



BIOMECHANICAL HIPPO THERAPY CENTRE AND CULTURAL PAVILION

INVESTIGATING SPECIALISED [HORSE-ASSISTED] THERAPY
IN THE RURAL LANDSCAPE OF SEMONKONG, LESOTHO

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DECLARATION

Dissertation submitted in partial fulfilment for the requirements for the degree of M. Arch. (Prof). All the work contained in this document is my own except where otherwise acknowledged.

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cover page:

Fig. 01
Sketch by author



Fig. 02
"In the Steppes of Central Asia"
Painting by Charlie Wilbourn
609mm x 762mm
[Acrylic on canvas]
(Wilbourn, 2018: online).

PREAMBLE

Horses were first domesticated in around 3500 BC by the Steppe people of Euroasia, modern-day Kyrgyzstan (Kelekna, 2009; 398). The horse is an extremely fast, strong, courageous, and intelligent animal; qualities hard to tame, and yet most human exploration and conquest was done on the backs of horses. The horse has been instrumental to human achievement. The relationship between horse and man is significant throughout history (Kelekna, 2009; 398-403). This relationship runs deeper than the horse only being used as a tool. There exists a deep bond between man and horse.





INTRODUCTION

This dissertation grew out of an interest in Lesotho's unique horse culture and the identification of the lack of basic healthcare and therapy for people residing in rural areas, especially people living with disabilities. The solution became apparent to design a hippotherapy [horse-assisted therapy] centre that could provide an opportunity for specialised therapy to take place whilst caring for the horse, involving the community and promoting social integration through placemaking; all within the cultural landscape of rural Semonkong.

Chapter One [Milieu and Orientation] familiarises the reader with part of the history, culture and background of Lesotho and shows the unique relationship that exists between the Basotho and their horses. It further sheds light upon the current circumstances regarding therapy in Lesotho and gives an in-depth understanding of how hippotherapy can improve the quality of life of people with disabilities.

Chapter Two [Exploration and Identification] recognises what the proposed hippotherapy centre will entail and explores both the concrete and abstract properties of place in order to understand the existing relations. A dynamic interplay between culture and nature is identified and explored as a state of dynamic tension. Complexities are revealed within this space of dynamic tension and translated into specific design methodologies demonstrated in the concepts. Chapter Three [Gathering A Design Synthesis] is a process of gathering these concepts and applying them to architectural solutions rendered into the proposed facility. In the fourth chapter, I reflect on the project as a whole and give suggestions to how this dissertation can assist further investigations in the built environment of Lesotho.

keywords: hippotherapy, biomechanical movement, cultural synergy, state of dynamic tension

Fig. 03

"Rethabile Motsapi - Tsenekeng, Lesotho"

Photograph by Thom Pierce, 2016

(Pierce, 2016: online).

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CHAPTER ONE

MILIEU AND ORIENTATION

Part One takes us through the brief narrative of the Mountain Kingdom and shows how the Basotho Pony has played a substantial role throughout its history. A synergy is suggested between the two identities and recognises the horse acting as intermediary between the Basotho and their environment. The chapter goes on to explore more of this Mountainous landscape, paying attention to geographic composition. Here, within the landscape, the vernacular is introduced and analysed to better understand the built environment of Lesotho. Part Three identifies the reasons for the investigation as physiological and social challenges resulting from the lack of therapy and support for people living with disability in Lesotho. The complexities and contradictions of what it means to live with disability in Lesotho are explored by looking at what therapeutic interventions are in place and how the opportunity to use the Basotho Pony could produce a working synergy in providing therapy. Part Five looks at local approaches of building in Semonkong and lays the foundation for the proposed design's architectural aims. The first chapter ends with the research question of the investigation.

Fig. 04
The vast rolling mountains
and grasslands of Lesotho

(Photograph: author).

Muso oa Lesotho:	Kingdom of Lesotho
Mosotho:	Person
Basotho:	People
Sesotho:	Language
Lesotho:	Country
Horse	Pere
Mokorotlo:	the traditional Sotho hat weaved with grass sourced from the Moseha [<i>Merxmuellera macowanii</i>] plant (Mpongo, 2005: online).
Litema:	geometric patterns used by the Basotho to translate meanings and messages into their built environment through engravings, mural paint and mosaic (Kammeyer, 2011: 234).

PART ONE
NARRATIVE

1.1 THE FORMATION OF THE MOUNTAIN KINGDOM

In the 1820's, separate clans of Basotho people were living in present day Eastern Free State and Lesotho. A chief by the name of Moshoeshoe succeeded in uniting the clans of the small mountain kingdom into one nation to defend their land from invaders (World Digital Library, 2014; online). The nation that arose is still known as the Basotho, with a well established common language, territory, and culture. During the early and mid 19th century, the borders of Lesotho were often contested as people groups, including white settlers (Boers), moved through the interior of Southern Africa seeking territory. Moshoeshoe sought protection for his kingdom from the British government which he eventually received in 1868. The Protectorate was annexed to the Cape Colony in 1871 and became a Crown Colony in 1881. This arrangement allowed traditional chiefs to maintain local jurisdiction and lasted until Independence in 1966 (World Digital Library, 2014; online).



Fig. 05
The Lesotho National Flag
(Photograph: author).



Fig. 06
King Moshoeshe the
Second , a descendant
of Moshoeshe the First
with his horse.

(Face2Face Africa,
2019: online).



“Horses have been instrumental in our advancement and people forget the role that horses have played in history.” - Jacky du Plessis
(Beautiful News, 2018: online)

Fig. 07

“Thabo Lekhotsa - Ha Lesala, Lesotho”

Photograph by Thom
Pierce, 2016

(Pierce, 2016: online).

PART 1.2

THE BASOTHO PONY

NARRATIVE

The history of the Basotho Kingdom is synonymous with the history of the horse in Lesotho. King Moshoeshoe I saw the need for his people to be mounted on horses as a defence mechanism against groups infringing on their land (Millin, 2007: 32). The first horses were Cape Horses captured from Zulu or Boer armies and brought into Lesotho in 1825 (Lekota, 2003: 79). The introduction of the horse into Basotho culture was successful and by 1870 it is estimated that 90 percent of the Basotho could ride (Millin, 2007: 32).

Basotho Ponies were used extensively during the Anglo Boer wars by both the Boer and British armies. More recently, unregulated trading and the introduction of foreign thoroughbreds for racing weakened the breeding pool to the extent that in the 20th century, local and international programmes were implemented to preserve the quality of the Basotho Pony breed (Millin, 2007; 33).

Travelling by horse became a necessity for every Basotho boy and girl growing up. Because they grew up in the saddle, the Basotho became very good riders, especially at negotiating the steep mountain terrain. Horses were also used for ploughing and cultivating fields (Lekota, 2003: 79). The horses adapted to the harsh environment resulting in the development of a unique breed known as the Basotho Pony, which in time became world renowned for its unique qualities (Lekota, 2003: 80). The breed is able to endure extreme temperatures and live on the changing qualities of

available mountain grazing. The average height of the Basotho pony is 14.2 hands, classifying it as a horse and not a pony. The horse is well mannered, intelligent, has endurance and a gentle temperament. Their thick-walled hooves make it possible to negotiate the steep mountain terrain of Lesotho. Another key feature is the ability to triple: a two-time lateral gait slightly faster than a trot, but much more comfortable for the rider, especially on long journeys (Lekota, 2003: 80).



Fig. 08

"Mamasisi and Masisi Letsapo - Mohlakeng, Lesotho"

Photograph by Thom Pierce, 2016

(Pierce, 2016: online).



Today there are estimated to be around 98 000 to 112 000 horses in Lesotho (Grobber, 2017: online). The dry mountain climate has a relatively low incidence of pandemic diseases and high mountain pastures are ideal for grazing these horses. The fertile farmlands of the Basotho offer high-quality feed (Grobber, 2017: online).

Horse racing in Lesotho is an important cultural and social event. Thousands of people gather monthly and on commemorative days to race, the largest of which is held on King Letsi III's birthday and is hosted in Semonkong, the horse capital of Lesotho (Panchia, 2017: online). The races are unlike horse racing in the West and unique to the Basotho culture. Horse racing became a national sport in 2018. Children are used as jockeys because of their smaller size and weight, racing not on a track, but across the natural landscape (Miller, 2017: online).

Fig. 09

Basotho jockeys horse racing in Ha Mateketa, Semonkong, Lesotho

(Panchia, 2017: online).

Fig. 10

Jockey stands with his horse after the race

(Panchia, 2017: online).



Culture

/ˈkʌltʃə/
noun.

“The ideas, customs, and social behaviour of a particular people group or society”

(Oxford, 2019: online).

Synergy

/ˈsɪnədʒi/
noun.

“the interaction or cooperation of two organizations, substances, or agents to produce a combined effect greater than the sum of their separate effects”

(Oxford, 2019: online).

The horse has become a central part of the Lesotho culture since its arrival in the early 1800s (Mackenzie, 2005: Online). The image of a Basotho man wearing his mokorotlo hat, wrapped in his blanket, riding his horse embodies national pride. The strength and endurance of the horses are a symbol of the status and dignity of the people of Lesotho. Horses might not be as 'pampered' in Lesotho, but they are vital for transport, agriculture and wealth creation (Grobber, 2017: online). The relationship between the Basotho man and the Basotho Pony is one of reverence. Horses are essential to life for people in Lesotho as much of the country's steep mountainous terrain is only accessible by horse or by foot. Lesotho is arguably the only country in sub-Saharan Africa to have its own homegrown horse culture; an African example of breeding horses for specific and unique domestic purposes (Mackenzie, 2005: Online).

A cultural synergy exists between the Basotho Pony and the Basotho Nation: each reliant on the other. The Basotho Pony makes the mountainous terrain accessible to the Basotho people, while the Basotho way of life in the mountains of Lesotho has made the Basotho Pony a strong and sought-after breed.

PART 1.3
A CULTURAL SYNERGY
NARRATIVE

Fig. 11

Basotho man with his horse
(African Outposts, 2019: online).



narrative

A CULTURAL
SYNERGY



PART 1.4
HISTORICAL TIMELINE
NARRATIVE

Fig. 12
Panoramic view of
Lesotho mountains
(Photograph: author).





narrative

HISTORICAL TIMELINE

Second Anglo Boer War

**1899-
1902**

St Leonard's school was opened in Semonkong

1924

St. Leonard's Clinic was built and named after the chief Leonard Lehoko, of Semonkong

1934

Lesotho gained independence from British Rule

1966

Irish Government instituted a breeding programme for the Basotho Pony

1978

Establishment of the Semonkong Hospital Trust

2006

Prince Harry of the United Kingdom and Prince Seiso of the Kingdom of Lesotho founded Sentebale, a charity organisation for the vulnerable children of Lesotho

2006

World Horse Welfare initiated a training programme in Lesotho to improve horse care

2007

Lesotho signed a UN Convention protecting the Rights of Persons with Disabilities

2008

National Disability Rehabilitation Policy was approved by the national Cabinet

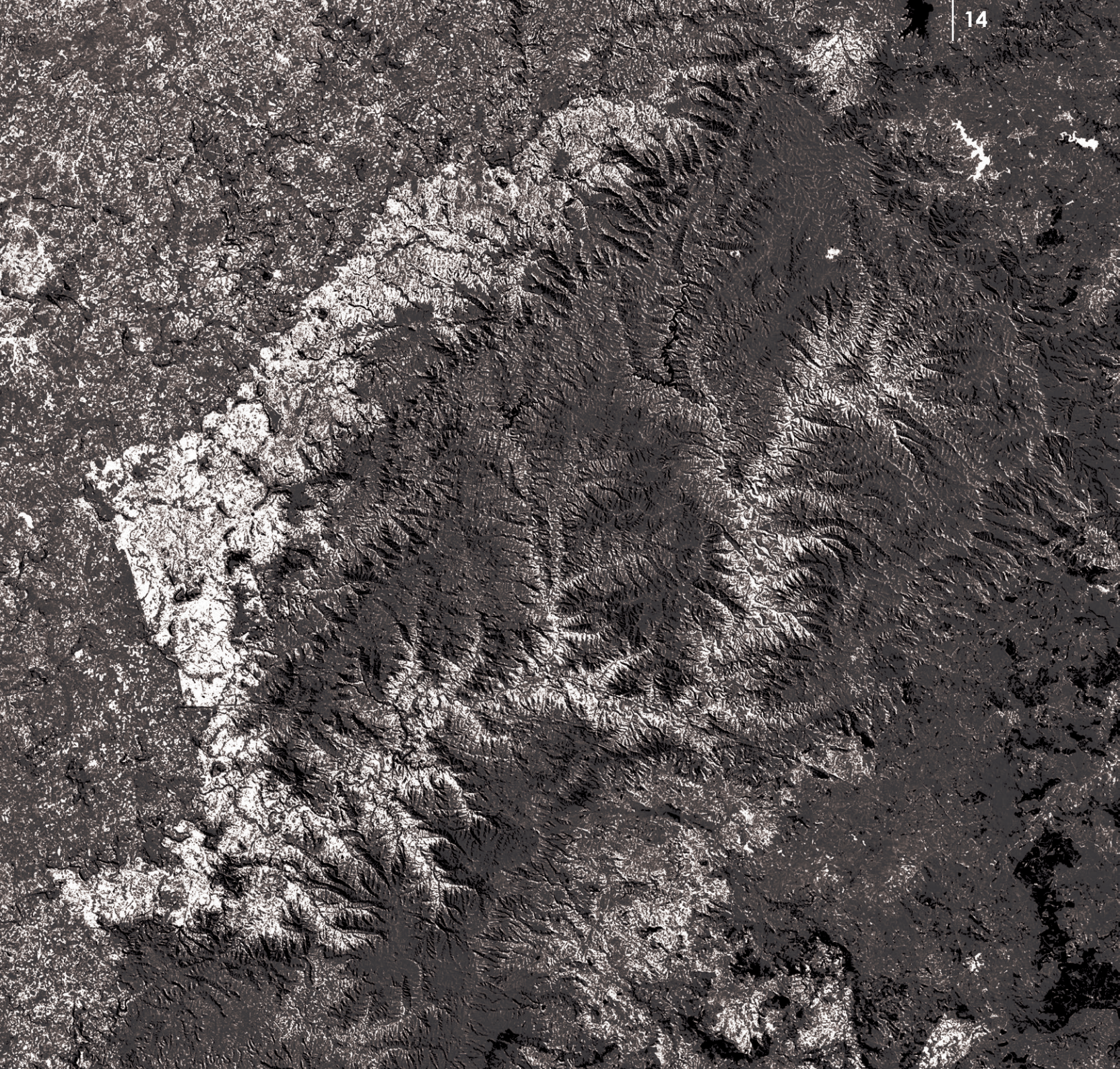
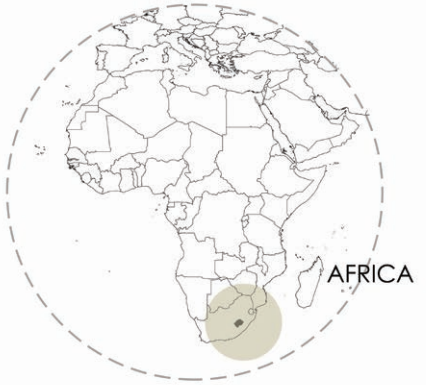
2011

Construction of the Semonkong Hospital Trust's veterinary clinic has begun.

2019

[The events listed are discussed and referenced throughout this document]

PART TWO
LANDSCAPE





PART 2.2

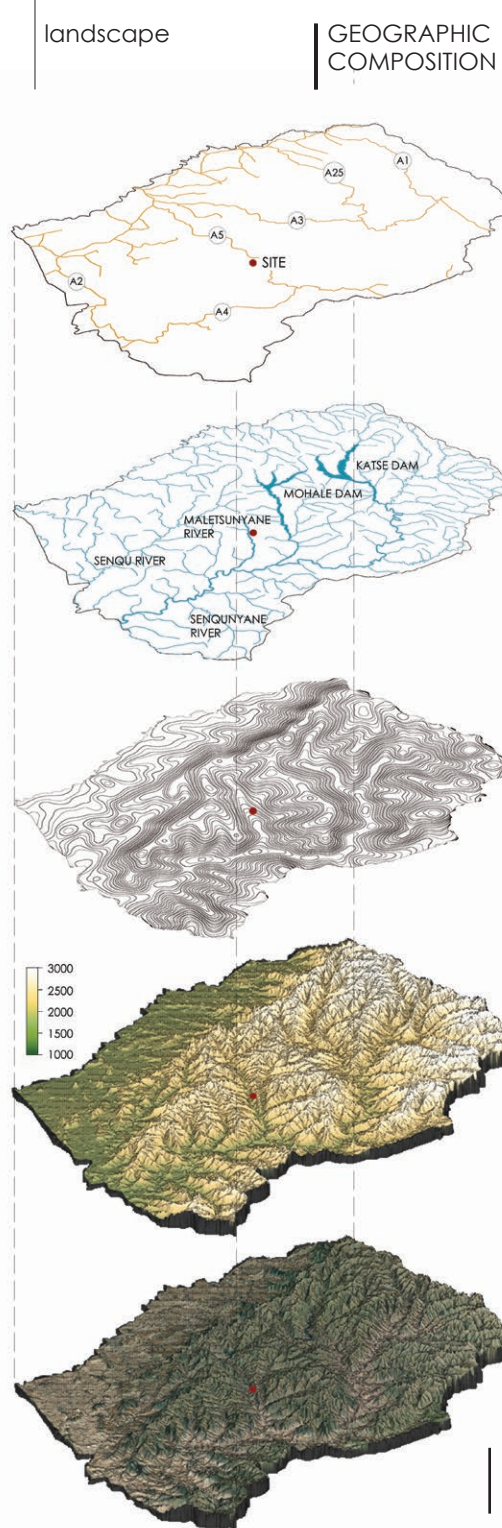
GEOGRAPHIC COMPOSITION

LANDSCAPE



Fig. 16
Farmlands of Lesotho
(Photograph: author).

Fig. 17
Exploded view of
geographic composition
(Diagram: author).



ROADS

Most of the roads in Lesotho are gravel roads with only a few national roads connecting the main cities. Due to the extreme poverty rate and lack of infrastructure, roads are mainly used by cattle and horses which are the main mode of transportation. Tar roads, like the A5 national route, was recently built to promote tourism in the country and ease the transport of building material to the highlands. More roads are being built as the use of cars is increasing within the western lowlands, while people in the highlands still use horses to negotiate the small trails across the mountainous landscape.

WATER

The Lesotho Highlands is one of the most water abundant areas in Southern Africa. The high rainfall during summer and snowfalls in winter provide the country with an estimate of 340 million cubic meters of groundwater and 5.5 trillion litres of surface water per year (The Lesotho Review, 2018: online). Despite this abundance, the major catchment areas are all located in the highlands leaving the Western Lowlands with limited supply. Future development aims to bridge this gap with projects like the Lesotho Highlands Water Project (LHWP) which transfers water from the Katse Dam to the Vaal River in South Africa (Odendaal, 2019:

CONTOURS

The vast valleys and steep slopes of the highlands contribute to an abundance of resources, especially surface water. The unique alpine terrain allows villages to be self sustaining and survive deep within the mountains.

ELEVATION

Lesotho is the only country in the world with a minimum elevation higher than 1000 metres across the whole country (Murphy, 2013: 140). As such, the country has one of the highest elevation averages in the world (Weinhouse, 2015: online). The high elevation causes a cooler climate than in South Africa.

TERRAIN

Lesotho is often referred to as the Mountain Kingdom because of its vast grasslands and rolling mountains. The landscape can be compared to countries like Kyrgyzstan which provides the perfect terrain for horses able to negotiate the steep hills and valleys.



..... Vernacular Malaini

..... Level surface between sloped terrain

..... Vernacular Rondavel / Hut

PART 2.3

THE VERNACULAR

LANDSCAPE

Kraal

Close proximity
of buildings

Most houses in Semonkong today are built in a traditional circular structure known as the 'rondavel'. The structure is primarily made of stone with a daub mixture consisting of earth, animal manure and water sometimes applied to interior walls for finishing. Local timber is used for the roof construction and thatched with grass sourced from the region, secured by plaited grass rope. This building method is preferred as it makes use of existing material which is readily available in the area and can be constructed by most Basotho families as the building techniques are transferred from one generation to the next.

Fig. 18

Semonkong Sunset
(Photograph: author).

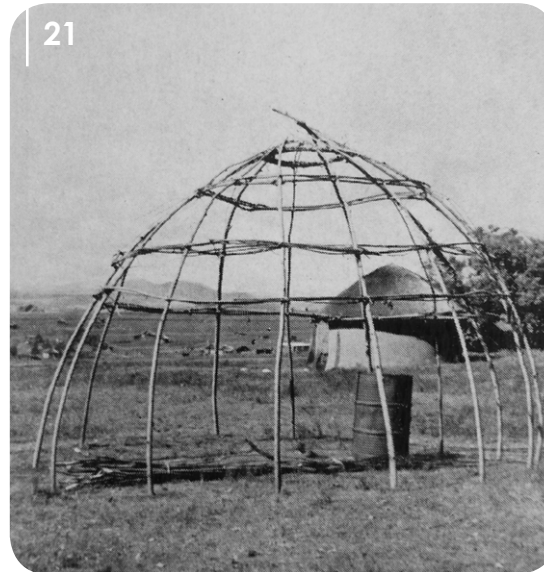


Fig. 19
Mohlongoa-fatse with exterior
stone wall
(Walton, 1911-1999: online).

Fig. 20
Mohlongoa-fatse completed
(Walton, 1911-1999: online).

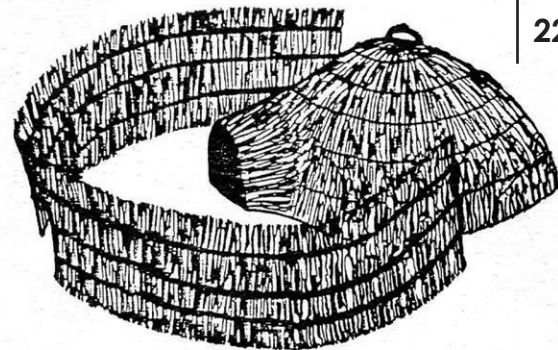
Fig. 21
Mohlongoa-fatse framework
(Walton, 1948: 142).

The use of the present day Rondavel wasn't always the preferred construction method used by Basotho people. Some houses still reveal the more ancient building techniques used to construct what can be called the vernacular of Lesotho architecture, known as the Mohlongoa-fatse dwelling.

In the construction of the traditional Mohlongoa-fatse dwelling, timber is used as the primary structure tied together by rope or thin branches to erect the frame. After the secondary structure of *Acacia Dealbata* wood (silver wattle) (Maile, 2001: 133) is added, daub is used as infill to serve as insulation and fire protection (Houben, 1994: 189). During the dry season (winter), earth is mixed with cow or horse manure, straw and water to create a muddy daub solution workable by hand. Horse

urine is sometimes used instead of water to increase the strength and quality of the daub (Houben, 1994: 189). The solution is worked until it has reached the correct plasticity and is then applied in-between the wattle screens. The builder is physically engaged throughout the process; kneading the materials together and using his body as a tool to press the earth into position (Kammeyer, 2011: 236).

The exterior of the Mohlongoa-fatse dwelling included a small enclosure built from wattle screens that served as a threshold into the private dwelling. Some variations in the construction of the Mohlongoa-fatse occurred over time as different regions made use of the available material. Stone was gradually added to the construction process as an exterior wall which developed into the present day Rondavel.



22

Fig. 22

A mohlongoa fatsi home with a reed screen (Kammeyer, 2011: 191).

Fig. 23

Harvesting grass for thatching

(The Semonkong Hospital Trust, 2019: online).

Fig. 24

The entrance of a mohlongoa fatsi home (Kammeyer, 2011: 213).



23



24



The dwelling of the Basotho Rondavel comprises both interior and exterior spaces. The present day application of the wattle screen as a gathering space is translated into a low stone wall typically with fire pit placed in the centre. The stone wall is also used as an enclosure for horses and cattle known as the kraal. Parallels can be drawn between the kraal and the gathering space as both gather the lived experience of the Basotho man into his built environment.

Informal gathering space to serve as threshold into rondavel

Vegetation as part of the exterior dwelling space

Present day Rondavel

The Kraal

Close proximity to surrounding buildings

Locally available material

27



Fig. 26
Mohlangoa-fatse home with exterior stone wall and exposed wattle (Dichtl, 2019: online).

Fig. 27
Stone rondavel with surrounding elements (Photograph: author).



PART THREE
CHALLENGES

Healthcare in Lesotho is one of the country's main challenges. A large percentage of the population live in rural areas and need to travel several hours to the nearest healthcare facility (Partners In Health, 2014: online). Healthcare is difficult to access because of the mountainous topography and the small number of functional healthcare facilities. As an example, stopping the spread of HIV has been hampered by the inaccessibility of healthcare facilities. Primary healthcare facilities have begun decentralising medical care and horses are being used to deliver life-saving antiretrovirals to remote villages in the district of Mokhotlong. Horses have proven to be the most reliable mode of transport to these villages and are accessible to most people living in rural areas (MacLean, 2011: online). Recent studies show the incidence of HIV declining between 2010 to 2018 (Avert, 2018: online).

The motivation for the establishment of this proposed facility in the rural area of Semonkong is the physiological and social challenges faced by people living with disabilities. The United Nations defines persons with disabilities as "those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others" (UN, 2006: online)

Physical impairment is not unique to Lesotho, but the unique conditions facing these rural villages present challenges worth investigating. People living with disabilities in Lesotho are not only limited in their autonomy and mobility by their disabilities; they are also limited by the scarcity of healthcare facilities and the extreme natural topography (Kamaleri & Eide, 2011: 18). Apart from the physiological challenge, the stigmatisation, discrimination and exclusion from community participation faced by people with disabilities are social challenges that will also be explored in this investigation.

Fig. 28

Basotho mother and her six children outside their home (Partners In Health, 2019: online).



Fig. 29
Grandmother pushing her
grandchild in a wheelchair
(Malamulele Onward, 2019:
online).

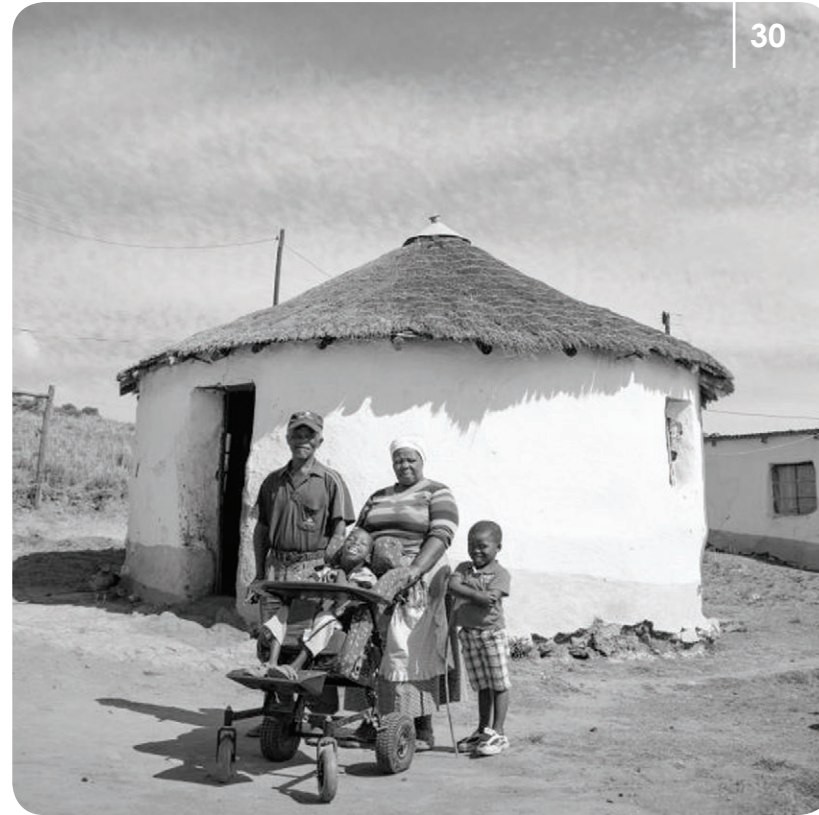


Fig. 30
Family standing outside their
rondavel. Youngest child
has cerebral palsey
(Malamulele Onward, 2019:
online).

PART 3.1

PHYSIOLOGICAL
CHALLENGES

Physical disabilities have an effect on a person's autonomy. Although the person wants to walk, speak, see, or function independently, he/she is not able to. The physiological conditions causing disabilities appropriate to this investigation include cerebral palsy, autism, arthritis, multiple sclerosis, spinal cord injuries, diplegia, sensory integration disorders, developmental delays, genetic syndromes and strokes (Barlow & Ballim, 2016: 32). These conditions may be congenital, trauma-induced, or pathological.

During a comprehensive report by the Lesotho National Federation of the Disabled (LNFOD), participants revealed that 10.1 percent of the households had at least one member with a disability while 5.7 percent included at least one member with a severe disability (Kamaleri & Eide, 2011: 36). These estimates are taken across Lesotho households with representatives from every district, both in rural and urban areas. A comparable study by the Lesotho Ministry of Health and Social Welfare in 2008 showed an estimated 5.2 percent of the population having some form of disability (Shale, 2015: 183). More recent studies estimate at least 31 500 children are presently living with a disability in Lesotho (UNAIDS, 2012: 32).

The medical model of disability focuses on the person and the impairment and aims to provide assistance in areas where a person's body is unable to function naturally. Assistive interventions include physical therapy, nutrition, pain management, occupational therapy and speech therapy. Each is aimed at improving quality of life (Kamaleri & Eide, 2011: 14). Recreational activities are successful at integrating people with disabilities into society and can be incorporated into the therapy of people with disabilities. As yet, people with disabilities in Lesotho are denied their right to participate in recreational activities. And there are little to no recreational facilities where they can go and spend time and socialize with other people. (Chitereka, 2010: 89).



PART 3.2
SOCIAL
CHALLENGES

Fig. 31
School children
(Kalebe, 2017: online).

Social stigmas surrounding people with disabilities often exclude them from normal public life. In Lesotho, it is common for families to hide their affected children from the public because of a tradition of social shaming. This is a typical practice in most African countries because of the perceived association between witchcraft, infidelity and disability (Chitereka, 2010; 84). The overprotection of people living with disabilities tends to lead to the development of dependency on primary caregivers, which further prevents them from independently accessing social and economic services. This can further trap affected families in the cycle of poverty; perpetuating the poor living conditions of people living with disabilities.

These individuals often live without dignity or autonomy and are frequently marginalised (Chitereka, 2010: 85). They also face difficulty in finding employment because a

significant portion of the population living with disabilities have low levels of education and training. Most are discouraged from looking for employment due to prolonged failure to find work and lack of access to assistive technology (Chitereka, 2010: 86).

Research studies conducted in Lesotho on people living with a disability indicate that emotional support is most lacking, surpassing all other types of assistance. Overall, mental health is lower among people living with disabilities as compared to those without. (Kamaleri & Eide, 2011: 6). This is an important consideration when developing services for people with disabilities, as emotional needs will more readily be neglected when the focus of service delivery is practical help and economic and material needs (Kamaleri & Eide, 2011: 87).



Fig. 32

Young boy in wheelchair
(Kalebe, 2017: online).



Fig. 33
Volunteer therapist with child
(Malamulele Onward, 2019: online).

Fig. 34
Volunteers with child that has CP
(Malamulele Onward, 2019: online).

Fig. 35
Part of the organisations awareness
program for parents
(Malamulele Onward, 2019: online).

Fig. 36
Carer2 Carer workshop
(Malamulele Onward, 2019: online).

PART FOUR

COMPLEXITY & CONTRADICTION

1.1 EXISTING RESOURCES

Before considering possible architectural solutions to the above-mentioned challenges, I first investigated existing facilities regarding therapy and upliftment programs for people living with disabilities in Lesotho.

There are very few schools for people living with disabilities and they are all located in the major cities of Maseru and Botha Bethu which are not easily accessible for rural communities. The focus of these schools is inclusive education, which includes some physical assessment, therapy, care and support. The main aim is for their students to become more independent and lead meaningful lives with roles in their communities and families (Thuso Centre, 2019; online; St. Angela Cheshire Home; 2019; online).

Malamulele Onward's Carer-2-Carer Training Program hosts workshops in Lesotho to train the parents of children with cerebral palsy in the basics of care, to improve their quality of life at home, and to teach their skills to other parents in local workshops across Lesotho. The aim is to give parents more background knowledge of their child's condition to increase basic awareness and to ensure that when affected children do see professional therapists, the consultations are as effective as possible (World Cerebral Palsy Day, 2018; online).

According to Gillian Saloojee, founder of Malamulele Onwards, "over 80 per cent of children with cerebral palsy in Lesotho are dependent on the public health care system for therapy. Within this system, children receive (at best) 35 hours of therapy over their entire lifetime. After being given the diagnosis of cerebral palsy, rural parents are often left bewildered and with nowhere to go for information or support (World Cerebral Palsy Day, 2018; online)." Holistic therapy relies on the involvement of the family and community.

Semonkong village is an important central hub for many rural communities living in the Eastern Highlands of Lesotho. The founders of the Semonkong Hospital Trust saw the need for these communities to access healthcare and birthed the Semonkong Hospital Project and Rural Development project in 2006. The project has involved the community in a detailed design process for a future healthcare facility, partnering with Lesotho's Ministry of Health to provide mobile healthcare for the time being. The project team plans to start construction of the hospital in the near future. On completion, the hospital will have 150 beds to provide quality healthcare to roughly 100 000 people in the surrounding areas (The Semonkong Hospital Trust, 2019; online). The hospital will, however, focus on primary and secondary healthcare and will not be geared to provide specialised therapy facilities for people living with disabilities.



Fig. 37

Therapists assisting child in hippotherapy session

(Timion, 2019: online).

Hippotherapy

/,hɪpə(ʊ)'θerəpi/
noun.

Treatment with the help of a horse.

Ancient Greek

Hippos [ἵππος]

English

Horse

The word hippotherapy is derived from the ancient Greek word 'hippos' and literally means "treatment with the help of a horse". It is a form of physical treatment where the therapist utilises the characteristic movements of a horse's spine and back muscles to primarily improve a patient's strength, coordination and balance (Barlow & Ballim, 2016: 31). In a typical therapy session, a patient is placed on a horse led by a riding instructor, and a medically trained therapist constantly analyses the patient's responses and adjusts the sessions to suit their specific needs (Barlow & Ballim, 2016: 32). Hippotherapy is used by physio-, occupational and speech therapists to provide carefully graded motor and sensory input from the horse's gait which mimics the normal walking movement of humans, stimulating the patient's muscles in a rhythmic and repetitive motion (Koca & Ataseven, 2015: 247-249).

PART 4.2

SPECIALISED THERAPY

COMPLEXITY &
CONTRADICTION



Fig. 38, 39

Children participating in hippotherapy
(SARDA Cape Town, 2019: online).

Although the use of hippotherapy is still relatively unexplored compared to other types of therapy, research among medical professionals has increased extensively over the last twenty years (Barlow & Ballim, 2016: 31-32). Numerous studies now prove the benefits of hippotherapy regarding gross motor control, coordination, balance, attention, sensory processes, functional ability and gait parameters as conducted by the Research In Developmental Disabilities Journal (Antunes et al., 2016: 66).

Hippotherapy is used to treat both physical disabilities and psychological disorders. People with disabilities have shown to be more receptive and motivated during their interaction with horses than in a traditional therapy setting (Favali & Milton, 2010: 256-258). A list of disabilities treated with hippotherapy includes autism, cerebral palsy, arthritis, multiple sclerosis, spinal cord injuries, diplegia, sensory integration disorders, developmental

delays and genetic syndromes (Barlow & Ballim, 2016: 32). The treatment of these disabilities is especially relevant to this Semonkong proposal as no treatment for these types of disabilities is currently available in the area.

During a comprehensive study in Pretoria, Du Plessis examined the effects of twelve hippotherapy sessions on children suffering from diplegia who could otherwise not afford therapy due to their impoverished background. Her results showed a significant increase in participants' walking speed and a positive effect on their daily activities and schoolwork (Du Plessis, 2016: 106,130). This study confirms the relevancy of hippotherapy for underprivileged children whose living conditions are comparable to the children living in Semonkong. Hippotherapy is not limited to children but has also proven to be effective for strength, mobility and balance in elderly patients as concluded by De Araujo, et al. (2013: 481) and Homnick et al. (2013: 626).

A man on a horse is spiritually as well as physically bigger than a man on foot. – John Steinbeck

(Du Plessis, 2016: 123).



PART 4.3

A WORKING SYNERGY

COMPLEXITY &
CONTRADICTION

There is an obvious possibility for implementing hippotherapy into this rural community where specialised therapy is otherwise not available. The benefits hippotherapy holds for both physical disabilities and psychological disorders have also been shown.

The need for emotional support may, however, be even greater than the physiological needs experienced by people living with disabilities as shown by Kamaleri and Eide's report of Lesotho (2011: 6). Changing community perceptions of those living with a disability should therefore also be considered in the design approach to this proposal. The cultural significance of horses in Lesotho and specifically in Semonkong may serve as a threshold for altering this perception.

The horse is seen as a symbol of pride, status and dignity in the community of Semonkong. Seeing a person with a disability riding a horse could help change the stigmas of incapability and unworthiness surrounding people living with disabilities.

Hippotherapy will contribute to the healing process of children and adults living with disabilities in Semonkong, both physiologically and socially.

Fig. 40

Basotho man taking medical supplies to nearby village by horseback
(The Semonkong Hospital Trust, 2019: online).

Ubuntu ungamntu ngabanye abantu [Xhosa]

“a person is a person through other people”

(Tutu, 1999: 34).

5.1 A LOCAL APPROACH

When considering the culture of Semonkong, it is important to understand the facility's dependence on the community as a whole, rather than only the people directly influenced by disabilities. Basotho communities are, like many other African cultures, based upon the value system of Ubuntu, translated in Sesotho as “bothu” (Dreyer, 2015: 195). As the term is best expressed through practices, beliefs and traditions rendered deep into the hearts of African people, it can not fully be translated into English (Tutu, 1999: 34). What makes Ubuntu different to a mere way of relating to others, is that it becomes a way of being; both a rule of conduct as well as a social description (Louw, 2006: 161). Desmond Tutu translates Ubuntu as “a person is a person through other people” (1999: 34). An individual is defined by a greater community where they are able to belong, participate and share in a communal way of life.

Being part of the greater whole implies sharing in other's experiences, whether they are humiliation, oppression or victory (Tutu, 1999: 35). The responsibility of the community becomes the responsibility of every individual and vice versa (Dreyer, 2015: 196). People living with disabilities should not be forced to face their struggles alone and on the periphery of society. By integrating therapy into the everyday life of the community, and the involvement of horses, a symbol of communal pride, it is hoped that persons living with disabilities would be afforded a far better communal social standing.

By proposing a therapy facility for people living with disabilities in Semonkong, I envision an initiative which involves the whole community and not just those affected by disabilities. Working in a relatively small community such as Semonkong and surrounding villages, it would be important to maintain a close relationship with the surrounding chiefs to allow community involvement during and after the construction of the development. The facility should not only provide access for the public but also encourage participation in the therapy process. This would help to successfully integrate the proposed development within the broader social context. In this way, the facility not only provides the community with medical treatment but also an opportunity to celebrate their cultural values and heritage.

PART FIVE PROJECT AIMS

Fig. 41

Children celebrating on a
soccer field

(Erraticus, 2019: online).



project
aims

A LOCAL
APPROACH

THE SEMONKONG VETERINARY CLINIC

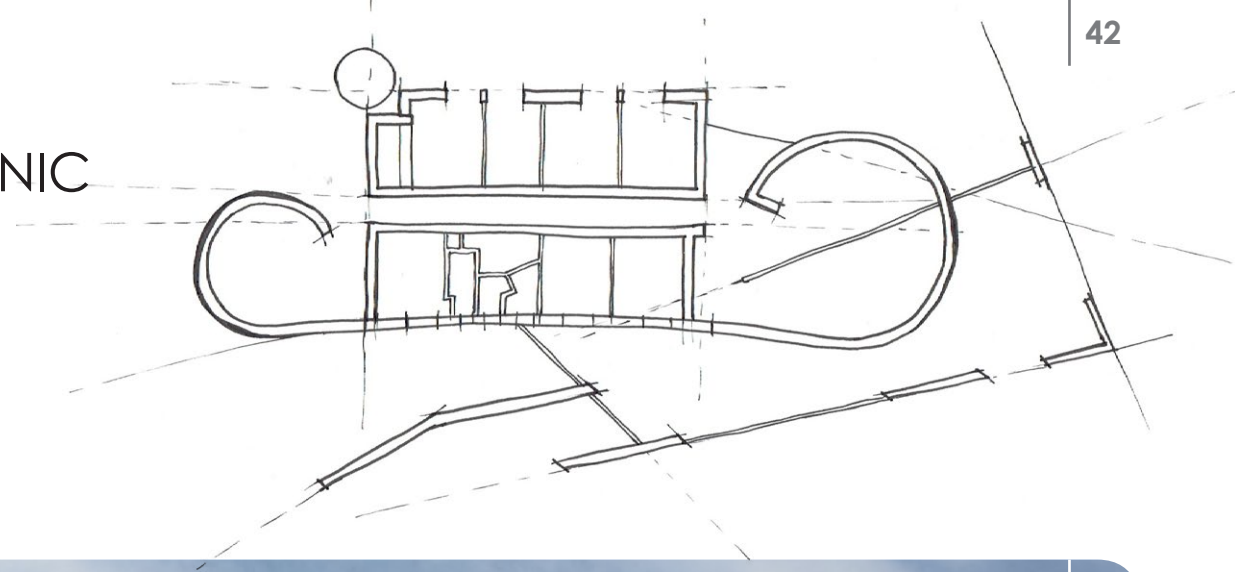
Architects: Celtis Architects and Landscape Architects
Bantu Studio Design & Research
Oikos Consulting

Location: Semonkong, Lesotho

Year: 2019 – ongoing

Size: 200 m²

Clients: The Semonkong Hospital Trust
Lesotho Ministry of Health



PART 5.2
**A LOCAL
CASE STUDY**
PROJECT AIMS

The Semonkong Veterinary Clinic is the first phase of the Semonkong Hospital And Rural Development Project. The project originated in 2006 when the desperate need for a functioning hospital and veterinary clinic was identified by a group of medical students who travelled to the remote villages of the Semonkong area (The Semonkong Hospital Trust, 2019: online). Thousands of people from these villages have to travel hours (by foot or by horse) to receive proper medical attention. The same was true for the surrounding animals and livestock. Since 2016, the Semonkong Hospital Trust has worked with local chiefs and the community members to bring change to the villages in the surrounding area (The Semonkong Hospital Trust, 2019: online).

Fig. 42

Parti sketch of the facility
(Drawing: author).

Fig. 43 - 45

Design renderings of the facility
(The Semonkong Hospital Trust, 2019: online).

HOW CAN A
VETERINARY FACILITY
HELP CREATE
SYSTEMIC BENEFITS TO
AN IMPOVERISHED
COMMUNITY?



44



45

Fig. 04

A thatch mohlongoa fatsi home with a reed screen
(The Semonkong Hospital Trust, 2019: online)



MORE THAN A MEDICAL FACILITY

This project is about more than building a veterinary facility: it's about benefitting the community it serves. The design and building process has been directed towards the people in the community by involving and engaging with them during all stages of the design development. The project team has aimed to work closely with the community to allow skills development, knowledge transfer and valuable partnerships.

Over the past five years, the project team has brokered mutual agreements with Lesotho's Ministry of Health to develop a shared vision regarding the aims and objectives of the project. The community has been involved in extensive participation processes to initiate community ownership in the project. These processes include public presentations, project awareness, local building participation, agreements with chief authorities, medical outreach and support to local clinics. It has also formed valuable alliances with the World Horse Welfare Society and the National University of Lesotho (The Semonkong Hospital Trust, 2019: online).

Fig. 46 - 52

Community involvement preceding the construction of the veterinary centre (The Semonkong Hospital Trust, 2019: online).

APPROACH:

CONVERGE LOCAL KNOWLEDGE



SOURCING LOCAL LABOUR AND MATERIALS



UTILISING EXISTING RESOURCES



SERVICES:

EDUCATION, TRAINING & SKILLS DEVELOPMENT



SUSTAINABLE VETERINARY CARE



HOLISTIC HEALTH CARE



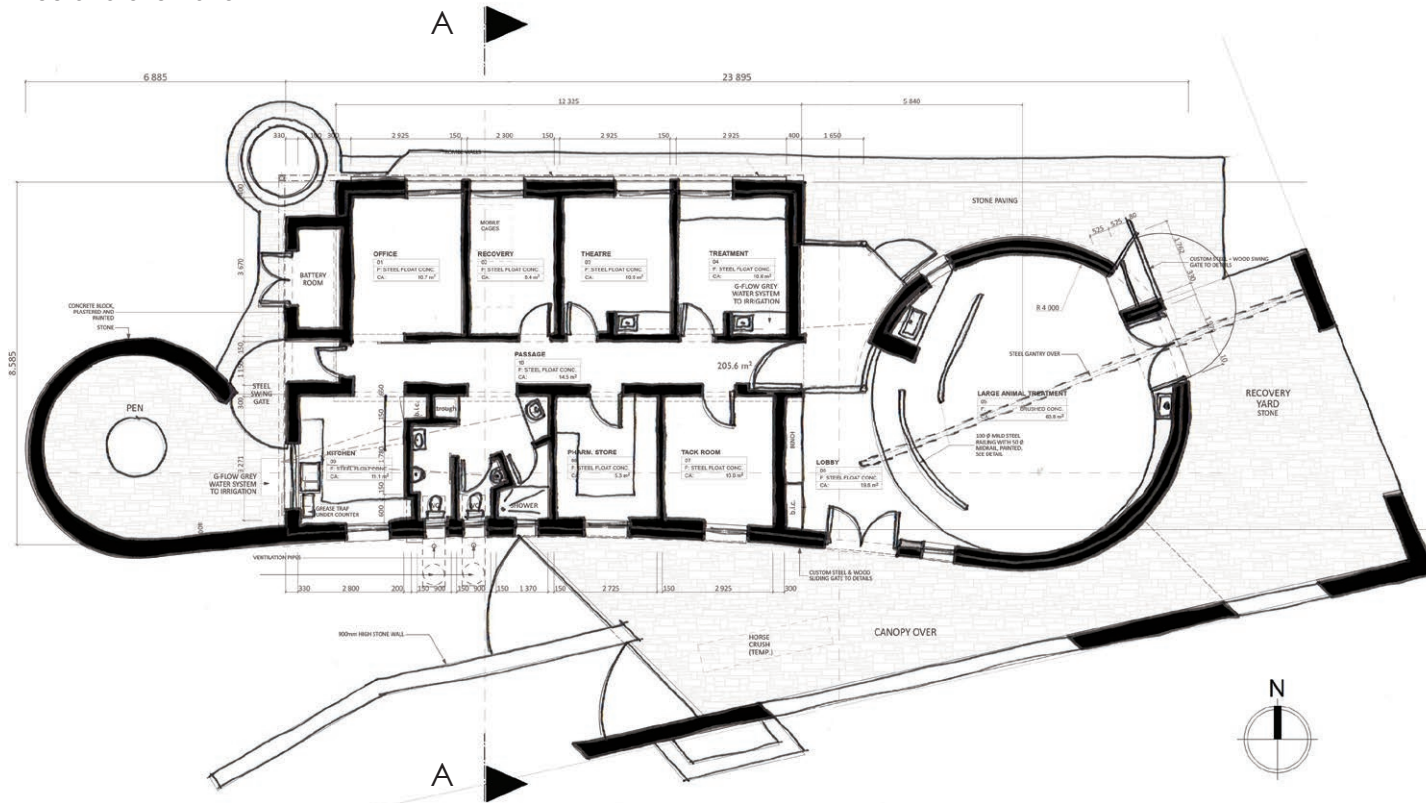


Fig. 53
Floor plan of facility, (not to scale)
(The Semonkong Hospital Trust, 2019: online. Redrawn by author).

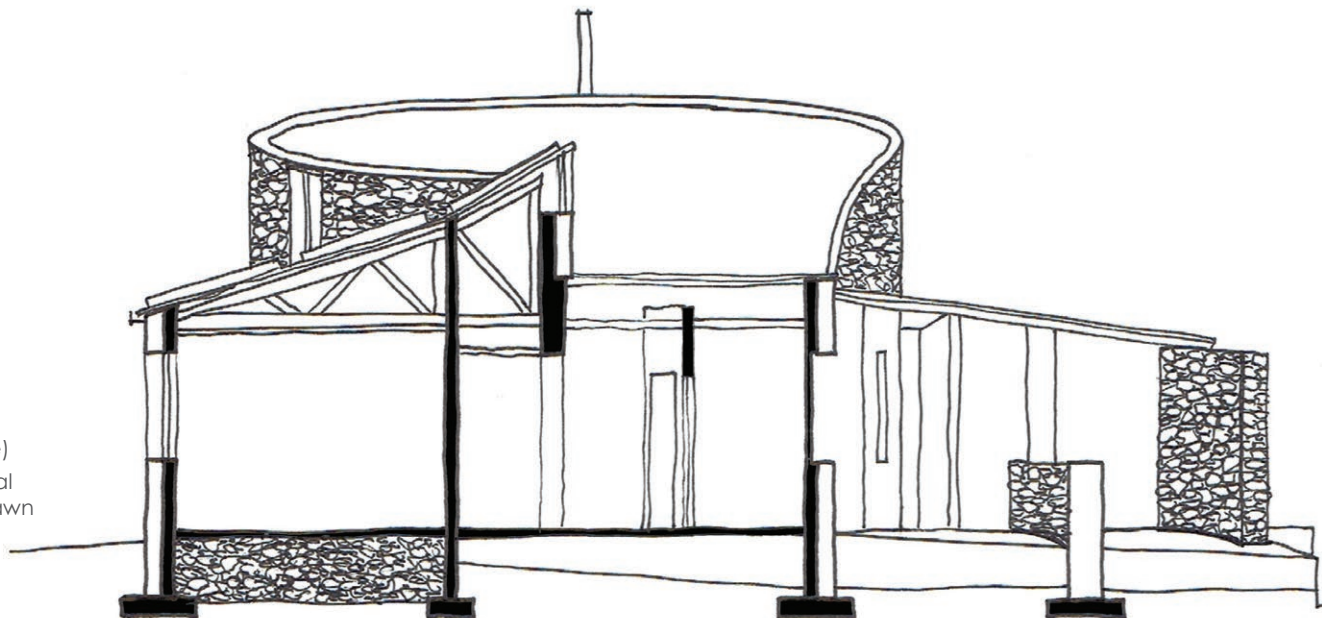


Fig. 54
Section AA (not to scale)
(The Semonkong Hospital Trust, 2019: online. Redrawn by author).

CHALLENGES

- Utilising available resources to construct a clean and healthy working environment
- Not merely providing veterinary services but also benefitting the local community
- Designing a facility that will gain cultural and social acceptance
- Protecting the facility from extreme weather conditions such as rain and snow

The project team employed local craftsmen to shape locally sourced stone as the primary construction method for the project. In addition to the stone walls that provide excellent insulation, low-tech trombe walls were constructed with an external glass layer covering certain areas of the stone, trapping air between the glass and stone walls. This provides passive heating during winter to maximise thermal comfort. The use of photovoltaic panels and solar geysers allow uninterrupted renewable energy for the facility. Rainwater is harvested into water storage tanks and recycled after use for irrigation and agricultural purposes. Waterless toilets were designed because no waterborne drainage system was available on the site.

CONTRIBUTION TO PROJECT

- Respecting the culture and social system of the people through community involvement
- Training local craftsmen to partake in the construction and design processes using local techniques
- Using available materials in innovative ways that are appropriate to Semonkong
- Optimise thermal comfort through simple design solutions such as trombe walls
- Designing a facility that is functional and practical for working with large animals
- Sustainable design solutions such as greywater recycling, renewable energy and waterless toilets

Fig. 55

Children walking with their horses
(De Beer, 2019: online).



RESEARCH QUESTION:

HOW CAN A SPECIALISED HIPPO THERAPY CENTRE CREATE SUSTAINABLE IMPACT THROUGH A HOLISTIC APPROACH TO THERAPY, HORSE CARE, COMMUNITY PARTICIPATION AND SOCIAL BELONGING WHILE REMAINING ROOTED IN SEMONKONG'S CULTURAL AND NATURAL LANDSCAPE ?

In light of the previous sections, the main focus of the project is not limited to providing therapy for the people living with disabilities in Semonkong and the surrounding villages, but also to improve the social perception of those with disabilities. The facility strives towards sustainable architectural and social impact through a holistic approach to therapy, addressing both physiological and social challenges. Community participation is vital to address both types of challenge and should form an intricate part of the facility design, expressing the Ubuntu narrative. As part of the therapy program, the facility further aims to provide quality horse care for the surrounding horse owners, creating shared spaces for the patients and the community to interact.

PROJECT AIMS

- Facilitating treatment for people with disabilities who don't have access to therapy
- Creating a place of safety for the people living with disabilities in Semonkong and the surrounding villages
- Equipping patients living with disabilities to function within their communities both physiologically and socially
- Promoting a positive social effect regarding disability within the community
- Encouraging community engagement and participation in the therapy process within the value system of Ubuntu
- Providing quality care for the horses involved in therapy treatment as well as horses belonging to the supporting community
- Publically revealing complexities within the therapy process that addresses the physiological and social challenges faced by people with disabilities in Semonkong
- Introducing simple, innovative architectural solutions that reflect the dynamic nature of therapy while encouraging skills development in the community.

PART 5.3
ARCHITECTURAL AIMS
PROJECT AIMS

Fig. 56
A young boy in his
wheelchair
(Able Too, 2019: online).

“What design and architecture doesn’t produce a positive social effect? And if it doesn’t, should we be doing it at all?” - MASS Design Group

(Mass Design Group, 2011: online).





CHAPTER TWO

EXPLORATION AND IDENTIFICATION

This chapter provides us with concrete analysis and information to understand the functioning of the proposed hippotherapy centre through the client, programme alternative precedent studies. It further explores both the concrete and abstract properties of place in order to understand the existing relations. A dynamic interplay between culture and nature is identified and explored as a state of dynamic tension between culture and nature, as well as man and horse. Complexities are revealed within this space of dynamic tension and translated into specific design methodologies demonstrated in the concepts.

1 Programme

- 1.1 Client Brief
- 1.2 Hippotherapy
- 1.3 Precedent Studies
- 1.4 International Case Study
- 1.5 Accommodation List

2 Site Analysis

- 2.1 Quantitative Site Analysis
- 2.2 Qualitative Site Analysis

3 Discourse

- 3.1 Understanding The Existing Relations
- 3.2 Revealing Complexities Within The Existing
- 3.3 Ritual And Place-Making:
Gathering To Form New Possibilities

4. Concept

Fig. 57

Basotho men on their horses

(Vagrants of the World, 2017: online)



PART 1.1
THE CLIENT
PROGRAMME



Sentebale was founded in 2006 by Prince Harry of the United Kingdom and Prince Seeiso of the Kingdom of Lesotho following Prince Harry's gap year tour of Lesotho in 2004 (Sentebale, 2019: online). Sentebale means "forget-me-not" in Sesotho and is a charity organisation dedicated to the vulnerable children of rural countries (Sentebale, 2019: online). Sentebale partners with local Grassroots Support Organisations (GSOs) from Lesotho, Botswana and Malawi who are focused on giving children the support they need in order to lead healthy and productive lives. Sentebale is an appropriate client because of the work already done in Lesotho and specifically in Semonkong. The patronage of both Royal families will also be valuable in this project. One of the very successful fundraisers is the Sentebale Polo Cup hosted by a different country each year.

Fig. 58
Prince Harry and Prince Seeiso
(The Culture Trip, 2018: online).

Fig. 59
Sentebale Polo Cup
(Horse Talk, 2016: online).

The proposed facility will also be in collaboration with the Ministry of Health And Social Welfare of Lesotho. The Ministry of Health has signed the UN Convention on the Rights of Persons with Disabilities in 2008 and developed a National Disability and Rehabilitation Policy in 2011 (United Nations, 2012: 18). These commitments urge them to ensure the availability and use of new proven technologies and techniques to support professionals, train local staff and improve the quality of life for people with disabilities. The Lesotho Ministry of Health together with local organisations like Sentebale has implemented programmes that give these children access to education, skills development and dignity that will enrich their lives and have a ripple effect on the community.



WorldHorseWelfare

The World Horse Welfare works with horses, horse owners, communities, organisations and governments to help improve welfare standards of the horse worldwide. The World Horse Welfare has been working in Lesotho since 2007 and has established many mobile horse clinic programmes. Their courses in saddling, farriering and equine nutrition have been well attended and has formed valuable alliances with the communities. The World Horse Welfare acknowledges that although horses play a pivotal role in rural households by supporting livelihoods, providing transportation, and existing as a symbolic cultural figure for the Basotho, a lack of attention to their welfare exists (World Horse Welfare, 2019; online). Remoteness and the resulting difficulty in accessing services and medication results in many horses suffering from curable diseases, untreated injuries, ill-fitting tack and poor nutrition (World Horse Welfare, 2019; online). Since the proposed hippotherapy centre will utilise local horses, the welfare of these horses is of priority to provide high-quality therapy.

Fig. 60

Prince Harry visiting
Lesotho
(Hills, 2019; online).



THE THERAPEUTIC INTERACTION

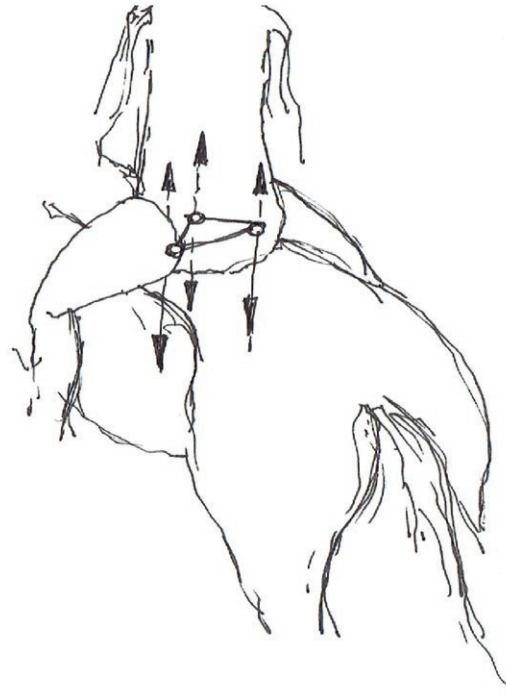
We have already described hippotherapy as a form of physical treatment where the therapist utilises the characteristic movements of a horse's spine and back muscles to translate a therapeutic physiological effect onto patients living with disabilities. The therapy is focused on the interaction between the patient and the horse that occurs at the central points of gravity shown in figure 61.

HOW IT WORKS

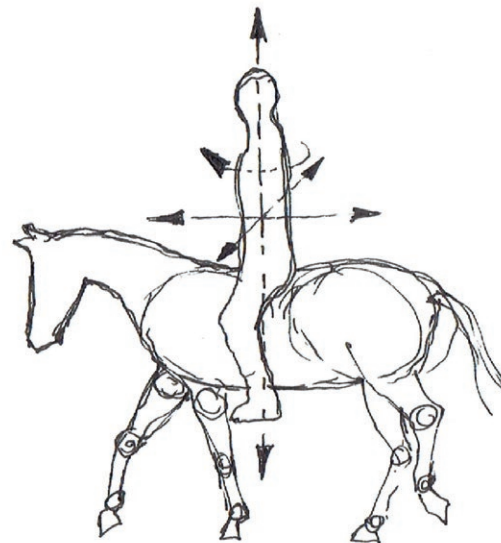
The core principle that allows hippotherapy to work is the three-dimensional movement of the horse's spine and its effect on the back muscles (Koca & Ataseven, 2015: 249). For the patient to remain stable on the horse while walking, the patient starts to instinctively adjust their body accordingly to the horse's movement (Figure 62). These responses have been proven to mimic the pelvic movement of a patient when walking and provide the sensation of normal human ambulation (Du Plessis, 2016: 25). The patient's spine receives this input into the central nervous system and stimulates motor neurons to rectify incorrect movement patterns as indicated in figure 63 and 64 (Barlow & Ballim, 2016: 32). In summary, the horse's spine provides movement which the patient actively responds to, generating correct pelvic movement of the patient. The horse's spine and the patient's spine are therefore in constant interaction, working together to achieve the therapeutic outcomes.

Fig. 61-63

Sketches indicating the direction of movement of human body on horse
(Drawing: author).



61



62

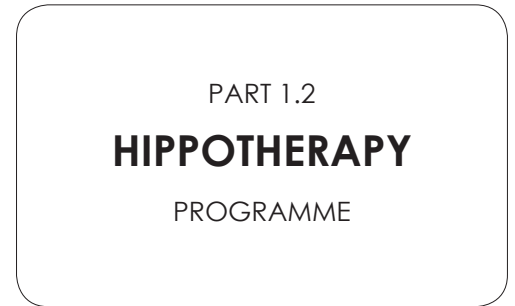
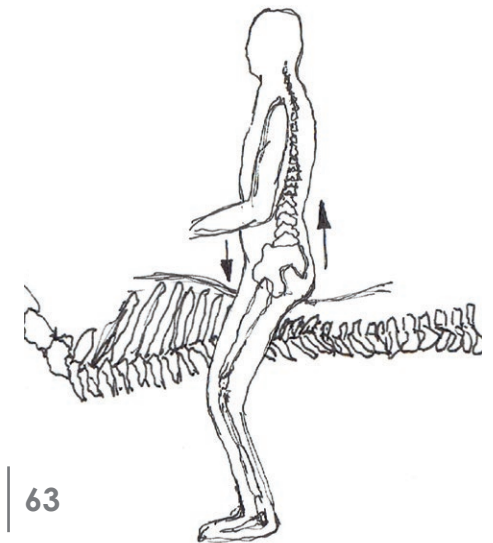


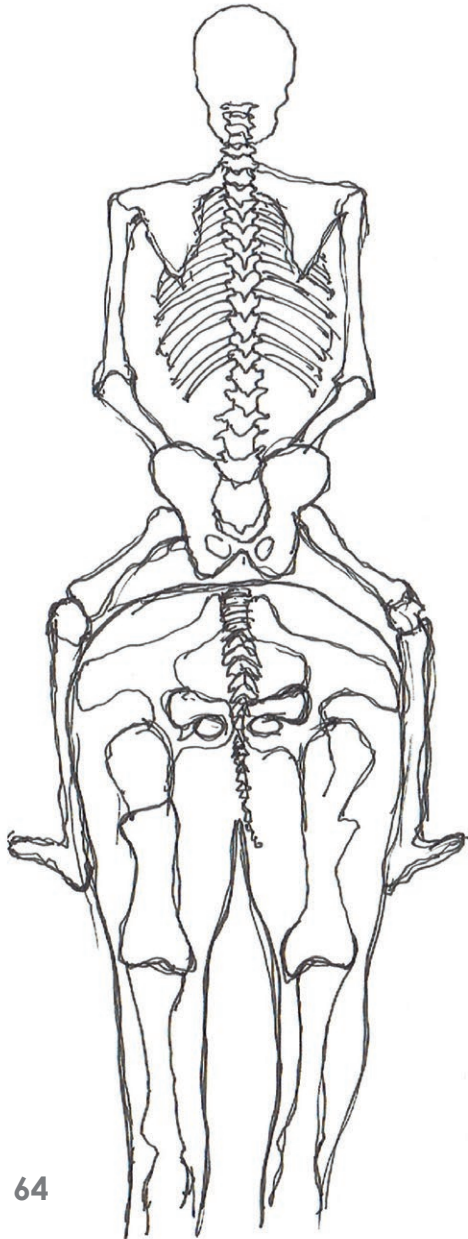
Figure 63 and 64 clearly reveals the interaction between the two spines and the surrounding muscles, stimulating the patient. The muscles used by the patient to react to the horse's movement are also indicated along the spinal cord, necessary for human ambulation.



63

WHAT IS NEEDED

The equipment needed for hippotherapy sessions include safety gear, horse tack and therapeutic equipment. The safety gear involves helmets, and in some cases back protector vests (Bower, 2009: 337). Horse tack includes bridles, reins, a lead rope used to guide the horse, and a numnah (a blanket normally worn beneath the saddle). Saddles are not used during therapy to allow maximum contact between the patient and the horse. Specialised saddles can be fabricated by local saddle makers to provide extra grip without compromising direct contact with the horse. Therapy equipment includes balls, rings, balancing devices and other toy-like equipment used by the therapist during therapy. Storage must be provided for these items.



64

Fig. 64
Sketch of muscles involved in hippotherapy
(Front Range Hippotherapy, 2010: online).

Fig. 65
Reins with easy grip
(Front Range Hippotherapy, 2010: online).

Fig. 66
Numnah with special saddle to allow
direct contact with horse's movement
(Front Range Hippotherapy, 2010: online).



65



66

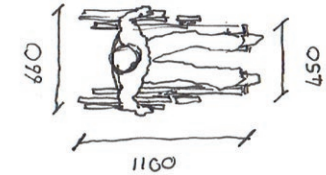
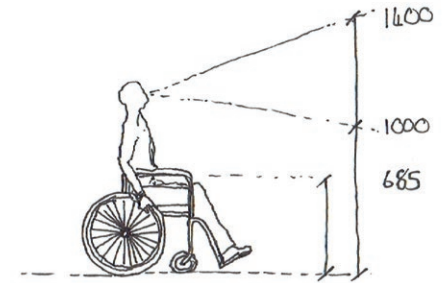


SPECIAL EQUIPMENT

Certain special equipment is needed for the safety of the patient. After consultation with a therapist, the patient will first need to practice mounting before it is safe to proceed to the therapy session sessions. Horse dummies for mounting practice can be made out of steel drums fixed 700mm from the ground with a steel or timber structure. Ramps should be provided for patients with wheelchairs to mount from. An additional platform opposite the ramp should be provided for therapists to secure the safety of the child. Ramps should be designed in accordance with SANS 10400-S, with a gradient of 1:12 not exceeding six meters between landings.

DIMENSIONS

The following dimensions will aid in the design process while determining the scale of arenas, stables and circulation routes. The visual periphery of children and adults using wheelchairs should be able to be kept in mind when designing railings, windows and other openings.



69

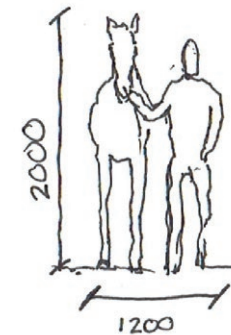


Fig. 67

Child practices balance before mounting a horse
(SARDA Cape Town, 2019: online).

Fig. 68

Mounting ramp
(Spirit Horse Kingsburg, 2015: online).

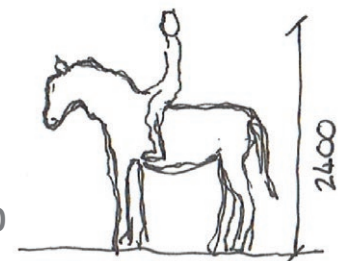
Fig. 69

Wheelchair dimensions and periphery
(Drawing: author).

Fig. 70

Wheelchair dimensions and periphery
(Drawing: author).

70



INTERACTION

Horse-patient interaction is vital to the effectiveness of therapy. Patients who are scared of horses will be gradually introduced to them in order to build a trust relationship with the horse before they are able to start with hippotherapy. Daily interaction between patient and horse is crucial to the development of the child and needs to be encouraged by mutual environments that are used simultaneously by both the horses and patients.



Fig. 71
Child interacting with horse
(SARDA Cape Town, 2019: online).

GROOMING

Grooming is very much a part of the therapy process as it becomes a bonding ritual between the patient and the horse. Rituals such as handling and grooming the horse have shown to provide social benefits for the patient and should be used interchangeably with therapy sessions (Kruger & Serpell, 2010: 36; Grandin, Fine, & Bowers, 2010: 261).



Fig. 72
Child grooming horse
(SARDA Cape Town, 2019: online).

HORSE CARE

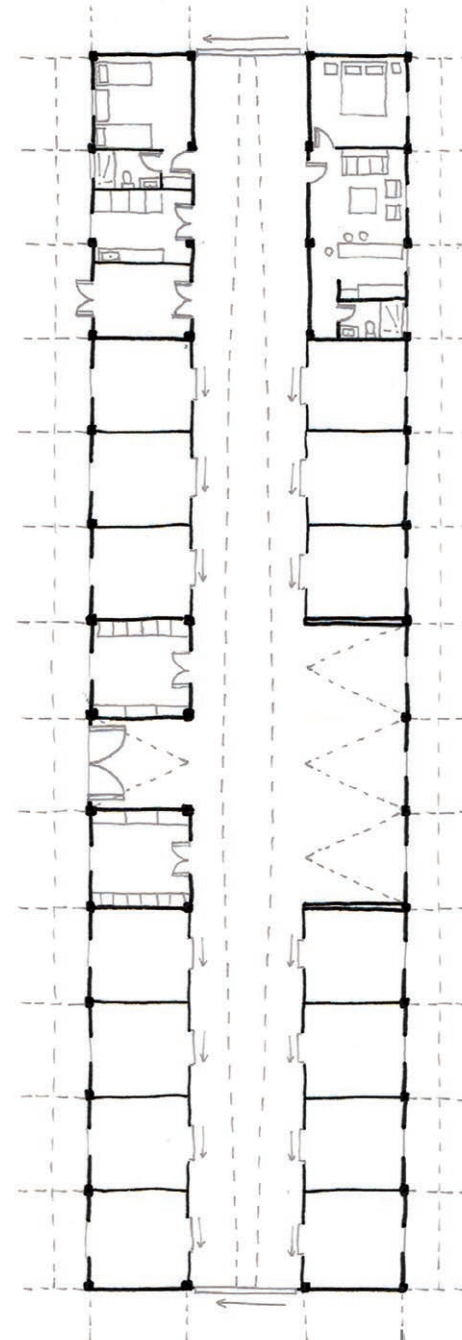
In addition to regular interaction and bonding rituals (such as grooming), patients should be encouraged to care for the horses they encounter. Feeding, washing and cleaning the horse's hooves provide the patient with a sense of ownership and responsibility.



Fig. 73
Child cleaning horse's hooves
(SARDA Cape Town, 2019: online).

MS SPORT HORSE STABLES

Architect: Matias Zegers
Location: La Dehesa, Santiago, Chile
Year: 2017
Clients: MSporthorses



PART 1.3
PRECEDENT STUDIES
 PROGRAMME

The plan consists of 14 stables, horse showers and saddle rooms, as well as food storage and an emergency care room for the horses. There are also two bedrooms, two bathrooms, a kitchen and living area, designed to encourage interaction between horses and humans (Zegers, 2017: online).

The early morning routine starts with feeding, followed by a grooming session before the morning exercises. Thereafter the horses go through a shower before continuing the day's work. While the horses are out, the stalls and all the horse-riding equipment is cleaned. In summer, horses are left to graze in the fields before the day ends. The late afternoon is spent on unsaddling, showering and feeding the horses once again (Zegers, 2017: online).

CHALLENGES

- Allowing sufficient year round daylight into the building while providing protection against cold weather during winter.
- The functionality of performing daily routines within the stables.
- Encouraging a close connection between humans and horses.

MORE THAN A STABLE

The architect has dealt with horses for most of his life as his family culture and traditions are very much engraved with horsemanship. When given the brief to design a barn in La Dehesa, Zegers wanted to create an environment that would most benefit the wellbeing of both horses and humans. The morphology was based on appropriate vernacular references but allowed for ample natural light into the building by creating a continuous skylight running along its structure. Natural light is essential to the performance of the morning human and equestrian routines. Natural light infall was achieved through the design of a curved ceiling which filters light into the barn (Zegers, 2017: online).

CONTRIBUTION TO PROJECT

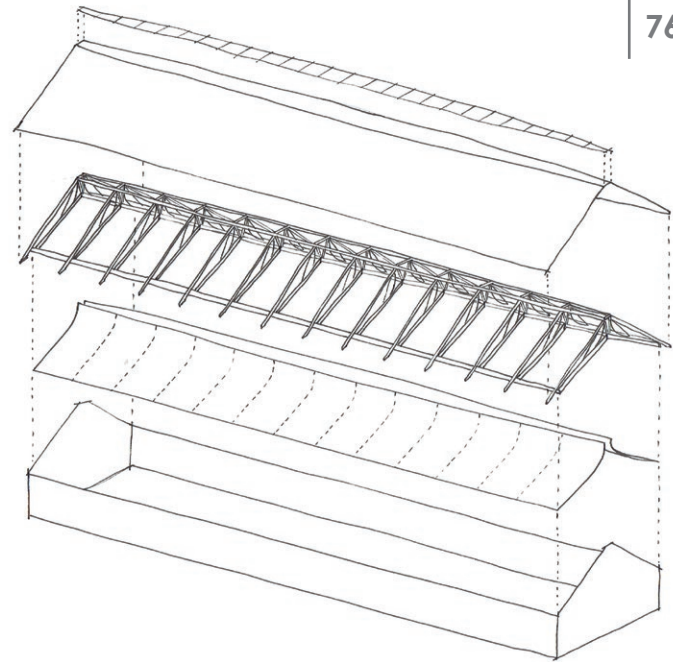
- Understanding the spatial layout required for the daily routines of equestrian care.
- Perceiving the poetic relationship between man and horse through the use of light and spatial design.

Fig. 74, 78 - 80

Photographs of MS Sport Horse Stables
(Zegers, 2017: online).

Fig. 75 - 77

Drawings of MS Sport Horse Stables
(Drawing: author).



THE BUTARO DISTRICT HOSPITAL AND DOCTORS' HOUSING

Architects: MASS Design Group
Location: Burera District, Northern Province, Rwanda
Year: 2011 - 2012
Size: 6,000 m²
Clients: Rwanda Ministry of Health
Partners In Health



PART 1.4
INTERNATIONAL CASE STUDY
 PROGRAMME

The Butaro District Hospital opened in January 2011 after the desperate need for a sustainable, cost effective, local hospital was identified by the architects. Their vision went beyond merely creating another large-scale medical facility, to include a wide social and economic impact on the surrounding community. The architects achieved this goal by investing as many resources as possible into the local community through the use of local materials, local labour and local workshops for design and construction training and development. Emphasis was placed on the building process in order to achieve the best result (Mass Design Group, 2011: online).

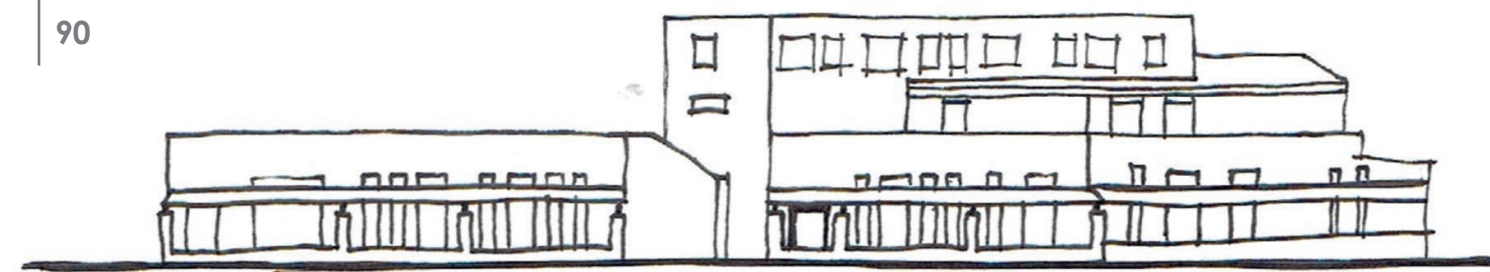
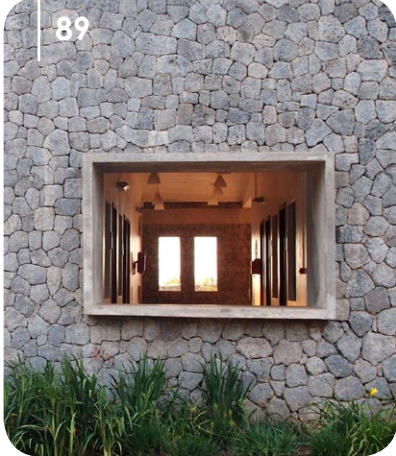
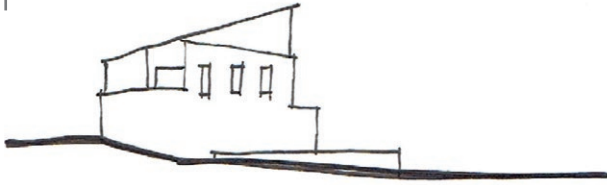


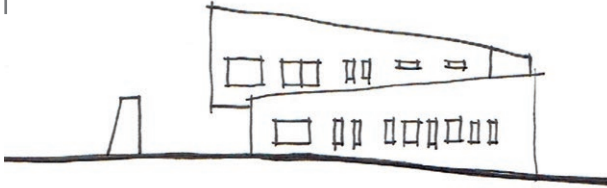
Fig. 87, 88, 89, 91
 Photographs of Butaro District Hospital and doctor's housing
 (Mass Design Group, 2011: online).

Fig. 90
 Eastern elevation drawing of Butaro District Hospital
 (Drawing: author).

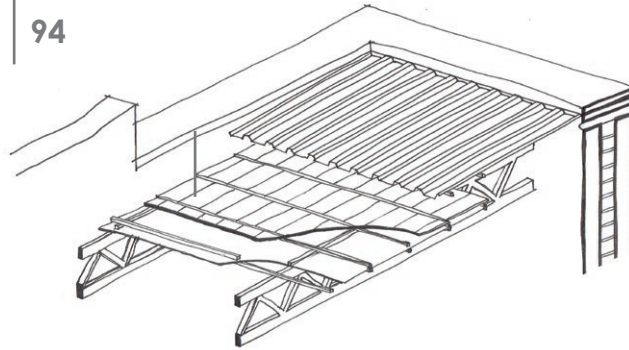
92



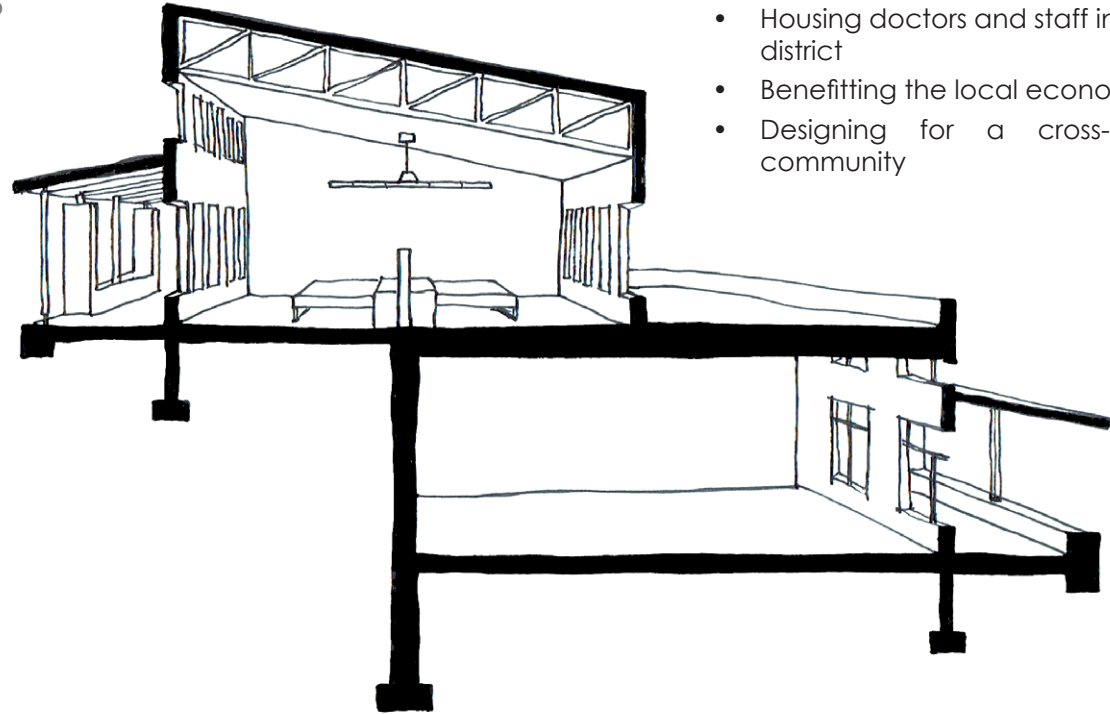
93



94



95



CHALLENGES

- Keeping the cost of the project to a minimum
- Utilising materials available on site due to the project's rural setting
- Providing excellent medical facilities in an area where resources are limited
- Avoiding the transmission of airborne diseases
- Housing doctors and staff in a rural district
- Benefitting the local economy
- Designing for a cross-cultural community

FACILITATING TREATMENT

Many innovative systems as well as elementary solutions were used to approach these challenges. The team, conscious of the high risk of contracting airborne diseases in existing Rwandan hospitals, re-imagined conventional hospital design by inverting the overall masterplan: Corridors were placed on the outside of the buildings instead of in between them, minimising the risk of air infection. This fundamental modification combined with louvered windows and cross-ventilation made for natural air exchange through interior spaces. The ward interiors were designed with high ceilings and fitted with large low-speed fans placed at strategic points (Mass Design Group, 2011: online). The overall layout of the masterplan allowed for a staff and patient flow which further limited disease transmission. Integrating natural vegetation into the building and the framing of garden views has shown an increase in patient development and reduced stress among patients and staff. The use of local materials, such as volcanic stone, created a site-appropriate design which is relevant to the community.

Fig. 92, 93

Eastern and northern elevation diagrams respectively (Drawing: author).

Fig. 94

Skylight roof construction detail (Rosenfield, 2011: online. Redrawn by author).

Fig. 95

Sectional perspective (Rosenfield, 2011: online. Redrawn by author).



Fig. 96, 97, 98

Photographs of community involvement during construction process (Mass Design Group, 2011: online).

EDUCATION THROUGH PROCESS

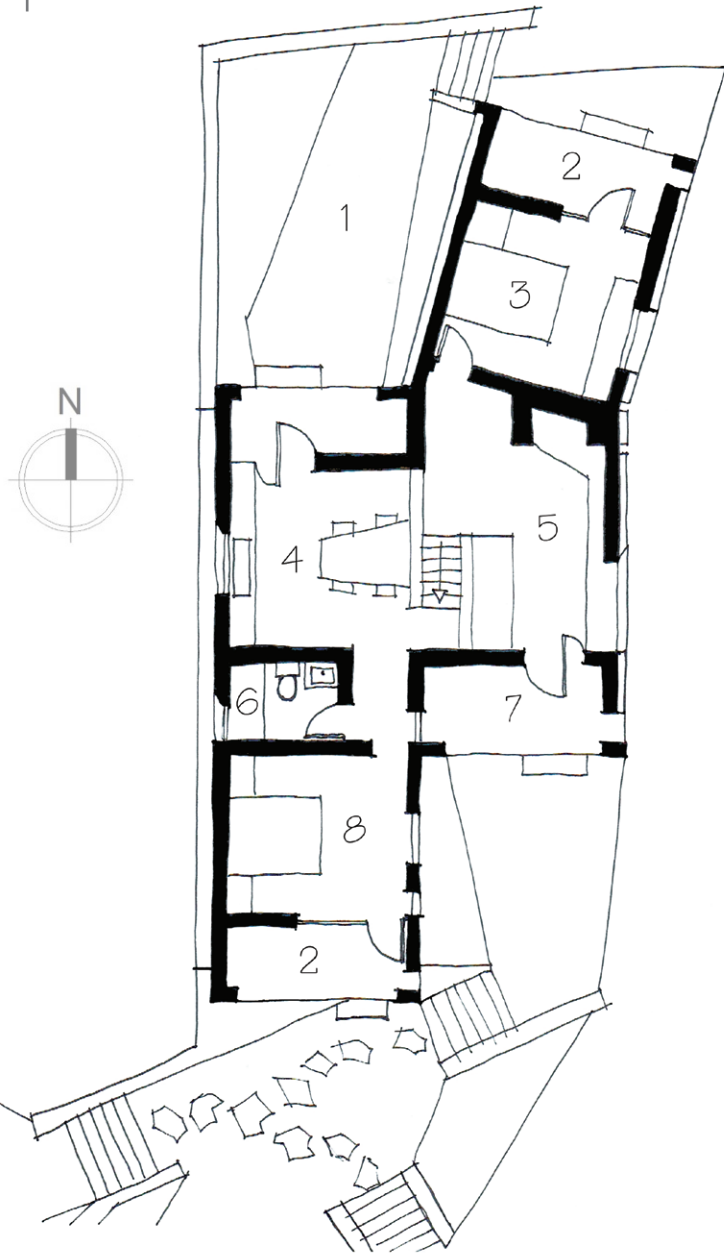
The project was constructed using local labourers only. The use of heavy equipment was kept to a minimum through the employment of extra builders. The construction group was divided into six teams, each working two-week shifts, allowing for the employment of even more labourers. By involving more people in the project, the architects expanded community involvement (and thus ownership) and also created more job opportunities. Design and construction workshops were held to educate and train local builders, whilst also learning traditional building methods and solutions from them. The budgeting was continually evaluated and revised during the design and construction process, resulting in the cost being thirty percent less than comparable projects in Rwanda (Mass Design Group, 2011: online).



Fig. 99

Hospital floor plan (Rosenfield, 2011: online. Adapted by author).

100



101

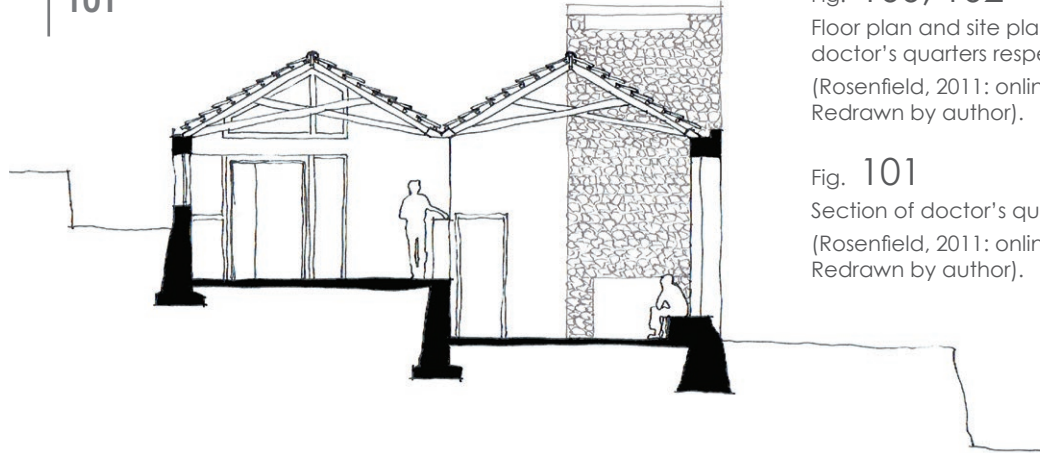


Fig. 100, 102
Floor plan and site plan of
doctor's quarters respectively
(Rosenfield, 2011: online.
Redrawn by author).

Fig. 101
Section of doctor's quarters
(Rosenfield, 2011: online.
Redrawn by author).

102



THE VALUE OF PEOPLE

The hospital would only be successful if it could attract and retain good doctors and staff to its rural location. By providing staff with a space for rest and recovery, the housing units play a key role in the level of care to the patients. The buildings were constructed using compressed stabilised earth blocks (CSEBs) which were fabricated with soil from the site. The CSEBs eliminated the transportation of other bricks, reduced the amount of cement needed and created job opportunities through block production. Custom-made furniture, interior fixtures, doors and windows were also designed and crafted by local artisans from leftover construction materials (Mass Design Group, 2011: online).



CONTRIBUTION TO PROJECT

- Using passive design strategies to successfully ventilate a building in a rural landscape.
- Making the best use of the master layout regarding patient and staff flow, the surrounding landscape and existing structures.
- Understanding and engaging with the local community and culture throughout the project, from design to construction.
- Utilising available resources and local materials in innovative ways.
- Landscaping the surrounding context and providing open views for patients, promoting healing.
- Connecting the staff housing with the medical facilities which they serve.

Fig. 103-105

Photographs of doctor's quarters
(Mass Design Group, 2011: online).

PART 1.5
ACCOMMODATION LIST
PROGRAMME

Since hippotherapy is generally only provided in first world countries, the proposed facility will look fairly different than existing hippotherapy centres. From the previous precedent studies, an overall measure can be drawn to determine the spatial requirements for horse care, medical consultation and the process of therapy itself. The following diagram gives an outline of the facility's requirements as well as the circulation between them.

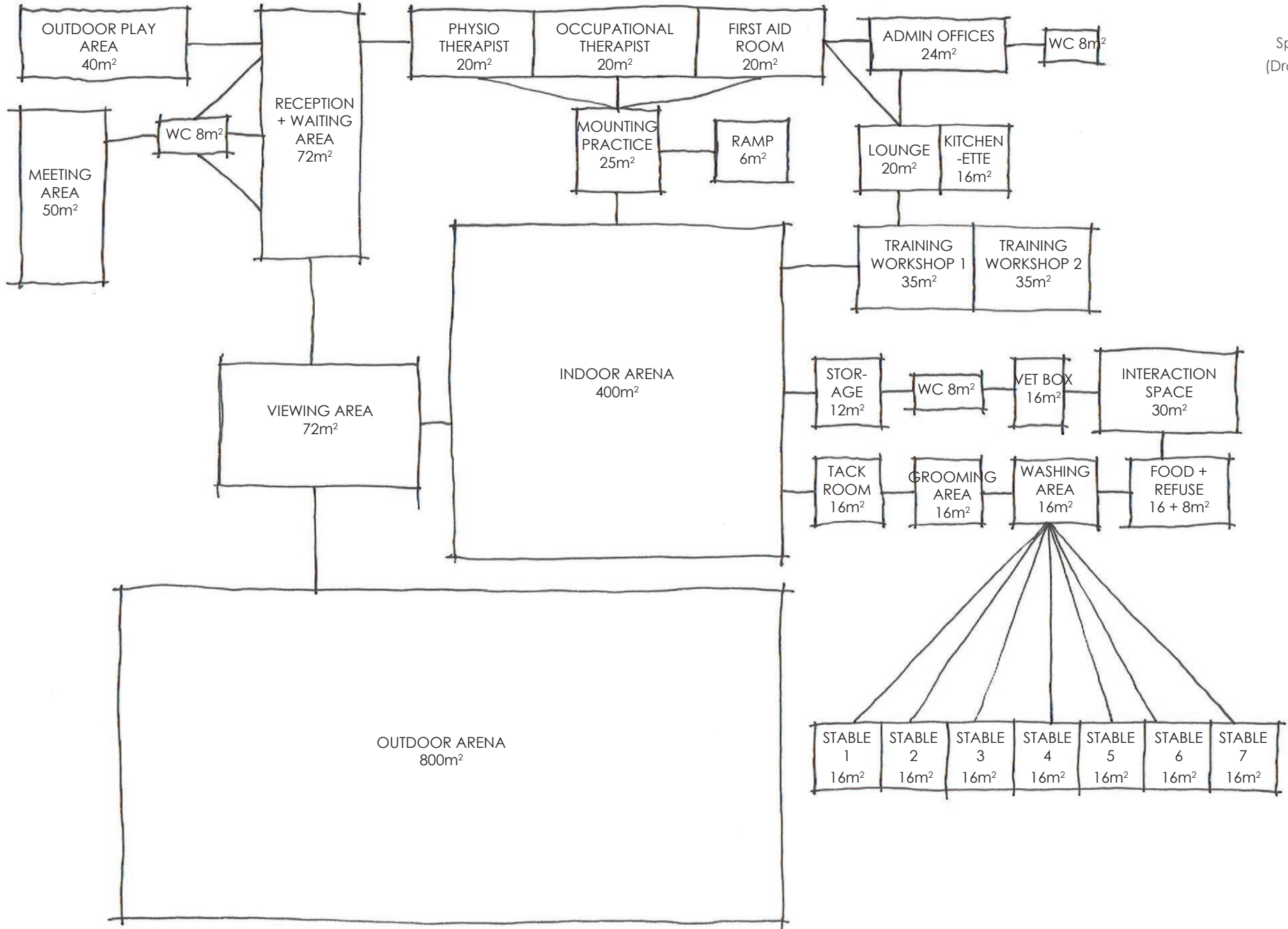
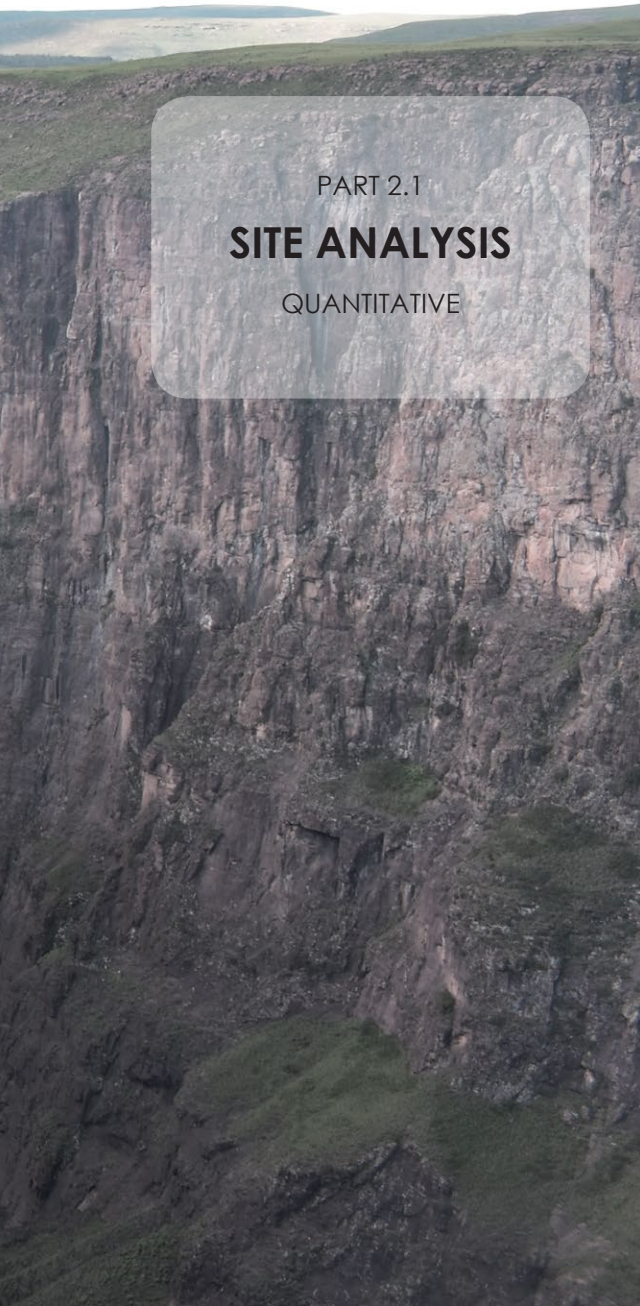


Fig. 106
Spatial diagram
(Drawing: author).





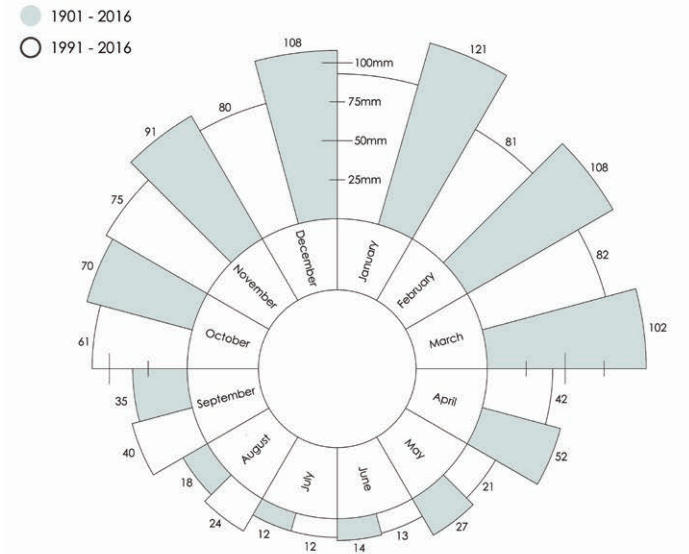
PART 2.1
SITE ANALYSIS
 QUANTITATIVE

Lesotho is one of the most water abundant areas in Southern Africa. The high rainfall during summer and snowfalls in winter provide the country enough water to even export to South Africa. Semonkong is no exception as the area has two of the country's biggest waterfalls; the Meluntenyane and Ketane Falls. During winter the temperatures can drop to -5 degrees Celcius and reach a maximum 24 degrees Celcius in summer. Buildings in Semonkong should provide enough protection form both rain and snow while providing sufficient ventilation during summer.

Fig. 107

Maletsunyane Waterfall
 (Photograph: author).

GRAPH OF ANNUAL AVERAGE RAINFALL IN SEMONKONG



GRAPH OF ANNUAL TEMPERATURE IN SEMONKONG

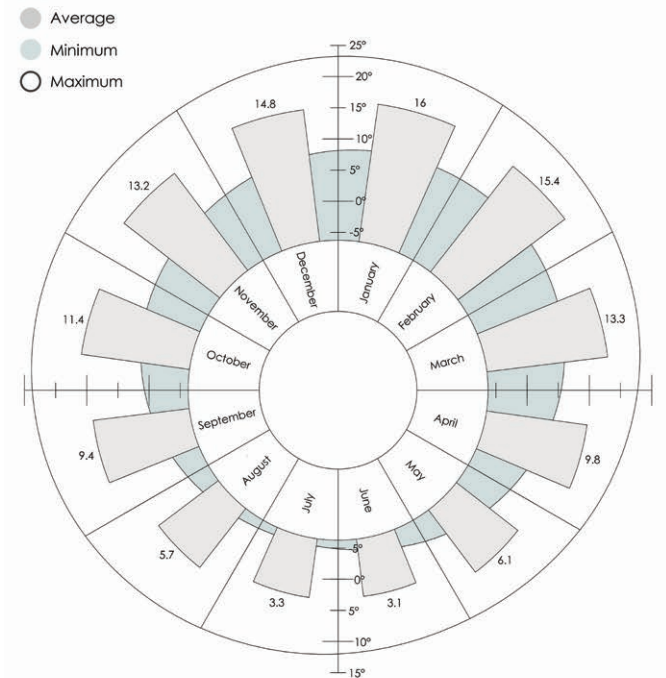


Fig. 108

Rainfall and temperature graphs
 (Diagram: author).

PART 2.1.1

MACRO CONTEXT

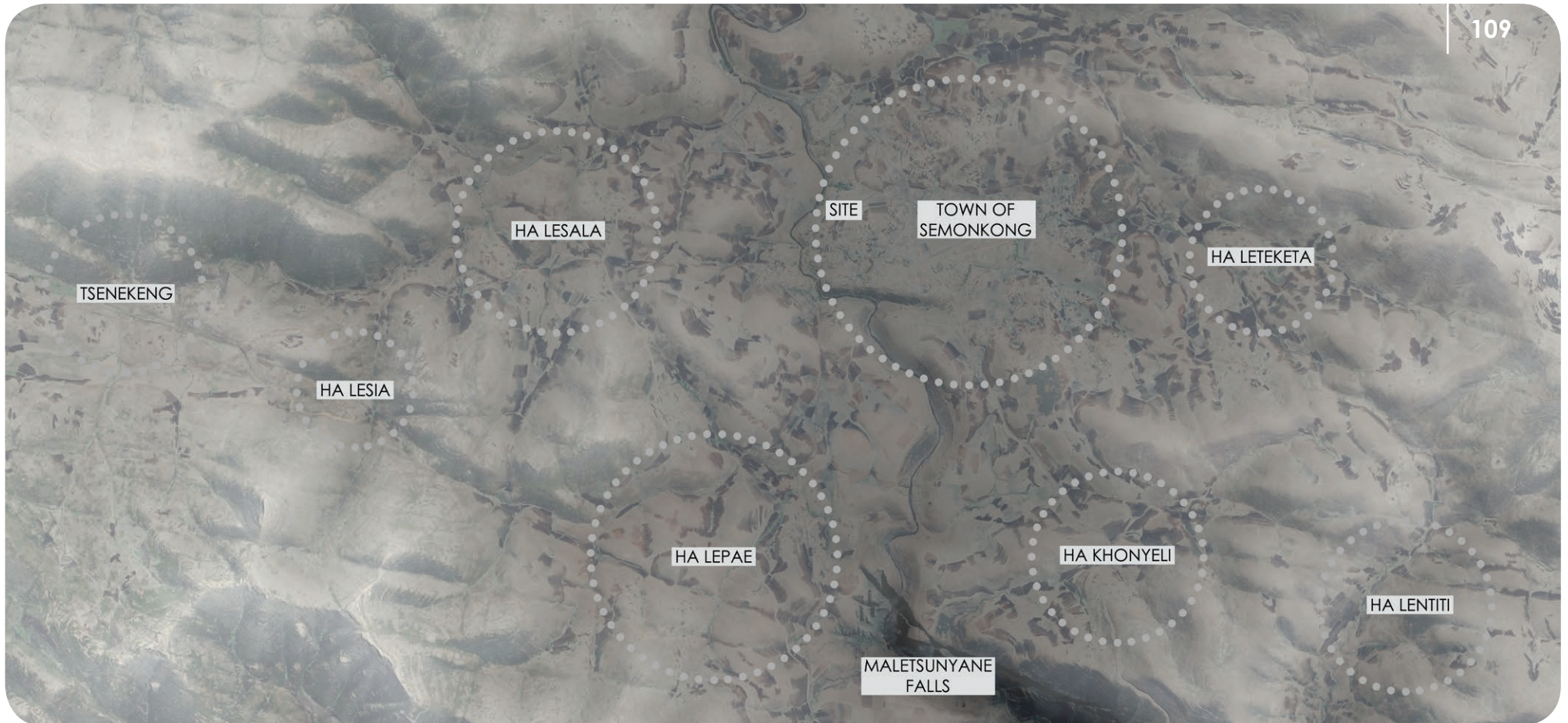
QUANTITATIVE ANALYSIS

Although the settlement of Semonkong was formally established next to the Maletsunyane River, the village has expanded significantly due to its accessibility and central location within Lesotho. The settlement now consists of multiple villages with over 100 000 people living across the area. The following aerial photograph identifies the major villages spread around the Semonkong settlement.

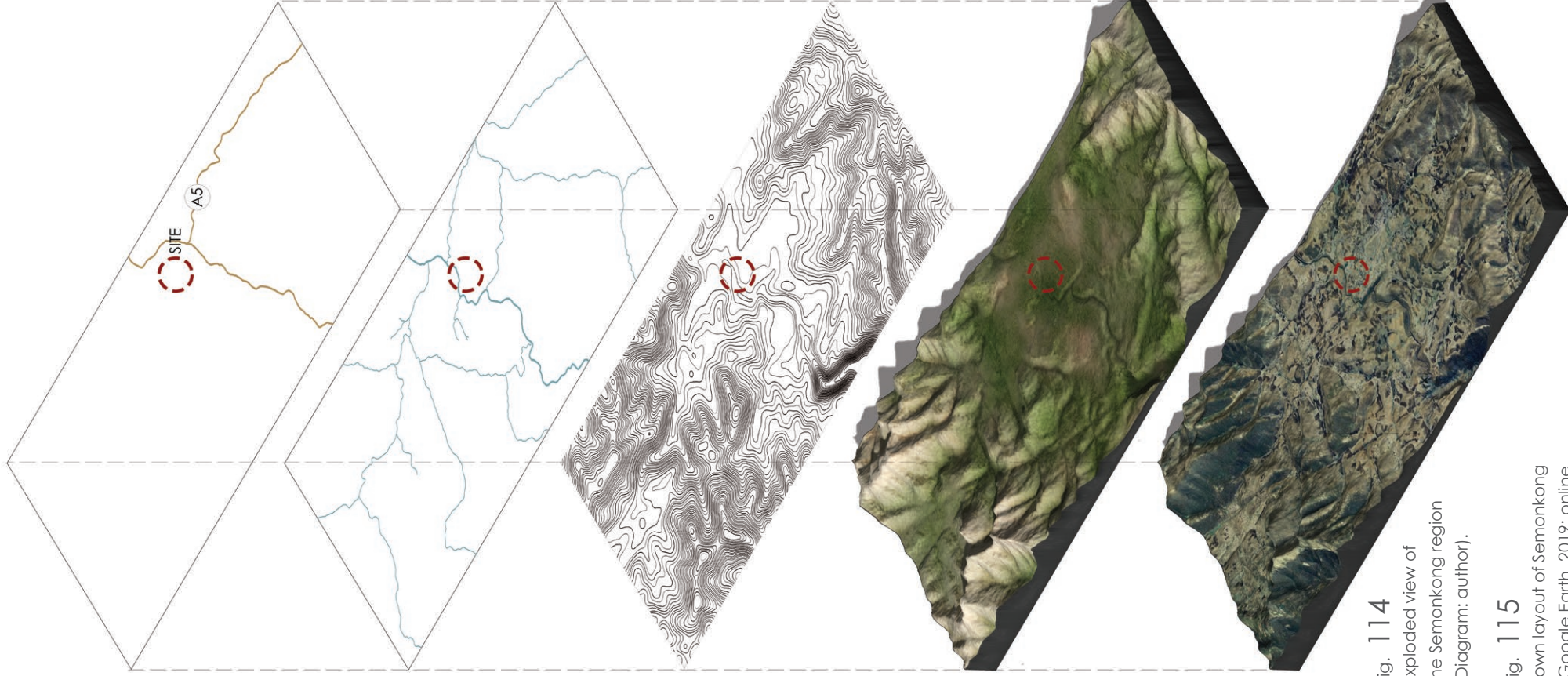
Similar to the mountainous landscape of Rwanda, Semonkong's topography is characterised by steep hills and slopy terrains. The built environment reflects great respect for the landscape and is mostly guided by its contours. The following aerial photographs show some of the surrounding villages indicated in figure 109. The relationship between the natural terrain and built environment is clearly visible.

Fig. 109
(Google Earth, 2019:
online. Adapted by
author).

Fig. 110-114
(Google Earth, 2019:
online. Adapted by
author).







ROADS

The proposed site is situated next to the A5 main route which provides the possibility of importing building material that could otherwise not be sourced.

WATER

One of the biggest challenges maintaining horses is the amount of water needed for proper horse care. The site is situated next to the Maletsuyane River which will provide sufficient water for the horses.

CONTOURS

Semonkong is situated in a deep valley within the Lesotho highlands. The town originated from the Maletsuyane River is spread alongside its riverbanks to provide the people with water.

ELEVATION

The area has an average elevation of 2300m above sea level. The cooler temperatures and significant thunderstorms keep the area wet throughout the year.

Fig. 114

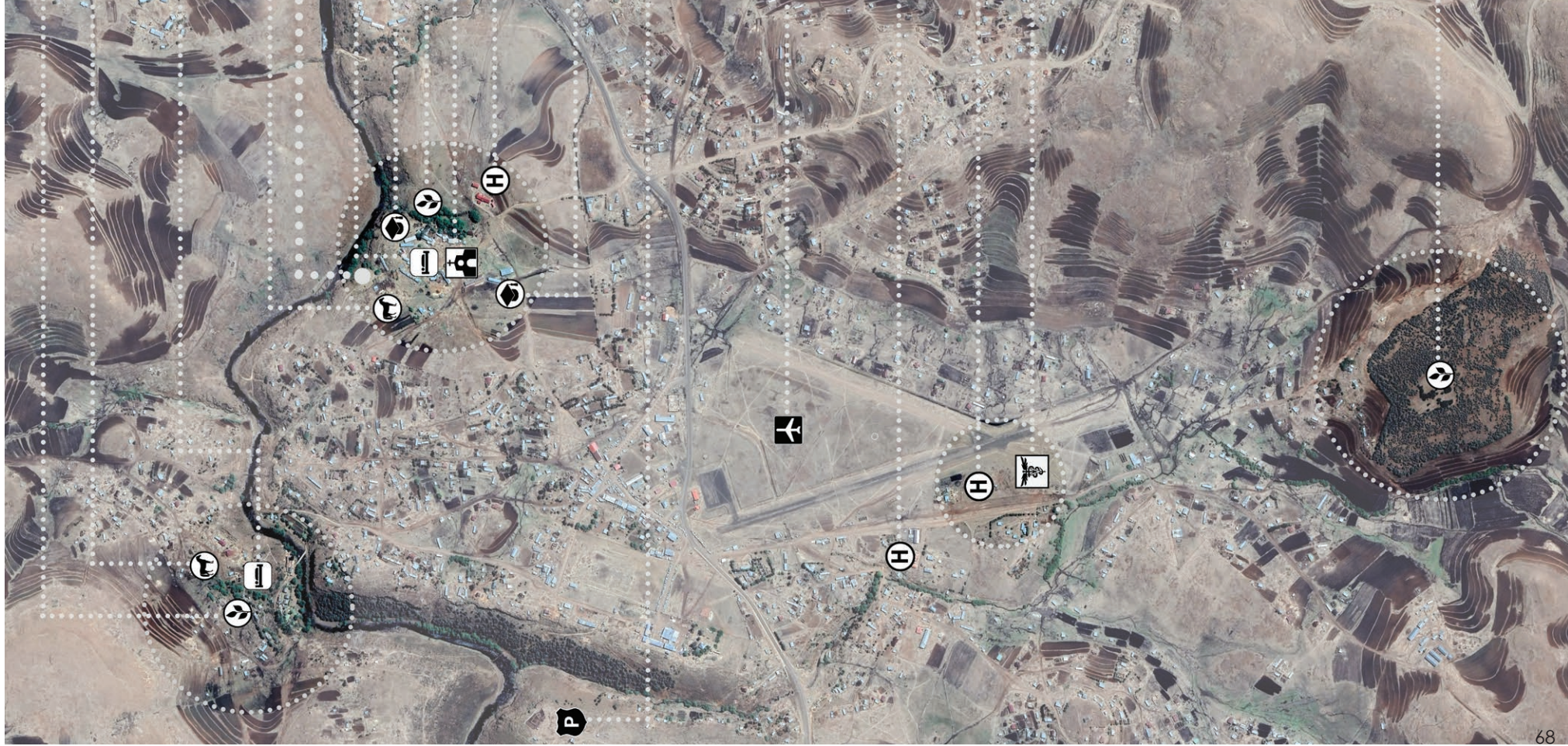
Exploded view of the Semonkong region (Diagram: author).

Fig. 115

Town layout of Semonkong (Google Earth, 2019: online).

TERRAIN

Semonkong is known as the horse capital of Lesotho due to the slopy terrains and steep hills around the area.



The Semonkong Lodge

Various alpine flora is preserved in the area
 The lodge uses Basotho ponies that belong to the surrounding local community for tourists to do pony trekking
 Guest Accomodation

The St Leonards Community Centre

Horses and cattle kept in stone pens

PROPOSED SITE

- Guesthouse for sojourners
- Sentebale Shepherd School
- Nature Reserve
- St Leonards Church
- St Leonards Clinic
- St Leonards Primary School

Local Police Station

Semonkong Airport

Semonkong Clinic

The Semonkong Hospital Trust Project

- Future Semonkong Hospital
- Veterinary Centre (under construction)

Semonkong Forest Plantation

Pine trees were planted to supply timber for building construction and fire wood



PART 2.1.2
MESO CONTEXT
QUANTITATIVE ANALYSIS

The proposed site is located on the property of the St Leonard's community centre which was named after Chief Leonard Lehoko after missionaries came to Semonkong to open a primary school in 1924. The school was very successful in the community and the site soon expanded to open a clinic in 1934.

The St Leonard's community centre has greatly contributed to the surrounding villages of Semonkong as the site now runs the biggest church in region, two clinics, a shepherd school sponsored by Sentebale, a community hall for functions and weddings as well as a guest house for sojourners passing by Semonkong.

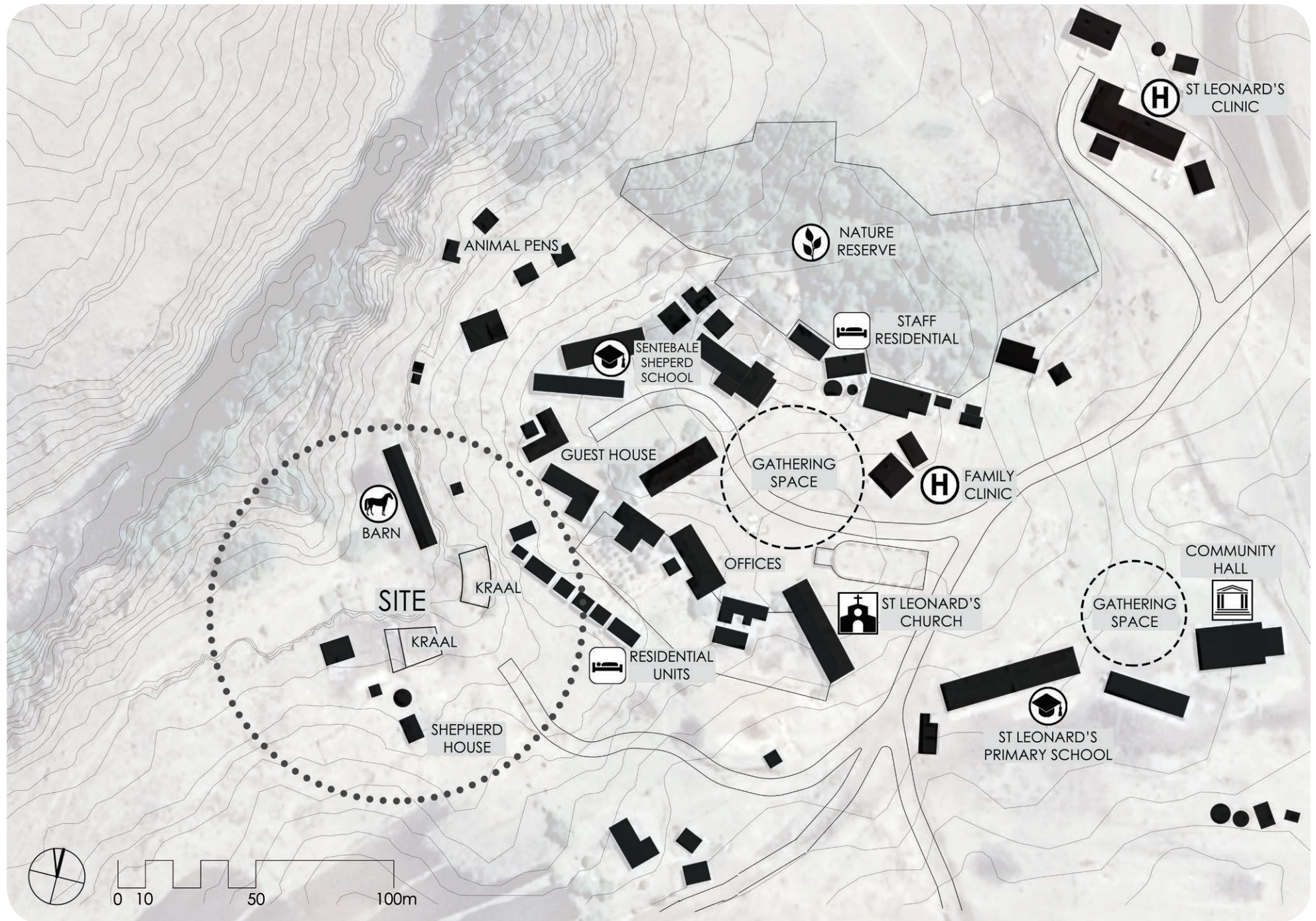
Fig. 116
Proposed site overview
(Photograph: author).



Fig. 117
St Leonard's Primary School
Building built in 1924
(Photograph: author).

Fig. 118
Shepherd school sponsored by
Sentebale close to proposed site
(Photograph: author).

Fig. 119
Site Plan
(Google Earth, 2019: online.
Adapted by author).





PART 2.1.3
MICRO CONTEXT
QUANTITATIVE ANALYSIS

The proposed site includes some of the existing residential units and a barn built for the horses and cattle of the residents. The site also holds two enclosures for animals (kraals) as well as the shepherd's house. The site is also easily accessible from the rest of the community centre.

Fig. 120
Proposed site
(Google Earth, 2019: online).

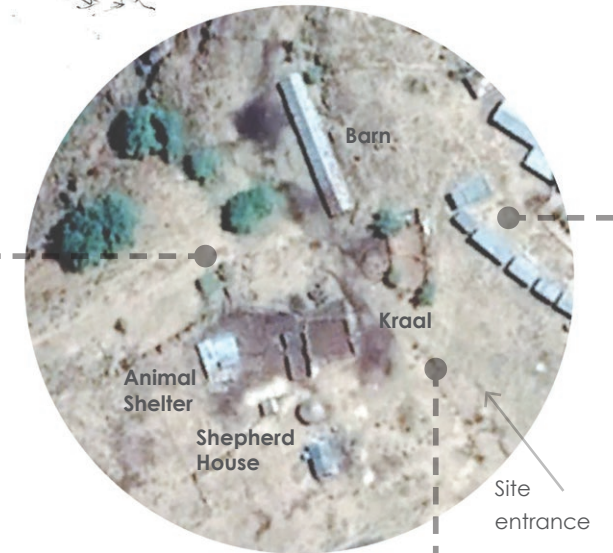


Fig. 121-128 Proposed site (Photograph: author).



Fig. 122 Existing residential units on site (Photograph: author).



Fig. 123 Entrance to site, showing the kraal and barn in the background (Photograph: author).

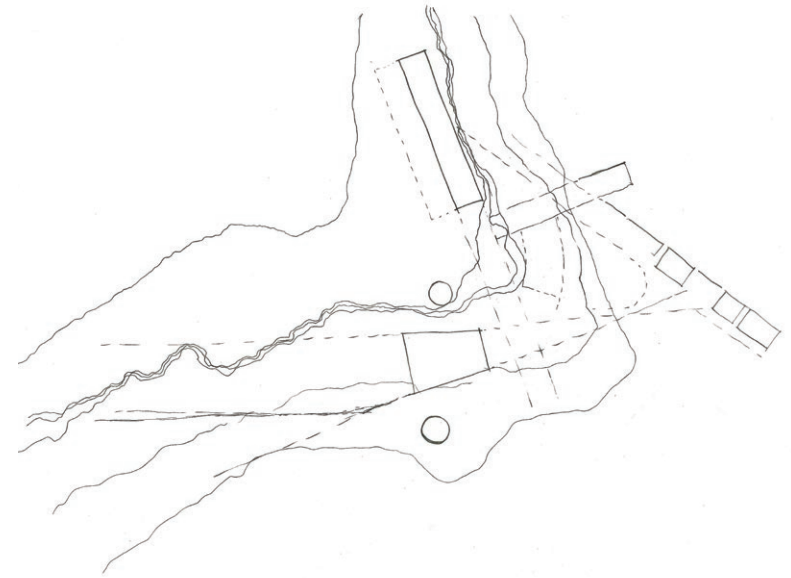


Fig. 124, 125
Initial site sketches
with surrounding
context and axes
(Drawing: author).



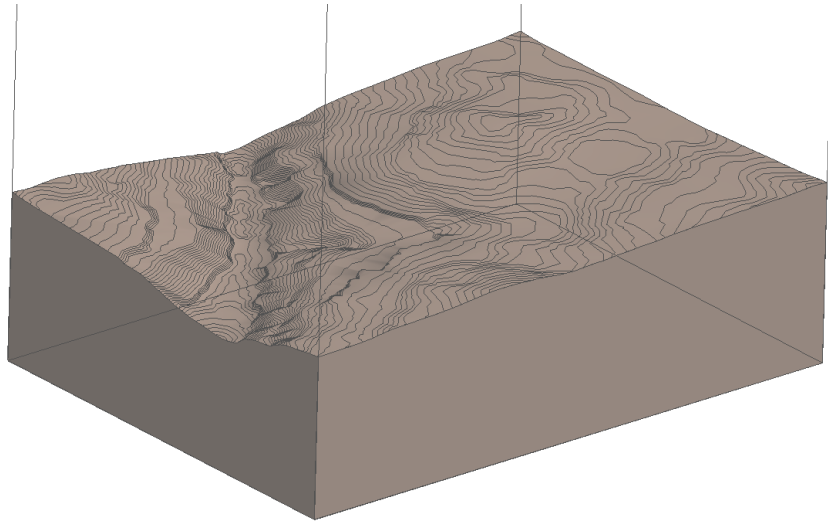


Fig. 126 3D Model of site terrain (Diagram: author).

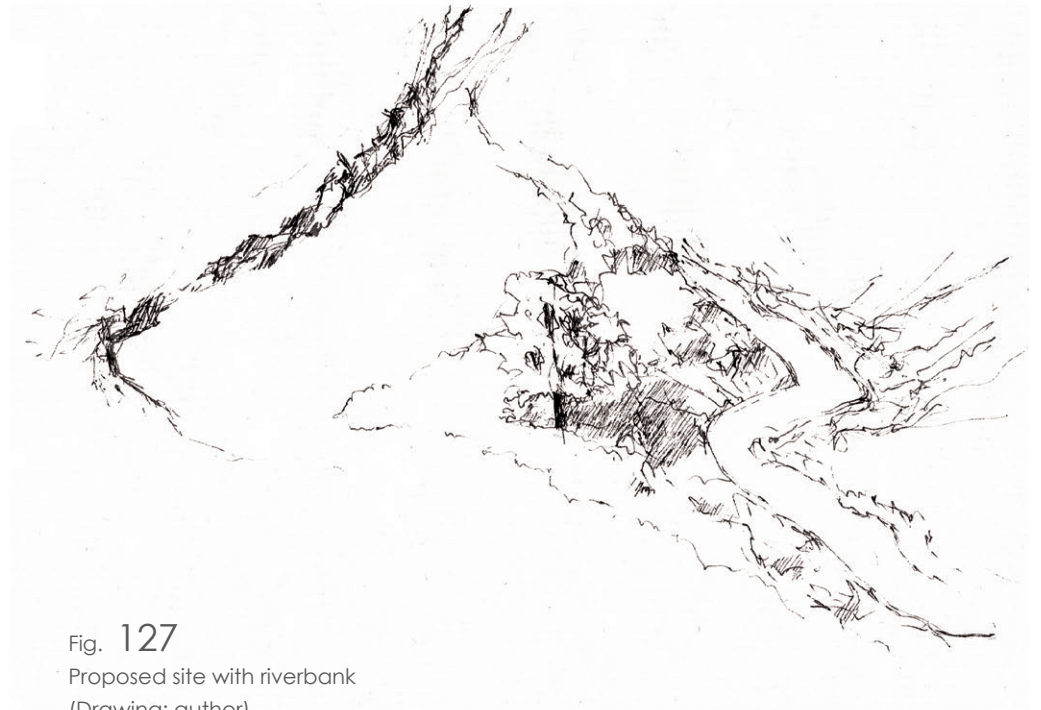


Fig. 127
Proposed site with riverbank
(Drawing: author).



The barn is currently in a deteriorating state and is not used during the day. Many of the other structures are also in need of structural reinforcement and maintenance. Soil tests were done at Simlab in Bloemfontein and will be discussed in the technical investigation of this document. Soils have shown to be structurally suitable for building with adobe bricks or for wattle and daub earth construction methods.

Fig. 128
Author collecting soil
samples for analysis on site
(Photograph: author).

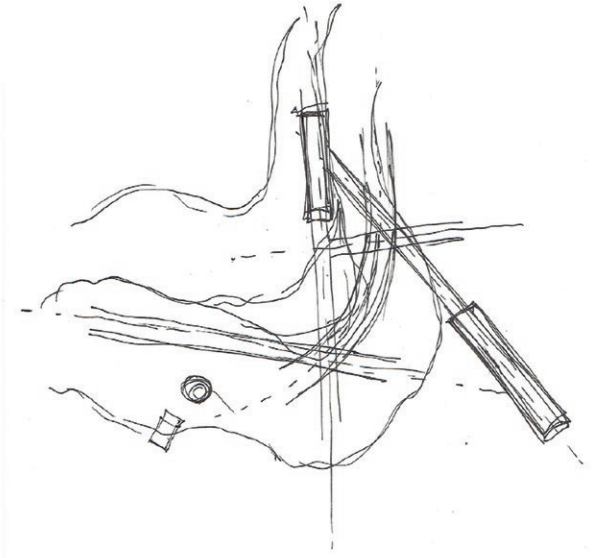


Fig. 129
Existing barn interior on proposed site
(Photograph: author).

Fig. 130
Northern facade of barn
(Photograph: author).

Fig. 131
Site parti
(Drawing: author).

Fig. 132
Barn exterior wall on proposed site
(Photograph: author).





PART 2.2
QUALITATIVE
 SITE ANALYSIS

The site holds many therapeutic qualities with the sound of the Maletsunyane River and panoramic views looking across the Lesotho mountains and valleys. The rock formations found along the riverbank create a unique texture to the site and are reflected in the stone structures and surrounding buildings. The St Leonards community complex provides the site with enough public exposure to allow for community participation while its tranquillity can aid in the therapeutic process.

Fig. 133

Texturemap of site surroundings

(Photograph: author).

Fig. 134

The sound of the river can be heard from the site

(Drawing: author).

Fig. 135

Rock formations of site

(Drawing: author).

Fig. 136

Site overview

(Drawing: author).

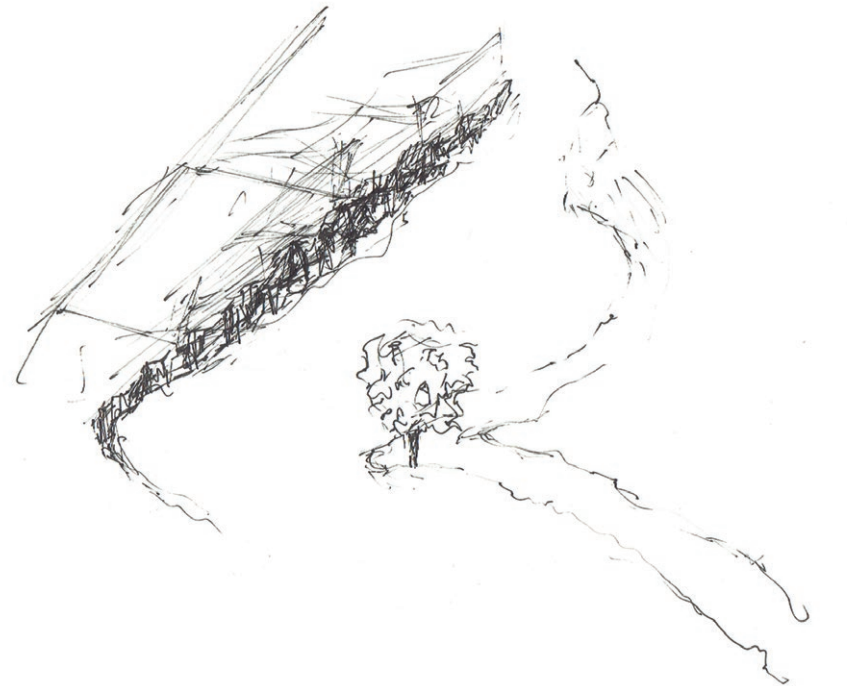
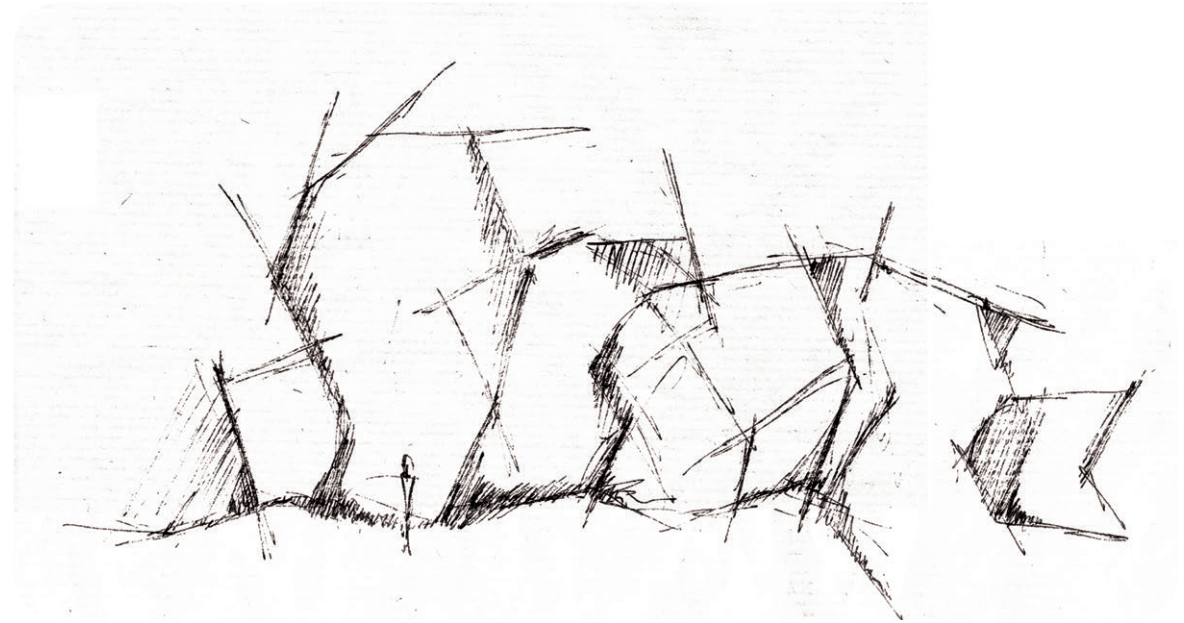




Fig. 137
Photograph of
galloping horse in
Semonkong
(Steinigeweg &

PART THREE

DISCOURSE**INTRODUCTION**

The aim of the Hippotherapy centre is to both provide physical therapy and to help to re-integrate people living with disabilities into everyday society. This theoretical investigation aims to find tools to do this through the exploration of ideas and the subsequent translation of these ideas into specific design methodologies. Three conceptual notions are investigated: The existing culture-nature dualism and the space of dynamic tension which exists between the two, the metaphorical deconstruction of biomechanical movement, and the gathering of ritual as a place-making tool.

The investigation begins with an explanation of the culture-nature dualism and a look at everyday life in Semonkong with its existing relations. It then shows the value of the horse as a medium between culture and nature and how the horse's movement can be investigated as a metaphor for revealing morphological design. Finally, the investigation looks at the role of gathering and place making and draws parallels between movement mechanics and the ritual of reintroduction into society undergone by persons living with disabilities. The potential for the translation of these notions into design methodologies is then explored.

WHAT IS LACKING?

WHAT IS EXISTING?

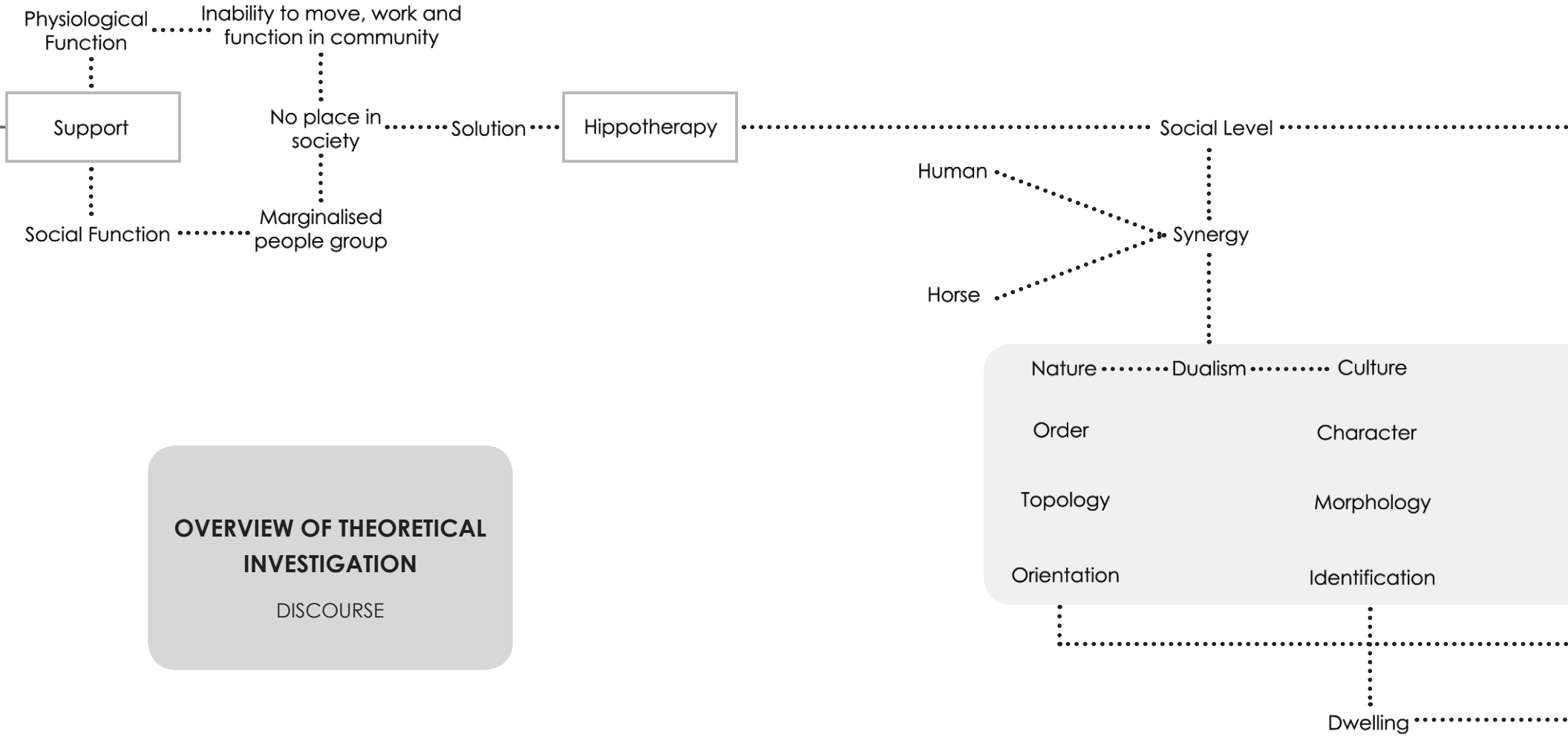
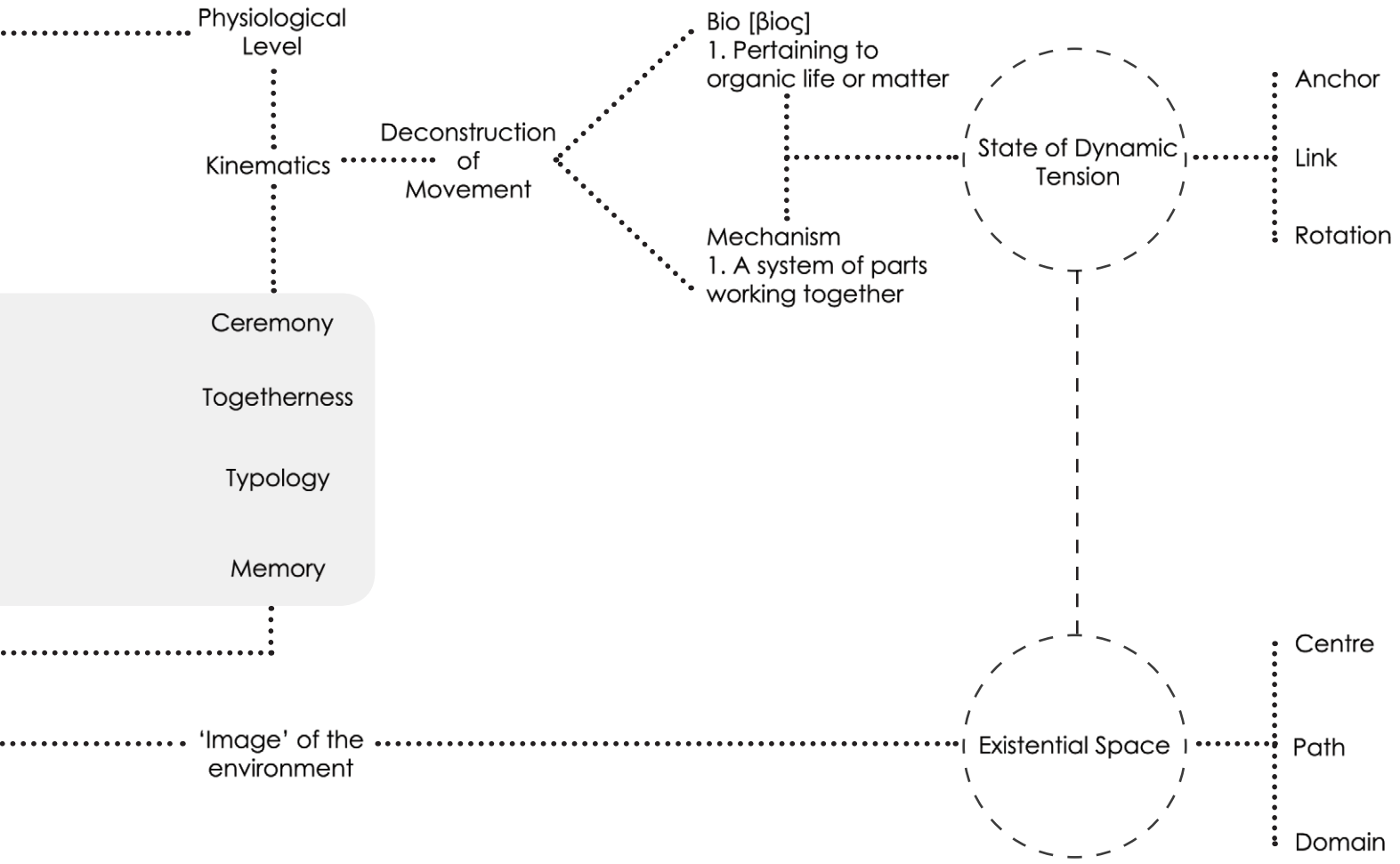


Fig. 138
A thatch mohlongoa
fatsi home with a reed
screen
(Diagram: author).

WHAT IS REVEALED?

WHAT IS GATHERED?



Time

Occasion

Physiological Function

Belonging

Ubuntu

Social Function

Place

Space

Reaggregation

“A striking landscape is the skeleton upon which many primitive races erect their socially important myths”
(Lynch, 1960: 4).



Fig. 139

Photograph of Lesotho landscape
(Woodman, 2014: online)

PART 3.1
WHAT IS EXISTING?
DISCOURSE

UNDERSTANDING THE EXISTING RELATIONS

3.1.1 CULTURE-NATURE DUALISM

Since our earliest attempts at construction, we have been confronted with the relationship between culture and nature. From the Ancient Greek philosophers to modern critics, we have debated this intricate relationship and especially how that influences our built environment (Owen, 2008: 40). Since the first man-made shelters there has been an increasing separation between culture and nature. Today, living in fully industrialised cities we are as far removed from nature and its effects as we have ever been. This gradual disregard for nature is seen as “a progressive unfolding from Platonic soul-body dualism” and reflects how man, and inevitably architecture, has grown in dominion over nature (Owen, 2008: 40). This has created the impression, especially amongst urban populations, that we are somehow separate to, or independent from nature.

This understanding of a culture-nature dualism poses problems to both ecocentric and anthropocentric theory; one will always dominate the other (Eisenman, 1996: 569). Either we neglect human functionality by placing the environment above human concerns (ecocentric) or we refuse to acknowledge the increasing environmental crisis caused by human development (anthropocentric). There is however a space in between; a “state of dynamic tension that can challenge traditional representations of human-environment relations as alternatively undifferentiated or ontologically distinct” (Owen, 2008: 40-41). We recognise from culture-nature dualism the two distinct polarities of culture and nature, but as Owen explains, there is much to be explored in the space in-between.

3.1.2 THE SUBSTANCE OF OUR LIVED EXPERIENCE

When considering the culture-nature dualism, 'culture' is viewed as the substance of human behaviour while 'nature' refers to the external environment excluded from human activity, translated as 'wilderness' (Haila, 2000: 155). This leads to the understanding of two entirely different realms characterised by subject-object relations. However, it is in the spaces between culture and nature that our lived experience is formed. "Culture consists of the derivatives of experience, more or less organized, learned or created by the individuals of a population, including those images or encodements and their interpretations (meanings) transmitted from past generations, from contemporaries, or formed by individuals themselves" (Avruch, 1998: 17). Our culture is therefore dependent on our experiences in the world as well as the experiences of past generations. Culture gradually progresses as we move through the world while constantly interpreting our lived environment. Berleant concludes the following:

"The environment is not an external distant object or phenomena, and the arts are more than objects in occasions for delectation, since they form the very substance for human life experiences." (Berleant, 2016: online)

Haila describes the interrelationship between the two and argues that "because the nature-culture dualism is continuously produced and reproduced by cultural processes, it cannot be discarded on its own terms" (Haila, 2000: 157). The merging of processes which occurs between culture and nature form our lived experience and therefore cannot be separated even when viewed as ontologically distinct. The continual interrelationship between culture and the natural environment ultimately adds meaning to place through the orientation and identification of man within our environment (Norberg-Schulz, 1979a: 44).

This is true in the rural communities of Lesotho where the people live in constant interaction with nature, being both physically and spiritually dependent on the natural environment. Physically living off the land's fresh produce and livestock, and spiritually being connected to the ancestors buried in the earth (Kammeyer, 2011: 238). As previously shown, most of these villagers' daily activities include some physical interaction with the natural environment. Although many farmers living in Semonkong live a subsistence lifestyle, often on the brink of outright poverty, they choose to remain in a rural area to retain their identity as a Basotho farmer (McCartney, 2008: online).



Fig. 140
Thatched rondavels in
Lesotho landscape
(Photograph: author).



Fig. 141
Thatched rondavel
(Tracy, 2009: online).

3.1.3 A STATE OF DYNAMIC TENSION

The culture-nature dualism, in the context of Semonkong, can consequently be understood as a “state of dynamic tension”, forming the basis of a lived experience. Rather than culture and nature being two opposite polarities, they have interdependent relationship adding meaning to place. The built environment of Semonkong reflects this state of dynamic tension as one is constantly influenced by both the surrounding culture and the natural environment. Architecture designed here should, therefore, communicate both the cultural and the natural environment in which it is situated in order for it to successfully convey the meaning of place.

The Basotho's built environment is closely connected to natural and cultural lived experiences. Freund suggests that the study of architecture is a valuable tool for understanding culture (Freund, 2007: 5-6). An investigation into vernacular building techniques and traditions should reflect the interdependence between nature and culture described above. It should show a state of dynamic tension between the two.

The relationship is especially clear in the traditional process of building homes out of the earth in Semonkong (Kammeyer, 2011: 239). By shaping the soil into a wall, the character of the builder is translated into the construction, breaching the gap between culture and nature.

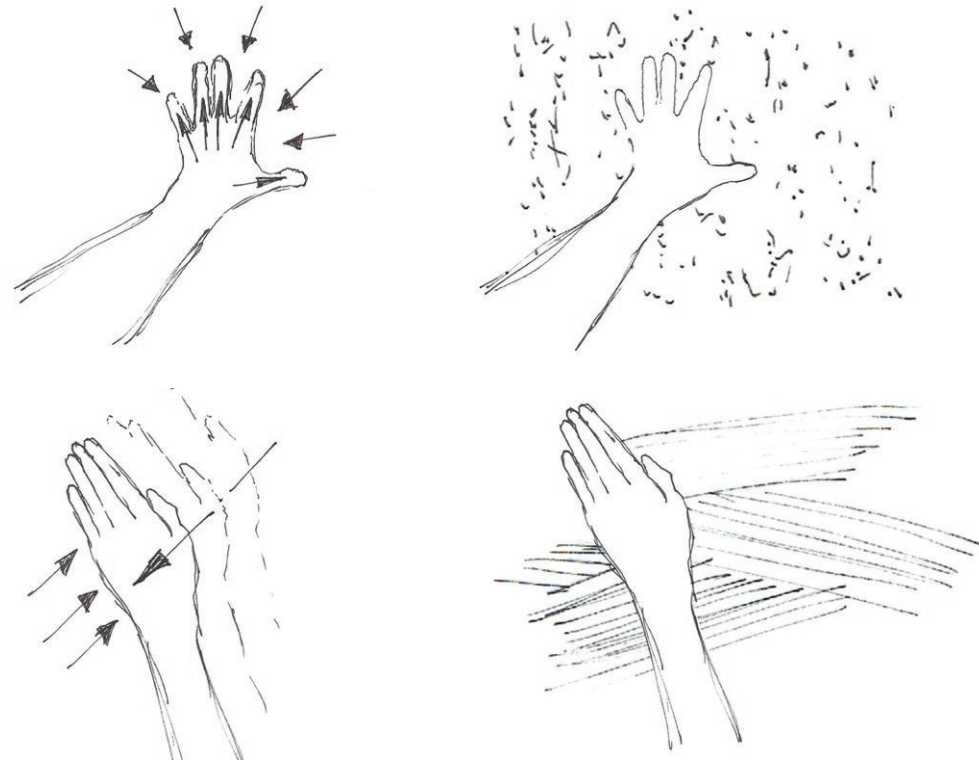


Fig. 142

Drawings communicating the state of dynamic tension during the construction process (Drawing: author).

After the daub solution is placed in between the wattle screens as described in chapter one, a mixture of earth, manure and water is used to plaster the exterior walls. How the earth is applied is unique to every hut as the builder's technique directly influences its texture (Kammeyer, 2011: 244). The plastering exposes how the earth was shaped either by hand or using natural artefacts to create the desired 'feel'. The dynamic rhythm of man is imprinted onto the wall as the hand becomes an "extension of the body" to shape the earth into form (Kammeyer, 2011: 230-233). This rhythmic sweeping movement can be seen as a pattern of engagement between culture and nature thus revealing the state of dynamic tension between the two.

Litema is the final finish to the walls and is best described as a unique "language of the earth" (Van Wyk, 1998: 78), used by the Basotho to translate meanings and messages onto their built environment (Kammeyer, 2011: 227). The word is derived from "ho lema" which means 'to cultivate' in Sesotho. The process involves engraving the exterior or interior walls with grass or sharp objects to create unique patterns with symbolic cultural meanings. Mural paint and mosaic tiles are also sometimes used with the engravings (Kammeyer, 2011: 234). Litema was initially used in the interior of dwellings and only started appearing on exterior walls during the 19th century. Today litema is usually practiced on special occasions such as celebrations, weddings, births and other rites of passage (Lange & Beyer, 2003: online). The carving of the surface can be compared to the cultivation of land by ploughing the soil in preparation for sowing (Kammeyer, 2011: 244). Similar to shaping the earth into built form, this process reveals the state of dynamic tension between culture and nature. The imperfections of the handmade litema give the buildings a haptic quality which speaks of the builder's lived experience (Pallasmaa, 2005: 194).



Fig. 143

Litema on exterior wall of rondavel
(Walton, 1948: 140)



Fig. 144

Process of Litema
(Kammeyer, 2011: 155)

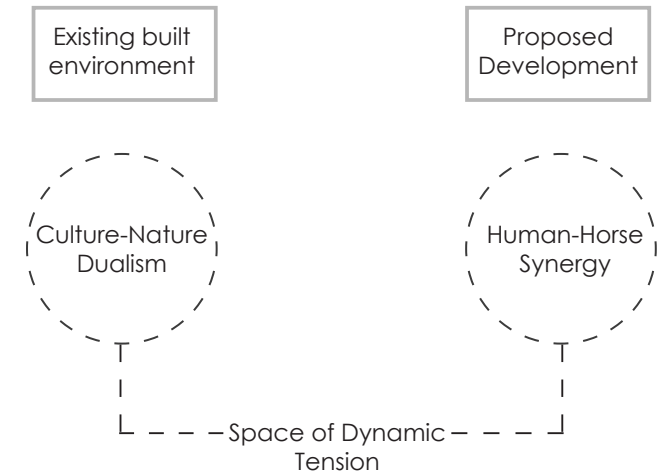
Fig. 145

River and valley in
Semonkong, Lesotho
(Steinigeweg &
Stolarow, 2017: online).



CONCLUSION OF THE EXISTING RELATIONS

The culture-nature dualism plays an important role in the built environment of the Basotho culture. Culture and nature, although being ontologically distinct, cannot be separated as they form the very substance of the lived experience, especially in Semonkong, where everyday life is so deeply rooted in culture and nature. The layering of lived experience, when translated into the built environment acts as a form of gathering to successfully add meaning to place through the orientation and identification of those who live there. Traditional houses are therefore both of nature and of culture, a symbiosis between the two, representing the space of dynamic tension between the two. The house's role as a medium between nature and culture promotes a way of dwelling which is deeply engrained in the local context. The proposed development aims to do the same within the human-horse synergy that exists in Semonkong. It uses the horse's movement to reveal a similar space of dynamic tension.



REVEALING COMPLEXITIES WITHIN THE EXISTING

The role of the Basotho Pony can be seen as a medium between culture and nature. The horse makes the mountainous terrain (nature) accessible for the Basotho people but is also deeply engrained in Basotho lore and traditions (culture). It is a physical representation of the meeting between nature and culture. It links man to the greater world around him, whilst giving him the tools to navigate that world. In a similar sense, the aim of hippotherapy is to reintroduce people living with disabilities into the everyday life of society. Again, the horse forms the link between the individual and the greater communal realm. The horse exists in the space of dynamic tension between those with disabilities and those without. The kinematics (movement/motion) of a horse is central to the functioning of hippotherapy and is also closely connected to Semonkong's lived experience, both as a method of transportation and for agricultural purposes such as ploughing. Because of the importance of the horse in this context, perhaps it is possible, through an understanding of the horse and it's movement, to extrapolate design principles from the horse itself for the hippotherapy centre.

PART 3.2
WHAT IS REVEALED?
DISCOURSE

Fig. 145b
Horses in motion
(Photograph: author).



discourse

REVEALING COMPLEXITIES
WITHIN THE EXISTING



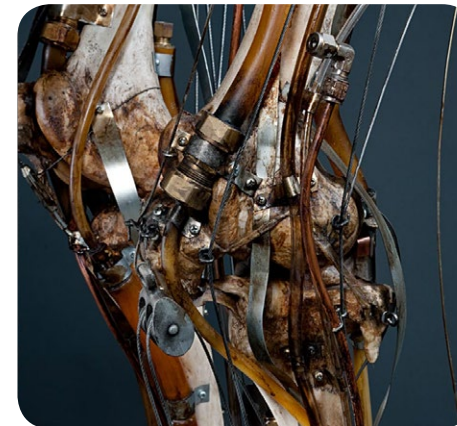
Fig. 146 - 149
"Bestia Mundi" - 2009
1727 x 635 x 2692 mm
[Mixed media with horse
and cow bones]
(Pippin, 2019: online).



3.2.1 COMPLEXITY OF FORM

Ron Pippin is an American sculptor who attempts to reveal the relationship between science, nature and art (Slete Gallery, 2019: online). His work is primarily inspired by mechanisms from the 19th century where, according to the artist, science still had a close connection to form (Farrier, 2010: online).

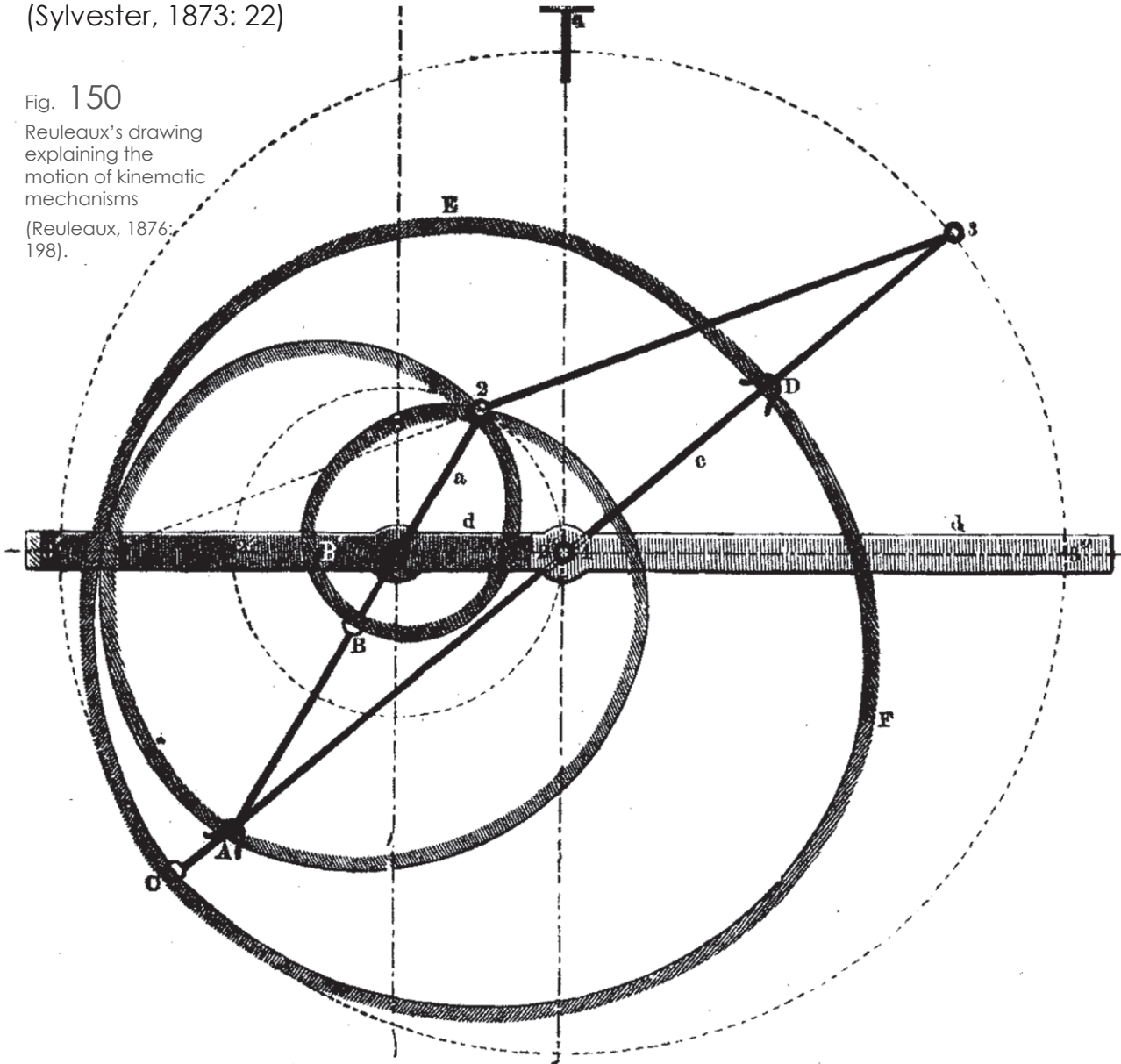
Ron Pippin's sculpture 'Bestia Mundi' portrays movement by revealing the complex anatomy of the horse and its mechanical augmentations (Farrier, 2010: online). He draws attention to how its biomechanical structure can be deconstructed into individual components which are intricately connected to one another. The piece is an assemblage of parts working together towards the greater whole, revealing how form is created through function. Similarly, the hippotherapy centre exists as a series of overlapping functions, connected to one another to create a whole. The systems which make up a horse's movement patterns are therefore a useful metaphor for the design methodology of the centre. The horse's movement will serve as foundation for revealing complexities within the existing synergies between culture and nature and will be analysed in further detail by deconstructing it to its individual components.



“Take to Kinematics... It is more fecund than geometry; it adds a fourth dimension to space.”

(Sylvester, 1873: 22)

Fig. 150
Reuleaux's drawing explaining the motion of kinematic mechanisms (Reuleaux, 1876: 198).



3.2.2 A SHORT INTRODUCTION TO MACHINES

Before we investigate the horse's movement, we will cover a brief introduction to the basic principles of mechanics. The word “machine” is derived from the Greek word “mēkhanē” and was first used in ancient Greek theatre to describe mechanical systems which lifted actors into the air to represent flight. There are six simple machines (the lever, the wheel and axle, the inclined plane, the wedge, the screw and the pulley) as defined by Renaissance scientists during the 17th century (Usher, 1988: 98).

Franz Reuleaux, a 19th century mechanical engineer, believed that all machines could be deconstructed into simple movable parts known as mechanisms (Moon, 2004: 10-13). His research concluded that mechanisms are actually composed of one or more of the six simple machines and could essentially be categorised into two main groups:

1. Block sliding over a level surface (inclined plane, wedge, screw)



2. Body rotating around a hinge (lever, pulley, wheel and axle)



Fig. 151, 152
Two main groups of mechanisms (Drawing: author).

According to Reuleaux, a machine can be defined as an assemblage of constructive elements specifically arranged to collectively perform the desired motion (Reuleaux, 1876: 50). The following drawings depict some of the machines used specifically in Semonkong and how they fit into the two categories described above.

The Hand Plough

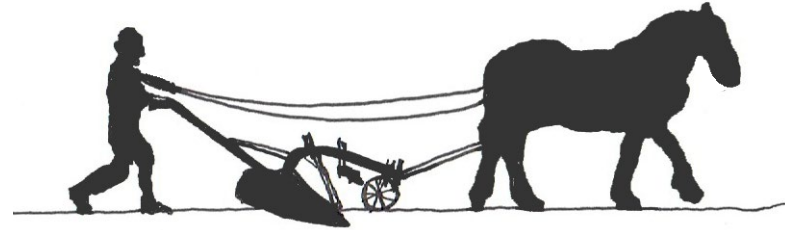


Fig. 154
The hand plough pulled by horses or cattle
(Drawing: author)

Fig. 155
The hand plough detailing
(Drawing: author)

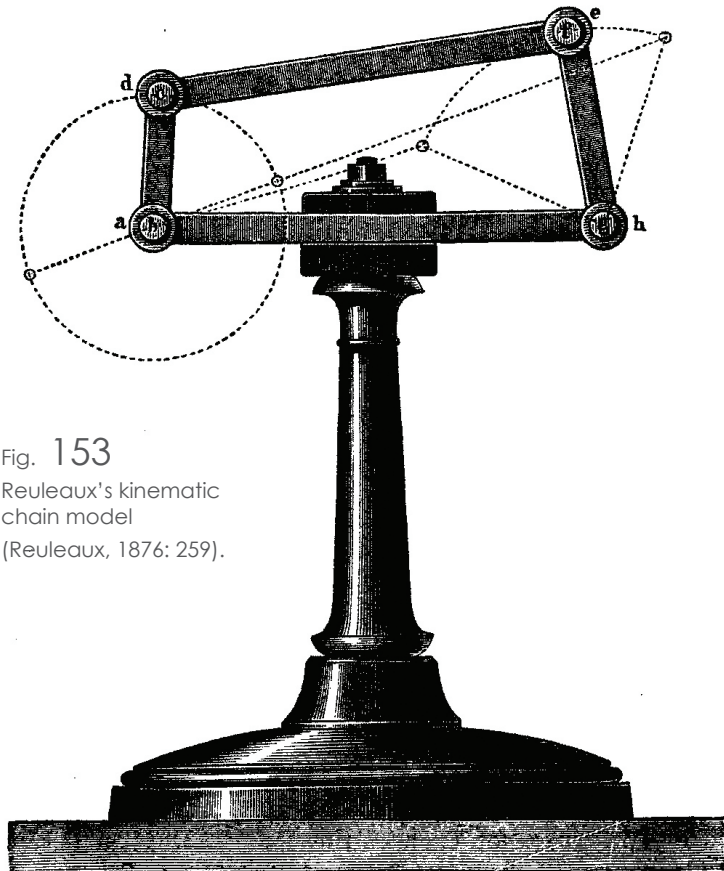
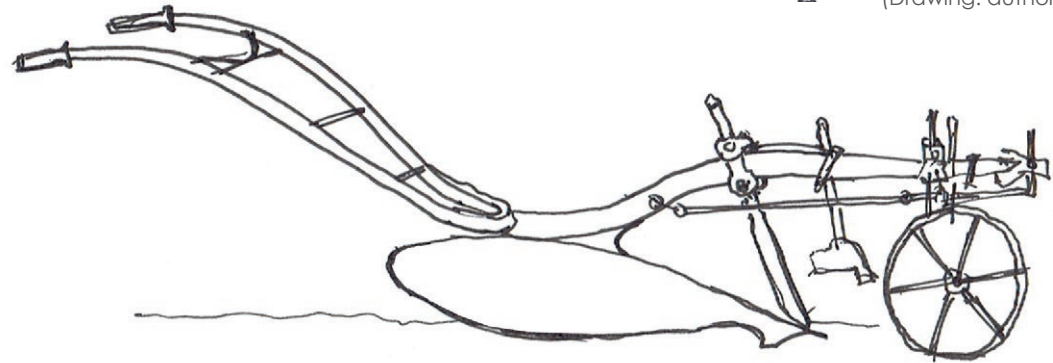
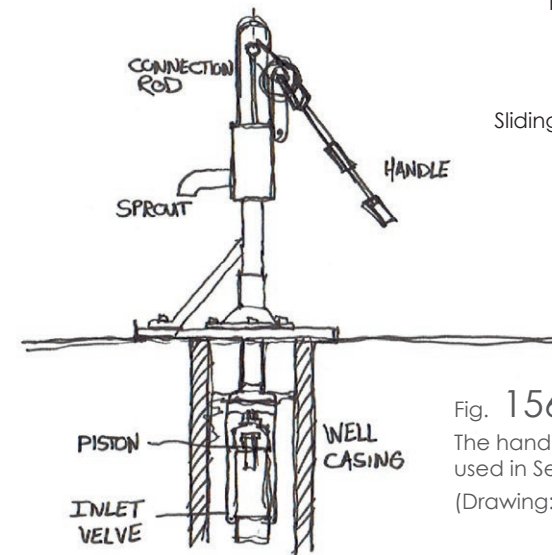
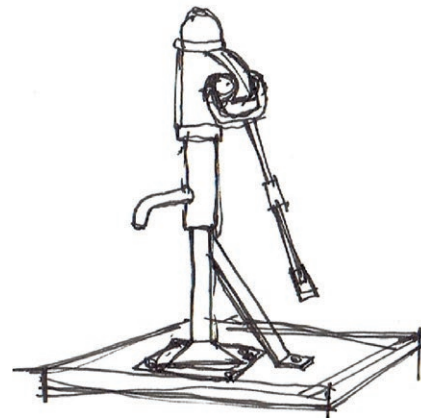


Fig. 153
Reuleaux's kinematic chain model
(Reuleaux, 1876: 259).

The Hand Water Pump



Rotating around hinge

Sliding over surface

Fig. 156
The hand water pump used in Semonkong
(Drawing: author)

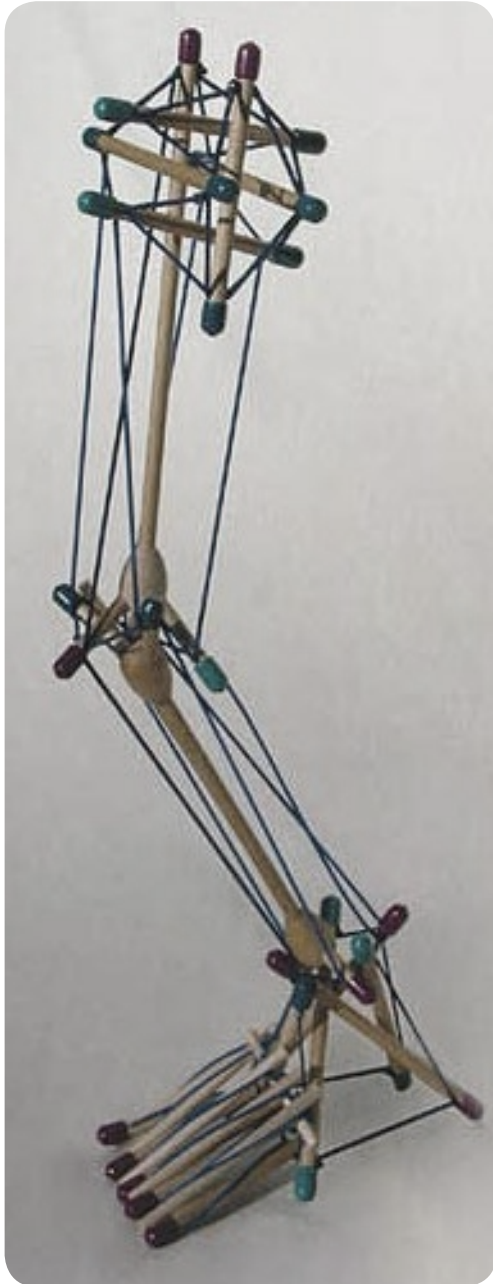


Fig. 157
Biomechanical model of
human leg
(Flemons, 2018: online).

3.2.3 BIOMECHANICAL MOVEMENT

Biomechanics

/ˌbaɪə(ʊ)mɪˈkænɪks/
noun.

“Biomechanics, or biological mechanics, uses the principles of mechanics to investigate the effects of energy and forces on biological matter and/or material systems in order to model and predict the mechanical behaviour of a living system” (Chon, 2019: online)

According to the ancient phrase of Aristotle, “the whole is greater than the sum of its parts”, it is believed that a system cannot merely be described by the sum of its components (Auyang, 1998: 4). So, rather than acting as individual members with their given attributes, a synergy which is formed between mechanisms re-determines their combined properties. Reuleaux argued that for new mechanisms to develop out of the six simple machines, the relationship between the mechanisms, rather than the mechanisms themselves are most important (Reuleaux, 1876: 86).

Reuleaux defined the grouping of two mechanisms as a kinematic pair. Where multiple kinematic pairs are linked into one mechanism, a kinematic chain is formed and is no longer defined by the individual parts but rather by how the components are able to move in relation to each other. In essence, a kinematic chain can be described as rigid bodies or links connected

by specific joints to provide constrained movement in the desired direction (Reuleaux, 1876: 67). It is a series of mechanisms joined together, but it is the joints which are most important as they allow each component in the system to work together toward the desired result. We can, therefore, reduce a kinematic chain to three basic types of elements namely anchor points, links and rotation joints as shown in figure 158.

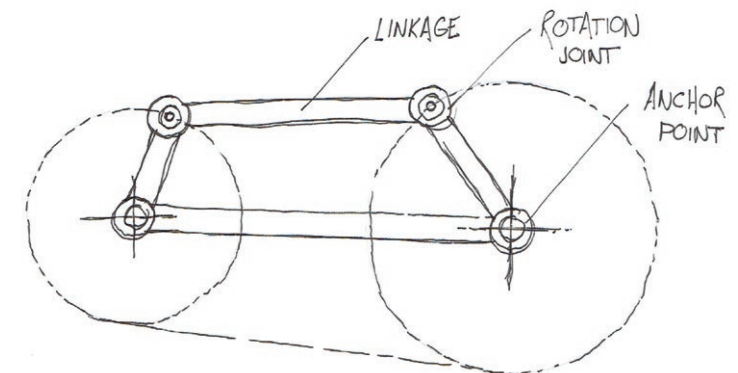
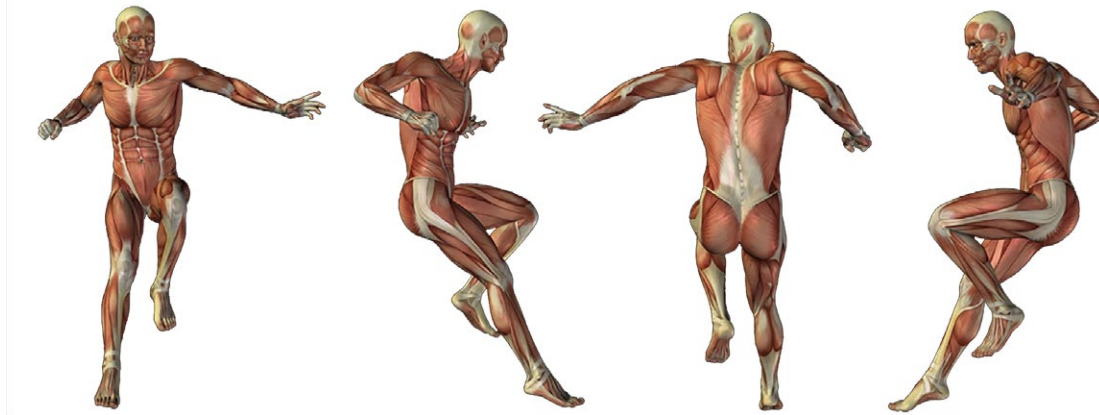


Fig. 158
Simplified kinematic chain
(Drawing: author)



Anchor points are static, keeping a machine in one place. Links act as joints between anchors and rotation joints. They are dynamic and are often in a state of motion. Rotation joints, between links allow points in the machine to move relative to itself. They are generally locations of high energy. From these descriptions, we can begin to determine morphological and spatial applications for the proposed centre.

The human skeleton is a good example of a kinematic chain. The body is connected through a series of systems to create constrained movement of the members in relation to one another, thereby allowing forward motion of the 'system' as a whole (Dischiavi, 2018:

92). The bones function as the rigid links while ligaments and tendons act as rotation and anchor joints to allow different types of movement between the members. Although in reality, the anatomy of the body is much more complex than the simplified kinematic chain, it is a good example of the basic principles of biomechanical movement (Levin, 2017: 668).

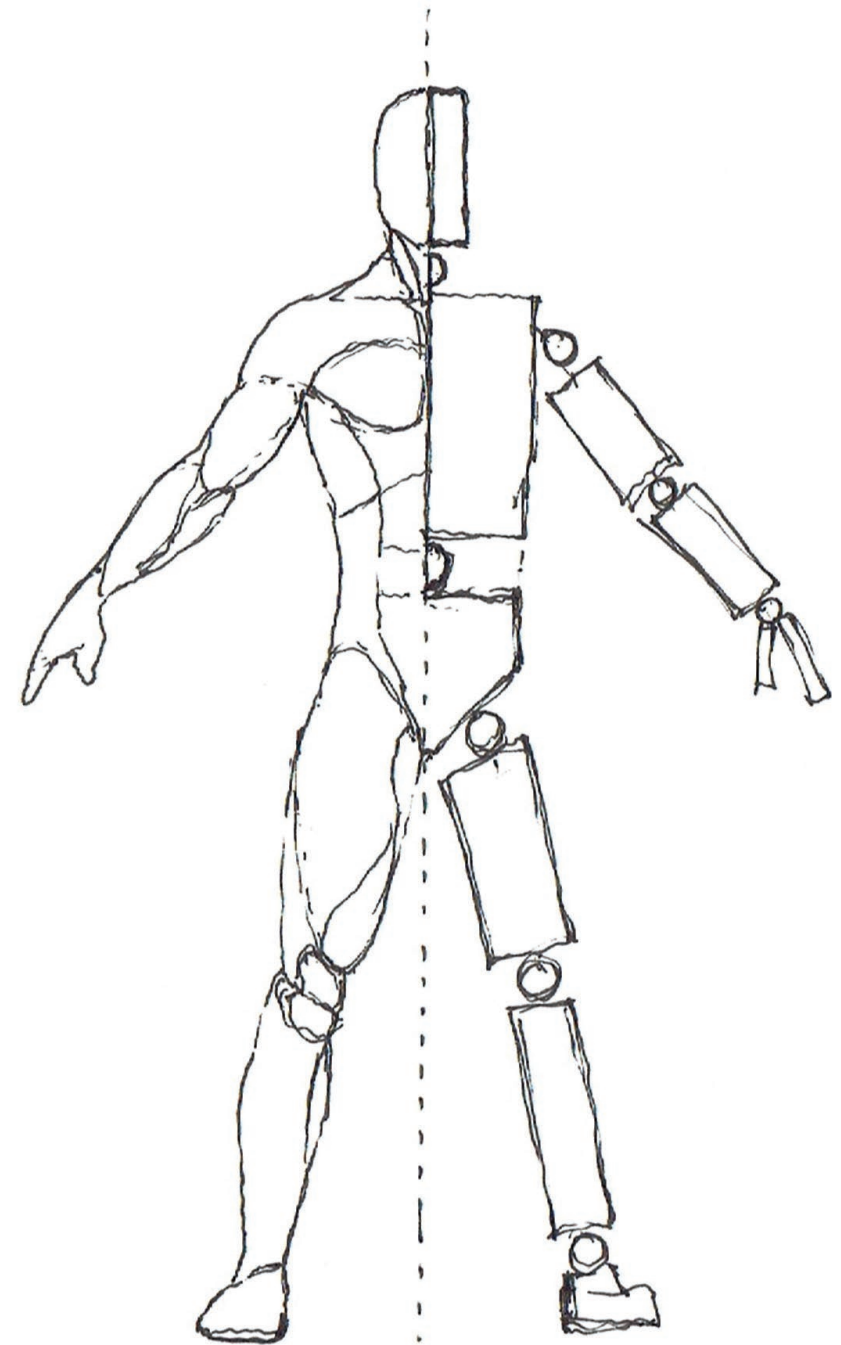
The individual parts of the body not only function together to perform the desired motion but also directly influence the other member's position in space, changing the properties of the whole. In this way, the body is able to make biomechanical movement possible.

Fig. 159

Human motion
(HFPA, 2019: online).

Fig. 160

Kinematic chain of
human body
(Drawing: author)



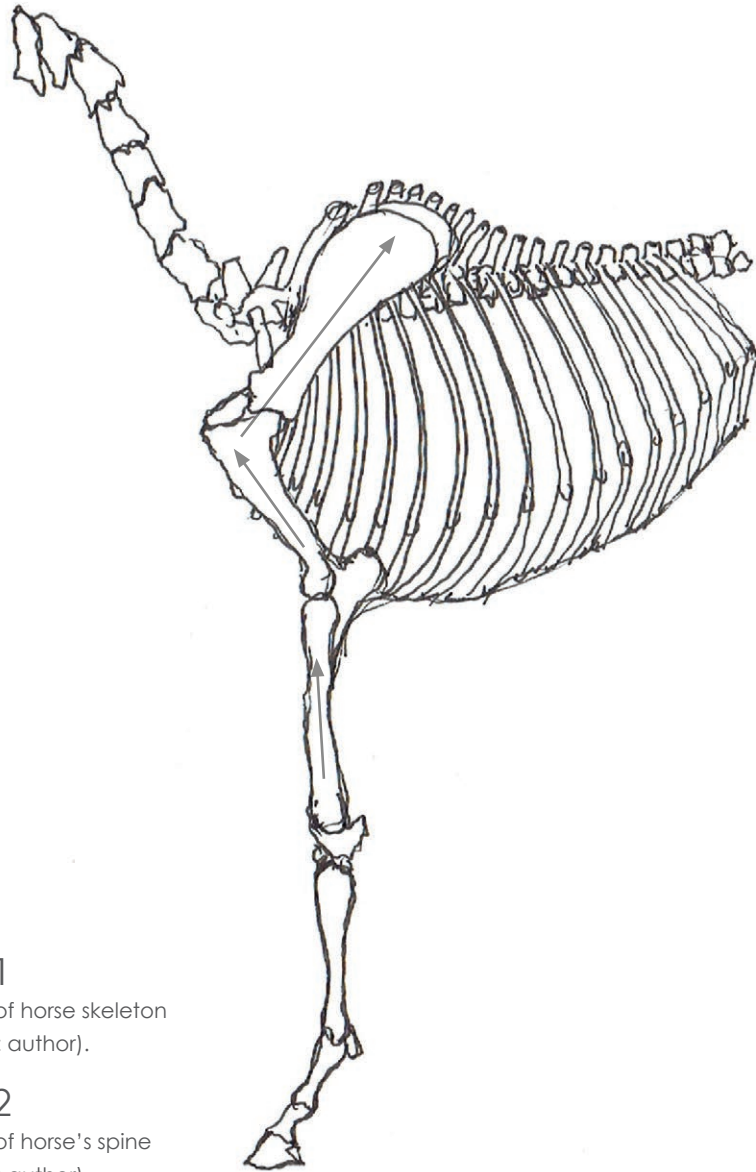
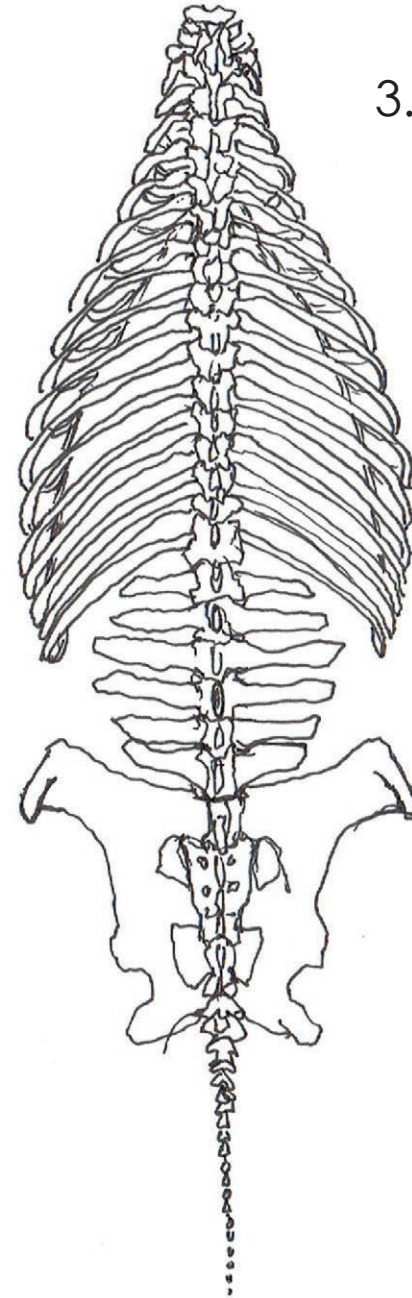


Fig. 161
Drawing of horse skeleton
(Drawing: author).

Fig. 162
Drawing of horse's spine
(Drawing: author).



3.2.4 THE HORSE AS 'MACHINE'

"While in appearance a machine differs greatly from any of the force or motion-distributors of nature, yet for the theoretical or pure mechanician no such difference exists"

(Reuleaux, 1876: 29)

The horse's body can be seen as a complex machine which man has utilised for different purposes. Although the horse's body can seem highly complex, its structure can be broken down into individual elements and understood as a biomechanical system.

The vertebral column forms the primary structure of the skeleton and plays a vital role in the horse's movement (Álvarez, 2007: 3). Its structure can be divided into five sections, all with limited curvature but which together provide the body with a significant range of movement (fig. 162). These sections include the neck, the upper back, the loins, the croup and the tail. The structure of each vertebra has the same basic form (fig. 164). The dorsal spine extends out of the main body with the corresponding rib pair attached on either side (Pilliner, Elmhurst, & Davies, 2004: 68). Besides connecting the front and hind limbs

of the body, the spine houses the spinal cord which transfers nerve impulses between the brain and the rest of the body (Pilliner, Elmhurst, & Davies, 2004: 66-67). Each style of gait (walk, trot, gallop etc.) involves a unique sequence for how the horse's feet touch the ground (Pilliner, Elmhurst, & Davies, 2004: 80). The sequence of contact determines the course and intensity of movement and is carried over to the vertebral column as shown in figure 161. The vertebral column and its supporting muscles are what provide carefully graded motor and sensory input for hippotherapy (Barlow & Ballim, 2016: 32).

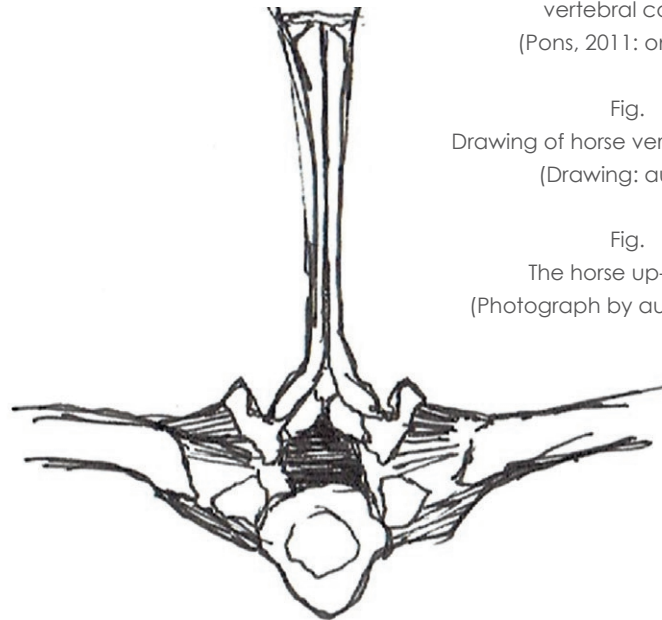


Fig. 163

Photograph of horse's
vertebral column
(Pons, 2011: online).

Fig. 164

Drawing of horse vertebra
(Drawing: author)

Fig. 165

The horse up-close
(Photograph by author).





STATE OF DYNAMIC TENSION

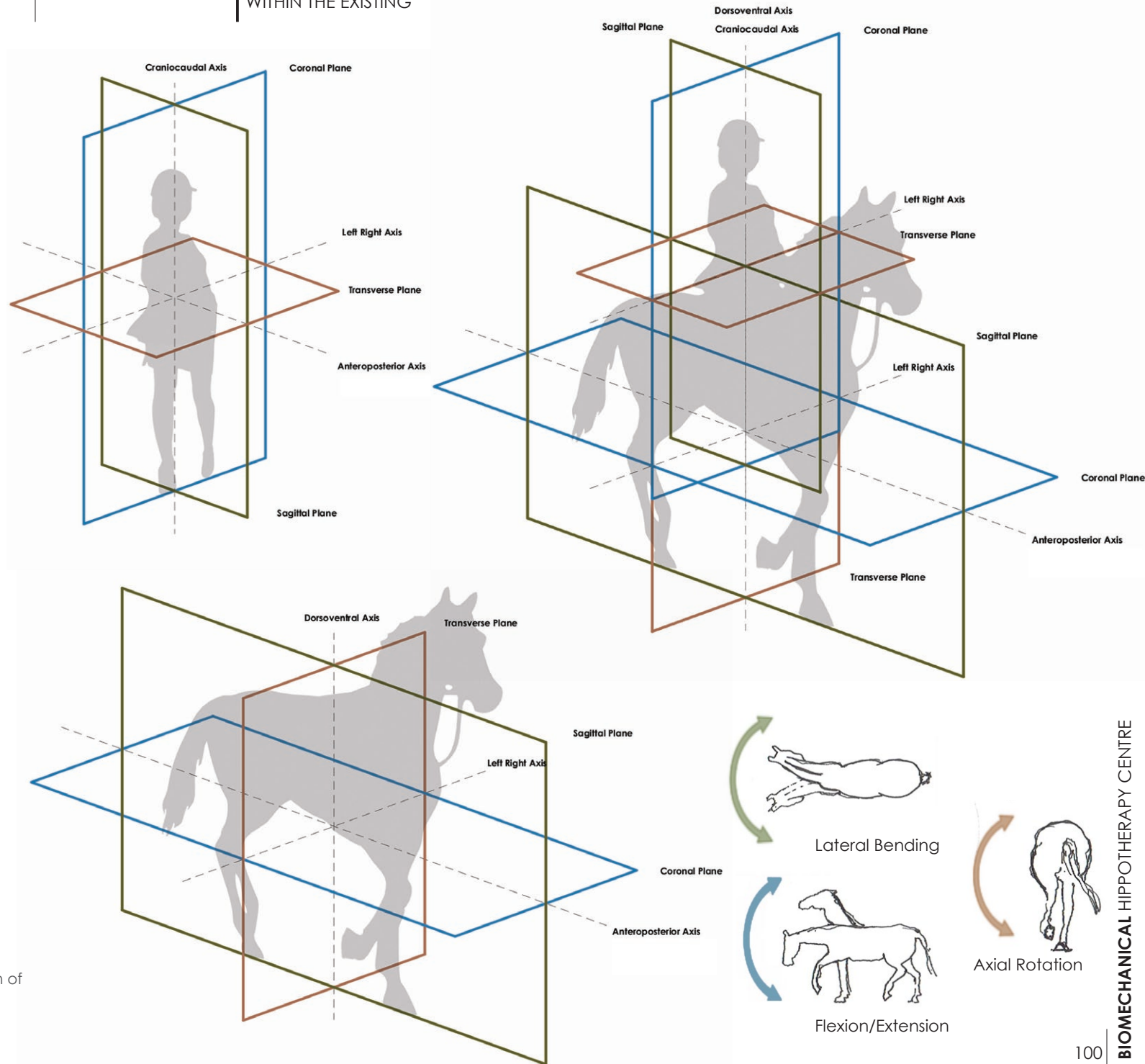
The types of movement in the vertebral column are lateral bending, flexion/extension and axial rotation which together form the three-dimensional movement pattern of the horse's gait (Rhodin, 2008: 12). These movement patterns can be better understood in relation to their corresponding axes and planes shown in figure 168. This process results in the different three-dimensional movement patterns experienced by patients during hippotherapy.

Due to the vertical orientation of man and the horizon orientation of the horse, their coronal and transverse planes are swapped around, resulting in different types of movement patterns when combined as a whole (Clayton & Hobbs, 2017: 124). This phenomenon can be compared to the state of dynamic tension within the synergy between man and horse. It is this same phenomenon that results in the patient's spine mimicking the horse's pelvic movement (Koca & Ataseven, 2015: 249).

Fig. 166
The gait of the horse
(Photograph: author).

Fig. 167
Drawing of planes of
movement of horse
and human
(Diagram: author).

Fig. 168
Drawing of direction of
movement
(Drawing: author).





THE KINEMATIC CHAIN

Similar to the human body, the kinematics of the horse can be understood through elements that are specifically arranged to collectively perform the desired movement. These elements are made up of the same kinematic pairs discussed earlier in the document, consisting of anchor points, links, and rotation joints, working together to perform the horse's walking or trotting motion (Varipon Institute, 2018: online). Figures 0 and 0 not only show the flexion/extension movements but also the lateral bending and axial movement respectively.

Architectural space, like a horse's biomechanics, can be divided into anchor points, links and rotation joints. By designing with these types of space in mind, the designer would be mimicking the principles guiding the horse's movement and hopefully designing a building which also serves as a link between nature and culture. This will be further discussed later in the investigation.

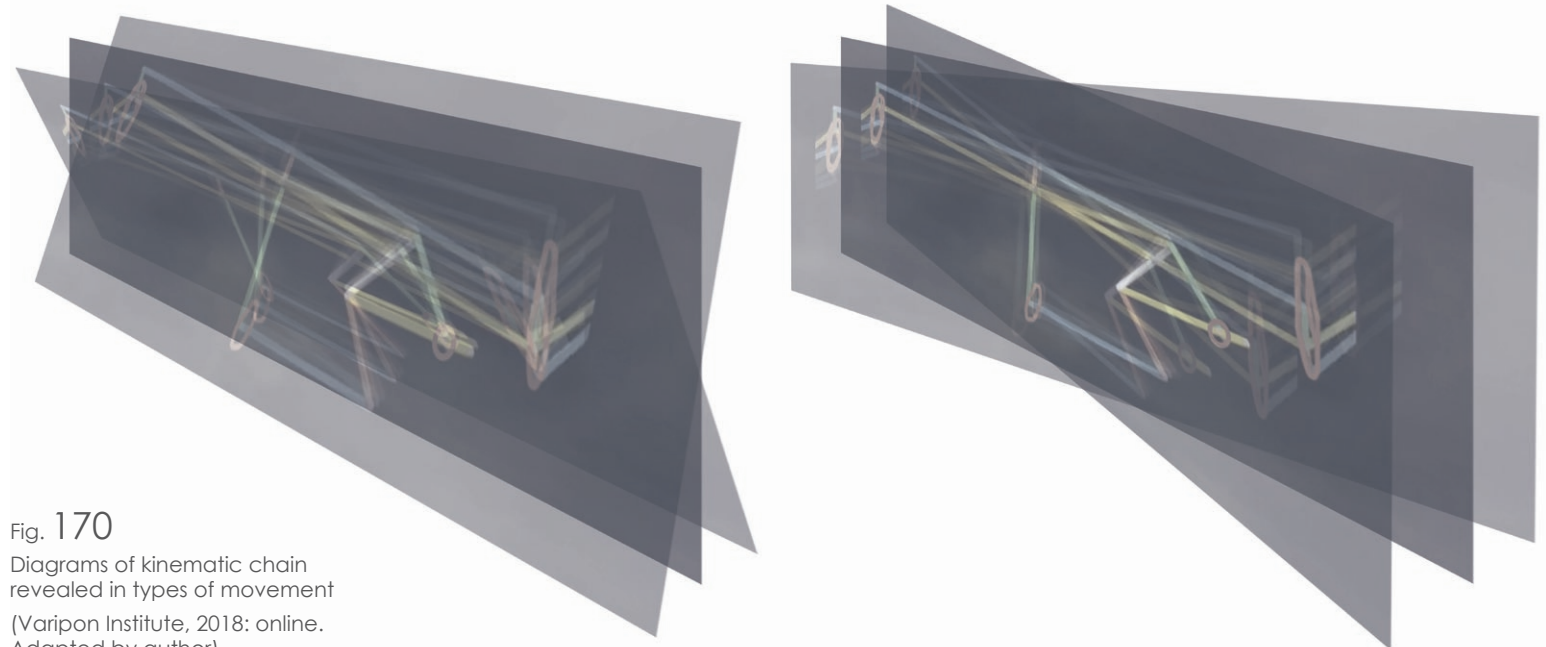
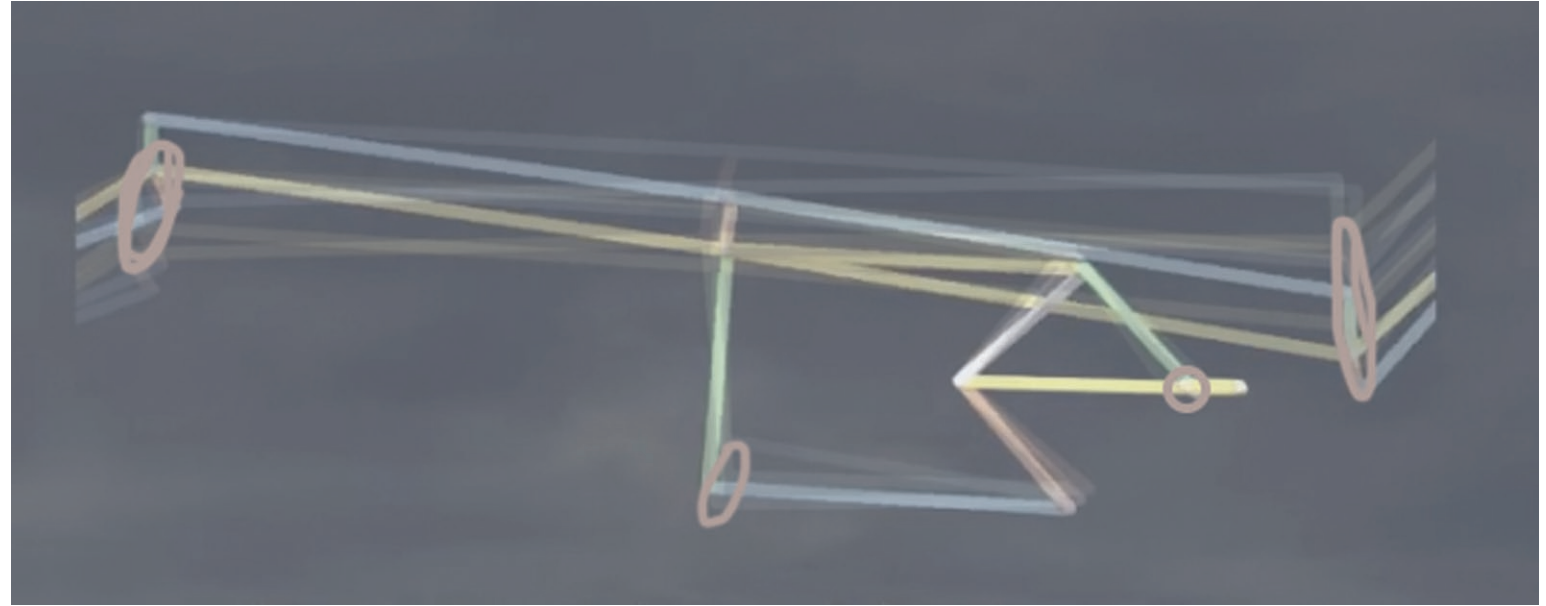


Fig. 169

Drawing of kinematic chain revealed in horse's movement (Photograph and drawing: author).

Fig. 170

Diagrams of kinematic chain revealed in types of movement (Varipon Institute, 2018: online. Adapted by author).

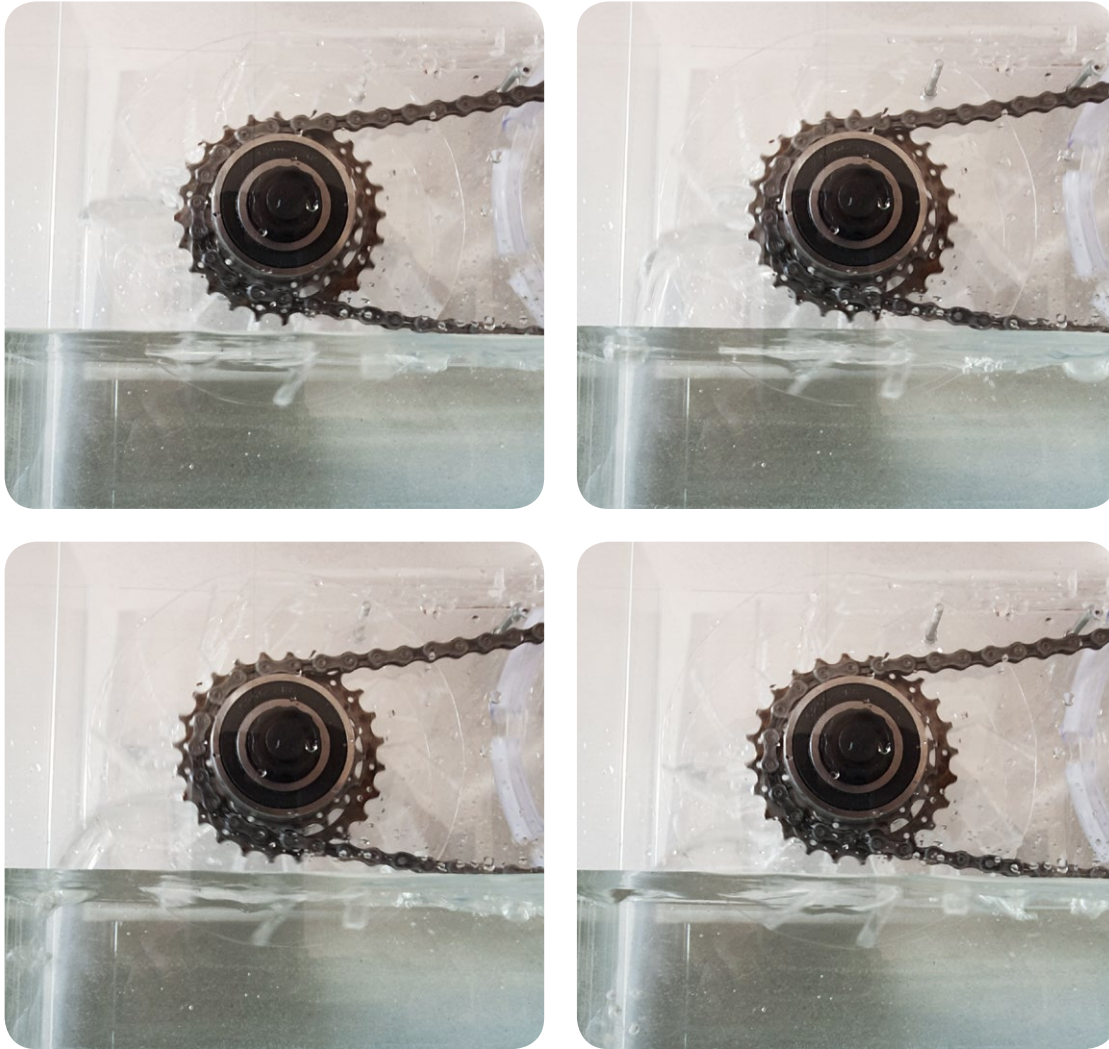


Fig. 171
Figure indicating motion
of touchstone
(Photograph: author).

Fig. 172
Biomechanic movement
(Drawing: author).

PART 3.2.5
TOUCHSTONE
DISCOURSE

The touchstone is both an abstract representation of the project's initial objectives and a conceptual generator to fuel possible design solutions. The essence of hippotherapy can be captured in the synergy between man and horse and their combined movement to achieve specific therapeutic outcomes. The model signifies a kinematic chain revealing the state of dynamic tension between horse and man.

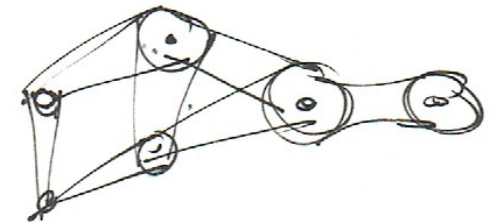
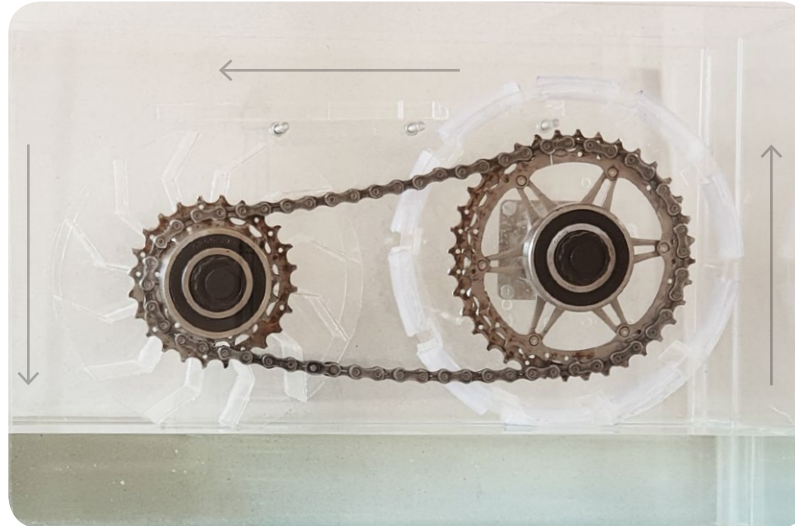


Fig. 173
Touchstone
(Photographs; author).

In an isolated system, removed from the external forces of gravity and friction, the two wheels form the same kind of synergy. One wheel displacing water as it rotates and the other serving as a water catcher, fueling the ongoing process. When the chain linking the two wheels is introduced to the system, the work produced by both wheels will theoretically result in perpetual motion; the system will continue to create sustainable work as one wheel rotates the other.



The two wheels individually represent the horse and the patient working together. This relationship is further facilitated through architecture, which can be seen as the link in-between, guiding their energy towards specific outcomes. The system utilises existing resources by focusing their workflow to form a functioning synergy. As the existing relations and resources needed for hippotherapy are already available in Semonkong, the architecture should only facilitate improved therapy treatment in the area, benefiting both the patient and the horse.

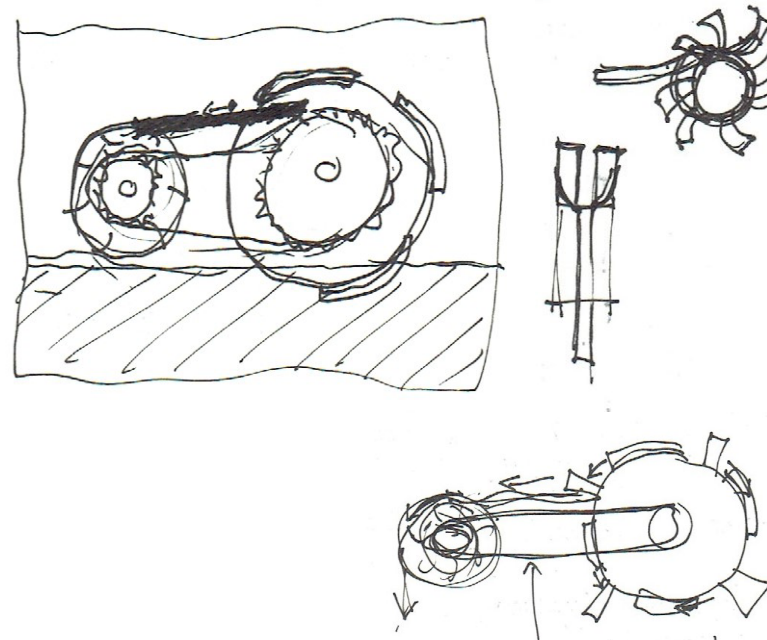
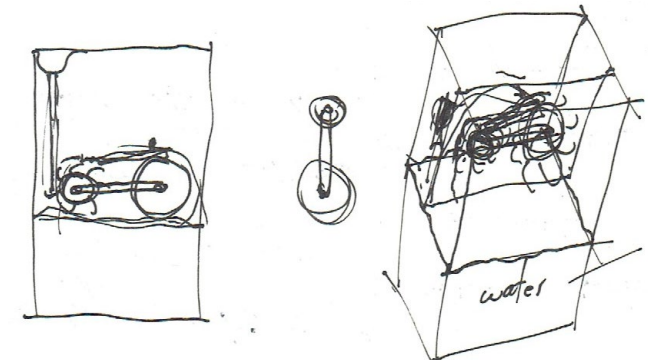
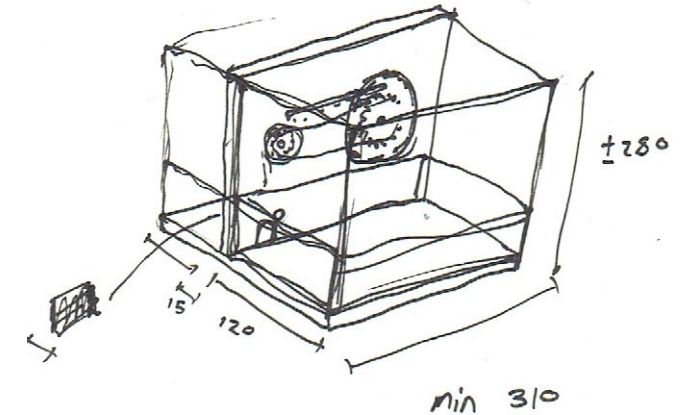
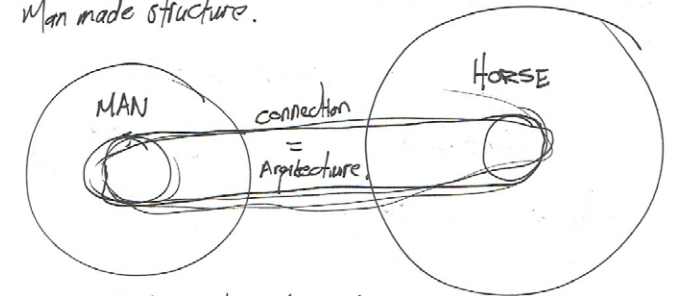


Fig. 174 - 175
Process of building the
touchstone
(Drawing: author).

Man made structure.



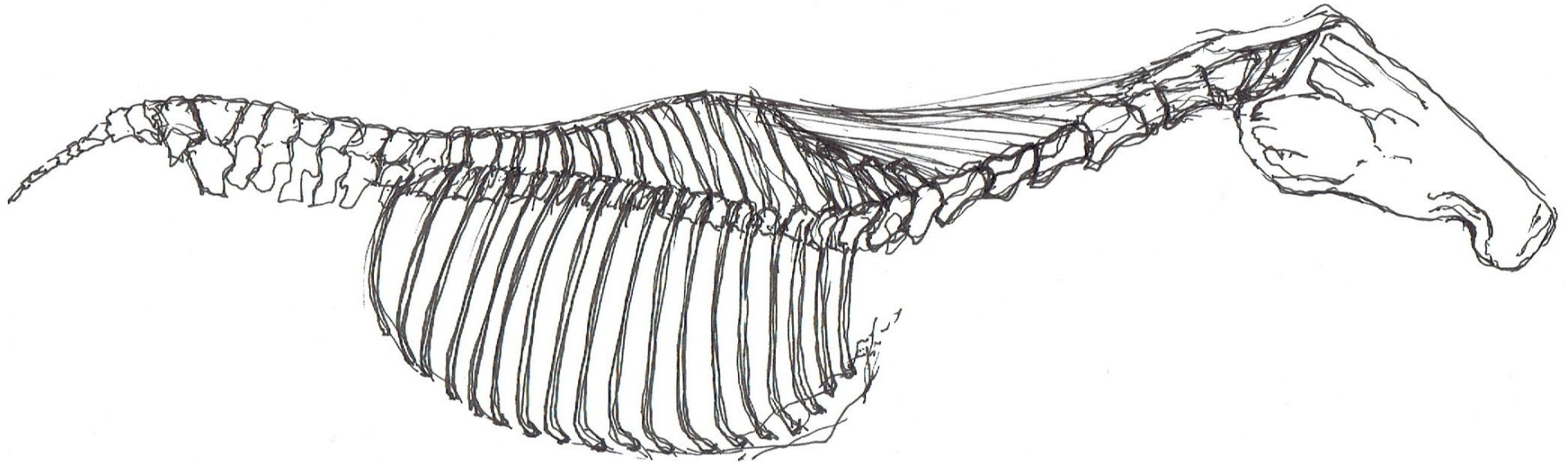
CONCLUSION OF THE REVEALED COMPLEXITIES

In this section, we investigated the kinematics and structure of the horse especially in relation to hippotherapy. By deconstructing the horse's biomechanics into smaller elements such as anchor points, links and rotation joints, we are able to draw possible architectural solutions applicable to the proposed project. Considering the current technological and resource limitations in Semonkong, I specifically used elementary methods to explain the fundamental principles of biomechanical movement that could be applied to architecture without describing high-tech solutions such as electronic or hydraulic systems.

The vernacular architecture of Lesotho has been shown to reveal a state of dynamic tension between culture and nature. The building processes can be seen as a pattern of engagement which translates lived experiences into the built environment to add meaning to place. The state of dynamic tension that occurs within the synergy of man and horse is seen as a similar engagement to the lived experience in Semonkong. The proposed development aims to reveal the state of dynamic tension through the metaphoric use of mechanisms in biomechanical movement identified as anchor points, links and rotation joints.

Fig. 175b

Metaphorical representation of
biomechanical movement
(Drawing: author).





“When the spatial organization, built form and typological constitution of a place satisfies man’s need for orientation, identification and memory, he dwells, and gains his identity”

- Norberg-Schulz

Fig. 176
Village in Lesotho
(Photograph: author).

PART 3.3

WHAT IS GATHERED?

DISCOURSE

RITUAL AND PLACE-MAKING: GATHERING TO FORM NEW POSSIBILITIES

In the first chapter of this document, we discussed some of the challenges faced by people living with disabilities in Semonkong. Many of these individuals are displaced from their communities due to their inability to walk, work or function within their social groups. We further analysed how the Basotho are constantly engaged with their environment as they engage in a state of dynamic tension between culture and nature. Daily rituals like washing, cooking, cultivating the land and shepherding cattle all reflect the same engagement within the culture-nature dualism. People living with disabilities are often excluded from these rituals and are unable to engage with their environment.

These individuals are therefore placed within a liminal state; separated from the society they once belonged to, without any support to progress towards re-incorporation. The exploration of biomechanical movement and the culture-nature dualism has shown that the relationship between man and horse may act as a threshold to re-introduce those living with disabilities into the community. This needs to be translated through the topology, morphology and typology of the proposed facility to investigate new possibilities for the patient to belong and to explore their identity within the specific place of Semonkong.

Fig. 177

Initiation of the Basotho Men is known as *Lebollo la banna*

(NUL, 2018: online).

Fig. 178

Initiation of Basotho Women is called *Lebollo la basadi*
(One Day In Africa, 2012: online).



Fig. 179

Basotho ceremonial
celebration

(Lesotho Embassy Rome,
2016: online).

3.3.1 RITES OF PASSAGE

Arnold van Gennep was the first anthropologist to write about the concept of “rites of passage” in his book “*Les rites de passage*”, published in 1908. He described the notion as “rites which accompany every change of place, state, social position and age” (Turner, 1969: 94). The reintegration of children living with disabilities into society can be understood as a rite of passage. Rites of passage can be divided into three phases, known as the preliminal, liminal and post-liminal phase, although the emphasis on each phase is dependent on the type of ritual (Van Gennep, 1908: 11). During the preliminal phase the focus shifts from being gathered into, to being separated from society and can be interpreted as the current isolated existence of children with physical disabilities near Semonkong.

The second phase, Liminal or “limen” which is the Latin term for “threshold” signifies the ability to move from one state to another. The liminal phase consists not only of physical therapy but a state of social transition from having a disability to overcoming it mentally. For the children in this specific context, emphasis is placed

on this phase because therapy is not limited to one event or ritual, but is seen as the on-going process of achieving smaller outcomes within realistic time periods. Victor Turner dedicated his work to a lifelong study of the Ndembu tribe of Zambia and explored in more detail Van Gennep's concept of liminality. Turner compares liminality to J. S. Mill's writing as “a state of progressive movement” (Turner, 1967: 94) in which the process, though in-between phases, is not a static waiting period but rather a transformation on its own (Turner, 1967: 94).

The post-liminal phase of hippotherapy celebrates the occurring rituals as their ultimate goal is “to ensure a change of condition” (Van Gennep, 1908: 11) both physically and socially. During this phase, the patient is reincorporated into the community and now learns to function within this new state. The post liminal phase is celebratory, hailing the arrival of the arrival of the patient into everyday society, as Turner concludes: “Ritual is transformative, ceremony confirmatory” (Turner, 1967: 95). The movement of the person living with disabilities from exclusion to inclusion can be seen as a form of ritual. But ritual is also a form of place-making; adding layers of meaning to spaces.



Fig. 180

Basotho village in Lesotho
landscape

(Dichtl, 2019: online).



3.3.2 PLACE MAKING

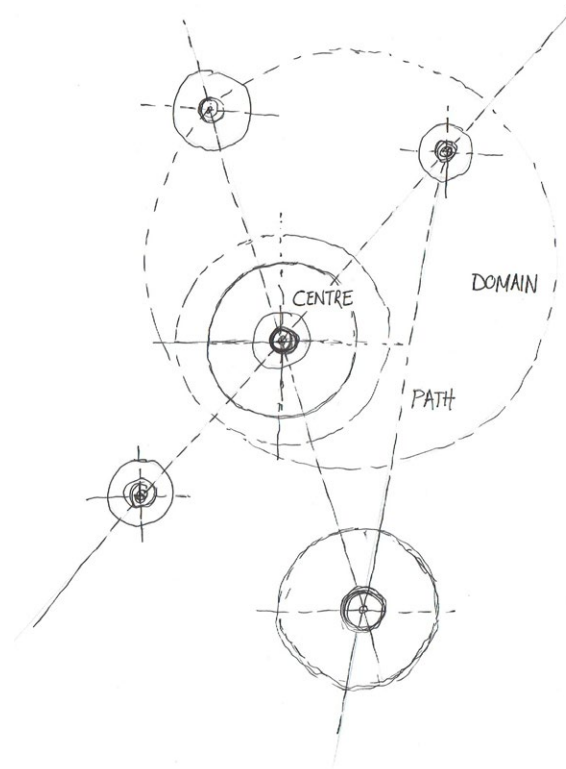
According to Norberg-Schulz, for architecture to convey meaningful place-making it needs to be translated “through a process of gathering” (Norberg-Schulz, 1979a: 44). He interprets Heidegger’s work ‘Hebel - Friend of the House’ by concluding that the earth is gathered as an “inhabited landscape” including our rituals, beliefs and understanding of the environment (Norberg-Schulz, 1979a: 44).

Our lived experience is interpreted through an existential space which allows for orientation and identification within a landscape. Norberg-Schulz defines existential space as “a relatively stable system of perceptual schemata or ‘image’ of the environment” (Norberg-Schulz, 1971: 17). This ‘image’ consists of both concrete and abstract properties of place in an attempt to build a relationship between man and our environment (Norberg-Schulz, 1971: 14). Place-making, as such, becomes an act of gathering both concrete and abstract properties of the landscape which form part of our lived experience. Concrete elements

include the physical landscape and surrounding buildings, whereas abstract elements relate to the qualities of ritual, memory and identity. Thus the ritual of inclusion for person's with disabilities involves helping to create places in which they feel a sense of belonging. Placemaking and inclusion go hand in hand.

In my attempt to gather the lived experience between man and horse into meaningful place-making, the 'image of the environment' is divided into existing and revealed schemata which can be applied architecturally. The interpretation of biomechanical movement into simple architectural elements such as anchor points, links and rotation joints has already been discussed but the guideline is incomplete.

These principles need to be applied in relation to an environmental image to allow the patients and community to identify and orientate themselves within the space.



ORGANISATIONAL SCHEMATA

The location and spatial organisation of our settlements play a vital role in the phenomenology of our architecture (Norberg-Schulz, 1979b: 175). In his book *Existence, Space & Architecture*, Norberg-Schulz proposes three elements of existential space. These are defined as centre, path and domain which make up the basic organisational schemata of the environment (Norberg-Schulz, 1971: 18). 'Centre' is described by Norberg-Schulz as a point, anchor or place of reference within the environment. Centres can be recognised as spaces of social interaction or a reflection of home and security where people are able to gather their experiences, memories and identity (Norberg-Schulz, 1971: 18).

Paths or directions are drawn from centres that extend into the landscape and can be seen as the links in between. During the extended journey out of the centre, a path guides the user towards alternative experiences of the environment and therefore contains a character of its own, expressed through continuity and movement (Norberg-Schulz, 1971: 22). Paths divide domains into different areas while their boundaries separate them from the surrounding landscape (Norberg-Schulz, 1971: 57).

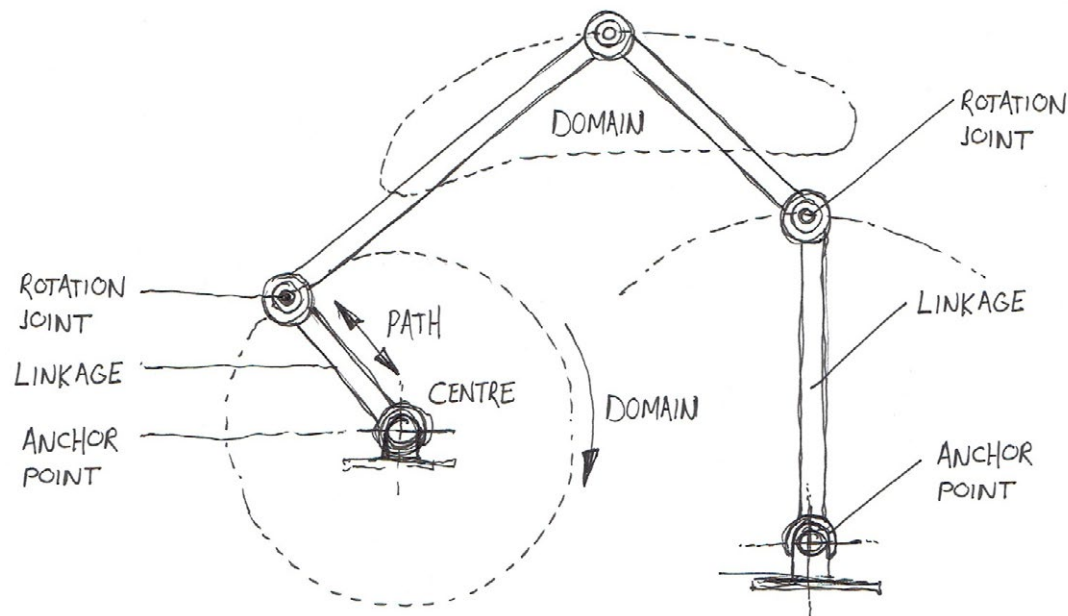
Domains exist where man takes possession of the environment without necessarily belonging to them. These areas hold potential for man's activities and do not function as destinations themselves but rather spaces of dynamic intensity (Norberg-Schulz, 1971: 23).

Basotho man on his horse riding
past the Maletsunyane Falls
(Gatland, 2019: online).

*Please see page 81 for the
theoretical overview.

3.3.3 AN OCCASION FOR BELONGING

The elements of existential space proposed by Norberg-Schulz can be compared to the elements of biomechanical movement discussed in the previous chapter. The following diagram shows how anchor points relate to centres, links relate to paths and rotation joints relate to domains:



This comparison links spatial categorisation with the attributes of the horses' biomechanical movement, thus reflecting existing and revealed schemata within the lived experience in Semonkong. These processes can be translated into the built environment to convey a combined environmental image to provide the user with a sense of belonging and security (Lynch, 1960: 4). "When the spatial organization, built form and typological constitution of a place (building) satisfies man's need for orientation, identification and memory, he dwells, and gains his identity" (Norberg-Schulz in Auret, 2015: 130).

The relationship between Anchor/Centre, Link/Path and Rotation/Domain form the basis of the form giving concepts for the proposed project and are used as ways of classifying spaces and organising them into logical relationships.

By creating spaces that reveal man's lived experience and affirms his identity within the existing environment, the architecture is able to impart a sense of belonging to people living with disabilities allowing them to be reconciled with their community. For the child living with a physical disability, the facility becomes a place of belonging; the therapy, an occasion for freedom of movement. The gathering of lived experience as a state of dynamic tension reflects both the culture-nature dualism and the synergy between man and horse. It is this gathering that provides a holistic approach to therapy, horse care, community participation and social belonging while remaining rooted in Semonkong's cultural and natural landscape.

“Whatever space and time mean, place and occasion mean more. For space in the image of man is place, and time in the image of man is occasion” (Van Eyck, 1966: 121).



PART FOUR

CONCEPT

CONCEPTUAL DEVELOPMENT

In the site analysis of Semonkong (p.67), we see how the settlement consists of many individual villages with the same 'sense of place', referred to in Sesotho as Semonkong (place of smoke). The concepts developed for this investigation rely heavily on the relationship between these villages because the aim of the facility involves a holistic approach to community participation and integration.

By exploring alternative existing conditions outside the built environment, the project may reveal complexities and intricate relationships which already exist within the cultural and topological boundaries of the project. The greater whole of Semonkong acted as an inspiration generator, especially as the villages function together to achieve collective goals. The three concepts explained here should be seen as an interdependent creative development rather than as three separate approaches to design.

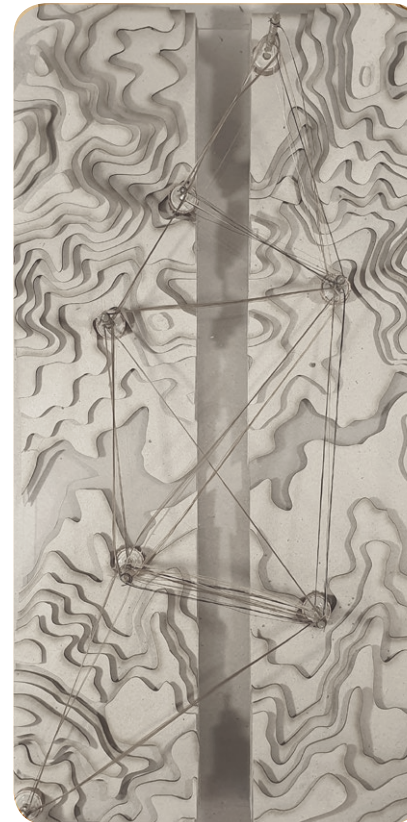
**BIOLOGY:
SPINAL SYNERGY**

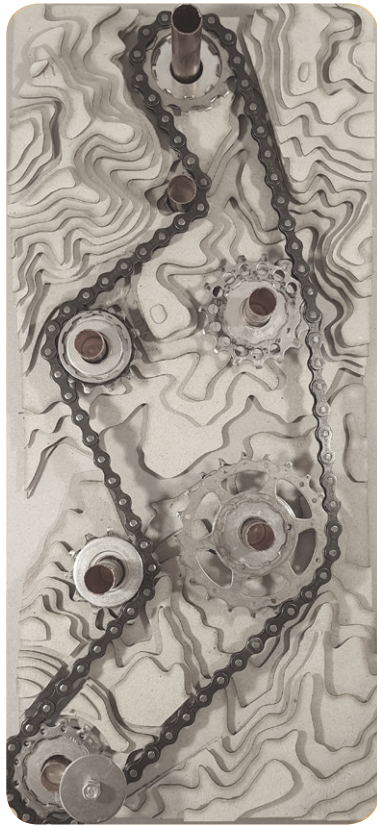
Fig. 182-187
Concept models based
on actual terrain of
Semonkong's villages
(Photograph: author).

The historical and cultural significance of humans and horses within the Semonkong region has created a unique relationship between the two. For the facility to succeed in its aims, it will need to introduce culturally acceptable solutions while building on existing relationships within the community. In order to bring healing to any society, one must first understand the existing relationships, challenges, rituals and systems. The process of hippotherapy has further revealed how the spines of the horse and patients work together to aid in the rehabilitation of people with disabilities. The therapy becomes a mediator between people with disabilities and the rest of the community and shows how possible connections can be made. The model reveals this divide through the use of strands of human and horse hair woven together to connect the surrounding villages.



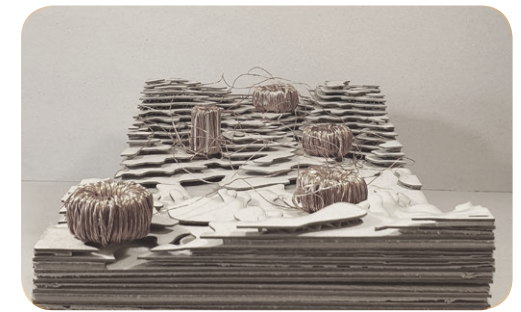
MECHANICS: THE KINEMATIC CHAIN

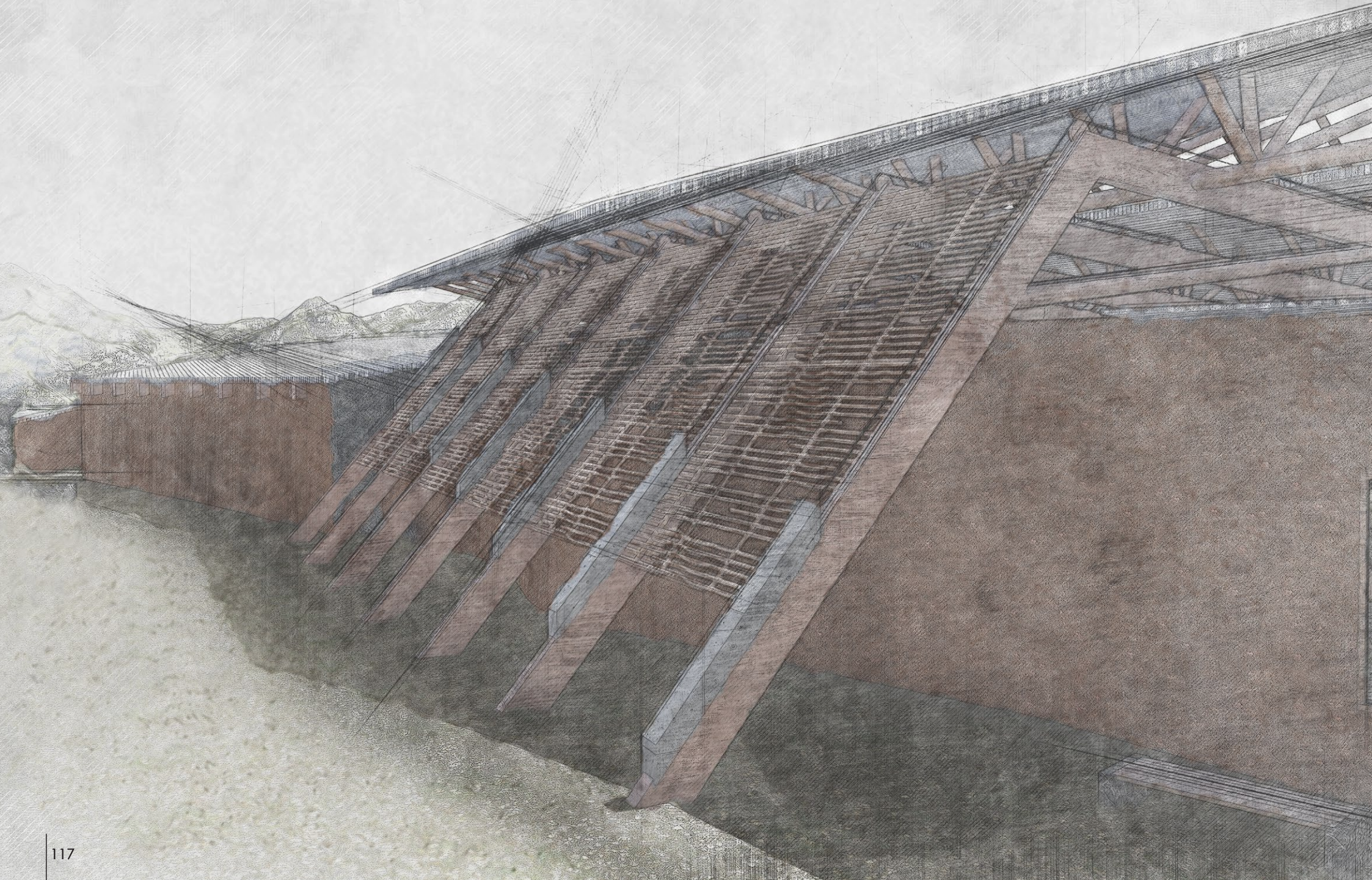
As explored earlier in the document, the essence of hippotherapy lies in the movement of the horse's body (Koca & Ataseven, 2015:25). The three-dimensional movement patterns caused by the horse's spine stimulates the same movement one would experience while walking (Du Plesses, 2016:25). This movement revealed through an analysis of the biomechanical structure of the horse can be simplified to a kinematic chain. With the horse as the key element behind hippotherapy, this biomechanical chain becomes the link between the different communities, improving therapy for people living with disabilities. The chain can be viewed as individual parts working together to form a holistic system.



PHYSICS: GATHERING POTENTIAL ENERGY

An object contains potential energy based on its position or state relative to other objects. It can therefore be assumed that an object's potential energy changes when changing its position or state. As a stagnant object is placed in a favourable position, the potential energy becomes kinetic energy (Davis, 2019: Online). The concept of gathering potential energy is represented by copper wire spread out across a plane. When the copper wire is gathered into a spiral formation it can be used as an electromagnetic coil (Markgraf, 2018: Online). This coil transfers the kinetic energy produced by the magnetic field into an electrical current to illuminate the lightbulbs as shown in figure 186. This process represents the gathering of existing resources throughout the Semonkong region (potential energy) into a concentrated area to create new movement (kinetic energy).







CHAPTER THREE

GATHERING A DESIGN SYNTHESIS

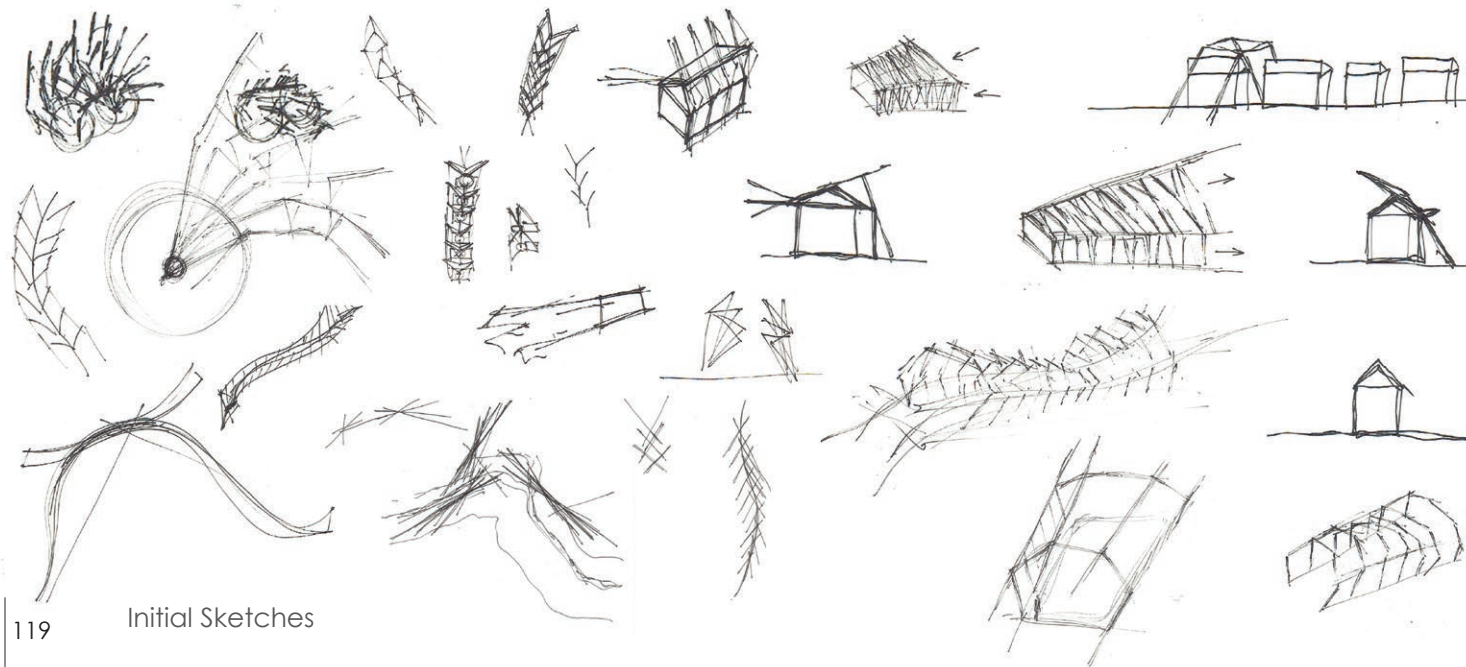
In this chapter, the conceptual development will be explored in three different phases, although at the same time being intricately woven into one another. The three phases correlate with the three concepts respectively and add layers to the design methodology during each development. The first phase [Spinal Synergy] translates the functioning of the two spines during hippotherapy into spatial and morphological applications while addressing the existing cultural relationship between man and horse. Phase two [The Kinematic Chain] reveals the biomechanical movement of the horse translated into morphological principles and looks at how its movement can allow the building to encourage community participation. Phase three [Gathering Potential Energy] combines the first two phases and draws inspiration from potential energy to create a state of dynamic tension. The final section takes us through the proposed hippotherapy centre and how it might aid in the architectural aims identified throughout this document.

- 1 Conceptual Development**
 - 1.1 Phase One: Spinal Synergy
 - 1.2 Phase Two: The Kinematic Chain
 - 1.3 Phase Three: Gathering Potential Energy
- 2 Towards a Final Design**

Fig. 188
Conceptual rendering
of design development
in phase two
(Rendering: author).



Model reveals how the movement of the horse forms the link between the community and people living with disabilities



Initial Sketches

PART 1.1

PHASE ONE

SPINAL SYNERGY

INITIAL SKETCHES

The initial design was based on the synergy between man and horse that is active during the course of hippotherapy. The interaction between the two spines can be interpreted as a structural system revealing the state of dynamic tension between the two. Again, it is the movement of the horse that forms the central core of hippotherapy and can therefore be seen as the link between the community and people living with disabilities.



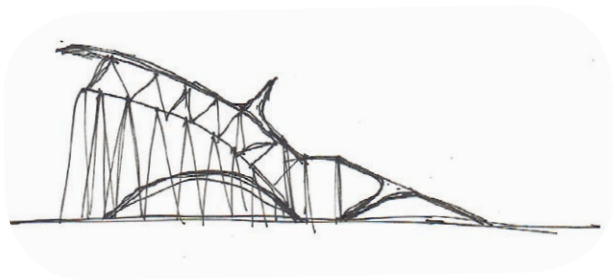
The Príncipe Felipe Science Museum

INSPIRING WORKS:

The Príncipe Felipe Science Museum

The museum was completed in 2001 by Santiago Calatrava in Valencia, Spain. The structural integrity is revealed in both the exterior and the interior of the building resembling the biological structure of a skeleton.

The structures form a holistic system which is derived from the biological structure of the spinal cord. The different vertebrae are held together by members that are both in tension and compression respectively.



Abstract model of the spinal cord

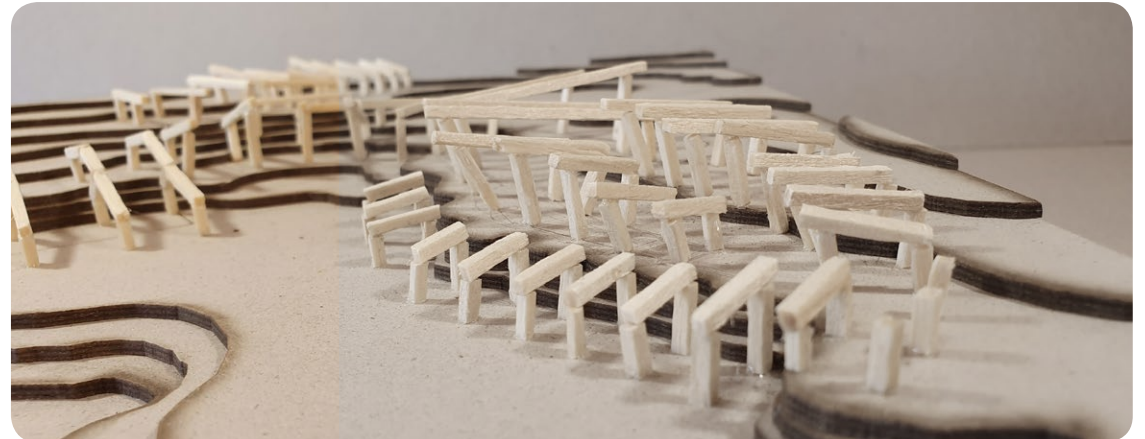
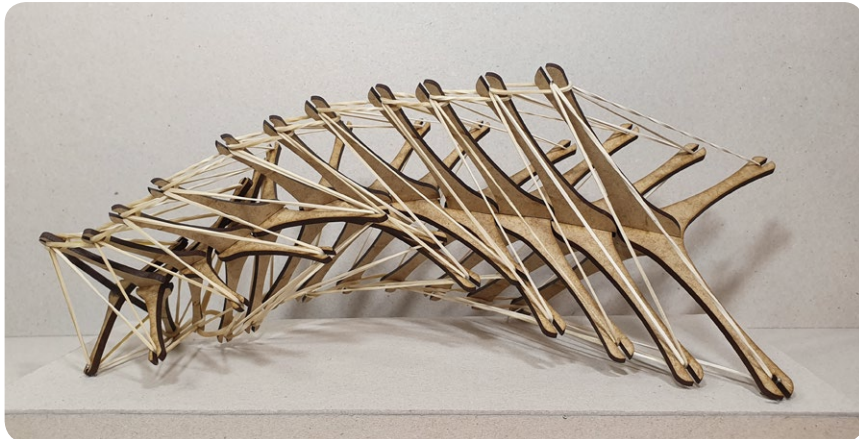




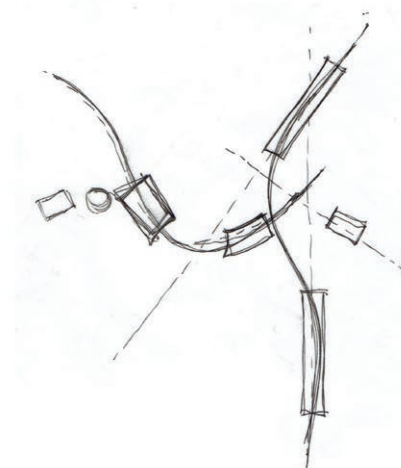
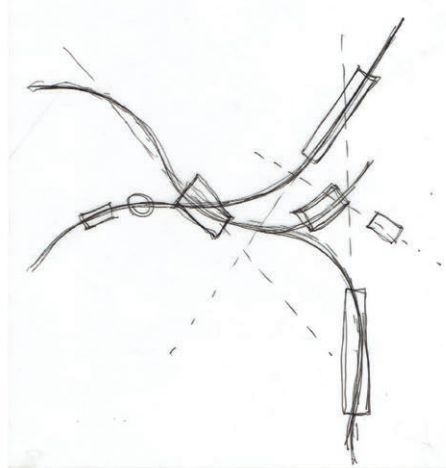
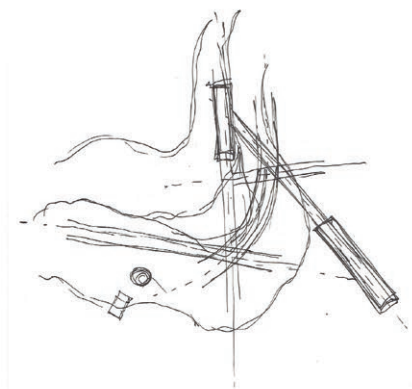
Abstract, three-dimensional extrapolation of the horse's spine



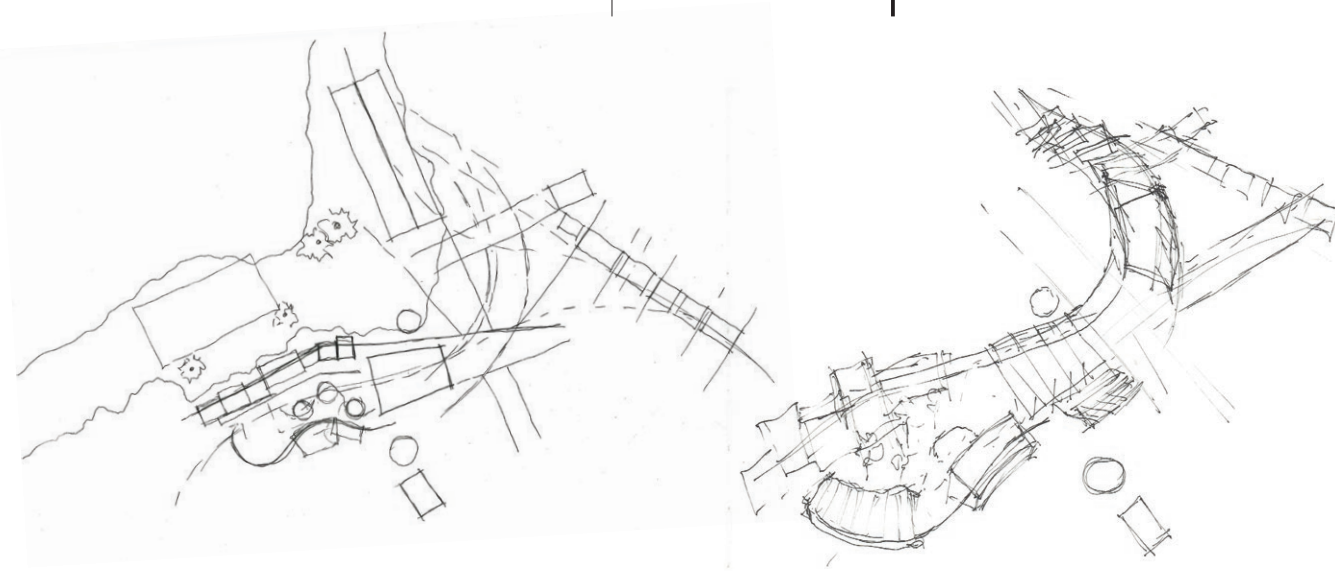
Spinal Synergy formed between man and horse



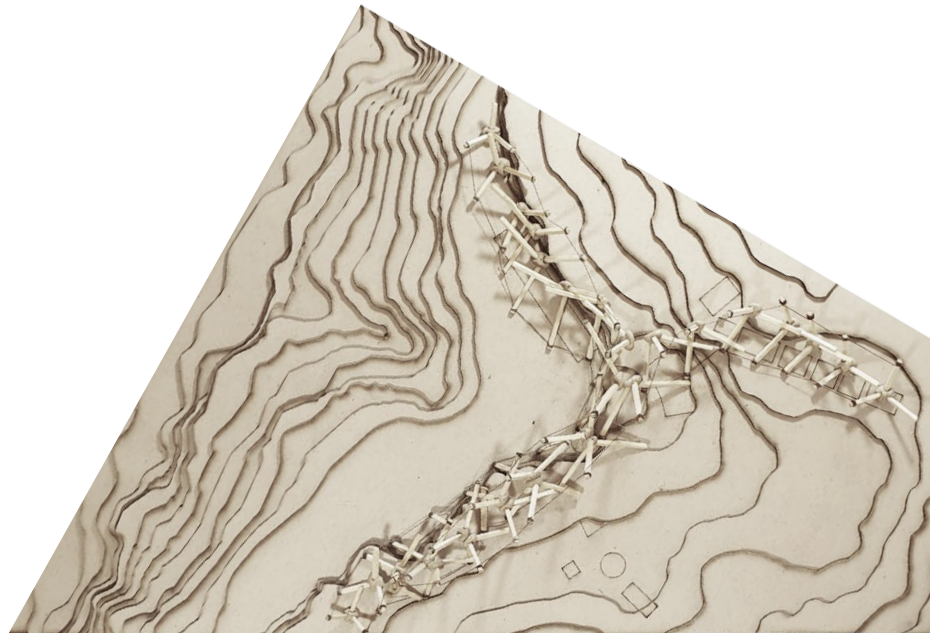
Spinal structure applied to spatial organisation



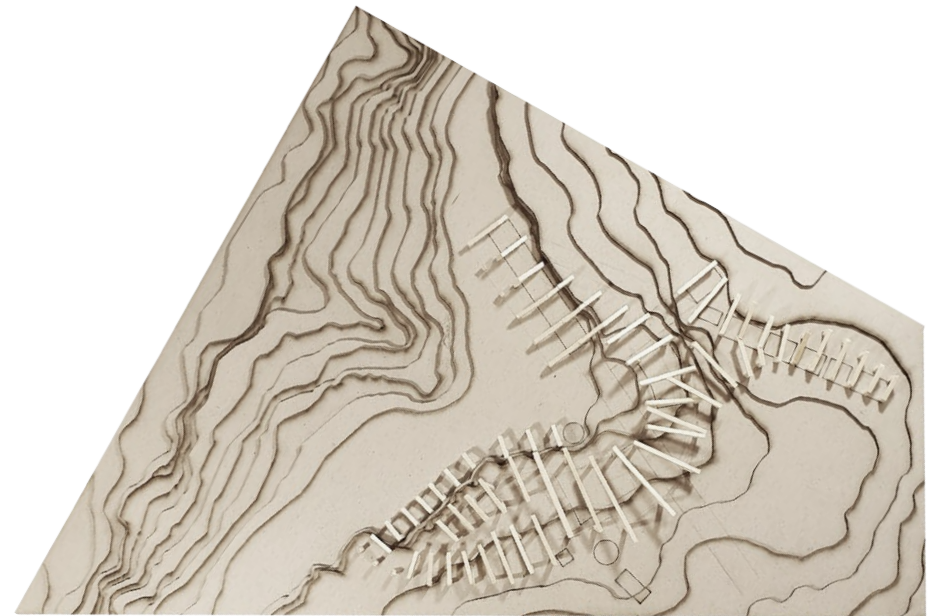
The structure of the vertebral column protecting the spinal cord can be interpreted through the design principles of tensegrity structures. Tensegrity structures are described as "an assemblage of tension and compression components arranged in a discontinuous compression system" (Fuller 1962). The word combines tensile with compression and was first used by Richard Buckminster Fuller in the 1960s. Biotensegrity can be described as the use of tensegrity principles in biological structures and can similarly be applied to architecture (Morgan, 2003).



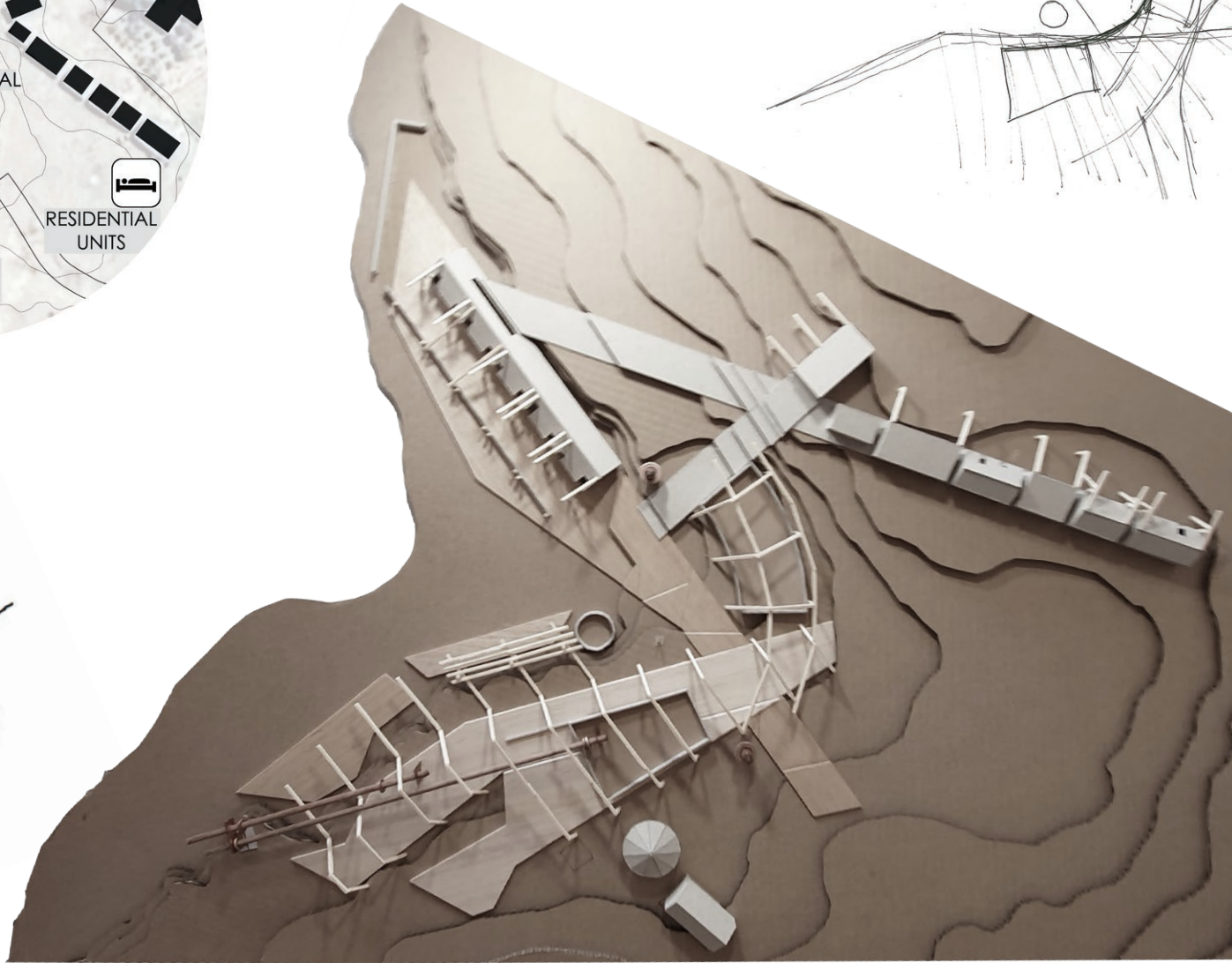
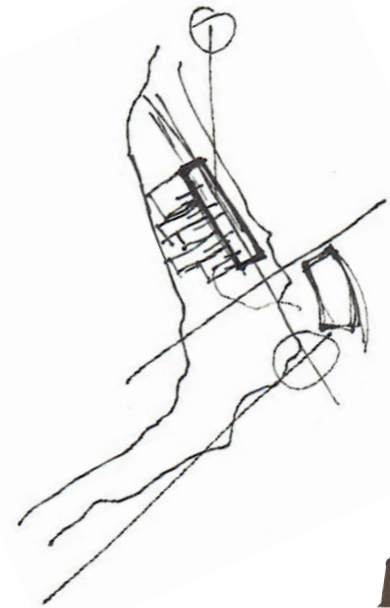
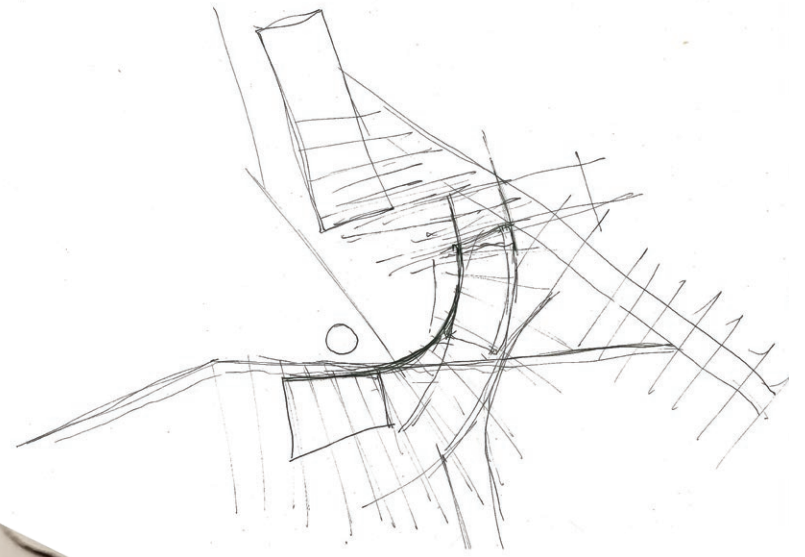
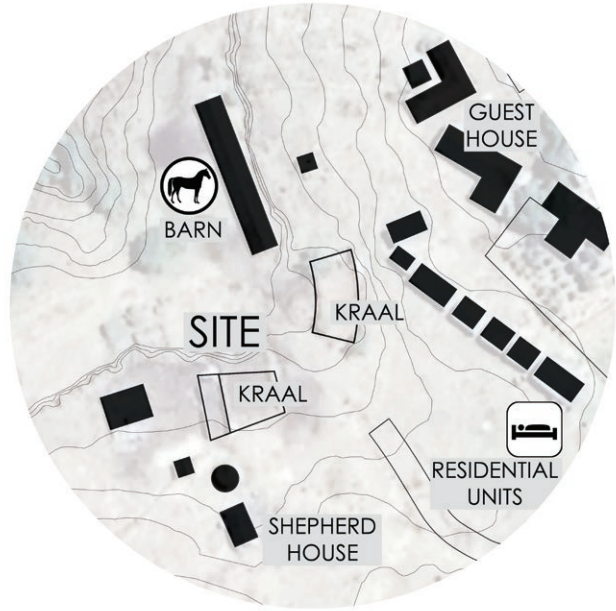
The spatial organisation of the site originated from the synergy formed between man and horse. The existing barn and residential units located on the site served as manmade axes forming the structural core of the metaphorical 'spines', interpreted as tensegrity structures. The following structural models show the relationship between the individual parts in compression, connected with members which are in tension to form the tensegrity relationship.



Spinal Synergy formed between man and horse



Spinal structure applied to spatial organisation



Site Model One: Spinal Synergy

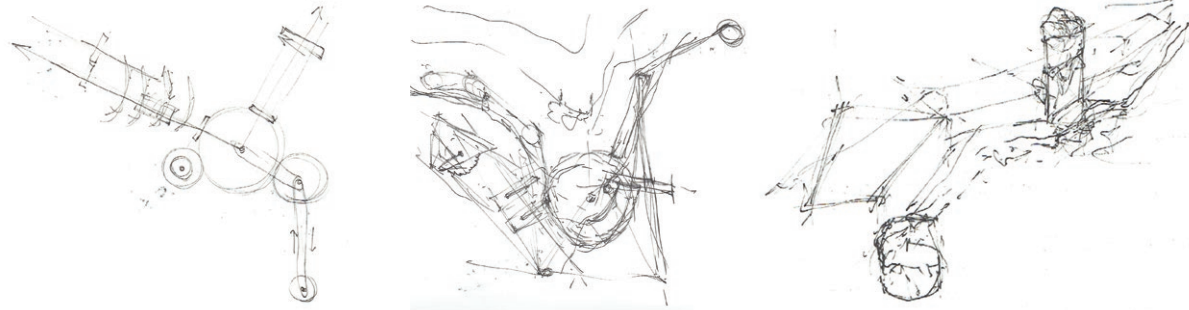
The application of the vertebral column posed useful methodologies to the spatial organisation of the project. The surrounding context was used to convey the existing relationships and functions to establish specific domains and points of engagement within the site.



PART 1.2

PHASE TWO

THE KINEMATIC CHAIN



Milwaukee Art Museum West Elevation



Milwaukee Art Museum Southern Perspective



INSPIRING WORKS:

Milwaukee Art Museum

Also designed by Santiago Calatrava, the Milwaukee Art Museum reflects the same principles of biotensegrity while combining them with mechanical

systems. The museum was constructed in 2001 in Milwaukee, USA and uses hydraulic systems to control two large brise soleil wings which can be opened or closed during to protect the building from prevailing wind conditions in the area. The wings span 66m across when opened and are made from steel fins rotating 90

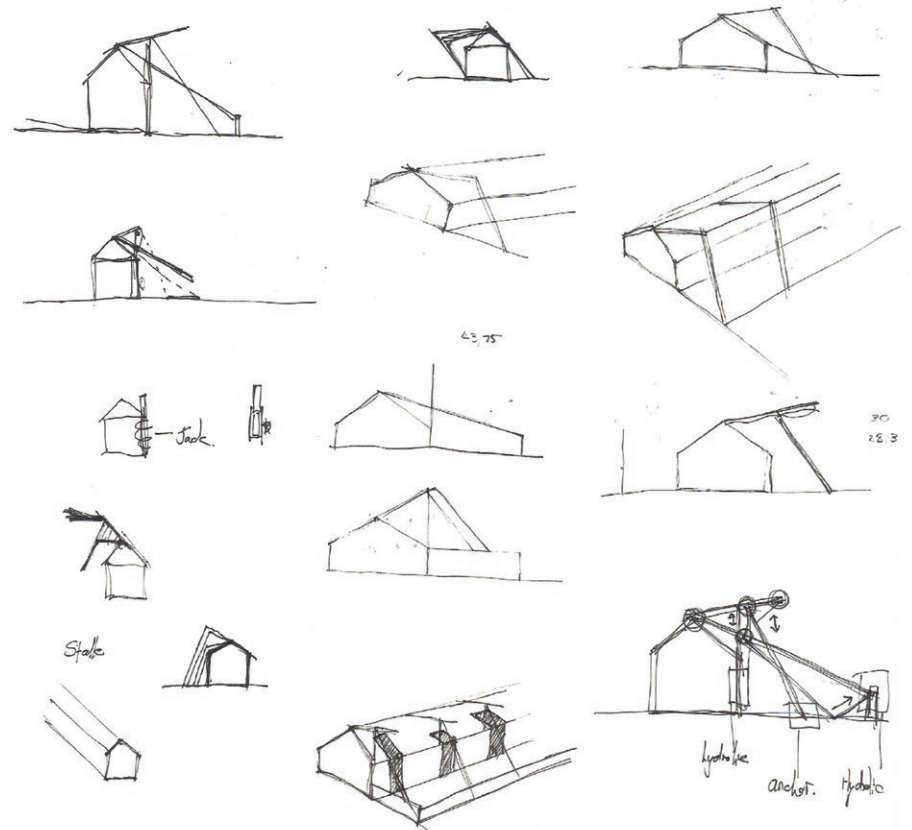
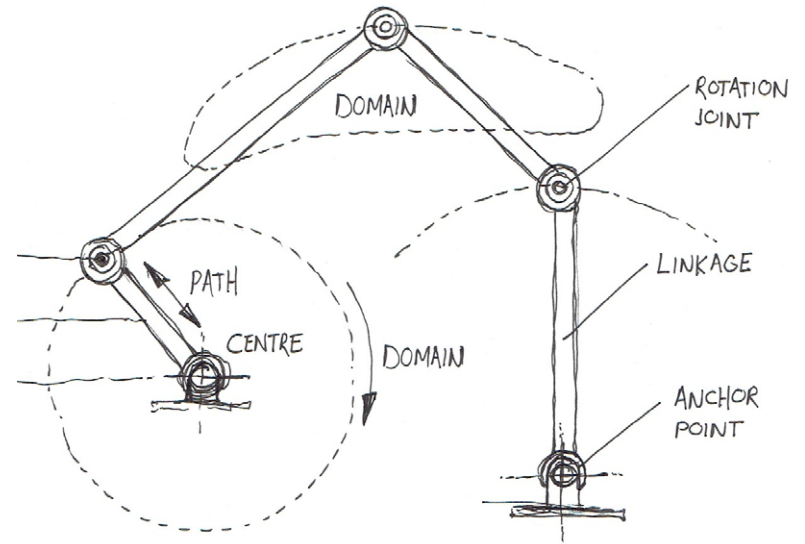
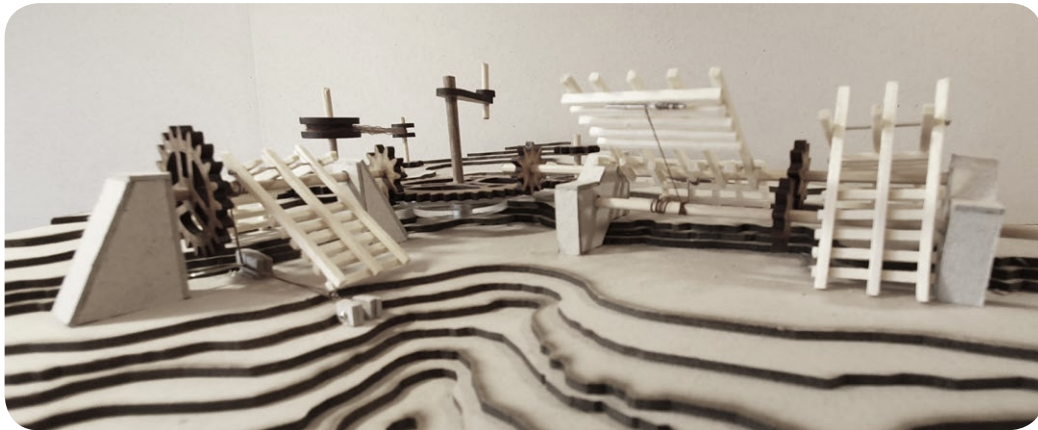
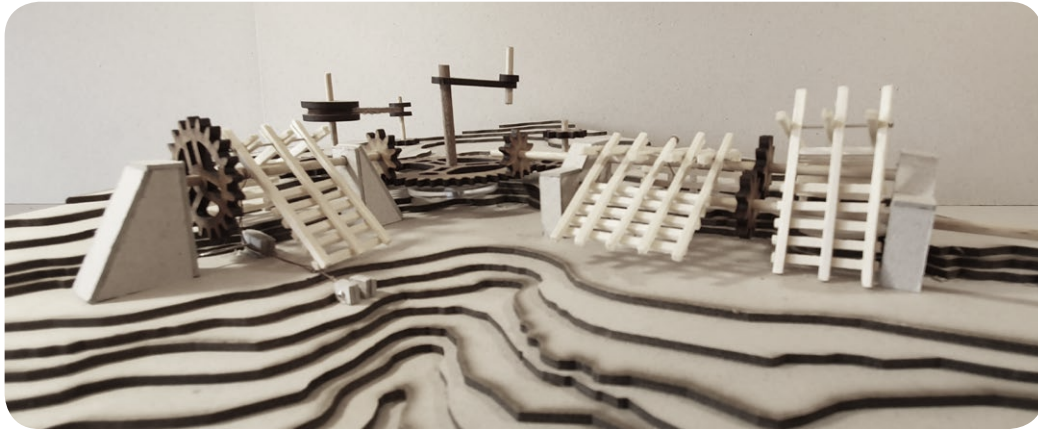
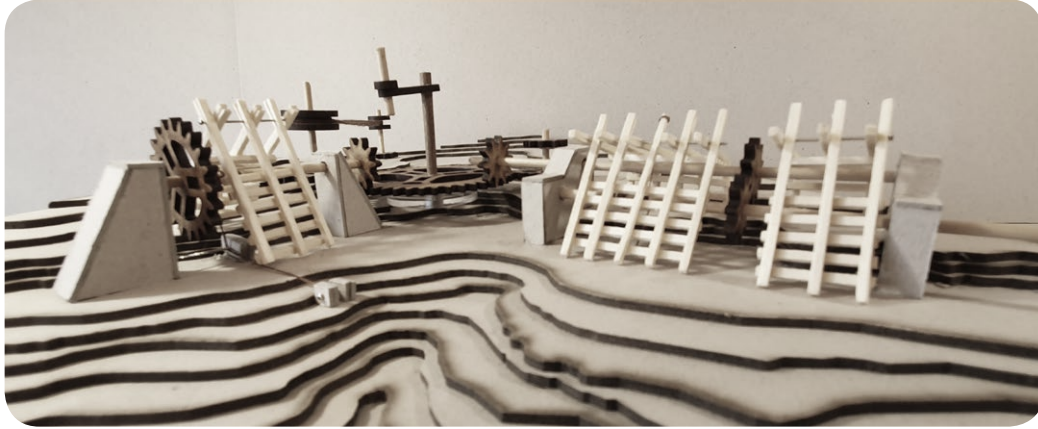
degrees at different intervals. Although the building is primarily constructed out of concrete, the flying buttresses and ribbed vaults reveal the biotensegrity structural system of the building.

phase two:

THE KINEMATIC CHAIN

PHOTO COLLAGE
ABSTRACT PLAN





INSPIRING WORKS:

Calvary 360

The following experimental models looked at how biomechanical movement can be translated into morphological principles based on the organisational schemata discussed in chapter two. The interaction of man with the built environment can possibly aid in community participation. Moreover, the interaction of man and horse working together within the built environment could result in recognisable space for man to orientate and identify himself in.

Calvary 360 is an installation piece by Neon Architects in Chesters Roman Fort, England. The steel structure is designed to interact with its environment by means of mechanical wind turbines which recreates the sound of horse hooves hitting the ground. The main objective of the structure was to revive the history of the site as well as the cavalryman and horses that participated in its wars. The steel frame touches the ground lightly leaving a minimal footprint, while having a large impact through motion and sound.



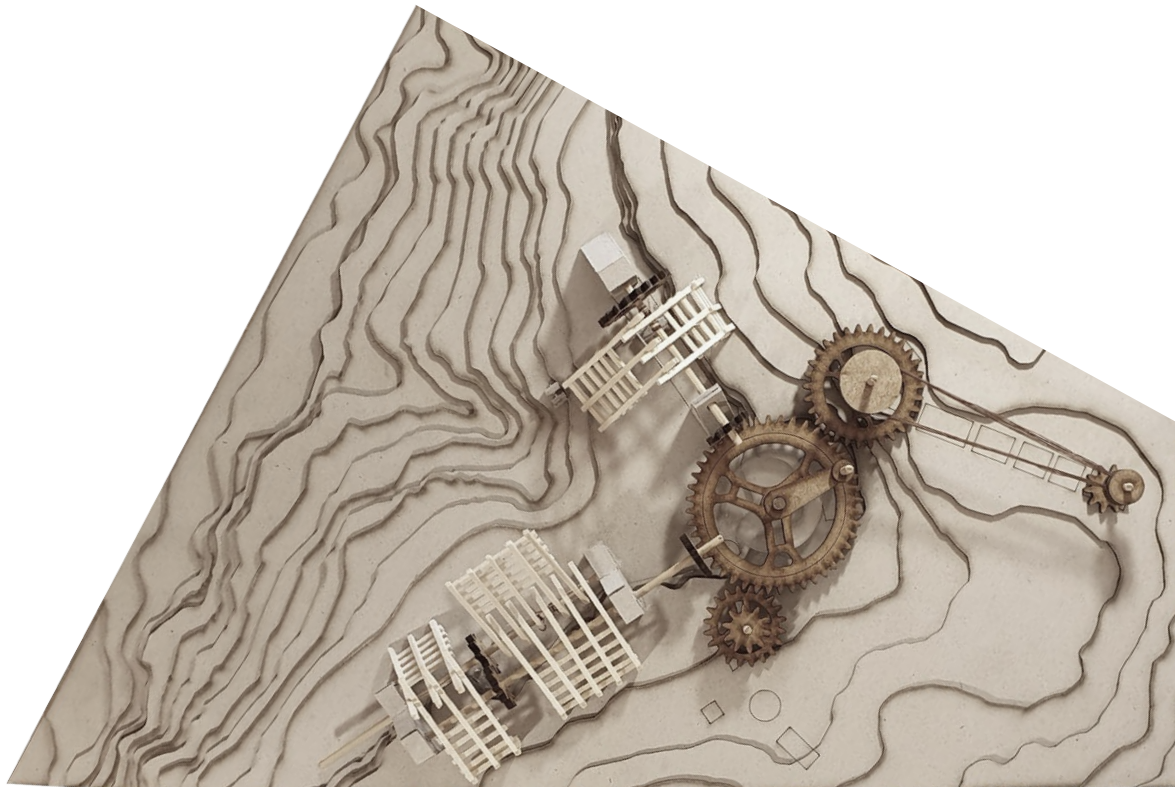
Calvary 360 Perspective

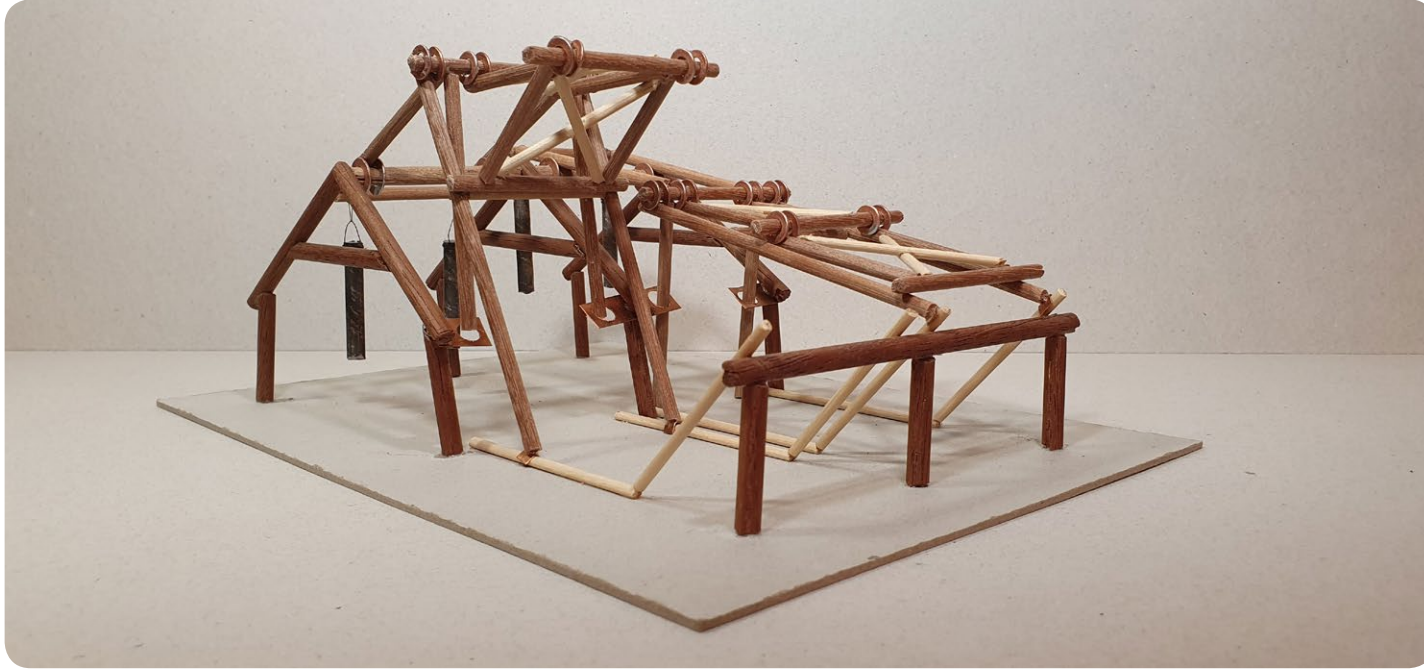


Calvary 360 Aerial View



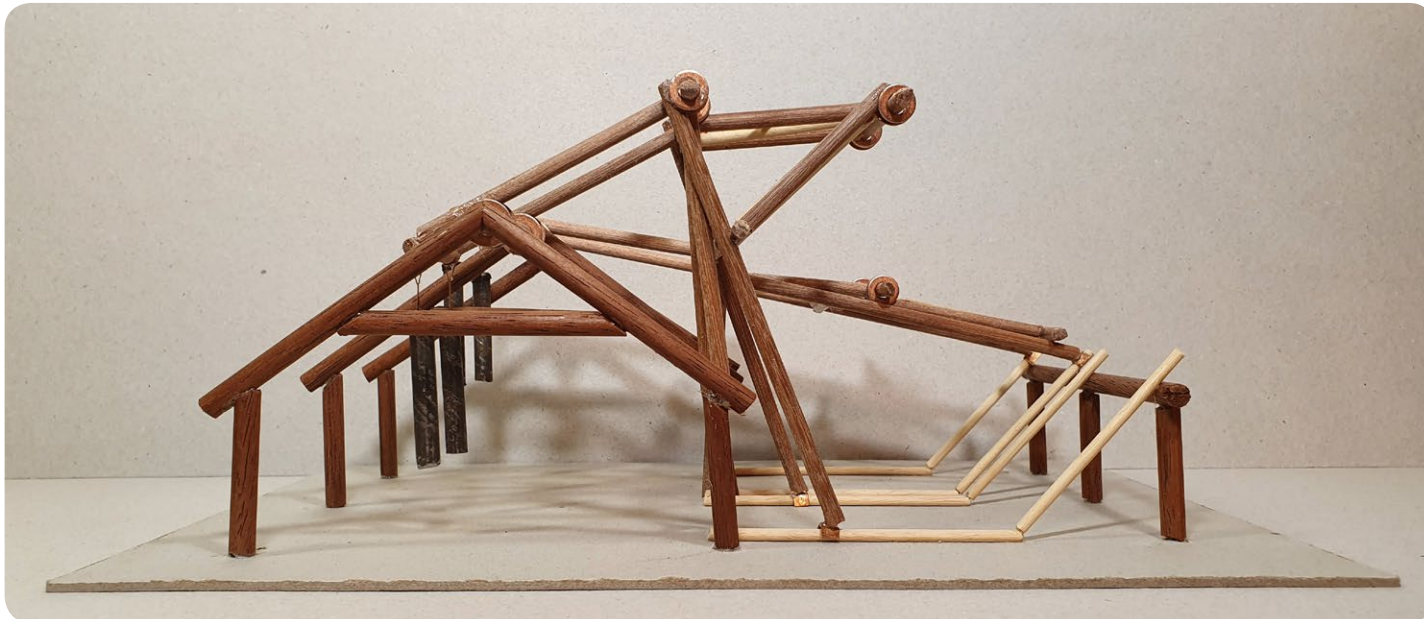
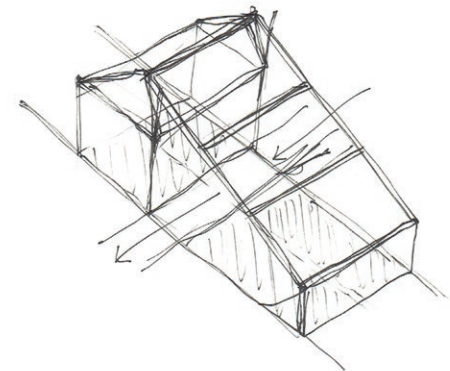
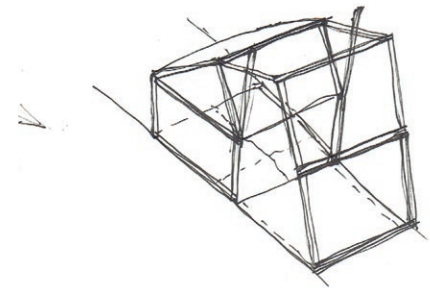
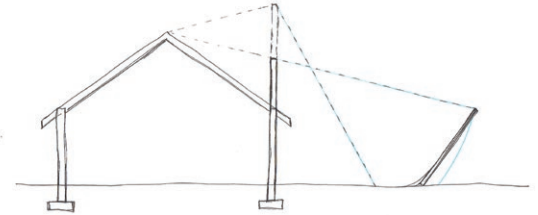
Calvary 360 Ground Level Perspective

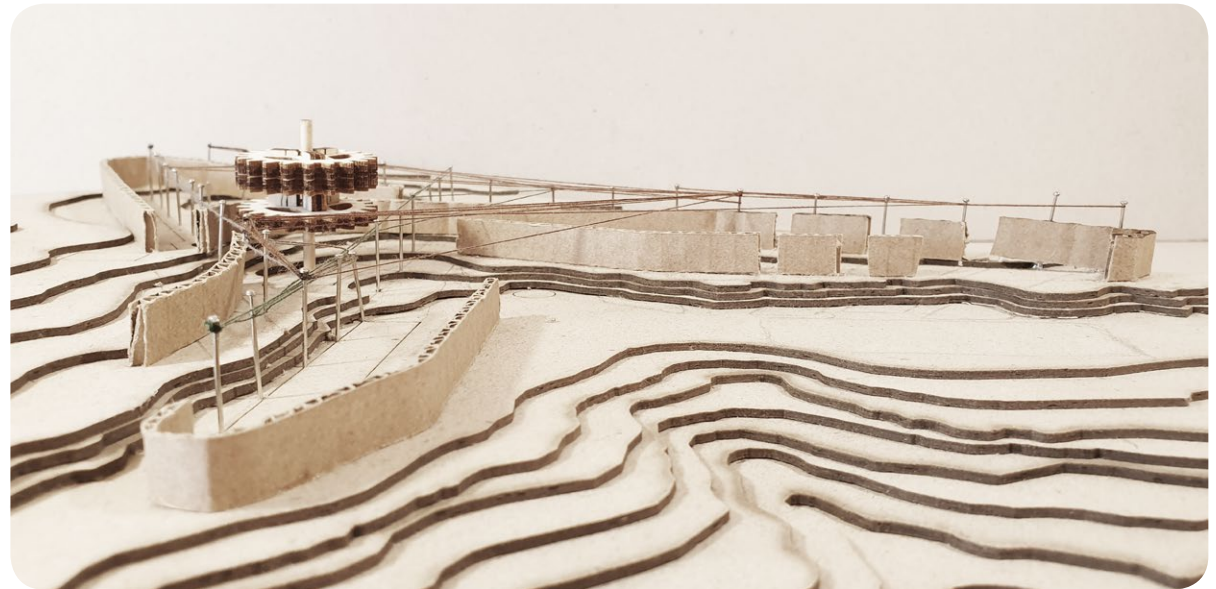
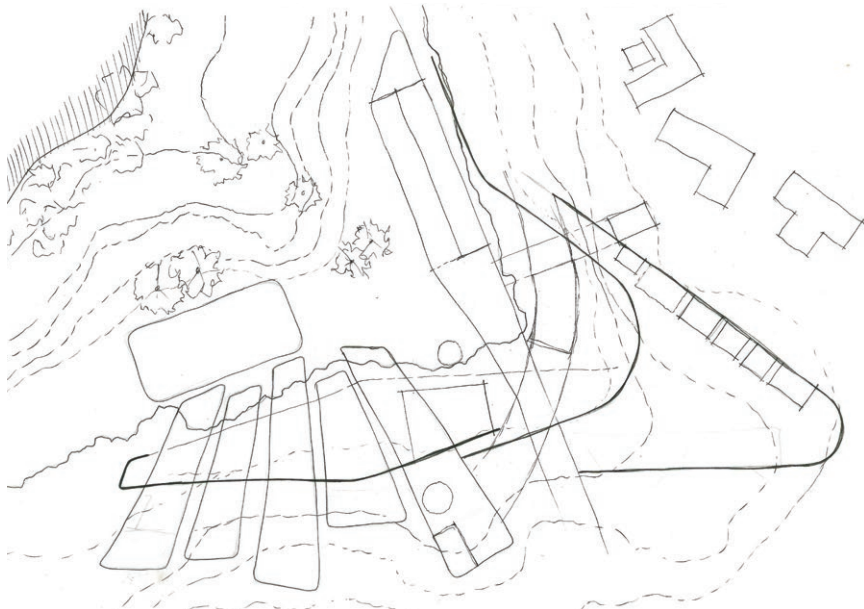
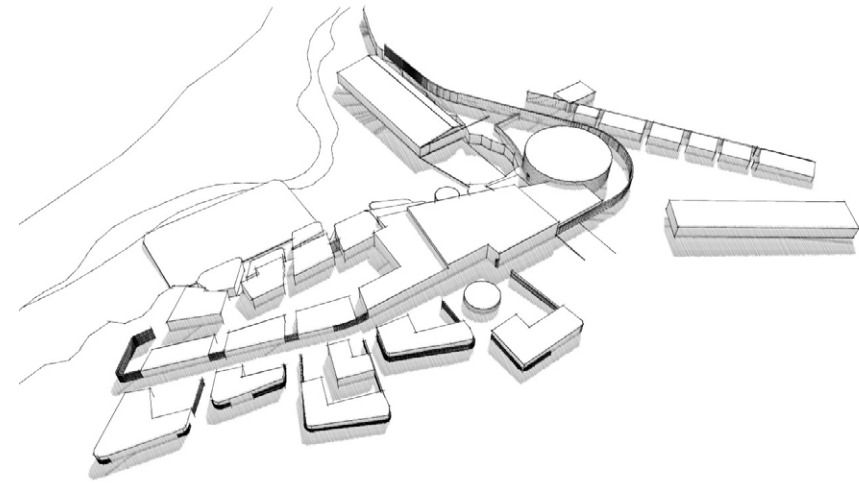
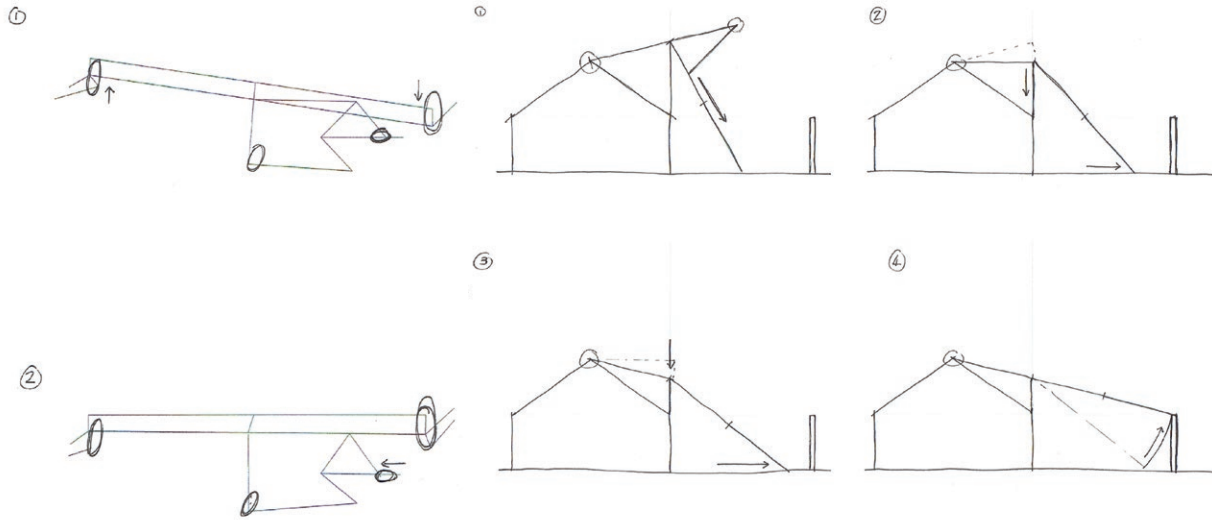


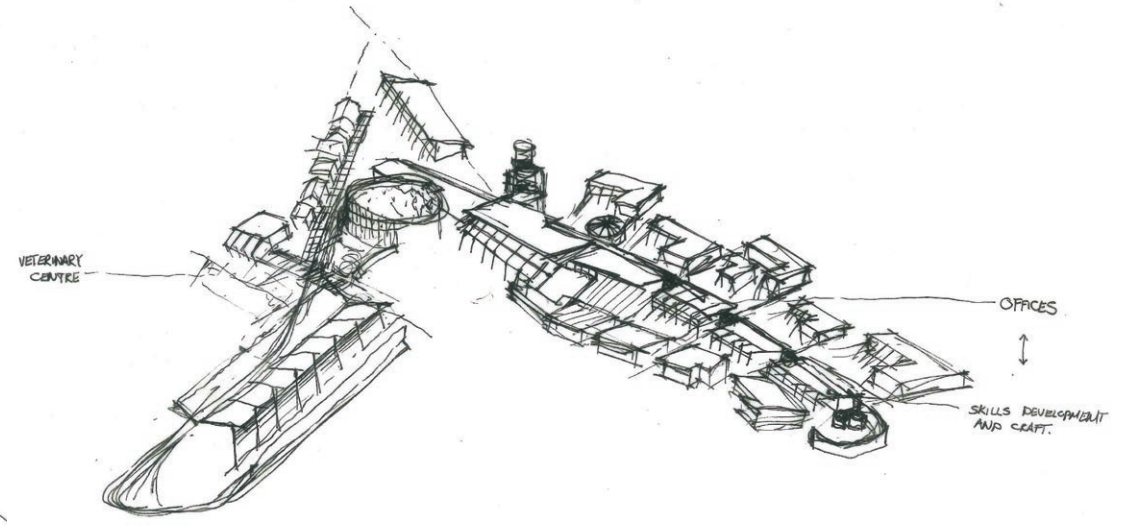
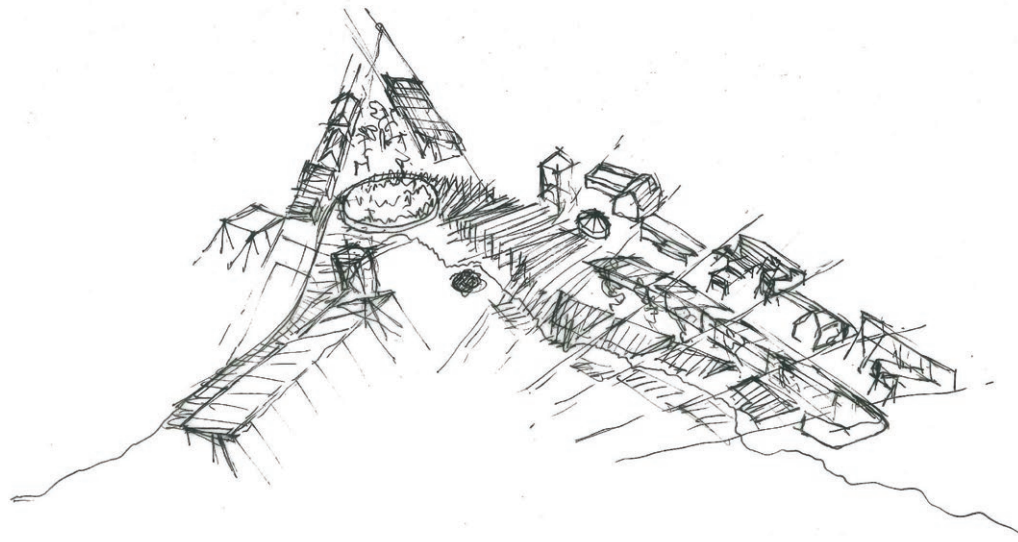
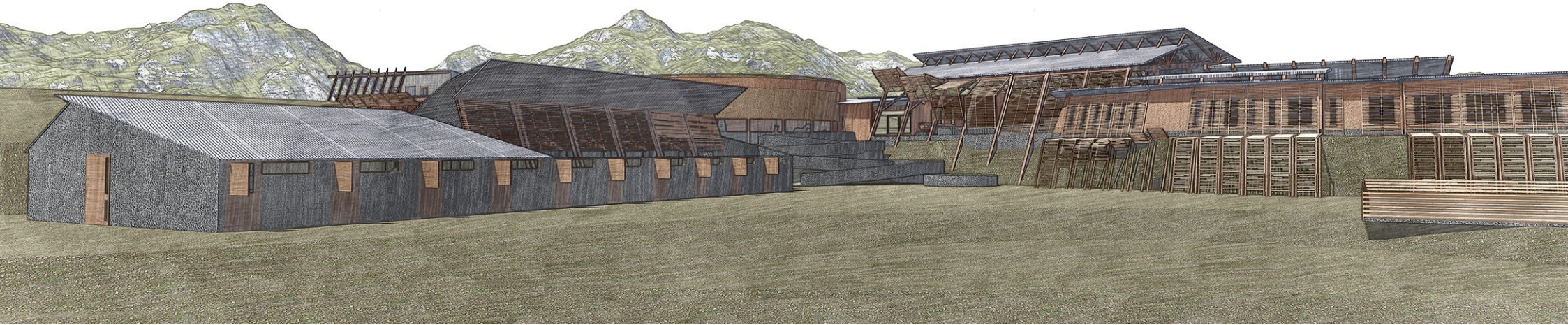


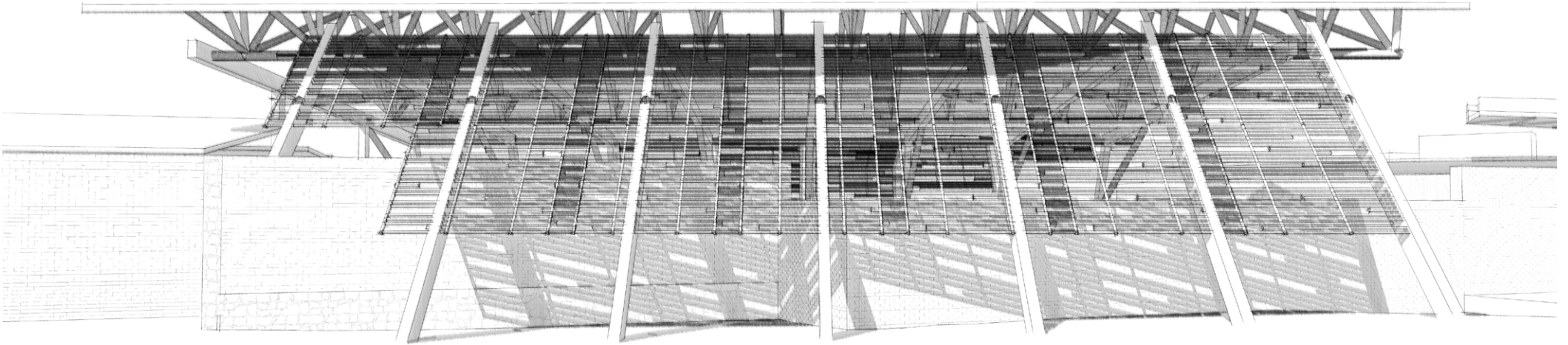
BIOMECHANICAL MOVEMENT

Development models proposing biomechanical movement to integrate inside and outside spaces of the barn. Note how anchor points, links and rotation joints can be translated into the built environment to create spaces of dynamic tension.

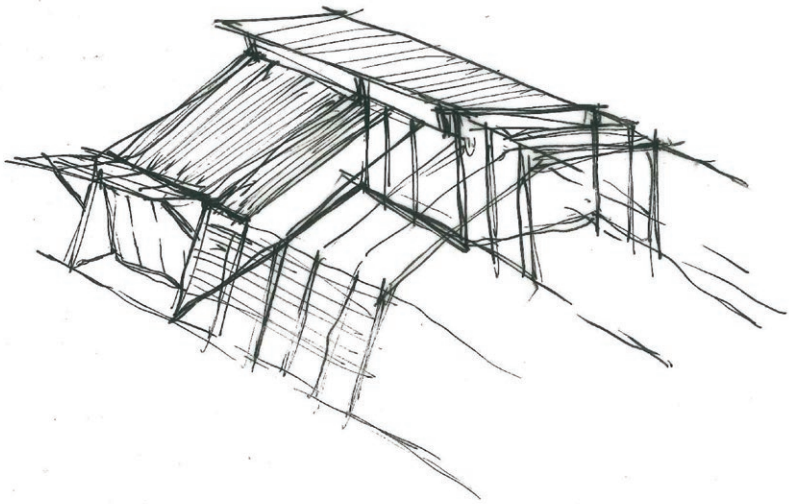




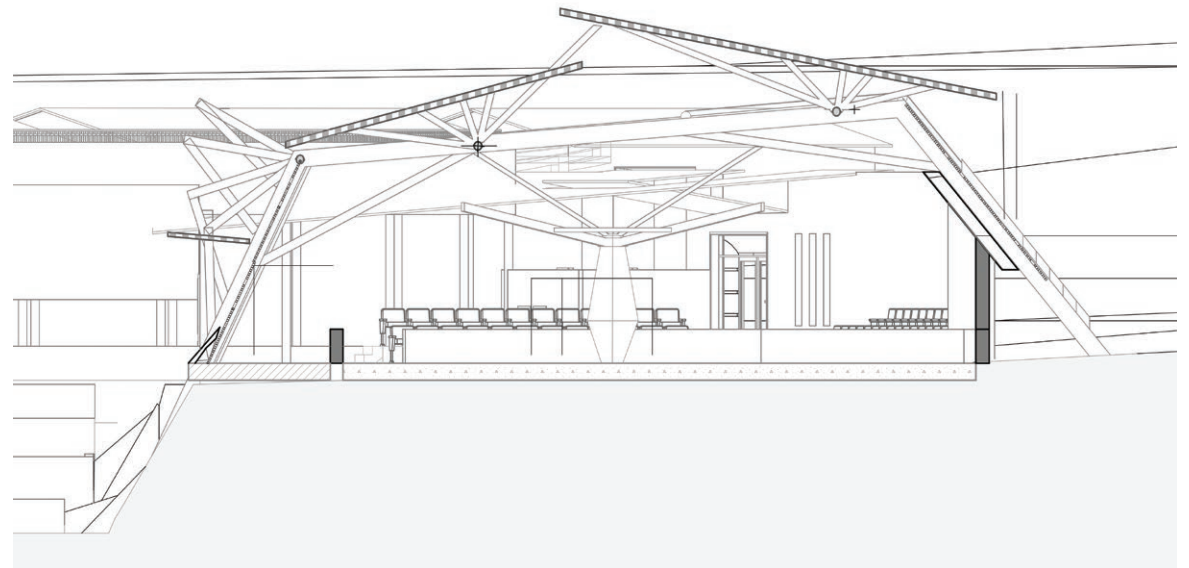




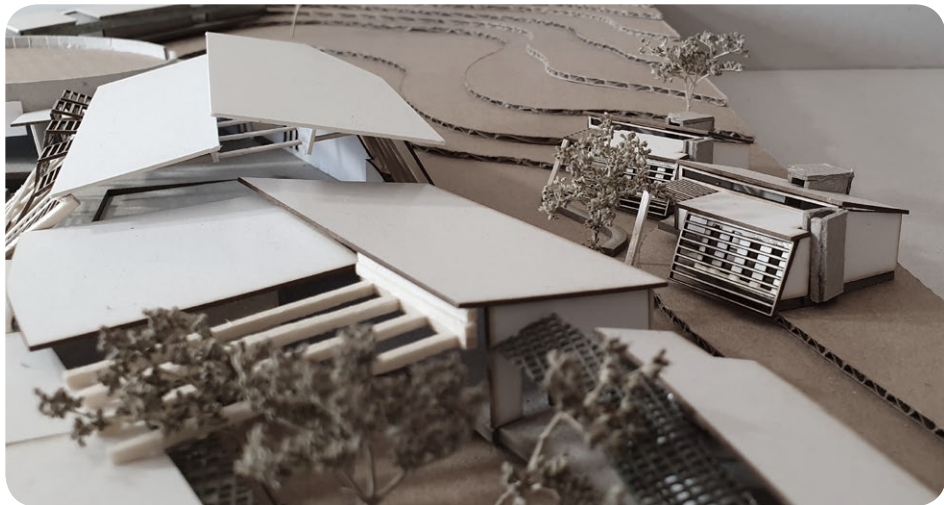
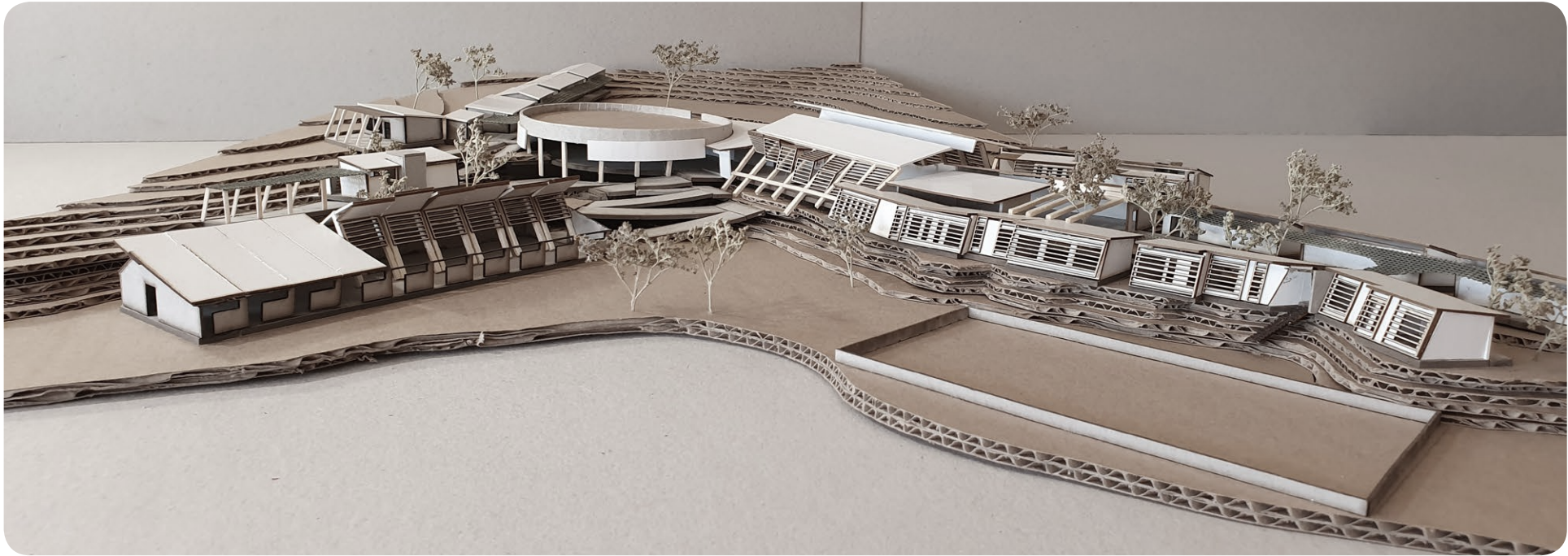
EXTERNAL FACADE OF THE INDOOR ARENA



VOLUNTEER LIVING UNITS PHASE TWO



SECTION OF ARENA PHASE TWO



Site Model Two: The Kinematic Chain

phase two:

THE KINEMATIC CHAIN



FLOOR PLAN PHASE TWO

SCALE 1:200





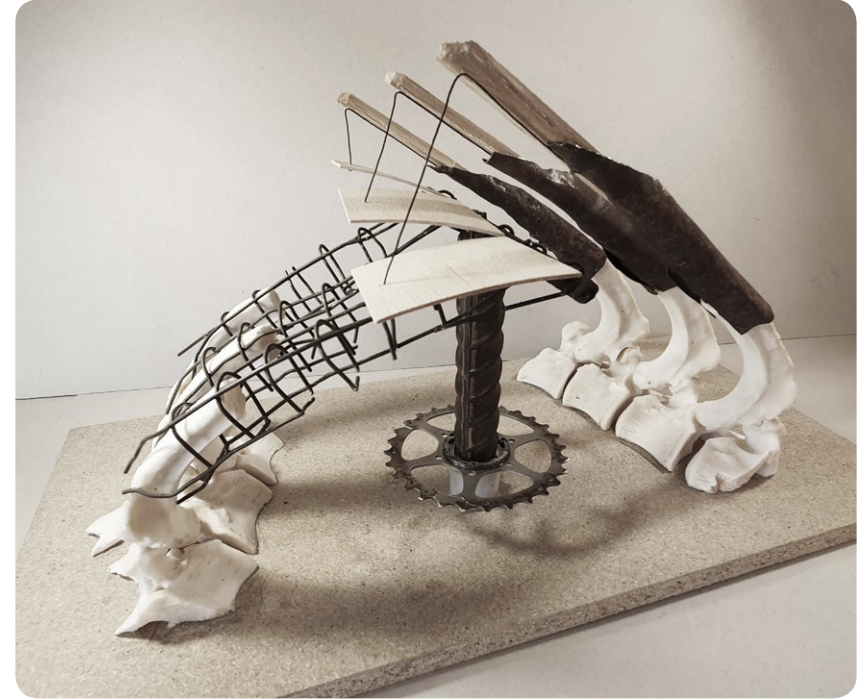
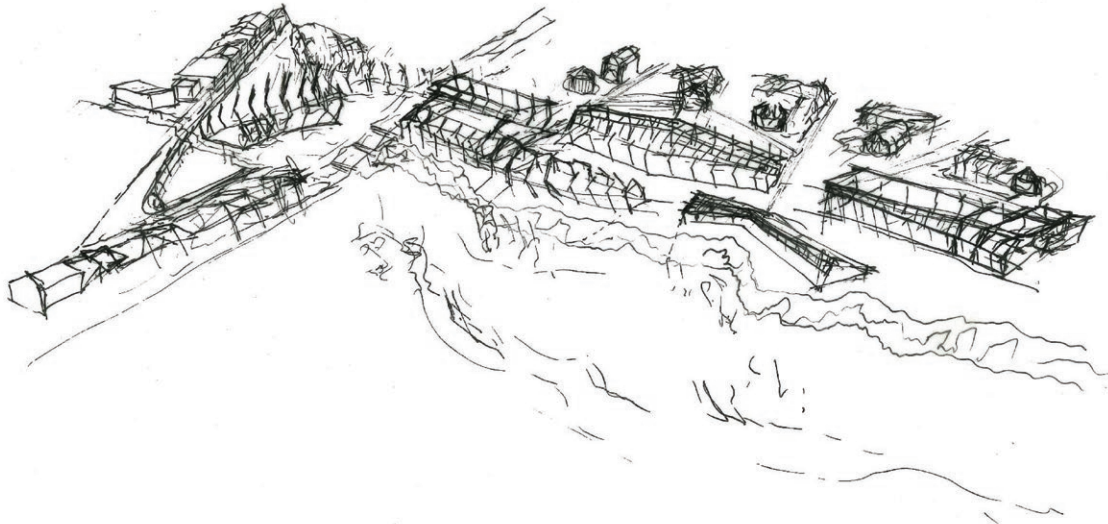
A conceptual model was built, again using horse and cow bones, to convey the synergy between man and horse through two different structures actively engaged with one another: forming a state of dynamic tension.

PART 1.3
PHASE THREE
GATHERING POTENTIAL ENERGY



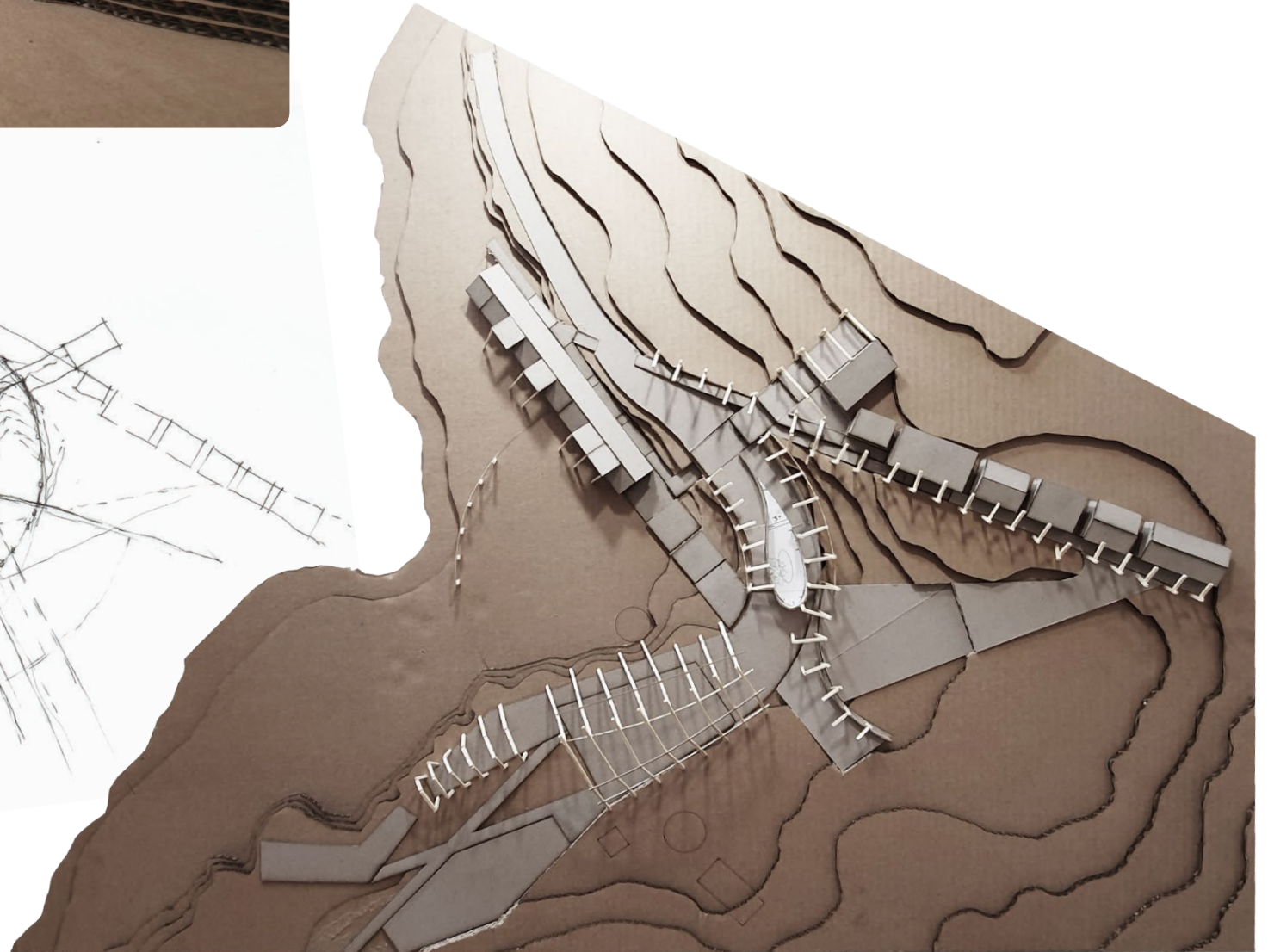
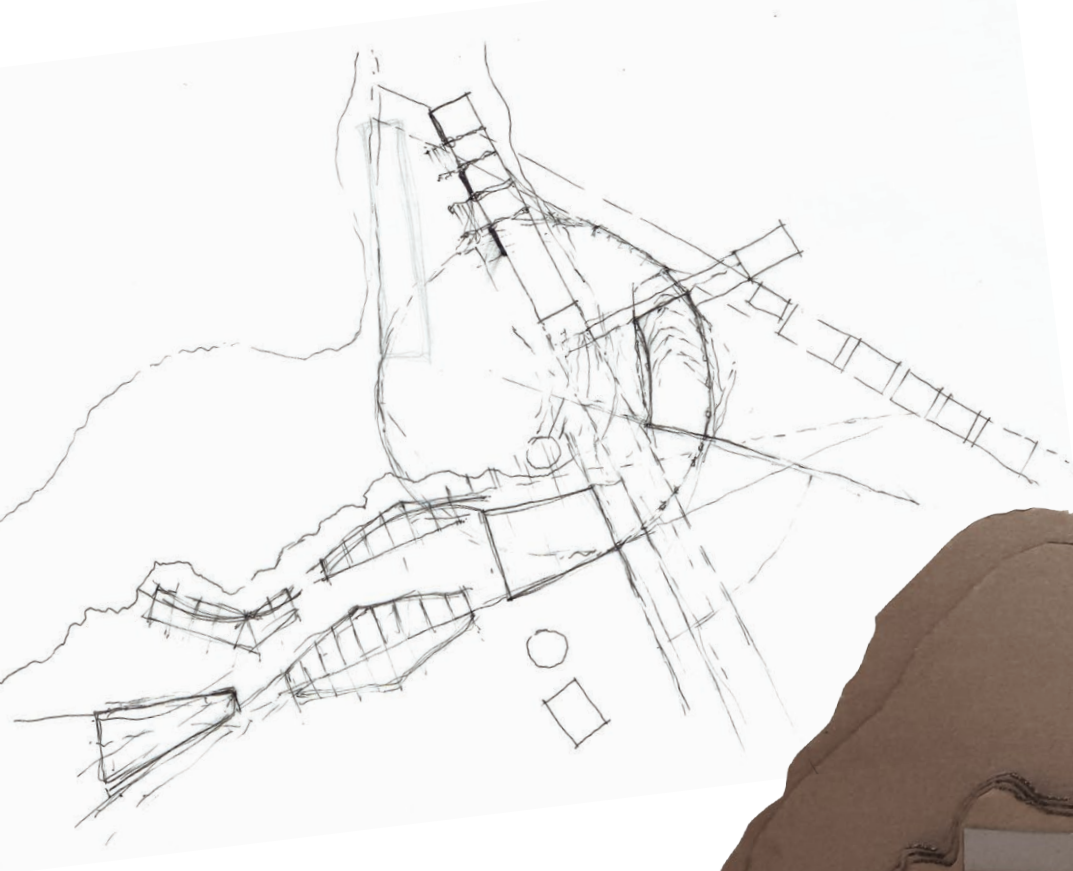
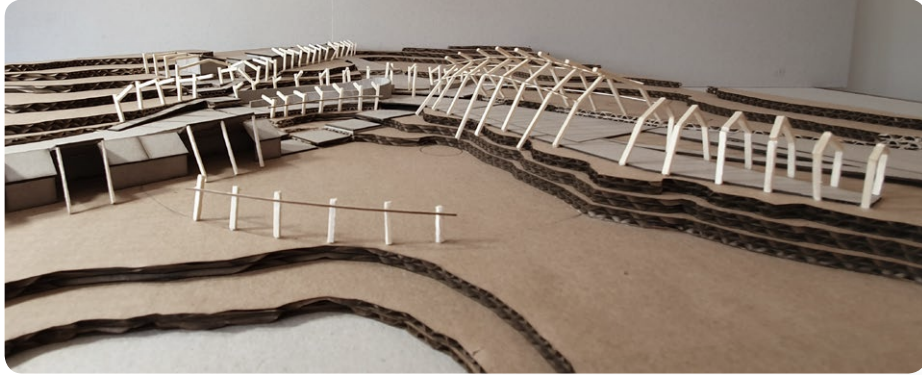
Inspirational Works:

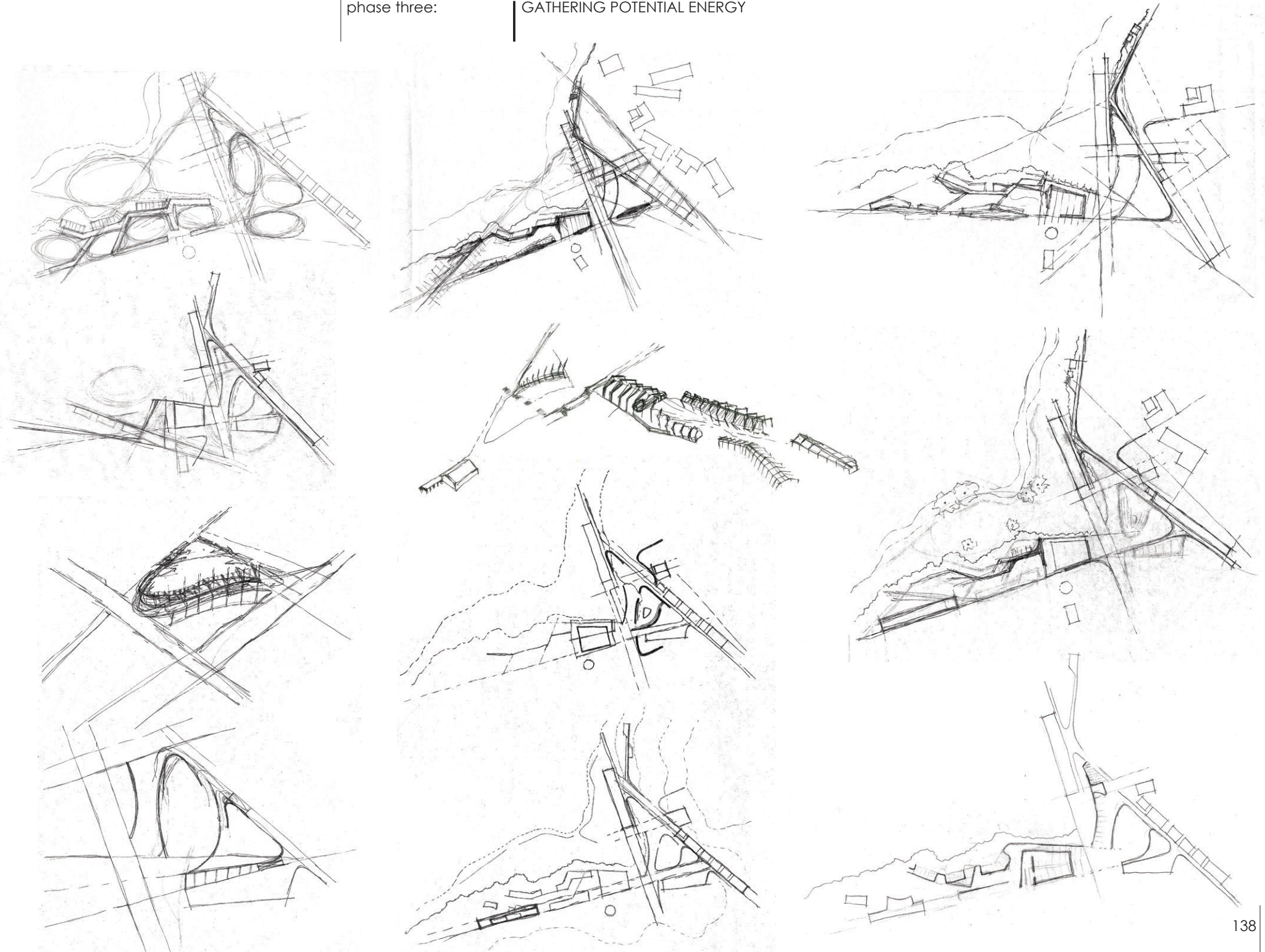
The Stirling Engine. Transfers temperature difference as potential energy into kinetic energy. By utilising the existing resources the therapy arena is able to benefit from the existing synergy between man and horse.

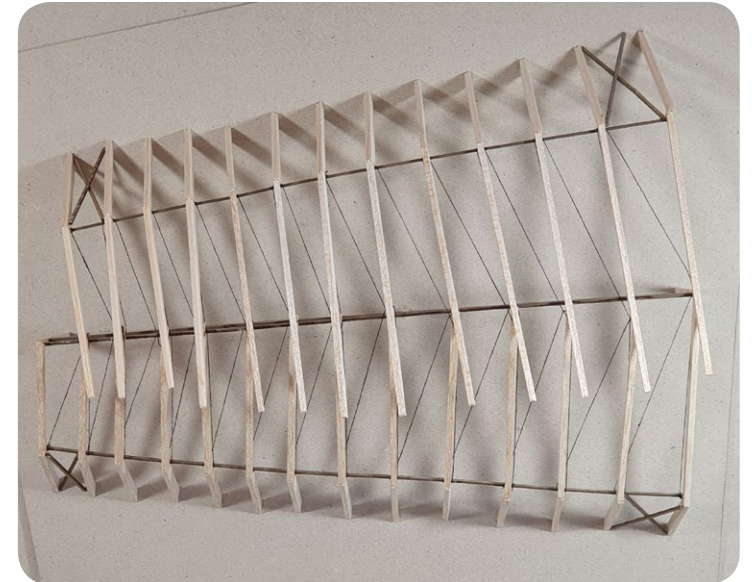


The third phase of the development focused on combining the two previous sections into a gathering of place. Here the synergy between horse and man was translated into the metaphorical structure of the indoor hippotherapy arena by using two separate vertebral columns with a state of dynamic tension in between them. The horse is also used in collaboration with man not only to facilitate therapy but to regulate the functionality of the building. Panels are attached to the roof of the structure and operatable from the centre of the hippotherapy arena. This mechanism will allow natural ventilation of the facility in summer while being able to close in winter.



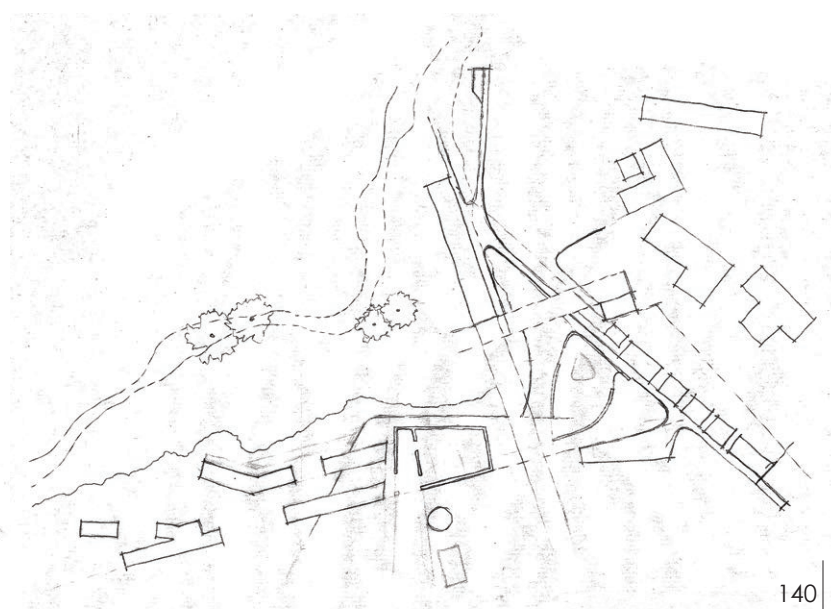
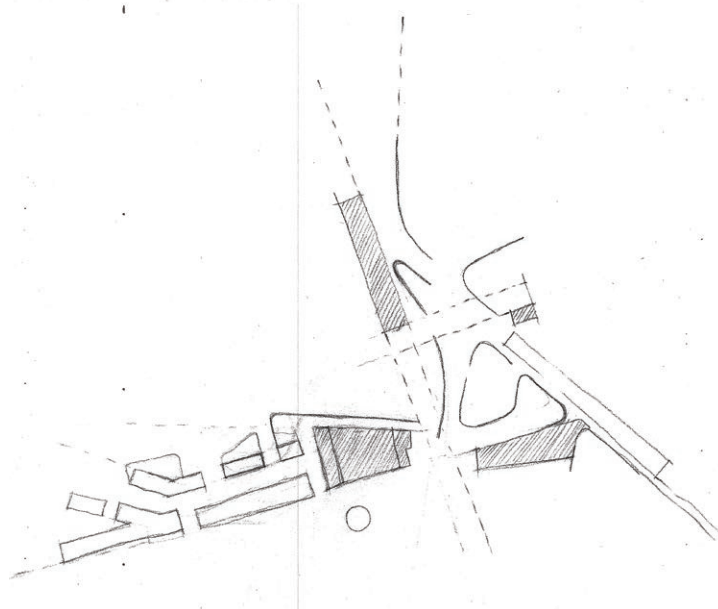
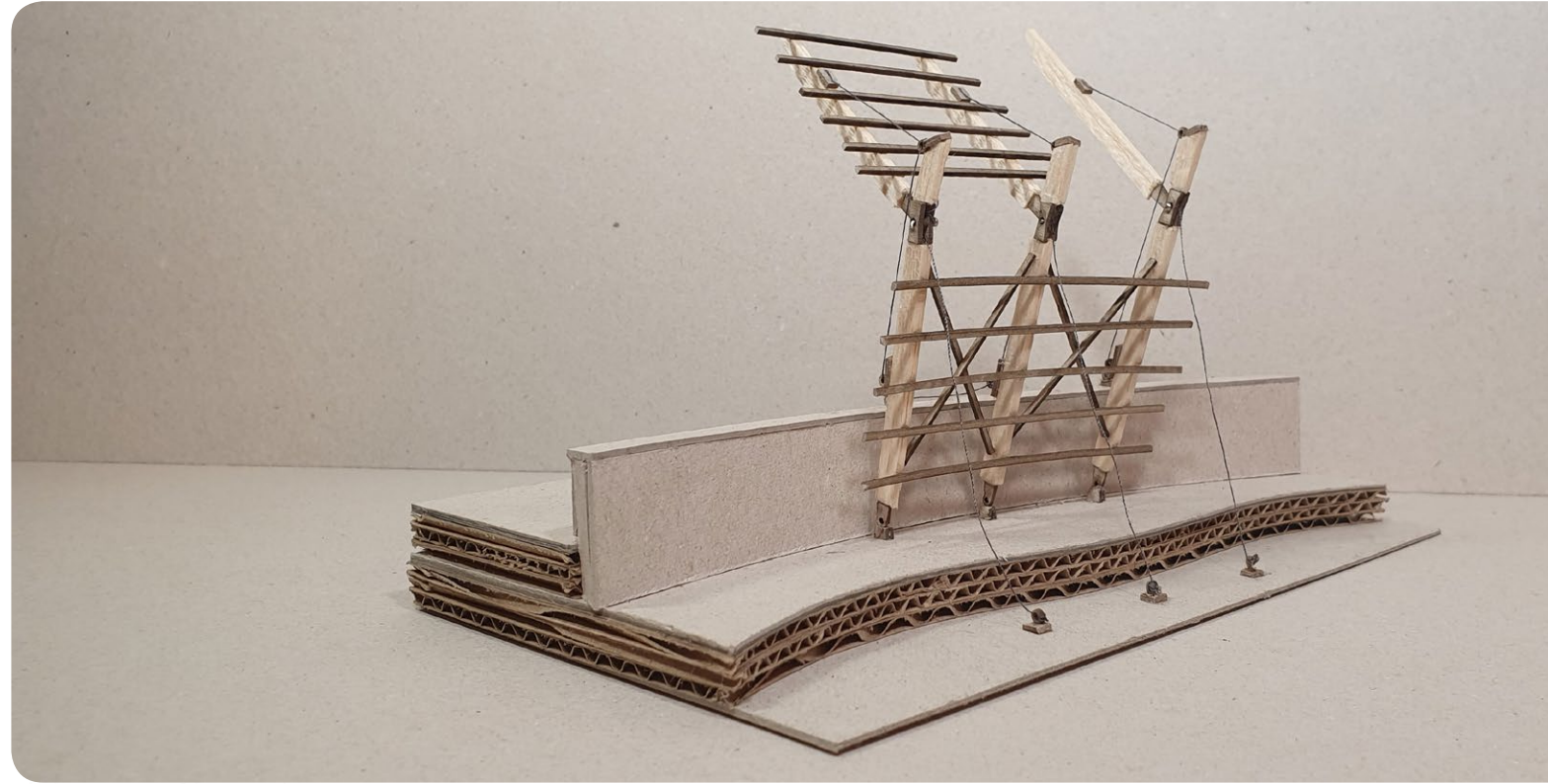


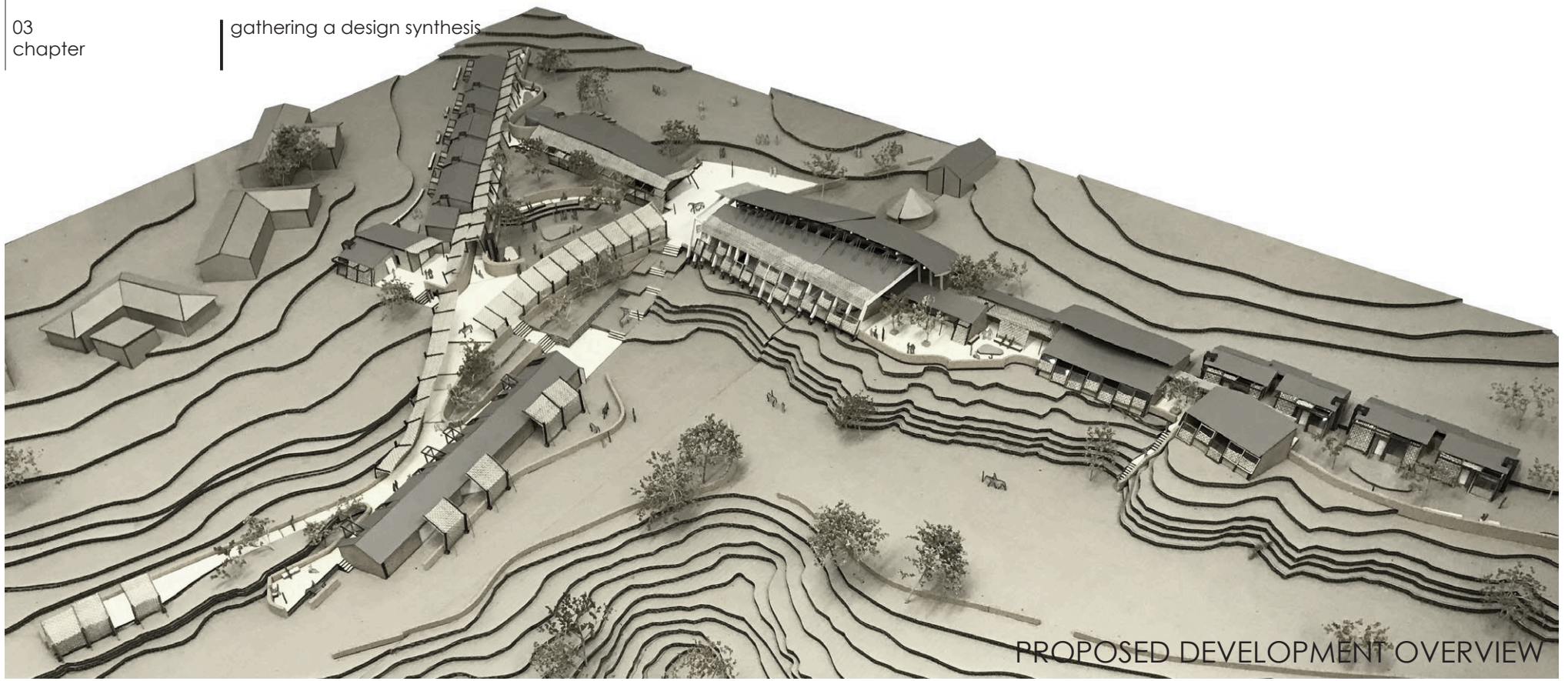




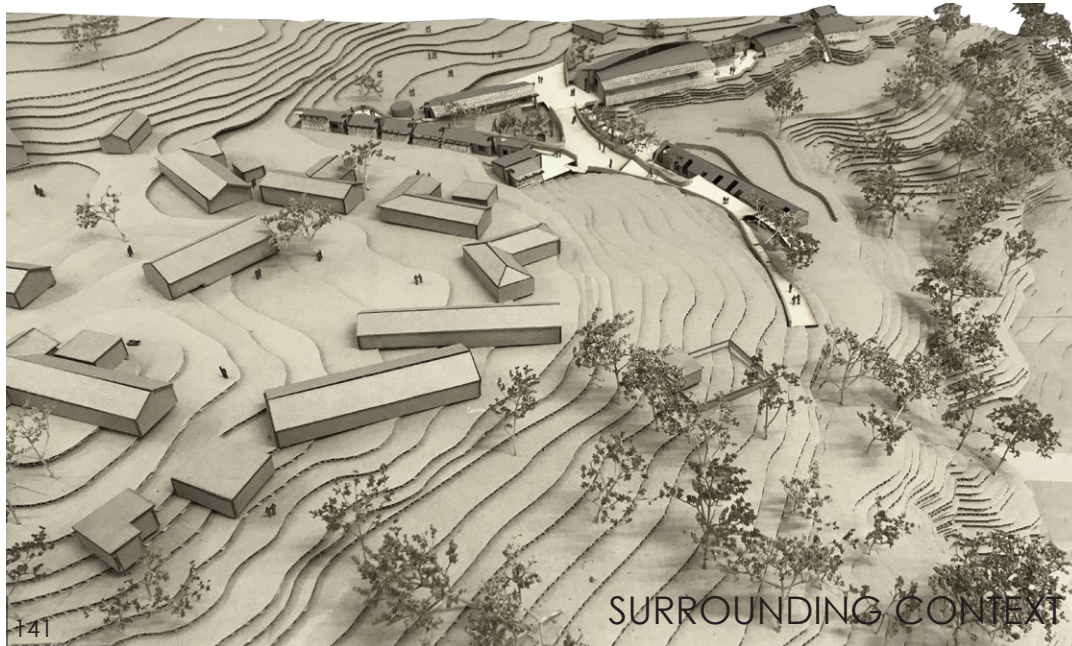
The nature of the hippotherapy centre required the structure to span over the existing parameters confining the arena of the kraal. The structural solution became apparent after analysing the spine of the horse once again. The timber frameworks work against each other by pushing the building's weight in a state of compression. Steel cables are used to secure this weight by pulling them together, thus forming a tensegrity structure.

A conceptual model was built, again using horse and cow bones, to convey the synergy between man and horse through two different structures actively engaged with one another. Forming a state of dynamic tension.





PROPOSED DEVELOPMENT OVERVIEW



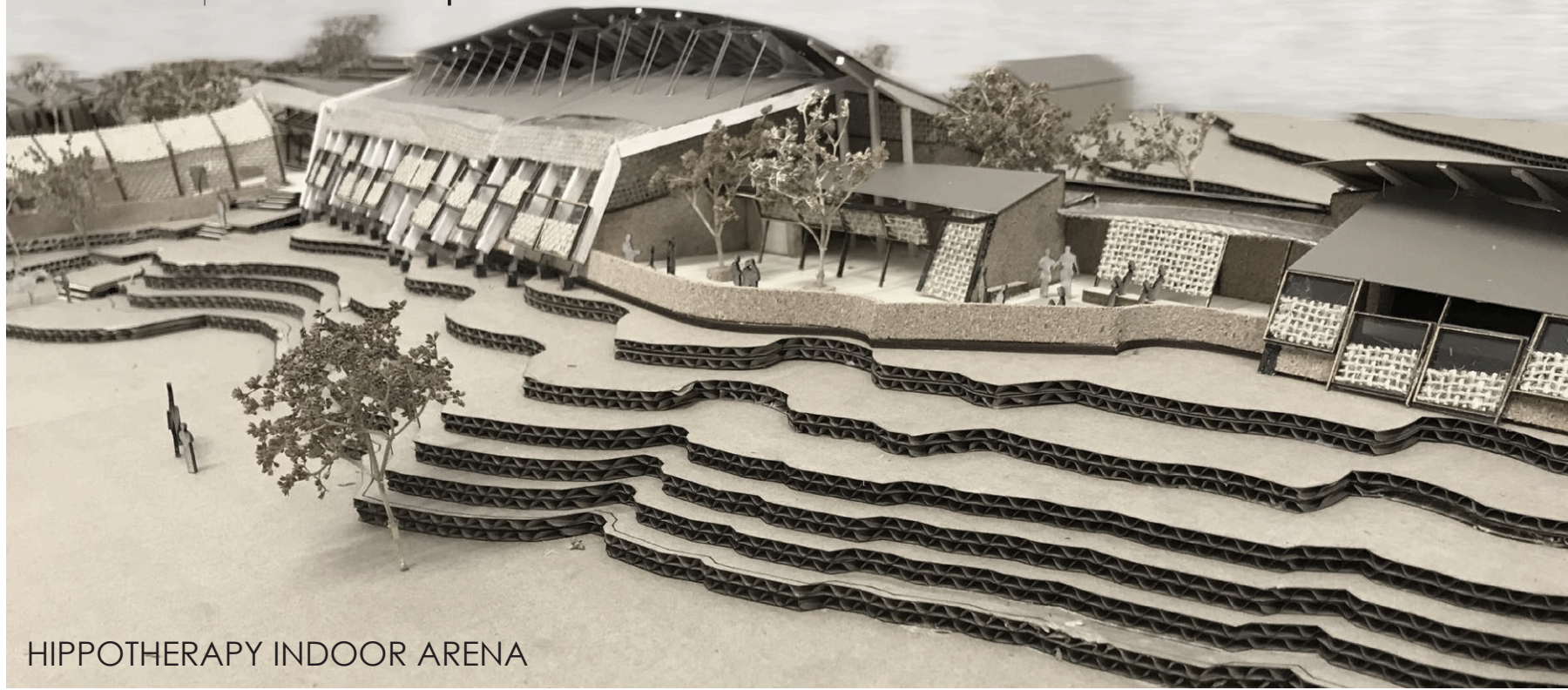
SURROUNDING CONTEXT



COMMUNAL AREA

phase four:

FINAL MODEL



HIPPOTHERAPY INDOOR ARENA



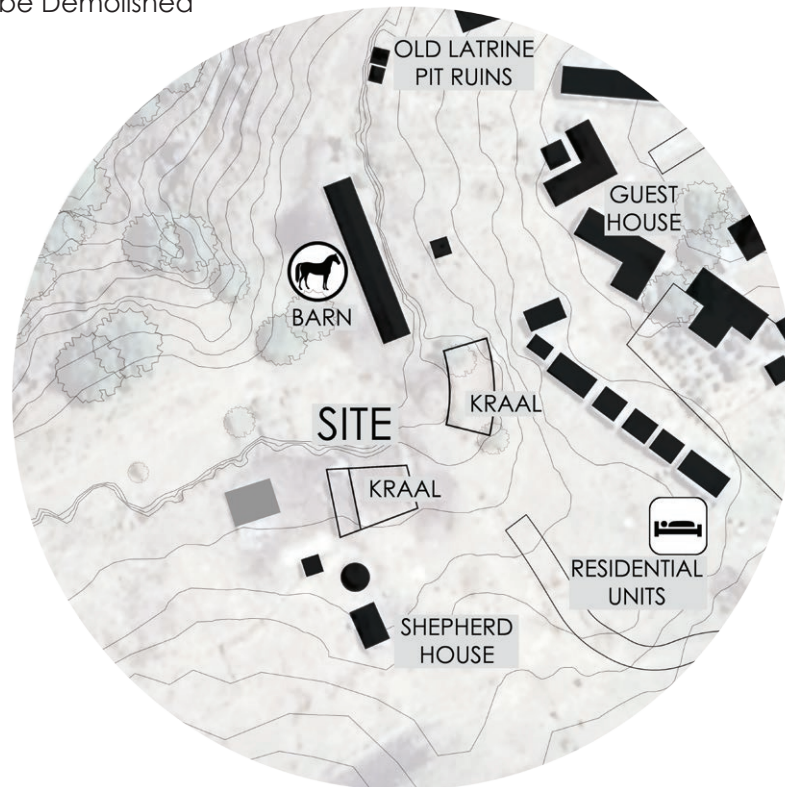
COMMUNAL AREA



INTERACTION AREA

The Biomechanical Hippotherapy Centre and Cultural Pavilion seeks to create sustainable impact through a holistic approach to therapy, horse care, community participation and social belonging through simple biomechanical design solutions uniquely rooted in Semonkong's cultural and natural landscape.

- Existing Structures
- Structure to be Demolished



PART TWO

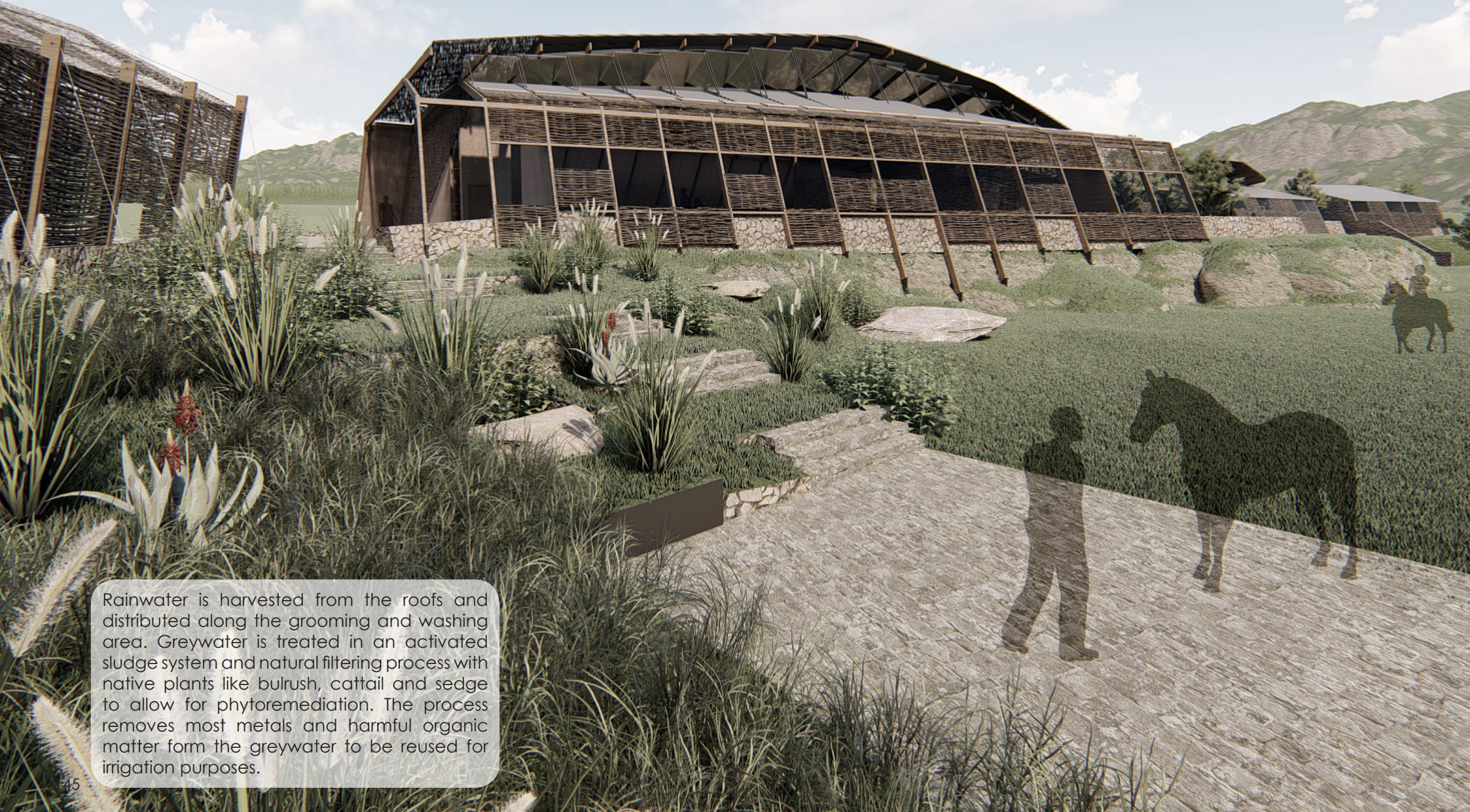
TOWARDS A FINAL DESIGN

The design incorporated most of the existing structures to respect both the cultural and natural landscape. One building is proposed to be demolished as the building is deteriorating and houses farm animals for which better shelters will be built. The two existing kraals serve as the foundation for the spatial organisation of the development due to their cultural significance and guidance by the natural landscape. Existing trees are also taken into consideration. The two made-made axes, directed by the existing residential units and the barn built around 1934, extends through the landscape to illustrate the physical connection between horse and man. These axes are 'jointed' in a space of dynamic interplay moving through the first kraal into the main indoor hippotherapy arena. The kraal is seen as a mediator between the strict geometry of man and the natural landscape of the horse. A synergy exists between the two, creating spaces where they can interact and form part of the community.



AERIAL VIEW OF PROPOSED FACILITY





Rainwater is harvested from the roofs and distributed along the grooming and washing area. Greywater is treated in an activated sludge system and natural filtering process with native plants like bulrush, cattail and sedge to allow for phytoremediation. The process removes most metals and harmful organic matter from the greywater to be reused for irrigation purposes.

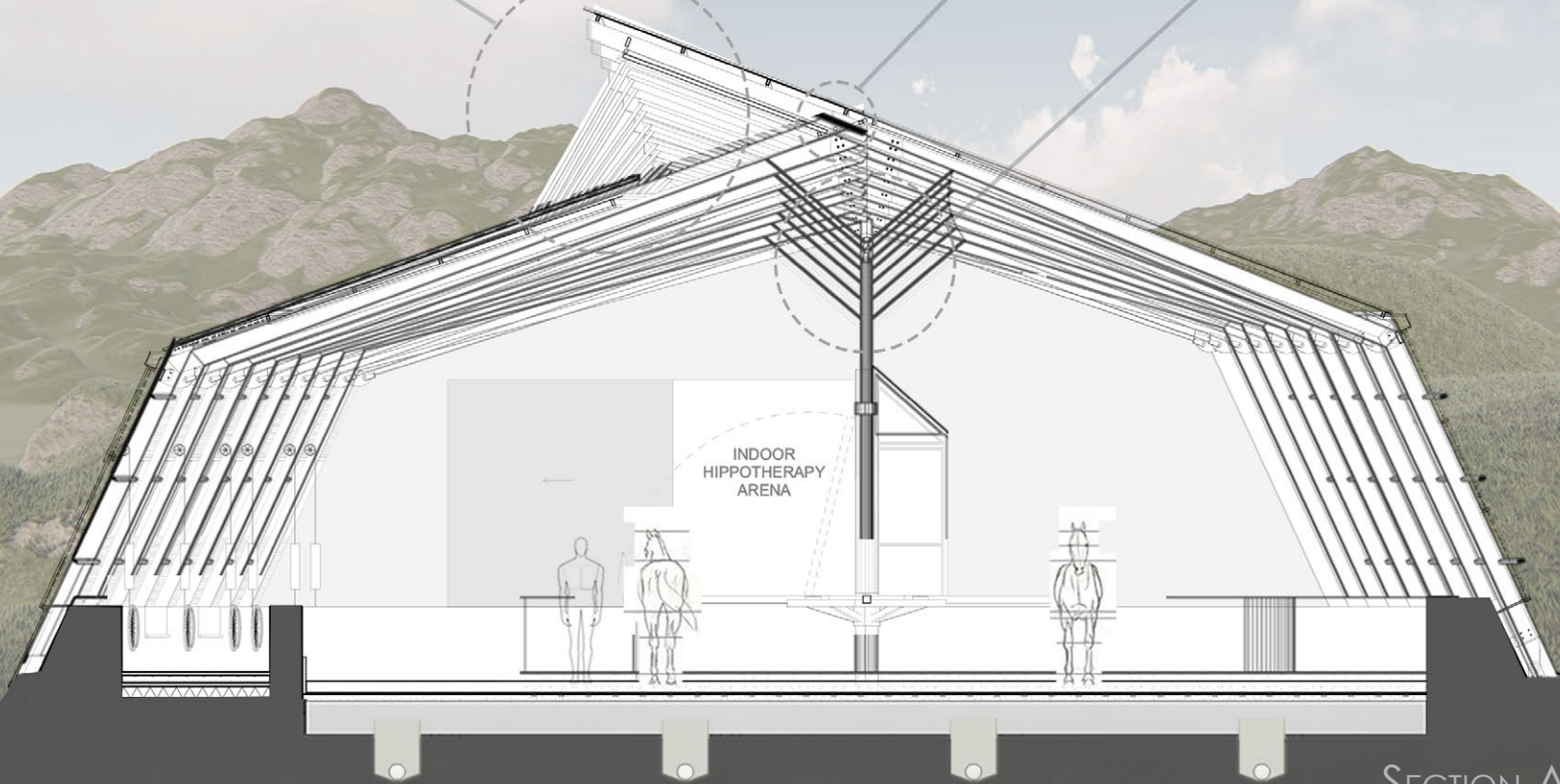
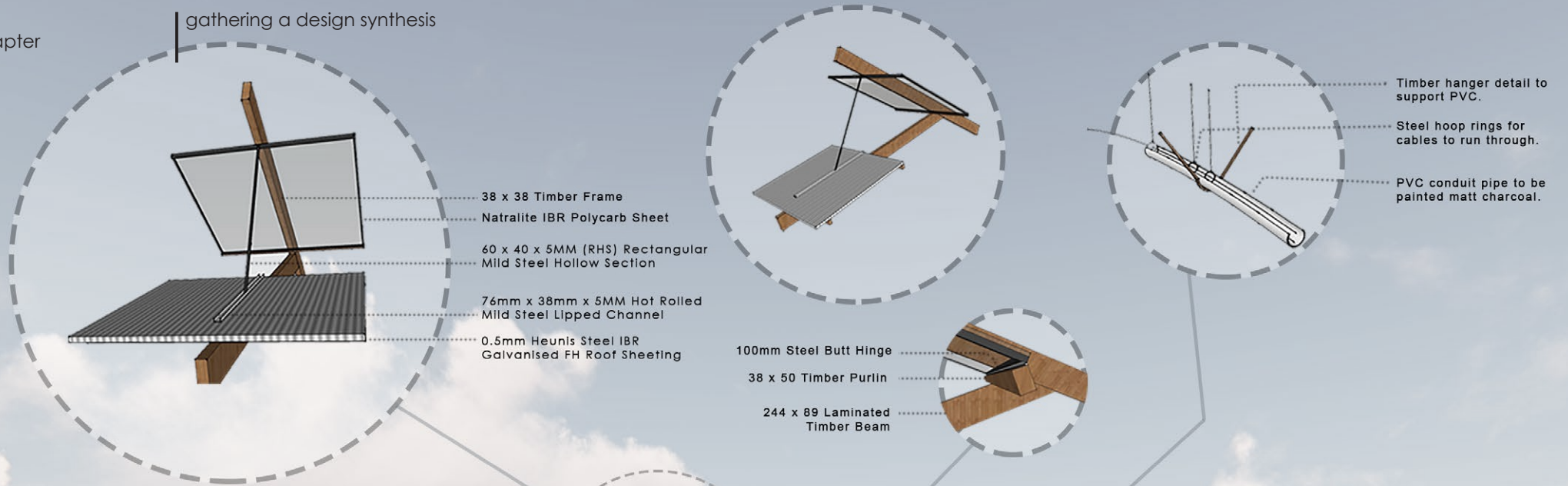
The facility provides residential units for families with children or adults living with disabilities. One of the major challenges regarding the facility was to provide wheelchair access throughout the slopy uneven terrain of the site as well as to the existing residential units. The linear plan thus provides opportunity to gradually introduce ramps along the site, allowing patients to access the stables and interaction spaces. The linear plan also offers a progression of 'initiation' for the ceremonial culture the centre aims to impart. Children living with disabilities are welcomed into the community through a series of reinterpreted 'litema' woven into the fabric of the facades. These patterns will be woven by the community as well as by parents attending the workshops to celebrate the patient's progress.



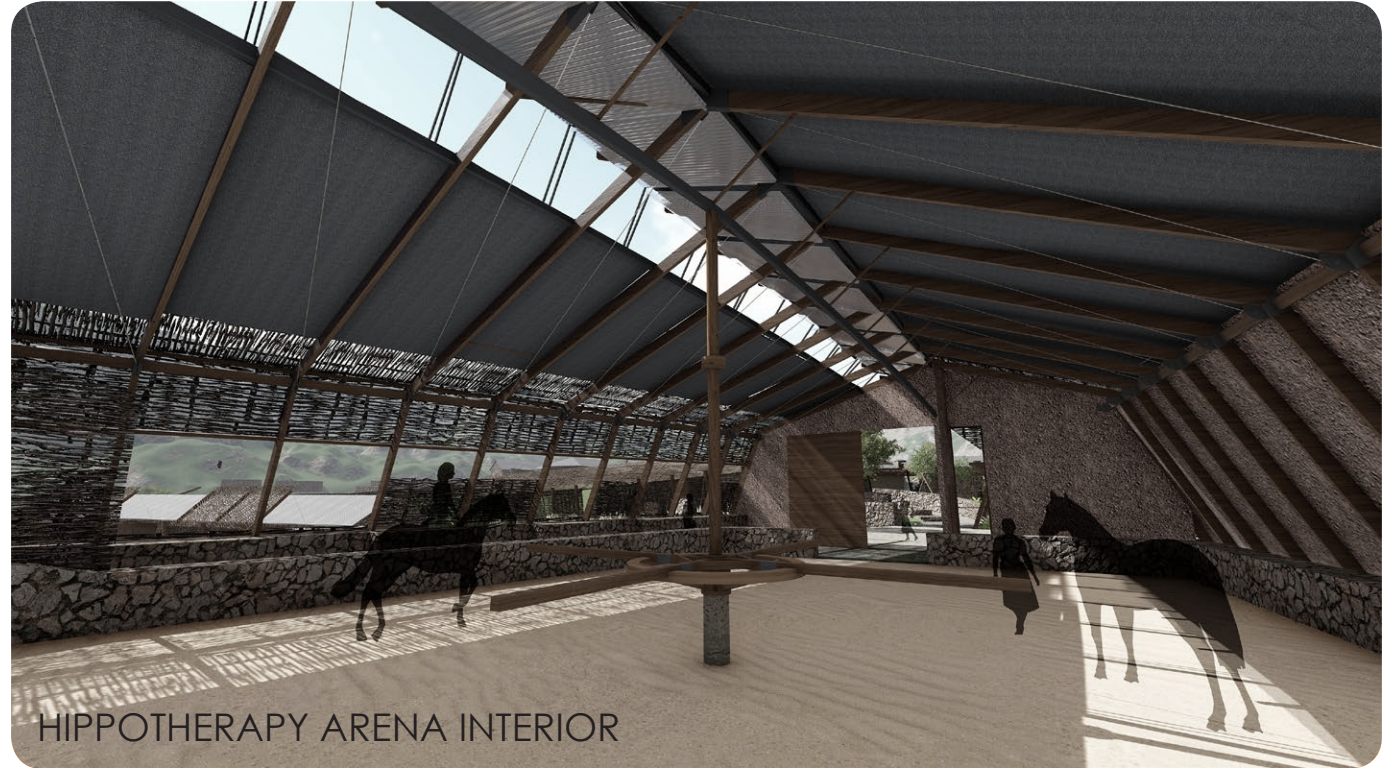
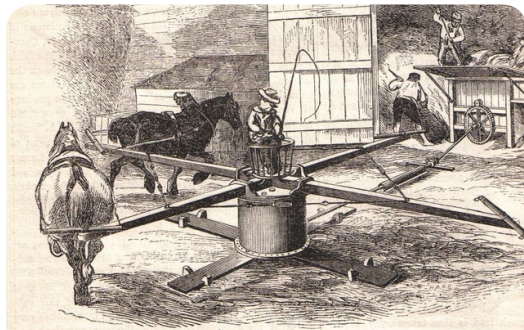
GROUND FLOOR PLAN

SCALE 0 5 10 15 20 m





SECTION A-A
SCALE 1:100



HIPPOTHERAPY ARENA INTERIOR

The walls of the second kraal is retained to form the boundary of the indoor arena. Similar to the Mohlongoa-fatse, the structure uses a timber framework with wattle and daub earth construction in between the panels. The timber frame is tied together with steel cables holding the structure in place. The system works as a tensegrity structure with the timber beams in compression and the steel cables in tension. The centrepiece of the structure functions as a horse mill which dates back to the 16th century. As stated in chapter one, it is important

for therapy horses to also do other exercises as the therapy can cause imbalances in the horse's muscles. By being harnessed to a mechanical system the horses first do a morning routine where they turn the central wheel causing weights to be hoisted up in the air. These weights store potential energy used to open up the polycarbonate panels above. This will allow the building to ventilate without direct rain infiltrating the arena. Steel cables are fixed to the horse mill and run across a PCV pipe to hoist the different panels simultaneously.

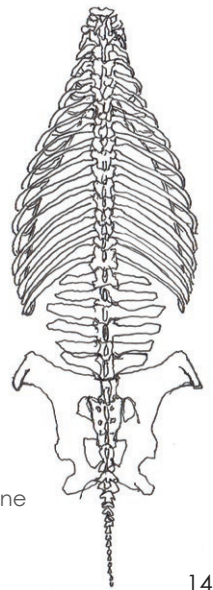


Fig. 162
Drawing of horse's spine
(Drawing: author).



INTERACTION AREA WITH STABLES



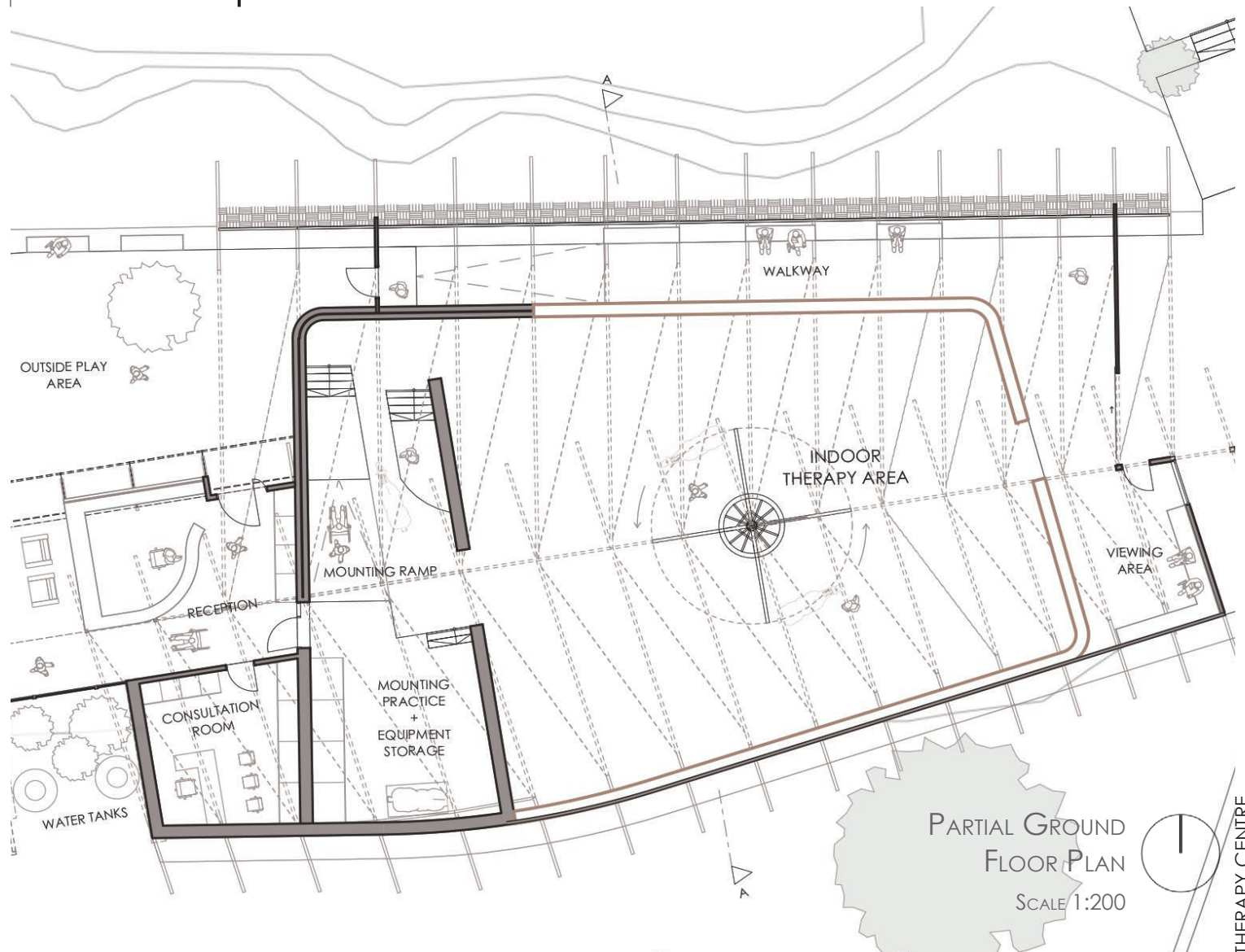
MAIN ENTRANCE AREA



The proposed development aims not only reflect the relationship between culture and nature, but also the dynamic relationship the Basotho man has with the horse. People are encouraged to bring their horses to through the grooming area while partaking in communal activities and rituals initiated in the kgotla. As part of the therapy process, patients are encouraged to wash, groom and take care of the horses, providing opportunities for interaction between the patients and the community. The site also provides access







The plan of the indoor arena indicates where the steel cables meet the timber framework. The existing walls are indicated in brown to show the original kraal within the arena. Most of the newly built walls in the facility are constructed with locally sourced stone and in some cases plastered using a daub mix consisting of earth, horse manure, horse urine, straw and water.



Parents, siblings and sojourners are encouraged to attend workshops where hippotherapy sessions are taught and explained to promote awareness. There are also workshops teaching them to make basic tools and toys used by occupational therapists to treat patients. These workshops are located close to the arenas together with the consultation rooms where families can stay close together as familiarise themselves with the processes of hippotherapy. A family lounge is also located in the area which opens up towards the courtyard. The design proposal aims to narrow the gap between indoor and outdoor spaces by allowing panels to open and close throughout the facility, also creating a sense of ownership and the ability to change the environment around them.







CHAPTER FOUR

TECHNICAL INVESTIGATION

In this investigation I explored in further detail the built environment of Semonkong as well as possible technical solutions for the proposed development. Part one analyses the larger site of the Saint Leonard's Mission Community Complex in detail, especially regarding material use and soil types. Part two focuses on combined structural elements of the development whereas part three gives further insight into the material used for the structures. Part four indicates the building's environmental impact while part five reveals how the building serves both the community and the environment simultaneously.

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Fig. 18
Sandstone construction
in Semonkong
(Photograph: author).



Lesotho Land Department committee surveying land in Semonkong (Photograph: author).



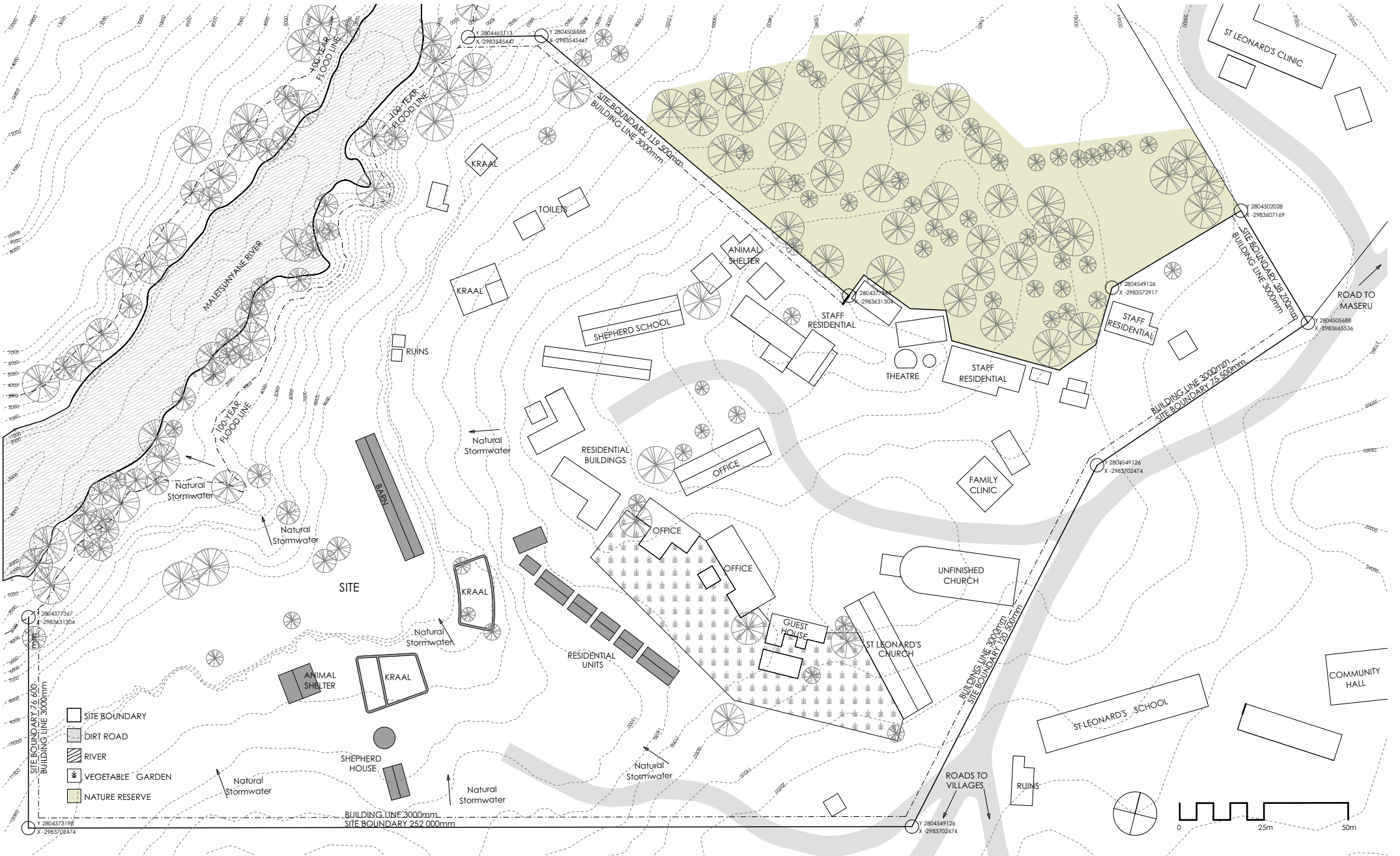
Our vehicle together with the Lesotho Land Department committee (Photograph: author).

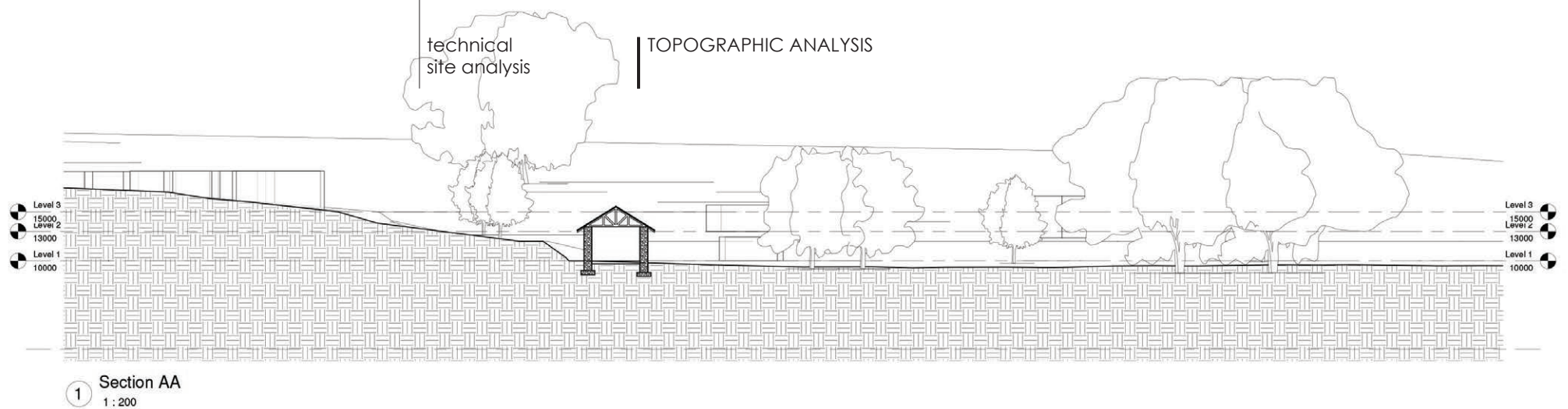
PART ONE
**TECHNICAL SITE
ANALYSIS**

1.1 SITE REGULATIONS

According to K. Makhethe, a town planner for the Lesotho Land Department, the area of Semonkong is currently not classified for any specific zoning and will only be subdivided as future projects develop (personal communication, March 21, 2019). Most of Lesotho's land is distributed among chiefs who are appointed to rule over certain areas. The chiefs decide how land is divided amongst the families in the area and they set out boundaries for the people to use for housing, farming, and grazing. Once a new development is approved, the land is privatized and more specific boundaries are drawn up (K. Makhethe, personal communication, March 21, 2019).

During my visit to Semonkong, I met with the Lesotho Land Department Committee to experience first-hand how they go about measuring, negotiating and allocating land for new developments. First, a meeting is arranged with the local chief to discuss possible land allocations for the proposed development. Then, the chief discusses the development with the affected occupants before he advises and negotiates with the Committee as to the specific location of the new zonings. Title deeds are only created and issued once new developments are approved in accordance with the applicable building regulations. Building regulations in Lesotho's are based on the South African National Standards (SANS 10400).





PART 1.2

TOPOGRAPHIC ANALYSIS

TECHNICAL SITE ANALYSIS

The area for the proposed development is situated in central Semonkong, on the premises of the Saint Leonard's Mission community complex. The Saint Leonard's School was the first building to be built on the premises in 1924 and the complex has since expanded towards the Maletsunyane River. Today, the complex consists of two schools, a church, administrative offices, a guest house, staff residences, storage and agriculture facilities, a barn and additional residences (figure 0). The proposed site extends over both agricultural and residential domains within the larger community complex. According to Pama Aloysius, the current church father of Saint Leonard's Mission Church, the existing barn was built in 1934 (personal

communication, March 24, 2019). Several of the other buildings were built between 1924 and 1940 and were constructed from Basaltic Lava rock and cement. The other residential buildings were added much later by missionary teams using cement blocks and corrugated metal roof sheeting.

The 100-year flood line is positioned 20 meters from the site with no wetlands within the site's boundaries. The surrounding vegetation includes large indigenous trees as well as a protected nature reserve. There is a large pine tree plantation 1 km from the site and trees from it which can be used for building material. The complex uses pit latrine systems or 'long drops'. Electricity is provided on-site by the national grid although the area often experiences power outages, necessitating the provision of backup power supplies (P. Aloysius, personal communication, March 24, 2019). The administrative offices have access to a borehole for water and most buildings make use of above-ground water storage tanks to harvest rainwater from the roofs.



The author together with Pama Aloysius within the site surroundings (Pearson: 2019).

PART 1.3
**GEOTECHNICAL
ANALYSIS**
TECHNICAL SITE ANALYSIS

1.3.1 LITHOLOGY

The dominant lithology of the Semonkong area is Basaltic Lava which dates back to the Jurassic period in the Mesozoic era. There are also traces of mudstone and sandstone which are prominent in surrounding areas such as Bloemfontein, South Africa.



Lithological investigation
on-site
(Photograph: author).

1.3.2 SOIL CONDITIONS

Soil types are categorised into five main particle groups based on their size. These are stone, gravel, sand, silt, and clay (Laubscher, 2013: 156). In Earth Construction, gravel, sand and stone provide the soil with strength and add volume to the mix, while silt and clay provide elasticity to bind the other particles together (Houben, 1994: 21-25). All particle types are needed in order to ensure a balanced mix that provides both strength and plasticity for the building material. During the site visit, I performed basic soil tests to identify the consistency, workability, and strength of the soil located on-site. A hole of 0.5m deep was dug to obtain accurate soil percentages (figure 0).



Soil samples were taken at 0.5 meters below the ground line
(Photograph: author).

1.3.3 SOIL TESTS

The following soil tests were executed in order to reveal soil characteristics and properties:

THE SMELL TEST

Water was added to the soil and the mixture was smelled to identify clay content within the soil. The smell was musty and showed a sufficient clay content.

THE TACTILE TEST

More water was then added to the soil and rubbed between my hands. Then water was poured over my hands and to wash the soil off. The soil was washed off with some difficulty which confirmed a high clay content.

THE BOTTLE TEST

A glass bottle was filled with soil to a third of its volume and then filled with water to 80% of its capacity. The bottle was then shaken to mix all the soil into the water. After 30 minutes, the process was repeated and the bottle was left to stand for a day. The soil settled into layers from coarse to fine aggregate and which again showed a soil with a high clay content and but also with adequate sand volumes.



Stages of the tactile test
(Photograph: author).



Layers visible during the
bottle test
(Photograph: author).

THE CIGAR TEST

The soil was rolled up into cigar-shaped pieces 3cm in diameter and 15cm long. The 'cigar' was placed on a level surface and slid over the edge to test at what point the cigars would snap. The broken pieces measured 13.5cm, 11.5cm, 10cm and 13cm respectively. This showed that the soil had a high clay content and should be suitable for use as adobe clay blocks rather than compressed earth blocks.



Soil shaped in a roll of 3cm in diameter and 15cm in length
(Photograph: author).

Pieces broken off and measured to perform cigar test
(Photograph: author).

THE BISCUIT TEST

The aim of the biscuit test was to determine the best mix of soils from across the site to manufacture the best blocks. The soil from next to the river was found to have a higher sand content than the rest of the site. Clay rich soil was combined with the sandy soil in different ratios in order to identify the best strength when dry. 5 biscuits were shaped, each with different sand to clay ratios.

Sand : Clay Ratio				
Biscuit 1	Biscuit 2	Biscuit 3	Biscuit 4	Biscuit 5
1:4	2:3	1:1	3:2	4:1

After executing the biscuit test, it was concluded that biscuit 4 was the hardest to break and had the best sand-clay ratio for use when forming adobe blocks.



Five soil 'biscuits' after it was dried
(Photograph: author).



Soil samples taken for strength test
(Photograph: author).



Different 'biscuits' after strength test
(Photograph: author).

SIEVE ANALYSIS TEST

For further soil analysis, a sample of 15kg of soil from the site was tested at Simlab (Pty) Limited Geotechnical Services in Bloemfontein (Table 1).

The results show that the total percentage of fine soil is 36%. This indicates an acceptable percentage as all methods of earth construction

need at least 20% of fine soils to bind the material together. The total percentage of fine sand is 15% while coarse to medium sand is 21%. Gravel makes up 28% of the sample. The Grading Modulus (GM) of the sand is 1.52 which indicates an acceptable average for building sand. There is however a lack of coarser gravel which can be overcome by using two-thirds of the soil and adding a third of coarser gravel collected from the river next to the site.

ATTERBERG LIMITS ANALYSIS TEST

Table 2 shows the plastic and liquid limits of the soil measured by Simlab. These limits specify whether the soil is workable before going into a liquid or solid state. The soil has a low potential expansiveness with a medium plasticity of 17. This indicates that the soil is workable but contains enough sand for structural purposes. The soil's Plasticity Index and its Liquid Limit makes the soil ideal for Adobe Block construction according to Houben's (1994: 130-139) soil identification diagram.

Table 1

Soil	Type	Size	Sieve Size in mm	Passing Percentage (%)
Coarse Soils	Gravel	Coarse	28.0	100
			20.0	97
	Sand	Fine	14.0	87
		Coarse	5.0	72
		Medium	2.0	61
Fine Soils	Silt		0.425	51
			0.075	36
	Clay		0.002	3

Table 2

Plasticity Index (PI)	17
Liquid Limit (LL)	43
Plastic Limit (PL)	26

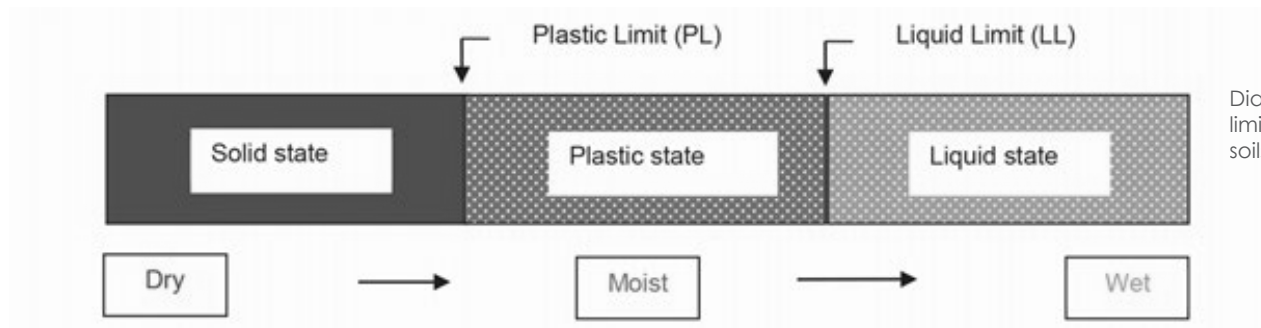


Diagram of the plastic limit and liquid limit of soils (Lewis, 2013: 8)

2.1 FRAMED STRUCTURES

The proposed facility makes use a timber framed structure together with non-load bearing stone walls interpreted from the Mohlongoa-fatse (traditional Basotho dwelling). These structural systems are largely used in Semonkong due to the availability of material and construction expertise.

PART TWO

STRUCTURAL SYSTEMS



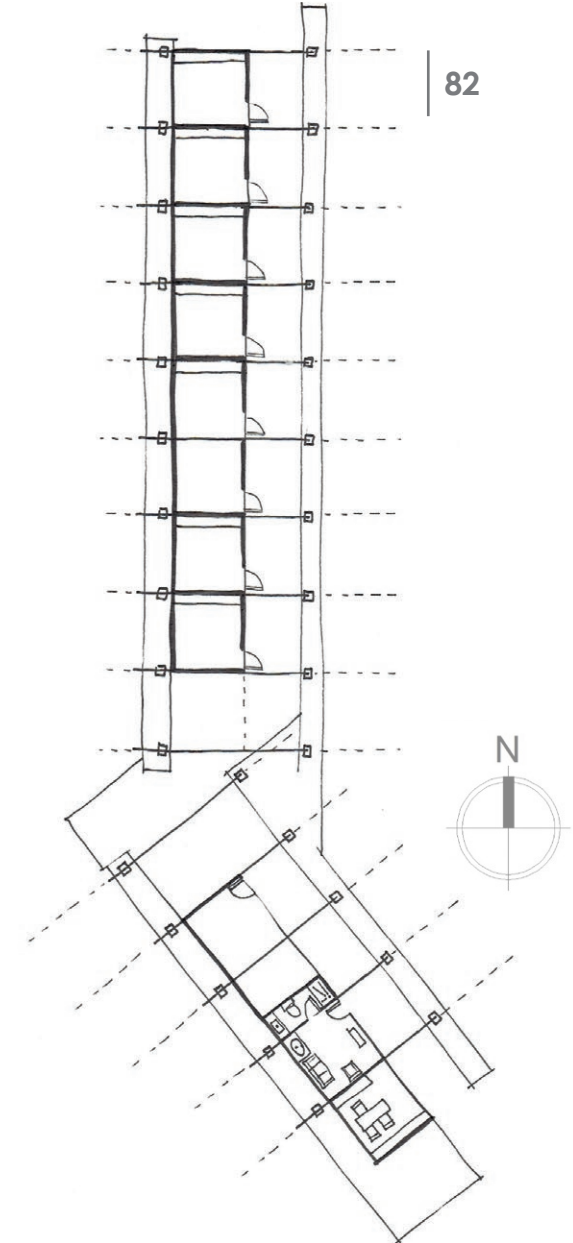


LOS LEONES STABLES

Architects: Pablo Lamarca & Tomás Swett
Location: Los Leones, Osorno, Chile
Year: 2009

PART 1.3
PRECEDENT STUDIES
PROGRAMME

The site is situated in a high rainfall area with an average of 3000mm per year. This required that the design include extensive protection from weather conditions, including efficient ventilation and shelter from the rain (Lamarca, 2011: online).



CHALLENGES

- Integrating spaces for horses and people.
- Creating a space that is protected against weather conditions whilst still allowing natural ventilation.

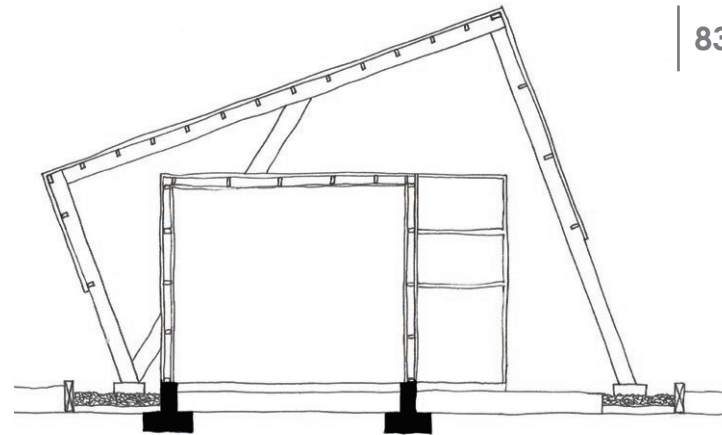
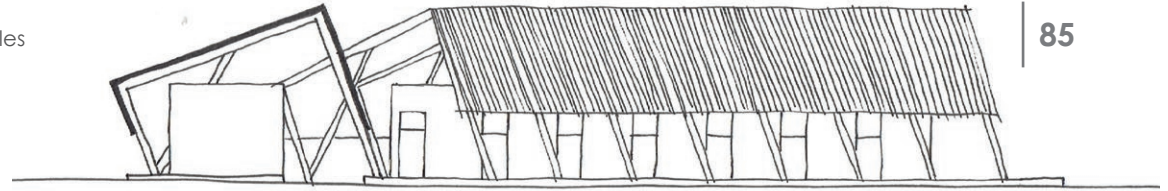
The project is seen as a meeting between human functionality and the well-being of stabled horses. One module of the building contains the horses' stables while the other houses offices, living areas and sick rooms. The two modules are joined where the functions integrate; the cleaning areas and saddle rooms. The architectural solution uses two independent structures working together, creating a high volume space to allow natural ventilation. Structural integrity is shown through the connections and joints supporting the wooden frames (Lamarca, 2011: online).

CONTRIBUTION TO PROJECT

- The integration of two independent systems to reach the stated objectives.
- The translation of basic elements such as anchor points and fixed connections into an architectural language.

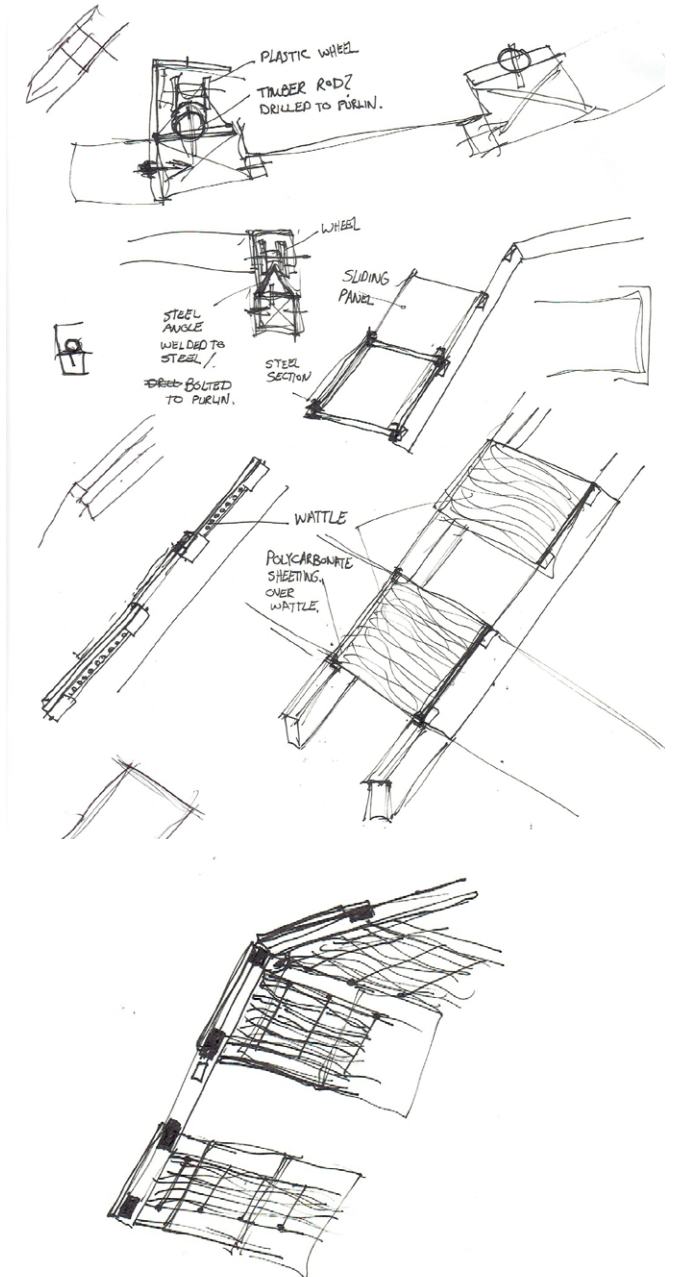
Photographs of Les Leones Stables
(Lamarca, 2011: online).

Drawings of Les Leones Stables
(Drawing: author).

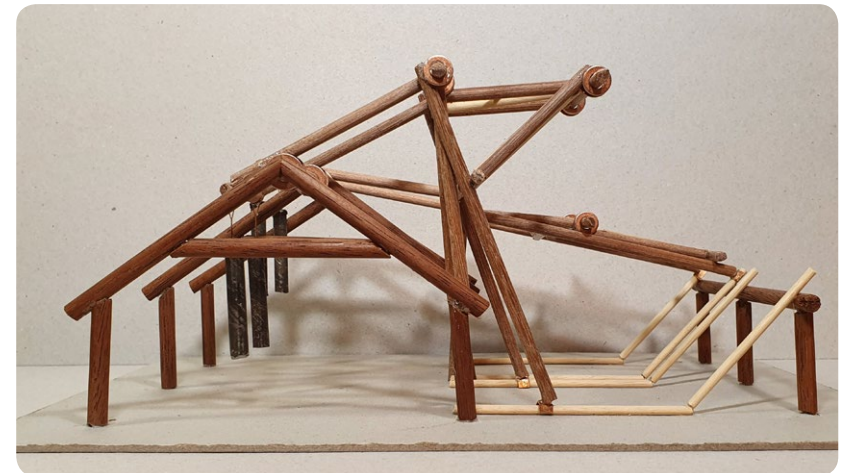
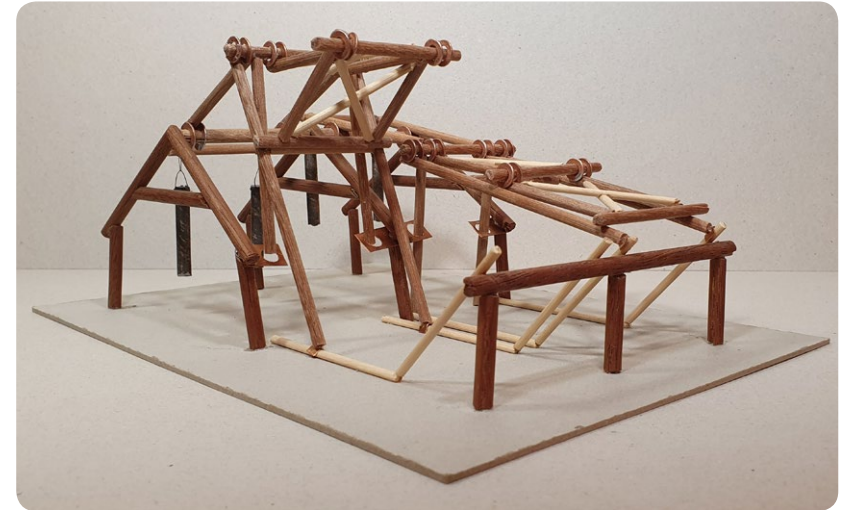
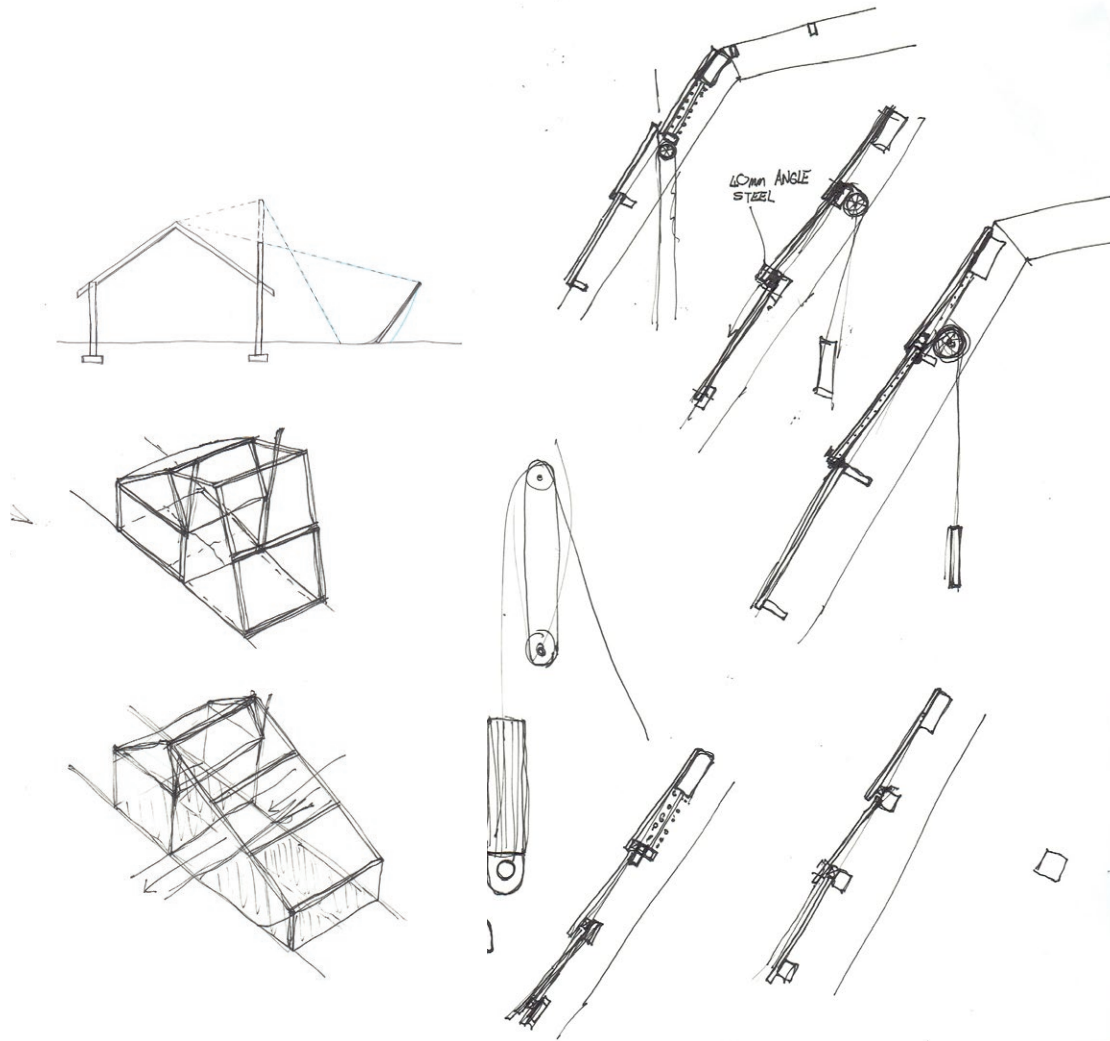


2.3 BIOTENSEGRITY STRUCTURES

The third phase of the development focused on combining the two previous sections into a gathering of place. Here the synergy between horse and man was translated into the metaphorical structure of the indoor hippotherapy arena by using two separate vertebral columns with a state of dynamic tension in between them. The horse is also used in collaboration with man not only to facilitate therapy but to regulate the functionality of the building. Panels are attached to the roof of the structure and operatable from the centre of the hippotherapy arena. This mechanism will allow natural ventilation of the facility in summer while being able to close in winter.



2.4 MECHANICAL STRUCTURES



PART THREE

MATERIALITY

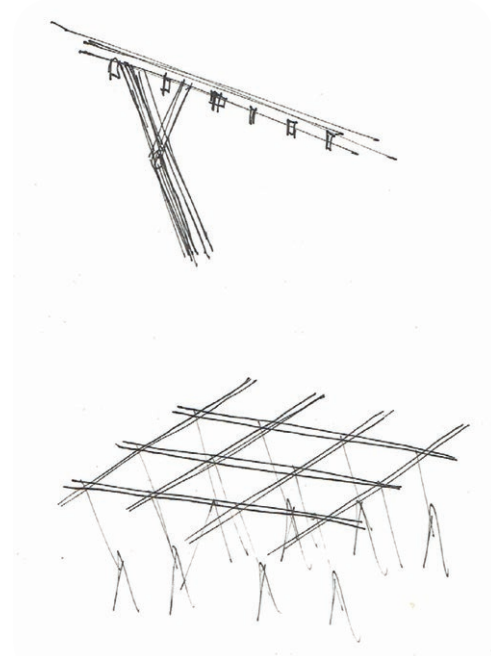
Most of the timber used in the development can be sourced from a local pine tree plantation which is located just over 1km from the proposed site as indicated in the overall site analysis. Larger structures that require specific strengths according to the engineer's specifications can be transported from Lesotho Timbers (PTY) Ltd in Maseru or from SML Building Materials in Ladybrand who stocks SATAS (South African Technical Auditing Service) approved laminated timber beams.

PART 1.3

PRECEDENT STUDIES

PROGRAMME

The facility was designed by TYIN Tegnestue Architects in Sumatra, Indonesia and reveals the clear relationship between form and materiality. As the project is situated in a forest rich area the structure appropriately uses timber construction as the primary material. The nature of the material allows vertical and diagonal structural elements to project from the earth to the sky. The roof is carried lightly and allows for natural ventilation of the timber structure.



CASSIA COOP TRAINING CENTRE

Architect: Matias Zegers
Location: La Dehesa, Santiago, Chile
Year: 2017
Clients: MSporthorses



3.2 TEXTURE

Villa Eila was designed by Heikkinen + Komonen Architects in Guinea, West Africa. The architects wanted to use local materials as far as possible and spent time learning more about the local culture and their building techniques. The design used locally produced earth blocks to construct the non-loadbearing walls while the roof floated above it on a timber frame. The Eastern façade was clad with woven bamboo to produce a textured screen against the sun (Arnardóttir & Merina, 2006: online).



PART 1.3
PRECEDENT STUDIES
PROGRAMME

VILLA EILA

Architect: Matias Zegers
Location: La Dehesa, Santiago, Chile
Year: 2017
Clients: MSporthorses



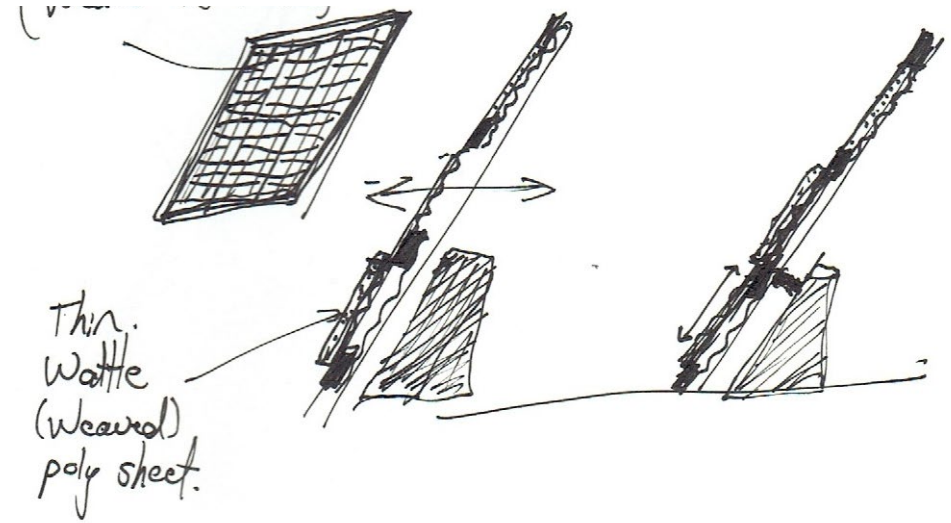
3.3 FINISHES

The Basotho culture uses similar techniques to weave local grass into useful artefacts. The grass is sourced from the *Merxmuellera macowanii* plant species or better known as Moseha in Sesotho (Mpongo, 2005: online). Basotho women are trained from an early age to make hats, brooms, ropes, baskets, and mats using different weaving patterns (Sekaleli, 2000: 9). These patterns are often used to identify hierarchy, function, and tradition in the Basotho culture. By allowing these patterns to express the building envelope, the project will serve as a constant reminder for the integration of children with disabilities into the community. Patients, their parents, and the involved community will be encouraged to weave patterns to use as shading devices in an ongoing process of the facility.



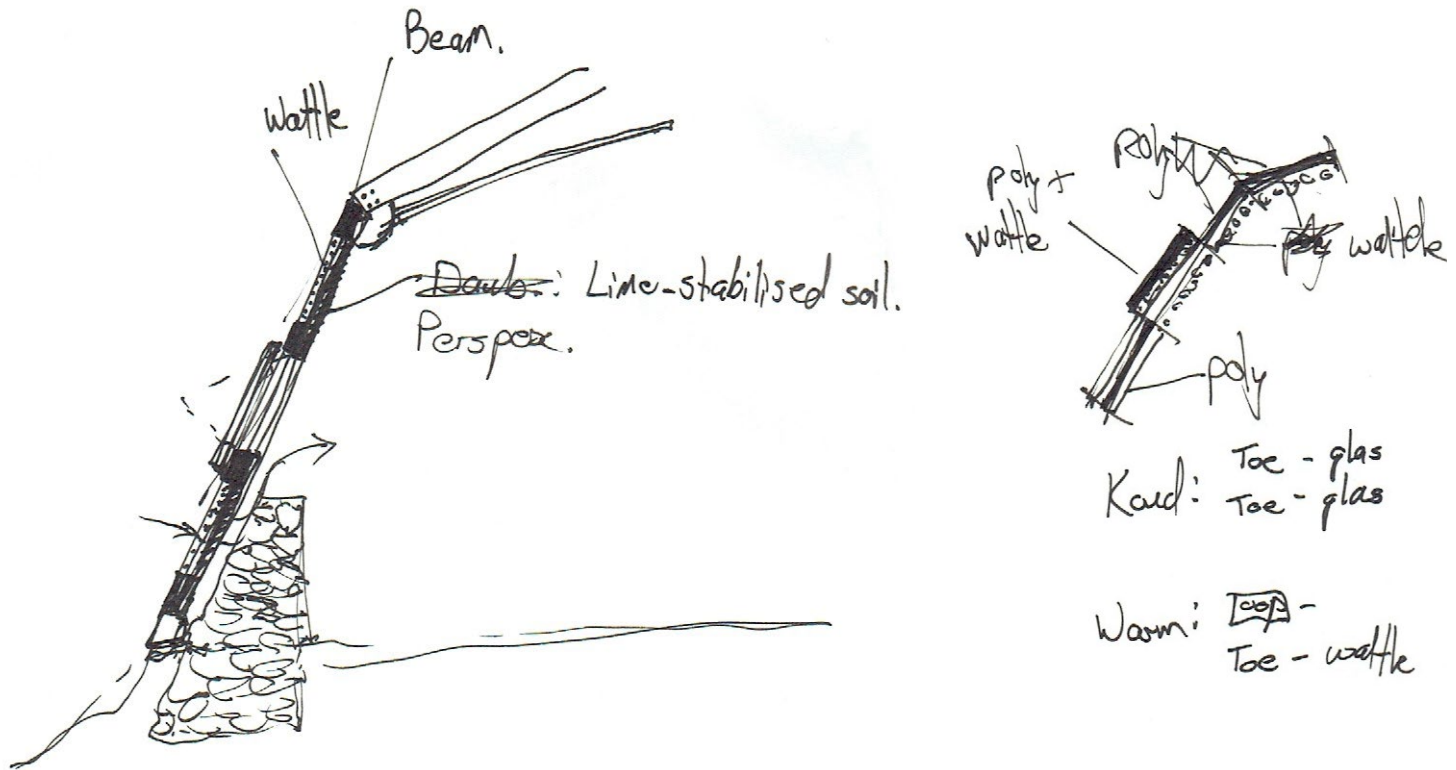
PART FOUR
SUSTAINABILITY

northern facade of the indoor therapy arena. The polycarbonate sheeting circulates airflow within the building that is heated by the thermal mass of the stone wall. In summer the vents are opened and the mechanical windows are lowered to allow for ventilation and create shade over the trombe wall.



4.1 PASSIVE HEATING

Sustainability has been discussed throughout the document as it is one of the core principles of the proposed development both practically and theoretically. The use of hippotherapy itself speaks of a sustainable facility that can be maintained by the Semonkong community. The building materials and functionality of the facility are also contributing to sustainable design. Most of the materials are locally-sourced and applied in simple mechanical solutions to allow skill-transfer and development within the community. These solutions allow the buildings to adapt to weather conditions by means of passive heating and cooling systems like the trombe wall on the



4.2 COMPOST HEATING AND BIOGAS PRODUCTION

A major challenge in the design of a hippotherapy facility is the accumulation of horse manure in the stables. Over the years, farmers have developed ways of using the manure more effectively than simply disposing of it. Jean Pain developed a compost heater in France during the 1970s which was capable of heating enough water to use for washing, cooking and the heating of his house without any combustion or waste (Pain & Pain, 1980: 50-51). He also used the compost heap to produce biogas for cooking and to generate electricity by storing the generated methane in gas reservoirs (ibid: 50-51). Pain's process was able to heat water to 60 degrees Celsius at a rate of 4 litres per minute (Bane, 2000: online).

Walter Witte further developed Pain's strategy by adding horse manure to the compost to create the Eco-Kiln system (Haupt, 2015: online). This model achieves even higher water temperatures than Pain's, because the compost contains more nitrogen and thus decomposes more thoroughly (Haupt, 2015: online). Native Power, a permaculture company based in Germany, uses Witte's horse-manure model to educate farmers across Europe and the United States to successfully construct compost heaters on their property. One of these models is constructed at the Reinstall Weberhof facility in Austria where the manure of only ten horses, approximately 250kg manure per day, is used to generate heat for the entire facility (Cuhls, 2019: online).

The heating system consists of a large compost heap, made up of wood chippings, manure and other organic materials, through which PVC piping is laid. Microbiological degradation in the heap creates heat, warming the tubing and its contents. The system retains its heat for the lifespan of the degradation process which ranges between 12 and 24 months (Sjöberg, 2013: online). The pipes are connected to water tanks from which cold water flows into the system, gradually heating up as it circulates through the compost heap. Once the degradation process is complete, the remains of the compost heap (humus) are spread over agricultural land to improve soil structure.

Humus holds many benefits for farming and gardening such as allowing the soil to better retain moisture and nutrients (Farmer's Weekly, 2012: online). In addition to using the compost heater to generate warm water, it can also be used to harvest biogas. A sealed container is placed at the centre of the heap during construction. Compost is placed in the container where it undergoes the same degradation process, however, because of the closed system biogas is trapped inside the container to be harvested. In this way, the entire composting process is used effectively in an environmentally responsible way (Haupt, 2015: online).



This system can be easily replicated in Semonkong because it requires no technical expertise and can be constructed by local builders. Many have successfully replicated Pain's strategy to generate warm water even in extremely cold weather conditions as the heat produced by the compost stays deep beneath the heap's surface. The necessary water pump and PVC pipes are available from hardware shops in Semonkong and the system will use a mixture of horse manure, food and plant waste, straw and other organic material from the facility as compost.

A system to harvest biogas may also be constructed for the use of cooking and electricity, but aside from its inherent safety concerns, it will probably not be necessary in this instance. For the compost heap to generate enough warm water throughout Semonkong's winter, it will have to be at least 4.5 meters in diameter and 2.5 meters high, amounting to approximately 14 tons of compost mixture (Cuhls, 2015: 40). For optimal performance, the horse manure and other organic material must first be aerated and turned for a period of two to six months. This allows the degradation process to start before the compost is used in the heater. Manure bunkers will provide temporary storage for this stage of the composting process to allow for protection from the rain.



PART FIVE
SERVICES

5.1 HEALTH AND SAFETY

The services provided in the facility are meant to serve the health and safety of the patients, the staff and the larger community of Semonkong. The facility is heavily reliant on community involvement to illustrate the Ubuntu value system discussed in chapter one. The functionality of the facility, as well as maintenance and adaptations, will be managed not only by the client but by the community, much like the community hall located on the neighbouring site. As such, it is very important that the proposed development allows public circulation and wheelchair access throughout the facility. Ramps are provided in accordance with the SANS 10400-S: 2011.

FIRE SAFETY

No multistorey buildings are proposed in the development as this could create further challenges regarding fire hazards and wheelchair access. The timber used for the development will be treated according to the SANS 10400-T: 2011. All structural timber will be treated with *Flambor Dual Purpose Fire Retardant And Preservative Treatment* to have a fire-resistance of at least 30 minutes. The smaller individual structures of the development provide additional safety as fire escapes are frequently available along the main circulation route.

DELIVERIES AND SECURITY

Although most of the food prepared in the facility will be grown in the on-site vegetable gardens, both kitchens have additional southern accesses for deliveries when needed.

The Semonkong community is based on the Ubuntu value system (discussed in chapter one) with chiefs ruling over specific areas. This largely removes the need for security systems in the facility because the space will be seen as community-owned under the dominion of the local chief. However, private and public domains are separated with subtle thresholds which will be respected by the people. The entire therapy workshop and office space can be completely closed off if necessary.

Pollution near the
Maletsunyane river
(Photograph: author).



5.2 REFUSE REMOVAL AND REUSE

In Semonkong, refuse which has not been properly disposed of is having a negative environmental impact. Systems are not always in place to dispose of waste and other unwanted materials in a responsible way. Water pollution and groundwater pollution is a major threat because most drinkable water in Semonkong comes from open rivers which need to be preserved if they are to remain a usable resource. (Makutla, 2012: 8).

Possible conservation efforts include recycling materials rather than disposing of them near rivers and the use of composting toilet systems instead of the current pit latrine systems which can cause groundwater contamination. The Semonkong Hospital Project (discussed previously in this document) is well established in the community and has already proposed a recycling plant in the area. This plant is to be used both by the hospital and the surrounding communities to create a better environment for all. The proposed Hippotherapy Centre will contribute to this facility by collecting recyclable matter into assorted containers and transporting it to the recycling plant.

Horse manure will be used for the compost heater as discussed in the sustainability report. After the degradation process is completed, the humus will be used as a soil supplement to improve the soil structure, and additional manure can be added as fertiliser. In this way, the facility's waste is almost entirely recyclable with systems in place to deal with food waste, the disposal of unwanted recyclable material, horse manure. Systems for dealing with human organic waste will be discussed under sanitary systems.

PART 1.3
PLUMBING SYSTEMS
SERVICES

WATER SUPPLY AND DRAINAGE

There is currently no water supply provided to the proposed site and current residents make use of the river below the site. Water is, however, an abundant resource in Semonkong and rainwater can easily be harvested into water tanks. Each residential unit will be equipped with a water tank for washing and cooking as well as a waterless composting toilet to reduce water usage. Water tanks will also be provided to public basins and kitchens and waste water will be recycled and used for the irrigation of vegetable gardens. Water collected at the arena will be channeled across the grooming area to provide drinking water for the horses, after which it will be filtered into the surrounding gardens. Excess stormwater flows into the river from the South-east to the North-west along the natural slope of the site. The slightly sloped walkways and drainage pipes in between stone walls direct stormwater to first filter through the landscaped gardens before following the natural slope towards the river.

Below is a comparison between vertical above-ground water tanks and underground water tanks:

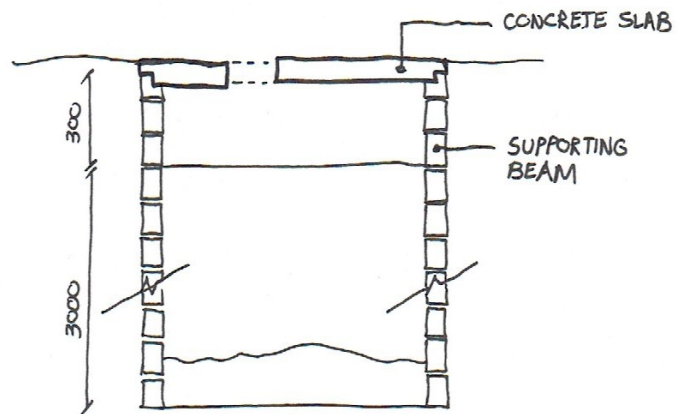
	Advantages	Disadvantages
Above-ground Water Tank	<ul style="list-style-type: none"> • Lower initial costs • Easy to install 	<ul style="list-style-type: none"> • Water can freeze during winter and get very hot during summer • Exposed to weather conditions, fire and vandalism
Underground Water Tank	<ul style="list-style-type: none"> • Aesthetic value • Retain steady water temperature year-round • Less exposed to weather conditions and vandalism 	<ul style="list-style-type: none"> • Higher initial costs • Excavation and reinforcing needed

(Rainharvest, 2014: online)

After considering the advantages of each type of water tank, a hybrid solution is suggested to utilise the benefits of both. Above-ground water tanks can be buried partially when careful detailing is executed and reviewed by an engineer (Go To Tanks, 2018: online). By excavating only one meter of soil and using back-fill to cover the tank partially, the initial installation cost will be kept relatively low while the thermal mass of the surrounding soil will prevent the water from freezing during winter. The water tank will also be less exposed to sunlight and adverse weather conditions.

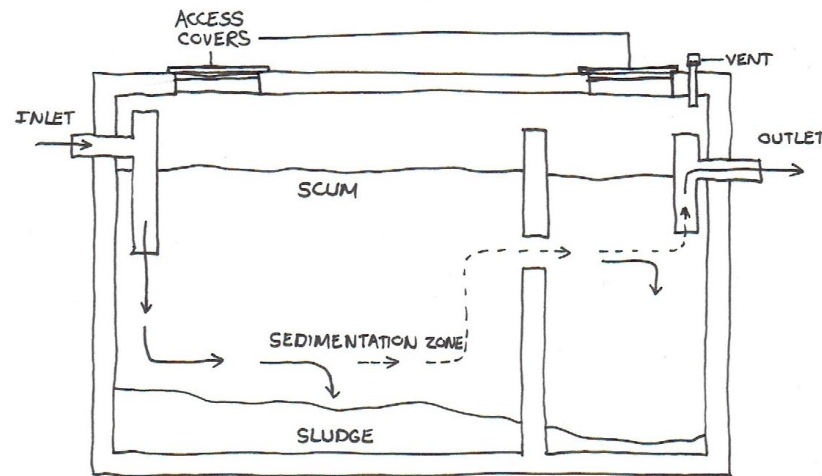
SANITARY SYSTEMS

In addition to reusing horse manure as compost, I explored the different types of sanitary systems available to consider the most appropriate sanitary system. The proposed site makes use of pit latrine systems, also known as a "long drops". The system consists of a hole dug into the ground about three meters deep and one meter wide. The hole is then covered with a concrete slab with a small hole and a corrugated steel shelter around it.

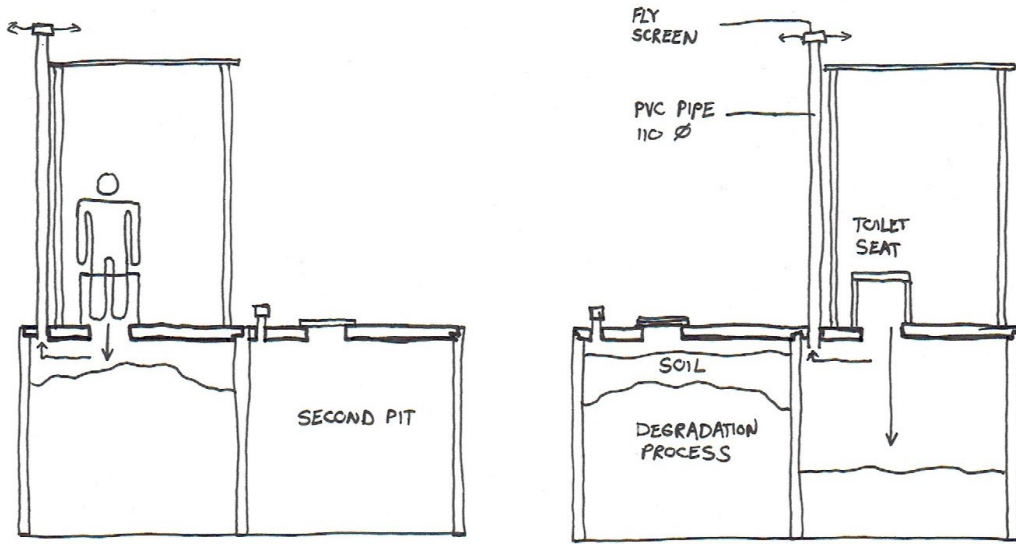


Pit Latrine System (Tilley, et al., 2014: 61).

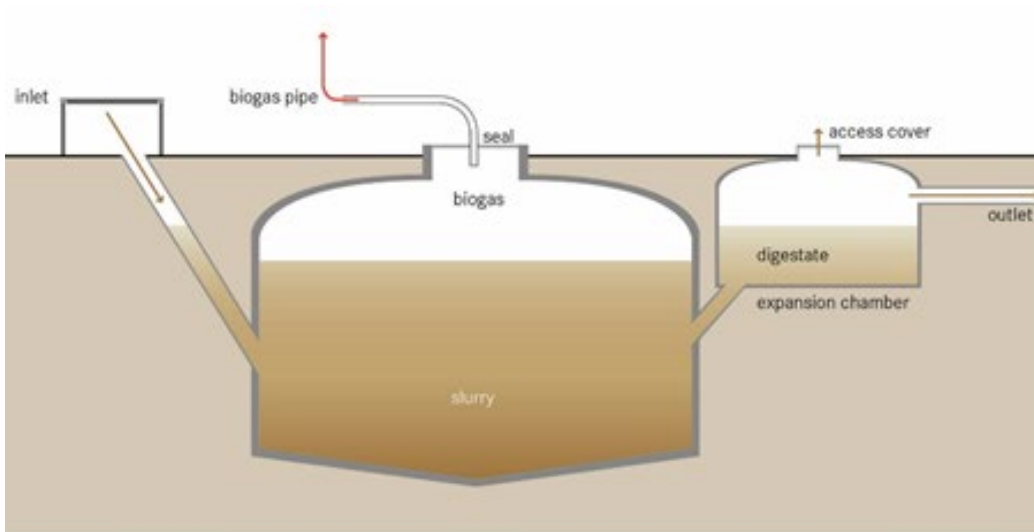
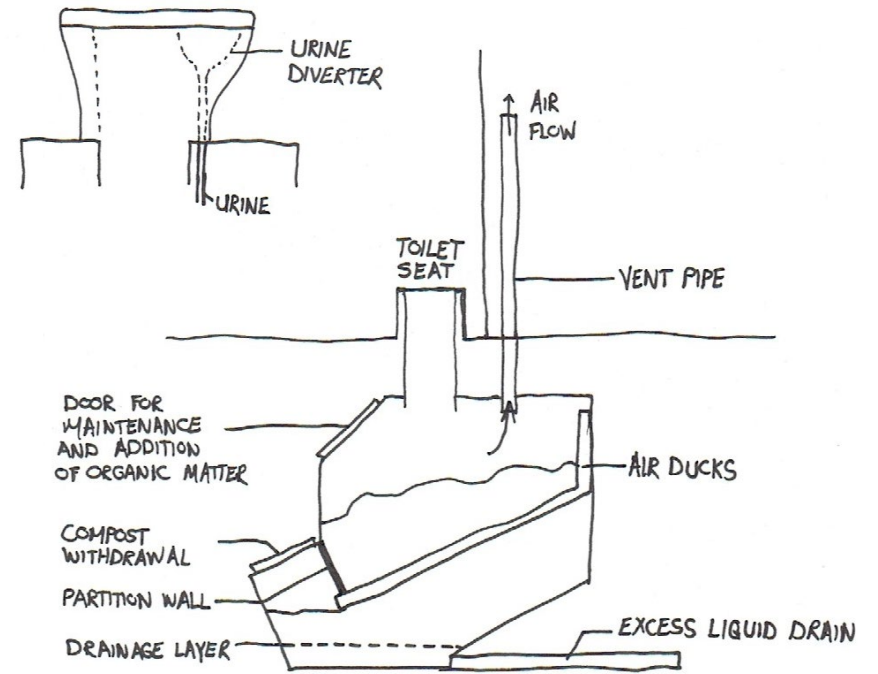
Although this system is inexpensive and easy to build, the disadvantages include odours and flies being attracted to the area, the slow reduction of organic matter, possible groundwater contamination and high costs of emptying the pits (Tilley, et al., 2014: 61). Alternatives systems to be used in Semonkong include septic tanks, composting chambers, double ventilated pits and biogas reactors. The following diagrams will explain each of these systems briefly.



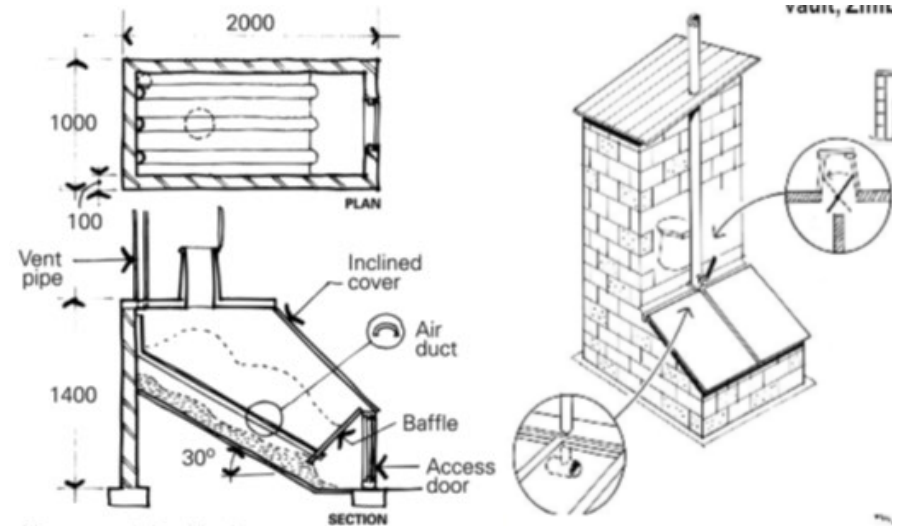
Septic Tank (Tilley, et al., 2014: 63).



Double Ventilated Improved Pits (Tilley, et al., 2014: 65).



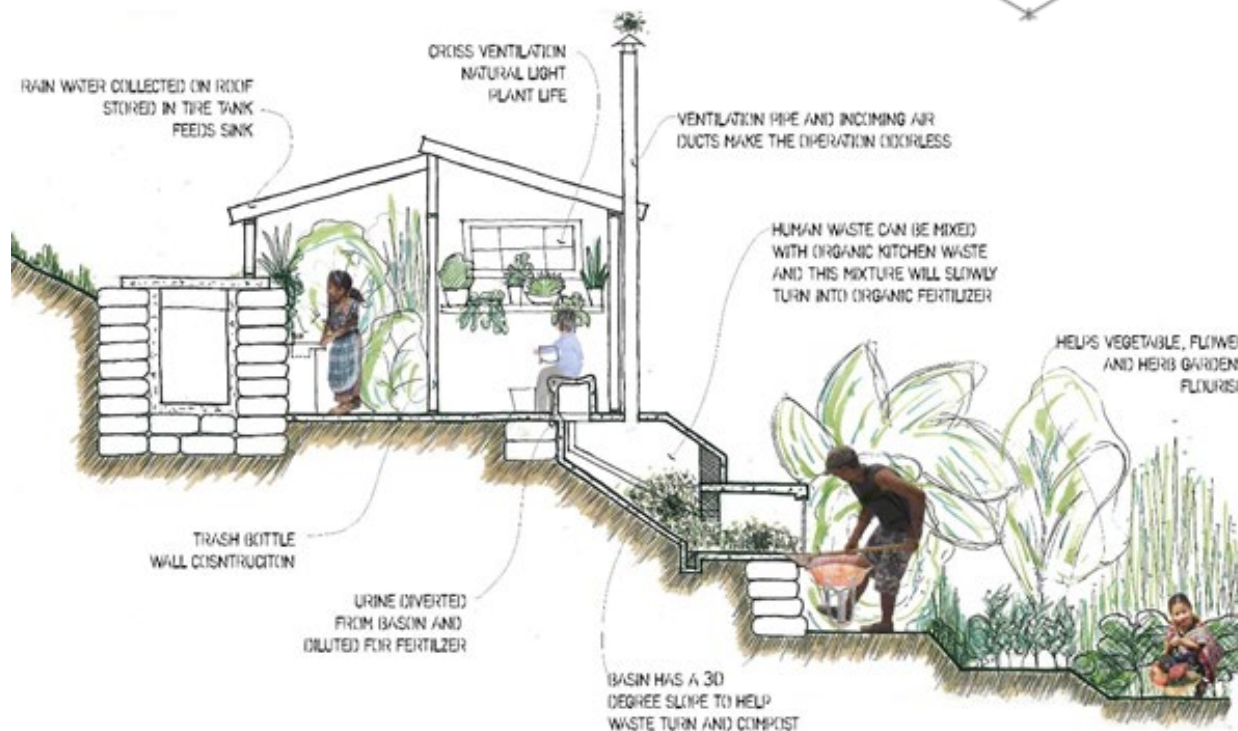
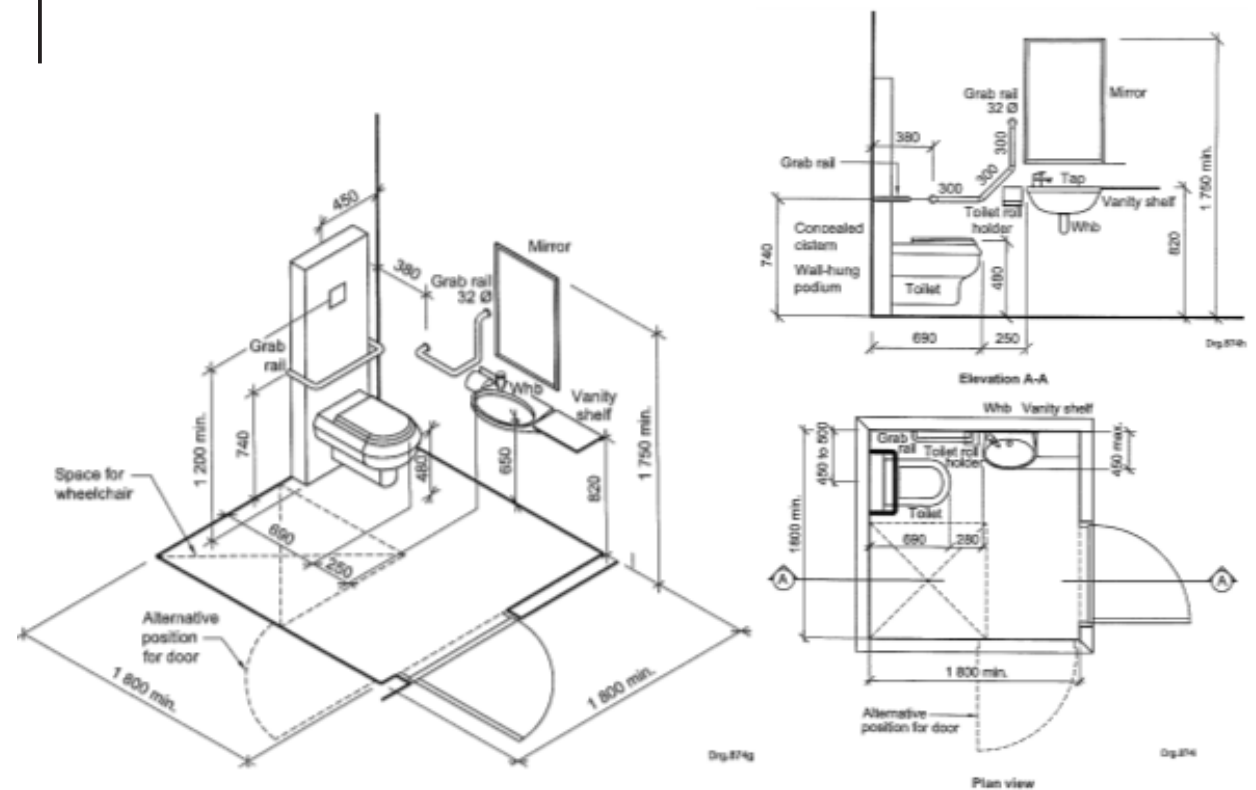
Biogas Reactor (Tilley, et al., 2014: 69).



Composting Chamber (Tilley, et al., 2014: 64).

DRY COMPOSTING TOILET

The dry composting toilet system demonstrates the advantages of decomposing organic matter in a concurrent waterless process. Organic human waste is combined with other organic materials like food waste, ash or leaves and then decomposed by microorganisms, and the resulting materials will be used as compost (Tilley, et al., 2014: 72). Urine can be diverted using a urine-diverting dry toilet as indicated in the drawing above. This will improve the quality of the compost and can be used in a diluted form for additional fertiliser. The end product of a composting toilet is safe to handle and can be used as an effective soil conditioner. The main challenge to the implement the system will be to keep the compost dry and ventilated, this will require careful detailing and execution during the construction process.



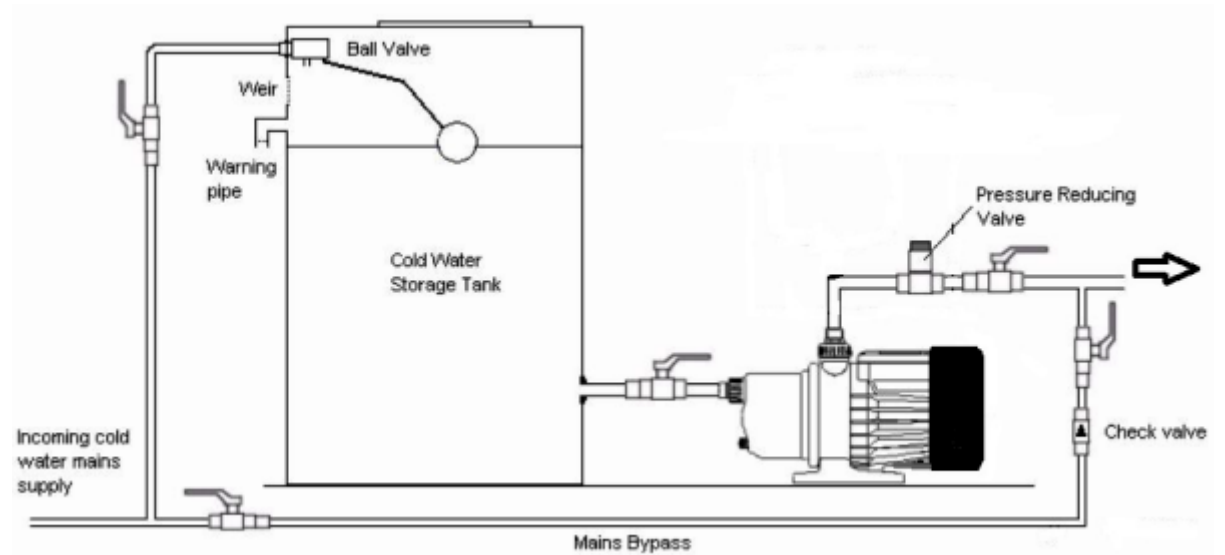
FACILITIES FOR PERSONS WITH DISABILITIES

As Lesotho does not have any specific regulations regarding wheelchair access, sanitary systems are designed in accordance with SANS 10400-S: 2011. The facility will set the standard for future developments, emphasising the importance that both the patient's residential units, and the public restrooms provide wheelchair access that is both practical and inclusive.

5.4 MECHANICAL INSTALLATIONS

Although the proposed site has access to electricity, the region of Semonkong experiences many power outages due to its rural setting and poor infrastructure maintenance. As such, the mechanical requirements of the proposed development are implemented through simple solutions that don't require hydraulic systems or technological expertise. All devices are operated manually with counterweights attached to pulley systems. Some devices that require the use of electricity like water pumps, fridges and lighting will make use of locally available solar systems as an additional power source during power outages. The Solar Company provides photovoltaic (PV) systems throughout Lesotho and offers delivery and maintenance to Semonkong (The Solar Company, 2019: online). The systems consist of 150-watt solar panels, a solar charge controller, a deep-cycle battery bank and a 4000-watt power inverter.




Electric water pump for water storage tank
(The Solar Company, 2019: online).




Water pump operation



Solar panel installation in Semonkong
(The Solar Company, 2019: online).

-  SITE BOUNDARY
-  DIRT ROAD
-  RIVER
-  VEGETABLE GARDEN
-  NATURE RESERVE



<p>GENERAL NOTES</p>	<p>BUILDING NOTES</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">LIST OF DRAWINGS</th> <th colspan="2">REVISIONS</th> </tr> <tr> <th>DRW. NO.</th> <th>DESCRIPTION</th> <th>REV. NO.</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td>HTC-1</td><td>SITE PLAN</td><td></td><td></td></tr> <tr><td>HTC-2</td><td>GRADING/CONCRETE PLAN</td><td></td><td></td></tr> <tr><td>HTC-3</td><td>FLOOR/ROOF PLAN</td><td></td><td></td></tr> <tr><td>HTC-4</td><td>ROOF PLAN</td><td></td><td></td></tr> <tr><td>HTC-5</td><td>ELEVATIONS</td><td></td><td></td></tr> <tr><td>HTC-6</td><td>ELEVATIONS</td><td></td><td></td></tr> <tr><td>HTC-7</td><td>SECTIONS</td><td></td><td></td></tr> <tr><td>HTC-8</td><td>SECTIONS</td><td></td><td></td></tr> <tr><td>HTC-9</td><td>WINDON ESCAPE ROUTES</td><td></td><td></td></tr> <tr><td>HTC-10</td><td>DRIVE ON REGULATORY CALCULATIONS/ELECTRICAL PLAN</td><td></td><td></td></tr> </tbody> </table>	LIST OF DRAWINGS		REVISIONS		DRW. NO.	DESCRIPTION	REV. NO.	DESCRIPTION	HTC-1	SITE PLAN			HTC-2	GRADING/CONCRETE PLAN			HTC-3	FLOOR/ROOF PLAN			HTC-4	ROOF PLAN			HTC-5	ELEVATIONS			HTC-6	ELEVATIONS			HTC-7	SECTIONS			HTC-8	SECTIONS			HTC-9	WINDON ESCAPE ROUTES			HTC-10	DRIVE ON REGULATORY CALCULATIONS/ELECTRICAL PLAN			<p>PROJECT ADDRESS</p> <p>ERF NUMBER</p>	<p>CLIENT</p> <p>SENTEBALE</p> <p>PROJECT NAME</p> <p>BIOMECHANICAL HIPPOThERAPY CENTRE</p>	<p>DRAWING TITLE</p> <p>LOCALITY PLAN</p> <p>SCALE</p> <p>1:500</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Drawn by:</td> <td>Herlu Greeff 2014025478</td> </tr> <tr> <td>Date:</td> <td>29 October 2019</td> </tr> <tr> <td>Drawing number:</td> <td>HTC - 1</td> </tr> <tr> <td>Revision number:</td> <td>A</td> </tr> <tr> <td>Project type:</td> <td>Commercial</td> </tr> </table>	Drawn by:	Herlu Greeff 2014025478	Date:	29 October 2019	Drawing number:	HTC - 1	Revision number:	A	Project type:	Commercial	 <p>Space-Time Architects</p> <p>herlu.greeff 2014025478 herluggreeff@gmail.com</p>
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documentation

Natural Stormwater

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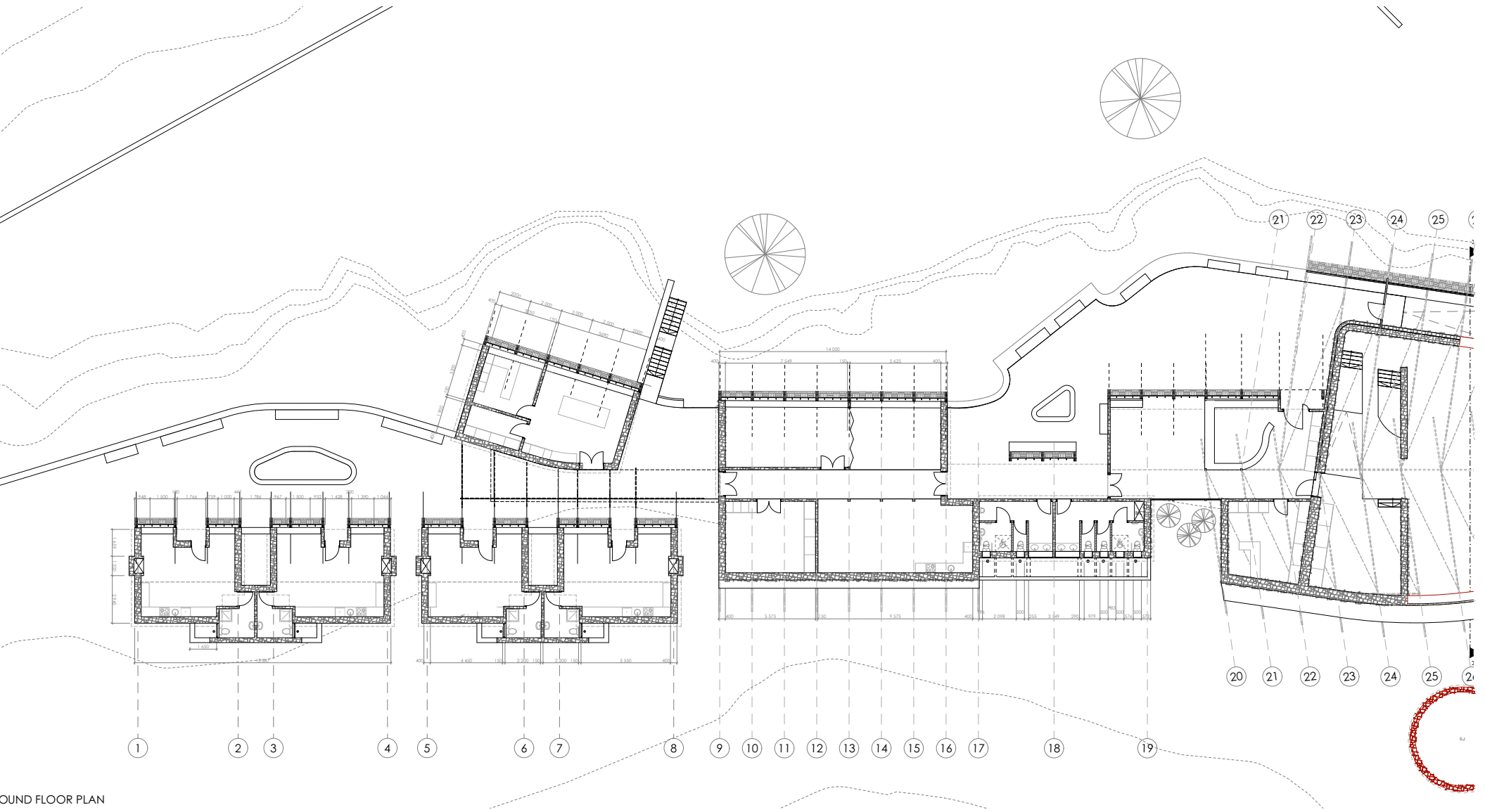
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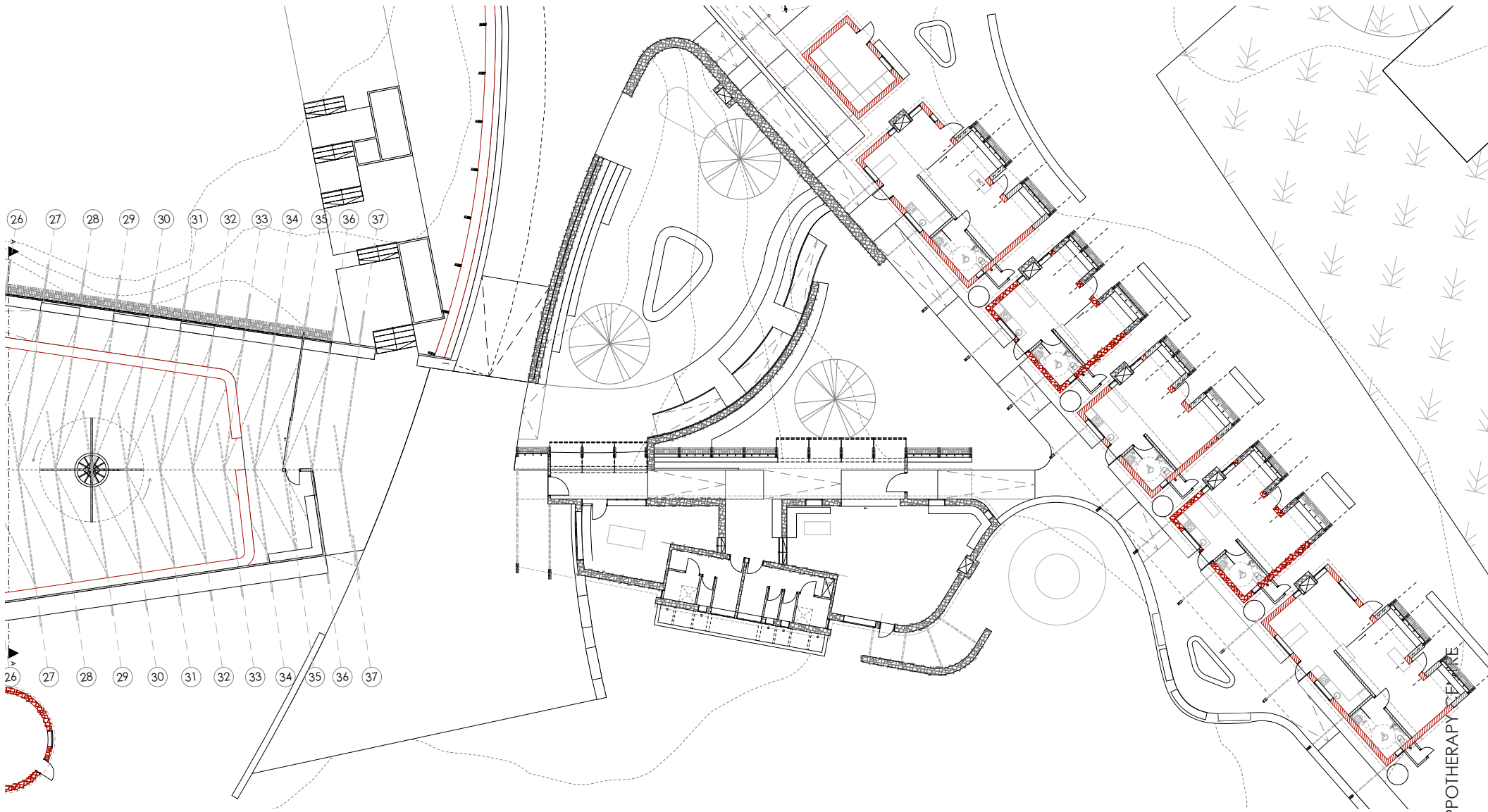
SITE PLAN

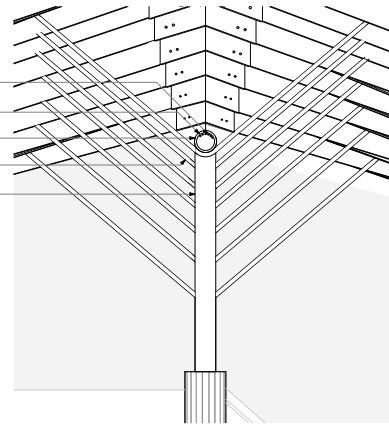
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BIOMECHANICAL HIPPO THERAPY CENTRE



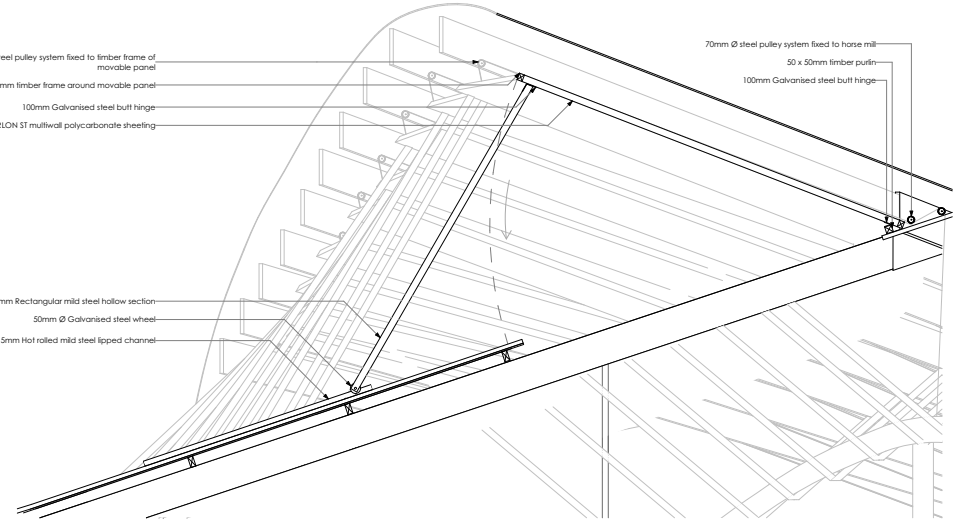
GROUND FLOOR PLAN





- 15mm Ø Galvanised steel cable running through PVC pipe from horse mill to operable roof system
- 150mm Ø Galvanised steel hoop ring fixed to PVC pipe for cables to run through
- 160mm Ø PVC pipe painted matt charcoal with cutouts for cables to span using timber hangers towards roof system
- 38 x 38mm Timber hanger fixed to laminated timber beams to support PVC pipe
- 150mm Ø Timber post with side grooves for cables to run through

DETAIL 2 - HORSE MILL
Scale 1:20

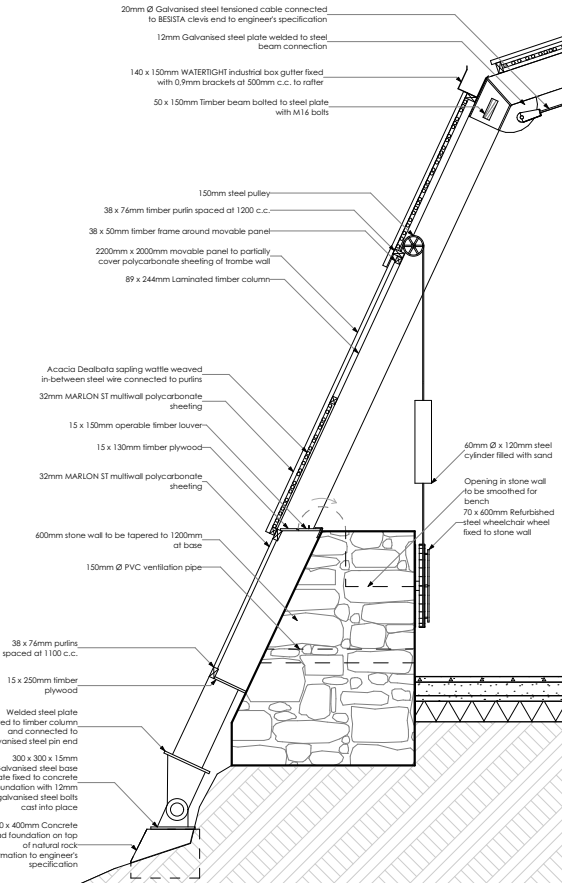


- 70mm Ø steel pulley system fixed to timber frame of movable panel
- 38 x 50mm timber frame around movable panel
- 100mm Galvanised steel butt hinge
- 32mm MARLON ST multiwall polycarbonate sheeting

- 70mm Ø steel pulley system fixed to horse mill
- 50 x 50mm timber pulley
- 100mm Galvanised steel butt hinge

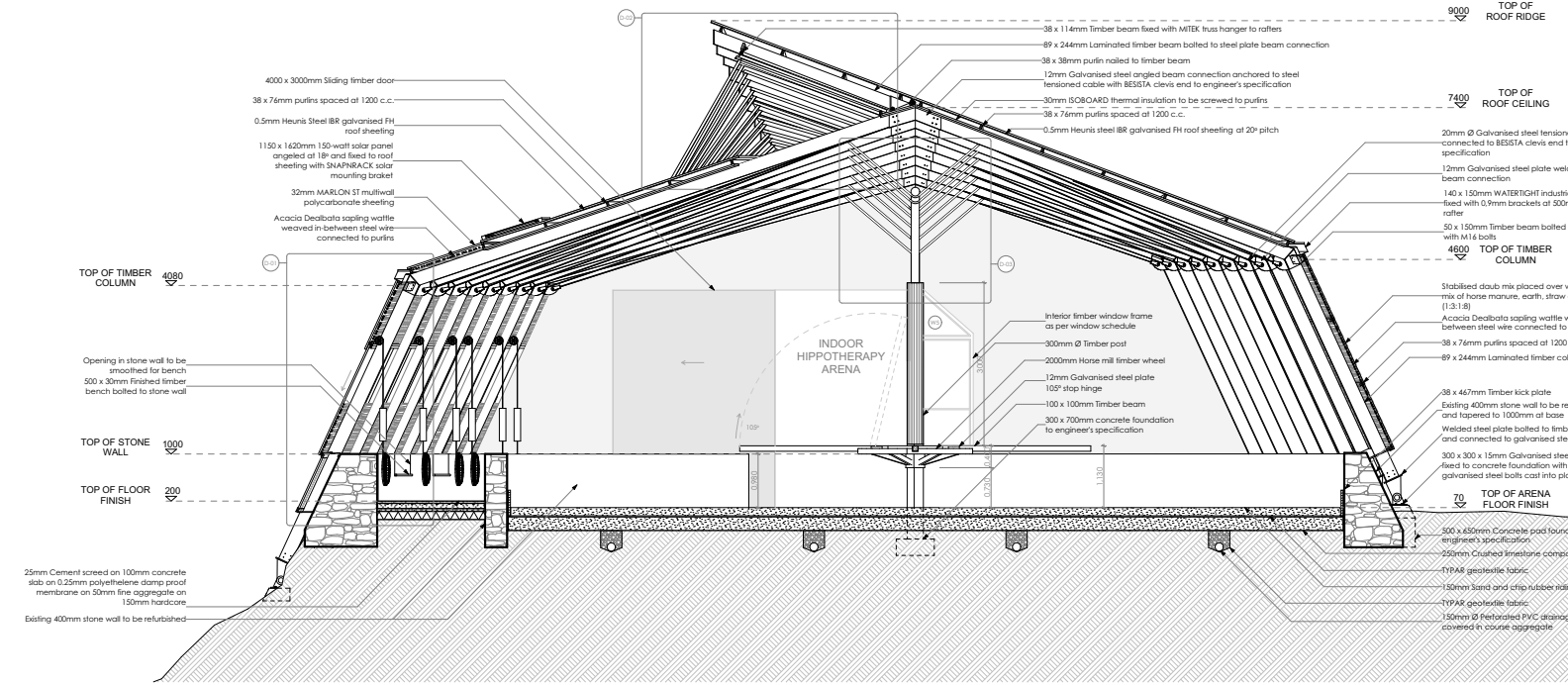
- 60 x 40 x 5mm Rectangular mild steel hollow section
- 50mm Ø Galvanised steel wheel
- 38 x 76 x 5mm Hot rolled mild steel lipped channel

DETAIL 3 - OPERABLE ROOF SYSTEM
Scale 1:20



- 150mm steel pulley
- 38 x 76mm timber pulley spaced at 1200 c.c.
- 38 x 50mm timber frame around movable panel
- 2200mm x 2000mm movable panel to partially cover polycarbonate sheeting of trombe wall
- 89 x 244mm Laminated timber column
- Acacia Dealbata sapling wattle weaved in-between steel wire connected to purlin
- 32mm MARLON ST multiwall polycarbonate sheeting
- 15 x 150mm operable timber louver
- 15 x 130mm timber plywood
- 32mm MARLON ST multiwall polycarbonate sheeting
- 600mm stone wall to be tapered to 1200mm at base
- 150mm Ø PVC ventilation pipe
- 38 x 76mm purlin spaced at 1100 c.c.
- 15 x 250mm timber plywood
- Welded steel plate bolted to timber column and connected to galvanised steel pin end
- 300 x 300 x 15mm Galvanised steel base plate fixed to concrete foundation with 12mm Ø galvanised steel bolts cast into place
- 250 x 400mm Concrete pad foundation on top of natural rock formation to engineer's specification
- 40mm Ø x 120mm steel cylinder filled with sand
- Opening in stone wall to be smoothed for bench
- 70 x 400mm Refurbished steel wheelchair wheel fixed to stone wall
- Opening in stone wall to be smoothed for bench
- 500 x 30mm Finished timber bench bolted to stone wall
- 25mm Cement screed on 100mm concrete slab on 0.25mm polyethylene damp proof membrane on 50mm fine aggregate on 150mm hardcore
- Existing 400mm stone wall to be refurbished

DETAIL 1 - TROMBE WALL
Scale 1:20



- 4000 x 3000mm Sliding timber door
- 38 x 76mm purlins spaced at 1200 c.c.
- 0.5mm Heunis Steel BR galvanised FH roof sheeting
- 1150 x 1620mm 150-watt solar panel angled at 18° and fixed to roof sheeting with SNAPRACK solar mounting bracket
- 32mm MARLON ST multiwall polycarbonate sheeting
- Acacia Dealbata sapling wattle weaved in-between steel wire connected to purlins
- TOP OF TIMBER COLUMN 4080
- Opening in stone wall to be smoothed for bench
- 500 x 30mm Finished timber bench bolted to stone wall
- TOP OF STONE WALL 1000
- TOP OF FLOOR FINISH 200
- 25mm Cement screed on 100mm concrete slab on 0.25mm polyethylene damp proof membrane on 50mm fine aggregate on 150mm hardcore
- Existing 400mm stone wall to be refurbished

- 38 x 114mm Timber beam fixed with MITEK lugs hanger to rafters
- 89 x 244mm Laminated timber beam bolted to steel plate beam connection
- 38 x 38mm purlin nailed to timber beam
- 12mm Galvanised steel angled beam connection anchored to steel tensioned cable with BESISTA clevis end to engineer's specification
- 30mm GCSBOARD thermal insulation to be screwed to purlins
- 38 x 76mm purlins spaced at 1200 c.c.
- 0.5mm Heunis steel BR galvanised FH roof sheeting at 20° pitch
- 20mm Ø Galvanised steel tensioned cable connected to BESISTA clevis end to engineer's specification
- 12mm Galvanised steel plate welded to steel beam connection
- 140 x 150mm WATERIGHT industrial box gutter fixed with 0.9mm brackets at 500mm c.c. to rafter
- 50 x 150mm Timber beam bolted to steel plate with M16 bolts
- 4600 TOP OF TIMBER COLUMN
- Stabilised double mix placed over wattle. Double mix of horse manure, earth, straw and water (1:3:1:8)
- Acacia Dealbata sapling wattle weaved in-between steel wire connected to purlins
- 38 x 76mm purlins spaced at 1200 c.c.
- 89 x 244mm Laminated timber column
- 38 x 467mm Timber kick plate
- Existing 400mm stone wall to be refurbished and tapered to 1000mm at base
- Welded steel plate bolted to timber column and connected to galvanised steel pin end
- 300 x 300 x 15mm Galvanised steel base plate fixed to concrete foundation with 12mm Ø galvanised steel bolts cast into place
- TOP OF ARENA FLOOR FINISH N.G.L.
- 500 x 650mm Concrete pad foundation to engineer's specification
- 250mm Crushed limestone compacted in layers
- TYPAR geotextile fabric
- 150mm Sand and chip rubber riding surface
- TYPAR geotextile fabric
- 150mm Ø Perforated PVC drainage pipe covered in coarse aggregate

SECTION A
Scale 1:50

Space-Time Architects
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2014025478
herlугreeff@gmail.com

GENERAL NOTES

BUILDING NOTES

LIST OF DRAWINGS	
DWG NO.	DESCRIPTION
HTC-1	SITE PLAN
HTC-2	SPACING/ROOF PLAN
HTC-3	FRONT ELEVATION
HTC-4	ROOF PLAN
HTC-5	ELEVATION
HTC-6	ELEVATION
HTC-7	SECTION A
HTC-8	SECTION B
HTC-9	INDOOR COOL SCHEDULE
HTC-10	SWITCH REGULATORY CALCULATIONS/ELECTRICAL PLAN

REVISIONS	
REV. NO.	DESCRIPTION
Rev. 01	Rev. Description

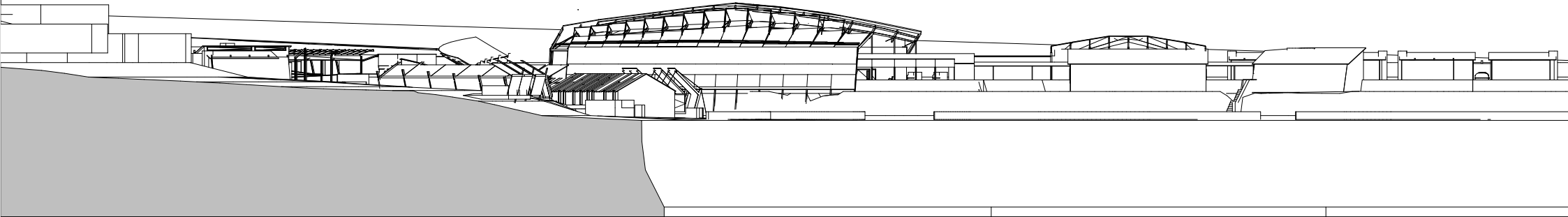
PROJECT ADDRESS
Semonkong,
Lesotho
ERF NUMBER
528W+4V

CLIENT
SENTEBALE
PROJECT NAME
BIOMECHANICAL
HIPPO THERAPY CENTRE

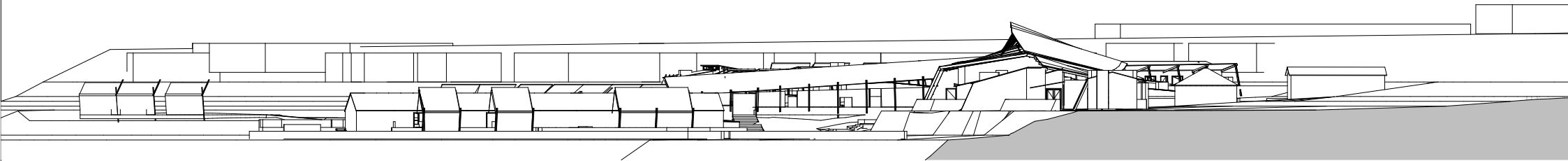
DRAWING TITLE
SECTION A
SCALE
As indicated

Drawn by:	Herlu Greeff 2014025478
Date:	29 October 2019
Drawing number:	HTC - 7
Revision number:	A
Project Type:	Commercial

Architect Signature _____ Client Signature _____



NORTHERN ELEVATION
Scale 1:200



WESTERN ELEVATION
Scale 1:200

GENERAL NOTES

BUILDING NOTES

LIST OF DRAWINGS	
DRW NO.	DESCRIPTION
HTC-1	SITE PLAN
HTC-2	GROUND FLOOR PLAN
HTC-3	FIRST FLOOR PLAN
HTC-4	ROOF PLAN
HTC-5	ELEVATIONS
HTC-6	ELEVATIONS
HTC-7	SECTIONS
HTC-8	SECTIONS
HTC-9	WINDOW SCHEDULE
HTC-10	SWITCH REGULATORS CALCULATION/ELECTRICAL PLAN

REVISIONS	
REV. NO.	DESCRIPTION
Rev. 01	Rev. Description

PROJECT ADDRESS
Semonkong, Lesotho
ERF NUMBER
528W+4V

CLIENT
SENTEBALE
PROJECT NAME
BIOMECHANICAL HIPPO THERAPY CENTRE

DRAWING TITLE
ELEVATIONS
SCALE
1:200

Drawn by:	Herlu Greeff 2014025478
Date:	29 October 2019
Drawing number:	HTC - 5
Revision number:	A
Project Type:	Commercial



CHAPTER FIVE

REFLECTION

In the final chapter of this document, I will critically evaluate the project as a whole and give a personal reflection on the aims identified in chapter one. I will also consider how the design methodologies explored throughout the document can be used for further investigations in the built environment of Lesotho.

1. Technical Evaluation

2. Conclusion

3.1 List of Figures

3.2 Works Cited

3.3 Addendum

Fig. 188

Farmlands of Semonkong
(Photograph: author).



PART 4.1

**TECHNICAL
EVALUATION**

REFLECTION

The structural application of the hippotherapy centre may present significant challenges with regards to the available professionals involved, the skills and expertise of local construction workers and the validation of material standards and processes. Even though local techniques and materials are used throughout the facility, the design of the indoor arena will require imported materials and regular quality checks during construction.

The National University of Lesotho is situated in Roma and is approximately two hours' drive away from Semonkong. The university encourages students to participate in local construction projects to gain experience. Having students visit and inspect the construction of the center may broaden their understanding of what is possible in the design of institutional projects. Although this investigation presents new morphological and typological solutions in the built environment of Semonkong, its design methodologies can be used as a precedent for the design of similar community facilities in other areas of Lesotho.

Fig. 189

Rondavel on a hill
(Photograph: author).

“Horses change lives, they give our young people confidence and self-esteem. They provide peace and tranquillity to troubled souls, they give us hope”. – Toni Robinson (Carlin, 2018: online).



Fig. 190
Basotho man riding into the sunset
(Steinigeweg & Stolarow, 2017: online).

PART 4.2

CONCLUSION

REFLECTION

The project is about more than building a therapy facility; it's about benefiting the community as a whole. The aim of the Hippotherapy Centre is to both provide physical therapy to people with disabilities and to help to re-integrate them into everyday society, addressing both their physiological and social challenges. The topology, morphology, and typology of the building aims to reinterpret the built environment of Lesotho and celebrate existing relationships to reveal a space of dynamic tension between culture and nature, horse and man. The facility strives towards sustainable architectural and social impact through community development and ownership. It further conserves the unique relationship between man and horse in the Basotho culture and celebrates the synergy of working together towards specific therapeutic outcomes.

HOW CAN A SPECIALISED HIPPO THERAPY CENTRE CREATE SUSTAINABLE IMPACT THROUGH A HOLISTIC APPROACH TO THERAPY, HORSE CARE, COMMUNITY PARTICIPATION AND SOCIAL BELONGING WHILE REMAINING ROOTED IN SEMONKONG'S CULTURAL AND NATURAL LANDSCAPE ?

Although the initial project cost will be inflated because of the cost of constructing the biomechanical systems, the facility aims for long term sustainability through the careful use of limited resources in a rural landscape. The project shows innovative ways of interpreting our lived experience into design methodologies, drawing parallels between existing and revealed schemata.



Fig. 191

A cultural synergy
(Steinigeweg & Stolarow, 2017: online).



Fig. 192
Rolling Mountains of Lesotho
(Steinigeweg & Stolarow, 2017: online).

LIST OF FIGURES

All figures not listed
are part of the
author's own work.

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ADDENDUM

PLAGIARISM REPORT

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Fig. 193
Author reaching
for horse

(Photograph: author).