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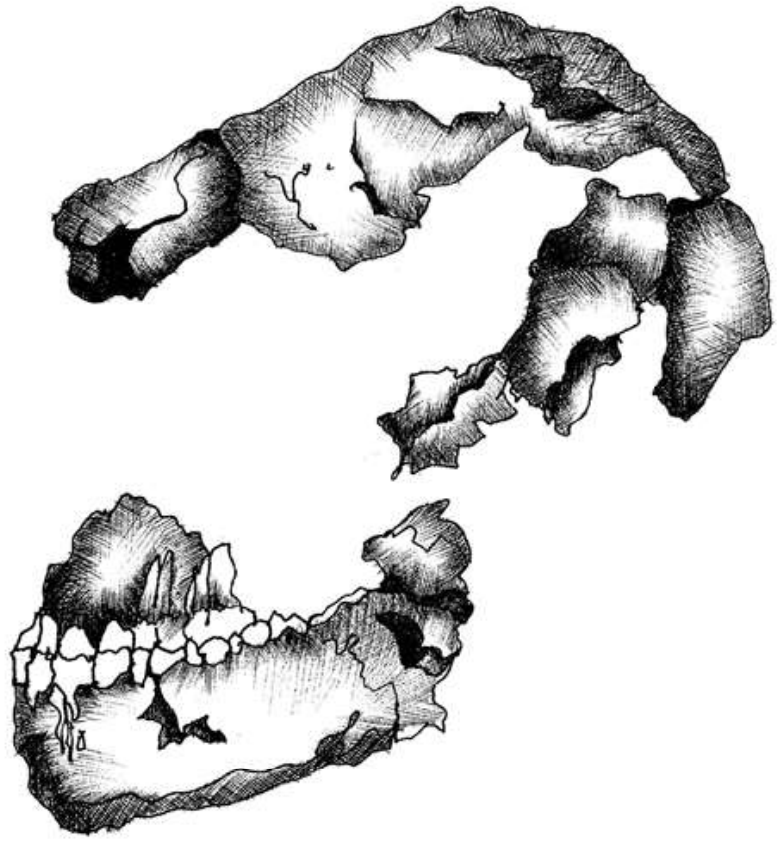
The Scientist, The Collector, & The Treasure Hunter.

A Knowledge Centre for The Cradle of Humankind



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The Scientist, The Collector, & The Treasure Hunter

A Knowledge Centre for The Cradle of Humankind

ABIGAIL BARNARD

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DECLARATION

In accordance with Regulation 4(e) of the General Regulations (G. 57) for dissertations and thesis, I declare that the thesis, which I hereby submit for the degree Master of Architecture (Professional) at the University of Pretoria, is my own work and has not been submitted by me for a degree at this or any other tertiary institution. I further state that no part of my thesis has already, or is currently being submitted for any such degree, diploma or other qualification. I further declare that the thesis is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

ACKNOWLEDGEMENTS

This dissertation is dedicated to my father, Eugene Vaughan Barnard.

A special thanks to:

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ABSTRACT

The Cradle of Humankind, famous for its abundance of hominid fossils, has been preserved as a pristine landscape throughout the modern era, thanks to the establishment of the site as a natural and cultural World Heritage Site in 1994 (Maropeng 2016). In this dissertation the complexity surrounding a world heritage hominid fossil site is investigated.

Kromdraai Cave, one of the five original caves included in the World Heritage declaration on the Cradle of Humankind, is investigated as a point of connection between conflicting values within the world heritage context. Through the intervention the site is envisioned as connecting not only the values of the world heritage site, but also providing an understanding of the landscape as a whole.

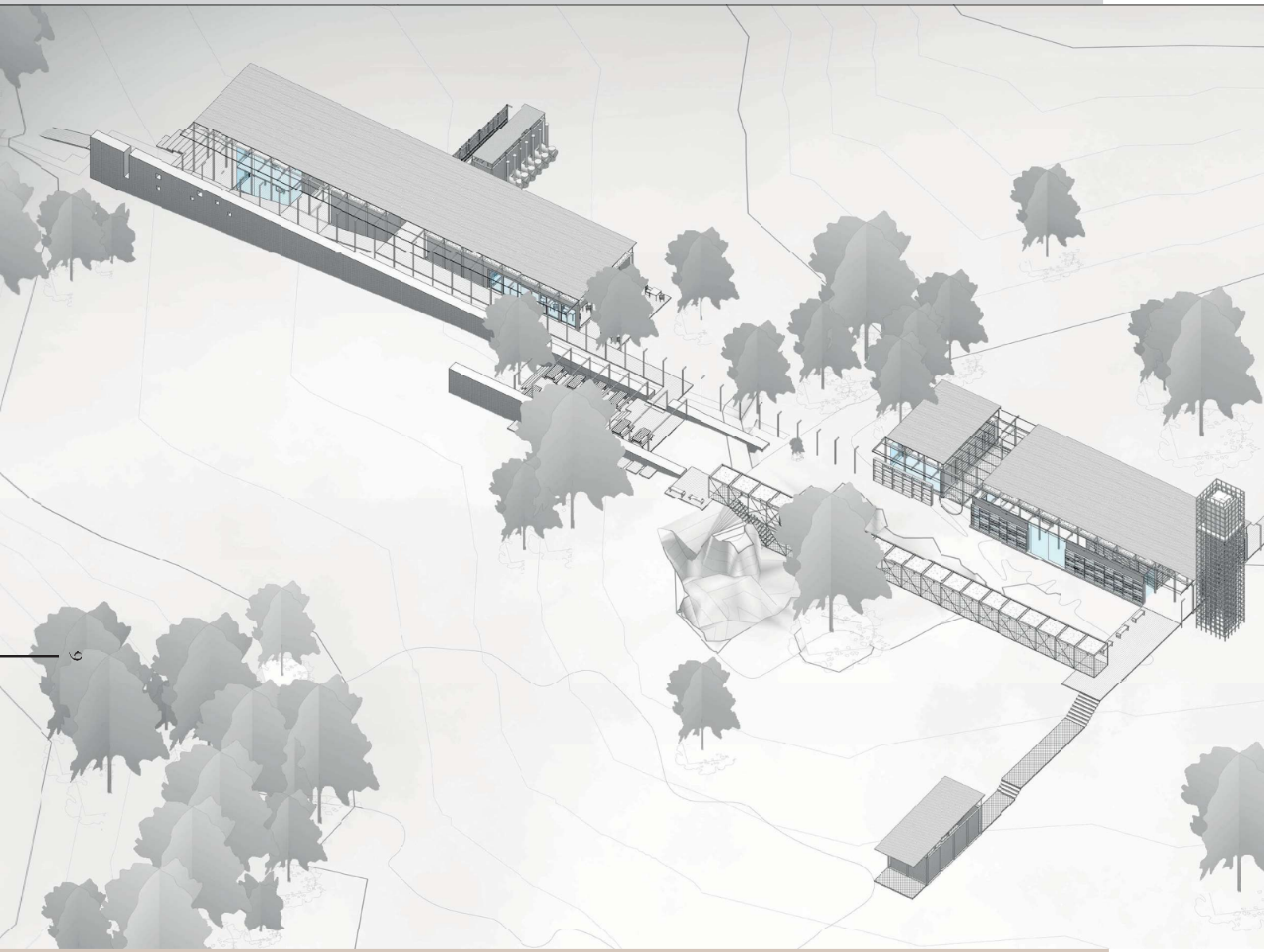
The site is envisioned as a centre of knowledge, relating the value of the site directly to the context. The distribution of knowledge will allow the heritage to be accessible, not only to the scientist but also to the community.

EKSERP

Die Wieg van die Mensdom is bekend vir die oorvloed hominied-fossiele wat daar voorkom, en is dwarsdeur die moderne era as 'n ongerepte landskap bewaar, danksy die die feit dat dit in 1994 as 'n natuurlike en kulturele Wêrelderfenisgebied verklaar is (Maropeng 2016). Hierdie skripsie ondersoek die kompleksiteite wat so 'n hominied-wêrelderfenisgebied omring.

Kromdraai-grot, een van die vyf oorspronklike grotte wat ingesluit is toe Wêrelderfenisstatus aan die Wieg van die Mensdom toegeken is, word as aansluitingspunt tussen teenstrydige waardes binne 'n wêrelderfeniskonteks ondersoek. Deur die voorgestelde ingryping word dit moontlik dat die terrein nie alleen 'n verband skep tussen die onderskeie waardes wat 'n wêrelderfenisgebied verteenwoordig nie, maar dat daar ook 'n beter begrip van die landskap as 'n geheel verskaf word.

Die terrein word as 'n kennissentrum beskou, wat sy waarde direk met die konteks in verband bring. Die verspreiding van kennis sal die erfenis toeganklik maak vir nie net wetenskaplikes nie, maar ook vir die gemeenskap.



1.1 - (Author, 2016).

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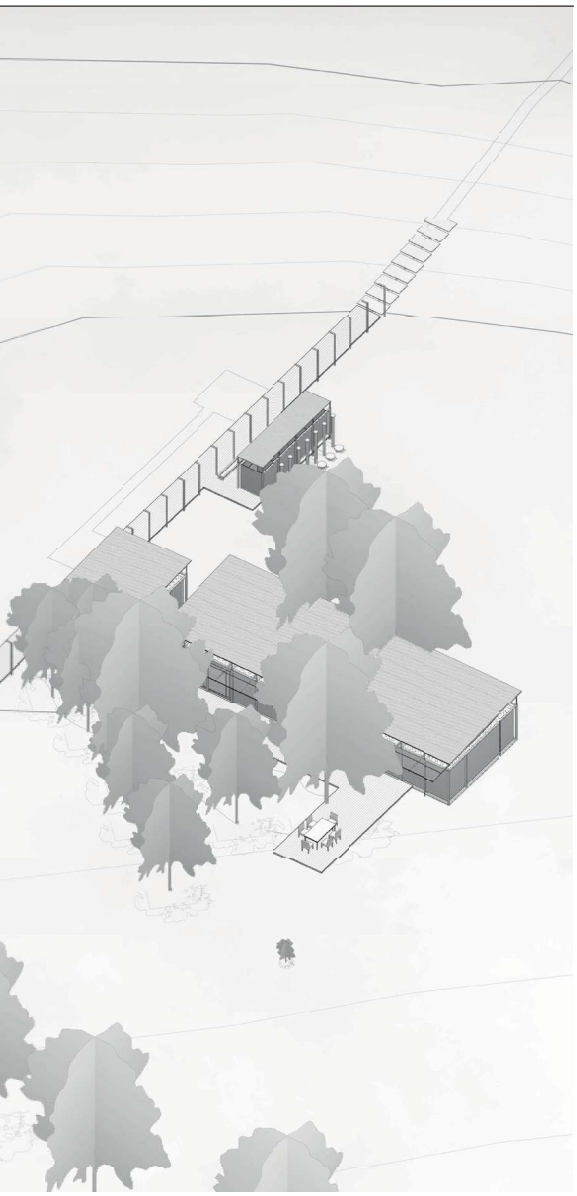


Chapter 1

Introduction

This chapter gives a brief introduction to the context, the choice of site, identified issues and research questions, the intentions of the dissertation, the research methodology and the contribution to architecture.

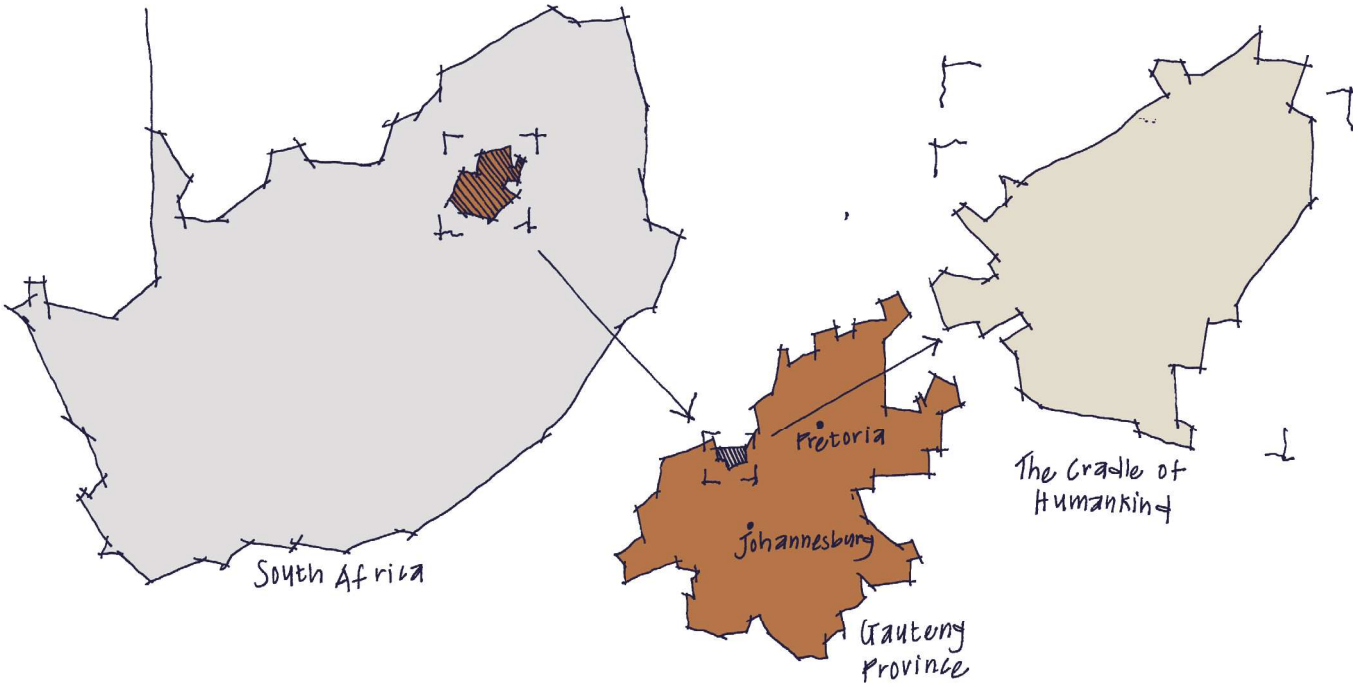
1.1 The background

Throughout the modern era archaeologists and antiquarians have been associated with playing a negative role, as archaeologists were seen as intransigent enthusiasts of the past, driven by an appetite for experiencing the past as present (Schnapp, Shanks & Tiews 2004:3). Today, the field of archaeology is driven by a culture of artisan connoisseurship and collecting, relating to the suburban estate, the bourgeois, the university and the museum. These collectors have separated the archaeologist, archaeological object and archaeological site, with the sole understanding of the archaeology resting on architectural design, which is an architecture mainly driven by the creation of a symbol of capitalism and propaganda.

This dissertation investigates the role of architecture as the connection between the study of the past, the understanding of the present, and the possibilities of the future. The ability of architecture to adapt to the needs of its time is furthermore explored, where the concept of temporality shapes the design process.

1.2 The proposed context

1.2 - The proposed context (Author, 2016).



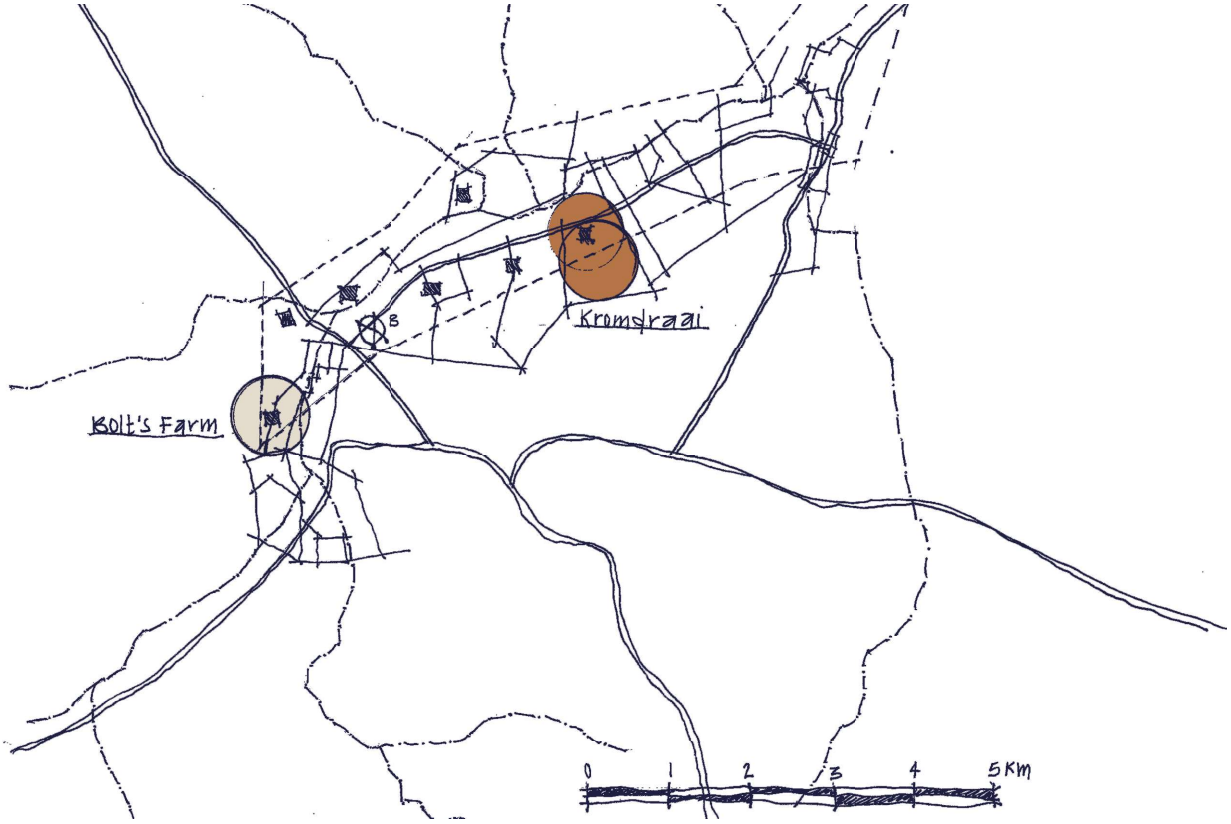
1.3 - The Cradle of Humankind (Author, 2016).

1.2.1 The Cradle of Humankind

Figure 2

The United Nations Educational, Scientific and Cultural Organization, UNESCO, has identified places of Outstanding Universal Value (OUV) throughout the world in an effort to conserve and make them accessible for public interpretation. South Africa boasts eight sites of Outstanding Universal Value, one of which is the Cradle of Humankind. The Cradle of Humankind, famous for its abundance of hominid fossils, has been preserved as a pristine landscape throughout the modern era thanks to the land being used for animal husbandry, and the establishment of the site as a natural and cultural World Heritage Site in 1994 (Maropeng 2016a).

The fossils, owing their existence to the unique geological landscape, are found scattered in caves, many of which are still to be discovered. Investments in the area have been made in the hope of developing the Cradle as a world tourism destination, but the mere size of the area has led to many of the sites still being unknown to the general public. The area remains as mysterious to the visitor as the prehistoric past, inaccessible and possibly even irrelevant.



1.4 - Kromdraai cave (Author, 2016).

1.2.2 Kromdraai cave

Figure 3

Kromdraai Cave, one of the five original caves included in the World Heritage declaration on the Cradle of Humankind, sits in the centre of the known fossil sites to the south. The cave is located 2km from the existing Sterkfontein visitor centre, and connects to the cave because of the discovery of P. robustus, a prehistoric hominid known for its robust appearance. The discovery of P. robustus was the first discovery of a robust australopithecine in the world. Historically the cave represented a turning point for South Africa as the birthplace of humankind, yet today the cave is unknown to the general public, with its significance as well as the efforts of its researchers undervalued.

1.3 The research problem

According to Pallasmaa (2012:35), man has a mental need to grasp that he is rooted in the continuity of time, yet contemporary architectural culture has shifted towards distancing and desensualising man's relation to time. The fossil collector is fascinated by the object's life, the story of its origin and its end (Schnapp et al. 2004:13), yet in current practice the aura and authenticity, the rootedness in place and time of the fossil, has been lost.

This loss is evident in buildings of ageless perfection of which the function is to display and enable the understanding of fossils. The buildings avoid the dimension of time and focus on the memorable visual image instead of allowing for a grounded authentic experience.
Places of outstanding universal value, such as the Cradle of Humankind, are treasured because of man's fascination with his place in the universe and the continuity of time. The existing infrastructure brands the Cradle of Humankind as an international world heritage site, yet the fossil sites remain isolated, with fossils being removed from these sites and taken to universities or museums. The area itself has become a missed opportunity for displaying the landscape, while the aura, mystery and excitement around the discovery of fossils could be lost.

1.3.1 General Issue

Although paleoarchaeology pieces together clues as to the prehistoric past through the study of fossils, the site of the fossil plays an equally important role, especially the context of the site in relation to other sites. The context allows for the creation of a "map" of the prehistoric past, not only providing tangible clues, but also intangible clues such as for example the "aura of place". The Cradle of Humankind, with its collection of fossil sites, is a pristine landscape for the piecing together of the prehistoric past, yet the locations and connections between the fossil sites are generally unknown.

Furthermore, the archaeological act of excavation is destructive by nature and displaces fossils from the site and the timeline of the site. Fossils are removed and placed in museums or universities, robbing the site of its value. The dissertation investigates the Cradle of Humankind as a set of coordinates forming a map of its prehistoric story, and aims to maintain, even without the presence of fossils, the coordinates of the sites for future generations.

1.3.2 Urban Issue

The value of a world heritage site holds immense potential for not only the country, but also community members directly affected by its presence. The predominantly agricultural nature of the Cradle of Humankind has protected the known and unknown fossil sites from commercial and residential development, yet the landscape is undergoing many changes relating to tourism developments. Although tourism threatens the conservation of fossil sites, it generates funding for the identification and conservation of such sites. In this developing and changing landscape, it is important for the value of fossil sites to relate to the context. The fossil sites have become coordinates on a world map of places of outstanding universal value, yet cannot contribute value to this context if they remain stagnant coordinate points. Therefore the dissertation investigates the integration of one fossil site with the context, pertaining to the current state of the site, the site after excavation, the site in the future, and the site in the distant future.

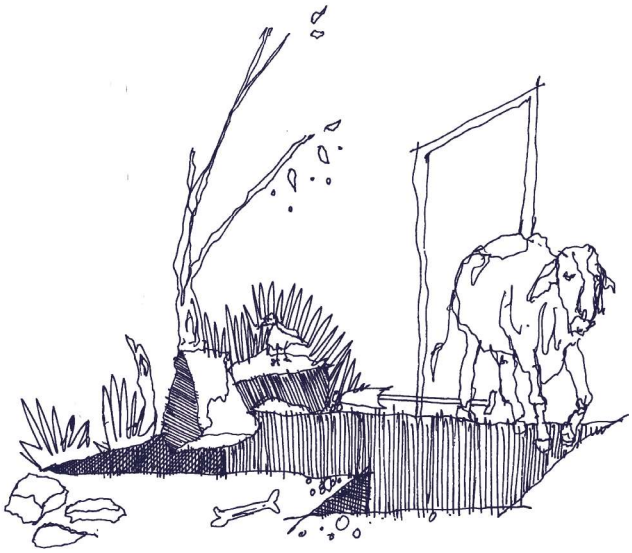
1.3.3 Architectural issue

With the act of excavation destroying the sensitive landscape, the question becomes: How does one build as sensitively as possible on this landscape? The question not only refers to structure, but also to the appropriateness of the architectural resolution and design, the hierarchy between the landscape and the design, and the relationship between the past, future and present. Demountable architecture is investigated as a means of responding to the sensitivity of the landscape and allowing for the representation of the future on the site.

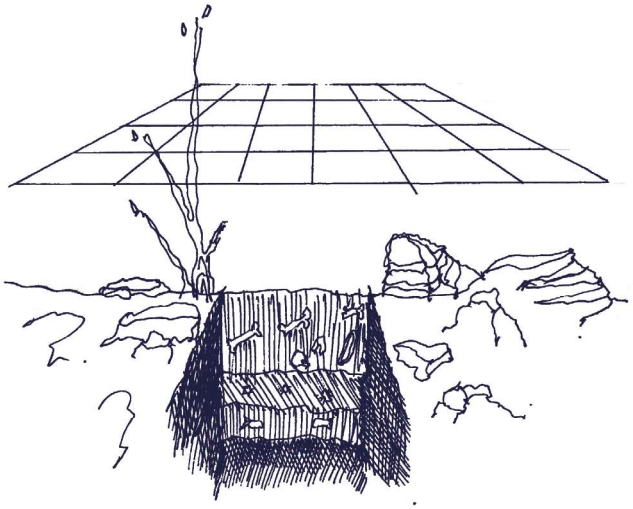
In terms of understanding and experiencing the site, the architecture poses a dual challenge to the

typology of the research centre and interpretation centre, with the focus mainly on the framing of important aspects within the context and site. The knowledge collected from the fossils and landscape is exhibited within the living landscape, allowing the visitor or researcher to build a new memory of the site and imagine the past through discovery.

1.5 - General Issue (Author, 2016).



1.6 - Urban Issue (Author, 2016).



1.7 - Architectural issue (Author, 2016).

1.4 Research questions

The research questions that arise from the problem statement are the following:

- How can the typical process of paleoarchaeology be challenged to add value to a site rather than purely remove value?
- How can the fossil site and paleoarchaeological process be connected to the excavated fossils and made accessible to the public?
- How can the intangible qualities of the site be highlighted and made accessible?
- How can more be done with less?
- How can architecture mediate between the past, present and future?

1.5 The intention

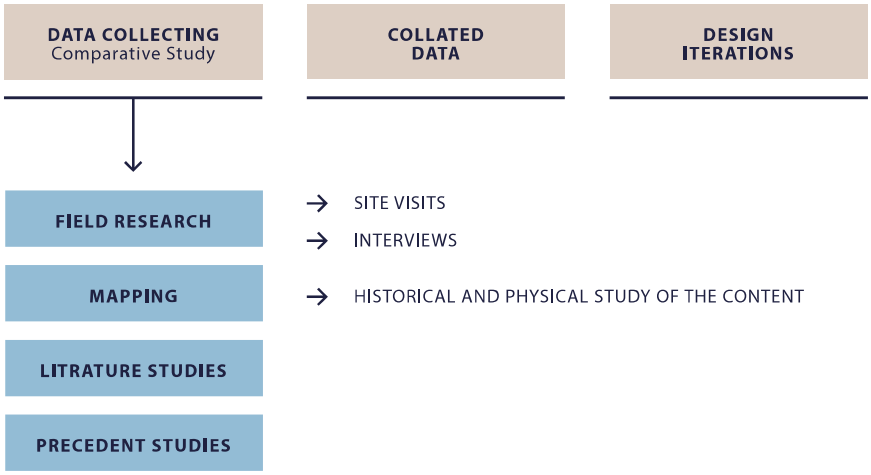
This dissertation intends to follow a value-based approach to designing for a world heritage site, focused on sensitivity to the landscape and qualities of the site. The intervention aims to emphasise the unique value of the Cradle of Humankind as a whole, as well as Kromdraai Cave within this whole.

The goal is to facilitate researchers at Kromdraai Cave, and to connect the cave as a coordinate to the Cradle of Humankind landscape map. In response to the location of the site and the existing informal farming community, the design integrates the community with the scientific processes taking place on site, aiming to communicate and conserve the value of the site. The intervention aims to directly benefit all involved parties and enhance the value of the site.

The intention can be divided into the following categories:

The past: The intervention aims to connect the past to the present through the creation of a new memory of the site. The present, the process of excavation, becomes a part of the story of the site, exploring how a temporary act becomes permanently etched into the landscape.
The present: The intervention does not compete with the existing infrastructure in the area, but aims to strengthen and connect to it. The addition of a research facility generates new discoveries and interest in the Cradle of Humankind, stimulating the existing.
The future: The intervention recognises the changing values of the world heritage landscape and aims to facilitate these changes and adapt accordingly.

1.6 The methodology



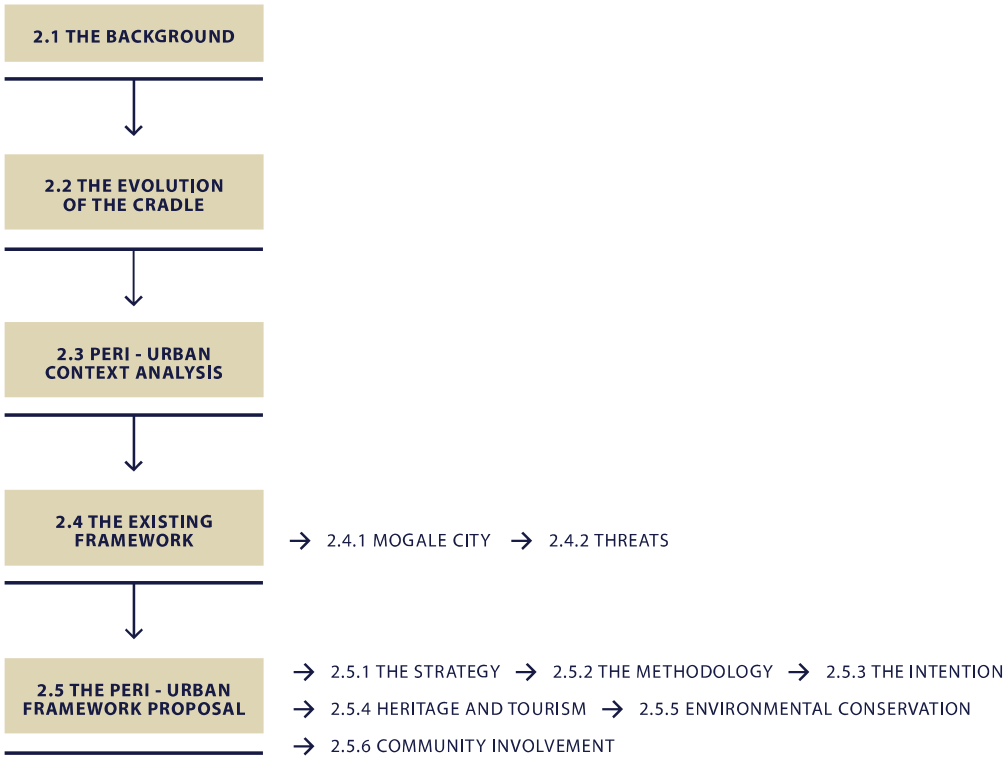
1.7 The contribution

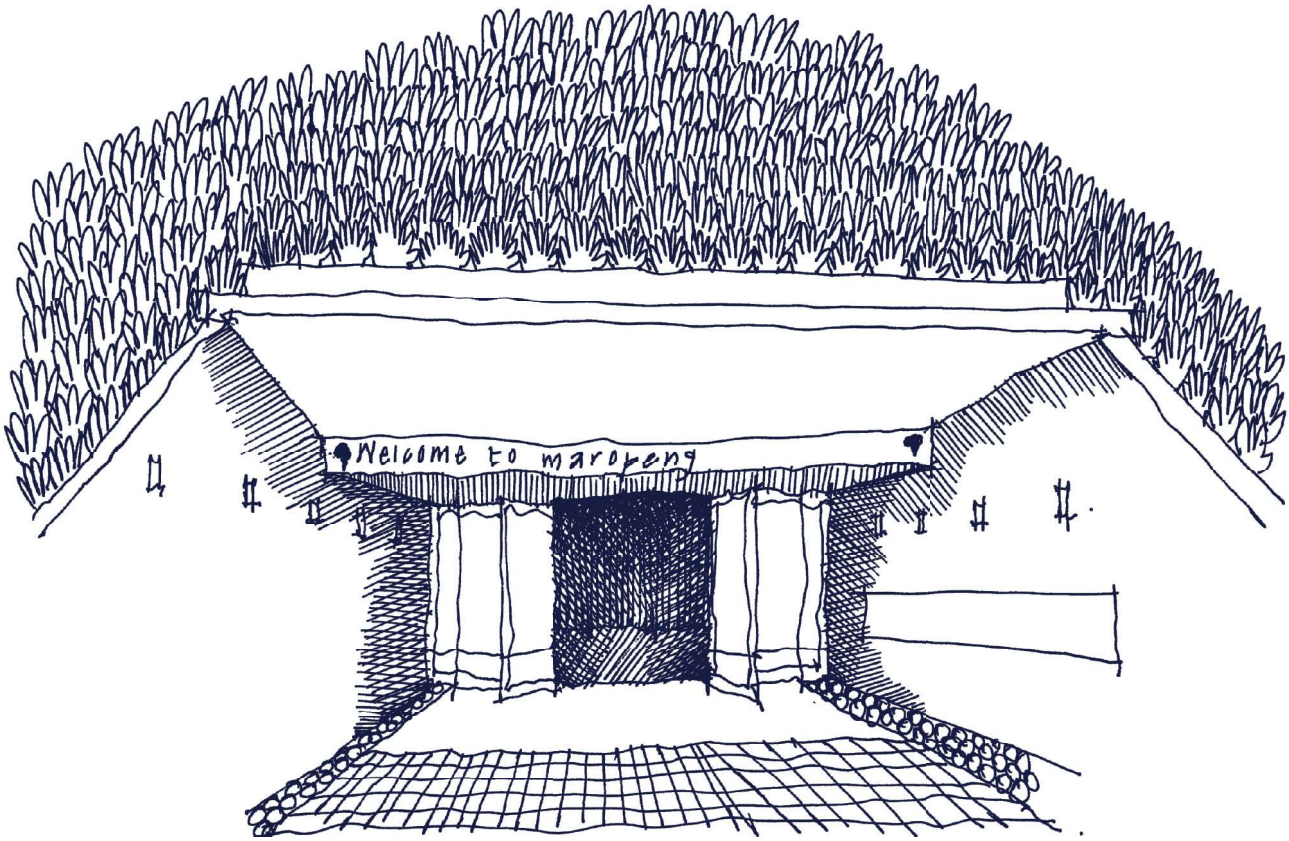
The dissertation provides an approach to designing for and on a sensitive and unique landscape, while respecting the qualities of the landscape and attempting to strengthen and frame these qualities.

Chapter 2

The Cradle of Humankind

The context of the dissertation is the Cradle of Humankind, a UNESCO World Heritage Site. This chapter provides the background to the Cradle of Humankind, the analysis of the Cradle of Humankind, and a summary of the existing framework, and group peri-urban framework.





2.1 - The background (Author, 2016).

2.1 The background

The Cradle of Humankind is a designated UNESCO World Heritage Site named for the wealth of fossil hominid sites generally located within the area in caves or rocky outcrops. The Cradle of Humankind was listed as a World Heritage Site in 1999, with the listing including the sites of Sterkfontein, Swartkrans, Kromdraai, the Makapan Valley and Taung Skull Fossil Site (UNESCO, 2016). The area was listed as such due to the abundance it contains of extraordinary scientific clues as to the pre-historic and historic landscape of man.

The Cradle has over time delivered the highest concentration of hominin fossils found in South Africa, and 35% of all fossils found in Africa (McCarthy & Rubidge, 2005:283). The locations of the hominid fossils within the area show their paleontological relationships, playing a crucial role in furthering our understanding of prehistoric human behaviour and interaction with the environment. Additionally, the site provides key information on fossil mammals, micro mammals and invertebrates, providing evidence of faunal evolution, palaeobiology and palaeoecology ranging back into the Pliocene era.

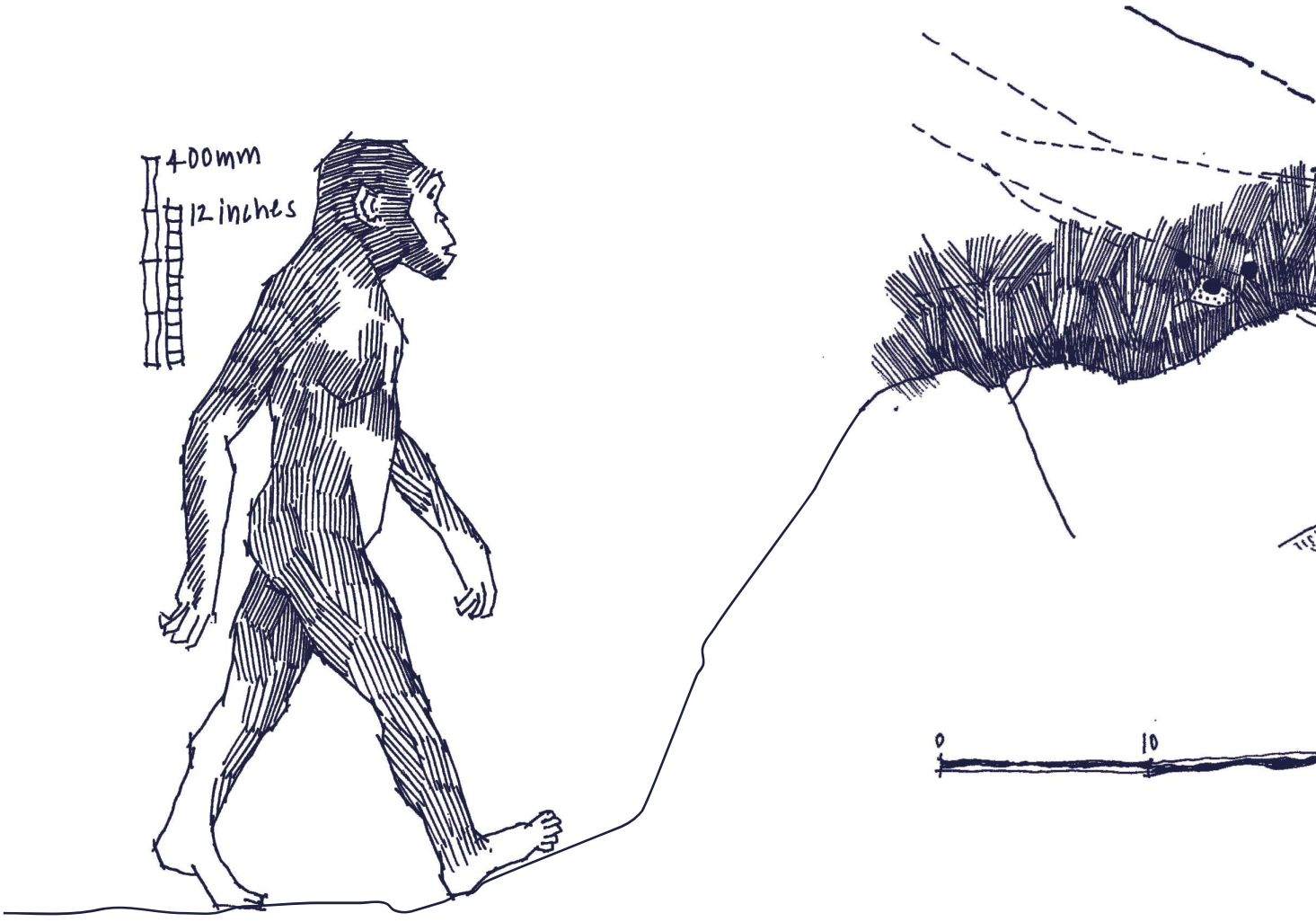
During the evaluation of the Cradle of Humankind, the following criteria were met for it to be declared a site of Outstanding Universal Value (UNESCO, 2016):

Criterion (iii): The nominated serial site bears exceptional testimony to some of the most important Australopithecine specimens dating back more than 3.5 million years. This therefore throws light on to the origins and then the evolution of humankind, through the hominisation process.

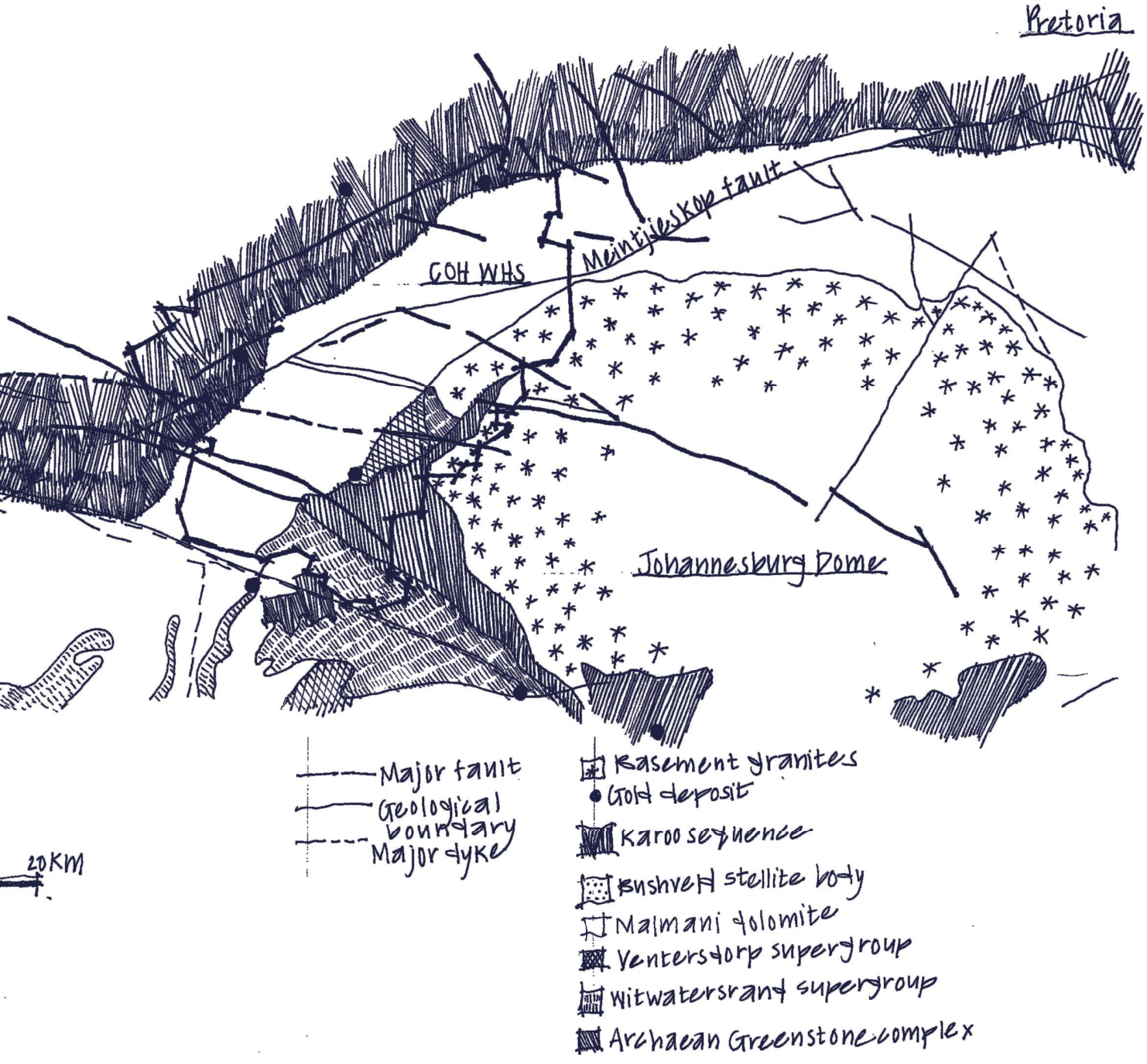
Criterion (vi): The serially nominated sites are situated in unique natural settings that have created a suitable environment for the capture and preservation of human and animal remains that have allowed scientists a window into the past. Thus, this site constitutes a vast reserve of scientific data of universal scope and considerable potential, linked to the history of the most ancient periods of humankind.

Today the landscape additionally represents an important aspect of geodiversity which is significant on an international level. The area forms part of a strategy to safeguard global geodiversity, and the landscape is as important as the cultural heritage within it (Macgregor & The South African Krast Working Group, 2010:4).

2.2 Evolution of the Cradle of Humankind

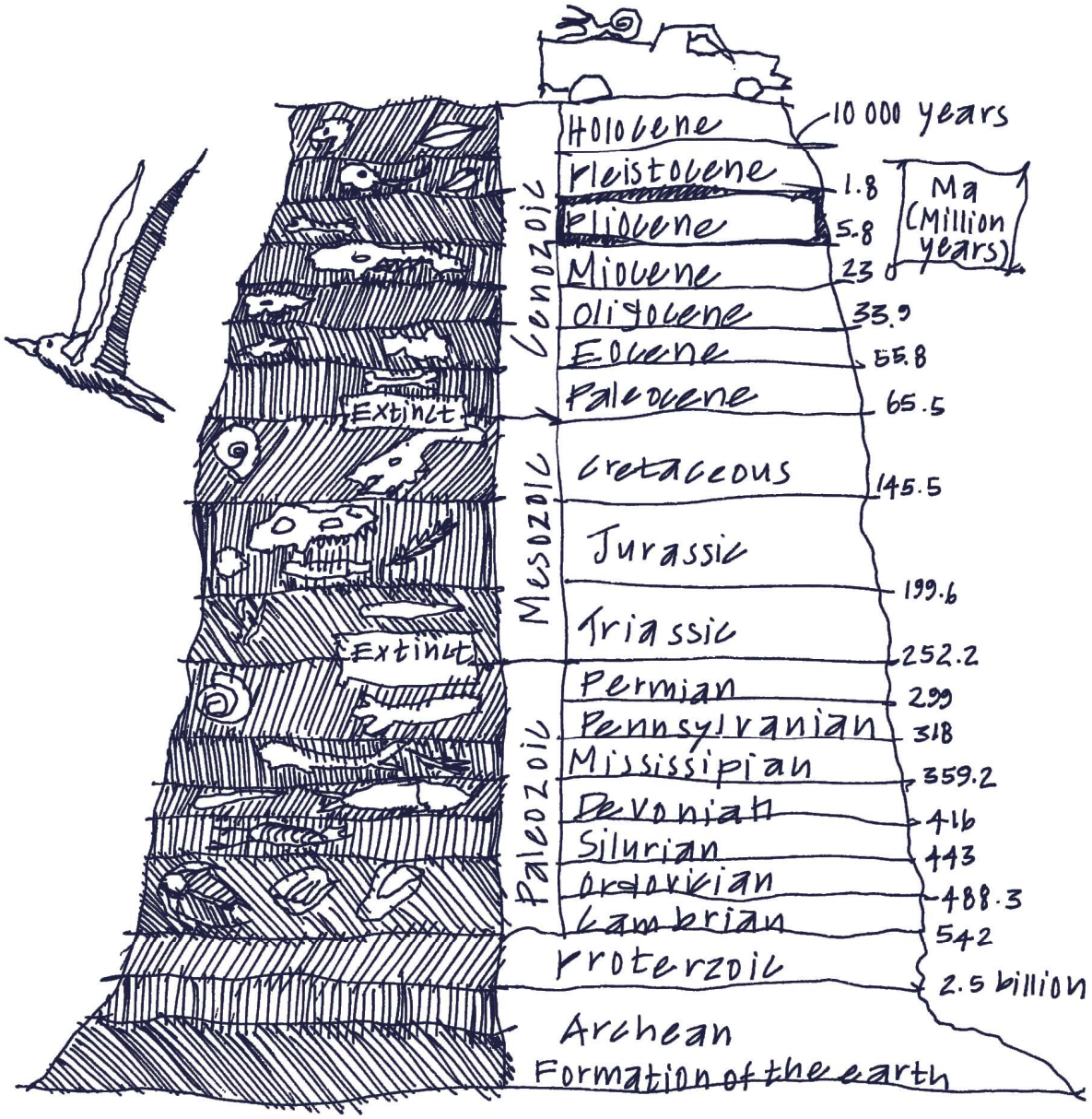


2.2 - Evolution of the Cradle of Humankind (Author, 2016).



The era known as the "boring billion" represents the time between the great oxygenation event and the first appearance of common life. There is no evidence of billion year old complex life forms, yet 2 billion years ago eukaryotic life (large cells with a nucleus) occurred, similar to amoeba, paramecia, euglena and their cohorts living today (Ward & Kirschvink, 2015:90).

35 Millennia ago the earth's climate cooled due to the rise of the eastern and southern African plateaus. This event, christened the African "superswell", caused an increase in aridification and open grassland. It has been proven through geological evidence to have had an effect on the evolutionary and migratory events in Africa, including the appearance and dispersal of early hominins (Pickering, Kramers, Hancox, de Ruiter & Woodhead, 2011:110) In addition to the superswell creating the conditions for hominid habitation, the Johannesburg Dome affected the geology of the area, leading to the stromatolite-rich dolomite sequences deposited on a late-Archaean continental shelf and the formation of a unique krast landscape (Dirks et. al. 2012:113). Today the landscape is vital to the region's water supply and forms part of a unique ecosystem housing a variety of organisms (Macgregor & The South African Krast



2.3 - The boring billion (Author, 2016).

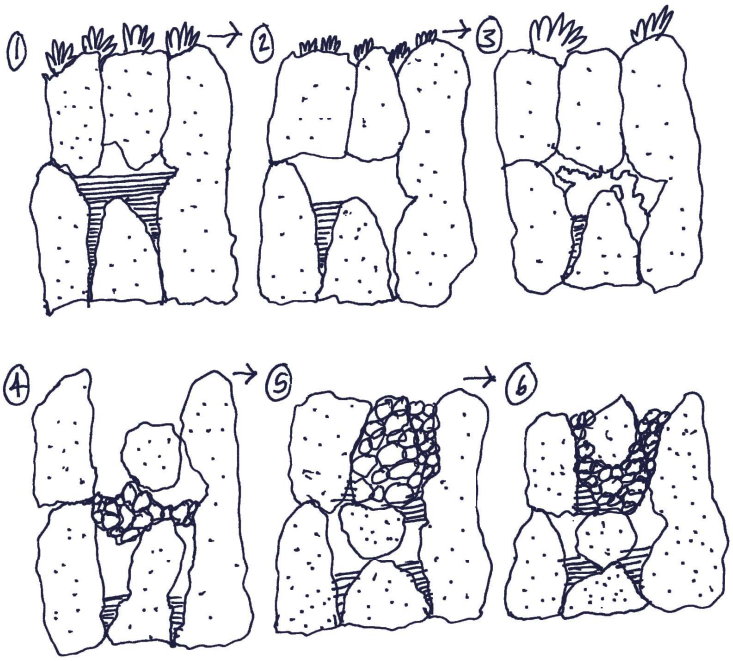
Working Group, 2010:i).

Within the specific krast geology of the Cradle, the formation of caves occurred as moisture passed through the atmosphere, collecting CO2 particles and becoming acidic. The acid quantity rose as rain moved through the soil, resulting in a solution capable of dissolving dolomite (Eloff, 2010:5). During this time the caves were formed in submerged conditions and then drained by the eroding streams of the Crocodile drainage net. The caves, expressions of extensional tectonics, resulted in a dynamic, high-relief landscape known as the Blaauwbank River valley.

The Plio-Pleistocene landscape which preceded the Cradle landscape today is estimated to have been more forested, with gallery forests along watercourses and patchy open grasslands or woodland providing the dietary requirements of the mid-Pleistocene hominids. The landscape forms part of the Transvaal Supergroup which supports a unique ecosystem with a variety of organisms. It is due to this fact that fossil remains such as Australopithecus africanus, Australopithecus sediba, Paranthropus robustus and early Homo remained in a state of preservation (Pickering et al., 2011:23).

Many bones accumulated in caves at the Cradle were amassed from leopards feeding in trees that overhung cave entrances and from hyenas, owls and porcupines that lived in the caves. Hominins were the hunted during this time and not the hunters. Excavations of Paranthropus show that they had a coarse vegetation diet and the capacity to use stone tools. Paranthropus robustus is the best represented hominin in southern Africa and probably the best in the entire African record; it is found in Swartkrans, Drimolen, Kromdraai, Cooper's and Gondolin.

Gold was discovered during the 1880s on Langlaagte, a farm 50km south of the Cradle of Humankind on the Witwatersrand ridge. Thick seams of lime were deposited during stage 2 of the cave formation, and in following the lime seams underground, miners exposed the breccia deposits which resulted in the existence of fossils becoming known (McCarthy & Rubidge, 2005:284). The artificial process of lime mining in the 1800s and 1900s additionally altered



2.4 - The formation of a cave (Author, 2016).

the vegetation in the creation of rock piles. Partly due to these rock piles, cave entrances boast distinctive vegetation communities, as seven plant communities are spatially distributed in response to the various abiotic habitat factors, which include the presence or absence of chert. The vegetation surrounding the cave entrances is not only important for the identification of caves but assist in regulating ecosystems and endemic cave dwelling species or "troglobites".

Mining played a large part in the discovery of fossils; in 1924 palaeontologist Raymond Dart's attention was drawn to a fossil baboon by the only female student under his supervision, Josephine Salmons. Salmons noticed the skull in a friend's living room. It originated from a lime-quarrying operation near a place called Taung (Reader, 2011:188). This skull, at first appearing to be that of a baby ape, would turn out to have humanoid features not found in any known ape (Cartmill & Smith, 2009:130). Dart described the fossil as Australopithecus africanus (Latin: "Southern ape from Afar"), known today as the Taung child. The notion of an ape with humanoid features originating in Africa was fervently opposed by most scientists, as the conventional science of the day anticipated an Asian or European "cradle of humankind" (Maropeng, 2016b).

No more discoveries were made at Taung, but the discovery of the Taung child fuelled an interest for Scottish palaeontologist Robert Broom. Upon request of General Jan Smuts in 1934, Broom became assistant palaeontologist at the then Transvaal Museum in Pretoria (now Ditsong National Museum of Natural History). In 1936 he began the search for Australopithecus africanus, starting at the Sterkfontein Caves. Broom's controversial use of dynamite was questionable, but his efforts to extract fossils yielded hundreds of bones and teeth resembling the infant skull from Taung. He worked at Makapansgat, Cooper's Cave, Kromdraai Cave and Swartkrans Cave. The most famous discovery by Broom is the 'most complete' australopithecine skull, Paranthropus robustus "Mrs Ples" (Thackeray, Braga, Treil, Niksch & Labuschagne, 2002) and the Kromdraai Ape-man.

Through his work Broom substantiated Dart's previous work, and with the publishing of his monograph in 1946, made Africa the birthplace of man (Berger & Hilton-Barber, 2006:61).

Historically the landscape contains mostly agricultural activities, in spite of lacking access to water and the appropriate soil chemistry, climate and ease of access. The degree of difficulty related to the rocky soils and slopes of the area make ploughing challenging, and have contributed significantly to the area staying in its natural state. Mainly grazing has been put into practice, with areas connected to water in the flat-sloped bottomlands showing a distinct anthropogenic influence, such as ploughing, unnatural fire regimes and foreign plant species (Eloff, 2010:123).

The fact that the Cradle of Humankind is a proclaimed World Heritage Site means it is afforded some level of protection in terms of the World Heritage Convention Act (Act No. 49 of 1999) and the National Environmental Management: Protected Areas Act (Act No. 57 of 2003), placing emphasis on its correct management in order to retain this valuable status (Eloff, 2010:8) .

According to Eloff (2010:126) an understanding of the natural vegetation occurring within the Cradle should be the foundation on which management of the area must be based. The justification for the ongoing protection of the Cradle as not only a World Heritage Site of cultural significance, but also as an irreplaceable component in the conservation of Bankenveld grassland and subterranean ecosystems associated with karst landscapes, could thereby be accomplished.

In 1999 the significance of the Cradle of Humankind was confirmed by the International Council of Monuments and Sites (ICOMOS), in recognition of its provision of a rich yield of hominin fossils bearing information on the evolution of humans over the past 3.5 million years, which includes the preservation of the prehistoric habitat and way of life (17th General Assembly of ICOMOS, 2011). The evaluation led to the naming of the Cradle of Humankind (CoH) as a UNESCO world heritage site of cultural significance, the aim being the safeguarding of the Cradle against the pressures of shifting socio-economic circumstances and decay (Eloff, 2010:1).

Today the Cradle of Humankind World Heritage Site, located an hour's drive from the major cities of Pretoria and Johannesburg, incorporates an area of 47 000 hectares containing approximately 20 main caves and an additional buffer zone of 80 000 hectares. Due to the World Heritage status of the site and agreed responsibilities, authorities have not only drawn up management plans for the site (Tourism Strategy for Mogale City Local Municipality and District Management) but also spent over R 300 million to build a visitor centre known as Maropeng in the proximity of the fossil sites. In addition to the new visitor centre, the Sterkfontein visitor centre next to the site of the Sterkfontein Cave was upgraded (Flemminger, 2008:10).

The development of the region's mineral wealth has brought great prosperity to the country as a whole. Increased knowledge of the world demands new commodities, technological advances and transformations. Although the influx of tourism poses a threat to the conservation of the sensitive cave sites, tourism holds the possibility of contributing to economic growth and increased employment opportunities for the area and its people, while creating funds for its conservation (Ndoro, 2015:393).

PARANTHROPUS ROBUSTUS

Paranthropus is based on the Greek words para meaning “beside” or “near” and anthropus, meaning “man”. The Latin word robustus means “strongly built”.

Paranthropus robustus is significant as it became the first "robust" species of hominid ever uncovered – well before P. boisei and P. aethiopicus – and showed that the trail leading to Homo sapiens was not a straight line, but one of rich diversity (Smithsonian National Museum of Natural History, 2016).

At home in parts of Africa predominantly consisting of open savannah grasslands and woodlands, the species had large teeth as well as a ridge on top of the skull, where strong chewing muscles were attached. These distinctive features permitted individuals to crush hard foods such as nuts, seeds and roots, although the species is thought to have been a dietary generalist, also eating a variety of other foods such as soft fruits and possibly young leaves, insects and meat (Dorey & Blaxland, 2015).

Although no clear connection has been drawn between stone tools and Paranthropus robustus fossils, experiments and microscopic studies of bone fragments show that it is likely that bones were used as tools to dig in termite mounds.

2.5 - Paranthropus Robustus (Author, 2016).

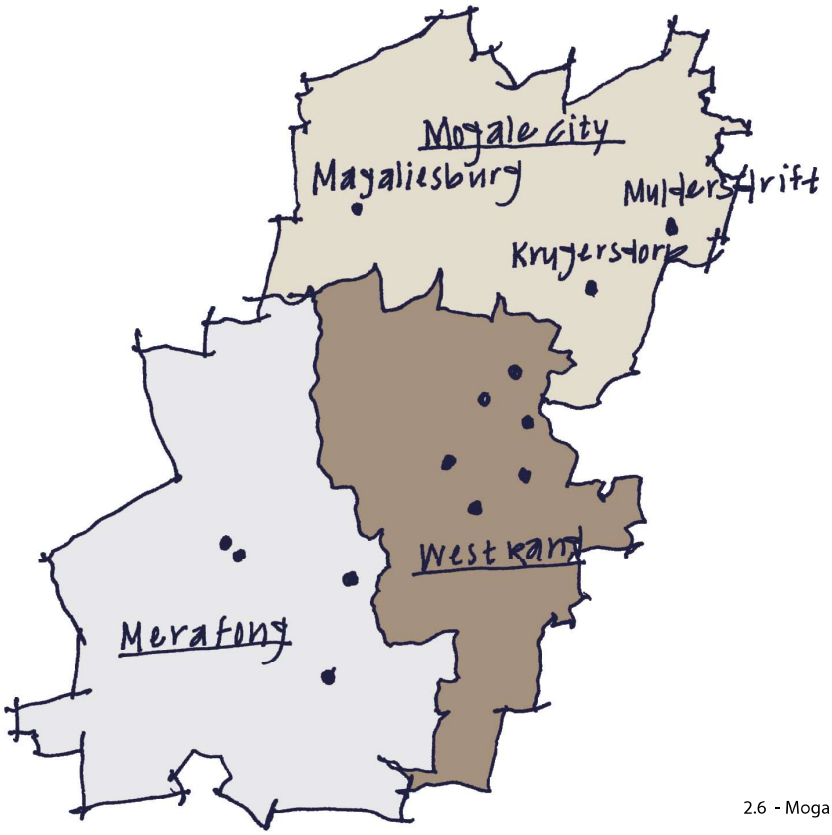
2.3 Peri-urban context analysis

2.3.1 Mogale City

Mogale City lies west and south of the Johannesburg and Tshwane metropolitan areas. The West Rand District Management Area lies within the central-northern part of Mogale City, and this area comprises the bulk of the Cradle of Humankind World Heritage Site.

The largest part of Mogale City is rural in nature, with a specific urban concentration in the south-eastern part of the municipality. The municipality also comprises the urban-rural transition zones typical of large urban areas. The spatial structure of Mogale City is made up of four major development/use zones, namely:

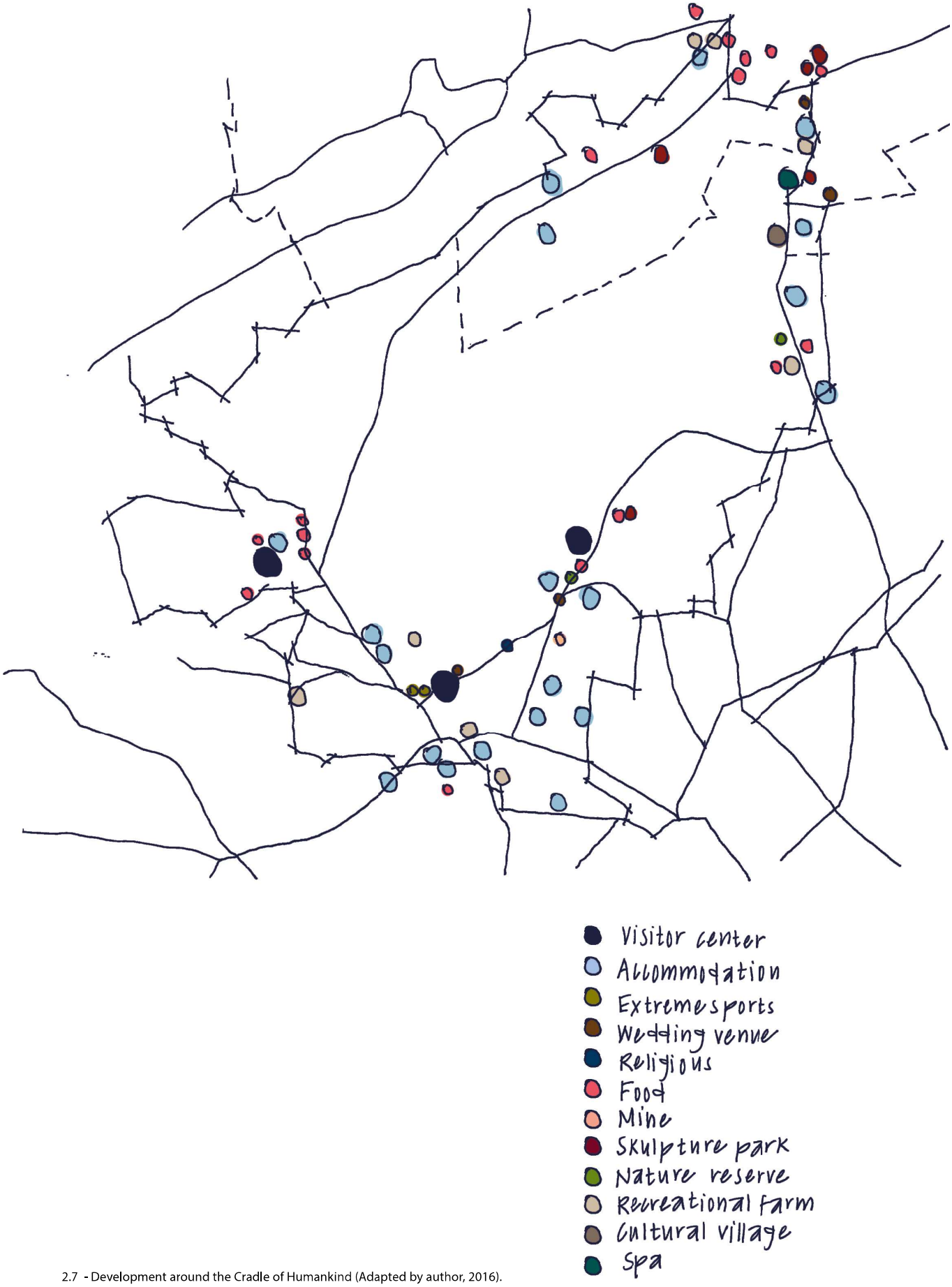
- The Muldersdrift rural/urban transition zone;
- The extensive rural environment;
- The urban area; and
- The Cradle of Humankind UNESCO World Heritage Site and Buffer Zone.



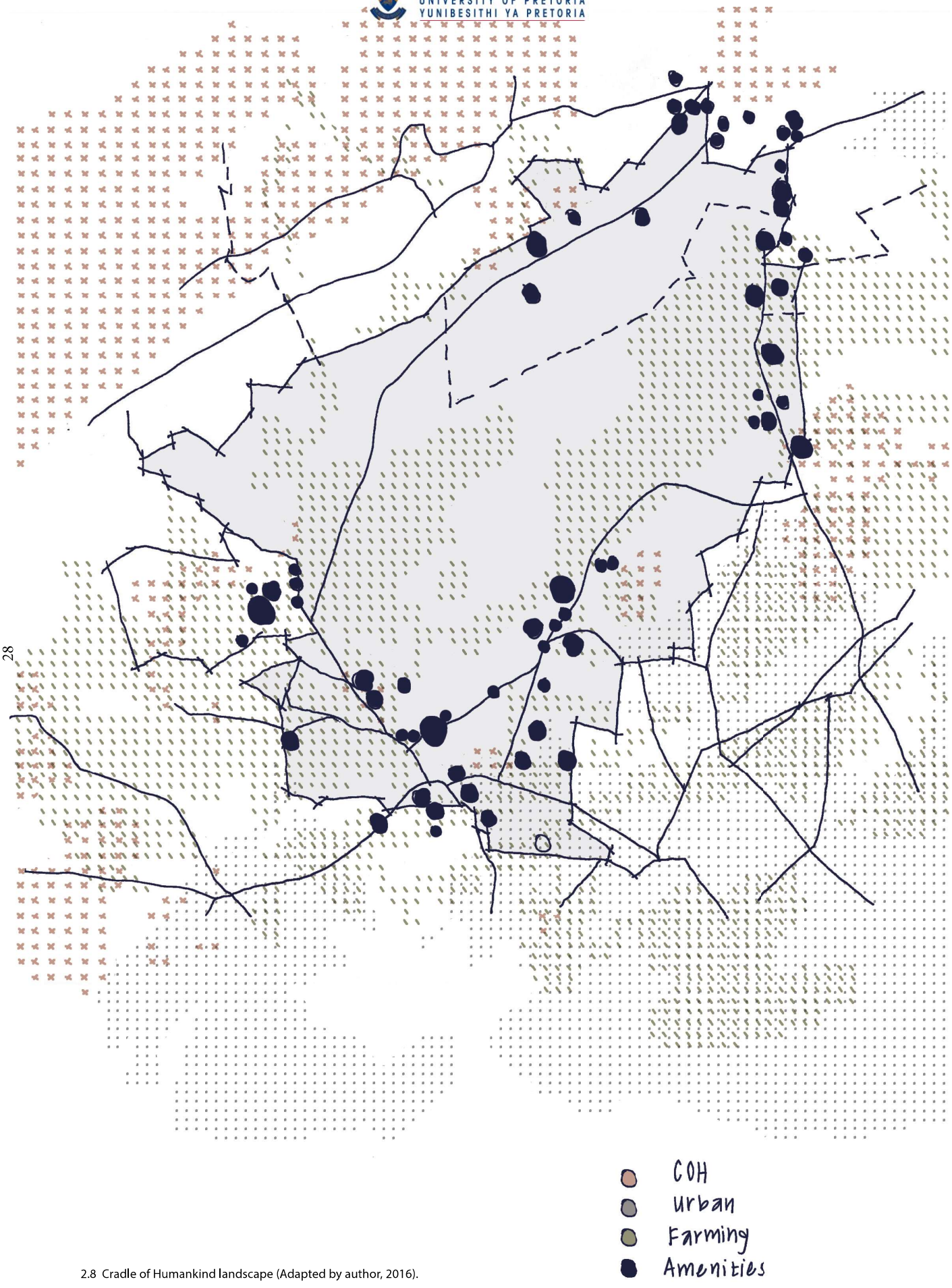
2.6 - Mogale City (Author, 2016).

The rural environment is characterised by the following prominent features (Mogale City Local Municipality 2011:33-34):

- The Magaliesberg and Witwatersberg mountain ranges in the north-west of Mogale City;
- Nature conservation areas; and
- Rural towns such as Tarlton, Magaliesburg and Hekpoort.



2.7 - Development around the Cradle of Humankind (Adapted by author, 2016).

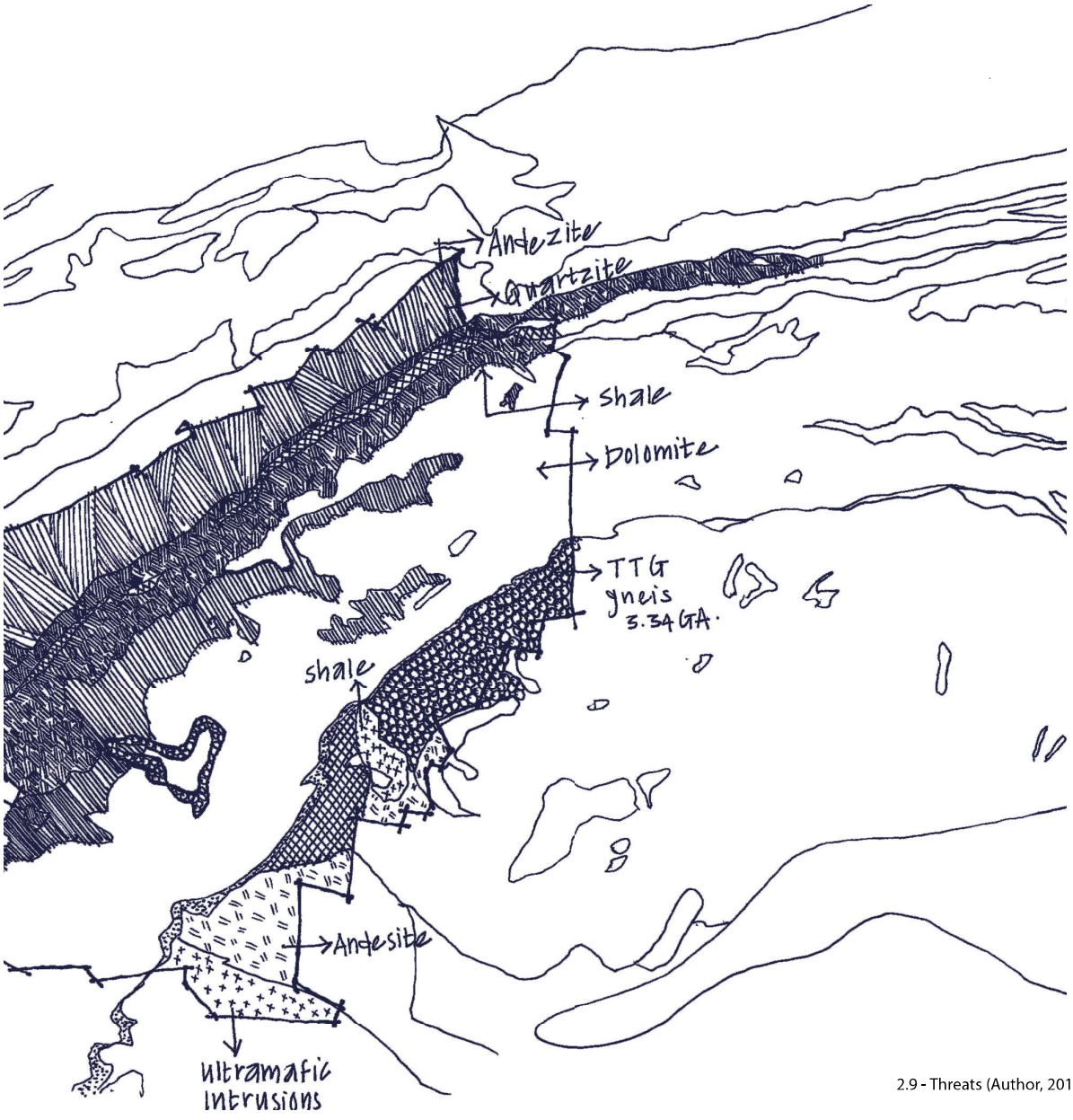


2.8 Cradle of Humankind landscape (Adapted by author, 2016).

2.3.2 Threats

The impact of the Vredefort meteorite led not only to the protection of subterranean gold streams driving gold deposits to the earth's surface, but also to an increase in oxygen, leading to more complex life forms (Berger & Hilton-Barber, 2002:52). Along with depositing gold, the impact led to the formation of the geology of the Cradle of Humankind, known today as a unique krast geology which consists essentially of shallow marine stromatolitic dolostone with variable amounts of chert. The dolomite mineral reaches a thickness of 1 450m in the Sterkfontein area (Eloff, 2010:20).

The important krast geology of the Cradle of Humankind World Heritage Site is vulnerable to contemporary human actions such as the over-use of natural resources and pollution, urban development, and acidic water decanting from the West Rand. The integrity of the site is affected by the unauthorized removal of dolomite, cave formations, fossils and archaeological artefacts by the public (Durand, Meeuvis & Fourie, 2010:74) while invasive species such as Campuloclinium macrocephalum have invaded pristine as well as disturbed areas, threatening ecosystems and their associated processes (Makokotlele, 2009:74-75).



2.9 - Threats (Author, 2016).

2.4 The existing framework

In order to conform to the UNESCO listing, the Cradle of Humankind Management Authority has promised to adhere to and develop the following principles (Berger & Hilton-Barber, 2006:50-51):

- To develop measures for the cultural and environmental protection and sustainable development of, and related activities within, World Heritage Sites, and ensure that the values of the WHC are given effect to;
- To promote, manage, oversee, market and facilitate tourism and related development in connection with World Heritage Sites in accordance with applicable law, the WHC and the Operational Guidelines in such a way that the cultural and ecological integrity are maintained;
- To identify cultural and natural heritage that must be transmitted to future generations;
- To take effective and active measures for the protection, conservation and presentation of the cultural and natural heritage;
- To facilitate steps that encourage investment and innovation;
- To facilitate programmes that encourage job creation;
- To take measures that ensure the values of the WHC are promoted;
- To establish and implement the Integrated Management Plan;
- To initiate steps regarding research, education, training, awareness raising and capacity building; and
- To liaise with, and be sensitive to, the needs of communities living in or near the World Heritage Sites.

As a product of the R347-million development, the Cradle of Humankind today has improved bulk infrastructure and roads, together with two visitor centres: Sterkfontein, located near the Sterkfontein Caves, and Maropeng, located a considerable distance from the fossil cave sites. Sterkfontein facilitates an exhibition, a tour of the caves, a small exhibition of the moulding of fossils process, a café and a shop. Maropeng, located outside of the Cradle itself, hosts a visitor centre, conference facilities, three restaurants, a luxury boutique hotel an amphitheatre, accommodation for schoolchildren, visitors' information points, a marketplace, and parking.

The Cradle is managed by the Cradle of Humankind World Heritage Site Management Authority (Government Communication and Information System, 2016). The Management Authority and the Gauteng Department of Agriculture, Conservation and Environment (GDACE) were appointed in order to carry out certain responsibilities, as listed above. In accordance with the 1972 World Heritage Convention agreement, the primary goal of the Management Authority is to safeguard, preserve and interpret the Outstanding Universal Value (OUV) of the site.

The Cradle of Humankind Trust, a product of The Cradle of Humankind World Heritage Site Management Authority, consists of a community benefits programme, a scientific community, and stakeholders. The Trust was formed in terms of section 8 of the World Heritage Convention Act (Act No. 49 of 1999) and works towards the implementation of an Integrated Environment and Conservation Management Plan. The plan supports a number of specialist studies, including studies on the state of the environment, archaeology and paleoanthropology, geology, hydrology, ecology, land use and infrastructure, tourism and marketing, stakeholder participation, and financial plans.

The Cradle of Humankind World Heritage Site stakeholders include, but are not limited to, the following (Cradle of Humankind, 2016):

- Mogale City Local Municipality
- West Rand District Municipality
- Landowner associations
- Tourism establishment owner forums
- Local councillors
- Provincial government departments
- National government departments
- Local community formations
- Government agencies such as the Gauteng Enterprise Propeller (GEP), Tourism Enterprise Partnership (TEP), Small Enterprise Development Agency (SEDA) and the Culture, Arts, Tourism, Hospitality and Sport Sector

Education and Training Authority (CATHSSETA)

The cave sites at the Cradle of Humankind are researched primarily by the Evolutionary Studies Institute of the University of the Witwatersrand. Kromdraai Cave is being excavated and researched by this institute in collaboration with two Erasmus Mundus programmes, AESOP and AESOP+ (A European and South African Partnership on Heritage and Past). The programmes are composed of 21 South African and European universities and 6 associated partners. The collaboration provides unique opportunities for the promotion of natural and cultural heritage, as well as educational opportunities for not only members of the scientific community, but also the community of the Cradle.

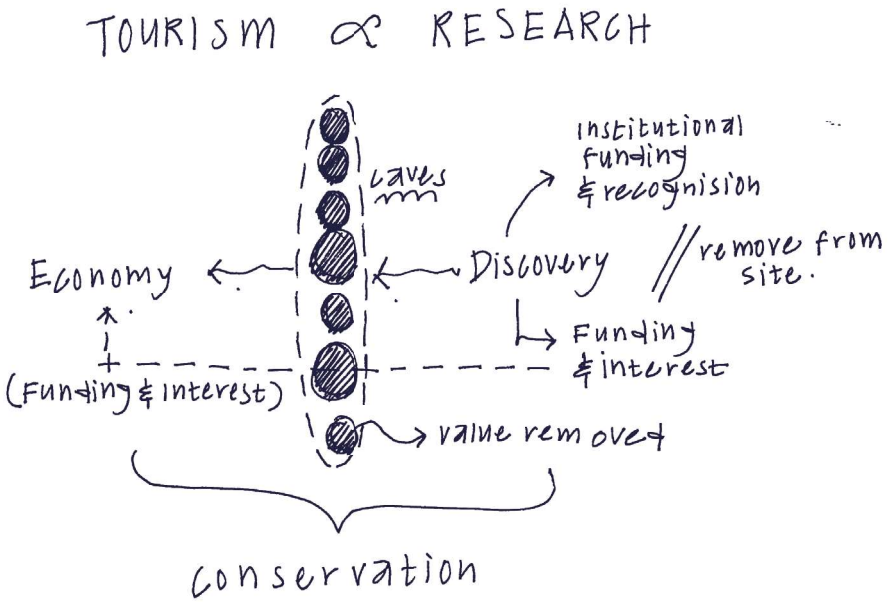
Although the conservation and protection of natural and cultural heritage is the main driver in the management of the Cradle of Humankind, the involvement of surrounding communities is recognised as equally important. Community programmes focused on arts and crafts cooperatives have been established in the area, with a sub-unit of the Cradle of Humankind Trust ensuring benefits accruing from the World Heritage area are to the advantage of the local communities (mostly consisting of farm workers and their families).

The following are community projects identified for the Cradle of Humankind World Heritage Site, in conjunction with the integrated development plan (IDP) of the municipalities involved (Government Communication and Information System, 2016):

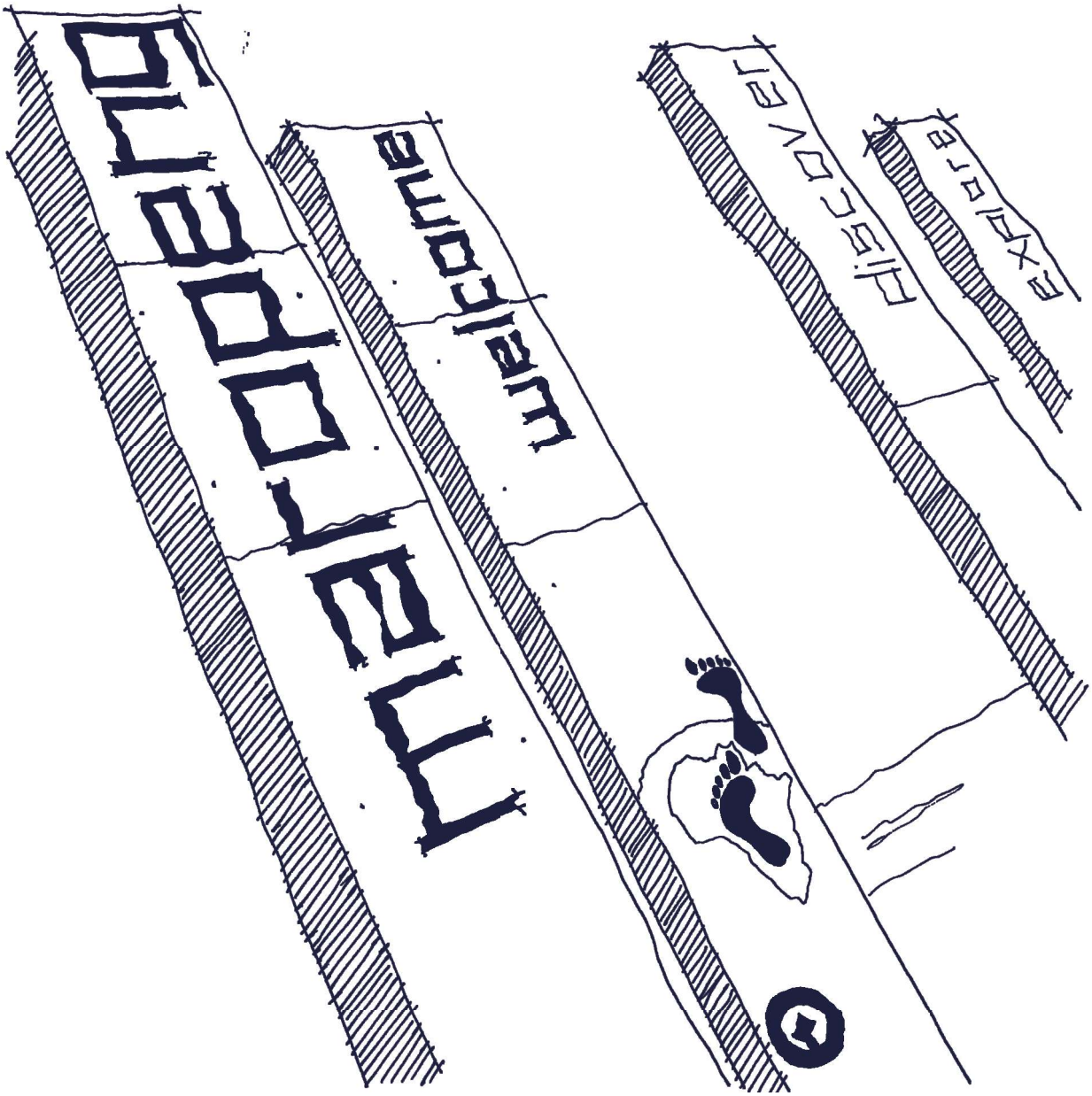
- HIV/Aids clinic
- Transportation for academics/ learners
- Skills growth
- School visits
- Tourism safety monitors
- SMME development
- Craft community beneficiation projects
- Housing

The goals of the community projects are:

- Job creation
- Providing local communities with skills to work in the tourism sector
- Assisting municipalities to achieve their IDP goals
- Enterprise development
- Changing the face of business ownership



2.10 - Tourism & Research (Author, 2016).



2.11 - Maropeng (Author, 2016).

2.5 The peri-urban framework proposal

In 1997 the South African government signed the 1972 UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (Flemminger, 2008:7), which focuses on the preservation and promotion of the world's natural and cultural heritage, in preparation for the Cradle of Humankind becoming a World Heritage Site in 1999 (Eloff, 2010:2).In order to promote the site's outstanding universal value, the public-private partnership between Blue IQ and the Gauteng Provincial Government undertook a R347-million development of the Cradle of Humankind (Cradle of Humankind., 2016). The University of the Witwatersrand acts as the major excavator of the area, removing fossils from their original environment to be analysed and safeguarded at the university, while the university and Maropeng a'Afrika Leisure (Pty) Ltd (MAL) manage Maropeng together with any developments on the site.

2.5.1 The peri-urban framework strategy

The Cradle of Humankind World Heritage Site and Dinokeng are initiatives of the Gauteng Provincial Government to establish geo-spatial tourism destinations close to the densely populated metropolitan areas of Johannesburg, Tshwane and Ekurhuleni. If managed and planned properly, local and international tourism can be used to add immense value to these sites with appreciation for the prehistoric remains providing contemporary worth to the area, and thereby protecting it. The area already boasts thousands of cyclists every weekend and acts as a "garden" for the city.

Taking the existing tourism networks into consideration, the framework focuses on developing a conservation strategy which relies on the economic development of the Cradle of Humankind through tourism development. The rural nature of the Cradle of Humankind and the richness of its ecology offer an opportunity for the site to become a heritage park which is rich in memory and biodiversity. The group urban framework concentrates on the southern edge of the Cradle, which acts as the gateway to the larger world heritage site and contains the highest known number of discovered fossil sites. The framework not only aims to address the issue of conservation of the world heritage site, but also aims to address the unarticulated, commodified and fragmented nature of the Cradle.

2.5.2 The methodology

The framework was developed for the Cradle of Humankind through determining a strategy for long-term preservation with short-term gains. The dynamics of tourism and conservation were analysed in order to draw on the positive qualities of each, while preventing possible economic, heritage and ecological threats.

2.5.3 The intention

Owing to the location of the Cradle being an hour's drive away from two major cities, Pretoria and Johannesburg, the area is envisioned to become a tourism corridor and an escape from the city, with activities such as hiking, sport and leisure.

2.5.4 Heritage and tourism

2.5.4.1 Fossil-based and other tourism activities

The framework takes into account the location of the fossil finds within the boundaries of the Cradle of Humankind. Due to the nature of the formation of fossils, the majority of the fossils finds are clustered around the Rietspruit and Blaauwbankspruit. These water bodies run along the major vehicular routes, next to which most other tourism activities, such as adventure sports facilities, sculpture gardens and accommodation, can be found.

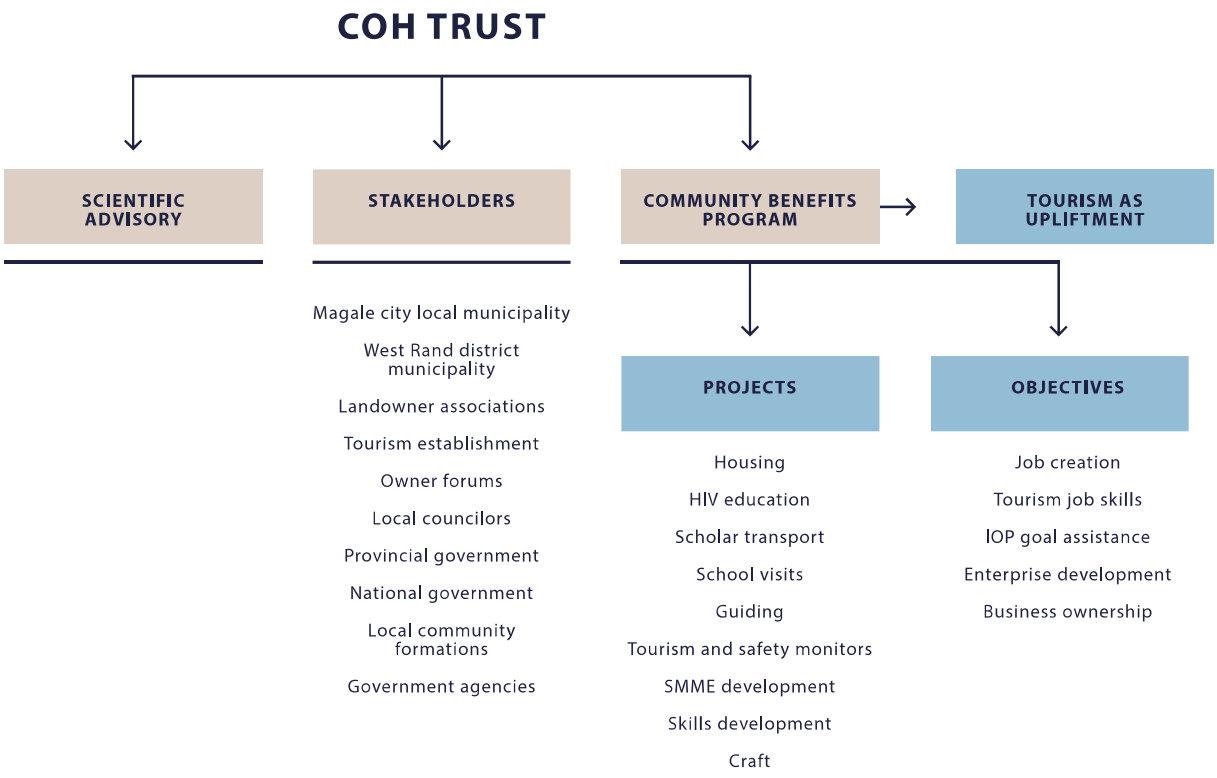
2.5.4.2 The UNESCO heritage conservation framework

The UNESCO strategy for managing tourism at World Heritage Sites includes the following (Pedersen 2002:96):

- Reducing the number of visitors to a site;
- Changing visitors' behaviour;
- Dispersing or concentrating people to reduce use in a particular area;
- Reducing conflicts between visitors;
- Reducing conflict between tourists and the communities;
- Encouraging visitors to practice particular activities; and
- Making the physical environment more resistant to impacts.

2.5.4.3 The proposed heritage framework

As proposed by UNESCO, the management strategies which have a physical or spatial impact on world heritage sites were taken into consideration in the development of the framework. The intention of the proposed framework is to cluster future commercial activities around existing ones, with tourists moving along a Cradle "corridor". This corridor, with the necessary infrastructure, accommodates tourism while managing and limiting the extent to which the tourists are allowed to move within the Cradle – an approach which protects existing sites as well as future discoveries, and connects different parts of the site as one world heritage site. Information points together with access to parking and transportation services are placed at the entrances to the corridor, limiting vehicular activity in the area and announcing the status of the site.



2.12 - COH Trust (Adapted by author, 2016).

UNESCO

STRATEGY

Reducing the number of visitors:

Limiting group sizes.

Reducing the number of people who enter an area.

Not providing facilities.

Visitors' behaviour changed through:

Education programmes teaching low-impact ways to visit a site.

Interpretation programmes teaching respect for a site's resources and protection issues.

Actions for reducing conflicts between visitors include:

Zoning an area for compatible activities.

Influencing the types of tourism activities practised at a site by providing or not providing facilities.

Dispersing or concentrating people to reduce use in a particular area:

Limiting the length of stay in the threatened area.

Raising the entrance fee for the threatened area only.

Not providing facilities in the threatened area.

Zoning for a particular activity and not permitting the activity in the threatened area.

Directing tourists to more resilient areas through zoning and offering more facilities or fewer facilities.

Reducing the number of people who enter an area.

Charging different entrance fees on certain days of the week.

Encourage visitors to practise particular activities by:

Restricting opening hours.

Prohibiting certain activities through regulation and enforcement.

Physical environment made more resistant to impacts by:

Adding infrastructure to "harden" a site.

Relocating infrastructure to more resilient areas.

Reducing conflict between local people and the communities:

Channelling economic benefits to local populations.

Incorporating socio-cultural values into management by increasing community participation.

2.13 - The UNESCO heritage conservation framework (Adapted by author, 2016).

2.5.5 Environmental conservation

2.5.5.1 The state of the environment at the Cradle of Humankind

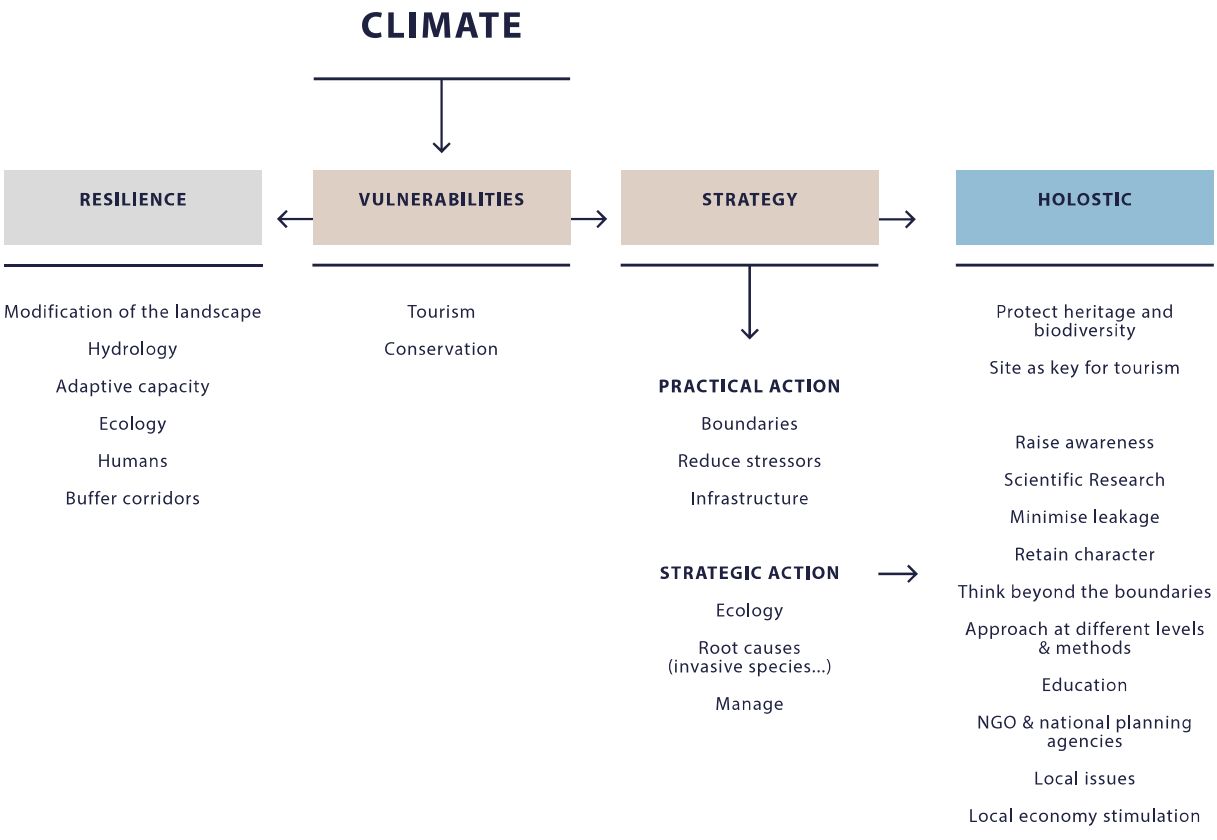
Together with the seminal fossil discoveries of pre-historic humans, the Cradle of Humankind also offers visitors to the area a view of the rich biodiversity of South Africa, spanning over two biomes and including the grassland and bushveld biomes (Eloff 2010:19). The Cradle is also home to a complex karst system, an underground network of rivers and cabins formed within carbonate-rich rock such as limestone and dolomite (Leyland 2008:67). The surface of the landscape, as well as the hidden karst network, is however becoming increasingly threatened by a multitude of factors such as mining, agriculture, tourism, and increased urbanisation in the area.

2.5.5.2 Climate change adaptation for natural world heritage sites

As a response to the state of the environment, Falzon and Perry (2014:1-82) developed a practical guide for climate change adaptation for natural World Heritage Sites. The guide proposes a holistic approach to the protection of the heritage and biodiversity, while retaining the site as a key for tourism. The strategy as proposed by Falzon and Perry (2014:67) includes practical and strategic actions, such as creating buffer corridors and the development of infrastructure.

2.5.5.3 The proposed environmental framework

Building on the proposed heritage framework for the Cradle of Humankind, buffer zones are created around the commercial clusters to limit public access to sensitive undisturbed sites. The framework also builds on existing projects in the area, aiming at the removal of invasive species, rehabilitation of the polluted river, and community upliftment and involvement. A sensitive intervention strategy is crucial, and therefore the strategy focuses more on long-term strategic interventions with limited practical actions.



2.14 - The proposed environmental framework (Adapted by author, 2016).

2.5.6 Community involvement

2.5.6.1 The community of the Cradle of Humankind

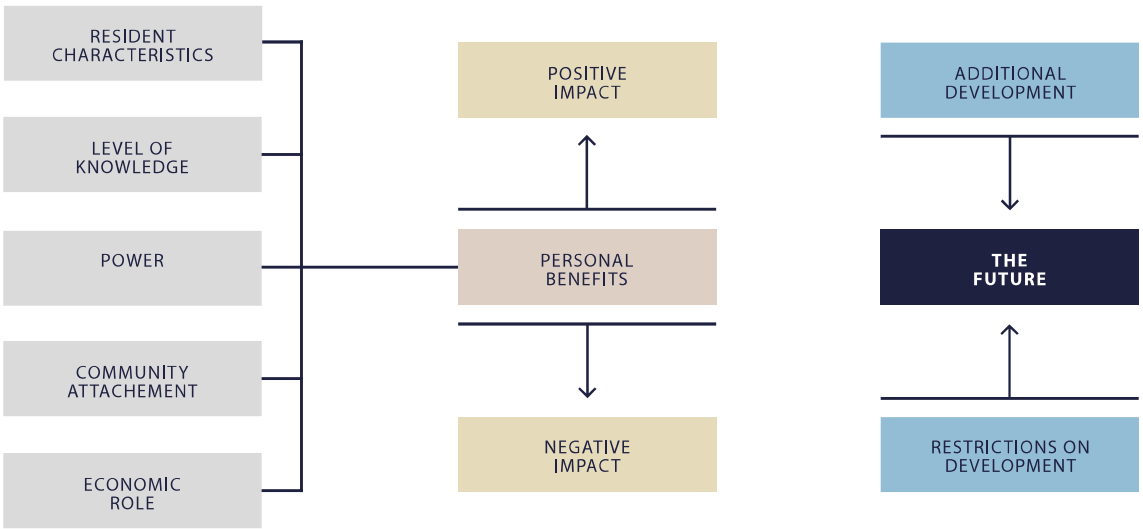
The majority of community members living within the borders of the Cradle of Humankind are employed in the agricultural sector, with more than three quarters living in informal dwellings. The Panorama, Tweefontein and Kromdraai informal settlements are the three major informal settlements found in the region, with many other small informal settlements dotting the landscape of the Cradle (Mogale City Local Municipality, 2011).

2.5.6.2 Community involvement & current stakeholders

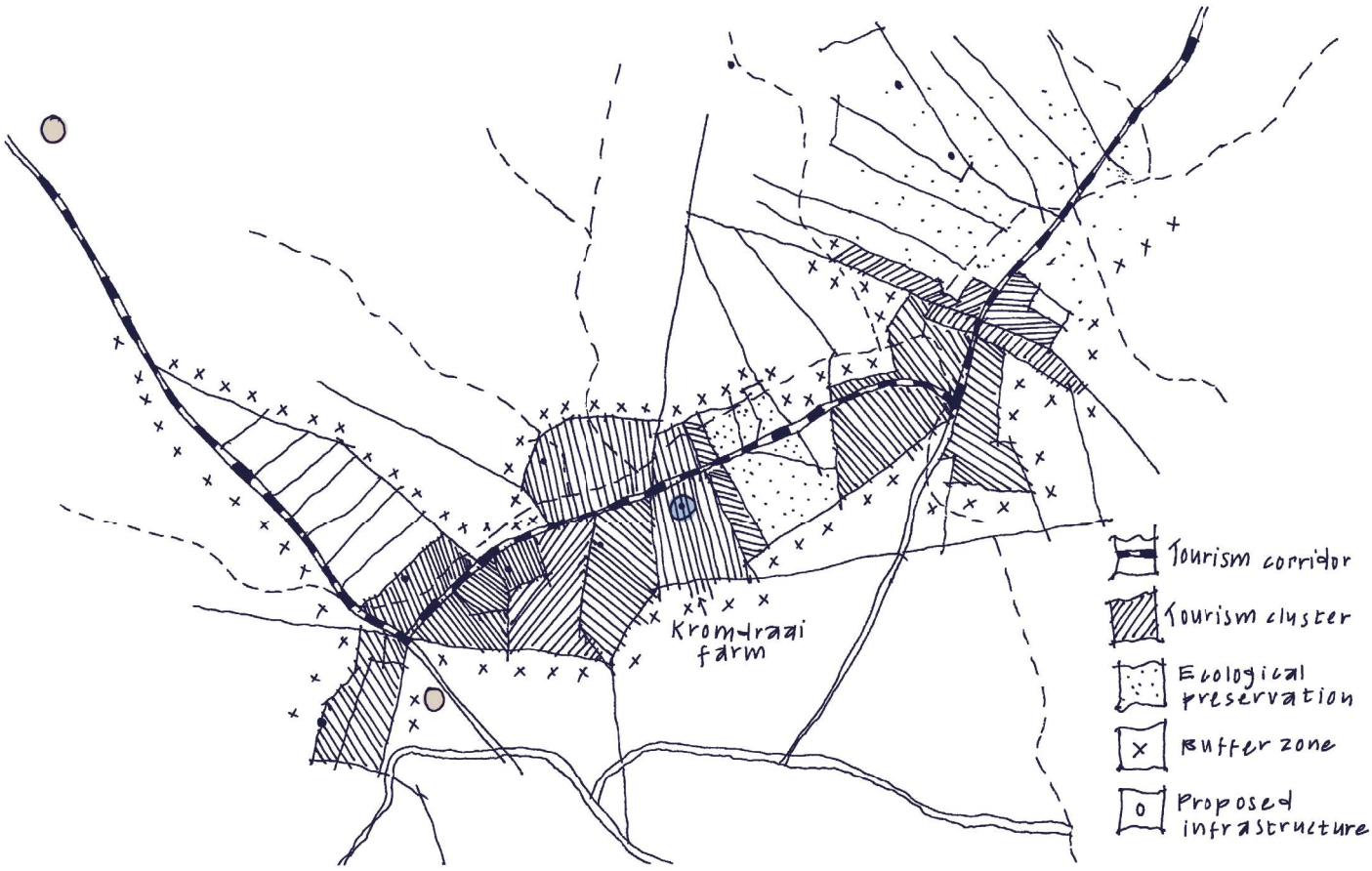
The Cradle of Humankind Trust aims to develop the region for the benefit of the tourism industry as well as the local community. The current stakeholders include the Mogale City Local Municipality, tourism establishment owner forums, and local community organisations, amongst others. The Cradle of Humankind Trust aims to use tourism as a means of upliftment, with projects such as housing and skills development. The objectives of the trust include job creation, tourism job skills, and enterprise development (Mogale City Local Municipality, 2011).

2.5.6.3 The proposed community framework

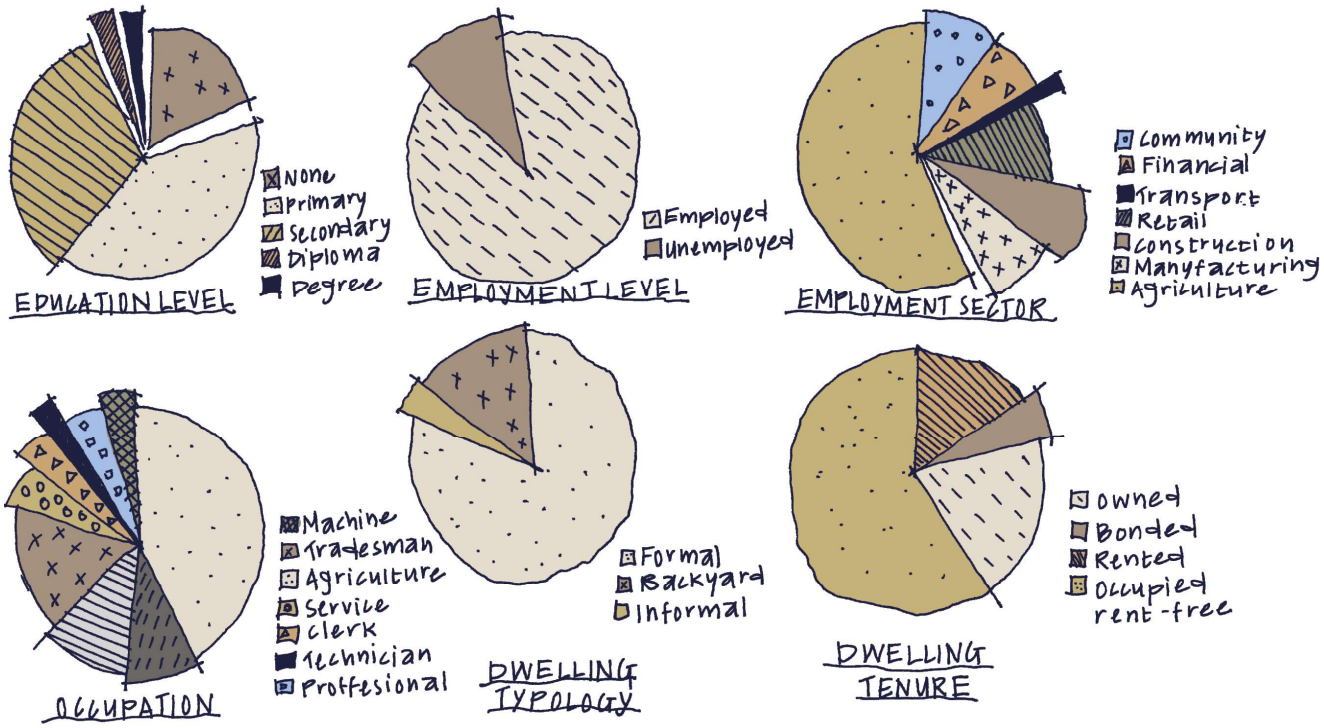
The proposed community framework aims to improve access to the commercial clusters, enabling the local communities to engage with the tourism market and thus providing economic opportunities. The framework proposes a series of bus stops and routes connecting to existing train and bus stops leading from the informal settlements along the Cradle "corridor".



2.15 - The proposed community framework (Adapted by author, 2016).



2.16 - The community of the Cradle of Humankind (Adapted by author, 2016).

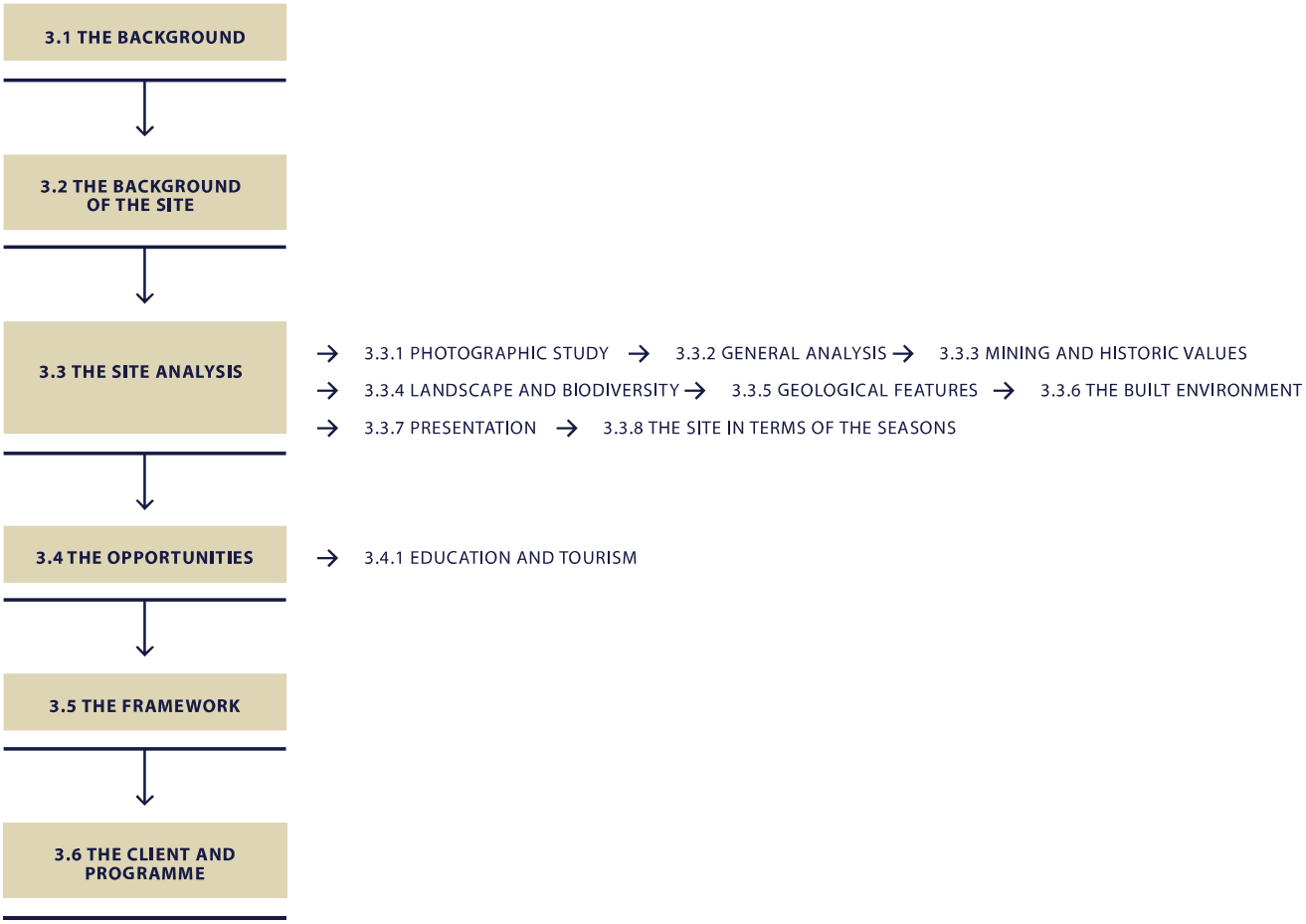


2.17 - Community involvement & current stakeholders (Adapted by author, 2016).

Chapter 3

Kromdraai Cave

This chapter provides a background to the Kromdraai Cave, the analysis of the Kromdraai Cave, the placement of the Kromdraai cave within the peri-urban framework, and the selected client and programme.



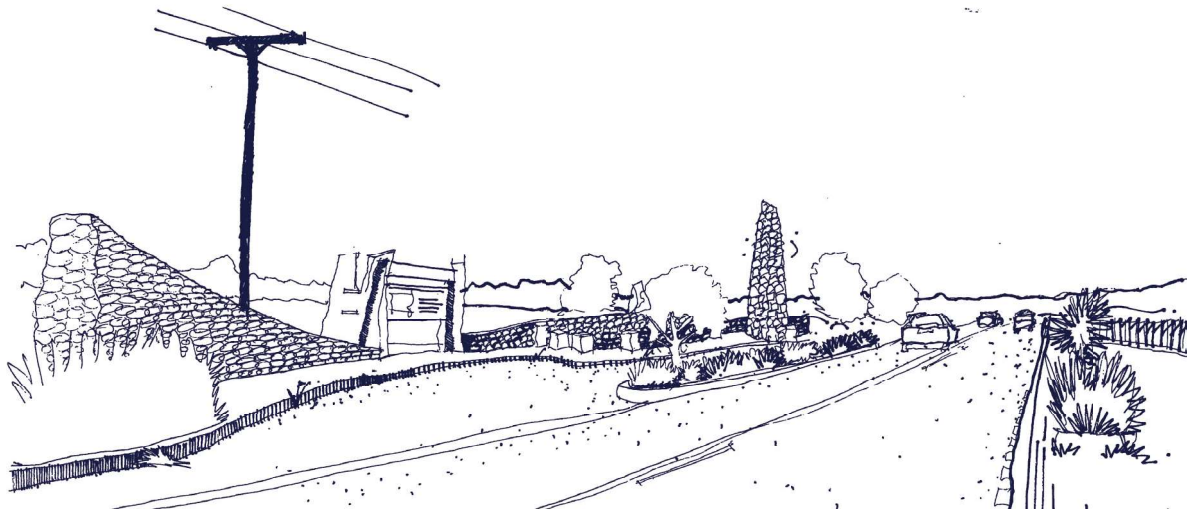
3.1 The background

Located at 26"00'S, 27"45'E, 2km east of the better known Sterkfontein Caves, the discovery of hominid fossils at Kromdraai represented one of the most important events in South African and universal archaeological history (Hilton-Barber & Berger, 2004:209)(Berger et al. 1994:209). On the site evidence can be found of an important development in South African prehistory representing advances in technological innovation, but which also impacted South African history and most probably the future.

Today few know the location of the Kromdraai fossil site or the significance it holds in the archaeological community. Aside from the discovery of over 6 800 remains, exploration of the site initiated the notion of South Africa being the birthplace of humankind and it plays a pivotal role in understanding the larger australopithecine landscape. The unroofed cave forms part of a vast network of galleries formed during the Miocene-Pliocene period, and is partially cut by an erosional surface, due to the deepening of the Blaauwbank River valley.

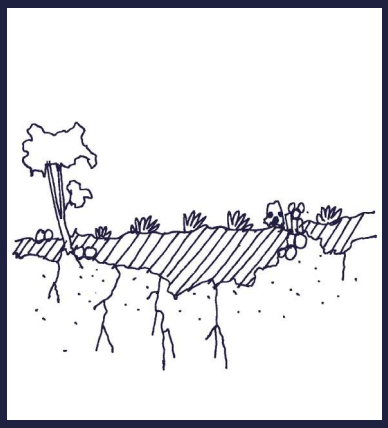
The cave consists of two erosion channels, which were used by carnivores such as Dinofelis, an extinct sabre-toothed cat, as a lair. The site therefore consists of two excavation sites, Kromdraai A and Kromdraai B, located 40m apart. The channels were filled with breccia over time, with Kromdraai B producing mammalian fossils, two stone tools from Earlier Stone Age Acheulian or Developed Oldowan technology, and nine sets of Paranthropus robustus remains dating from between 1.5-2 Millenia (Thackeray et al., 2002:43). The Paranthropus robustus remains (TM 1517) are dated to a minimum of 1.95 Ma, based on the Olduvai Event. Since discovery the remains have been kept at the Transvaal Museum (Berger & Hilton-Barber, 2006), with the cave still functioning as a habitat for bats and owls – "bone collectors" – today.

The dolomite near the cave has remained intact and chert bands are common in the area. Mat and biscuit stromatolites and oolites used to occur in loose pieces in the surrounding landscape, but in the 1960s due to collectors and commercial exploitation of Pelindaba Stone caused these popular stones to disappear. The cave was subsequently stripped of speleothem by lime workers in the 1920s and 1930s.



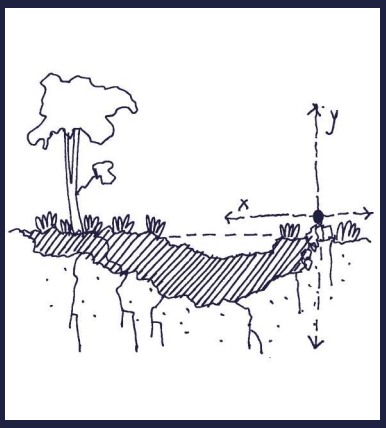
3.1 - Kromdraai (Author, 2016).

3.2 The background of the site



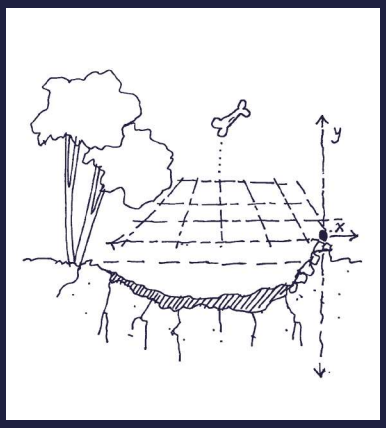
1
Original State

3.2 - Original State (Author, 2016).



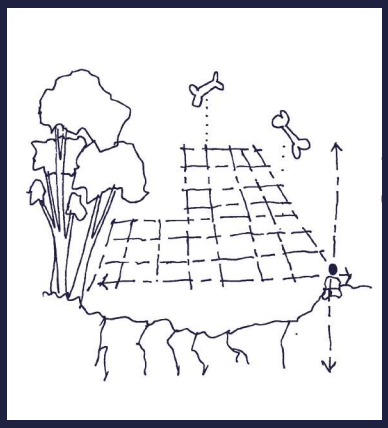
2
Vrba Datum Point

3.3 - Vrba Datum Point (Author, 2016).



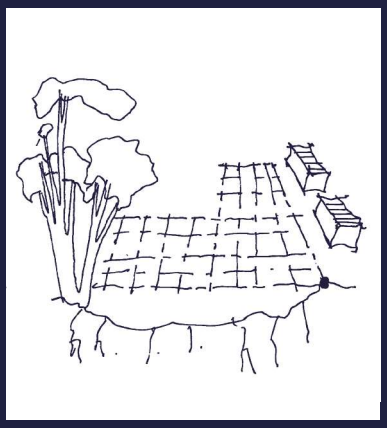
3
1970 Vrba Grid

3.4 - 1970 Vrba Grid (Author, 2016).



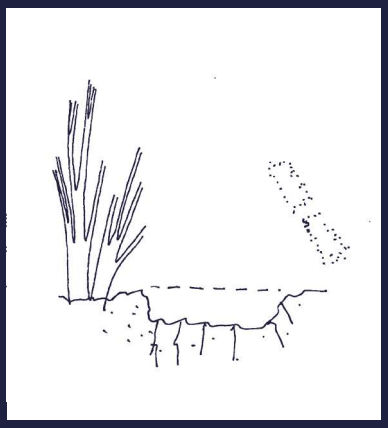
4
1990 Grid Extention

3.5 - 1990 Grid Extention (Author, 2016).



5
1990 Structures

3.6 - 1990 Structures (Author, 2016).



6
Site today

3.7 - Site today (Author, 2016).

Excavation at Kromdraai took place during five periods (Braga, Thackeray, Bruxelles, Dumoncel & Fourvel, 2015:4-5):

- 1938-44: Broom 1938; 1942; 1943; Broom & Schepers 1946
- 1955-56: Brain 1958; 1975; 1978; 1981
- 1977-80: Vrba 1981; Vrba & Panagos 1982; Partridge 1982; Grine 1982; 1988
- 1993-2002: Berger et al. 1994
- 2002 – ongoing: Thackeray et al. 2001, 2002, 2003, 2005; Braga et al. 2003, 2013

Previously an abandoned lime works, the discovery of robust ape-man teeth in 1938 by a schoolboy (Berger & Hilton-Barber, 2006:209) transformed Kromdraai Cave into a rich fossil hominid treasure. The exact location within Kromdraai B of the Paranthropus robustus discovery in 1938 (TM 1517) is not clear, as it is unknown whether these specimens had been found in situ or in a loose block. Although the exact circumstances of the discovery remain a mystery, it revealed a new genus and species, coined Paranthropus robustus by Robert Broom (Thackeray et al., 2002:43).

In 1941 intensive excavation of the site started at Kromdraai B (Berger & Hilton-Barber, 2006:209) and several more hominid fossils followed. During the excavation a juvenile mandible was discovered and named TM 1536, which allowed for a juvenile comparison to the Taung Skull (Thackeray et al., 2002:43) . The location of the 1941 juvenile mandible is only known to be within four feet of the place where the skull lay(Broom, Schepers & Schepers, 1946: 109-110) with records of fossil finds proving a conundrum.

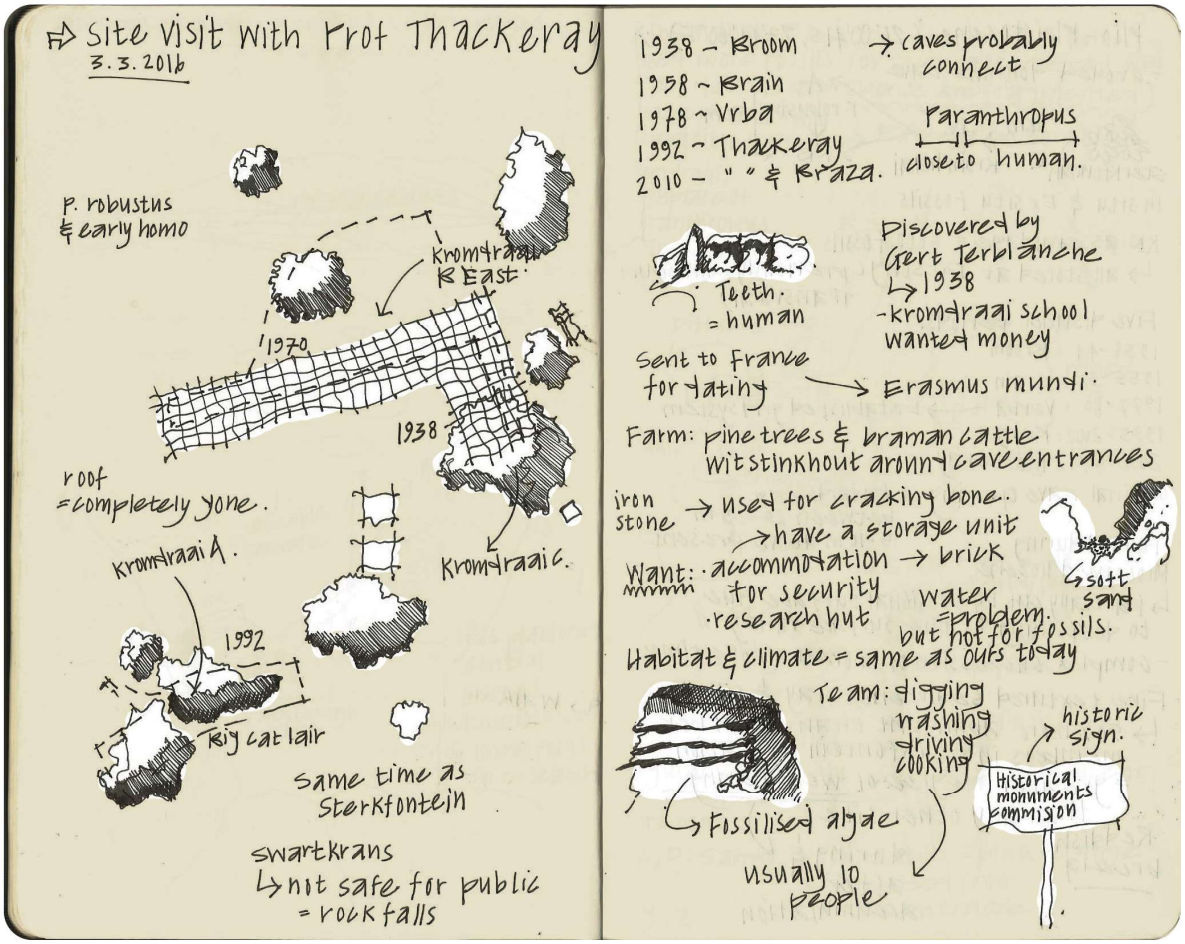
In 1947 a three-month excavation at Kromdraai A started with the goal to obtain a faunal assemblage relating to that of Paranthropus robustus. The excavation resulted in the blasting of breccia at Kromdraai A which revealed abundant fauna for investigation.

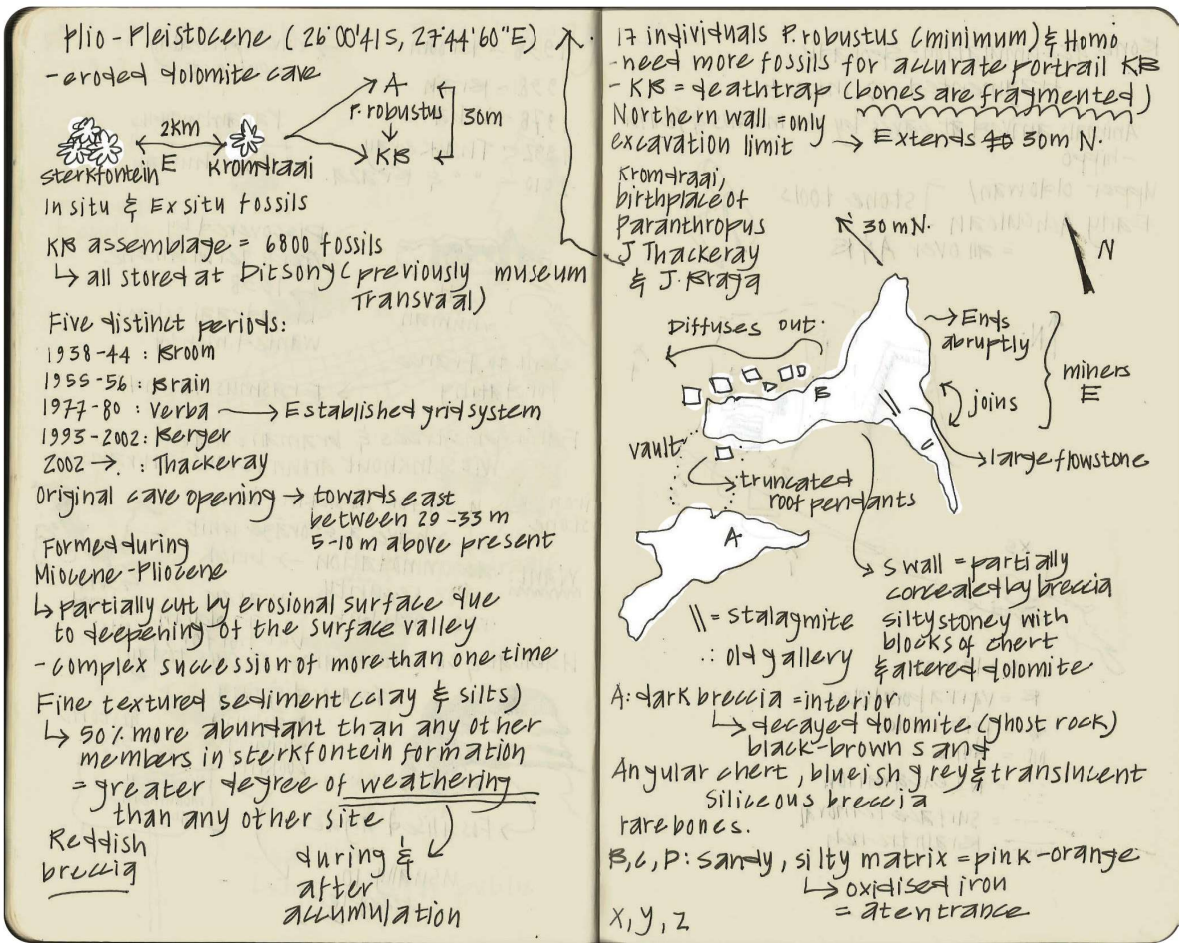
Excavation of Kromdraai Cave ceased as Mrs Ples was discovered at Sterkfontein in 1947 (Thackeray et al., 2002:43) but in 1955 C.K. Brain renewed excavations at the site (Berger & Hilton-Barber, 2006:209). Brain's excavation concentrated on mainly decalcified breccia along what he believed to be "the northern wall" of the KB East Formation, estimated to be situated between E-W coordinates 20 and 30m, to a depth of approximately 5m. Excavations revealed diverse fauna at Kromdraai B, yet only that of 2m could be directly associated with the australopithecine fossils. C.K. Brain's efforts led to the first discoveries of cultural material at Kromdraai B, which consisted of artificially introduced blocks of pebbles and quartzite, and an unquestionable flake of chert (Braga, Thackeray, Bruxelles, Dumoncel & Fourvel, 2015:4).

Elisabeth Vrba, seeking in situ fauna associated with hominid fossils, started excavations at Kromdraai in 1977, which proved to be the most extensive to date (Berger & Hilton-Barber, 2006:209) . During the three years of excavation Vrba, together with Partridge, established a stratigraphic member sequence allowing her to place fossils recovered from earlier work within a geological sequence. During the 1977-80 fieldwork led by Vrba, a grid system was established for the first time on this site. The location of the original cave opening was assessed to lie towards the eastern end of the site, between E-W coordinates 29 and 33m, likely between 5 and 10m above the present erosion level (Braga et al., 2015:5). During this time numerous mammal and five hominid fossils were discovered and non-hominid fauna was used to draw inferences regarding the prehistoric environment(Thackeray, Senegas & Wallace, 2005:43). Several tools were discovered during the early excavations in Kromdraai B marking the appearance of the first lower Oldowan tools in South Africa(Braga et al., 2015:13)(Granger, Gibbon, Kuman, Clarke, Bruxelles & Caffee, 2015:522). In comparison with the material from Kromdraai A, these tools were attributed to be Upper Oldowan/ Early Acheulean, and were set in a wide time bracket ranging between 1 and 2 Ma.

J.F. Thackeray and L.R. Berger commenced excavation at Kromdraai B in 1993 as a joint research effort by the Transvaal Museum and the Paleo-Anthropology Research Unit of the University of the Witwatersrand (Berger & Hilton-Barber, 2006:209). The 1993 excavation extended 100m east of Vrba's 1977 grid, with a 30-40m northern extension and a 0-10m eastern extension of the grid, removing a 5m layer of decalcified deposits from the area. Blocks of breccias were recorded in 3D based on Vrba's grid, using measuring staffs and measuring tape. The grid was stolen during the 1990s. Today a total station is used to record the precise position of fossils(Braga et al., 2015:5-7).

After the 2000s the Kromdraai Research Project was been established, prompted by the discovery of additional fossil material at Kromdraai B, and it was concluded that the site was six times larger than previously estimated and may have an extension more than 30m towards the north(Braga et al., 2015:5).



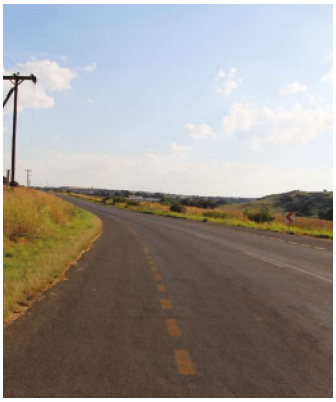


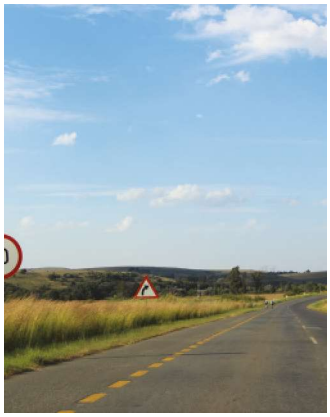
3.8 - Site visit (Author, 2016).

3.3 The site analysis

3.3.1 The photographic study

The photographic study provides a visual understanding of the characteristics and context of the cave. The vastness of the landscape and functioning of the context is evident in the images, as well as the isolation and "neglect" of the fossil site.





3.9 - Photos of Kromdraai cave (Author, 2016).

3.10 - Aerial of Kromdraai (Thackeray, sa).

3.11 - Photo of Kromdraai cave (Author, 2016).

3.3.2 The general analysis

The Kromdraai Site Management Plan (Leyland, 2008:14) identifies the values of Kromdraai fossil site as landscape, palaeontological and archaeological assets, mining and history, research, biodiversity and ecology, education, and tourism.

3.3.3 The mining and historical values

Although mining at Kromdraai was never extensive due to limited limestone at the cave, the existing speleothem was stripped from the cave and surface outcrops of travertine removed. Although the linkages between Kromdraai Cave and mining are not strong, mining played an important role in the history of the area and must be acknowledged in understanding the site.

3.3.4 The landscape and biodiversity

The vegetation found at Kromdraai Cave is found in the Cradle of Humankind generally and is known as Carletonville Dolomite Grassland (Eloff, 2010:19). The vegetation regionally coincides with the Rocky Highveld Grassland within the Grassland Biome of South Africa (Berger & Hilton-Barber, 2002:12), or Bankenveld (Eloff, 2010:18) . Rocky Highveld Grassland, as described by Bredenkamp, Brown & Pfab (2006:65), is fairly rare in its natural state, with over 65% of it being classed as altered (Eloff, 2010:19).

With more than 500 plant species making up this open grassland vegetation, together with the view, Kromdraai Cave has major potential for showcasing the environment. Although species on the Red Data List are known to be part of the environment, these have not been listed yet. The subterranean environment has remained intact and resident porcupines, owls and bats occupying caves.

3.12 - The landscape at Kromdraai Cave (Author, 2016).

RESIDENT PORCUPINES, OWLS AND BATS ACT AS "BONE-COLLECTORS"

3.13 - Animal species at Kromdraai cave (Author, 2016).

3.3.5 The geological features of the cave

3.13 - The geological features of the cave (Author, 2016).

3.3.6 The built environment

During the 1990s excavation, a storage shed, water storage tank and caretaker quarters were erected next to the fossil site (Gauteng Provincial Government, 2008:25-26). Since the caretaker acting as security for the site has been absent, all equipment as well as the physical structures have been stolen. Today the only evidence of these structures lies in their remaining foundations. During periods of excavation the researchers rely on bed and breakfast accommodation in the area.

The lack of infrastructure, such as access to electricity water and ablution facilities, impedes the excavation process as water has to be hauled to the site, or the excavation team has to drive fossils to better equipped locations.

3.3.7 Presentation

No tourism-related activities or infrastructure exist on the site, nor is it open to the public. Its location is generally unknown, yet one board indicating the status of the site can still be seen. The public may only access the site if accompanied by a researcher.

Lack of presentation and little public knowledge of Kromdraai Cave have resulted in a missed opportunity for education and dissemination of information. The site offers strong opportunities for tourism, and the lack of tourism infrastructure could diminish the experience of the Cradle of Humankind. The site is at risk of losing important information as elements may be left unrecorded or vulnerable to damage. Funding opportunities for conservation and future research have been missed, with researchers and academics being undervalued and unacknowledged.

3.3.8 The site in terms of the seasons

Excavation of the site usually occurs during the winter months. During this period the grassland becomes dull and unassuming, with semi-deciduous trees dotting the landscape. Of these trees the white stinkwood (Celtis africana) is the most relevant to archaeology as the tree acts as an indicator of the presence of caves (Berger & Hilton-Barber, 2006:17).

During springtime the white stinkwood tree expresses gentle, light-green new leaves which contrast with its pale bark, and in autumn the leaves turn yellow before dropping off. As the tree is semi-deciduous, the old leaves are dropped all at the same time when the new spring leaf flush appears (Berger & Hilton-Barber, 2002:199). The leaves are eaten by livestock and may attract the attention of the Brahman cattle of the farm. The tree provides food for the larvae of various species of moth, the presence of which attract bats, and the food simultaneously attracts butterflies like the blue-spotted emperor and the African snout. With greenish flowers appearing in early spring and summer, the flowers are pollinated by various insects, particularly honeybees. Following the flowers, small, rounded, berry-like fruits grow, turning yellow-brown to black when ripe. The fruit is sought after by wildlife, such as fruit-eating birds like Rameron pigeons, doves, willow warblers, bulbuls, mousebirds and crested barbets, all living exhibitions of the ecological system and habitat of the landscape (Gardening in South Africa, 2016); therefore the tree itself serves as an indicator of seasonal changes and acts as a coordinate of the seasons.

3.4 The opportunities

3.4.1 Education and tourism

As the site is situated only 2km from Sterkfontein and 400m from Cooper's Cave, it opens up the opportunity to connect to the existing tourism infrastructure. The caved-in roof makes the site safe for the public, and the cave demonstrates the main geological features of the cave itself and the area.

The clumped distribution of large trees and examples of economically significant plants, including edible and toxic plants, can be pointed out within the greenbelt. The cave itself provides the possibility for education on the main geological features, as it displays good examples of weathered dolomite, chert bands, stromatolites, pisolites and oolites.

Kromdraai Cave forms part of a network of caves within the Cradle of Humankind. In the context the site is one of only three to host Earlier Stone

Age tools (Berger et al. 1994:209). Through the presence of Paranthropus robustus fossils the site is connected to the larger Cradle landscape as a means of understanding the australopithecine environment.

Due to the topography of Kromdraai farm the site has a 360-degree view over the Blaauwbank River valley, and seven caves can be pointed out from the cave site. The land encompassing the view consists of farmland, tourism and recreational activities as well as economic enterprises. The natural state of the landscape has generally been altered, as many farming and commercial structures as well as infrastructure such as roads and telephone poles are visible, but the landscape has generally maintained a rural ambience.

3.5 Kromdraai cave within the framework

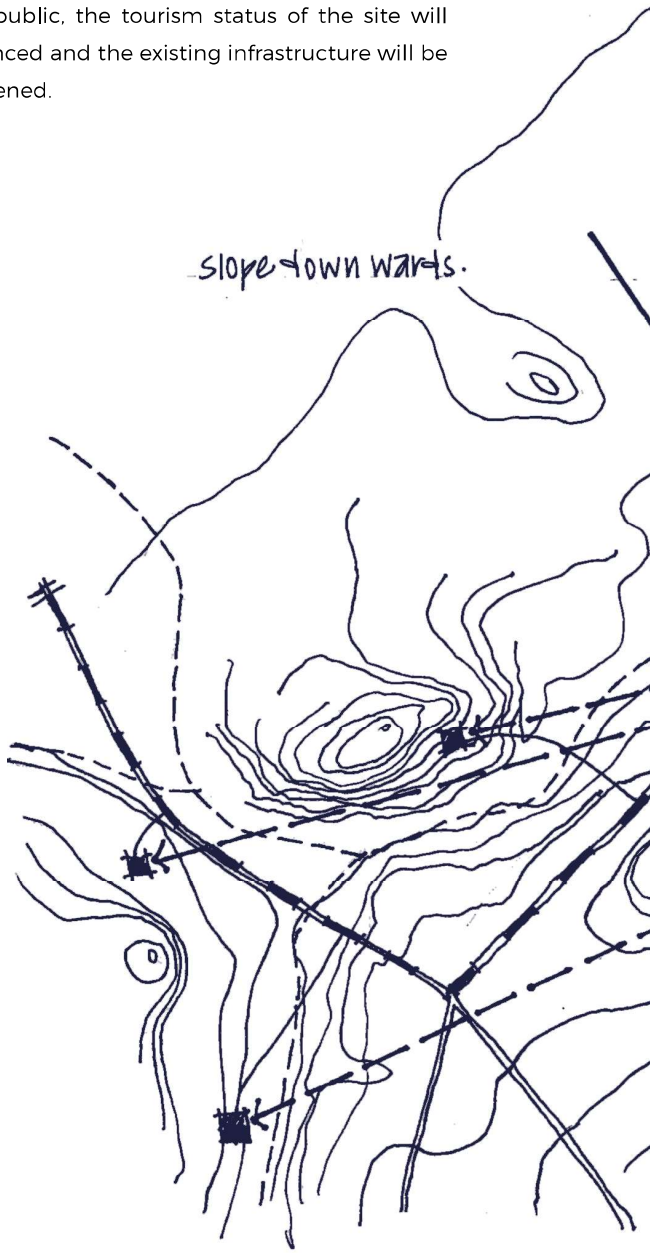
Although Maropeng boasts an array of community projects (Cradle of Humankind., 2016), funded by a community development trust to comprise 7.5% of the revenue generated once the goal of 400 000 visitors per annum have been reached, the visitor numbers have not been achieved and, therefore, no projects have been developed for community benefit (Development Bank of South Africa, 2011:21). Other than a few employment opportunities at the site, benefits have remained limited. The approach of the framework thus focuses not only on conserving heritage but investigates a strategy to bring value directly to the informal Cradle community.

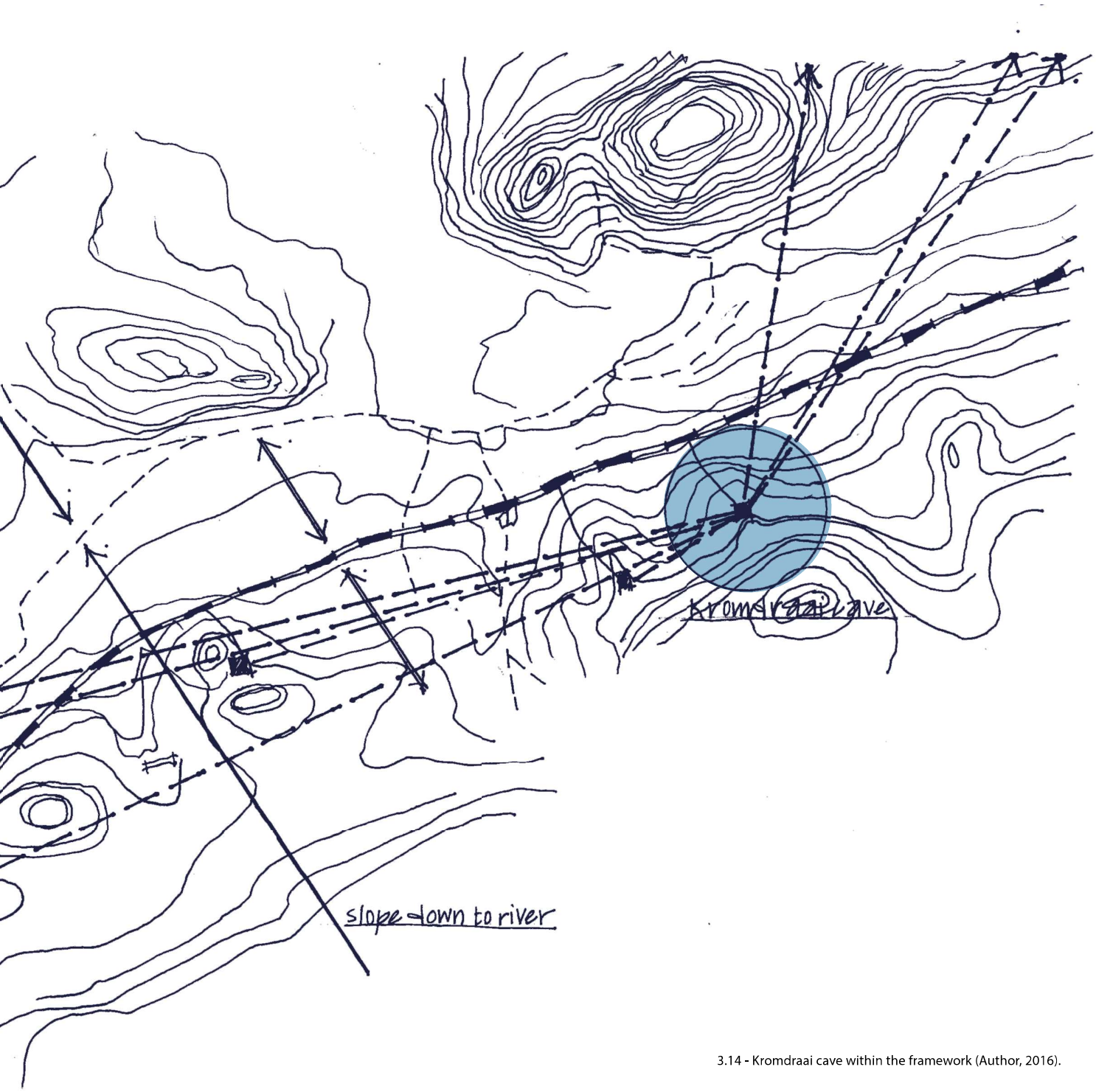
The presence of the informal farming community on and next to Kromdraai farm, together with its proximity to the existing Sterkfontein visitor centre, makes the farm the ideal location to reach the goals of the Cradle of Humankind Trust.

3.6 The client and programme

The Evolutionary Science Institute is to act as main client for the development of an on-site research and excavation facility with a community education and tourism interface. The programme aims at facilitating excavations and research done by the Evolutionary Science Institute at Kromdraai Cave in order to generate new discoveries. As the intervention would support the existing facilities and form part of the proposed corridor, UNESCO and Maropeng a'Afrika Leisure (Pty) Ltd. would act as supporting clients.

The site will function as a research facility, utilizing the presence of the scientific community on site to assist in providing the local community with the skills to work in the tourism sector. The site will become a living exhibition of the outstanding qualities of the area, making information about the values of the landscape accessible. In doing so, it will aid in the conservation and protection of the landscape. As knowledge about the landscape and fossils is transferred to the community and general public, the tourism status of the site will be enhanced and the existing infrastructure will be strengthened.



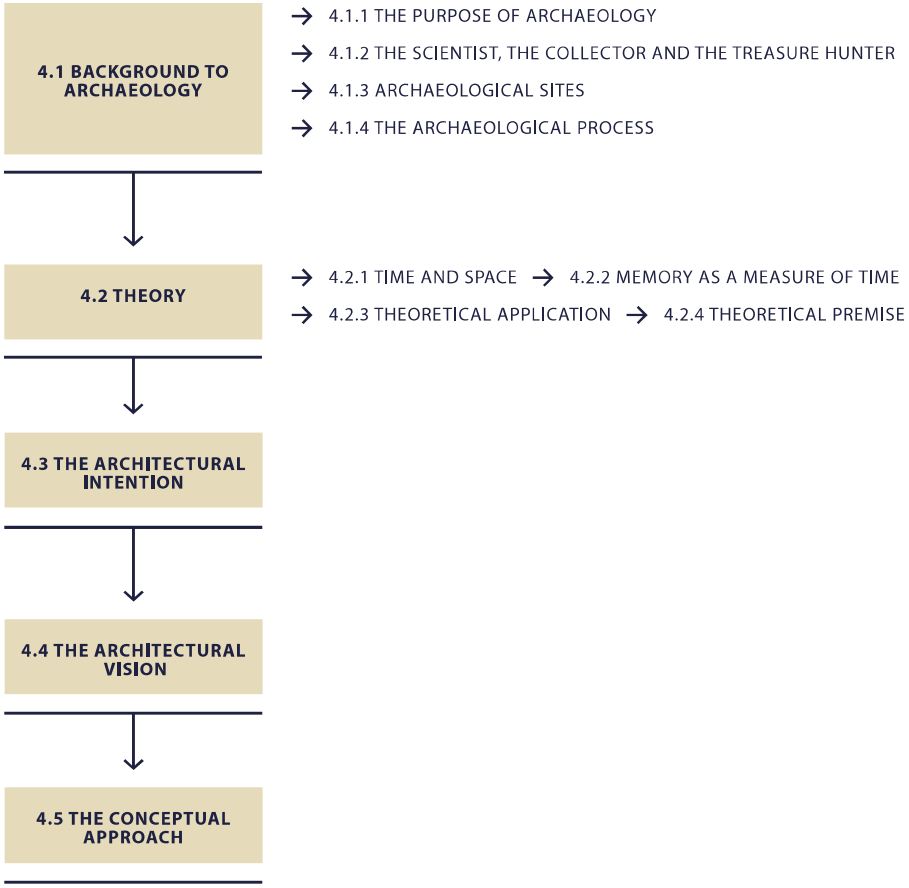


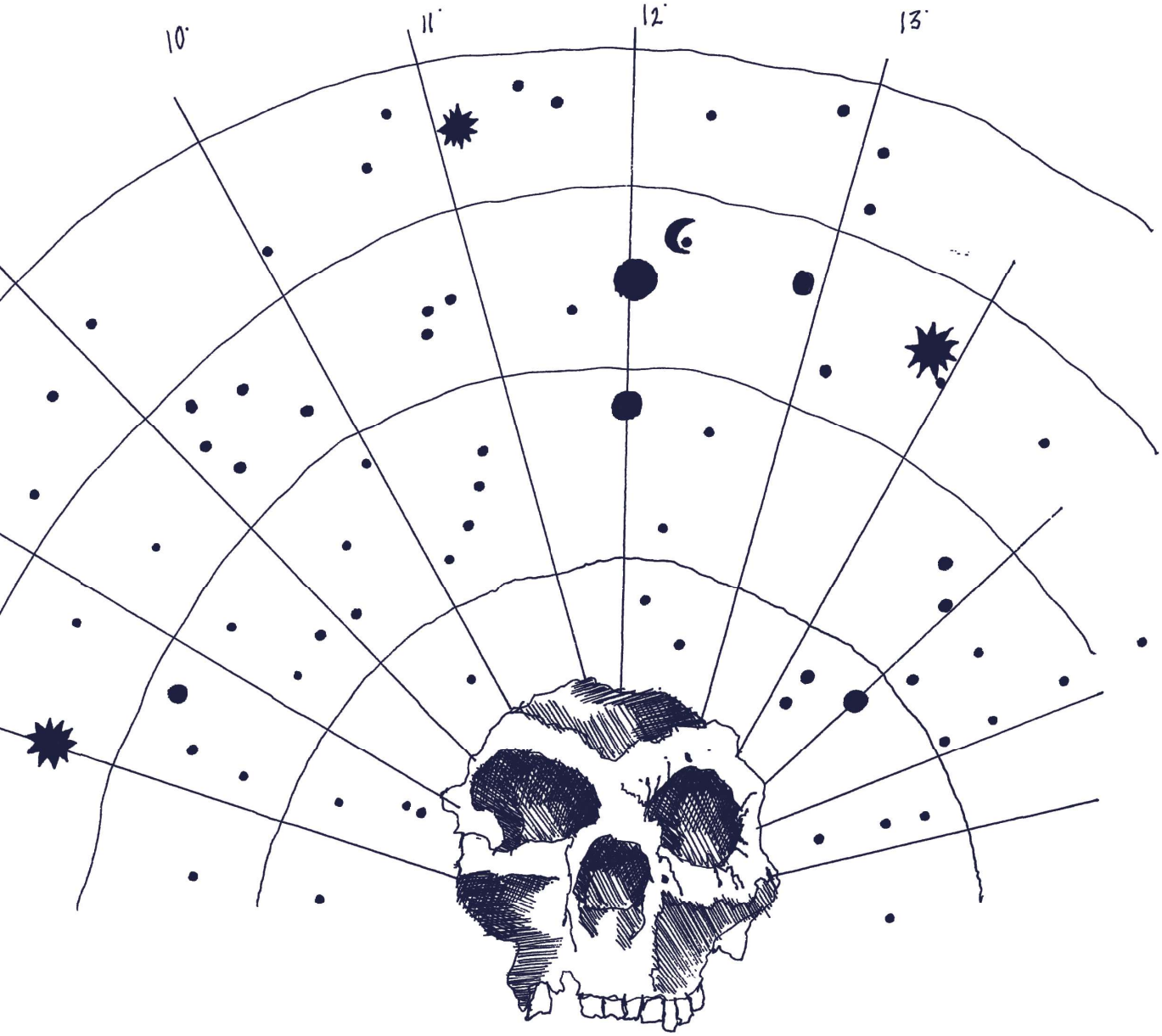
3.14 - Kromdraai cave within the framework (Author, 2016).

Chapter 4

Theory and concept

This dissertation is situated within a UNESCO World Heritage Site, named for the abundance of prehistoric hominid fossil sites in the area. This chapter provides a background to the archaeology, the theoretical approach and theoretical intention.





4.1 - Background to archaeology (Author, 2016).

4.1 Background to archaeology

Humankind has through time expressed a fascination with the mysteries of the world. Authors and film producers have simulated fantasies and adventures based on ancient civilisations and natural phenomena, making archaeologists into explorers, treasure hunters and collectors – brave souls charting unknown territories and defying danger. The romance of archaeology transports people across the world and stimulates tourism and associated economic enterprises.

Although the exact definition of archaeology and its delimitations are disagreed upon in the field itself, it is generally accepted that archaeology consists of three components: the past, material remains, and excavation (Drewett, 2001:1). Archaeology thus constitutes the use of material remains to reconstruct the past; in other words, to understand the way man interacted with his environment in the past. The general field is divided into four distinct subdisciplines, of which paleoarchaeology concerns itself with the study of deep time, before the existence of the written word, from the time of the earliest human beings (Fagan, 2012:35-36).

4.1.1 The purpose of archaeology

Archaeology provides answers to the curious fascination humankind has with its complex and mysterious world. Quoting Gotthard Booth, Pallasmaa (2012:35) states, "nothing gives man fuller satisfaction than participation in processes that supersede the span of individual life", and argues that man has a mental need to grasp that he is rooted in the continuity of time. This process superseding the span of life, known as time, is defined by the Timekeeper (Popova, 2016) as "most simply a coordinate which lets us understand the evolution of the universe".

Central to the field then is the philosophical place of humankind in the universe (McCarthy & Rubidge, 2005:298). For many years the Earth lay at the centre of the universe, with man having dominion over it. Astronomical discoveries such as Nicolas Copernicus discovering that the sun and not the Earth was the centre, shifted the status and place of man. While astronomical discoveries erode our imagined status in the universe, the fields of archaeology and geology erode our place on the planet, as the existence of humankind has been proven to have been very short. The record of mass extinctions, five in total, warns us that Homo sapiens may not be very special, and that our intellectual actions and developments may have accelerated the sixth mass distinction a thousand-fold (McCarthy & Rubidge, 2005:298&315) . As the philosopher George Santayana (1905:6) wrote: "Those who cannot remember the past are condemned to repeat it." Our set of unique evolutionary skills, proven in the geological record, places a responsibility on us to learn from the past and to prepare for the future.

Archaeology is not only important to mankind seeking its place in the world, but relates to the world directly as well. The late authority on world myth, Joseph Campbell, stated unequivocally that "we need new myths that will identify the individual not with his local group but with the planet" (Campbell, 1988:30). The world is filled with bewildering diversity, yet mankind is yet to come to an understanding of said diversity, and its ability to collaborate between multiplicities remains elementary. History, as well as prehistory, serves the present, as every society projects its umwelt (the world as it is experienced according to one particular organism) to manufacture the past according to a specific agenda. Archaeology provides an educational weapon in the fight against ignorance, with paleoarchaeology especially providing a heritage common ground in a world where racism is commonplace (Fagan, 2012:40-41).

Lastly, archaeology today provides a means of protecting shared universal value, as well as sharing roots in private business. Post World War II, the role of archaeology has primarily shifted towards the identification and conservation of important sites rather than its adventure-filled Hollywood role previously mentioned. Archaeologists have become managers, overseeing a precious and rapidly vanishing resource: the human past (Fagan, 2012:35-36).

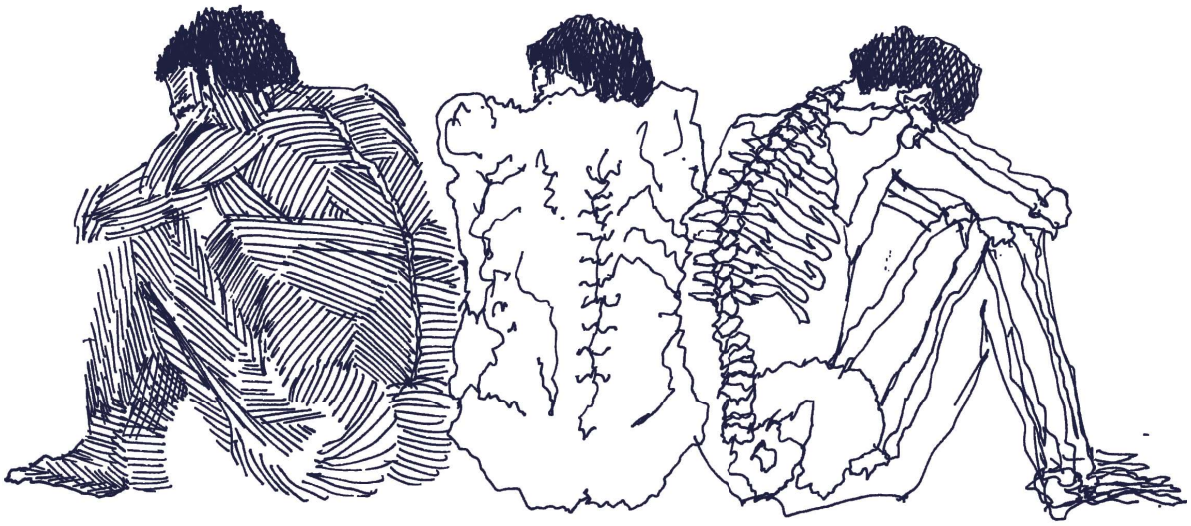
4.1.2 The archaeologist, collector and treasure hunter

In the academic community, according to Drewett (2001:7), field archaeologists are broadly divided into three groups: members of the scientific archaeological community; cultural resource managers; and persons participating as a hobby or form of leisure.

Scientific archaeology, being driven by field research supported by academies, usually engages in archaeology as part of a wider project due to limited funding. Projects often entail museum curation or field schools with research funded by government institutions and universities.

4.1.3 Archaeological sites

The archaeological site is seen as a matrix and an amalgam of layers, as these sites are areas which have experienced change through time. The change occurred during the life of the activity area, at the point of discard or abandonment, and then changed again after discard. Archaeological sites are therefore transformed or changed activity areas (Drewett 2001:24).



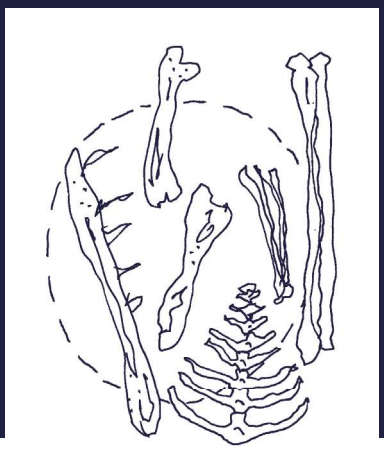
4.2 - The archaeologist, collector and treasure hunter (Author, 2016).

Physical remains, together with tangible and intangible context derived from the site, form the supporting facts for speculation on the distant past (Drewett 2001:3). Although the process of archaeology relies primarily on the physical remains of the past, the contemporary context of the find is of equal importance. Humans consciously and unconsciously shape and change their environment as they interact with it, leaving more clues on the behaviour of the studied subjects (Nash, Edwards, Thompson & Barfield, 2000:1). Nature, too, interacted with the studied subject, as it played a large part in shaping and reshaping the habitat and forming the background for the story, while finally working towards removing its traces in the continuum of time (Drewett 2001:25).

An archaeological site exists in a state of tension and contradiction. Materiality lends itself to continuity as traces of the past have survived, while ruin and decay present the reverse as discontinuity. Fragments of the past can be assembled into a narrative, although this narrative relies on socio-cultural continuity. Historical discontinuity throws suspicion on the narrative as it transcends history and human values.

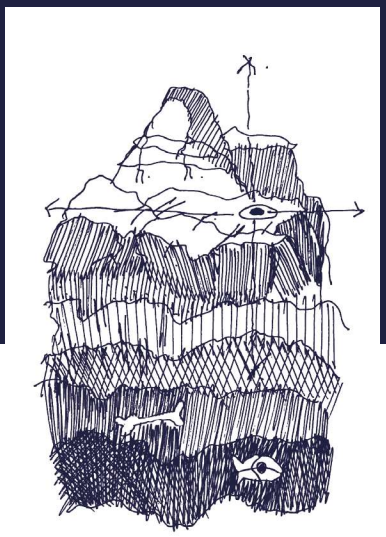
The state of contradiction is further reinforced in the act of excavating archaeological remains. The process depletes the archaeological site and in doing so discontinues the status of the site in history. Excavation then, being inherently destructive, permits questions to be asked only once. If the excavation is very precisely recorded, some questions can be asked of the record, but never again of the whole site (Drewett 2001:58). The site is a finite resource which can never be replaced or recreated. Remains in context provide two vital clues to the archaeologist: what activity took place and where it took place. Without the context, the remains become objects allowing no insight into the depths of human behaviour, and effectively cheat society and future generations of knowledge (Fagan 2012:31).

4.1.4 The archaeological process



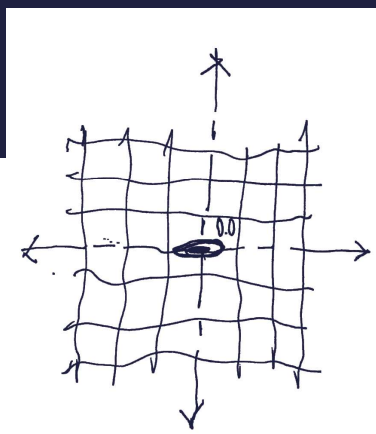
1
Identify presance of fossils.

4.3 - Identify presance of fossils (Author, 2016).



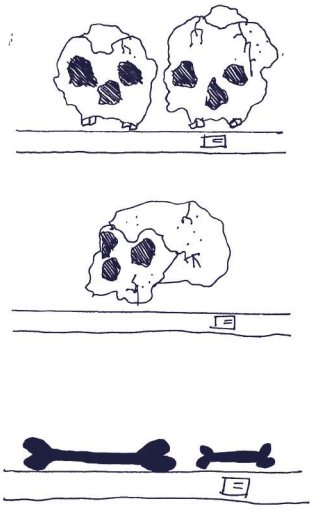
2
Select datum point.

4.4 - Select datum point (Author, 2016).



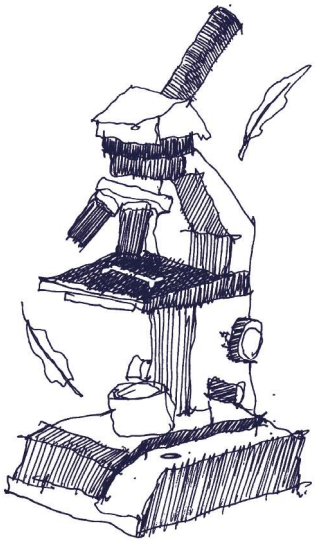
3
Develop grid according
to cardinal points.

4.5 - Develop grid (Author, 2016).



4
Collect fossils.

4.6 - Collect fossils (Author, 2016).



5
Analyse and deduce.

4.7 - Analyse and deduce (Author, 2016).

6
Distrobute new knowledge.

4.8 - Distrobute new knowledge (Author, 2016).

The archaeological process consists of five phases (Drewett, 2001:15):

- The project planning phase
- The fieldwork phase
- Assessment and potential for analysis
- Analysis and report preparation
- Dissemination

The following explanation of the archaeological process is based on that provided by the Archaeological Institute of America (2016), unless stated otherwise:

The recording of archaeological sites discovered in the field essentially has three elements: a written description of the site, a survey including plans and elevations, and a photographic record.

Excavation, the most well-known part of the archaeological process, is the result of a careful scientific process. Excavations are aimed towards answering a particular question or resolving a particular issue. Once a reason to dig is provided, the archaeologist must establish where to dig and has to create an excavation plan after acquiring permission from the government of the place being excavated. At first the goal is not to excavate, but rather to identify and plot sites across a landscape or region to see the big picture of the habitation or activity which took place in the area.

The process of excavation starts with a site identified during a manual or digital survey, usually revealed by identifying sites corresponding to specific patterns. Imagery from satellites and airplanes aid archaeologists in identifying surface features, while geophysical prospecting tools, such as magnetometers, conductivity meters and ground-penetrating radar, aid in locating subsurface features. Once an excavation site has been located, a detailed map is also made before digging begins. Traditionally, archaeological surveyors used compasses, tape measures, stadium rods and various other survey tools. Today, most archaeologists also employ electronic devices, such as total stations and Global Positioning System (GPS) units, to help them map an area or site. In GPS technology satellite signals are used to record the location of a feature or site. The map is thus the first of a series of records made during an archaeological investigation.

The archaeological matrix is considered as an amalgam of layers formed in time through slow accumulation or dramatic climatic events that are evidence of the site growing, changing and being destroyed. The concept of stratigraphy is used to decode this amalgam as the archaeological map extends on section to strata. The strata allow for the recording and reading of the layers, although the process is impossible without the concept of horizontal surface interfaces, i.e. edges and moments of discontinuity when one layer becomes another (Shanks 2016:10).

In aiming towards recording the archaeological site in order to preserve the context of the remains and features, the digging site is furthermore divided into a grid consisting of squares to help keep track of the location of each find. To allow for a vertical recoding, a datum point is established in an easily identifiable location. The remains are allocated coordinates within the grid and the vertical relationship to the datum is established, the site plan being continually updated. Other means of recording such as photographs, drawings and detailed notes are taken or made in order to assist future investigations.

The process of setting out the grid starts with determining a point of origin. This point is a fixed point outside the area to be surveyed and provides a permanent spot, undisturbed by future work. The origin is determined by convenience, as it is used constantly for reference and for locating the grid on a map. The orientation of the grid is usually north-south, although this bears no significance in archaeology and is done generally for neatness. In writing up data and in the field, magnetic north, not geographical north, is used.

Laying out the grid can be performed by two people using half a dozen ranging poles, two tapes and, if the site slopes, a plumb bob or theodolite. The longest possible line is laid out from the point of origin along one side of the grid, and if the grid is orientated north-south, it is set up using a prismatic compass. The prismatic compass is a hand-held compass with a prism, which one reads by looking between two sighting marks (Drewett, 2001:64-65).

Excavation tools include shovels and trowels, brooms and brushes, buckets, and sieves. In the case of fine and delicate excavations, archaeologists use dental picks, brushes, spoons, and very fine blades. When an artefact is removed from dirt, it is sieved in order to preserve small finds such as seeds or small bones which might be missed. The sieved finds are then recorded as coming from the square or deposit within it. The excavation process works horizontally until all the finds in an area have been exposed and their relationships noted.

Post excavation, the find and the conservation thereof usually takes place in a laboratory, but sometimes the object is so fragile that the archaeologist needs to work immediately to save or stabilize it. In the laboratory, objects are further cleaned, stabilized and conserved, and thorough records are made. Once excavation is completed and the features and objects have been conserved and analysed, the archaeologist is responsible for interpreting the findings and creating the story of the site, making the significance of the find known. The story is one possible version of the site's history, as the evidence will always prove incomplete.

4.2 Theory

4.2.1 Time and space

In architecture one is fundamentally confronted with questions of human existence in space and time, expressing and relating to man's being in the world. This is mostly due to aesthetic and cultural practices being susceptible to the changing human experience of space and time. Architecture becomes the construction of the spatial representations and artefacts of human experience, and thus becomes the primary instrument in relating the human body to the world. It is the task of architecture to enable us to create embodied and lived existential metaphors that concretise and structure our being in the world (Pallasmaa 2012:19 &76).

Otero-Pailos (2005:ii-iv) and Till (2009) state that, since modernism, design cultures have tended to prioritize space apart from time. Buildings of this technological era in general deliberately aim at ageless perfection and avoid incorporating the dimension of time, mentally avoiding the significant process of aging.

According to Juhani Pallasmaa (2012:35), this weakening experience of time has had devastating mental effects, and Gotthard Booth (cited in Pallasmaa, 2012:65) states that "nothing gives man fuller satisfaction than participation in processes that supersede the span of individual life". Pallasmaa goes on to say that we have a mental need to be rooted in the continuity of time, and it is the task of architecture to facilitate this need.

In order to explain this disjunction between space and time in architecture, capitalist globalization has brought forth the theory of the 'incredible shrinking world' where globalization has become tied up in a crisis of the capitalist mode of production. This crisis has brought forth a state of accelerated time, with a dual spatial state evident in modes of travel, highways, and data transmission such as the internet (Crysler, 2012:292).

The crisis of accelerated time has simultaneously led to the commodification of the past. The past has become dependent on Baudrillard's (1975:117) "the mirror of production", which is based on economies of desire. This way of thinking was absorbed into postmodernist architecture, originally as a reaction to the symbolic alienation of high modernism, but then became a means of enabling Manfredo Tafuri's (1976)"architecture and utopia", where architecture has become a self-advertising sign. Instead of architecture being grounded in special experience, it has adopted the strategy of advertising and instant persuasion. Buildings have become products detached from existential depth and sincerity (Pallasmaa, 2012:33) . The sense of 'aura' and the authenticity of presence as a necessary aspect of an authentic piece of art have been lost (Pallasmaa, 2012:33).

The strategy of visual advertising is described by Pallasmaa (2012:33) as an ocular bias, never more apparent in architecture than today, in the type of architecture which intends to create a striking and memorable visual image. The use value of architecture has therefore become that of communication, a visual currency of an emerging brandscape. Contemporary culture has drifted towards a de-sensualisation of reality, with a distinct change occurring in our sensory and perceptual experience of the world.

The argument is not for rejecting the notion of time, but rather to reconceptualise how time can be defined and related to architecture. Architecture inhabits limitless space but should likewise inhabit endless time, allowing us to inhabit the continuum of time.

4.2.2 Memory as a measure of time

As one of the consequences of accelerated time, the world is in a state of a ballooning 'memory industry', characterized by the exponential growth of museums, archives, institutional sites, scholarly research and memory devices. The need to capture memories, as C. Greig Crysler (2012:281) explains, is yet another consequence of the boundaries between the past and present becoming less distinct as the past has become constructed in the present. Events have started slipping from the historical domain into another, with time speeding up and thus causing the past and future to disappear.

Merleau-Ponty's (1992:203) philosophy makes the human body the centre of the experiential world. He argues that it is through the body that we choose our world and that our world chooses us, thus making the body in the world as the heart is in the organism, keeping the spectacle alive and becoming part of a system.

As buildings lose their plasticity, the connection architecture has with the body becomes increasingly isolated in the realm of vision, ignoring the conceptual and material nature of architecture as embodying the passing of time and the experience of architecture as multi-sensory. In our culture of photos and pictures we have begun to experience our world from the outside as spectators of images. Reality has become what we see in the camera (Pallasmaa, 2012:33).

The loss of the connection between architecture and the human body has caused structures to become flat, sharp-edged, immaterial and unreal (Pallasmaa, 2012:34). The psychological result has been a loss of critical consciousness in that the body isn't able to locate itself, order its immediate surroundings perceptually, or cognitively map itself and its position in the external world (Crysler, 2012:293). To combat the loss of temporality, architecture should embrace body and emotion as a means of knowing the world and transcending the empty realm of vision. Memory, seen as something worth preserving, can then be redefined in architecture as something that is socially constructed in the present. The past is therefore codependent on the present (Crysler, 2012:299).

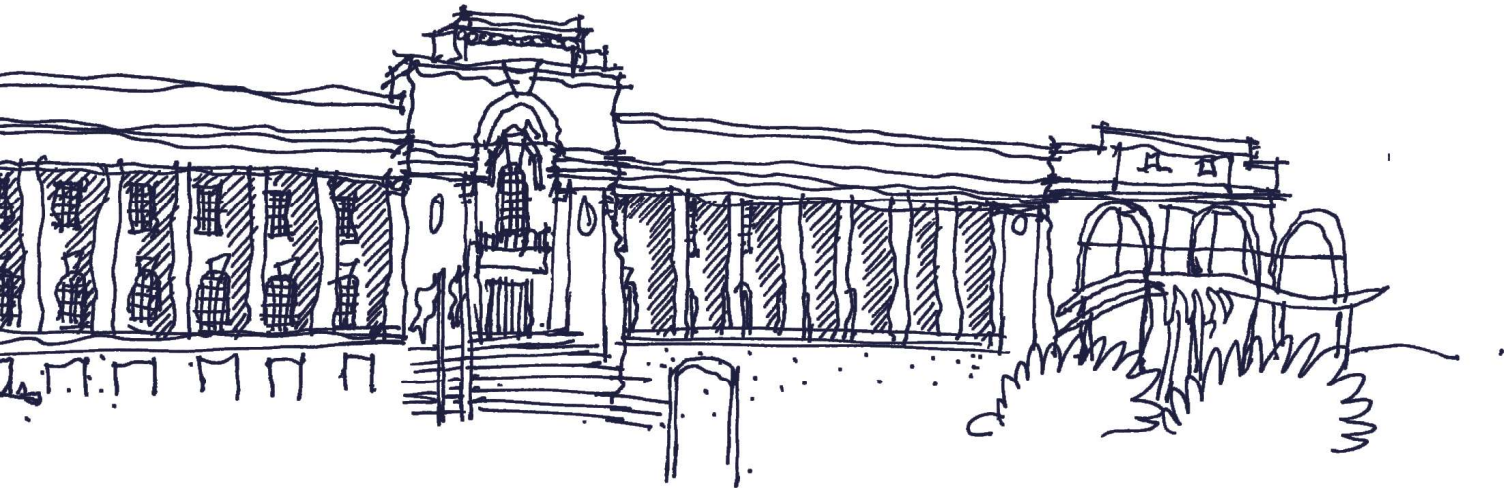
The potential for minimalist architecture to engender multiple meanings incorporates a more inclusive strategy. As Michael Kimmelman (2002) states: "minimalist abstraction, with its allegorical pliancy, turns out to function in a memorial context as the best available mirror for a modern world aware of its own constantly changing sense of history." Buildings should allow for strong associations with experiences and provoke feelings, while leaving history unresolved. Memories are therefore imparted through an embodied experience.

4.2.3 Theoretical application

The following section relates Kromdraai Cave fossil site to the relationship between space, time and the body. An imagined illustration is given of how the intervention can incorporate and relate to the notion of time within the design and programme.

4.2.3.1 Intervention

During the excavation of Kromdraai Cave the programme would function towards facilitating researchers by providing infrastructure to complete the dig. The knowledge of the researchers is



4.9 - Natural History Museum (Author, 2016).

harnessed through the means of community involvement and an educational programme. In interacting with the researchers, the community will benefit directly from the excavation process in learning new skills, and in turn the value of the environment is made clear and actively conserved.

4.2.3.2 Post excavation

As the excavation has a time limit, the structure will take on the role of acting as physical evidence of the excavation event as well as commemorating the presence of fossils. Functions associated with research and excavation are disassembled and fall away, and the functioning of the site as an interpretation centre commences as a means of generating income and continuing the process of awareness. If it is found that the site is no longer relevant or heritage values have changed profoundly, the structure can be completely demounted. The educated and informed community is left to take ownership of the site and to act as managers thereof. The landscape intervention on the excavated area draws new life to the cave starting the cycle once again.

4.2.3.3 The distant future

When all traces of known society have disappeared the question becomes: What will the legacy of our society be and what place does the site have in the future? The programme takes on the role of signifying that Kromdraai Cave was significant to modern man and played a role in our understanding of our place in the world. In allowing for permanence, this point in time is celebrated in the form of a monument, and leaves some clues as to what the site would represented after all memory is lost.

4.2.4 Theoretical premise

Within the world heritage context, this dissertation looks at designing for a transient site. Evidence of man, and man's interaction with his world, have been preserved in the unique geological archive of the site, with time gently grinding the evidence away. Where the site has a rich stratigraphy, with multiple narratives forming a palimpsest over time, the architecture is considered as one of these layers. The physical character of the space relates to the fleeting nature of life, the experience of forgotten times and unknown worlds. The focus lies on anchoring architecture to its time, time here referring to the past, present and future.

The dissertation explores architecture as a celebration of the value of the site while revealing the tangible and intangible qualities thereof. The landscape developed over millions of years and carried with it the aspects we find of value today, and the qualities of the landscape which made this possible, are all

still evident. The celebration and acknowledgement of these qualities and the character of the landscape will create a new memory of the site, the memory then keeping the site alive.

Time in architecture is visible through weathering, temporality and use of space. This dissertation focuses mainly on the ideas of temporality and use of space, as temporality dually provides a means of a sensitive intervention. The design resolution therefor focuses on designing a building to accommodate changes over time while permanent elements maintain clues to future civilisations of the importance the site held to this civilisation.

The design process was informed mainly by understanding the context and value of the site. Other informants included: design intent, theoretical and conceptual premise, existing values and threats, programmatic requirements and the relationship between the programme and existing facilities, the tangible and intangible values of the site and environmental concerns. The process was challenged by a lack of physical informants and limits, an abundance of intangible informants and necessities of interventions. The question was asked: How do you build where you should not build?

4.3 The architectural intention

The architectural intention aims to continually give utterance to the valued aspects of the site through the creation of a sensitive coordination system, expressed and generated from the grid. The building accommodates the collection of knowledge of the past and its application in the present, while looking to its conservation for the future. The interpretation of the prehistoric past leads to the creation of a new memory and connection to the landscape, facilitated by the intervention on site. The research centre becomes an expression of excavation and interpretation while respecting the existing character of the landscape. The intervention is inspired by the rural agricultural nature of the site and its mining history, and facilitates the changing climate of the UNESCO environment.

The intervention on the Kromdraai Cave site was approached by addressing the sensitivity of the site, and focused on allowing human interaction in a fragile landscape in a way that would protect and enhance the landscape, rather than destroy and cause harm to it. The project focused on creating an environment of value to the international tourism and science community as well as the local community directly affected by the site. The research facility therefore amplifies the value of the site for all. The architectural intention aims towards the creation of spaces which exhibit the landscape, creating an awareness of spaces which might have gone unnoticed and unarticulated. The intervention responds to the hierarchy of the site as well as the hierarchy of the site in the context, while framing and defining in-between spaces.

The design acknowledges the existing state of the site as an excavation site, while mediating the value of the site as an exemplary and intact landscape system. The vision is for the intervention to create a seemingly transparent building not only framing the context, but also carrying a narrative for the site and creating a link between the lost memories of place.

4.4 The architectural vision

The architectural intention endeavors to create a means of accessing the site as well as accessing the values of the site through a system of co-ordination derived from the site's archaeological grid. The connection of the cave to other caves within the landscape, as well as the experience of the natural landscape guided the masterplan for the experience of the site to co-ordinate the visitor within the landscape. The intervention attempts to expose the visitor to the many layers and rich history of the site as well as to the current state and use of the site.

The grid is once again used as a means of framing specific views and articulating important areas in the landscape. The frames then link to a proposed identification system scattered within the Cradle, indicating the presence of caves or fossil finds. The architecture aims to allow the visitor to interact with the landscape and in this way stimulates learning and new memories of the site. The frames does not present biased information to the user but rather

highlight instances of note, letting the user imagine and extract meaning.

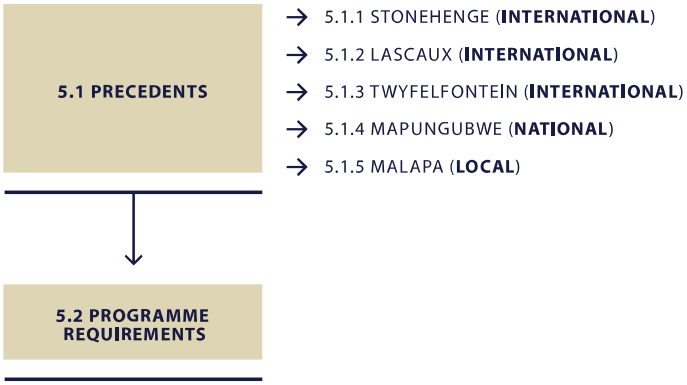
4.5 The conceptual approach

The design relies heavily on the archaeological grid placed over the site as a device to excavate the site while linking the excavated material symbolically to the cave. The geological context of the site is the most important aspect of the cave and so becomes the most significant attribute of concern. The geology carried and protected our heritage for millions of years and influenced the development of the area in various ways. Understanding and expressing the nature of the unique geological environment will allow for an intervention to facilitate the existence of the environment into the future and therefore support the proposed programme.

Chapter 5

Precedents and programme

The programmatic precedents were studied in order to understand the relationship visitor centres should have with a UNESCO World Heritage Site itself. An understanding of visitor centres allows the architect to assess the role architecture plays in explaining and interpreting the environment. The chosen precedents range consecutively from international, to national, to local. The facilities were assessed in terms of visitor numbers, location, facilities, purpose, aspirations, relationship with the landscape, and the extent to which visitors are allowed onto the sites themselves. The assessment then assisted the researcher in developing the programmatic requirements of the site.



5.1 Precedents

5.1.1 Stonehenge

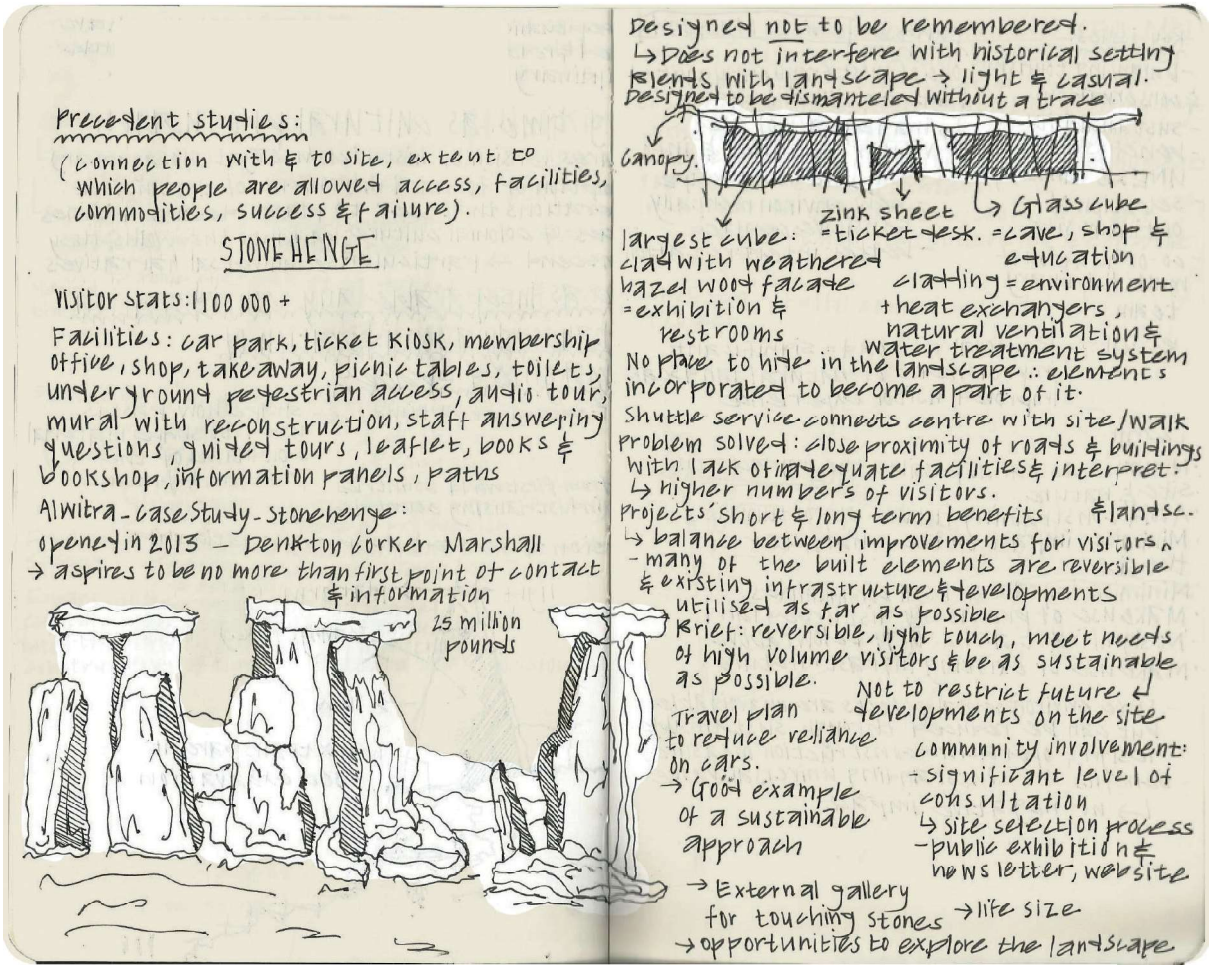
Date: 2013 | Visitor numbers: 1 000 000 per year | Context: Roads and buildings

Facilities: Exhibition area, rest rooms, café, museum shop and educational facilities, ticket desk, and shuttle service with pathways (Alwitra, 2015:2).

Purpose: The brief involved improvements to the landscape setting of the Stonehenge monument, as well as a sensitively designed and environmentally sustainable visitor centre acting as a gateway to the Stones and the wider World Heritage Site (Stonehenge Environmental Improvements (Alwitra, 2015:2).

Aspiration: The design of the visitor centre aspires to be no more than a first point of contact and information, secondary to the attraction in all ways. Stephen Quinlan of Denton Corker Marshall (Case Study Stonehenge Visitor Centre 2015:2) states that: "When visitors to Stonehenge go back home again remembering the stone circle but not the visitor centre they have passed through, then we will have achieved exactly what we wanted". Relationship with the landscape: The light and casual building opens up to the horizon so as to blend with the undulating landscape. The lightness contrasts with the monolithic stone circle. The whole structure has been designed so that it could be dismantled at any time without leaving a trace ((Alwitra, 2015:2).

Visitor access: A shuttle service connects the visitor centre with the Stones for those who prefer not to walk (Stonehenge Environmental Improvements Project 2014:[s.p.]).



5.1 - Stonehedge (Author, 2016).

5.1.2 Centre International d´Art Pariétal Montignac Lascaux (Lascaux IV Caves Museum)

Date: 2009 | Visitor numbers: 1 100 000 per year | Context: Farmland

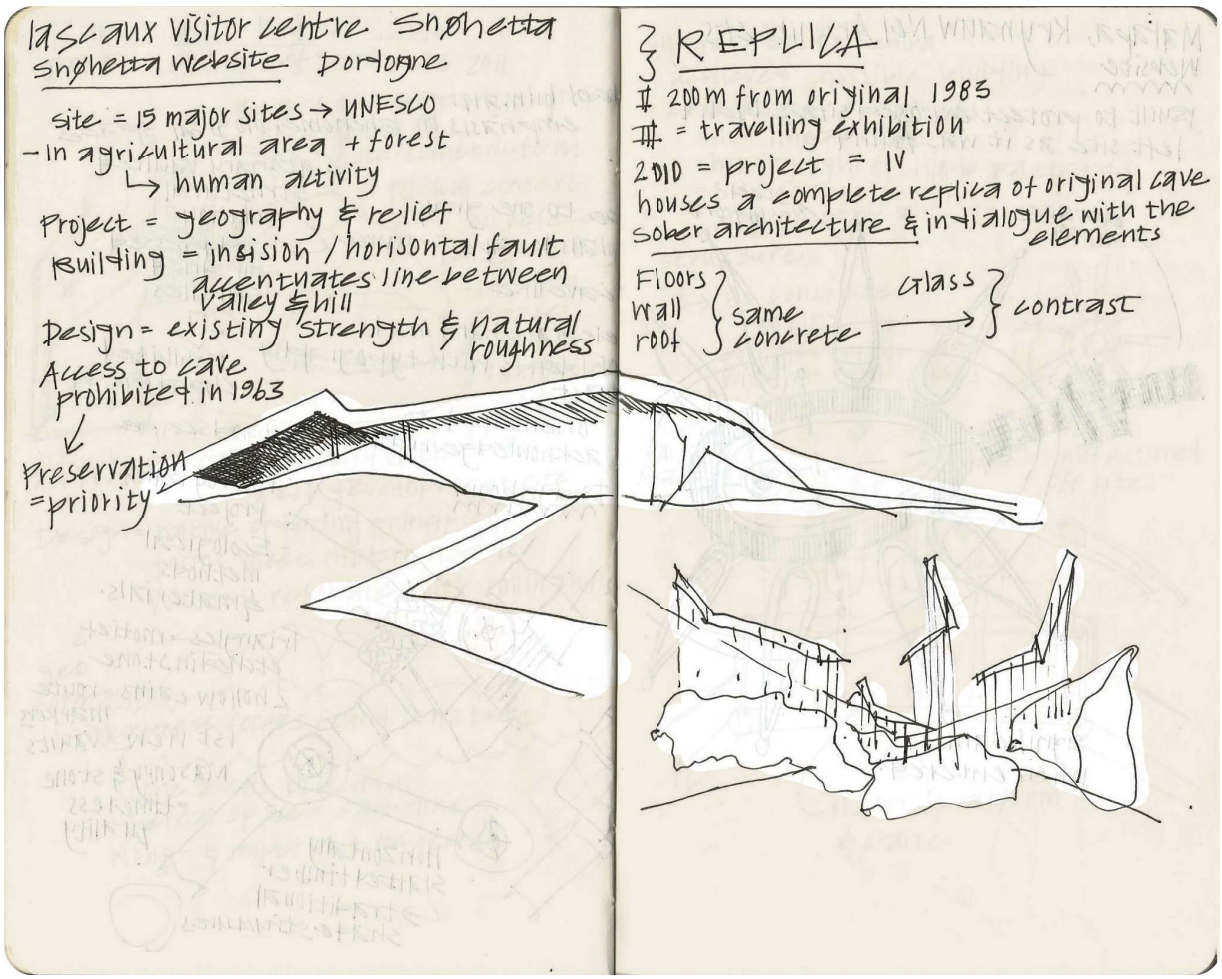
Facilities: Car park, ticket kiosk, membership office, shop, take-away outlet, picnic tables, toilets, underground pedestrian access, audio tour, mural with reconstruction, staff answering questions, guided tours, leaflet, bookshop, information panels, paths.

Purpose: In 1955 evidence of damage to the rock art on the cave walls started to appear. The cave was closed overnight in 1963, abandoning an economy fully reliant on the touristic exploitation of the site. The Hall of the Bulls and the Axial Gallery, commonly known as Lascaux II, were built in 1983 as a partial reproduction of the original cave. The reconstruction reached its limits as visitor numbers of between 250 000 and 300 000 were experienced annually (Hudson, 2012).

Aspiration: The aim with the building is to provide the visitor with the same experience the cave would provide, while protecting the latter.

Relationship with the landscape: The landscape is viewed as essential to the conservation of the caves. The design responds to it in order to improve the state of the landscape and minimise construction and visual impact, while providing protection from risks such as development and vandalism. The building sits in a dip and follows the contours of the site so as to expose the intricacies of the landscape.

Visitor access: The facility is designed as a replica of the original cave as the original is inaccessible to the public.

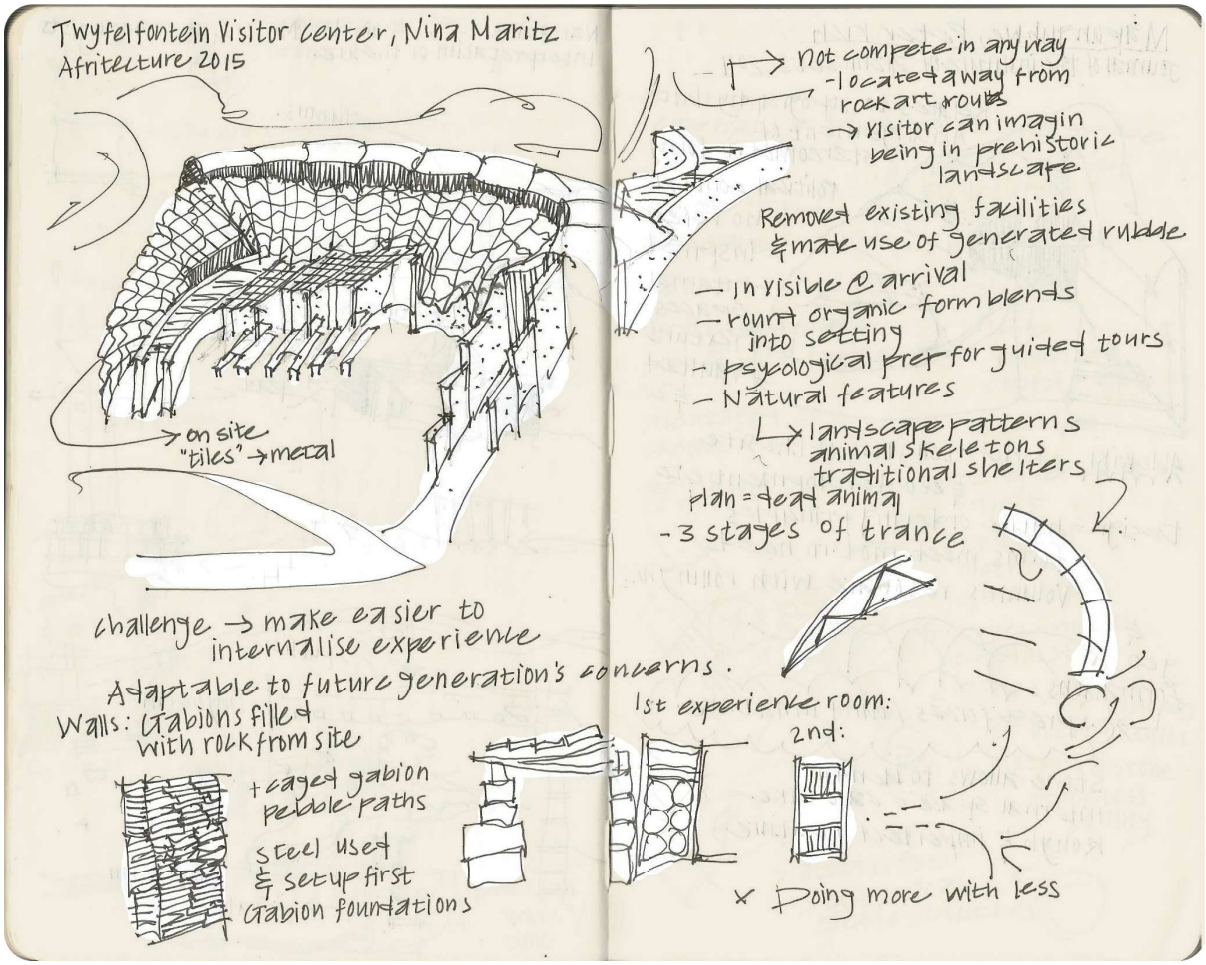


5.2 - Lascaux IV Caves Museum (Author, 2016).

5.1.3 Twyfelfontein

Visitor numbers: Approximately 56 425 per year | Context: Isolated rural area

Facilities: The visitor centre consists of a reception area with ticket office and tour guides; an exhibition area with historical and background information and visual material; a curio and craft shop; an outside café and kiosk; and paths to specific decks for viewing rock art (Rivett- Carnac, 2011:25).
Purpose: Interpretation of the site and, as an effort to protect the rock art, the facility controls the extent to which visitors have access to the landscape.
Aspiration: The design, location and materiality of the facility blends into the landscape in order to become invisible.
Relationship with the landscape: The visitor centre is located away from the rock art, with visitors being encouraged to use official tour guides to access the site, as the service is included in the ticket price. The actual rock art areas are protected by viewing platforms (Rivett-Carnac, 2011:22).
Visitor access: Only a few specific sites are accessible to tourists on paths developed for tours (Rivett-Carnac, 2011:22).
Community: The management of Twyfelfontein allows for local communities to make use of the land and draw income through their own activities. The community thus benefits directly, not only economically from the income generated by the centre, but also from enterprise fees as a levy received from providers of private accommodation in the area. Local guide training was facilitated, although the San who produced and once created the rock art aren't directly involved at the site. An opportunity has also been created for local crafters to exhibit and sell their wares at the visitor centre shop (Rivett-Carnac, 2011:21).

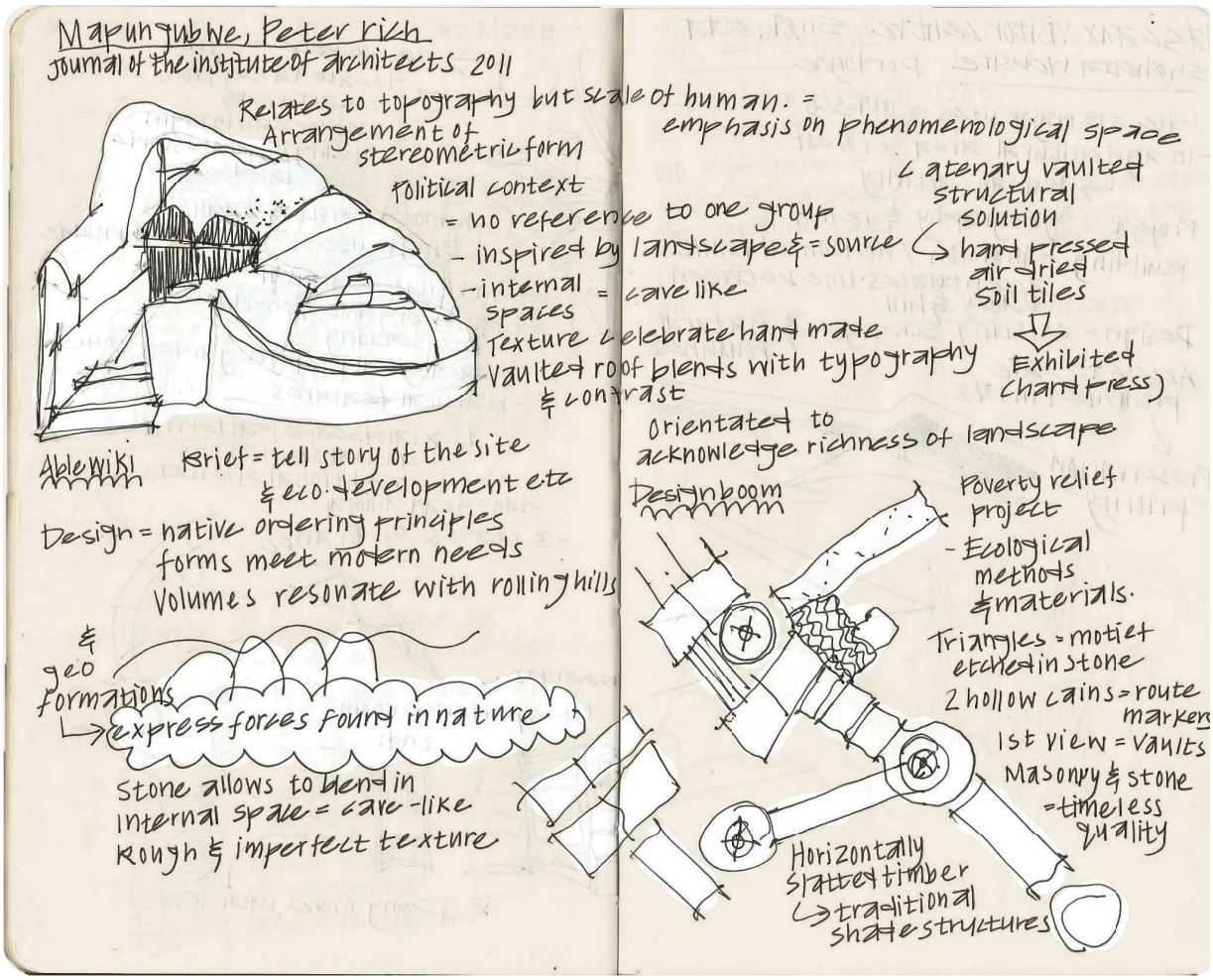


5.3 - Twyfelfontein (Author, 2016).

5.1.4 The Mapungubwe Interpretation Centre

Context: A dramatic hill and stone landscape (Tall, 2013:5).

Facilities: Museum, introduction hall with information on the context, rooms hosting exhibits, coffee bar, restaurant, shop, offices and outdoor amphitheatre. Facilities for researchers are included in the programme (Tall 2013:3).
Purpose: To provide an interpretation centre giving the visitor an understanding of Mapungubwe (Tall 2013:9).
Aspiration: To interpret the context in the design.
Relationship with the landscape: The design development was inspired by the natural and social context. The volumes respond to the topography of the landscape, and trees frame the buildings. The visitor exits at a vantage point overlooking the valley (Holcim Awards, 2007:2).
Visitor access: At the centre the movement of visitors is controlled with a path moving through the museum into the landscape. The landscape is only accessible if accompanied by a guide (Holcim Awards, 2007:3).
Community: Sixty unemployed low-skilled people were hired and trained to manufacture bricks.
A hundred people were trained in construction work, while the site workers continuously used and were able to find a job on site due to this training (Tall, 2013:9).

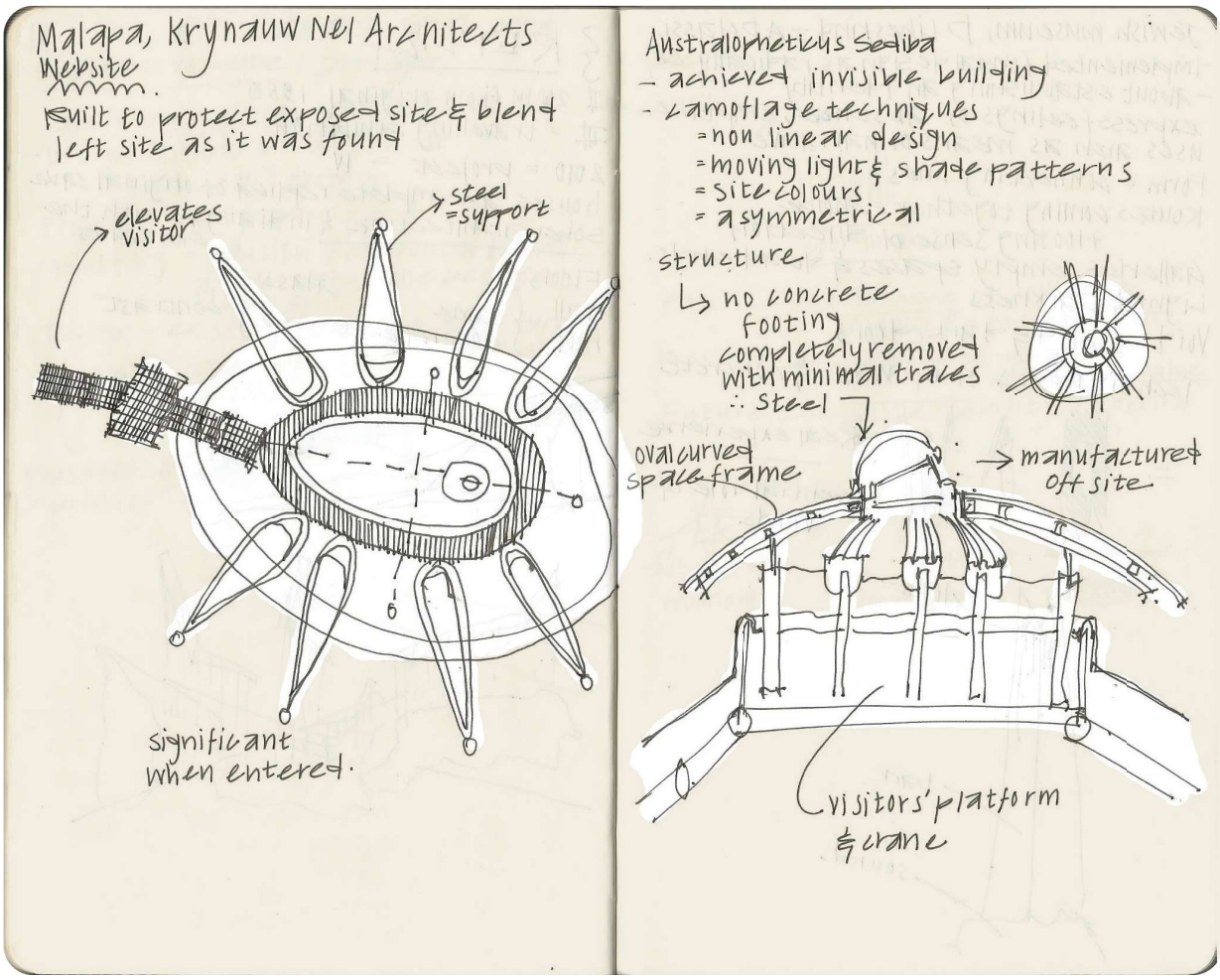


5.4 - The Mapungubwe Interpretation Centre (Author, 2016).

5.1.5 Malapa

Visitor numbers: Undetermined; limited by game farm activities
Location: Malapa Game Farm, Cradle of Humankind

Facilities: A removable structure over the cave, a tourist viewing platform, and a crawl hoisting structure to lift out rocks with a mass of up to 1 ton (Malapa Fossil Excavation Site takes top honours at Steel Awards 2014:[s.p.]).
Purpose: To protect the site and the exposed fossils from the extremes of the weather and to allow for as much 'dig time' as possible. It also had to blend in with the 'ring of trees' and the rest of the bush on the hillside. The structure in addition imparts maximum natural light to the covered area while not hindering the movement of the natural wildlife.
Aspiration: In order to be sensitive to the landscape, the architecture aspires to be invisible from the exterior and visible from the interior. The structure has no concrete footings and can be removed in order to leave minimal traces. Elements of the structure were manufactured off site to enable minimal construction (South African Institute of Steel Construction, 2014:29).
La**ndscape:** The structure simulates the colours of the landscape and undulating topography while sitting in between trees. The structure enables the removal of visitors from the landscape so as to protect it.
Visitor access: The structure allows for visitors to have direct access to the site from above while experiencing the landscape.



5.5 - Malapa (Author, 2016).

5.2 Programme requirements

Programmatic implications concluded from the precedent study.

Purpose: The purpose of the research facility is to act as a map, highlighting and enhancing the various aspects of the landscape which make it of outstanding universal value. The intervention thus becomes the creation of a living exhibition and collection of knowledge. The process surrounding the excavation and understanding of the excavated materials become part of an educational programme, transferring the knowledge of the scientific community to the local community. The local community then become curators of the site and landscape.

Aspiration: The aspiration is for the building to be a background building but to be designed in such a way so as to remain of world heritage standard. The design is aimed towards creating an awareness of the landscape, thus making the building only a coordinating system accommodating the visitor.

The relationship of the building with the landscape: The strategy of contrasting with the landscape is implemented as a means of highlighting the nature of the site. A linear, unimposing and background building is envisioned within the organic and natural landscape and which frames this natural landscape. The intervention is located within the World Heritage Site itself, as the aim is to emphasise the tangible and intangible qualities of the landscape.

The Kromdraai Cave Programme

Programme: Research and education centre
Facilities:
Restaurant and administration:

- Reception
- Reception lockers and repository
- Offices for administrative staff
- Boardroom
- Restaurant with outdoor seating area accommodating staff, locals and the visiting public
- Ablution facilities

Excavation and education:

- Site office
    - Equipment storage
    - Power access
- Sieving area
- Excavation dumping area
- Reference material
- Fossil drying area, repository and reference material

Library, exhibition space and archive

- Pavilion seating with view over excavation
- Reading material
- Samples and specimens
- Study area

Research

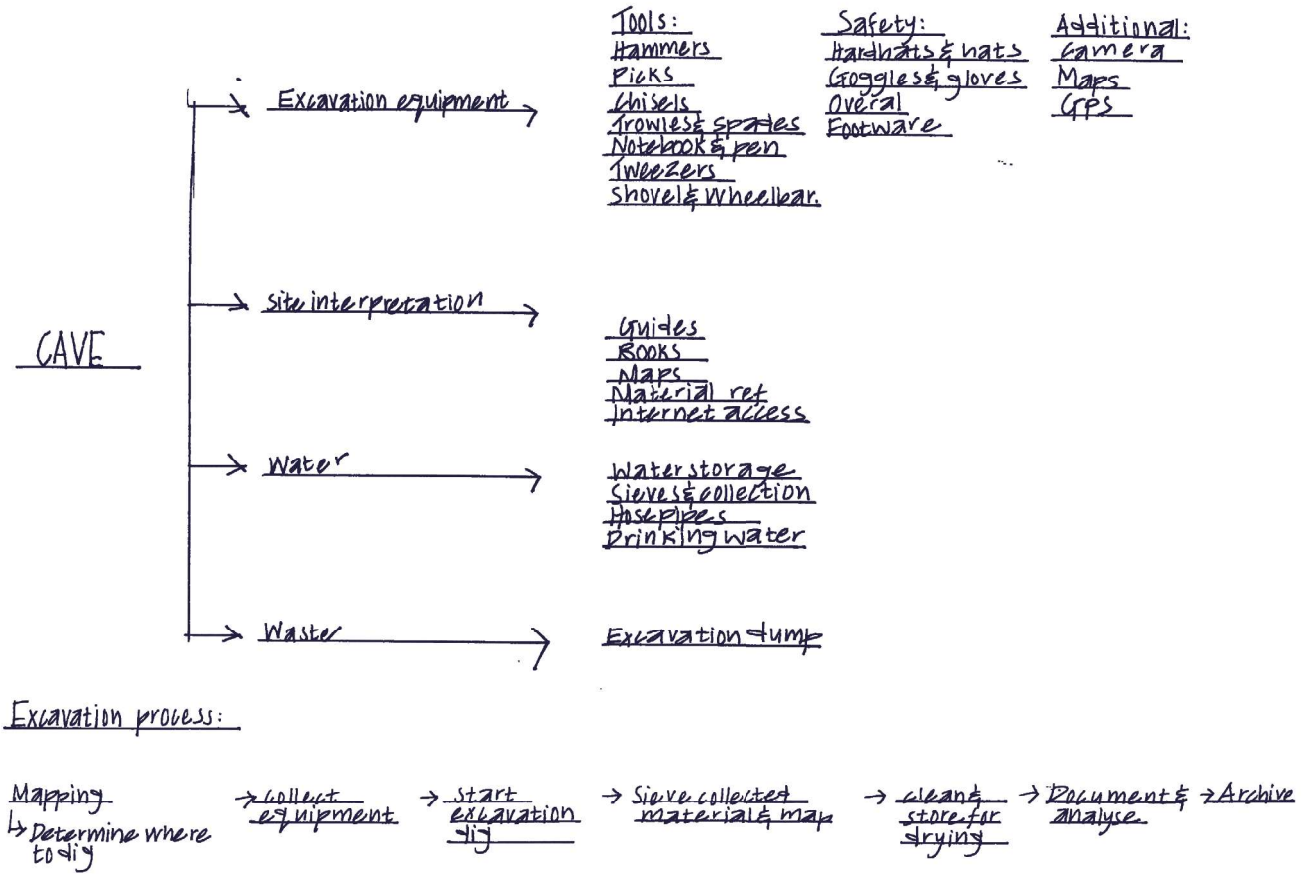
- Studio and workshop
- Mammal bone laboratory
- Environmental laboratory
- Microscope laboratory
- Herbarium laboratory
- Workshop and lecture room
- Casting and photography room
- Equipment storage
- Chemical storage
- Staff area
- Ablutions

Landscaping and management interventions follow the updated fossil site management findings for Kromdraai (2009-2013):

- The provision of circulation routes
- The rangeland condition is improved as it has deteriorated due to overstocking, overgrazing, trampling and wildfires.
- Erosion is addressed as the site has experienced a loss of topsoil, especially due to the movement of vehicles. Parking is provided as parking occurs frequently on site.
- Mitre drains are implemented in order to rehabilitate eroded tracks, while surface ruts are restored with rocks and brushwood to break the flow of water.
- The provision of fire management
- A proper fire regime is deployed for the Brakenveld fire management strategy.
- Lists of Red Data species are compiled through surveillance and maps within the

programme.

- Invasive plants are addressed through listing invasive species and infestations through visual checks and photographic monitoring, reducing the need for controlled fires.
- The provision of infrastructure
- Caves and the ecology of the subterranean environment are incorporated into the interpretation of the site without having the general public physically entering the cave.
- The disturbance and displacement of animal resting places such as porcupine lairs and owl roosts are avoided within the programme, as these are important as modern equivalents for processes of the past.
- Ablution facilities which are suited to the environment are made available on site.
- Waste management for excavations must is implemented in the form of litter bins which are unaffected by the wind and can be collected and removed easily.
- Erosion measures must are taken in ecologically sensitive areas and no more pathways than necessary are created.
- Water is brought to site through the addition of a swale system, with a water dispersal and filtration system.
- The lack of energy supply reduces the speed and efficiency of the excavation and thus energy is provided on site.
- Access to the bottom of the excavation is implemented to address future needs.
- The provision of security
- A security fence as a means of monitoring the site is installed to protect the site against theft or criminal activity such as property theft and the removal of rock, fossils, breccia and artefacts.
- Theft of Pelindaba stone and stromatolites are prevented through monitoring soils and patches of overturned and disturbed rocks or soils.

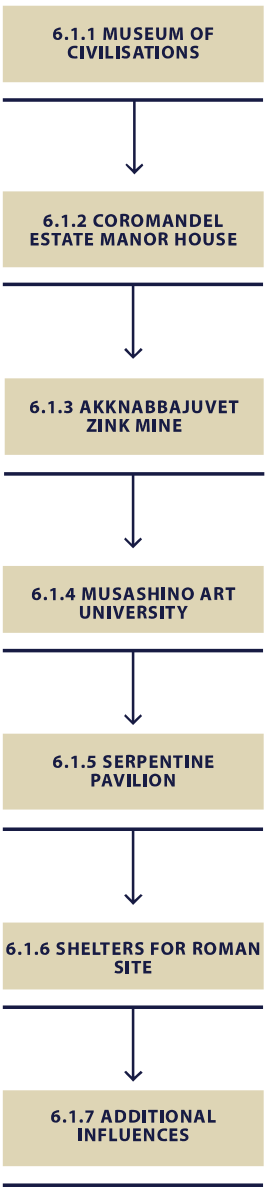


5.6 - Excavation Process Flow (Author, 2016).

Chapter 6

Design Precedents

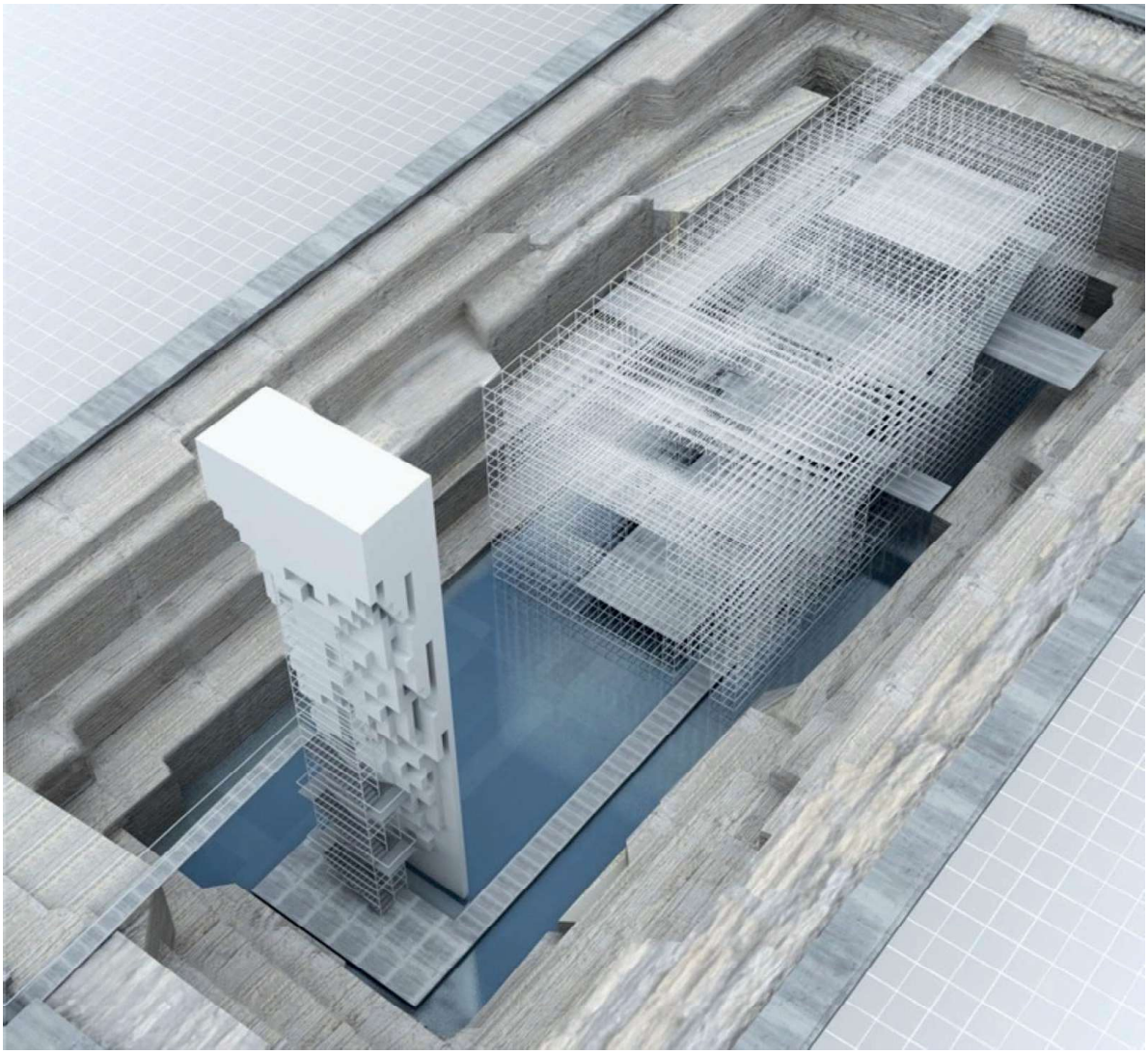
The design precedents assisted the researcher in the design process.



6.1 Design precedent

6.1.1 GM Architects, Museum of Civilisations

The museum proposal is for the structure to be sunk deep into the ground in Martyrs' Square in the centre of Beiruit. The design directly exposes the stratigraphy of the civilisations underlying Beirut, making up the Lebanese culture of today, as the design becomes an archaeological dig, exhibition space and place for reflection (Frederickson, n.d.). The hole is filled with two structures, one consisting of 20 m x 60 m of gridded scaffolding, the other a tall white tower. The white tower is based on Stanley Kubrick's monolith from the film 2001|: A Space Odyssey, with the front being unblemished and smooth and the back eroded, referring to the uncertainty of the future. The two structures are connected by a singular circulation path with a succession of voids creating platforms for exhibition and general observation (Frederickson, n.d.). The floor of the site is an expanse of water, representing the Mediterranean basin as the origin of all involved civilizations (Walker, 2014). Frederickson (n.d.) describe this approach as 'contextual immersion' which refers to possessing an awareness of the past and being rooted in the context.



6.1 - Museum of Civilisations (Archdaily, www.archdaily.com).

6.1.2 Coromandel Estate Manor House

Coromandel Estate is located in Lydenburg, South Africa, and has become an iconic ruin, overwhelmed with mystery and tragedy. The design has allowed the structure to adapt and fuse with the landscape as the approach was one of manipulation of the landscape, offering shelter within rational lines. The structure consists of a planted roof with indigenous and endemic plants. These plants have grown on the cavity walls and spread along stone cladding, creating an ecological landscape and habitat (Peres, 2013:34-35).

6.2 - Coromandel Estate Manor House (Architizer, www.architizer.com).

6.1.3 Peter Zumthor, Allmannajuvet Zinc Mine

The Zinc Mine Museum was commissioned as an attempt to stimulate tourism in Sauda, Norway and celebrate a once-booming mining industry. Four buildings are clustered within a natural route upon Allmannajuvet gorge. The cluster includes a museum, café, shelter and service building. The buildings sit ghostlike above and away from the archaeological remains and are designed to look as though they have always been there (Meredith, 2014).The buildings are positioned in order to provide individual views of the landscape as birch and pine trees and the steep mountainside combine to form dramatic views. The buildings are supported by a timber grid in some instances perching along the side of a stone wall. The small and simplistic museum design is not poor, but modest, as it responds to the historic working conditions and circumstances of the mine workers. The timber framework and metal roofs become a dialogue referring to mining as well as the landscape(Hakanoglu, n.d.).

6.3 - Allmannajuvet Zinc Mine (Archdaily, www.archdaily.com).

6.1.4 Sou Fujimoto Architects, Musashino Art University Museum & Library

The library, designed for the Japanese Musashino Art University, functions as an ark, with 100 000 open-archive shelve units with another 100 000 closed-archive units. The library is constructed out of shelve units, which become the books, light and place. The layered 9m high walls together with a spiral sequence of bookshelves wrap the periphery of the site as an external wall creating a relationship between the interior and exterior. Within the library exploration and investigation are opposing yet dependent entities, as investigation refers to the location of specific books, while exploration relates to the discovery of unexpected information. The space is therefore renewed and constantly reformed, while a logical system facilitates the existence of both systems (Divisare, 2012).

6.4 - Musashino Art University Museum & Library (Archdaily, www.archdaily.com).

6.1.5 Sou Fujimoto, Serpentine Pavilion

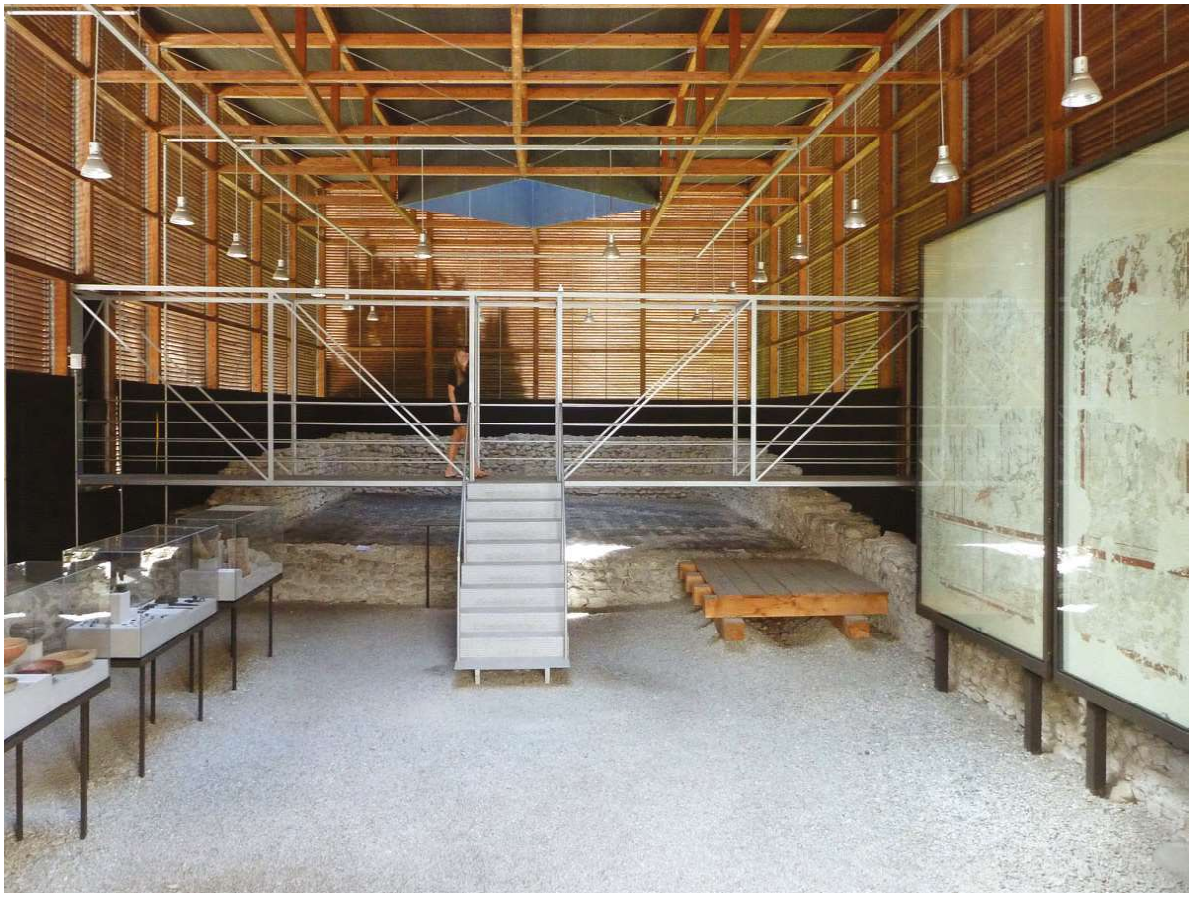
The pavilion by Sou Fujimoto became the first pavilion the public could interact with. The three-dimensional steel grid created from 400 mm steel bar modules create a light structure which is broken in certain areas to allow public access as well as different uses within. The structure becomes translucent to the landscape, encouraging exploration of the site. The concept of manmade geometry blends with the natural and human, the geometry and greenery are merged in order to create a new environment. The structure protects visitors from the landscape while allowing them to move through it (Portilla, 2013).

6.5 - Serpentine Pavilion (Archdaily, www.archdaily.com).

6.1.6 Peter Zumthor, Shelters for a Roman Archaeological Site

Built in 1985 in Chur, Graubünden, Switzerland, the protective Housing for Roman Excavation was awarded the Pritzker Architecture Prize in 2009. In the Pritzker essay Phillip Ursprung (2009) describes Zumthor's buildings as continuously revolving around the relationship between the human body and its environment, and the experience of specific situations.

Excavations in Chur, the oldest Swiss town, unearthed a complete Roman Quarter. Authorities decided to preserve the excavations and open it for public exhibition. Zumthor, through the use of a lightweight wooden enclosure designed a protective wooden pavilion, not only as a protective enclosure but also as a museum. The design consists of "cases", referring to a volumetric reconstruction of the original Roman buildings with the entrance placed on one of the side facades. The metal box entrance is suspended from one of the timber walls, avoiding contact with the ground where the entrance then extends to a modern metal Pratt type beam footbridge. The footbridge functions as a raised observation level (Martin, 2013).



6.5 - Shelters for a Roman Archaeological Site (Archdaily, www.archdaily.com).

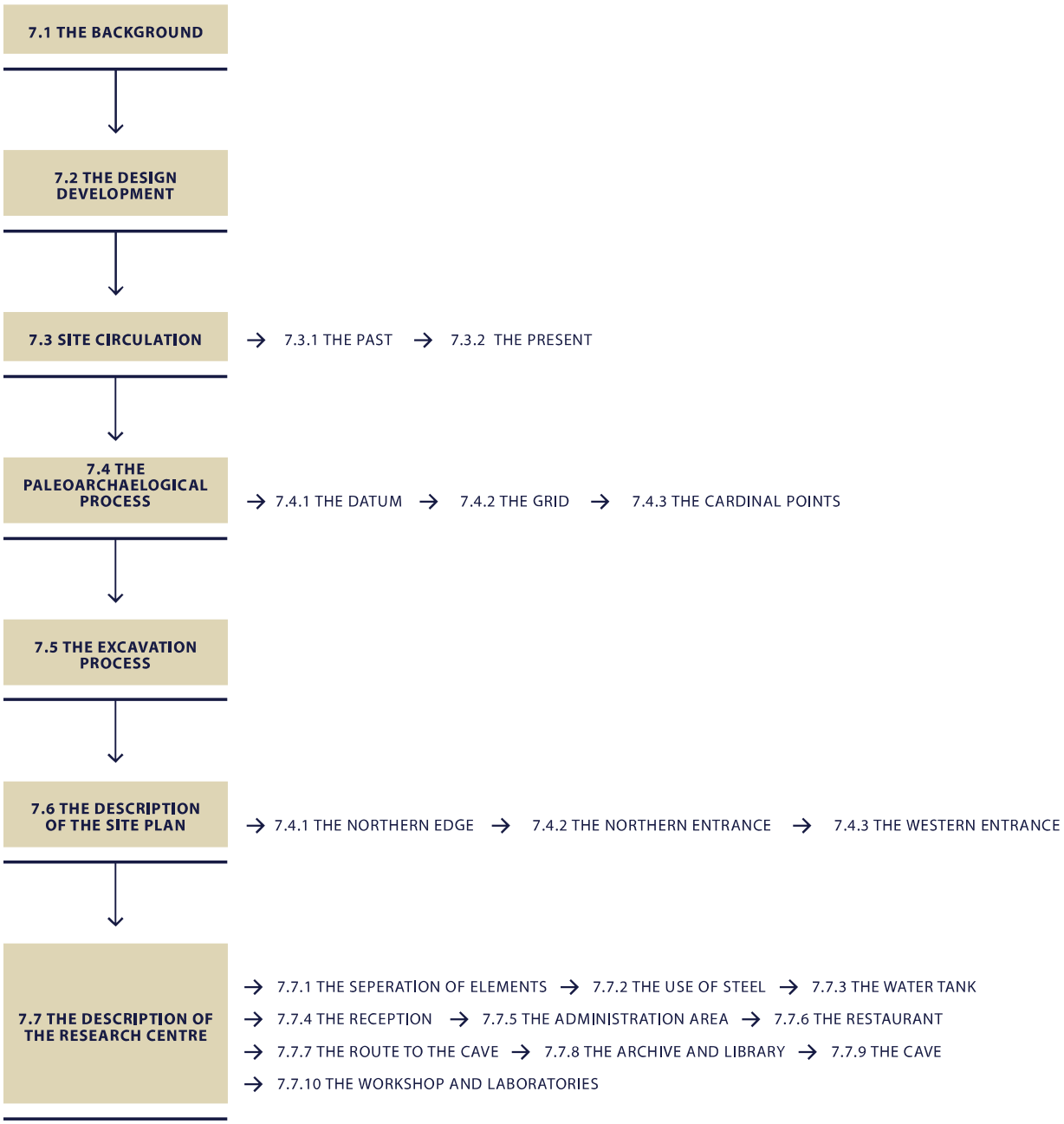
6.1.7 Additional influences: Frank Lloyed Wright | Taliesin West**, Tom Kundig |** Rolling Huts and Delta Shelter, Case Study Houses**, Renzo Piano |** Tiny Diogene Hut

Left to right: 6.6 - Taliesin West (Archdaily, www.archdaily.com), 6.7 Rolling Huts and Delta Shelter (Archdaily, www.archdaily.com), 6.8 Tiny Diogene Hut (Archdaily, www.archdaily.com), 6.9 Case Study Houses (Lanonservancy, www.laconservancy.org)

Chapter 7

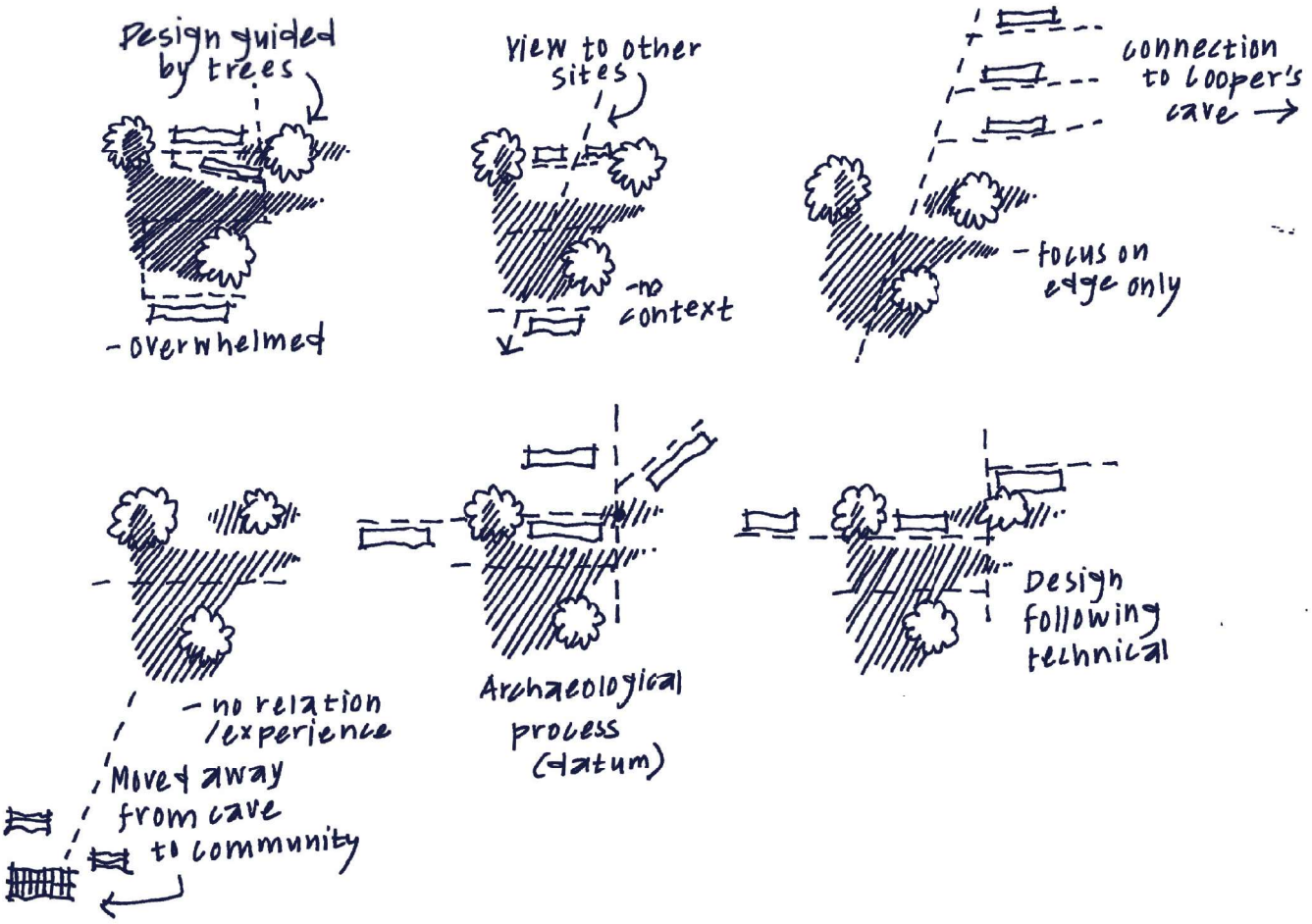
Design development

This chapter provides an understanding of the main design generators and design process. The generators address design and heritage aspects developed from the background, analysis, frameworks, precedent studies and theoretical premise.



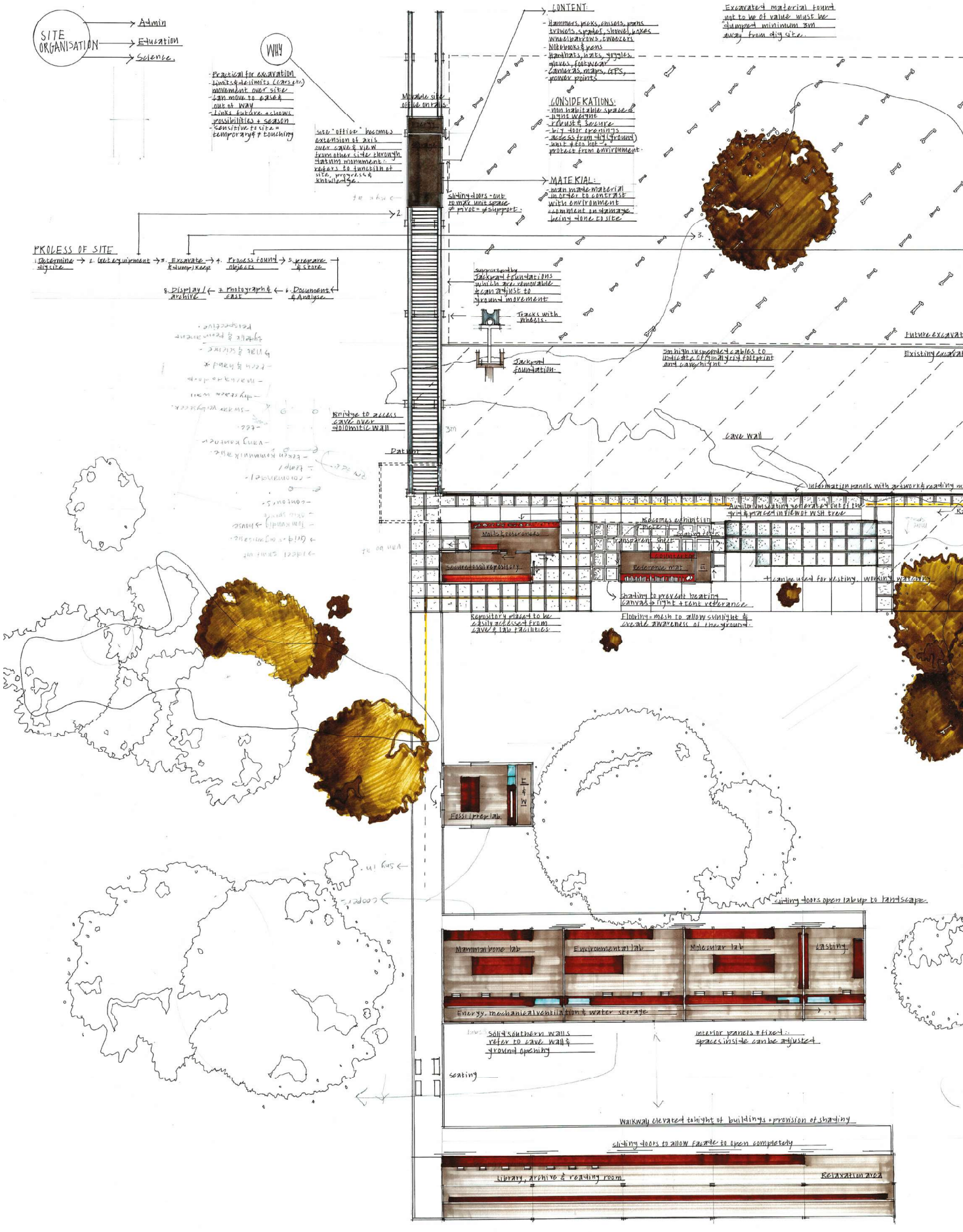
7.1 The Background

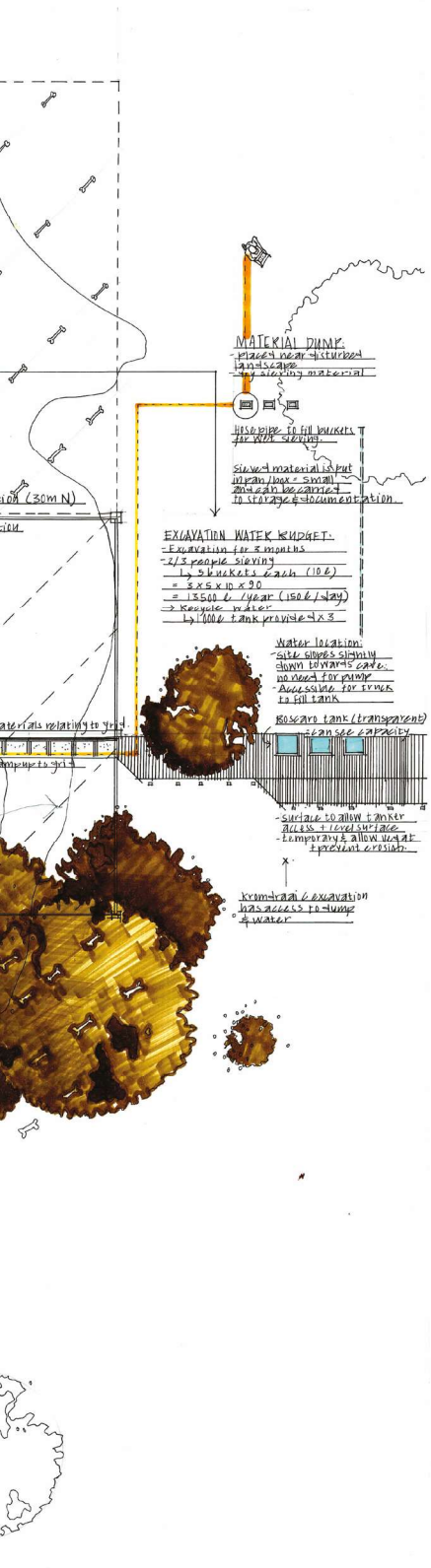
The project follows a series of interventions as finding limitations within the open landscape and lack of physical informants proved challenging. The first approach focused on the white stinkwood trees surrounding the caves, as the specific pattern of the trees indicate the presence of a cave in the Cradle landscape. The intervention proved to overwhelming and dominated the cave site. The second approach relied on the paleoarchaeological process as the process relates directly to a method for understanding the prehistoric landscape in relation to the present. A series of interventions resulted from using the grid as a means of understanding the site, being distilled down to the simplest possible intervention. The site and precinct design were only properly resolved after the circulation on the site was resolved.



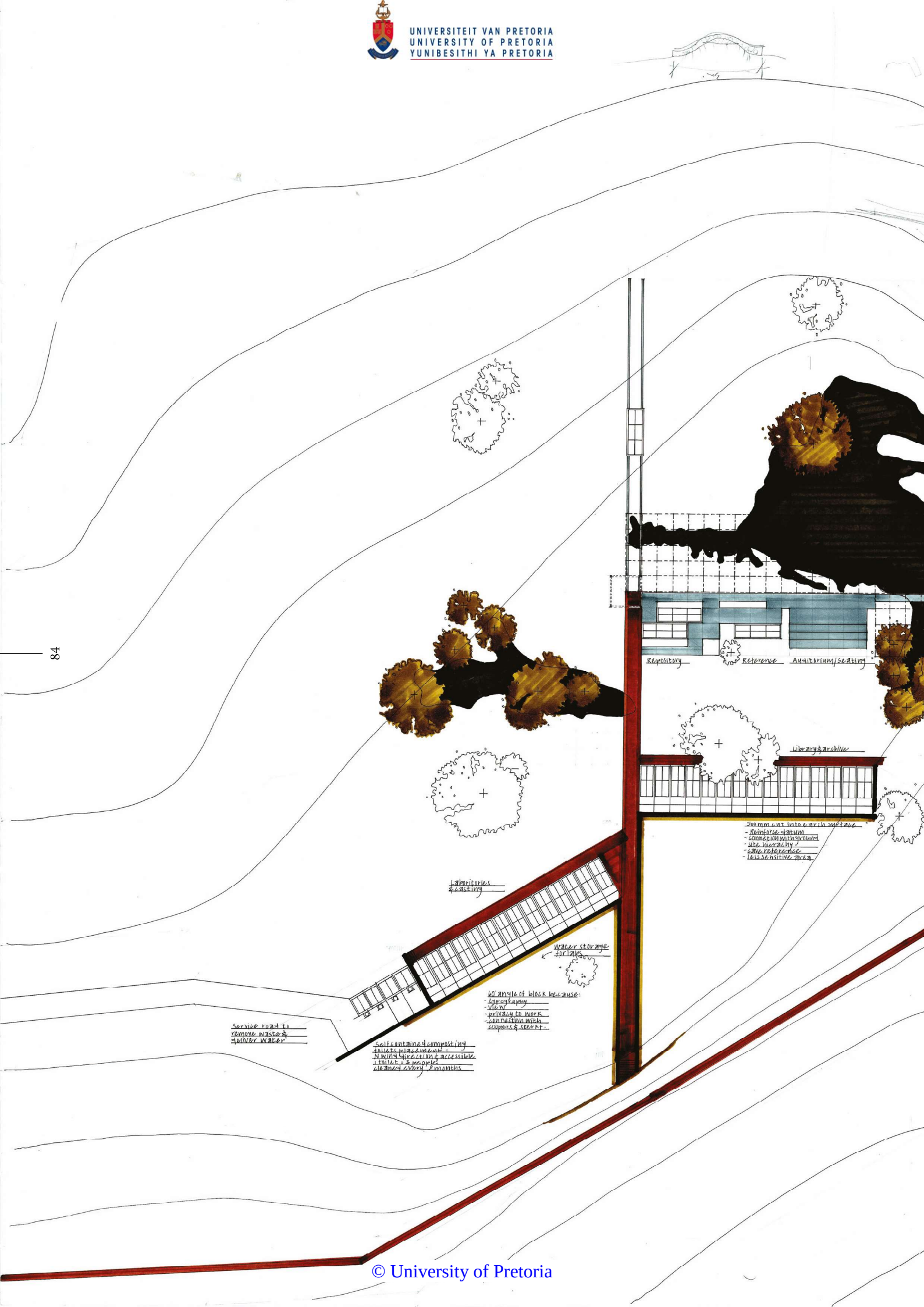
7.1 - Design development background(Author, 2016).

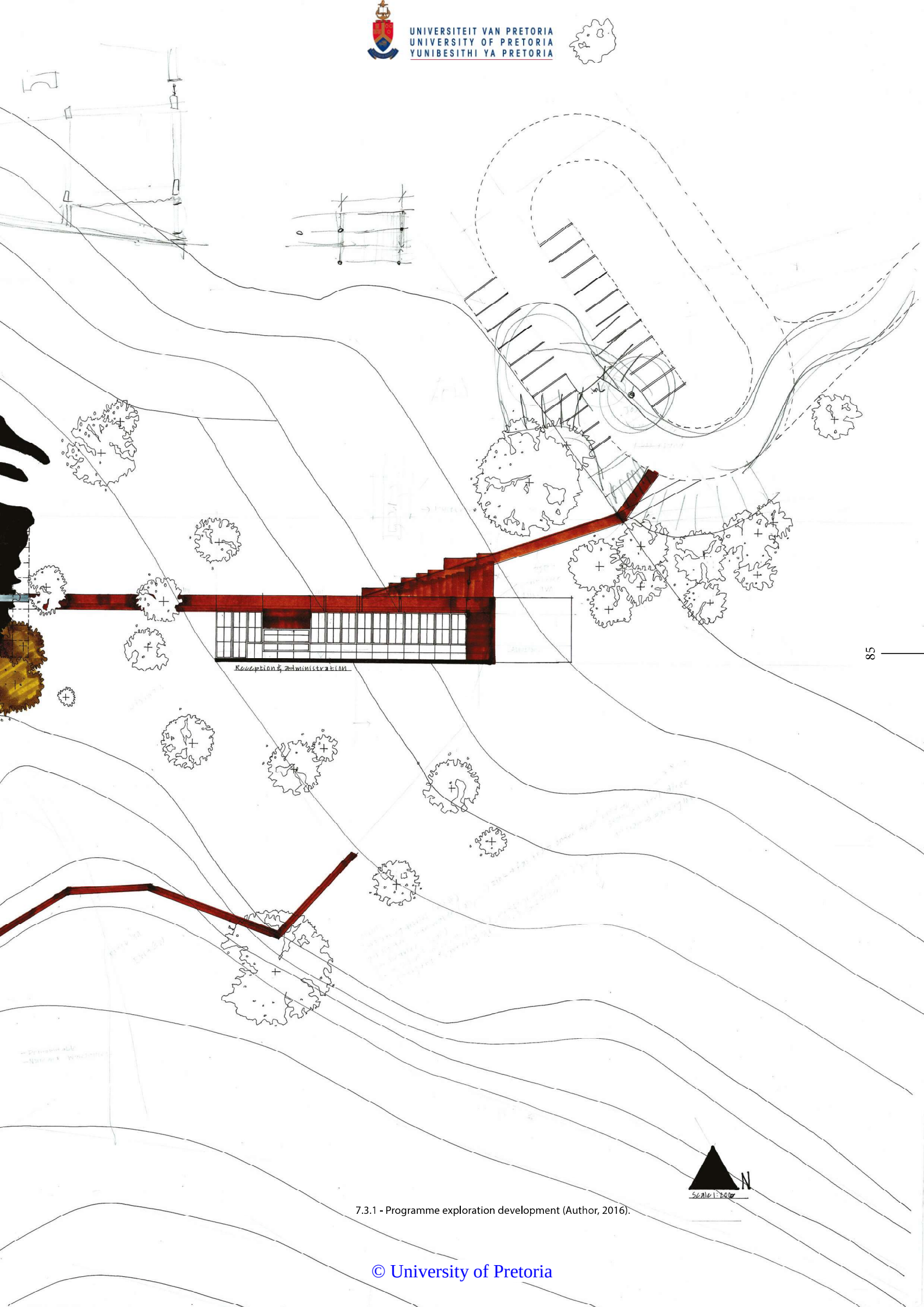
7.2 Design development



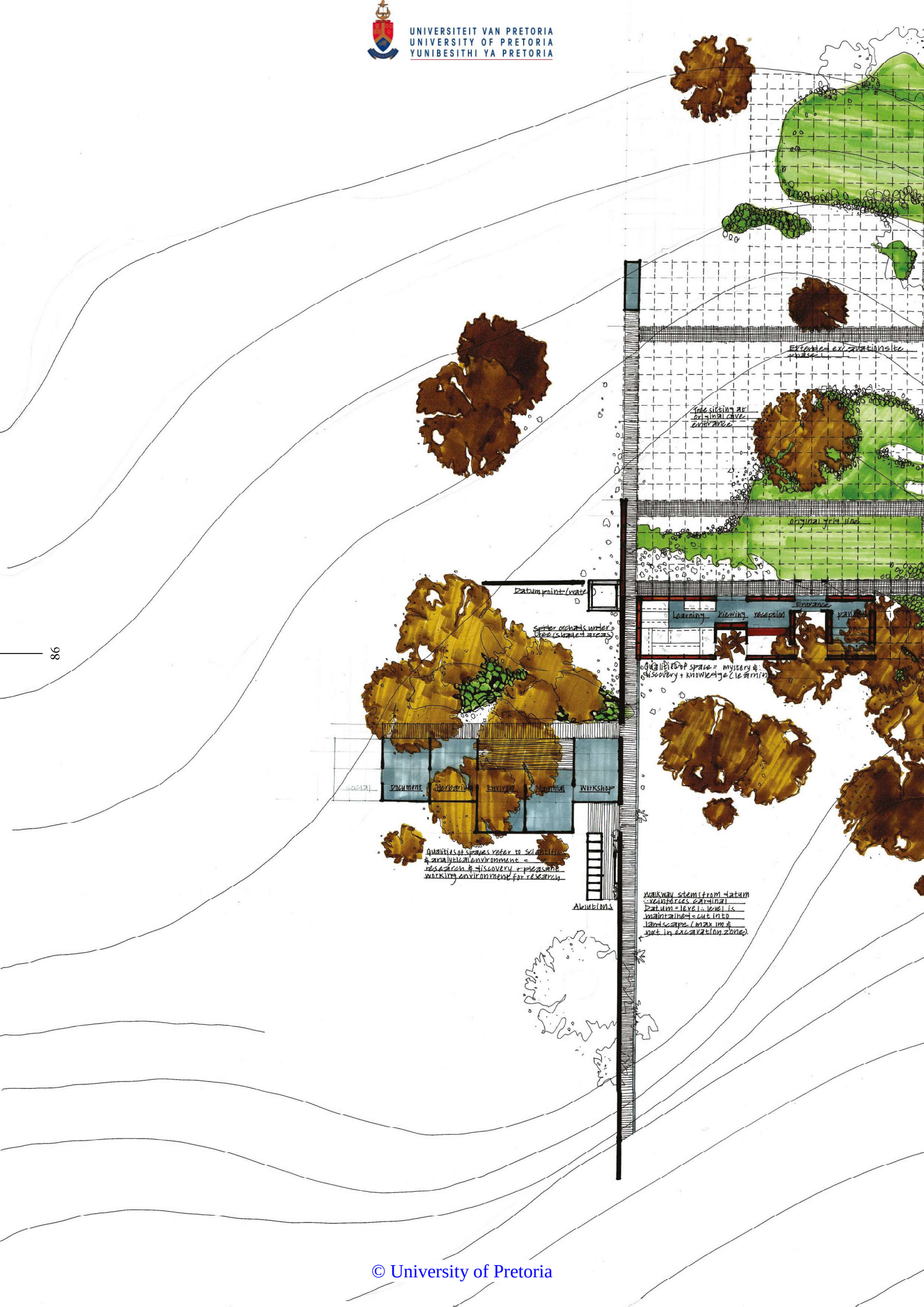


7.2 - Programme exploration drawing (Author, 2016).





7.3.1 - Programme exploration development (Author, 2016).



7.3.2 - Final programme layout (Author, 2016).

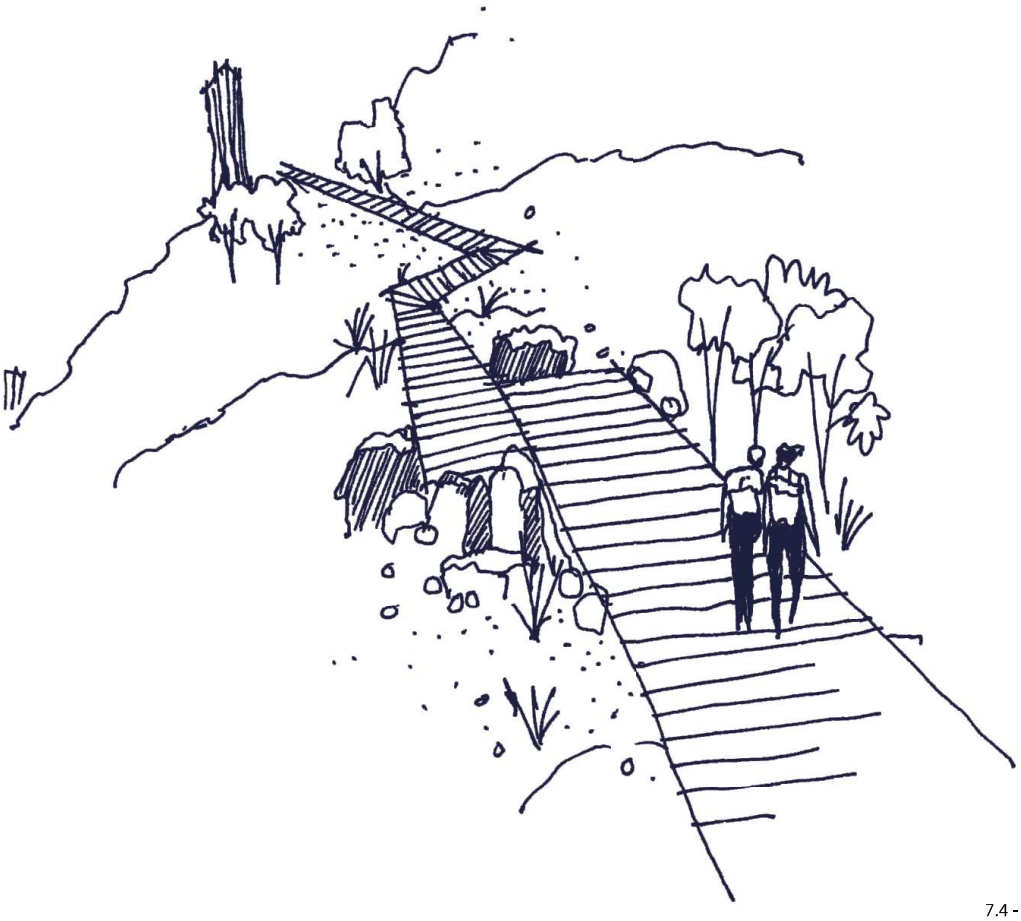
7.3 Site circulation

Circulation posed a challenge for the site design, resulting in much iteration during the design process. Taking multiple circulation routes on the large site into account the following challenges were posed:

- Circulation concerning a proposed route between Sterkfontein Cave, Coopers Cave and Kromdraai Cave from the North West. Users of this route do not necessarily want to enter the cave itself.
- Circulation concerning the proposed Cradle Corridor of the group framework from the south.
- Ease of access by the community, researchers and the disabled with a steep northerly slope.
- Sensitivity of the landscape.
- Experience of the landscape.

7.3.1 The past

The cave connects to Sterkfontein Cave, Cooper's Cave, Drimolen Cave and Gondolin Cave through the presence of Paranthropus robustus. Furthermore, Sterkfontein, Cooper's and Kromdraai caves have produced numerous stone tools from the Oldowan Age. This connection is realised through a meandering route between the nearby Sterkfontein Cave and Cooper Cave. On route the features of landscape are presented to the visitor through a series of resting points and artworks. The typography allows for the connecting caves to be pointed out to the visitor. A landmark system indicating the presence of caves is proposed.



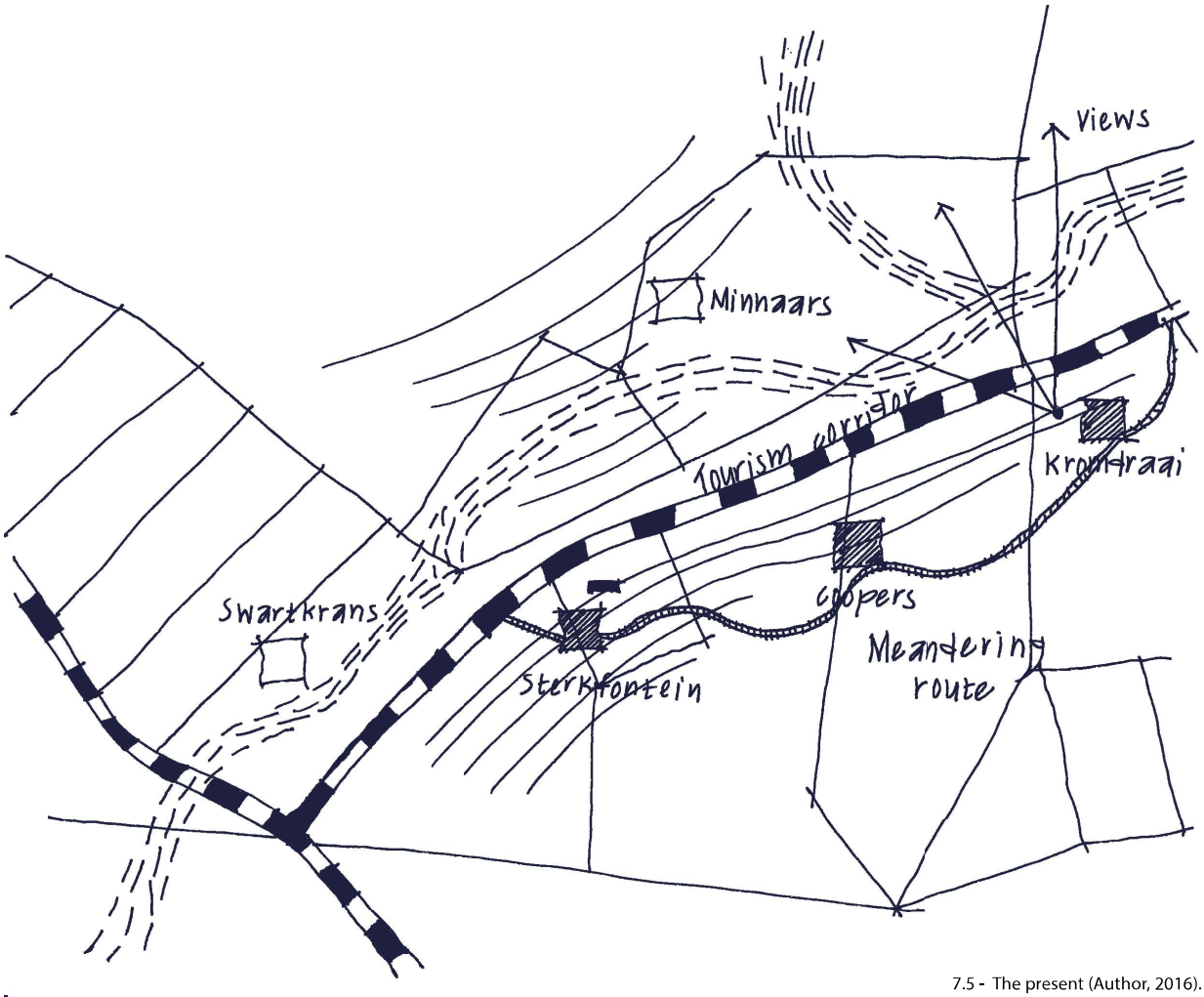
7.4 - The past (Author, 2016).

7.3.2 The present

The proposed area of intervention is located on a disturbed and relatively flat area to the east and south of the cave. The road permits researchers and logistical vehicles to easily access the site, with the proposed shuttle service being able to drop tourists off if need be. The informal farming community can access the proposed design easily from this road. A landmark is provided within the design to indicate the presence of the cave as well as to provide a method of orientation within the site.

The northern route towards the cave starts at and runs through a growth of indigenous trees, filtering the visitor into the landscape. The visitor passes through the informal farming community while moving up the slope. The visitor is met by the reception building, with the reception area forming the connecting point between the hiking route from Sterkfontein and the group framework access route from the south. The visitor here has the option to move past the building to continue through the landscape, or through the reception to gain access to the cave. This form of security is necessary to prevent theft or damages to the site.

In this landscape trees function geologically as indicators of the presence of a cave, as the seedlings are able to grow easily in a protected environment. This concept of a vertical reference point leads to the use of the archaeological datum point to provide a reference from which the archaeological system is set out. This in turn orientates and leads the visitor through the landscape. Circulation within the vertical element directs the visitor to specific views in the landscape. In the present, circulation is therefore focused on highlighting archaeological processes and values, as well as the geological qualities of the landscape.



7.5 - The present (Author, 2016).

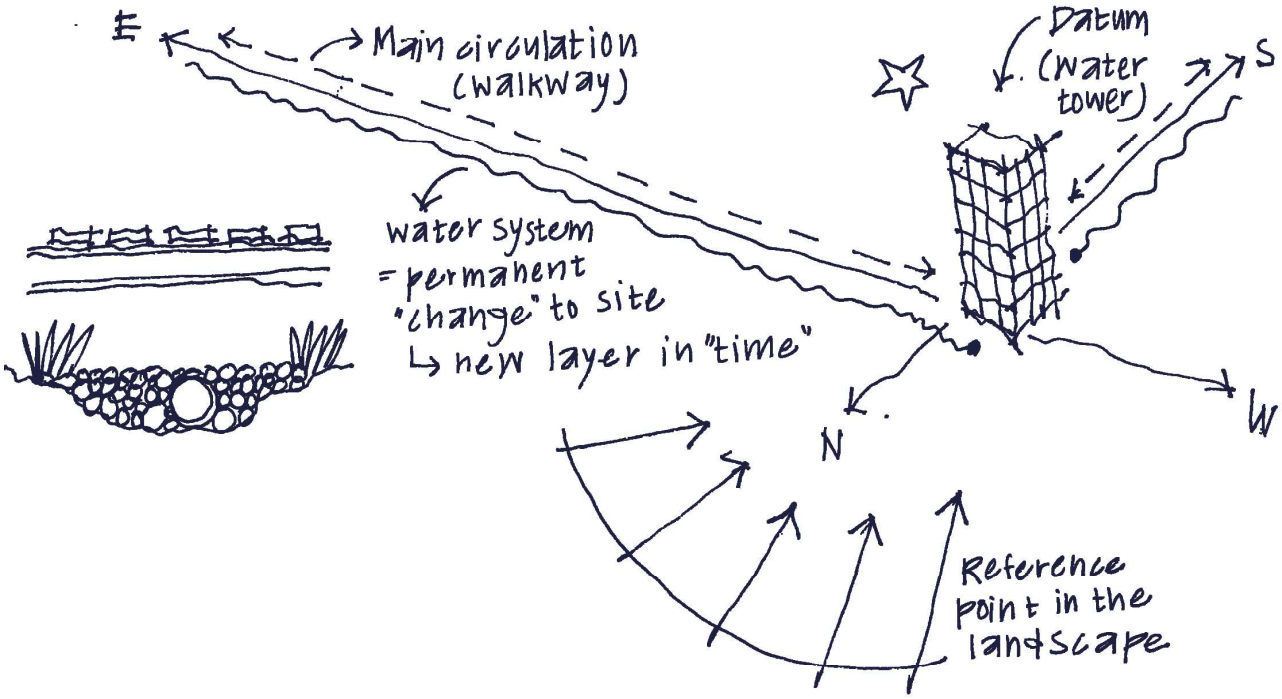
7.4 The paleoarchaeological process translated within the design

Background to the paleoarchaeological process is provided in Chapter Two. The design responds to the process in the following manner:

7.4.1 The datum

Before starting the excavation process on an archaeological site, a datum point is established in order to provide a reference point for the setting up of the grid as well as for the stratigraphic layers of the studied area. The datum point, given the coordinate 0.0., is reinforced in the design as a reference point in the landscape which guides the visitor to the cave site. The datum point is translated into a water tower referring to the rural nature of the site, as water towers are scattered over the landscape. Clumps of trees usually suggest the presence of caves and in this instance the water tower reinforces the idea of a vertical indication of a cave. Originally the datum was intended to act as a lookout point, but the nature of the site already provides adequate views without the need for elevation.
As vertical element the water tower symbolically becomes a gnomon, one of the first instances of man using a vertical element to enable the keeping of time. The word gnomon when translated refers to "knowledge", indicating the purpose of the site.

The datum point refers to the origins of the cave and the starting point, and in this instance is kept as a permanent reference for future generations of the importance the cave held for the current civilisation. The concrete support structure – concrete referring to lime mining in the area – will stand as a permanent monument representing the status, value and memory of the site.



7.6 - The datum (Author, 2016).

7.4.2 The grid

The grid is the most important design informant. The grid not only allows for archaeological objects to own coordinates within the cave, but is also used as a device in astronomy to locate and position celestial objects. The grid has been implemented throughout time in design and architecture, with multiple meanings and implementations. The intention is to extrude structures trough the grid onto the site while expressing the geometric and ridged nature of the grid – which relates to the scientific rationalisation of man – and placing it in opposition to the organic natural shapes and order created by nature. The grid is expressed in the use of modular units in steel construction and the connection between the units, the lines created by the addition of panels to the structure, the coming together of the floor, wall and ceiling, and the expression of shadow and light.

A study of the cave grid revealed much about the excavation timeline. Originally the design intended to use variations in the thickness of the grid to explain the period in which excavations were done. This intervention was found to be too dominating over the cave. The solution was to provide a simple walkway over the cave (relating to the two-by-two-meter archaeological grid) and introduce information panels along the way identifying and explaining the discovery of artefacts directly above the place of discovery.

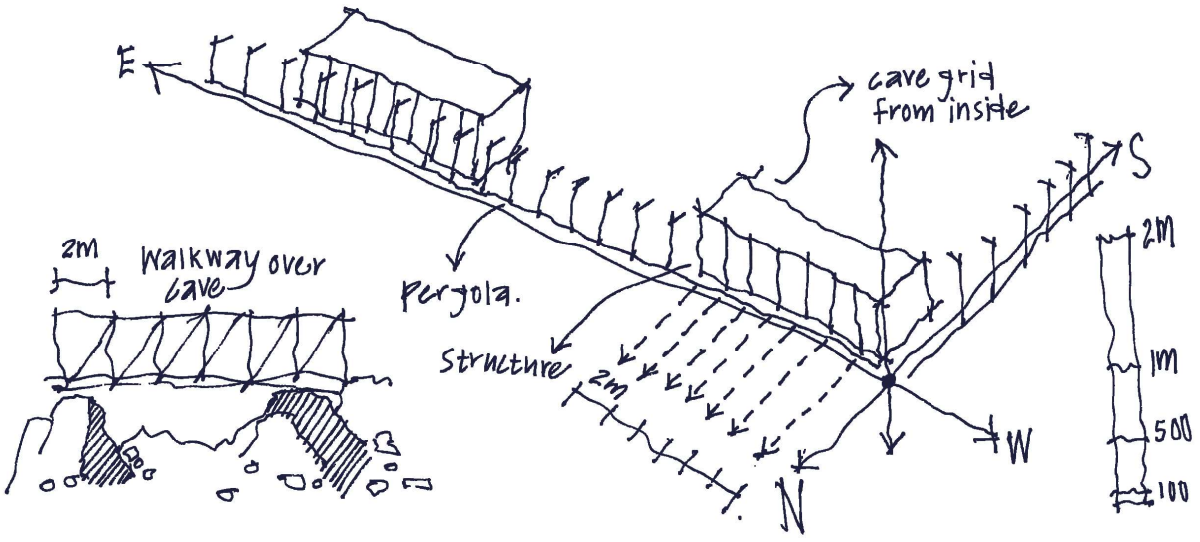
The library is placed within the negative space of the cave grid and completes the grid. Here information can once again be accessed in direct view of the cave and landscape.

Extending from the datum, the two-by-two grid is used in the design as an indicator for the placement of structures. The two-meter unit grows into a two-by-two-by-two and a two-by-two-by-three rhythm - rhythm being a means of keeping time in music.
The architecture becomes a celebration of the grid, as a steel exoskeletal frame provides the support for the infill structures and roof. The infill structures become boxes pulled 100mm back from the skeleton to accentuate the grid and to accommodate the addition or omission of spaces.

7.4.3 The cardinal points

The combination of the datum and archaeological grid extends into the design along an east-west axis and north-south axis. Cardinal points historically provide a means of orientation and navigation and are therefore the navigation routes within the design from which the buildings are accessed.

A masonry wall celebrates the cardinal points along the envisioned walkway and becomes a part of the landscape as a "ruin". This intervention relates to time in the sense of weathering and creates a dialogue between matter and time. A swale aqueduct is placed underneath the walkway as it follows the brick wall. The origins of the cave are rooted in the erosive effect of water on the landscape, and in the powers of water to attract prehistoric life to the area. The swale below the structure is celebrated by a pergola above the structure as life and nature's ability to rejuvenate is symbolized by the plants growing along the pergola.



7.7 - The grid and cardinal points (Author, 2016).

7.5 The excavation process translated within the design

To understand the workings of the Kromdraai site the process of excavation was investigated. Understanding the excavation process dually determined the future of the site and lead to a prediction of what the site will be when the archaeological process has ended.

The destructive nature of excavation not only robs the landscape but also scars it. The loss of value is addressed through architecture in the provision of the Library and Museum at the cave site. An answer to addressing the scarred landscape was found in the existence of a particular plant on the site. The indigenous and valuable plant in the Cradle of Humankind, the Aloe greatheadii, a spotted aloe, attracts birds, bees and butterflies and stimulates new life in the cave. The introduction of a mass display of the plants gives life to the site and pays homage to the death which has occurred in the cave. The plant is also used as a soil binder, healing the scar.

7.6 The description of the site plan

7.6.1 The Northern edge

Connecting to the proposed Cradle corridor and as a device for celebrating the edge of the farm, a swale system is proposed where Kromdraai farm meets Sterkfontein Road. The swale filters water running down the slope before meeting the Blaauwbankspruit and creates a landscaping edge to the site. Indigenous plants such as Aloe greatheadii (the spotted aloe), turning pale pink or red during the winter months when the site is most active, are used to indicate the entrance to the site..

7.6.2 The Northern entrance

The northern entrance extends southwards up the steep slope and is designed to have an incline no greater than 10m horizontally for every 1m vertically, thus decreasing the threat of erosion. The route allows visitors from the Cradle Corridor to access the site by tourist shuttle or bicycle. The route moves past the historically important plaque put up at the first commemoration of the site being declared a World Heritage Site. It is articulated and framed, incorporating the site into a cave identification system for the whole Cradle. The route moves through a cluster of trees in order to introduce the visitor into the site by a change in light, air and sound. Once through the trees, the visitor will see Brahman cattle and the activities of the informal farming community. The option is given for tourists to explore this area. The informal farming community will house the scientific and international community as a way of providing year-round financial security, and the route makes access from the accommodation to the cave easy for the community and scientists. Parking is afforded away from the view of the pristine landscape of the site. The Nirox Foundation Sculpture Park is incorporated into the route as a means of leaving temporary landmarks for visitors and children to explore.

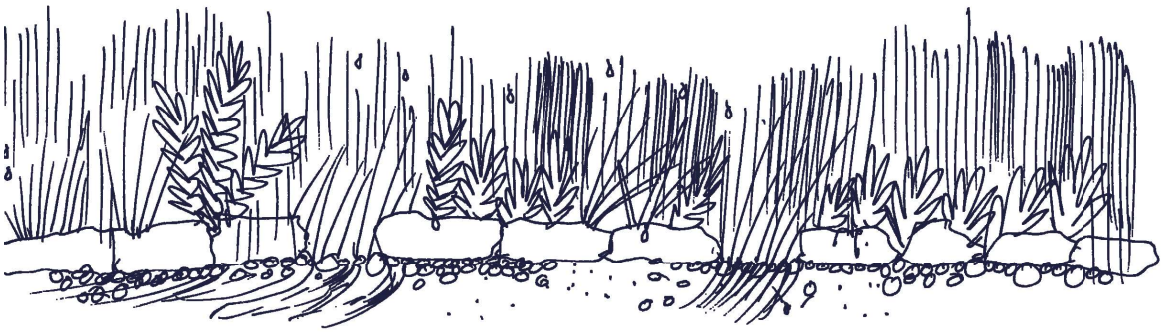
7.6.3 The western entrance

Tourists or scientists visiting the Sterkfontein Interpretation Centre are given the opportunity to walk or cycle a route connecting the Sterkfontein Caves, Cooper's Cave (1500m west of Sterkfontein) and then Kromdraai Cave. What is interesting on this route is the progression of weathering between the caves, as the Sterkfontein Caves are intact, Cooper's Cave is mostly intact, and Kromdraai Cave has completely caved in. Fossils in Sterkfontein are only visible in the interpretation centre where they are imbedded into rock, and at Cooper's Cave they are scattered along with stone tools in the landscape. At Kromdraai Cave, fossils lie scattered in the landscape and cave. The water tower acts as a navigation device indicating the presence of the cave to visitors. The route is designed to provide the best view of the landscape as well as elevate visitors next to the hill, making them walk down the slope to the cave. This device allows visitors to see the site in its entirety in order to orientate themselves. The Nirox Foundation Sculpture Park is once again incorporated into the route and unifies the northern and western routes.

7.7 The description of the research facility

7.7.1 The Separation of elements

The roofs of the new structures form a part of a separate system to make the visitors aware of the cave's missing roof. The repetitive roof trusses form a rib-like system, relating to the nature of the fossils in the area. During the formation of the cave, a hollow was carved into the landscape as walls, floors and ceilings become one. The new structures celebrate this with the placement of separate boxes within the structure, suspended in space. The buildings and ground are separated from one another as the design of the footings allow the structures to float within the landscape. This device points to the temporality of the intervention and permanence of the landscape.



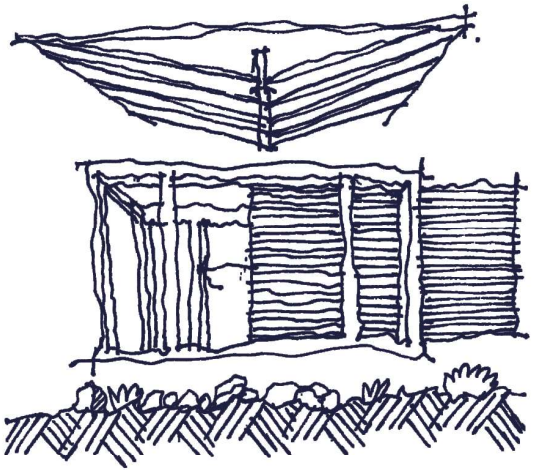
7.8 - The Northern edge (Author, 2016).

7.9 - The Northern entrance (Author, 2016).

7.10 - The western entrance (Author, 2016).

7.7.2The use of steel

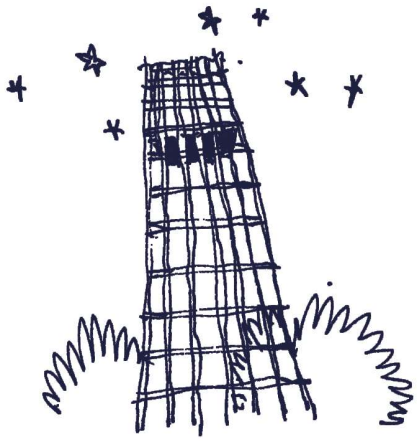
In order to celebrate the nature of the site steel is juxtaposed to natural elements. The archaeological grid, as well as the industrial mining nature of the site inspired the use of steel, while the intangible natural qualities of the site inspired the use of timber cladding. What makes the cave itself so special is the natural stone wall displaying the geology of the area. A prehistoric stone that was transported from 5km away and that was used for the breaking of bones, was found during the early periods of excavation. This stone inspired the use of brick wall near the restaurant.



7.11 - The use of steel (Author, 2016).

7.7.3 The water tank

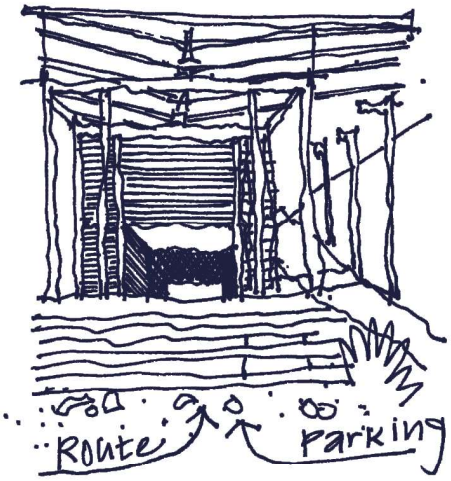
As an infrastructural aspect facilitating the functioning of the place for gathering knowledge, the agricultural typology of a water tank serves as a vertical coordinate for the site. The water tank does not only 'link' the heavens and the earth, but celebrates the keeping of time and the movement of the sun, the giver of life. The tower symbolically indicates the search for knowledge and on plan serves as a point in time or, so to say, a coordinate in time. At this point the past, present and future come together.



7.12 - The water tank (Author, 2016).

7.7.4 The reception

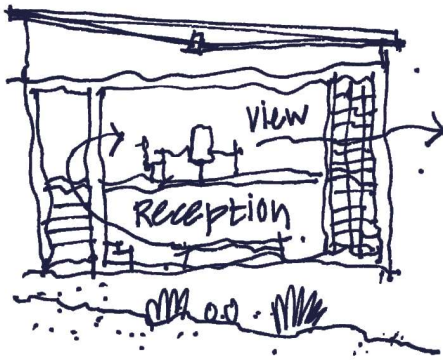
The reception is the meeting point between the two circulation routes and controlled movement into the cave. Located between two clumps of trees, the reception offers filtered light and shading to the visitor. The balustrade in the form of a brick wall and planted pergola progressively make more of the landscape visible to the visitor. During spring the flowers provide a strong scent along the walkway, creating a sensory association with and memory of the landscape. The location of this block stems from the axis created by the datum and expresses a more "solid" approach to the design. The grid is visible within the structure as well as the finer details.



7.13 - The reception (Author, 2016).

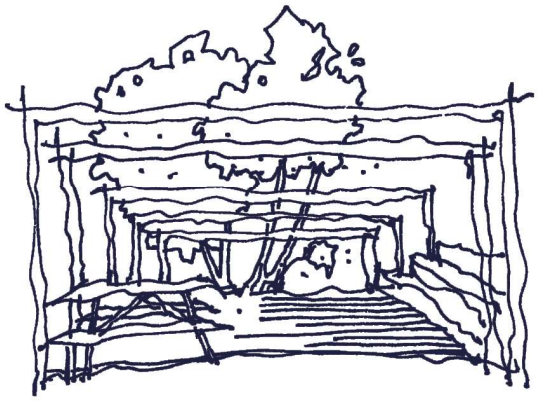
7.7.5 The administration area

The south-facing administration block is placed facing the slope of the Highveld landscape. The staff area is afforded privacy from the caving activities but is easily accessible from the reception.



7.7.6 The restaurant

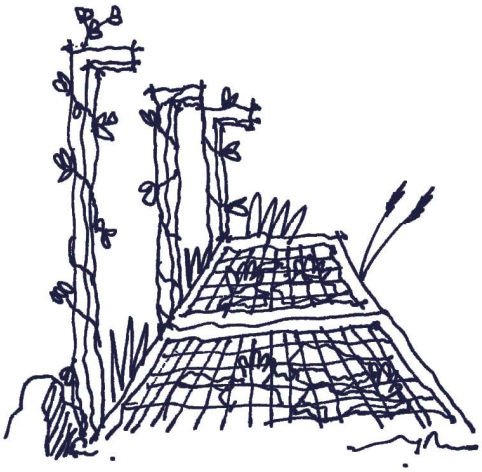
The planted pergola, as well as the view over the farming area reinforce the agricultural nature of the site, as well as creating a mutually dependent relationship between the design intervention and the informal farming community.



7.14 - The administration area and the restaurant (Author, 2016).

7.7.7 The route to the cave

The approach to the cave is envisaged as one of exploration and discovery. The visitor is slightly elevated above the ground by a ramp creating a sense of awareness of the ground level, but which also speaks to the sensitivity of the area. From this standpoint the light grid spread across the site starts to create axes and frames around views, leading the visitor into the cave while presenting the landscape. The visitor follows a set of displays which hold specimens and moulds of fossils found in the cave, while the displays correspond to the coordinates within the cave. The visitor can then see where the fossils were found.

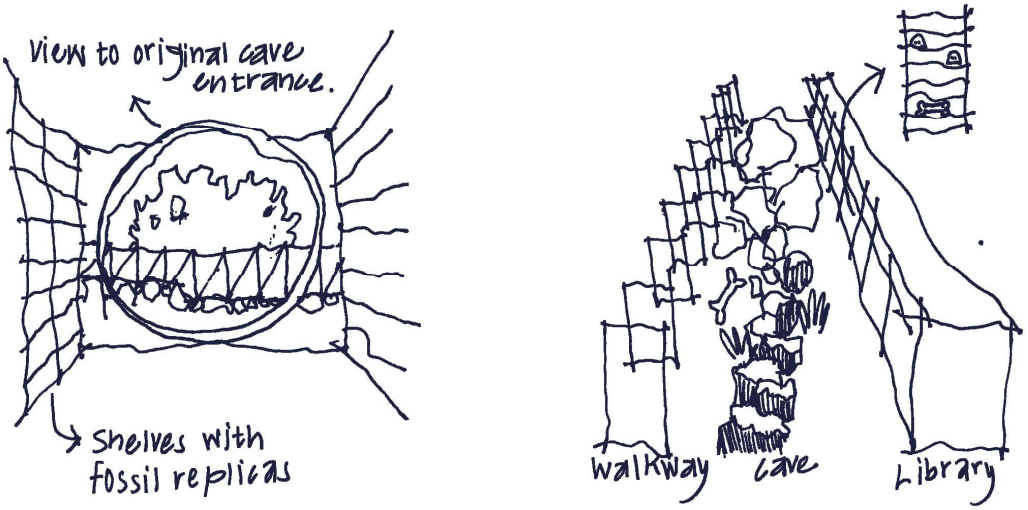


7.15 - The route to the cave (Author, 2016).

7.7.8 The archive and library

Initially the library was placed to the south of the site along the Southern axis created by the datum. After much consideration, the decision was made to place the library in a direct relationship with the cave grid, thus reinforcing the concept. The archive and library are not constrained by the external walls but spill over into the landscape to provide a living exhibition. The building is envisioned as a place of learning and education, allowing for the community to interact with the gathered knowledge on the Cradle landscape. In doing so they will generating value for the site as well as for the community.

Shelves reinforcing the notion of the grid form the primary elements within the library, directly relating knowledge to site. The grid is extruded vertically to provide a pavilion seating space, while also providing an exploration of information in the reading area. The entrance is placed in relation to the white stinkwood tree which grew at the original cave entrance.

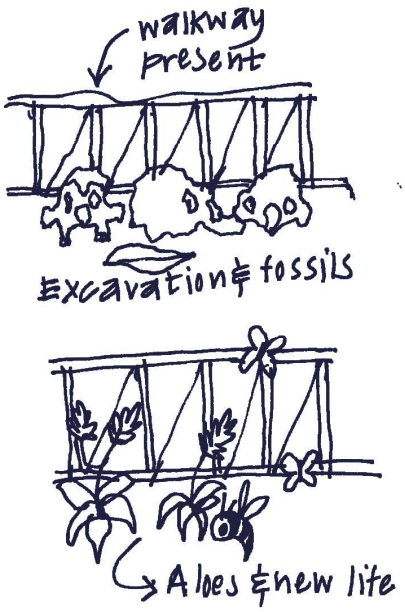


7.16 - The archive and library (Author, 2016).

7.7.9 The cave

Platforms hovering sensitively above and in the cave allow the visitor to experience Kromdraai cave itself. The important aspect here is the cave wall, which displays important geological formations and scars created by excavation. This system also functions to enable the excavation team to access the excavation area and for fossil finds to be easily carried into the workshop area.

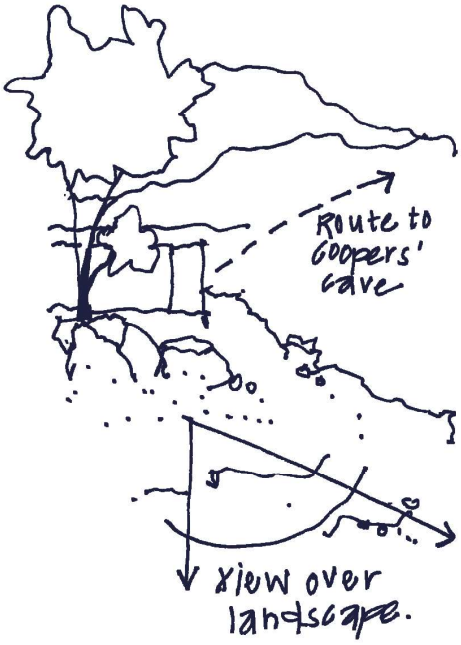
The walkway refers to the future of the cave, in that the walkway is shaped according to future excavations. The walkway follows the grid across the past limit of excavation, the current location of excavation and the future of the excavation. The walkway is predicted to outlive the demountable structures in the intervention, thus allowing for future exploration of the cave as explained previously. Resting places with seating, as well as exhibition boxes framing aspects important to the landscape, are provided.



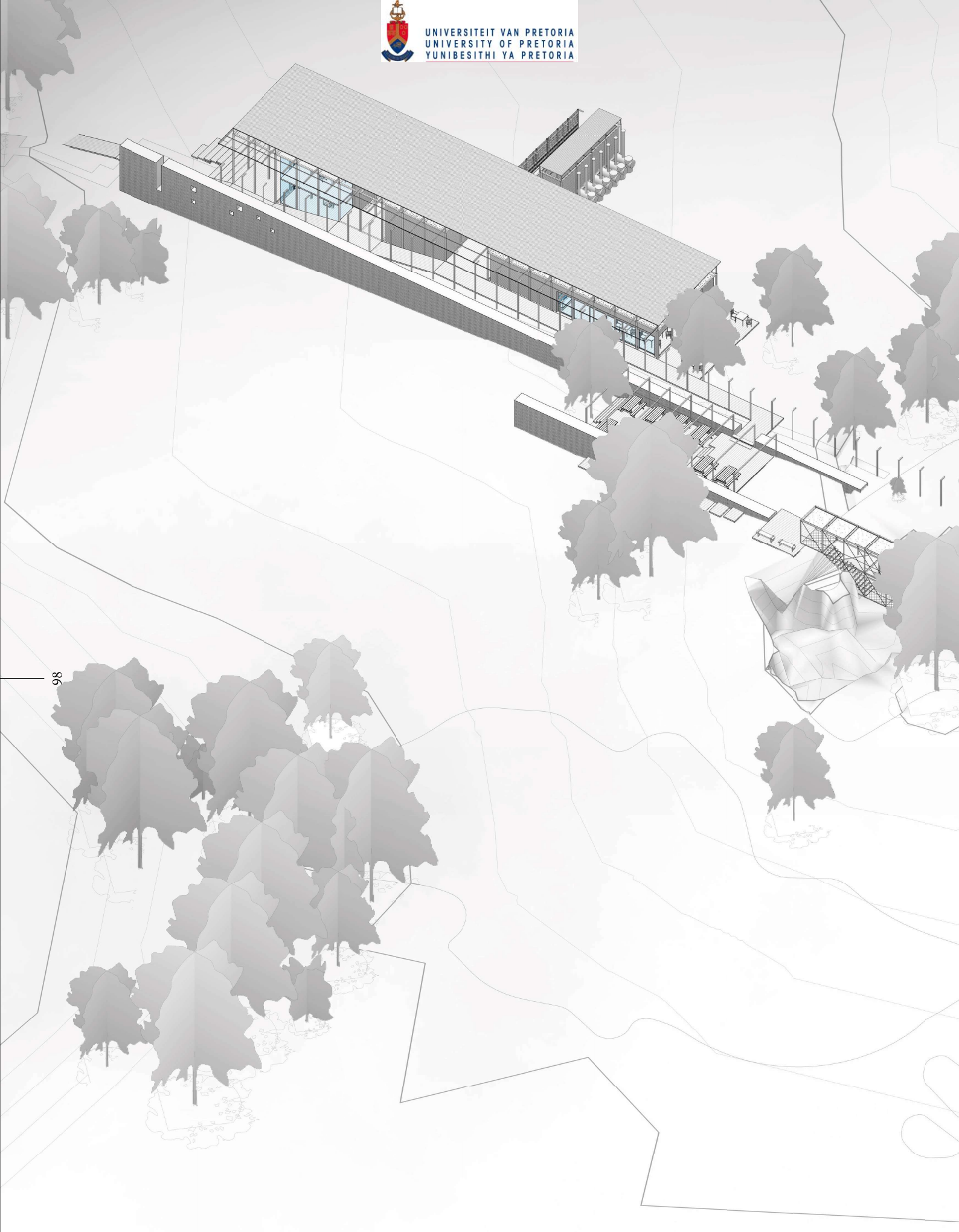
7.17 - The cave (Author, 2016).

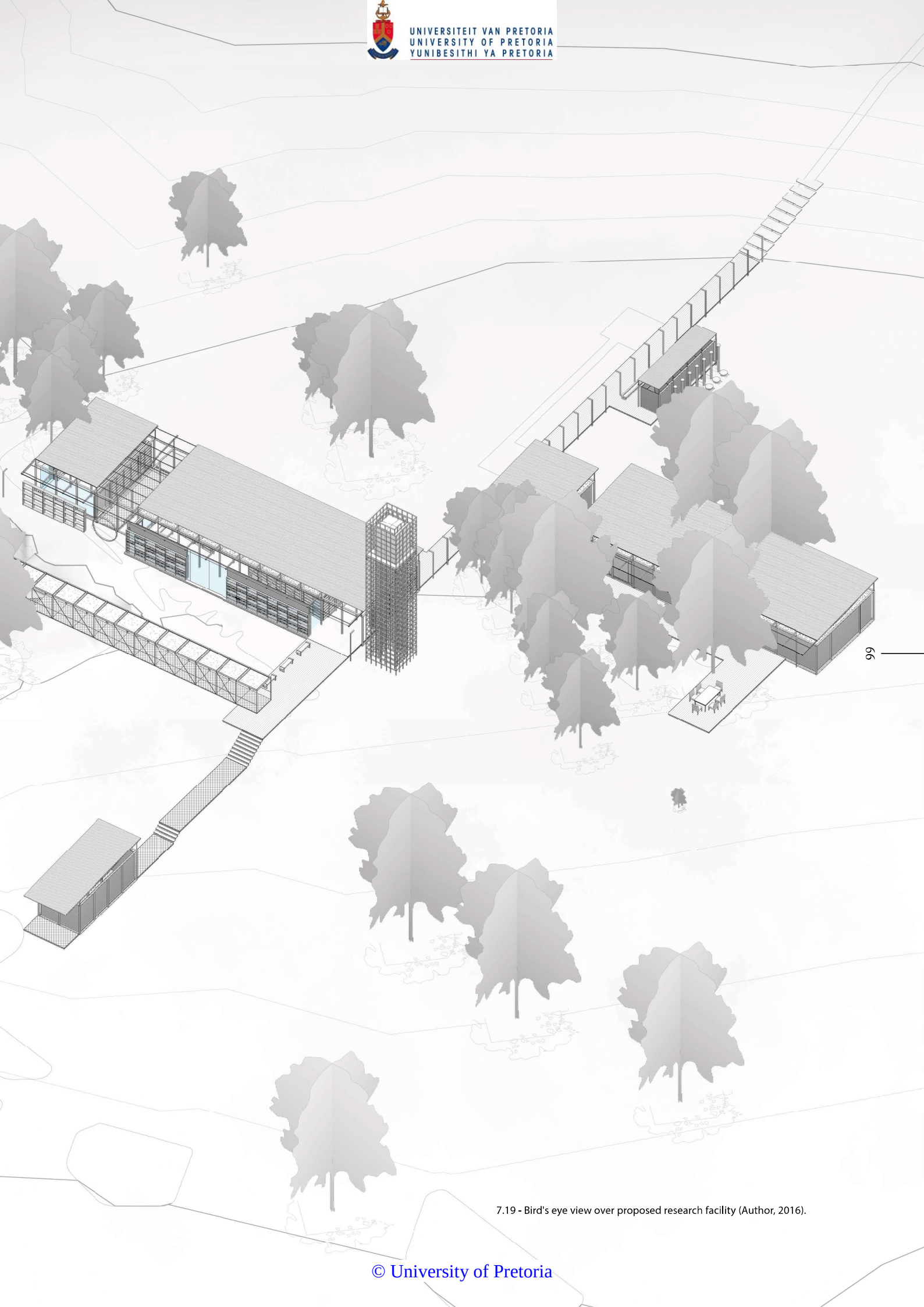
7.7.10 The workshop and laboratories

The laboratories are placed in between the trees of Kromdraai A excavation site, as the placement allows for a sense of privacy and connection to Cooper's Cave excavation site. The laboratories are separated to correspond to the hierarchy of the site, as well as to allow for social spaces between the structures.

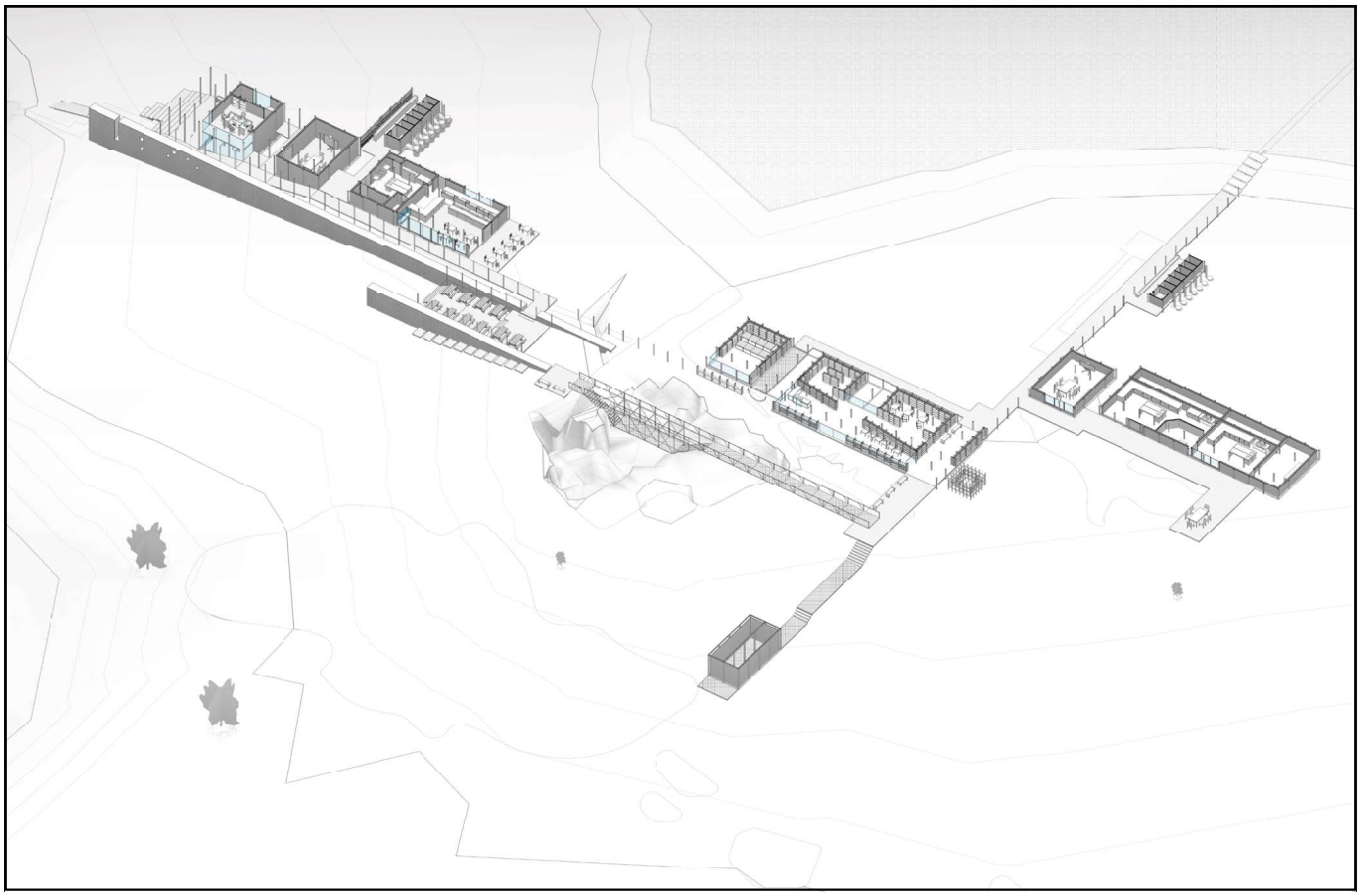


7.18 - The workshop and laboratories (Author, 2016).

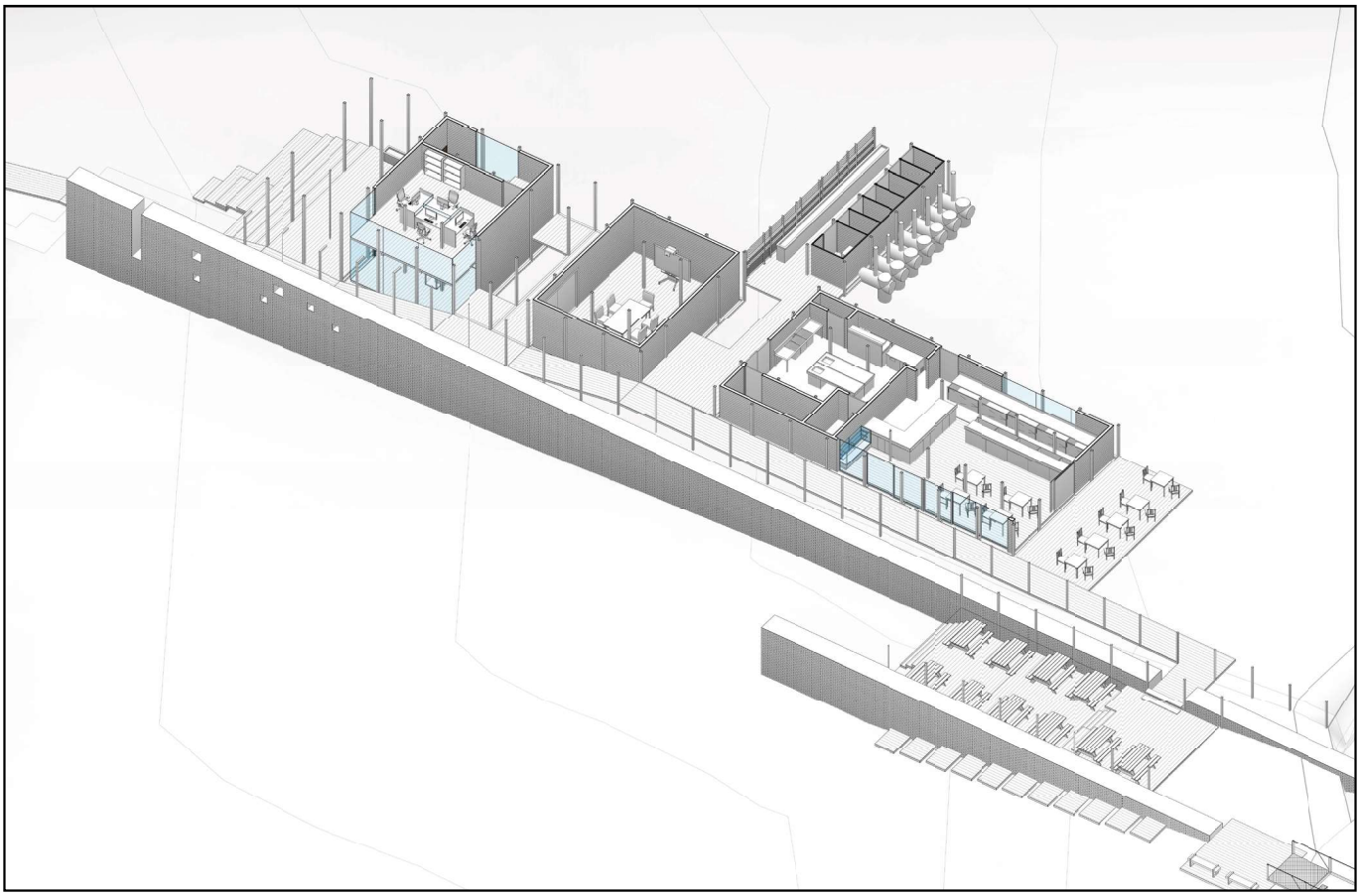




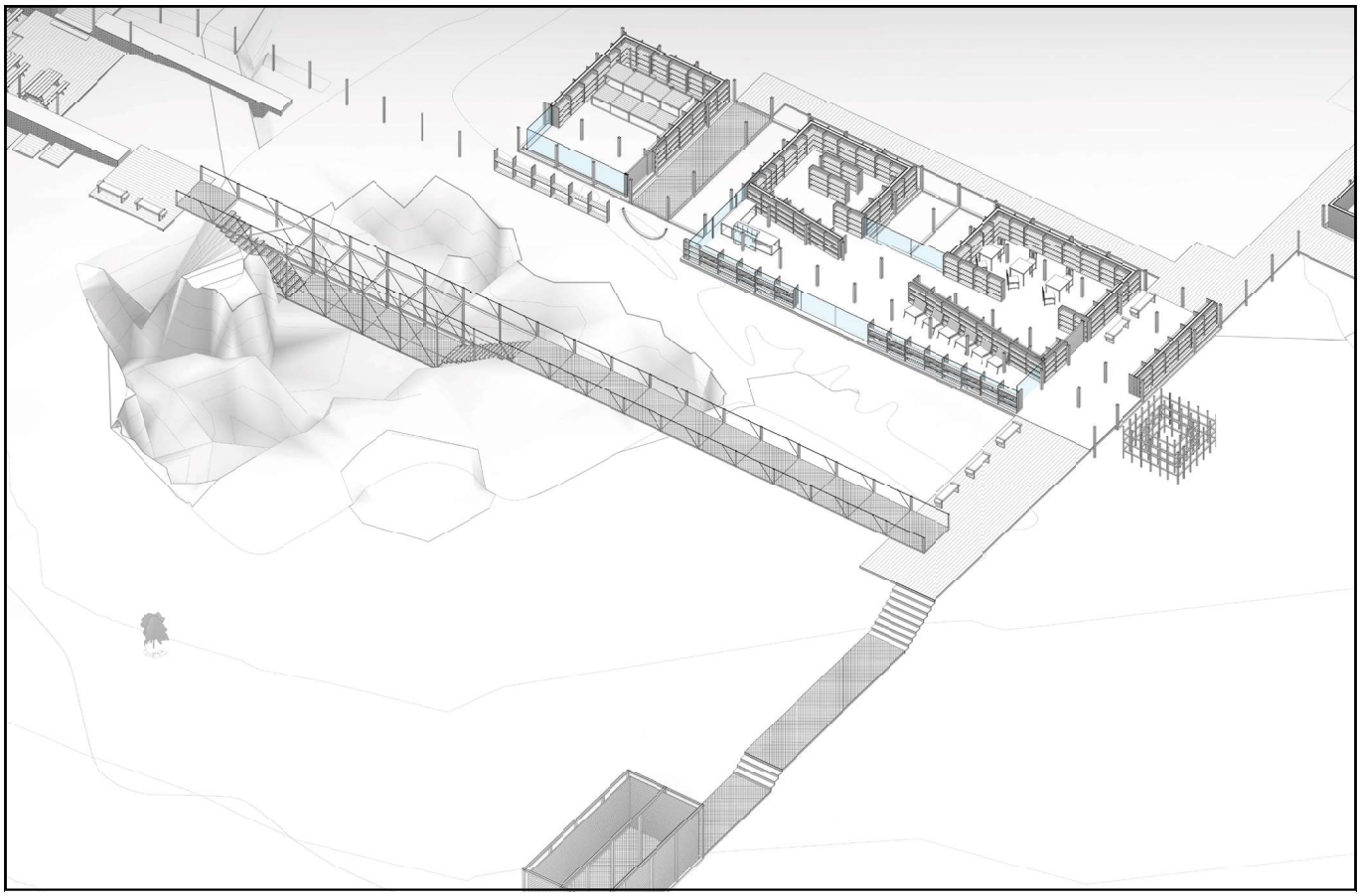
7.19 - Bird's eye view over proposed research facility (Author, 2016).



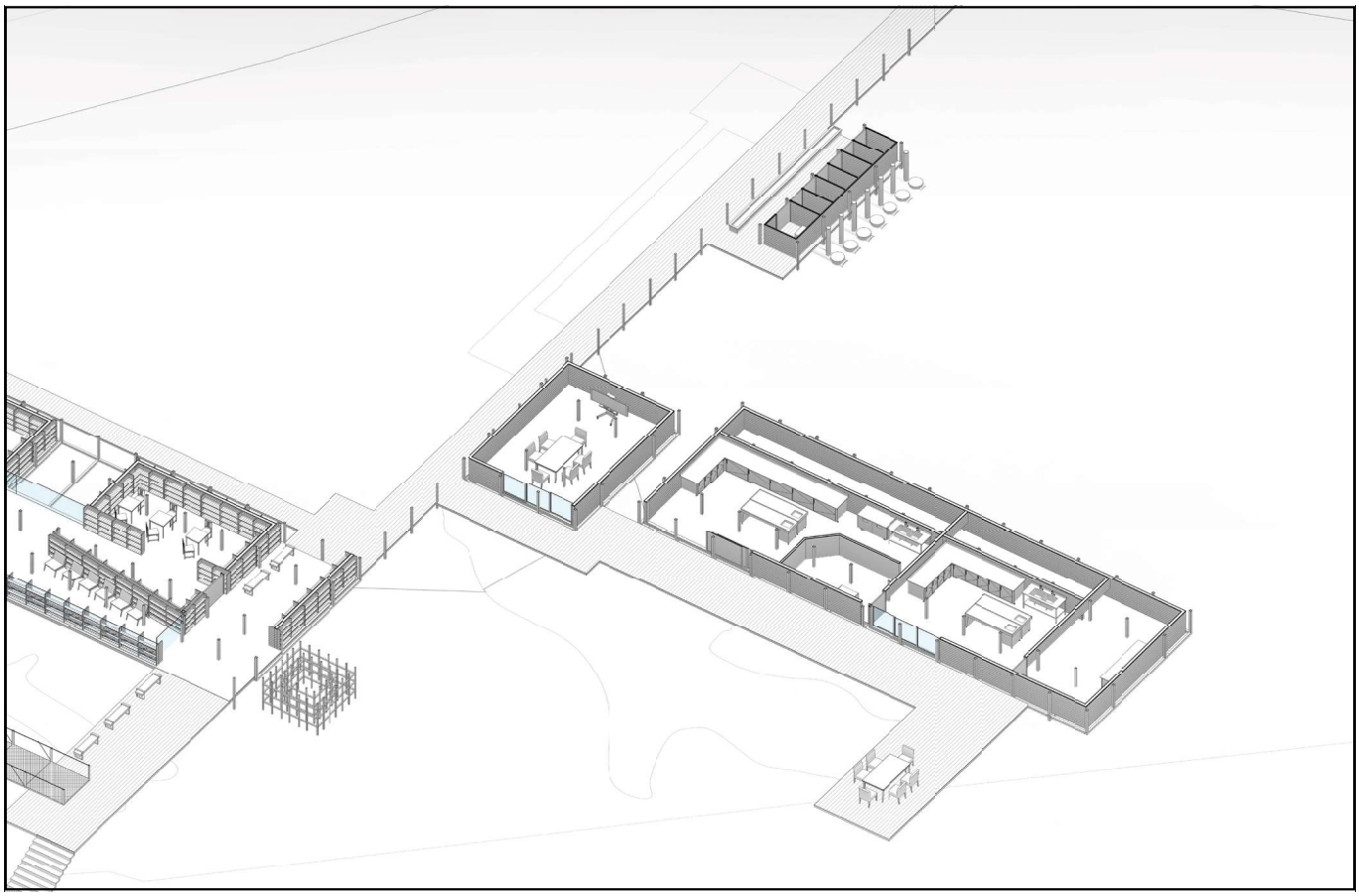
7.20 - Section perspective over proposed research facility (Author, 2016).



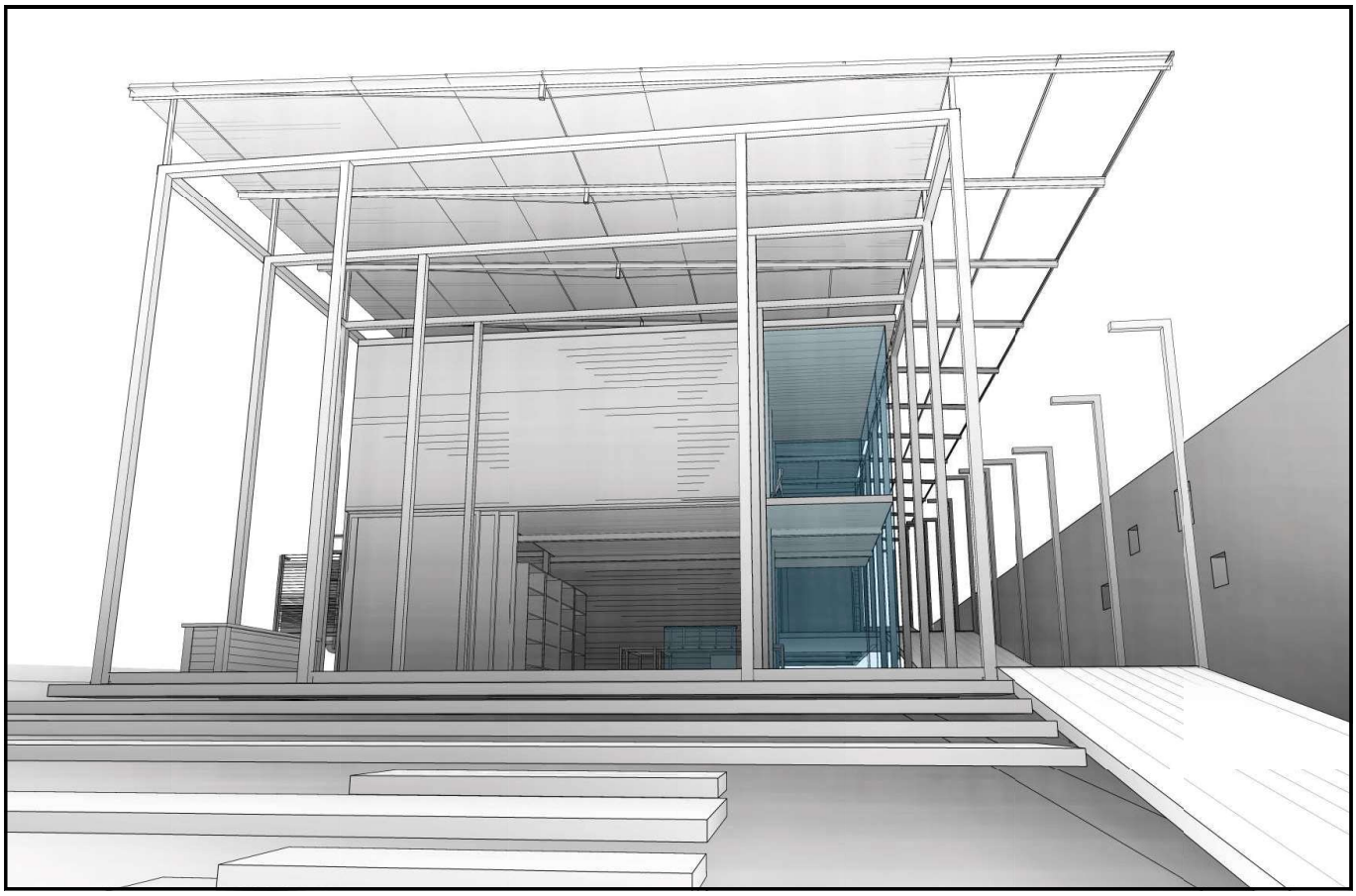
7.21 - Section perspective over proposed administration block (Author, 2016).



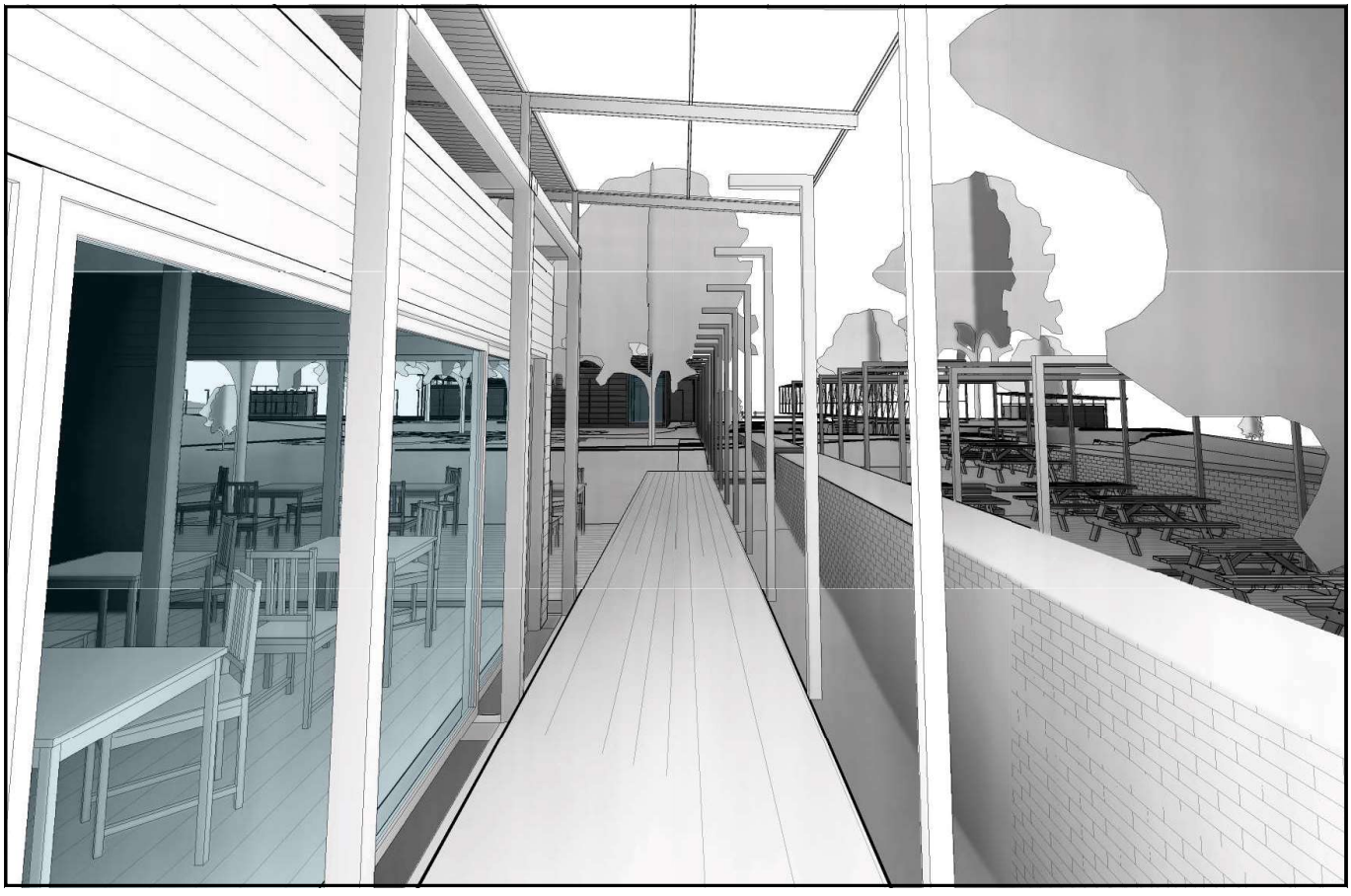
7.22 - Section perspective over proposed library and archive (Author, 2016).



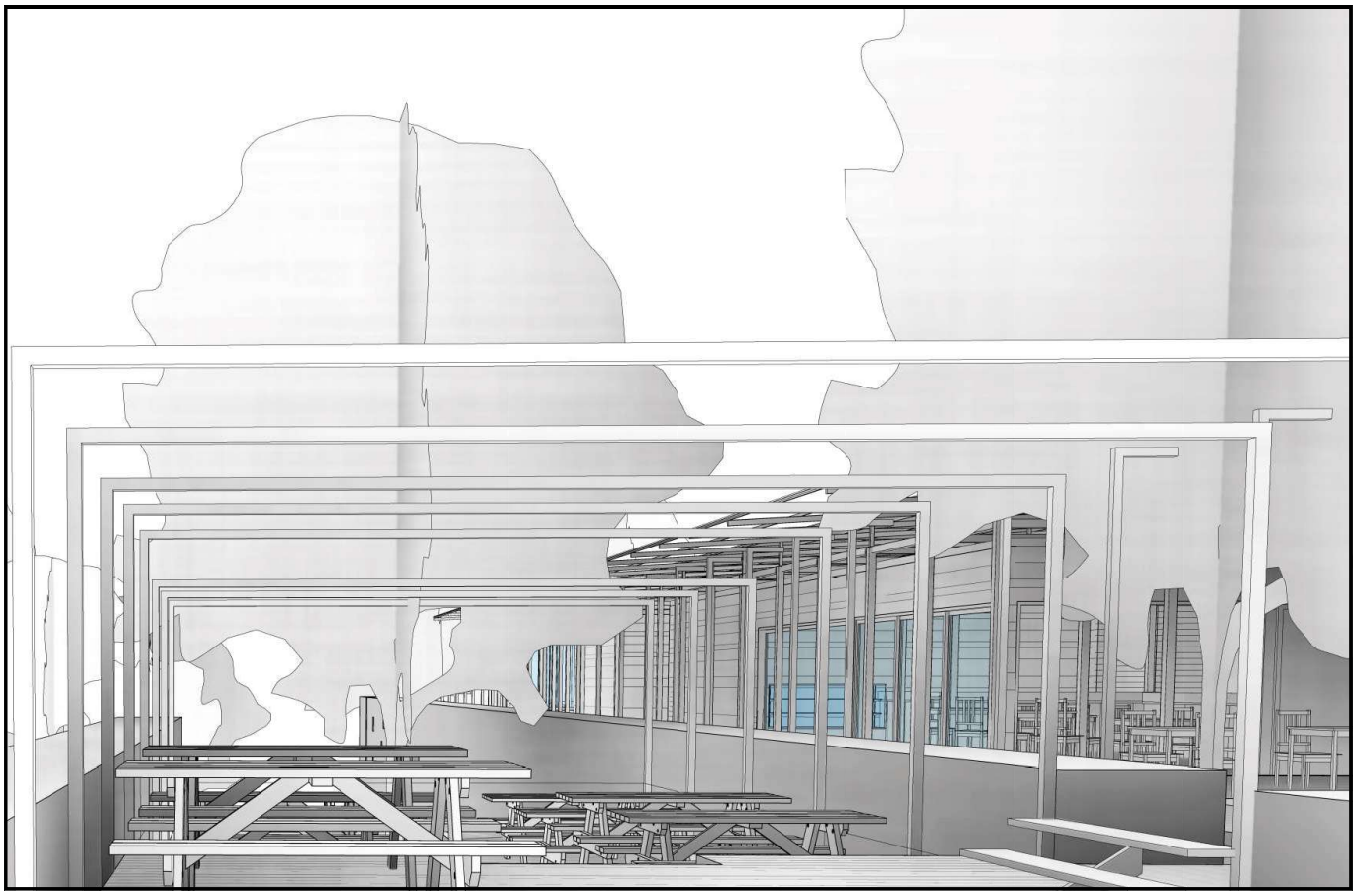
7.23 - Section perspective over proposed laboratories (Author, 2016).



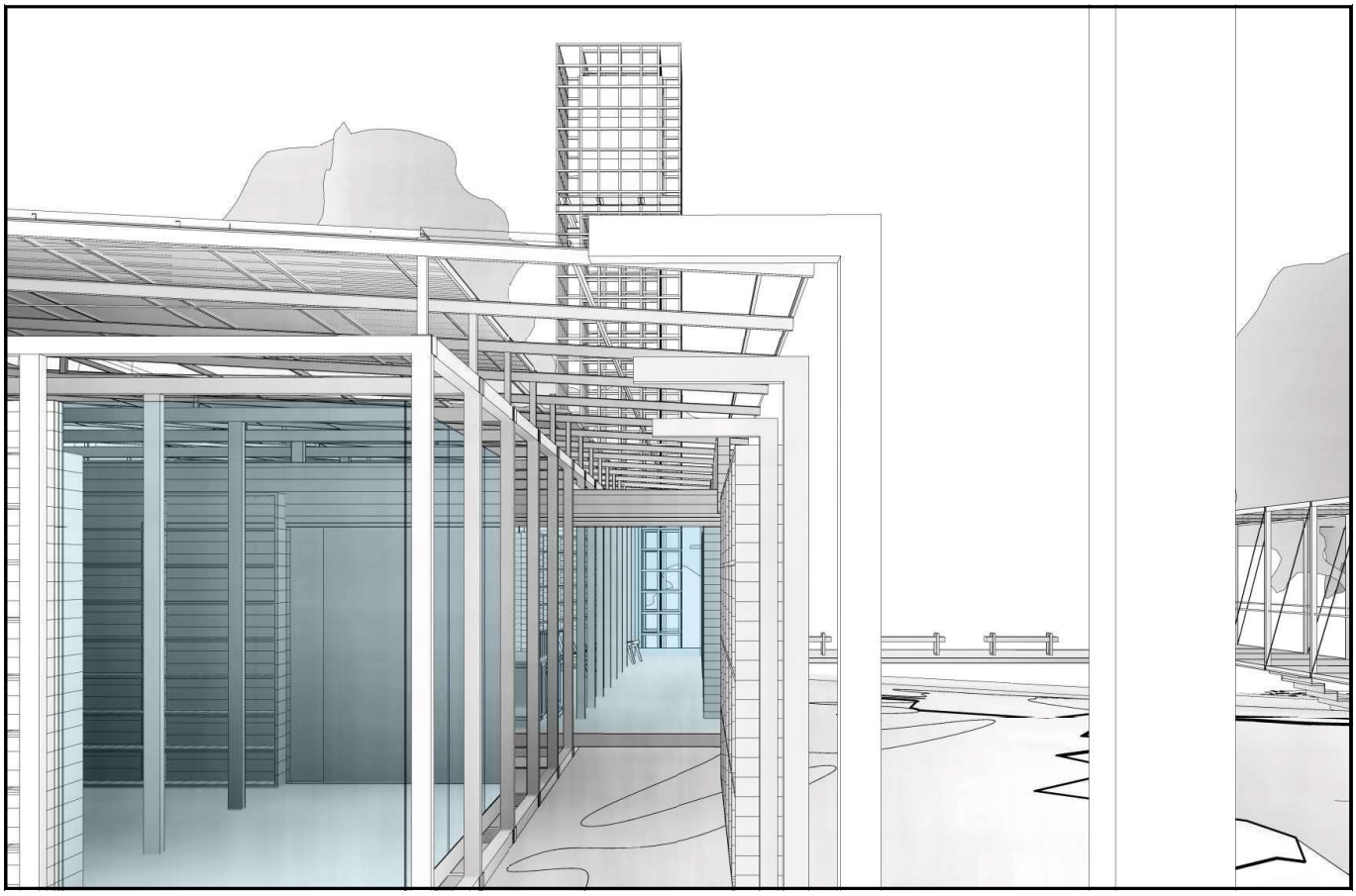
7.24 - Perspective of reception (Author, 2016).



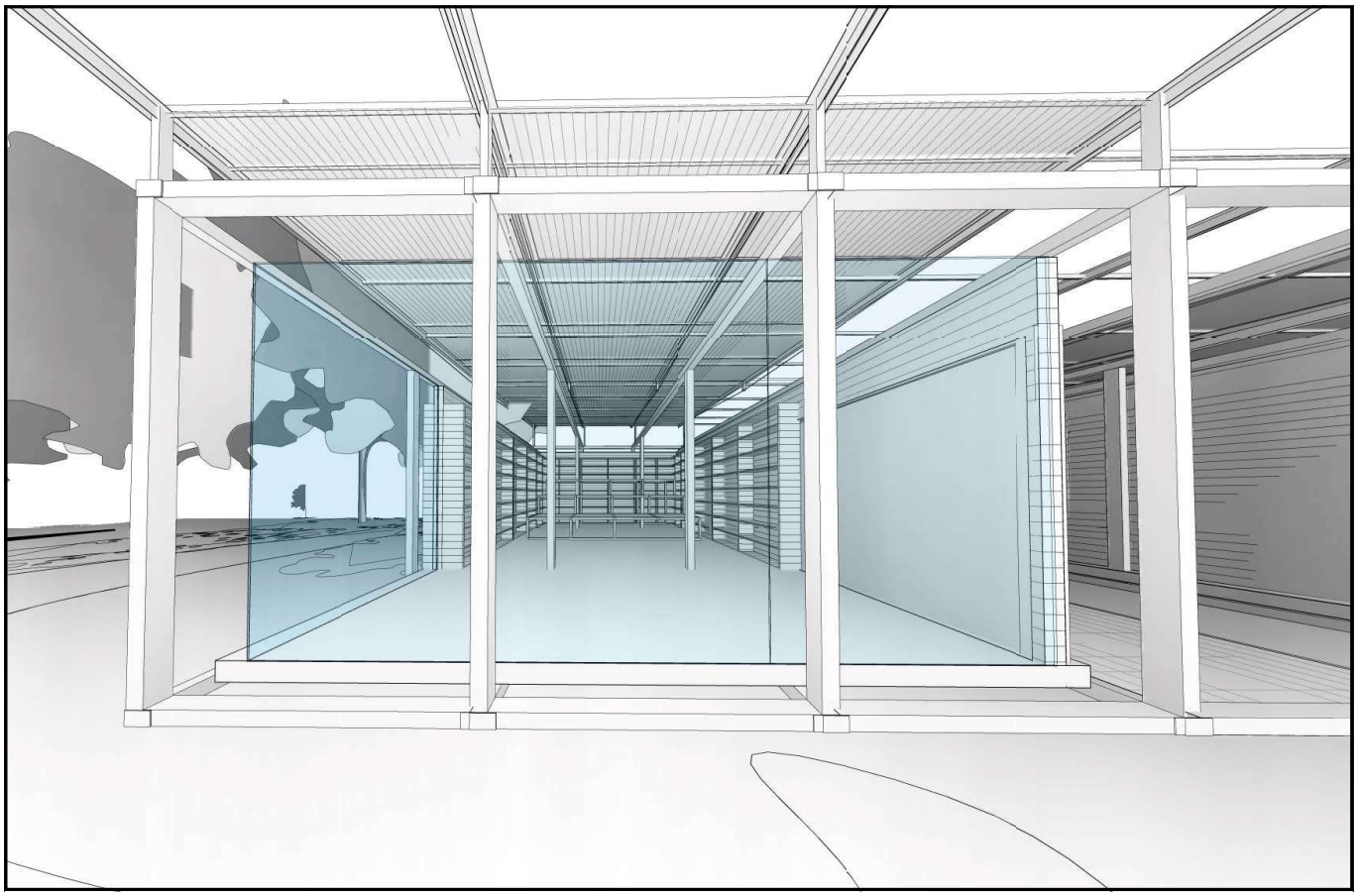
7.25 - Perspective of walkway between restaurant (Author, 2016).



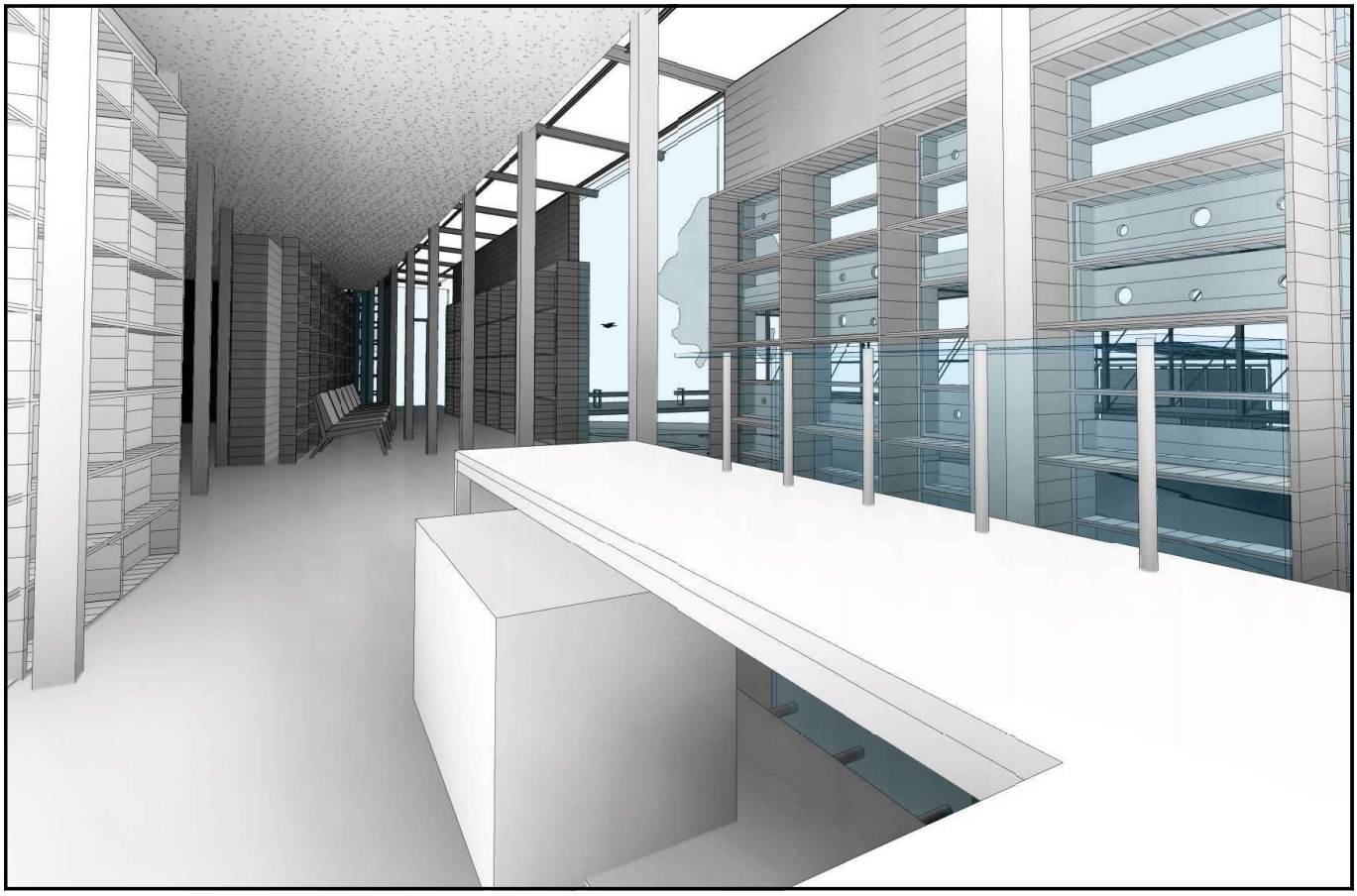
7.26 - Perspective of outside seating area (Author, 2016).



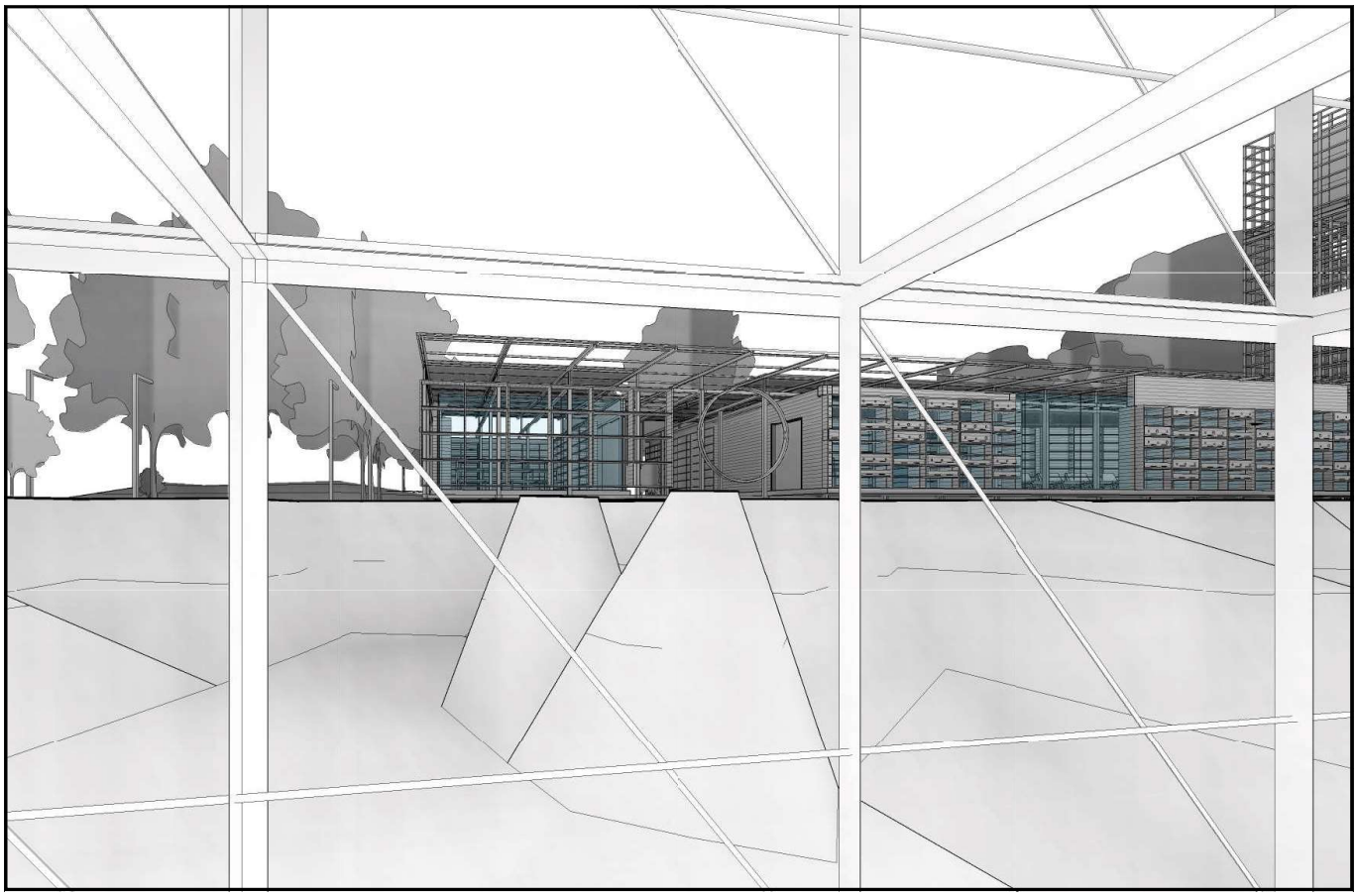
7.27 - Perspective of library entrance (Author, 2016).



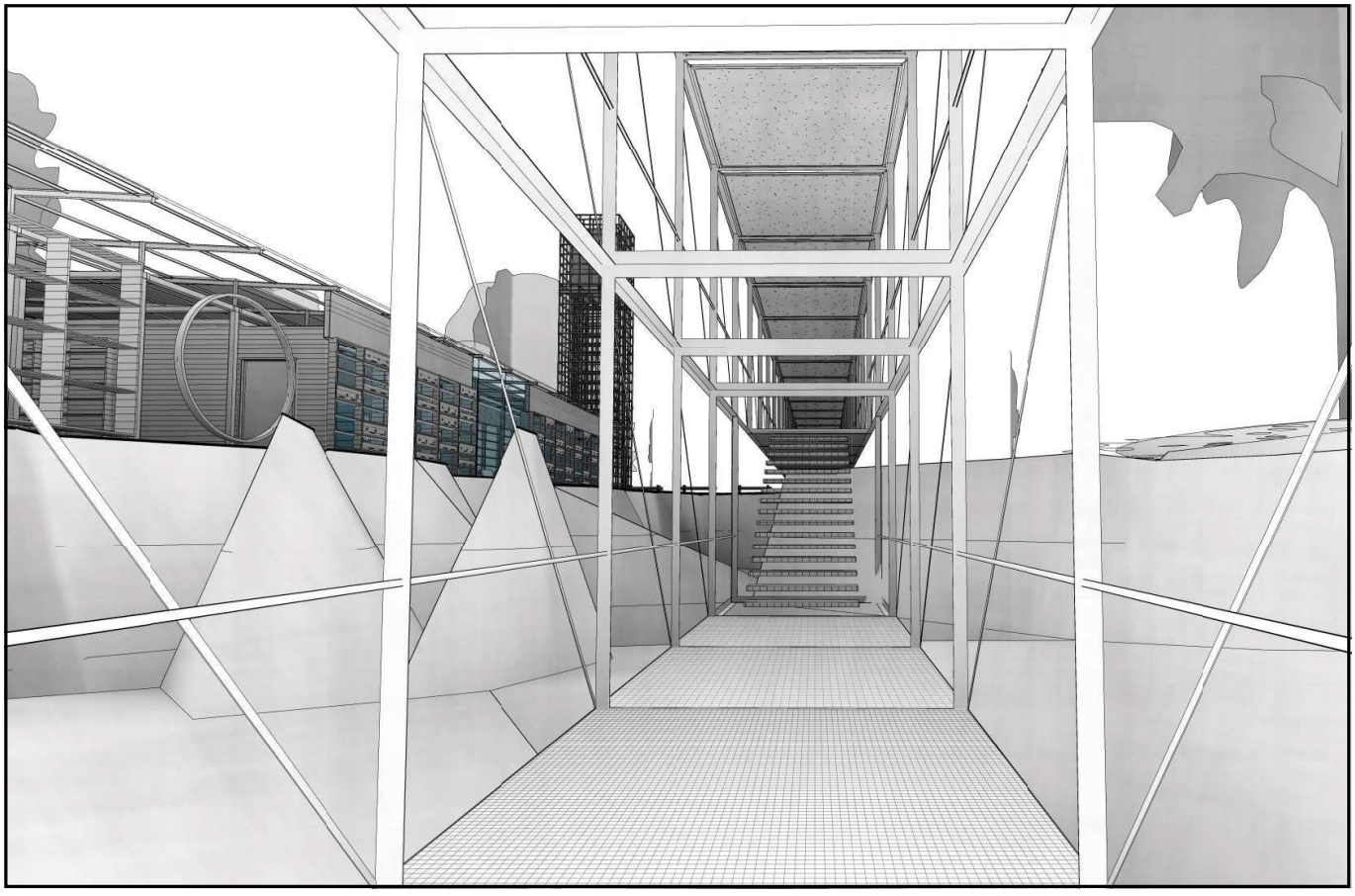
7.28 - Perspective of pavilion (Author, 2016).



7.29 - Perspective of library interior (Author, 2016).



7.30 - Perspective of cave walkway (Author, 2016).



7.31 - Perspective of cave walkway (Author, 2016).

Chapter 8

Technical Resolution

The value of a world heritage landscape is ever changing. As a fossil hominid site, the development of Kromdraai Cave is subject to possible future discoveries, in that the cave may produce a treasure of important fossil finds, or may prove to be disappointing. The site has been scientifically analysed to locate the presence of fossils adjacent to the known excavation site, but surrounding areas on Kromdraai farm could possibly still be linked to the identified fossil site.

The development and future of the site is therefore unpredictable, leading to the necessity of the structures to be adaptable and flexible. The need for adaptability, together with the sensitivity of the site itself, leads to the concept of a demountable structure. The technical investigation examines the notion of demountability as a means to design sensitively and provides an approach to designing on fossil hominid world heritage sites.

Relating to the design concept of embracing the archaeological grid and process, the technical concept aims to express the grid throughout the structure.

8.1 THE BACKGROUND

↓

8.2 SANS 10400

↓

8.3 ITERATIONS

↓

8.4 TECHNICAL PRECEDENT STUDY

↓

8.5 MATERIALS → 8.5.1 THE STRUCTURAL MATERIALS → 8.5.2 THE INFILL MATERIALS

↓

8.6 THE STRUCTURE → 8.6.1 DEMOUNTABLE PRIMARY STRUCTURE → 8.6.2 DEMOUNTABLE FOUNDATIONS
→ 8.6.3 DEMOUNTABLE ROOF

↓

8.7 THE SERVICES → 8.7.1 DEMOUNTABLE SERVICES → 8.7.2 DEMOUNTABLE WATER SUPPLY
→ 8.7.3 DEMOUNTABLE ENERGY SUPPLY → 8.7.4 DEMOUNTABLE ABLUTIONS

↓

8.8 THE SYSTEMS → 8.8.1 INTRODUCTION TO THE CLIMATE → 8.8.2 PASSIVE STRATEGIES → 8.8.3 ACTIVE STRATEGIES

↓

8.9 THE LANDSCAPE INTERVENTIONS → 8.9.1 ACCESS → 8.9.2 PARKING → 8.9.3 ACTIVE STRATEGIES → 8.9.4 FIRE
→ 8.9.5 RED DATA SPECIES

8.1 The background to the technical concept

The value of a world heritage landscape is ever changing. As a fossil hominid site, the development of Kromdraai Cave is subject to possible future discoveries, in that the cave may produce a treasure of important fossil finds, or may prove to be disappointing. The site has been scientifically analysed to locate the presence of fossils adjacent to the known excavation site, but surrounding areas on Kromdraai farm could possibly still be linked to the identified fossil site.

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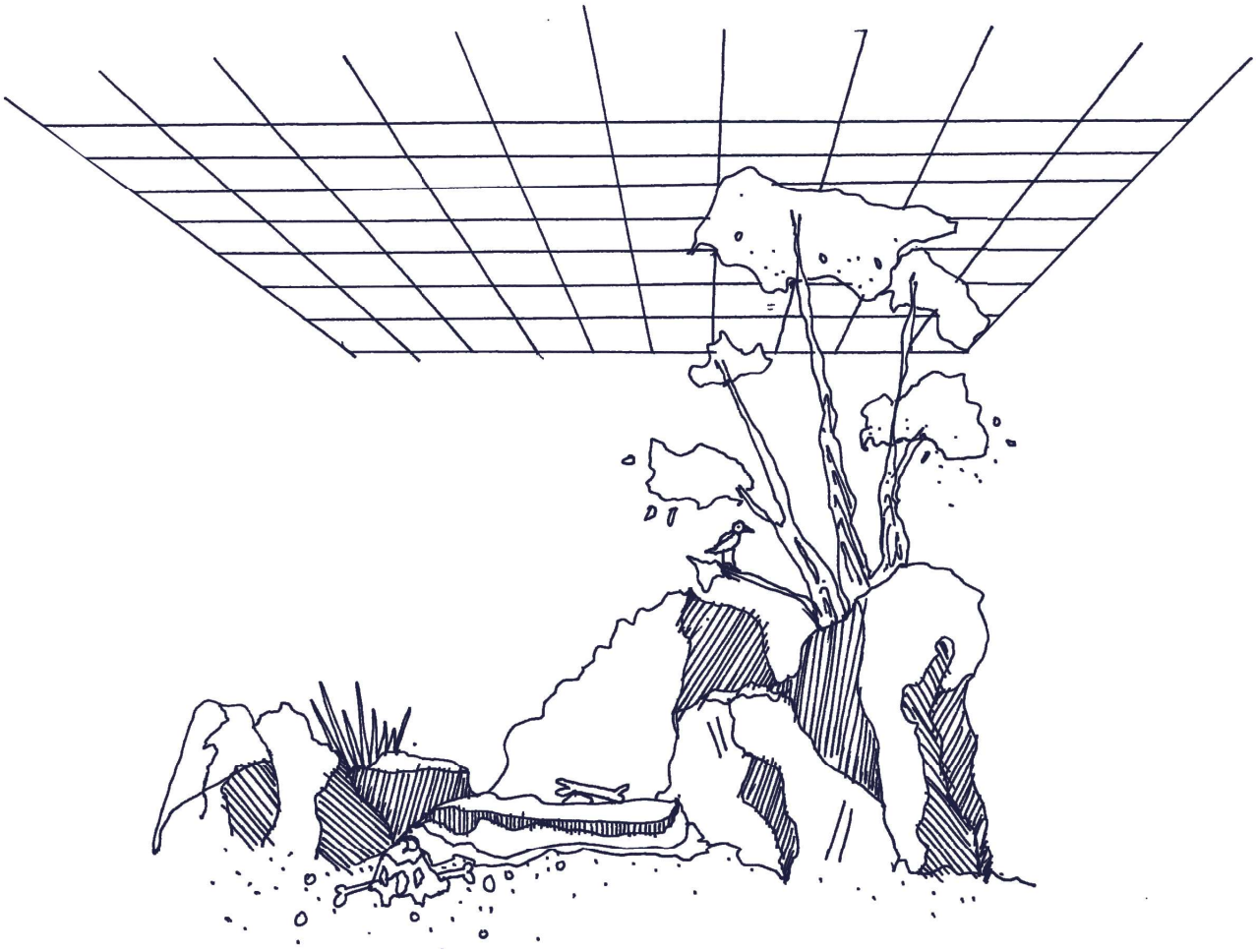


8.1 - The background to the technical concept (Author, 2016).

8.2 SANS 10400

The SANS 10400 guided the technical resolution of the project as a means of achieving the national standards and regulations.

Occupancy and building classification and Design population:

Restaurant and administration block:

- A1 Entertainment and public assembly _ number of fixed seats or 1 person per m2
- C1 Exhibition hall ¬_ 1 person per 10 m2
- F2 Small shop _1 person per 10 m2
- G1 offices _1 person per 15 m2

Laboratories and workshops:

- A3 Places of instruction _1 person per 5m2
- J1 High risk storage _1 person per 50 m2
- J3 Low risk storage _1 person per 50 m2

Archive and library:

- C2 Library _ 1 person per 20 m2

Ventilation:

The total area of an opening shall not be less than 5 %% of the floor area of a room or 0,1 m2 with respect to category E4, H3m H4 or H5 and 0,2m3 in respect of other buildings.

Air requirements for different types of occupancies:

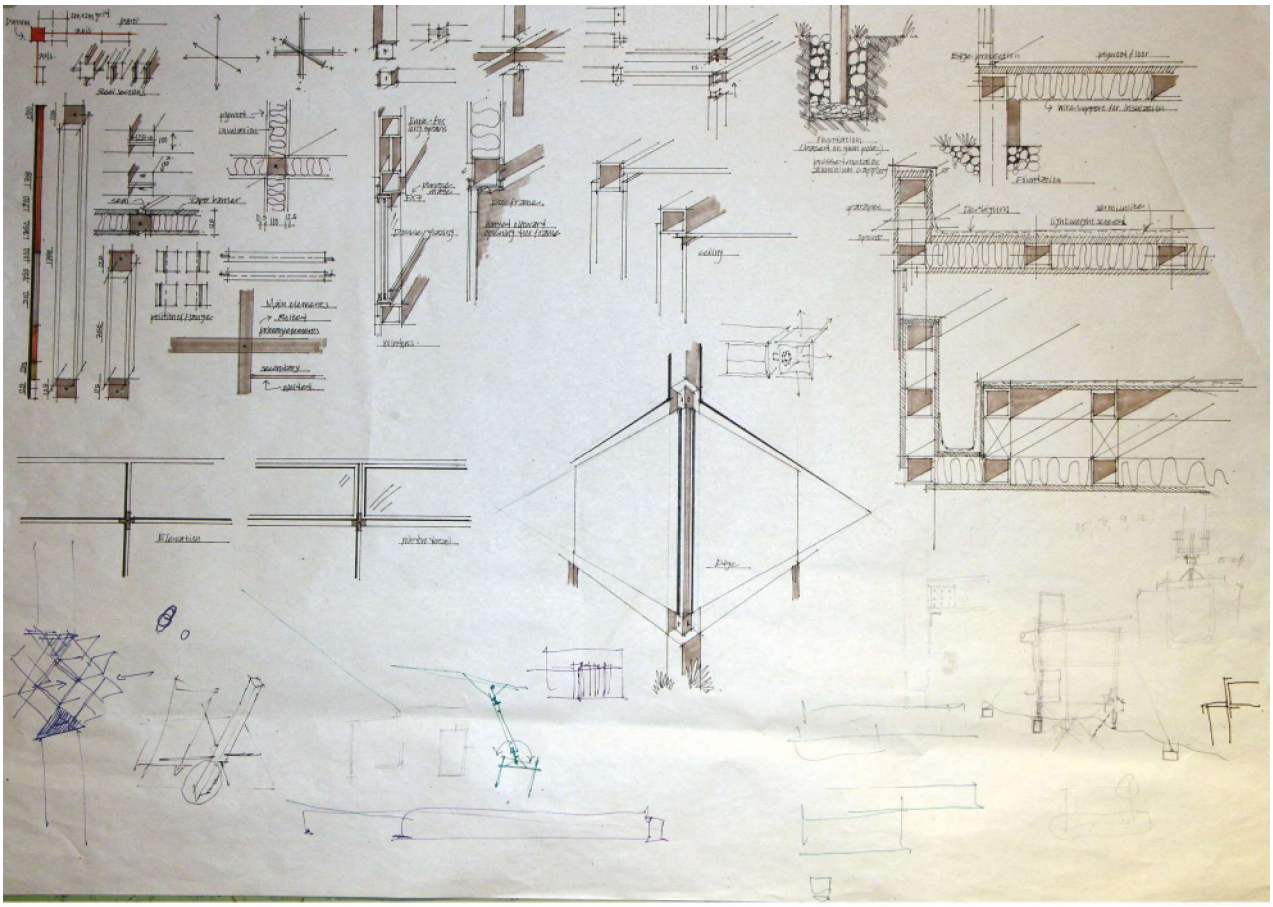
- Public halls: 10 air changes per hour & 7.5 L/s per person
- Educational buildings (classrooms, laboratories and libraries): 2 air changes per hour & 7,5 L/s per person
- Food and eating facilities: 10 air changes per hour & 7,5 L/s per person
- Kitchen: 20 air exchanges per hour & 17,5 L/s per person
- Photographic dark room: 10 L/s per person
- Library: 2 Air exchanges per hour & 7,5 L/s per person
- Offices: 2 Air exchanges per hour & 7,5 L/s per person
- Board rooms: 10 Air exchanges per hour & 10 L/s per person
- Film room: 10 Air exchanges per hour & 7,5 L/s per person
- Ablution facilities: 20 Air exchanges per hour & 20 L/s per person

SANS 10400-P Number of sanitary fixtures to be installed:

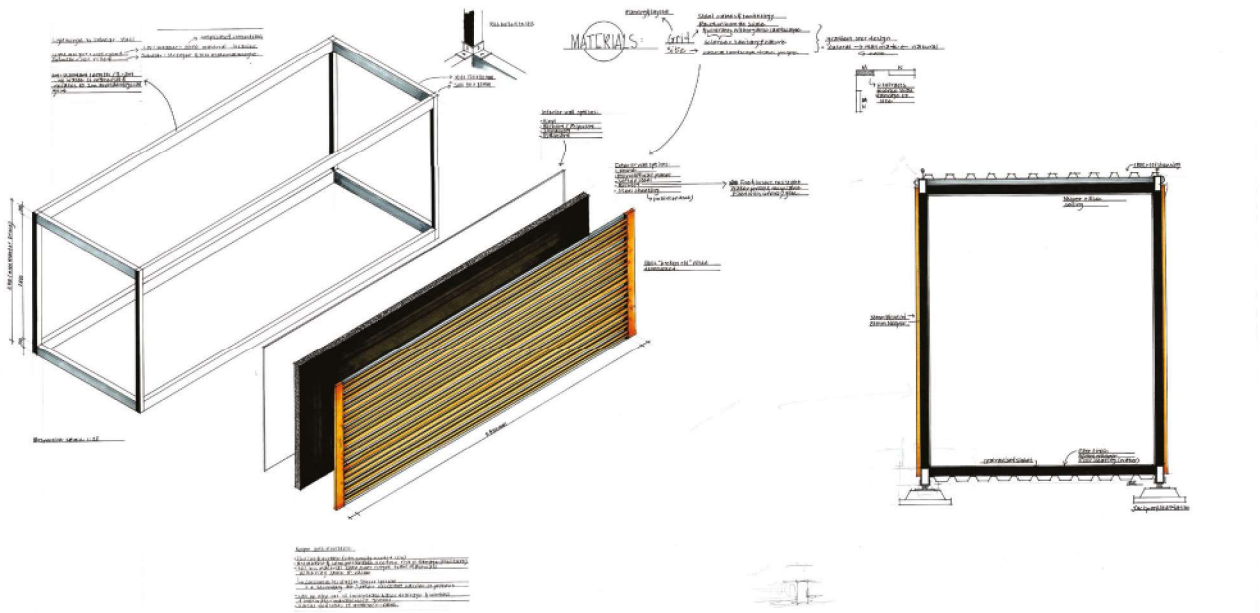
- Laboratories and workshops_ males: 1 toilet pan, 1 urinal, 1 WHB females: 2 toilet pans & 1 WHB
- Restaurant and administration block_ 3 toilet pans, 5 urinal, 4 WHB & Females: 7 toilet pans & 4 WHB
- Archive and library_ 1 toilet pan, 1 urinal, 1 WHB females: 2 toilet pans & 1 WHB

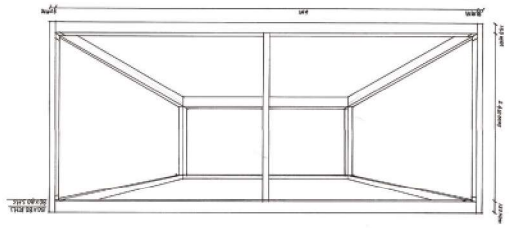
8.3 Iterations and process

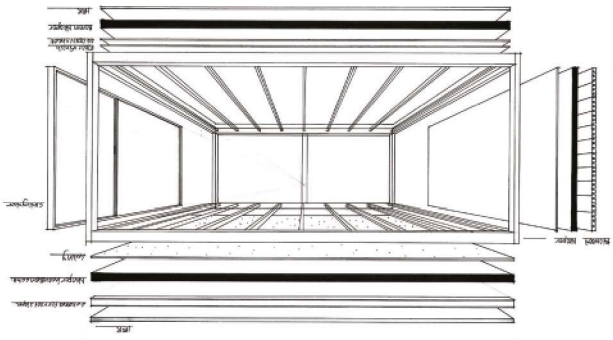
The Kromdraai iteration process contained four investigations, the first being a modular system, the second a prefabricated system, the third a kit-assembly system and the fourth a refinement of the kit assembly system. The design of a modular system with bolted connections consisted of too many connections and problematic edges, with changes in levels being difficult to resolve. A prefabricated system would limit disruption to the site, but proved to waste materials and resulted in a non-contextual resolution. The final iteration, the kit assembly, allowed for all components to be constructed off site and bolted together on site, with minimum material wastage and allowing for adaptability and demountability.

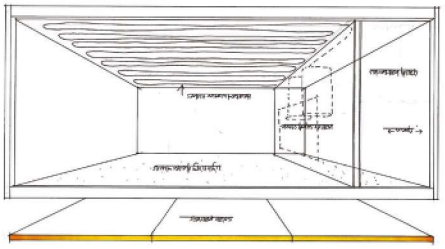


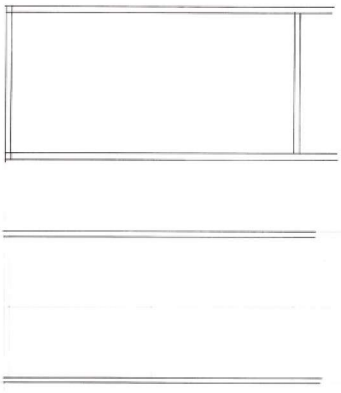
8.2 - Iteration 1, modular system (Author, 2016).



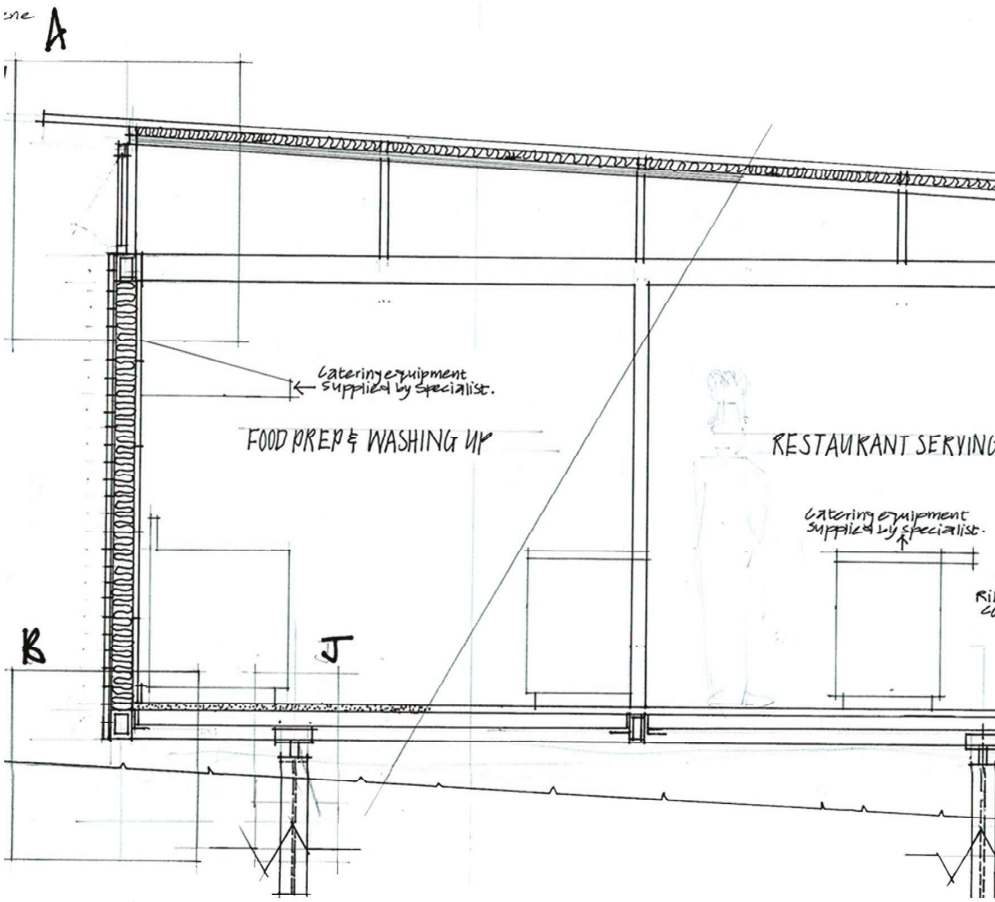


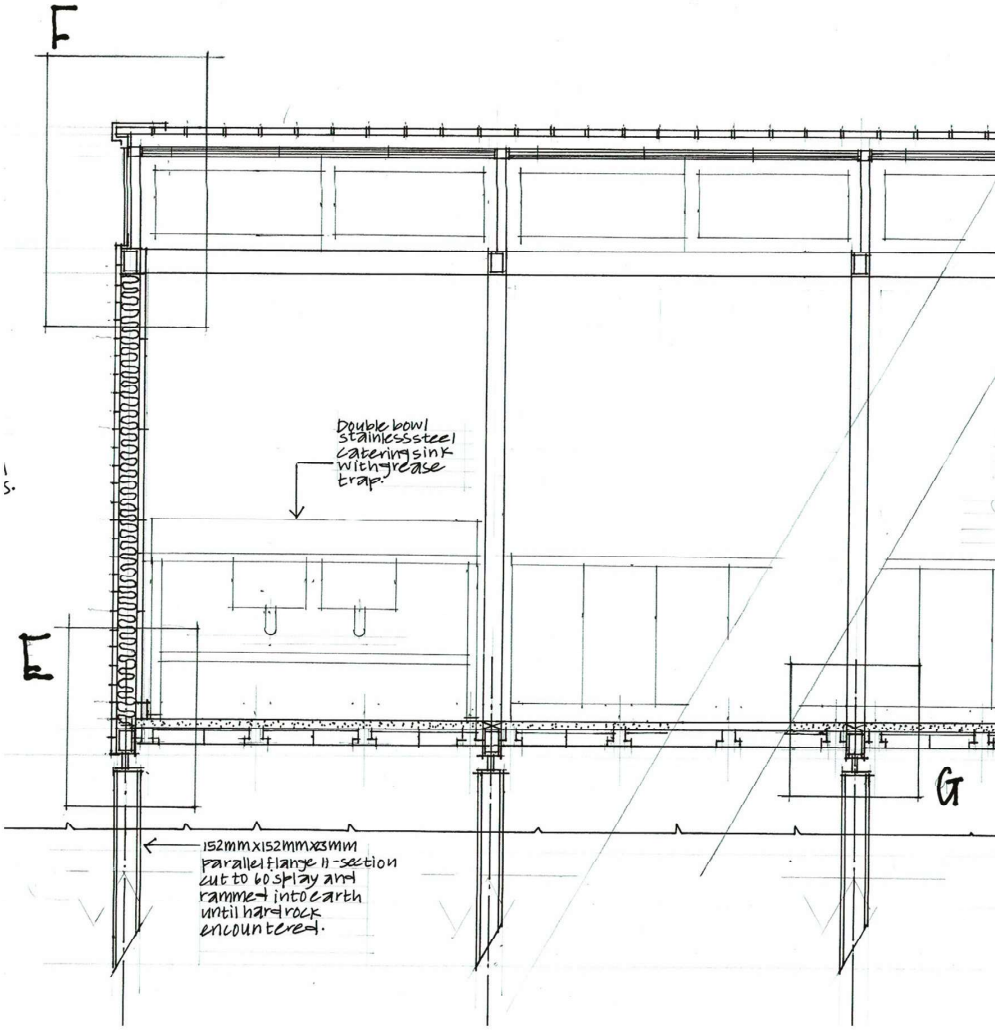


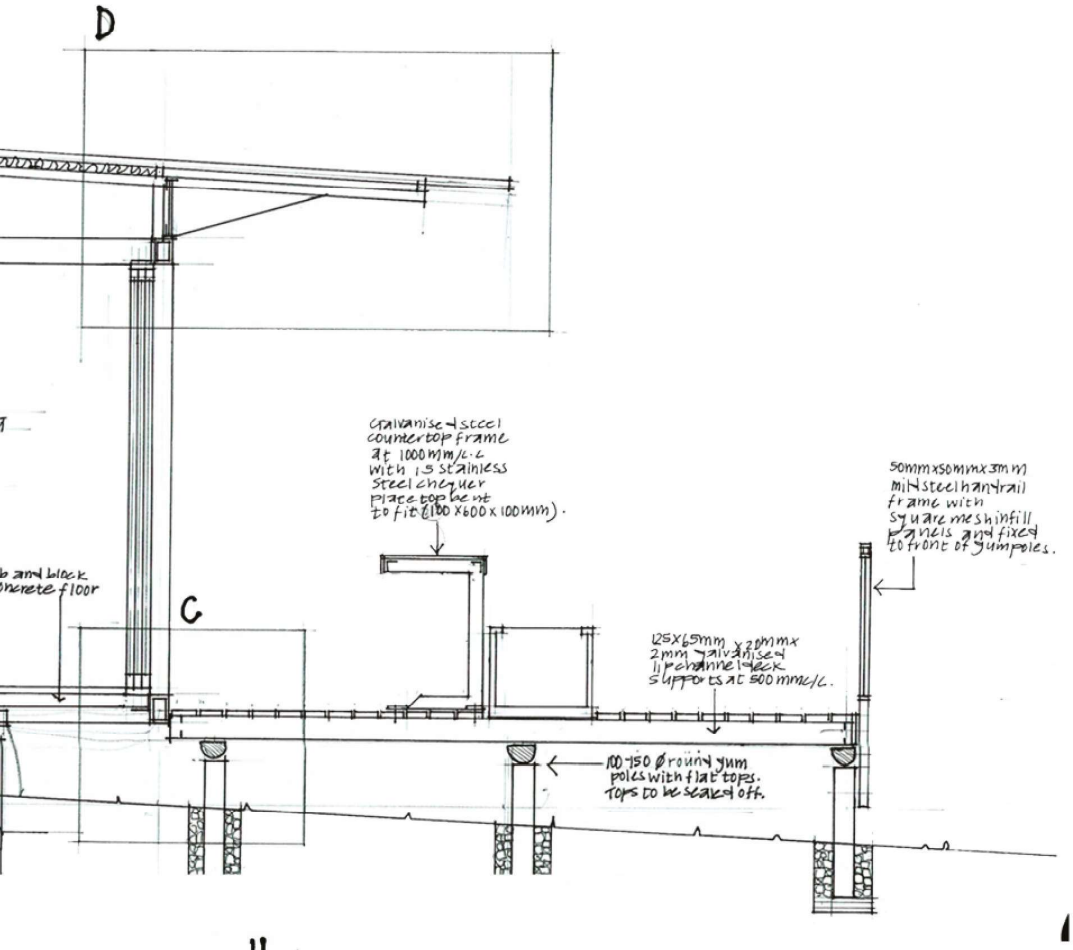


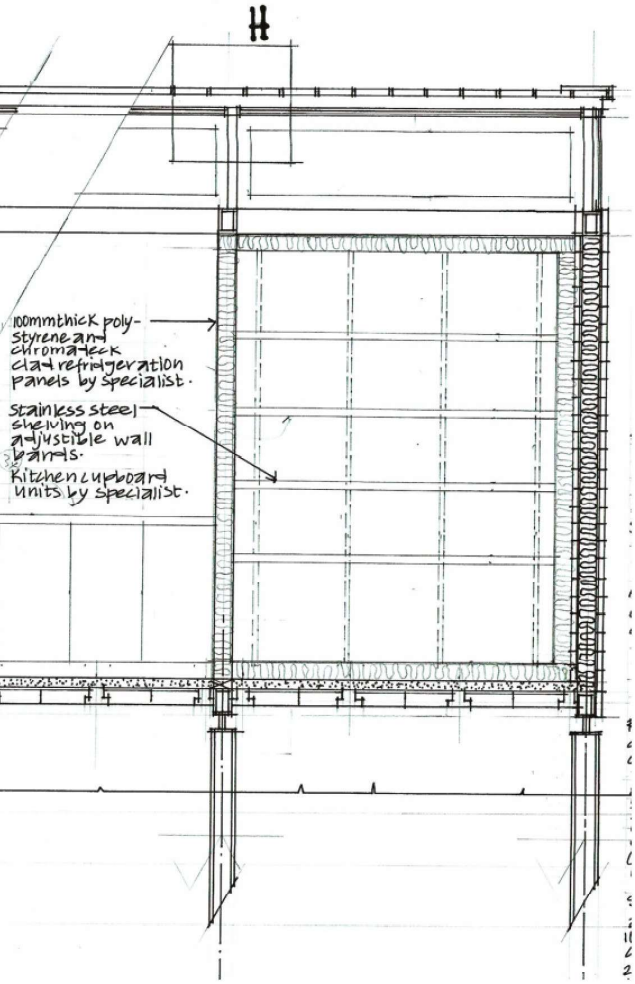


8.3 - Iteration 2, prefabricated system (Author, 2016).

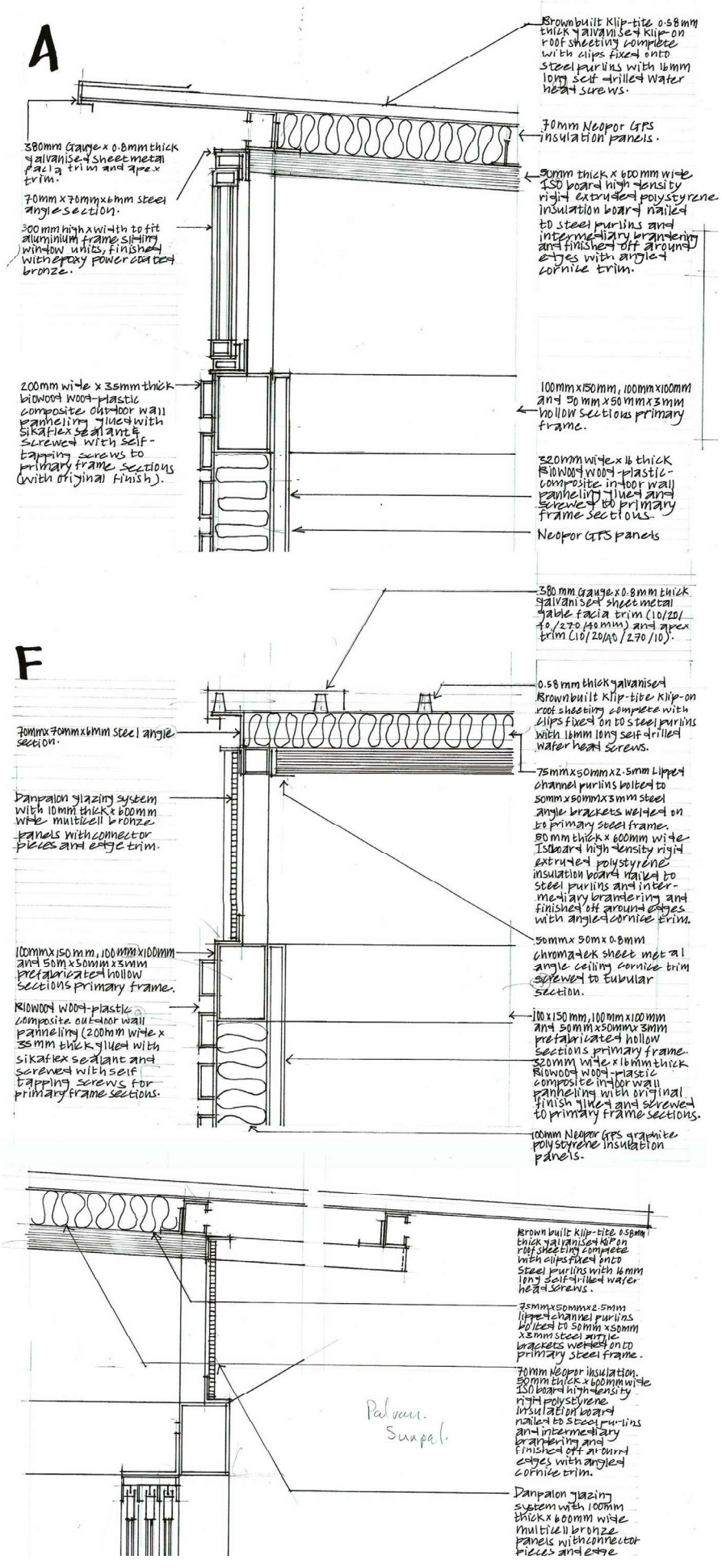




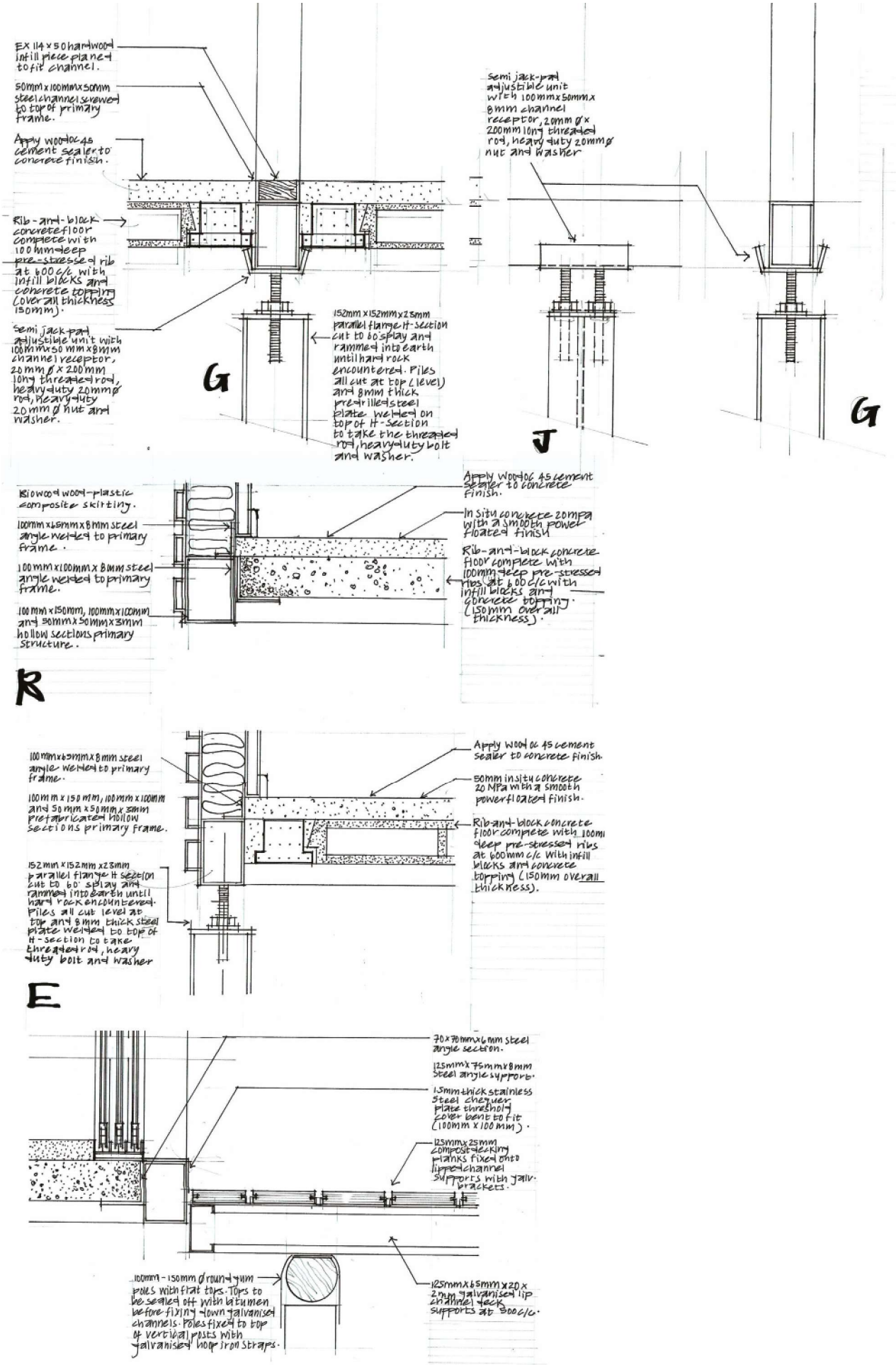




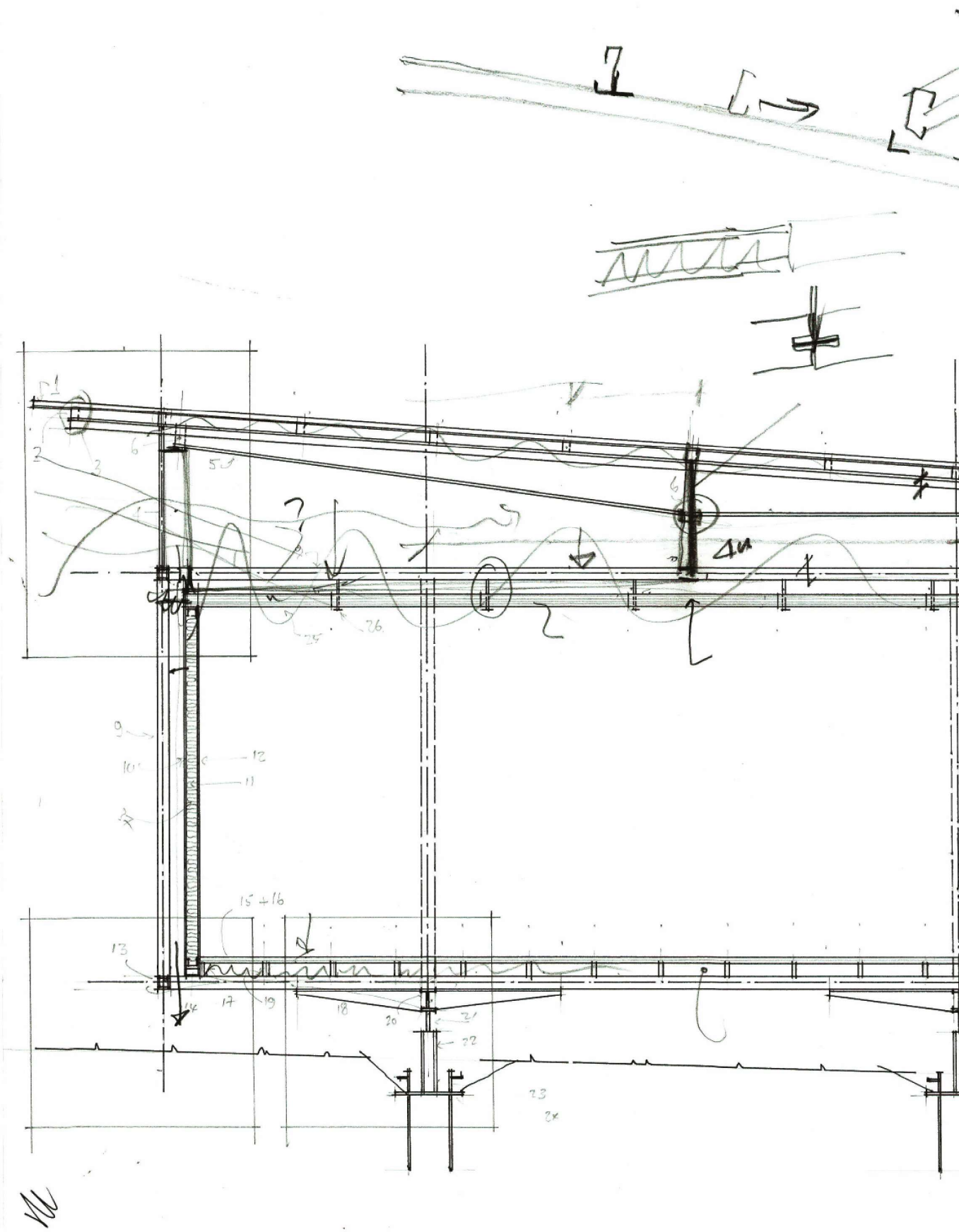
8.4 - Iteration 3, kit assembly system (Author, 2016).

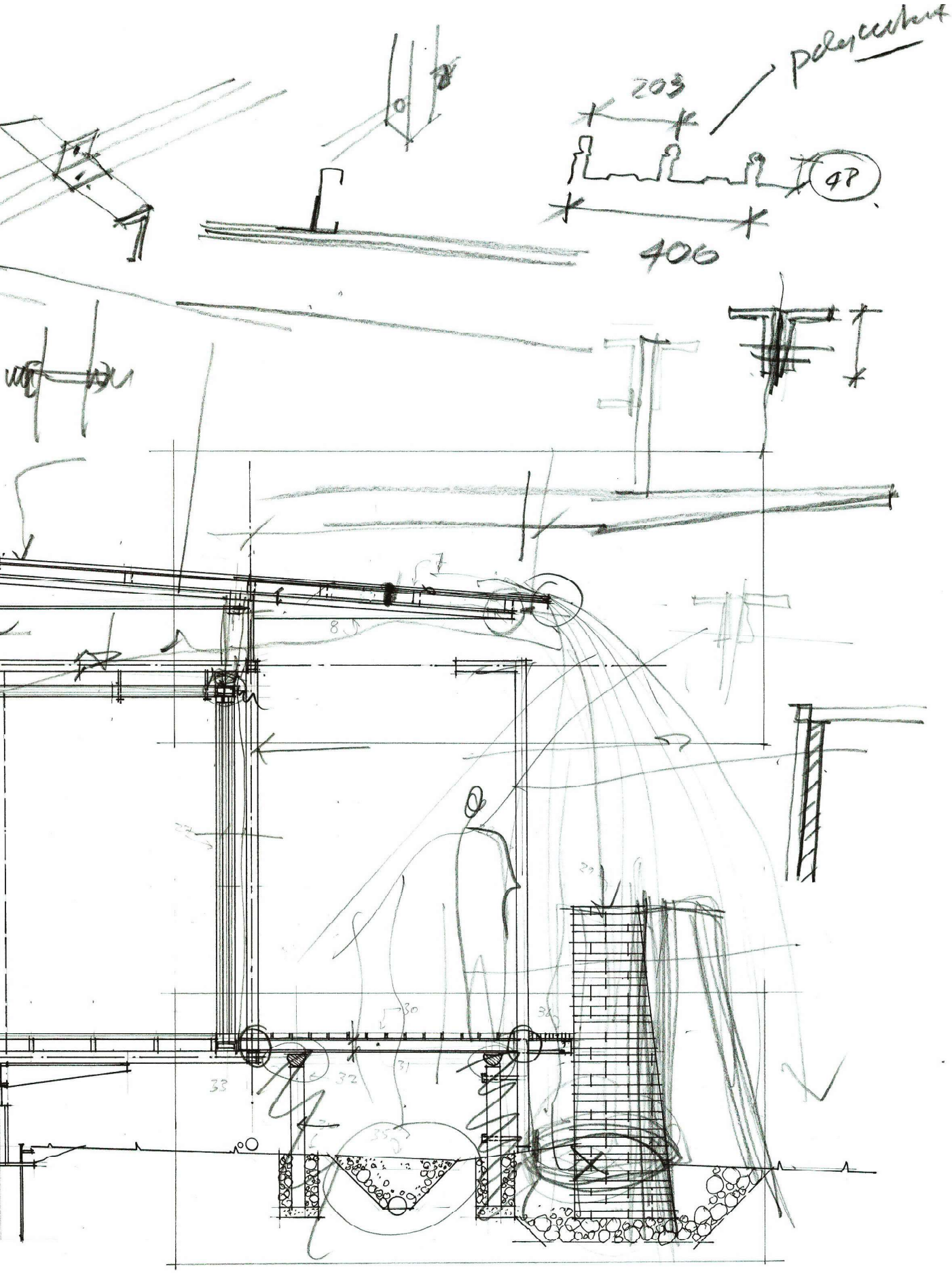


8.5 - Iteration 3, kit assembly system roof details (Author, 2016).

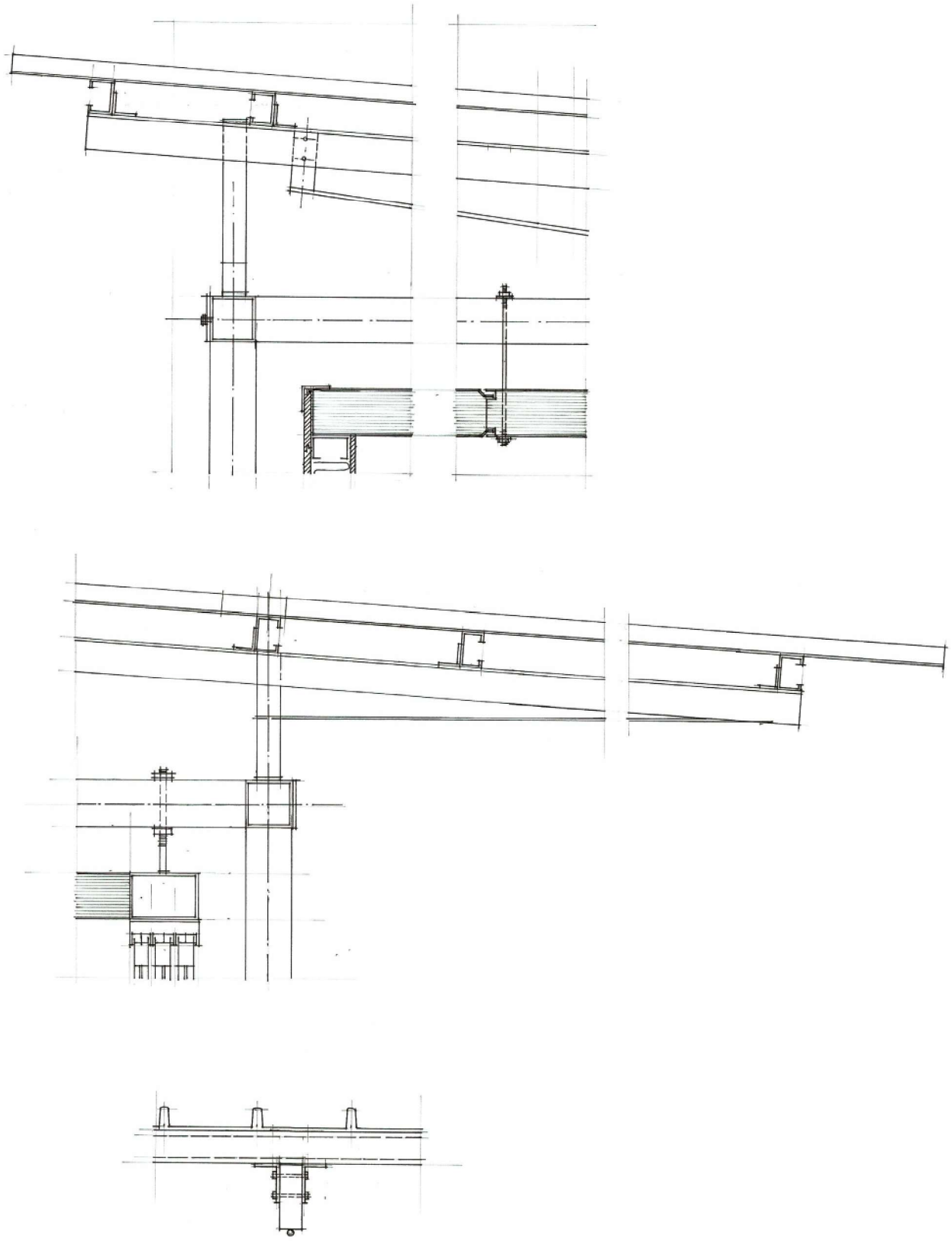


8.6 - Iteration 3, kit assembly system floor details (Author, 2016).

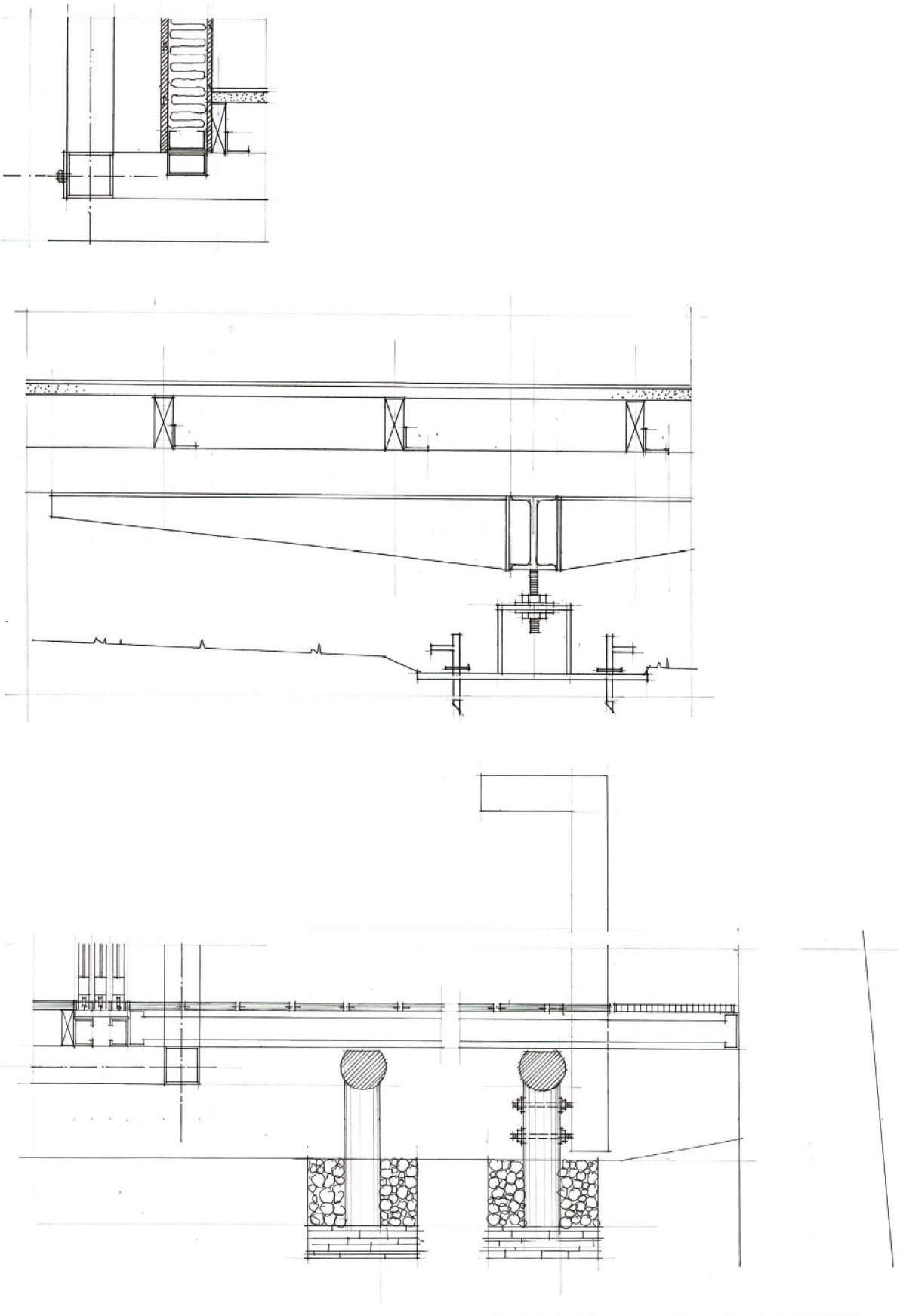




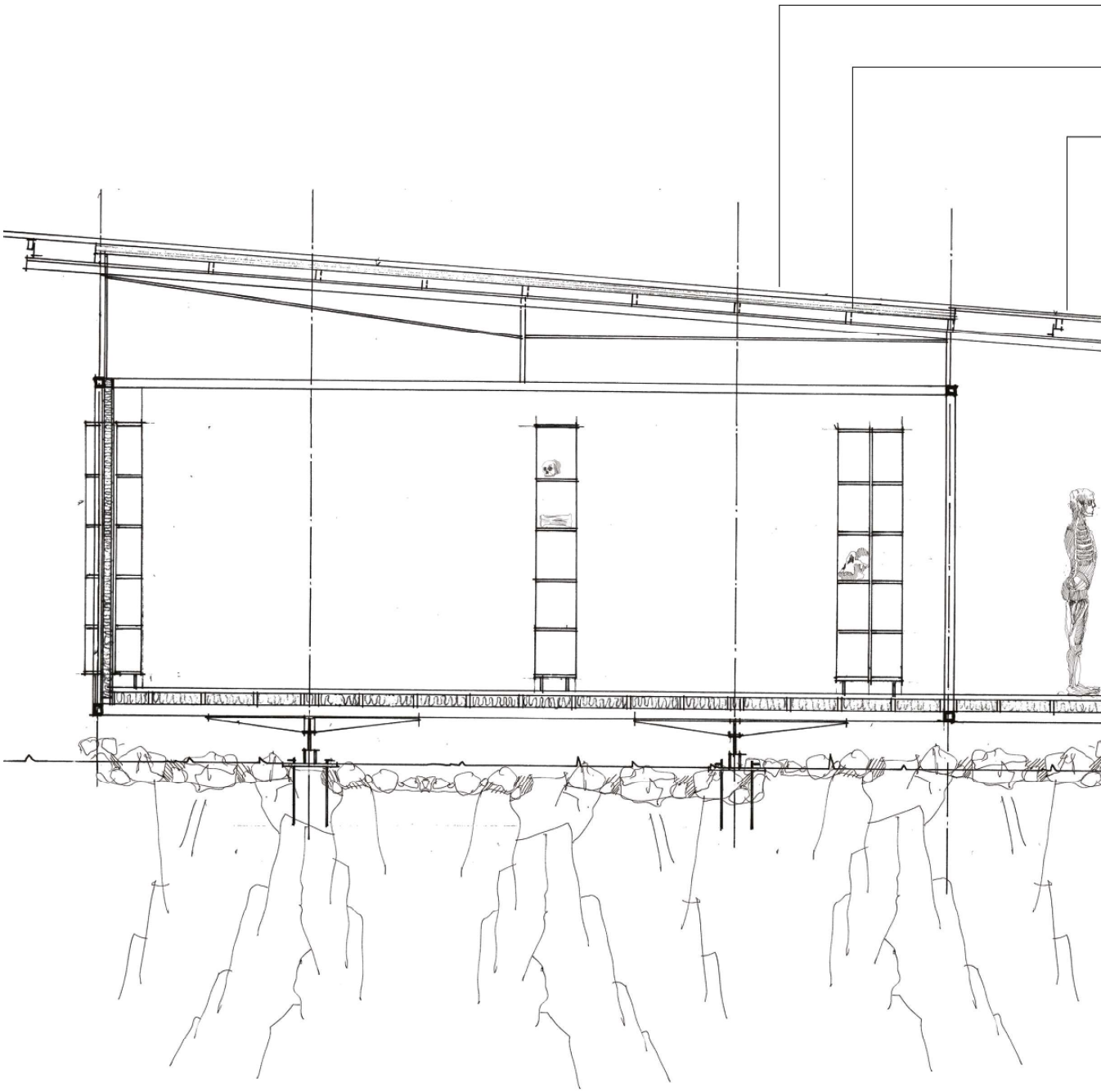
8.7 - Iteration 3, kit assembly system development (Author, 2016).

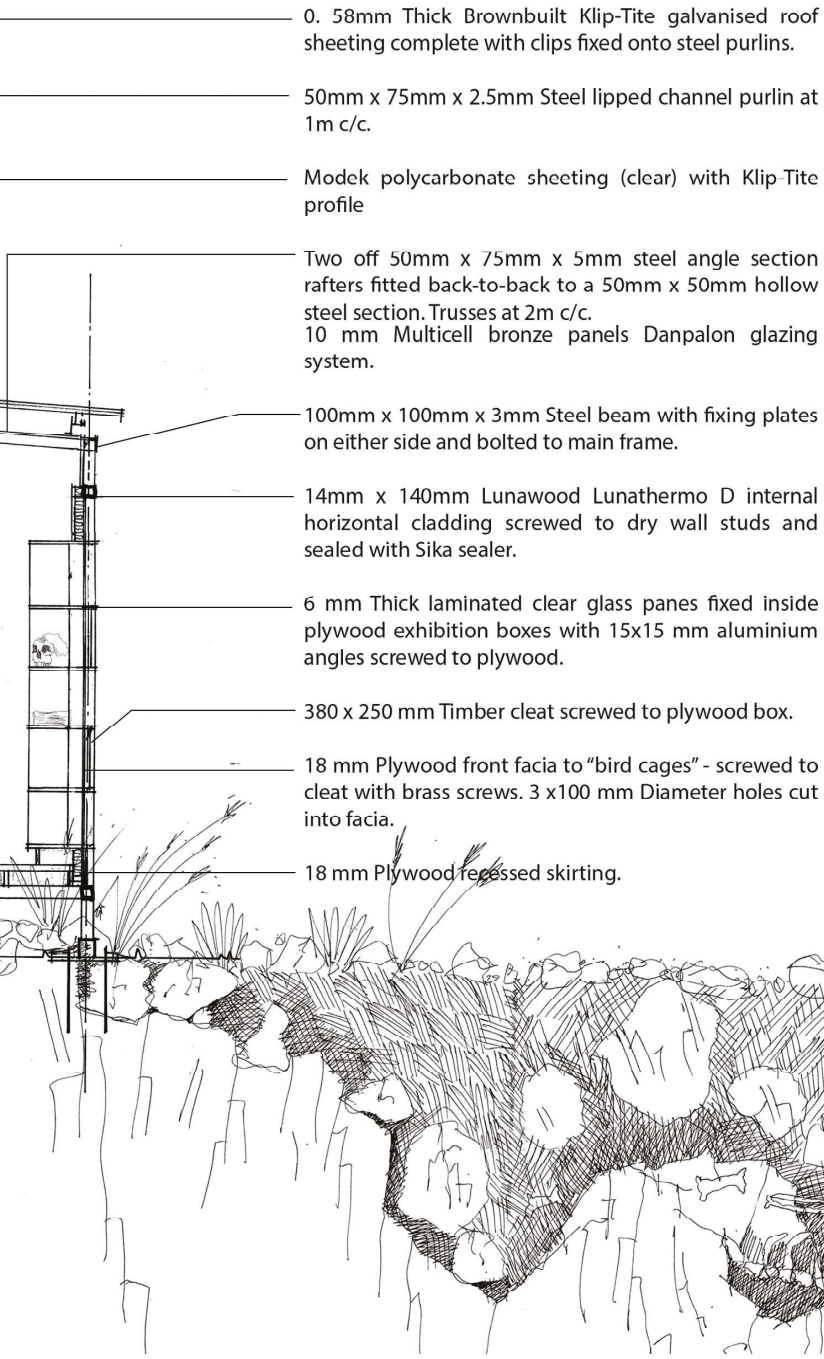


8.8 - Iteration 3, kit assembly system roof development (Author, 2016).

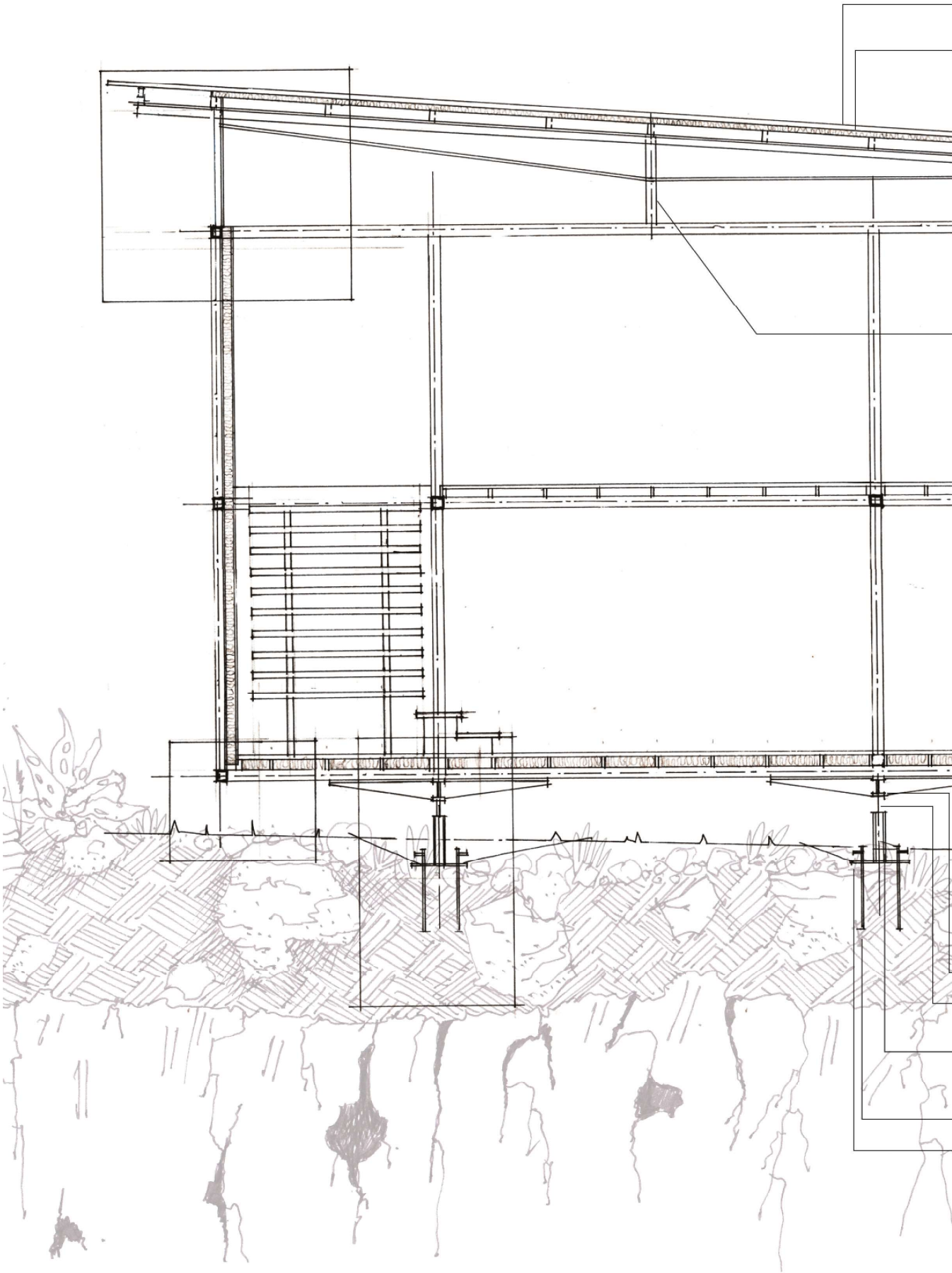


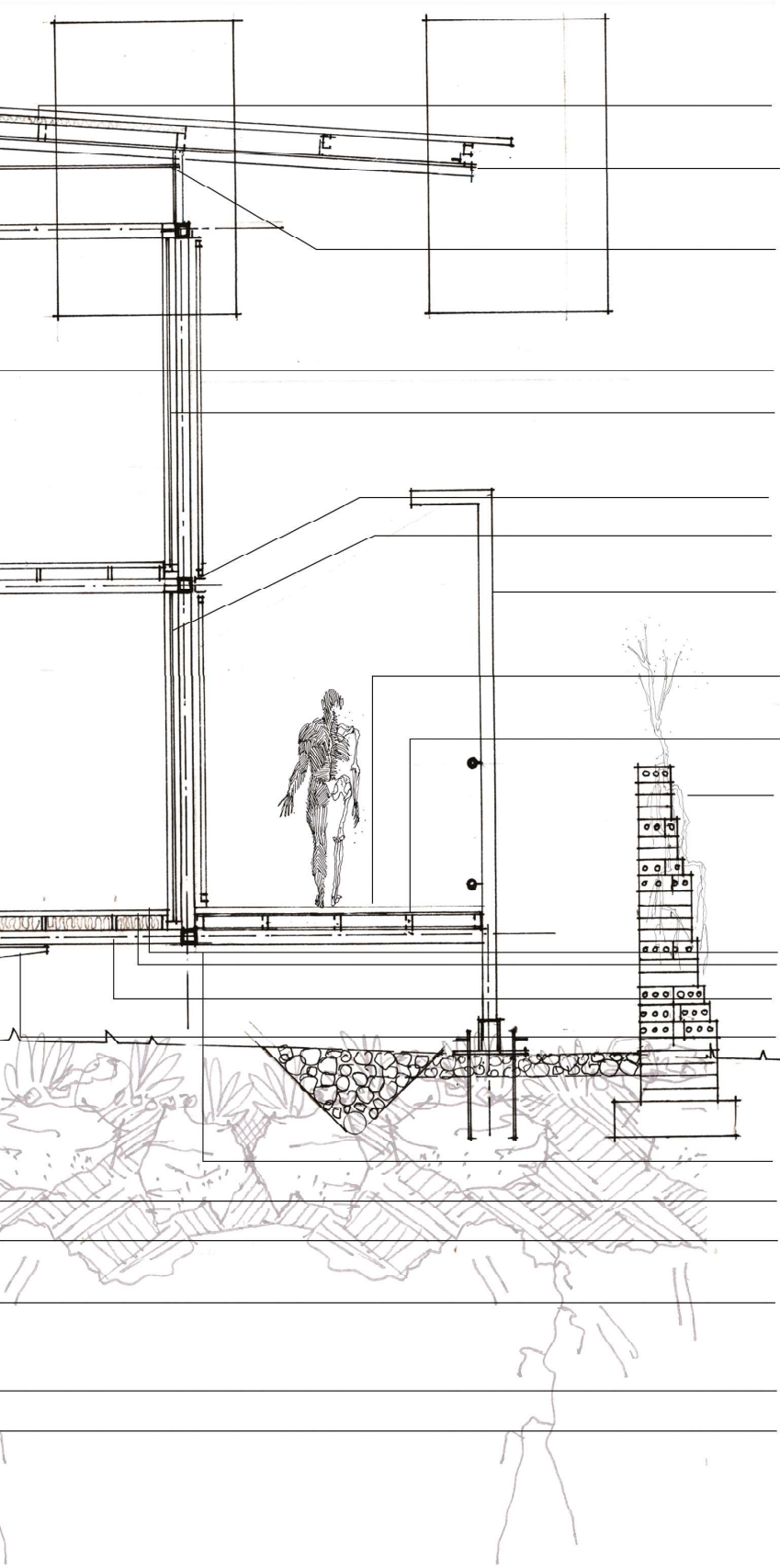
8.9 - Iteration 3, kit assembly system floor development (Author, 2016).



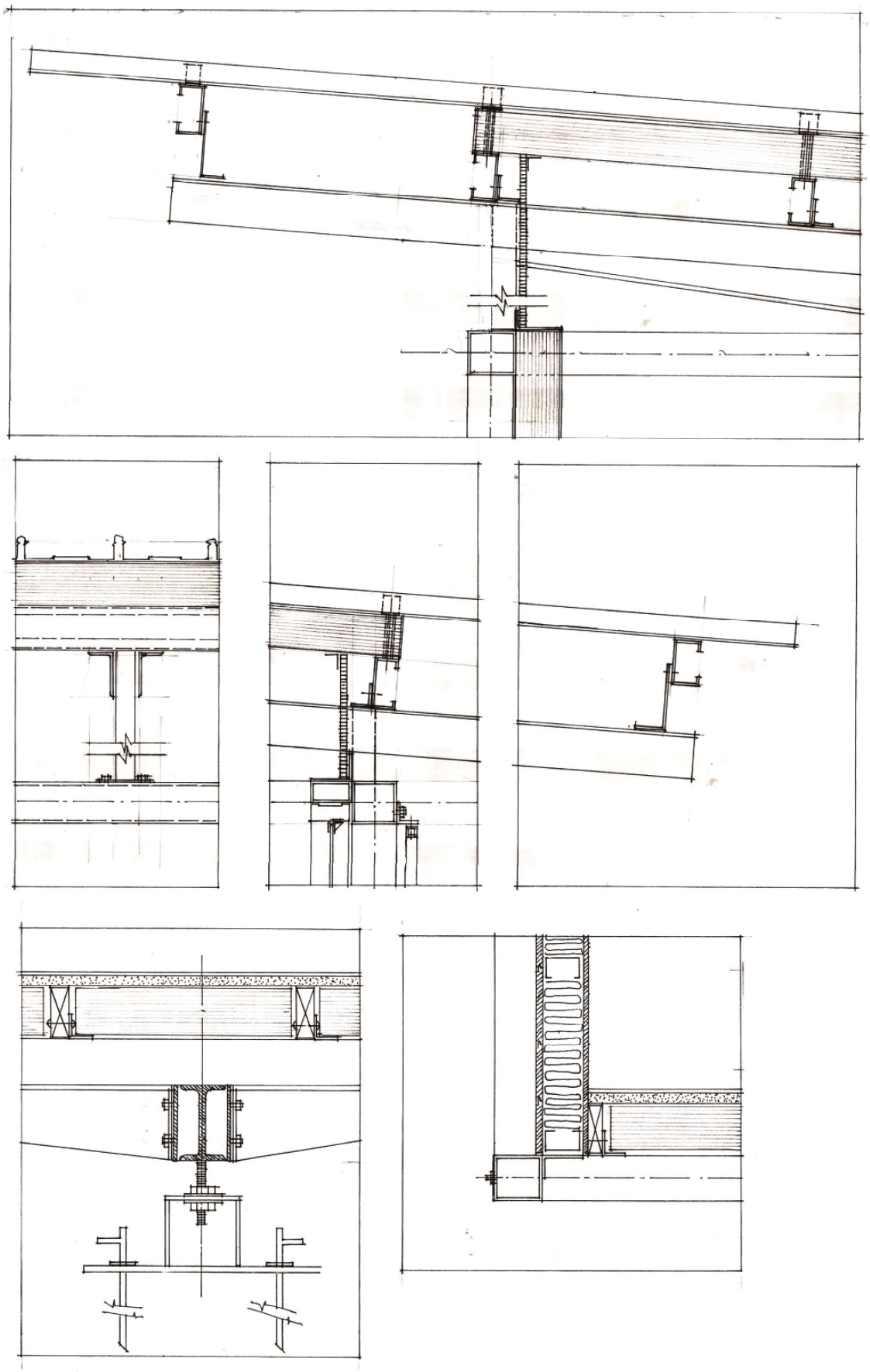


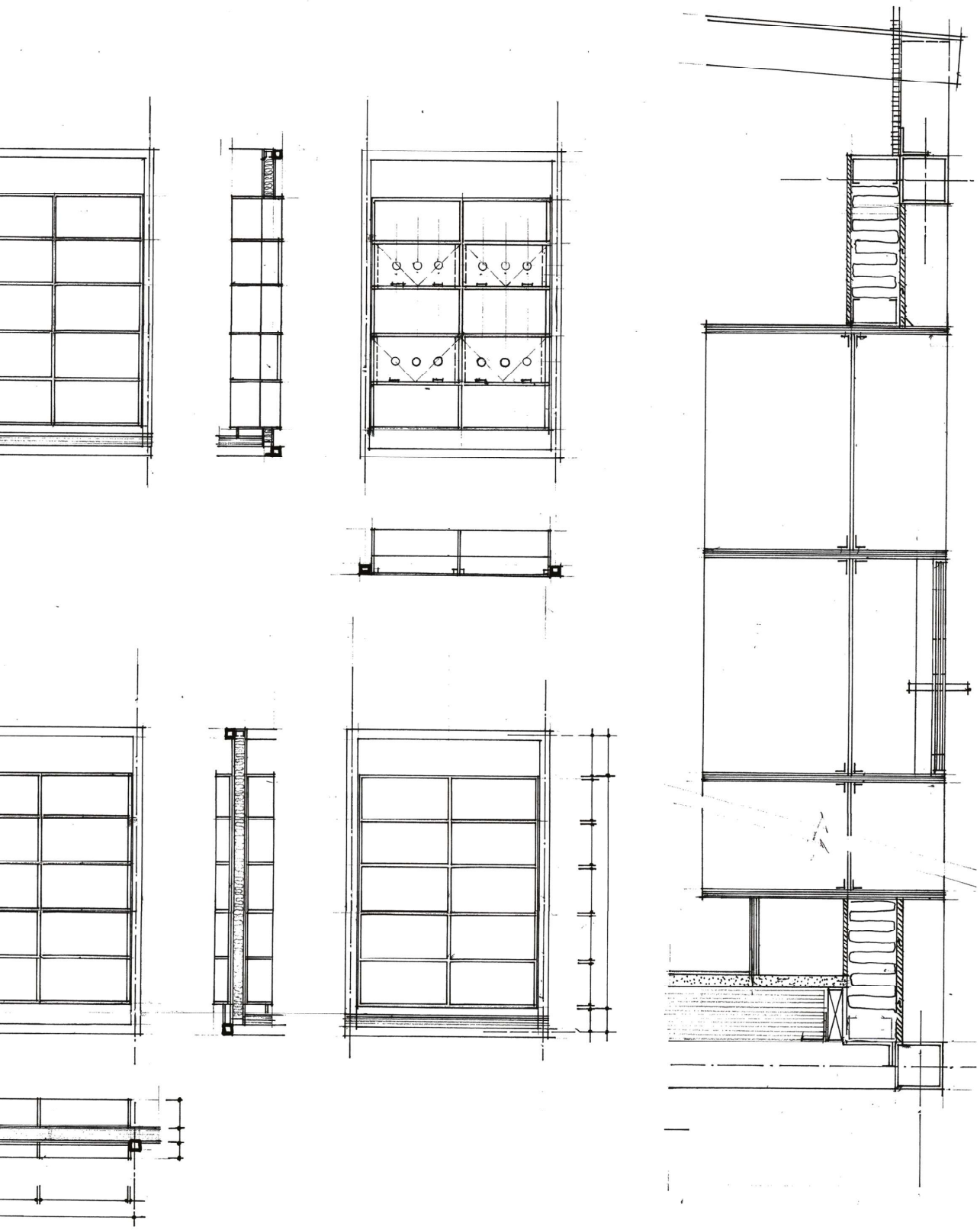
8.10 - Iteration 3, kit assembly system finalised section through library (Author, 2016).





8.11 - Iteration 3, kit assembly system finalised section through reception (Author, 2016).





8.12 - Iteration 3, kit assembly system finalised details (Author, 2016).

8.4 Technical precedent study

"The love of the site environment will prohibit one from leaving the building as a mark." – Krynauw Nel

Malapa refers to a fossil hominid site in the Cradle of Humankind. The site became known for the discovery in 2010 of a new species of hominid, the two-million-year-old Australopithecus sediba (Vuso, 2014). Krynauw Nel Architects and engineer Peter Fellows were commissioned to design a structure for this site, with the brief requiring a structure which would protect the fossil site from the elements – specifically violent rainstorms, acid rain and falling debris.

The structure won the 2014 Steel Awards, with the Southern African Institute of Steel Construction's Spencer Erling stating that: "The judges noted that the determination of the construction team, the quality of its work and the fact that it left the site almost as it found it, were among the factors that made it obvious that this project represents excellence in the use of steel for every possible reason" (van Wyngaardt, 2014).

The structure facilitates research as well as small groups of tourists separated from the research activities. Rocks can be lifted from the site by the structure to a vehicle point from where they can be transported for further analysis. The structure had to be low maintenance, and due to the possibility of veld fires had to be fire resistant for 20 minutes. Water was to be harvested and held by the structure. Although the brief required materials to be manufactured in South Africa, the need for environmentally-friendly materials eventually outweighed this prerequisite. Finishes include a white stinkwood ceiling, sheltered by an aluminium and wood-fibre cement roof. A hoist is able to carry weights of one ton and deposit them on a truck (Blaine, 2014).

The foundation is not significant, allowing the structure to be relatively free-standing, and the structure itself does not make contact with the ground earmarked for future excavation. Instead, the eight spindly steel "legs" of the structure are bolted into rock, so its largest impact on the site is the size of a piece of A5 paper. In addition, the structure was designed to be largely assembled off-site and craned in for final assembly. The architects wanted minimal damage by contractors to the area (Blaine, 2014).

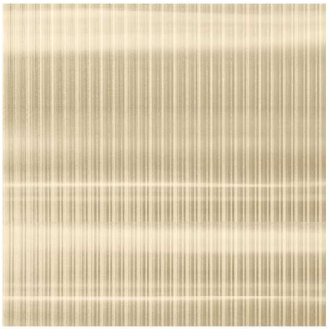
Due to the nature of the environment the construction is temporary, resulting in it being bolted together, but also permanent as it will be used for an extended period, thus necessitating durable materials. Each leg is fairly easily moved so that if the excavations move in a different direction, this can be accommodated. As a collarbone was the first fossil found here, the structure's "legs" are clavicle-shaped at the top — and then split on the downward swing to disappear into the trees. These legs were inspired by nature, as insects such as mosquitoes use their many legs to distribute their weight. The inspiration also included the oval formation of the surrounding trees, the slope of the surrounding hills, the concept of an anatomy theatre-in-the-round, and poetry such as making the visitor crouch to enter the structure – mimicking entering a cave and being relieved on emerging.

The architects designed the structure to be higher than the thick clump of trees in order to allow tourists to view what is going on without disrupting the work of the scientists. The elevated structure contains a free-floating walkway, constructed of recycled plastic, which allows wildlife such as snakes to move under it, and leopard and buck to not be disturbed (Blaine, 2014).

8.13 - Malapa (GIfA Awards 2015, www.youtube.com).

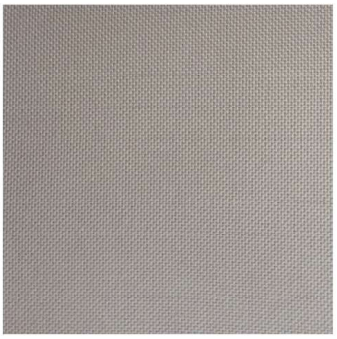
Steel hollow sections

Steel bolt fixings



Danpalon glazing system bronze tint

Modek polycarbonate sheeting



Canvas shading material

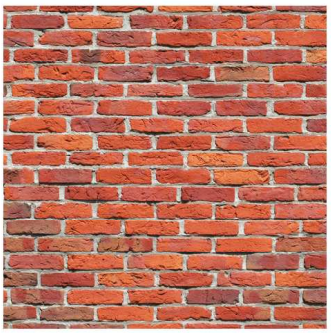
Vinyl floor finish

Composite decking planks

Crate floor grate

Lunawood exterior and interior cladding

Marine plywood shelving system



Common burnt clay bricks

8.14 - Material palette (Author, 2016).

8.5 Materials

8.4.1 Demountable structural materials

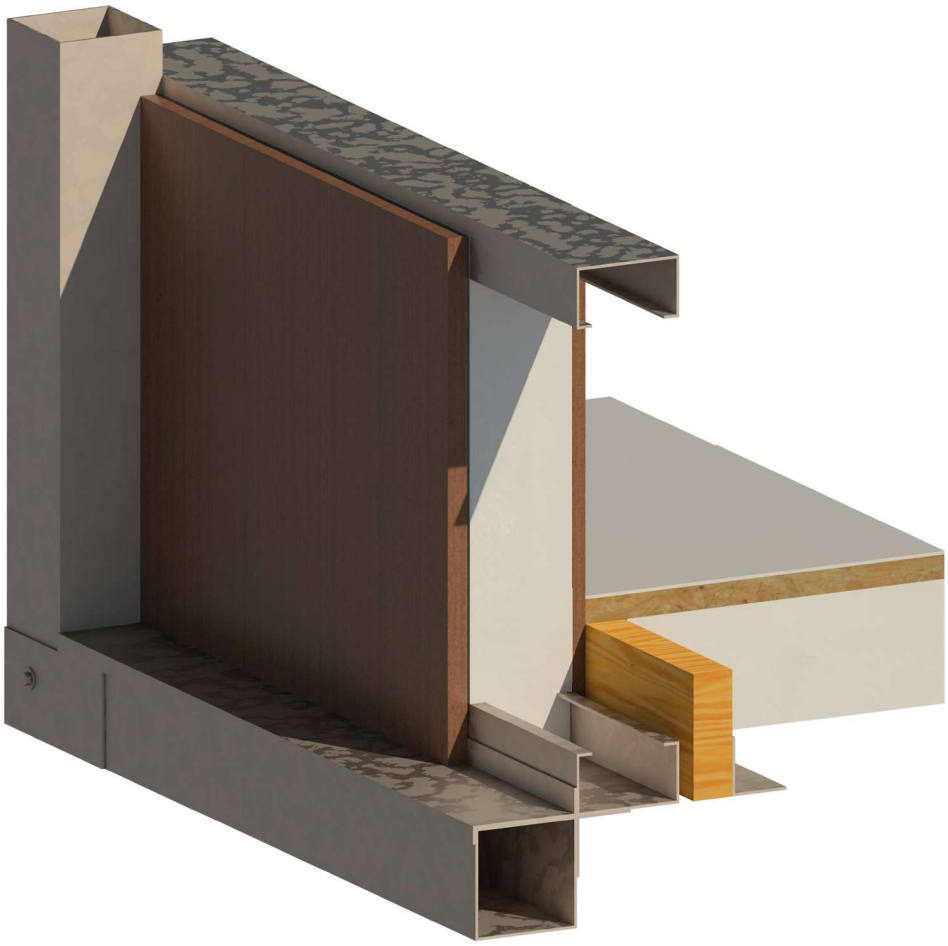
Steel was chosen for the primary structure, as the use of metal refers to the archaeological grid (consisting of steel cables) and allows for the structure to contrast with and emphasise the natural landscape. No wet construction is required and the material is easily sourced from close by.

8.4.2 Demountable infill materials

The choice of infill materials was primarily based on the weight and functioning of the material within the landscape. Although the design does not aim towards mimicking the landscape but rather to contrast with it, it remained important to recognise the qualities of the landscape which draw people out of the city towards it.

IInitially Biowood wood-and-plastic composite interior and exterior wall panelling was explored in order to clad dry wall partitioning, as the material is light, waterproof and fire resistant, and incorporates a tongue and groove connection system. But it was found to be less suitable for the environment than Luna wood. The tongue and grove exterior cladding is screwed to the structure and sealed with Sika-flex glue.

The elevated walkways consist of composite decking planks supported by the primary structure. Loose-packed bricks and cobblestones address any topographical edges and allow for vegetative growth.

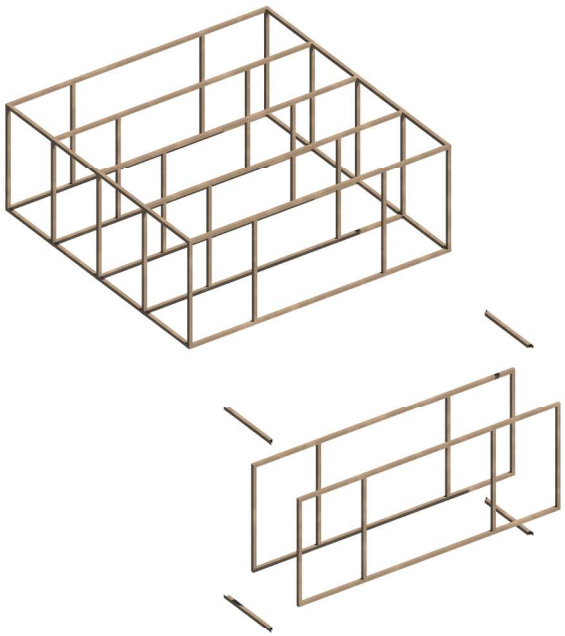


8.15 - Detail section perspective of infill materials (Author, 2016).

8.6 The structure

8.6.1 Demountable primary structure

The primary structure consists of 100mm x 100mm square hollow sections, welded together under factory conditions to form a rectangular 3m x 8m panel. Additional structural supports are welded to the panels 2m from either side. The panels are placed vertically on site and then connected horizontally by 100mm x 100mm square hollow sections with connector plates on either side and bolted to the main panels.



8.16 - Detail perspective of primary structure and exploded view (Author, 2016).

8.6.2 Demountable foundations

The dolomitic nature of the site requires the structure to respond to geological movement. Because of the sensitivity of the site, and the solution is dictated by the concept of demountability. Pile foundations and permanent concrete solutions are to be avoided. The Jacpad foundation system was considered. Jackpad foundations can reach a maximum height of 450mm. The system will therefore not work where the slope of the site calls for a higher solution. In order to address this, as well as actually fixing the structure to the site as required in certain instances it was initially decided to replacing the support block and incremental packers with a 152mm x 152mm x 30mm H-section which is rammed into the earth and cut to be level. This solution was found to be insensitive to the landscape and consisting of too many supports (for each 2m x 3m unit). The system was iterated by the addition of a load bearing I beam running horizontally underneath the structure, with would reduce the need for support to 4m x 4m. The system now consists of three components:

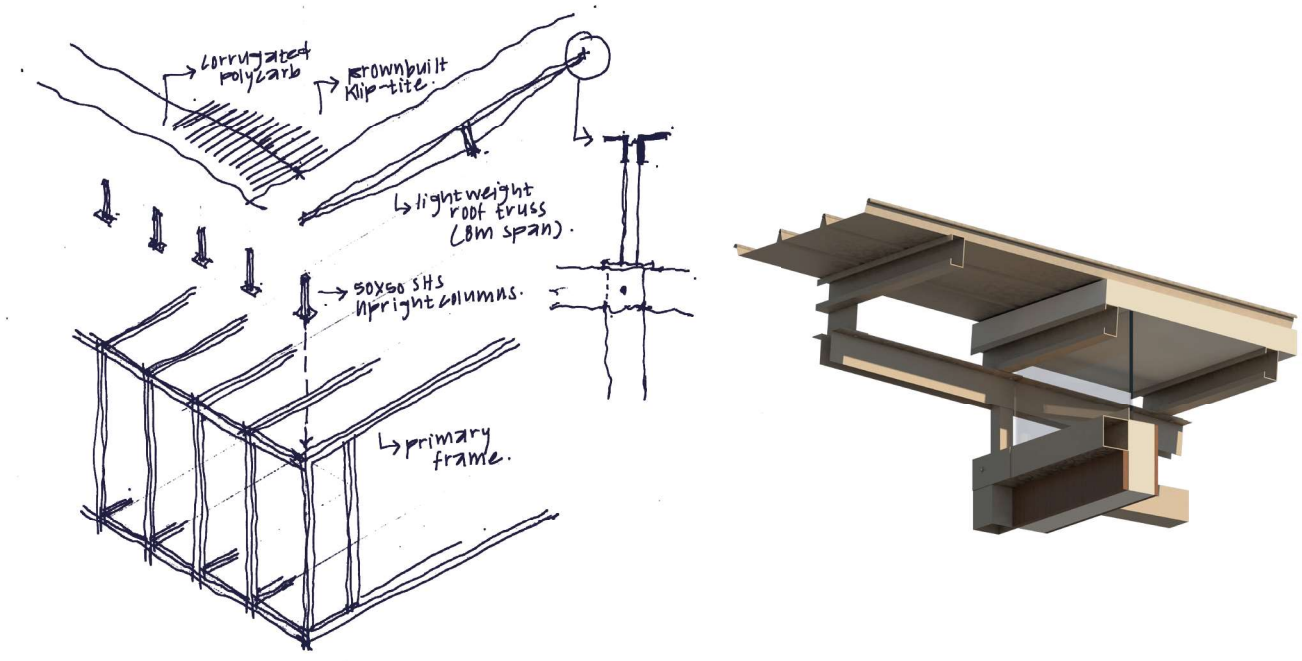
- Double threaded rods welded to the bottom of the 160 IPE.
- The rods are bolted to the head of a 152mm x 152mm H-section mounted vertically with a double system of nuts and washers
- The H-section is supported from a 500mm x 500mm x 10mm steel base plate which is placed level on a compacted section of earth. Four 16mm pegs rammed through holes in the base plate into the earth secure the bases in the landscape.

The advantages of the system are that it is small, relatively light and portable, the height can be adjusted to support the structure in the case of moving dolomite and the installation is quick with little ground or remedial works necessary.

8.17 - Detail section perspective of demountable foundations (Author, 2016).

8.6.3 Demountable roof

In order to unify the primary frame, as well as reduce joints and complicated connections, light weight roof trusses at 2m centres span separately over the primary frames. The roof consist of 0.58mm thick Brownbuilt Klip-Tite galvanised roof sheeting fixed onto 50mm x 75mm light steel lipped channel purlins that are supported on two back-to-back 50mm x 75mm steel angles separated by and supported on 50mm x 50mm upright columns. These columns are in turn bolted to the primary frame structure. The two steel angle rafters are strengthened by a 12mm tensile rod. The roof acts as the proverbial broad rim hat and overhang the primary structure on all sides.



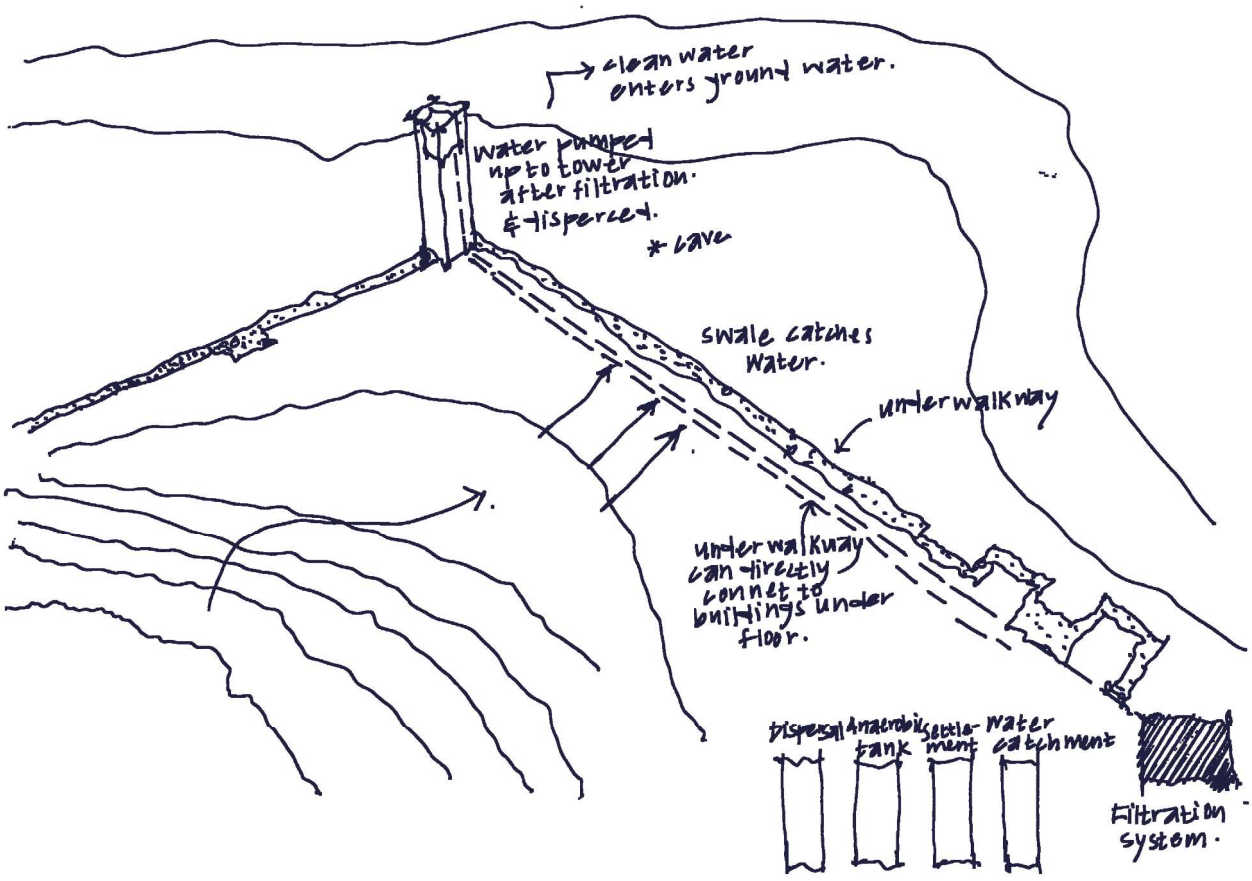
8.18 - Detail section perspective of demountable roof (Author, 2016).

8.7 Demountable services

8.7.1 Demountable water supply

The limited availability of water at the Cradle of Humankind is not only the result of environmental and climatic factors, but is owed to historic and current mining activities. The Cradle of Humankind forms part of the Malmani Subgroup, which houses within the dolomitic geology an extensive karstic aquifer. This aquifer supplies most of the groundwater in the area while overlying the gold-bearing quartzite rocks of the Witwatersrand Supergroup. Although groundwater is abundant in the area, the dolomitic rocks along the southern part of Gauteng and the North West Province were dewatered for deep mining. This dewatering dislocated the usual recharge and discharge rates for the groundwater and interfered with the natural flow of the ground- and surface water in these areas. In addition to the disrupted discharge and recharge rates of the groundwater, the water system is threatened by mining pollution in the form of acid mine drainage (Durand, Meeuvis & Fourie, 2010:74&79); therefore, although groundwater is present in the area, it cannot be used.

In order to maintain the lowest possible impact to the landscape and geology, as well as keep to the concept of demountability, water harvesting is implemented. Through calculations it became evident that not enough water could be harvested from roofs, so swales which follow the natural topographical flow of the site were implemented to harvest water from a greater area. The swale runs underneath the proposed walkway where water from the landscape and roof can be harvested. The water is then filtered and processed, after which it is pumped to a water tower located on the archaeological datum point of the site. The



8.19 - Demountable water supply (Author, 2016).

pipes of this system are not buried in the ground, but lie underneath the elevated walkway provided adjacent to the buildings. Water then runs below the elevated structures to where it is needed.
Greywater, such as water from dishwashing, is filtered through an immediate grease trap before connecting to the water harvesting system. Brown water is addressed through the implementation of self-contained toilets.

The water system filters all water to be potable, which then allows for clean water to infiltrate the groundwater if there is spillage during processes such as wet sieving in the course of excavation. The water source can be extended to serve the informal farming community, adding additional value to the intervention.

8.7.2 Demountable energy supply

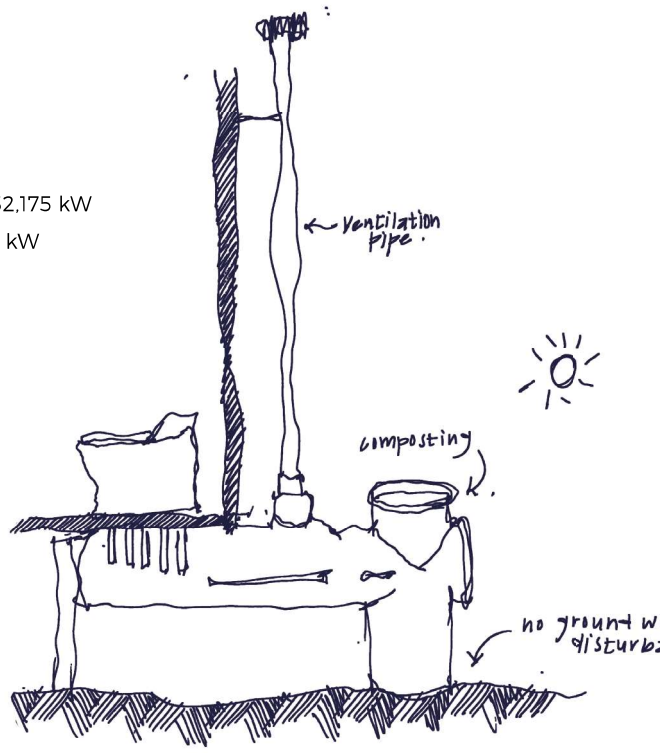
Solar energy is harvested from solar panels on the roofs. Calculations suggest the amount of energy generated in this way is insufficient to satisfy demand. Gas will augment the supply. Each building block is equipped with a distribution board with circuits connecting power to each unit. When a unit is removed, the circuit is disconnected. In so doing, power to other units is not interrupted.

8.7.3 Demountable ablutions

Self-contained composting toilets and urinals are implemented on site in order to reduce water consumption and site works. The toilets stand above ground, with the composting facility underneath the structure. The placement of the toilets allows for sunlight to reach the composting facility . Each composting toilet facilitates 3 to 4 people and is cleaned every nine months. For this reason, the toilets have been located and the vehicular access determined by the need for easy access. The dominant wind direction is NNW which means that odours will be blown away from the buildings.

Solar panel calculations:

Restaurant and administration: 224 m2/1.9m2 = 117 panels = 32,175 kW
Workshop and laboratories: 155 m2/1.9m2 = 81 panels = 22,275 kW
Archives and library: 244 m2/1.9m2 = 128 panels = 35,2 kW



8.20 - Demountable ablutions (Author, 2016).

8.8 Systems and climatic strategies

8.8.1 Introduction to the climate

The climate of the Cradle of Humankind corresponds to that of the typical Highveld climate and falls within the Cold interior climatic zone. The Cradle is a summer rainfall zone with temperate summers and moderately cold winters (Eloff, 2010:25-26). Eloff (2010:25-28) shows rainfall to be 781.7mm on average, with the highest amounts of rain falling in late February and early March. The highest levels of humidity are experienced in the month of February at 80.06%, with the lowest occurring in September and reaching 46.77% (Eloff, 2010:29). The highest wind speeds are reached in the month of August, mostly found to be northerly, and with north-easterly winds also prominent. Wind is the most dynamic variable influencing fire behaviour (Eloff, 2010:30-32). Wind conditions have an ecological function, as they have a particular impact on the fire system, pollination and seed dispersal in the area.

8.8.2 Passive strategies

The following passive strategies, suggested by Peter Muller (2013:105), are implemented in the design:

- Insulation is provided in the form of Neopor GPS, which achieves the same quality of insulation as polystyrene but with 30% less material usage. During the iteration process it was found that additional insulation was required in the roof.
- North- and south-facing walls are maximised.
- Northern and southern glazing is dominant.
- Cross ventilation and night-time cooling is implemented,.

8.8.3 Active strategies

The implementation of underfloor water heating was investigated but deemed unnecessary. Mechanical ventilation is required in the laboratory facility which is powered solar power.

SANS 204 FENESTRATION

	ORIENTATION	PROJECTION		HEIGHT	P/H	E	SHGC	AREA
Window N	n	2	3	0.67	0.33	0.37	2.28	0.278
Window S	s	0.5	0.1	5	0.16	0.81	4.56	0.59
Window E	e	0	0	0	1.19	0.37	2.655	1.17
Window W	w	0	0	0	1.3	0.37	2.655	1.28
							3.318	

Danpalon 10 mm Bronze SHGC 0.37
U- value 2.11
R- Value 0.4739
SHGC Constant = 0.15 for Climate zone 1 x 46.61 = 6.99

U constant = 1.2 x 46.61 = 55.93

Conductance

	AREA	U VALUE	Total	
N	2.28	Danpalon	2.11	4.88
S	4.56	Clear single	7.9	36.02
E	2.655	Danpalon	2.11	5.6
W	2.655	Danpalon	2.11	5.6
			52.1 = smaller than 55.93	

8.21 - Detail section perspective through fenestration (Author, 2016).

8.9 Landscape interventions

8.9.1 Access

The site is currently fenced off with wire mesh and gum poles to prevent public access and cattle theft. The researchers access the site through an overgrown farm gate from Sterkfontein Road, while three other points of illegal entry have been identified. After entering the site, the researchers travel up an eroded gravel road using off-road vehicles.

A new access road from Sterkfontein Road is proposed, connecting to the group framework tourism corridor, which would allow research staff as well as a tourist shuttles to enter the site. The road moves past the informal farming community, connecting the cave site and the community as well as the proposed researcher accommodation located within the area. The route follows a slope no greater than 1:10 to reduce the risk of erosion.

8.9.2 Parking

Currently erosion on site is most evident at the access road to the fossil site. Where the new access road is proposed, care is taken to not create any hard surfaces that could become eroded and would lead to an increase in runoff. An EnviroGrid Geocell system is implemented, which consists of a three-dimensional cellular confinement system made from plastic with individual cells resembling a honeycomb. The grid is filled with rocks or soil and can be vegetated, allowing for deep root growth. The system slows the flow of water down the slope, thereby reducing erosion. The intervention is extensive, yet will have a positive long-term impact on the landscape.

8.9.3 Storm water

Rain occurs mainly during the summer at the Cradle, often in the form of thunderstorms. Averaging between 650 and 750mm per year, it recharges the natural groundwater through sinkholes (Maropeng, 2016). As karst areas often lack well-defined natural surface drainage systems, surface water dissipates through infiltration or by dropping into sinkholes. Sinkholes are typical formations of karst terrains and are in essence surface expressions of the internal drainage and erosion process. Acting as funnels, rapid surface storm water runoff is directed from the ground surface into karst aquifers. Additionally, storm water runoff can modify local groundwater conditions, increasing the possibility of sinkhole collapse.

Kromdraai Cave lies on a topographically high position in the Cradle. Management measures are implemented in order to address the accumulation of storm water at the northern edge of the site, which is contaminated by cattle farming activities and road water before meeting the Blaauwbankspruit. These management measures consist of vegetative controls and wetlands.

Vegetated surfaces can decrease runoff velocity, filter solids, enhance sedimentation, and increase infiltration (Zhou & Beck, 2008). Pollution removal is therefore assisted naturally while soil erosion is decreased. Near the ditch of the Sterkfontein Road, runoff accumulates and continuously filtrates into the underlying karstic aquifer. A swale on either side of the road is proposed to aid soil filtration, maximising contact with the soil and reducing the threat of sinkhole collapse due to ponding surfaces. Moving further down the slope, a wetland area is proposed adjacent to the Blaauwbankspruit, where the water table is near the ground surface and the land is swamped by relatively shallow water. The wetland treatment system, a variation on detention pond methodology, removes runoff pollutants primarily through sediment retention and vegetative uptake. The wetland provides highly effective highway runoff management, because it absorbs large quantities of suspended and dissolved materials (Zhou & Beck, 2008).

8.9.4 Fire

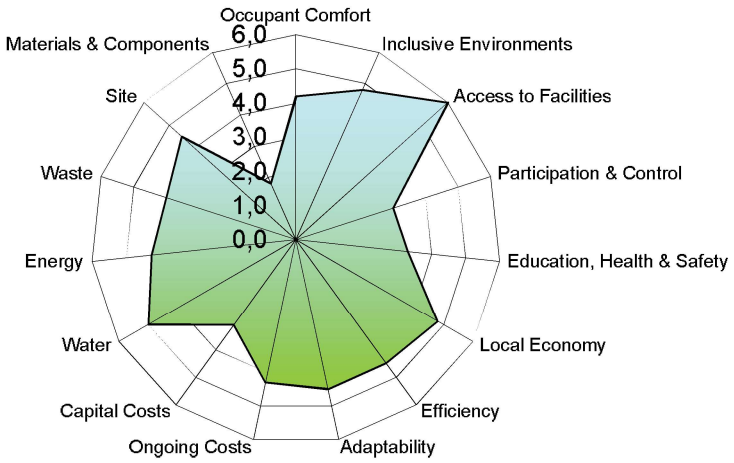
Wild and uncontrolled fires are a general problem within the Cradle of Humankind, and currently no guidelines exist to deal with the issue. Many families reside nearby and fire is a constant safety threat in dry seasons. Fire-prone structures are at risk and the site is ultimately vulnerable. The owner of the site uses controlled fires to aid the growth of vegetation and as a means of controlling invasive species.
Firebreaks on the boundaries of the farm are implemented as a means of preventing wildfires from spreading across to neighbouring farms. In the case of controlled fires, structures should not be impacted as the process is managed to not reach the areas around the proposed intervention. Nonetheless, the following measures are additionally implemented to increase the safety of the structure (Michler, 2013):

- Eaves and vent openings are secured to prevent embers from starting a fire in the interior.
- The roof is protected by choosing an appropriate material such as steel.
- Window openings are kept small as smaller sizes are more stable than larger windows.
- Complex shapes and protuberances are avoided to reduce the threat of embers lodging in the structure. A standing water source is available for firefighters, fire hose reels are provided at strategic points and each space is provided with fire extinguishers.

SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT- P) V1

PROJECT

Project title: The Scientist, the collector and the treasurehunter
Location: Kromdraai cave
Building type (specify): Commercial
Internal area (m2): 600
Number of users: 100
Building life cycle stage (specify): Design



8.22 - Sustainable building assessment (Author, 2016).

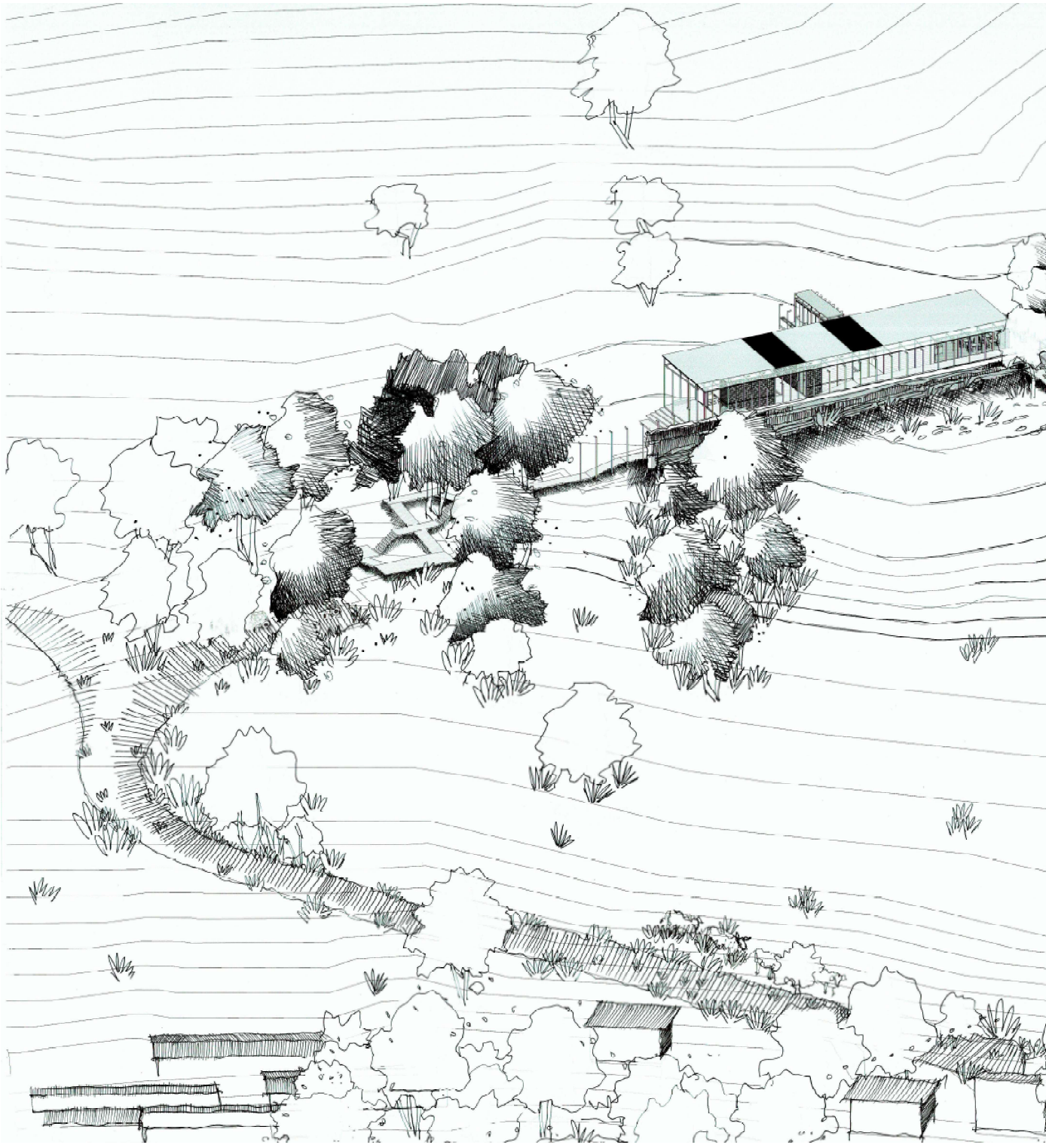
8.9.5 Red data species, rare plants and wildlife

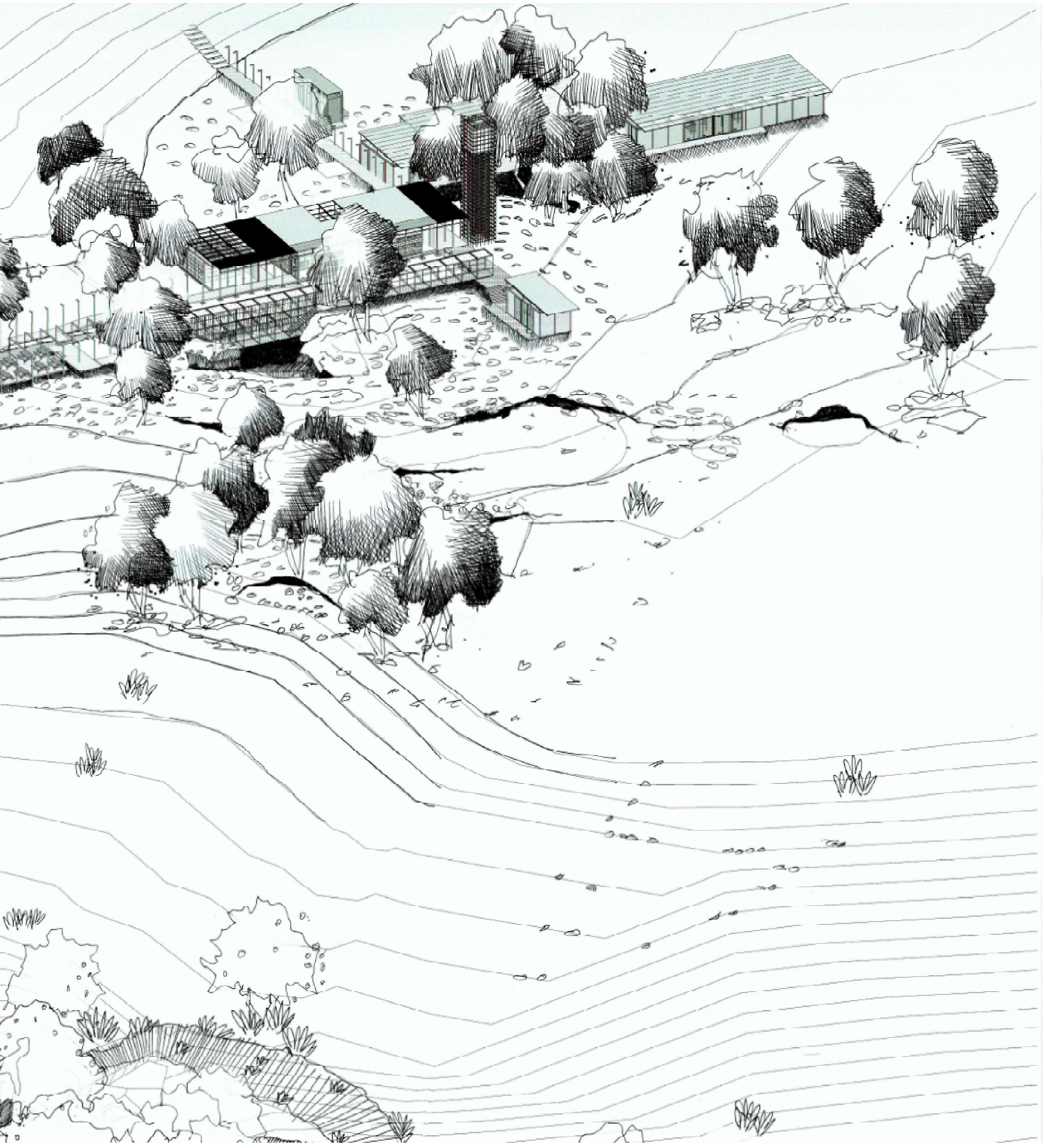
Although it is known that species on the Red List of South African Plants as well as other important plants occur at Kromdraai, no known records or botanical and faunal lists exist. The lack of information makes the protection and proper management of these species impossible. The programme of the research facility allows for an archive to be established of not only the fossil finds, but for the documentation of the landscape surrounding the fossil finds. The intervention limits access to the site during night-time, aiming to not disturb wildlife such as owls and bats.

Aloe greatheadii var. davyana, commonly known as the spotted aloe or Transvaalaalwyn, is proposed as a means of rehabilitating the excavated site. The plant is indigenous to the Cradle of Humankind, with a specimen already located on the site. The plant has been used as a soil binder in disturbed areas such as mine dumps and is pollinated by birds, bees and butterflies (Hardy & Hardy, 2007). The Aloe greatheadii is the most important indigenous South African bee plant(Human, 2006:13). The plant furthermore possesses medicinal properties and can be used commercially. Because of the succulent nature of the plant, very little water is needed.

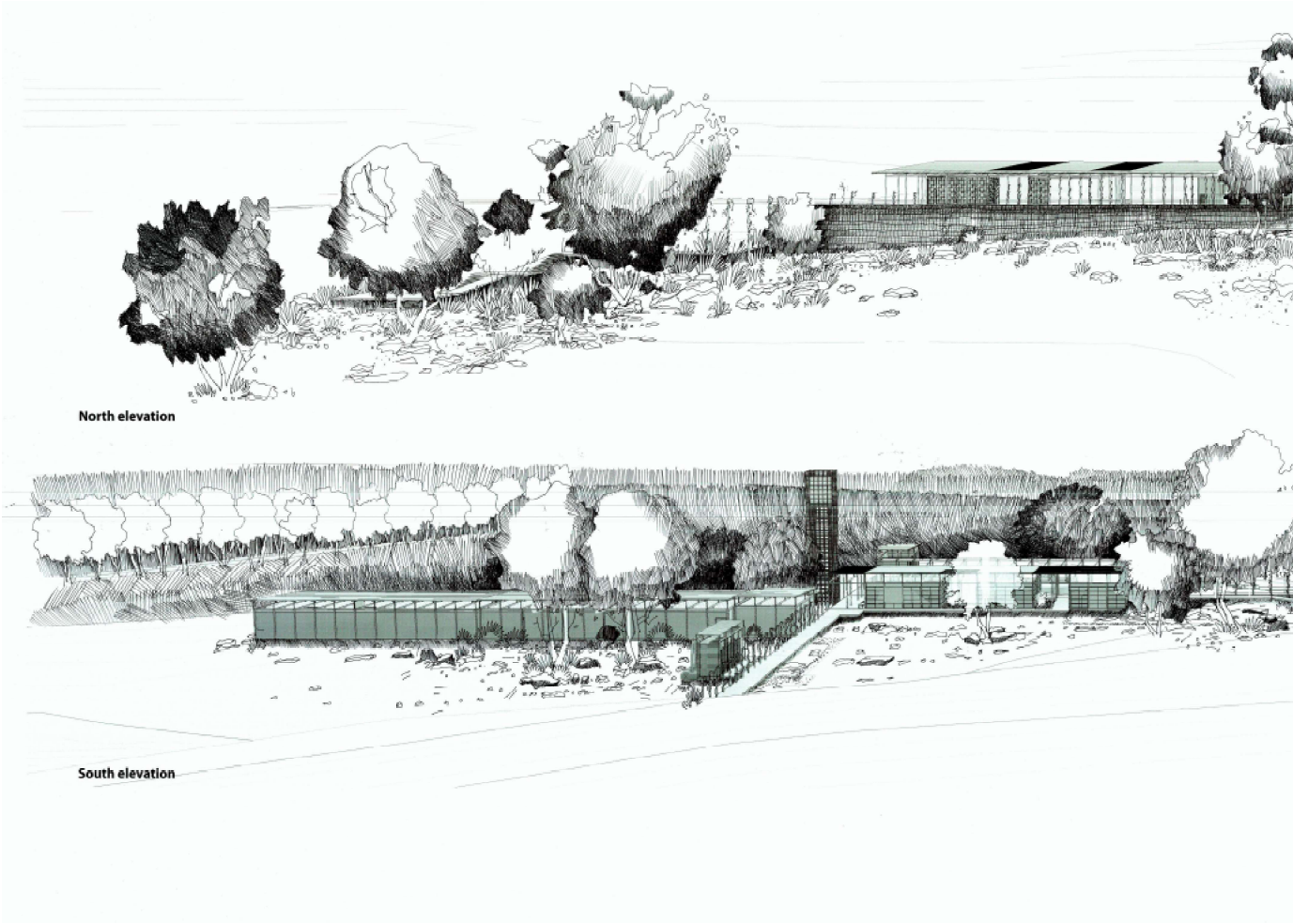
Chapter 9

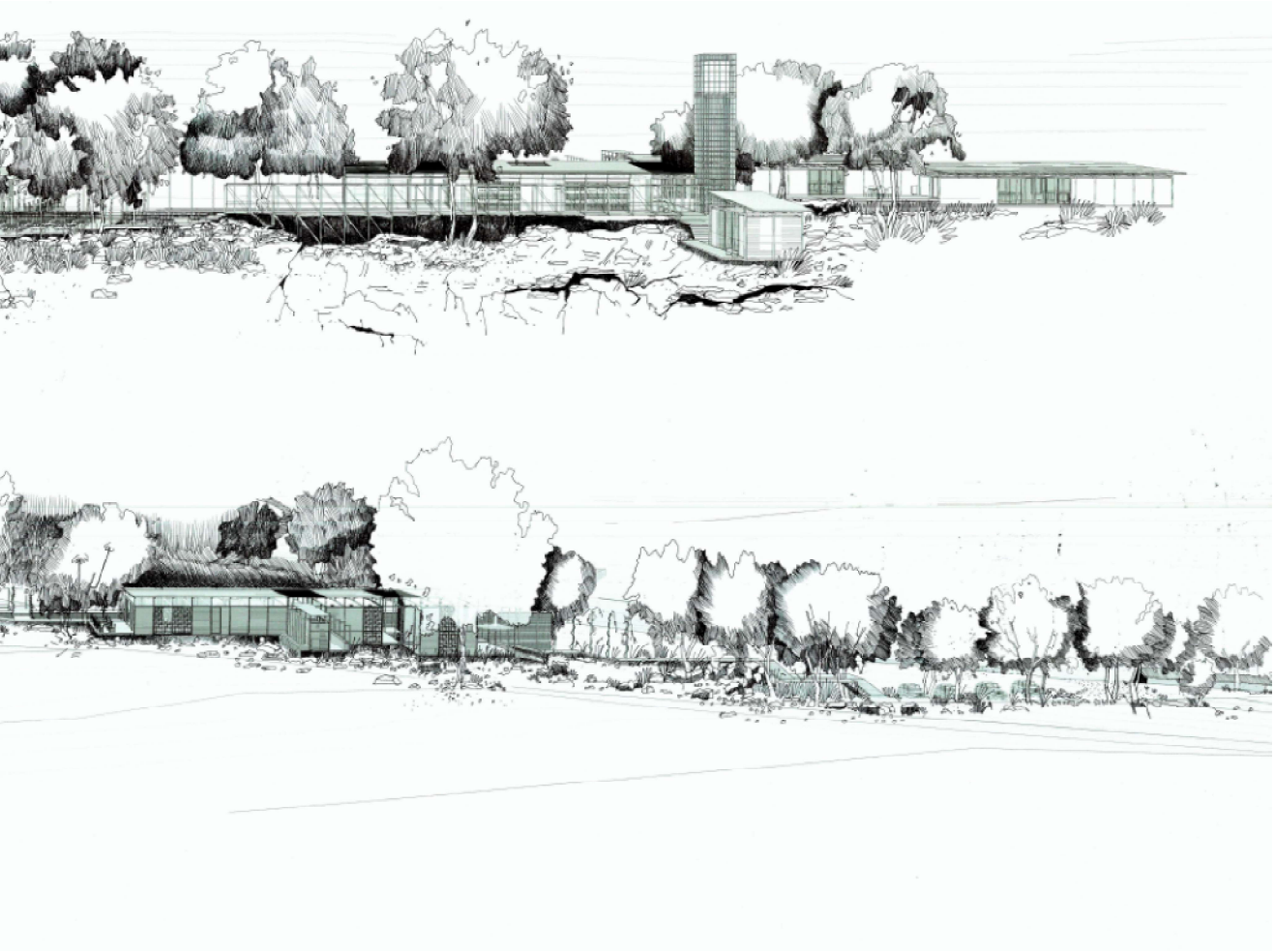
Design resolution

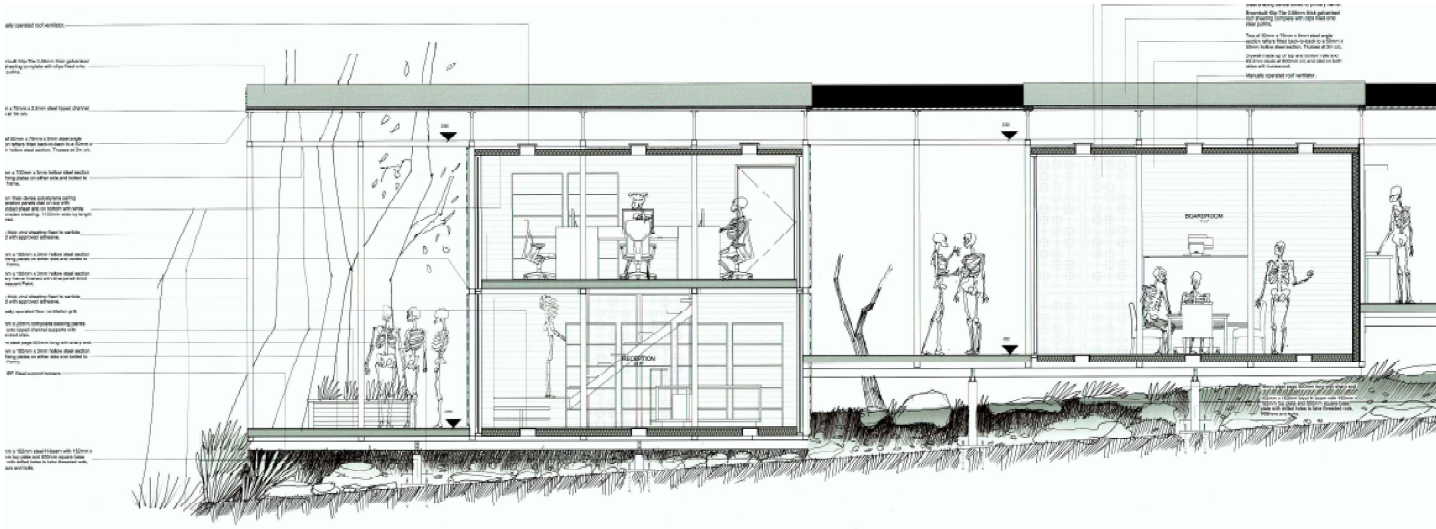


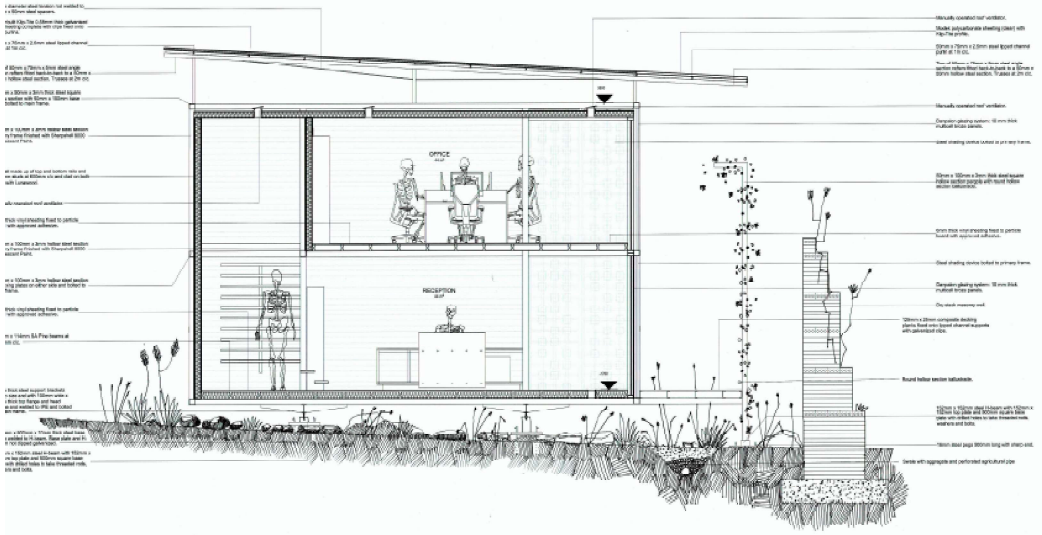


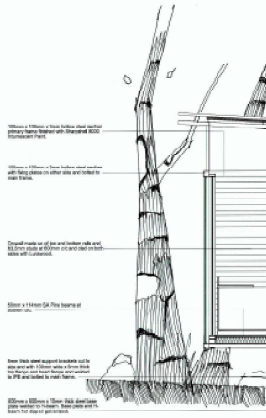
9.1 - Site plan perspective, not to scale (Author, 2016).





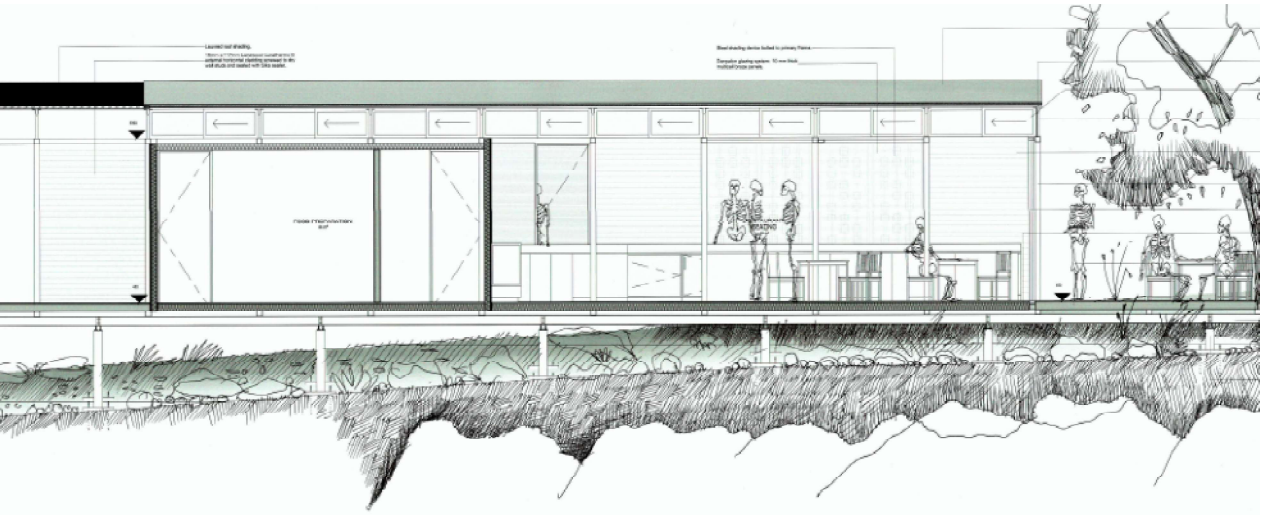


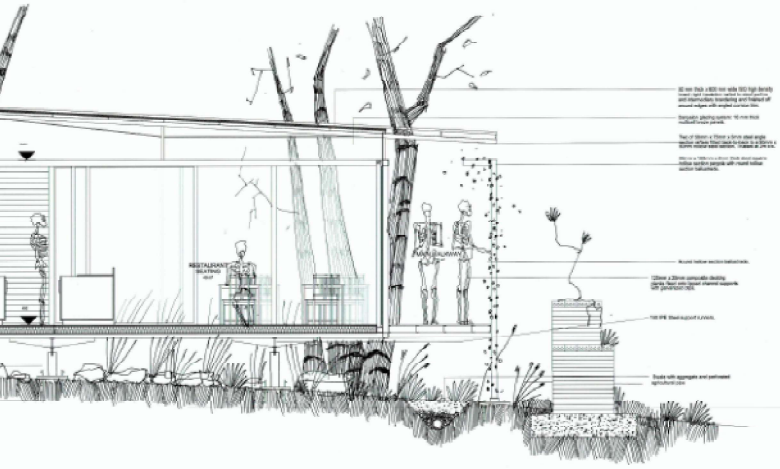


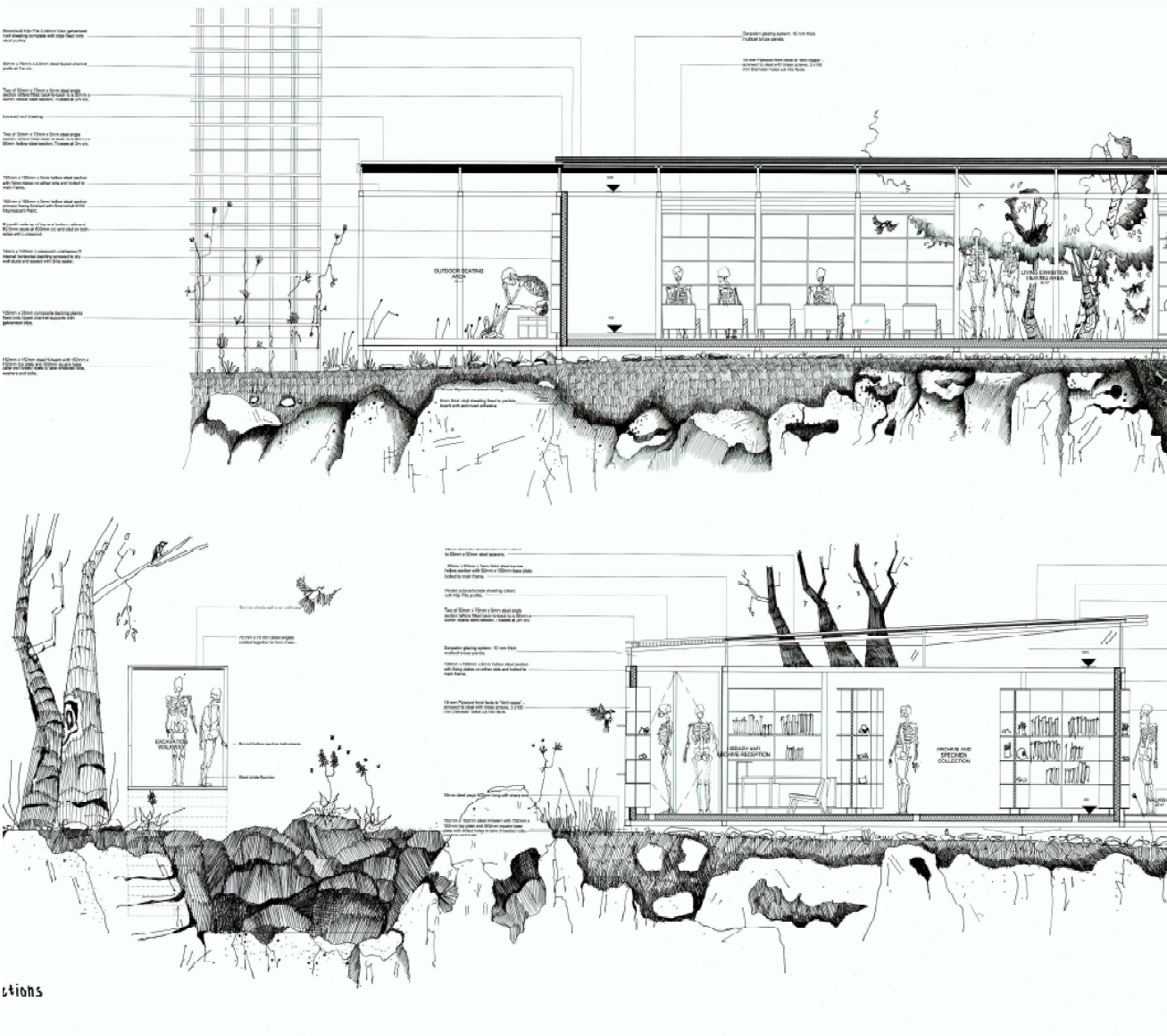


Section 3

scale 1:20







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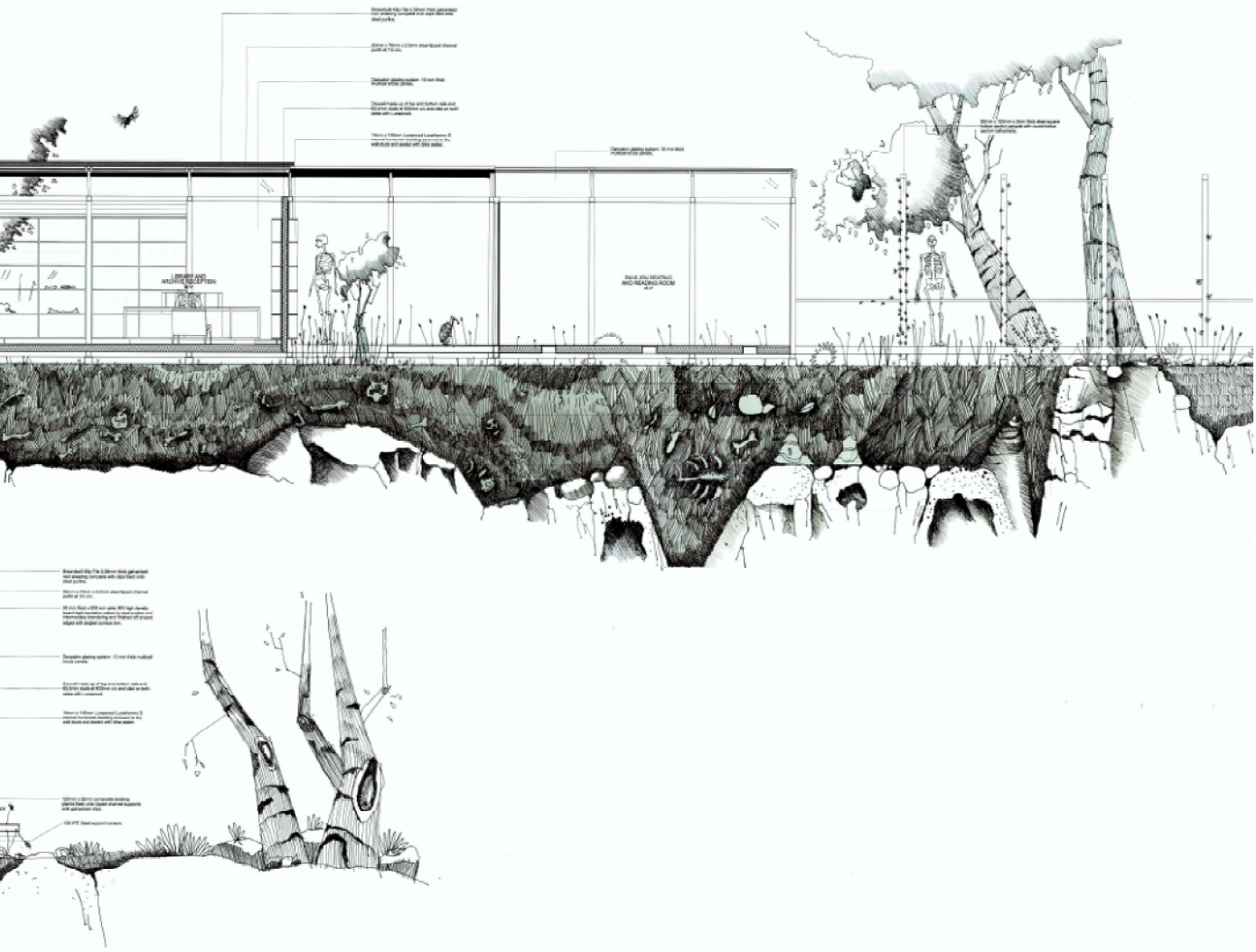
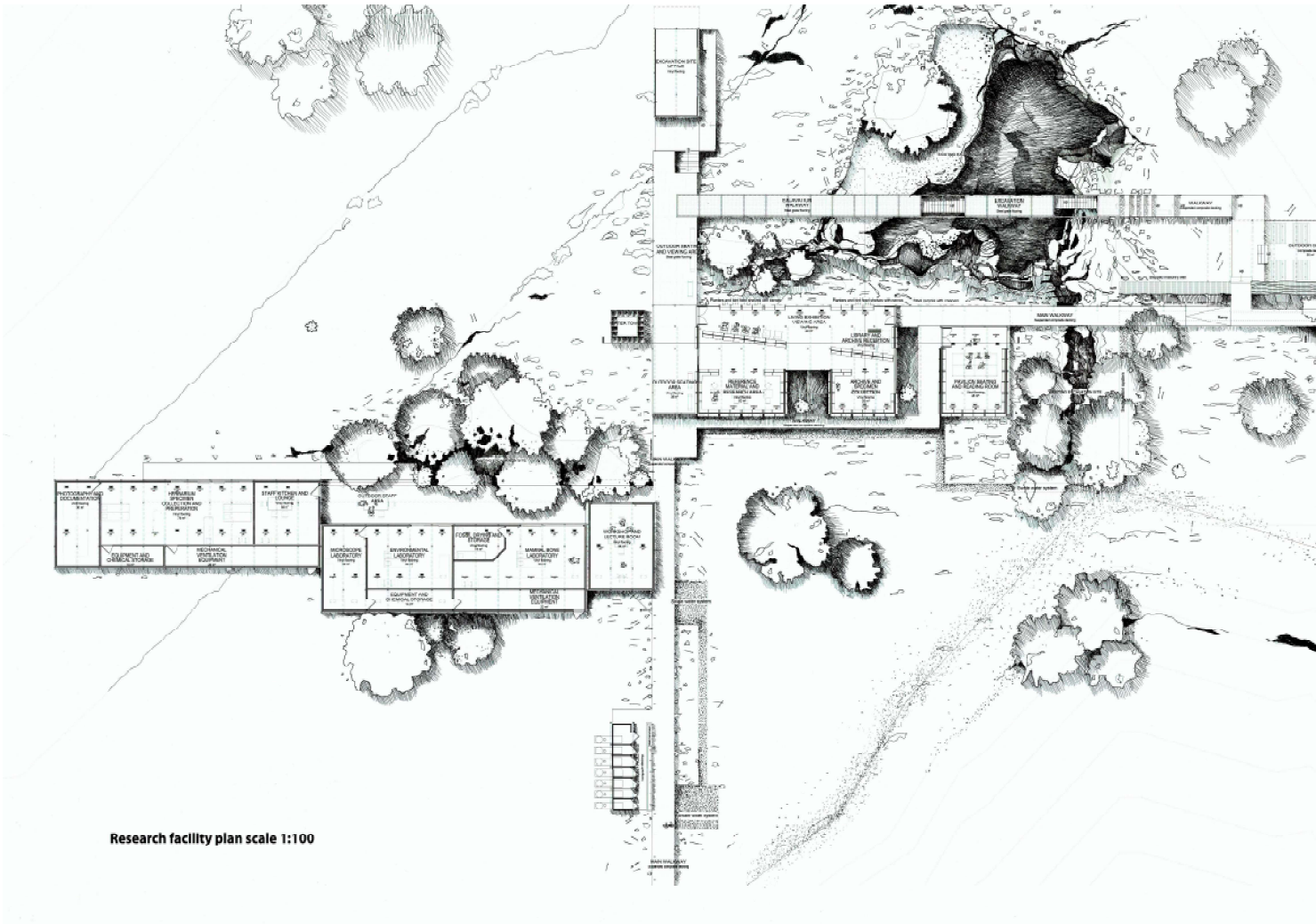
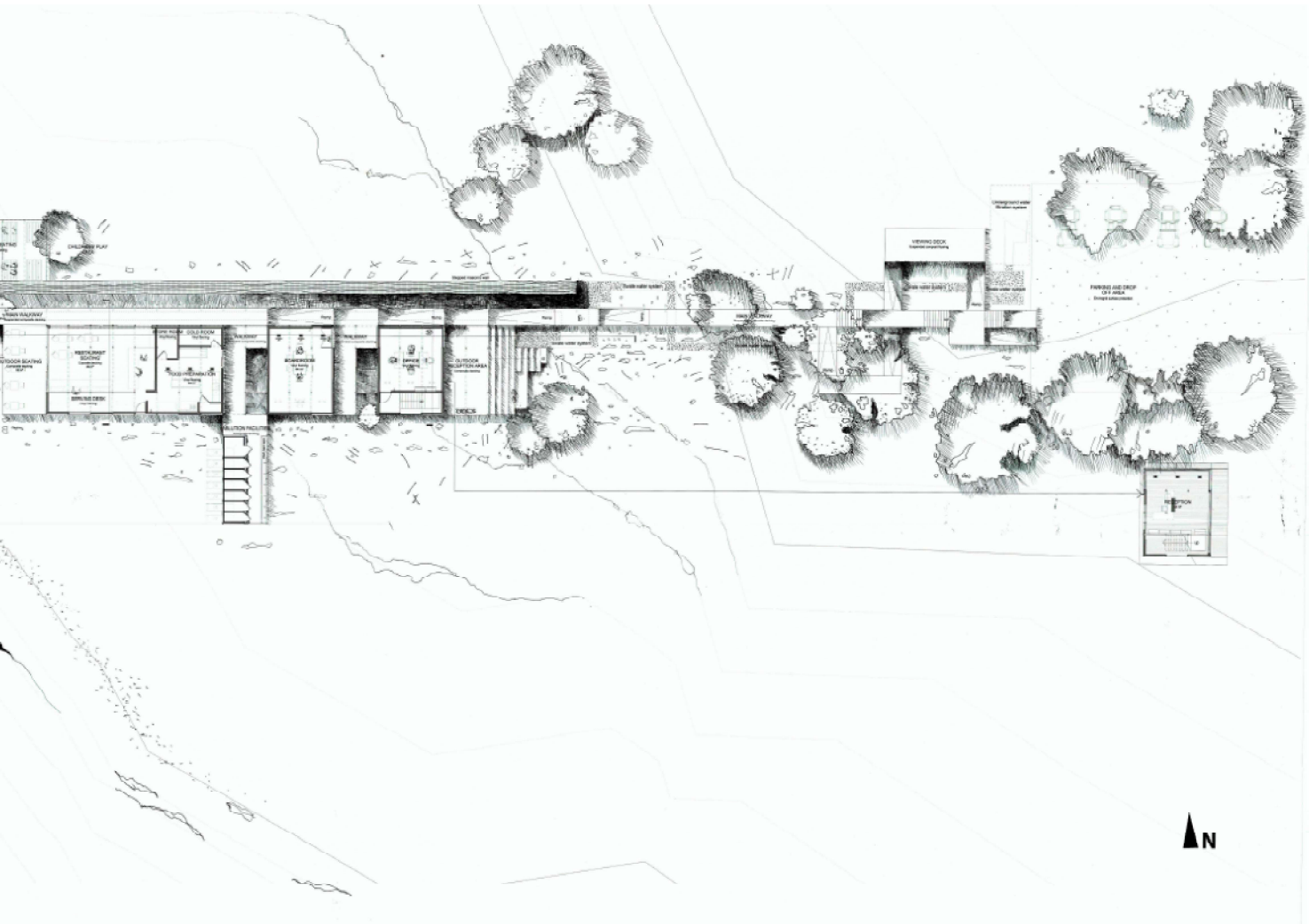
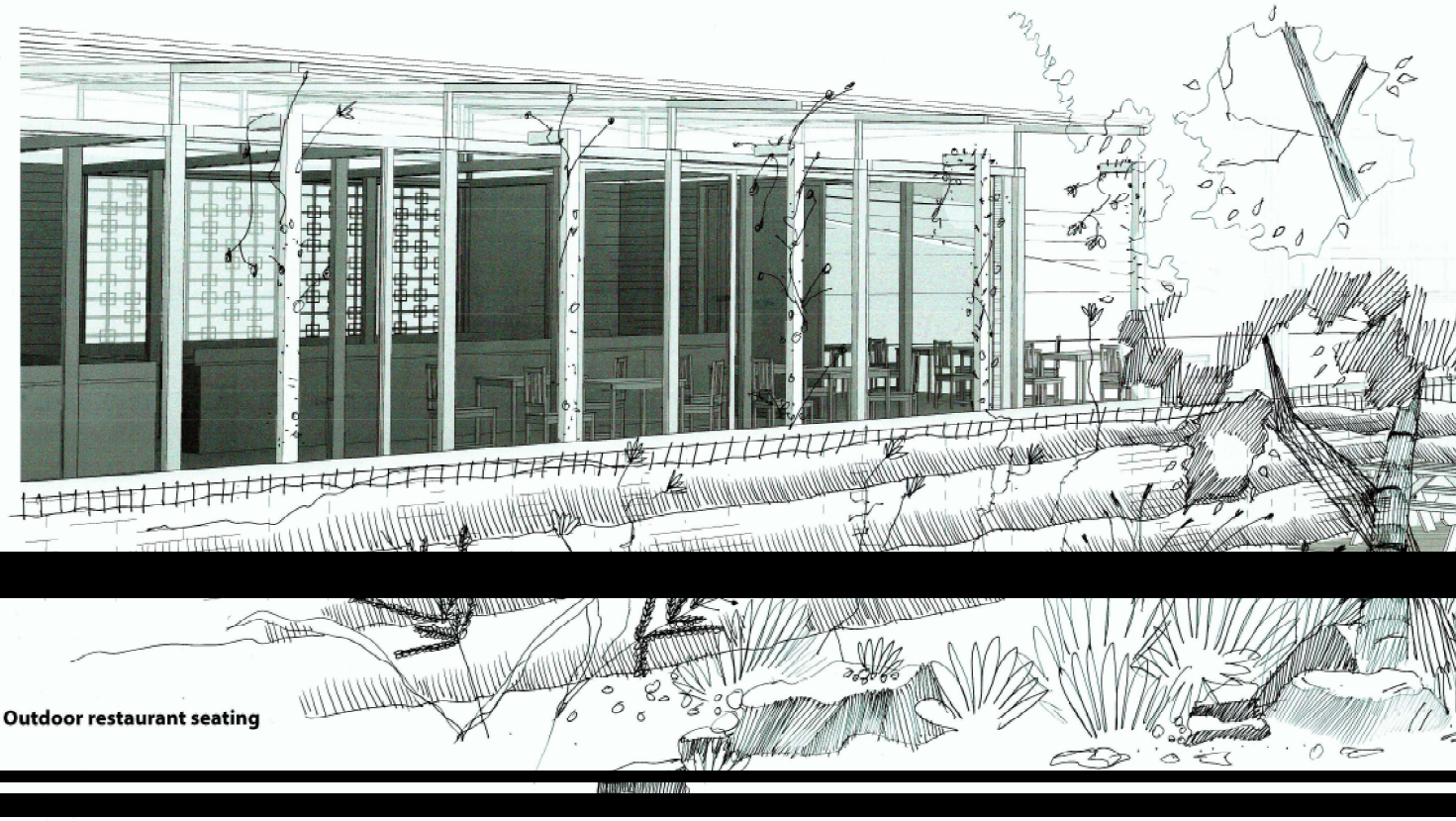


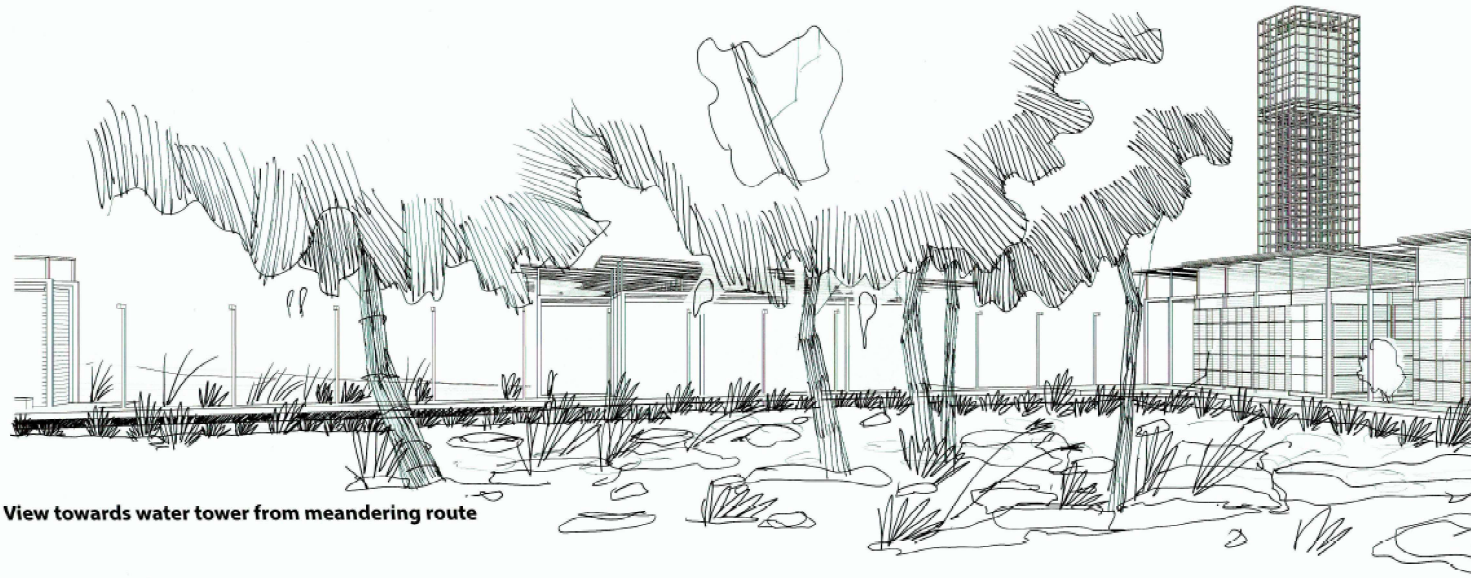




9.2 - Ground level layout (Author, 2016).

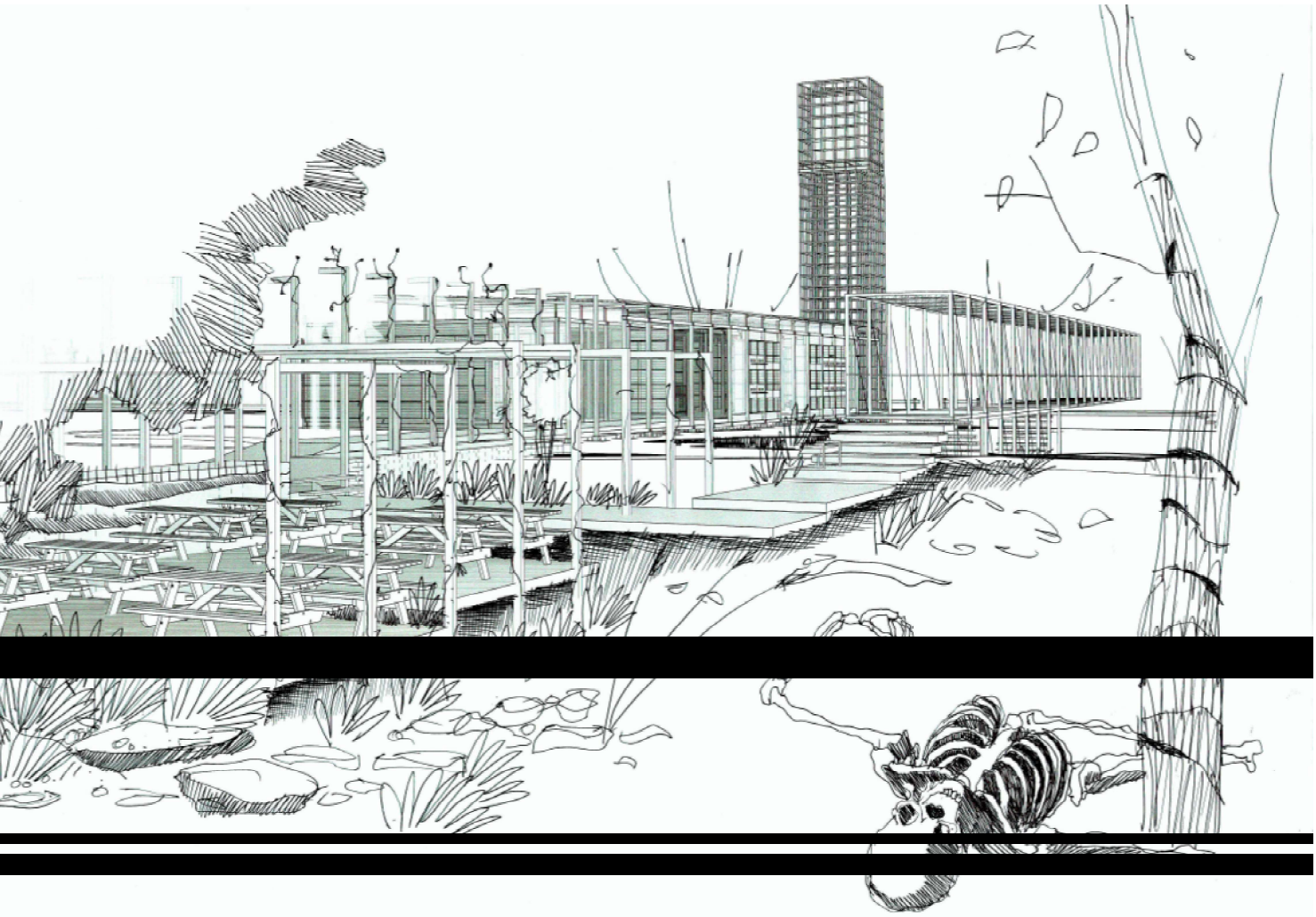


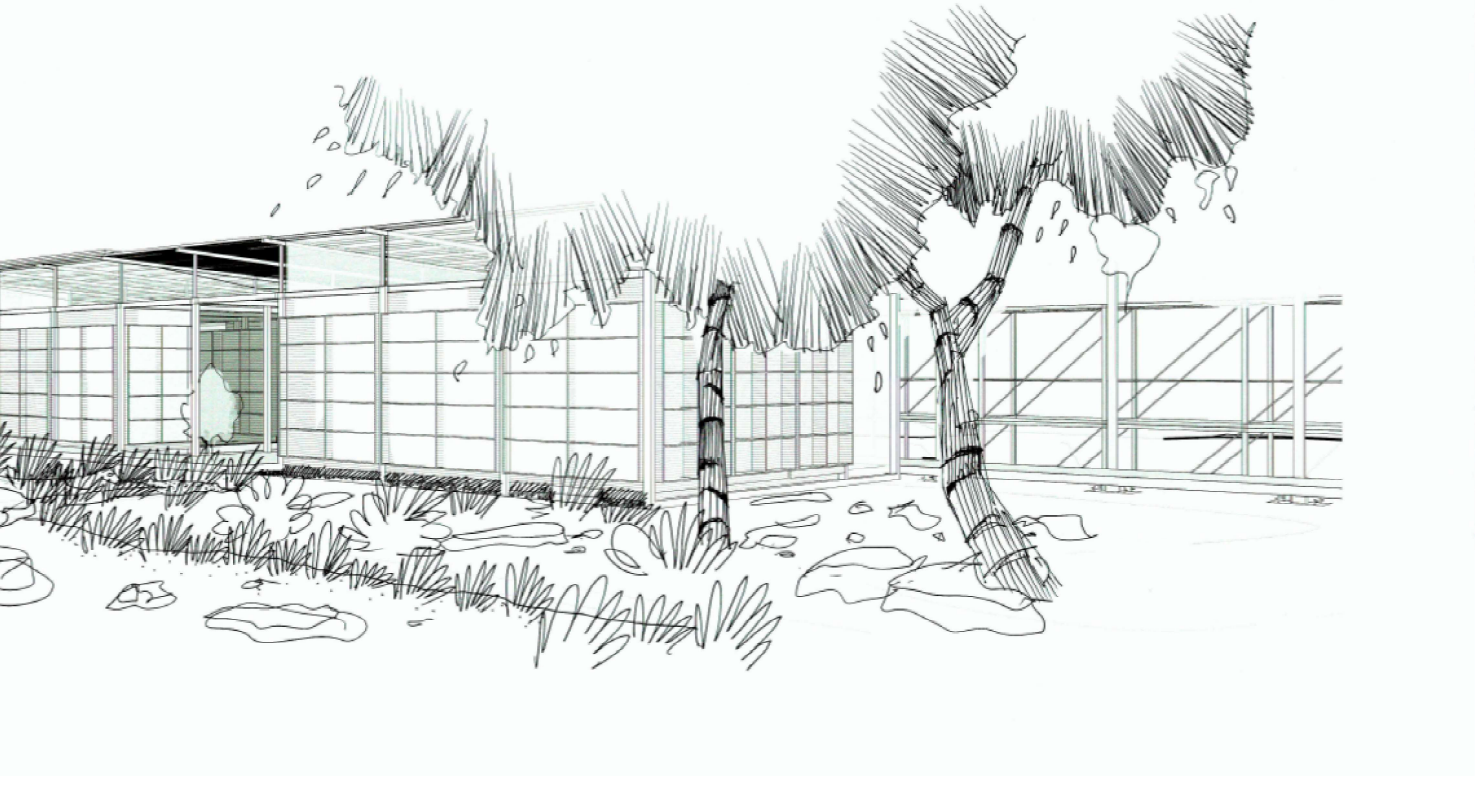
Outdoor restaurant seating

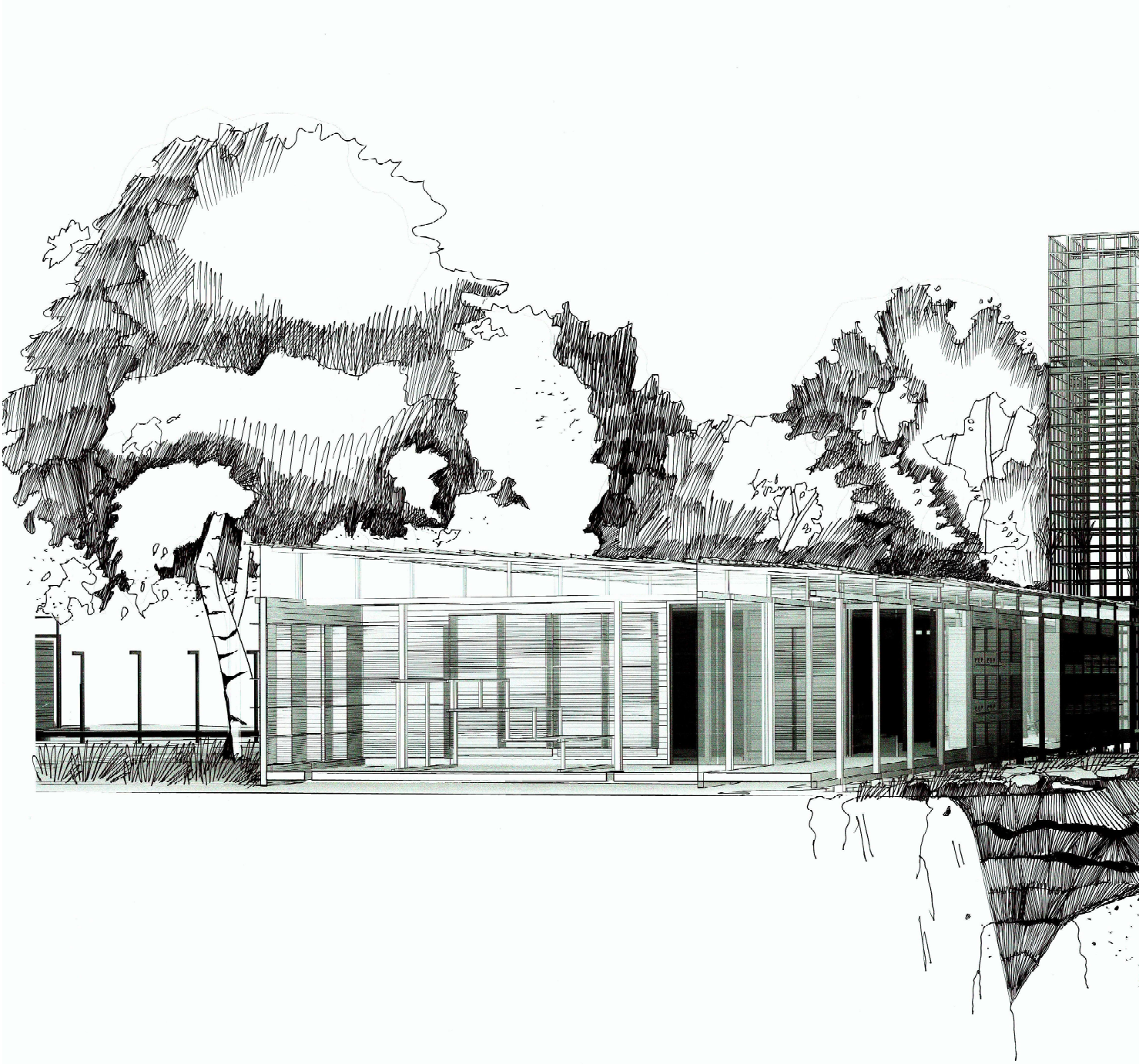


View towards water tower from meandering route

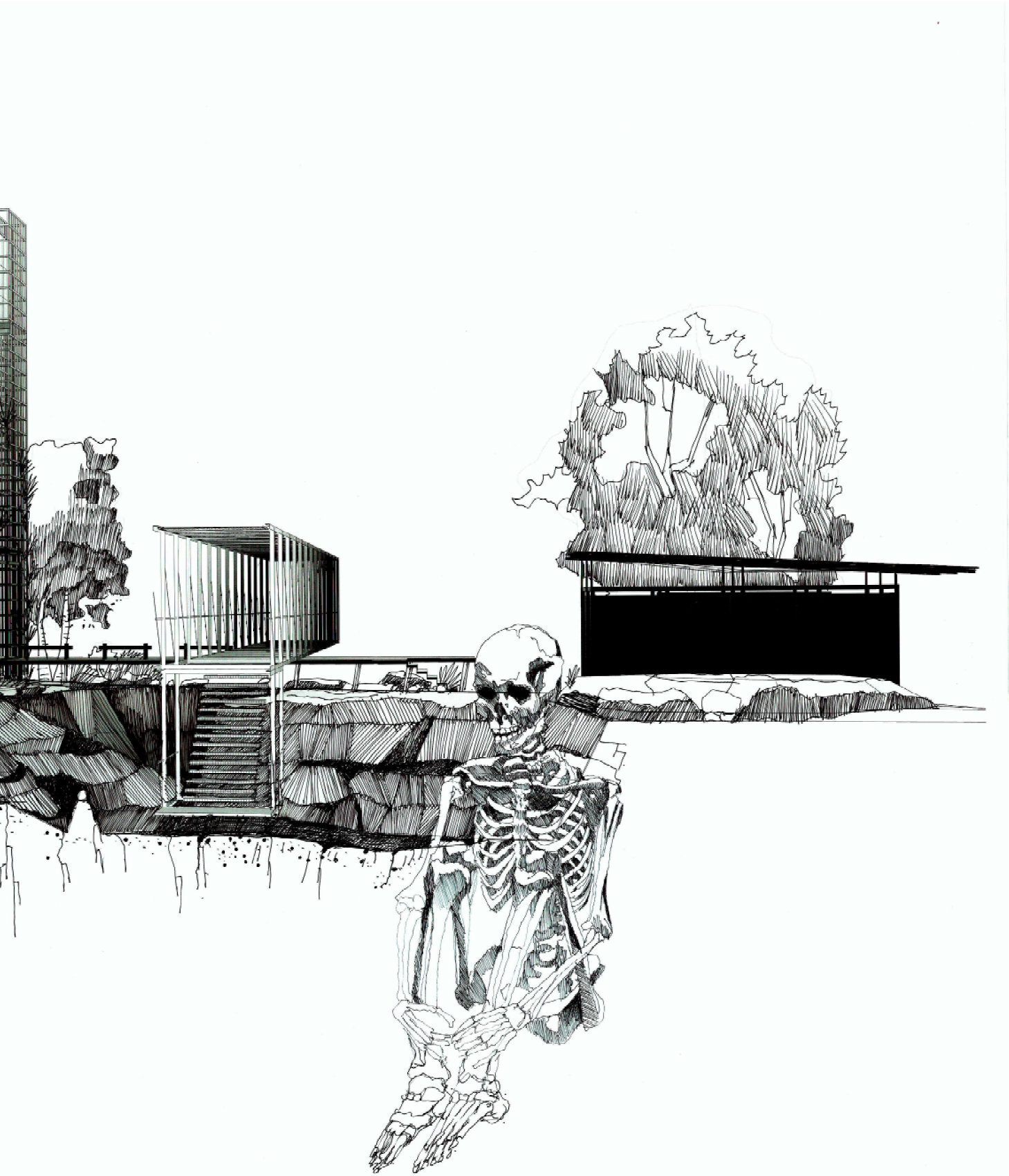
Perspectives



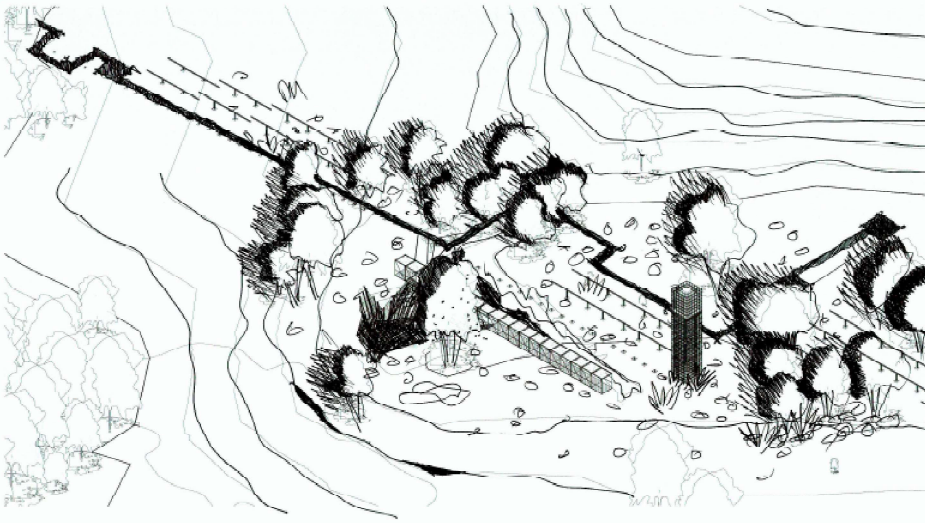




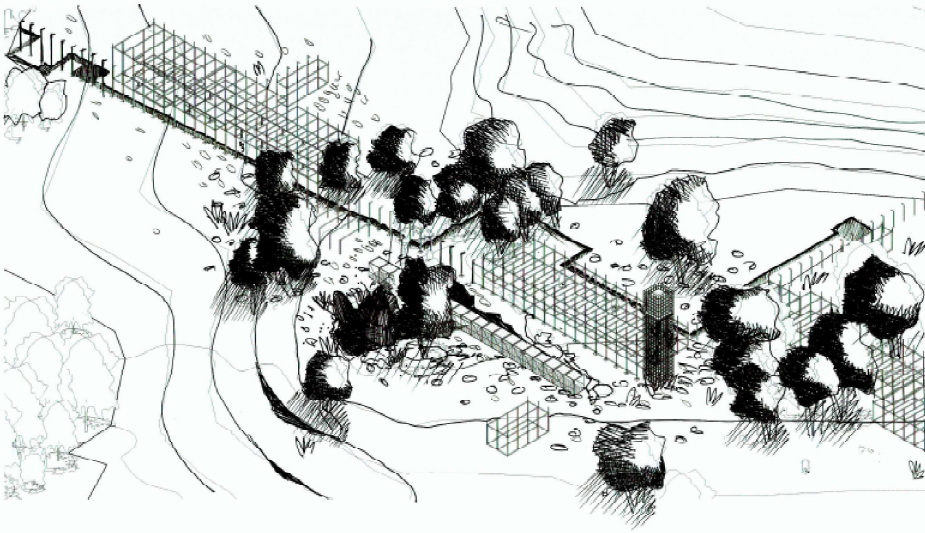
The grid

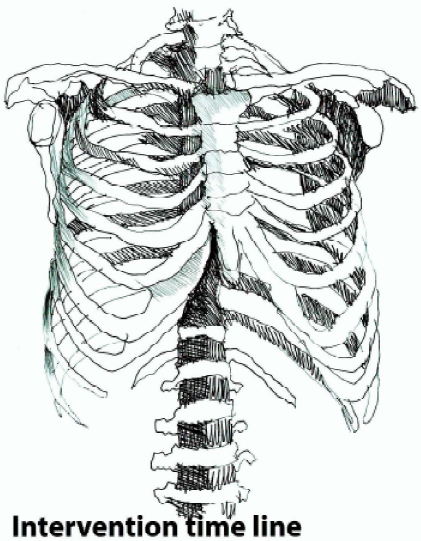


Supporting structure

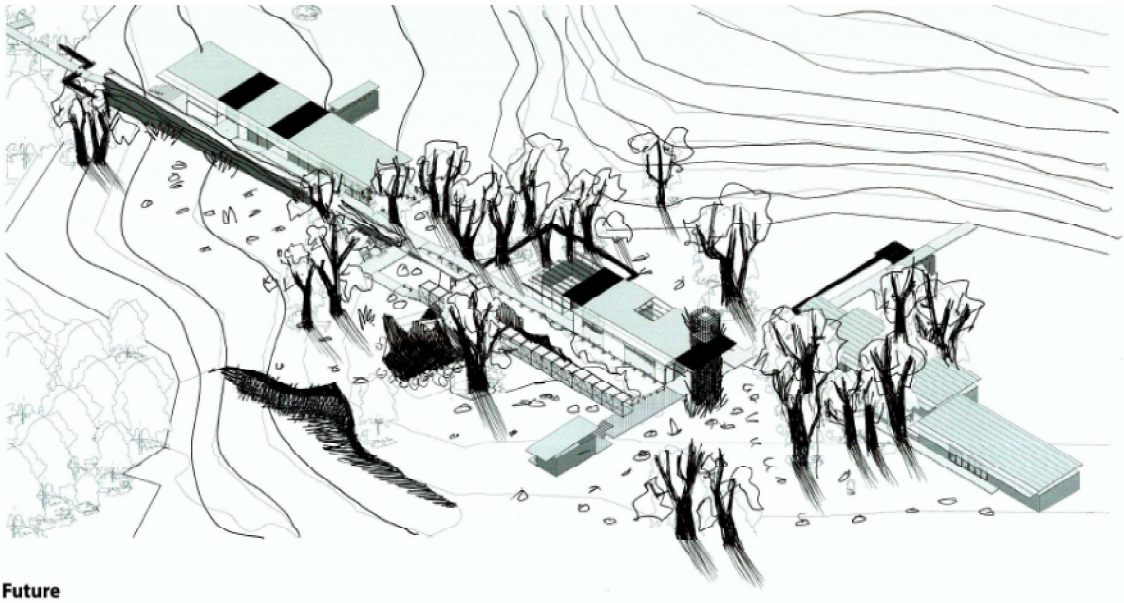


Primary structure

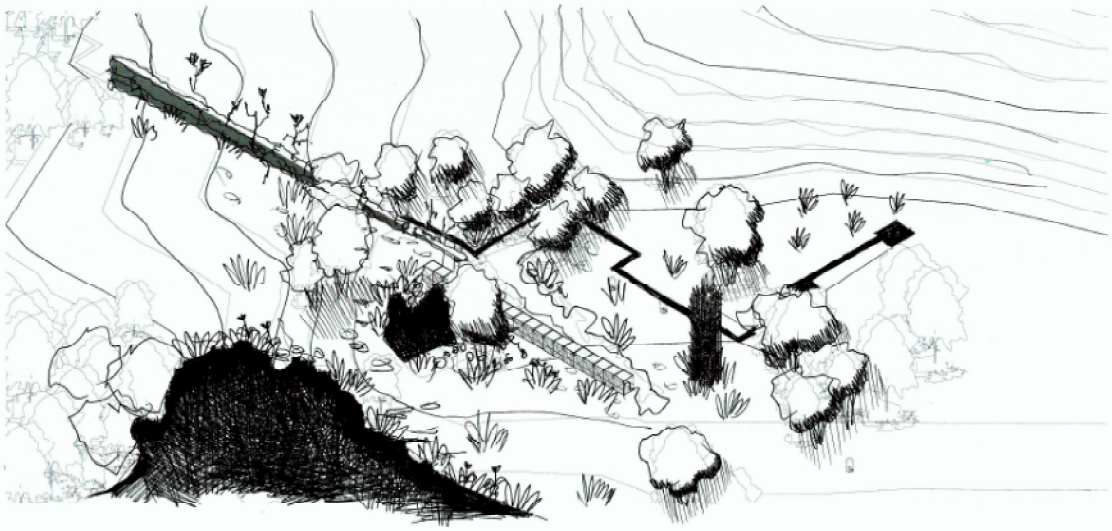




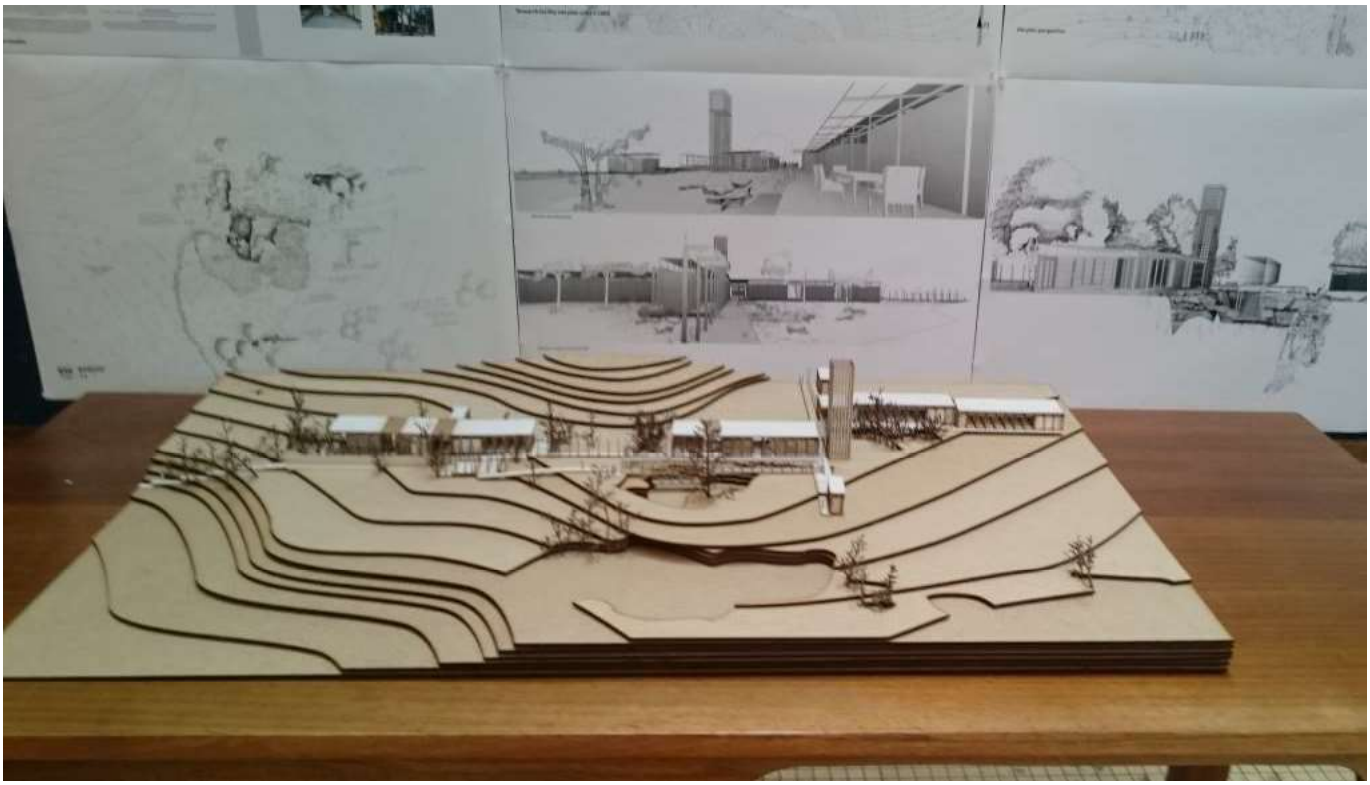
Intervention time line

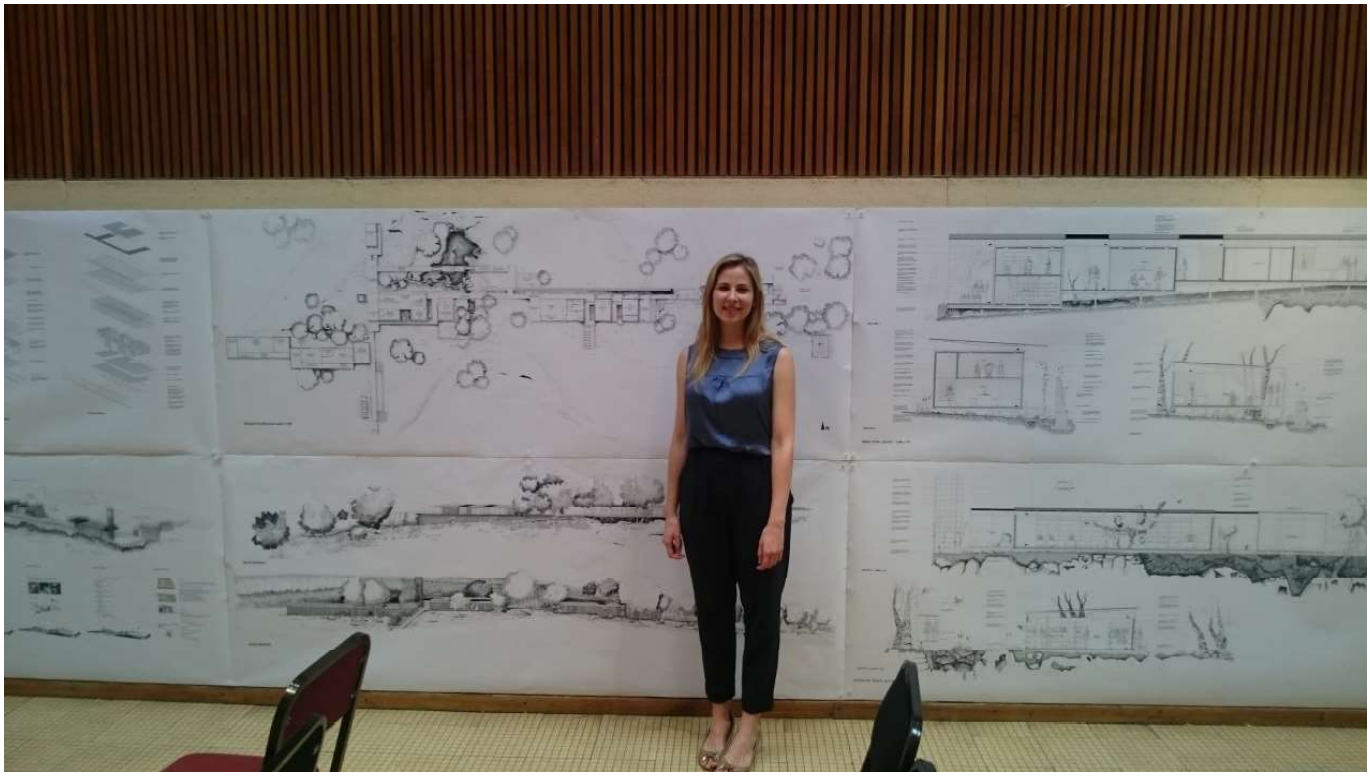


Future



Far future





Chapter 10

Conclusion

The area known as the Cradle of Humankind is one of mystery and intrigue. It is filled with hidden secrets and uncharted potential and is saturated with meaning at many levels. Its complex landscape, complicated geology and rich history has been challenging to appraisal, appreciate and assimilate. All this has, however, provided an exceptional backdrop to the process of developing an intervention that is both appropriate for the present and visionary for the vast unknown future.

This dissertation attempted to find a means of designing systems and structures that are sensitive to the landscape. It searched for a language and approach that celebrates time (past, present and future) and enhances accessibility to the knowledge embedded in the very landscape. Furthermore, the dissertation attempted to find a way of increasing the value of the landscape in the eyes of the public and elevating its worth through the creation of new experience and memory of space and environment.

Through the discipline of the design process and its many iterations, the distillation and reduction to the level of contextual essential has made it possible to achieve more with less and to celebrate the natural intangible qualities of the design rather than to create a celebrated design.

The journey I travelled taught me to be unrelenting in questioning, rehearsing and searching in my quest to find the optimal solution.

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