not to be limited by practical decisions in the design phase and construction process. Rather he sees potential difficulties as positive challenges. Also, for the library design, he encouraged me to 'go crazy.'³⁰

30) Conversation with Kwame Deheer, 31.1.2020, Accra

31) Studio Hive Earth, 2022

Other products he works on besides rammed earth are sun-dried tiles. For strength and aesthetics, he adds crushed palm nuts and palm fibres, two natural products that are a by-product of cooking palm nut soup and that are often used as supplements in traditional earth construction in Ghana.

In general, *Hive Earth Studio* does not shy away from colour and patterns. If the different natural colours of the earth mixtures are not satisfactory, they use colour pigments. From this love of colours and patterns, they have also developed their signature look for their rammed earth walls, which Kwame calls 'waves'.³² They use different earth mixtures and ram them not in straight layers but in a waveform. Through these eye-catching walls, their construction company and rammed earth have experienced a boom in Ghana. They have become so well established that they now build outside of Ghana and are consulted by renowned architects, such as David Adjaye, on their earthen construction projects.³³ Kwame thinks of rammed earth as an evolution of the Atakpamé walls technique.³² The local earth-building techniques and the rammed earth technique are explained in detail in the chapter *Earth-building techniques*.

After I visited *Hive Earth Studio*, it was time to visit Nsutam.



Fig.22: Sun-dried earth tiles



Fig.23: Sun-dried earth tiles with crushed palm nuts



Fig.24: Palm fibres and crushed palm nuts



Fig.25: Rammed earth wall from *Hive Earth Studio* in their signature technique „waves“ | Accra 2020



Fig.26: Rammed earth wall from *Hive Earth Studio* | Accra 2020

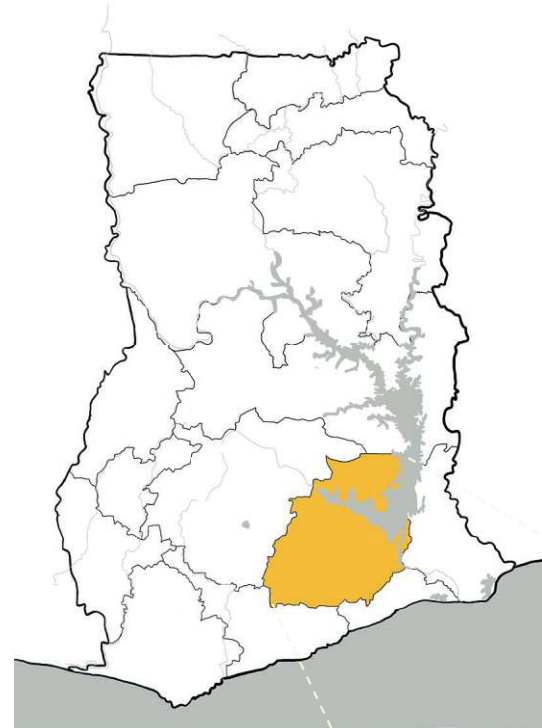


Fig.27: Eastern Region

WELCOME TO NSUTAM



DAY OF ARRIVAL

From Accra, I took the bus to Nsutam. The choice was between a minibus, called Tro-Tro, or a big coach, which is more expensive but has more space. For my first trip, I chose the coach. This bus has no official departure times but leaves as soon as all seats are occupied, which can lead to long waiting times. Seth from *LOATAD* told me that my trip should take about 2 hours and gave me the phone number of Richard Oppong. Richard is his friend and works at *Radio 1 Ghana*, the local radio station that broadcasted the appeal for the new library. Seth also informed me that I should look out for a big rest stop named Linda Dor Highway Rest Stop, get off there and that Oppong will pick me up.³⁴

After 1:30 hours, the bus stopped for the first time. When I looked out the window, I was surprised that we had already arrived at Linda Dor. I quickly got out, and Richard Oppong picked me up. He briefly showed me the Radio Station since it is right next to the rest stop. After that, he told me that the Chief and the Council of Elders were already waiting for us at the Chief's Palace, and we had to go there immediately.³⁵ To get to the Chief's Palace, we took a cab and drove for about 5 minutes along the main road that leads through the town.

³⁴) Phone call with Seth Avusugulu, 1.2.2020, Accra

³⁵) Conversation with Richard Oppong, 1.2.2020, Nsutam



Fig.28: Linda Dor Highway Rest Stop | Nsutam



Fig.29: Richard Oppong I Nsutam

THE CHIEF AND THE COUNCIL OF ELDERS

Most people in Nsutam identify themselves as Akyem, a subgroup of the Akan people. The two main languages are Twi and English. In Nsutam, the traditional political system is centred around the Chief, in Twi also called Hene or Nana. For the *mudLIBRARY* project, the Chief and the Council of Elders were the primary contact persons and decision-makers. There is also a democratic system that coexists with the traditional one. However, the Chief and the Council were the key figures for the project's development and implementation.

The Council of Elders gets formed around the Chief, who does not get elected but is born into his office. When a decision or a problem arises, it always gets brought to him. During the decision-making process, council members are always present to advise him. Hence, the last word and the final decision remain with the Chief. The place where all those meetings are held is called Chiefs Palace and is located in the middle of Nsutam.³⁶

Above him is the King also called Okynhene. Nsutam is located in the kingdom of Akyem Abuakwa. It dates back to the fourteenth century and is one of the five primary Akan states. The current Okynhene is Osagyefuo Amoatia Ofori Panin.³⁷

In addition to the Chief, there is always a Queen Mother. She is not necessarily the direct mother but always comes from the same family. She represents all the women's concerns and is mainly responsible for social relations. She is also the one who proposes who will be the next Chief. The Council of Elders consists of an equal number of women and men. Each representative on the council has a clear role. For example, the Linguist speaks and translates for the Chief. Council members can get recognised by the fact that they all have the suffix „Hene“ after their name, or „Hema“ for women.

Another characteristic is their clothing. On official occasions, they wear a 6-meter-long cloth wrapped around their body, also called *Kente* - the women have two pieces of cloth.³⁷ The queen-mother can be recognised by wearing large, colourful necklaces. If she is not in traditional robes, she can be recognised by bangles that all those who belong to the royal family wear on their right wrist.³⁶



Fig.30: Chief of Nsutam and the Council of Elders | Nsutam



Fig.31: Hierarchy of the Kingdom Akyem Abuakwa

Nsutams's Hene is Osambarima Bafi Sarpong Komakuma, but for short, he gets called Nana. He has been the main initiator of the project. The queen-mother at his side, Nana Ama Apontoua, is not his mother but his elder sister.³⁸



Fig.32: The Chief, the Queen-mother and the Council of Elders | Nsutam

FIRST MEETING WITH THE CHIEF AND THE COUNCIL OF ELDERS:

When Oppong and me arrived at the Chief's Palace, it was different than I expected. We were not in front of a palace but in front of a courtyard house. Only by a symbol at the entrance, it differs from the other houses. When we entered, the Chief and the Council were already there. They were sitting in a semicircle in the covered open area. The Chief was easily recognisable because his chair was on a pedestal in the middle.

Before I entered, Oppong briefly introduced me to what to expect and how to act. Taking off my cap was a matter of respect, greeting the elders starting from the right, but not the Chief. After that, I had to sit down and speak only when asked. It is essential to stand up and not speak directly to the Chief but to his Linguist, who can get recognised by the fact that he is holding a stick.³⁹ At that first meeting, I had to briefly introduce myself and ArchiFair and tell them why I was there. I explained to them that the main goals of my stay are as follows:

- Getting to know the city and the local structure
- Visiting the construction site
- Discussing wishes and visions for the library
- Presenting the project to the community
- Making the final decision if the project will take place

The Chief told me that on the following Tuesday, there would be a meeting for the whole community where I should introduce ArchiFair, myself and the project to everyone. Also, they wanted me to write down ArchiFair's terms and conditions for the project. The decision on whether everyone agrees to the project would be made only after this meeting. Tuesday was necessary because, on that day, all the people from the farm stayed at home and had time to participate in the meeting.⁴⁰ After that, he introduced me to Nana Opoku, the Chief of the Youth. As the name says, he is responsible for everything concerning the community's youth. Nana Opoku was my contact person representing the council for everything I wanted to know about the project during my stay.

For the further success of the project, it was essential to understand the importance of the different hierarchies, ceremonies and rituals and to follow and respect them. The Chapter *Implementation of the mudLIBRARY* will describe this in more detail.



Fig.33: Nana Opoku I Nsutam

TOWN STRUCTURE

„Nsutam“ gets translated as „In-between water“. It combines the two Twi words „Nsu“, which means „water“, and „Ntam“, which is the word for „in-between“. The name stems from the small streams and rivers surrounding it.⁴¹

Nsutam is a small town in the Fanteakwa South district in the Eastern Region of Ghana, located about 100 km south of the capital Accra. The population is around 5000 people, according to the Chief.⁴² The closest city is Korforidua, also the Eastern Region’s capital, at a distance of 40 km.

The townscape of Nsutam settles linearly along both sides of the Accra- Kumasi Road, which mainly influences the townscape. This road runs from Accra to the neighbouring country of Burkina Faso. It is used for passenger and private transport and is the leading trade route for import and export goods. Therefore, many heavily loaded transport trucks, pragya* drivers, buses, minibuses and cars are on the road all day and night, often leading to traffic jams throughout the town. This road is also the central spot for the residents for any daily errands. There are many small food and fruit stands, street kitchens, handicraft stores and service providers right next to the street. Also, bars, restaurants and small pubs are found there, from which loud music comes out and accompanies the lively activity. Behind the stores that serve as a buffer to the

main street is where the residential area begins. The neighbouring villages of Bunso - Nsutam - Osino are all located very closely. The natural boundaries of the localities are not noticeable, and the places seem like they flow into each other. At Nsutam’s beginning and end, two large Resstops, Linda Dor and Paradise Resort, mark the town’s border. Nsutam is located in the forest zone of Ghana, meaning there is much forest and green space.⁴³ Most people work on cocoa farms or mining sites. The primary mining goods are construction materials such as gravel and minerals, first and foremost, gold. Also, wood plays an important role as an export good.⁴²

The centre of Nsutam isn’t marked by a marketplace or a church but by the Chief’s Palace. The only other asphalted road of the town, the „Main Road“, leads there. Again, small stores, service providers, handicraft stores and churches are located directly next to the street. This area around the Chief’s Palace is called „Old Town“. ⁴² The map shows it is the most densely populated area.



Fig.34: Site analysis I Nsutam



Fig.35: Nsutam

The Chief Palace is a public building where the Chief and the Council of Elders meet, and community and visitors are received. It is a meeting place for the community and one of the town's most important public buildings. The plaza adjacent to the Chief's Palace is where public festivals, funerals, wedding ceremonies and other events are held. The meetings and discussions occur outdoors – only the seating areas are in a covered alcove. For the internal meetings of the Chief and the Council of Elders, there is a small room with sofas, small storage and sanitary facilities attached to the Palace. Following the Main Road further north, it leads to the mining sites on the town's outskirts.

There are two school campuses in Nsutam. On is the Nsutam Senior High Technical School west of Kumasi-Accra Road. The second one is the campus of Junior High and Primary Schools. This one is located at the Accra-Kumasi road junction to the Main road. The construction site for the new library is located at the campus. Besides the Chief's Palace, this is also where public events are held. For these occasions, tents get erected in the squares and fields surrounding the School Campus. According to the Chief, a new community centre and hospital would be constructed next to the campus in the following years. They plan to generate a new and expanded city centre.⁴⁴ The construction site will get analysed in more detail in the chapter *Construction Site 2020*.

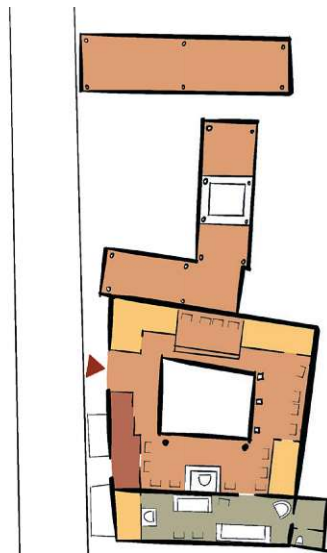


Fig.36: Structure of the Chief's Palace

- Roofed outdoor area
- Storage
- Secretariat
- Internal meeting room



Fig.37: Book handover from LOATAD at the Chief's Palace



Fig.38: Plaza adjacent to the Chief's Palace

The stores and restaurants along the Accra-Kumasi road are usually in small metal cabins. These cabins often are painted in bright colours or patterns. The food stands mainly have wooden tables and, if necessary, a small grill placed under a tree or near a roof overhang to sell fruits, vegetables, fried rice, jollof or other specialities.

The structure in the residential area is characterised by single-story, rectangular houses often placed in a courtyard structure. A family or extended family usually shares this courtyard. During the day, most activities take place outside. The interior rooms are mainly used during nighttime. By orienting the houses towards the yards, privacy is created. Occasionally these courtyard houses are interrupted by mansion-type residences that usually belong to the mining owners or are guesthouses.⁴⁵ These are usually separated from the rest of the neighbourhood by a high wall. They are differentiated because they usually have a second floor and glazed windows secured with a metal grille.

The dominant building material is concrete. One disadvantage of this is that cement is relatively expensive. That is why many unfinished cement block buildings dominate the town. During a conversation, Richard Oppong explained that these building sites often stand still for years. One builds as long as money is available. If more is needed for the completion, the building process is stopped. So it often takes years to finish a house, or, in some cases, the building never gets completed.⁴⁵

The cement blocks are produced manually in the town, either with a simple mould or a brick press machine. Sand, cement and water are mixed and placed in the mould, pressed and left to dry in the sun. This mixing ratio varies according to the desired strength. These blocks are stacked everywhere besides the main road on the town's small paths and the courtyards. They are used for foundations, external, internal, and boundary walls.⁴⁶ Then, the walls are plastered and often painted in one or two colours.



Fig.39: Nsutam town structure | Old Town



Fig.40: Nsutam town structure | Accra - Kumasi Road



Fig.41: Nsutam town structure | Main Road

CONSTRUCTION METHODS

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Fig.42:Nsutam construction methods I residential area



Fig.43: Nsutam construction methods IUnfinished cement block house



Fig.44: Production of Cement blocks | Sand, cement and water get mixed.



Fig.46: After that, the brick mould gets turned over to remove the brick from it.



Fig.45: The mixture gets filled into a brick mould & compacted.



Fig.47: In the end, the bricks get placed in the sun to dry.

Since Nsutam is a wood-rich area, many constructions are made of wood. It is often used for roof trusses covered with corrugated sheets and columns. Also, window frames, door frames and lintels are wood-made. It is essential to distinguish between hardwood and softwood. Hardwood is heavier and stiffer than softwood and is used where greater strength and durability are needed – that is why constructive elements such as roof construction support and lintels are mostly made of hardwood.⁴⁷ However, hardwood is comparatively much more expensive. Therefore, softwood is often used for furniture, doors and non-structural elements.⁴⁸ Next to the main street are carpenters who sell this timber and also make furniture, doors and window frames in their workshops.

Besides wood and concrete, bamboo is another widely used material. Occasionally it is used as fencing, site scaffolding, filling material or skeletal structure for earthen buildings.

There are also a few earth houses, especially in the „Old Town“. They are often difficult to recognise because most are plastered with cement. Richard Oppong told me that earth is seen as a material for people on low - incomes, and thus those who can afford it try to build with cement as a status symbol.⁴⁹



Fig.48: Carpenter | Nsutam



Fig.49: Wooden shutters | Nsutam



Fig.50: Cement block house with wooden roof frame



Fig.51: Bamboo facade

47) Diffe,2023

48) Conversation with Nana Opoku, 7.2.2020, Nsutam

49) Conversation with Richard Oppong, 1.2.2020, Nsutam



Fig.52 :Overview of the different earth techniques

EARTH BUILDING TECHNICES

When discussing earth, many terms are used; loam, adobe or mud are only some. This thesis uses the term „earth“ to describe the building material. Raw earth has different colours, granularity and physical qualities depending on the region. These differences and also different cultures, histories and tools led to the development of various techniques and shapes.⁵⁰

The following chapter focuses on the traditional technics in and around Nsutam. This area's three main technics are earth bricks, atakpamé walls and the wattle and daub technic. Rammed earth will also be discussed as a relatively new technic for Ghana that experienced an upswing in the last years, as mentioned before in the chapter *Hive Earth Studio*.

50) Gauzin Müller D., 2019, pp.24

GOOD FOR CONSTRUCTION

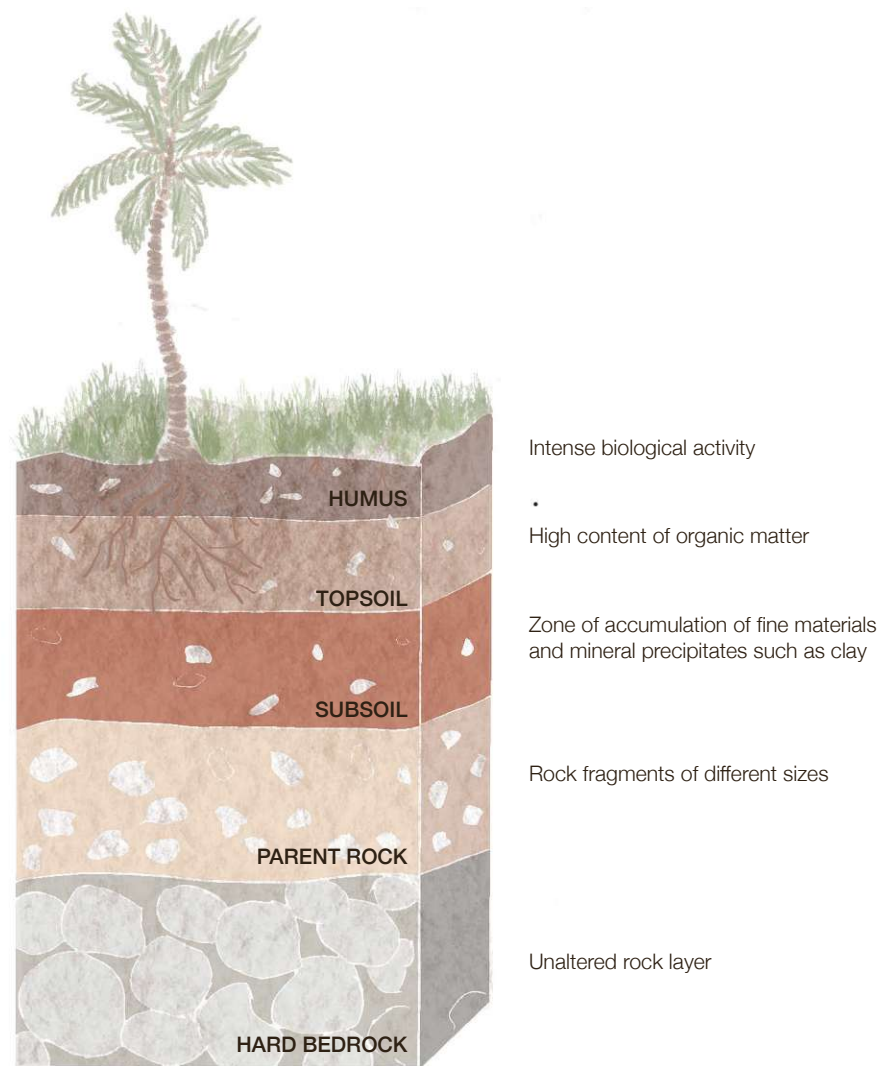


Fig.53: Soil profile⁶⁰

OVERVIEW

The components we describe as earth and use as building material are a mixture of clay, silt, sand and larger aggregates such as gravel or stones.⁵¹ A long natural fragmentation process, earth movement, precipitation and reconstruction formed the different soil layers. The top layer is essential for agriculture. It is fertile soil with a richness of organic and mineral substances. Below this layer is the earth, which is ideal for construction.⁵² When used without additives such as cement or lime, a significant advantage of earth is that it can be endlessly recycled and retains the same quality.⁵³

Historically, earth was and still is used as a building material in all areas for residential-, religious- and public buildings. Despite the common preconception, buildings are made of earth around the globe and in various cultures, not only the Global South. In Central Europe, for example, it was used as an infill in timber-frame buildings and to cover straw roofs to make them fire-resistant. In France, building with the rammed earth technique called *Terre pisé* was and is also common.⁵⁴

One significant benefit of building with earth is that the resource for it is available almost everywhere and is ready to use without complex transformation and production. Most of the time, it is enough to add water, and it is, depending on the technic, ready for usage.⁵⁵ Sometimes, fibres, such as hemp or straw, are added to the earth mixture. In Nustam, people use palm nuts fibres and crushed palm nuts to increase strength and reduce cracks.⁵⁶

Earth is a building material that produces low grey energy and has one of the smallest ecological footprints if used pure or only mixed with natural supplies. Low carbon dioxide (Co2) emissions are possible because no chemical processes are needed to produce the material. The landscape will also be protected when using the excavated material of the own or other construction sites. The best option would be to search for raw earth in the near surroundings to reduce the transport route as far as possible.⁵⁷ Cement production, on the other hand, is responsible for around 10% of the world's Co2 emission, which is the leading cause of the human-made climate crisis; that is why it is advisable to use cement and concrete only where it is indispensable.⁵⁸

Earth often struggles to get rid of its bad image. Especially in the Global South, psychological and cultural blockades exist because bricks and concrete blocks symbolise progress.⁵⁷ During the discussions in Nustam, it was repeatedly questioned whether building with earth is the right material choice since it would be the material of the „poor“, very maintenance-intensive and not „beautiful“. When asked which building was more comfortable to live in, people said the earth houses, but still, if they had the chance, they would build a house made of concrete blocks.⁵⁹

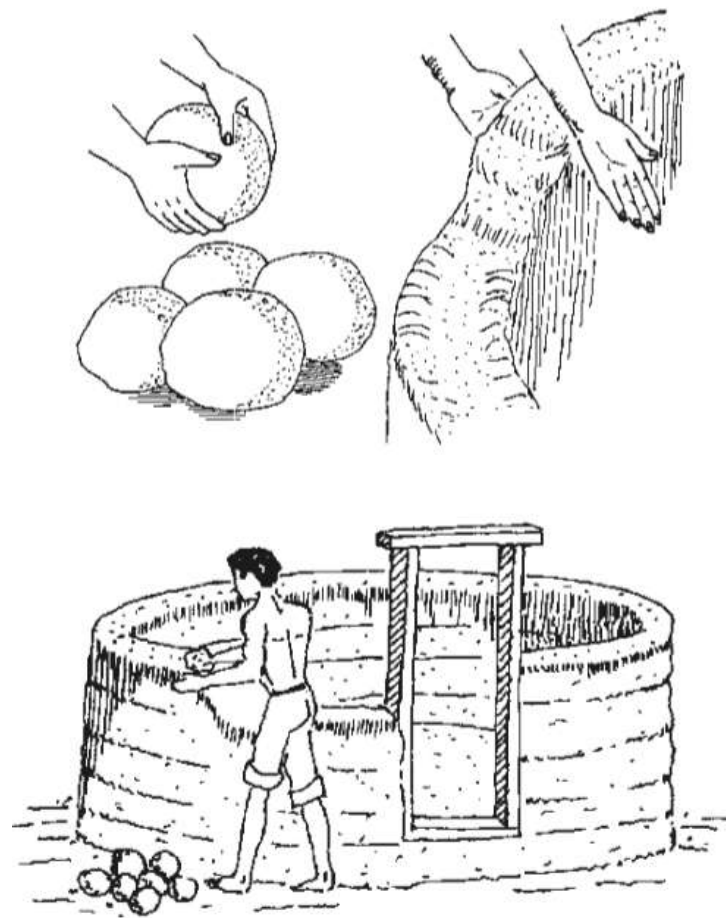


Fig.54 : Construction of Atakpamé walls

ATAKPAMÉ WALLS

Atakpamé walls get constructed by sticking balls of wet, moulded earth to each other. With this technique, it is possible to form load-bearing walls with a thickness of around 300mm.⁶¹ This makes building round and rectangular shapes possible. Both shapes are found in Ghana, although in Nsutam, they are only rectangular. The round shape is more typical for the north of the country.

Therefore, Atakpamé walls do not collapse while they get constructed; the stacking happens in sections. When the section reaches a height of around 600 mm, it gets levelled at the top and left to set and dry before the next section gets added. The different sections are still visible after the earth wall has dried.⁶¹ On some walls, those gaps get smudged with hands to blur the gaps and to get a smoother surface.

In Nsutam, often, walls are plastered. Commonly, cement gets added to it. On the one hand, that is to protect the walls from water. On the other hand, it is to hide that it is an earth house.⁶² For windows and doors, wood gets placed to act as lintels during and after construction.

Although this technique is time-consuming because it is necessary to wait until each section is dry, the advantage is that there is no need for other tools except craftsmanship. Also, finding a suitable material is uncomplicated. Most of the time, only water and fibres are added to the earth. The fibres are added to increase strength and reduce shrinkages and cracks.

Atakpamé is also the name of a town in the northern part of present-day Togo. It is said that the Atakpamé building method got its name from a group of travel builders who spread the knowledge of the construction method.⁶¹



Fig.55 : Circular Atakpamé construction | North Ghana



Fig.56 : Rectangular Atakpamé construction | Nsutam, Eastern Region



Fig.57 : Atakpamé wall | Nsutam, Eastern Region



Fig.58: Atakpamé wall | Nsutam, Eastern Region



Fig.59: Window detail | Wood is used as a lintel during and after construction | Eastern Region

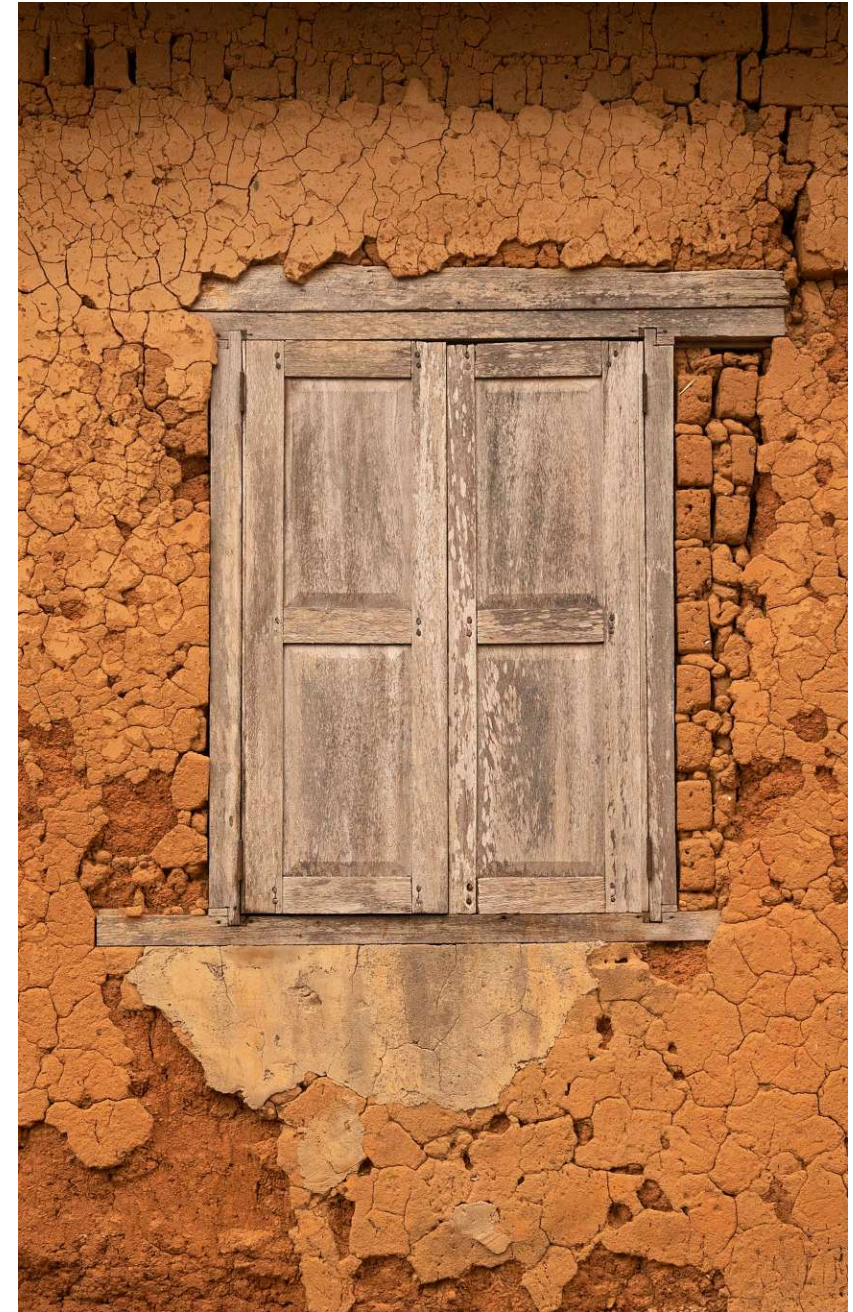


Fig.60: Plastered Atakpamé wall where partly also earth bricks got used | Eastern Region



Fig.61: Earth brick house with a quarry stone plinth | Eastern Region

EARTH BRICKS

Earth bricks, also called „adobe“, are sun-dried bricks produced with the help of moulds. For this purpose, a sandy loam gets mixed with water, thrown into moulds and laid in the sun till it dries. Often fibres or cut straws get added to reduce the shrinkage and avoid cracks. Traditionally, loam mortar gets used to lay bricks, whereas nowadays, cement often gets mixed into it.⁶³ These houses are primarily rectangular-shaped.

In Nsutam, for some houses, different techniques and materials get mixed. Some look like earth bricks got used, but if looked closely, it is visible that an Atakpamé wall is behind it, and plaster was added to make it appear like bricks. Earthen houses often do not have clear plinth and appear to grow directly out of the ground. At this particular house(Fig.61), it is interesting that they used quarry stones for the plinth to protect the earth wall from water.

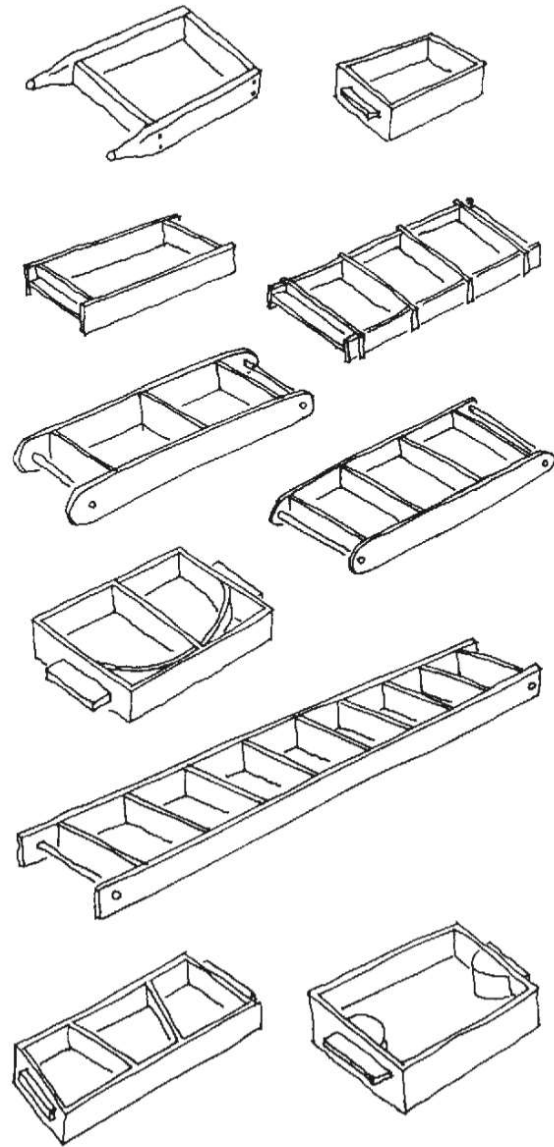


Fig.62: Moulds for the production of earth bricks



Fig.63: Atakpamé wall, which at first sight looks like an earth brick wall because of the plaster in Eastern Region

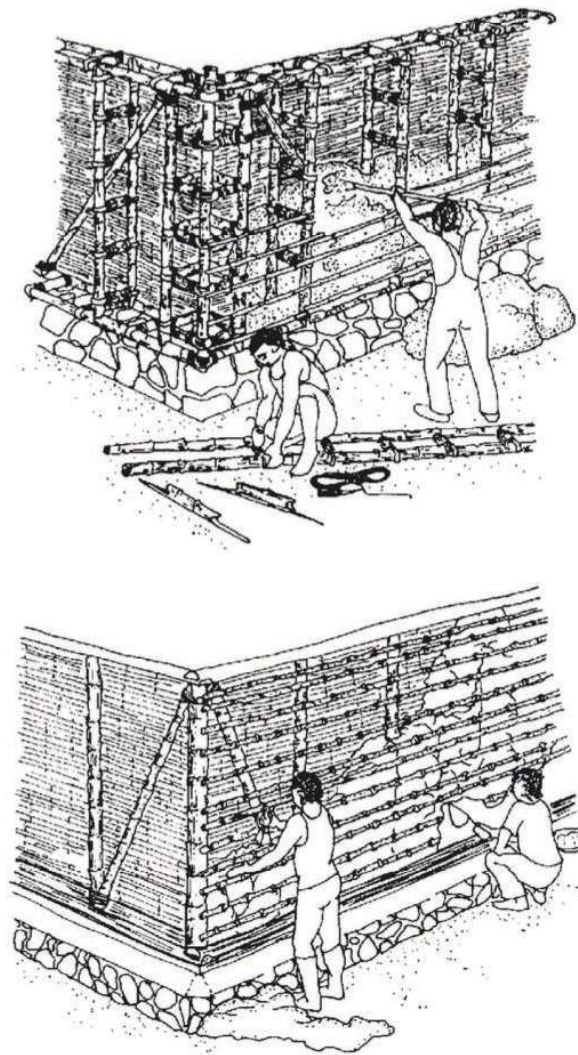


Fig.64: Wattle and daub technique

WATTLE & DAUB

For this technique, a basic skeleton structure of horizontal and vertical wood or bamboo gets constructed, filled and covered with earth afterwards. The clay-rich earth, mixed with fibres, gets thrown and pressed onto the network until completely covered. Stones and other materials sometimes fill the wooden structure and get covered with layers of earth after. These often happen in layers to avoid cracks on the wall because of the shrinkage while drying.⁶⁴

After the rainy season, repair work is often necessary since most houses do not have a plinth or overhanging roof to protect the earth walls from water.⁶⁵

Most roof frames are wooden with corrugated iron sheets. Those sheets also fill the gap between the walls and the roof. Only a few houses have straw roofs. Therefore straw gets tied in bundles and then installed overlapping on the wooden roof frame.



Fig.65: Wattle and daub house | Nsutam



Fig.66: Wattle and daub house with a skeleton structure of bamboo and wood | Nsutam



Fig.67: Construction of a straw roof | Eastern Region

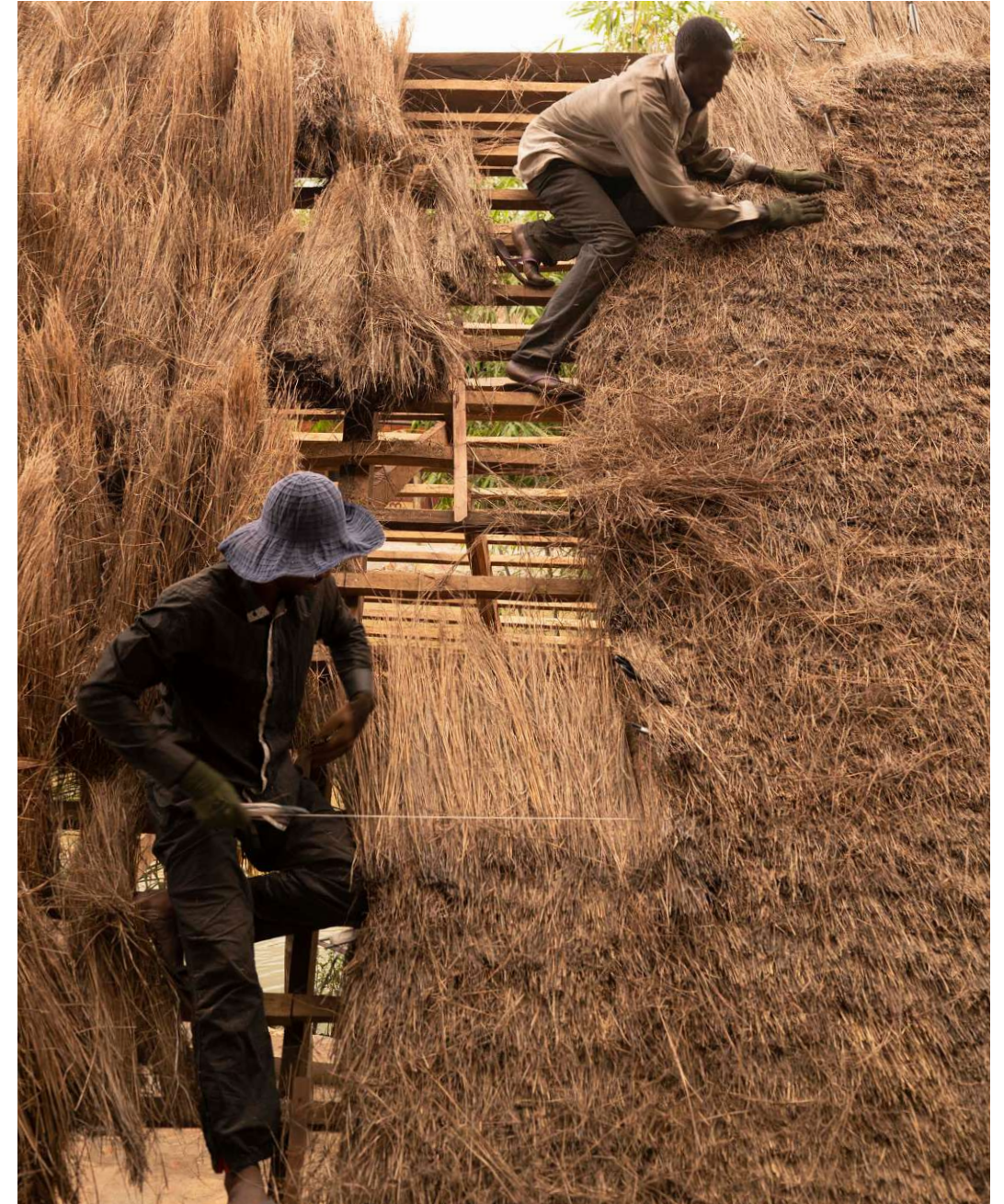


Fig.68: Construction of a straw roof | Eastern Region

RAMMED EARTH

Rammed earth is an ancient building technique used for thousands of years. It is prevalent worldwide but not a typical technique for Ghana. In Europe, the technique is widespread in France under the name ‚pise‘.⁶⁶ Also, it has been gaining popularity in Austria, primarily through Martin Rauch, an expert in rammed earth who works on precast elements in his factory, Lehm Ton Erde, in Vorarlberg. On the African continent, Morocco is mainly known for its rammed-earth buildings.⁶⁷ This technic has recently experienced an upswing in Ghana, as mentioned in the chapter „Hiver Earth Studio“.

To build a rammed earth wall, one pours loose, earth-moist material into a formwork, distributes it evenly and then compacts it with a manual or hydraulic rammer. This technique makes it possible to tamp load-bearing walls.⁶⁶ The load acting on the wall determines the thickness, usually between 35 cm and 1m for non-stabilised walls*. Compared to other techniques, rammed earth requires a relatively large number of tools and experience. The essential tools needed are a manual or hydraulic rammer and a formwork. A mixing machine is also beneficial, but it is possible to do the mixing process by hand.⁶⁸

A suitable functioning formwork is one of the critical elements for a good end product. In principle, the wall can have any shape wished

for if it is possible to create a stable formwork. If the formwork is challenging to set up, crooked and cannot withstand the load of the ramming, it will be visible in the wall afterwards.⁶⁹

A formwork consists of plywood, vertical and horizontal stiffeners and tie rods. Other tools, such as tension belts, are often used to support it. It is possible to use the same formwork used for concrete constructions. The only thing to be aware of is that a large force gets generated during the ramming process that pushes outwards.⁷⁰

Hive Earth Studio uses a metal formwork we used for our walls during the construction phase in 2022. That formwork fits walls of different thicknesses, heights and lengths.⁶⁹ The chapter *Rammed-earth wall - step by step* describes this in more detail.

Generally, the formwork must be relatively light for the workers to lift since the formwork of rammed earth walls gets built in sections. A new board gets added when the rammed wall reaches the top of the previous formwork board. Another option is to loosen the formwork and pull the entire box upwards. The formwork must be easily adjustable so that only little working time goes into setting it up. This flexibility should work vertically, horizontally and for the wall thickness so that the same formwork can be installed for different projects.⁷¹



Fig.69: Rammed earth wall | Accra

66) Dethier J., 2019, pp.46

67) Guillaud H., 2019, pp.33

68) Minke G., 2013, pp.50

69) Hive Earth Studio, 2022, pp.16

70) Conversation with Kwame Deheer, 21.7.2022, Nsutam

71) Minke G., 2013, pp.51

*stabilised rammed earth = 2-8 % cement gets added to the earth mixture ⁷⁰

*non stabilised rammed earth = made of 100% earth and natural supplements



Fig.70: Wooden rammed earth formwork | North Ghana

In the case of a non-stabilised rammed earth wall, removing the formwork immediately after the wall is done is possible. For stabilised earth walls, it is essential to let it dry for at least 24 hours.⁷²

In general, it is possible to use any road-based material for rammed earth. However, creating a universal rammed earth recipe is impossible since all raw materials are different in composition. Conversely, that is why experience, exchange with experts and making samples are all the more critical. Material that is well suited for rammed earth construction is clay-rich gravel material. Round and crushed gravel must be present in the mixture. The round gravel blends well with the mass, whereas the broken, angular gravel interlocks better. It is enough to have round gravel for small projects, but a mixture of both is ideal.

Clay-rich earth is good because it increases strength and withstands rain better. However, it shrinks more and is more challenging to work with than lean earth. Conversely, lean earth is easier to work with and causes less shrinkage cracking, but it is not as strong and is more susceptible to rain. The choice of the raw earth and the aggregates affect the appearance of the surface: on the one hand, the earth differs in colour, and on the other hand, the grain sizes make the surfaces appear rough or the fine clay layers are visible. When the wall gets exposed to water, the fine clay particles are washed out over time by erosion. That is why the surface

of a rammed earth element constantly changes. The earth mixture, the storage, the formwork technique, the humidity of the mix when it gets compressed, and the compression technique all directly impact the quality of the end product.⁷³

72) Conversation with Kwame Deheer, 21.7.2022, Nsutam

73) cf. Rauch M., 2015, pp.117

CHARACTERISTICS OF RAMMED EARTH

Water-soluble

Earth is water soluble – if a rammed earth wall is left unprotected, it will be worn away by rain over the years and return to the ground. To prevent this, the wall needs a good „hat“. In traditional rammed earth construction, this is usually done with an overhanging roof. Secondly, the wall needs a good „boot“, meaning a water-resistant plinth. Also, rising damp and splash water must be kept from the rammed earth wall.⁷⁴

Erosion occurs when water runs down the earth wall. Since earth walls are water-soluble, the wall must get protected from water running off too quickly, thereby washing out material, especially the fine clay particles. If it runs off slowly, more clay will stick in the gaps. This can get controlled with erosion barriers such as burnt clay or inbuilt trass lime layers. Alternatively, a sufficiently large roof overhang can get planned to protect the wall from rainfall.⁷⁵

Natural erosion control

The surface of a rammed earth wall is constantly changing and becomes rougher in appearance over the years. Between the exposed stones, the clay particles are then deeper in the wall. If the particles become moist, they swell and prevent water from entering the wall further. This creates a natural erosion barrier, and the wall stabilises itself. Hence, a rammed earth wall's „finished“ surface can only be seen after years.⁷⁵

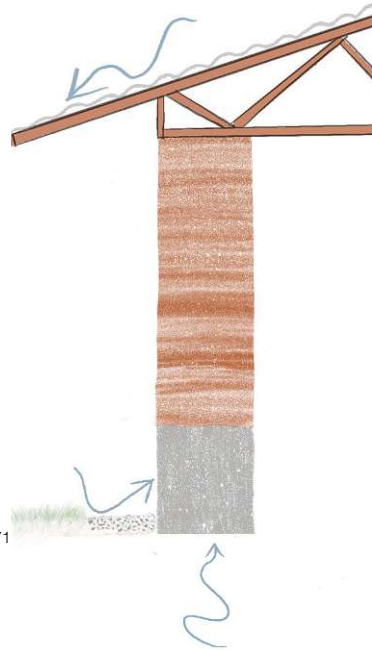


Fig.71

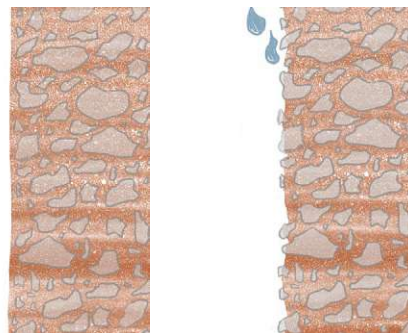


Fig.72

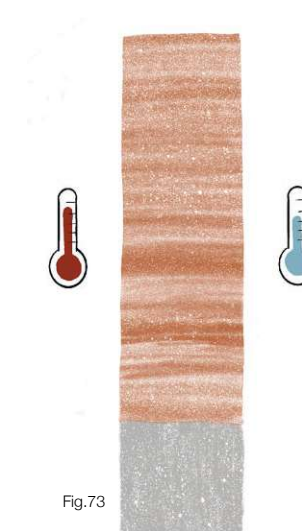


Fig.73



Fig.74

Thermal mass & Humidity

Due to their high mass and thermal capacity, rammed earth walls can store heat. As a result, they act as a thermal buffer and release the heat from the outside to the interior at a slower rate. In addition, earth is a hygroscopic material that attracts and absorbs air humidity. Hence, earthen elements also passively regulate the indoor climate by absorbing excess humidity and releasing it to the room again when needed.⁷⁶

Acoustics

Rammed earth walls absorb sounds. From a thickness of 30cm, they have a sound reduction index of $R=57\text{dB}$. Loud talking or amplified sounds get noticeably dampened. Also, rammed earth has excellent sound reverberation properties due to its high surface area and porous structure.⁷⁷

74) Rauch M., 2015, pp.65

75) Rauch M., 2015, pp.70

76) ERDEN, 2021, pp.10

77) ERDEN, 2021, pp.12

CONSTRUCTION SITE 2020

The construction site is located in the middle of the Nsutam Junior High School and Primary School campus, between Accra - Kumasi Road and Main Road. The school kids attending the campus are between 4 and 15 years of age. Hence, the building site is located exactly in the surroundings of the new city centre and has a very prominent location. It lies slightly higher than the Accra - Kumasi Road and is very quiet.

The biggest surprise was that there was already an old unfinished structure on site. This one was made of cement blocks. The ground plan was already recognisable, but construction was stopped at a wall height of about 1.20m. Bushes and grasses overgrew the whole structure, so it looked like it had been decaying for years.

In conversations with Nana Opoku, I learned there was a plan to build a community centre with an integrated library at this site eight years ago. Then, however, the money became tight, and construction stopped. Now they have received money from the government to build a new community centre and only want a library and study place for the children and youth on this site. ⁷⁸

Various school buildings, a canteen, fields and small stores surround the building site. Directly in front of the old structure in the eastern direction is a small area that gets shaded by four large trees. It is the only place next to the school buildings that offers shade. The children often gather there during their breaks to play, study and eat. This place is also swept every morning and kept very clean.

The fields in front of the schools and around the site are used as sports fields. Football and volleyball are played there at every chance the school kids get. In general, it is noticeable that the children spend most of their time outside, but there is almost no place to hang out that offers shade or protection from the rain.



Fig.75: The area in front of the building site is shaded and defined by four large trees.



Fig.76: Unfinished community center structure and construction site for the new library



Fig.77: Unfinished structure of the community centre

1. Construction site & old community centre structure
2. Stores + houses
3. Cocoa seed storage
4. Kindergarden
5. Construction of new Primary School
6. Primary School
7. Outdoor area used as sport areas / football field
8. School toilets
9. Construction community center
10. Construction hospital
11. Junior High School
12. Canteen
13. Food and drink stores
14. Fabric shop
15. Tool Store
16. Barber shop
17. Tailer
18. Church
19. Pharmacy
20. Print shop
21. Residential area



Fig.78: Site plan I February 2020



Fig.79: Sports areas I no.7 on the site plan



Fig.80: View in the direction of the Old Town and on the right is the primary school I no.6 on the site plan

The school buildings are all one-story rectangular longitudinal buildings with a steep gable roof. All of them are slightly elevated on a plinth so that they are not flooded during heavy rain. They are built of cement blocks, plastered and painted afterwards. They get painted in different colours depending on the level of schooling. Also, every grade has its school uniform, so it is easy to recognise which school level the kid attends.

The window frames and doors are wood-made. There is usually no glass in the window openings, and only some windows have mosquito nets, but most of the time, only wooden shutters are closed at the end of the school day.

A covered open corridor is in front of the classrooms, sometimes on both sides. Wooden columns delimit the area and hold the roof. All wooden parts standing in the open get painted. On the one hand, for aesthetic reasons and on the other, to protect them from insect damage.⁷⁹

This roofed outdoor area is often used as classroom expansion, a rest area during breaks or a viewing area when sports are played in front of the classrooms. Before and after a school day, temporary food stalls get set up there.

As mentioned, the squares and meadows next to and around the construction site are used for parties and events. Besides the Chief's Palace and Church, these are the only public areas for community meetings.⁷⁹



Fig.81: Junior High School 1 no.11 on the site plan



Fig.82: Covered open corridor in front of the Junior High School | no.11 on the site plan

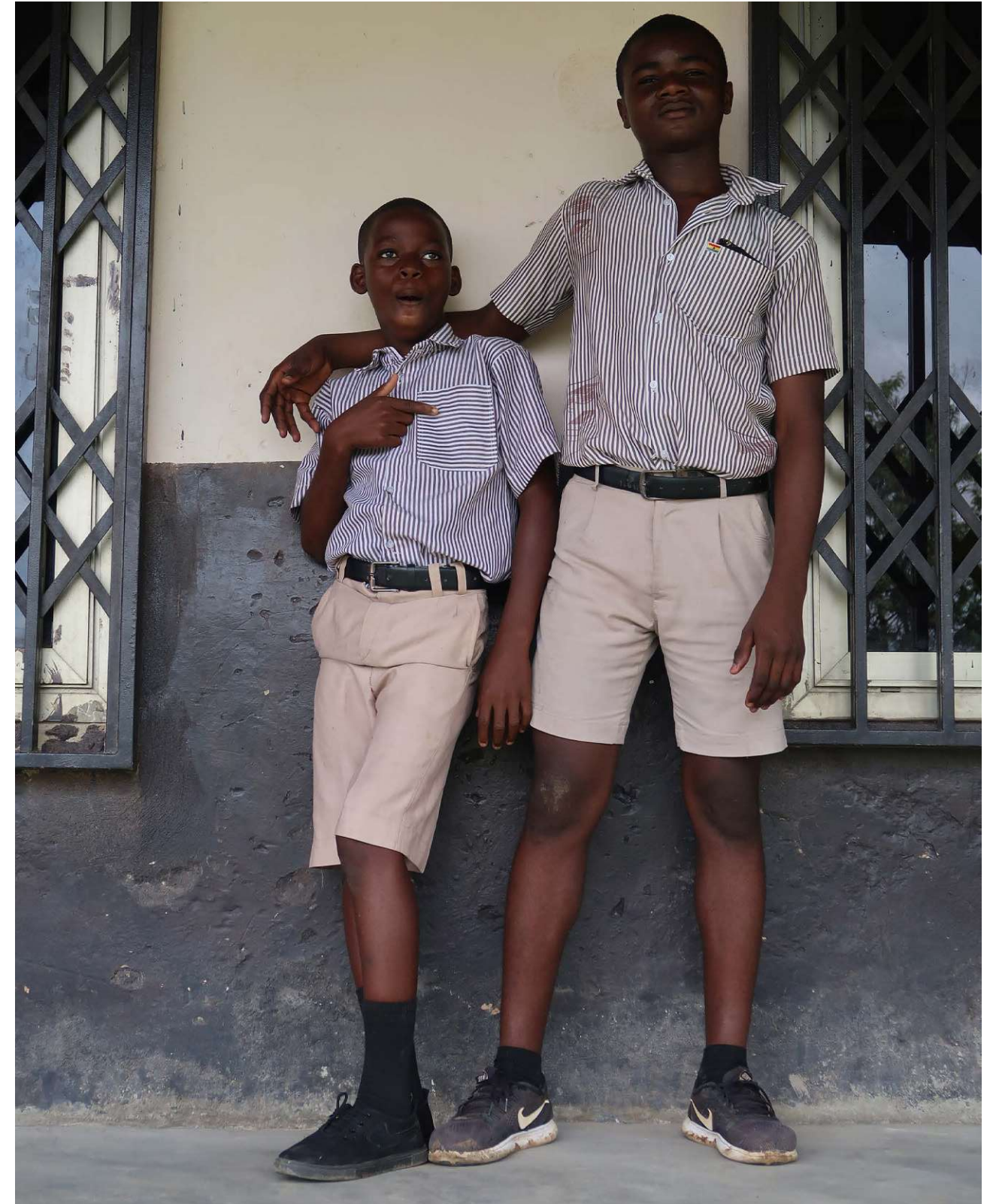


Fig.83: School kids from Junior High School



Fig.84: Children in front of kindergarten I no.4 on the site plan



Fig.85: Primary School I no.6 on the site plan



Fig.86: Primary School I no.6 on the site plan

OLD DESIGN AND WISHES FOR THE NEW LIBRARY

After seeing the site, I asked the Chief and Nana Opoku about the old unfinished structure from the community centre. They showed me photos of the plans, but unfortunately, there was no contact with the architect.⁸⁰

After seeing the design, it was clear that we had to talk again about the fact that we cannot provide such a building with ArchiFair. Since ArchiFair and Hive Earth Studio will design and build mainly with earth, the building would differ in design and probably would be much smaller due to our budget. Also, we had short construction time and wanted to build together with the community, volunteers and students. The Chief assured me that they already heard about all this from Hive Earth Studio. He agreed to use earth in the whole planning and building process. They just wanted to see the design in advance and have a voice in it.⁸⁰

I suggested possibly integrating the old structure into the design, but they did not think that would work and wanted to tear it down instead. I did not want to relinquish the idea, so I talked to Kwame from Hive Earth. He agreed with the Chief. Since the building had been abandoned for over eight years and was already overgrown with plants, he wanted to avoid taking responsibility for it.⁸¹

It was important to the Chief that there would be a reading room, book storage, and computer room. Also, it should be large enough to hold space for events and meetings. It would also be desirable if the building was independent of the electricity network and equipped with photovoltaics.⁸⁰

I also learned that the land was given to the Chief by the government to create a project for the positive development of the community. He was not allowed to use this land for private purposes. The building permit was a simple process they would take care of as soon as we sent them the first design. After the library would get completed, the Chief and the Council of Elders would co-manage the library and form a library committee with the Library of Africa and the African Diaspora.⁸⁰



Fig.87: Design for the unfinished community center



Fig.88: Unfinished structure of the community center

PRESENTATION FOR THE COMMUNITY

On the day of the project presentation to the community, Kwame from Hive Earth Studio had to cancel spontaneously, but Sylvia from the Library of Africa and the African Diaspora came from Accra. She also brought the first batch of books as a gift to the Chief and the community and as a sign that they fully support the project.

⁸²

The meeting was held in the plaza next to the Chief's Palace. First, Richard Oppong welcomed the community in Twi and briefly explained why the meeting was held. Then Sylvia briefly introduced herself and explained the role of LOATAD and how our collaboration came about.

After that, it was my turn. I briefly introduced myself and ArchiFair and showed pictures of the *mudCAFETERIA*, *ArchiFairs* pilot project. I wanted to give the community an idea of the implementation process and the direction of the design. After that, the Chief asked me to read the terms and conditions under which ArchiFair would provide the library.



Fig.89: Sylvia Arthur and the Council of Elders at the project presentation to the community | Nsutam 2020



Fig.90: Me and women from the community at the project presentation | Nsutam 2020

TERMS & CONDITIONS

- The library will get built on the site that the Ghanaian government has given to the Chief of Nsutam. The land is particular for a project to support the community's development and is not to be used for private purposes.

- *ArchiFair* will design the library in close collaboration with the community of Nsutam. The construction work is planned for the end of the summer of 2020. The building time will be approximately three months.

- *ArchiFair* will fund all the materials needed to build the library.

- *ArchiFair* will provide the labour to build the library. Besides, many volunteers, local workers and specialists need to support the *ArchiFair* team with the construction work.

- *ArchiFair* has limited financial resources, so the unconditional support of the community is needed to get the job done.

- The *ArchiFair*-team is in charge of the construction site during its stay in Nsutam.

- Team *Hive Earth Studio* will organise a workshop on-site to teach our volunteers and workers the basic techniques regarding building with rammed earth.

- Team *Hive Earth Studio* will also supervise the construction work. They will visit the site at least every two weeks and provide the *ArchiFair*-team with feedback and technical assistance.

- The community of Nsutam has to arrange for a secure place where building materials can be stored safely at night.

- When needed, the community of Nsutam assists the *ArchiFair*-team with transporting building materials or other related chores.

- In order to support the *ArchiFair*-team on site, a member from the community needs to be readily available to help out with all kinds of issues, e.g. buying building materials, translating tasks

- *ArchiFair* does not cover the running costs of the library. After completion, the management of the library will be in the hands of the council of elders under the patronage of the Chief of Nsutam. They are responsible for the library's maintenance and catering to its staff.

- The *Library of Africa and the African Diaspora* will support the community with library management, offer workshops and supply books.⁸³

All present agreed to them.(Projektpräsentation)
The Chief, *LOATAD* and me signed the Terms and Conditions. With those signatures, it was sealed that we would realise the mudLIBRARY project together.⁸⁴

83.) Email from Jaap Willemsen, 28.1.2020

84.) Conversation at the project presentation with the Chief of Nsutam, Sylvia Arthur, 11.2.2020, Nsutam

mudLIBRARY - DESIGN & ORAGANISATION

- MEETING WITH ARCHIFAIR
- FIRST DESIGN 2020
- CALCULATION & SPONSORING 2020-2022
- DESIGN PROGRESS 2021 - 2022
- PREPARATION FOR THE VOLUNTEERS 2022



Fig.91: ArchiFair Meeting I March 2020

MEETING WITH ARCHIFAIR

Back in Austria, I met with Anna and Jaap from *ArchiFair* to discuss my trip to Ghana and how to proceed. Luisa Zunft also joined the team.⁸⁵

We knew each other from other university projects. She supported us further with the planning of the library, especially concerning architecture in the context of development, which is also the subject of her diploma thesis.⁸⁶

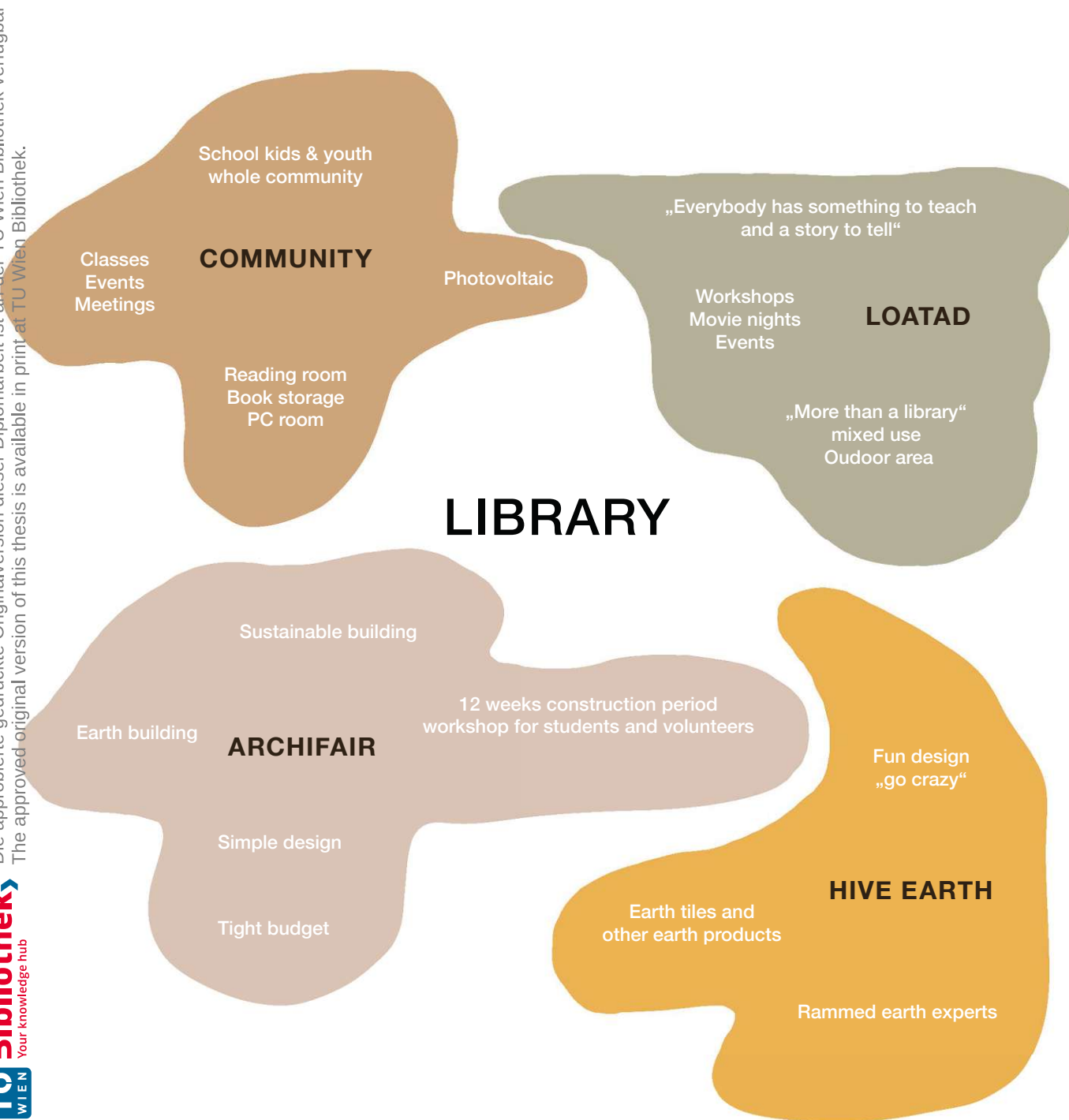
The first step was to present a design concept so we could send a proposal to the community as soon as possible to clarify whether we envision the same thing.

According to our schedule, the idea was to start with the first lecture at Vienna University of Technology in March 2020 to inform volunteers about the project. Also, we wanted to start looking for sponsors as soon as possible. This meeting took place at the beginning of March 2020. Our plan for the lecture and implementation of the building would be thrown out a week later with the first COVID lockdown. Since it was now uncertain when we could start, our focus was on the first draft and the start of the fundraising and sponsorship campaign.⁸⁵

85.) Meeting with ArchiFair , March 2020, Vienna

86.) cf. Zunft L., 2023

THOUGHTS AND WISHES FOR THE LIBRARY



SUMMARY

Users: primarily children and teenagers
 secondarily whole community

Building use : library
 events
 meetings
 movie nights
 flexible use

Roomprogramm: book storage
 reading room
 PC room
 outdoor area

Type of construction: mainly earthen construction

Construction team: students and volunteers
 local workers
Hive Earth Studio
ArchiFair

Budget: around 35.000 Euro

Building time: 12 Weeks

Important sidenote: It is sometimes the case that buildings created in a development context are eventually used for a different purpose than initially planned. Therefore in the design concept, it was also essential for us that the building offers qualitative space that can be used when the building remains closed. Also, it should be easily repurposable as a school room, canteen or other. ⁸⁷

SITE ANALYSES



Fig.92: Site analysis

MATERIAL LIBRARY



Fig.93: Atakpamé walls



Fig.94: Wattle & daub



Fig.95: Earth bricks



Fig.96: Rammed earth



Fig.97: Bamboo



Fig.98: Rattan



Fig.99: Cement blocks



Fig.100: Wood

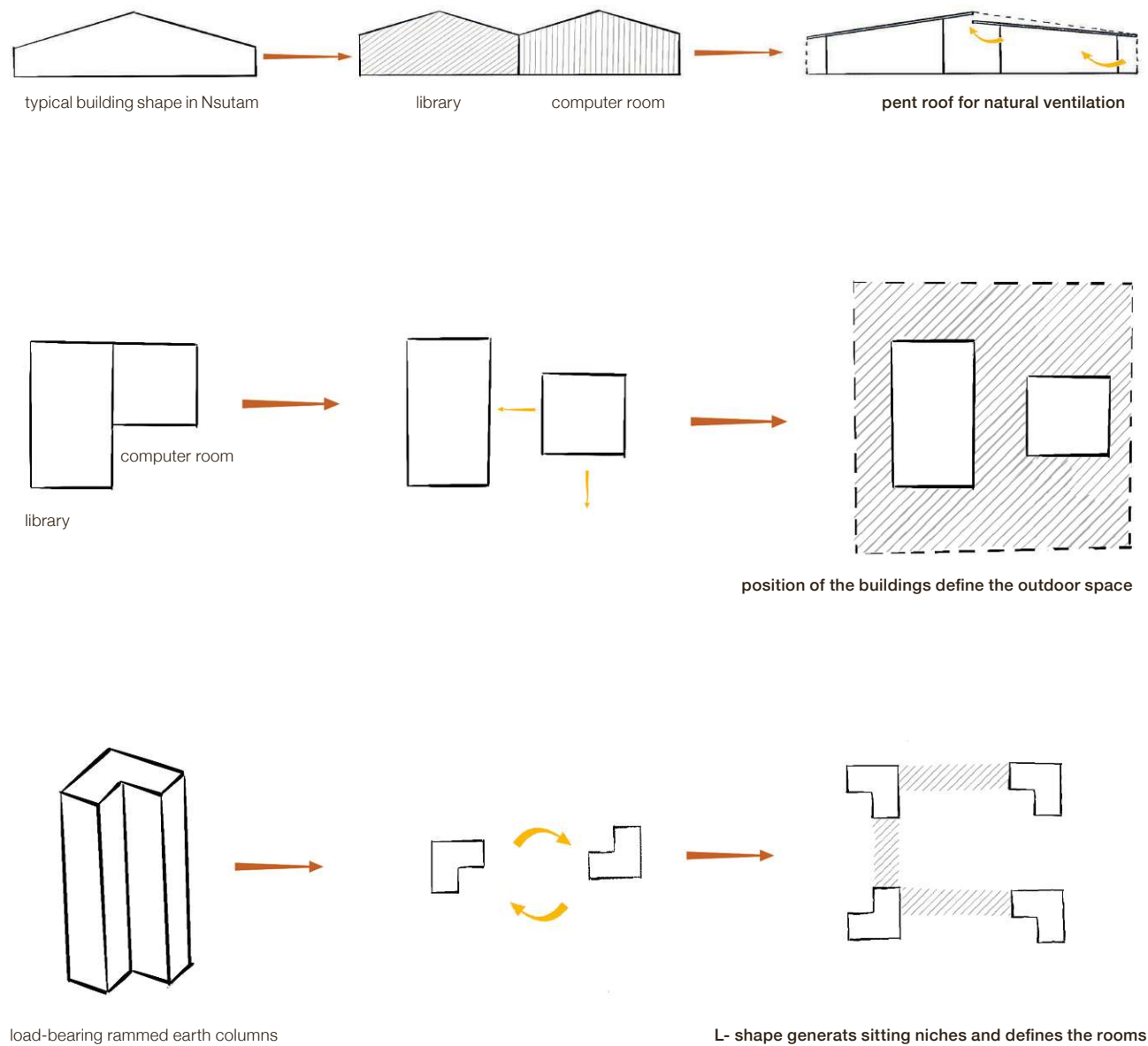


Fig.101: Design concept

DESIGN CONCEPT

Building structure:

The building shape is based on the neighbouring buildings, which almost all have a rectangular form and a gable roof. In this design, the two main functions, the library room and the computer room, got divided into two structures, and both have a pent roof to support the natural ventilation of the building and to direct drainage away from the earth walls.

Materials:

The approach was to design an earthen building that could also aesthetically compete with the locally respected architecture, at best becoming a positive example of earthen construction and reawakening interest in the material.⁸⁸ The idea was to combine the traditional techniques with the rammed earth technique and to apply them according to their strengths. Rammed earth as a load-bearing element, and the other techniques as non-load-bearing walls.⁸⁹ To create, in a sense, also a library of earthen building techniques.

Niches and sitting areas get generated through the L-shape of columns, which help shape the interior and exterior areas. The positive characteristics of rammed earth, such as temperature-regulating and sound-insulating, are intended to create a comfortable and calm indoor climate.⁹⁰

Rooms:

The climate in Nsutam makes it possible to be outside at any time, day or night, and many activities generally happen outdoors. Therefore it was essential to include a covered outdoor area. Considering our tight budget, generating qualitative space with minimal material was also a thought. By separating the functions of the library and the computer room, the positioning of the buildings define the outdoor space. The wide roof overhang provides shade and protection from rain outdoors. It was also crucial that the rooms and buildings could be used multifunctionally. For this reason, the shelves were integrated into the wall to be able to quickly change the use of the room for events or meetings. The computer room was kept relatively private and should serve as a back office for events to lock things away safely.

Nevertheless, it was also crucial that the rooms meet the requirements of the library. The reading area was placed to the west as this is the quietest part of the site. The most significant open space is located to the east, towards the shaded trees, to connect with the surrounding area. A see-through mesh out of bamboo defines this open area. This way, it is defined and calm but not isolated from the surrounding activity.

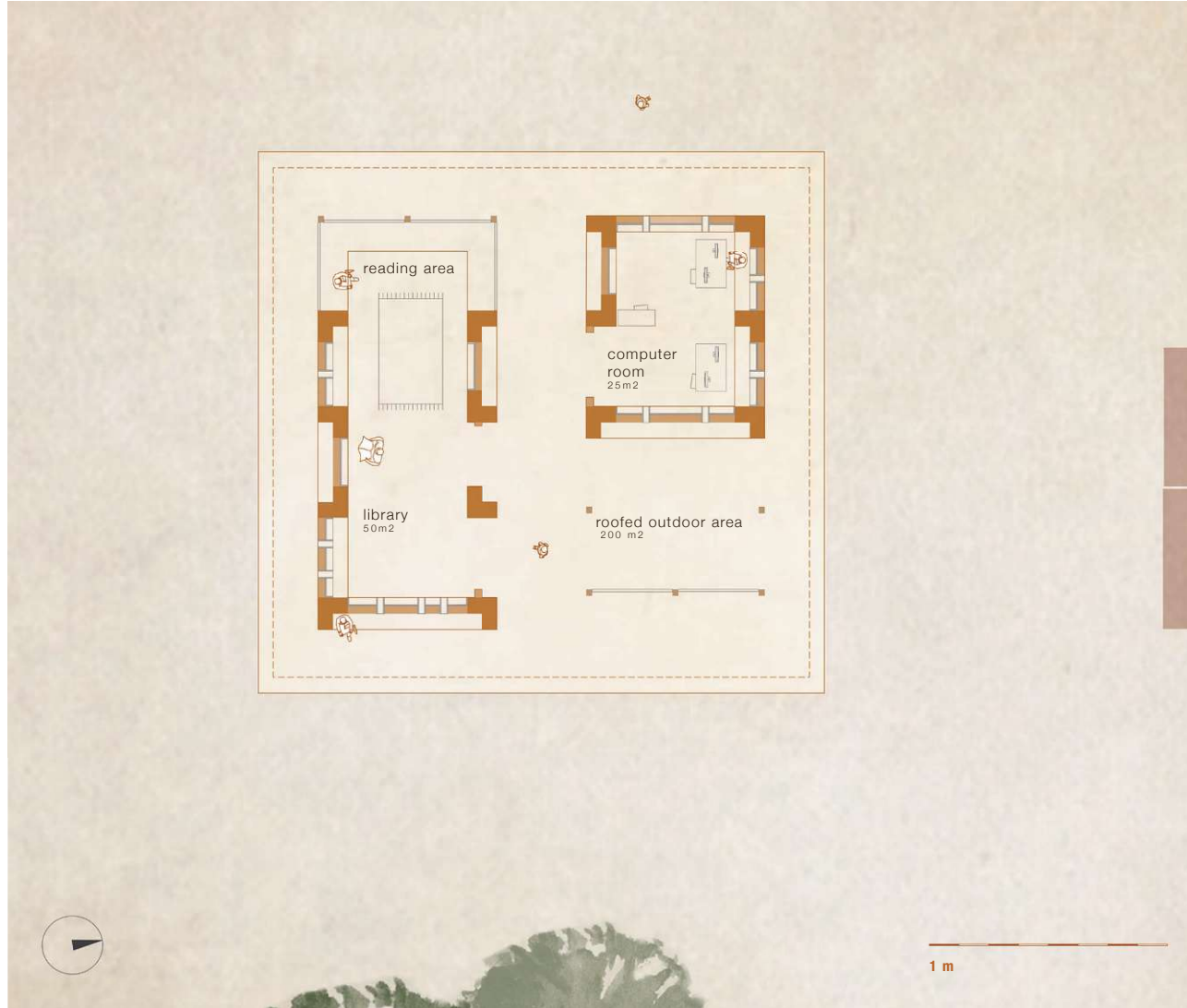
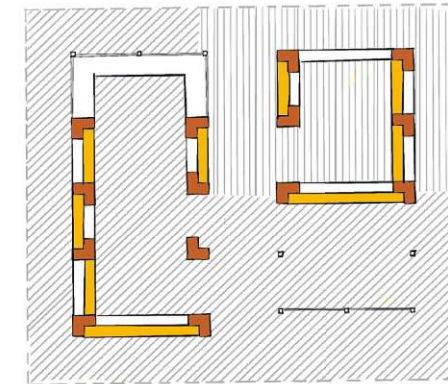
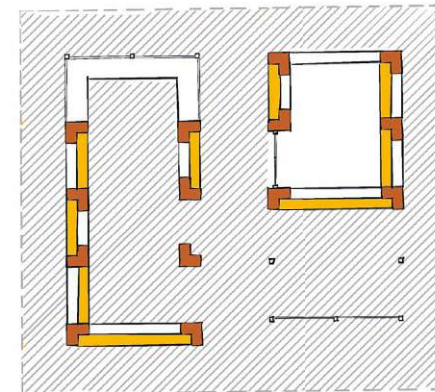


Fig.102: Floor plan I first design

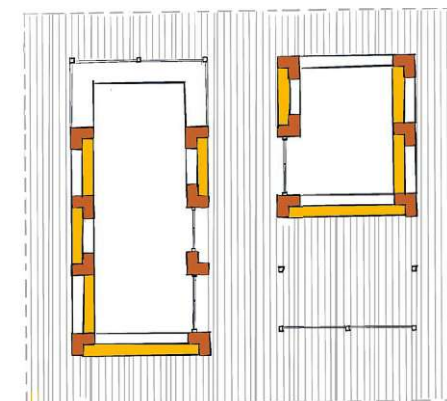


Utilization concept

When both parts of the building are open, the exterior and interior spaces should flow into each other. The structure of the buildings and the outdoor area should make it possible for two groups to have a workshop or lesson simultaneously without distracting each other.



The computer room should be lockable and serve at events or crowded meetings to store things safely. Through the wide doorway of the library, the outside space can be connected to the inside space, providing a large area for celebrations or exhibitions.



Even if the library and computer room remain closed, the surrounding area is open day and night. It should invite children to read, play or just rest during school breaks.

- rammed earth L - columns
- niches & sitting areas

Fig.103: Utilization concept



Fig.104: Front elevation I first design



Fig.105: Visualization of the roofed outdoor area and seating niches | first design

MATERIAL CONCEPT

Die approbierte gedruckte Originalversion dieser Diplomarbeit ist an der TU Wien Bibliothek verfügbar. The approved original version of this thesis is available in print at TU Wien Bibliothek.



For the non-bearing walls, traditional earthen building techniques are used.



Fig.112

Photovoltaic should get installed on the roof.



Fig.113

Wood is used for the roof structure, and the beams are designed as nail trusses.



Fig.114

Bamboo is used to close the gap between the earth walls and the roof, allowing air to pass through.



Fig.106: Section I first design



Fig.110

Excavated material is used for the earthen elements.



Fig.109



Fig.108

Rammed earth is used for the load-bearing L-columns and for the floor in the interior area.



Fig.107

The reading area should be separated from the outside only by rattan to create a pleasant lighting atmosphere and to connect inside and outside.

To protect the earth walls from water, the plinth one should be made of other stabilised rammed earth or plastered cement blocks.

CALCULATION & SPONSORING

CALCULATION 2020

After the first design concept was finished and we had to wait for feedback from our partners, we wanted to start the search for sponsors as soon as possible since we suspected it would be difficult due to the pandemic. Therefore we made a rough calculation based on the first design concept.

Based on the experience Jaap and Anna gained from their first project, a budget of about €30.000 was set for the mudLibrary. This calculation was done according to the prices they obtained for their previous project in the North of Ghana.⁹¹ Since we knew it was cheaper to build in the north of the country, I asked Martin Orthner, an architect working in Ghana, if he could provide us with one of his calculations for a project he did in Accra.⁹² These prices would be closer to the prices we would pay in Nsutam. Based on this price list, a second calculation was done. This one also included a buffer in case of any unforeseen circumstances.

This calculation resulted in costs of €35,000. These costs got divided into 54% material costs, 9% labour costs, 7% tool costs, 20% building services, 5% transport and 5% for other expenses. Thus, our budget goal was defined, and we now tried to raise this amount of €35,000.

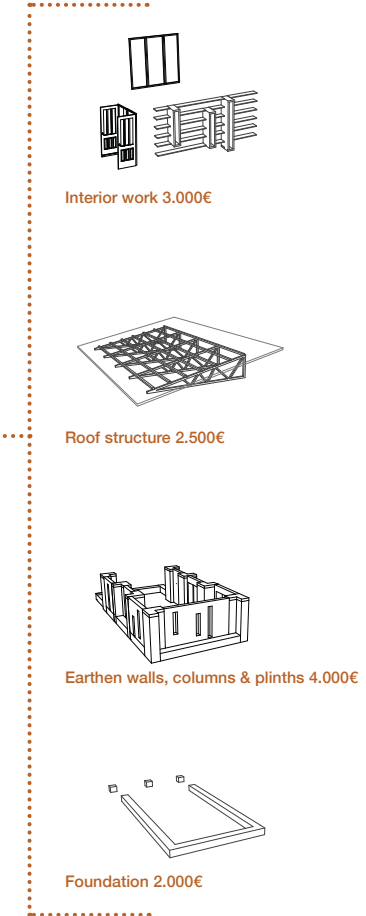
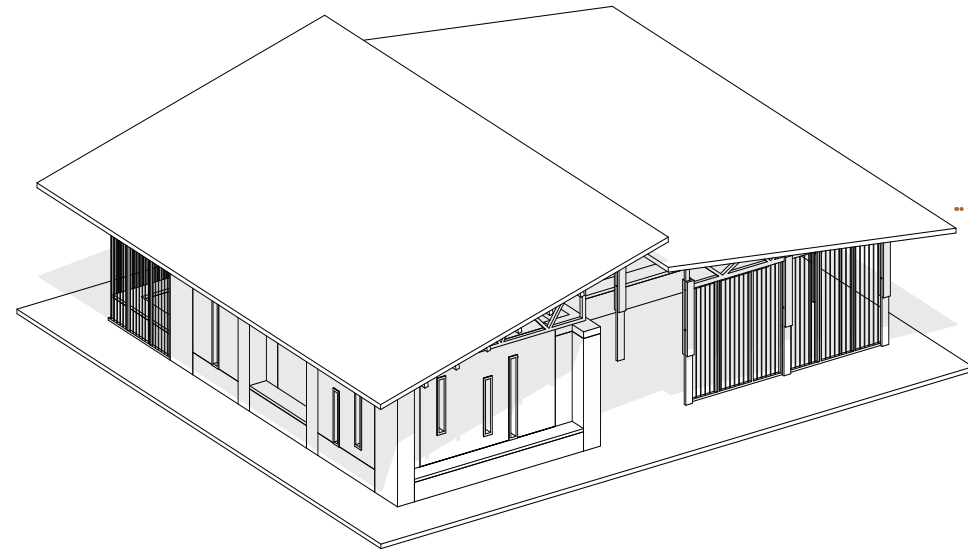
BOQ/NO.2/1					
ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
				GH¢	GH¢
BROUGHT FORWARD					5.708,50
BILL NO. 2 - MALLAM ATTA CLINIC					
Plain in-situ concrete: B. S. 5328, designed mix C20p, 20mm aggregate					
<i>Foundations</i>					
A	generally	10,81	m3	650,00	7.026,50
Reinforced in-situ concrete, B. S. 5328, designed mix C20, 20mm aggregate, minimum cement 240 kg/m ³ ; vibrated					
<i>Isolated foundations</i>					
B	generally	1,15	m3	650,00	747,50
<i>Beds</i>					
C	thickness not exceeding 150mm	18,76	m3	650,00	12.194,00
<i>Columns & Roof Slab</i>					
D	generally	5,5	m3	650,00	3.575,00
E20: FORMWORK FOR IN-SITU CONCRETE					
<i>Formwork and basic Finish</i>					
<i>Edges of beds; plain vertical</i>					
E	height not exceeding 250mm	40	m	9,55	382,00
<i>Columns; isolated</i>					
F	regular shape; Base	5,76	m2	38,20	220,03
<i>Columns;</i>					
G	regular shape; rectangular;	18,24	m2	38,20	696,77
<i>Roof slab</i>					
H	Soffit of slab	35	m2	42,02	1.470,70
CARRIED FORWARD				GH¢	32.021,00
BOQ/NO.2/2					

Fig.115: Calculation by Martin Orthner

91) Schweiger A., Willemsen J. 2019, pp. 155

92) Email from Martin Orthner, 18.2.2020

CALCULATION 2020



MATERIALS 19.000€

TOOLS 2.500€

TRANSPORT 1.600€

35.000€

PAYMENT 3.000€

BUILDING SERVICES 7.000€

OTHER 1.900€

SPONSORS CAMPAIGN 2020-2022

Private donations: To start our fundraising campaign in 2020 we contacted all donors and people involved in the the previous project of ArchiFair by newsletters. We also posted information and appeals for donations on social media. We did this regularly throughout the years and generated €9000.

Corporate sponsors: Since many companies supported the previous project, we hoped for their support for this project as well. Therefore we developed a concept for larger donations. Companies would, for example, be mentioned by name in our forthcoming publication, depending on the amount donated. They could use our project for marketing and would appear on our homepage and social media channels. Due to other acute crises at the time, we gained only a few corporate donations over the years. We sent out requests for donations at various times but received little response.

Presentations: Since Anna and Jaap had documented their first project in the form of a book, they wanted to raise donations for the new project by giving presentations. Unfortunately, this was impossible due to the pandemic, and only one presentation actually took place.

Government Funding: We also tried to access government funding for the project, but with no success. For example, we applied to the City of Vienna for a tender for development projects, but unfortunately, we could not convince them

either. We also requested project donations from the Vienna Chamber of Architects. However, they eventually also declined our request for funding. Only the four project leaders received funding from the University, enabling us to cover our travel costs and partly our on-site living expenses.

Project contribution from volunteers:

Generally, we wanted to enable volunteers to participate without any financial contribution. Since raising donations under the given circumstances was challenging, we were forced to include a project contribution. So, each volunteer had to contribute €300. Ultimately, these contributions made the project possible and accounted for most of the funding.

Sponsoring Pakete

Für Firmen, die uns unterstützen wollen, gibt es folgende Möglichkeiten:

	GOLD	SILBER	BRONZE
			
	ab 5.000 € ca. 15 % der Gesamtkosten	ab 1.500 € ca. 5% der Gesamtkosten	ab 500 € ca. 1,5 % der Gesamtkosten
Unser Logo & Projektbilder für Ihre Kommunikationskanäle	✓	✓	✓
Ihr Firmenlogo auf unserer Website und unseren Kommunikationskanälen	groß	mittel	klein
Das Projekt wird bei Vorträgen & Publikationen genannt als:	'Präsentiert von'	'Unterstützt von'	X
Bei Vorträgen hat Ihr Unternehmen die Möglichkeit, sich selbst zu präsentieren oder wird von uns vorgestellt	✓	X	X
Eine Seite für Firmenwerbung in unserer Projektpublikation	✓	X	X

Fig.116: Sponsorship packages for companies

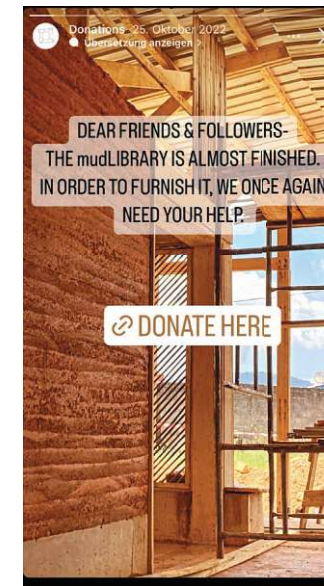


Fig.117: Fundraising appeals on social media

OVERVIEW OF THE FINAL FINANCING 2022

CAPITAL RESOURCES:

Generous reserves from ArchiFair's first project could be used for the mudLibrary.

10.000€

DONATIONS:

These could be raised through massive support from friends and family and a broad social media presence.

9.000€

2.000€

SPONSORS:

Due to the crises of the COVID years, many sponsors had to cancel at short notice.

14.000€

VOLUNTEERS:

The biggest support came through the volunteers. They supported the project with their incredible work on the construction site and their contribution of € 300 per person.

PUBLIC RELATIONS 2020 -2022

Regarding public relations, we discussed how we wanted to present ourselves and the project to the public. We worked on updating the website, generating a stronger presence on social media and creating information brochures.

We also had internal discussions on how we would like to position ourselves as an association and what kind of mindset we wanted to transmit online. A particular concern of Luisa Zunft and myself was to rethink how to come across as an association that initiates constructional „aid projects“. We agreed to mainly focus on topics of 'sustainable building', 'building with earth', and 'international exchange in architecture' in our public appearance. In her diploma thesis, Luisa Zunft details the sensitivity that projects need in a development context. We tried not to reproduce prejudice or to generate one-sided images. As we presented ourselves mainly through social media accessible worldwide, we wanted to communicate sensitively and transparently.

To build an online following, we began posting about the new project mudLIBRARY on Instagram and Facebook. We introduced the project and its design and shared my first trip to Nsutam. Afterwards, we introduced our partners, LOATAD and Hive Earth Studio.

The biggest follower increase and interaction with the project happened during the implementation. We shared many photos and videos from the construction site and reported on the building process. So we started to use our growing online presence during the implementation to fund the project. We also received several requests regarding our projects. Interested people asked us about our earth-building experiences, wanted to visit us on-site, or wanted to share our project on other platforms.⁹³

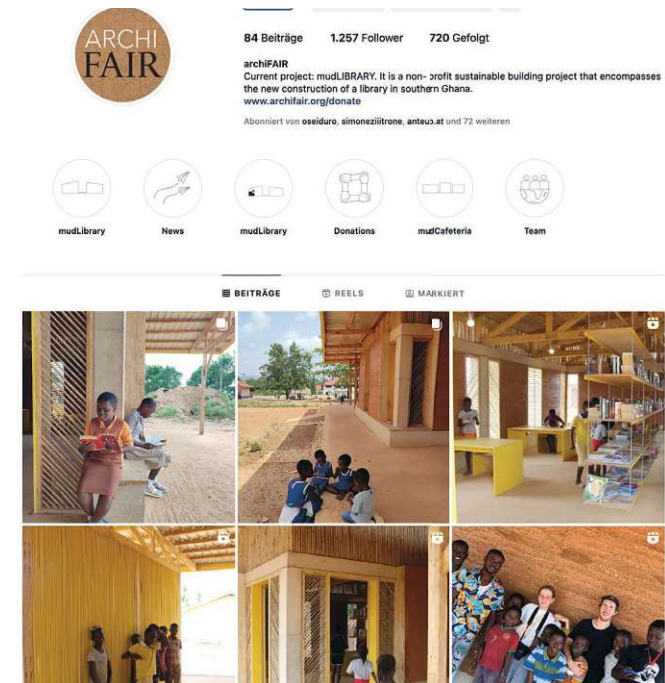


Fig.118: ArchiFairs social media during the implementation phase I 2022

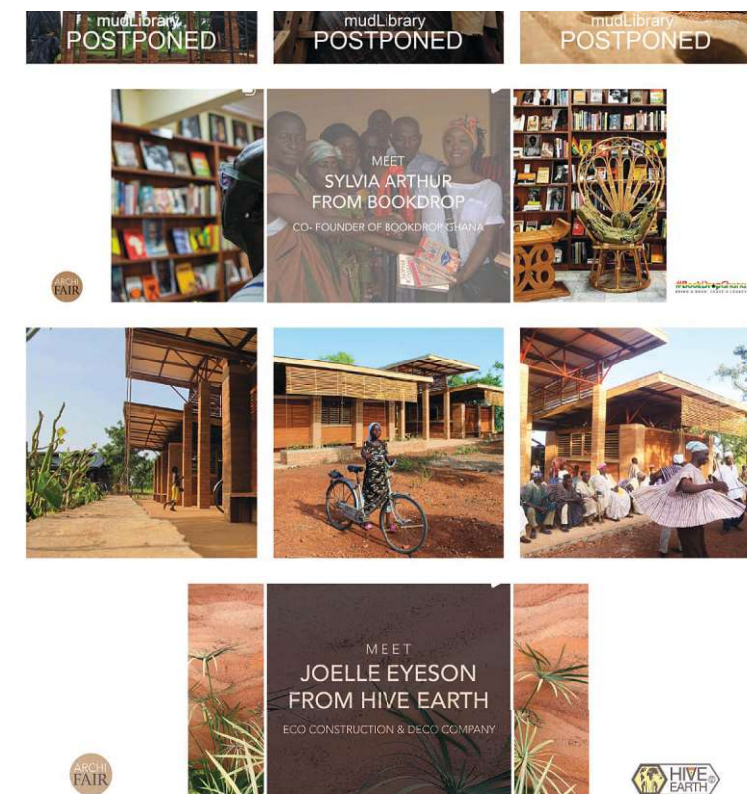


Fig.119: ArchiFairs social media at the start of the project I 2020

DESIGN PROGRESS 2021-2022

DESIGN ADAPTION 1 | 2021

After the first draft, it was difficult to stay in constant contact with everyone involved due to the uncertainty of the pandemic. Finally, in the early autumn of 2021, it seemed like we might be able to start in 2022, so we started developing the draft again.

Feedback for the first design:

The feedback from the community was that they liked the design. But they were sceptical about the load-bearing elements of rammed earth, mainly because we planned to do them without cement. Other than that, they were happy with how it looked.

Sylvia and Seth from LOATAD gave us feedback that they liked the arrangement and the outdoor area. They also made us aware that children's books are often oversized and need wider shelves.

Hive Earth Studio liked the idea of unstabilised rammed earth columns and building a „pure „earthhouse. However, they were concerned about the community's acceptance of it.

Still, if we wanted to stick with it, they suggested making stabilised rammed earth columns with a 3-8% cement content.⁹⁴

After this feedback, we also reconsidered the idea. Also, regarding the short construction time, we would not have time to do material testing in a lab and did not want to implement the idea without the assurance of an expert.

We also became aware that the formwork for the L-columns would be complex. This was another concern, mainly because of the implementation

process with many unskilled workers. So it became clear we would have to give up the idea of the unstabilised rammed earth columns. Firstly, the community's scepticism was so high and secondly, Hive Earth Studio, our local earth experts, were also not 100% convinced.

If we stabilised the L-shaped columns, they would be entirely upper-dimensioned, and if their dimension got slimmer, the design no longer worked because the niches would become too small.

New concept: stabilized rammed earth columns

We considered making stabilised square rammed earth columns with dimensions of 45x45 cm for the next design concept. They would be easy regarding the formwork, which benefits our tight schedule. Also, they would save material which benefits the environment and our budget.

In addition to the load-bearing structure, the floor plan has also evolved. The library was opened more to the shaded area in the direction of the trees so that this area can be integrated into the daily life of the library and can also get used for bigger events. The children could take the books outside, read and learn in the shade of the trees. Also, an outdoor area was created behind the computer room to the west by extending the roof area. This would create a quiet reading or learning area outdoors.

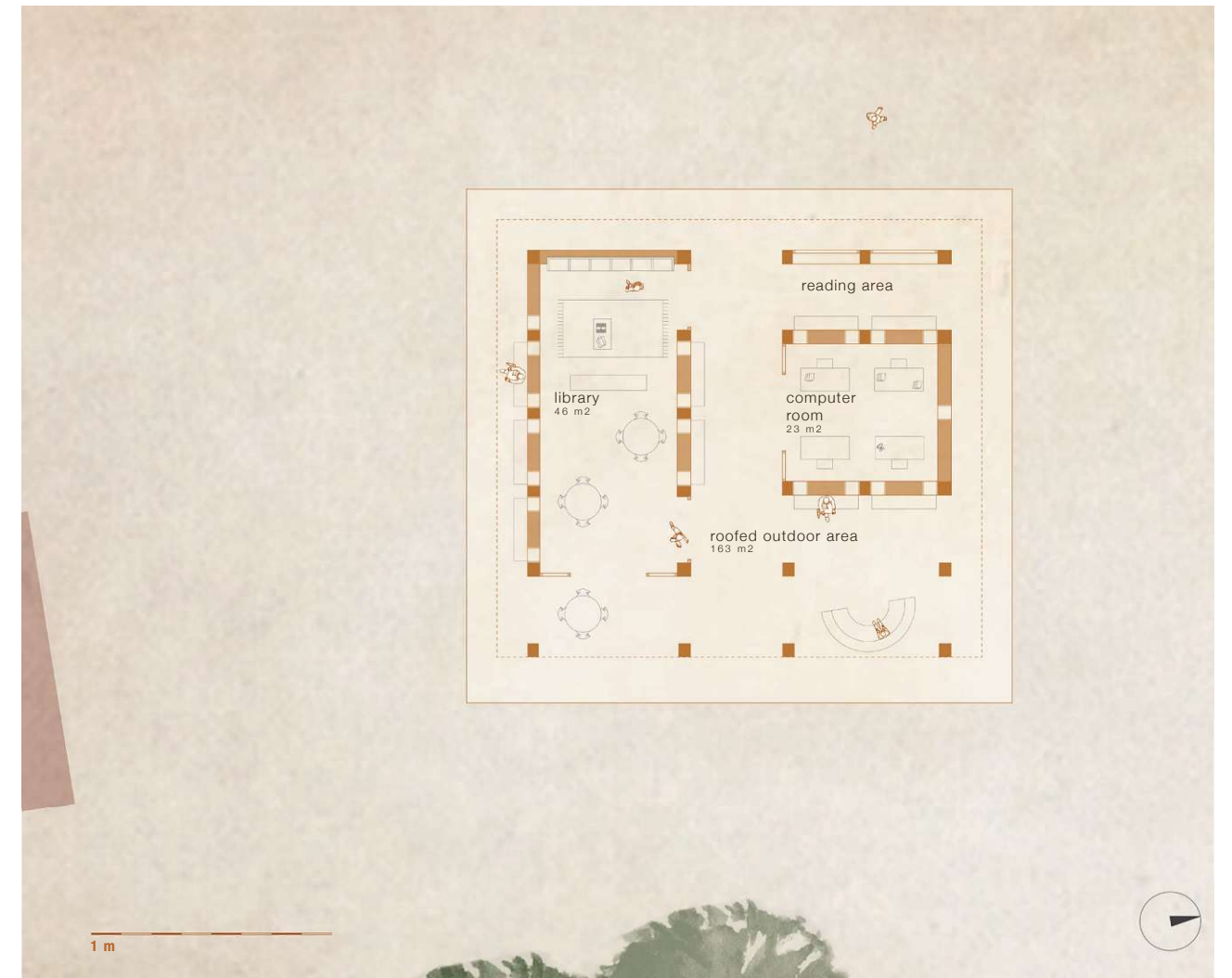


Fig.120: Floor plan I second design

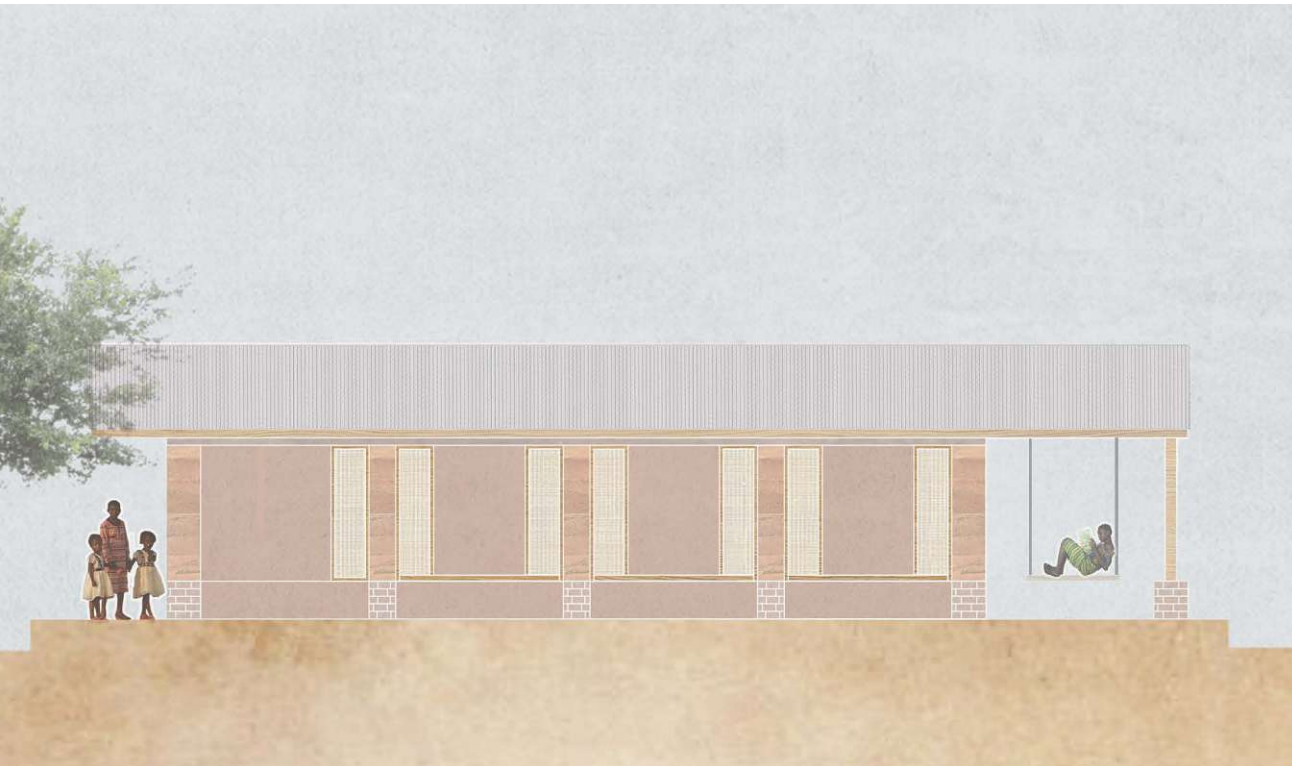
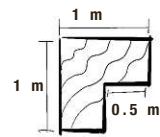


Fig.121: Side elevation | second design



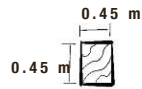
Fig.122: Front elevation | second design

STABILIZED RAMMED EARTH OR CONCRETE COLUMNS?



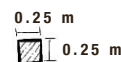
L-shaped stabilized rammed earth column 3 % cement:

$$0,75 \times 0,03 = \mathbf{0.022}$$



stabilized rammed earth column 7 % cement:

$$0.45 \times 0.45 \times 0.07 = \mathbf{0.014}$$



concret column 22% cement :

$$0.25 \times 0.25 \times 0.22 = \mathbf{0.013}$$

However, we as a team were not satisfied with the new design for two reasons: The idea of the seating niches was wholly lost, and we were also wondering if a stabilised rammed earth load-bearing structure was the right solution.

The reasons for the scepticism were:

- The rammed earth columns have to be dimensioned stronger than the reinforced concrete columns; therefore, more material is used.

- The community's scepticism was already very high towards the earth columns.

- Considering the life cycle of the building, the supporting structure would look like an earth structure that can be recycled, but in case of its demolition, it would still be hazardous waste.

These thoughts opened the discussion if we should separate the materials and use earth only as a non-load-bearing element.

Concerning the cement consumption, which we wanted to keep very low in this project, we were unsure if the stabilised columns were the best choice. Compared to the 22% cement we would use for the concrete columns, the 3-8% cement for the stabilised earth columns sounded much more environmentally friendly.⁹⁵

A simple comparison calculation of the different column types showed that we probably would not save any cement with the stabilised columns.

For the stabilised rammed earth columns, however, we would need more excavated material and more supplements like gravel and stones, which would also get extra mined.

All these arguments and concerns made our decision final, and the materials got separated for the next design. The supporting structure got designed as a concrete skeleton, and the walls remained in rammed earth.

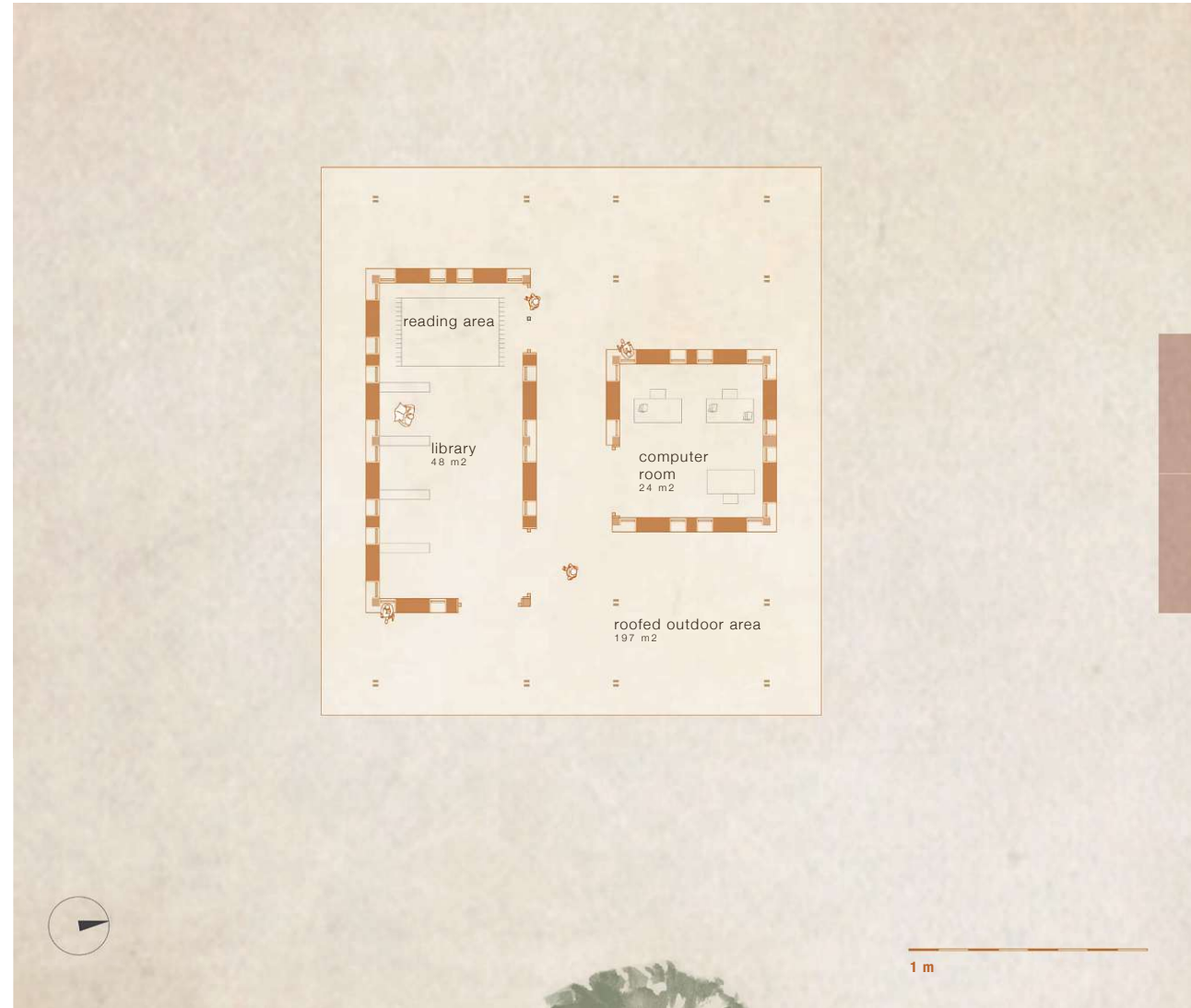


Fig.120: Floor plan I third design

DESIGN ADAPTION 2 | 2022

We all agreed to make the load-bearing structure from a reinforced concrete skeleton in this last design phase. The community also agreed with this design and was happy about the concrete columns. The non-load-bearing walls would be made of rammed earth.

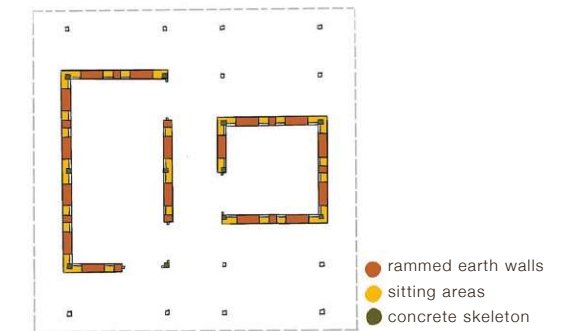
We decided to cancel the plan for the different earthen techniques because the community did not agree to it. Moreover, they could not assure us of experts who could help us with these on-site.⁹⁶ Also, Hive Earth Studio specialises in rammed earth, and we didn't want to use the project as an experiment.

Considering the construction time and the support of many volunteers, we wanted to use as few different elements as possible to keep the construction process simple since we expected enough unforeseen complications in advance.

This design decision was made only a few weeks before we left for Ghana. Therefore, there was little to no time to verify details and availability of materials with the community in advance. Upfront, some considerations about detailed solutions were made, but they were options rather than fixed decisions. Since we could only check the availability of materials

on-site, we turned to local workers for support with these calculations since they tend to know better how to build in the region and which details make the most sense.

The foundation, columns and ring beams were designed of reinforced concrete. The roof was planned as a wooden roof with nail trusses covered with corrugated iron. The underside was to be covered with bamboo mats. The window frames were designed in wood, and the window openings should get filled with bamboo or rattan.



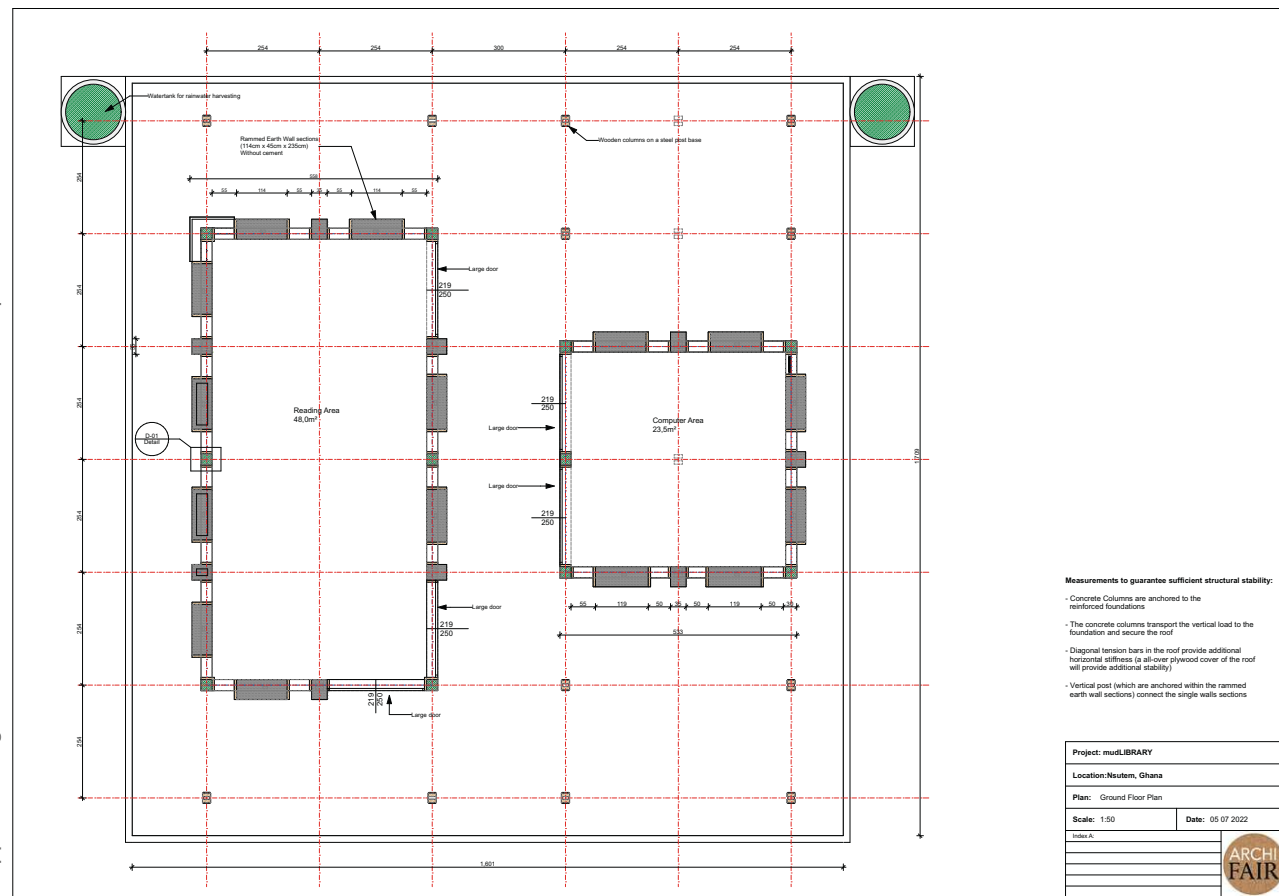


Fig.124: Plan status of the floor plan at departure to Ghana | July 22

PLANNING STATUS BEFORE DEPARTURE 2022

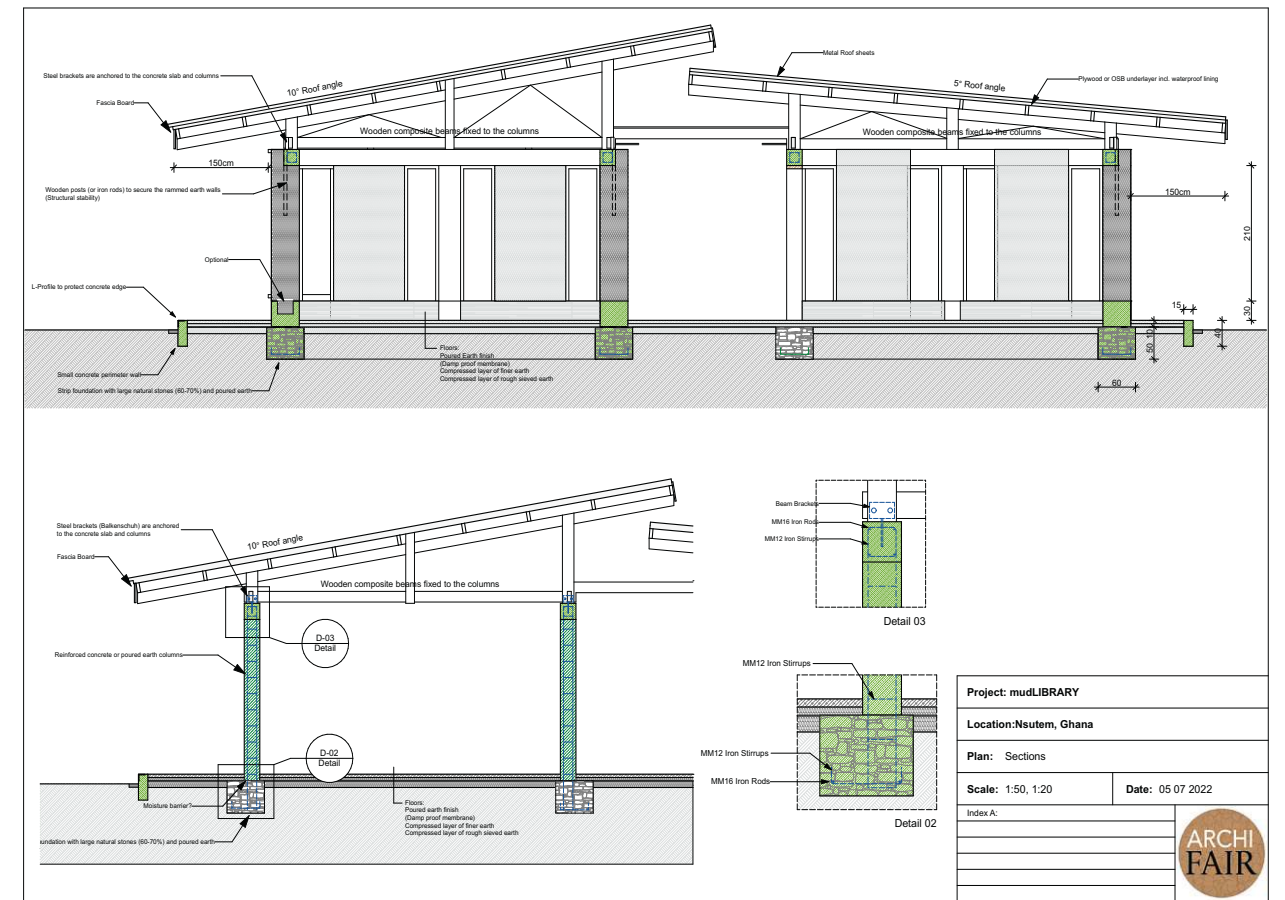


Fig.125: Plan status of the sections at departure to Ghana | July 2022

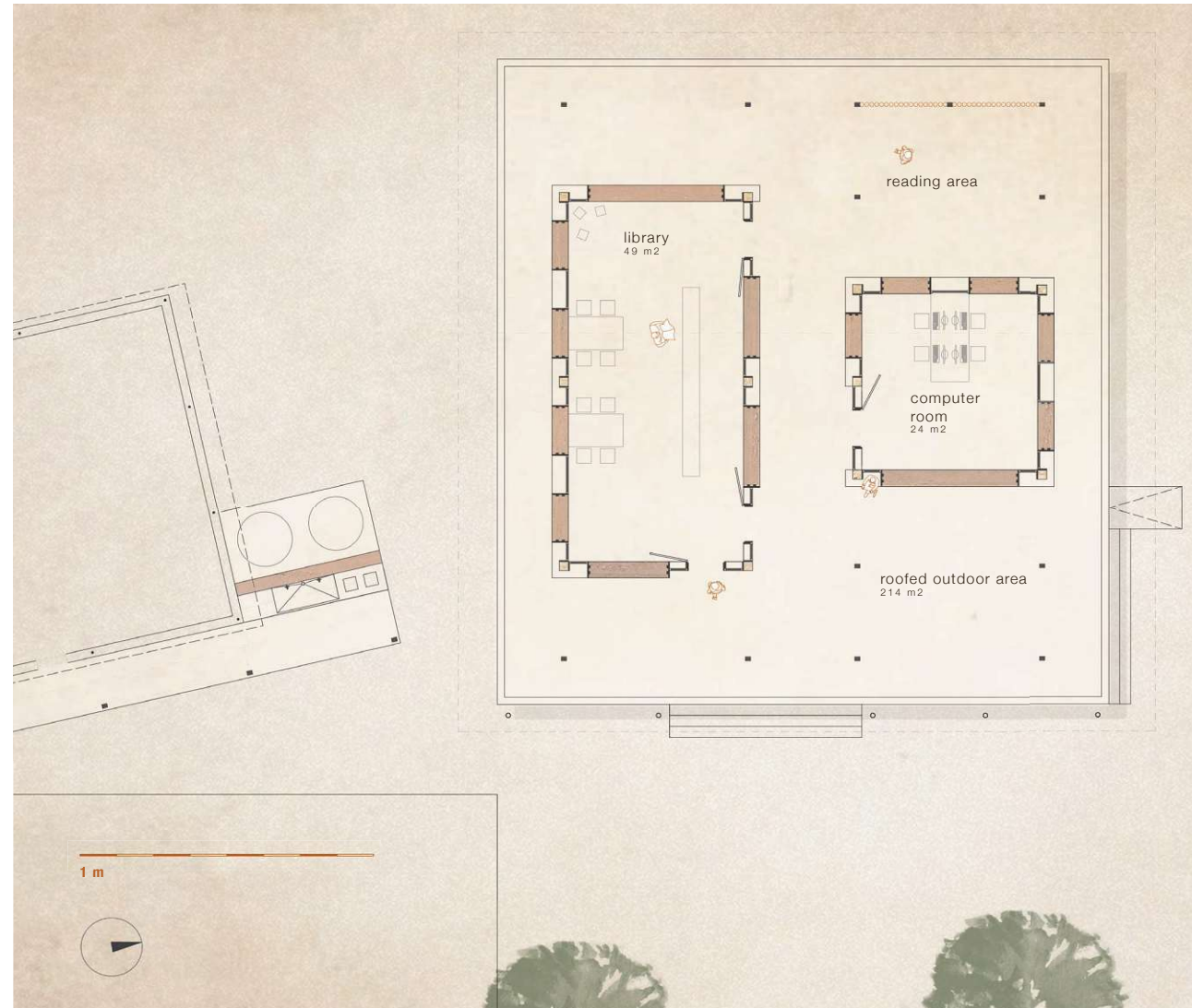


Fig.126: Floor plan I implemented design

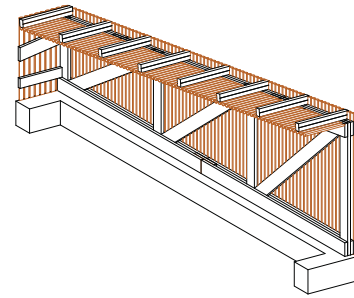
IMPLEMENTED DESIGN 2022

During implementation, as suspected, changes of plan constantly arose on site. These were often dealt with on the construction site with quick sketches on a wooden beam, earthen sample or sheet of paper. Manuel Obermoser describes the entire construction process and the details developed in his diploma thesis *mudLIBRARY - Construction of a Library in Ghana*

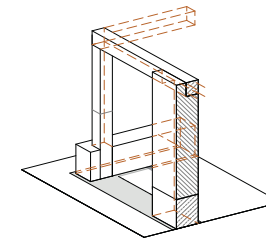
The most significant change was that it was decided to renovate the neighbouring canteen during the library's construction as well. It was connected to the electricity network, a washing- and cooking area was installed, a covered porch was added, and it was repainted. The centrepiece is the washing- and cooking area, which is made of stabilised rammed earth because of the constant contact with water.

Despite many challenges such as rising inflation and the additional canteen renovation, the calculated €35.000 budget was only slightly surpassed. A total of €35.528,29 was required for the entire construction project. Delivery difficulties, construction delays and the weather often led to a delay in the construction schedule. Ultimately, the very optimistically planned 12 weeks turned into 20 weeks.⁹⁷

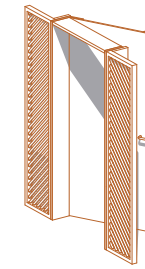
The roof was constructed of trusses and lathing made of „dahoma wood“, which is a local hardwood and, therefore very resistant. The roof cladding is made of corrugated iron.



The boarding of the roof was made with bamboo that was cut in half to avoid the intrusion of birds etc., but still allow natural ventilation.



The columns and the ring beam were made of reinforced concrete.



Windows and door frames were made of wood. The window openings were then filled with bamboo.

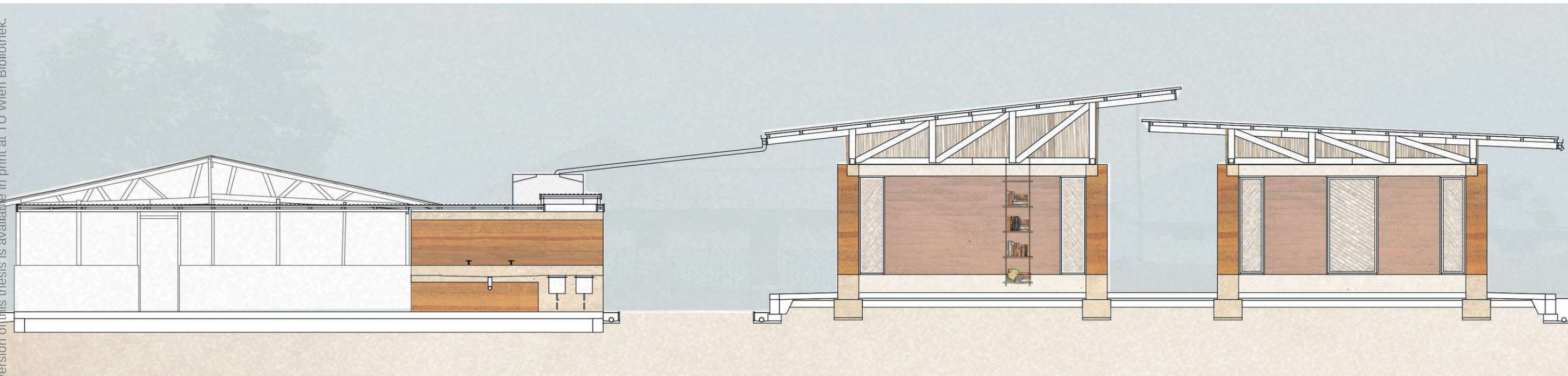
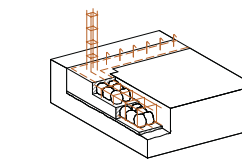
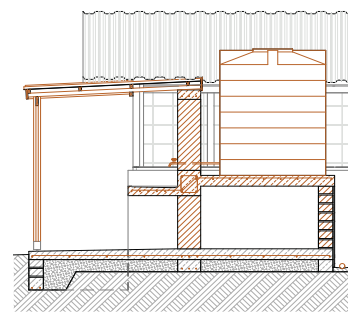
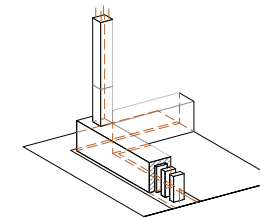


Fig.127: Sections | implemented design

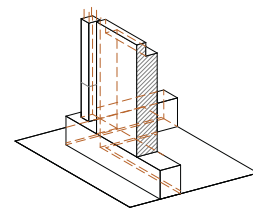
The canteen was extended with a washing and cooking area. The work surface was made of concrete and the back wall was made of rammed earth stabilised with 5% cement.



The foundation was made of reinforced concrete. In order to save concrete and cement, quarry stone and brick fragments were used.



The plinth was made of concrete to protect the earth walls from rising damp and splashing water. Cement blocks were also used here to reduce the amount of concrete.



Non-load-bearing rammed earth walls are the eye-catching feature of the design.⁹⁸

PREPARATION FOR THE VOLUNTEERS

The University of Technology Vienna also played a big role in the development of the project. As mentioned before, the first *ArchiFair* project also cooperated with the University. The cooperation was facilitated by Professor Andrea Rieger-Jandl, who lectures at the Institute of History of Art, Building Archaeology and Restoration. As part of the *mudCAFETERIA* project, Andrea Rieger-Jandl was responsible for lectures on preparing the students for the excursion to Ghana. As mentioned, I also took part in this first project, and that is how I got in touch with *ArchiFair* in the first place.

The other team leaders of the *mudLIBRARY* who became part of the project over the years, Manuel Obermoser, Beatrice Aimeé and Luisa Zunft, also joined the team through a connection with the Vienna University of Technology.

The lecture on the *mudLIBRARY* started in the summer term of 2022 and was intended to prepare the students for the upcoming construction workshop. The *ArchiFair* team decided in advance that there would be places for 48 students during the construction period. The students were divided into teams of 12 and would each spend three weeks on the construction site. Luisa and I gave the first presentation to introduce the project, the partners and the organisation around it. Since there was much interest, we had to establish an application process as a motivation letter and, unfortunately, refuse

some applicants in advance. Forty-eight participants were selected. Andrea Rieger-Jandl, Anna Schweiger and Jaap Willemsen prepared them for the excursion in further lectures. In addition to the excursion to Ghana, there were also small tasks that the students had to complete during their stay. There were teams to write construction diaries, site analysis teams, people to conduct on-site interviews, and documentation teams for films, photography and social media.



Fig.128: The team leaders of *ArchiFair* for the *mudLIBRARY*

mudLIBRARY IMPLEMENTATION

- ARRIVAL
- CONSTRUCTION SITE 2022
- CONSTRUCTION START
- RAMMED EARTH WALLS
- TIMELINE OF THE PROJECT

ARRIVAL

FIRST DAY IN GHANA 2022

On July 6, 2022 Beatrice, Manuel, Luisa, and I left for Ghana. Since the three of them were in Ghana for the first time and only knew our partners by phone, our first trip was to visit Sylvia and Seth from LOATAD. Once there, they gave us a short tour of their library. Then we showed them the current state of the design and discussed it with them. We agreed that they would visit us regularly during the construction period and that they would also hold workshops in Nsutam with the community to prepare them for the library. Kwame from Hive Earth Studio didn't have time during these first days, but he arrived at Nsutam during the first week of construction and met everyone there.



Fig.129: Meeting with LOATAD | Accra 2022

FIRST WEEK IN NSUTAM 2022

On July 9 we took the bus from Accra to Nsutam, where Nana Opoku welcomed us at the Linda Dor rest stop. He took us to the Chief's Palace, where the Chief and the Elders were already waiting for us. We also met Richard Oppong there again.

It was important for the Chief and the Elders to have a clear assignment of tasks. Thus, we decided that I would be responsible for the communication between us, the Chief and the Elders and for the material supply together with Nana Opoku. Manuel took over construction management, which he also documented in detail in his master thesis *mudLIBRARY - Construction of a library in Ghana* and the organisation of the on-site workers and volunteers. Luisa and Beatrice handled the questions, accommodation, and everything related to our volunteers.

Organisational matters dominated the first days. I had to bring the new plans to the construction office with the Chief. This was a matter of 10 minutes; no questions were asked, nor any written permission was issued. We were just warmly welcomed and should contact them in case further questions came up.

Then Manuel and I had to go to the Chief's Palace to be present at the workers' salary negotiation. Two of them were assigned to us

by the Chief for the entire construction period. Samuel was a mason, and Kromuel a skilled carpenter. In addition, after the meeting, we were given a list of workers we could call as needed.

Furthermore, the Chief also provided us with a driver, Nico, and two cooks, Madame Joyce & Madame Rosemarie. It is essential to mention that the Chief determined all these people and the building materials suppliers & companies from which we bought all our tools.¹⁰¹



Fig.130: Samuel



Fig.131: Kromuel



Fig.132: Madame Rosemarie



Fig.133: Madame Joyce

CONSTRUCTION SITE 2022

A lot has changed from the first visit in early 2020 to the second one in the summer of 2022. The first thing that stood out was that the new community center and hospital plans were implemented. Both buildings were finished, but only the hospital was already open. For the construction of the community center, the school toilets were demolished. Next to it, the construction of a new Chiefs Palace was started. It seemed, however, as if the construction site had been at a standstill for some time.

The new school building right next to the construction site was also completed and used as the new primary school. The old primary school buildings were now used as storage and partly as church rooms. The old library ruins had been torn down; only the demolition waste reminded us of it. For our design, this meant that we had to adjust the positioning of our library based on the newly built buildings.



Fig.134: Construction site I February 2020



Fig.135: Construction site I July 2022



Fig.136: New community center



Fig.137: New Chiefs Palace



Fig.138: New Primary School



Fig.139: New hospital

1. *mudLIBRARY*
2. Stores + houses
3. Cocoa seed storage
4. Kindergarden
5. New primary school
6. Old primary school used as church & storage
7. Outdoor area used as sport ares / football field
8. Demolished school toilets
9. New community center
10. New hospital
11. Construction chief's palace
12. Junior high
13. Cafeteria
14. Food and drink stores
15. Fabric shop
16. Tool Store
17. Barber shop
18. Tailer
19. Church
20. Pharmacy
21. Print shop
22. Residential area



Fig.140: Site plan I July 2022

CONSTRUCTION START

After a week of organising, the first group of students arrived, and the construction started on 16.07.2022. Since I was only on-site for the first six weeks of the construction period, Manuel took over the detailed construction documentation in his master's thesis, *mudLIBRARY - Construction of a library in Ghana*.¹⁰² Against this background, I will give a short overview of the first 6 Weeks and only go into detail about the rammed earth samples and the first wall since material sourcing was one of my responsibilities.

However, before the construction could begin, communication with the Chief and the Elders was also essential on the site and during the process since there were specific rules and rituals to follow before we could break ground.

It was essential to be in exchange with the Chief and the Council constantly. It would be disrespectful if only some decisions got discussed without them. That is why there was always a representative of the Councils on site. In our case, that was Nana Gyazi. Also, it was essential at the beginning of the construction before breaking ground; the site had to be blessed and

'Tano', the traditional Spirit, had to be prayed for to support and protect us. A priest first blessed the site, and then Nana Opoku prayed for Tano and poured liquor on the ground as an offering to the Spirit.

Also, it was a concern of the Chief that the King, needed to get all the information about our project. The correct way would have been for the King to visit the site before the construction started, but this was impossible because he was abroad. Since we had such a short construction schedule and could not wait until he returned, we agreed on the compromise that we could start with construction immediately and visit the King as soon as he was back.¹⁰³

These events often delayed our schedule as the rituals and meetings involved hours of preparation, discussions and ceremonies and often we were not informed about them in advance.

However, for the positive progress of the project, it was essential to respect these traditions and procedures and to adjust the schedule accordingly.



Fig.141: Blessing of the construction site



Fig.142: Blessing of the construction site



Fig.143: Setting up of the batter board | Week 1



Fig.144: Foundation digging | Week 1

OVERVIEW OF THE FIRST 6 WEEKS

After all this was done, we could start with the implementation. Before starting with the earthen walls, the first weeks included digging the foundation, binding the reinforcement baskets, and concreting the plinth zone and the columns. Most things happened parallel to each other. Generally, there were three construction sections: Section I, the library; Section II, the PC room; and, later on, section III, the cafeteria renovation, was added. These divisions were necessary due to the high personnel capacity and the short construction time to avoid standing times and obstructions.¹⁰⁴

The first step was to set up a batter board, which enabled the excavation of the foundations on the construction site. This work had to be done with shovels and picks, as we had no hydraulic equipment. Since this work was physically very exhausting, the students and workers always worked in teams that took turns. Thus, this work took more than a week. At the same time, construction work started on the perimeter wall, which forms the outer boundary of the pedestal and separates the stabilised part

of the building from the surrounding terrain. For this wall, cement blocks were used in addition to concrete and reinforcing steel. This choice of material resulted from the time savings that bricklaying brings in contrast to formwork and concreting. A concrete plinth was made to protect our rammed earth walls from water, because rammed earth is water soluble, and wetness can lead to the destruction of the wall structure.¹⁰⁵ Therefore, a plinth with a width of 45cm was made and placed in the centre of the foundation below. The plinth heights varied between 53cm and 73cm.¹⁰⁶ Besides all these tasks, we were also searching for the right materials for our rammed earth walls.



104) cf. Obermoser M., 2023, pp. 110

105) Rauch M., 2015, pp.65

106) cf. Obermoser M., 2023, pp. 147



Fig.145: Foundation detail | Week 2



Fig.146: Setting up the formwork for the reinforced concrete columns | Week 4



Fig.147: Setting up the formwork for the second part of the reinforced concrete columns | Week 5



Fig.148: Concreting the plinth | Week 4





Fig.149: Samuel and Kromuel on the perimeter wall | Week 5



Fig.150: Construction of the perimeter wall with cement blocks | Week 5

RAMMED EARTH WALLS



Fig.151: Earth samples

MATERIAL SOURCING

As mentioned in the Chapter *Rammed earth* any excavated or road-based material is generally suitable for rammed earth. The critical factor is that it does not contain any organic matter. In Nsutam, the search for suitable earth started with telling the townspeople and our contact persons about our project and finding someone to help us with the search. Our contact person was Nana Opoku - the Chief of the Youth and close confidant of the Chief. He was also responsible for approving the land where the mining companies are allowed to mine next and visiting them regularly. Therefore he had a good overview of where excavated material might be available.¹⁰⁷

Since the material from our building site was not suitable because it was mixed with too much organic and demolition material, we had to look for other excavated material that was freely accessible. The main requirements were that enough of it was available for the entire building, that it was not far from the construction site, and that it was easily accessible for transport. A mining company provided its machines for transportation. For this, Nana Opoku drove us through the whole town. When we found a mound that met all the criteria, we took a headpan* full with us to do on-site tests and samples. Since much of the material search depends on experience, Kwame from Hive Earth came to Nsutam to support us. Suitable material was right next to the building site, but more material was needed to build all walls. Therefore, finding

another one was essential. We found one on the Chief's land, but the earth had to get extracted, and it was difficult to separate the upper layer of the earth with the organic content from the lower suitable layer. In addition, we intended not to mine any material but to use only excavated material. We still took a sample of it to test it for a backup plan in case we do not find any other soil.¹⁰⁸

* A round metal container, used for construction work

107) Conversation with Nana Opoku, July 2022, Nsutam

108) Conversation with Kwame Deheer, July 2022, Nsutam

We still kept our eyes open daily because we were not yet 100% satisfied with the earth we found at the first attempt. For a while, we had the support of Lorenz Kastner, a rammed earth expert at the company *Lehm Ton Erde*. Nana Opoku had the idea to drive us to the mines because holes are dug there for gold mining, and they have no further use for the earth.¹⁰⁹

At a mining site, we found what we were looking for. On the one hand, the material had an aesthetic colour. On the other hand, it seemed clay-rich and easy to reach for delivery. We arranged a meeting with the mine manager. Also, there was no problem from his side, and he assured us that we could use the earth. The deal was that we would get in touch again after we made a sample we tested the soil.¹¹⁰

We found the second, quite promising, earth by chance because Nana Opoku wanted to introduce us to his Grandmother. When we arrived at her house, we saw she was expanding, and the excavated earth looked perfect.

We asked if we could take a sample and use the material in case it was suitable. Opokus's Grandmother agreed and said she was happy to support us.¹¹¹ The only issue was that getting there with a big truck was impossible. This meant the material had to be delivered by a pickup, which had to be filled with headpans and wheelbarrows.

The deal with the mining site did not work out eventually since the mound served as a protective wall against burglars and the mining site would remain in operation for a few more months.¹¹⁰ Outside the property was another earth hill that looked promising – we also took a sample from it. After we had enough raw earth together, we started with the on-site tests and samples.

In addition to the earth, we also needed larger stones, round and square ones, and sand. Those are used to supplement the raw earth and create the perfect mix. A nearby mining site provided these materials.



Fig.152: Material search with Lorenz Kastner at Nana Opoku's grandmother's house



Fig.153: Material search at a mining site



Fig.154: Sedimentation test



Fig.155: Sedimentation test

ON SITE TESTS

Since we did not have a laboratory nearby, we had to rely on expert knowledge and on-site testing.

These tests were:

1. Visual inspection: Clay-containing grounds can get identified visually. Clay soils usually have a smooth surface and a fine grain composition. They often have a typical red, brown or grey colour.

2. Smell test: Mud smells very neutral - so if the material smells like humus or a bit mouldy, this is the first sign that it contains organic materials and is, therefore, unsuitable.¹¹²

3. Feeling test: To do this, take the soil in hand, spray it with water and smear it on the hand. It indicates very silty soil if it dries and can get wiped off without water. However, if it is sticky and water is needed to clean the hands again, it implies clay-rich soil.¹¹³

4. Sedimentation test: The material is put into a bottle or glass and then filled with water. It is then shaken well and left until all the particles settle. The largest particles settle at the bottom, the finest at the top, and the organic particles float on the water's surface. This way, the earth's composition is easy visible.¹¹⁴



Fig.156: Lorenz Kastner demonstrating the sedimentation test to the volunteers

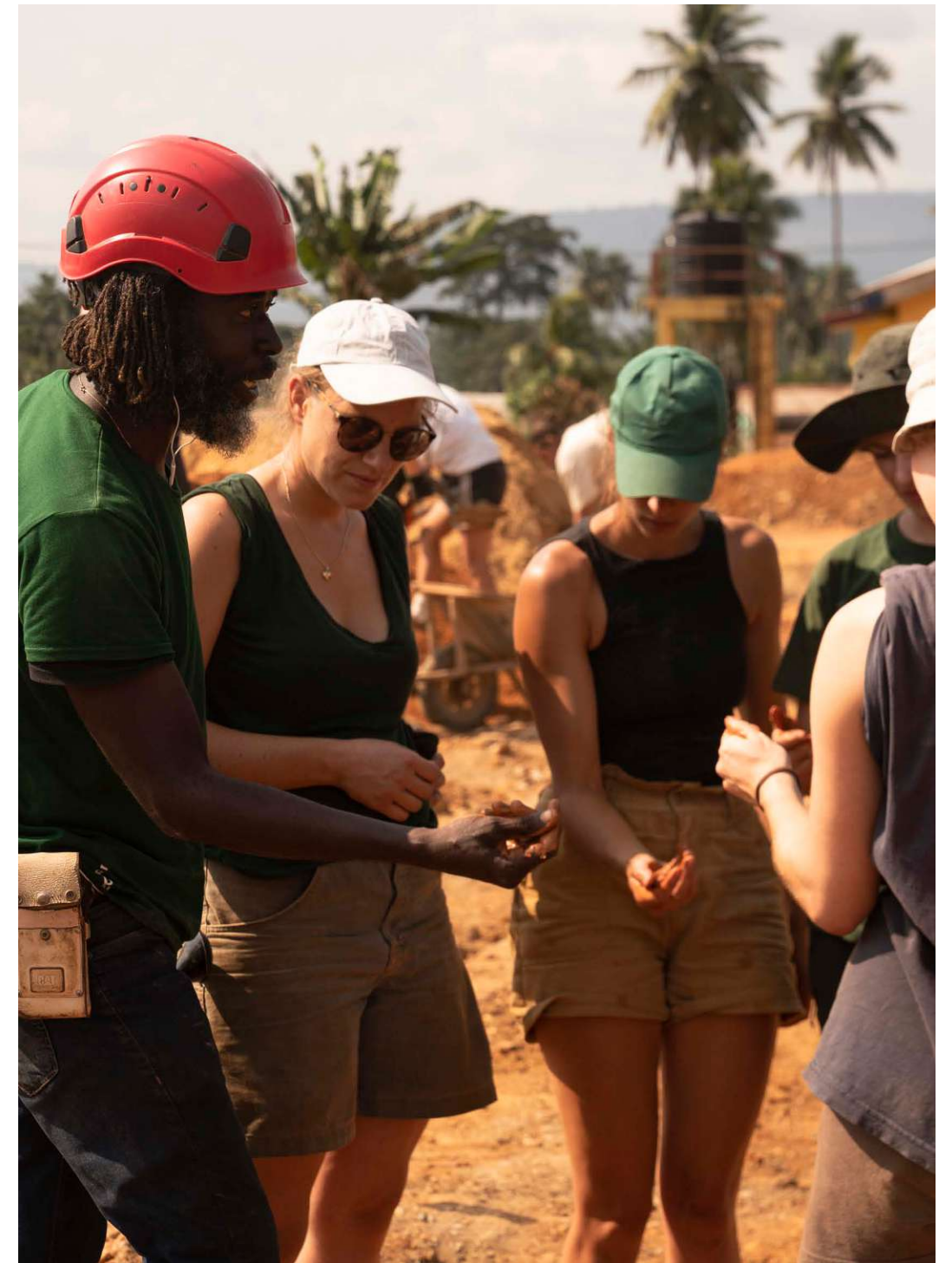


Fig.157: Kwame Deheer showing the volunteers the feeling test

SAMPLES WEEK 1

In order to not mix up the earths, and so everyone knew which one we were talking about, we labelled them and decided to name them according to the place they were found. So, in the end, there was a „Chiefs Earth“, „School Earth“, „Young Granny“, „Gold Mine“ and „Palm Tree Earth“ for the samples. In the first week, we started with a large sample together with Kwame from Hive Earth Studio. Therefore we built up the formwork he had brought and rammed two 1x1.2m sample walls. We used the earth we found next to the Chief’s house and the earth directly on the school campus.¹¹⁵

As an aggregate, we used gravel, which we got from a nearby mining site, and crushed granite, of which there was a pile right next to our building site. Since we were thinking of making our walls with the waves technique, we also tried this technique on a sample.

After we took off the formwork, we were quite pleased with our first samples. However, there were a few problems with these mixtures. The „Chief’s Earth „would have to be extra mined, and we wanted to avoid that if there was an alternative. The crushed granite would not be enough for the whole project and was not available from nearby. Also, we were not so happy with the dark colour. This is why we did more samples in week 3-4.



Fig.158: Left - Chiefs Earth Sample I Right - Chiefs Earth Sample II with „Waves“



Fig.159: Chiefs Earth



Fig.160: School Earth

SUPPLEMENTS:

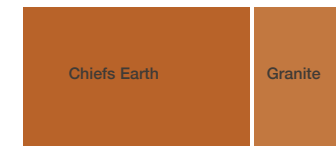


Fig.161: Crushed granite



Fig.162: Red gravel

Chiefs Earth sample I:



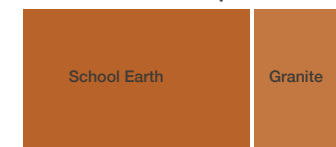
- + easily compactable
- + enough earth available for the whole project
- would have to be mined extra
- therefore difficult to separate from organic matter
- colour does not meet aesthetic criteria
- crushed granite is not available for the whole construction project

Chiefs Earth sample II :



- + easily compactable
- + enough earth available for the whole project
- + redder in colour because of the addition of red gravel
- would have to be mined extra
- crushed granite is not available for the whole construction project

School Earth sample - Waves:



- + good for the waves technique
- + good for stabilised rammed earth walls
- low clay content
- hard to compact
- not enough material for the entire project

Young Granny sample




Fig.163

Fig.164: Young Granny sample

Young Granny	Stones	Gravel
--------------	--------	--------

- + clay rich
- + very compact mix
- + enough material for the whole project
- + aesthetic colour
- delivery difficult

Gold Mine sample






Fig.165

Fig.166: Gold Mine sample

Gold Mine	Stones	Gravel
-----------	--------	--------

- + clay rich
- + very good mixture
- + enough material for the whole project
- + aesthetic colour
- high shrinkage, therefore slight cracks
- material not available

Palm Tree sample






Fig.167

Fig.168: Palm Tree sample

Palm Tree	Stones	Gravel
-----------	--------	--------

- + clay rich
- + enough material for the whole project
- + aesthetic colour
- + Delivery by truck
- high content of dead organic material

SAMPLES WEEK 3 & 4

In weeks 3-4, we experimented with more samples with the mixes of „Young Granny“, „Gold Mine“ and „Palm Tree“ earths.

The samples were used to find out the correct mixing ratio, how well the material could be compacted, whether cracks form during drying and to see the colours of the different earths. After stripping the formwork, Lorenz and Kwame compared the earth samples again.

They both agreed that the „Young Granny“ mix was very suitable since it was rich in clay, which is beneficial in rainy regions since this earth is more water-resistant than a lean one.¹¹⁶ The second choice would have been the „Gold-mine“ mix - but we could not get ahold of this material. Therefore, the choice fell on the „Palm Tree“ mixture. This one was also very clay-rich. Adding enough stone and gravel to this mixture was necessary because the earth had many

small aggregates.

Based on the sedimentation test, we could roughly estimate the composition of the raw earth – whereby one must always mix a representative sample of the earth with the water; otherwise, the sample is not very informative.

In the case of the „Palm Tree“ earth, after the sedimentation test, it looked as if there were no stones in it, but this turned out to be wrong when looking at and feeling the raw earth.

Therefore, it is always important to do more than one test and best to have experts on site since much of finding the right earth mixture has to do with experience.¹¹⁷



Fig.169: Young Granny



Fig.170: Golde Mine



Fig.171: Palm Tree

SUPPLEMENTS:



Fig.172: Stones



Fig.173: Red gravel

SELECTED MIXTURES & DELIVERY

The selected mixtures were „Young Granny“ and „Palm Tree“. We readjusted them in the mixing ratio. For the Granny mix we added 1 part of Granny earth to increase the clay content and for the Palm Tree mix we used only 2.5 parts of the Palm Tree soil instead of 3, because the sample had slight cracks and we wanted to lean the mix a bit. As a unit of measurement for the earth recipes, we used a wheelbarrow.

Young Granny recipe:

- 3 wheelbarrows of Granny earth
- 1 wheelbarrow of larger stones
- 1 wheelbarrow of red gravel

Palm tree recipe:

- 2,5 wheelbarrows of palm tree earth
- 1 wheelbarrow of larger stones
- 1 wheelbarrow of red gravel

In week 6 the mixtures were adjusted again because a smoother surface was desired. Therefore, the large stones were removed from both mixtures.

The Palm Tree soil was delivered to us by truck,

while the Granny soil had to be brought by a pickup truck that had to be filled manually with a shovel and wheelbarrow. Our goal was to make 2-4 deliveries a day, so we always had enough material to mix at the construction site. In consultation with Kwame and Lorenz, we decided to go without another test cube and stamped the first wall of the building as the last „sample“.¹¹⁸



Fig.174: Young Granny Sample

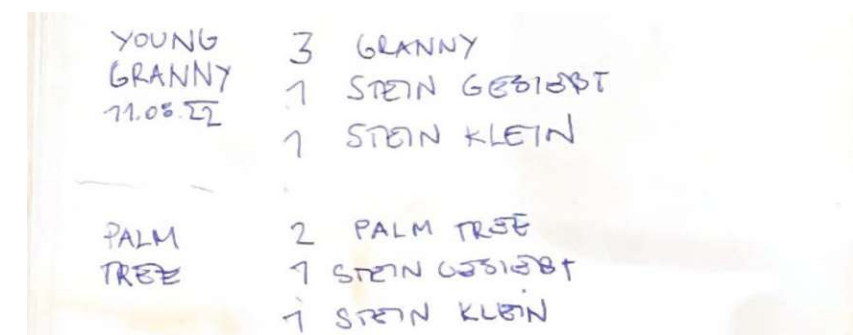


Fig.175: Recipes for earth mixtures

Fig.176: Material sourcing

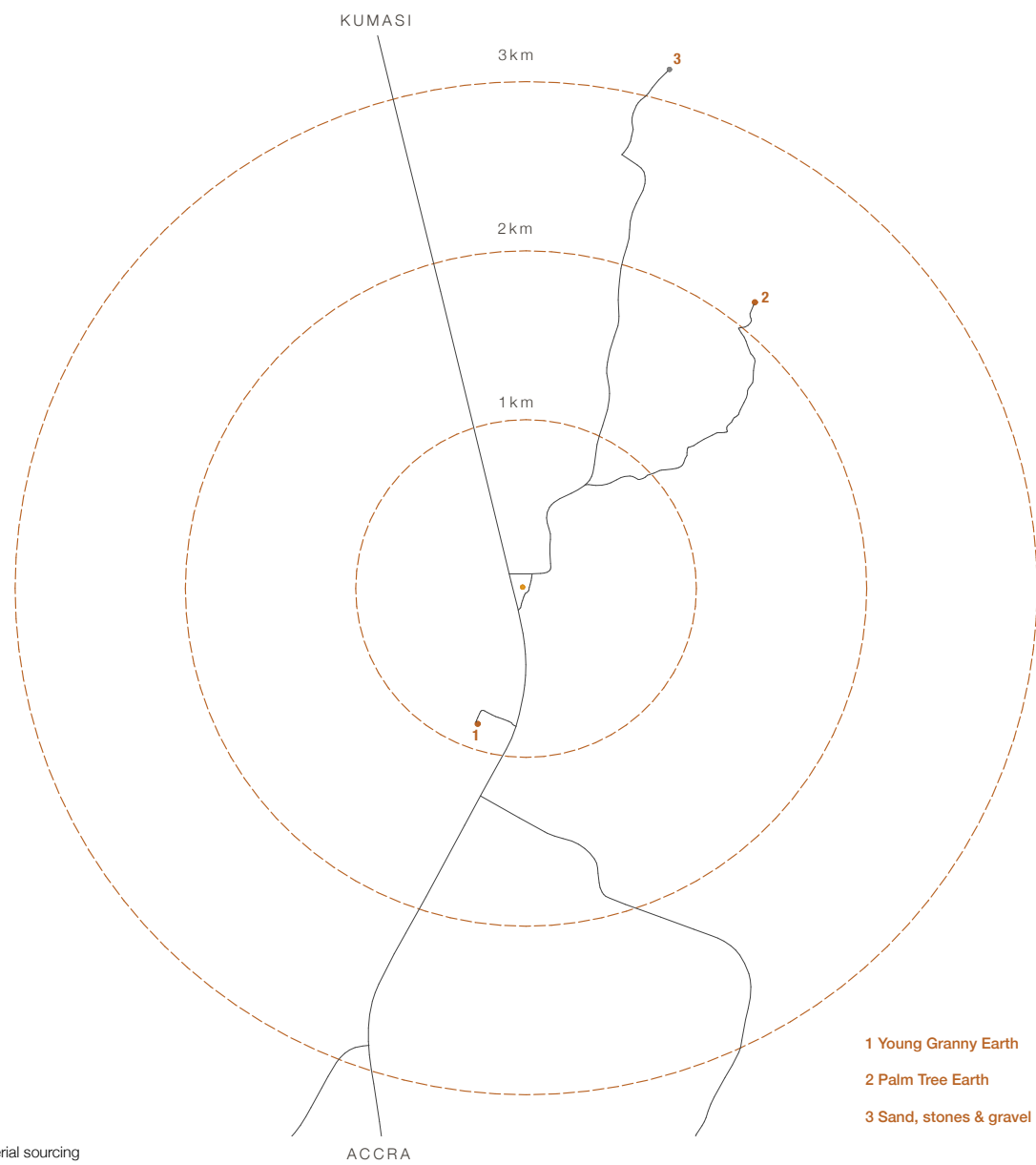


Fig.177: Delivery of the Young Granny earth

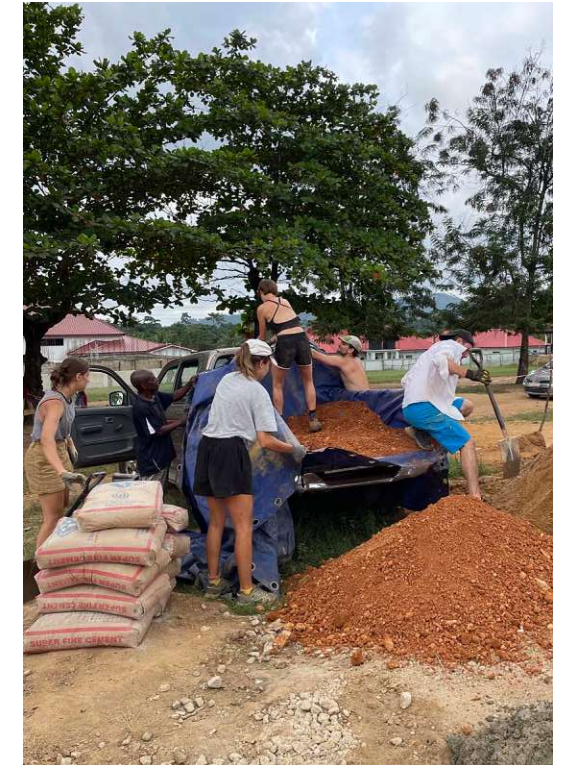


Fig.178: Delivery of the Young Granny earth



Fig.179: Delivery of the Palm tree earth

RAMMED EARTH WALL - STEP BY STEP

1. mixing the material:

Since we had only one mixing machine on the site, which was used for the concrete work, we had no choice but to mix the earth mixtures manually with shovels. For this purpose, a mixing area was set up on the construction site. Since no organic materials should get mixed into the earth, we needed a solid, clean and washable base.

The Palm Tree earth needed to be thrown through a sieve to remove all the wood pieces and other organic materials before it could get mixed. This made the mixing process a bit complicated. The organic material was added through the excavator delivery and the storing of the earth directly under a tree. After this step, the mixing process was the same for both mixtures.

First, the fine gravel were dumped onto the mixing area and spread out in a circle. Then the larger stones were dumped on top and spread in a circle over the fine gravel again. This stone mixture then got moistened. Each stone should get wetted to combine well with the clay particles and the remaining soil. How much water was needed depended on whether it rained that day or not.

Then the first wheelbarrow of the earth was emptied onto the stones and spread out. After this step, it was best to have 3-4 workers lining up in a circle, shovelling the mixture from the outside to the inside onto a pile, and spreading it out again. This process was usually repeated 2-3 times. Then the next batch of earth was added, and the mixing process was repeated. Rammed earth should be rammed moist, so water was added as needed. After everything was well mixed, it was brought to the storage.

2. Storage of the material:

First, we stored the material outside next to the construction site and covered it with tarpaulins. In theory, if the material is protected from rain and sun, the mixture can be used at any time without adding additional water.

In practice, this storage proved to be very difficult because of the frequent rain showers that soaked the earth mixtures. In order to solve the problem, the school cafeteria was cleared in week 6, and the mixes were further elaborated and stored there.



Fig.180: Fine gravel were dumped onto the mixing area



Fig.181: Then the larger stones were added



Fig.182: Then the earth was mixed



Fig.183: Mixing process



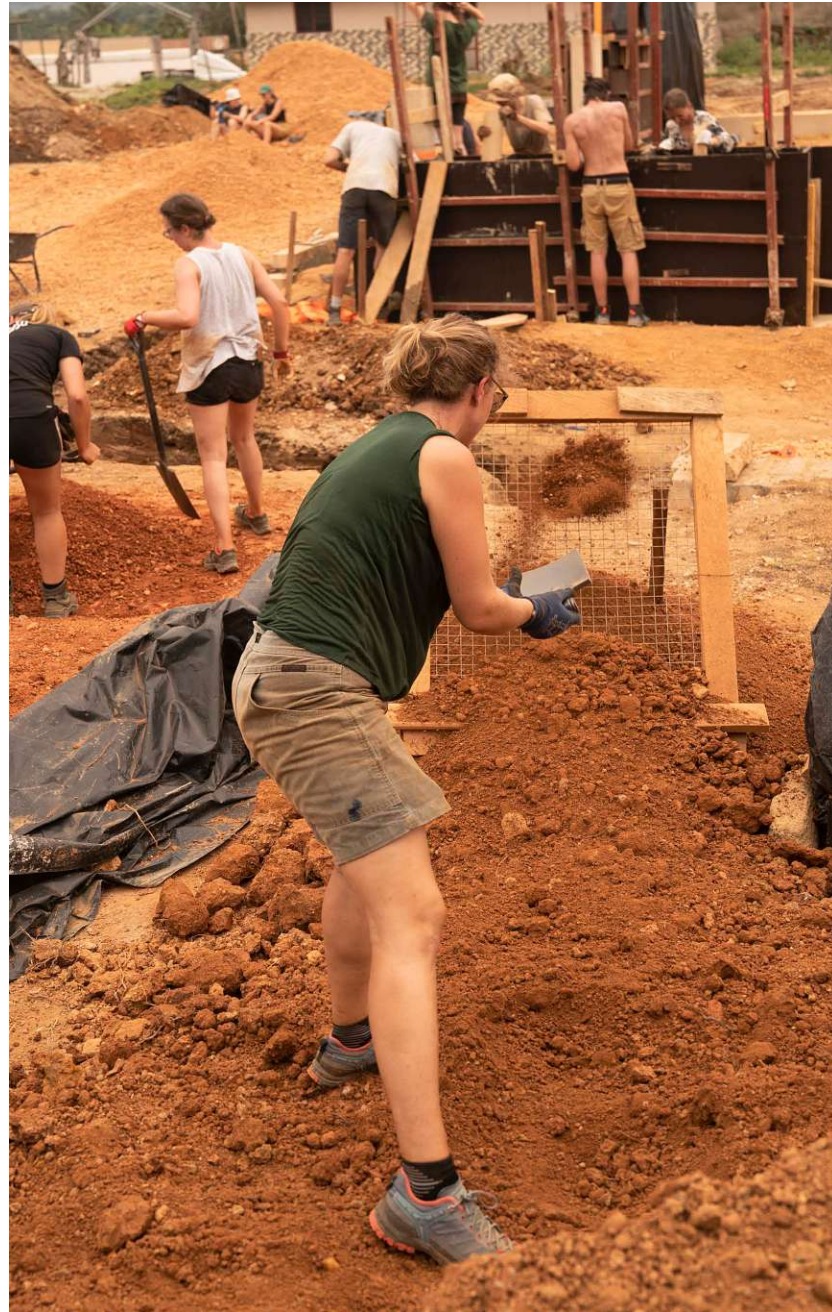


Fig.184: Sieving the Palm Tree earth



Fig.185: Earth storage outside | week 3 -6



Fig.186: Earth storage in the canteen | week 6

3. Formwork

Kwame brought the formwork we eventually used, which was the formwork Hive Earth Studio uses on all their projects. The formwork involved plywood panels, horizontal metal elements, vertical metal studs, and tie rods. Until a few years ago, they worked with wood-only formwork, meaning they had to buy horizontal and vertical wood studs for each new project. With the current system, only the plywood box had to be custom-made for each project, but the metal elements could be used multiple times. We used this formwork for the earth walls, concrete plinths and columns.

Setting up the formwork

The first step was to create the negative of the wall with the formwork panels. To do this, we had to cut two sideboards and headboards to the wall length and thickness dimensions. Before the formwork was placed, all four formwork panels were covered with oil. To prevent the earth from sticking to them when the formwork was loosened, and the fine clay particles would not be torn out of the wall. Then the formwork got positioned. For this purpose, the first tie rods got placed on the plinth. After that, the two long formwork panels – the sideboards – were plugged into it. Then the short parts – the headboards – were put in position. When everything was in place, the sideboards and headboards

were screwed together. It was important to work accurately and have all four sides at the correct angle. Any inaccuracy would have affected the wall and would be visible in retrospect. Once this was done, the vertical metal upstands were added. Every 30cm, flanges were welded on them, where the horizontal members got placed. They also had holes every 1,20m for the tie rods to pass through.

After placing the vertical stands, the tie rods were stuck through the holes. Those got tightened only so far that the vertical stands remained standing. When they were in position, the horizontal members could get placed on the flanges. Once all was in place, the tie rods were tightened. When everything was set up, it was essential to measure again at the inside of the formwork box whether everything was still at the right angle. Everything had to be well screwed together, and the tie rods had to be tight so the boards did not bend outward during the ramming process.

Sometimes that happened to our walls: The formwork started bending slightly outwards, especially at the upper end. We tried to counteract this with tension belts and additional horizontal members.



Fig.187: First, the formwork was positioned on the plinth



Fig.188: Then the two sideboard were added



Fig.189: Sideboards and Headboards were screwed together, and vertical metal upstands were added



Fig.190: When everything was set up, the tie rods were tightened

4. Filling in the earth:

In order to have an overview of how thick our layers would be in the end and how far we could compress them, we kept a ramming protocol.

To do this, we measured the distance from the top of a formwork panel (sideboard) to the plinth. The height of the formwork, in our case, was about 113 cm.

The plinth was moistened slightly before filling in the first headpan of earth. Then enough material was poured in to reach a layer of about 12cm. To avoid measuring each time, we always counted how many handpans we had to pour in to reach this 12cm. This was usually 8 headpans for the short walls and 10 for the longer ones. We used both earth mixtures for each wall. There was no exact ratio because with this technique, we wanted to achieve a „waves“ style. We made sure to use more of the „Young Granny“ earth because it was easier to compact and mix. When placing the material, it was essential to dump it against the formwork so that the large stones would be in the center of the wall and not exposed on the surface of the finished wall.

After enough earth was in the formwork, we levelled it by hand or shovel and removed large stones from the sides and corners. It was essential to avoid stepping on the loose mixture. It had to be pre-compacted beforehand. ¹²⁰



Fig.191:Filling in the Earth

5. The earth ramming process

For ramming, we used manual metal rammers. The first step was to pre-compact the loose earth – first along the sides and then in the middle so the large stones were not pushed outwards again. At this stage, it was important not to step into the mixture.

Once lightly compacted, one can climb into the formwork and start ramming. First, again, the sides along the formwork and then the middle were compacted strongly. That was done by repeatedly moving the rammer up and down with full force on the material. The corners were compacted with squared timber or a piece of plywood. Alternatively, the sides can be compacted with a sledgehammer. When the surface gets shiny, and the sound of the rammer becomes metallic, it indicates that the layer is done. In addition, a nail was used to test whether the layer was sufficiently compacted. The nail was pressed into the earth layer and was not supposed to penetrate further than 1cm into the layer..

The goal was to compact the loose earth layer of 12cm to about 50%. Once it seemed like the layer was compacted enough, the ramming protocol served as a control. Again one measured from the top of the formwork to the earth layer.

In the above example, the calculation would be:
 Measure from the top of the formwork to the plinth: **113 cm.**

Measure after placing the earth mixture: **101 cm**
 Measure after compacting the earth mixture: **107 cm**

Compacted layer: **113 - 107 cm = 6 cm.**

Thus, a layer of 6cm would have been achieved. Completing precisely 50% was not always possible with manual rammers. In consultation with Lorenz and Kwame, it was determined that layer thicknesses of 5cm-9cm were acceptable.¹²¹ Two people mainly rammed the layers in this process, and another 2-3 people delivered the material. The workers usually changed after 3-5 layers because the process was physically exhausting.



Fig.192: Metal rammer



Fig.193: Ramming protocol

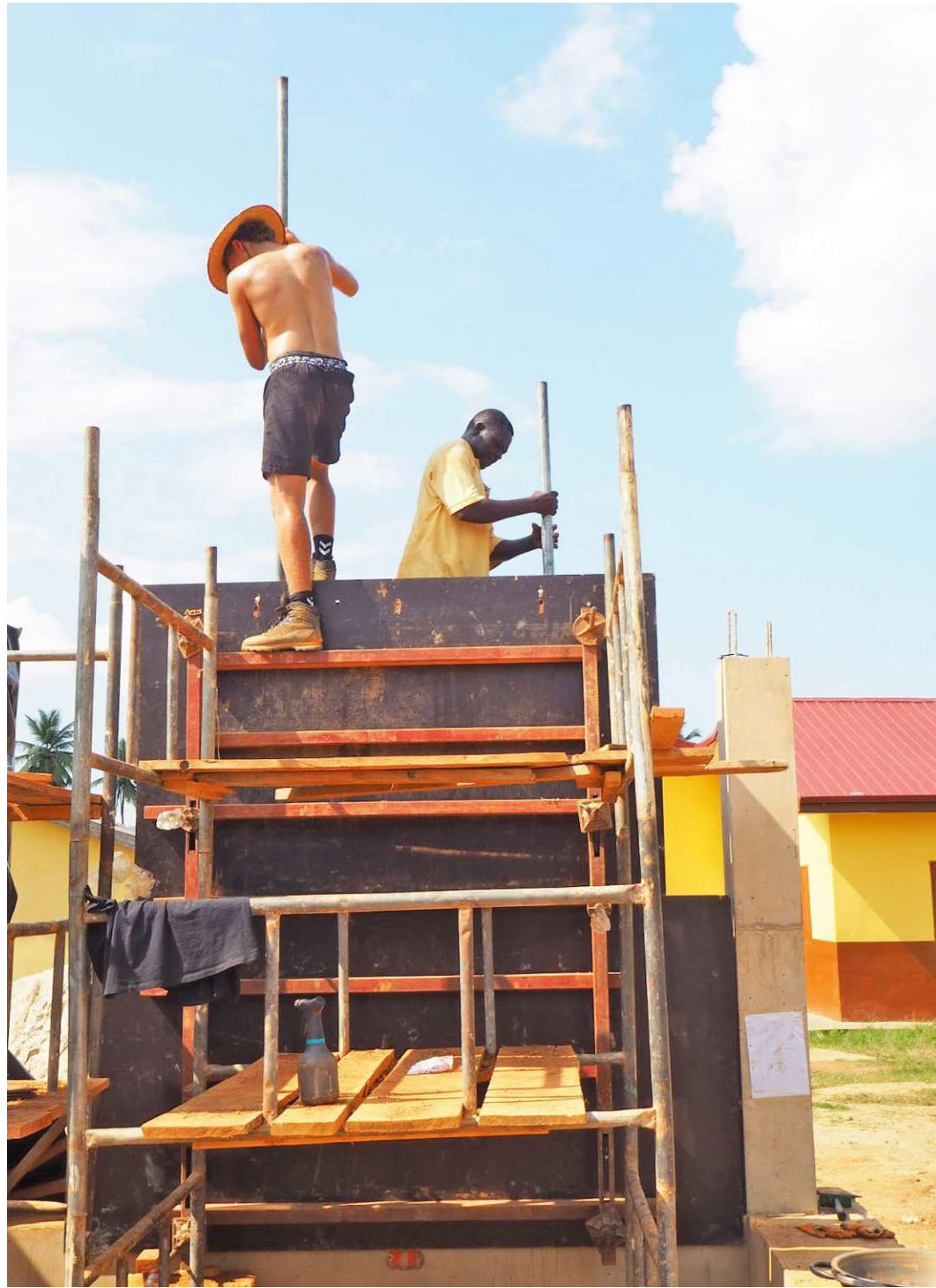


Fig.194: Earth ramming process

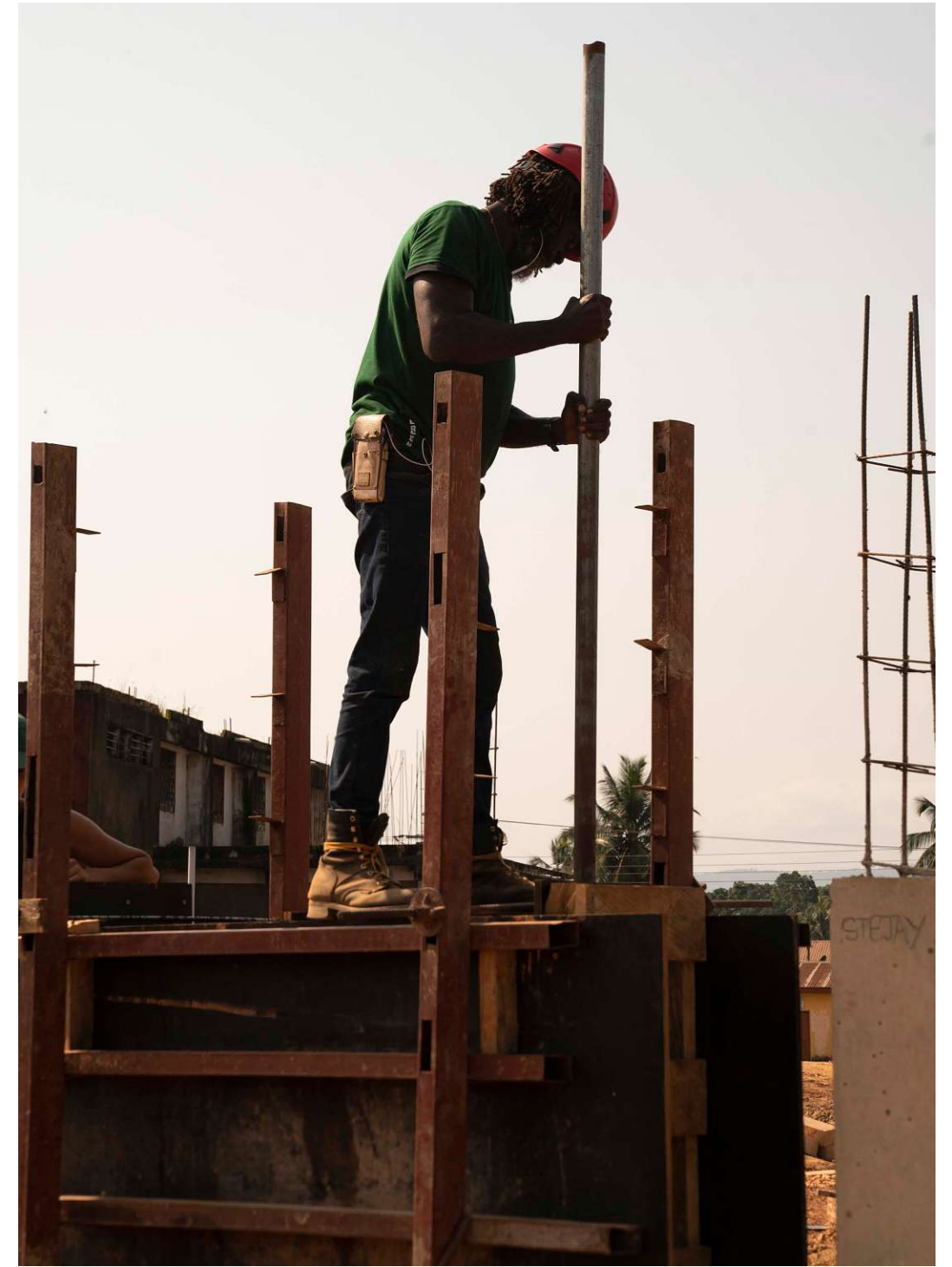


Fig.195: Earth ramming process

Shifting the formwork:

When we reached the top of the first formwork panel at the height of 1,10m, either a second formwork was installed on top of the first or the lower formwork was pulled upwards.

Ring beam:

Since a concrete ring beam held our walls and we did not want it to be visible, we used a wooden spacer holder at the top layers. This allowed us to ram the outside of the wall to the desired height. On the inside, however, space was left for the ring beam. Logging the layers in our ramming protocol made it possible to adjust the height of the earth layers if necessary to insert the space holder at the correct level.

Break:

If we did not ram a wall by the end of the work day, it got covered with a plastic sheet at the top. The foil was removed the next day – the last layer was moistened again and the ramming continued.



Fig.196: Wooden spacer holder for the ring beam



Fig.197: Wooden spacer holder for the ring beam



Fig.198: Shifting the formwork | Formwork was pulled upwards



Fig.199: Shifting the formwork | Second formwork was installed

Removing the formwork:

When the desired wall height is reached, an unstabilized rammed earth's formwork can be removed directly. For this purpose, all tie rods got loosened, and the vertical and horizontal uprights were removed. Workers still held the formwork panel so it did not fall away from the wall. Then the formwork panel were pressed against the wall and lifted away upwards

Clay particles may remain attached to the panel - these are not torn out of the wall but distributed in the wall when the formwork gets lifted upwards. It is possible to put oil on the plywood before to minimize this problem. After that, the wooden placeholder for the ring beam was also removed.



Fig.200: Removing the formwork

Aftercare:

After stripping the formwork, the earthen walls were treated with round wood and a hammer to smooth out the joints created by the formwork panel. The holes in the walls created by the anchor rods were plugged with the same earth material. The corners of the earthen walls are the most fragile as long as they are not protected. However, it is not a problem if some material breaks off during the construction or afterwards. These parts can be repaired again.

In order to do this, the damaged area gets roughened and moistened again. Then, ideally, the same material is used and stuck to the wall. In order for the material to stick to the wall well, it is helpful to use a piece of wood and a hammer to compact it. The first layer may crack - if this happens, simply repeat the process. It takes some practice to reproduce the ramming pattern, but one gets the hang of it after a few tries.

In general, it is important to be aware and to communicate to all future users that the surfaces of rammed earth walls are constantly changing

and that the clay particles can become loose due to weathering and friction. This is not construction damage or poor material quality but a characteristic of rammed-earth walls. Kwame recommended an acrylic coating to reduce this process. He assured us that the characteristics of the rammed earth walls would not be lost. Only the surface will be more resistant to weather conditions.¹²²



Fig.201: Aftercare of the walls

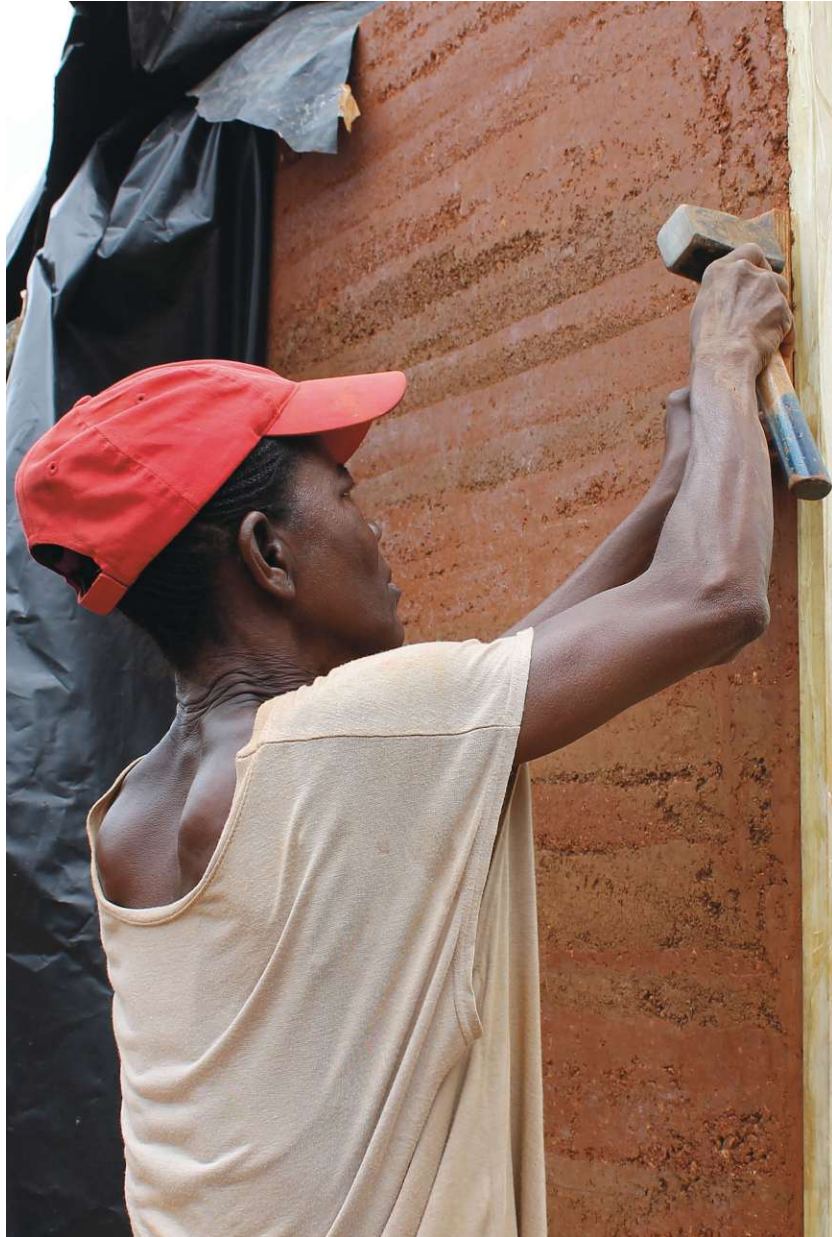


Fig.202: Aftercare of the walls



Fig.203: Aftercare of the walls



Fig.204: First completed rammed earth wall | Week 5



Fig.205: First completed rammed earth wall | Week 5

LAST DAY AT THE CONSTRUCTION SITE

After the first walls were finished, we received a surprise visit from the Chief, the head of the construction office and the press. They were all curious and happy to see the first finished rammed earth walls. They asked questions about technology, durability and the progress of construction. This visit was also the opportunity for me to tell the community that from now on, my duties as coordinator would be handed over to Luisa and Anna as I would leave the following week.

After construction week six, it was time for me to say Goodbye.



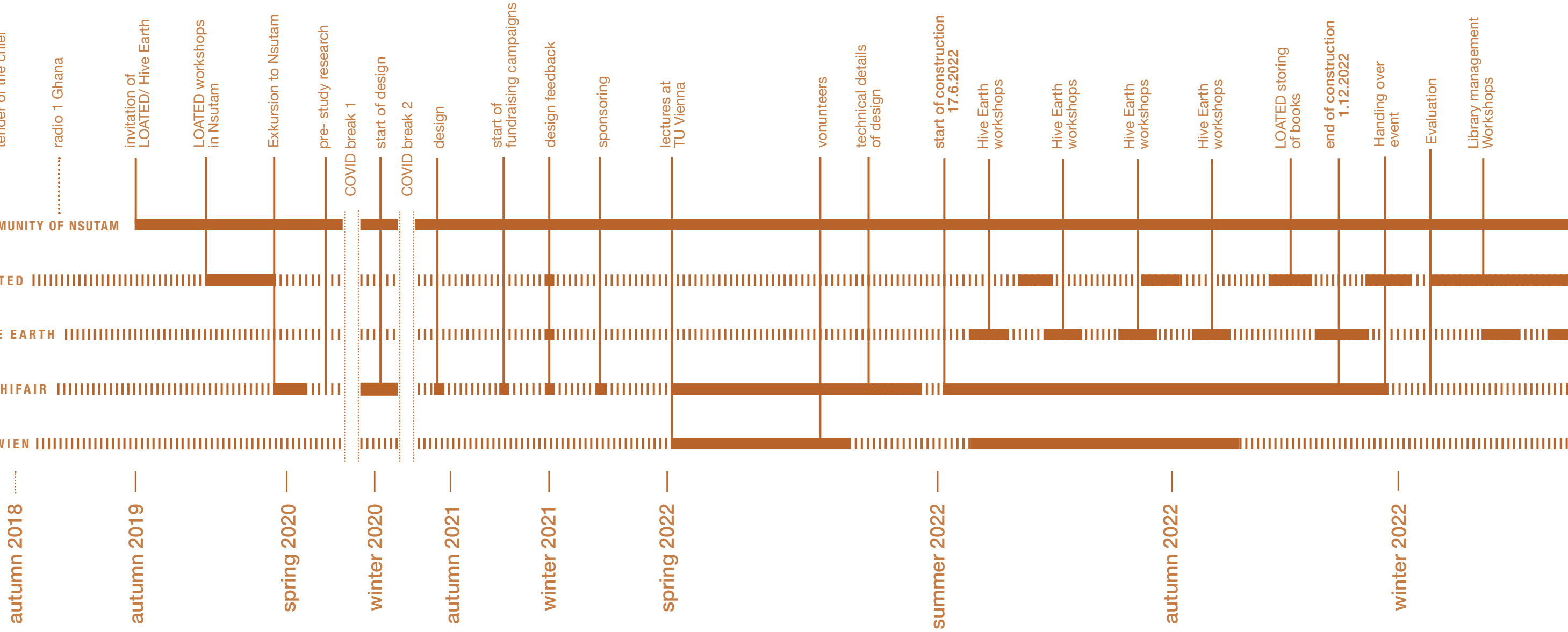
Fig.206: Visit from the Chief the head of the construction office and the press

PROJECT STATUS AT WEEK 6



Fig.207: Project status at week 6

TIMELINE OF THE PROJECT



mudLIBRARY RESULT

- THE RESULT: PHOTOGRAPHS
- PARTICIPANTS MOSAIC



Fig.208: The mudLIBRARY



Fig.209: The mudLIBRARY



Fig.210: The mudLIBRARY

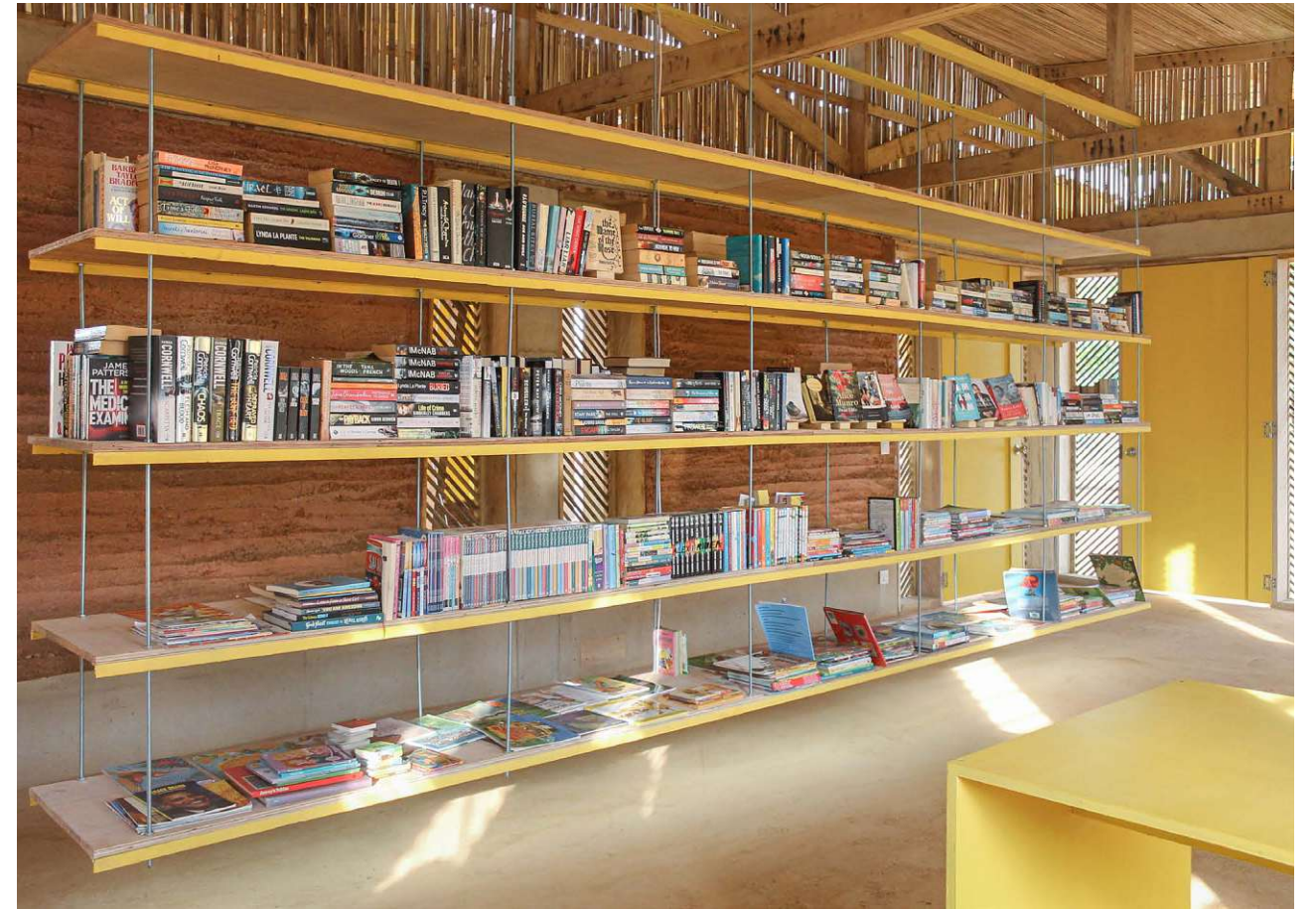


Fig.211: The mudLIBRARY



Fig.212: Participants mosaic

CONCLUSION

My motivation to start this project with ArchiFair three years ago was mainly the perspective of being able to spend an extended period abroad in my expected last term at university and to deal with earth-building techniques in depth. I would never have thought this would turn into three years in which euphoria and frustration were often only minutes apart. After the first highlight of the research trip in 2020, the following years were characterized by uncertainty because of the pandemic. At the same time, there was always hope that we would soon be able to start implementing the mudLIBRARY. Due to these constant ups and downs, staying motivated and keeping in touch with all the local partners took much work.

In addition, it was only over time that I became aware of the responsibilities that a project in the context of development involves, especially in public relations as an organization. I am grateful for the lessons learned during this experience, and I think it is important to actively study the history of development cooperation when embarking on such a project. Even if it is uncomfortable to question one's thinking and views, it is an essential part of such work to examine one's steps again and again critically

and to change them if necessary.

Regarding the design phase, getting insightful feedback via WhatsApp and video calls was often challenging. For a new project, I would plan a second trip to the construction site. This way, there would be time for more detailed conversations, preferably with the community. Also, to check material offers, discuss planning details with artisans, and, if necessary, make adaptations to the design. Concerning the climatic conditions, it would be beneficial to experience rainy and dry seasons.

Regarding the first research trip, I would spend more time involving the later users, in our case, the students and teachers, and encourage their participation throughout the process. On my first visit to Nsutam, this was, unfortunately, very difficult as it was characterized by getting to know our local partners. I had little to no chance to explore the town on my own because there was always a member of the Council of Elders on my side. In order to better understand the wishes of the future users of the building, it would be essential to talk not only to the decision-makers but to as many residents as possible.

In our case, although there was an attempt to give earth-building workshops during the construction phase, unfortunately, there were only a few participants, and in addition to the daily work on the construction site, it was challenging to adjust the workshop design to enhance participation. Therefore I would dedicate more time to planning such offers in advance for a new project. Based on my experience, the most promising participants for such workshops are the school children. They were the most curious on our construction site and stopped by every day. If you think about child-friendly workshops in advance, it would be easy to get them to join. Earth building is suitable for this because it is completely harmless as a building material and contains no toxins.

The absolute highlight of the whole project was the on-site implementation. The exchange with the team, the students, the volunteers, the community and the local partners created experiences and friendships that added the most significant value besides the finished building. Also, the intensive exposure to the building material earth and the great knowledge transfer by the experts Kwame Deheer, Lorenz Kastner and ArchiFair were an enormous enrichment.

I can't presume whether or not the building technique of rammed earth is the type of construction that animates to imitate. But rammed earth has, in any case, a publicity effect, whether in the community or on social media. This was evident in our project at the latest when the Chief, the head of the building authority and the press visited the construction site to inspect the first earthen wall. Thus, rammed earth offers the building material earth a showcase and attention that it usually does not get. For a follow-up project, I would, in addition, focus on other techniques that require less expertise and equipment and are, therefore, more accessible to the general public.

The long-term success of the library is, in my opinion, very promising. The site is very central, the local partners LOATAD are highly motivated to keep the library running, and the community stands behind it.

In the end, little of this project went as planned initially, but looking back, I am happy to have stuck with it until the end, even if the planned one year turned into three.

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Daheer Kwame: 21.7.2022, Nsutam

Daheer Kwame: 07/2022, Nsutam

Kastner Lorenz: 07/2022, Nsutam

Opoku Nana and his Grandmother: 07/2022, Nsutam

Opoku Nana and the Mine manager: 07/2022, Nsutam

Opoku Nana: 07/2022, Nsutam

Oppong Richard: July 2022, Nsutam

Osambarima B.S.K. Chief of Nsutam: 05/2022, (Phone call)

Osambarima B.S.K. Chief of Nsutam: 06/2022

Meetings:

ArchiFair: March 2020, Vienna

ArchiFair: March 2022, Vienna

Council of Elders: 02/2020, Nsutam

Osambarima B.S. K. Chief of Nsutam, Hive Earth Studio and LOATAD, 8.2.2021, (Online Meeting)

E-Mails:

Arthur Sylvia: E-Mail to ArchiFair, 9.1.2020

Orthner Martin: E-Mail to ArchiFair, 18.2.2020

Osambarima B. S. K. Chief of Nsutam : E-Mail to ArchiFair, 9.1.2020

Willemsen Jaap: Email to Community of Nsutam, Hive Earth Studio, and LOATAD, 28.1.2020

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