FUTURE-PROOF HOSPITAL IN TANZANIA

supporting the healthcare development through flexible hospital planning and design

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Gothenburg, Sweden - Spring 2018

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ABSTRACT

The hospital layout and the spatial organization influences the quality and efficiency of healthcare. The term flexibility is often used in developed countries' discussions around healthcare design, since the physical design can impede (or facilitate) improved processes and future needs. However, most strategies concerning flexibility are only implemented in the western world which has much greater resources than countries in the developing context.

This thesis focus on the physical setting in Tanzania and seeks to answer the question "How can flexibility be implemented into masterplan and surgery building design of Mkula Hospital in Tanzania?".

On-site investigations / observations, theoretical evaluation and workshops were conducted and formulated in to a design proposal for a new master plan for Mkula Hospital together with an extension and re-design of the current surgery department. The master plan could act as an overall action plan for the planning and implementation of future renovation, retrofit, and development projects.

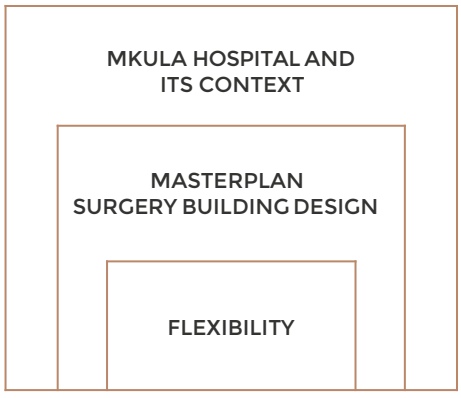
The thesis shows that the Swedish knowledge on healthcare facility design cannot be directly transferred or applied in the context of Tanzania. In this developing context it is necessary to use low cost methods to promote flexible design. The existing building techniques already include many flexibility aspects and could with small changes provide facilities well prepared for future challenges.

Low cost techniques including building layer independence, open ended corridors and placing the facilities in a campus layer composition are effective tools together with carefully considered construction and design methods that create conditions for future demands for change.

To create flexibility for the hospital's surgeries, the operation rooms need to be seen, designed and placed with a general approach, not specialised for one specific need. One example is to place the c-section theatre in the surgery complex with a regular theatre design to be used for other emergencies when needed. Also, by providing good visual contact between the staff they could easier assist each other in an environment with scares human resources.

Finally, it is of great essence to have a constant dialogue between on-site specialists and global research for the proposal to be successful and long-term sustainable with local managers feeling involved, ownership and responsibility for the existing and future process.

Keywords: Hospital building design, Healthcare facilities, Masterplan, Future-proofing, Flexibility, Tanzania



ABOUT THE AUTHOR

Nathalie Kullberg

I began my architectural studies in 2013 and I have a bachelor's degree in architecture from Chalmers University of Technology. I was introduced to healthcare architecture during my bachelor studies where I worked with the pre- and post- surgery department in Uddevalla.

During my master studies I have followed studios with focus on future visions for healthcare, housing and work.

Reading instructions

If nothing else is noted the photo, picture and illustration is taken or made by author or the project group on site in Mkula.

ACKNOWLEDGEMENTS

My sincere appreciation goes to Linda Bergquist and Annika Danielsson for their honest support in shaping my proposal and in aiding my understanding for healthcare architecture and the local conditions in Tanzania.

This work would not have been possible without the participation and support from Nanette Cronemyr and Angelica Lexell, that literally was by my side during the whole field study.

I would also like to express my special thanks of gratitude to Elke Miedema for helping me discover and see the path in the fog.

Finally, I thank my family for their unconditional support and love during this work and process.

COLLABORATIONS

Nanette Cronemyr and Angelica Lexell, Master thesis in Civil Engineering.

Architecture Sans Frontières

Engineers without boarders

Mkula Hospital, Africa Inland Church of Tanzania

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PART 1

INTRODUCTION

PROJECT BACKGROUND

Mkula Hospital was established in 1986. It is run by Africa Inland Church of Tanzania (AICT) as an educational voluntary Agency Hospital. The hospital has catchment area of approximately 204'000 people and a bed capacity of 105. The hospital is located in Mkula town and is the only hospital in Busega District.

This master's thesis is part of the development project "Healthy hospitals" initiated 2014. The project has previously been working with the sister hospital in Kolandoto, Tanzania. The work there has been carried out through three different phases and acts as case study for in total six master thesis (three architectural and three civil engineering).

This thesis is part of the first phase at the Mkula Hospital, also located in Tanzania. The project aims at supporting a sustainable development of water, electricity and building infrastructure. Two civil engineer students from Chalmers university of technology have been part of this phase and conducted a separate thesis together.

GOAL AND AIM

The main goal of this master's thesis is to explore how the current layout, distribution and flows correspond to the actual need to guarantee good health care services and see how the healthcare facilities could develop to promote future-proof design in the development context in Tanzania.

The aim is to, in collaboration with the hospital staff and management, incorporate flexible design strategies in two different scales. The large scale of a masterplan for long term development and the smaller scale for the extension and re-configuration of the surgery department. The aim is to create a hospital area that promotes the hospital's ability to perform care, now as well as in the future.

Original masterplan being transported.

RESEARCH QUESTION

How can flexibility be implemented into masterplan and surgery building design of Mkula Hospital in Tanzania?

DELIMITATIONS

The thesis focuses on the flexibility in the design product and does not consider the flexibility within the design process. The masterplan is not including analysis and proposals regarding the technical services or the medical equipment and furniture.

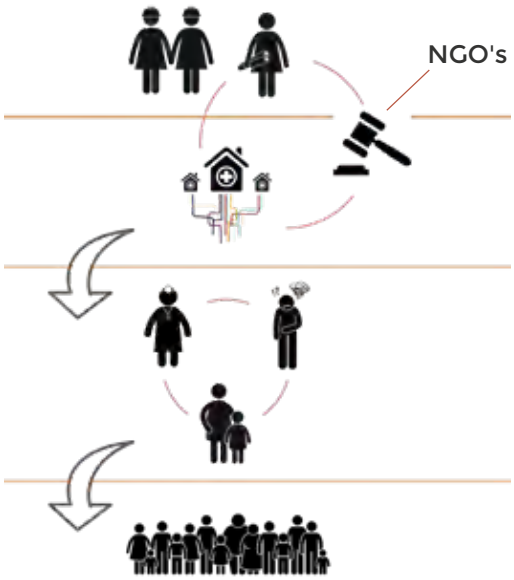
STAKEHOLDERS

Who can affect of be affected by this thesis? The answer is easiest described through a hierarchy illustration.

In addition to this thesis two civil engineer students conducted a separate thesis that focuses on how to promote collaboration and local ownership in an aid project with the task to improve and analyse the water situation. Together the three students worked with the staff and management to improve the infrastructure, logistics and flows of the hospital.

The thesis could also be used by the hospital to search external funding through NGO's or other companies, to continuously develop and maintain the hospital.

With well working logistics and flows the facilities could provide good environments for staff, patient and their relatives. With facilities that support the staff's ability to provide good care and increase the patients' experience and their recovery process, the hospital could easier live up to the UN sustainable development goal 3, ensure healthy lives and promote well-being for all the ages.

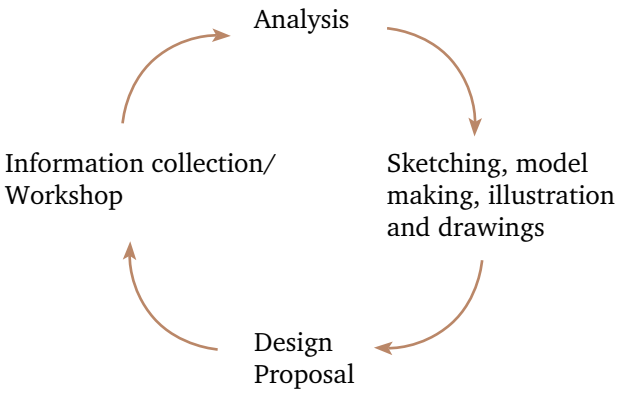


METHODS

To answer the research questions, on-site investigations / observations, shadowing, theoretical evaluation and workshops were conducted. Shadowing a staff member at each department was conducted primarily to understand the context of operations and obtain a better understanding of the dialogues and discussions in the workshops. The shadowing also created a good base of knowledge used in discussions with the management regarding the hospital needs.

The collected information was analysed to formulate design strategies that are applied in a design proposal. The feedback from workshops and meetings resulted in an iterative design process with several rounds of information collection, analysis and strategies formulation and creation of design proposals.

Methods for creating the design proposal and generating ideas were workshops, sketching, building models, making illustrations and drawings.



PART 2

BACKGROUND

COUNTRY, REGION AND DISTRICT

Tanzania

Tanzania is located on the east coast of Africa, south of the equator. The capital is Dodoma, but the major commercial and largest city is Dar es Salaam. The second largest city is Mwanza situates approximately 140 km from Mkula.

The country is totally 945,000 km2 and has almost 60 million inhabitants among which 80% of the population is rural. Approximately 158 ethnic groups are represented in Tanzania. The different groups have their individual language, but everyone use the national language Kiswahili as well.

Tanzania has received large amount aid and loans since the independence 1961 but remains one of poorest countries in Africa. The healthcare system is under a lot of pressure due to weak economic growth and a rapidly growing population (Moyo, 2010 and Tanzania Government Portal, 2018).

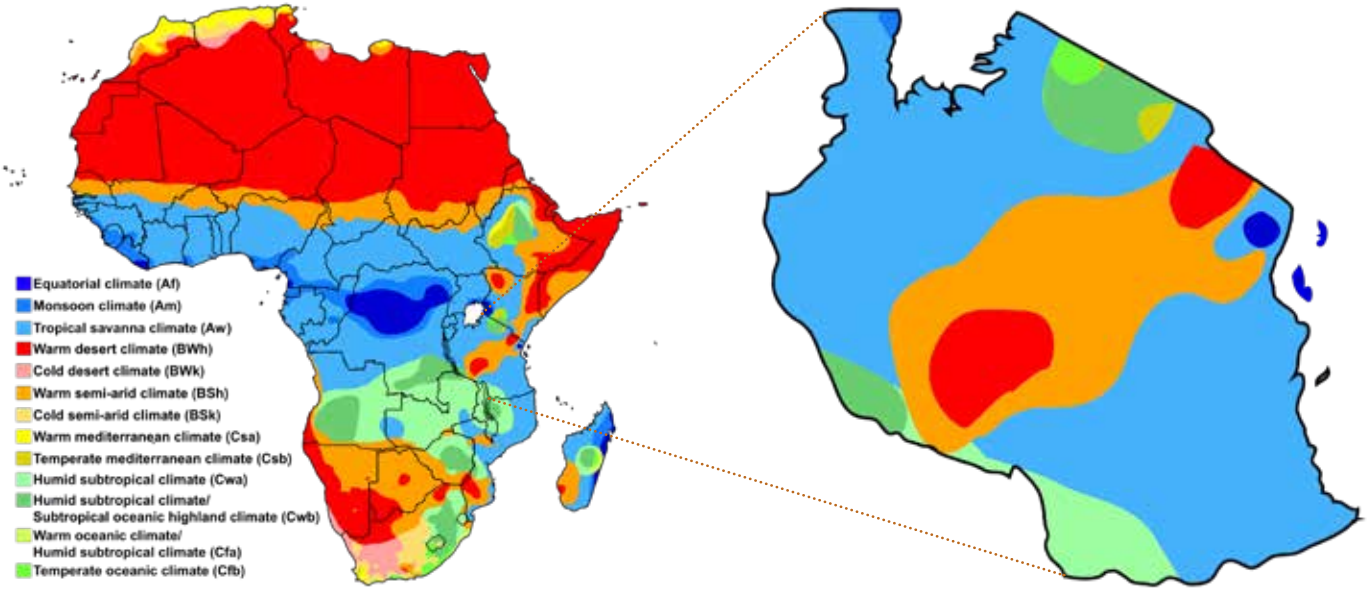
Simiyu region and Busega district

Tanzania is divided in 30 regions, with Mkula being situated in Simiyu region. The region is about 25 215km2 with Bariadi as its regional capital. Each region is subdivided into districts (wilaya) and Mkula is located in the northern district Busega which borders Lake Victoria.

Mkula village has a population around 20 000 people. The hospital is situated in the northern part of the village with close access to the main road between Lamadi and Bariadi (Tanzania Government Portal, 2018 and City Population, 2018).

(Google Maps, 2018)

CLIMATE



(Wikipedia 2018)

Tropical savanna climate

According to the Köppen-Geiger classification Mkula is located in an Aw area (also called tropical savanna climate).

The annual average of precipitation is 966 mm. But the amount of rain varies a lot between the different months. July is the driest with an average of 4 mm and April is the wettest with 177 mm rain.

The average temperature is 22.1 degrees. The warmest month is October with 23.2 degrees and July has the lowest average temperature at 20.9 degrees (Climate data, 2018).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avr. Temperature (°C)	22,3	22,3	22,6	22,2	21,9	21,3	20,9	21,5	22,5	23,2	22,5	22
Precipitation (mm)	87	93	146	177	79	22	4	16	29	62	135	116

MKULA HOSPITAL

Mkula Hospital was established in 1986 with the support of German donors. Mkula Hospital provides both preventive and curative services of various ranges. The hospital owns the nearby Health and allied Sciences education, Bishop Kisula College. The College has two programs, Nursing and Midwifery, as well as Community Health Workers.

The hospital has numerous sources of funds which are as follows;
- Government grants (salary grants),
- Basket fund,
- Patient collection (direct, or through Health Insurance),
- Donors support projects, for example AGPAHI.
- Hostel, venues and so forth

From all these sources the hospital collects around 100 million TZS per month, an amount that is not enough to cover all operational cost for the facility. Although Mkula Hospital have had various donors over time, there have only been one stable collaboration which is the Elizabeth Glaser Paediatric AIDS Foundation that runs the Care and treatment Centre building for HIV treatment (Dawood, Engver, Joelsson, Mangold and Öhman, 2017).

Departments

Out-patient department (OPD) - including Dental and oral health, Reproductive Child Health (RCH) and Care and treatment centre for HIV & AIDS (CTC).

In-patient departments
- Imani ward – Female ward (surgical & medical)
- Kisula ward – Maternity ward (including Labour ward)
- Upendo ward – Paediatric ward (surgical & medical)
- Yegela ward – Male ward (surgical & medical)

Surgery department, Laboratory, Radiology, Pharmacy and Administration.

Patients

The number of average patients at Mkula Hospital consists of 30-40 outpatients /day and 45-50 inpatients / day. Around 4-5 deaths occur each week.

Staff

In total 68 medical and management persons are employed at the hospital (not including cleaners, canteen staff etc.)

Courtyard between male and female ward

Maternity ward.

Masterplan and surgery unit

Mkula Hospital was established in 1986. It is unique in the sense that most of the hospital was built at one time. Thereafter only minor construction projects have occurred. This means that the hospital is rather well planned while rather over-crowded. The hospital has for the most part followed the original masterplan from 1981.

Most departments need more space and planned extensions are perceived to occur without the larger picture of the hospital in mind. Without an updated masterplan with a long-term strategic plan the placement of the building development could risk preventing the hospital from providing good health care services in the future.

The surgery department is in critical need of re-configuration. The following issues have been observed:

- Logistical flows of patients, staff, material and air throughout the surgery department could act as factor for medical errors and infections.
- No clear division between restricted / non-restricted areas.
- No room for recovery (recovers at regular ward)
- Only one of the two operating rooms are connected to a scrub and changing area (only one theatre being used).
- Emergencies and C-sections need to wait for the ongoing surgery to finish.

Future proofing

In healthcare facilities the space design and functionality are important due to the rapidly changing demands and environment. Unsuitable and inadequate spaces can create room for medical errors, space redundancy or deficit and impede the staff performance and quality of care (Ahmad and Demian, 2014).

Space flexibility and space standardisation can be applied in hospital buildings to improve design, construction and service delivery in healthcare. The use of generic spaces is encouraged in the design of healthcare facilities as they allow flexibility and adaptability (Pati, Harvey and Cason, 2008).

The concepts of flexibility and standardisation have globally been implemented in the healthcare sector. Unfortunately, many of the recommendations deriving from research and evidence-based design, causes for great investment costs. In the developed context this is defended with the argument that the investment will be financially beneficial in the long perspective (Shepley and Song, 2014).

However, in many developing countries the funds are simply not available. This thesis will therefore focus on the use of flexibility in the development sector and what design strategies to use when access to very limited resources.

SURROUNDING HEALTH INSTITUTIONS

Mkula is the only hospital in Busega district. In addition, there are three health centres, Nasa, Igalukilo and Lukungu. Nasa H/C is situated in Kabita and Igalukilo H/C are both 39 km from Mkula by car. Lukungu H/C is in Lamadi only 12 km away. Bunda hospital is the closest hospital but this is in a different region. The distance between the facilities is 36 km.

The regional referral hospital is located in Bariadi, called Somanda district hospital. The hospital is located 57 km from Mkula hospital.

Study visits were conducted at Bunda and Kolandoto hospital to increase the understanding of the context and collect inspiration for local solutions.

STUDY VISIT KOLANDOTO

The picture shows the main entrance point. To the left is the path to outpatient entrance and the gate to the right is the main entrance.

Good to divide different flows with different entrances, but the entrances must be clearly visible and defined to avoid confused and stressed patients.

The natural flow of relatives is closed and directed through the hospital. The new masterplan suggests opening the path which has not been done even though it requires a very small action. Does the management not understand its purpose, or do they not support it?

Important to understand the context and iterate the design with the management.

Unclear, broken signing and complicated connection points.

To improve the way-finding it would ease if the connection points are clear with good directions.

The sign-system are done with pastel colour and low contrast, they appear to blend in with its surrounding.

Signs need to be visible for all patients and be easy to read from a distance.

STUDY VISIT BUNDA

The picture shows main entrance point, with the tower as landmark.

A large centrepiece would make it easier to find the entrance in a large complex.

Visible storm water management and water connections to the building.

Simple well-structured water and sewage system ease the maintenance.

Skylights covered with plastic light up the outdoor corridor between two buildings.

Skylights can be created with help from transparent plastic roof (similar technique used at Swedish barns).

Patients and relatives spend lot of time outdoors. Well maintained courtyards, with greenery, seating and playground creates a park feeling.

Courtyards good place for family time.

VISION FOR FUTURE

UN Goal 3

Ensure healthy lives and promote well-being for all at all ages.

The absolute vision for the hospital's future is supported by the sustainable development goal 3. Significant progress has been made on access to clean water and sanitation, but this is still one of Mkula's largest obstacles when providing healing environment. The number of malaria, tuberculosis and spread of HIV/AIDS is decreasing but the future is predicting new persistent and emerging health issues which could complicate the access to appropriate health. Support from the facilities is needed.

(Gershuni, 2015)

Maslow's need hierarchy

The theory was developed by the psychologist Abraham Maslow. It is a tool to categorise different needs for humans to be satisfied and self-fulfilled. The five categories are placed in a hierarchy with the idea that the higher values are not important until the lower ones are satisfied. The needs could exist together, but no priority is put on the higher level until the existing is fulfilled.

There are very little empirical evidence supporting this theory, but it is important to keep in mind when working in a developing context. When discussing future visions and dream scenarios most people focus on the basic needs and have a hard time focusing on the higher levels. When talking with people in Mkula it becomes apparent that they completely focus on the basic needs.

PREAMBLE

The hospital layout and the spatial organization influences the quality and efficiency of healthcare. Since the healthcare sector is rapidly developing with new possibilities for prevention, treatments and diagnostic, the requirements for facilities are changing. In parallel, the continuous breakthroughs in research imposes updated methods and strategies that influence the demand of hospital organisation and facilities.

It is a very costly procedure to replace or upgrade existing hospitals that is no longer functional for its purpose even though the building itself could be in a good condition. One suggested solution to future proof the hospitals is the concept of flexibility, since the physical design can impede (or facilitate) improved processes and future needs.

The Mkula Hospital in Tanzania will act as a case study for this thesis and research regarding flexibility in the developing context.

DEFINITIONS

Masterplan

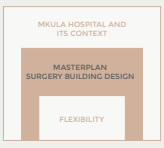
To develop a masterplan means to plan in the long term. To do a forward-looking work, it is important to determine what could affect the project regionally, nationally and globally. The masterplan is an indicative base when deciding on construction projects in the hospital area. It outlines the direction of the future development of the hospital area and aims to maintain preparedness to meet the care development. A long-term, sustainable planning is conducted with environmental analysis including an understanding of the future needs of future healthcare and what the significant global megatrends are (Hinnerson, Johansson 2014).

In the literature review made by Carthey, Chow, Jung and Mills (2011) conclude that the local conditions like building and planning regulations, climate, health funding models etc. have a clear impact on the success of flexibility strategies used in different countries.

The flexibility aspects have a great influence on the masterplan and to achieve a good, sustainable plan it is necessary to use design strategies adapted for the specific region and its local conditions.

Surgery Building design

The important aspects of a building design for a surgery department are to create good conditions for the staff to follow good hygienic procedures and to consider the direction of the air flow. Possibilities to adapt to emergency situations are strongly preferable. In a context with very scars human resources it is beneficial to allow flexibility in working procedure, to be able help and assist each other both within and between surgical teams.

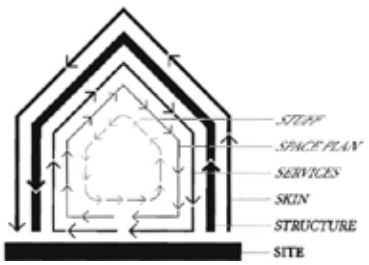


Future-proofing

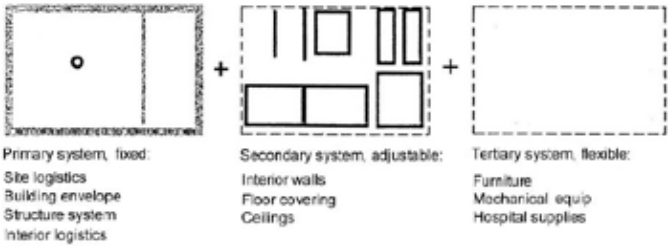
Flexibility, adaptability, agility, elasticity, versatility, generality, repeatability, changeability, convertibility, and modularity are different qualities that can be collected under the term "future-proofing". Since healthcare facilities are constructed during a time when future circumstances are unknown, it is not possible to design a "future-ready" hospital. Hence it is important to prepare for change, designing “future prepared" hospital facilities is of great essence. This is what the term future-proofing means, a future prepared facility (Kjisik, 2009).

Future-proofing methods could be more easily applied by separating the building in different layers depending on their function and durability. The method of treating different building components or layers independently will allow the layers to change independently and create a flexibility within the system. There are many different classification structures of building systems proposed (Pati et al., 2008). This thesis shortly explains two systems.

A concept developed by Frank Duffy and Stewart Brand called "Shearing layers" argue that there isn’t such thing as a building, instead it is several layers of built components. The different layers have different level of change and evolve in different time scales. The different layers are Site, Structure, Skin, Services, Space plan and Stuff (Brand, 1995).



A similar system but with fewer divisions was presented at the International Union of Architects Congress in South Africa 2014. The spatial organisation was here separated into Primary system, Secondary system and Tertiary system (Kendall, Kurmel, Dekker and Becker, 2014).



Micro-level and Macro-level

The expressions micro-level or macro-level are normally used to define the scale of something. In this thesis the definitions are used to consider the scale of the proposed strategies in terms of their effect on the life of the building.

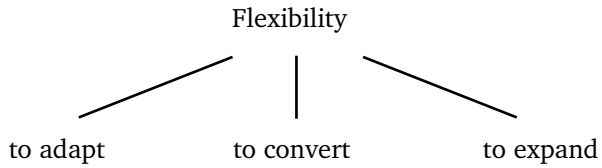
The illustration on next page spread is explaining the connection between the building system and the functional requirement for flexibility together with their location on a micro- and macro scale.

Flexibility

The word *Flexibility* have a varied and sometimes conflicting definition. The concept of flexibility could be considered abstract and intangible which makes it difficult to define with short-term definitions. Flexibility is more meaningful when applied to an actual design or project rather than in theoretical terms. Designing for flexibility is a way of preparing for the unknown change, but without a crystal ball it is impossible to evaluate the result of flexibility until the future change is about to happen (Carthey et al., 2011).

Flexibility is defined in the Swedish national encyclopedia as ability to adapt to different situations ("förmåga till anpassning till skilda situationer") (NE, 2018). Some studies see flexibility as a subset or dimension of adaptability. Schatvet, Støre-Valen and Haddadi (2017) divide adaptability into flexibility, generality and elasticity. They express flexibility as the possibility of changing the space distribution in the building, whereas generality is seen as the possibility for a building to change functions within the building. Finally, elasticity expresses the possibility of changing the volume.

Pati et al. (2008) have a similar division but use the words differently. In this definition adaptability, convertibility, and expandability are subsets of flexibility. This will form the base for the thesis and its discussion.

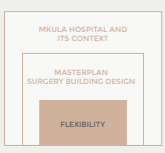


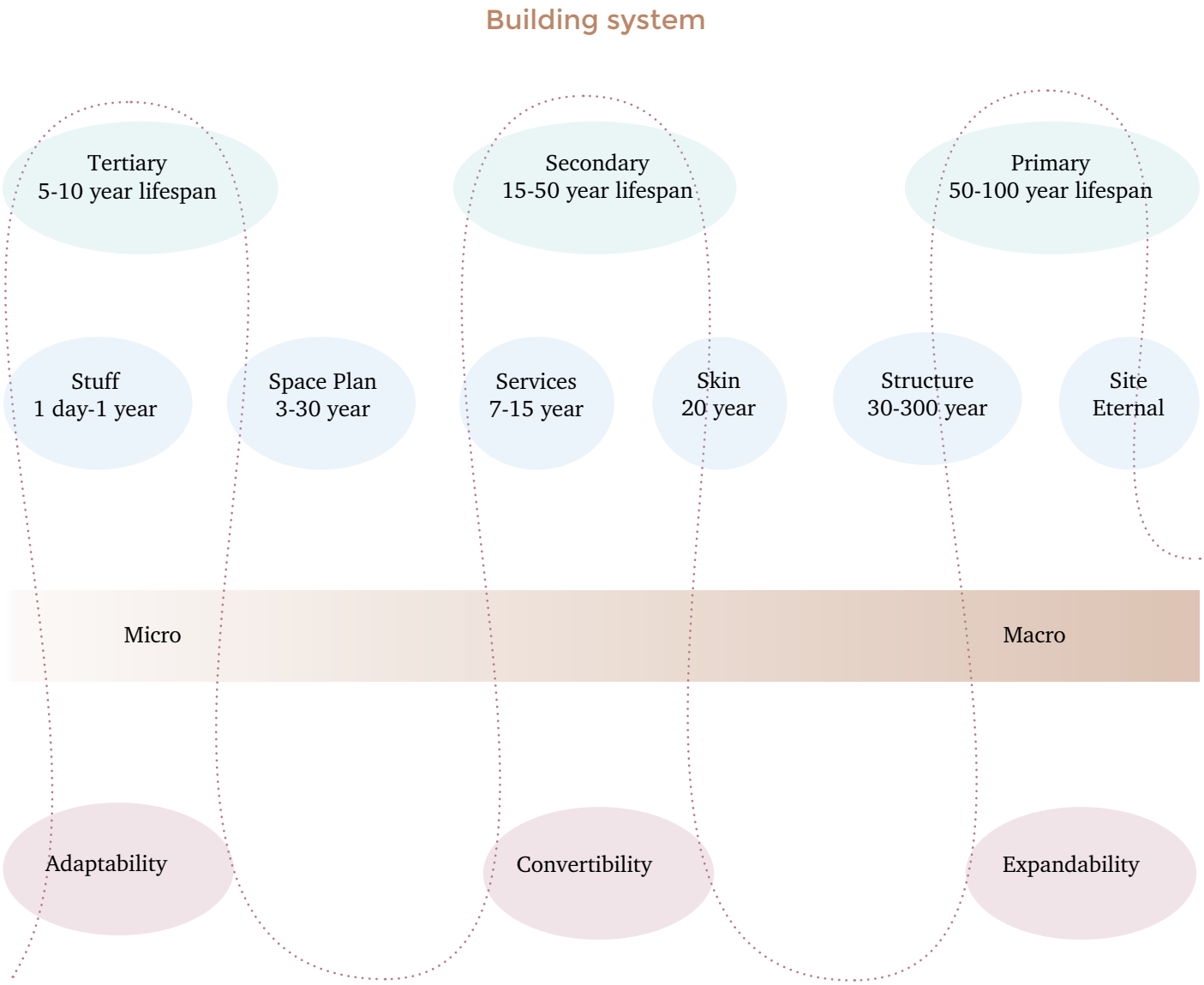
Flexibility can be seen as the ability to adapt (adaptability), to convert (convertibility), or to expand (expandability).

Adaptability is defined as the ability to adapt the care environment to change, without making changes in the environment.

Convertibility is defined as the ability to convert the environment to change, with simple or inexpensive physical alteration to the environment.

Expandability is defined as the ability to expand a space over time (Pati et al., 2008).





(Carthey et al., 2011).

PART 3

FINDINGS

MAPPING THE SITE

Since the hospital was build 1986 only few additions have been added. The hospital chief is pleased with the buildings' condition, that only received few cracks and erosion over the years (Dawood et al., 2017).

Nearly all conditions described below is due to the lack of maintenance and are caused by normal ageing and wear. However, the deterioration is accumulating over time and will gradually become worse if no maintenance occur.

Sanitation

The major issue is the hygienic conditions. No pipes have been built or updated after 1986. Lack of water supply have caused problems with hand-washing routines and alcohol-based hand sanitizers are too expensive. Most toilets inside is out of order, and outdoor alternatives without connection to water or sewage are used.

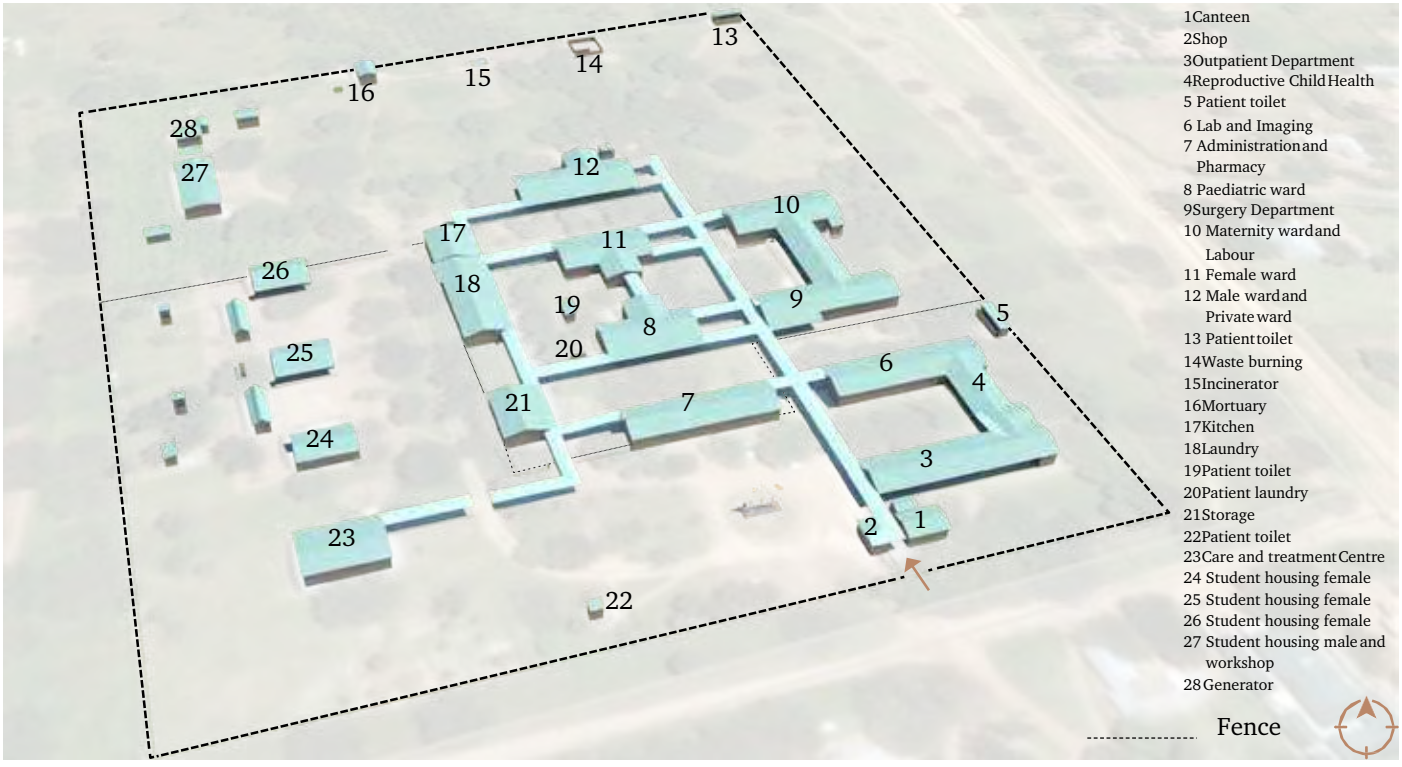
Building shell

The roof is covered with aluminium sheets with holes in a few places which have resulted in damaged ceilings. Most windows and doors need to be renovated and/or updated.

Interior surfaces

The internal wall surface layer consists of painted plaster but are poorly maintained and hard to keep clean due to cracks or corrosion. Most concrete floors are also covered with cracks and holes that makes it hard to keep them clean.

Following pages describes the building conditions based on information collected from staff interviews, workshops, management discussions and authors own observations.



Main entrance

Waiting area for relatives are located outside the entrance gate. The seating has comfortable shading. Next to the small gate is a larger opening for cars, but this entrance is only used by staff. Patients arriving with vehicle are parking outside along the street.

Problems: No roof for rain protection. Very narrow entrance point. No designated space for parking.

3. Outpatient department entrance

Good and fast flow of patients. Close connections. Narrow building with very good daylight condition, no electricity used.

Problems: Very poor patient integrity. Patients waiting outside can hear the conversation from inside. Staff goes in and out of the examination room to deliver files or talk while patients are inside. No storage for wheelchairs etc.

3. Outpatient department registry

Registry work well, two openings for efficient work flow.

Problems: The registration is hidden from the entrance and the way to go there is through a path mostly used for wheelchair and equipment storage.

4 + 6. Reproductive and child health

The lecture hall on the picture was constructed in 1987. Facilities is well functioning and have enough space.

Problems: Entrance is hard to find and vaccinations occur in the vaccination waiting room. Noisy department due to small kids that disturbs the OPD working environment.

5. Patient toilets

The toilets for outpatient department is placed in a separate building behind imaging and lab. Built in 1986.

Problems: There are no water or sewage connected to the building. It is assumed that the faeces just go down into the ground.

6. Imaging and Laboratory

In general, well-functioning and in good condition.

Problems: No workspace for radiologist and computer room need increased space. Walls around x-ray is probably not blocking the radiology. The lab needs more space to do different procedures correct. The sampling room is also used as the entrance to the lab area.

7. Administration

Building contains management offices and pharmacy. Building in very good condition. Narrow body allowing good daylight.

Problems: Pharmacy need more space. Located in the centre, offices experience partially disturbance from patients and daily operation.

8. Paediatrics ward

The facility is in good condition, with much space for storage.

Problems: Isolation room is not isolated. Patient rooms with 8 beds and very little space for relatives. Big sanitation issues. Very crowded, often used for females as well.

9. Surgery and sterilization

Building placed very strategically between Labour and Imaging / lab department

Problems: Major logistical and zoning issues, no place for recovery and only one theatre in use. Poor working climate. More detailed described in separate chapter.

10. Maternity ward and delivery unit

Close connection to surgery. Many empty beds for the antenatal patients. Good storage space.

Problems: No C-section theatre. Want a receptor corner for the midwife students. Neonatal area too small and dysfunctional. No changing and bathing space for staff moving between maternity ward and labour. Inside toilets in extremely bad condition are the only available.

11. Female ward

Building in OK condition. This ward is often used as back-up space. Females are placed at paediatric ward due to lack of staff.

Problems: Isolation room is not isolated. Patient rooms with 8 beds, no patient integrity. No room for relatives. Big sanitation issues.

12. Male and private ward

The facility is in good condition, with much space for storage. Inside toilets in OK condition, used during night.

Problems: No connection between the wards. Isolation room is not isolated. 8-patients in one room, no patient integrity. No room for relatives. Outdoor toilet far away.

13. Patient toilets

Male ward toilets are in the north corner of the site. Built in 2000.

Problems: Long distance, reached by a long, uneven path. No water or sewage connections.

14. Waste

Well-functioning place for burning regular waste on a good distance from the wards.

Problems: No paved path to any of the waste areas, only bumpy dirt path.

15. Incinerator

The incinerator is used for burning medical waste. Place on a good distance from the wards

Problems: Totally destroyed with no chimney. Waste are being burned on top and are in general way too small. Needs to be replaced.

16. Mortuary and placenta pit

Both placed in the top of the site. The mortuary is the only one in the district. Currently space for 6 bodies

Problems: The mortuary needs space for more bodies and a cooling system. Ventilation in the placenta pit is broken and causes an extreme odour when opening. Also need fence to keep animals away.

18. Laundry

The water is being tapped inside and carries outside for heating over open fire, then brought back in for the washing procedure.

Problems: Need washing machine (water supply need to be improved first). Would prefer a small boiling place with direct connection to water.

19. Patient toilets

For female and paediatric ward. Connected to a sewage tank that has the possibility to be emptied. Build in 1986.

Problems: No path from the walkway. Very bad condition. The tank has most likely never been emptied. No water or sewage pipes are connected.

20. Patient laundry

Laundry is made by the relatives. Laundry sink outside paediatric ward.

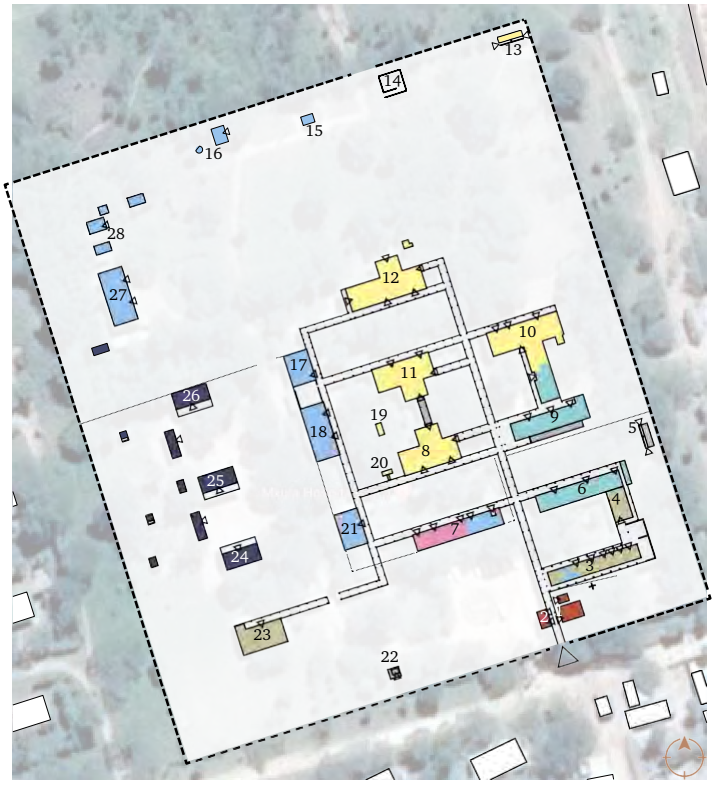
Problems: No water tap close by, and no designated space for drying.

23. CTC HIV/AIDS and TB clinic

Originally build as a canteen but renovated and changed function in 2014. Building in much better condition than rest of hospital. Plans to extend. Used as CTC Monday, Wednesday and Friday. Other days as TB clinic.

Problems: Placed far away from other OPD departments with no roof covered or paved path to the entrance.

ZONING ANALYSIS



Scale 1: 2500

- Inpatient
- Outpatient
- Staff
- Diagnostic and treatment
- Support, goods and materials
- Public & non-hospital function
- Student
- Fence

Zoning

The hospital in very well zoned. The different categories are kept together. The more public functions as OPD is placed closest to the entrance and more private departments further in. The technical department are situated close together.

The CTC is partly separated from the rest of the OPD department. Non-hospital functions, two shops and a bank function are located within the fenced hospital area as well as the student housing.

Flow

Patients and staff use the same flow. There are no separate emergency, bed or waste transport paths. The different wards have many doors used by everyone.

Everyone enters through a very narrow gate at the southern end. All patients enter as outpatients and must go through the registration process. It is necessary to go around the OPD building to reach the registration office.

The Care and treatment centre for HIV and AIDS is in a separate building. No paved path exists, and patients must cross the staff parking to enter.

Goods are being stored at the pharmacy and dispensary. Supplies for the different wards are normally being picked up at the pharmacy but use the dispensary for emergency cases when the pharmacy is closed. The dispensary's main purpose is to serve the OPD patients.

Important to note for the relatives' flow is that they enter in waves during specific visiting times. During other times no visitors are allowed.

To reach the college north of the fenced area the students need to go around the whole site since the northern gate rarely is open.

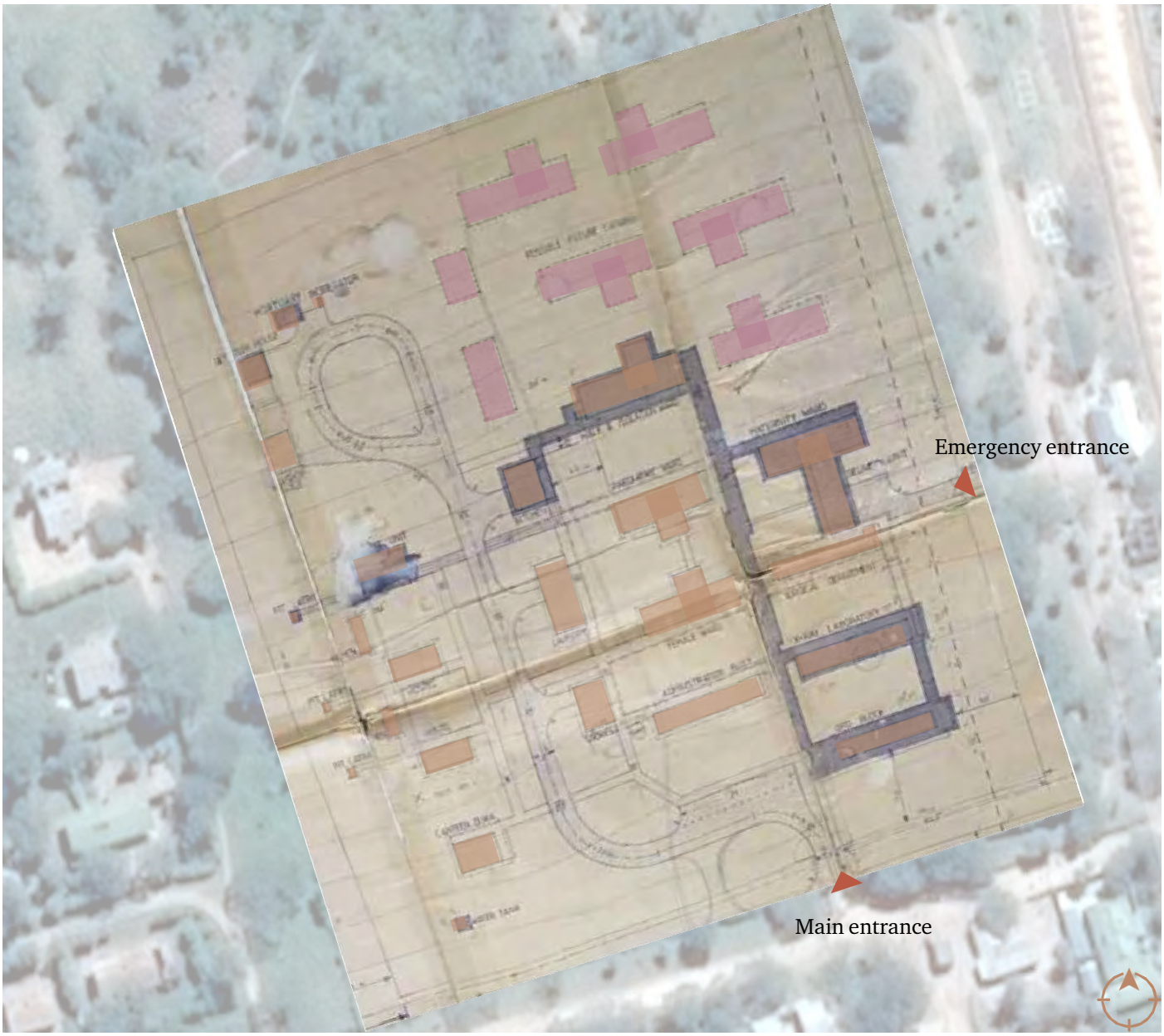
FLOW ANALYSIS

Inpatient
Outpatient
Staff
Support, goods and materials
Relatives
Student
Fence

0 25 50 100

Scale 1:1500

EXISTING MASTERPLAN



Existing buildings
Possible future expansion

FLEXIBILITY ANALYSIS

Flexibility to ADAPT

The current facilities allows good visual connection for the staff and promotes an adaptable way of working. The narrow building allow good daylight condition that makes the operation resilient to power-cuts. However, there are very limited space at the patient's bedside. This prevents adaptability for increased acuity, increased need for isolation or access to future electronic charts. A combination of integrated and movable interior is provided. The portable furnishings promote an adaptable way of working and possibilities to adapt the setting. Flexibility between staff is allowed through the close physical distance between different department.

Nursing station at male ward.

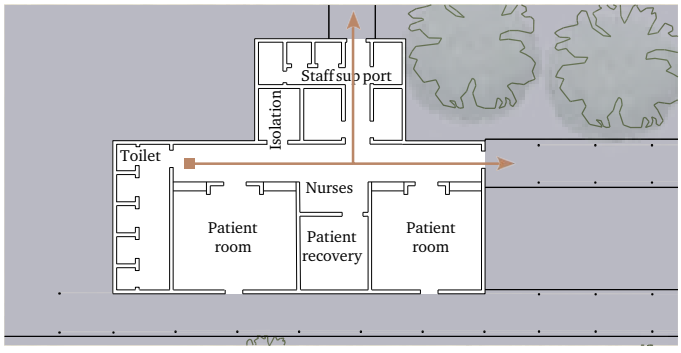
Flexibility to CONVERT

The most conventional way to construct a building is with plastered bricks, wooden trusses and steel roof. Since there is no isolation and a light roof construction doors and windows could easily be removed or added. The massive walls complicate the demolition and convertibility of the floor plan. A repetitive window placement creates a clear grid for "facade openings". All healthcare facilities have a ceiling height at 3 m, which supports all types of care. The pitched roof saves plenty of room for necessary installations. It could be seen as a low-cost variant of the "general room" concept.

Student houses that have been converted over time

Flexibility to EXPAND

The current masterplan suggests a continuous expansion of small detached facilities in a north direction and an emergency entrance directly to the surgery building. The campus layout makes the individual department independent from each other from an expandability perspective. The existing buildings are too small to provide good care from a crowdedness point of view. The open-ended corridor would create potential for extension, but all current facilities block this opportunity with toilet units.



Floor plan showing principle layout for wards

DESIGN APPROACH

There are many different approaches and design strategies related to flexibility.

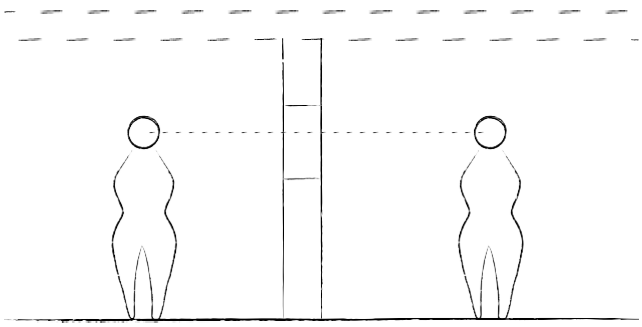
Some strategies like floor loading capacity, interstitial floors, shaft and elevator dimensions are relating to vertical expansions. These aspects are not relevant in this context since the non-reliant electricity supply prevents usage of elevator. The Mkula hospital currently consists of single floor buildings in a campus structure and has enough space for expansion horizontally. The campus layout allows, unlike a single-building entity, progressive development of the individual departments without causing a domino effect. The scattered composition also allows the ability to selectively renew, replace, and expand individual buildings without affecting the other departments operation.

The economic circumstances will affect the possibilities of using strategies like acuity-adaptable and universal rooms. The concept of having shell space or using the empty chair model will neither be applicable due to minimal funding possibilities (Chefurka, Nesdoly & Christie 2005 and Shepley and Song 2014).

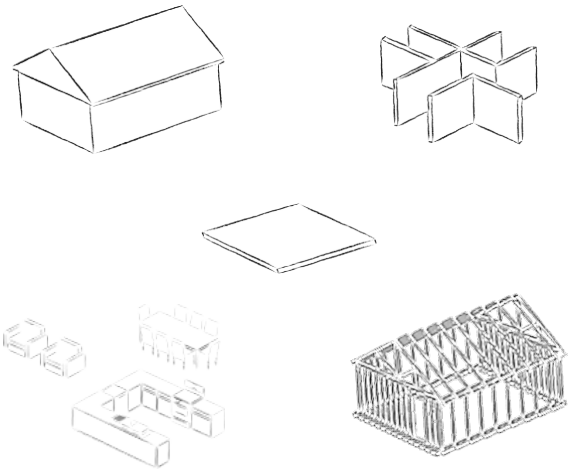
The current facilities have already many flexibility aspects integrated and these need to be addressed and used as an inspiration in future planning and constructions. The aspects that today creates a barrier for flexibility need to be highlighted to be avoided in the future, such as blocking the open-ended corridor with permanent, hard to move sanitation volume.

Following design approaches will be brought into the redesign of the masterplan and surgery department.

FLEXIBILITY TO ADAPT

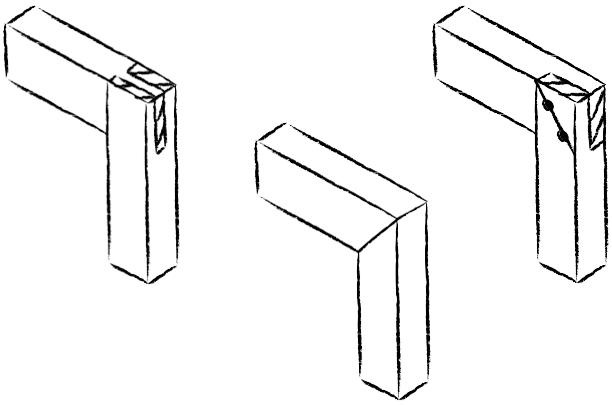


Peer and patient visibility

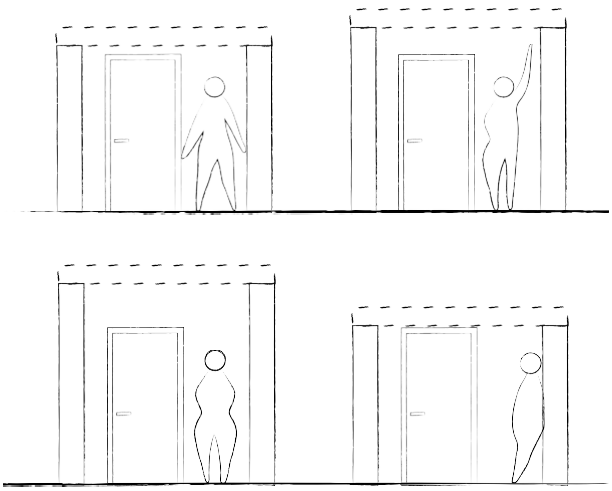


Building layer independence

FLEXIBILITY TO CONVERT

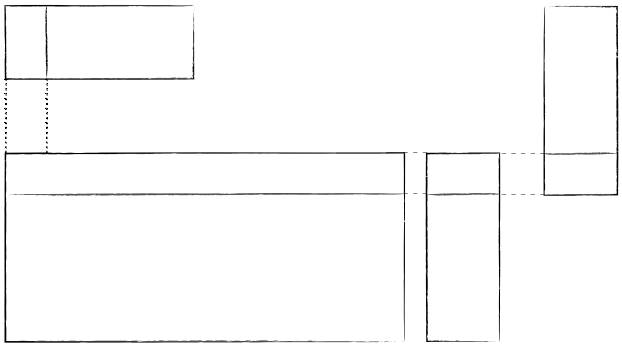


Construction method

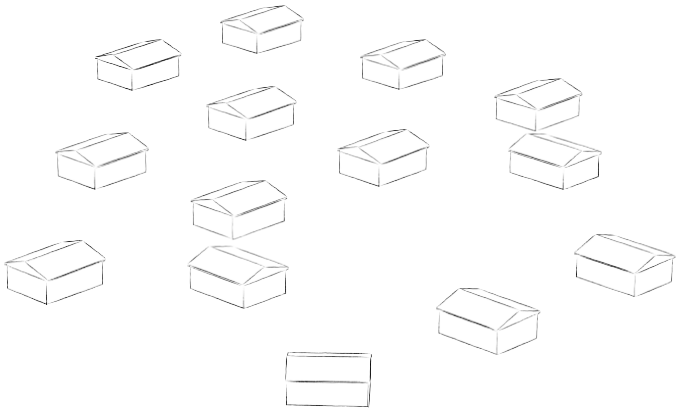


Ceiling hight

FLEXIBILITY TO EXPAND



Open ended corridors



Campus structure

MANAGEMENT PLAN

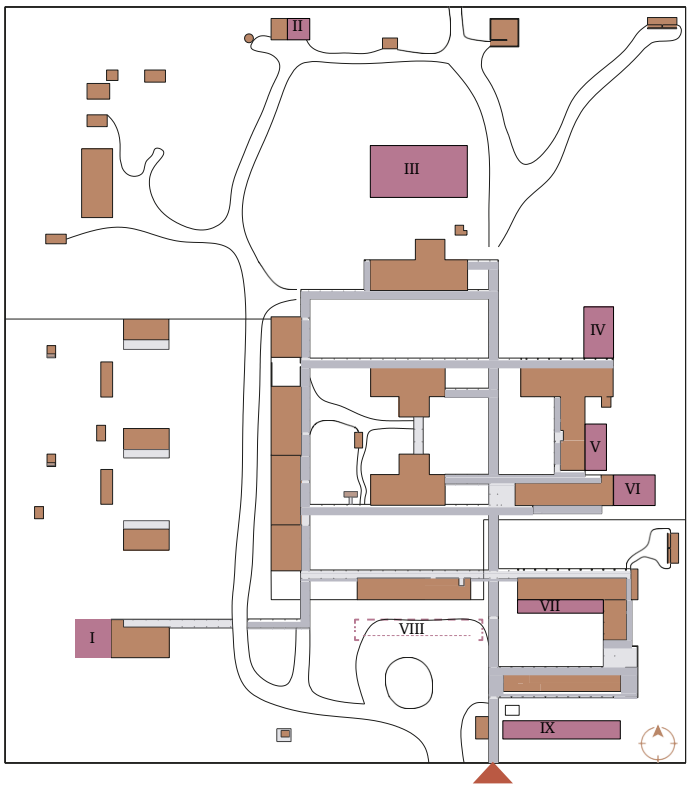
When arriving to the hospital, its management had already a clear idea of how they wanted to develop the hospital and what they needed. The role of an architect was fairly unknown. Initially I had to explain the purpose of making a new masterplan and how that would benefit the hospital in the long term, even though it would take a few months to get it prepared.

It is important to have the hospital and their management feeling involved and in control of decisions so that they will feel ownership of the procedures. Therefore, their proposal was used as the base for the further work. Together the proposal was evaluated and compared to two other quick sketches.

Problems with their plan, that were discovered together was:

- If widening the Imaging and Lab volume it would be hard to achieve a good ceiling height.
- By widening the Labour department, it would decrease the natural light for both labour and surgery department.
- Placing the c-section theatre north of the maternity ward causes difficult flow for females in labour.
- The hospital currently has close efficient connections and placing the private ward further north would lengthen that distance.

A workshop with staff representing different part of the hospital was performed, with the task to define the ultimate connection between the different functions. The result was then interpreted into the illustration on next page.



Scale 1:2000

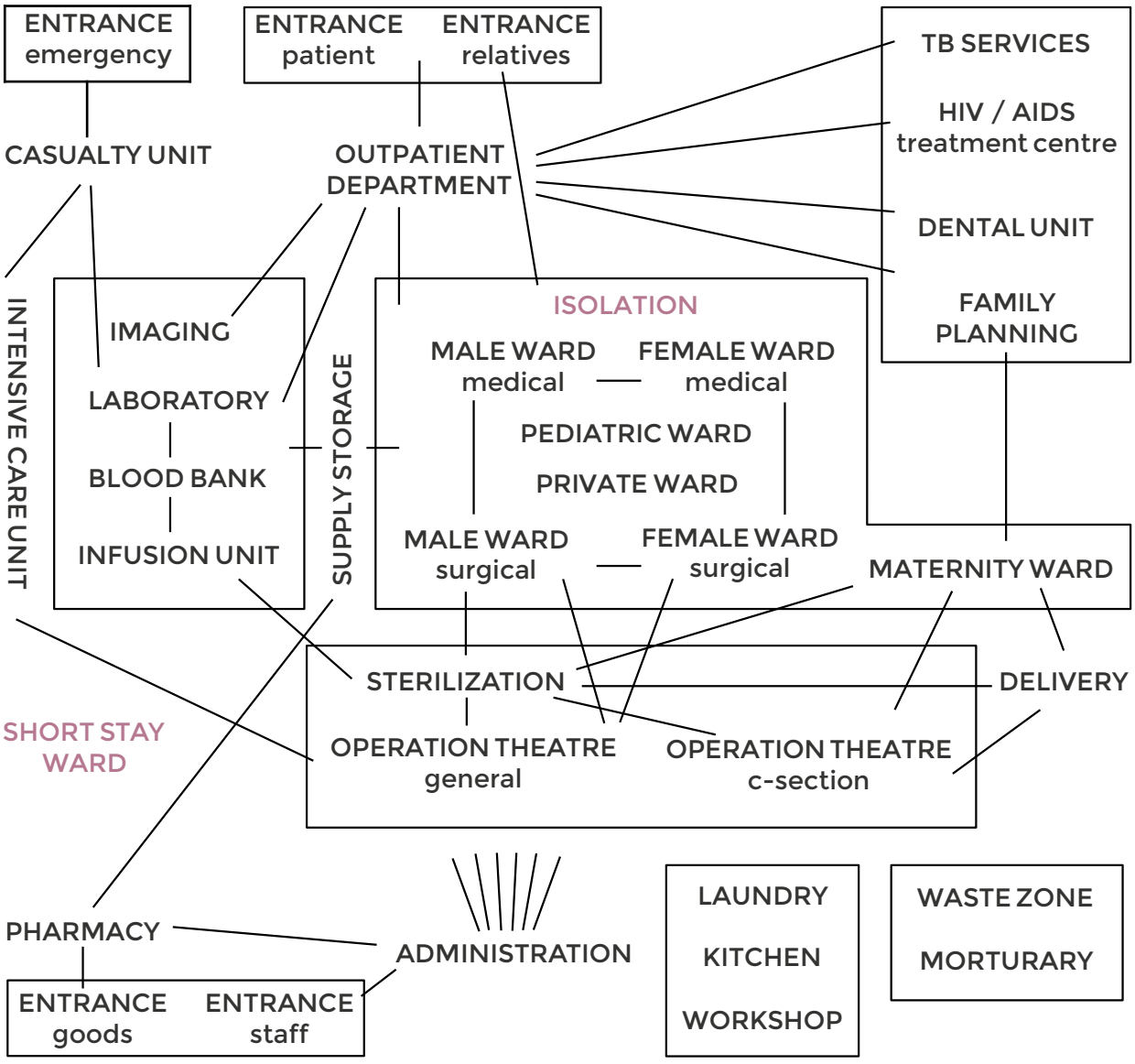
Existing buildings
Planned expansions

Planned changes without priority:

I.- Add youth centre to CTC
II.- Larger mortuary with cooling system
III - Separate private ward
IV.- C-section theatre
V.- Receptor corner for students & more labour beds
VI - Add recovery room to surgery
VII - Widen the lab and imaging building for more space
VII - Roof over staff parking for shade
IX - More examination rooms for OPD

RELATIONSHIP BETWEEN FUNCTIONS

INTERPRETED WORKSHOP RESULT



NEEDS

The list of needs is a result of discussions with the managements combined with observations and conversations with staff.

Wards

Space for staff to discuss work-related procedures and patients' issues.
Less patients in each room, male ward extremely crowded.
Separate ward for private rooms.
Toilets and bathing, poor sanitation.
Make the isolation rooms more isolated.
Larger premature room with space for patients to change their clothes.
Social areas for patient to meet relatives outside
Overview of waste handling procedures

Staff and Administration

Place for staff to sign in (today they use the casualty room)
Changing room for staff
Roof over parking for shade
Meeting room / break room for staff
Resting room for on call staff
Administration building to be pushed aside

Support, goods and material

Increase the capacity in mortuary (add cooling system)
New incinerator, current one not repairable
Washing machine for laundry department
Renovate ventilation in / new placenta pit
Add space for pharmacy, put dispensary in connection to pharmacy.

Outpatient Department

More examination rooms for staff at wards to assist when high pressure.
Move registration area to entrance.
Renovation of doors and add door handles.
New waiting area with bigger distance to examination room for patient integrity.
Waiting room at RCH very noise, move further away from regular OPD patients.
Add public path from entrance to CTC
Extend the CTC with a child-department.
Divide insurance and non-insurance patient (nothing the author have taken into consideration during process, the division could be made through working procedures instead of facility planning).

Diagnostic and treatment

Extend labour room to include 3-4 beds
Add a C-section theatre
Extend theatre, add recovery room and connect minor theatre to scrub.
Improve the sterilization process
More Lab room for different procedures and not having the sampling room as entrance passage.
More space for computer room for image review and a separate working space.
Casualty unit, currently one room in use when rest of OPD is closed.
In connection to labour it would be beneficial with a receptor corner for the midwife students.

PROGRAM

The result of the needs have been translated by author into an updated program for the hospital.

Department	Current m²	Estimated m²
Maternity (Kisula) and Labour ward	130	190
Operating Theatre	160	280+20
Laboratory	60	85
Imaging	60	75
Outpatient Department	150	170
Emergency / Casualty department	15	160
Reproductive child health	110	130
HIV/TB clinic	130	165
Female (Imani) ward	200	370
Pediatric (Upendo) ward	200	370
Male (Yegela) ward	170	370
Private ward	70	370
Pharmacy	60	100
Administration	100	200
Mortuary	25	60
Laundry	150	150
Workshop	150	150
Kitchen	90	90
Security	15	25
Total	2045	3370

PART 4

PROPOSAL MASTERPLAN

NEW SKETCH

Discussed with management

The following masterplan was discussed and agreed together with the management. The different changes were divided whether it could occur independently or need to affect or be affected by other processes.

Processes that can occur independent without affecting other departments:

Extension of surgery, keep the operation ongoing while constructing.

Reconfiguration OPD

Mortuary extension to be constructed while using the current one.

Incinerator and placenta pit have received new location and the existing can be used until the new are finalised.

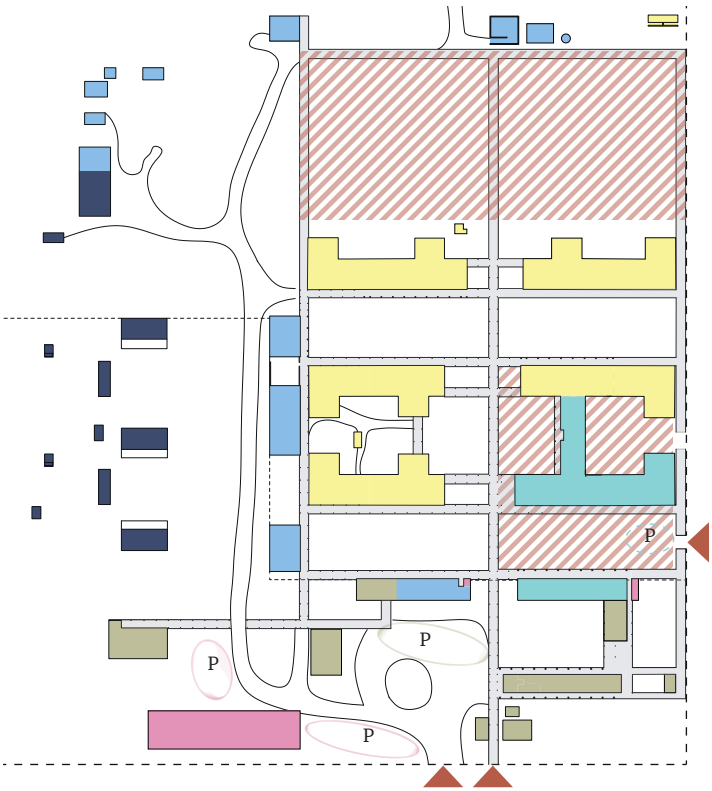
Extension of pediatric and female ward is not dependent on something else. The existing inside toilets need to be demolished but since they are not in use it does not affect the process.

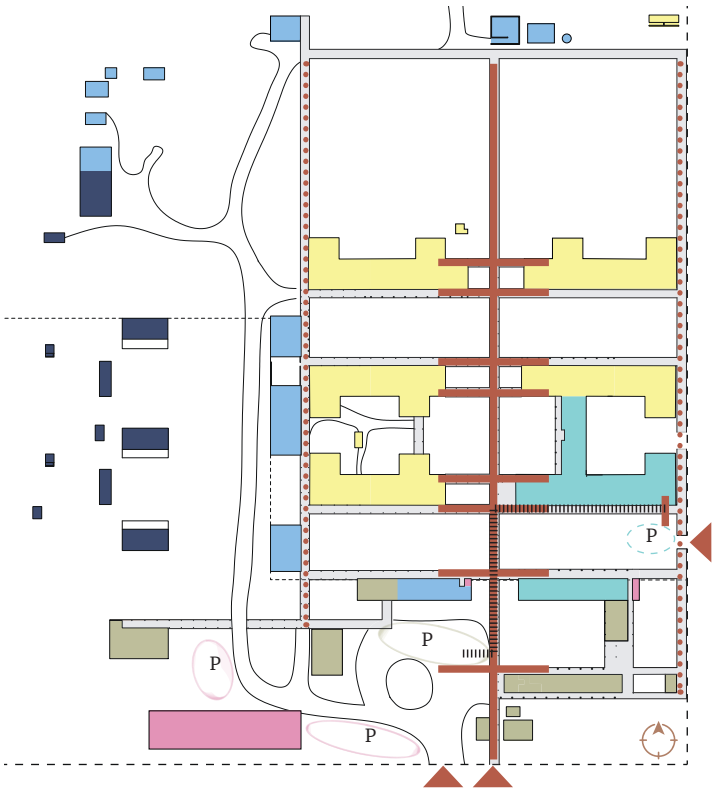
Processes that affect or depend on another:

1. New private ward
2. Reconfigure and extension male ward

1. New administration building
2. Relocation Dispensary
3. Relocation parts of RCH
4. Reconfigure Lab and Imaging

1. New RCH lecture hall
2. Old facility becomes OPD waiting room, alternatively more room for lab and imaging





0 20 40 60 80 100 150

Scale 1:2000

Main flow and public flow
Staff flow
Emergency patient

When looking from a flexibility perspective it would be hard to further develop the hospital once it reached its northern boundary.

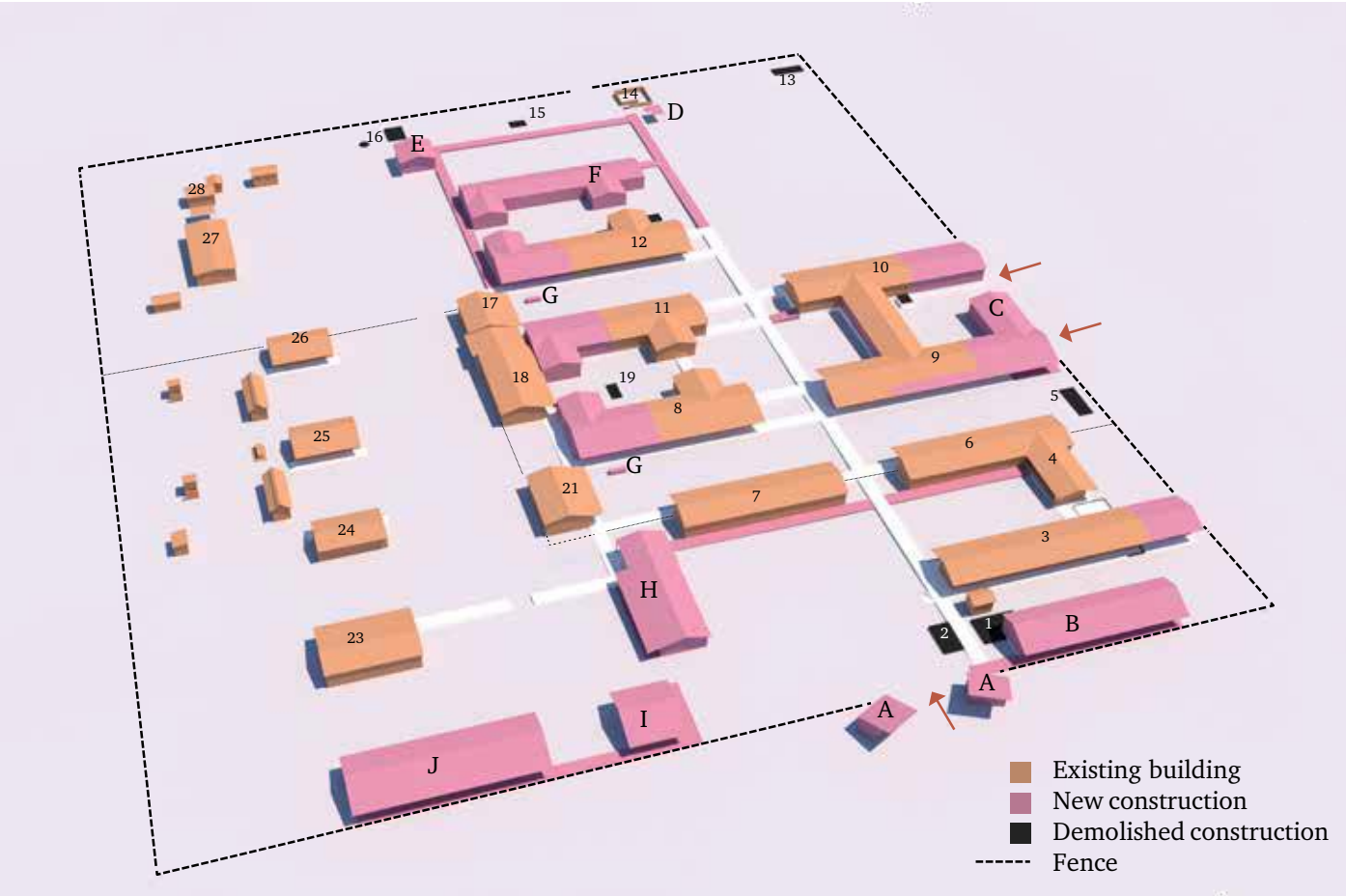
The technical and equipment heavy departments are being built in with very little flexibility to expand if needed in the future since it is close surrounded by other departments.

The proposal keeps the central communication vain for patients and relatives and the staff was referred to the outer communication paths.

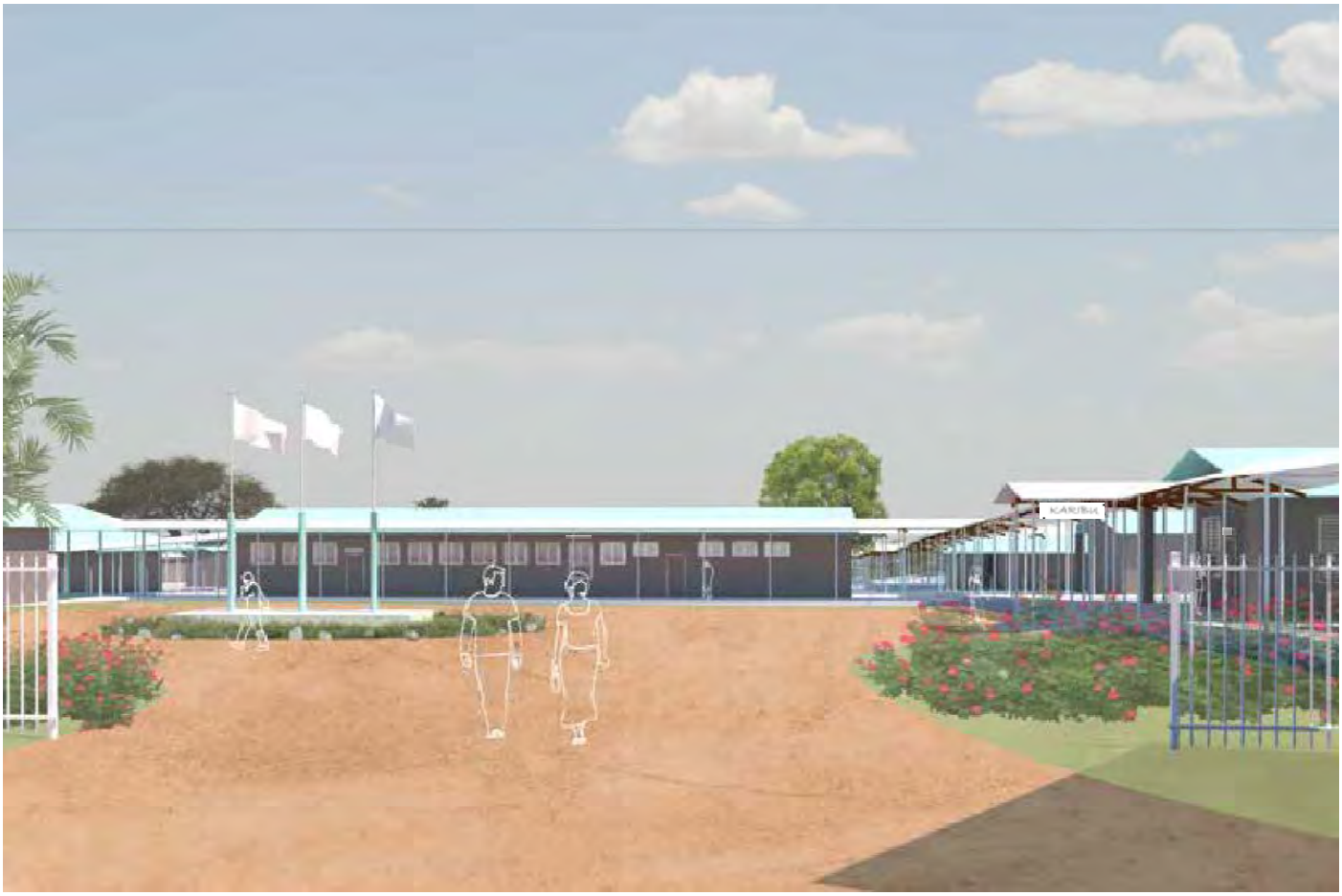
A separate emergency entrance as suggested on the original masterplan was re-introduced. But when looking at the flow for emergency patients entering from the main entrance they will need to be transferred through the main communication core.

PROPOSAL

Reworked without local dialogue



A - External shop / boutique
B - Care and Treatment Centre HIV / AIDS
C - Emergency / Casualty
D - Incinerator
E - Mortuary
F - Private Ward
G - Patient laundry
H - Reproductive Child Health (RCH)
I - Canteen
J - Administration and staff

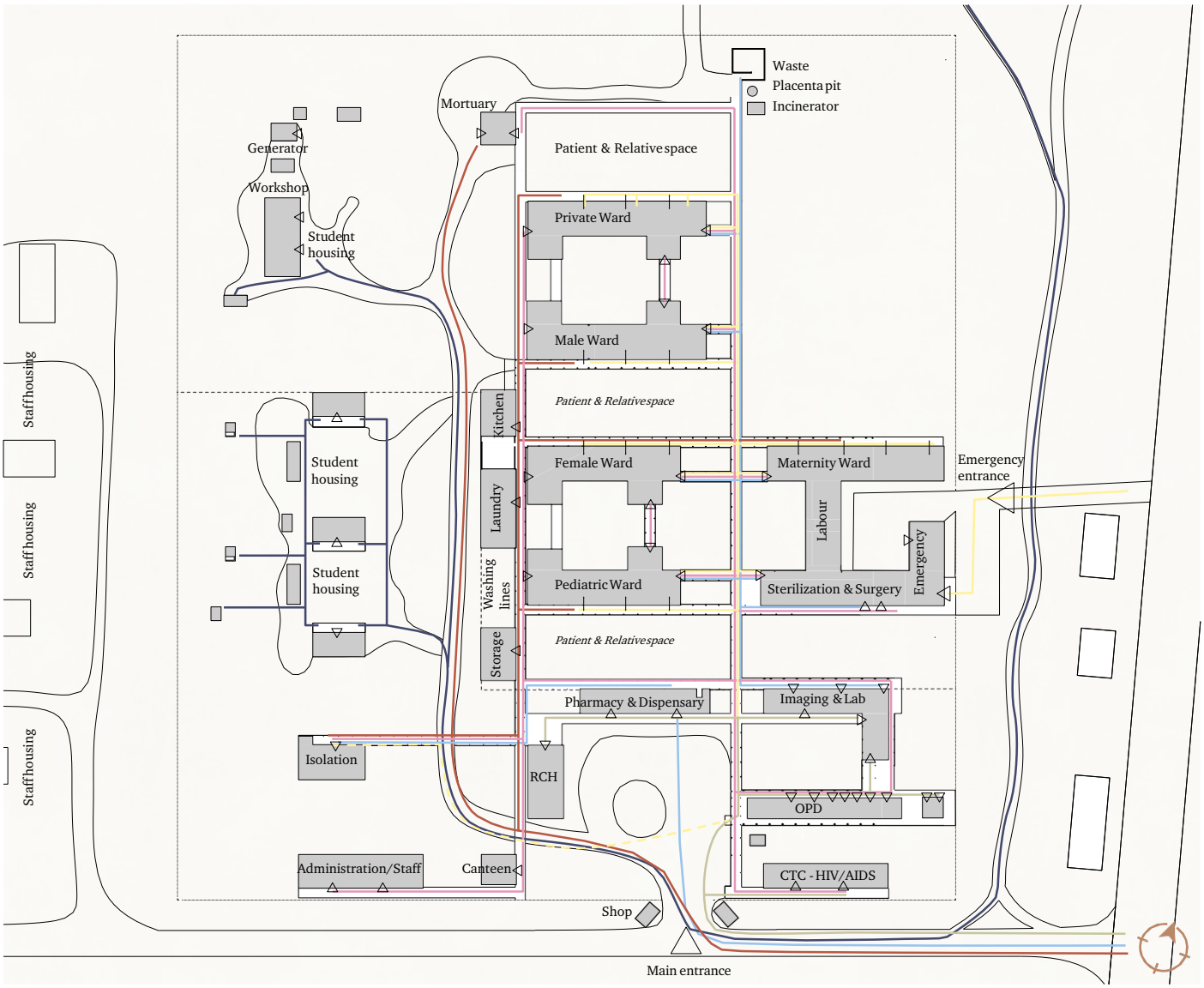


The proposal was updated to handle the observed flexibility issues. From a building perspective the private ward was relocated were management first suggested.

A new main entrance through the large gate is introduced. To clearly indicate its location the small shops have been moved outside the fenced area to create an entrance square. Arriving at the site the visitor is welcomed by an open square with visual connection to all OPD units.

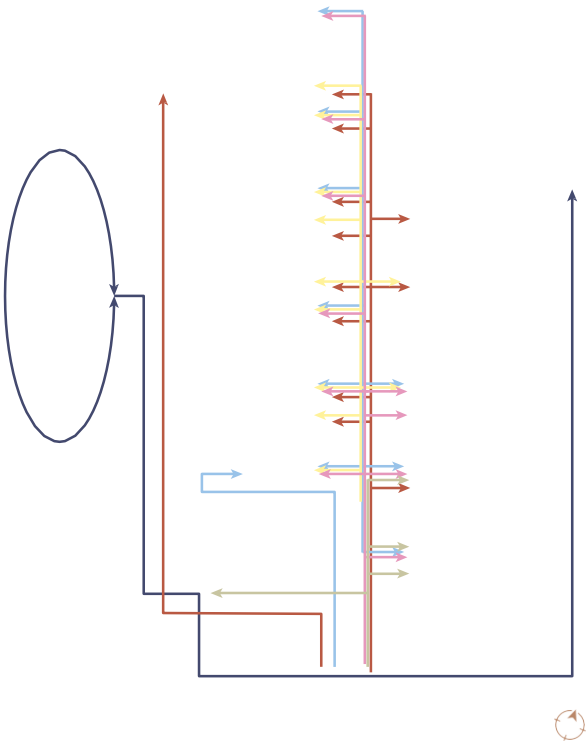
The flow was redirected so that the public flow moved to the secondary path to the west, leaving the existing central communication core for only staff and emergency transportation.

FLOW

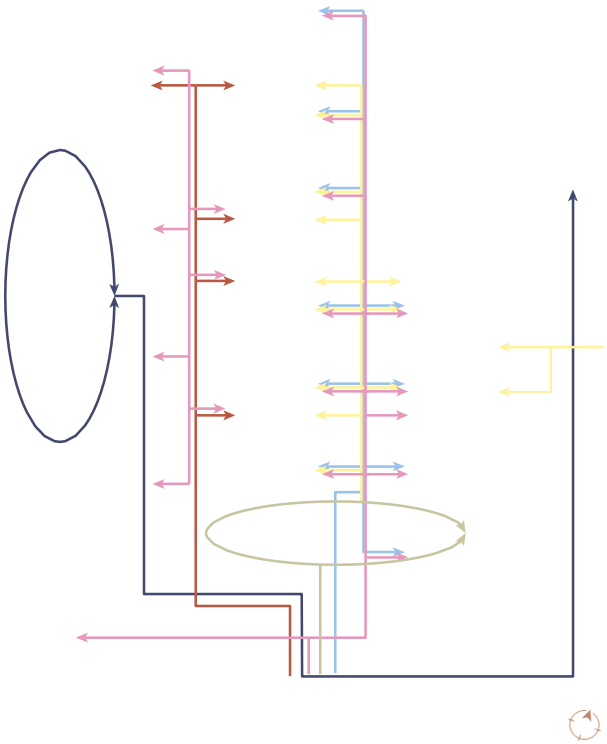


- Inpatient
- Outpatient
- Staff
- Support, goods and materials
- Relatives
- Student

BEFORE



AFTER



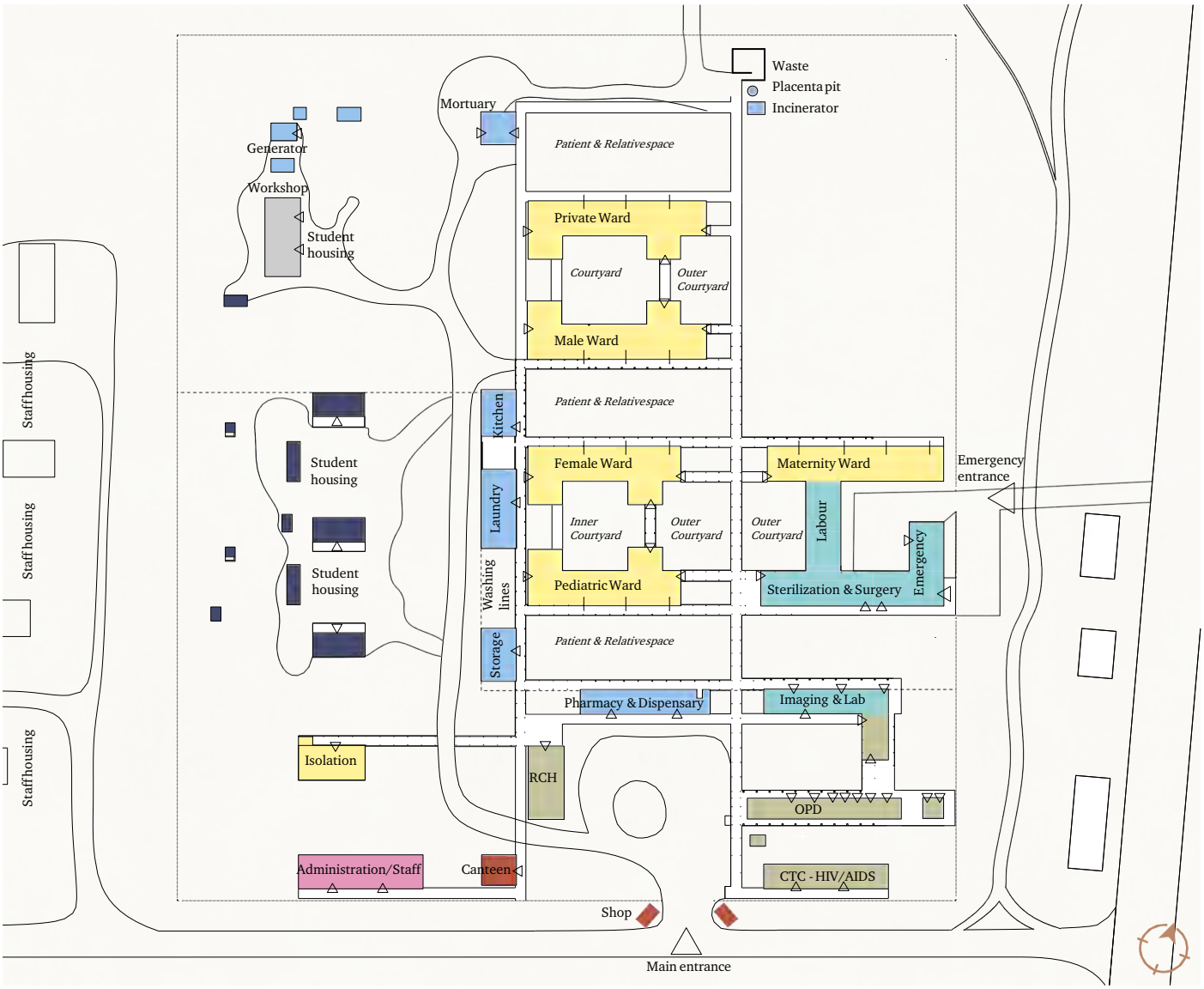
By moving the visitor flow to the western communication path, emergency patients arriving at main entrance could easily be transported to the emergency department without being interfered.

Due to restricted visiting times the flow for relatives comes in waves, intense during certain times and completely still at other. When still the staff can use the path to communicate between the support functions and the wards.

If maximum expanding north is made it is now possible to expand west without disturbing the flow, provided that the student housing is moved outside fenced hospital area.

By dividing and widening the entrance situation the risk for transmission of communicable diseases and bacteria is decreased. It will also be easier for the OPD staff to monitor patients.

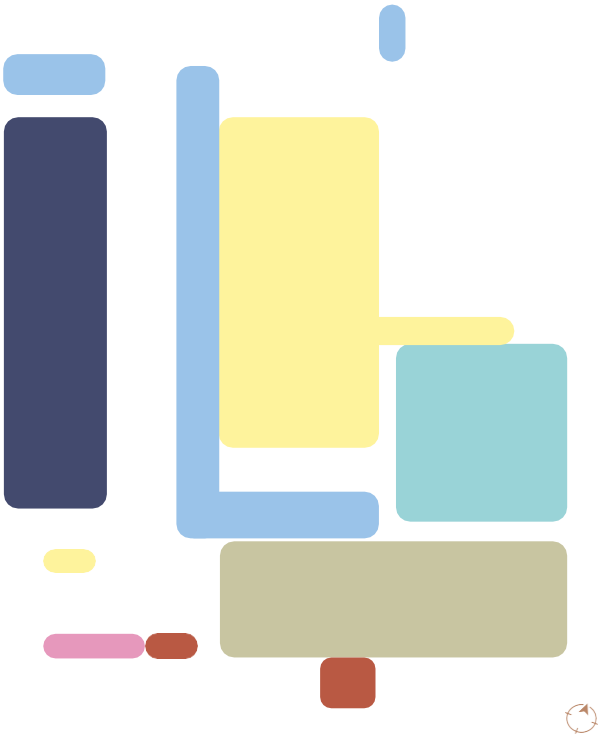
ZONING



- Inpatient
- Outpatient
- Staff and administration
- Diagnostics and treatment
- Support, goods and materials
- Public and non-hospital functions
- Student

BEFORE

AFTER



The OPD has been closer grouped and the non-hospital functions have been moved outside the hospital area, creating an entrance square for relatives and staff.

Administration moved away from daily operation but close to entrance so that visitors don't have to go through the hospital for meetings.

By leaving the space behind maternity empty, it will allow the treatment and diagnostic department to gradually expand if needed.

FLEXIBILITY

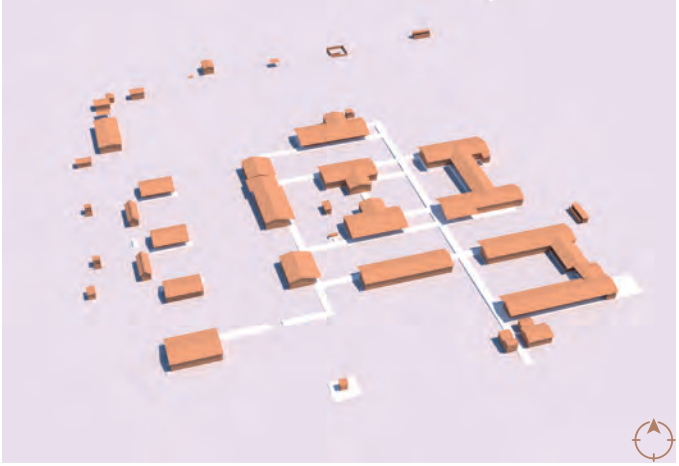
Campus structure

The masterplan has mainly focused on flexibility to expand but maintained the current width of the buildings to keep the good daylight conditions. The suggestion also incorporates the double ventilated pitched roof structure due to climate condition and space for future installations.

The existing structure with single floor buildings in a campus structure has been maintained and allow each department to develop individually. The horizontally expansion have been thoroughly analysed and developed. However, the vertical expansion has not been considered since it was not seen relevant by the author. The space horizontally is enough for a long-term development and the positive characteristics of the current building construction is seen as more beneficial from a flexibility perspective.

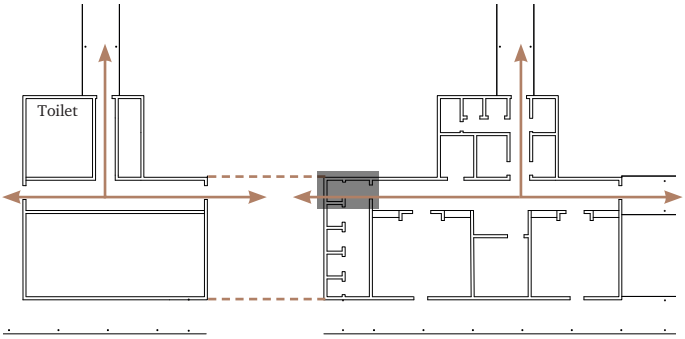
Open ended corridor

The existing sanitation volume blocking the possibilities for extension will be re-constructed. New sanitation blocks will be installed in a location that will allow the open-ended corridor to continue through the extended volume. This will allow the building to expand in all directions when and if needed. It will also allow light to enter and act as a positive factor for orientation.

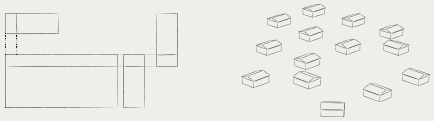


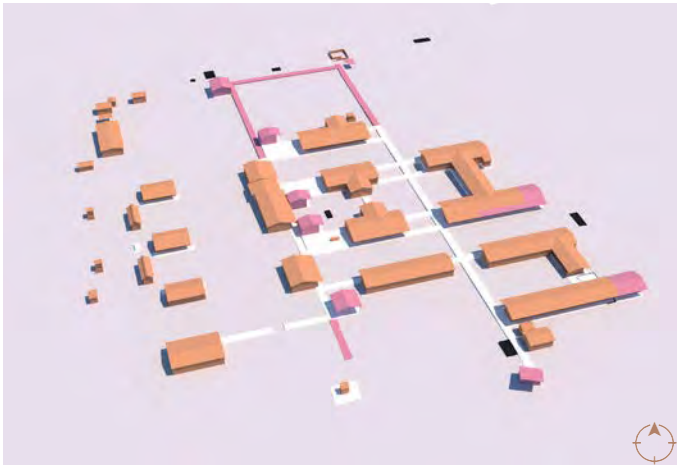
Current situation

Existing building
New construction
Demolished construction
Fence



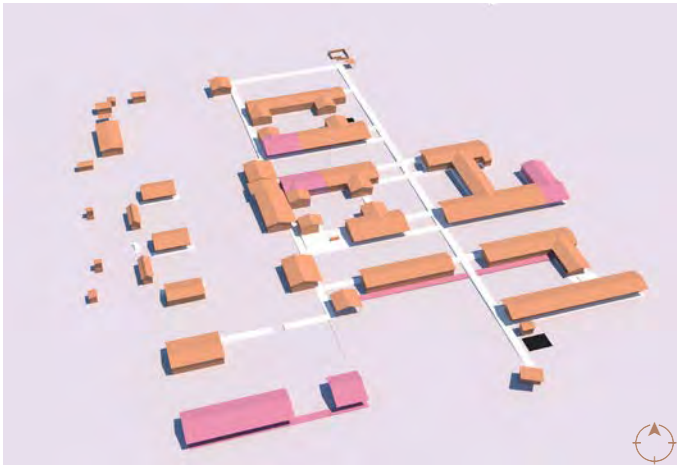
General illustration for wards. Existing toilet location will be opened, and the new installed toilets will allow open ended corridors. Allowing extensions in all directions.





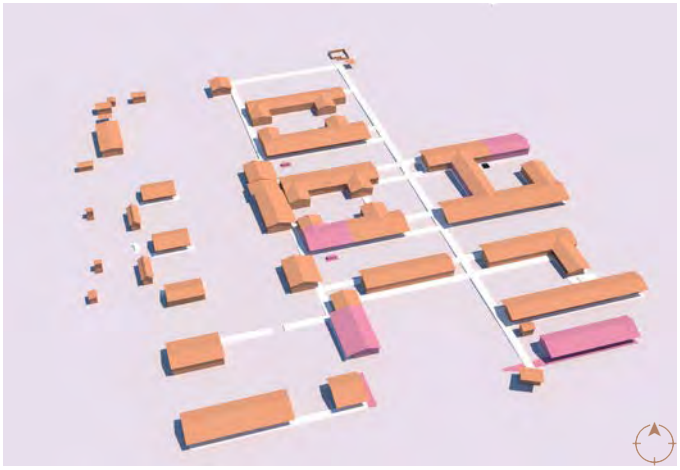
Phase 1

5 years perspective



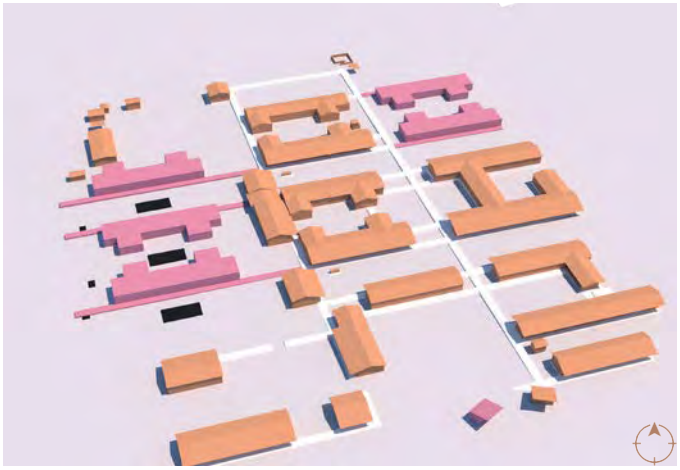
Phase 2

10 years perspective



Phase 3

New masterplan completed



Phase 4

Future possibilities

PRIORITIES

The masterplan describes the position and connection between the existing and new buildings within the hospital area. To be able to realize large changes and renovations it is important to plan the work in different stages in order not to affect the possibilities to provide good health care.

There are different strategies when planning the different stages. One approach is to do large changes and create new buildings gradually from scratch. This requires more extensive investments. Another way is to keep as much as possible and update the most critical parts. It is therefore important to investigate the economic situation for the hospital.

A place like Panzi hospital in the Democratic republic of Congo have better conditions to find large investors due to the world-renowned reputation and media attention. A masterplan with major upgrades and changes are suitable for this sort of hospital.

The situation for a small countryside hospital like Mkula asks for a masterplan with small gradually steps. The focus is to achieve as much change with as little money as possible. It is therefore important to ask, what is most important from a health and risk perspective.

Management

1. Private ward
2. Theatre
3. Casualty (Emergency)
4. Maternity theatre

Author's analysis

1. Emergency theatre
2. Surgery department
3. Sanitation situation
4. Outpatient department
5. Crowdedness at ward
6. Private ward

When listing the different priorities there is a great discrepancy between the Management and the author's ranking. It takes a long time to create a mutual cultural understanding. This is not possible during a two months study visit. This could be one of the reasons for ending up with two different lists.

The private ward is a good income source for the hospital. A new private ward could be a good way to increase the money flow which could lead to more renovations. However, the author observed that the two existing rooms were not currently congested and one could ask if there really is a basis for increased income.

From a health perspective the hospital has a very critical sanitation situation, but this is not something the hospital see as a great issue. The incentive for investing in things that not directly is giving anything back is hard to justify.

The updated masterplan and suggested developing steps in this thesis cannot be seen as final since it has not been talked over with the management. The proposal needs to be brought back for further discussion and conclusion so that the hospital feel ownership of the plan.

Prioritisation 1 and 2 (by author) are brought together and acts as the first development step. Prioritisation 3 and 5 are described together in step two even though the ward extension would occur after step three, the OPD. The last prioritization and the top priority for management, Private ward, is left aside since the financial benefit need to be further investigated in comparison to the health benefit.

DEVELOPING STEP 1

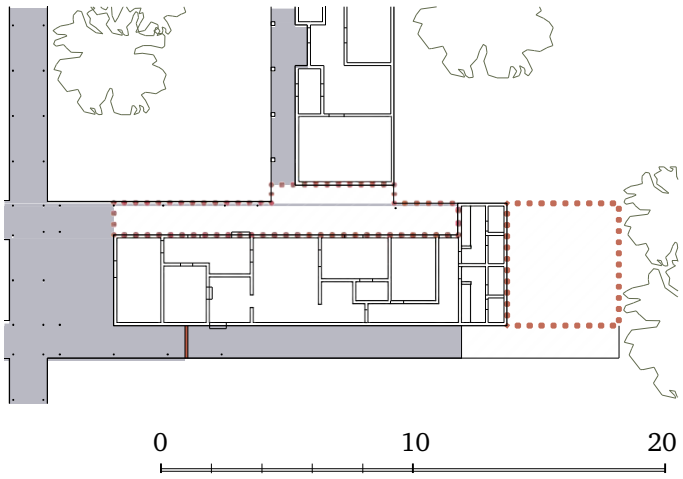
SURGERY DEPARTMENT

Problem description

The need for a maternity theatre and upgrading the current theatre could be merged into one project. The main theatre is only booked two days a week, so even if the amount of surgeries will increase it would be enough with only one theatre for planned operations. By adding an emergency theatre all unplanned surgeries could be covered.

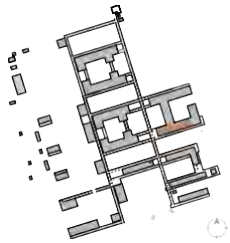
The room connections at the surgery department are currently constructed in a way that would allow a good flow for the main theatre, but the facilities are not used in accordance with national guidelines. The staff is automatically taking the quickest and easiest way despite crossing different zones etc.

The department will stay at its current location which means that the current theatre needs to be functioning during the refurbishment.



Demolitions
New construction

Scale 1:300



Program today

- Main operating theatre
- Minor theatre / c-section theatre
- Pre-operation
- Sterilization unit
- Sterilization storage
- Sluice
- Staff break room
- Scrubbing
- Changing room staff

Program future

- Main operating theatre
- Emergency theatre
- Pre-operation
- Recovery room
- Sterilization unit
- Sterilization storage
- Sluice
- Staff break room
- Scrubbing
- Changing room staff
- On-call resting room

DEVELOPING STEP 2

SANITATION AND CROWDEDNESS

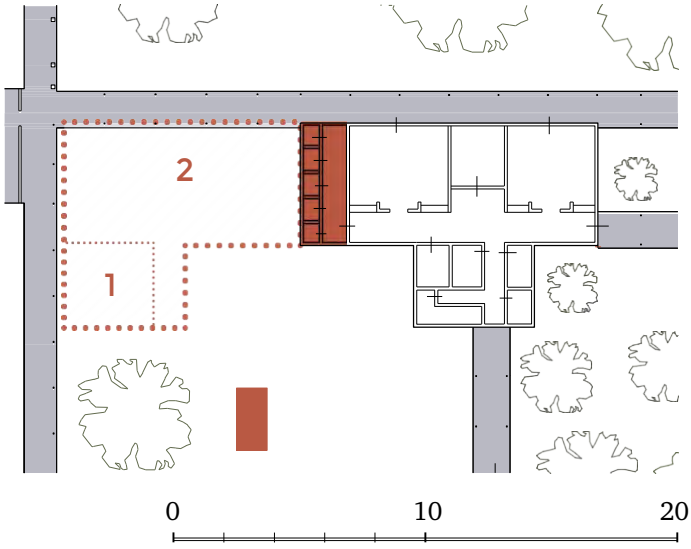
Problem description

The sanitation issue is described in the Appendix 1. Problems with the toilets have created a strong resistance from the management towards toilets inside the wards. Looking at hospital trends to tackle the post-antibiotic era it is through increased sanitation and decreased crowdedness.

One way to overcome the management resistance is by dividing the ward extension in two phases. Start by building new detached sanitation units that in a second phase will be connected through a building extension. This will release the pressure on the crowdedness at the wards and improve the sanitation situation.

The different wards have similar layout. The current inside and outside toilets will be demolished. The plan shows an example of new rest-room location that in a second step could be integrated in the building.

The second developing step only includes the first phase of this development. The second phase will be performed at later stages (see illustrations on page 57).



Demolitions
New construction
1 Phase 1 - Detached sanitation unit
2 Phase 2 - Ward building extension

Scale 1:300

Program today

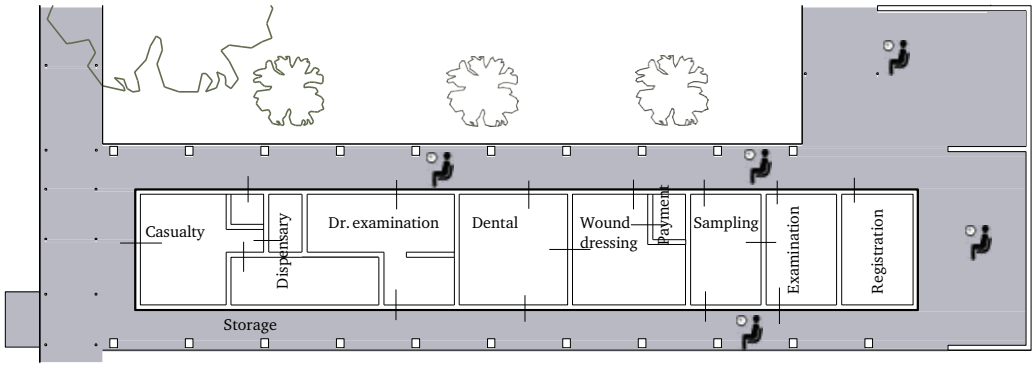
- 2 large patient room
- 1 isolation patient room
- 1 recovery room
- Patient bathing (non working toilet area)
- Nursing station
- Waste, dirty linen storage
- Medication room
- Linen storage
- Medical emergency room
- Staff toilet

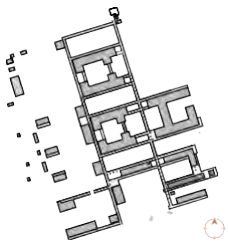
Program future

- 2 - 4 patient rooms
- Patient toilet and bathing - Nursing station
- Waste, dirty linen storage
- Medication room
- Linen storage
- Medical emergency room
- Staff toilet

DEVELOPING STEP 3

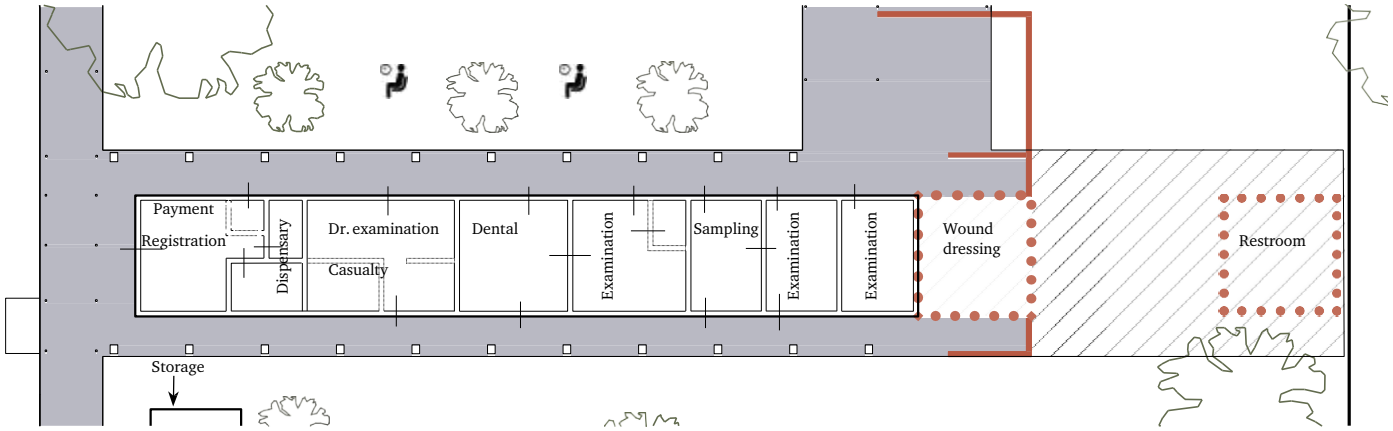
OUTPATIENTDEPARTMENT INCL. CASUALTY





Before

0 10 20



After

Demolitions
New construction

Scale 1:300

Problem description

Registration office in east end and the opposite side is empty during day and only used as casualty during evening and night. Rooms are standing empty at the same time as the management states a shortage of space.

Program change

Two more examination rooms.
Doctors room during day turns into casualty during evening and night.
Dispensary will gradually be moved.
Storage for wheelchairs and stretcher by registration

PART 5

PROPOSAL SURGERY

FUNCTIONAL ISSUES

Most patients are only under local anaesthesia and therefore awake during the surgery. The surgery environment is therefore affecting their experience and recovery.

The current acoustic is very bad and the sound from surgery tools can be heard even outside the building. Since there is no air-condition the windows in the operation theatre is kept open. This allows staff to talk to each other through the wall.

The doors connected to the operation room are constantly being opened and closed. It is a distracting event but also bad for keeping the area clean and sterile. There are three main factors to prevent postoperative infections. These are clothing, ventilation and routines. It is important to note that the human factors and routines are equally important as the technical solutions (Berezecka-Figacz, Ek, Fröst and Gustén, 2013).

In the context with very limited resources it is therefore extra important to create good conditions for the routines to work. The facilities need to promote the correct way of working so that the right way also is the most natural way.

Layout issues today includes no scrub area attached to the minor theatre, no cesspool in any of the rooms, sterile goods for wards to be transported through the sluice, no recovery space for patients and no access to running water.

Sluice between sterilization and its storage

Daily amount of rainwater collected by Faradja

BUILDING CONDITION

There are areas within research that are considered relevant in connection to the physical environment in an operating room. These aspects are noise, distractions, lighting, patient experience, hygiene and thermal climate (Berezecka-Figacz et al., 2013).

The building is in general need of maintenance. Tiles have been falling off the walls and creates surfaces that is not possible to keep clean. The overall wall and floor surface are full of small holes and cracks which creates good conditions for bacteria.

The building is very narrow with windows on both sides, which results in much daylight. This is very important in this context since power cuts occur regularly, the operations are possible to continue without electricity.

Most windows and doors need to be renovated. Most of them are not possible to open/close and the different zones blend together.

The ceiling needs to be replaced in many places, see picture below. To improve the noise situation, it could be good to investigate alternative materials for a new ceiling.

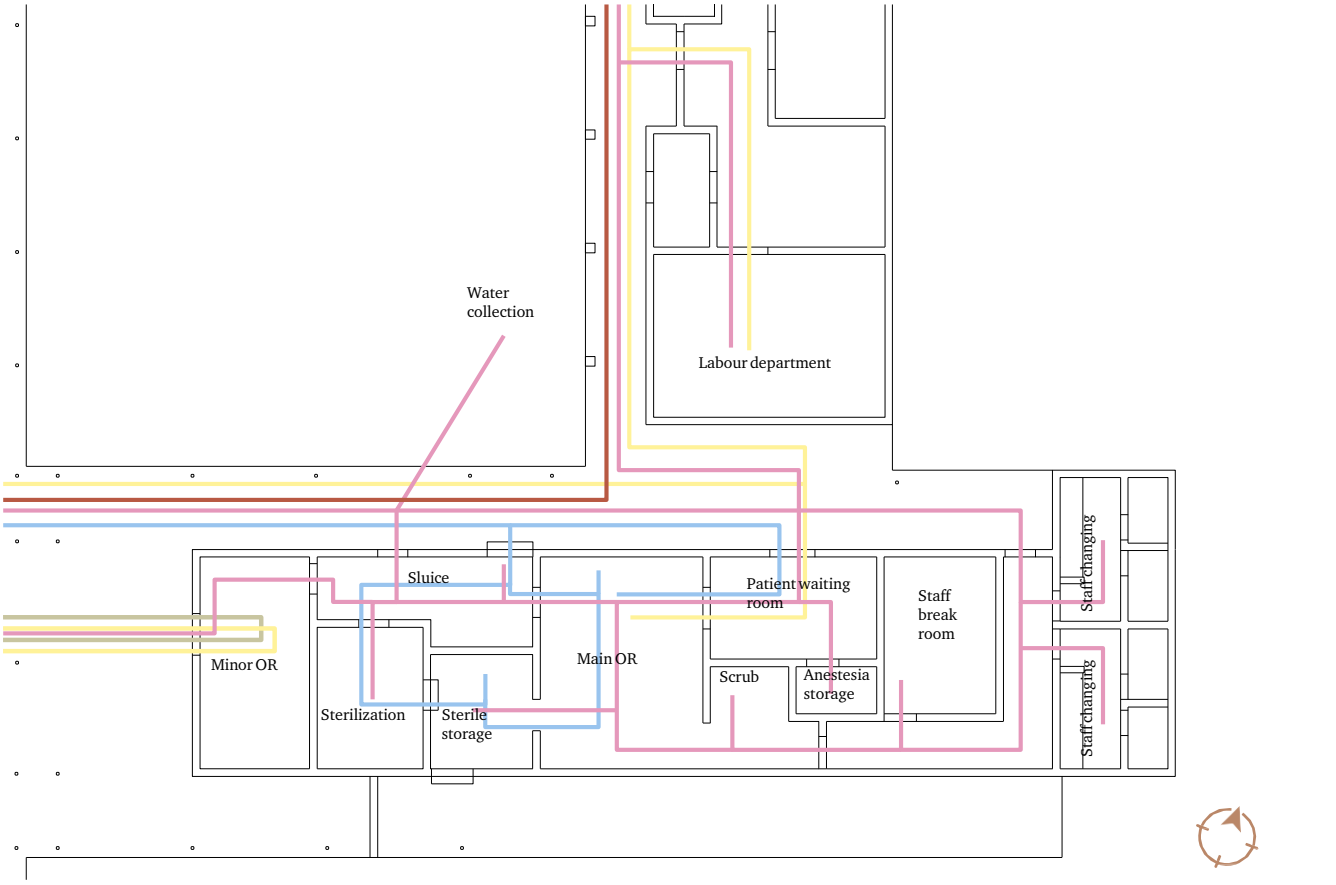
Ongoing surgery Dr. Nyanza

Ceiling condition in sterilization storage room

FLOW ANALYSIS

To reach the second theatre the only entrance is through the sluice where dirty things from surgery is kept. Patients enter directly from outside. Dirty, clean and sterilized goods crosses.

No recovery room, after surgery patient exit the same way they enter through the patient. The different rooms are completely open between each other and the rooms are (in reality) treated as one big room.



- Inpatient
- Outpatient
- Staff and administration
- Support, goods and materials
- Relatives

Scale 1:200

ZONING ANALYSIS

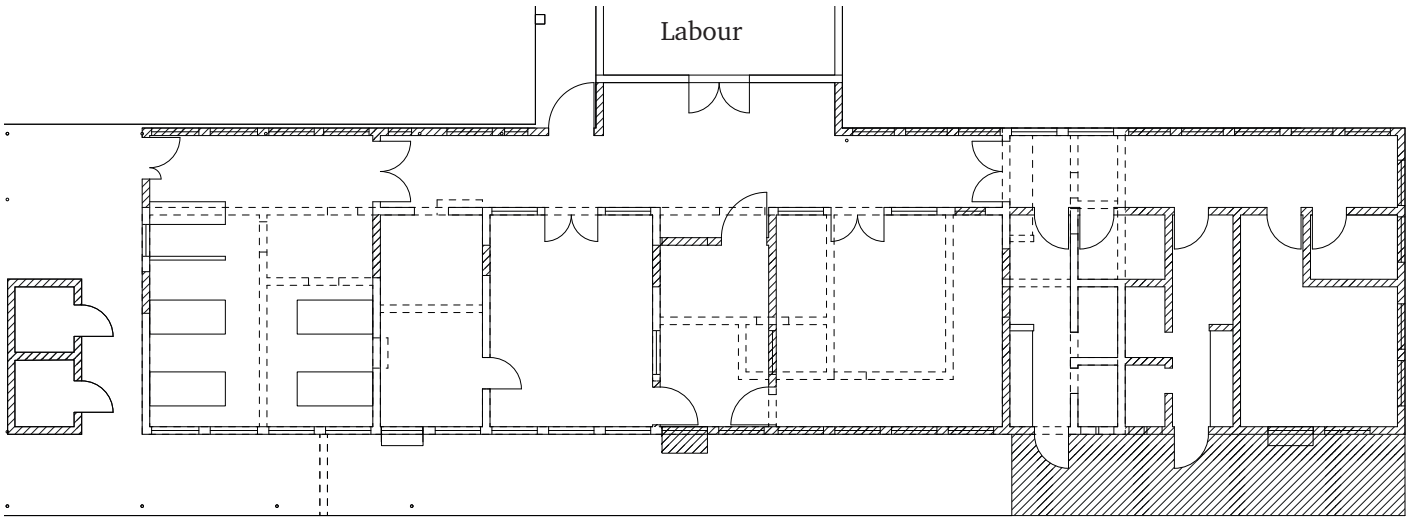
The biggest issue with the facilities is the lack of division between non-restricted, semi-restricted and restricted zones. Staff moves relatively freely between the buildings different room and between the inside and outside.

The flow is crossed by relatives taking a short-cut to the maternity ward. The logistic and zoning in the sterilization zone is undefined.

Non restricted
Semi restricted
Restricted (does not exist today)

Scale 1:200

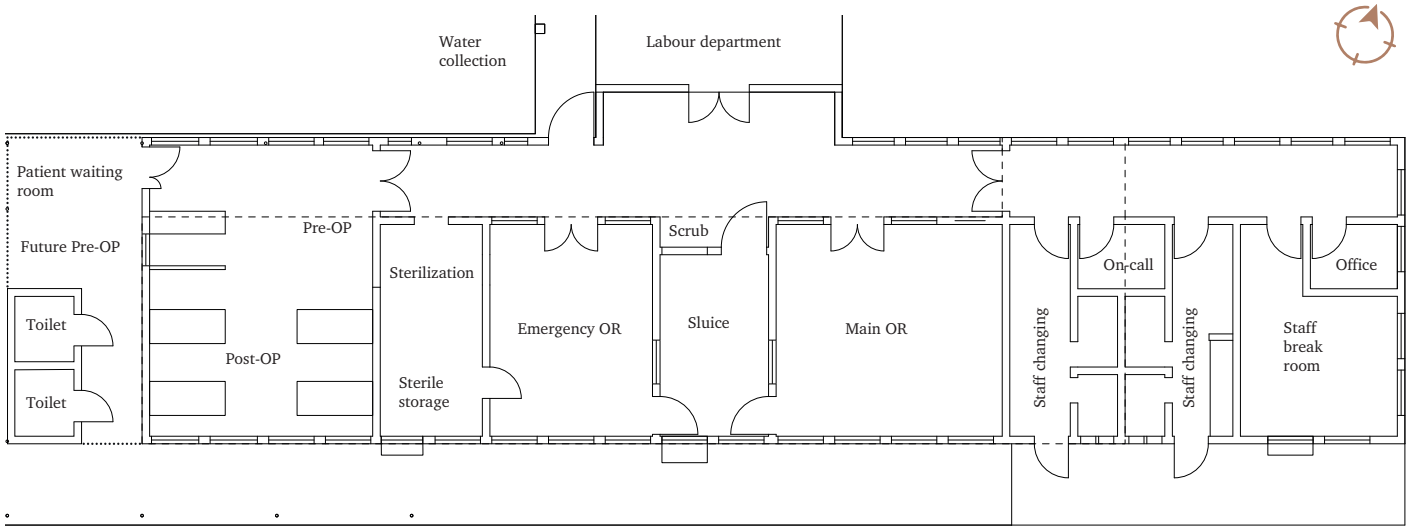
PROPOSAL



Demolitions
New

0 2 4 6 8 10 20

Scale 1:200



New floor-plan

Scale 1:200

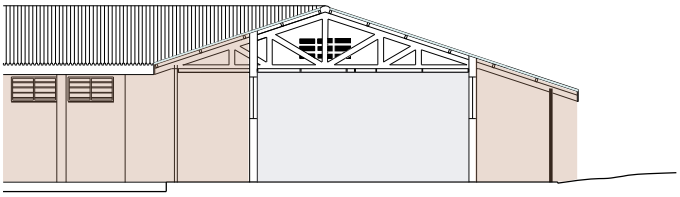
As mentioned in relation to the masterplan, the management are not very fond of having the restrooms within the different wards or department. These are therefore planned as separate unit outside the entrance. There will not be more than one patient waiting for surgery and the outside space by entrance could initially be used as a waiting room. It can later be transformed to a proper preparation room.

The sluice is placed between the two theatres. The waste will be put in a two-sided cabinet which will avoid the staff to exit in their surgery clothes to take the trash out.

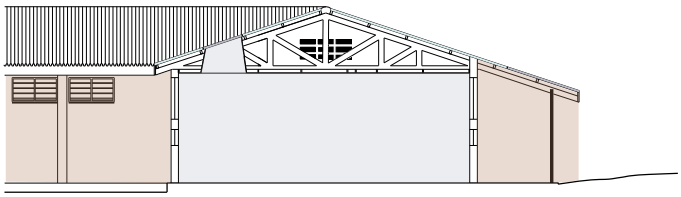
The breakroom has also been provided with a two-sided cabinet to avoid the staff that delivers the food to enter the building.

To enter the building, it is necessary to go through the dressing room or the recovery room. Hopefully this will be a reminder to change to proper clothing.

The suggestion takes advantage of the existing overhanging roof and transforms the outdoor space into indoor space.

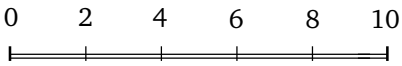


Current situation. Scale 1:200



New extended situation. Scale 1:200

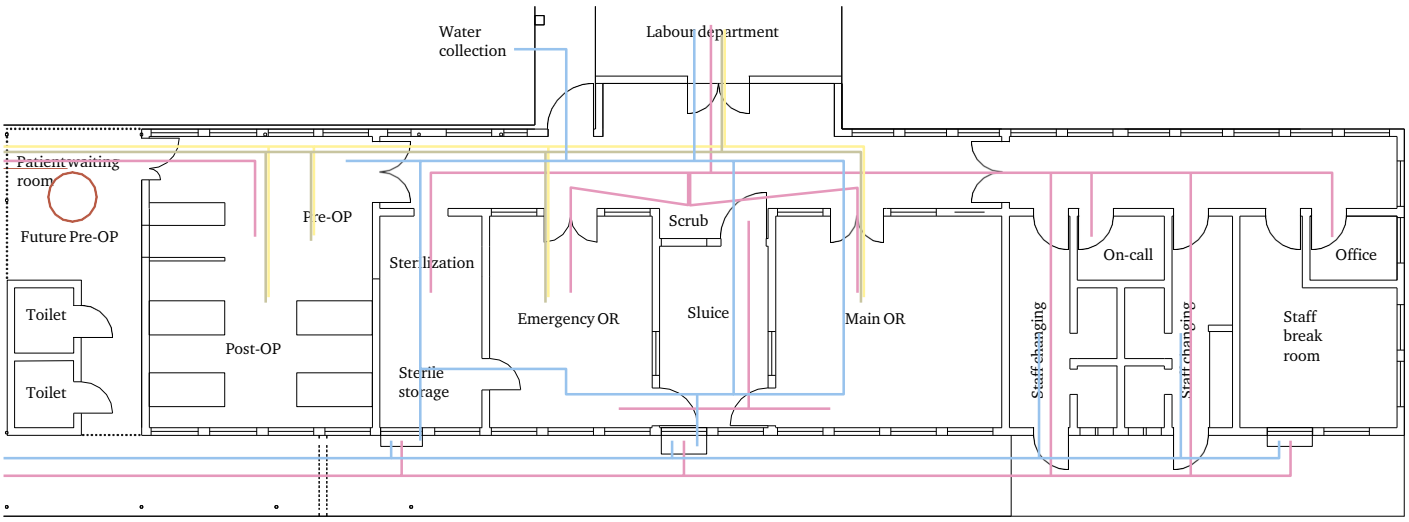
Inside
Outside



Current roof, corrugated steel.

Future roof, corrugated steel combined with plastic to create waterproof skylight.

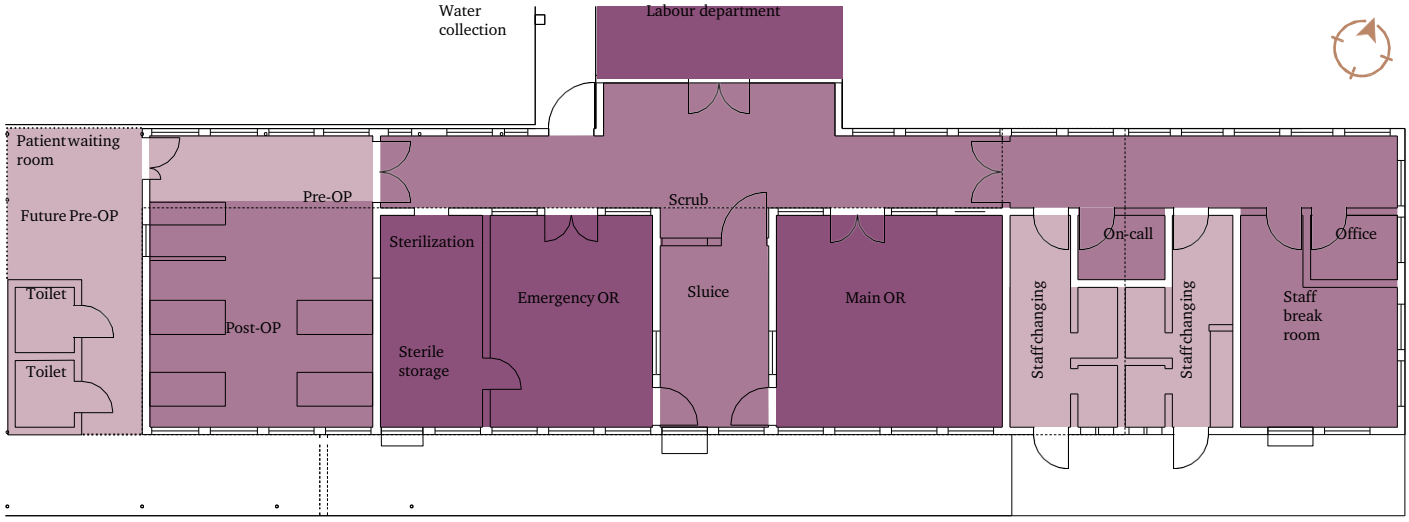
FLOW AND ZONING



- Inpatient
- Outpatient
- Staff and administration
- Support, goods and materials
- Relatives

0 2 4 6 8 10 20

Scale 1:200

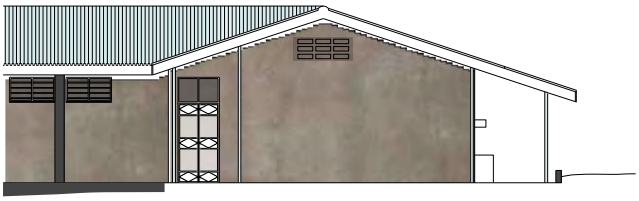


- Non restricted
- Semi restricted
- Restricted

Scale 1:200

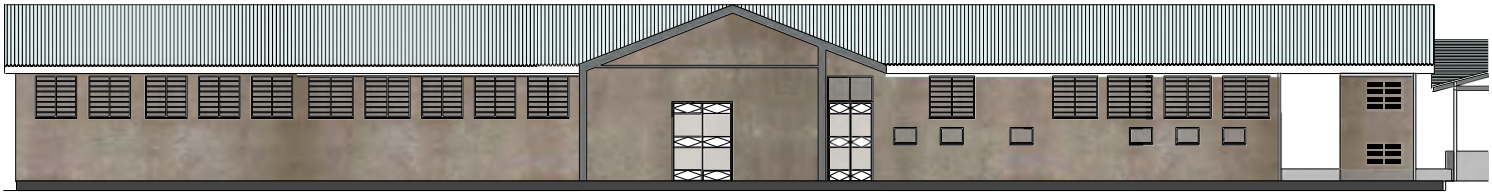
FACADE

South facade.
Staff entrance, sluice boxes for sterilized material for wards, waste and food delivery for staff.

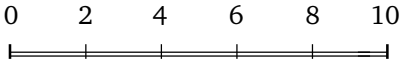


East facade.

West facade.



North facade.
The wide door in the central part of the building is connecting the Labour department to the emergency theatre.



Scale 1:200

FLEXIBILITY

Flexibility to ADAPT

The narrow body of the volumes allow inner walls to be non - load bearing. This allows full flexibility for the interior walls, however, the standard construction method with bricks makes it hard for "easy demolition". It would be beneficial for the flexibility aspects if it is possible to find a local material, easy dissembled to be used in the inner walls.

Power-cuts happen regularly and the daylight situation is therefore critical. This also results in a recommendation to use natural ventilation. The new skylights could assist in creating a stacking effect.

One of the large problems at the hospital is the low number of employees. When feeling alone at work the perception of flexibility decrease. To support each other and create flexibility between staff there are visual connections.

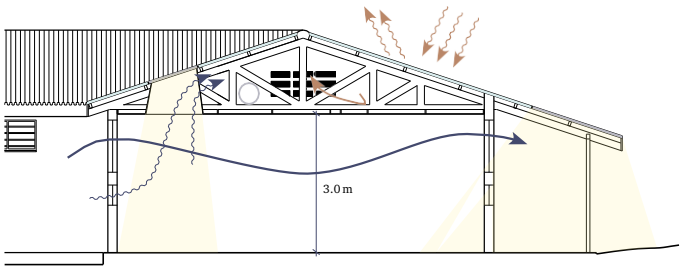
The Labour department have been directly connected to the surgery department. Since only one theatre have planned surgeries, most times one should be available and stand-by. This creates a great flexibility for the midwives that can move patients as soon as critical situation could occur without being in the way.

Flexibility to CONVERT

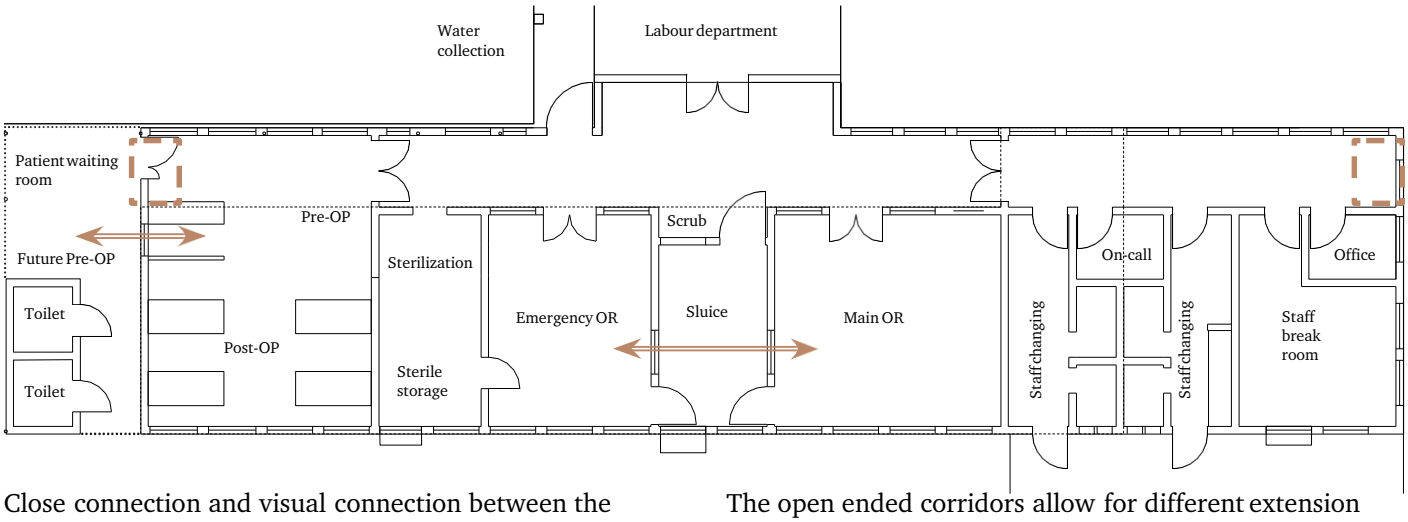
The construction method with plastered bricks allows for great flexibility in the facade. It is easy to move and fill old holes over time. The cons with the concept are the limitation in handling large glazed openings.

Pitched roof with ceiling allows plenty of room for future installations. All ceiling heights are currently between 2.8-3.0 meters (shifting both within and between the buildings). All additions should aim to keep the ceiling at 3.0 meters to create maximum flexibility for future use of the building.

The corridors end in facade which strengthen the sense of direction but also allow the building to be connected to new extensions.



The pitched roof allows plenty of space for possible future installations and always keep the ceiling height at 3 meters. Natural ventilation both above and below the ceiling. Small openings in the skylight creates a stacking effect. High reflective material on most of the roof but to allow light the lower part is made of plastic.



Close connection and visual connection between the theatres as well as between post-op and waiting room.

The open ended corridors allow for different extension options.

The new entrance to the building, with a separate volume for toilets outside and a perforated wall protecting the waiting area

PART 6

DISCUSSION AND REFLECTION

DISCUSSION AND REFLECTION

The main goal of this master's thesis was to explore how the current layout, distribution and flows correspond to the actual need to guarantee good health care services. The analysis then created the foundation for the suggested proposal with the aim to develop the facilities with a future-proof design focusing on flexibility. To answer the question ask in the beginning, it is necessary to see the thoughts behind the design decisions.

The campus structure is kept in the new masterplan to allow the different departments to grow independently. When different department are connected to each other one will have to move to leave place for the other. The campus layout does not create that domino effect. However, the process of reaching the new masterplan will force some movement between the different departments and these processes are in some cases connected to each other.

For the concept of expandability to work it is necessary for the individual building to have structure and floor plan that allows expansion. The suggested masterplan suggests an extension of the existing corridor that always end in a facade. It also gives a sense of direction and allows natural light. This structure in not applicable with a small or more limited site but works good in this context.

It would have been ultimate to keep the building layers independent. This have partially been possible by keeping furnishing separated from the inner walls and having the load bearing in the facade to allow floor plan changes. However, the traditional construction method by using bricks and plaster both on external and internal walls could make it more complicated to execute. All walls have a very permanent feeling even though openings easily change depending on need.

For the design to accommodate the future demands for the surgery department two different sight lines related to flexibility have been considered. It is the peer line of sight and the patient visibility. The window between the two theatres promote a flexible operational environment. The doctors and nurses can assist and support each other, feeling a sense of team. Visual contact with the colleagues can improve the individual's ability to be flexible in stressful and unique situations. The patient visibility is not only good for patient safety but also a key condition for the staff to work efficiently.

A second decision relating to flexibility is the merge between the surgery department's need and the labour's need. This decision aims at removing specialised rooms. Instead of one C-section room and one minor surgery with very limited area of use, they will together benefit from one large multifunctional theatre.

The building and construction design have a great impact on the flexibility. All healthcare facilities, not only the surgery department, have a double ventilated pitched roof with plenty of space for possible installation demands.

Many of these design alternatives could be used in the Swedish context, both in a macro- and micro scale. The Swedish knowledge on healthcare facilities can on the other hand not be directly transferred or applied in a context of Tanzania.

There is a great need for research in future-proofing in a developing context.

To finalize the suggested masterplan, it is necessary to meet the hospital management again and discuss the outcome. This pin-points one of the most important findings in this study that a constant dialogue between on-site specialist and global research is needed.

This small countryside hospital has a difficulty in receiving donations and funds. The masteplan has therefore been developed to include both small changes that would be possible for themselves to arrange, but also larger extensions that would need to be presented to different NGO's. Some projects are not dependent on another and could therefore be presented to different donors.

Once finalised Mkula management could use their new masterplan as a tool for themselves to gradually develop their hospital with help from the small steps as well as looking for external funding. It has been a priority to focus on the basic needs in this context and to achieve as much change with as little money as possible and to prioritise from a health and risk perspective.

PART 7

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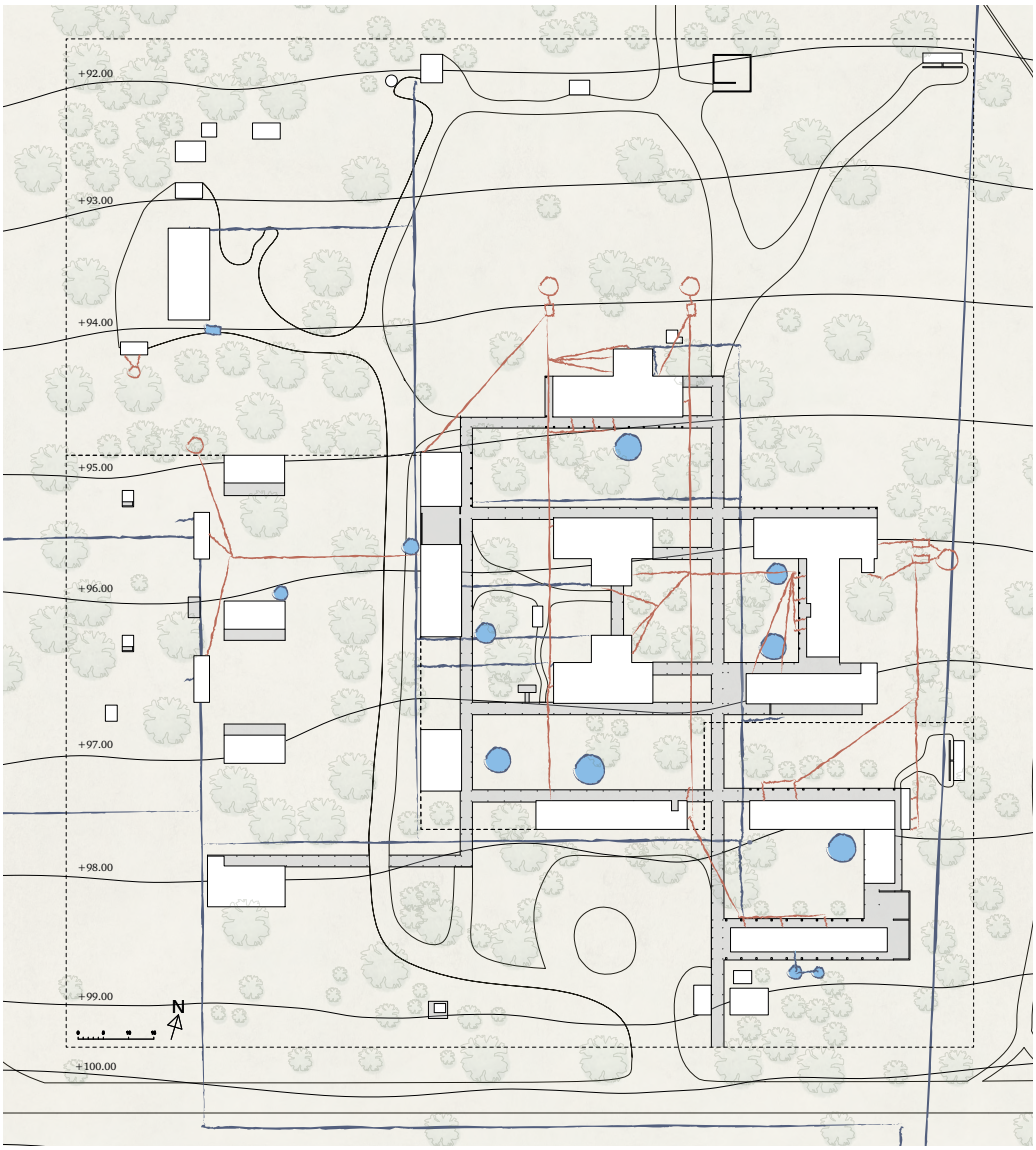
APPENDIX 1

CURRENT WATER AND SEWAGE



Rain water tank
Water distribution
Wastewater system

Scale 1:1500

Water, basic sanitation and waste management are needed to create a safe environment for healthcare. These aspects are essential to protect the healthcare staff and the community from infections.

The wastewater system at Mkula was built in 1986, at the same time as the rest of the hospital. Most toilets within the healthcare facilities are closed due to water shortage. Currently patients at maternity ward are using the inside toilet and patients at male ward use the inside toilet during night. There are five other toilets in use for staff. The hospital engineer believes that the wastewater system would work good with better water supply. The pipes are old and need continuous maintenance. All pipes lead to six wastewater tank systems and from all tanks, the wastewater is infiltrated into the soil. The areas around the infiltration places are wet and have an intensive smell during warmer days.

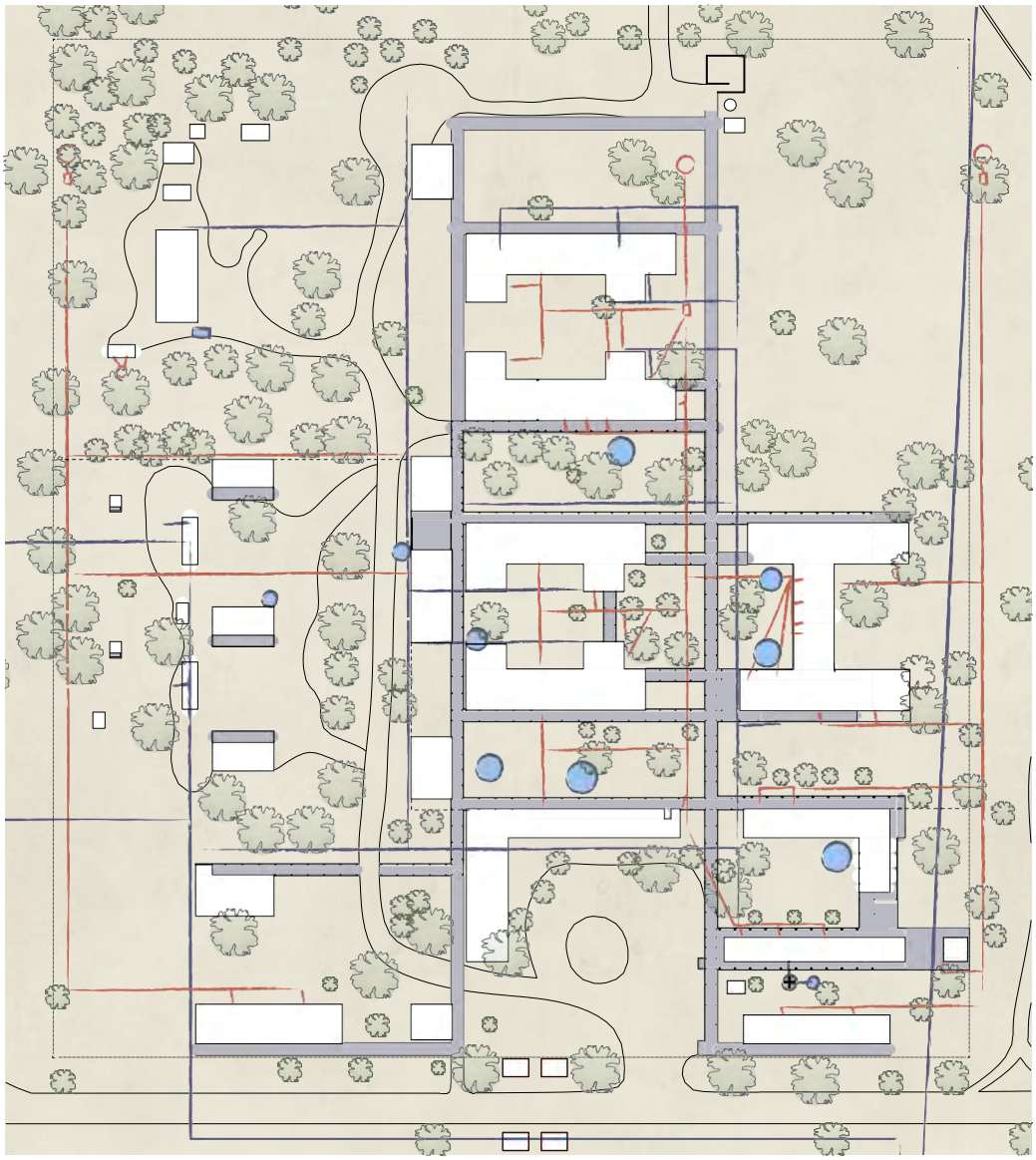
Outside toilets have been constructed to replace the inside toilet. These toilets are not connected to the wastewater system and the sewage is infiltrated directly in the ground under the building. This creates an intensive smell and both unpleasant and unhygienic environment. The placement also includes poor connections and long distances to the wards.
There are in total eleven larger rainwater tanks connected to the facilities waterspouts. Some are casted constructed underground while some are in plastic above ground. All water is collected manually since the pump system is old and out of function.

When discussing the sanitation situation with management they see it as a moderate and not critical situation. With an increased water supply they wish to have the indoor toilets in use during night but they still want to keep the outdoor toilets for use during daytime.

Toilets at Maternity ward.

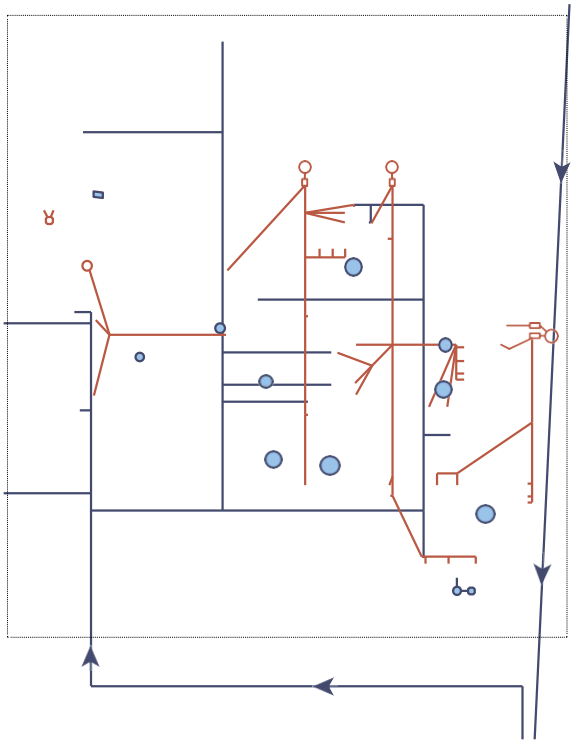
APPENDIX 2

SUGGESTED WATER AND SEWAGE

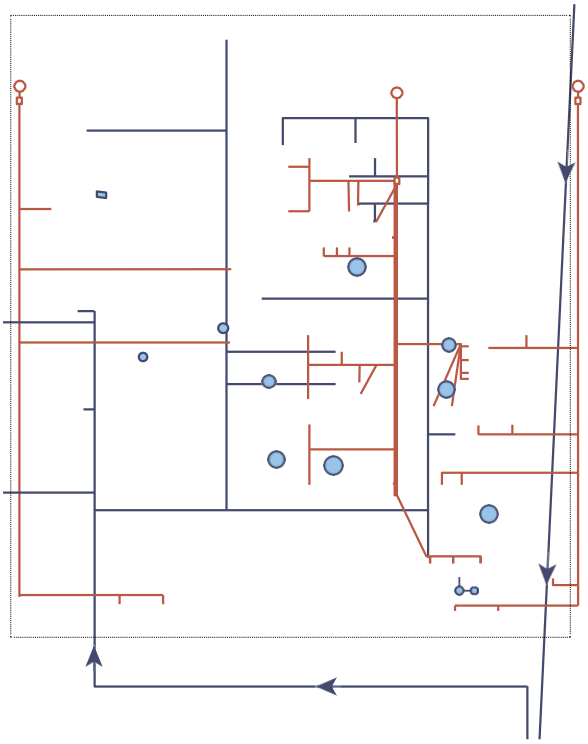


Rain water tank
Water distribution
Waste water system

BEFORE



AFTER



Two new sewege channels have been added and one removed. The three main channels runs in north-south direction, with secondary connections to the relevant building in east-west direction.

The eastern main channel is placed outside the fence where the hospital owns some extra land. Due to cultivation the western channel is kept just inside the fenced area. For safety the water and sanitation are kept on distance in case of leakage.

Sunset seen from the main entrance to Mkula Hospital