



A MATTER OF LIFE

*Designing a casualty department and reproductive child health
using research-based design.*

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Chalmers University of Technology
Supervisor: Lin Tan
Examiner: Peter Fröst



CHALMERS
UNIVERSITY OF TECHNOLOGY

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Examiner: Peter Fröst

INTRODUCTION

Abstract

It is known that the built environment affects our wellbeing and there are many design strategies to support healing and mental health in hospitals. The third United Nations Development goal: Good health and wellbeing, stresses the importance of healthy people to support a sustainable development. In the past years the world has made great progress in lowering premature deaths and increasing life expectancy, still some nations are struggling.

Mkula hospital in Tanzania is a district hospital with few resources in a context where healthcare is scarce and life expectancy is low. The hospital needs expansion and renovation. This thesis will be a part of the hospital's development.

By designing a casualty department for the hospital, they gain the ability to safely care for emergency patients which is crucial in a district hospital to prevent deaths. A new building for Reproductive Child Health (RCH) will also be designed as a step in the future expansion of the hospital.

This thesis will focus on exploring design strategies for architecture that supports healing and health in the above-mentioned buildings by answering the following question:

How can a design dialogue be used in a developing context to improve healthcare in a sustainable way?

The design method is an iterative process based on research for design. To investigate how these new buildings can contribute to a better healthcare environment a study on the site was conducted together with workshops, sketches, models, photos and observation. The research is the foundation of a design proposal based on the findings on site, previous research on healthcare architecture and the result of the design dialogue.

The result is a casualty department and RCH that support healing and health by caring for both patients and staff. Use of local materials and influences from traditional construction gives the new hospital a warm and familiar atmosphere that provides spaces for healing both indoors and outdoors.

The project explores how context influence design and how the healing environment can be built without great cost.

Key words: Tanzania, Healthcare, Sustainability, Design dialogue

STUDENT BACKGROUND



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Norconsult, 1 year

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CHAPTER ONE

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Background

PREAMBLE

Evidence and theories about how architecture influence our wellbeing have been around since the 1960:s. The purpose of architecture is to create a comfortable shelter for people, designing these shelters adds one more dimension that influence how people feel using them.

When we are ill we cannot control the environment around us, and at the same time it affects us more when we are already stressed. That is what makes hospitals so important when it comes to architecture, a hospital is not only a shelter, it is a place we go to heal and the building should support that.

Focusing on creating a building with a positive influence on the users should be a priority in any project and it gives architecture power to enrich peoples living.

PROJECT BACKGROUND

This thesis is a part of a project named Healthy hospitals. Healthy hospitals started in 2013 at Kolandoto hospital in Tanzania where three different phases were conducted. Healthy hospitals is a cooperation between Architects without borders (ASF) and Engineers without borders (ISF) with the goal to improve healthcare at Mkula hospital and save lives at the hospital.

This thesis is a part of the second phase in Mkula where the work from phase one is continued and improvements to the infrastructure is made. Kolandoto and Mkula are both district hospitals run by African Inland Church Tanzania (AICT).

STAKEHOLDERS

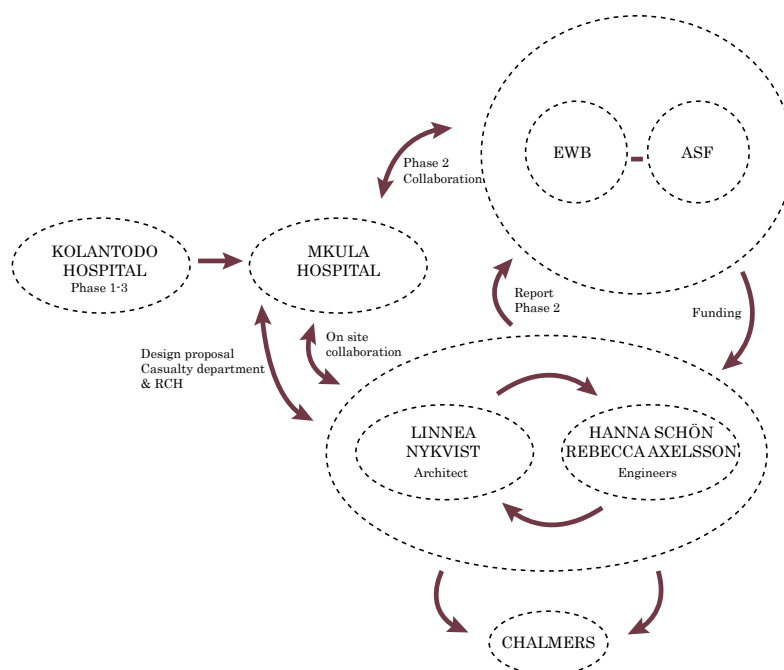
Mkula hospital
African Inland Church Tanzania (AICT)
NGO:s making decisions.
Four engineering students conducting their master thesis work.
The staff at the hospital.
The patients and visitors to the hospital.

DELIMITATIONS

The field study took place during seven weeks, which is a very limited time to understand a new context.

This thesis was designed in parallel to a construction project on site. Initially the design was adapted to be as cost efficient as possible, however after the field trip another design has been developed integrating the knowledge obtained on site.

The design investigation is also limited to the Reproductive Child Health (RCH) and Casualty, even though other buildings on site are affected by the suggestion of this thesis.



PROJECT GOAL

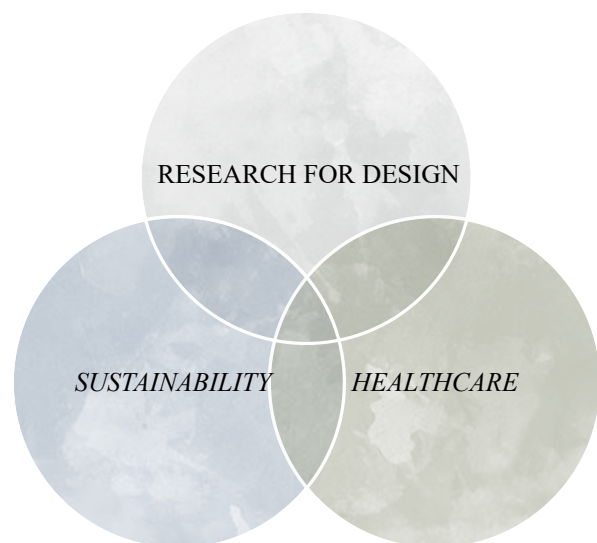
The project goal in Mkula hospital is to improve healthcare and lessen mortality. The Casualty department will provide the hospital with facilities to treat emergency patients brought to the hospital and the Reproductive Child Health (RCH) will gain more space to educate mothers, vaccinating children and preventing the spread of HIV.

The aim of this thesis has been to further develop the architecture of the new buildings to support wellbeing for patients and staff through sustainable solutions.

By designing the new Casualty department and RCH the hospital also receives a new front towards the village. The new buildings have a chance to improve the general impression of the hospital and by that raising the hospitals status which is important for the future expansion.

RESEARCH QUESTION

How can a design dialogue be used in a developing context to improve healthcare in a sustainable way?



UN SUSTAINABLE DEVELOPMENT GOALS

PROBLEM STATEMENT

The goal of this project is supported by the UN sustainable development goals. The main health problems we face today are the mortality rate of children under five, maternal deaths and diseases such as malaria and HIV. All of the above are more likely to affect people living in poverty and without education. Vaccination and education for mothers has had a good impact for the past 20 years but still needs improvement (UN 2019). Half of the emergency cases arriving to Mkula hospital are difficult births and there are currently no facilities equipped to deal with emergency cases. So to lower maternal deaths at Mkula a casualty department is essential. The RCH which deals with vaccination, antenatal care and education only has one examination room today. By providing them with more space the goal of lessening diseases among young children and mothers can be supported in Mkula.

Mkula hospital does not have a casualty department, this leads to emergency patients being treated in an inconsistent manner. The staff have to treat patients without proper equipment and sufficient space. A casualty department would help the hospital establish routines regarding emergency cases and a better work environment can attract specialized staff to the hospital.

The RCH only has one examination room today which leads to lack of privacy for patients when nurses need to go in and out to retrieve things during examinations. There is also consultations being held in a lecture hall completely without privacy. The RCH department is currently located behind the Outpatient Department (OPD) which leads to mixed flows between healthy and ill patients. A new RCH can improve the patients experience and prevent spread of diseases.



1. No Poverty



3. Healthcare



4. Education

CHAPTER TWO

—

Context

TANZANIA

Tanzania is located in the southeastern part of Africa and has a boarder towards eight countries and lake Victoria. The country became independent from Britain 1961 and held its first democratic election in the 1970s (CIA, 2019).

The population is 57,4 million and the official language is Swahili although English is used for higher education. The official capital is Dodoma while the actual capital Dar es Salaam (UI, 2019).

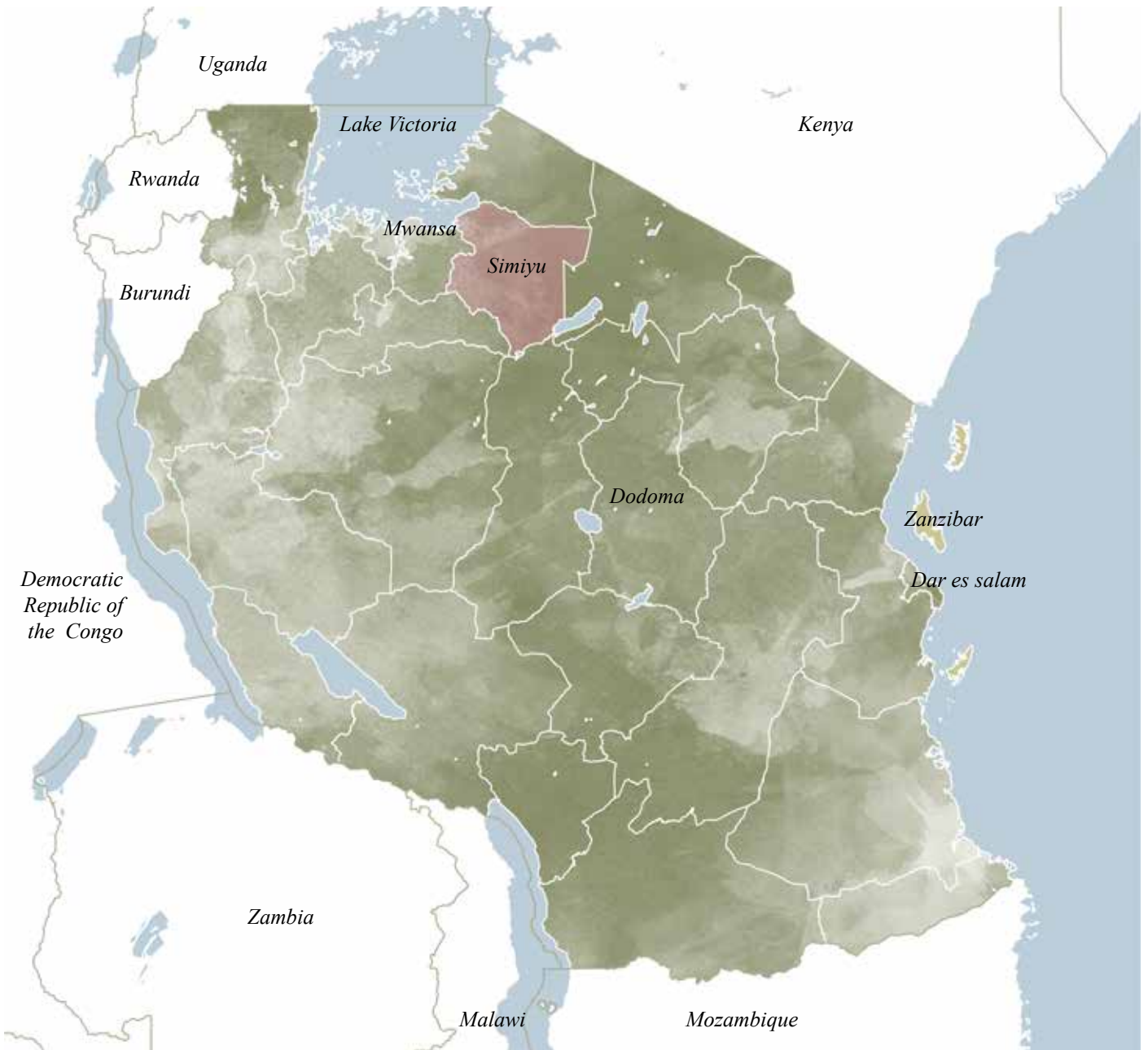
Tanzania is among the poorest countries in Africa despite having received considerable amounts of aid since its independence.

The country has been relatively stable in comparison to surrounding nations but has not been able to get the economy to flourish (UI, 2019).

Most Tanzanians live of small scale farming and the population have been growing rapidly which leads to the population in the countryside remaining poor (UI, 2019).

The population of Tanzania is still growing and almost half of the population are children under the age of 15 years (UI, 2019).

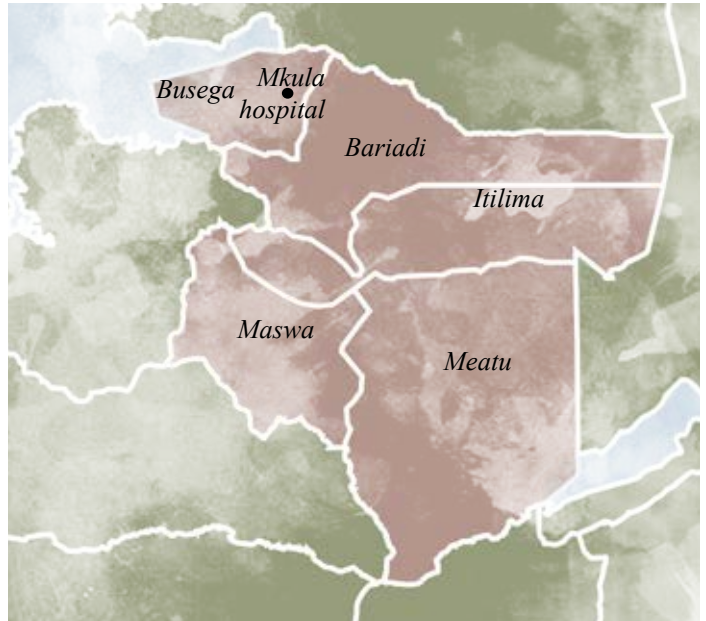
Only 61.6 percent of children starts elementary school (2013) and the literacy of the population is 77.9 percent (UI, 2019).



LOCATION

SIMIYU REGION

The Simiyu region is divided into five districts that each have a district hospital. Mkula is located in Busega district close to the Victoria lake. Busega has a population of approximately 200 000 who all belong to Mkula hospital.



MKULA HOSPITAL

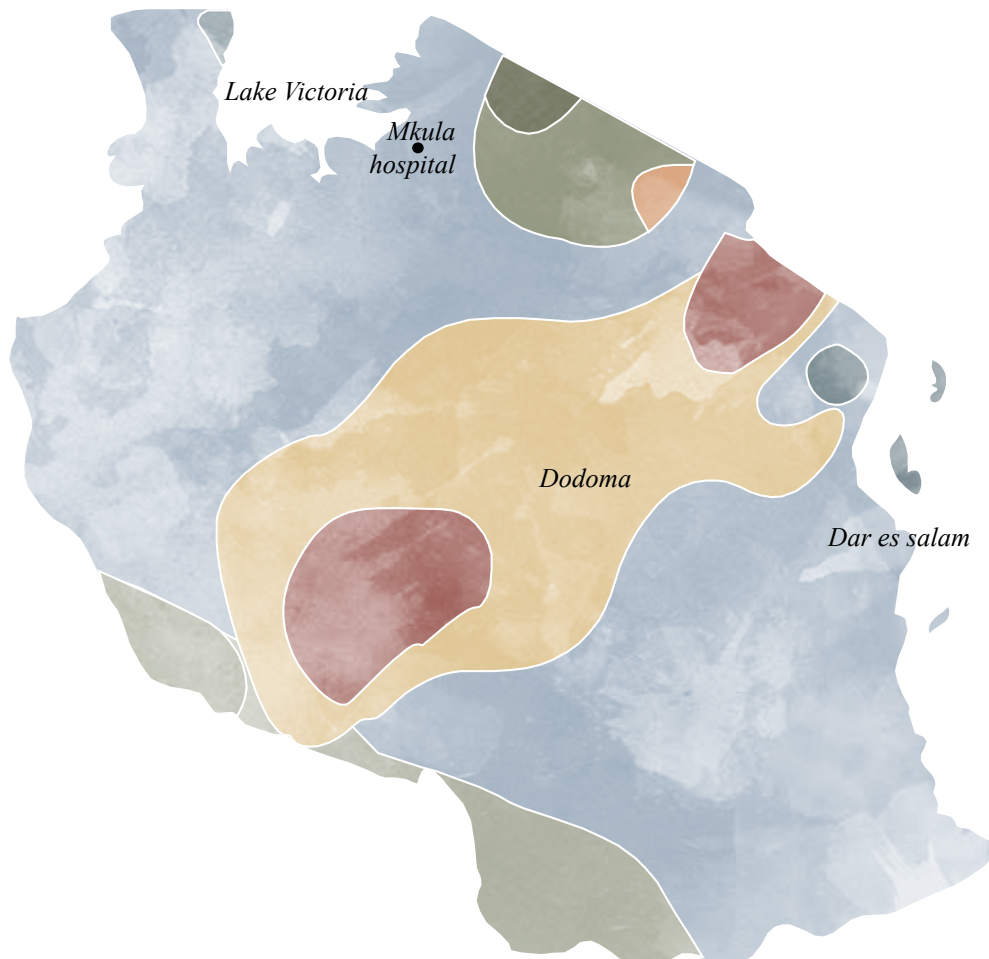
Mkula hospital is a district hospital and serves all of Busega district with advanced healthcare. The hospital has an approximate bed capacity of 100 and usually accommodates 30-40 in-patients / day, however an increased number of patients is predicted.

Children under the age of five are treated free of charge and the remaining patients are treated for a fee that is the hospital's main income, with the exception of some diseases sponsored by the government (Survey report Mkula Hospital ,2018).












Google maps 2019

CLIMATE



TROPICAL SAVANNA CLIMATE

Mkula has a tropical savanna climate which means that there is two seasons, winter and summer and two rain seasons going on from October to March. The average temperature never goes below 18°C during the full year and it never rains more than 60mm during the driest month. The vegetation consist of savanna with grasslands and mostly acacias trees that can adapt to the dry season (World atlas, 2019).

-  Warm desert climate
-  Warm semi-arid climate
-  Humid subtropical climate
-  Subtropical oceanic highland climate
-  Temperate oceanic climate
-  Temperate mediterranean climate
-  Equatorial climate
-  Monsoon climate
-  Tropical savanna climate

LOCAL ARCHITECTURE



Characteristic elements of the local design consist of heavy structured block buildings in compressed earth blocks, bricks or concrete. Many buildings are very colorful and then they often have more than one color at once. Even the traditional buildings with straw roofing get some coloring from the different shades of red and sand in the compressed earth blocks. They are often highlighted by colorful fabrics hanging out to dry in front of

every house. The double skin structure is highlighted by pyramid aluminum roofing that creates stacking effect and also reflects sunlight.

Entrances into buildings are usually highlighted in some fashion, it is common to distinguish it by bright colors or a porch. The porch also provides space for socializing in a shaded place. Gates and concrete tiles are common decorations.

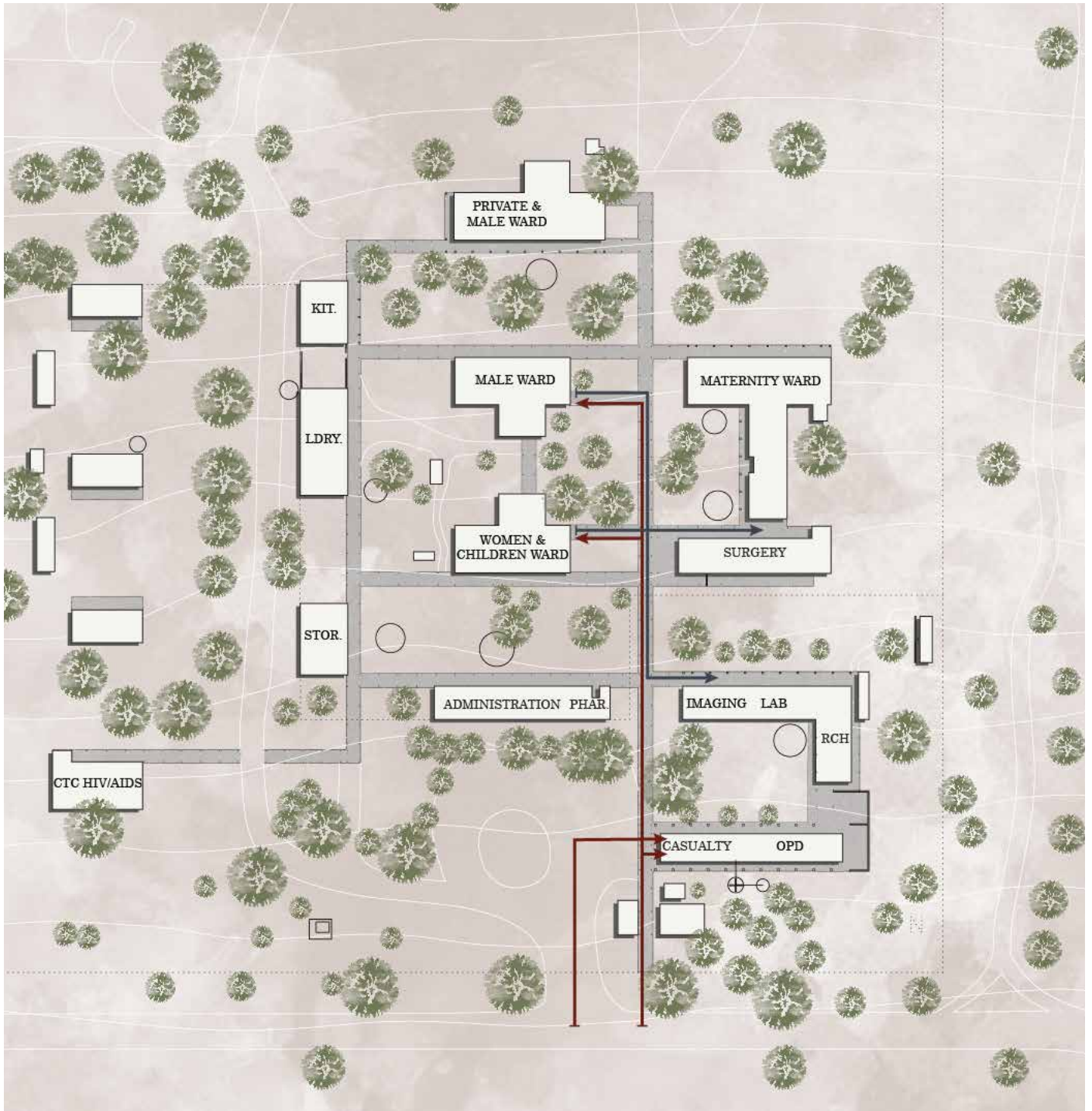
MKULA HOSPITAL ARCHITECTURE



Most of the hospital was built at the same time in 1986. The buildings are simple concrete buildings with sand colored plaster. All exterior communication takes place under roofed paths. Areas for waiting are generally very dark and furnished with concrete benches unless they are placed in the corridors outside of the examination rooms. Smaller complementary buildings are built from bricks.

Details such as window frames and doors are wooden, while decorative grills are made from steel. Windows generally have a high sill height where privacy is wanted and all windows are possible to open to allow natural ventilation. Other than the window grills it is common to have decorated concrete tiles or different types of perforations that allow some light and reduces heat.

SITE PLAN TODAY



— Arriving casualty flow

— Internal casualty flow

Flows as described by participants in WS 1 p 41

1:1000



MKULA HOSPITAL TODAY

OUTPATIENT DEPARTMENT - Treats less severe patients that does not have to become inpatients at the hospital. Also work as a casualty for people who arrive to the hospital with emergency syndromes.

RCH- Reproductive child health educates people about family planning and mothers and childrens health issues. They also vaccinate mothers and children and examine pregnant women.

X-RAY AND IMAGING - Serves both the inpatient and the outpatient departments.

SAMPLING AND LAB - The sampling and lab works with collecting samples both from the inpatients and the outpatients. They do some sample analysis and collect donated blood for the blood bank.

SURGERY DEPARTMENT - Has one main theatre for major surgery and one for minor surgery. The theatre is booked two days a week and for the rest of the week it is kept free in case of emergencies and cesarean sections.

MATERNITY WARD - The maternity ward is divided into two ward sections, one for expecting women and one for delivered. There is also a delivery section.

INPATIENT WARDS - There is one ward for females and children and two wards for men where one is divided into a private ward as well. Most treatment takes place inside the wards, it is also where emergency patients are brought to be prepared for surgery.

CTC HIV/AIDS - Care and treatment center for HIV. This is an outpatient department that is funded by an external donor and is therefore free of charge. When the facilities are available they are also used as a TB clinic.

EMERGENCY CARE TODAY

Emergency patients are brought into the hospital through one of the main entrances. When the patient arrive without ambulance they are firstly noticed by the hospital guard. Depending on their status they are brought either to a casualty room in the OPD department or they are brought into one of the wards to be stabilized before being moved to surgery. There is currently no proper equipment to treat casualty patients.

CASUALTY SITE ANALYSIS

1. The site is directly connected to the car and ambulance entrance of the hospital. It is mostly kept closed and not used by visitors.

2. Inside the gate and in front of the site there is a big yard used mostly for parking. When the car gate becomes the main gate the yard will be a welcoming entry point for patients and visitors. The yard will be surrounded by functions that should be easily accessible for patients, staff and visitors.

3. Currently the Administrative building is located on the site of the future Casualty department. This building is too narrow to be reconstructed to a Casualty department. In front of the building is an empty zone where the new building can be extended.

4. All the hospital communication takes place outdoors and is not separated into staff and visitor flows. When a casualty is built it is important to make sure that the emergency flow is not interrupted.

5. On the back side of the site is a green garden separating the administration from the children wards. This area should be made more accessible.

6. Next to the site in the shade from a group of trees, an outdoor space for waiting or rest can be planned connected to the casualty.



RCH SITE ANALYSIS

1. The site is directly connected to the main entrance of the hospital. It is marked by a painted sign, a small blue gate and greenery. There is also a large waiting area under a tree next to the gate.

2. Inside the gate where the site for the new RCH begins there is a red table with chairs where the hospital guard sits and watches over the entrance.

3. The canteen is a small building located on the site used for cooking. It is currently not in use, but will be saved on the site to minimize cost for demolishing. Next to the canteen is a large tree that is important for shadowing the site.

4. In connection to the canteen there is a shed used for cooking fires. This will be removed to make room for the RCH.

5. The fence marks the boarder to the site where the walk path to the RCH will be located. Saving the tree will be investigated during the beginning of the construction phase.

6. A cluster of younger trees are located on the site separating the fence from the OPD. Some of these will be removed because the RCH should keep some distance to the OPD.



CHAPTER THREE

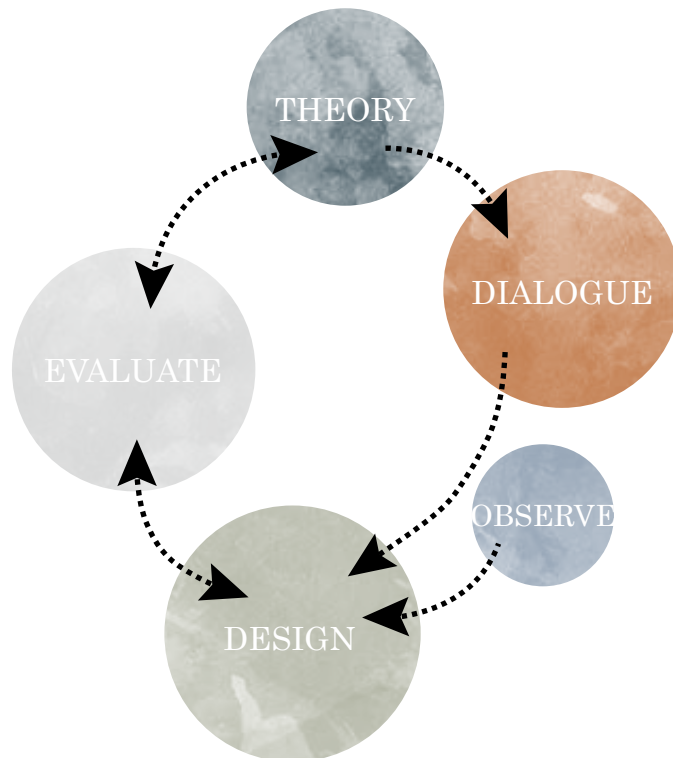
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Theory

3.1 RESEARCH FOR DESIGN

When designing a hospital in a previously unfamiliar context it is important to have design strategies that can help the design development. The needs of Mkula hospital are sometimes very specific and in order to provide them with solutions that they can benefit from in a longer perspective it is important to use existing research regarding healthcare facilities and integrate it into the Mkula context.

The research has involved looking at similar projects, learning about sustainable building design and investigate theories about healing architecture.



*The design process has been iterative and non linear.
The diagram shows the different parts of the process
and how they relate to each other.*

EVIDENCE BASED DESIGN

Evidence based design (EDB) has become best practice when it comes to designing healthcare facilities and means that the designer uses research to inform their design (Shepley, M. M., & Song, Y, 2014).

The design strategies often suggested are developed in relation to advanced hospital environments and therefore involve very costly solutions.

Still there are evidence based solutions that can be implemented in a developing context, such as sufficient light, ventilation and flexible constructions.

There is very little research done outside of Europe and the United states, which makes the cultural knowledge and awareness of the designer the most important tool to find specific solutions that can function in a new context “Design research must be focused on specific design objectives (e.g., infection control) rather than specific solutions (e.g., private patient rooms), the latter of which is only practical in regions with greater resources.”(Shepley, M. M., & Song, Y, 2014, pp 180).

There is currently nine design variables referred to regarding the built environment: Audio and Visual environment, Safety enhancement, Way finding, Sustainability, Patient room, Family-, Staff- and Physician support spaces. Each have suggested design strategies (Ulrich, R. S., Berry, L. L., Quan, X., & Parish, J. T, 2010).

Many important strategies such as natural daylight for both patients and staff and placement of sinks for hand washing can be applied in a developing context but aspects such as overheating and lack of water then has to be taken into consideration.

One of the most critical problems that healthcare facilities faces today is spread of infections. The use of single patient rooms has become a standard way of preventing infections spreading between patients (Clancy, C. M. (2008). This is a costly solution and in a project with scarce resources other solutions have to be considered, such as having waiting spaces outdoors, having sufficient natural ventilation or using stacking effect with bacteria killing UV-lamps (Wagenaar, Cor / Mens & Noor, 2018).

Evidence shows that viewing nature has a positive impact on our health. Studies that have been done all suggest that nature lessens stress and improves our wellbeing. In a hospital, gardens can serve many purposes. Viewing greenery for only a couple of minutes might reduce stress for both patients and staff. Having gardens can also offer refuge for patients, staff and relatives. This is helpful for nurses that work long shifts under a lot of stress and it can give patients an enhanced sense of control (Ulrich, R. S, 2002).

“Improving healthcare buildings is integral to improving healthcare.”

(Ulrich, R. S., Berry, L. L., Quan, X., & Parish, J. T, 2010)

SUSTAINABLE BUILDING DESIGN

Mkula has a hot and dry climate with only short periods of heavy rain. The warm temperatures and the high position of the sun makes keeping a good indoor climate difficult. The hospital economy cannot allow for any mechanical ventilation since electricity is an expensive expense. To still create a functioning indoor climate there are many low tech solutions that can be applied.

SUN SHADE

The most efficient way to reduce heat in a building is offering sun shade. The best solution to achieve this is using a ventilated double skin, where the roof is one ventilated structure separated from the building underneath which is cross ventilated. Surrounding vegetation can be used for shade as well as the roof structure. The building should also be oriented with the long side from east to west since the sun path will be directly above the building heating the roof instead of heating the facade. Placement of windows and other openings should also be in shaded positions (UN-Habitat 2014).

THERMAL MASS

To help achieving a balanced indoor temperature when the days are warmer than the nights, it is good to build a heavy construction that is slow to cool and heat so the walls can give away warmth during the nights and keep the indoor temperature down during the day to avoid temperature peaks (UN-Habitat 2014).

NATURAL VENTILATION

In hot and humid climates, cross ventilation is the easiest way to improve thermal comfort. Especially if the outdoor temperature is close to the indoor temperature and it is difficult to create a stacking effect. To ensure a good airflow the opening area of windows is important and should be as large as possible. In order to increase the air flow the air intake opening should be lower and smaller than the outflow opening. It is important to take the surroundings into account when designing the natural ventilation, low bushes close to the facade can prevent the air from flowing in whilst high canopies instead can increase the wind getting into the building (UN-Habitat 2014).

WATER COLLECTION

Clean water is a scarce resource in Tanzania and any water that can be collected can be used for cleaning, flushing and in some cases even drinking. Having a system for collecting water during the rain season is important to ensure that the clean water can be used where it is most needed.



Reflective roofs and sunshade helps keeping the sun from heating the building.



To make cross ventilation most effective the air intake should be smaller and lower than the outtake.



Tall canopies can help increasing natural ventilation through a building.



By ventilating the roof structure, the building is protected from the direct heating of the sun.



Bricks, concrete and earth blocks, all have slow thermal masses that can be used to avoid peaks in the indoor climate.



Gathered rain water can be used for cleaning and flushing, rain water tanks should be strategically placed for easy use.

SALUTOGENIC DESIGN

Sense of Coherence

The built environment affects our wellbeing, regardless if it is a shed or a hospital. Salutogenics is the theory of the socio-environmental influence on our wellbeing, both in positive and negative ways. Through understanding the impact of healthcare design on the individual, salutogenics can be used to improve outcomes in healthcare (Golembiewski J.A, 2017).

Since each person reacts differently to design it is important to understand the different factors that influence how we feel when attempting design in a new context. There are three concrete forces to Salutogenic design that are called “Sense of coherence” that should be considered.

COMPREHENSIBILITY

Comprehensibility is our capacity of understanding and managing things that happen to us and around us (Golembiewski J.A, 2017). When brought into a hospital patients are met by a completely new environment consisting of equipment and another language. In Tanzania the doctors are educated in English while the general population speaks Swahili, which is partly due to a lack of vocabulary in Swahili. This creates a barrier between patients and staff that enhances insecurity with patients. Ways in which architecture can help support comprehensibility of the physical environment is through windows for orientation, avoid institutionalized features, intuitive way finding and a familiar atmosphere.

MANAGEABILITY

Manageability is how well we manage to take care of basic needs such as eating, regulating heat or managing to perform your work etc. Most of which are considered in any hospital (Golembiewski J.A, 2017). In Mkula fewer services are provided by the hospital and manageability is not obvious. Factors to take into consideration are: efficient workflows for staff, places where relatives can cook, possibility for patients to control ventilation and daylight. Any design solution that can improve the experience of the patient and offer independence are important for manageability and can participate to the wellbeing of the patient.

MEANINGFULNESS

What gives us meaning in life differs a lot for different people and it might be difficult to bring to a hospital. One thing that most people have in common however is family and culture. So the best approach to achieve meaningfulness in a hospital could be to provide space for visiting relatives and designing a familiar atmosphere with cultural elements.



Closed of garden behind the current administration building.

3.2 METHOD

FIELD STUDY

The Tanzanian context and culture differentiates a lot from the Swedish. In order to create a better understanding for the differences this thesis is based on a field study. The field study took place during eight weeks in Tanzania and seven of those were spent on site.

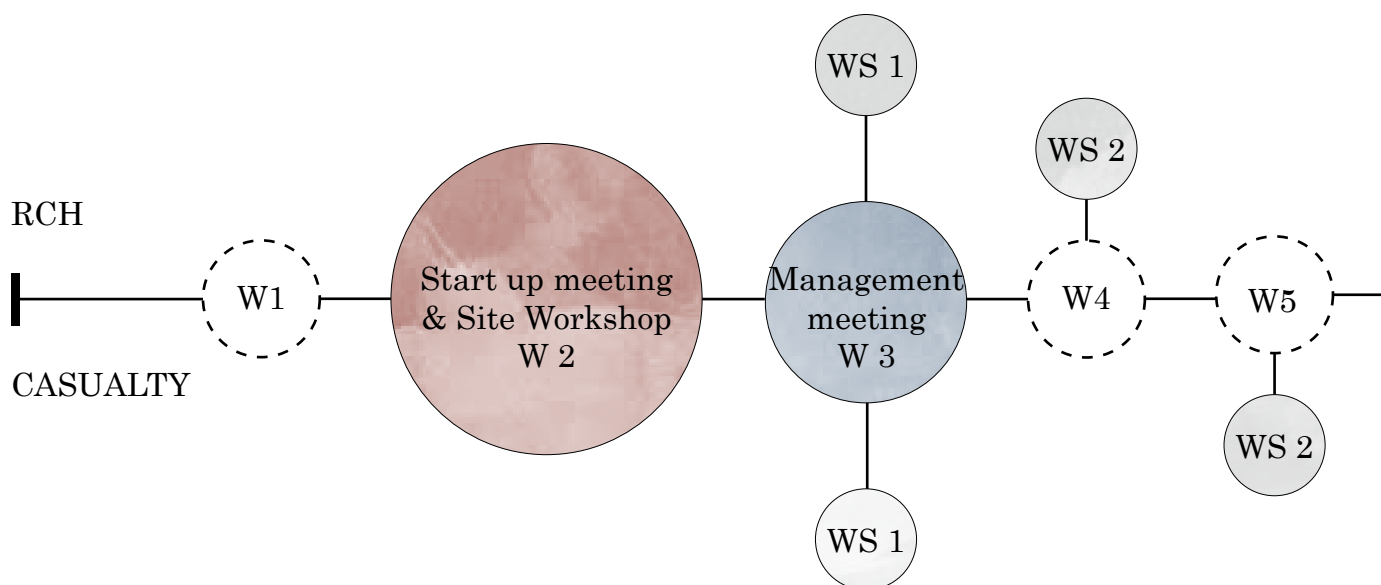
In addition to being on site, observing and documenting, there was an ongoing dialogue with the hospital management to understand the hospitals needs and finances.

Understanding the hospitals priorities gave a good understanding of cultural factors such as status and hierarchies.

The work conducted on site during the

seven weeks is a compromise between the project group and the hospital management. Taking part of both meetings and workshops gave a good foundation to cultural and contextual understanding to support the design work conducted in this thesis.

The work on site started with confirming a future site plan with the management that depended on their expected need of expansion.

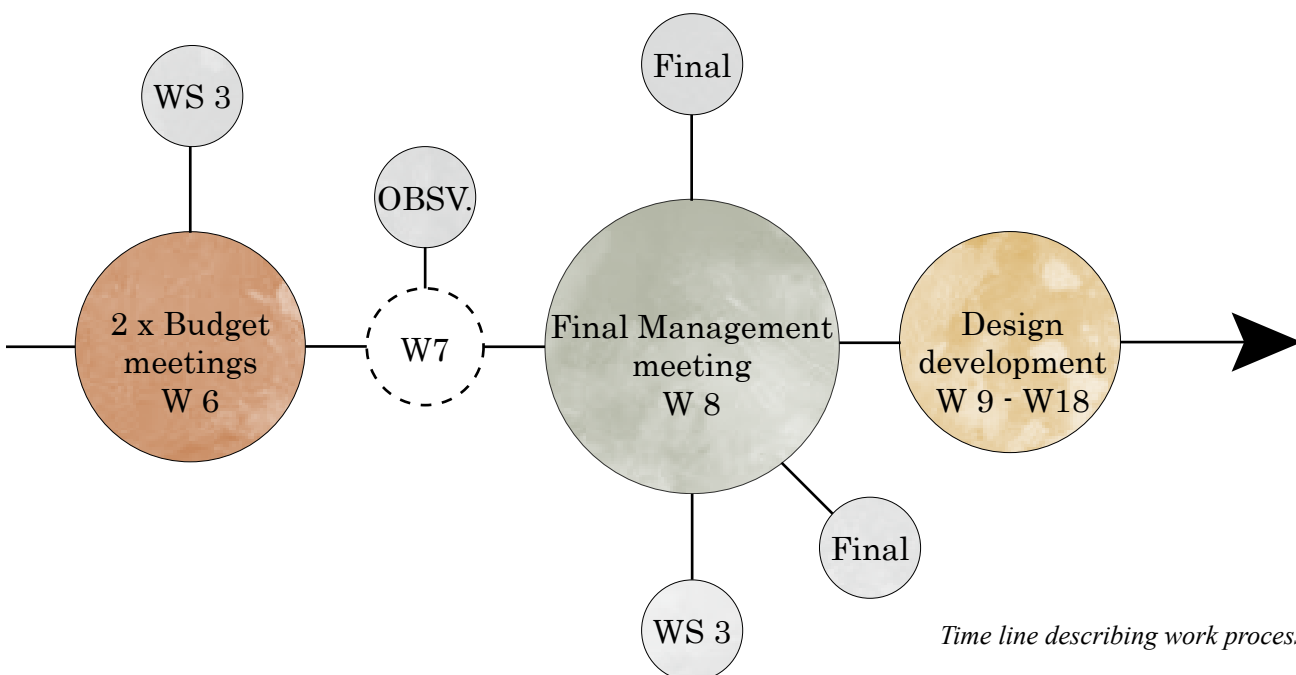


DESIGN DIALOGUE

In order to implement evidence based design in a project the designer needs to know the context in which they are designing (Shepley, M. M., & Song, Y, 2014). During the field study several workshops and discussions were organized as a method to gather knowledge. They were also used as an iterative process with the plans where staff could provide instant feedback. The meetings always included someone from the management which meant that it was important to find ways of organizing the meetings so that everyone could speak. Having regular and relatively short meetings and workshops made it possible to have a familiar atmosphere during the discussions where the staff responses to the design seemed genuine.

OBSERVATION

Observation was an additional method used to understand flows of patients, movement of staff and needs of activities taking place. Being able to observe gave an important input into the design, not only by supplying the necessary information of needs, but to give an emotional understanding of the patients experiences coming to the hospital. Seeing both the need of the staff and then that of the patient gave the project another dimension.



Time line describing work process on site.

3.3 INSPIRATION

BUTARO DISTRICT HOSPITAL

Photographer: Ivan Baan

Architects: MASS Design Group



Butoro district hospital from 2011 has the capacity of 140 beds and is located northern Rwanda. Butoro hospital was the first hospital in the district. The layout and volume of the hospital is designed to prevent spread of airborne diseases and have a good impact on patients recovery. By having natural cross ventilation, spacious rooms, natural lighting and by using ultraviolet light to remove bacteria they managed to design a well functioning low tech hospital built by local resources. (Wagenaar, Cor / Mens & Noor, 2018)

Reflection:

Butoro is a great influence when it comes to combining a building to support healing with beautiful architecture. For a building to contribute to the patients wellbeing it needs both technical and architectural features. The design of the low tech solutions used is very relevant in the context of Mkula. Also the use of local “waste” material to create a link with the local context is inspiring.

THE LIBRARY OF MUYINGA

Architects: BC-architects



The Muyinga library in Burundi was built as the beginning of a school project for deaf children in order to include them in the village life and traditions which are mostly oral.

The design and use of materials are all influenced by the local building traditions. Important local elements such as an exterior porch is included and only local building techniques was used. However the design is new and unique. (Le Fort, C., Ehmann, S., & Klanten, R, 2016)

Reflection:

Muyinga is interesting in the sole use of local materials and using local construction methods. It is a great example of delimitations turning into an interesting design. The combination of local materials to fit into the context and using ventilation as a design tool is very inspiring. And seeing that the building supports its function is something very important to bring into healthcare design.

CHAPTER FOUR



Design process

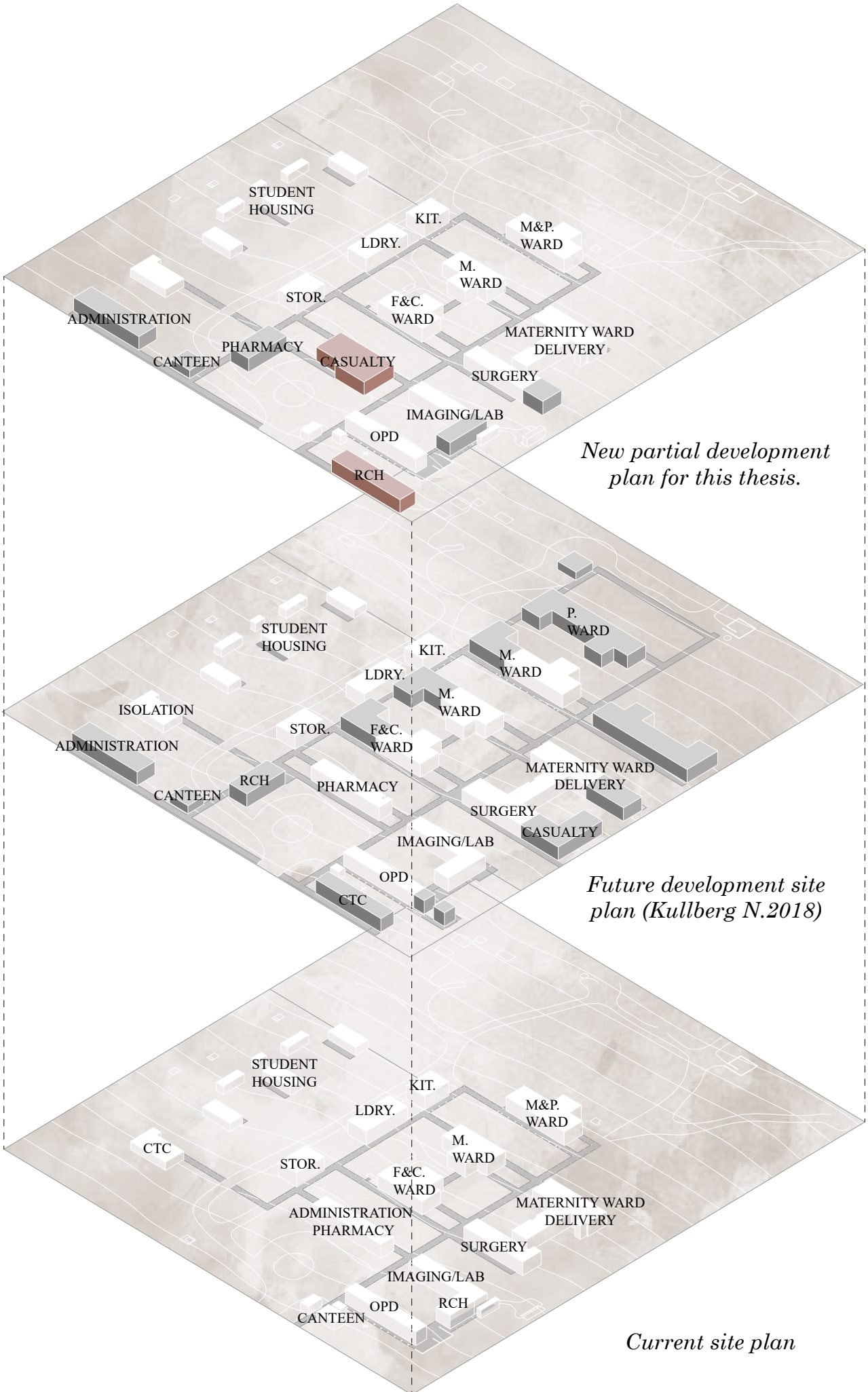
4.1 FUTURE DEVELOPMENT

Workshop: Site plan

29. 1. 2019

The first week in Mkula was used to confirm the project plan based on last years work on site. There had been changes made to the future development plan that had not yet been discussed with the management. In order to start the discussion and find out the hospital's new top priorities a workshop with the management was held. The workshop resulted in a new plan that could begin being realized immediately. The first step being the construction of a new RCH department to release space for an expansion of Imaging and Lab. By moving the RCH the patients, who are mostly outpatients, don't have to go further into the hospital and wait together with the patients from the outpatient department (OPD). The new site also offers the RCH a possibility to expand since they only have one examination room today, something that could also benefit the OPD. After the expansion of imaging and lab an extension

of surgery will be prioritized. Which in turn makes it possible to support a casualty department. Regarding the site for a future casualty the management agreed that the location as a front building of the hospital would be best, although they were very hesitant of the fact that an existing building for administration would have to be removed. The demolishing of the current administrative building creates the possibility to completely move the staff and visitor flow to the left side of the site so that it does not intervene with the inpatient and emergency flows, also by placing the pharmacy to the left the open space in front of the hospital today becomes a more welcoming courtyard. When people arrive to hospital on foot, the first buildings they will encounter will be the RCH and the Casualty, which is the base of the selected design tasks in this thesis.



New partial development plan for this thesis.

Future development site plan (Kullberg N.2018)

Current site plan

4.2 CASUALTY



Workshops

The best way of understanding how something works is by asking questions. During the time spent on site there were several meetings and discussions with the hospital management to understand the future need of the hospital and how the hospital operates. Even though the management participated in the workshops it was clear that they were not used to working that way and that they preferred meetings. It was important to explain the

purpose of each workshop several times since it was often quite basic information regarding their work flow being sought after, it seemed like they considered this “basic” information obvious and therefore tried to steer the conversation towards economics instead. It was also important to point out the importance of having a group discussion rather than interviewing one person for information since they all had different knowledge.

CASUALTY

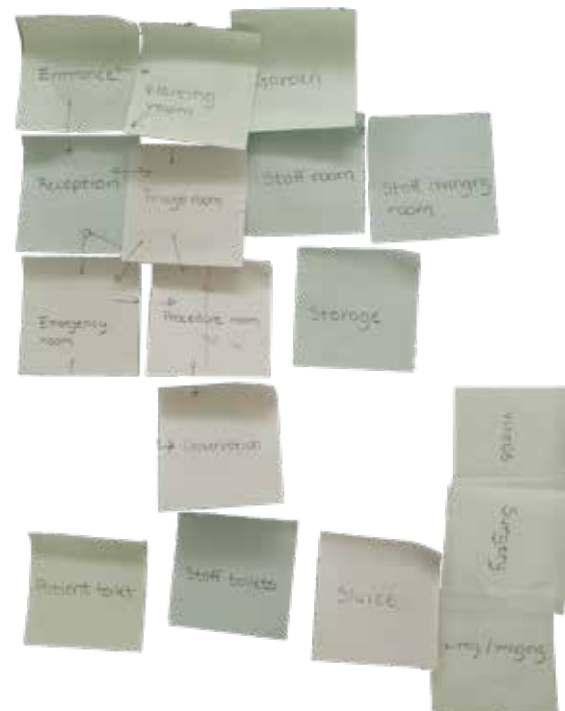
Workshop one . Program

8. 2. 2019

Workshop one aimed to create an understanding of how the casualty flow functions today, how the staff work with emergency patients and to define a program for the new casualty department. Since it was the first workshop it was started up with introductions and an explanation that this was a mixture of a future development plan and a master thesis. The lack of experience with any related projects was explained and the participants were asked to share as much information as possible about how they want a future casualty department to function.

The first thing they were asked to do was to write down three positive things about the emergency care today and then three negative things to start the discussion. The most important thing for the emergency patients today is that they receive a quick reception by a nurse at the emergency room located by the OPD. When an emergency patient arrives, they either examine them in the emergency room or bring the patient to the wards for stabilization. When they are stabilized, they are brought to x-ray or surgery. For the negative aspects they all agreed that the biggest problem is lack of a good emergency room with proper equipment, also there is not enough staff to handle emergencies and they are not always located in the right place. Secondly the participants drew the movement of a casualty patient through the hospital on a

site map. The final step of the workshop was to ask the participants to arrange functions in relation to each other in the new casualty building. They were divided into two groups and given post-it notes with all the functions that were included in the casualty department in Kolandoto (Bergstrand, L. 2017) and were asked to add functions they thought were missing. The surrounding departments were also included on the notes so that the functions could be placed in relation to those.



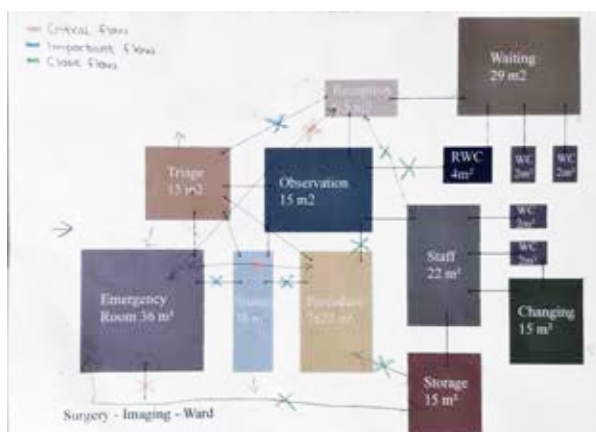
Collage made by the participants during the workshop.

CASUALTY

Workshop two . Flows
22. 2. 2019

For the second workshop a diagram was prepared with the connections from workshop one and the functions were arranged into rooms based on a 600 x 600 mm grid. The workshop goal was to arrange the flows from workshop one into critical, important and close flows and then place the previously prepared rooms on the site depending on what connections were important to the other departments. The participants were asked to mark the flows with separate colors and they were encouraged to add connection or remove connections they deemed unnecessary. During the categorization of the interior flows a discussion took place of the function of each room that was very important for understanding the way they would use the rooms and what needed to be close by. When they had decided on the interior flows they were asked to

once again take the external flows into consideration by placing the rooms on the site. They placed the rooms on the site while trying to keep their desired interior flows. This was very good since it gave an opportunity to ask about all flow to and from the building. Some key points that came up during the discussion was, the procedure room needs to be connected to the emergency room, observation should have access to one accessible toilet, there is not much need of a large observation room since critical patients are brought to the wards as inpatients, all patients should go through triage with the exception of patients brought in by an ambulance, the staff room and reception need to be close, staff arrive from the left side corridor and waste will be brought to the waste pit at the bottom of the right side corridor.



Marked out flows and functions placed on the site by the WS participants.

CASUALTY

Workshop three . Evaluation
11. 3. 2019

The purpose of the third workshop was to evaluate strengths and weaknesses in three different plan sketches. The workshop began with an introduction of the three proposals brought. In each proposal the critical and important flows from workshop three was marked with arrows. The participants were asked to evaluate each plan from a staff and then a patient point of view. This led to a new discussion regarding the placement of the building. The participants all agreed that the front location is the best, but they were all hesitant about demolishing the existing Administrative building. Finally, it was settled that the location will be decided by economic prerequisites if there are funds to build a casualty in the future and that it is better to investigate the best possible location in this stage. The discussion regarding placement of the casualty department and its relation to the other departments in the hospital occupied most of the time scheduled for the workshop, therefore it was most time efficient to let the participants evaluate the plans in Swahili, and then explain their main points, it was suggested that they use a S.W.O.T analysis which they all said they were familiar with.

In proposal 1 & 2 (p1&2) the connection from the ambulance through the casualty department continuing to surgery was too weak in case a patient should be brought straight to surgery. However, p1 had a very good view from the reception to the



Proposals brought to WS.

ambulance. It was also positive with a larger waiting area. The third proposal (p3) was considered best, since there is a direct connection from the ambulance into the emergency room and a continued way to surgery. That also provided a solution to how they could work if several accident victims would arrive at the same time, then some could easily be brought further into the hospital for treatment.

The conclusion was to go on with p3 and develop the weaknesses in comparison to p1&2.

PATIENT JOURNEY

A summary of the patient's areas in the emergency department.

When emergency patients arrive at the hospital it is of out most importance that the entrance for both patients and ambulance is clearly visible to avoid to avoid any delay of treatment.



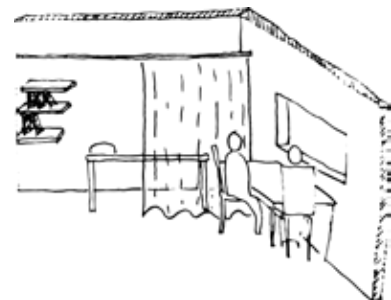
When entering the casualty department the reception should be clearly visible so that staff can respond quickly and patients feel that they have been seen.



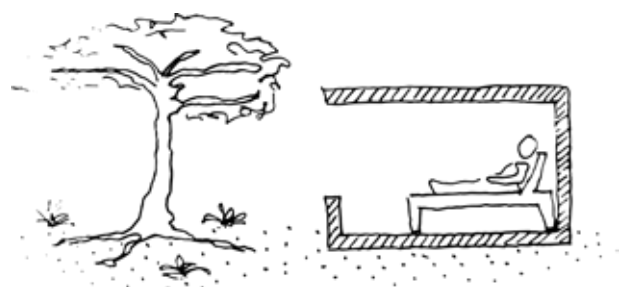
The waiting area can be designed to accommodate different needs varying from very ill patients to relatives waiting for someone being treated. A good connection to the reception is beneficial for both patients and staff and some distracting features while waiting can reduce stress.



In the triage room the patient can both be examined or treated for minor injuries. The triage room needs to be flexible and in close relation both staff and the emergency room in case a patient becomes critically ill.



After treatment the patient is either moved to the wards or they remain for observation until they are ready to go home. In the observation the patient should have comforts to rest and some view to distract and comfort them.



4.3 RCH

The work with the Reproductive Child Health (RCH) building had different requirements than the Casualty department. The aim was to have finished drawings and a construction firm ready for the fifth week on site. Initially because of the rush, more focus was put into looking at detailed requirements from the hospital and having larger management meeting rather than workshops. Parallel to this the expansion of imaging and lab into the current RCH building was investigated. During the dialogue with the hospital management their priorities shifted and the construction of the RCH was put on hold. While the construction was on hold the design investigation of the RCH for this thesis became the focus instead of the construction and to gather necessary input to the design

an observation was conducted. In the final week of the field study it was once again decided by the management that the RCH should be built as soon as possible. The plan and the design were now more refined since the design process had been ongoing. The latest plan was discussed with the management during the final meeting before being sent to the contractors. The same plan is the base of the design proposal in this thesis and is influenced by the need of keeping the cost of construction down by having a small footprint. The plan can also be extended with more examination rooms if needed in case the number of visitors increase. The design of the building has then been developed with more focus on architectural qualities than cost efficiency.



3. 3. 2019 One to one workshop for dialogue with contractors.

RCH

Observation

4. 3. 2019

When the design dialogue about the RCH started the management was reluctant to arrange workshops with the nurses working there. Instead they handed over a program and a drawing of a national standard plan for the RCH. This was the base for the first sketches and there was a continued dialogue with the management while the proposal was developed.

To test the design an observation / shadowing of the RCH head nurse was conducted during a full workday. The observation included everything from preparing the days work, holding lectures, vaccination, PMTCT, antenatal, consultation and family planning.

By participating in all of the RCH activities it became clear what could be improved in terms of privacy for the patient. It was also necessary to see the large and constant flow of patients that come to the RCH to plan sufficient waiting areas, from which the patients can be brought in to the examination rooms one by one.

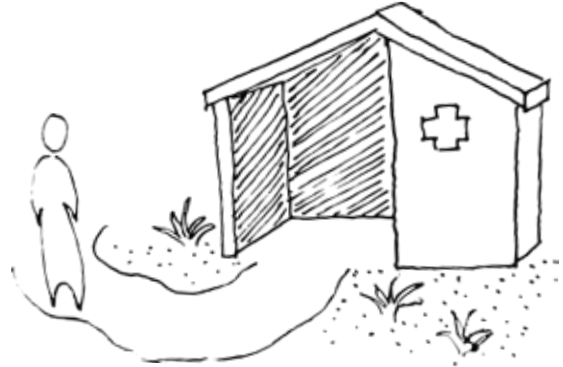
Based on observations made, the proposal was reworked and then discussed with the management once again to ensure that everyone was in agreement.



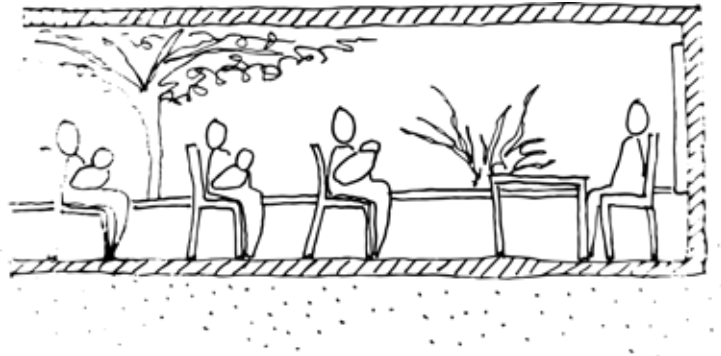
PATIENT JOURNEY

A summary of the activities in the RCH.

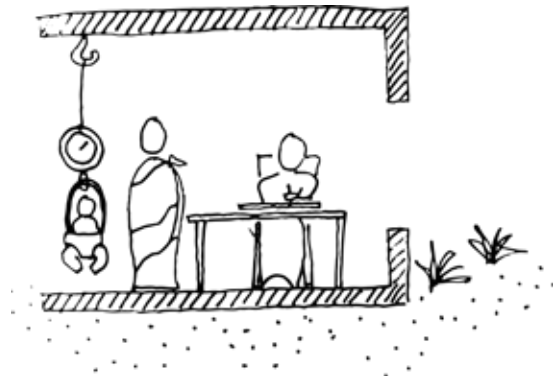
Many mothers arriving to RCH are not used to the hospital environment and by having a clear entrance some of the stress associated with new places can be avoided.



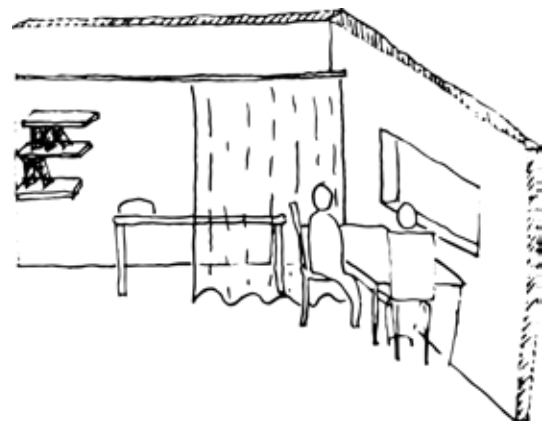
Most days in RCH starts with a lecture about nutrition, illnesses and hygiene. All women sit with at least one child and the lecture is attended by approximately 50 people. To create a stimulating learning environment the temperature and acoustics needs to be considered.



After the lecture the room functions as consultation for the children and they are weighed one by one.



All other activities take place inside consultation rooms. The children are vaccinated and given mosquito nets. Then there are appointments for PMTCT, family planning and antenatal. At some of the appointments such as family planning there can be several participants so it is important with a table that where more than two people can sit.



4.4 DESIGN DEVELOPMENT

Casualty

PROGRAM

Treatment:

Triage - 19 m²

Emergency - 33 m²

Procedure - 23 m²

Observation - 15 m²

Staff:

Staff and Reception - 22 m²

Staff workstation - 10 m²

Staff changing rooms - 18 m²

Support spaces:

Entrance zone / Waiting - 40 m²

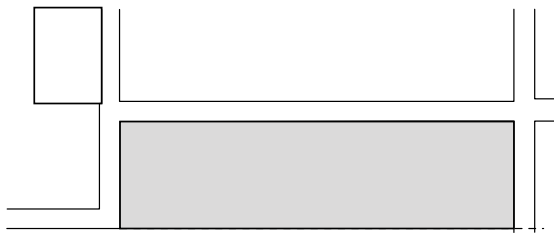
Sluice - 13 m²

Storage - 8 m²

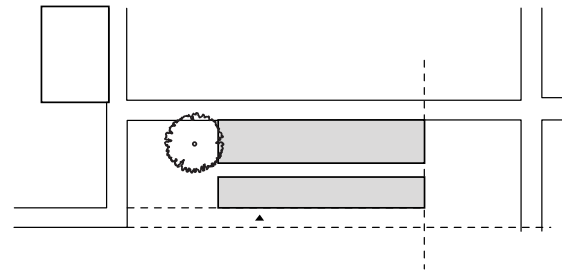
Toilets - 18 m²

Communication space - 65 m²

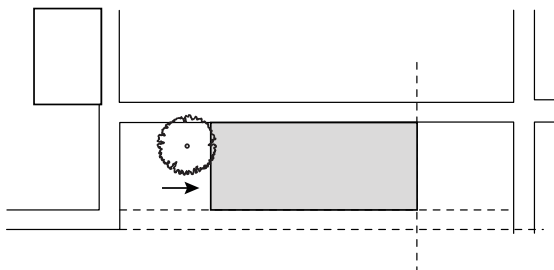
Total: 284 m²



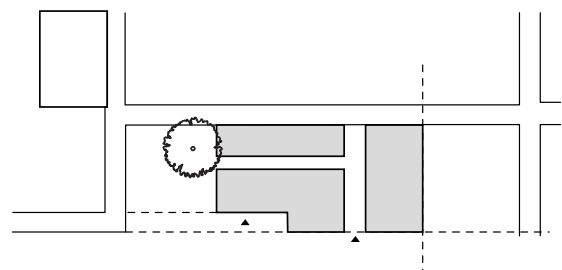
1. At first the casualty was limited by the existing exterior hospital communication space.



3. The functions of the casualty were divided to create an inner intensive care zone that would be reachable through triage and the staff area in accordance with result of workshop two.



2. The building was adapted to align with the wards on the right side and the left side was pushed back to preserve a green area. The existing communication was extended to pass in front of the casualty.



4. To create a straight connection from the ambulance into the hospital, the critical zone was rotated 90 degrees and an additional corridor was added.



DESIGN DEVELOPMENT

RCH

PROGRAM

Treatment:

Vaccination room - 13 m²

PMTCT - 13 m²

Antenatal / Consultation - 13 m²

Family planning / Counseling - 13 m²

Preventive:

Lecture hall - 60 m²

Support spaces:

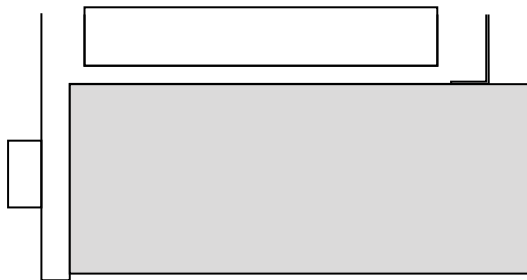
Waiting - 13 m²

Vaccine storage - 5 m²

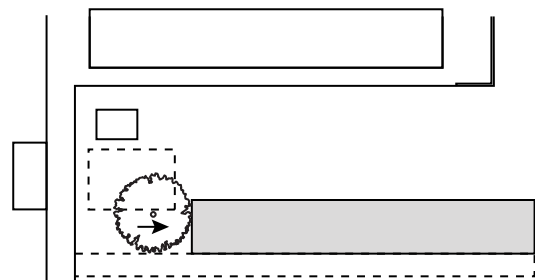
Toilets - 20 m²

Communication space - 60 m²

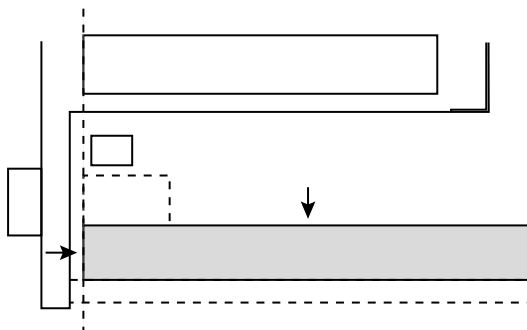
Total: 210 m²



1. The site is limited by the OPD and the entrance of the hospital.



3. Finally the building is pushed back to preserve the atmosphere of the site. It is possible to extend the building by three rooms in the future if the tree is removed.



2. To create some distance to the OPD the building has been pushed towards the entrance. The building is one sided for maximum cross-ventilation.



ATMOSPHERES

Model investigations of atmospheres and privacy.



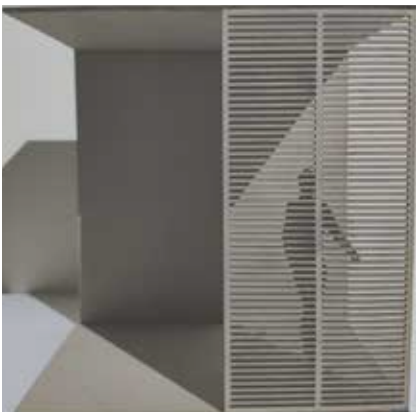
Wooden raster that provides great light but a closed atmosphere.



Rational brick pattern is too dim.



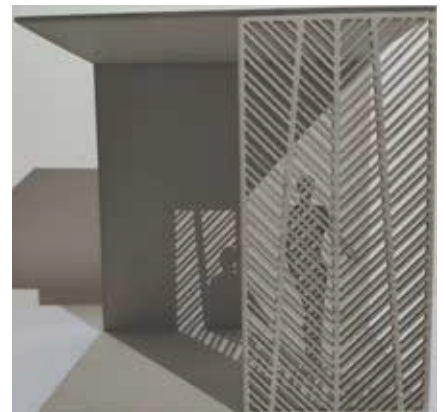
Brick pattern loosened for more light and a window for more openness.



Wooden horizontal raster completely blocks light.



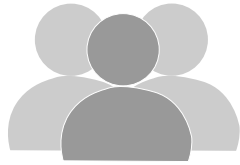
Diagonal pattern only lets light through from one direction.



Lets light through from two directions and has a more organic feeling.

4.5 DESIGN STRATEGIES

Person Centered Care



A good person centered architecture takes care of the spaces for staff, patients and relatives. Each group should have quality spaces adapted to their needs. To give the patient some control of their visual and thermal environment, the window design is important. And waiting areas have to consider that people might have come a long way and need a place to rest. To create a sense of safety for the patients, staff should be clearly visible. Clear way finding should be used to help with orientation and reduce stress.

Sustainability



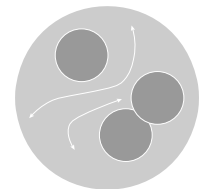
Sustainable design solutions need to consider both cultural and environmental sustainability. A part of designing for peoples wellbeing is the sense of coherence, where familiar environments benefit the patient. Using local materials and construction techniques benefits local contractors and is essential for environmental sustainability. Using additional sustainable design strategies such as cross ventilation, makes the building durable over time.

A Green Healing Space



In Mkula hospital there is no lack of beautiful greenery. However there is little opportunity to access the green spaces. Making the green areas a part of the hospital will be beneficial to both patients and staff. There is a possibility to create views for patients toward greenery, but also to create shaded seating under trees for staff on break or patients waiting. Since the climate is hot all year around it is also possible to have a close connection between indoor areas and gardens. The greenery can also offer both visitors and staff a sense of privacy.

Flows and Zones



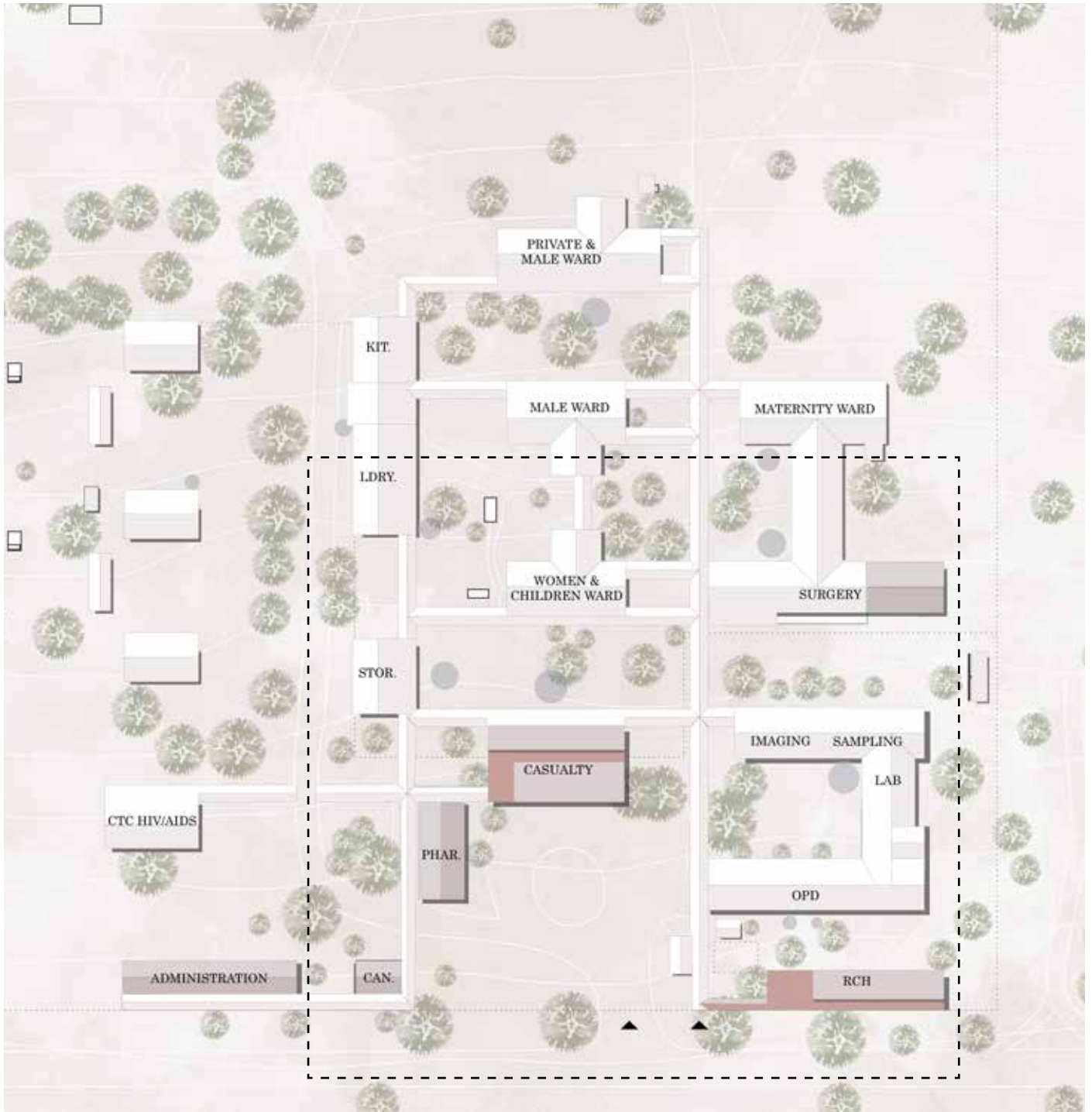
Flows and zones are critical aspects of healthcare architecture. A critical flow cannot be interrupted and by separating flows of patients and visitors, the risk of spreading diseases can be reduced. Having clear zones that are defined by visual elements can help simplify way finding which in turn reduces stress. Using clear flows and zones as a design strategy also benefits staff so they can work in their most efficient manor.

CHAPTER FIVE



Design proposal

5.1 SITE PLAN



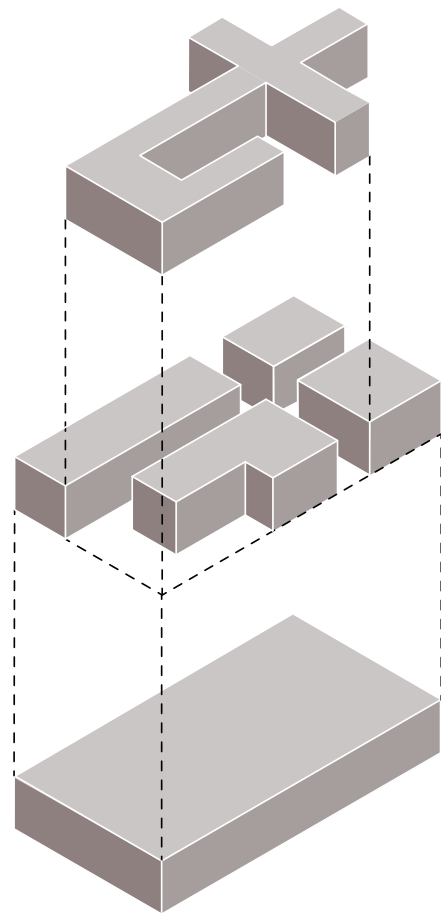
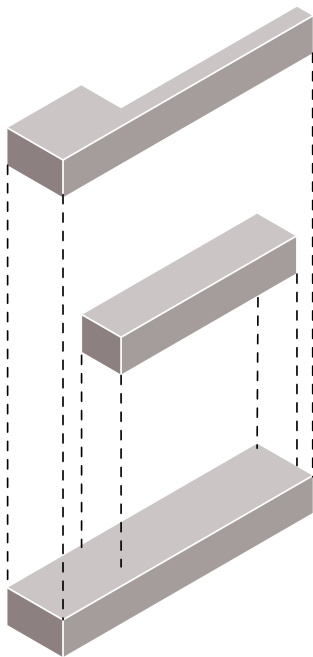
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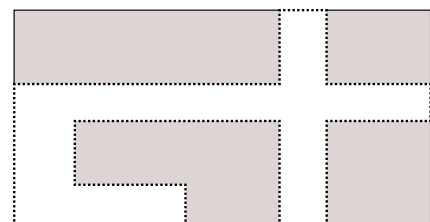
DESIGN CONCEPT

The buildings have been divided into open and closed volumes, where the closed volumes have a simpler expression and contains the medical functions. These have a double ventilated structure and a heavy thermal mass to maintain a good indoor climate. The open parts of the volume are constructed from a loose brick structure that allows air circulation and consist of waiting-and communication areas.

The division highlights the public parts of the building at the same time as it makes it possible to have a double sided structure and still provide cross ventilation.



RCH



Casualty

NEW FLOWS



- ■ ■ ■ ■ Staff flows
- ■ ■ ■ ■ Emergency patients
- ■ ■ ■ ■ RCH and OPD flows
- ■ ■ ■ ■ Visitors flows
- ▶ Entrance
- Existing rainwater tank
- New rainwater tank



5.2 CASUALTY



Perspective showing relation between the OPD department and the casualty department.

With the new main entrance to the hospital, the area in front of the casualty department becomes entrance plaza. From here it will be easy for staff to direct patients or visitors to where they should go. The staff and visitors flows will mainly

be located on the left side to keep the right side flow open as an emergency and inpatient flow.

EXTERIOR MATERIALS



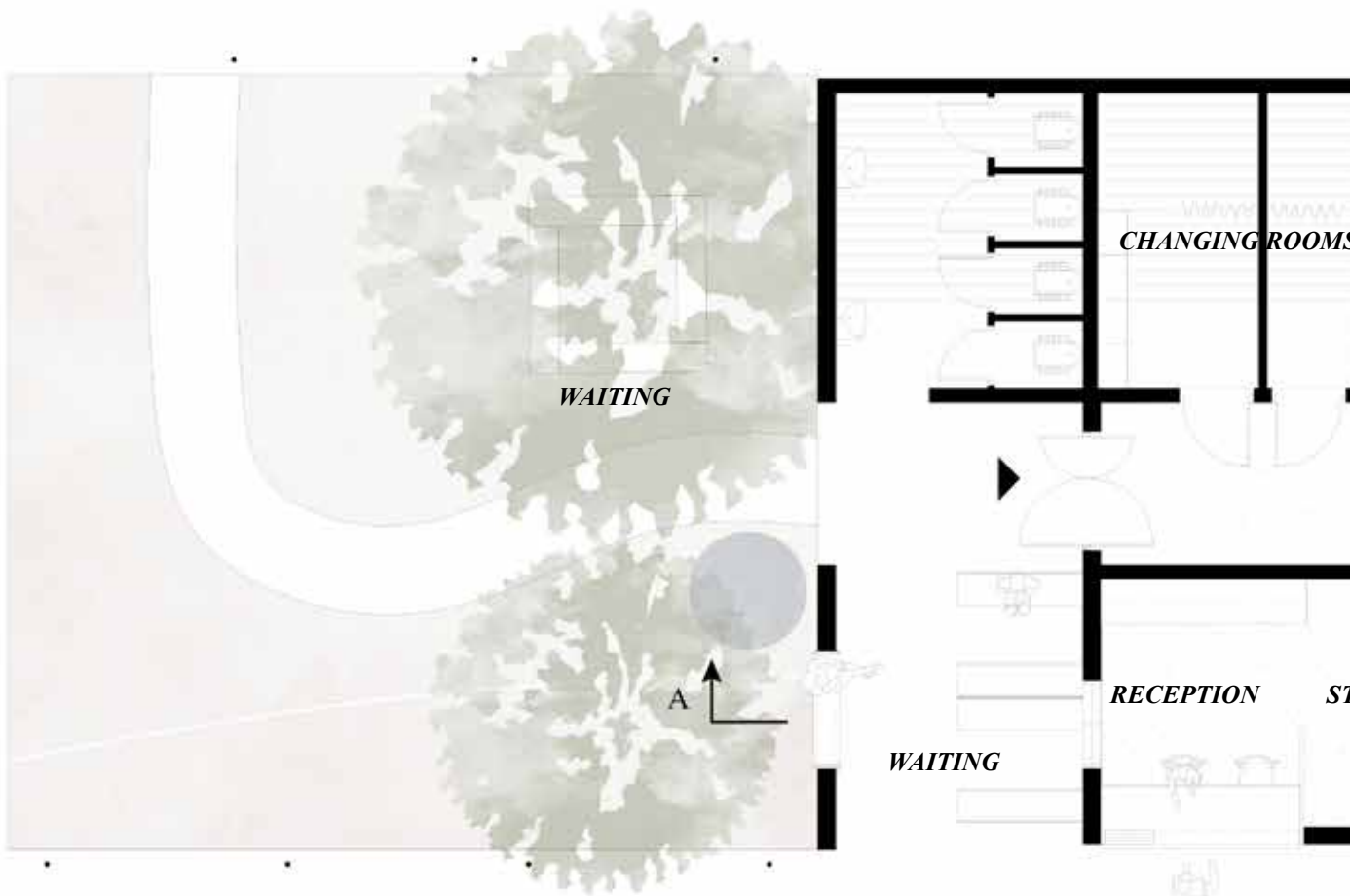
The chosen materials have all been found on site and is widely used within the area. Bricks are used to highlight the reception and lecture hall and as a grating for the double skin roof structure. On the closed facades around the treatment functions, plastered compressed earth blocks are used to connect to the appearance of the existing buildings. Wood is used to frame openings and for seating. Finally waxed concrete flooring is used and the concrete reappears as a visible concrete beam above all openings.

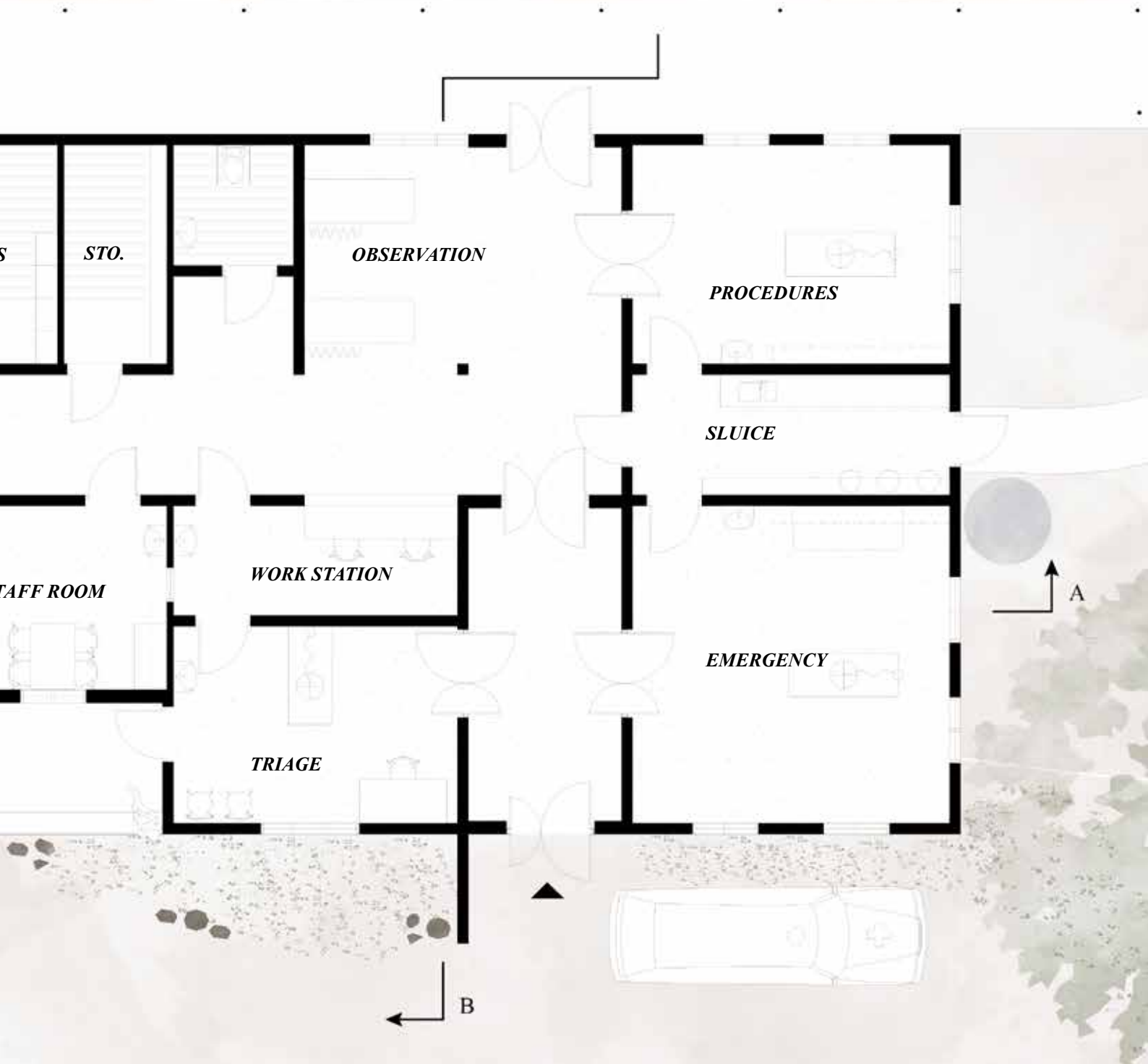
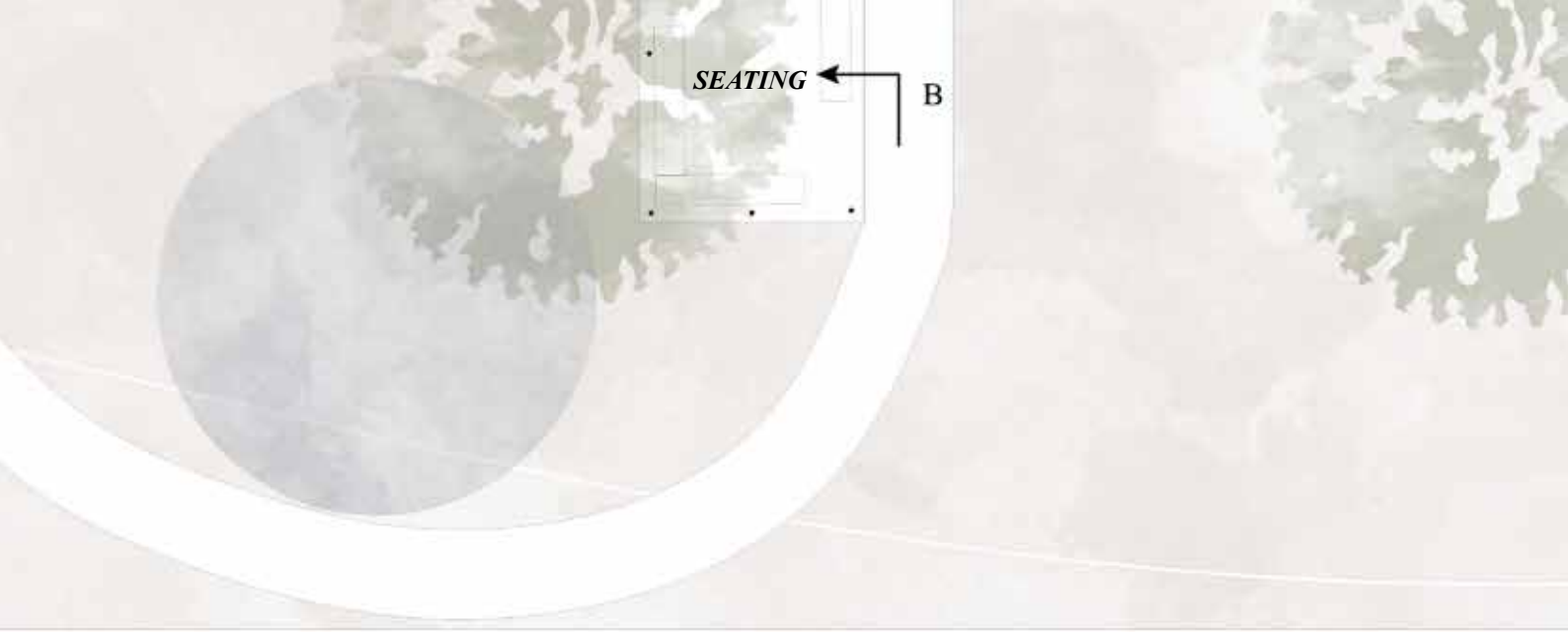


Exterior perspective of casualty, the entrance is marked by a porch structure that highlights the entrance and provides shelter from the sun.

In this illustration of the entrance it is shown how the porch highlights the entrance and the reception for easy way finding. In the village it is common to highlight entrances with an accent color, here it is highlighted with bricks instead.

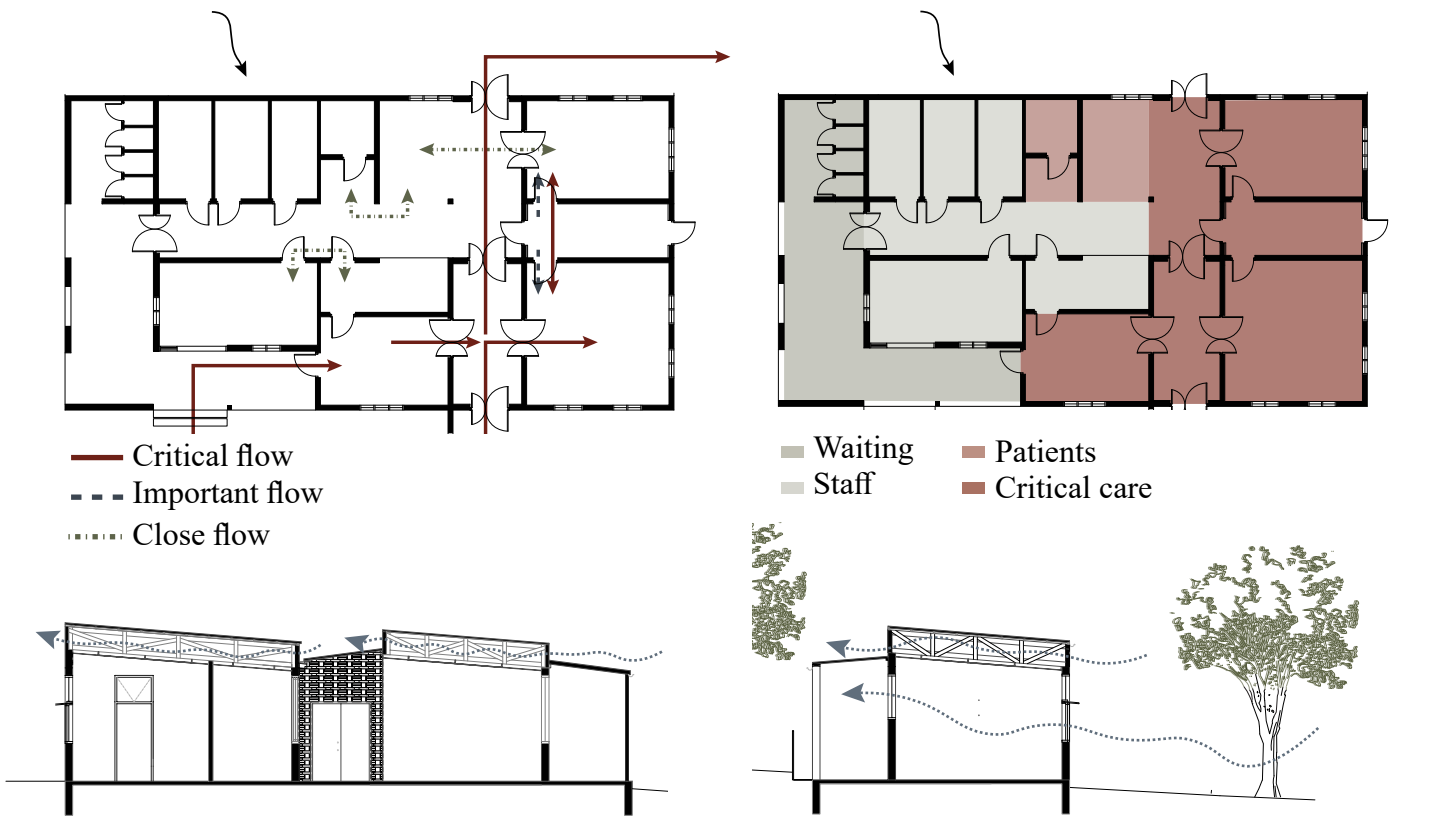
The perforated brick walls surrounding the entrance also refer to a common local element, perforated concrete blocks. However, the use of brick created a much warmer atmosphere that served the same purpose.





DIAGRAMS

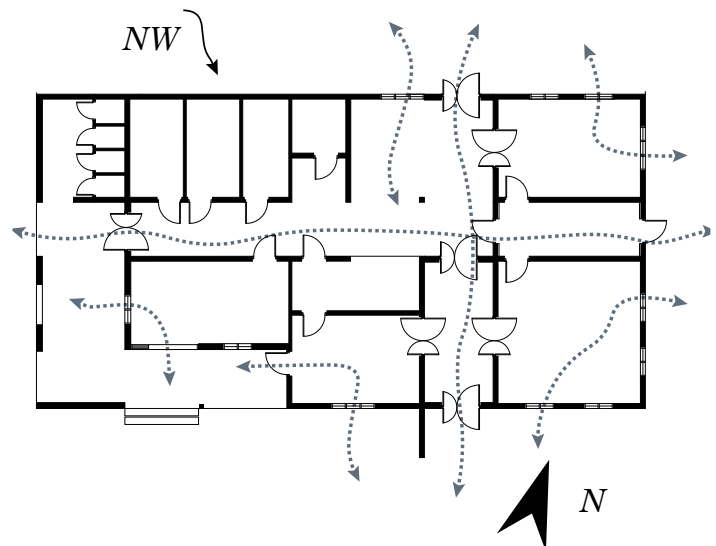
Interior flows, Zones and Cross ventilation



Double ventilated roof structure facing prevailing wind. Preserving the trees behind the RCH helps the cross-ventilation.

The casualty department is divided into clear zones to avoid crossed flows as much as possible. The flows are based on the wishes of the staff and the staff zone have close access to everything in order to make sure the department can function with few staff working.

North west is the prevailing wind direction, however the wind direction changes a lot which is beneficial in this case where not every room can have an opening towards north west.





Perspective from garden behind casualty.

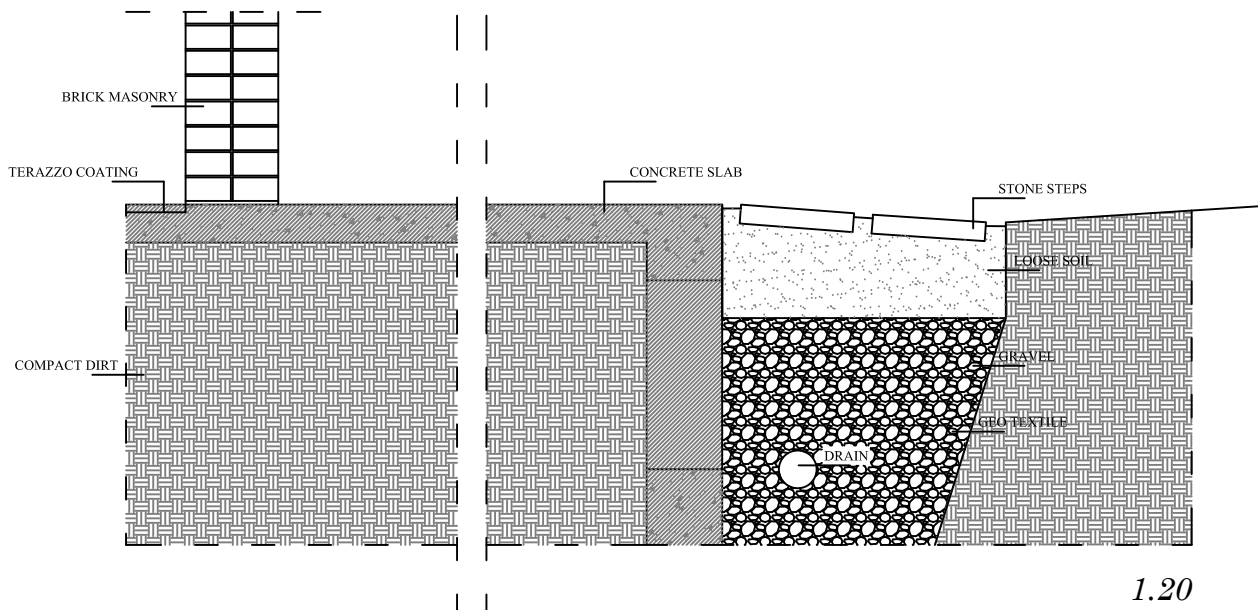
To provide an opportunity to use the garden behind the casualty department a walking path has been added. On this path a pavilion has been placed to provide a shaded seating area among the greenery. The pavilion is placed in between the casualty and the female ward and can be

used from both sides. There is currently very little seating so patients sit in the exterior corridors to stay outside and avoid the sun. The pavilion also provides a place to sit in solitude, both for staff, a relative or a patient.

CASUALTY DEPARTMENT
Detail storm water treatment



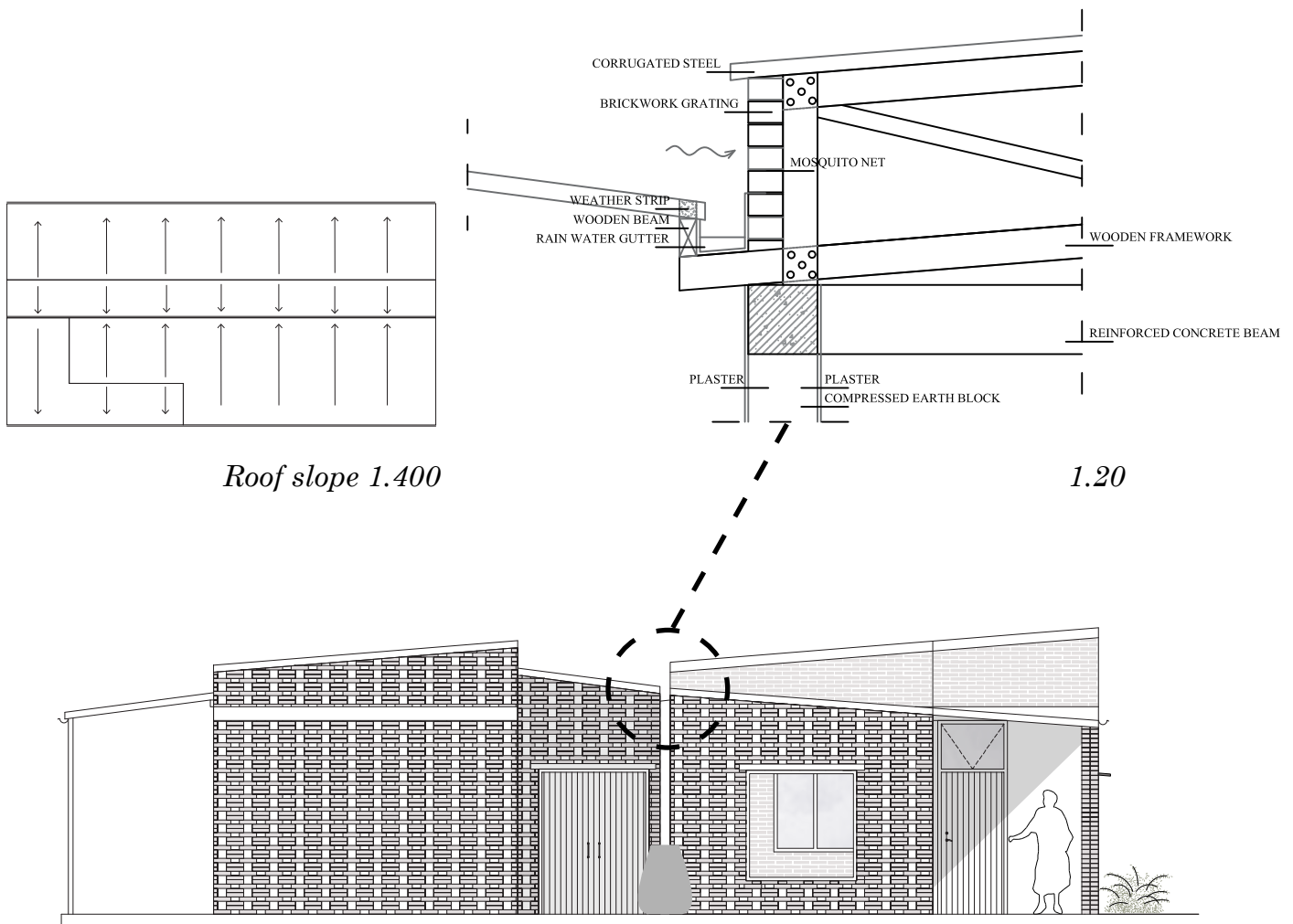
Perspective from waiting area. The water collection is meant to be a soothing distraction as well as a source of water when it rains.



Storm water solution in front of casualty. Stones are used as a connecting walking path over to the entrance.

Storm water is an important source of water in Mkula. It is collected everywhere and is used as drinking water, for cleaning, washing etc. During the rain season in Mkula, it sometimes rains up to 200mm in two weeks mostly in short heavy rains. During one day of such a down pour 1000 liters of water can be collected from the RCH roof and 2000 liters from the

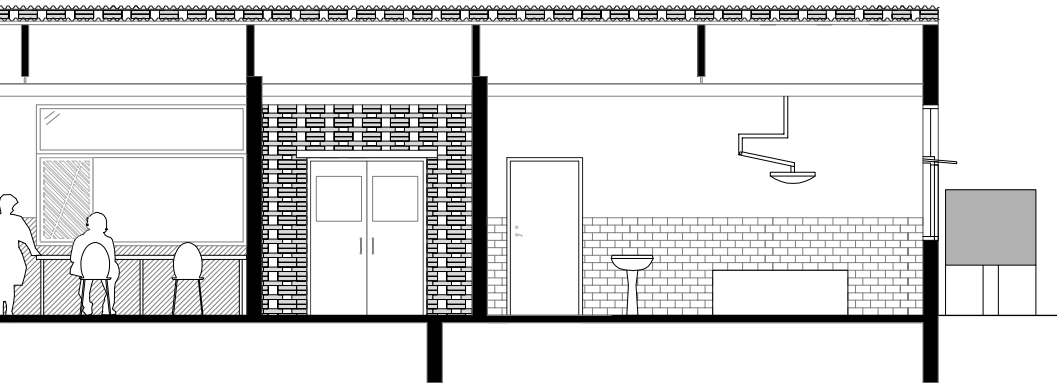
casualty building. The water collection for the Casualty is therefore divided into two tanks. One that can be used for the toilets, and one that can be accessed from the sluice. Each barrel needs to have a diameter of 1.2m and be one meter tall to contain 1000 l.



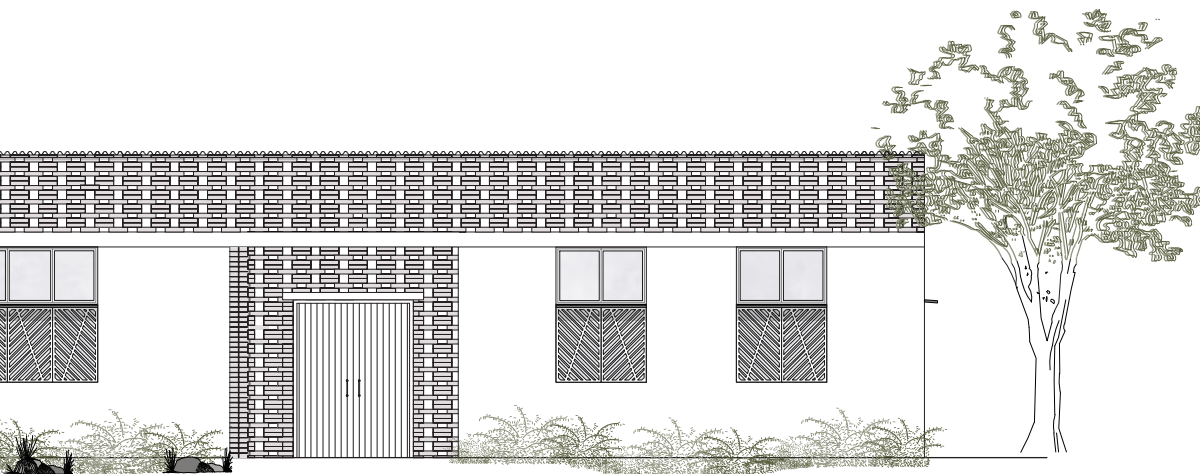
Storm water is collected both outside of the sluice and the waiting area close to the toilets where it can always be used.

CASUALTY DEPARTMENT
Section and Facades

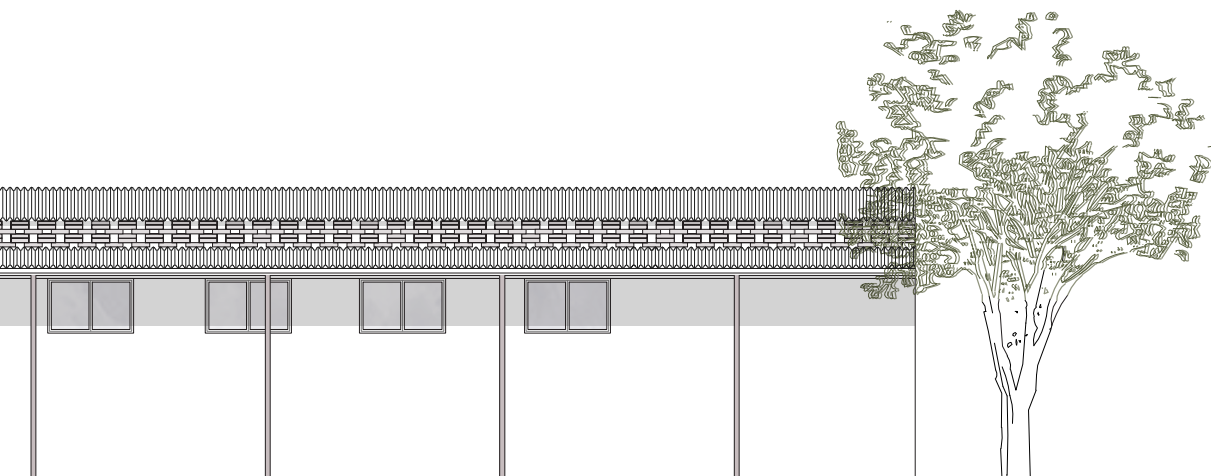




Section A-A Casualty 1.100



South facade 1.100



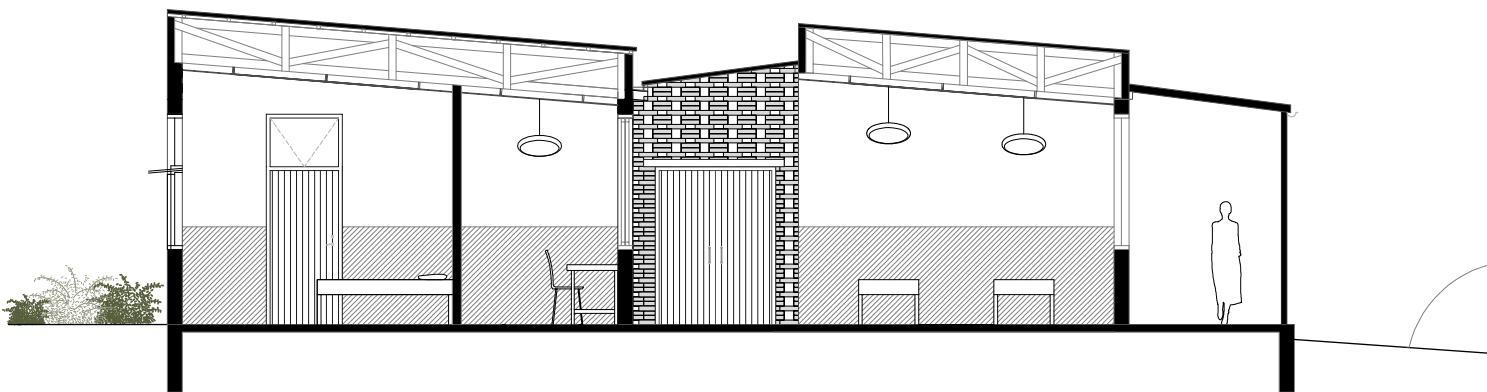
North facade 1.100

CASUALTY DEPARTMENT

Interior materials, Facade and Section Observation



East facade 1.100

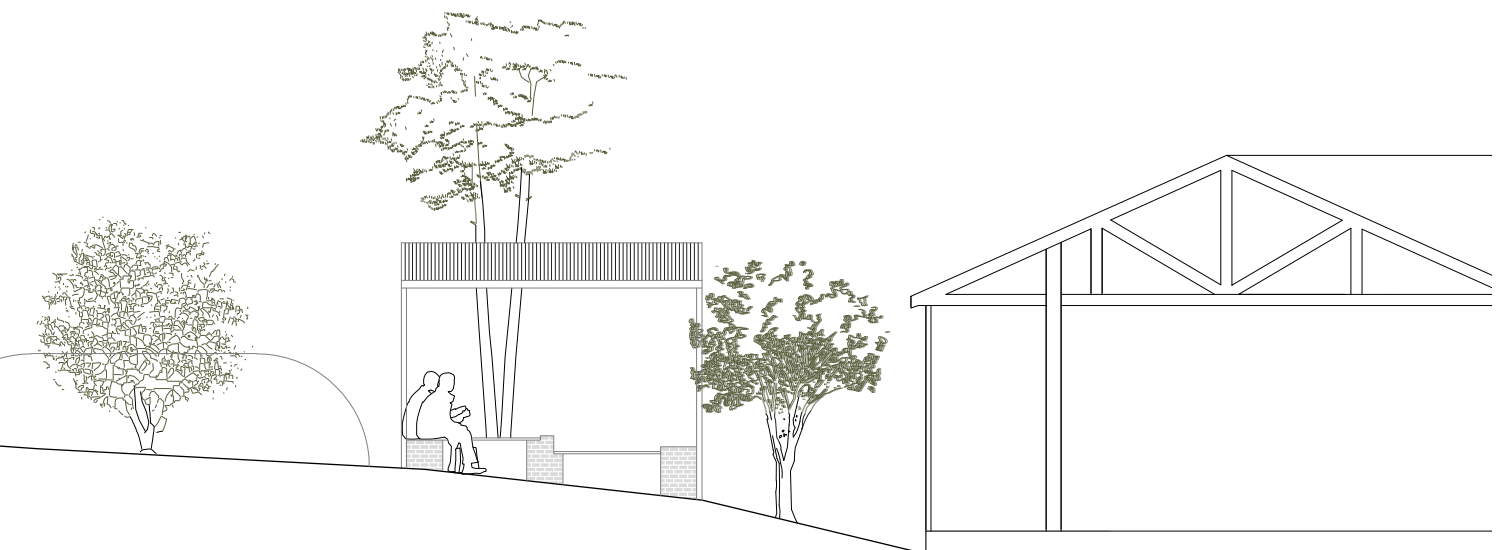




Observation perspective

The interior materials are chosen to create an environment that is robust and possible to maintain and clean. The flooring is cast terrazzo and the walls are plastered and painted white with the exception of the treatments rooms where there are half covered by tiles. To create a less sterile feeling for the patients resting in observation

there are screens made from wood and waxed fabrics that can be placed in front of the window if the patient requires privacy. This also allows the patient to regulate light into the observation area. However, if the window remains uncovered the patient have a view out to a garden.



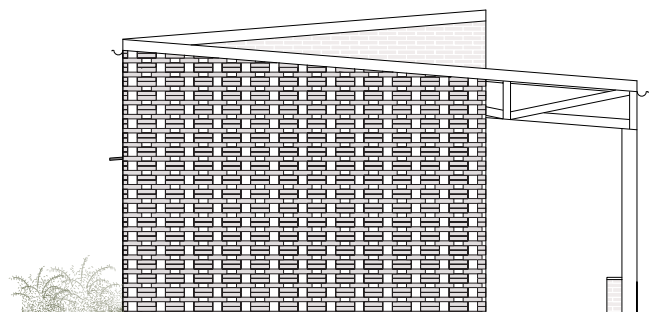
Section B-B 1.100

5.3 RCH



Perspective of entrance in to the RCH

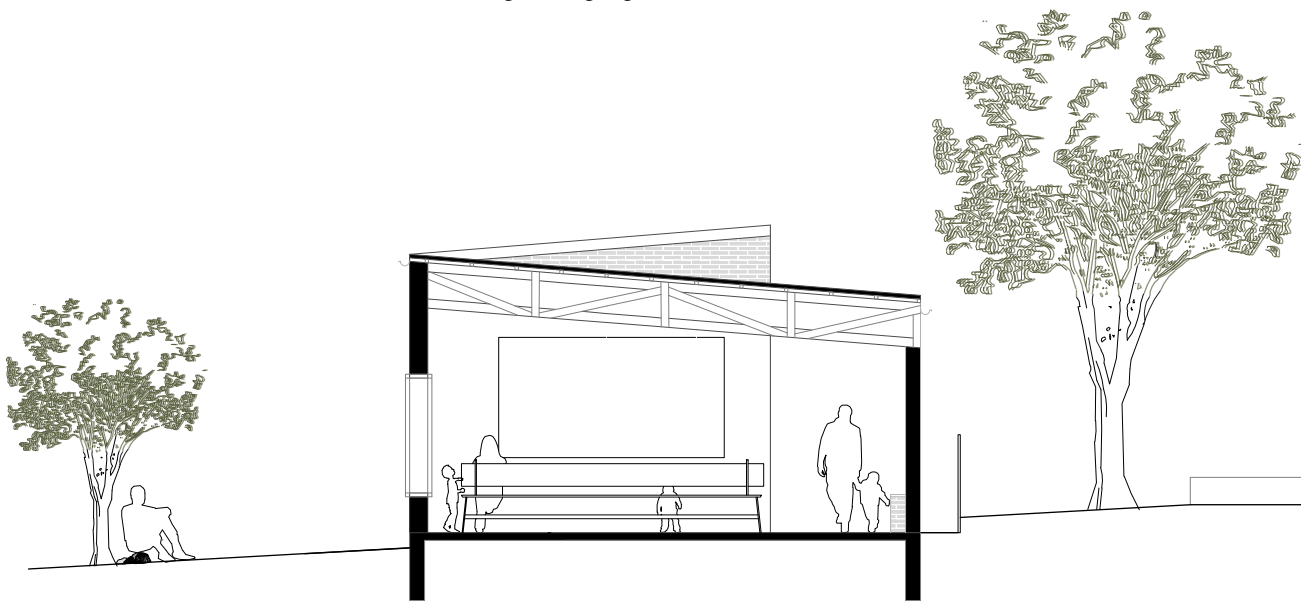
The entrance to the RCH building is pushed back in comparison to the surrounding buildings in order to preserve the use and atmosphere of the site today. The site contains large trees that provide popular refuge from the sun and the hospitals security are stationed on the site, just inside of the fence.



West facade 1.100

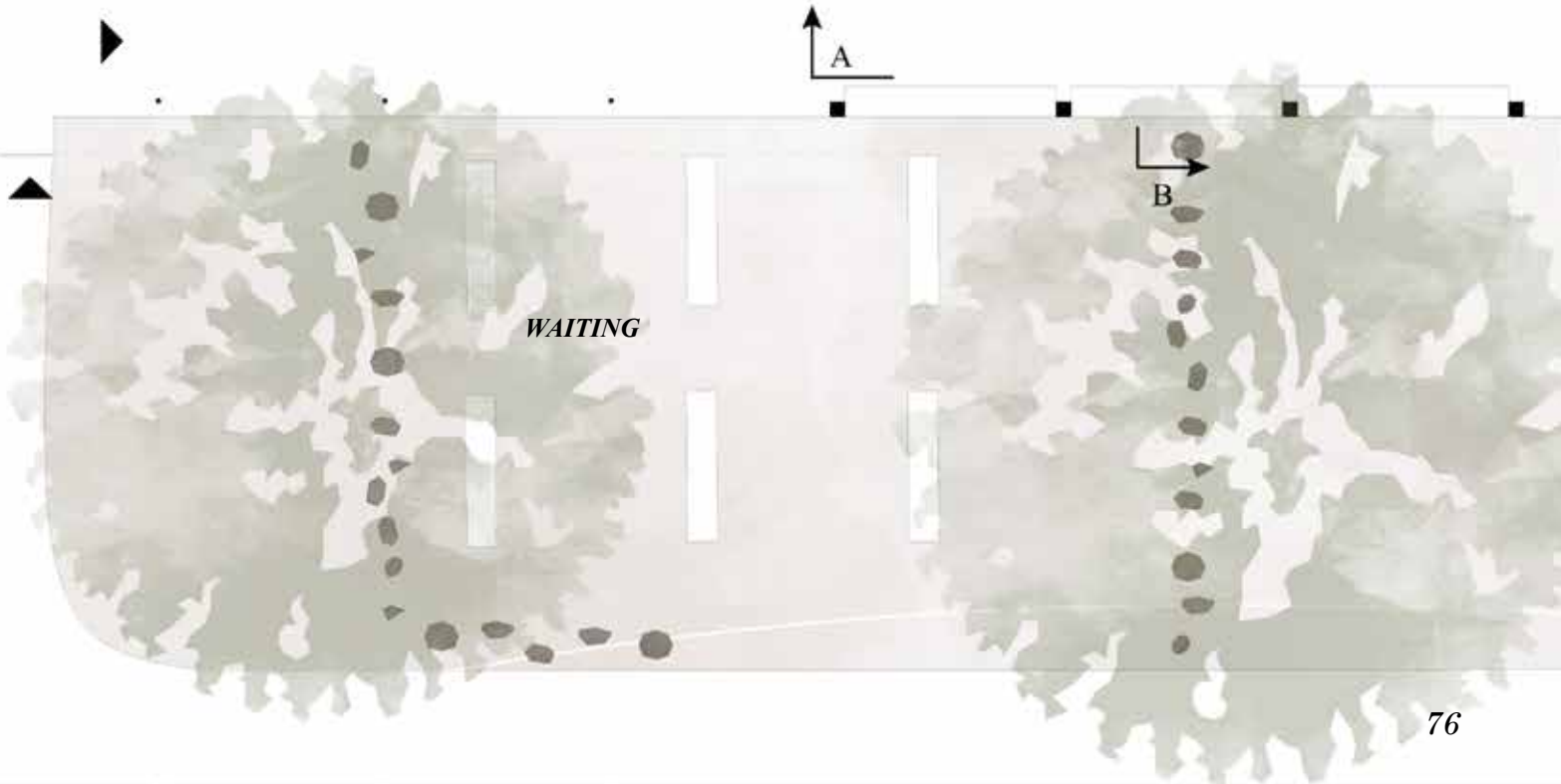
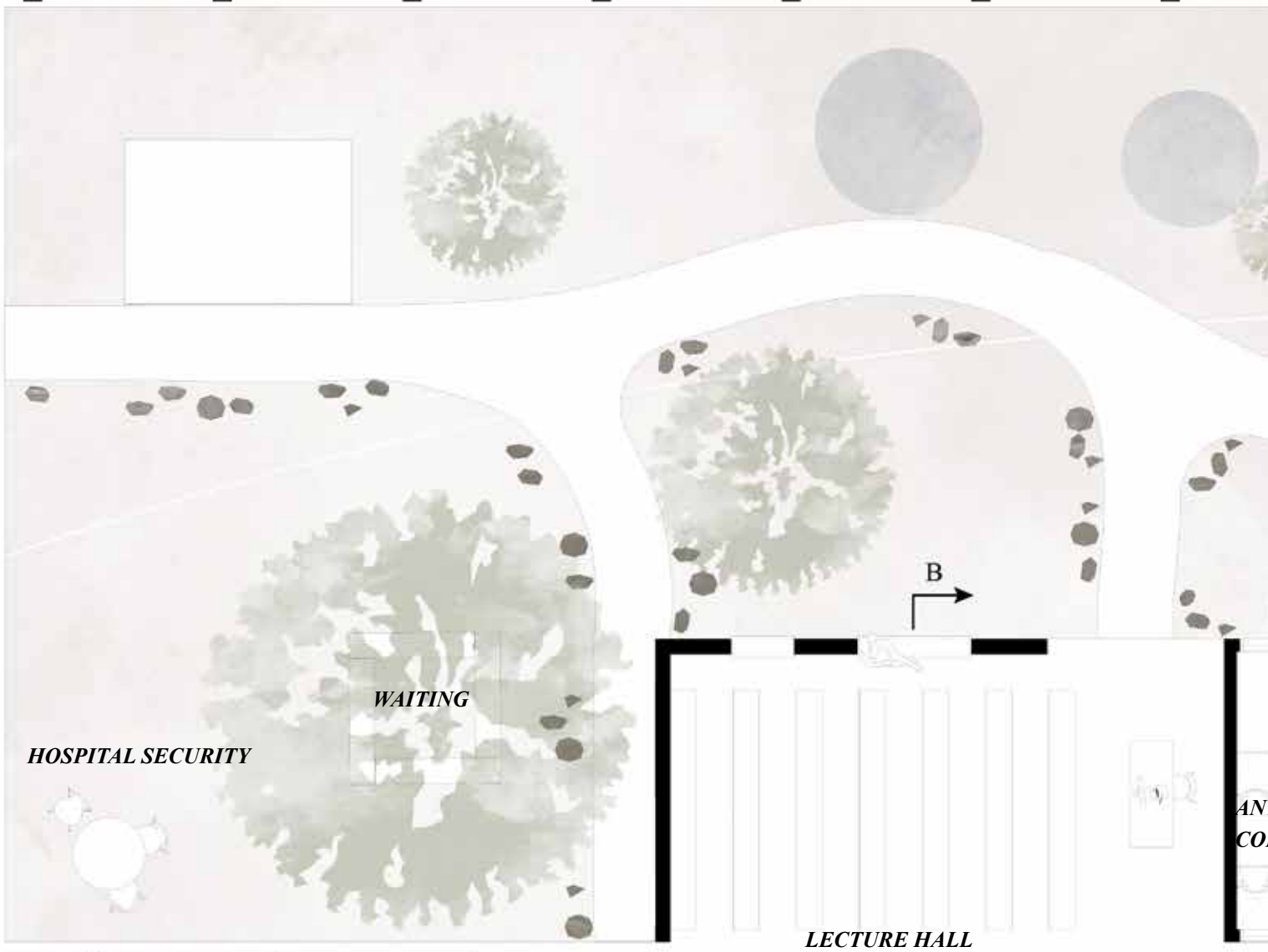


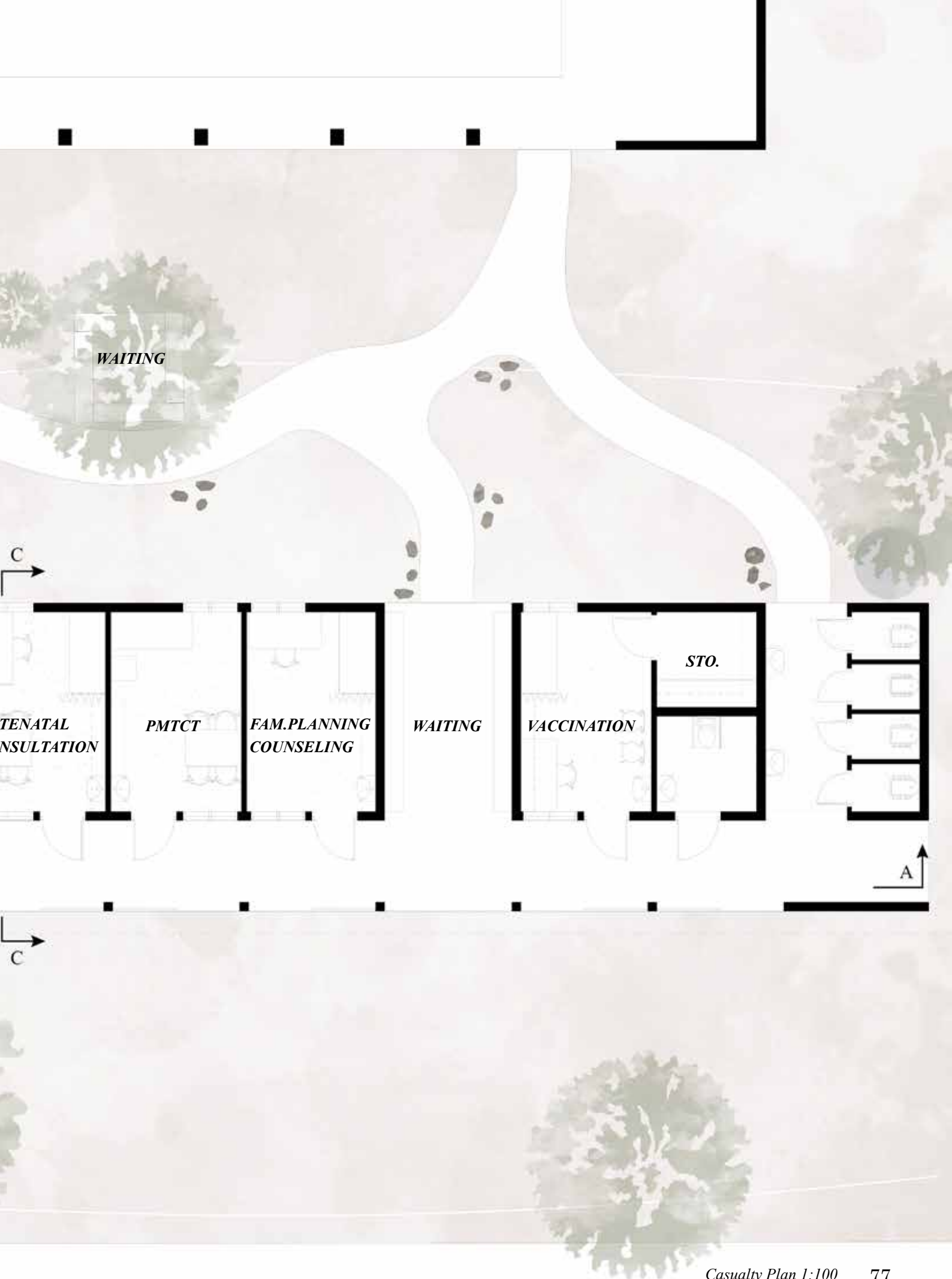
The lecture hall can seat up to 70 people and have both a view and a connection to the trees outside.



Section B-B Lecture hall 1.100

The window openings in the lecture hall is placed to provide additional seating but also to provide a good viewing height for a child learning to stand up.





WAITING

*PREGNANT
CONSULTATION*

PMTCT

*FAM. PLANNING
COUNSELING*

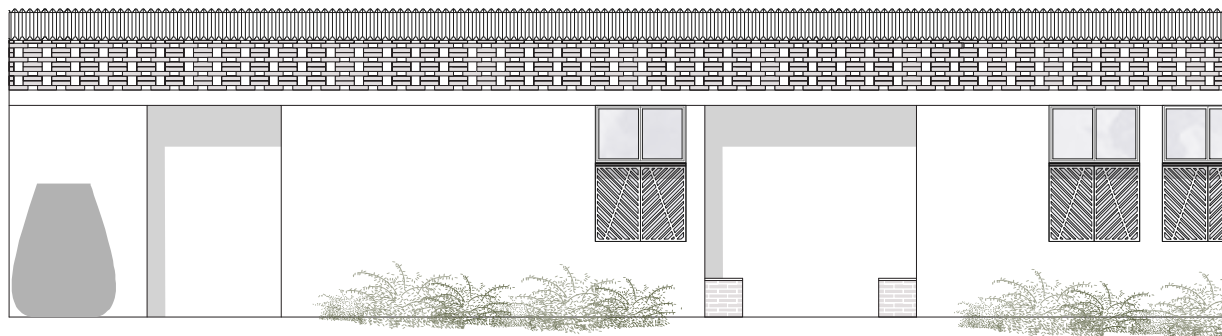
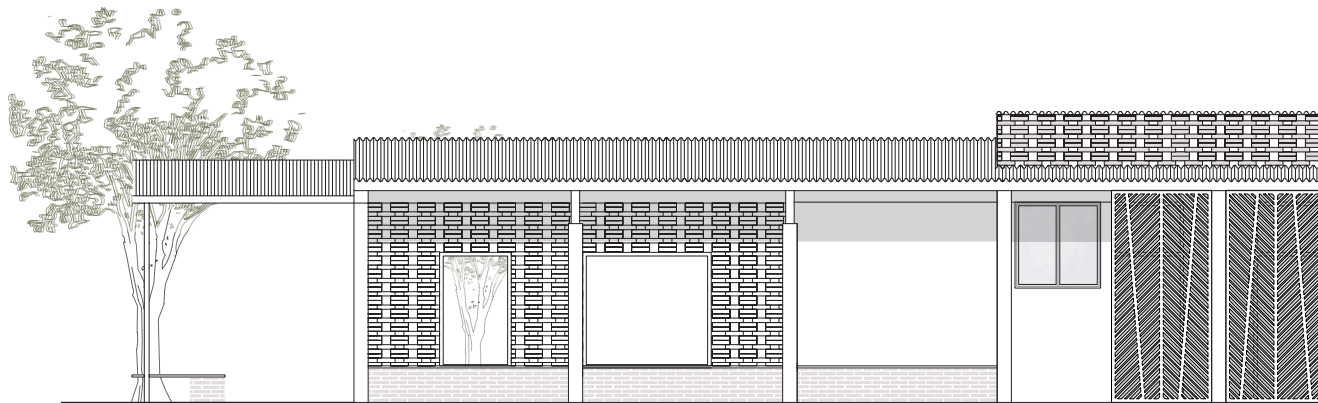
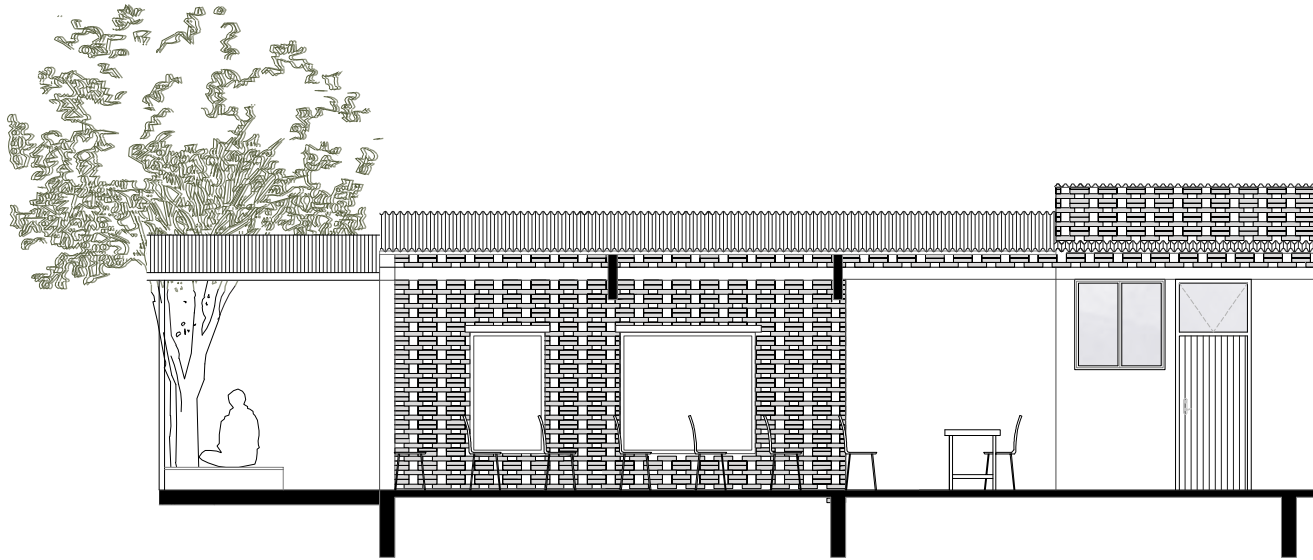
WAITING

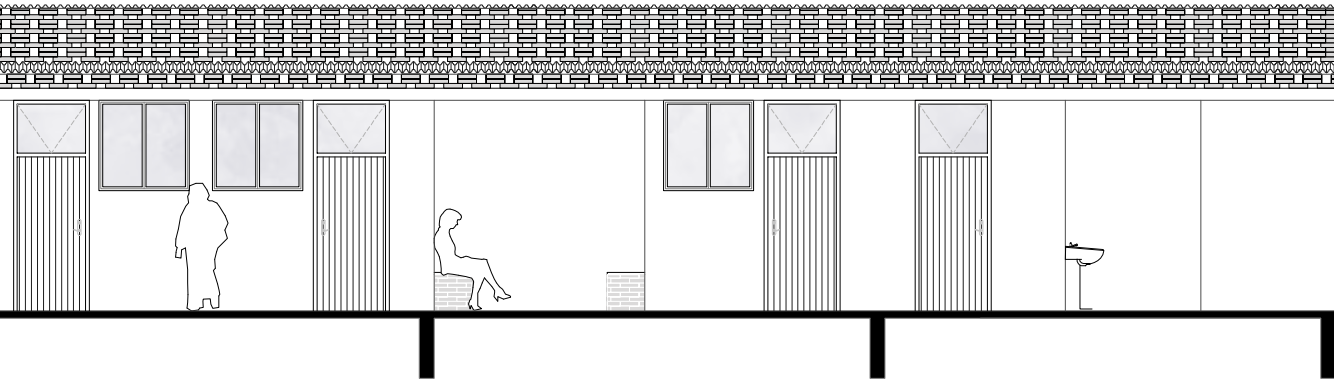
VACCINATION

STO.

A

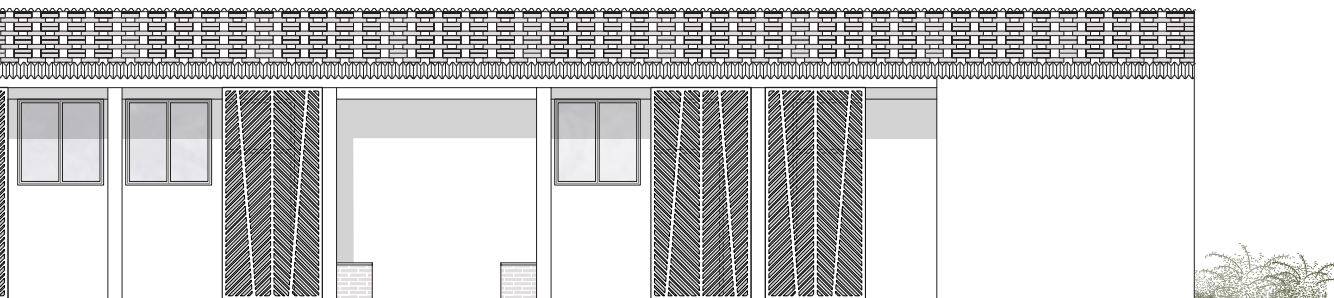
SECTION AND FACADE





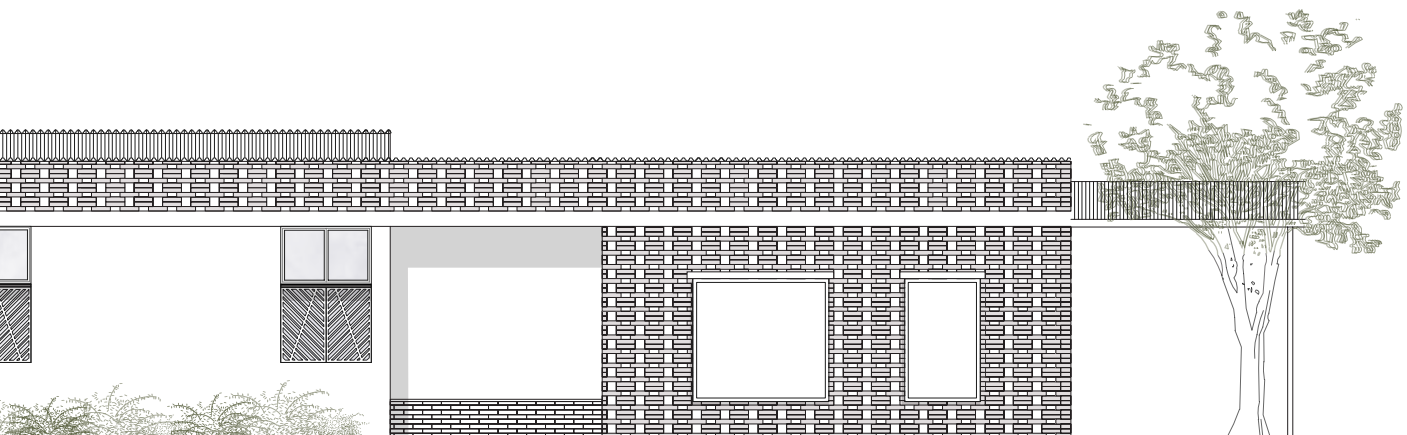
Section A-A RCH 1.100

There is an additional waiting area next to the vaccination room where patients can line up for an efficient flow into the vaccination room. The waiting area opens up to the garden as a soothing distraction.



South facade 1.100

The screens in front of the doors to the examination rooms are there to ensure privacy for the patient even if the door were to be opened during an examination, they also makes it less obvious which room the patient is entering.



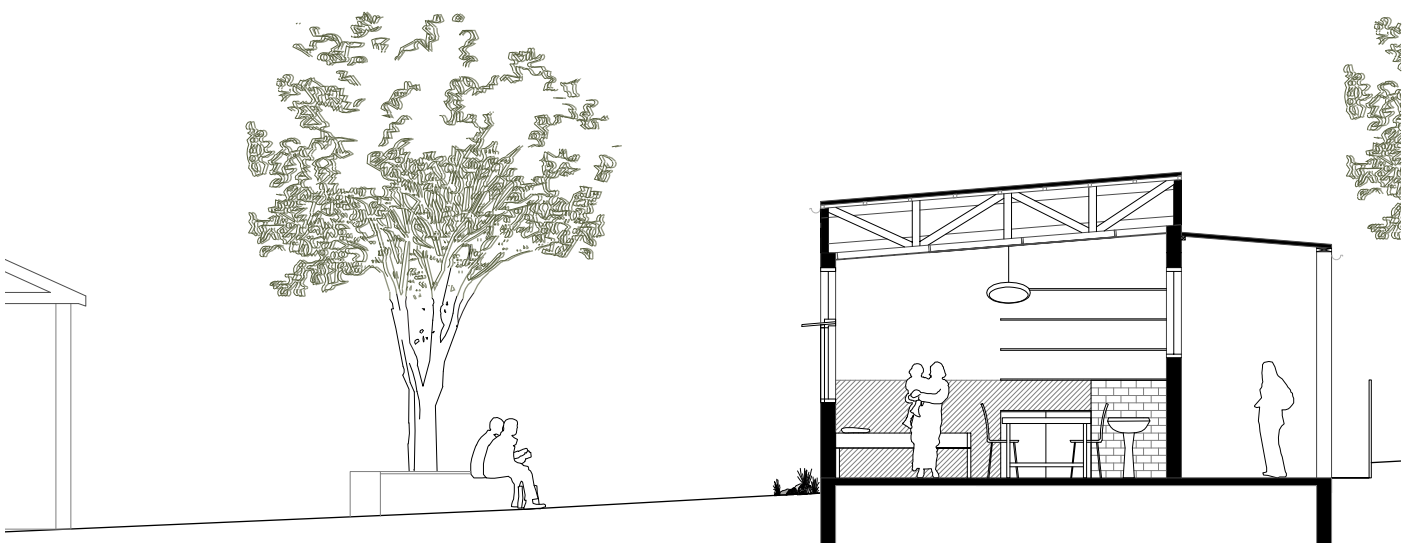
North facade 1.100

The windows towards north are covered by exterior sun screens and the storm water collection is placed for easy access from the toilets.

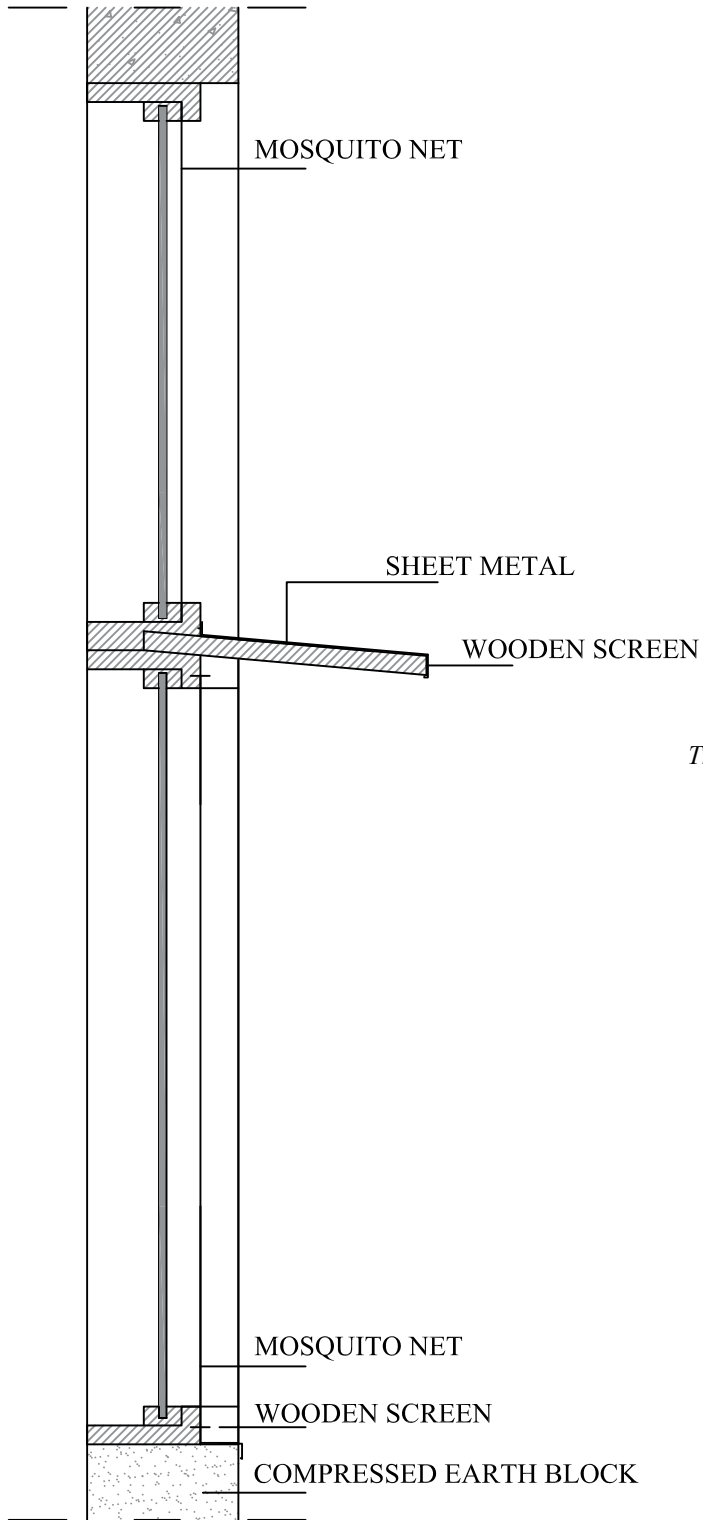
SECTION AND WINDOW DETAIL



Examination room perspective, the windows of the examination rooms and treatment rooms are covered by an exterior sunshade with a light shelf to bring light further into the room and protect from glare. The screens used during examinations have been designed with consideration of the women coming here, by using their fabric the building signals that it was made for them.



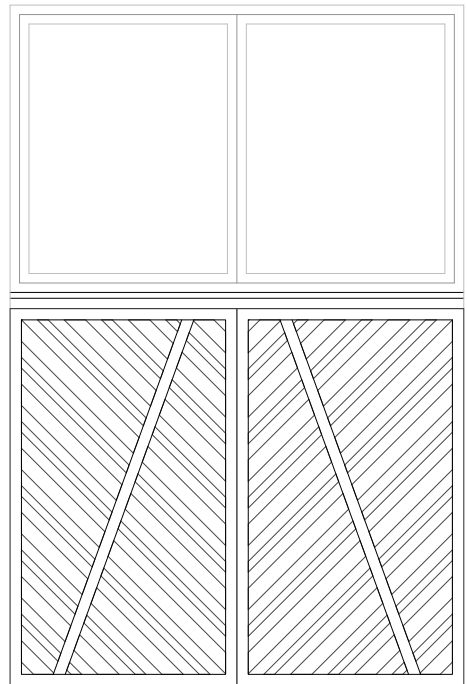
*Section C-C Examination room 1.100
The windows of the examination rooms are placed for maximized cross ventilation and to provide privacy during examinations.*



Window detail of light shelf 1.10



The design of the screen is inspired by the cultural appreciation for decorations and patterns.



1.20

CHAPTER SIX

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Discussion & Reflection

DISCUSSION & REFLECTION

The research question in this thesis has been "How can a design dialogue be used in a developing context to improve healthcare in a sustainable way?". After finishing this work, the answer to this question is that a design dialogue is essential when designing in a new context because sustainability means so many different things. A sustainable building should take the users, culture, context and environment into consideration. The struggle in this thesis has been to combine these into something that can also function as a safe healthcare environment. Without the stay on site where the everyday struggle of the hospital could be observed, it would have been difficult to grasp. Through the design dialogue it became clear what cultural factors needed to be taken into consideration, also how little resources the hospital has. Through the healthy hospital project, it is possible to provide the hospital with buildings, but not with equipment and staff, so there always must be a balance between what a safe healthcare environment looks like and what the hospital can manage to function in. The size of the projects in this thesis is equivalent to what the hospital could use today since they already have a shortage of staff. However, the RCH could easily be extended if the need would arise. Based on the number of emergency patients coming to the hospital today it is not likely that the casualty department would need an extension. In any case the surgery department would need to grow first.

The stay on site and the dialogue also helped to understand the severity of the lack of electricity and water which made ventilation, lighting and water collection the most important architectural features in this project. The problems that they currently have gave an understanding of which solutions are robust and lasts over time.

The design of the project was developed after the field study and cultural aspects in the design might have been different if the staff and patients would have been consulted. The plans of the proposal have been designed according to the needs of the hospital and regarding the patients. The exterior design has been an exploration of how the architecture can deal with climate, and how that can give a unique expression to the buildings. But would this project be built the design would have to be adjusted after the capacity of local contractors. So, during the design process for this thesis the local ability was overlooked to fully explore the design possibilities with the local materials. The project has been a balance between a design investigation for a master thesis and a base for the project taking place on site.

Having the opportunity to work with a real project with a stakeholder dialogue have been rewarding and difficult. There were high expectations on how much would be accomplished during the stay on site and eight weeks is a very short time. It is

difficult to plan to much ahead of time in a context where things change very quickly. The proposals in this thesis depend on other reconstructions and new buildings on the hospital campus. The projects vary in size and can be carried out over time, but it has been a sensitive discussion with the management since they have very little funds to build on their own and depend on donations. It has therefore been impossible to set a timeframe for the project. Since this thesis is only a small part of a bigger picture it was sometimes difficult to have the dialogue where other buildings were ignored. Also, the theory regarding healthcare architecture focus a lot on the patient, it was difficult to lift the patient's perspective during the discussions. For a better result there should have been a separate workshop with patients or interviews.

Finally, it will take time before this project can be realized and the design will be adapted after the budget and local contractors, still there will hopefully be a trace of the effort taken to create a caring atmosphere for the patients coming to Mkula hospital in this proposal and an architecture that supports healing.

CHAPTER SEVEN

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References

REFERENCES

Literature - Images - Other sources

BOOKS

Cor Wagenaar, Noor Mens (2018). Butaro District Hospital Butaro, Rwanda MASS Design Group. Hospitals: A Design Manual (pp. 122–123). Berlin, Boston: De Gruyter.

Golembiewski J.A. (2017) Salutogenic Architecture in Healthcare Settings. In: Mittelmark M. et al. (eds) The Handbook of Salutogenesis. Springer, Cham

Le Fort, C., Ehmann, S., & Klanten, R. (2016). Africa rising : fashion, design and lifestyle from Africa. (pp.89-93). Gestalten.

UN-Habitat (2014) Sustainable Building Design for Tropical Climates - Principles and Applications for East Africa. Nairobi: UN-Habitat

ARTICLES

Clancy, C. M. (2008). Designing for safety: evidence-based design and hospitals. American Journal of Medical Quality, (1), 66. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=edsgao&AN=edsgcl.242693252&site=eds-live&scope=site>

Shepley, M. M., & Song, Y. (2014). Design research and the globalization of healthcare environments. HERD, 8(1), 158–198. <https://doi.org/10.1177/193758671400800112>

Ulrich, R. S., Berry, L. L., Quan, X., & Parish, J. T. (2010). A conceptual framework for the domain of evidence-based design. HERD, 4(1), 95–114. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=21162431&site=eds-live&scope=site>

Ulrich, R. S. (2002) Health Benefits of Gardens in Hospitals. Paper for conference, Plants for People. Retrieved from https://www.researchgate.net/profile/Arvind_Singh56/post/I_am_interested_in_research_on_art_in_hospitals/attachment/59d64fbe79197b80779a8ceb/AS%3A499427246698496%401496084142830/download/Health_Benefits_of_Gardens_in_Hospitals.pdf.

MASTER THESIS

Bergstrand, L. (2017) KOLANDOTO ON CALL - Developing an emergency department through participatory design. Göteborg : Chalmers University of Technology

Kullberg, N. (2018) FUTURE-PROOF HOSPITAL IN TANZANIA. Göteborg : Chalmers University of Technology

IMAGES

Google maps (2019). Retrived from [https://www.google.se/maps/place/Mkula+Hospital+\(A-IC\)/@-2.3340762,33.8742083,899m/data=!3m1!1e3](https://www.google.se/maps/place/Mkula+Hospital+(A-IC)/@-2.3340762,33.8742083,899m/data=!3m1!1e3)

MASS design group Iwan Baan fotograf

Retrived from <https://massdesigngroup.org/work/design/butaro-district-hospital>

The Library of Muyinga

Architect: BC architects

Retrived from <https://www.dezeen.com/2014/01/14/childrens-library-muyinga-africa-rammed-earth-walls-bc-architects/>

OTHER

CIA (2019)

Retrived from <https://www.cia.gov/library/publications/the-world-factbook/geos/tz.html>

Healthy Hospital, Survey report Mkula Hospital (2018)

UI (2019)

Retrived from <https://www.ui.se/landguiden/lander-och-omraden/afrika/tanzania/>

UN (2019) Sustainable development goals.

Retrived from <https://www.un.org/sustainabledevelopment/health/>

World atlas, 2019-04-07. Retrived from <https://www.worldatlas.com/articles/what-are-the-characteristics-of-a-tropical-savanna-type-of-climate.html>