A master plan and new mother and baby unit at Panzi Hospital

A proposal for sustainable healthcare architecture by White Arkitekter

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A role model for sustainable healthcare architecture

Panzi Hospital, located in the Democratic Republic of Congo and founded by 2018 Nobel Peace Prize winner Dr. Denis Mukwege, needs to expand in order to continue providing women with quality healthcare. White Arkitekter's response is a proposal for a new mother and baby unit, as well as a master plan for the whole hospital.

PANZI HOSPITAL provides maternity care and treatment for victims of sexual violence in the Democratic Republic of Congo. Due to the poor conditions of the existing facilities and the shortage of beds, the staff currently cannot provide the level of care that they aspire to.

IN COLLABORATION with Panzi Hospital, healthcare experts, design practitioners, and sustainability experts, White Arkitekter has developed a feasibility study for a new mother and baby unit. During this project, a master plan to coordinate future expansions for the whole hospital was also developed.

A MULTI-DISCIPLINARY process has been the greatest strength of this project. Primary research, practical expertise and knowledge of local conditions have been combined from the fields of architecture, healthcare and sustainability. The result is a proposal based on a person-centered care philosophy and inspired by principles of healing architecture. The high ambitions in terms of sustainability were expressed as four main areas of focus – Health & wellbeing, Climate adaptation, Resource efficiency and Long-term development – which guided the design process throughout.

THE NEW MOTHER and baby unit features a care environment that promotes health through securing comfort, integrity and safety for patients, families, staff and visitors alike. The new building is easily oriented with designed spaces for both privacy and social interaction. Daylight and views of nature are abundant, both of which are known to support the healing process known to support the healing process.

THE DESIGN was shaped by extensive primary research into local conditions. The challenges presented by an unreliable energy supply and scarcity of material resources in the region require the use of technical solutions that are tailored to the local context and climate. The systems chosen for heating, cooling and lighting use natural, renewable resources to provide thermal and visual comfort. Electricity is produced on-site, and rainwater is collected and utilised for maintenance. To further reduce the project's carbon footprint and facilitate maintenance, local construction materials are used whenever possible. The simple modular building forms are designed to support a long-term development. Robustness of the buildings is promoted both in detailing and function.

ONCE COMPLETED, Panzi's new unit will serve as a blueprint for maternal and neonatal healthcare facilities in similar circumstances both in the Democratic Republic of Congo and beyond. The project is currently under development in collaboration with local architects and partners.

Introduction

In November of 2016, White Arkitekter accepted the mission to design a proposal for a new mother and baby unit at Panzi Hospital, Bukavu, Democratic Republic of Congo. This project also resulted in a master plan for the hospital. Central to this project was the multidisciplinary process, where White Arkitekter had a close collaboration with Panzi Hospital, healthcare experts and design practitioners.

Background

Panzi Hospital has become world famous for its treatment of victims of sexual violence in the long and violent conflict in the Democratic Republic of Congo (DRC). However, the primary purpose for the hospital was originally maternity care. Today, that care is compromised by overcrowded and run-down facilities, and the hospital lacks a development plan for expanding its capacity in the future.

Panzi Hospital

Panzi Hospital was founded in 1999. It is owned by the Pentecostal Churches in Central Africa (CEPAC) and was started with aid from the Swedish Pentecostal Mission. The hospital was originally planned for 110 beds and aimed primarily at maternity care and childbirth. Today, the hospital contains 450 beds.

Sexual violence has long been used as a weapon in the armed conflict in the DRC. In recent years, the work at the hospital has focussed mainly on treating victims affected by this. A holistic healthcare model is used to meet all of the needs of these patients: physical recovery, psychosocial and emotional support, community rehabilitation and legal aid. This ground-breaking work has made Panzi a world-renowned hospital and its founder, Dr Denis Mukwege, was awarded the 2018 Nobel Peace Prize in recognition of it.

Challenges in the current healthcare provision

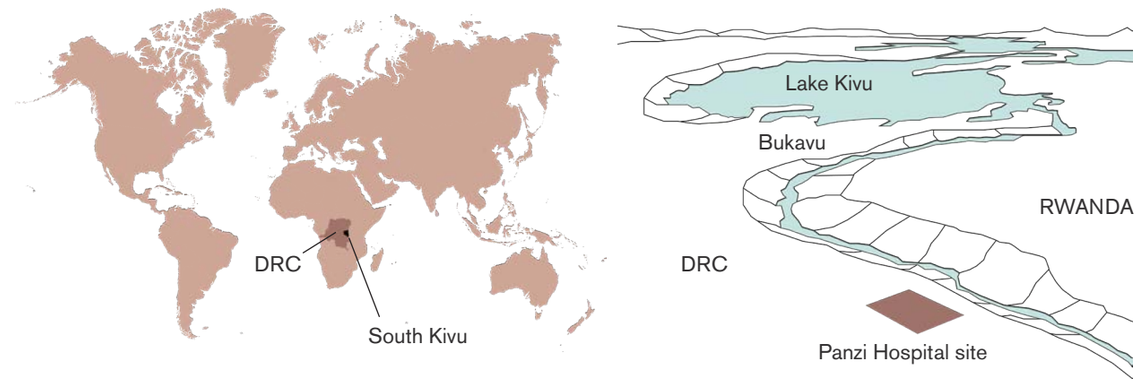
With up to 3,500 childbirths per year, the maternal and neonatal care at Panzi Hospital are still at the core of the work at the hospital. A high percentage of births are by caesarian section (as many as 38% of all births in 2016). The hospital serves a wide area and many patients develop complications by the time they arrive.

The current facilities are inadequate to meet the needs of these patients. Because the hospital is operating over capacity, there is a general lack of space and wards are over-crowded. This affects the mothers, diminishing the chance for privacy and peace. It also decreases the possibility for support from fathers and family members.

There are also inadequacies in the layout of the hospital in relation to the care provided. Currently, there is no possibility for co-care of mother and baby if they are both sick, since they are treated in different buildings. Patient logistics are suboptimal, with long distances between maternity ward, neonatal care unit, and operation facility. This also leads to sub-standard work conditions for the staff.

Challenges in the hospital environment

The original hospital layout consists of a series of pavilions with a clear system of covered pathways between them. Recent additions to the site and changes in building use have departed from this structure and complicated the logistics within the hospital. A coherent strategy is crucial for future-proofing the hospital.



The Democratic Republic of Congo is extremely rich in natural resources. However, it is politically unstable and suffers from a lack of infrastructure. After centuries of both commercial and colonial extraction and exploitation, DR Congo ranks as number 176 out of 187 countries on to the Human Development Index (HDI). Bukavu, where the hospital is located, is the capital of the South Kivu province in east DRC.

Although the hospital is not very old, the existing facilities are run-down and worn out. The strain on the hospital's capacity and its limited economical resources has led to a lack of maintenance. There is also a scarcity of energy, water and material resources. Due to this, the existing systems for heating and cooling are unreliable. Although the local climate is fairly mild, this leads to problems with indoor comfort, as well as access to daylight.

These local conditions pose a great challenge to the daily work in the hospital. A sustainable approach to architecture that has focus on conserving resources and adapting to the local climate becomes, not a choice but a prerequisite in this context.

The project: a new mother and baby unit and a master plan

As a first step towards better maternity and neonatal healthcare at Panzi Hospital, a feasability study for a new mother and baby unit has been developed. The proposed unit was designed by a multidisciplinary team in close collaboration with Panzi Hospital. During the work with the new mother and baby unit, the need for a way to coordinate future expansions became apparent. The scope of the project was therefore expanded to include a master plan for the whole hospital site.

Aims & objectives

Improving maternal and neonatal health is currently one of the Global Goals of the UN. Designing physical environments that support the provision of healthcare at the right time, in the right way, with the right resources is crucial to achieving this goal.

THE MASTER PLAN FOR PANZI HOSPITAL AIMS TO CREATE:

- A framework that optimises the provision of high-quality healthcare through development of the physical environment and the technical infrastructure
- An informative and relevant document that ensures the hospital's function for many years to come

THE NEW MOTHER AND BABY UNIT AT PANZI HOSPITAL AIMS TO BECOME:

- A mother-baby unit based on a scientific, patient-centred, holistic care philosophy, and informed by established principles of healing architecture
- A sustainable blueprint for other maternity and neonatology projects in similar geographical and demographic contexts

PHOTO: ROGER SVANELL

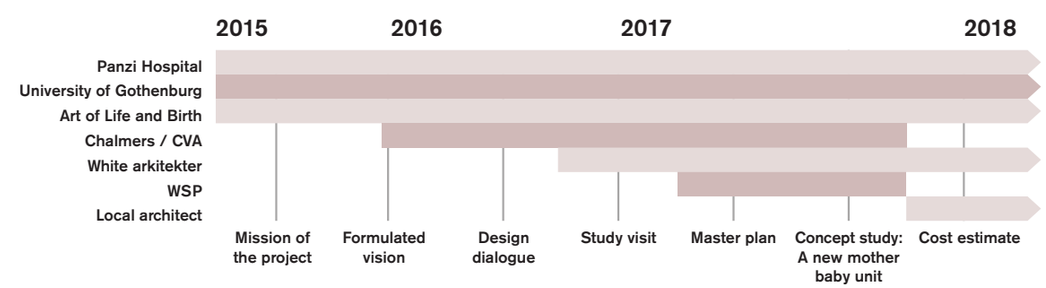
"All women should receive quality care throughout pregnancy, labour, birth and beyond. This new facility will holistically promote the health of women and children throughout their maternity and early years."

Dr. Denis Mukwege, Founder of Panzi Hospital and recipient of the 2018 Nobel Peace Prize

Team

The work on the feasability study and the master plan was carried out in close collaboration between Panzi Hospital, healthcare experts, design practitioners, and sustainability experts.

White Arkitekter	Architecture, healthcare architecture, and sustainability expertise
WSP Group	Construction, energy provision, sanitation, and water treatment expertise
The Centre for Healthcare Architecture (CVA), Chalmers University of Technology	Healthcare architecture research, and design process expertise
Centre for Person-Centred Care (GPCC), University of Gothenburg	Perinatal and neonatal healthcare research
Art of Life and Birth	Perinatal healthcare expertise
Panzi Hospital	Client, local expertise



A multi-disciplinary process

The unique process behind this project uses participatory design to combine three types of expertise – first-hand knowledge (Panzi Hospital), practice experience and current research – in the fields of architecture, healthcare and sustainability.

Participatory design

The ongoing dialogue with staff, patients and family members at Panzi Hospital has been a unique strength of the project. In addition to providing the necessary information about the needs of the hospital and the local environment, it has also been crucial for fostering a sense of involvement towards the project.

PHOTO: LIS PERSSON

	Healthcare	Architecture	Sustainability
Panzi Hospital	**Current healthcare provision** Current healthcare practice was understood through interviews and workshops with patients, staff, and family members of Panzi Hospital, conducted by healthcare researchers from Art of Life and Birth and University of Gothenburg.	**Architectural preconditions** A site visit was carried out by the design team and technical staff was consulted to create an overview of how the site and hospital functions today. Current topography, functions, flows and buildings were mapped and studied.	**Context & climate** The local preconditions were mapped through climate, wind and sun analysis. Local construction methods, availability of materials and other design and construction issues were mapped out. Finding accurate and current data proved a big challenge.
Research	**Care model** Current research on person-centred, holistic, maternal, and neonatal care was the foundation as a new care model was developed by healthcare researchers from Art of Life and Birth and University of Gothenburg.	**Principles of healing architecture** A strong theoretical basis exists for creating a physical environment that supports wellbeing and the healing process – Principles of Healing Architecture. The principles were extensively discussed in workshops with representatives from Panzi Hospital, CVA and White Arkitekter.	**Sustainable strategies** A selection of current research and exemplary case studies involving bioclimatic design, both from national and international examples, were examined and compiled by White Arkitekter. Primary research was carried out on locally used construction methods, availability of materials and other design and construction issues.
Practice	**Hospital planning** The requirements of the care as communicated by Panzi Hospital, and the conclusions from the research, were translated into a scheme for the project by White Arkitekter. The optimal ways of organising functions and flows in order to support the developed care model were designed based on substantial experience in hospital design.	**Design and physical planning** The design was developed by White Arkitekter through an iterative process involving sketching, 3D-modelling, drawings, simulations, and physical models. The results were continuously modified after discussions with the rest of the team. Technical solutions were studied and chosen together with WSP and incorporated in the design.	**Sustainable design** A sustainability analysis by White Arkitekter identified the challenges to be solved in the project and the possible potentials to be developed. This resulted in 4 chosen **areas of focus** for the project. Based on the sustainability strategies and design tools such as simulations, the goals for the areas of focus were translated into architectural elements and technical solutions.

Areas of focus for a sustainable architecture

Maintaining ecological balance is the starting point for creating sustainable architecture at Panzi Hospital. With long-term economy as necessary means, the ultimate objective is to achieve social well-being. The project team identified four main sustainability aspects considering the context and the goals. These four areas of focus laid the foundation for the architectural design and informed the whole project.

Health & Well-being

The physical environment has a great importance for the medical treatment outcomes and recovery. It is well known that features such as access to natural daylight, greenery and outdoor views can improve the healing process. As such, the principles for healing architecture were followed during the design process. The result is a proposal for a built environment which supports patients' health and psychological well-being.

Resource Efficiency

Due to the socioeconomic conditions in the region there is a lack of economical, material and energy resources. This makes resource efficiency an important question in the design process. Use of natural resources is crucial for the hospital operations given the shortcomings regarding energy and water infrastructure. The challenge is to design a high-performance building in a context with limited materials and lack of infrastructure.

Climate Adaptation

When designing for a context with limited resources and unreliable technical solutions, it is important to adapt the design to the local climate to create good conditions for indoor comfort. By placing particular emphasis on the impact of local climate and environmental conditions it is possible to improve how a building performs when in use. The principles of bioclimatic design were taken into account in the proposal for the new unit at Panzi with the intention to use natural sources for heating, cooling and lighting.

Long-term Development

An important aspect of sustainable architecture is designing for the future. It is especially significant in the case of Panzi Hospital where good maintenance of existing facilities has been a challenge during past years. Robustness, possibility for change and low maintenance requirements are key factors for a long-term construction that works over time. Designing to withstand natural disaster is particularly relevant in this context since the region is under seismic risk.

Master plan

The master plan is Panzi Hospital's own strategic document. It details current conditions and shortcomings of the hospital's function and environment, and outlines proposed strategies to deal with these. It is intended to form the basis for all new projects and investments supporting future expansions.

Current conditions & shortcomings

The master plan investigates, the most important topics relevant to the future development of the hospital. Healthcare provision and flows are mapped, building uses are detailed, and existing systems for electricity, water, and sanitation are described and evaluated.

Architectural strategy

The hospital opened in 1999 with a clear and well-functioning architectural strategy, with uniform pavilions connected to circulation in the form of covered pathways. In recent years, several new buildings have been added that do not conform to the original structure, and the way the buildings are used have changed. Because of this, the hospital currently suffers from suboptimal flows and logistics.

Technical provision

Technical systems for energy and water provision have become outdated and strained from over-use. New project plans concerning buildings and technical supply are already being prepared and need to be coordinated.

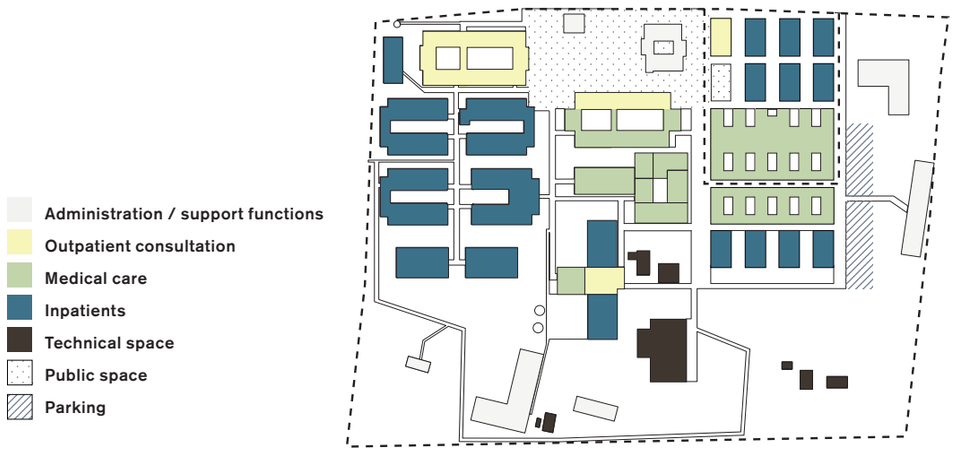
Proposal

New strategies for building use, logistics and technical infrastructure are proposed in the master plan. The new mother and baby unit is proposed to be the first completed building on the reorganised hospital site.

A thoughtful densification

The master plan shows suggested buildings, improved public spaces and moved functions. It will enable existing healthcare departments to expand their operations as the site is densified. Demolitions is kept to a minimum and renovations are designed to be undertaken in stages, avoiding disturbances to the hospital's daily work.

The new structure creates better links within the hospital and improves internal flows for patients, visitors, and staff. Improved technical systems for energy and water are also proposed.



A new mother and baby unit

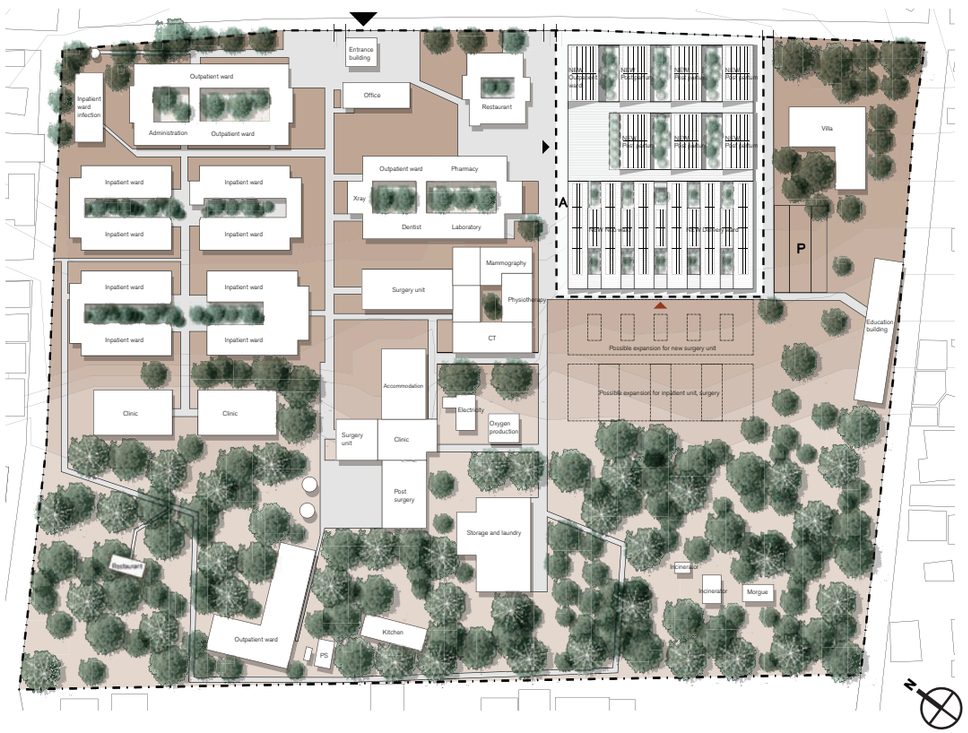
The new unit at Panzi Hospital aims to become a modern maternity and neonatal care facility in Central Africa. The proposal is based on a person-centred, holistic care model and the principles of healing architecture. The architectural proposal is characterised by adapting the construction to the local context and climate, using natural resources efficiently and having a long-term perspective.

Site

A sustainable building is created through a careful adaptation to the local context. The new mother and baby unit makes good use of the height differences on the site and preserves as much buildable area as possible.

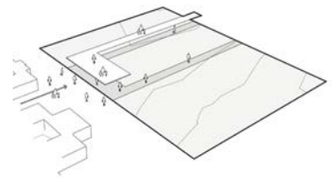
Disposition of the new building

The hospital is placed on a site that slopes towards the south-west, with the highest point at the entrance on the north-east side. There are no building restrictions on the number of floors at the hospital. Existing buildings are primarily single storey. The placement of the new buildings take into consideration the existing structure of the hospital. The new main corridors connect to existing ones and the building heights are kept low. The upper and souterrain floors are programmed strategically to benefit from the extra space created, but still avoid the need for elevators.



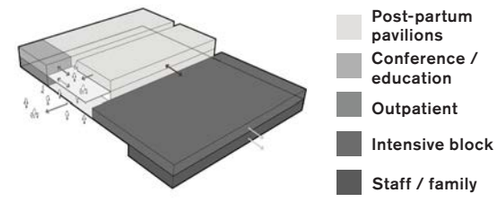
Volumes

The four aspects that informed the design.



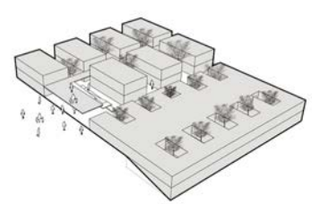
Entrance square

Visitors first arrive to a welcoming and generous entrance square which is oriented towards the main hospital entrance. The square are surrounded by reception, waiting areas, cafeteria, conference space and out-patient clinics. Two internal streets begin by the entrance square and connect the entrance to the rest of the building. This makes the building structure recognisable and easier to navigate within.



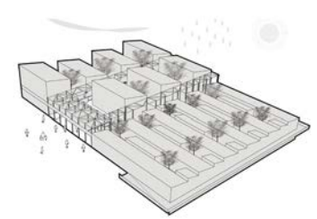
Intensive block/ pavilions/ internal streets

The new unit consists of two distinct parts: the pavilions and the intensive block. The pavilions house all post-partum patient rooms and the out-patient department in two stories. The intensive block contains the labour ward and neonatal unit. It is one story high and compact to enable good flows and short distances. The souterrain story below is used for space for families and staff.



Atriums

Both the intensive block and the pavilions are designed with atriums, with views onto gardens and plenty of daylight. The atriums are physically accessible from the surrounding rooms, so that the gardens can be used for rehabilitation, recreation and social activities.



Roof design

The intensive block and the pavilions are designed with mono-pitched roofs to maximise the roof area for solar power installation, facilitate collection of rainwater and increase natural ventilation.
A wooden canopy above the internal streets and the entrance square ensures protection against the rain and sun – and provides a striking architectural feature to improve orientation.

Layout

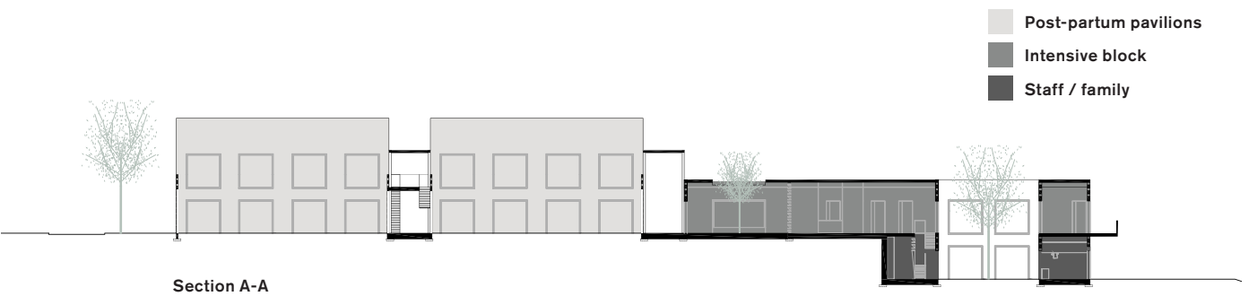
The building is designed to support the care model, with the goals of promoting the patient's security and wellbeing, as well as creating well-functioning spaces for family and staff.

Medical safety
The building's efficient layout will help reduce maternal and neonatal mortality and illness. It is characterised by optimal flows and short distances. The possibility to do caesarian sections in the labour ward is introduced and emergency flows now reach labour ward and neonatal unit directly.

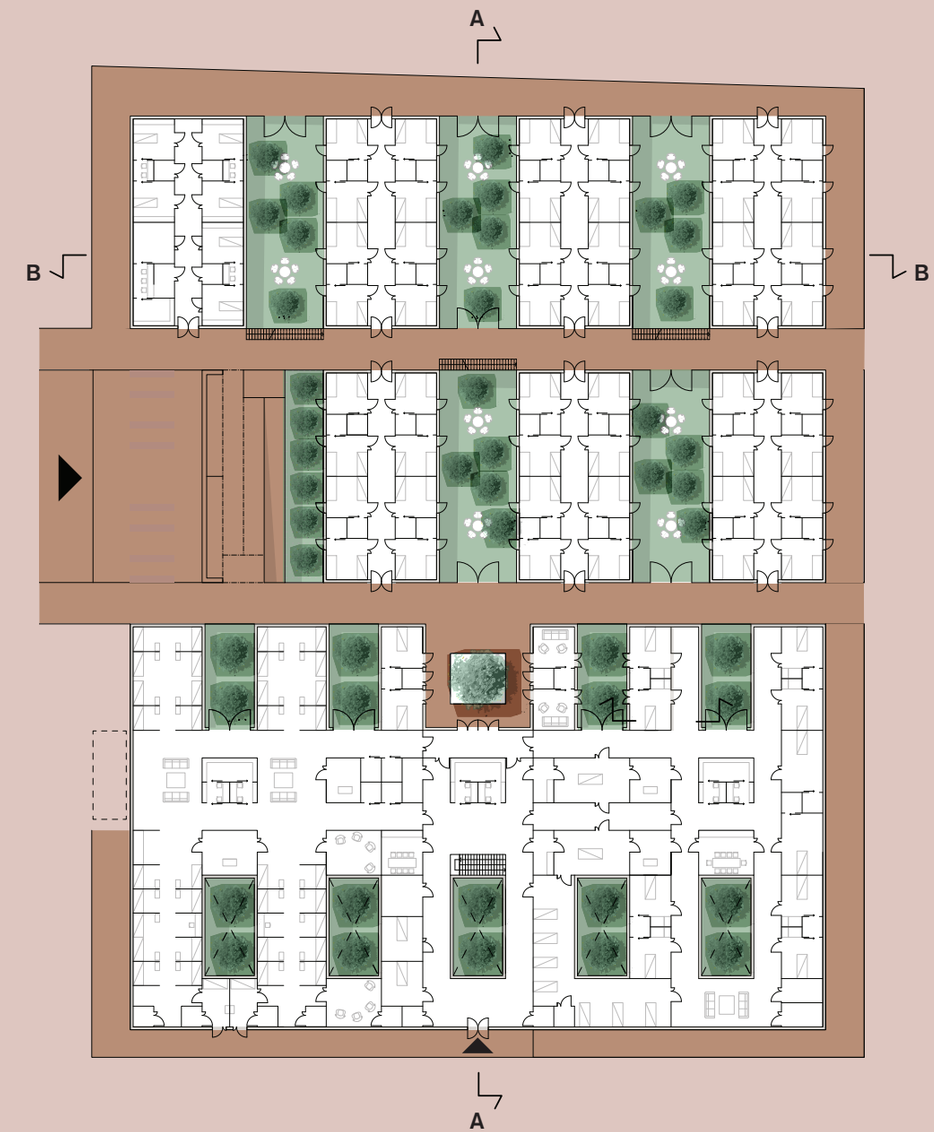
The patient's experience
Zero separation of mother and child is ideal. A heath promotive care environment securing personal integrity and safety is created. The labour ward and neonatal unit lies in direct proximity, enabling co-care of mother and child. The wards are small with patient rooms for one to two women maximum, they are grouped in small units of 8-16 patients. The environment is welcoming and attractive with access to good daylight conditions, views of nature, and quality indoor comfort.

Supporting the patient
Continuous support of a non-professional person such as the father, a family member or a doula is supported. There is space for supportive companions in all patient rooms. There is also a family area within the unit and an overnight space for relatives and supportive persons within the unit.

Superior work conditions
Good working conditions are created for the staff. The new buildings features efficient flows and short distances, staff areas with good daylight conditions, views of nature, welcoming and attractive environment, good indoor comfort, and noise reducing finishes. The technical systems for energy and water supply are simple and reliable and the building is robust and sustainable.



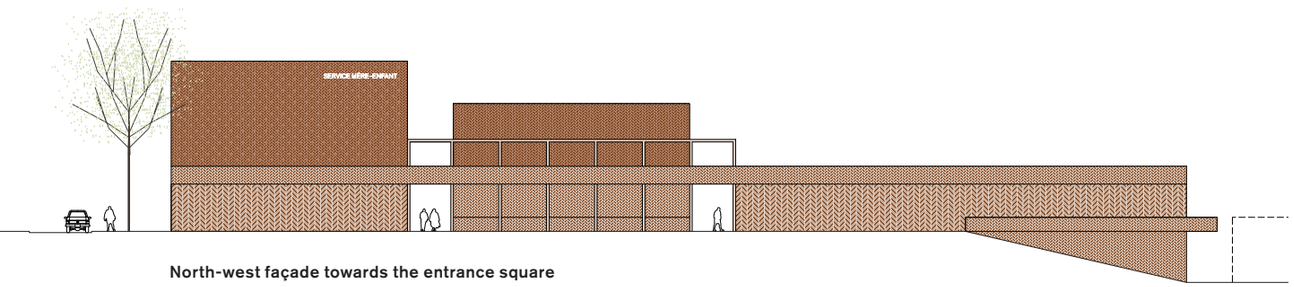
Section A-A



Entrance floor
Level 00

Design

The architecture of the new mother and baby unit is characterised by a beautiful simplicity and material integrity.

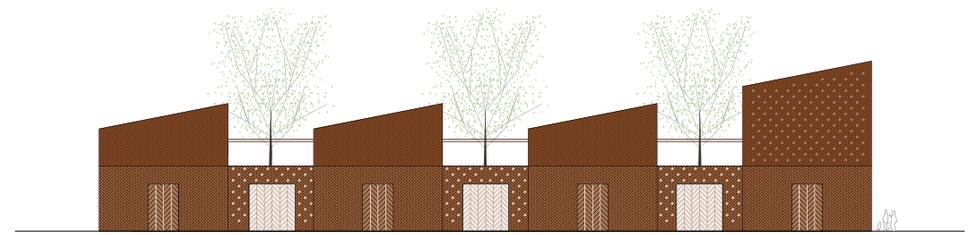


North-west façade towards the entrance square

North-west section A-A

A new mother and baby unit

The design intention was to create a coherency to the new unit – a collection of buildings that clearly belong together. At the same time, the scale should not be overpowering on the site. This is achieved by emphasising the different volumes as well as introducing a horisontal element that ties them together. The differentiation in construction materials – such as building volumes in brick and patterned canopies in timber – makes the building easy to read and provides for a varying and exciting architectural experience



North-east façade towards the street

North-west section B-B

Areas of focus

In our work with Panzi Hospital, the goal of creating a sustainable project informed every design decision. In the following chapter we highlight which challenges arose in relation to each area of focus – and what we did to understand and overcome them.

Health & well-being

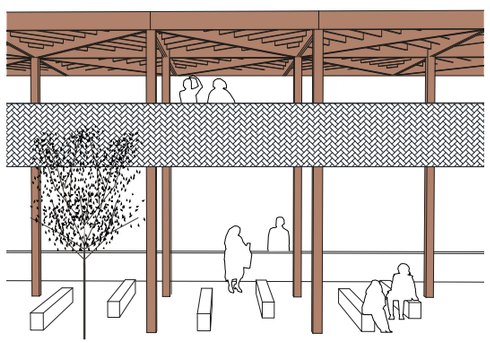
CHALLENGE: Improving the current situation regarding ineffective layouts and flows, lack of quality public and private spaces and poor indoor environments.

OUR APPROACH: Creating a health promotive care environment securing comfort, integrity and safety for patients and staff alike.

Attractive and welcoming environment

A beautiful, accessible and attractive environment symbolises consideration for the patient, the family and the staff. It has been shown to have a profound impact on the chances for recovery. The architecture of the new mother and baby unit is characterised by simplicity and harmony. Natural, local, and thus familiar materials are used.

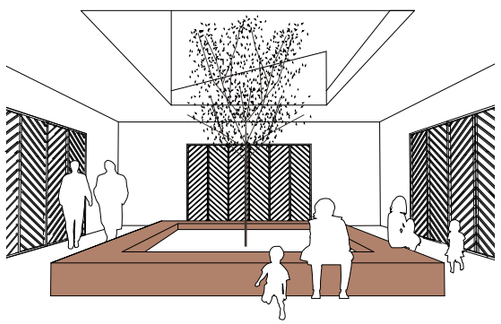
The technical solutions used are well-detailed to harmonise with the building. The building is formed around a range of green spaces, from smaller atriums to larger outdoor areas. These spaces can be used for rehabilitation, recreation and social activities – and all patient rooms are placed to have a view of the greenery.



Gradation between private and public

Patients, families, and staff all have access to a range of different types of environments: from the most public and active areas, such as the entrance square and the corridors, to the most intimate and peaceful, such as the patient rooms and the small atriums. This array supports the individual´s needs and the patient's autonomy. The public spaces are designed for a variety of uses, including education – a crucial component in promoting health.

The patient wards are designed as small units with 8-16 patients, creating a sense of familiarity and safety for the patient. The patient rooms are planned for maximum two beds, providing the patient with a calm environment in which to heal, but still sized to enable the presence and the support of family members during the stay at the hospital.



Easy orientation

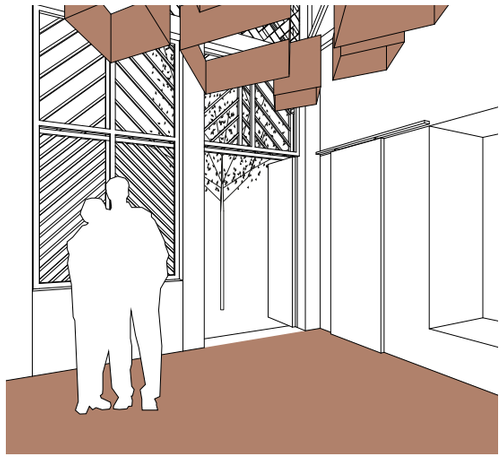
An easy orientation within the building is crucial, both for using it efficiently and for the patient's experience of it. In the new mother and baby unit, this is achieved by using a clear communication strategy. The placement of the new unit relates well to the existing structure of the hospital. The new main corridors connect to the existing ones on the site. The main communication system consists of two internal pathways between buildings, and secondary communication corridors within units. These have different scales and architectural qualities to render them easily identifiable. The main vertical communication – a ramp and staircase – is well visible by the entrance and easy to access from the main corridors.

Staff efficiency is promoted by placing related functions as close to each other as possible, with good overview between rooms when necessary.

Daylight and indoor comfort

Daylight, temperature, views of greenery and acoustics are all among the factors that affect our comfort when using a building. Daylight conditions in the new unit are optimised through the use of atriums and a careful placement of window openings. The window to outdoor wall area ratio has an optimum value around 30 % and window to floor area ratio of 20 %. The room depths are no more than 2.5 times the window height. While facades are designed to let daylight in and open views of the greenery, the patient's privacy is still protected.

Our experience of the environment is also positively affected by our perception of autonomy over it. Staff and patients have the possibility to control their surroundings through regulating indoor airflow and temperature by opening or closing windows, adjusting wind catchers and regulating exterior sun shading. Other potential problems are also addressed with empathic design details. Porous material, such as coconut fibre, are used to improve acoustics.



Climate adaptation

CHALLENGE: Providing comfortable indoor environments without using mechanical installations that depend on a reliable energy supply.

OUR APPROACH: Adapting the buildings to respond to the local climate according to the principles of bioclimatic design.

The local climate

Understanding the local climate conditions make it possible to identify which architectural strategies can be used to create spaces with good thermal comfort. Temperature, humidity and airflow are the three principal conditions that determine whether humans will feel comfortable in a given climate. To design for the local climate, we must first map out these aspects of it.

According to the Köppen-Geiger climate classification system, which is based on a world map, Bukavu has both a wet/tropical and dry climate consisting of a lengthy wet season and a relatively short dry season. Its climate can further be defined as a temperate-humid climate. Average daily temperatures are rather constant all year, with monthly temperatures varying between 15 to 27 degrees. Monthly precipitation varies from wet season (80-130 mm) to dry season (40 mm). Relative humidity varies during the day with an average level of 70%.

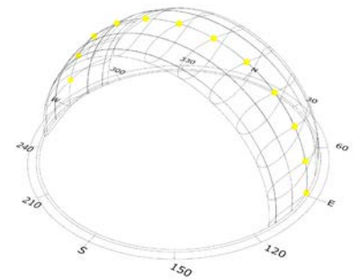
Prevailing winds in Bukavu come from the South with an annual average wind speed of 3 m/s measured at 10 meters height in an unobstructed area. Average wind speed at 2 meters above the ground in a suburban area (area with low buildings and trees) is estimated to be about 1.9 m/s.

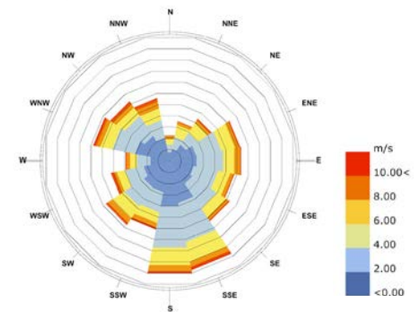
Design strategies

Bioclimatic architecture refers to using natural resources to provide thermal and visual comfort in a building. This means choosing the correct design strategies for heating, cooling and lighting a building in a given climate. When analysing the climatic conditions in Bukavu and comparing with an average person´s thermal comfort zone, a mismatch can be found. This means that measures to control thermal comfort are needed to create a comfortable climate in a building there.

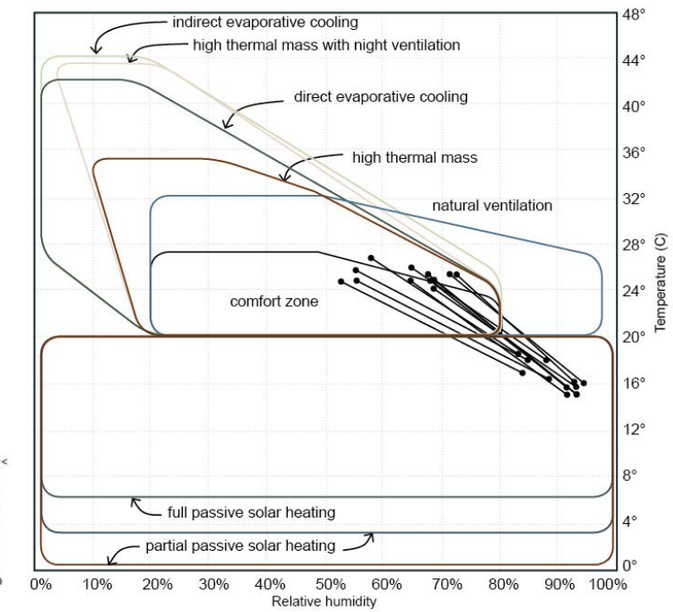
To figure out which design strategies are appropriate in this context, a bioclimatic chart can be used. This is a preliminary analysis tool where climate data for a specific location is introduced, showing the range of temperature and humidity in an average day. The range is matched to different design strategies that are suitable for that specific climate.

When applying the climate data for one year in Bukavu, we realise that because the temperature goes from cold to hot over the course of a day, and the relative humidity is often high, we need to address both heating and cooling issues. Suitable bioclimatic design strategies for this project should thus involve both natural ventilation and passive heating through high thermal mass.





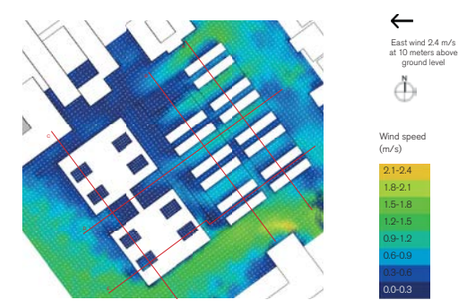
Wind rose



Bioclimatic chart for Bukavu climatic conditions

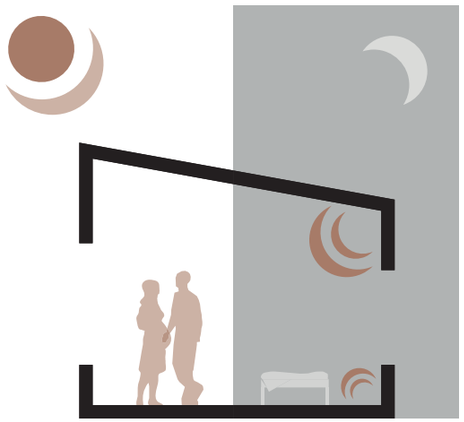
Wind and sun are clearly key factors for using natural ventilation and thermal mass strategies. The simulated sun path illustrates how the angles of the sun vary with latitude and helps visualise how the sun will move in relation to the building, which is located in the centre of the path. The graphical wind rose shows the typical activity of the wind in this location, what percentage of time the wind blows from the sixteen compass points, and how often the air is calm.

The proposed design of the new buildings can then be investigated and adapted to respond to these conditions. Wind simulations illustrate how the wind interacts with and can be directed by the buildings. Shadow studies show how different building volumes affect the daylight conditions on the site and in the buildings.



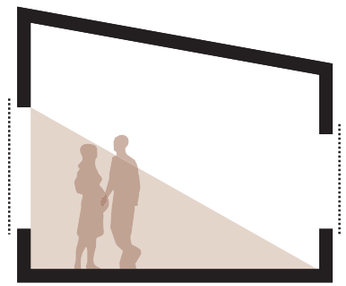
Wind simulation chart

These simulations are done iteratively, meaning that the results of each simulation affect the design direction. The final design is the one that best satisfies defined criteria for a high-performing, passive building.



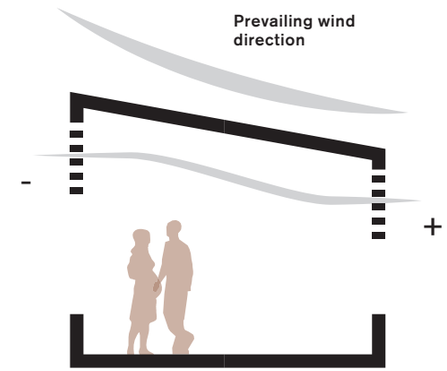
Passive heating

Most of the time, the outdoor climate at Panzi is quite comfortable, but the temperature tends to drop at night. In order to even out these temperature swings, the buildings are designed according to passive solar heating principles. Heat from the sun is absorbed and stored. For this purpose, materials with relatively high thermal mass, concrete and bricks, are used near openings with direct solar exposure. The mass-to-glass area ratio is at least 3:1. The storage of heat in materials is then released when the temperature drops. In addition to improving the indoor comfort during the day and night, this increases the chance to use natural ventilation effectively.



Lighting and sunshading

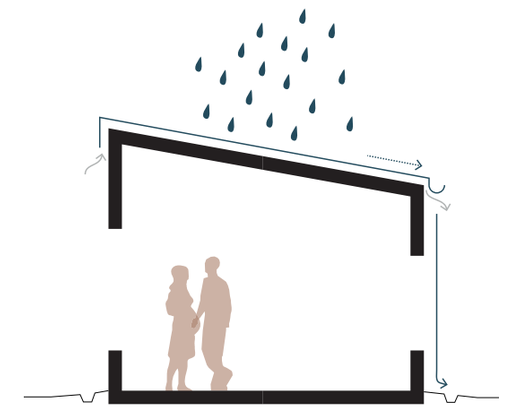
The new buildings are designed to simultaneously optimise the light environment and prevent glare and overheating. Since the electrical supply is unreliable, it is important to use as much as possible of the available daylight. The openings are placed to achieve this, with light reaching all the way into the depth of the buildings. The openings are oriented mainly towards the north and south. Direct light from the east and west, which can lead to an excessive heat load, is avoided. The interior is further protected from excessive direct sunlight by external sun shades.



Natural ventilation and passive cooling

A good airflow through the building is necessary both for hygienic reasons and to create a comfortable indoor climate. Since we cannot rely on mechanical ventilation, the buildings are designed to facilitate natural ventilation. In terms of site treatment, the new buildings are strategically placed to promote wind movement between the building volumes. The prevailing wind meets the long façades at more than a 45-degree angle, which maximises wind speed in the area.

At the building scale, ventilation and cooling are achieved with a combination of cross-ventilation and stack effect. The roofs are designed as mono-pitched roofs with the lowest part towards prevailing wind direction. Cross-ventilation is possible thanks to the air pressure differences created on each side of the volume, the limited width of the volumes and the location of openings on opposing walls. The spaces with less access to wind are provided with ventilation openings connected to the roof, creating an airflow due to the stack effect. Finally, interior atriums are provided with wind catchers which direct additional airflow through the building if needed.



Humidity

The high levels of humidity in the air and the recurring rains present challenges both in terms of building use and building technology. These can be overcome by working with rain protection and using materials cleverly. The most used outdoor environments are protected against rain with covered walkways. The floor level in the buildings is raised in order to create a light slope from the building to avoid water entering in the construction.

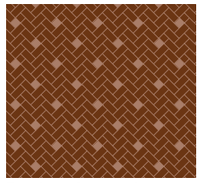
The roof construction is carefully detailed in order to protect the sensitive joint between roof and wall. It is well ventilated with an open space between the exterior roof and the ceiling to decrease the chance of mold growth. Drainage pipes are designed as a continuous integrated system to avoid leakage in joints.

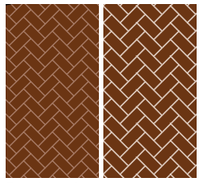
Materials with good waterproof properties are selected for the exterior elements, and the organic material in the façade is well ventilated. Selected indoor materials have good properties to manage moisture: non-absorbing, low growth of mold, and no change in appearance over time.

Resource efficiency

CHALLENGE: **Managing the lack of resources that are needed for a well-functioning hospital – among them an unstable electricity supply, deficient water system, and limited availability of materials.**

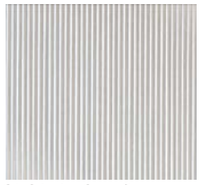
OUR APPROACH: **Designing a self-sufficient hospital using natural resources and local materials.**


Brick with outtakes


Brick with dark/light mortar


Painted brick


Polished concrete


Light steel roofing


Window frames of painted steel


Structural wood


Wooden shutters

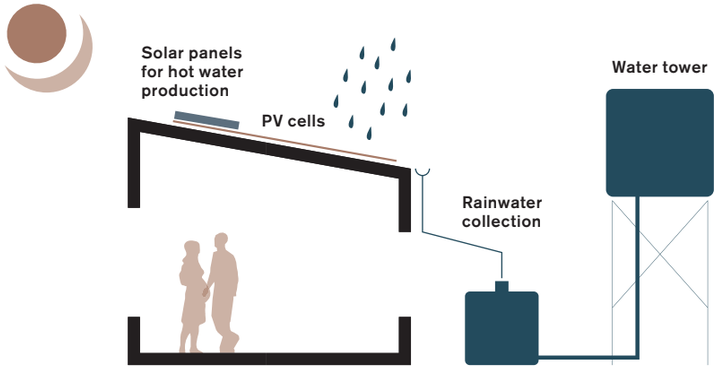

Coconut sheets

Local and sustainable materials

All proposed materials and construction methods have a long tradition in DR Congo with the intention to facilitate the construction process and minimise the risk for construction mistakes. Local materials are prioritised in the design in order to facilitate future maintenance and possible replacements. The main material used is clay bricks, a durable material produced nearby.

Locally sourced timber, a renewable resource that can be successfully treated to withstand the climate, is used whenever possible. It appears both in structural elements, in the form of sunshading and interior finishes.

The amount of concrete and steel used is kept to a mininum, since it will have to be imported. These materials are replaced whenever possible with local material, such as brick or timber. The amount of ceramic tiles was minimised, being used just in wet areas such as bathrooms, since this material is imported and the experience from the existing facilities is that tiles are easily worn out.



Carbon footprint

Minimising the carbon footprint is central to creating an ecologically sustainable project. Our approach to reduce carbon emissions consists of three strategies: reducing energy demand and using renewable energy when possible, selecting materials with low embodied emissions and sourcing local materials.

The emissions from heating, cooling, water and lighting systems are minimised by a bioclimatic design of the building, using natural resources for the building operation.

Materials have been selected based on a life cycle assessment: minimising the total amount of required material and prioritising materials with low embodied and transport emissions. The emissions from materials and operations systems which could not be reduced are compensated with renewable energy production onsite.

Energy

Located in an area with unstable electricity supply, Panzi Hospital is currently depending on generators that are run on fossil fuel. The new design aims to provide the hospital with local solar electricity production.

The roofs of the new building are designed with an angle between 0-20 degrees to maximise the compatibility with solar panels installation, as well as to minimise dust and dirt. Collector panels for water heating are also located on the roofs, to heat water for hygiene purposes.

Water

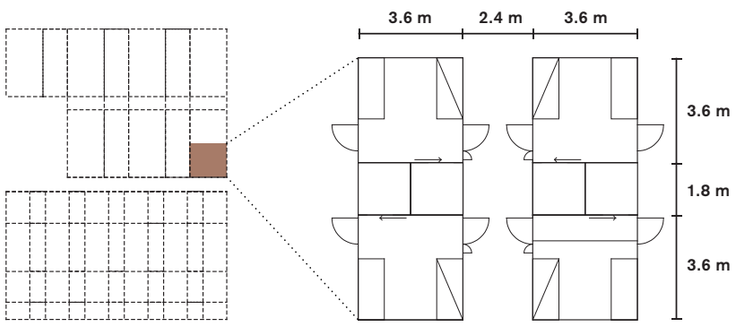
Water as a resource is actually present in abundance in the Bukavu region. It is predominantly accumulated through rainfall, which can be heavy during the wet season, but also sourced from a spring outside the hospital site. However, the spring water needs to be managed more efficiently, with an increased storage possibility, and the reliance on fresh-water should decrease if possible.

Two separate water systems are devised to create a more sustainable distribution of fresh water and rainwater. One system transports fresh water from the spring. A second system is used to collect and store rainwater onsite. The shape of the roofs make for a simple system for water collection. Water is conducted to rainwater cisterns (rainwater tanks), where it can be stored until use. The recommendation is to use rainwater for sanitation, hygiene and flushing, but it could also be possible to use for drinking water if properly treated.

Long-term development

CHALLENGE: **Designing buildings that works over time and can withstand wear and earthquakes.**

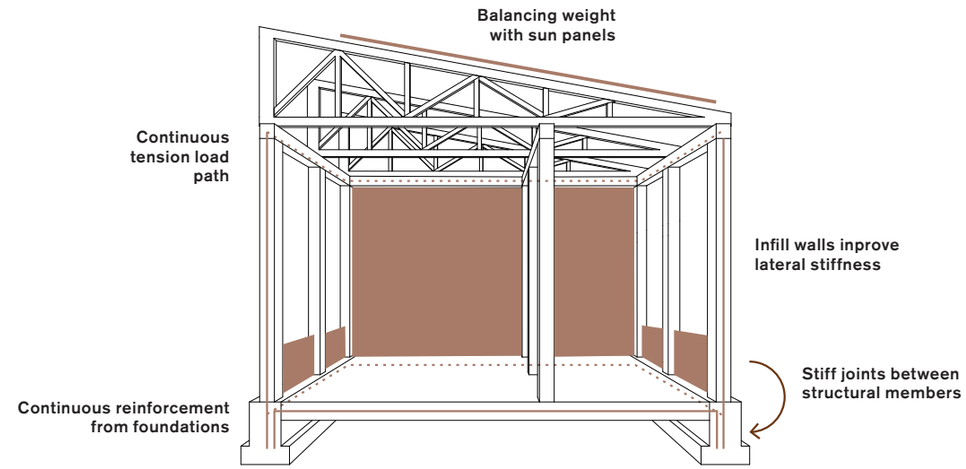
OUR APPROACH: **Buildings that can adapt both to future development and have low maintenance.**



Grid and modular buildings

Façades have a repetitive structure of bearing pillars each 1.8 m. Sizes of all corridors, rooms and atriums are based on measures multiple of 0.6 m. This modular structure enables repetition and standardisation of building elements, which simplifies the building construction and also the reuse of elements and materials during future refurbishments. Most rooms are designed with a general size (3.6 x 3.6 m) that enables different functions, such as patient room, consultation room, treatment room or administration. Patient rooms are generally planned as two-bed rooms but can in the future be changed to one-bed rooms.

Floor to floor height is generally kept to 4.0 m to enable future installation of technical equipment in the ceiling. The intensive block is designed as a one-story building to open the opportunity to technical rooms on the roof in the future.



Earthquake resistance

Panzi Hospital is located in an area that is subjected to seismic risk, which places a great deal of importance on the choice of construction methods and detailing. Using building methods that are already familiar locally and carefully considering construction principles are both key to creating a robust structure.

The new building is composed of voluminous symmetrical structures with openings that regularly distribute mass, strength and stiffness. Structures that are uniform and regular tend to dissipate the earthquake's energy uniformly when subjected to ground shaking, resulting in relatively well-distributed damage. The roof structure is not symmetrical in form, but the solar power installation is placed to obtain a symmetric load in the roof.

The foundations are able to resist earthquake-induced overturning forces and capable to transfer lateral forces to the ground. This is achieved by using individual spread footing foundations with reinforced concrete beams connecting and creating an integral unit. All parts of the building are tied together in order to provide a continuous load path, thus avoiding individual elements moving independently. The construction is able to handle loads in different directions – walls out of plane are supported by walls in plane.

Materials are selected taking into consideration the earthquake risk. Steel sheeting is used in the roof instead of smaller materials such as tiles, which can easily fall down during an earthquake. The steel sheets also provide a slight lateral stiffness.

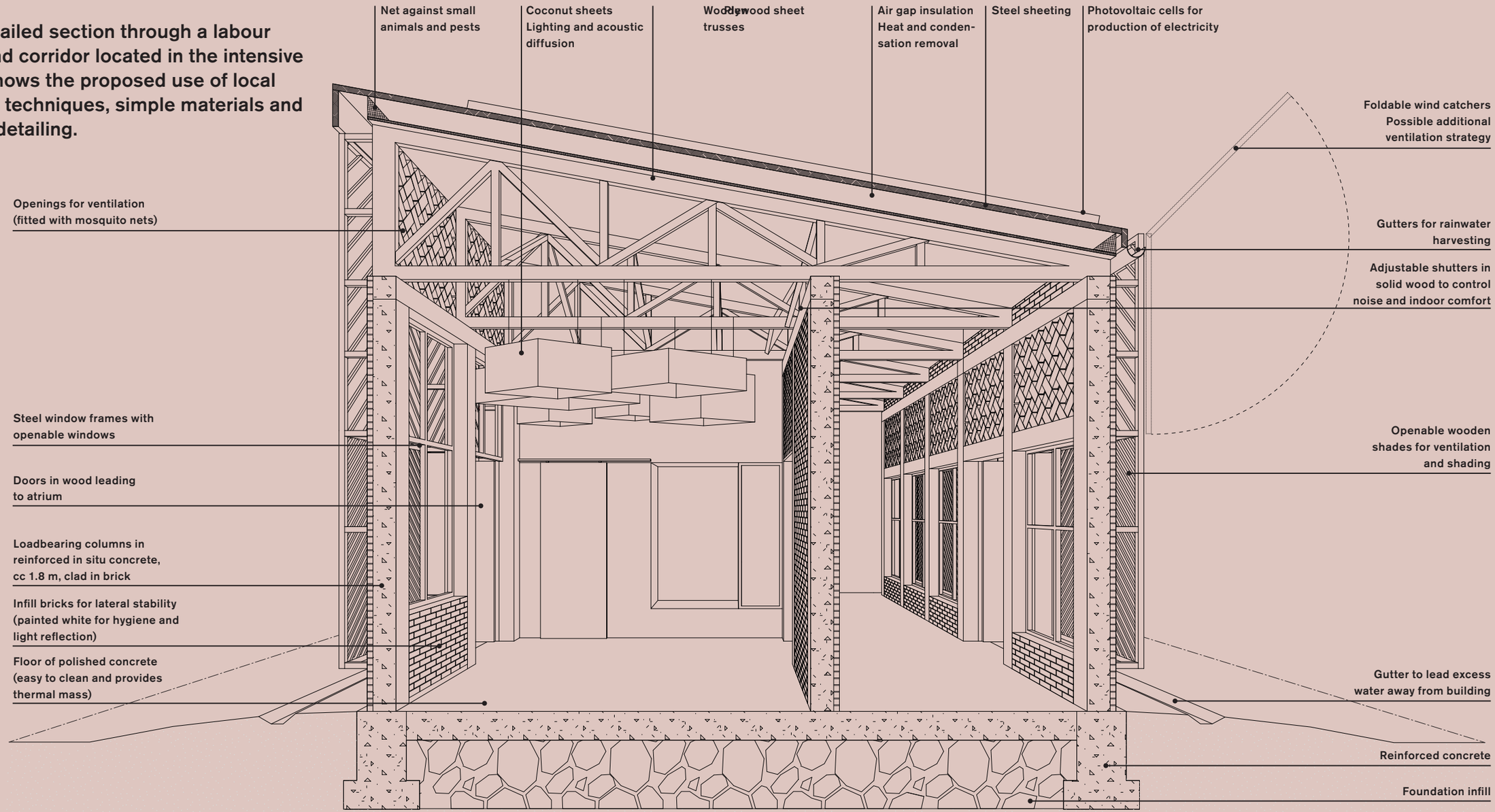
Low maintenance

Finishes that are robust, of good quality and designed with simplicity can reduce the building's need for renovation measures and facilitate cleaning. Interior brick walls are painted, and concrete floors are given a polished finish. Organic material vulnerable to weather exposure and insects is treated to improve its durability. Its use is also limited to places where it is either well-protected or easily reached and replaced.

Areas of focus

In practise

This detailed section through a labour room and corridor located in the intensive block shows the proposed use of local building techniques, simple materials and careful detailing.



Lessons learned

Working with the master plan and new mother and baby unit at Panzi Hospital has been an enriching experience. The most important lessons learned include the impact of multi-disciplinary knowledge, the need for an understanding of the local context – and realising the extent to which a patient's needs is universal.

IN EVERY architectural project, the design team strives to work as closely to the stakeholders as possible to achieve the goals of the project. A unique aspect in this project is the way that contemporary research knowledge in healthcare, architecture and sustainability has been incorporated into the design.

PRIOR TO White Arkitekter's involvement, experts in healthcare from University of Gothenburg and Art of Life and Birth had started to develop an improved care model for maternal and neonatal care at Panzi Hospital. The architectural project was allowed to evolve in parallel to this process, resulting in a proposal that is uniquely tailored to support its function. The lack of resources in the local context high-lights the need for a sustainable approach. Primary research from sustainability experts has been decisive when choosing which architectural strategies to incorporate in the project. This close collaboration should be a goal in any project.

MULTIPLE SITE visits by the design team were essential for gathering information and understanding the context, both theoretically and emotionally. At times, working at a distance proved demanding. The importance of a close dialogue between the design team and the stakeholders as the project develops cannot be overstated. Furthermore, the lack of reliable data – for instance climate data or properties of materials – has been a challenge when compared to working in a Scandinavian context. It introduces a risk for false assumptions and presents a requirement for increased critical thinking and robustness in the chosen design strategies.

THE GREAT extent to which a patient's needs are universal has been one of the most interesting discoveries during the project. The Principles of Healing Architecture form the foundation for all White Arkitekter's healthcare projects in Scandinavia. These principles – for instance, the positive impact of greenery on the healing process – have been immediately embraced by the stakeholders of Panzi Hospital. Finding this common ground has been invaluable in guiding the design process.

IN SUMMATION, it is an amazing privilege to work on this project and, in some small part, contribute to the remarkable work being done by Dr. Mukwege and his team at Panzi Hospital in providing women with quality care throughout pregnancy, labour, birth and beyond.

Into the future

THE PROJECT was officially presented to Dr Mukwege, Mukwege Foundation and Panzi Hospital in May 2017. Since then, installation works regarding the electrical infrastructure have been completed. A local architect has been appointed by Panzi Hospital to work with a preliminary cost estimate and the further architectural development of the project in collaboration with White Arkitekter. One of the possible first activities in the next stage will be to construct a full-scale mock up room, which enables testing new ways of working around the patient but also practically test proposed and alternative building materials, details, assembling methods and production.

THE IMPLEMENTATION of the project from a concept stage to a building project lies in the responsibility of Panzi Hospital. The capacity of the hospital to empower its in-house Facility Management to set up the project with support from dedicated, well experienced external project managers is the current and most crucial challenge. The outcome of this challenge will fully determine the success of the project.

DESPITE THE CURRENT proliferation of medium and large projects in developing countries such Congo, there is still, unfortunately, a great challenge with many projects which don't commence, are cancelled mid-way, or do not meet expected requirements and time frames. Project managers face systemic issues such as central and rigid organisational structures, political instability, improper clarification of roles and responsibilities, lack of clarity of internal and foreign-based stakeholders roles, security problems and other issues. The implementation of the project is, therefore, a new challenging and unwritten chapter of the story of this book.

THE DEVELOPMENT of the project embodies the opportunity for the local community and Panzi Hospital itself of a change of paradigm: from a history of charity and philanthropy into a future of empowered development. This shift is what we see as a key to shape the resilient, self-confident communities of the future and to fulfil the 2030 Sustainable Development Goals.

THE NEXT STEP follows after completion of the building phase. Staff and community at Panzi will own the challenge of shifting from the current healthcare approach into a holistic, patient-centred healthcare philosophy. Doing so will transform Panzi Hospital into a centre of excellence for maternal and neonatal care in Congo, Africa and the whole world.

About the publication

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The independent research trust ARQ, financed by White, offers research funding in architecture, urban development and planning, with the objective of linking academic research with practice in interdisciplinary activities and projects.

In November of 2016, White Arkitekter accepted the mission to create a proposal for a new mother and baby unit at Panzi Hospital, Bukavu, Democratic Republic of Congo. This project also resulted in a master plan for the hospital. This book, published in November 2018, tells the story of the design process in a project where architecture, healthcare and sustainability were inextricably linked.