

# Fort Merensky: abditory & observatory

Narrating the Botshabelo story through acts of hiding and revealing

by

Wilmé Müller



# Fort Merensky: abditory & observatory

Narrating the Botshabelo story through acts of hiding and revealing

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Submitted in partial fulfilment of the requirements for the degree of Masters in Architecture (Professional)

Faculty of Engineering, Built Environment and Information Technology.

University of Pretoria

## Location:

25°41'09.07" S ; 29°25'17.99" E  
Botshabelo Historic Mission Village,  
Mpumalanga, South Africa

## Programme:

Fort Merensky Interpretation Center  
& Researchers Retreat

## Research field:

Heritage and Cultural Landscapes

## Study leader:

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## Course coordinator:

Dr. Arthur Barker

## Edited by:

Jessica Cochrane

## Declaration

In accordance with Regulation 4(e) of the General Regulations (G.57) for dissertations and theses, I declare that this dissertation, which I hereby submit for the degree Masters of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I further state that no part of this dissertation has already been, or is currently being, submitted for any such degree, diploma or other qualification.

I further declare that this 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 acknowledges in the text and list of references.

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Wilmé Müller



Fig.0.1 Sketch inside Fort Merensky (Author, 2017)



## Expression of Thanks

Megan and Steph, thank you for sharing life with me - inside and outside of Architecture. The inspiration drawn from your beautiful lives is reflected on every page (the good ones atleast).

My dear Boukunde friends who shared in all the early morning studio coffees. Thank you for the joy and life that you have brought into a challenging year.

Daniël, thank you for helping me capture on film what a truly special place Botshabelo is.

Prof. Barbara Jekot for her patience, guidance and encouragement.

Dr. Arthur Barker for partnering with your students and sharing your wonderful architectural mind.

My parents for their continual support and confidence in me. Thank you for teaching me endurance and responsibility and for blessing me with the privilege of this education.

My Creator, for being my 'place of refuge'.

[ Psalm 91:2 ]

## Abstract

In a culturally diverse South Africa, the debate concerning whose history to commemorate, is an increasingly controversial issue. In light of this, a refreshing opportunity for the celebration of a shared memory has been identified in the forgotten Mpumalanga mission station, Botshabelo.

It is remembered as a place of harmony between different cultures, the natural and man-made landscape, this once self-sustainable, flourishing settlement that now stands abandoned and in a state of decay (Langhan, 2000:25).

This dissertation research focuses on design within sensitive heritage environments at various scales, through acts of layering. At the urban scale, the research investigates the possible mediation between heritage conservation and development for a returning local community.

At a more detailed scale, the project focuses on the rediscovery of Botshabelo's cultural precinct through layering of the old fabric with new ritual. And finally, at the precinct vision's climax, Fort Merensky (which overlooks the Botshabelo valley) forms the dissertation's site of design focus.

Finally, through the reinterpretation of Fort Merensky as a device for 'hiding' and 'revealing', a cumulative moment is formed by which a (figurative and physical) vantage point for the unlocking and celebration of Botshabelo's meaningful landscape is enabled.

The project intends to create an architectural device for the safekeeping, showcasing and testing of ideas that mark Botshabelo's memory, learning from it as a model for the development of South African self-sustainable, creative communities.



Fig.0.2 An early photograph of the red brick church interior (Berlin Archives, n.d.)

## Samevatting

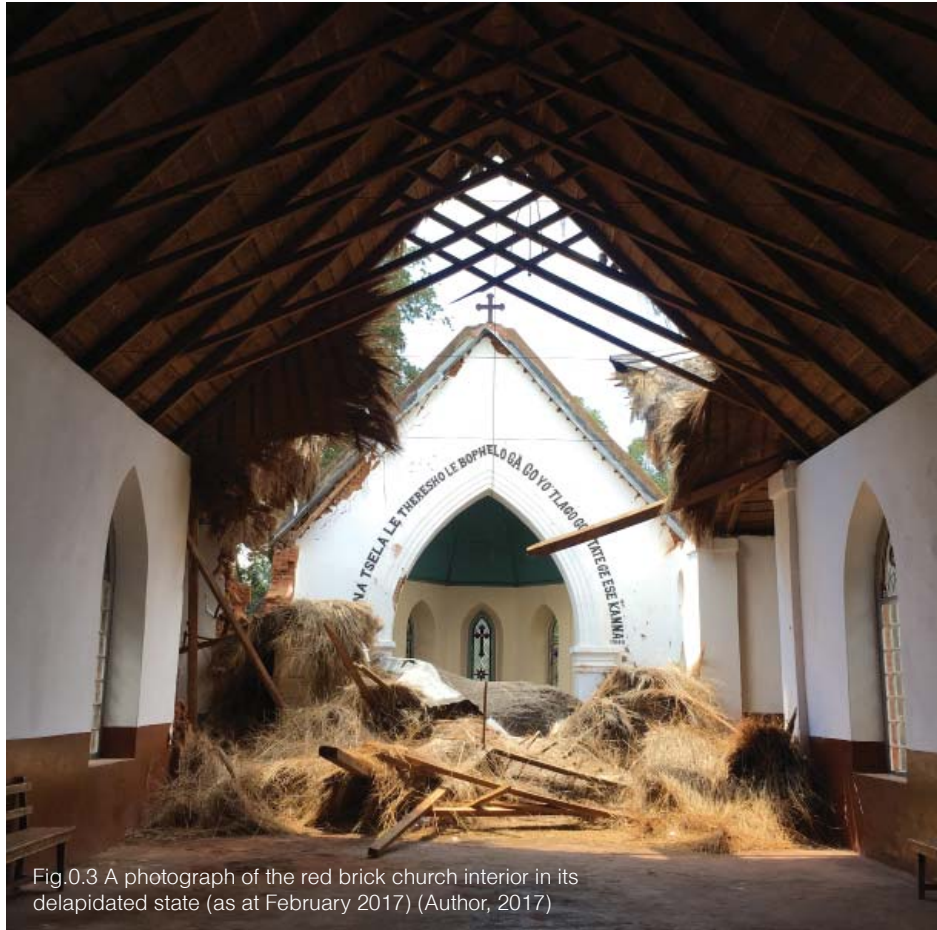


Fig.0.3 A photograph of the red brick church interior in its delapidated state (as at February 2017) (Author, 2017)

In 'n kultuurryke Suid-Afrika, is die debat rondom wie se erfenis behoort gedenk te word 'n kontroversiele onderwerp. 'n Verfrissende geleentheid om 'n gedeelde herinnering te vier is geïdentifiseer in die vergete Mpumalanga sendingstate, Botshabelo.

Onthou as 'n plek van harmonie tussen verskillende kulture, die natuurlike- en mensgemaakte landskap, word hierdie eens self-volhoubare, bloeiende nedersetting vandag bevind in 'n verlate en vervalle toestand (Langhan, 2000:25).

Die verhandelingsnavorsing fokus op die tema van ontwerp binne sensitiewe erfenisomgewings op verskillende skale deur middel van gelaagtheid. Op die stedelike skaal ondersoek die navorsing die moontlike bemiddeling tussen erfenisbewaring en ontwikkeling van 'n terugkerende plaaslike gemeenskap.

Op 'n meer gedetailleerde skaal, fokus die projek op die herontdekking van Botshabelo se kulturele gebied deur die ou stof met nuwe ritueel te laai. As hierdie gebied se klimakspunt, word Fort Merensky wat oor die Botshabelo-vallei uitkyk, die terrein van ontwerp fokus vir die skripsie.

Deur die herinterpretasie van Fort Merensky as 'n toestel om te 'versteek' en 'onthul', word 'n kumulatiewe oomblik geskep waardeur 'n (figuurlike en letterlike) uitkykpunt vir die ontsluiting en viering van Botshabelo se betekenisvolle landskap moontlik gemaak.

Die projek beoog om 'n argitektoniese toestel te skep vir die bewaring, uitstalling en toetsing van die idees wat Botshabelo se verlede kenmerk en sodoende daaruit te leer as 'n model vir die ontwikkeling van Suid-Afrikaanse self-volhoubare, kreatiewe gemeenskappe.

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# INTRODUCTION



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## 1.1 Verhaal as Inleiding

'n Persoonlike Ervaring

### *Verlief & Verlate in Botshabelo*

Die son het al hoog in die lug gesit toe my leer sandale vir die eerste keer die fyn rooi stof ontmoet. Dit was stil daar, behalwe vir die wind wat saggies deur lang gras gewaai het.

Die aangename man by die kleurvolle ingangshek het effens verward gelyk toe ons vir hom vra hoeveel dit sal kos om in te gaan. "The place...it is not well at the moment" het hy gesê met diep frons lyne op sy bruingebrande voorkop. "Twenty-five per person" kom die antwoord deur die afgerolde motor venster.

Ons was nie seker waarheen die lang tweespoor-stofpadjie sou lei nie, maar ons het met afwagting uitgestaar soos wat die ry bome ons uitsig soosflitsbeelde van 'n outydse filmprojektor reflekteer. Ons het skielik gebriek toe ons 'n kerkoring sien uitsteek bo die bebosde horison. Met die dramatiese optog deur die toegegroeiende kliptrappe wat tot by die kerkdeur lei, het ek geweet ek is op pad om iets buitengewoon te ervaar – iets geestelik. En dit was presies wat dit was toe ek oor die drumpel stap en die wolke sien. Kleurvolle loodglas venster, 'n kruis en deur die grasdak, sowaar- wolke.

Toe ons verder al langs die lae klip muurtjie ry kom ons by 'n groepering van geboue uit wat ons vermoed het meer

aktiwiteit moes bevat, wel, so het ons gedink, maar die enigste teken van lewe was die toeriste winkeltjie waar twee Ndebele vrouens krale aandenkings verkoop. Hulle het vertel dat niemand meer hier bly nie.

Op 'n bord word daar 'n teetuin aangedui met 'n pyl wat links wys. 'Dalk is dit oop net op sekere geleenthede' het ek gedink toe ons op 'n koddige pophuis met geslote deure afkom.

Ons het deur die vensters geloer en kon tekens van onlangse beweging sien en daar gaan my verbeelding op hol, besmet deur elke Hollywood gruwel film wat ek al ooit gesien het. Skielik bewus van my belaglikheid, rittereer ek so kalm as moontlik en keer terug na waar die ander was.

Dit was 'n vreemde gevoel toe die groen en wit geboutjies al hoe kleiner raak in die agterruit. Ek kon dit nie lekker plaas nie, dit was 'n teenstrydige gevoel. As ek woorde moes kies om dit te beskryf sou dit wees: 'verlief' en 'verlate'. Dis asof die plek se verlatenheid jou eie raak, en dit laat jou effens ongemaklik, tog stiltevrede in die mooi van iets wat eens was. Ek weet! Natuurlik. Dís wat ek gevoel het: verlange.

Ek verlang na jou Botshabelo.

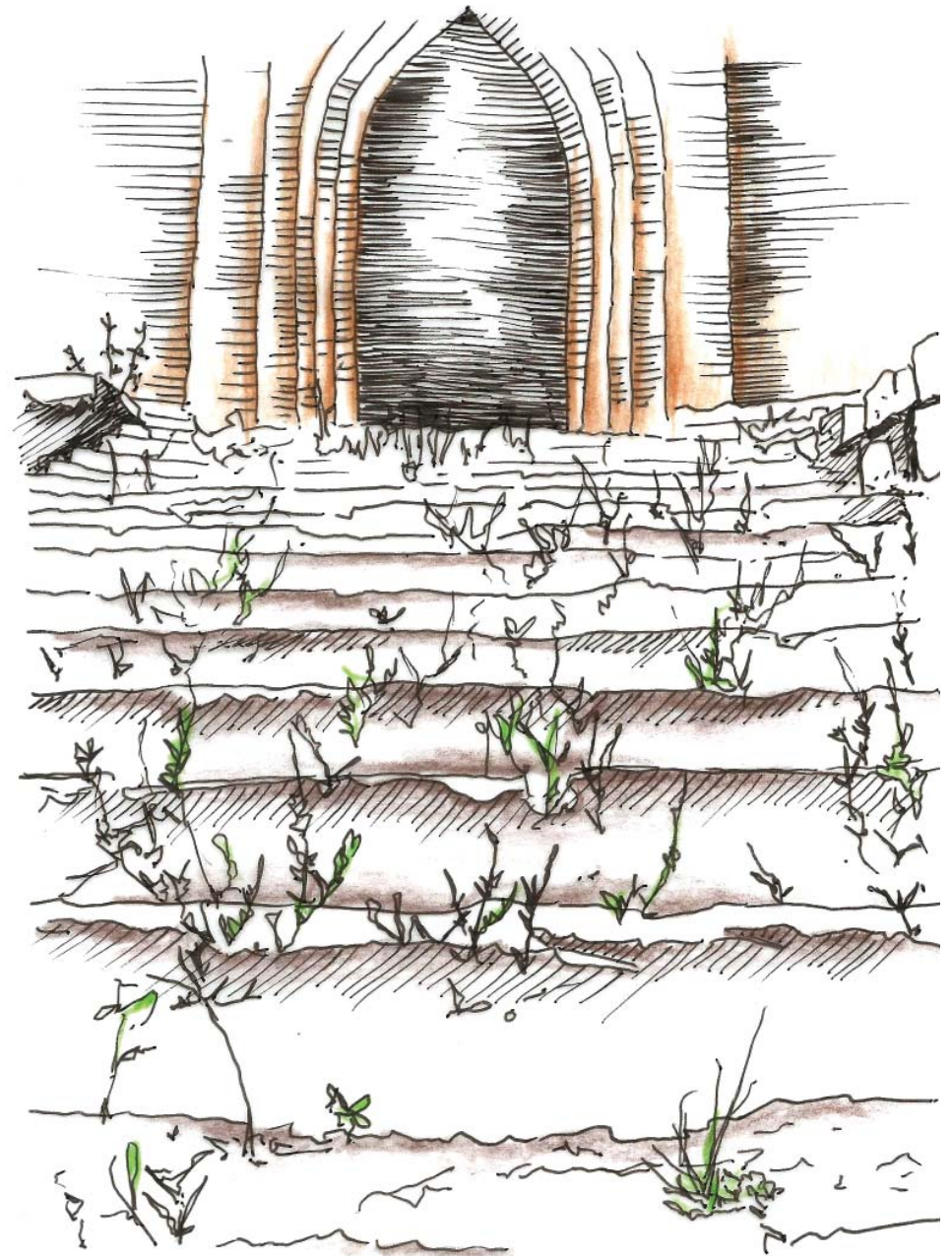


Fig.1.1 Sketch of the overgrown stone steps leading up to the church entrance (Author, 2017)

## 1.1 Narrative Introduction

A Personal Account

### *Inlove & Abandoned in Botshabelo*



Fig.1.2 Sketch of a creeper growing in front of old Merensky house as a sign of abandonment (Author, 2017)

The sun was already high up in the sky when my leather sandals met the fine red dust for the first time. It was quiet there, except for the wind that was softly blowing through the long grass.

The pleasant man at the colourful entrance gate looked a bit confused when we asked him how much it would cost to enter. "The place...it is not well at the moment" he said with a deep frown across his tanned forehead. "Twenty-five per person" came the reply through the rolled down car window.

We weren't sure where the long two-tracked dust road would lead, but we stared out with anticipation as the tree lining caused our view to appear like an old movie reel projection, frame by frame. We braked suddenly when we saw a church tower peak out above the tree tops. As I embarked upon the dramatic ascension towards the church door, up the stairs taken over by grass, I knew that I was about to witness something extraordinary – something spiritual. That was exactly what it was, when I crossed the threshold and saw the clouds: colourful stained glass windows, a cross and through the thatch roof, indeed – CLOUDS!

When we drove further along the low stone wall, we reached a grouping of buildings where there had to be more activity – or so we had thought, yet the only traces of life were two Ndebele women who sold beaded crafts at the curio shop. They told us that nobody lived there anymore.

A sign board indicated a tea garden with an arrow pointing to the left. "Maybe its only open on special occasions" I thought when all we found was a quaint doll house with locked doors. We peeked through the windows and saw signs that indicated recent movement. At once my imagination started running wild with every Hollywood horror movie I had ever seen. Realising how ridiculous I was being, I calmly backed away and headed back to the others.

It was a strange feeling as the white and green buildings became smaller and smaller through the rear window of the car. I could not put my finger on it, the feeling was contradictory. If I had to choose words to describe it, it would be 'in love' yet 'abandoned'. It was as if the abandonment of the place became my own, yet I felt infatuated by the beauty of its memory. A-ha! Of course. That's what it was: 'longing'.

I long for you Botshabelo.

## 1.2 Definitions

### “Abditory”

A safe location used to store valuable items, a place into which you can disappear; a hiding place  
(oxforddictionaries. 2017)

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### “Observatory”

A building used specifically as a device for the act of observation (oxforddictionaries. 2017); a place designed with the intention of creating an intensified viewing experience (term applied in a figurative manner, not necessarily associated with astronomy)

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### “Palimpsest”

An architectural theory by which landscapes / buildings are understood as layered artefacts that reflect the passage of time  
(Verheij, 2016:11)

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### “Place”

An architectural idea used to describe “a space which has a distinct character” (Norberg-Schultz,1980:5), closely associated with the term “*genius loci*” a Latin term which means “spirit of place”.

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### “Shared Memory”

A communal heritage; historical significance that is meaningful to more than one cultural group

### “Cultural Landscape”

An approach to heritage conservation by which a place is considered valuable due to the synthesis between the natural landscape, man-made infrastructure and cultural activity, thereby regarding the tangible and intangible components thereof as inseparable to its heritage value.  
(Smith, 2010)



## 1.3 Site Introduction

The Botshabelo Historic Mission Station

Botshabelo, which means ‘place of refuge’, is an old mission station located 10km North-West of Middelburg, Mpumalanga (fig.1.3).

The station was established in 1865 by two protestant German missionaries: Alexander Merensky<sup>1</sup> and Heinrich Grützner with followers from the local Swazi and Pedi tribes, who had fled from the hostile king Sekhukhune (Swanepoel, n.d:1). What originated out of necessity, grew into a very successful, self-sustainable village. However, the South African War in 1899 was the start of Botshabelo’s decline and conditions were further worsened under the Apartheid regime when forced removals were imposed on the black population (Pienaar, 2013:14). Since then, several attempts at restoring Botshabelo proved unsuccessful. Today, this historic settlement is at a critical point in time: a window period between granted land claims and new development implementation.

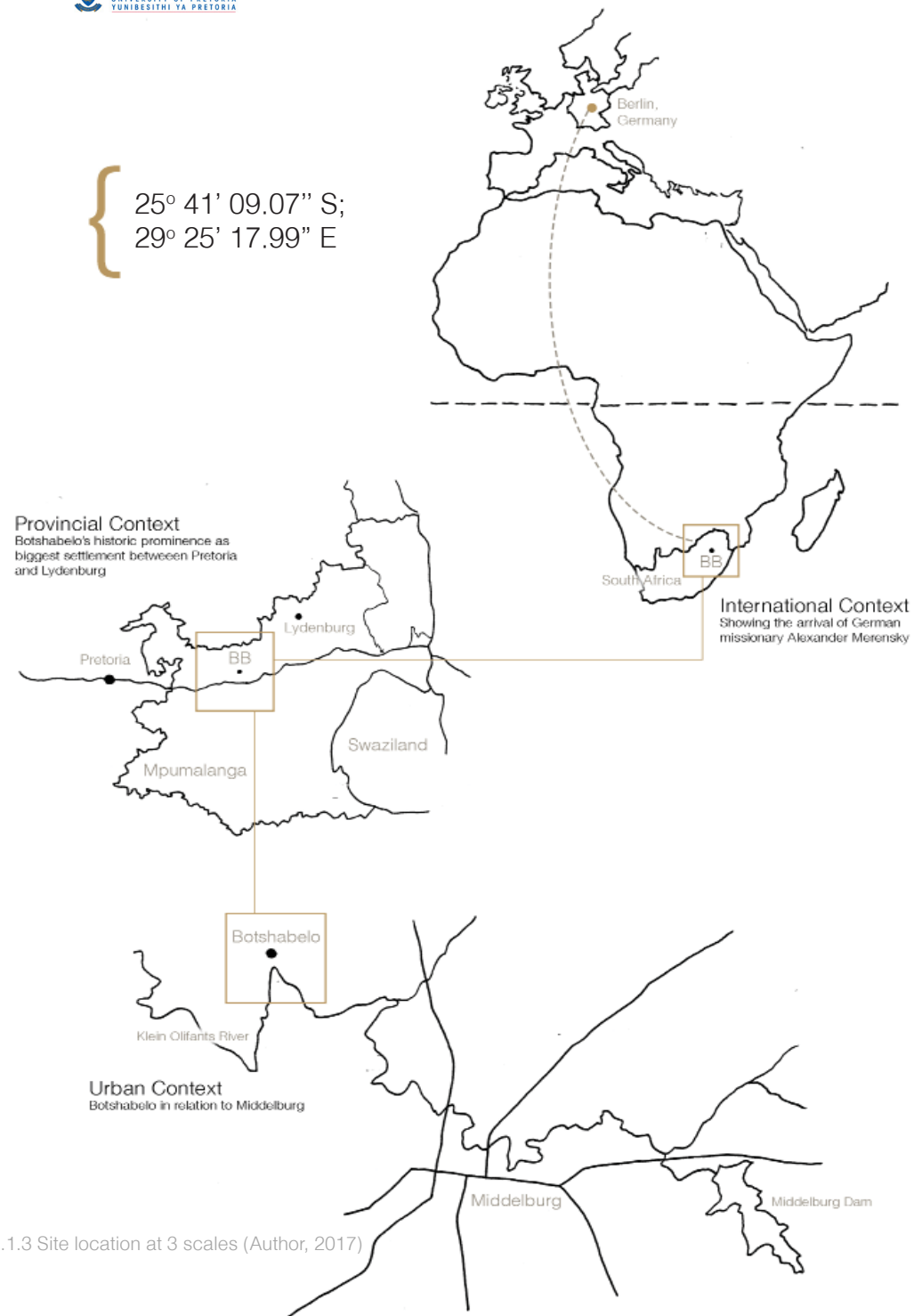
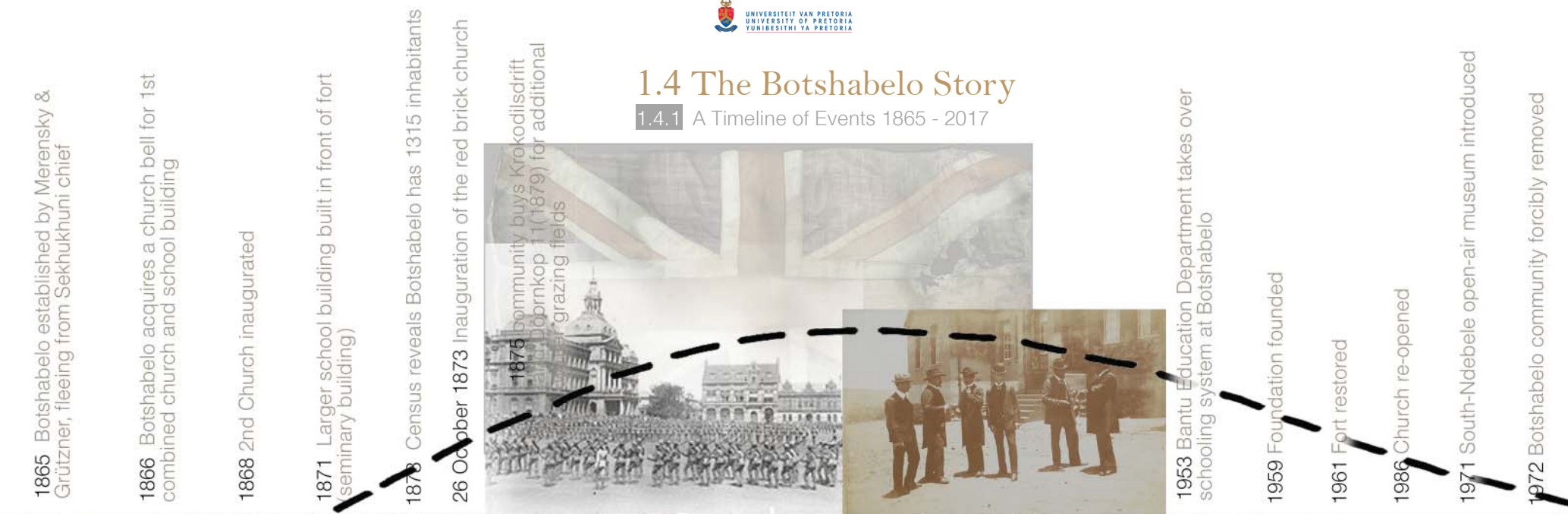


Fig.1.3 Site location at 3 scales (Author, 2017)

# 1.4 The Botshabelo Story

## 1.4.1 A Timeline of Events 1865 - 2017



1865 ESTABLISHMENT

1873 PEAK

1877 POLITICAL UNREST

1914 DECLINE

1953

1972



12 April 1877 a proclamation of British annexation read out in Church Square, Pretoria.

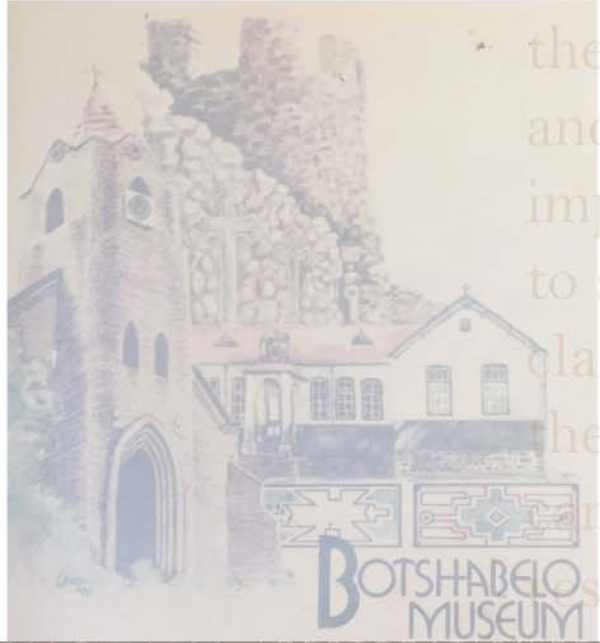
1882 Merensky leaves Botshabelo

1897 Seminary opened for school teachers

1899 Missionary work ended at Botshabelo

1914 World War I breaks out





1980 Visitors allowed to access Botshabelo upon payment of entrance fee

1980 Cycads declared vulnerable plant species (large population of cycads present at Botshabelo)

1985 Declaration of Botshabelo Nature Reserve

1988 Botshabelo mission station provisionally declared national monument (SAHRA)

1988 Museum function down-scaled  
Several proposals made for Botshabelo's reinterpretation: YWAM rents part of property for missionary training

April 1994 ANC wins general elections

“We are in principle not opposed to any land claim, but, as there are other stakeholders involved, we are concerned about and opposed to the unsolicited handover of a culturally important site to a specific cultural group. The NMC wish to state at the outset that it will only approve of any land claim subject to the submission of a conservation policy for the site. We fear that the site could degenerate into a squatter camp with the resultant destruction of an important heritage resource and the perpetuation of poverty. Alternatively, a proper conservation plan could ensure the meaningful revitalisation of the old mission station and greater prosperity for all those who have a rightful claim to the land” (Letter by F.Eramus of SAHRA concerning the Botshabelo land claim) (Le Roux et al, 2013:103)

2016 Church roof collapses

1974 Middelburg City Council donates Botshabelo to the Foundation

1974 Letter from the Foundation of Simon v.d Stel requesting financial assistance to restore the church

1975 National Restoration Fund "Botshabelo 100 000" launched

1978 Foundation donates Botshabelo mission station back to Middelburg City Council

1978 Botshabelo closed down as "black Christians may not sully an otherwise pristine white area"



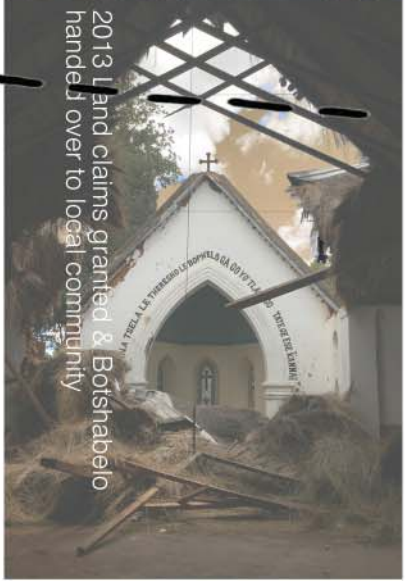
1994

1998

1998 Claim for the restitution of Land Rights lodged by Botshabelo Land Claim Committee on behalf of Botshabelo community

1999 need expressed for a binding conservation document that involves interests of all stakeholders

2013



2016

## 1.4 The Botshabelo Story

### 1.4.2 The Rise and Fall of the Mission Station

#### Botshabelo: 'Place of Refuge'

The events leading up to Botshabelo's cultural and economic peak can be summed up by the following sequence: safety, production, education, and finally: expression. Safety against the hostile Sekhukhune chief as the most immediate need was made possible by the topography that enabled surveillance. As a monumentalisation of this, Fort Wilhelm (later named Fort Merensky) was built upon the highest point of the settlement as the initial fortress against external threats. The 'place of refuge' became a 'place of

creativity' where several forms of artistic expression were encouraged, including music, visual and literary art. Botshabelo is the place where several prominent black South African personalities were educated, including; artists Dan Rakgoathe and Gerard Sekoto, the actor Ken Gampu, the writer Wally Serote, the radio and television personality Justus Tshungi, the spiritual leader Archbishop Desmond Tutu and the political leader Isaac Mogase, ex-mayor of Johannesburg (Langhan, 2000:26).

Botshabelo at its economic and cultural peak (c. 1868 - 1880) not only served its own needs, but also those of its broader rural community, which included the early settlement of Middelburg. Even though Middelburg was established more or less at the same time, Botshabelo overshadowed it as the biggest and most successful settlement between Pretoria and Lydenburg (Langhan, 2000:25).



Fig.1.5 Wangemann painting of Botshabelo (Ditsong Archive, 2017)

### The Decline

The decline of Botshabelo started in 1899 when missionary work was stopped due to the outbreak of the South African War. Conditions further worsened when WWI broke out in 1914. The Bantu Education Department took over Botshabelo in 1953, which resulted in a downgraded quality of education provided to its students. In the 1970's forced removals took place under the Apartheid government when many houses were demolished - remnants of this can still be seen today in the Motse3 ruins. The land was eventually sold to the Middelburg Municipality and resultantly the training college shut down shortly after in 1979. From here

onwards, the Transvaal Provincial Administration ran Botshabelo "solely as a heritage site and open-air museum... many of the buildings were restored with an interpretive focus on what can be described as a 'white endeavour'" (Pienaar, 2013:13-15). A Southern Ndebele cultural village was added to the open-air museum, commemorating the architecture of the Ndebele people, whose presence is found in the history of the broader region, although somewhat foreign to the specific history of Botshabelo itself. Ironically, the Ndebele addition has outlived the museum function and a few Ndebele women still run a bead curio shop on the premises.

### Abandonment & Decay

In 2005 the settlement was given over to the descendants of Botshabelo (known as the Botshabelo Community Development Trust) after land claims, based on ancestral burial rights, were granted. Despite the official new ownership, development has not yet commenced (at the time of writing this article), due to a lack of funding. The historic village remains uninhabited apart from the Ndebele women and a few caretaking staff (Clean Stream Environmental Services, 2013:15). Although some of the buildings are in a surprisingly good condition due to the quality of construction, an obvious lack of maintenance is evident as nature slowly takes over the man-made fabric, predicting a downward spiral of decay.

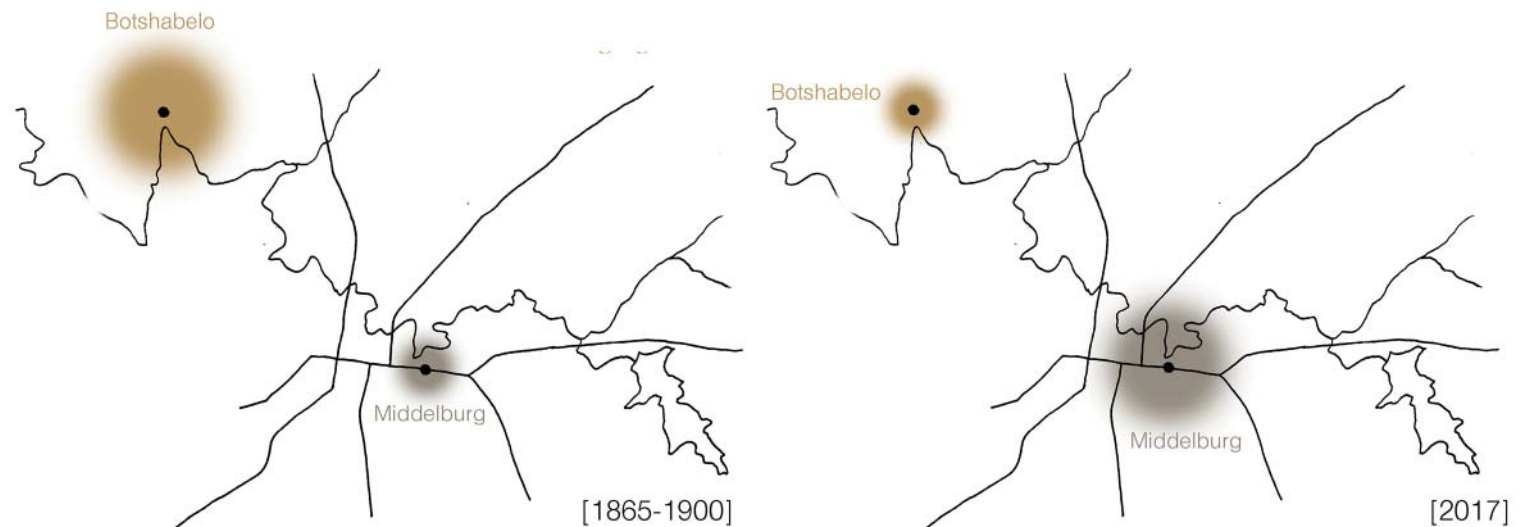


Fig.1.6 The reversal of roles between Botshabelo and Middelburg (Author, 2017)

{ Then }

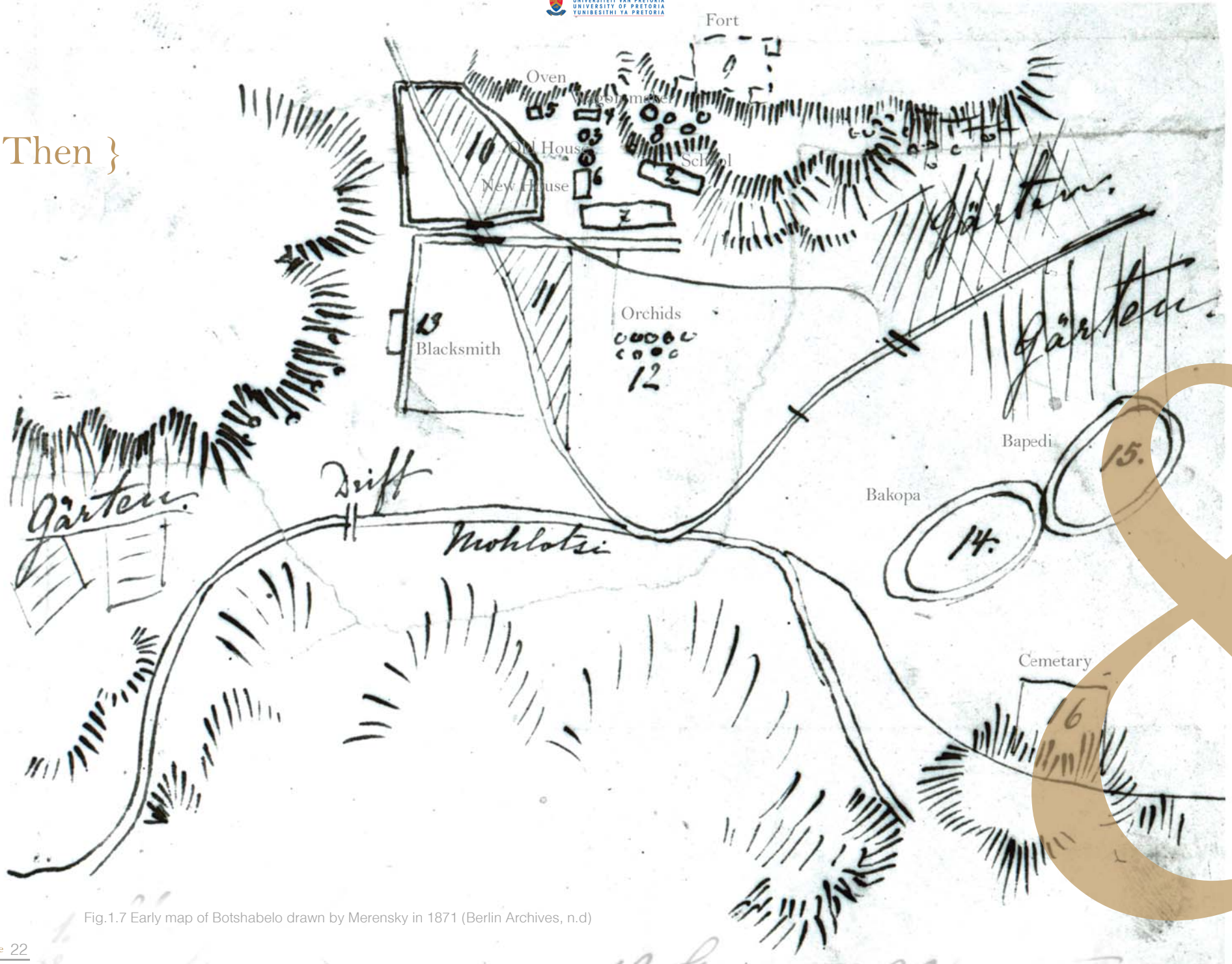


Fig.1.7 Early map of Botshabelo drawn by Merensky in 1871 (Berlin Archives, n.d)

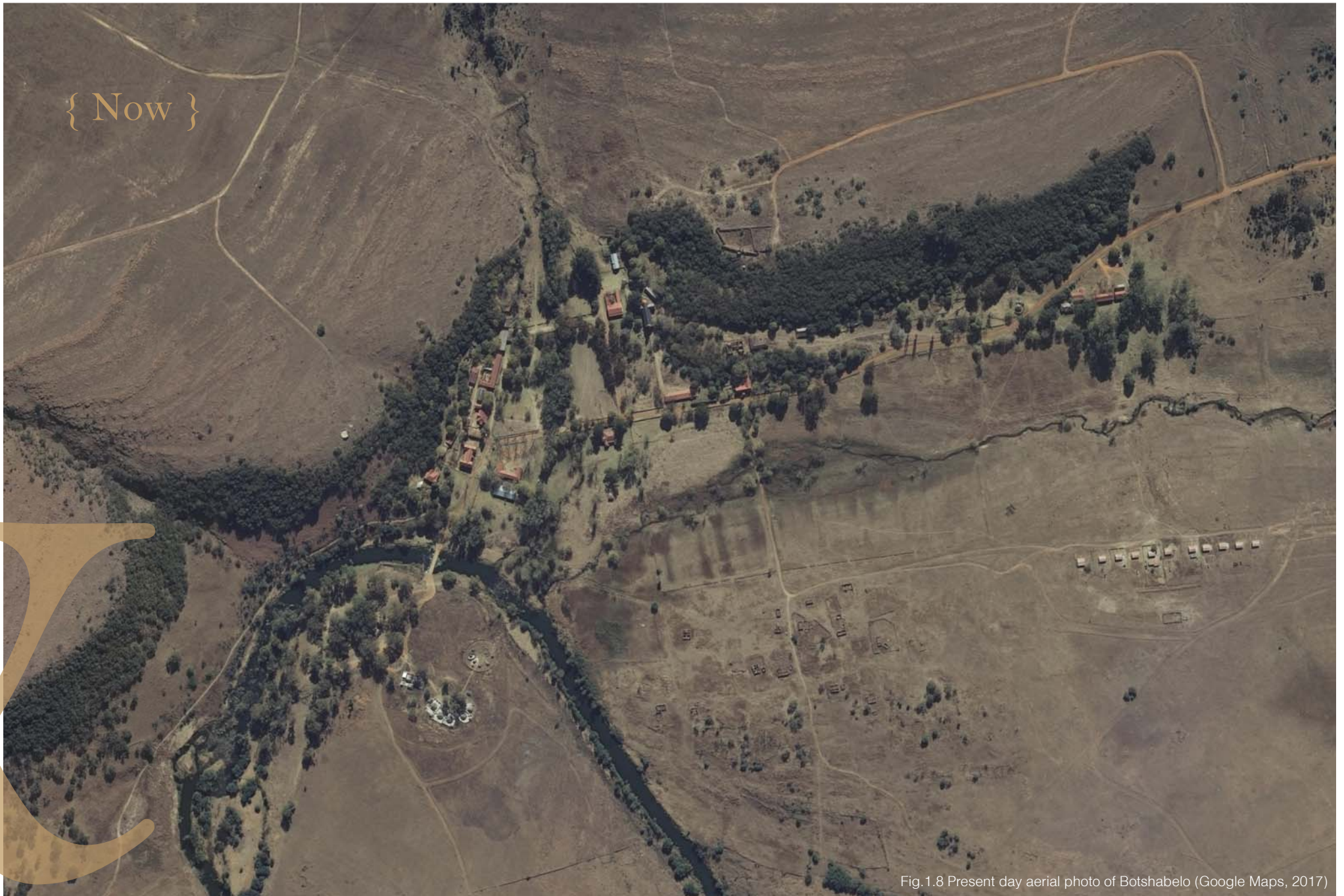


Fig.1.8 Present day aerial photo of Botshabelo (Google Maps, 2017)

## 1.5 Statement of Significance

### Botshabelo - a Shared Memory

In Le Roux, Fischer and Botes' (2001:6) document Conservation Policy Botshabelo, prepared for the Mpumalanga office of the South African Heritage Resources Agency, a statement of significance was written for the conservation of Botshabelo that highlights, in summary, that **the significance of Botshabelo lies within its embodiment of "the histories of many of the diverse cultural groups which comprise the people of South Africa"**.

A good example of this cultural fusion can be seen in the architecture that remains where a combination of Western and indigenous construction methods were employed to produce a uniquely regional typology (Fischer & le Roux, 1991).

The site's historic value as Cultural Landscape can be understood as an intangible character as created through the interaction of people with the site's tangible features. This phenomenon can be clearly noted in Dan Rakgoathe's description of Botshabelo as having "a sense of solidarity, a feeling of quiet respect for human beings and nature – which nurtured the spirit" (Langhan, 2000:26).

Botshabelo is therefore a unique case in the South African heritage repertoire due to its value as a SHARED MEMORY (fig.1.9) in a time in history where there is much contestation about mono-cultural heritage artefacts. Botshabelo is a refreshingly diverse symbol of South African cultural legacies and should therefore be recognised as such. Its conservation should be of primary concern to the entire nation.



Fig.1.9 Diagrammatic representation of the elements that constitute Botshabelo's shared memory (Author, 2017)



Church buildings associated with spiritual life, religious practises & ritual of the Berlin missionaries and converts

Buildings associated with black Christian missionaries

Buildings associated with the 1st translation & printing of the Bible into Sotho (Pedi)

Associations with contemporary users (memories of marriage, celebration, recreation & learning)

Buildings associated with black Christian missionaries

Memories of marriage, celebration, recreation & learning

War between Maléo & Sekhukhune & fortifications of European missionaries inspiration

Associations with contemporary users (memories of marriage, celebration, recreation & learning)

A cemetery with the headstones & remains of previous inhabitants has spiritual and sentimental ass. for relatives, descendants and those allying themselves with the faith and memory of those that have died.

Extant buildings associated with higher learning of the educators in the black community

The palimpsest of routes & infrastructure relating to the place for rest and repairs on the trade route to the Zoutpansberg (early white pioneers & settlers)

Higher learning of the educators

...a shared memory

...a shared memory

## 1.6 Problem Statement

### 1.6.1 General Issue

The coexistence and complementary nature of potentially opposing forces that once characterised Botshabelo have been lost. This harmony was created through the relationships formed between cultures, building techniques, settlement patterns and the integral symbiosis between the natural landscape and built form (fig.1.10,1.12). The current problem can be summed up as the change in these relationships from a state of attraction to a state of opposition (fig.1.11). The natural is taking over the old built fabric and accelerating its decay instead of serving complementary roles. Conceptually then, this dissertation questions if architecture can act as a mediator between the opposite forces (natural, political, cultural and spatial), to reach a time and context appropriate restoration of harmony. Considering Botshabelo's long, rich history and its present state of abandonment and decay, the problem described above can be seen in **the tension between the conservation of heritage, and the daily operation of a returning local community.**

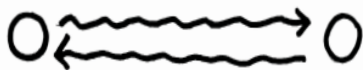


Fig.1.10 Symbiosis between opposite forces (Author, 2017)

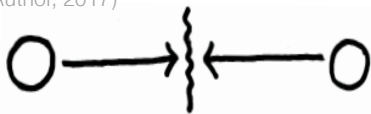


Fig.1.11 Tension between opposite forces (Author, 2017)

### 1.6.2 Urban Issue

Botshabelo is a destination. Its isolated existence, which was a favourable condition for its protection against invasion, is now one of the main factors contributing to its deterioration. Even though Botshabelo was once the more prominent settlement, this is no longer the case, as "Middelburg is now a flourishing and expanding town with an excellent mining industry creating work and economic stability; while Botshabelo, just 10km outside of Middelburg, is currently in a state of disrepair" (Swanepoel, n.d.).

### 1.6.3 Architectural Issue

Botshabelo's current condition as open-air museum has led to its gradual decline due to a lack of good management and funding. The remaining historic buildings are on the path of decay if left in their present condition. Clearly, the western museum typology has proven unsuccessful in the African context of Botshabelo (Da Costa & Van Rensburg, 2008). The challenge is thus presented for seeking an alternative architectural typology for the celebration of Botshabelo's valuable heritage.

The tension between Botshabelo's different stakeholders lies mainly between the original community and their direct descendants, and SAHRA (South African Heritage Resources Agency). The direct descendants of the original community were granted the land through their land

claim, based on ancestral ties to the site, while SAHRA has had parts of the site declared as National Monuments (Le Roux et al 2001:8). This political tension has a direct influence on the consideration of an appropriate architectural response contemplating how prominent the new built fabric should be so as not to detract from the heritage value of the old, whilst being dignified, confident architecture in its own right that recognises that the present 'layer' is as important as the old layers.

What further makes the context interesting is the tension created by notions of nostalgia felt towards the site in its present deteriorating condition. Nostalgia is defined as "pleasure and sadness that is caused by remembering something from the past and wishing you could experience it again" (Merriam-Webster, 2017). This definition accurately describes the tension between the sense of longing created by the abandonment of the site, yet appreciation of the sentiment of a past story that is heightened by a state of decay. The cultural anthropological notion of colonial nostalgia is explored through the writings of Bissel (2005) where he notices this as a common phenomenon among people who express a longing for better times in the past. A similar sense of nostalgia was noticed during informal conversations with the local caretaker who grew up in Botshabelo. He speaks fondly of his childhood

and expresses his appreciation for the German buildings, teachers and reverends. This he contrasts with his less than ideal present conditions. Bissel (2005) challenges the negative perceptions of nostalgia as an unproductive, regressive social "disease" and suggests that it can be valuable and "imaginative resource – a realm rich in invention, critical in possibility – for people struggling with the present, hoping to secure what can no longer be found in the future".

The architectural relevance of the research conducted by Bissel (2005) is interpreted by questioning whether it is possible to ensure the site's survival through active adaptation and progressive form-making, yet retention of elements of decay that bear witness to the memory of Botshabelo's past. This would create an awareness of time.



Fig.1.12 Collage representing Botshabelo's historic character of different forces within a harmonious whole (Author, 2017)

## 1.7 Research Methodology

■ A context driven qualitative study

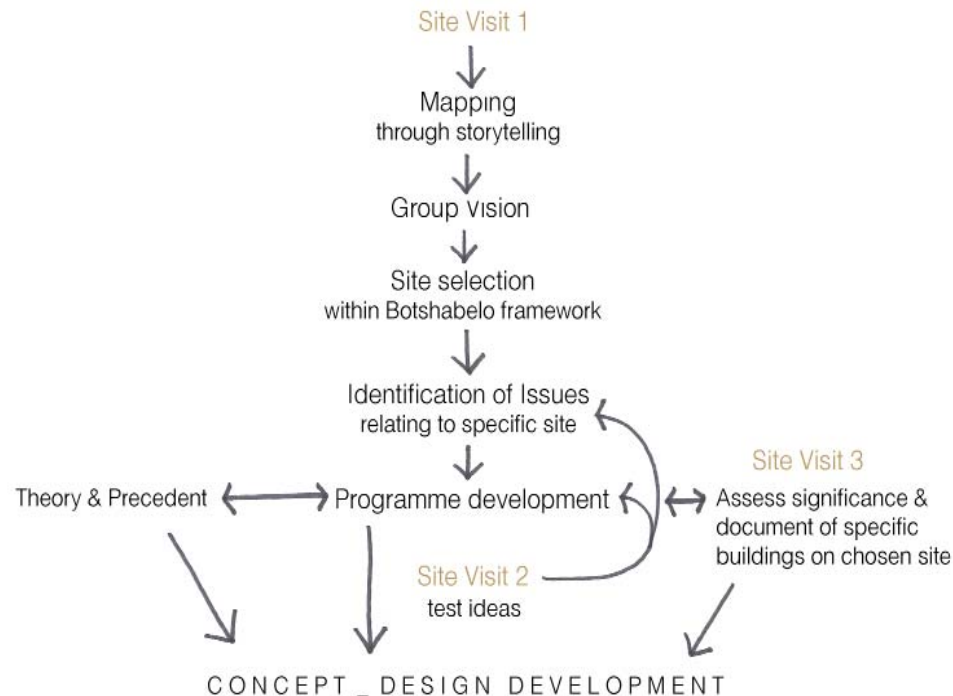


Fig.1.13 Diagram of Research Methodology (Author, 2017)

Qualitative research was conducted in this study, in order to gather an understanding of, and celebrate, Botshabelo's tangible and intangible heritage.

For the formulation of the project introduction, two site visits were conducted. The first served as a basic introduction to a completely unfamiliar context. General observations were made based on spatial orientation and the overall condition of the site, but more importantly the *genius loci* of Botshabelo was understood as a place of poetry, rich in stories, without necessarily reading this history. The extent of Botshabelo's abandonment was also realised during this initial visit.

Based on this broad understanding, a qualitative mapping methodology was followed, where Botshabelo was mapped through story telling. This mapping process aided the researcher in engaging with the site's history in an indepth manner, which established a reference that would guide future decisions. An engagement with the intangible aspects of the site allowed for an understanding of the site. This would be applied to principles adopted from appropriate urban framework precedent studies, in order to ensure a sensitive, context specific framework development.

During the second site visit, the group met with a local representative who was born and raised in Botshabelo and was a victim of forced removal. He returned to the area when the land claims were granted. His informal oral account of his experience at Botshabelo served

as informant to not only understand the past character of Botshabelo and the relationship between local community and German missionaries, but also to understand the perspective of the local community towards the future development of Botshabelo.

The methodology allows for a non-linear process and later stages will re-inform and strengthen earlier stages as the project develops, creating a more focused and refined, context-specific product (fig.1.13). Through this continuous contextual input, the methodology is designed around context as primary research driver by which all other informants (eg. programme) will be guided. Theory and precedent will further strengthen the research, which will shape the programme development for spatial exploration.

## 1.8 Dissertation Intent

### 1.8.1 Research Question

#### Old and New Meaning

Botshabelo is a place saturated in past meaning. Can architecture act as a device that both celebrated these memories of place and creates new meanings, which are relevant to its contemporary South African context?

### 1.8.2 Sub-Questions

#### Cultural Pluralism

As a sub-question that addresses Botshabelo's heritage significance as a place of shared memory, this paper will explore ways in which architecture can memorialise a historic narrative that represents cultural pluralism. This investigation will more specifically look at ways in which western and African typologies can co-exist, relevant to a culturally diverse country and specific post-colonial context.

#### Heritage vs. Local productivity

Can architecture serve to mediate the interests between the conservation of heritage as valuable tourist destination and the daily operation of a self-sustaining local community?

#### Museum Typology

What is an appropriate memorial archetype that challenges the static nature of the museum typology in order to be more relevant in an African context?

### 1.8.3 Hypothesis

Through the understanding of a historic context as palimpsest, and the application of Architecture as responsive new layer, a contemporary narrative that retains the memory of the old can be created. This approach ensures the new architectural layer's relevance to its contemporary context and its sensitivity to the existing heritage layers.

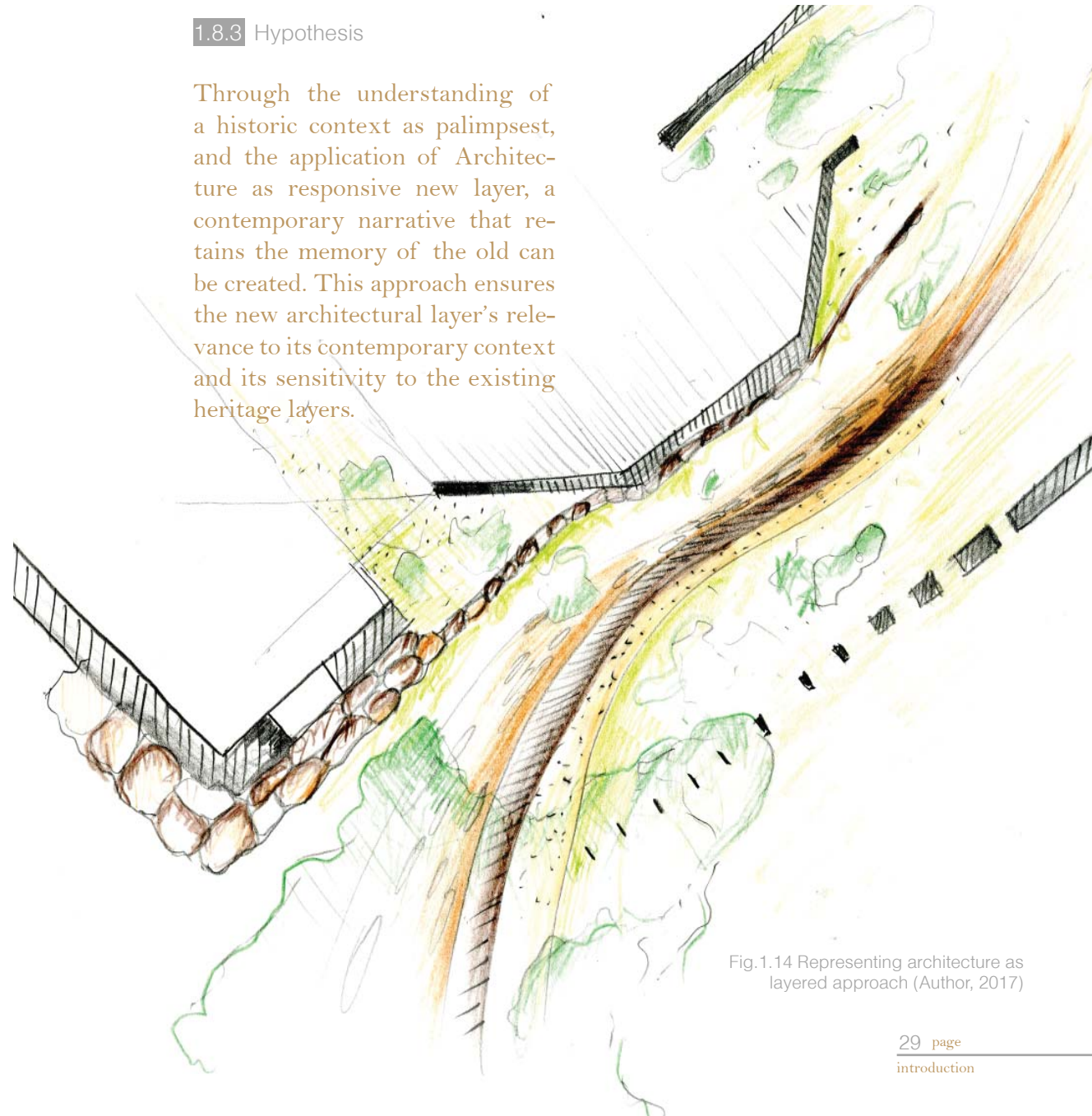


Fig. 1.14 Representing architecture as layered approach (Author, 2017)

#### 1.8.4 Delimitations

This research project will draw from and build on the existing research done by Franklin (2015). Differing slightly from Franklin's (2015) work which, focuses on the role of Landscape Architecture within a Western Cape context, this research will address Architecture within the north-eastern quadrant of the country's mission station legacy.

Due to the shortage of building documentation, the larger precinct requires a large amount of base documentation. Due to time constraints this project will only focus on the documentation of specific buildings directly involved in the identified design area.

For the purposes of designing a holistic group vision for Botshabelo, the existing housing proposal made by the Botshabelo Community Trust (2012) will be adopted in part. Although smaller scale local housing will be suggested as supplement, it is recognised that the expected population size is too large to be accommodated within the historic core

#### 1.8.5 Assumptions

The research will assume that information obtained through speaking to community members is accurate and unbiased.

It is also assumed that all written history and historic hand-drawn maps are accurate.

#### 1.8.6 Limitations

The site is situated in the province of Mpumalanga and is 150km away from where the researcher is stationed. Site visits will thus occur on a less regular basis, than it would if the site was situated within the Pretoria surroundings.

A historic overview of Botshabelo forms a large part of the dissertation research. Through this process it was found that information about Botshabelo remains scattered and the collection thereof becomes challenging as a single, comprehensive, documented collection of historic sources does not yet exist.

Due to the site's political contestation, much speculation about Botshabelo's future exists concerning investment and proposed development. It was therefore difficult to determine objective information about future prospects.

It was difficult to determine an accurate timeline of Botshabelo's development as exact dates of building projects were not always documented. The exact dates of some historic images also remain unknown.

Most buildings were not built from drawings, which means that little documentation of the buildings exist.

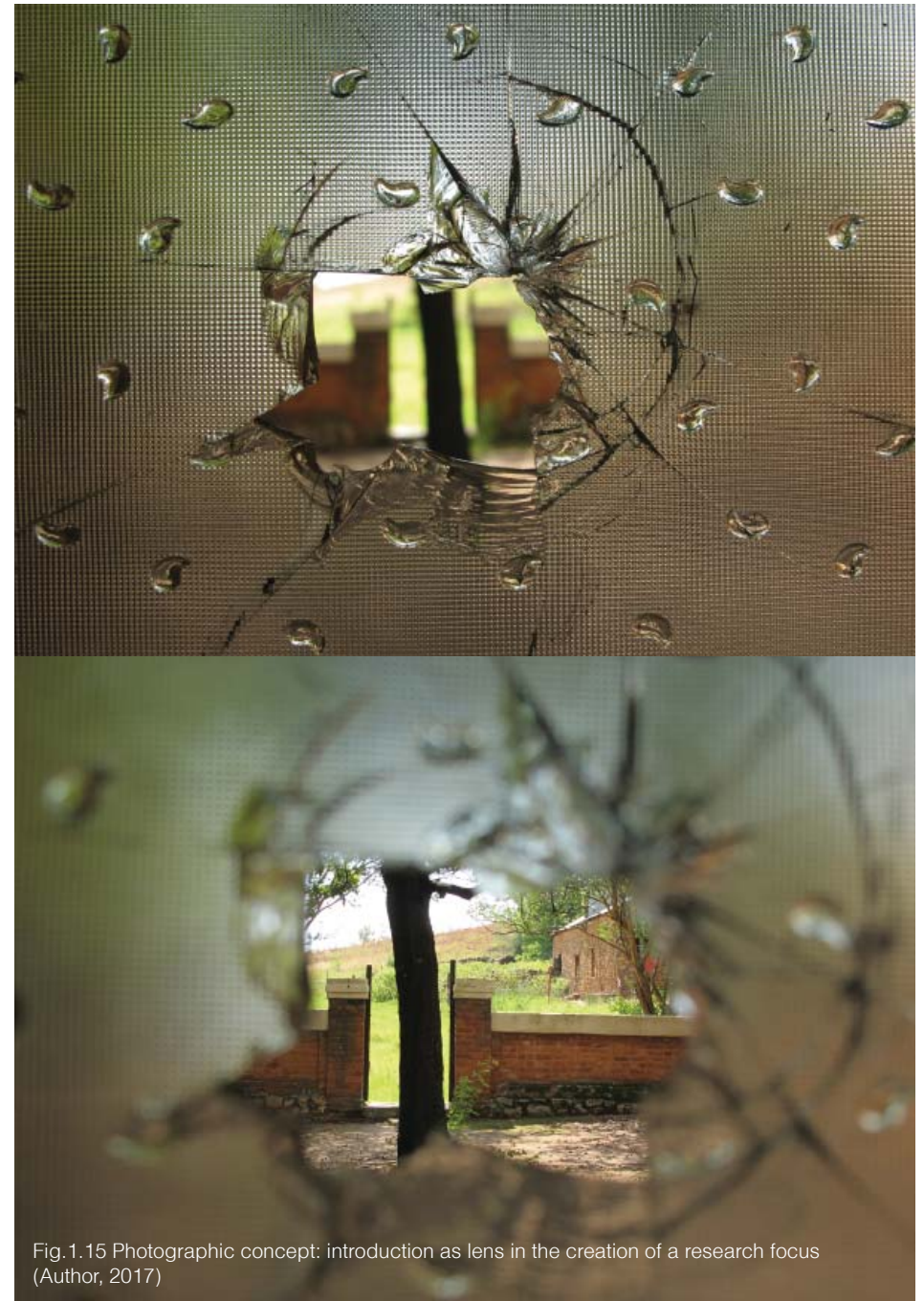


Fig.1.15 Photographic concept: introduction as lens in the creation of a research focus (Author, 2017)

- Chapter 02 -

# CONTEXT



2.1 Introduction  
2.2 National Scale  
2.3 Regional Scale  
2.4 Village Scale

2.5 Precinct Scale  
2.6 Site Scale: Fort Merensky  
2.7 Conclusion

## 2.1 Introduction

Synthesizing context and theory at several scales of investigation towards a sensitive design response based on an understanding of *place*<sup>2</sup>.

As a research methodology, this chapter will present an in-depth investigation of the specific context of Botshabelo as a means of informing an appropriate contemporary architectural response that is rooted in *place*<sup>2</sup>. This emphasis on contextualism is motivated by the author's architectural manifesto that:

“architecture based on an understanding of its physical and meta-physical context allows for complex architectural responses that holistically integrate social, functional, aesthetic, cultural, historic and environmental concerns, which results in a meaningful product.”

A contextual approach is therefore seen as the tool that will absorb the rich existing tangible and intangible context into a sensitive new architecture. Therefore hierarchically, this chapter serves as the weightiest informant to any later architectural conclusions.

The challenge presented in the case

of Botshabelo is the creation of new meaning in a context saturated in past meaning. How can a new architectural intervention simultaneously cement these memories of place, and create new meaning, relevant to its contemporary context?

The subjective notion of “appropriateness” can therefore only be based on a thorough understanding of context at various scales. These scales will be discussed in a consecutive manner, from the largest (national) to the smallest (building) scale, each being a more detailed fragment of its larger part, rather than being isolated scales of investigation towards a holistic understanding of context. The criteria for analysing each scale will be a synthesis of its physical and meta-physical factors, discussed in conjunction with the appropriate theories as explained by fig.2.1.

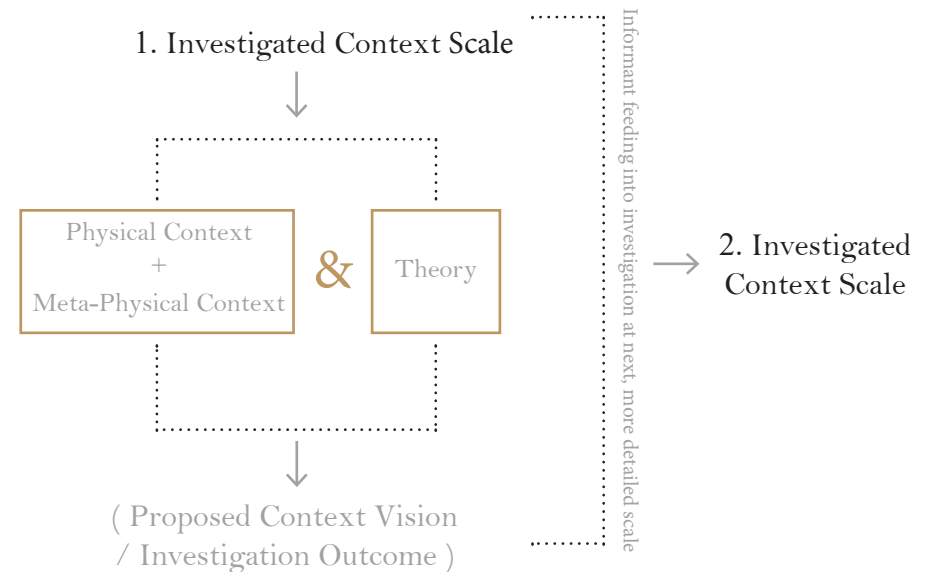


Fig.2.1 Chapter Methodology Diagram (Author, 2017)



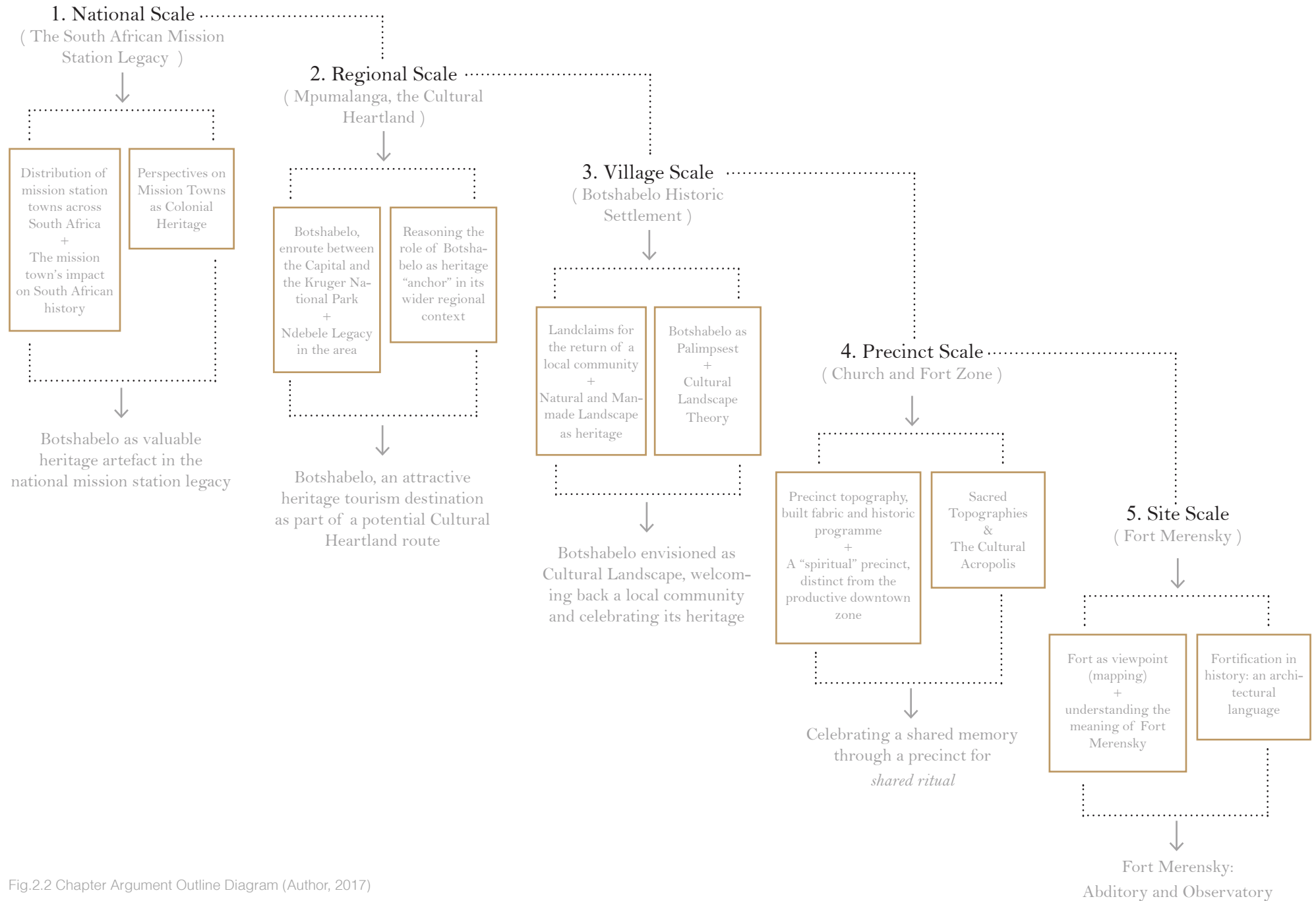


Fig.2.2 Chapter Argument Outline Diagram (Author, 2017)

## 2.2 National Scale

The South African mission town legacy

At its largest scale of investigation, the Botshabelo mission station is located within the South African mission station legacy: a colonial movement prevalent in the 19th century. Swanepoel (n.d.:1) notes that by 1904 there were more than 600 mission stations in South Africa. Missions in South Africa played a significant role in the shaping of the country's social, cultural, geographic and architectural history. New ways of life were introduced to local communities and the formation of many of the towns, which we now consider an intricate part of the country's geographic identity, were established by mission activity (fig.2.3). Many of these old mission stations have stood the test of time and now exist as small towns that have active communities residing in them, although they have outgrown their initial purpose. It can be noted as a general statement, that the infrastructural development of the mission station for the sustenance of its community has enabled its survival. Examples of such mission towns (among many others) are Wupperthal, Genadendal, Pella, Greyton and Phillipolis; each with their own distinct character - a result of the different denominational biases held by the various missionary societies responsible for their establishment. Botshabelo however, is not among these evolving mission station survivors. Although minor new additions have been made, the

historic fabric of the settlement remains largely intact, making a visit to Botshabelo seem like stepping into a frozen moment in time.

In order to determine what the revival of Botshabelo would mean in the national context of the mission station legacy, it is important to first consider what these settlements represent:

Manktelow (2016) describes the nature of the South African Mission stations as heterotopias: complex sites of ambivalent meaning. To some, the mission station represented threats of indigenous cultural abandonment, whilst to others, it meant cultural advancement in the form of education<sup>4</sup>. Whatever the attitude toward these sites may be, it can be agreed that the mission station was a site of exchange, driven by the missionary's Christian faith as "theology, ideology and pragmatism wove in and out of missionary motives and actions" (Manktelow, 2016:173). It is this notion that distinguishes the mission town from other towns, although these settlements essentially have the same material traits as the general town. Here, the urban fabric was merely a spontaneous consequence of a primarily spiritual reality.

At a national level, there seems to be an imbalance between the different South

African regions in their research outputs about its mission station history. Mission stations in the Western Cape have been widely studied and many have retained their historic fabric, and their heritages remain celebrated. However, many mission towns in the rest of the Coun-

try have dissipated and if developed, have lost their mission station heritage. Botshabelo can therefore be seen as a starting point in the rediscovery of this lost heritage narrative in the north-eastern part of the country, in dialogue with its western counterparts.

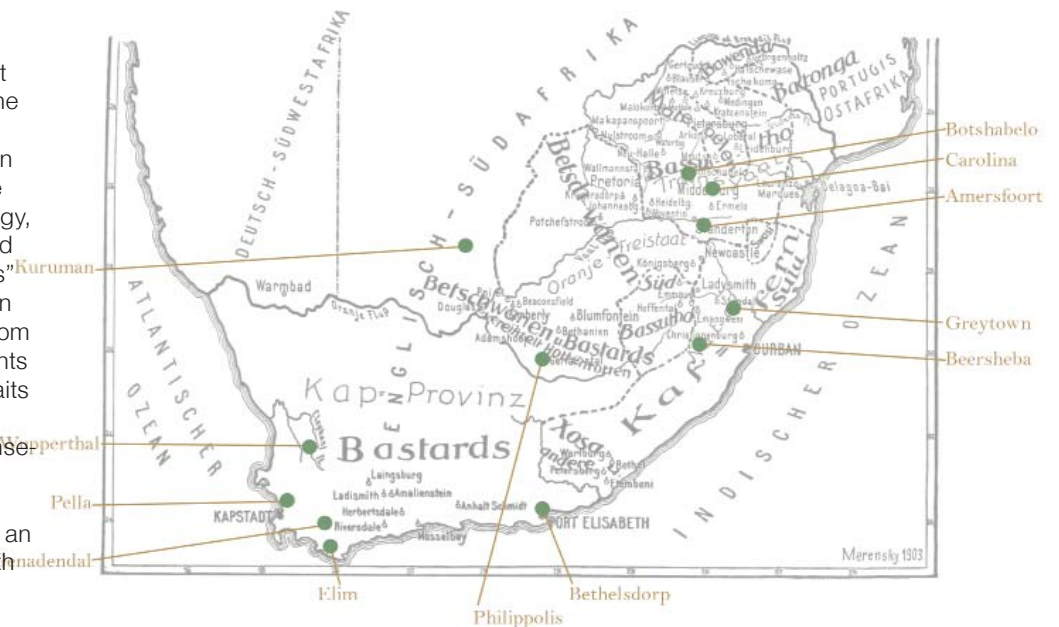


Fig.2.3 Early territorial map of South Africa drawn by Merensky showing the location of mission station towns scattered across the country (Berlin Archives, n.d edited by Author)

## 2.3 Regional Scale

Botshabelo's potential in the definition of a heritage route

At a regional scale, Botshabelo is located in what is known as the 'Cultural Heartland' (fig.2.5) of Mpumalanga province. This branding stems from the historic presence of indigenous Ndebele tribes found in the area (Mpumalanga Tourism and Parks Agency, n.d). In motivating the need for Botshabelo's reestablishment, the argument can be made that it is an important cultural anchor found along a greater cultural route. The centrality of Botshabelo between Pretoria and the Kruger National Park (fig.2.6) acts as an important clue that would motivate Botshabelo's significance as regional tourism asset.



Fig.2.4 Missionary activity in the Transvaal painted by Wangemann c.1867 [unpublished] (Ditsong Archive, 2017)

In addition to the Ndebele history in the area, there exists a wealth of other mission stations in the broader area too. Swanepoel (2015:9) notes that ten other mission stations were located in close proximity to Botshabelo and it was therefore seen as the most prominent mission station - a collection point, in service of its greater religious landscape. She argues that Botshabelo outgrew its classification as mission station and became a mission 'institution' due to its central religious, educational and industrial role. Investment in present day Botshabelo could potentially mean the rediscovery of a whole network of mission stations (fig.2.4) that were once connected to Botshabelo, thereby rediscovering a portion of the South African mission heritage, transcending the historic importance of the settlement itself.



Fig.2.5 N4 Road sign advertising Mpumalanga as 'Cultural Heartland' (Google Images, 2017)

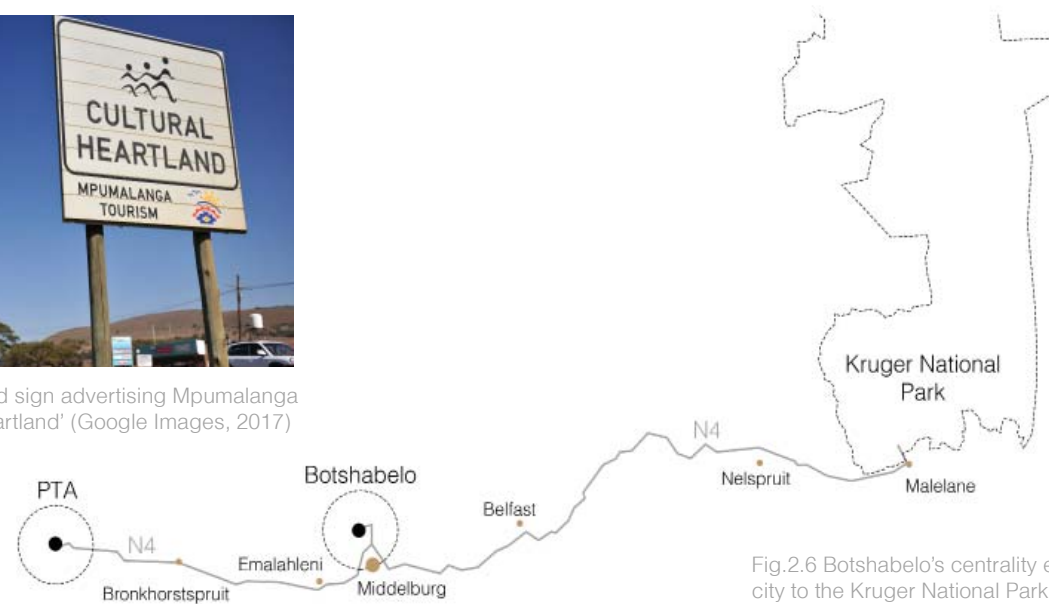


Fig.2.6 Botshabelo's centrality en-route from the capital city to the Kruger National Park (Author, 2017)

## 2.4 Village Scale

### 2.4.1 Understanding Botshabelo as Palimpsest

Swanepoel's (2015:1) study of Botshabelo, observes that the history and development phases of Botshabelo can be understood by reading the landscape as a palimpsest. It is argued here that this is a relevant approach to both the analysis of the existing, and as a strategy for tackling new interventions. The idea of palimpsest, or 'layering', acts as the general heritage approach that serves as a continuous thread that runs throughout the several identified scales of investigation; from the urban, to the most detailed. This approach's relevance is reaffirmed through its applicability throughout the scheme's various levels of detail.

Outside of its architectural interpretation, a palimpsest is used to describe "a parchment or tablet, reused after earlier writing has been erased". It bears the indentations and faded marks of the earlier writing as a background layer, which influences the surface on which new writing takes place (fig.2.7). This process might have been repeated several times, producing a complex layering of writings. Through this description we can clearly see how it applies to the field of architecture as an analogy that defines an approach for dealing with sites or structures of heritage value. In architectural terms, palimpsest can be understood as a heritage approach that "reflects how landscapes, buildings and

objects are layered through the passage of time [...] thus linking the past with the present and future." (Verheij, 2016:11)

**In addressing the tension between progress and sentiment in heritage design, the idea of palimpsest is seen as a "strategy for intermediacy" which recognises past layers without hesitating to add new layers. (Tran, 2008)**

This concept can be explained in a diagram (fig.2.8) that resembles geologic strata. It illustrates that any successive layers added onto existing layers will be directly influenced by the existing layers, which allows for a greater engagement of the historic fabric (Tran, 2011:25). It can be said that the new layer is therefore an 'absorption' or summary of all its sub-layers.

In approaching the heritage of the urban grain of Botshabelo as settlement, the existing natural and man-made conditions can thus appropriately be understood as a layered product (fig.2.9). This reading of the existing alludes to the making of a new urban 'layer', which brings significance to its underlying layers. This ultimately makes up the urban condition, namely: the topography and river that defines the valley, agricultural land, water channels, roads, and the relationship between pathways and existing buildings.



Fig. 2.7 A Georgian Palimpsest from the 5th or 6th century. (Google Images, 2017)

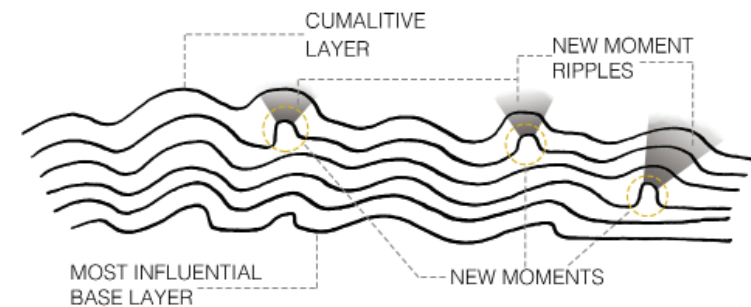


Fig. 2.8 Diagram explaining the idea of the site as palimpsest. (Author, 2017)

## 2.4.2 Natural Landscape

### The Base Layers

At an urban scale, the natural features and the man-made fabric that define Botshabelo will be considered in the light of its heritage significance as settlement, as opposed to any singular object within the settlement. More than Botshabelo's quantitative success as a flourishing settlement at its peak, its success was characterised by its intangible *genius loci* that fostered a sense of harmony and tranquility. This can be deduced from Dan Rakgoathe's bibliographic account of Botshabelo, describing it as having "a sense of solidarity, a feeling of quiet respect for human beings and nature – which nurtured the spirit" (Langhan, 2000:25). It will be argued that this harmony came as a result of its diversity as a layered product between the natural landscape, the man-made landscape, buildings and the social interaction that stimulated these abiotic factors. The success of Botshabelo was based on this network of influences, and can thus only be understood through an eco-systemic view. The factors that make up this complex network will now be discussed.

Botshabelo was established in a fertile valley along the Klein Olifant's River. The settlement is 'encased' by the steep topography between which it sits. Its topographic character served to create the sense of safety so desperately sought after by the missionaries and the local followers, against the persecution they were facing. For this reason, the original development occurred on the higher parts of the northern hill to maintain surveillance (through the fort) over the valley where later development occurred once conditions stabilised.

The topography's definition of the valley gives rise to the natural flow of water, which made it an even more ideal place for settling as agriculture would be a viable practice. The allocation of agricultural land took precedent above other building development in response to these natural features. Low stone walls demarcated these agricultural fields, which remain a prominent feature of the historic village and serves to define Botshabelo's greater urban grain.

These low stone walls, also used in the construction of the water channels that occur throughout Botshabelo, might be seen as a representation of Cicero's concept of 'second nature' in an architectural sense. This is especially experienced upon entering the settlement along the main road as one is guided by these low stone walls, built with stones from the naturally rocky Highveld landscape.

Low stone walls were commonly used in ancient African agrarian societies (especially the Bokoni people), native to the Mpumalanga area (Delius et al 2014). We can only speculate that their presence in Botshabelo is a remnant of this tradition – a speculation that would further support the argument that cultural synthesis can be read in the urban layout of Botshabelo.

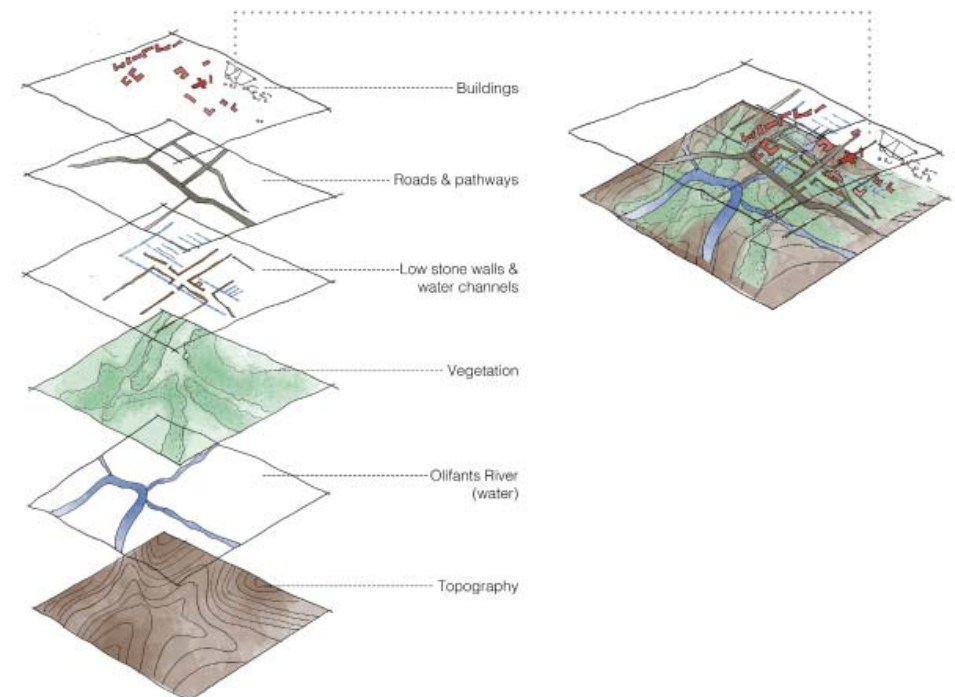


Fig.2.9 Diagram analysing Botshabelo's natural & man-made layers (Author, 2017)

### 2.4.3 Man-Made Landscape as Responsive Layers

When visiting Botshabelo today, even the layman would be able to recognize the linearity of its orderly layout. This linear layout produces striking visual axes, most notably the dramatic moment created along the main road as the old red brick church is revealed at the end of an ascending walkway (fig.2.10). Similar visual ‘moments’, or frames, reveal themselves in subtler ways throughout Botshabelo due to the overall linearity of the urban layout. According to Swane-poel (2015), Merensky was influenced by the Moravian model of mission station layouts in the planning of Botshabelo. This model can prominently be seen in Genadendal in the Western Cape. How-

ever, this model would have required a rigid ordering of the indigenous community’s housing, which was not the case at Botshabelo. Merensky understood that it would be safer for the community to socially and spatially function under the headship of their traditional chiefs and settlements were thus kept according to these patterns (Merensky, 1889). What resulted was a richness of public space around individual homesteads (Le Roux & Fischer, 1991). This can be understood by van Rensburg and de Costa’s (2008) concept of field independence in African space-making as cultural construct. Therefore the urban fabric of Botshabelo was, to some extent, a mediation



Fig.2.10 Sightline towards church framed by domestic science building & ascending low stone walls (Author, 2017)



Fig.2.11 Sightline towards Merensky house framed by bridge over stream (Author, 2017)



Fig.2.12 Sightline towards Merensky house framed by low stone walls (Author, 2017)



Fig.2.13 Sightline towards church transept framed by Merensky house veranda (Author, 2017)

between African and Western spatial ideals. This cultural synthesis is noticeably carried through to the smallest scale of the construction detail. A good example of this is the local technique of thatch roof covering that was used in combination with the German method of timber roof construction in the red brick church (fig.2.15). It should be noted that although Botshabelo is now perceived as consisting merely of the historic fabric that today defines its core, the land that was originally bought by Merensky consisted of 8 farms and covers a far greater area than its built core. Swanepoel (2015:8) records that smaller pieces of land

located around its core was allocated to local families where subsistence farming could take place, although today no prominent remnants of this activity remain. This means that the interpretation of the current day Botshabelo landscape should be regarded in a way that recognises the memory attached to these open pieces of land. It can therefore be said that the heritage of Botshabelo is found in its intrinsic connection to its greater natural landscape. The contrast created between the colonial language of the buildings and the natural Highveld landscape in which these sit, tempts one to believe that these buildings are objects to be conserved as the most

important heritage artifacts on site. Yet, through the discussed meaning of the natural and man-made Botshabelo landscape, it is argued that these buildings lose their meaning when regarded as being separate from their greater landscape. Thus, Botshabelo's heritage value is strongly connected to the landscape, which presents a challenge to the western approach of celebrating isolated monuments as these monuments have little meaning when detached from their surroundings. Any architectural intervention will therefore have to address the landscape as an equally essential heritage artefact.



Fig.2.15 Photo of the church's collapsed thatch roof (Author, 2017)



Fig.2.14 Sightline towards horse stables (Author, 2017)

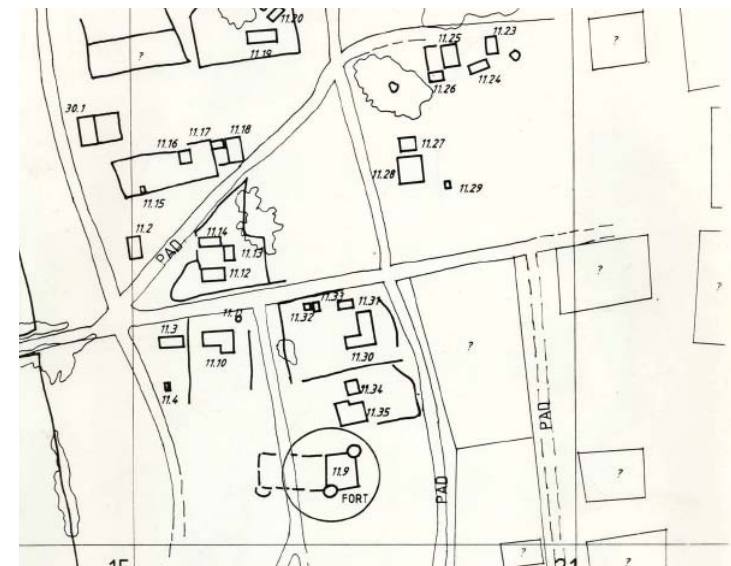


Fig.2.16 1990 Plan of the Motse ruins (Le Roux & Fischer, 1990:88)

#### 2.4.4 Reimagining Botshabelo as Cultural Landscape

##### The Cultural Layer: Reactivating the Natural and Man-made Heritage of Botshabelo

In the light of the discussed contextual analysis, it becomes apparent that Botshabelo today, is the remnant of an abandoned cultural landscape. In reimagining the village, it is therefore crucial that the cultural aspect that has been lost, be carefully considered as the key component to the renewing of Botshabelo as cultural landscape, thereby causing its active conservation.

In envisioning the future of Botshabelo, the research question to be considered is formed around the reconciliation between sentiment and progress.

*The urban framework seeks to mediate these conditions by creating an environment that is equally conducive to a self-sustainable local community and the interest of the visiting tourist.*

Cultural Landscape theory provides an appropriate approach to these seemingly conflicting interests, where this everyday social layer is seen as a necessary ingredient to the stimulation of the natural and built landscape's heritage value; adding to it, rather than subtracting from it.

It should be noted however, that the idea is not to recreate Botshabelo as mission station with the addition of 'role-players' to its historic fabric. The vision recognises and allows for new meanings to be projected onto the old landscape in a way that respects, or better yet, draws attention to the heritage value of the historic village.

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##### Cultural Landscape Theory

Cultural Landscape theory is a post-modern concept that creates a new paradigm in conservation thinking. It grew out of the Ecological Bias in the late 20th century (Smith, 2010:185). Based on an eco-systemic way of thinking, this approach allows for the conservation of complex, layered environments, in a dynamic manner that encourages the addition of new layers. This is based on the principle of diversity, in nature - the more diverse an ecosystem is, the more resilient it becomes. This approach therefore makes it possible to view the conservation of Botshabelo in a dynamic way that rejects static forms of heritage preservation.

Cultural Landscapes, according to Smith (2010:186), are dependent on experience and therefore allow for various

interpretations made by different cultural identities. This idea resonates with the context of Botshabelo where it is the intention to make its 'shared memory' accessible to multicultural interpretation, projecting different realities onto the same physical matter. The Cultural Landscape of the visitor would therefore be different to that of the resident, yet both interpretations remain equally valid (Smith, 2010:191).

In her writing on the application of cultural landscapes on historic urban landscapes, Smith (2010:185) states that:

*“Ritual and artefact define each other, and their cultural meaning emerges at the point of intersection.”*

This statement refers to the capacity of a cultural landscape approach to heritage, to simultaneously deal with the conservation of the tangible and intangible landscape in such a way that cultural meaning is produced. In the case of Botshabelo, the artefact remains abandoned and it is the stimulation of ritual that needs to be addressed in the search for new cultural meaning. It is

however, recognised that these rituals can only be determined up to a certain degree, as space designed for ritual is subjective and will spontaneously evolve based on cultural interpretations. Considering how recent this theory's development is and the difficulty that is posed by the intangible mapping this approach requires, it is obvious why it is a challenging task to regulate. Attempts to concretise this approach with conservation legislation has been made through initiatives such as the UNESCO HUL Recommendation. These frameworks have often been criticised as being too open ended, but it should be holistically understood that like nature, these environments are defined by highly sophisticated orders and are not illogical, although they do not adhere to Modern rationalism (Smith, 2010:190). Applying a Cultural Landscape conservation approach to Botshabelo will therefore require alternative forms of legislation through local community ownership.

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Fig.2.17 Photo Collage conceptually illustrating the idea of Botshabelo as a Cultural Landscape (Author, 2017)

## 2.4.5 Urban Precedent: Genadendal

A South African Mission Station, revitalised through a Cultural Landscape Heritage approach



Fig.2.18 Early painting of Genadendal during the first half of the 19th century (du Preez et al, 2009)

The case of Genadendal presents a practically implemented historic settlement conservation project, completed in 2008 (Du Preez, H. et al (eds), 2009). The project, although unique in some respects, generally addresses a similar context to Botshabelo and can therefore be referred to in the planning of Botshabelo's urban framework.

Genadendal was established in 1738, and is the oldest Moravian mission station in the Southern hemisphere. It has grown into a small village, found next to Greyton in the Western Cape. The recent intervention came as a reaction to the town's local unemployment rate and poor housing conditions. These problems led to the degeneration of the historic core and the loss of its heritage value. The framework focus was therefore on attracting heritage tourism that would encourage economic opportunities for the local community (Du Preez, H. et al (eds), 2009).

Like Botshabelo, Genadendal is representative of a European colonial influence in an African context, resulting in a multicultural history and collective

heritage. It can be said that the same underlying motivation reflecting "the 'ideals of nation building and restoration of humanity' as promoted in post-Apartheid South Africa" acts as driving force behind these conservation projects (Du Preez, H. et al (eds), 2009:1). The need for a progressive conservation approach is therefore necessary in the treatment of these culturally complex environments. Progress towards such an approach was made by the joint venture between South African and Dutch heritage interest organisations. The project was deployed by the Western Cape Cultural Commission and the Delft University of Technology. What resulted was an integrated approach between heritage design and community upliftment interests. Development principles were based on the:

- ICOMOC Charter for the Conservation of Historic Towns and Urban Areas
- "integrated conservation" approach formalised in the 1975 Declaration of Amsterdam
- South African focus on stakeholder-driven, action-oriented planning (Du Preez, H. et al. (eds), 2009:9).

Through these approaches, it was seen that Genadendal's socio-economic restoration would have to be expressed at several scales, including: "individual houses, of the ensemble of church werf with residential neighbourhoods and their public spaces, and of the complete settlement in its wider setting" (Du Preez, H. et al (eds), 2009:8). It is only through such an integrated conservation approach that the spirit of Genadendal's heritage could be accurately expressed. Considering the various scales at which the conservation of Botshabelo's heritage could be expressed, the following synthesized principles will be adopted from the Genadendal Project (Du Preez, H. et al (eds), 2009:1-10):

- Ecological conservation: recognising the valley as part of the mission station's natural landscape heritage
- Introduce agricultural activity as a present day economic driver and heritage of the historic mission's productive nature
- Identify the historic core zone(s) and strategically focus investment efforts

on these areas to spontaneously produce a wider conservation effect

- Respect the historic urban layout (main roads, pedestrian pathways and historic landscape infrastructure e.g. water channels) as far as possible, as part of the settlement's history.
- Consider the public space around important heritage buildings as equally important heritage artefact
- The reactivation of existing buildings should be based on a thorough heritage analysis, which will determine the appropriate conservation approach
- Introduce new activities to the old buildings and landscape in such a way that produces new interest, preventing depopularisation of the settlement, thereby conserving the tangible and intangible heritage



Fig.2.19 Present day Genadendal residential street scene (du Preez et al, 2009)



Fig.2.20 Genadendal church 'werf' (Google Maps, 2017)

## 2.5.6 The Botshabelo Framework

In the case of Botshabelo, the proposed urban vision is framed around the conservation and reactivation of Botshabelo's historic core as a place of productivity, education and spirituality. These were the ingredients that originally resulted in the spirit of Botshabelo, which will be celebrated through contemporary reinterpretation. Each theme will be focused on a specific zone<sup>5</sup> of the settlement and will guide the conservation focus of that area, although each zone will contain elements of all three of these themes.

These 'zones' are defined according to the following logic: the church and fort zone's focus will be driven by the theme of spirituality, the workshop precinct through the lens of education and the reappropriation of the abandoned agricultural land will be led by the theme of productivity. Conceptually, the zones are seen as overlapping circles, which provide seamless programmatic and spatial transitions between them, through their mutually beneficial relationships (fig.2.21).



Fig.2.21 The three existing characteristic zones, which guide the new development proposal (Author, 2017)

The urban fabric of Botshabelo can be understood as having three distinct zones (fig.2.22), an observation that is confirmed by Swanepoel (2015). The zones include: the fort and church zone; the industrial downtown 'workshop precinct'; and, the local African residential settlement zone (the Motse). Natural and man-made thresholds and boundaries give these three zones their individual character. The fort and church zone was historically separated from the industrial zone by ornamental and agricultural gardens, which are presently open fields taken over by wild plant species. As a result, these areas are still perceived as a gap in the built fabric. The main road that leads directly into the old industrial zone, separates the church and fort zone from the Motse. An off-shoot stream of the river runs parallel with the road and forms a green belt, further separating the Motse from the fort and church zone. Visual access is however, always kept between these two zones due to the steep topography. This might be understood as a spatial dialogue between the two zones, symbolic of the harmonious co-existence between cultures.

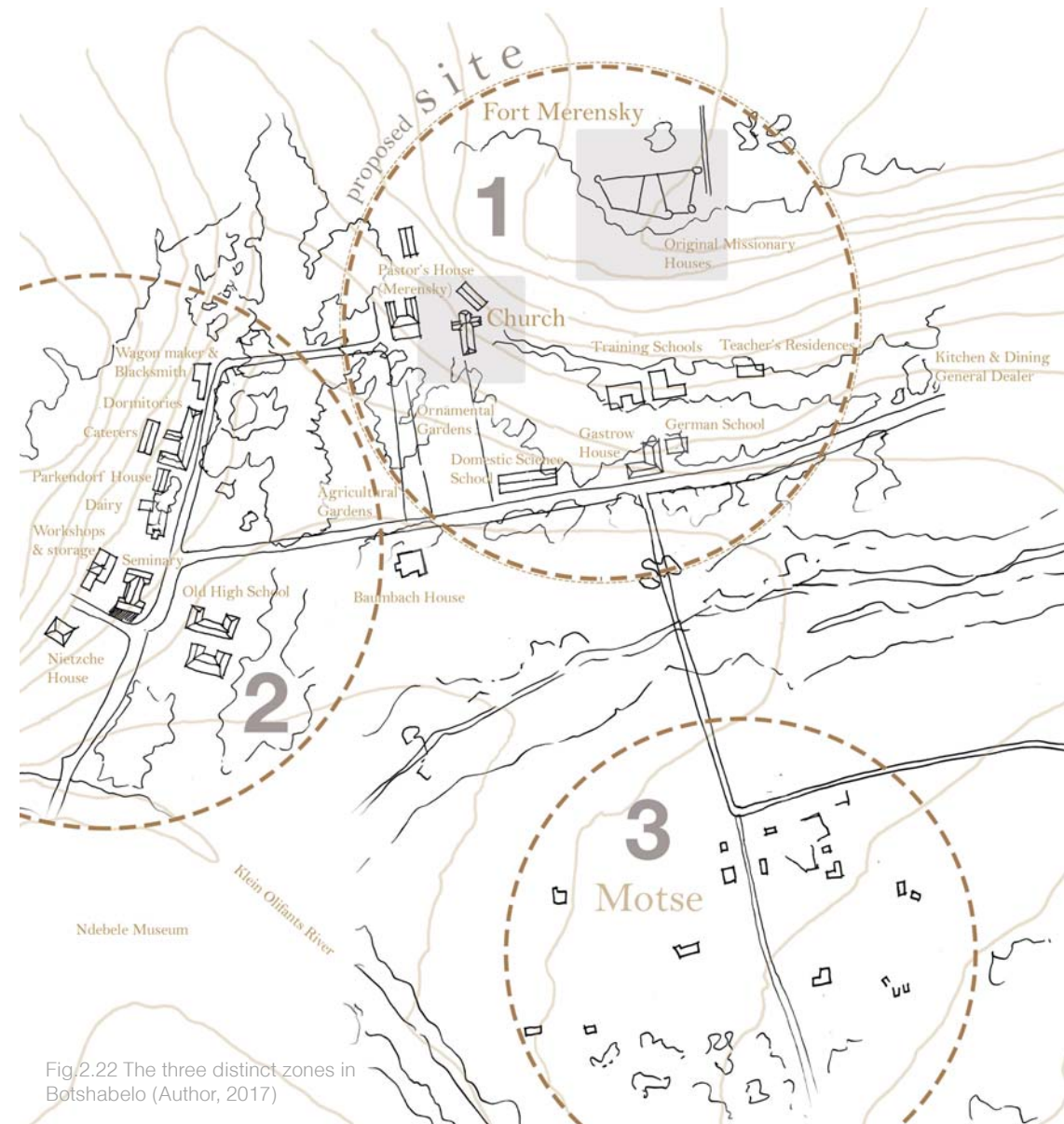


Fig.2.22 The three distinct zones in Botshabelo (Author, 2017)

The site vision entails the facilitation of a sustainable local community through the introduction of traditional African grains (sorghum, maize and millet) as an agricultural economic driver. The vision further focuses on productive ways that Botshabelo can become a self-sustainable community. This would add worth to the visitor's experience of the heritage fabric, by offering an interactive experience of Botshabelo's history through its sustainable future use. The vision therefore seeks to mediate between productivity and the conservation of its historic narrative, which can be seen expressed programmatically in the two proposed architectural schemes. These schemes focus on the two distinct zones identified in the reading of the historic urban fabric.

**Willem Müller**  
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an African Spiritual Retreat within a cultural precinct for shared Ritual

**Stephanie Nel**  
MProArch  
Ancient Agrarian Conservancy as Productive Landscape

**Anita Janeke**  
MProArch  
"Farm to Table" Culinary Spine as educational visitor's hub and local productivity

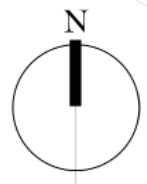
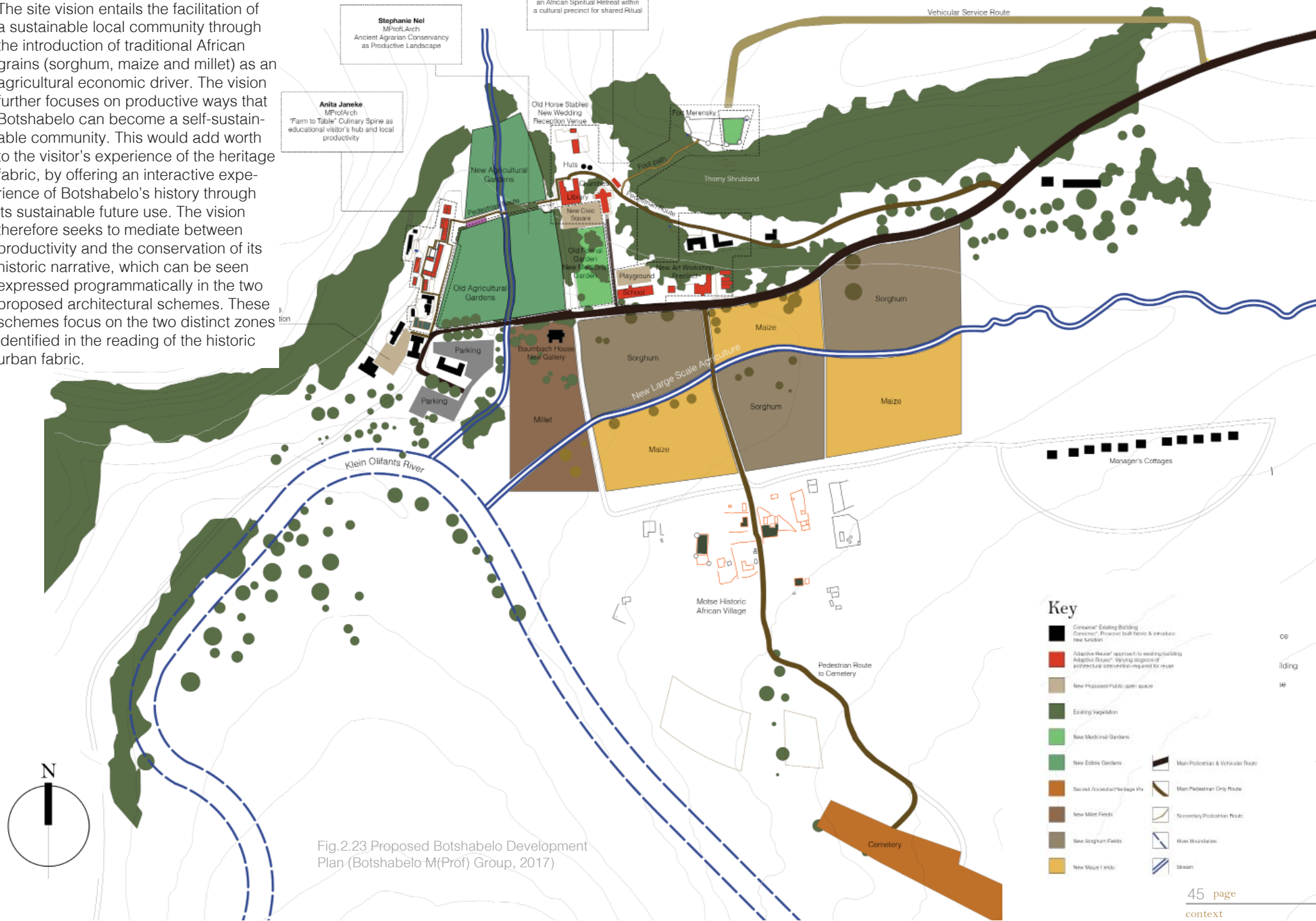


Fig.2.23 Proposed Botshabelo Development Plan (Botshabelo M(Prof) Group, 2017)

## 2.5 Precinct Scale

### 2.5.1 A Sacred Topography and the Cultural Acropolis

At the next level of detail, the research will specifically engage with the church and fort zone and will consider how this 'spiritual' precinct should be approached in the celebration of a 'shared heritage'. The term spiritual is here used to describe that which is concerned with the non-physical - that which transcends the basic needs necessary for the body's survival.

Of interest to the architectural research presented here, is how this intangible construct is translated into tangible form and how this is done differently in Western and African cultures. Is it possible to create a new architectural typology through the mediation of these different culturally specific spatial approaches?

This research sub-question will now be explored in the light of its application to the specific precinct context.

The chosen precinct has a distinct character that is significantly different to the downtown workshop fabric. Whereas the last-mentioned zone speaks of a productive nature, the church precinct's built fabric is less dense and programmatically different, implying a different intent – one that is less concerned with the productive nature of physical needs, and more focused on the spiritual. Apart from the original programmatic difference, communicated through the specific types of buildings in these two precincts, the unique sense

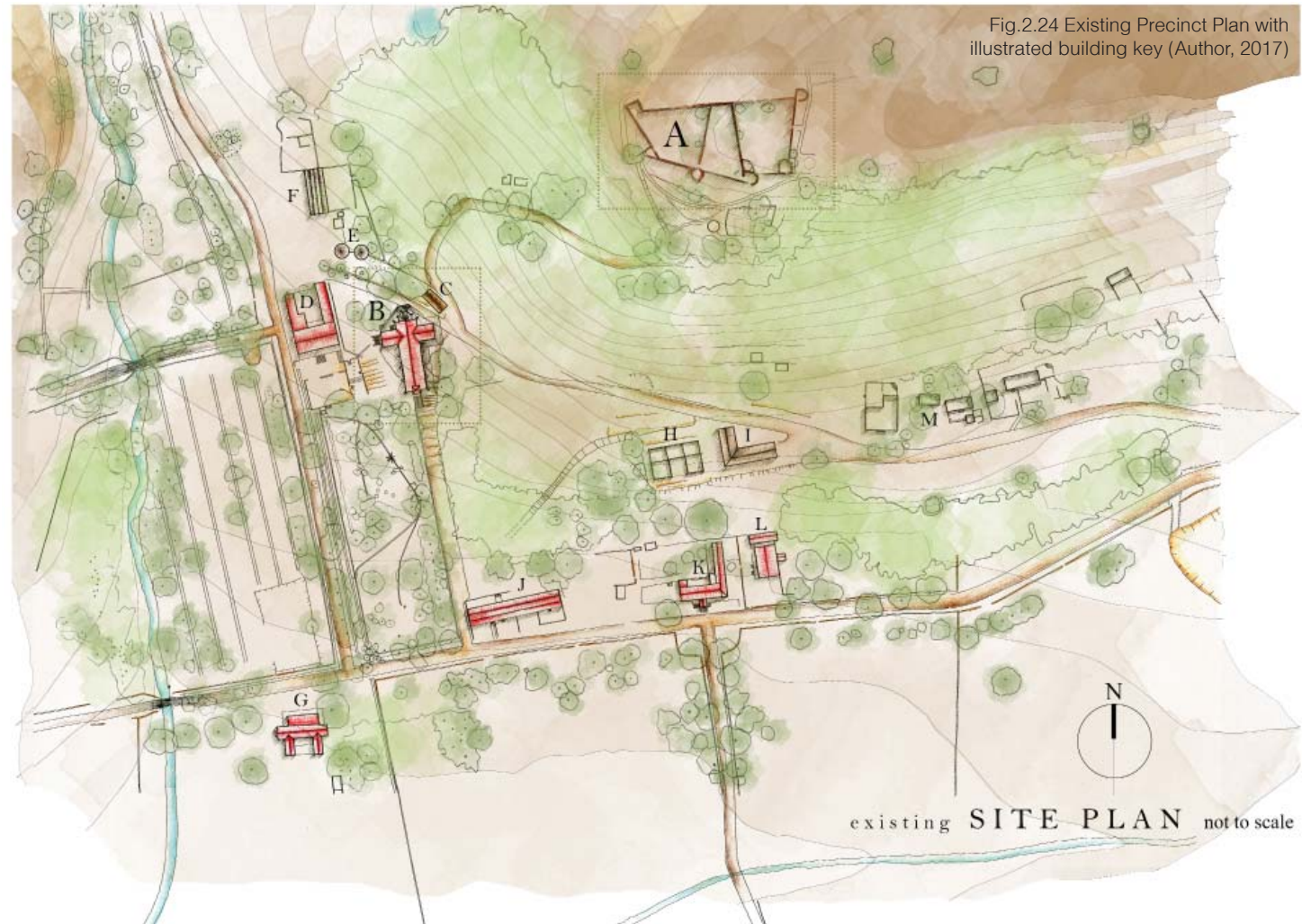


Fig. 2.24 Existing Precinct Plan with illustrated building key (Author, 2017)

of place can be differentiated through observing the spatial relationship between buildings and landscape. The church and fort precinct can be read primarily as a natural landscape with built structures as nodal points within the natural. Contrastingly, the workshop

precinct's fabric can be described as a higher density built 'spine' within the landscape. The focus precinct contains the 'symbols' of Botshabelo and it is their relationship to nature that define them as such. The fort and church are seen

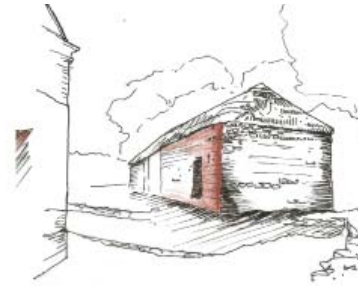
as these symbols that communicate Botshabelo's history; a settlement conceived as a 'place of refuge' for its religious intent as Protestant mission station. The precinct is therefore seen as containing the capacity to 'narrate' the Botshabelo story.



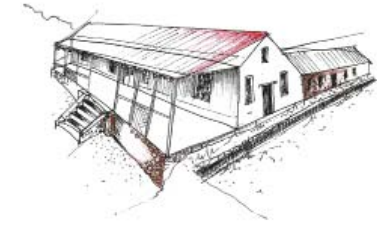
A Fort Merensky



B Church (second)



C Church (first)



D Merensky House (Pastor's residence)



E Merensky Hut



F Horse Stables



G Baubach House



H Training School



I Training School



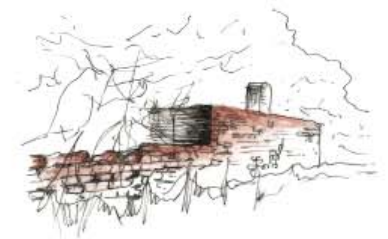
J Domestic Sciences School



K Gastrow House



L German School



M Teacher's Residence

## 2.5.2 'Sacred' Topographies

The precinct is geographically defined by the slope of the northern hill. The slope is first encountered by the dramatic moment created when passing the old domestic science school building, located along the main road. The passerby is drawn into the striking view by a long, linear walkway that ascends towards the church as the focal point. The stone wall that leads along this ascending walkway visually exaggerates what is actually a gradual incline. When passing the church, the slope becomes substantially steeper, creating an unseen boundary between the fort and church, which is reinforced by the overgrown thorny vegetation in which the footpath has been lost. This makes the fort feel like it is isolated from the rest of the settlement. These physical conditions emphasise the precinct's spiritual nature as it recalls the idea of sacred topographies and the pilgrim's route, leading to a spiritual climaxed destination. This idea can be seen as a universal way that man's spirituality has been projected onto the natural landscape. Examples in the Christian Bible include Jesus' retreat onto Mount of Olives in Jerusalem for solitude and prayer as well as the eastern example presented by the world heritage cultural landscape in the Kii mountain range in Japan. Here, several sacred sites are connected along a pilgrim's route (UNESCO, 2017). Another well-known example, where the site's natural topography sculpts

the architecture occurring on it into a harmonious composition, is the Acropolis in Athens. What makes the Acropolis a relevant precedent to the identified Botshabelo precinct is the spatial progression that is facilitated by the topography. The visitor is taken on an experiential route from a place of public gathering (the agora) to the Parthenon, the sacred temple. "Beyond the object was the space of the site" is the phrase that defines the lasting impression that the Acropolis made on the Father of Modernism, Le Corbusier as communicated through his analytic sketches of the Acropolis (fig.2.25) (Curtis, 2011). Le Corbusier's appreciation of the promenade/processional architecture created in the Acropolis was subtly translated into his later work through the Modernist idea of architecture that is activated by movement. This principle is seen in Ronchamp and even more so in the roof terrace of the Unité d'Habitation (Harris, 2015:1) (Curtis, 2011).

*The experience of the route forms part of the site's broader heritage significance and thus the topography is an essential part of the act of retreating, facilitated in this cultural landscape. This principle informs the conceptualisation of the Botshabelo precinct as a 'pilgrim's route', from a place of participation to isolation, encouraged by the site's natural topography.*

## 2.5.3 The Cultural Acropolis

In the writings on Patrick Geddes' urban design theories, the concept of the 'Cultural Acropolis' was formed as the heart of the notion of the city – a place that contains and reflects the ideals, around which the city is built. In his argument, he mentions the components that constitute these 'sublime locations' of ancient Greek cities, as a model for city planning. These parts being: "temple, academe, and theatre", an assemblage of extroverted and introverted spaces that create a civic sense (Welter, 2003:233-235). These spaces within a city can be thought of as the brain or the heart of a city, while the city is the body; this is likewise termed by Nietzsche as "Architecture

for Thinkers" (Welter, 2003:221). The importance of introspective spaces in an urban condition is therefore stressed as a crucial component of the Cultural Acropolis and is further defined as "institutions like universities, artists' studios, monasteries, and hermitages, places of retreat like the thinking cells" of a city (Welter, 2003:233). Bearing in mind the existing components of the identified Botshabelo precinct (fort, church and school buildings), the Cultural Acropolis is an appropriate way of understanding its genius loci in the conceptualisation of the precinct's new programmatic and spatial definition.



Fig. 2.25 Le Corbusier's sketch of the Acropolis during his Voyage d'Orient, (Harris, 2015)



Fig. 2.26 Precinct ritual analysis (Author, 2017)

### 2.5.4 Precinct Vision A New Layer of Ritual

Verheij (2015:34) explores the idea of 'Place' as a strategy for interpreting the theory of palimpsest in heritage architecture. He states that the addition of a new layer of ritual can act as a way to rediscover the site's "inscribed elements" that give the site its sense of 'place'. Smith (2010) echoes this idea, although in different terms: she argues that

through the lens of cultural landscapes, heritage sites can be conserved through the formula of artefact and ritual that equate to the production of cultural meaning.

These theories, in combination with the analysis of the focus precinct's distinct context, have led to the conceptualisation of the precinct as a place for multicultural ritual, which will give new, complementary meaning to the old precinct condition.

The idea of 'space as ritual' is explored by Da Costa and van Rensburg (2008) as an appropriate way of conceptualising Post-colonial African space that "begins with honouring the significance of the diverse perceptions and view-points of its society". The focus precinct will therefore be developed in a way that contrasts, overlaps and mediates sacred and everyday rituals associated with both Western and African cultures. Different spatial arrangements will be



considered in light of the variance between Western and African traditions and their sacred rituals (like the wedding ceremony) and everyday rituals ([include an example here perhaps]), and the how these are performed differently by residents and visitors.

In addition to the cultural focus of sacred and everyday rituals, ways in which space relates to natural rituals will also be considered. This will be done as a means of experiencing and giving importance to the natural landscape of Botshabelo as a crucial part of its heritage. The idea might be expressed through spaces that are influenced by the changing of the seasons, for example, thereby immersing one's experience within the natural cycles. Similar to the

seasons, another example of the natural cycles could be the ritual of sun and moon, which could be celebrated in the fort as the highest topographical point on the site.

Nodal interventions, respecting the existing precinct's relationship between built fabric and natural landscape, which will act as nuclei of ritual stimulation, will 'colour in' the rest of the precinct's landscape. Subtly designed landscapes around these nodes will act as gradual threshold spaces, facilitating the building's relationship to its natural surroundings, creating zones of "non-prescriptive" space where "differences may be negotiated and integration between multiple levels of identity, understandings and practices" (Da Costa & van

Rensburg, 2008:36). These points of building intervention, which define the route from participation to isolation (fig.2.28), from the main road, culminating in the fort as the most intentionally celebrated heritage, will now be briefly described (fig.2.27):

Firstly, along the main road leading into Botshabelo, where the old domestic science and Gastrow house is located, an 'art interface' is proposed where art is celebrated as a ritual that is valued in both Western and African cultures, referring back to Botshabelo's historic art education legacy. The spatial heritage approach here is to introduce new interventions that tie the old fabric, by forming a backdrop that puts the old fabric on display.



Fig. 2.27 Proposed Precinct Framework (Author, 2017)

Programmatically, it will consist of an art school for local children, and the Gastrow house's reappropriation as the Dan Rakgoathe lino print gallery. Tying these two spaces will be a community studio where locals and visitors find common ground to learn from each other's techniques – an exchange of ritual. To the east of the old Gastrow house will be a new printing workshop, a ceramic and sculpture studio as well as a leather workshop that draws from the urban vision's proposed introduction of cattle to the site.

The art interface will live out towards the north into a proposed sculpture garden, being an example of a landscape based threshold space between building intervention and the natural landscape.

Secondly, architectural intervention will be focussed on the old, red brick church, which at present has a section of collapsed roof along its apse. In the light of the theoretical approach of palimpsest, the addition of a new layer shall bear the remnants of the layer before it. Figuratively speaking, this roof section will be restored in a way that remembers what once was a 'wound', as a 'scar', bearing the accident's memory as a layer of its history. This intervention aims to retain the original programme by simply repairing the roof in a poetic fashion. This simple proposal is a reaction based on the fact that the church has been the only building used throughout Botshabelo's history, by various religious and secular groups as a place of gathering.

The argument here, is that the church's symbolic and cultural value therefore indemnifies it of the need for programmatic reappropriation.

Thirdly, a meandering route designed along the steep slope's natural contours is proposed to link the church to the fort on top of the hill. The route is consciously taken past two existing ruins, which is suggested as a resting place along the route. This space is reimagined as a subtle landscape intervention designed with the use of water, providing a cool space along the trail, which might provide the opportunity for a place of worship. The intention here is that by alluding to the idea of water and spiritual space, a place is created that is flexible enough for different cultural and personal meanings to be attached to it.

Finally, the route culminates at the old Fort Merensky, atop the hill, where the main design intervention will be realised.



Fig.2.28 Parti diagram explaining site concept of moving from a space of celebration to isolation along a defined route (Author, 2017)

## 2.6 Site Scale: Fort Merensky

### 2.6.1 The symbol of Botshabelo

*“...About 100 feet higher up the slope, above the house and church, we erected a fort and called it Fort Wilhelm. Its walls were of stone and their cavity was filled with dagga [daka]. The fort had walls twelve feet high and resembled a peasant’s fortification, not unlike some medieval city walls in southern Germany. These were four to five feet wide at the base; the upper part was narrower and had embrasures. The Post was finally finished with a central tower.”*

(Le Roux et al 2001:17)

An extract from: Merensky, D.A. 1899. *Erinnerungen aus dem Missionsleben in Transvaal 1859-1882*. Berlin: Buchhandlung der berliner Evangelischen Missionsgesellschaft.

Fort Merensky can be seen as the structure with the least programmatic relevance to its contemporary context as the need for defence against attackers is no longer a priority. It does, however have the most representational relevance in Botshabelo as it embodies the initial settlement that arose out the need for safety. The fort indirectly provides a reading of the natural landscape through its directly associated relationship to the topography. Essentially, the fort is a device for surveillance and protection, which can be reinterpreted to give new relevance to its symbolic potential in the narration of Botshabelo’s story.

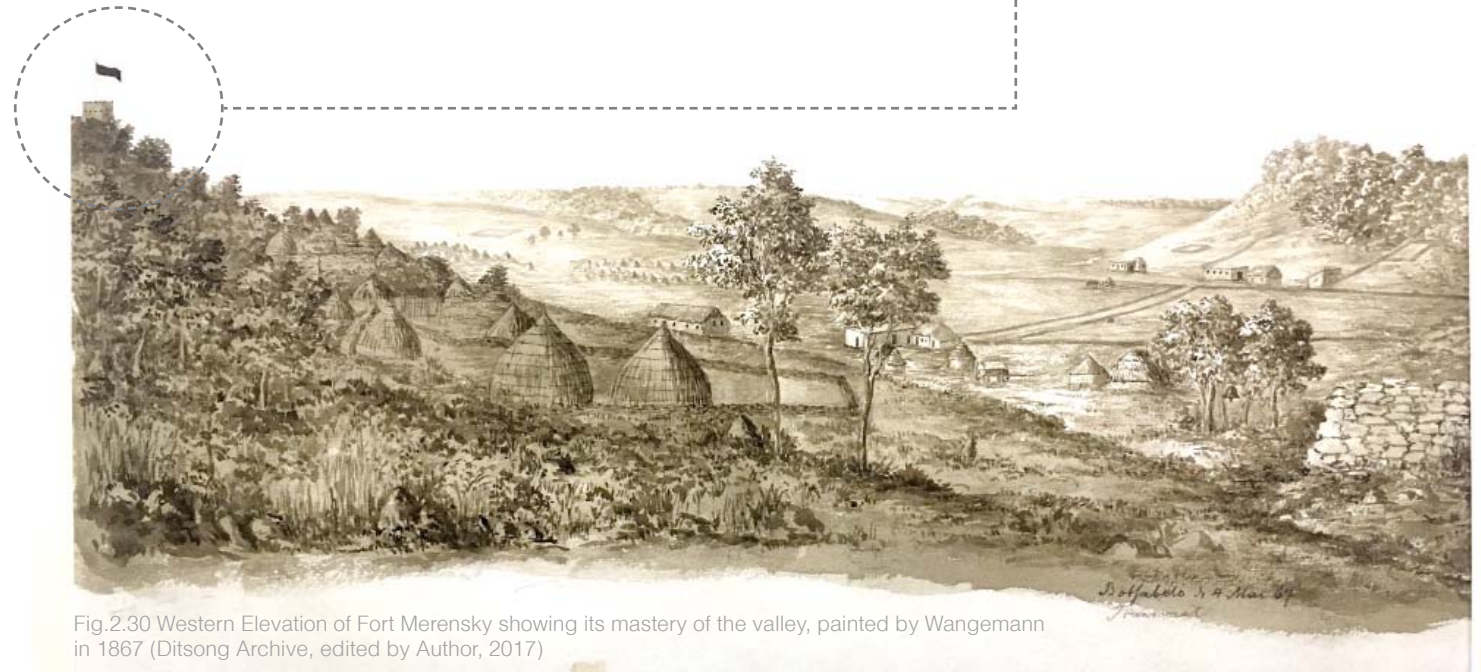


Fig.2.30 Western Elevation of Fort Merensky showing its mastery of the valley, painted by Wangemann in 1867 (Ditsong Archive, edited by Author, 2017)

Fig.2.29 Sketch of 1991 view towards Fort Merensky from the Motse (Le Roux & Fischer 1991, sketch by Author, 2017)

## 2.6.2 Fortification in the History of Architecture

In understanding what a sensitive design approach to the fort's heritage significance would be, it is first necessary to understand the meaning, or original spatial intentions of the fort and what is communicated by the different architectural components of this defensive architectural language: the curtain wall, the elevated walkway, the tower, bastions and embrasures (Hopkins, 2012:30-33).

In Merensky's writings of Botshabelo, he notes that the fort was "not unlike some medieval city walls in southern Germany" (Le Roux et al. 2001:17). This association made by Merensky alludes to the reading of Fort Merensky as a regional typology in the international evolution of defensive architecture in

history. Hill forts, such as Fort Merensky can be seen as an intermediate fortification typology in-between that of walled cities and castles. The hill fort is a microcosm of the walled city as it was designed to sustain the group seeking refuge for substantial periods of time when

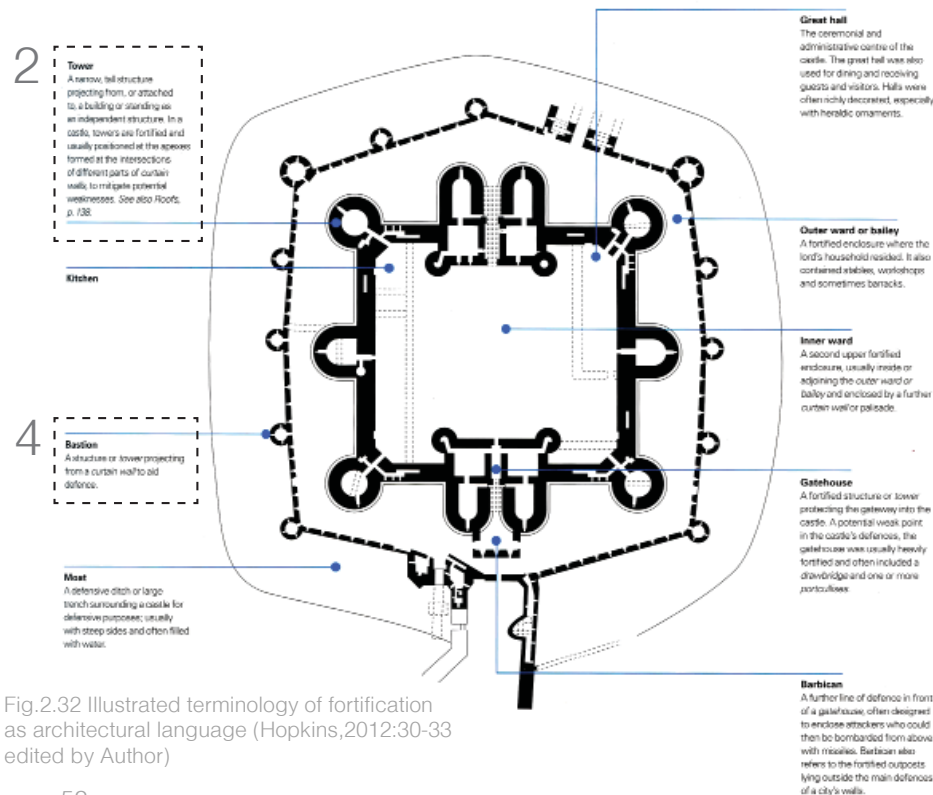


Fig.2.32 Illustrated terminology of fortification as architectural language (Hopkins,2012:30-33 edited by Author)

## WALLED CITY — [HILL FORT] — CASTLE



Fig.2.31 Evolution of fortification in architectural history (Author, 2017)

under siege (Hopkins 2012:30). The hill fort typology later evolved into the castle typology, on which much has been written in architectural theory. It is therefore possible to interpret the architectural intentions of a fort structure such as Fort Merensky through an understanding of the architectural elements of the castle typology.

Fortified structures can be seen as a type of architecture that was a direct response to warfare. The nature of warfare techniques have always been linked to the technology of the time.

This relationship is also clearly reflected in the architecture of these defensive structures largely based on the use of cannons and gunfire. When warfare techniques changed with the technology of aerial bombardment, these structures resultantly lost relevance (Hopkins 2012:30).

Forts are therefore, symbols of the specific historic battles that necessitated their creation and thus retain the narratives of these historic events. For example, through the placement of the bastions one can interpret the direction from which threats were expected.

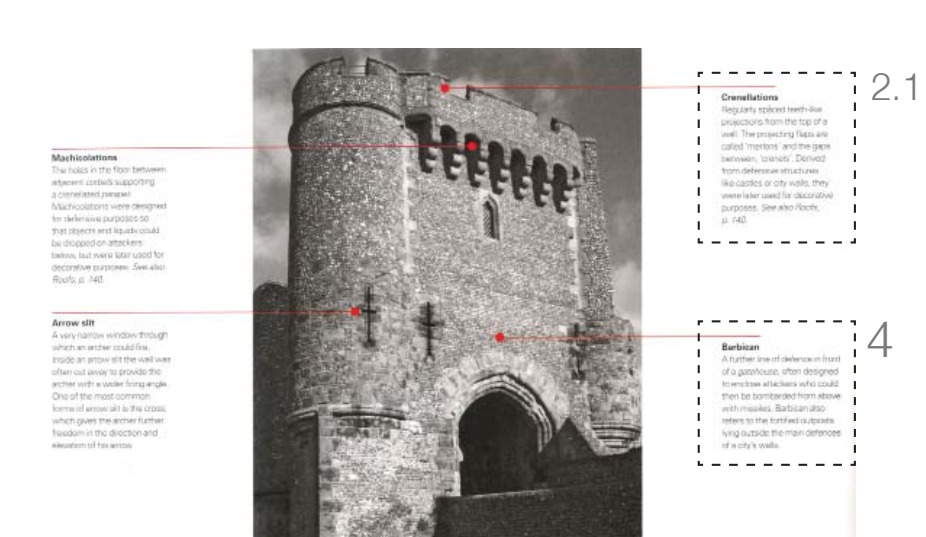


Fig.2.33 Elevational understanding of fortification as architectural language (Hopkins,2012:30-33 edited by Author)

### 2.6.3 An Interpretation of the Old

By understanding the architectural components of fortified structures, it is now possible to apply this knowledge to Fort Merensky, and its meaning, in context:

It can clearly be seen that the fort should be interpreted on plan, as consisting of three definite parts (fig.2.34). The eastern-most section with lower stone walls was originally the kraal and has its own bastions for the protection of the livestock. The remaining two sections have higher walls and can be understood as the area that required a greater degree of defence. Through a reading of the placement of bastions, the direction from which surveillance was most needed can be assumed, as these curved wall components contain the most concentrated collection of embrasure holes. The bastion's concentration on the southern fort façade, infers that attack was most likely expected from this direction, overlooking the valley down below.

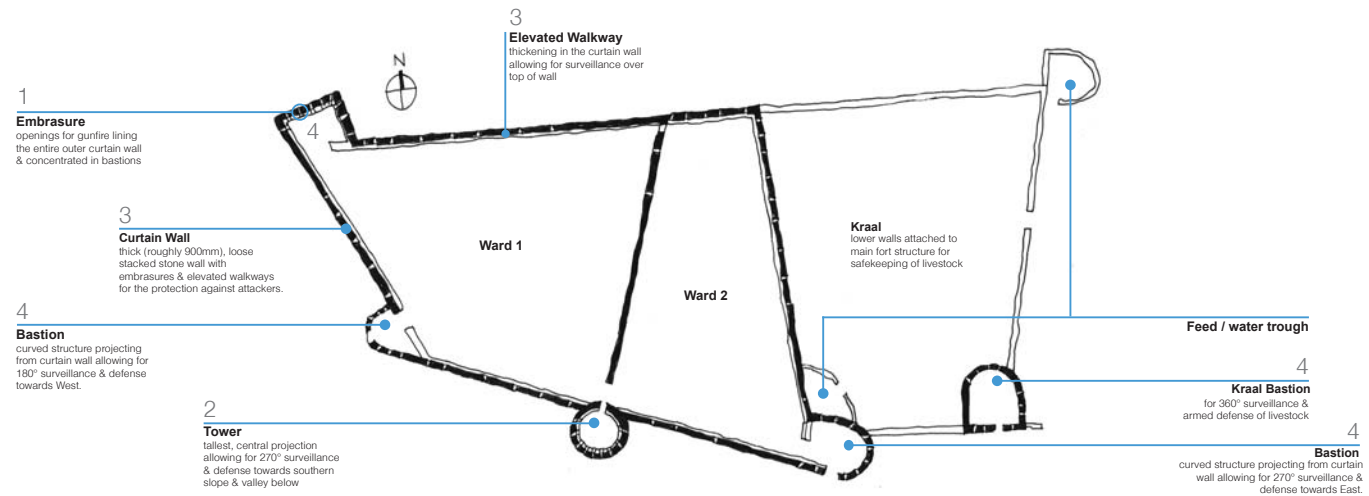


Fig.2.34 Identification of fortification terminology on the plan of Fort Merensky (Author, 2017)

## Outcome >

### 2.6.4 Fort Merensky's [re]interpreted New Layer

The fort can be understood as a structure that encases, and physically protects, whilst visually granting its inhabitant dominance over the Botshabelo landscape. The fort is therefore seen both as instrument for viewing or observation and as a structure that protects. It is an *abditory* - “a safe repository for valuables; a hiding place” (oxforddictionary.com, 2017). This understanding of the fort offers a way in which its original meaning can be reinterpreted into its contemporary use, and provides a way of conceptualising the new programme as a space for ‘hiding’ and ‘revealing’.

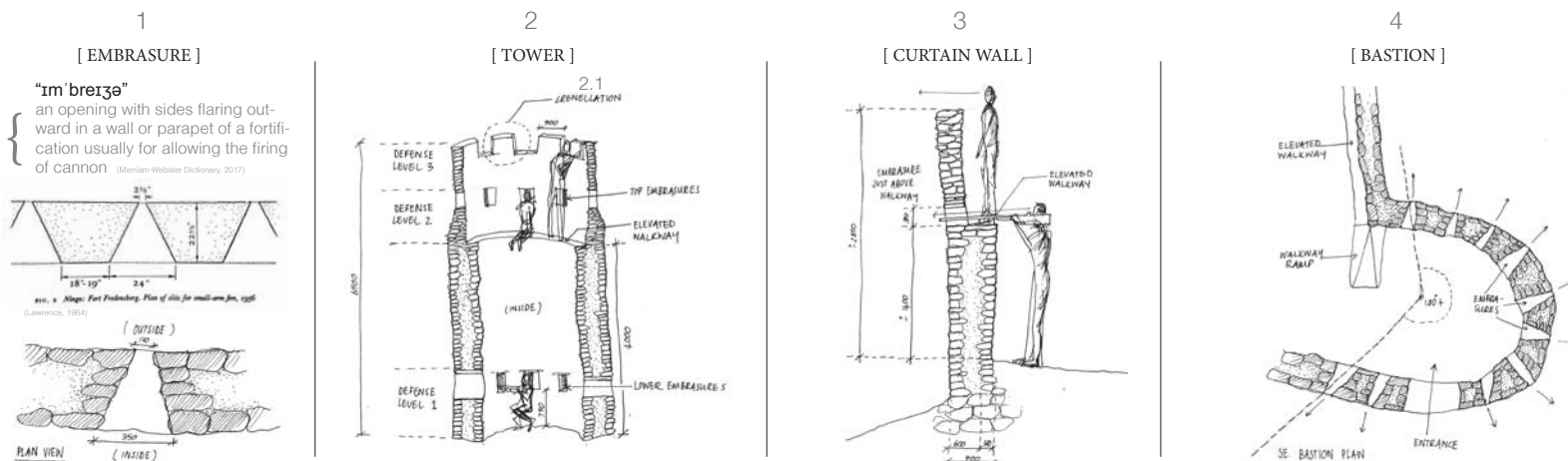


Fig.2.35 Detailed analysis of fortification elements of Fort Merensky (Author, 2017)

## 2.7 Conclusion

Architecture is understood to be a product of social values (Da Costa & van Rensburg, 2008:1). With this in mind, the envisioned future of Botshabelo anticipates that the social complexity of the space will evoke conflicting expressions, which respond to the space's 'shared heritage'. It has been argued that this complexity requires a progressive

approach to heritage, through the interpretation of Botshabelo as a Cultural Landscape that thrives on the cultural richness experienced here. This approach makes it possible to **dynamically conserve** the historic settlement through the reintroduction of a self-sustainable community, in a way that simultaneously promotes Botshabelo as heritage-tourism

destination. This active approach to conservation bases the 'new layer' of activity on the themes of productivity, education and spirituality as the heart of the historic mission, interpreted in a contemporary fashion that is relevant to its current day demographic.

The emphasis placed on the contextual analysis of the tangible and intangible elements of Botshabelo at several scales, has sensitively informed the rootedness in place that the focussed, single architectural intervention wishes to achieve. This is not only a sensitive reaction to the valuable heritage of the fort structure itself, but more importantly, a celebration of the greater heritage narrative of Botshabelo.

- Chapter 03 -

# PROGRAMME



3.1 Introduction  
3.2 Programmatic Concept  
3.3 Programme Requirements

3.4 SANS 10400  
3.5 Programmatic Precedents

### 3.1 Introduction

■ Translating the idea of 'hiding & revealing into programme'

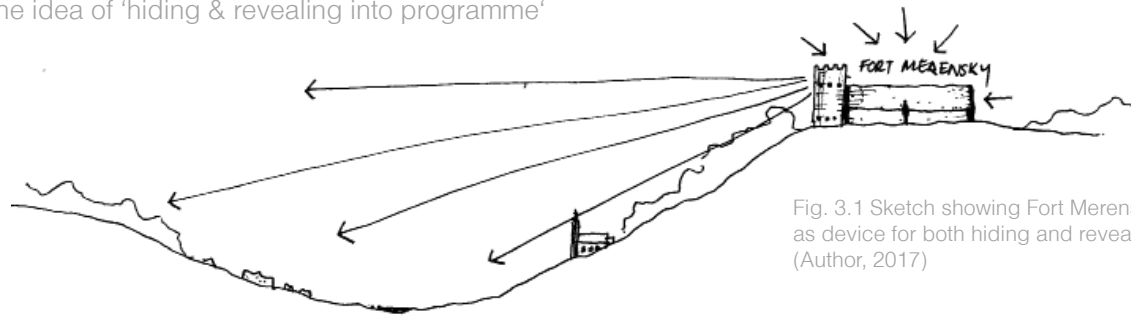


Fig. 3.1 Sketch showing Fort Merensky as device for both hiding and revealing (Author, 2017)

The fort can be understood as a structure that encases and physically protects, whilst visually granting its inhabitant dominance over the Botshabelo landscape. The fort is therefore seen both as an instrument for viewing (observatory) and as a structure that protects – an abditory, defined as “a safe repository for valuables; a *hiding place*” (oxforddictionary.com, 2017, emphasis added). This understanding of the fort offers a way in which its original meaning can be reinterpreted into its contemporary use, and provides a way of conceptualising the new programme as a space for ‘hiding’ and ‘revealing’. It should be understood that these two concepts were not mutually exclusive functions, but rather symbiotic. This relationship might be understood as “hidden in order to reveal”. This co-dependant relationship will be reflected in the new programmatic interpretation, analysed next:

The idea of hiding is interpreted through the new function of the fort as a retreat and archive space. Archive spaces will allow the on-site housing of the wealth of Botshabelo’s historical records. These records are currently held at the Middelburg Municipality. The opportunity will be created for researchers to access these historical records in the place that they were conceived, producing a stimulating research experience. Those accessing these records will be given the opportunity to ‘retreat’ for extended periods of study time, and can be provided with on-site accommodation. The fort should function as a retreat for ‘pilgrims’, for example: writers, historian, researchers, archaeologists, bird watchers. It shall be a sanctuary for those who seek the contemplative isolation offered here. Yet, due to the fort’s heritage significance, it will not be exclusive to these visitors.

The more private programme will be layered with the public use of the fort as an “interpretation centre”. This term is given to places that offer an alternative museum experience. This type of space is less focussed on the exhibition of artefacts within it, but rather considers the interpretation of the space itself and the way it relates to its surroundings, as a curated, phenomenological experience in the telling of a specific narrative.

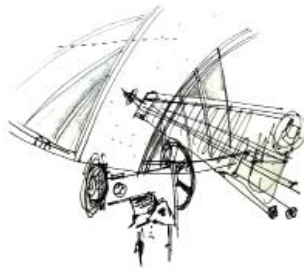
[ HIDE ]



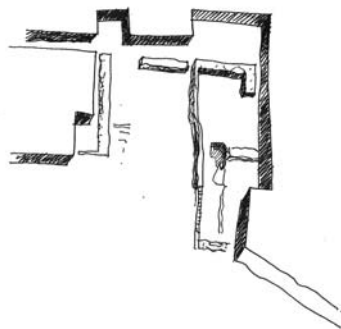
Fig.3.2 Diagrams illustrating the programmatic interpretation of the idea of ‘hiding’.  
(Author, 2017)



] REVEAL [



The act of 'revealing' is discovered by the Botshabelo visitor in the opportunities to lookout over the Botshabelo valley. For instance, at the reinterpreted fort tower. The fort, which is a roofless structure, holds a strong connection to the open sky. This spatial characteristic will be taken further by consciously revealing the sky in its changing phases between night and day.



The archaeological excavation of the original settlement at the foot of the fort is another act of revealing. This excavation will also be incorporated in the programme's research facilities and public viewing opportunities of these events will be carefully incorporated in

the project programme.

A supplementary narrative for further conceptualising the interpretation centre was termed "an abditory for natural holism". This idea was born from the earlier mentioned intention of celebrating Botshabelo's shared memory. Nature is seen as the common ground, which simultaneously celebrates the intimate relationship with the environment held in African cultures. This attitude was shared by Alexander Merensky who was not only a missionary, but also a botanist, cartographer and geographer. He was responsible for drawing some of the first maps of South Africa. Merensky is seen as a 'natural holist', creating a sub-narrative subject for the interpretation centre. This idea will be

curated in greater and lesser obvious ways, like directly informing the theme of exhibitions and indirectly informing the supporting programmes. The notion should be identified in the offering of traditional African refreshments to visitors, including African beer and tea, brewed from grains and herbs that are grown on site. This is done in the spirit of promoting a greater appreciation and dependence on nature, often lost by city dwellers.

The product that is created can be understood as a microcosm of a broader Botshabelo narrative through the reinterpretation of the Fort Merensky as 'abditory' and 'observatory' in the reading of a 'shared memory'.

Fig.3.3 Diagrams illustrating the programmatic interpretation of the idea of 'revealing'. (Author, 2017)

### 3.2 Programmatic Concept

Fort as Abditory and Observatory

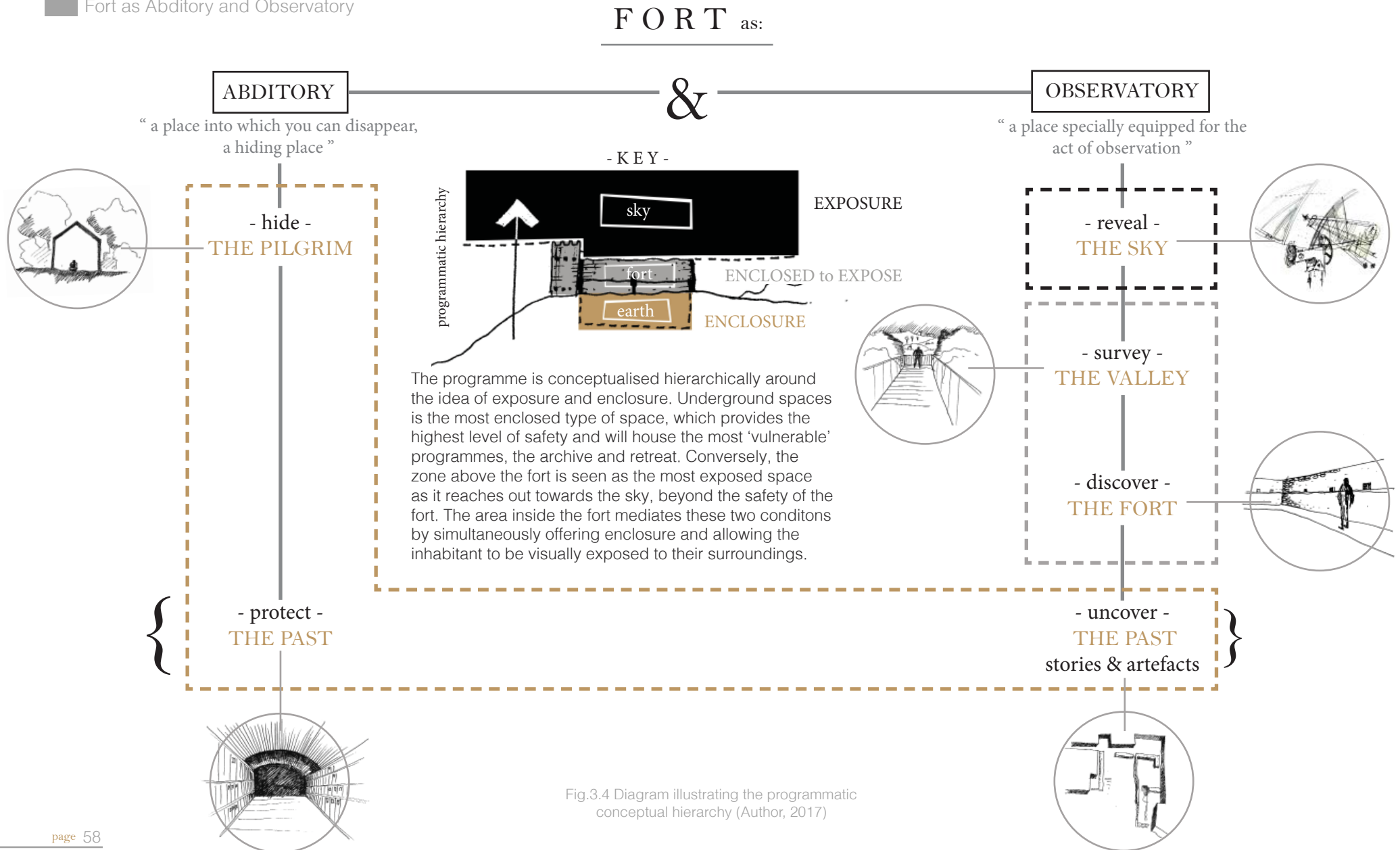


Fig.3.4 Diagram illustrating the programmatic conceptual hierarchy (Author, 2017)

## 3.3 Programme Requirements

### Schedule



### 3.4 SANS 10400

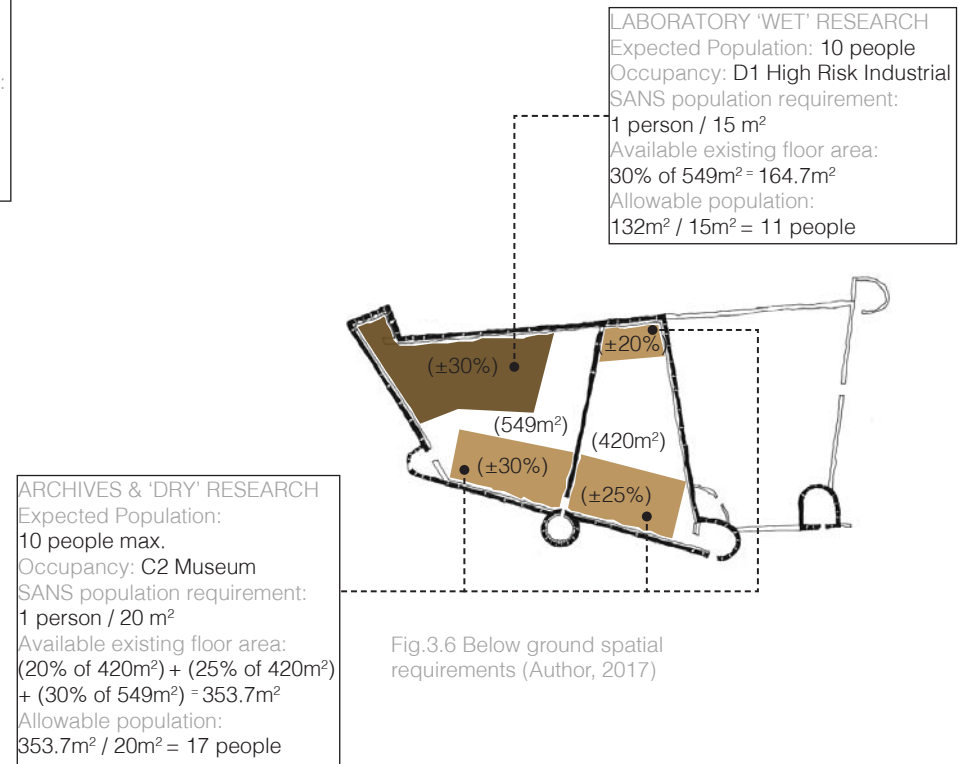
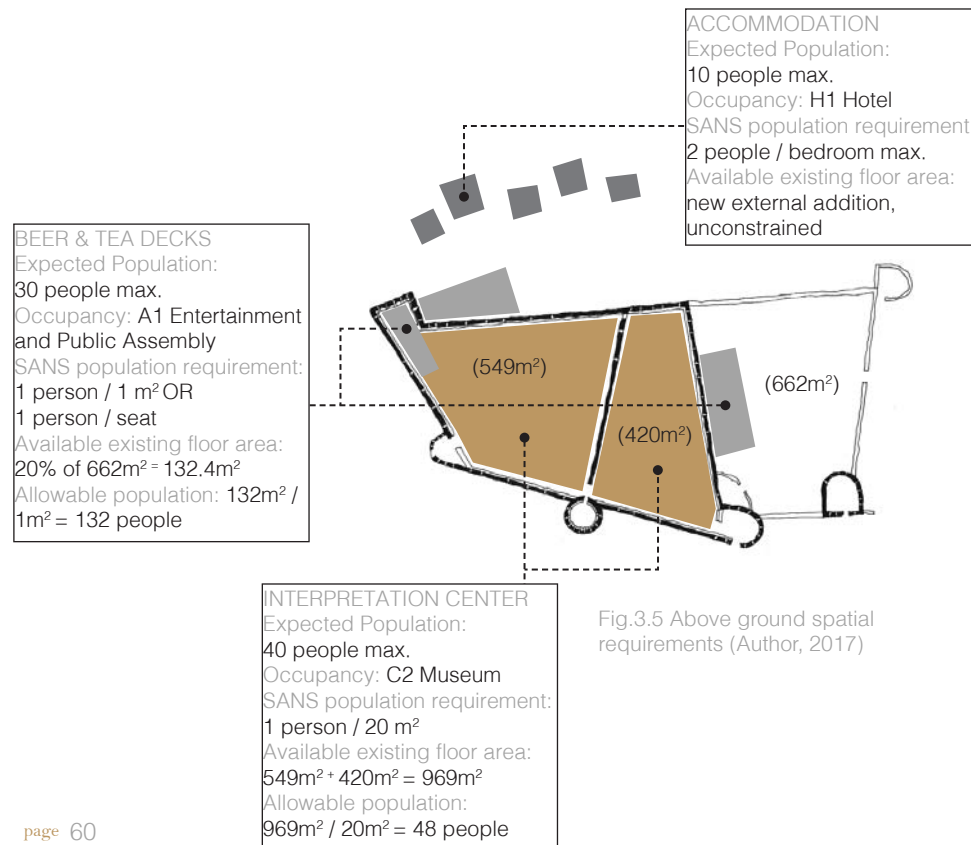
#### Programme Occupancy Requirements

The fort has a predetermined boundary. Occupancy therefore, has to be suited to the spaces already implied by the fort footprint with minor building additions on the fort exterior. The programmatic analysis is therefore, a mediation between the available space and the desired population.

POPULATION ANALYSIS:

| <b>expected day visitors :</b> | <b>staff:</b>                         | <b>overnight visitors:</b> |
|--------------------------------|---------------------------------------|----------------------------|
| ± 40 people at one moment      | interpretation reception : 1          | 10 beds                    |
|                                | accomodation reception : 1            |                            |
|                                | caretaker : 1                         |                            |
|                                | cleaning & maintenance staff: 4       |                            |
|                                | interpretation centre curator : 1     |                            |
|                                | tea deck kitchen & serving staff : 4  |                            |
|                                | beer deck staff : 2                   |                            |
|                                | archive secretary : 1                 |                            |
|                                | interpretation centre storyteller : 1 |                            |
| <b>total : 40</b>              | <b>total : 16</b>                     | <b>total : 10</b>          |

Total occupancy : **66 people at one moment**



## 3.5 Programmatic Precedents

Reveal: The Interpretation Center: the dynamic museum typology'

# R E V E A L

### [ LOCAL ] INTERPRETATION CENTER

Project: Mapungubwe Interpretation Centre

Architect: Peter Rich Architects

Year completed: 2009

Location: Mapungubwe National Park World Heritage Site

#### Project Description:

The Mapungubwe Interpretation centre is a sensitive, yet striking building intervention created with the intention of celebrating the memory of the great Zimbabwean ancient civilisation, which the landscape bears testament to. The design displays an elegant formal response and careful use of materials that reference the ancient cultural landscape in which it sits (Naidoo, 2009).

#### Relevance:

This project is an example of architecture that is based on the orchestration of a visual experience, where the building serves as monumentalisation of a cultural landscape. Although the building houses specific internalised programmes, the overall intention of the architecture is to focus attention on the external condition.

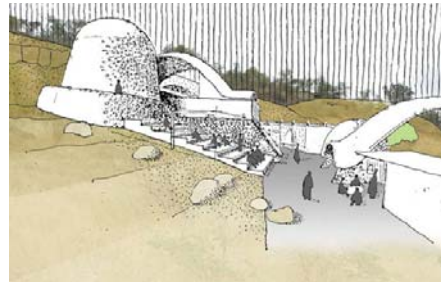


Fig.3.7 Drawing of the Mapungubwe Interpretation Centre theatre (designboom, 2009)



Fig.3.8 Pathway through Mapungubwe Interpretationcentre (Author, 2017)

### [ INTERNATIONAL ] INTERPRETATION CENTER

Project: Salburúa Nature Interpretation Centre

Architect: QVE Arquitectos

Year completed: 2003

Location: Vitoria-Gasteiz, Basque Country, Spain

#### Project Description:

The design of a 21 meter span cantilever wood and steel structure defies gravity in an effort to submerge the visitor in the park - a dramatic experience only made possible through the architecture (archdaily, 2009).

#### Relevance:

This design exemplifies architecture that is designed to specifically relate to its natural surroundings. The space grants the visitor a heightened experience of the setting, and shows how architecture can serve to 'exhibit' its surroundings.



Fig.3.9 Detail of observation platform construction (archdaily, 2017)



Fig.3.10 Photograph of viewing deck cantilevering over the lake (archdaily, 2009)

Hide: The phenomenon of “Retreating into Nature”

H I D E

AN ISOLATED  
WRITER'S RETREAT

Project: Writer's Retreat  
Architect: Architectare  
Year completed: 2015  
Location: Petrópolis, Brazil

**Project Description:**  
The phenomenon of retreating into a desolate location in a natural environment is typically displayed through this precedent study. The design used the symbol of the cave to further conceptualise the architecture's intention of providing a sheltered environment in which creative thought might be stimulated (archdaily, 2015).

**Relevance:**  
The project is an example of architecture that is informed primarily by the programmatic intention of 'hiding' in nature. It can be seen how this main informant is expressed through a formal response that creates a safe, internalised condition, which references the external condition.



Fig.3.11 Photograph of writer's retreat hidden within its natural landscape (Finotti, 2015)

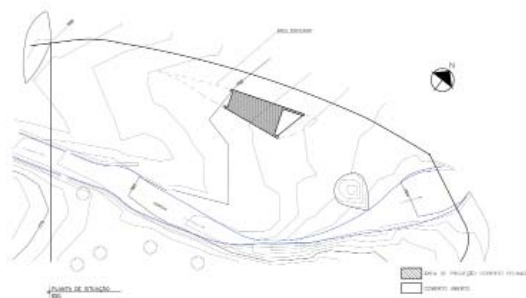


Fig.3.12 Writer's Retreat Site plan (archdaily, 2015)

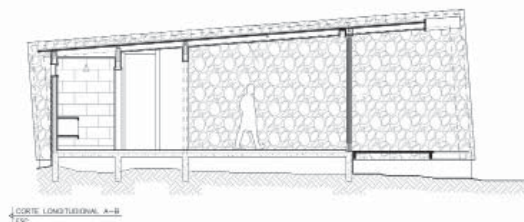


Fig.3.12 Writer's retreat longitudinal section (archdaily, 2015)

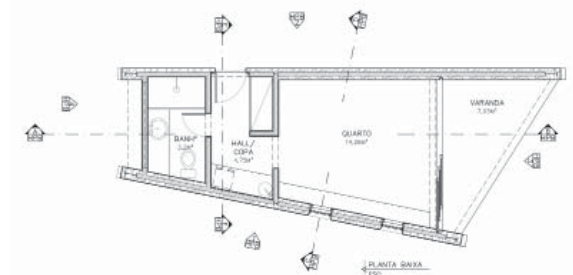


Fig.3.13 Writer's Retreat floor plan (archdaily, 2015)

- Chapter 04 -

# CONCEPT



4.0 Conceptualising a spatial  
response  
4.1 A Submerged Insertion  
    4.1.1 Conceptual Precedent  
4.2 The Gap

4.3 Fort as Walled Garden  
4.4 Fort Geometry: a response  
4.5 Fort Views & Vistas

## Conceptualising a spatial response

### 4.0 A 'hidden' new intervention, revealing the old

The idea of 'hiding' and 'revealing' extends beyond its programmatic implications and informs the spatial treatment of the new architectural intervention, in relation to an existing ruin.

A description of the hierarchy of design informants follows:

It has been established that Fort Merensky's symbolic significance is of extreme heritage value to the greater Botshabelo. The new intervention therefore has to not only respect the existing fabric, but be subservient to it on a programmatic and spatial level. Programmatically, this has informed the 'Interpretation Center' where the old is

rediscovered through the formalisation of this event. Spatially then, the new intervention is conceptualised in such a way that an amplified experience of the old is created. This approach calls for a sensitive intervention that submits to the dominance of the stereotomic fort walls.

In essence, the concept can be described as a "hidden new intervention that serves to reveal the old".

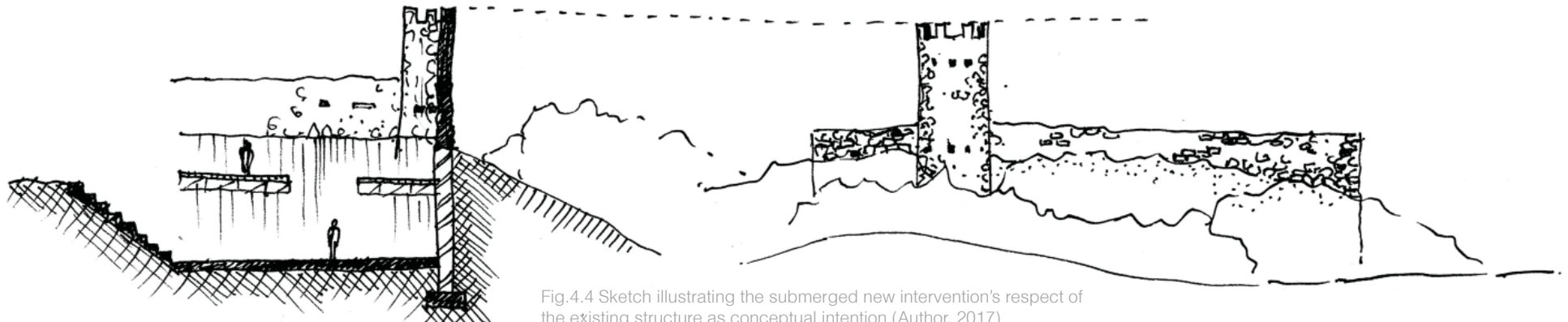


Fig.4.4 Sketch illustrating the submerged new intervention's respect of the existing structure as conceptual intention (Author, 2017)



# { 1 }

## 4.1 A Submerged Insertion

The theory of palimpsest in architecture as an approach to heritage, discussed earlier in the larger contextual investigation, is equally applicable for the singular architectural intervention scale, and thus forms an umbrella theory. Primarily, the first of Machado's seven strategies for the implementation of this theory is explored by 'building within' the existing (Robert, 1989).

In order for this new inserted layer to respond sensitively to the fort, yet obtain enough floor area for housing the programmatic requirements as analysed

in the previous chapter, it was decided to submerge the new intervention within the old, creating a dynamic roof/floor surface that acts as a platform on which the experience of the old is facilitated. This dynamic surface will act as mediator between the two conditions (open air above ground and submerged below ground) by treating devices for ventilation and daylighting into below ground spaces as opportunities that contribute towards the above ground experience. This floor/roof surface also serves to separate and at places, mediate the public and private spheres.

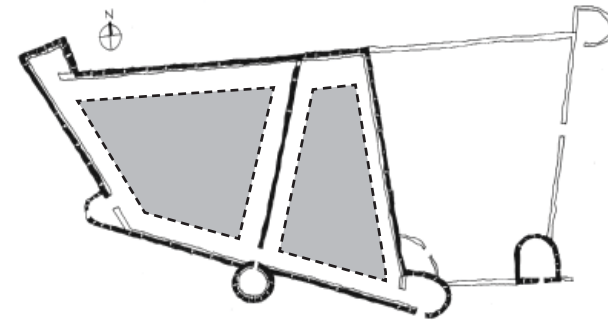


Fig.4.3 Diagram showing how the new submerged intervention will serve to define the existing ward layout (Author, 2017)

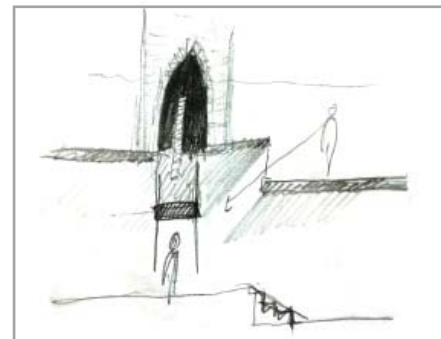
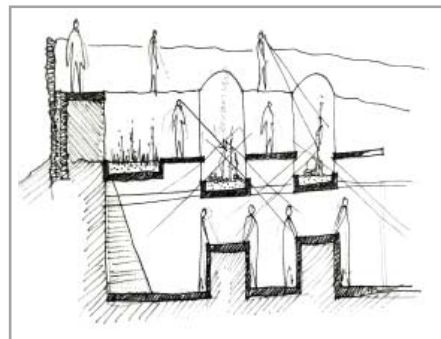
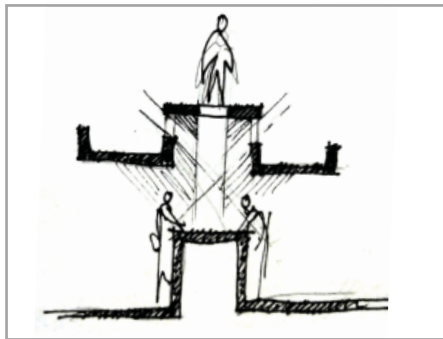


Fig.4.2 Sketch exploration of experiential/light opportunities created by the new dynamic roof / floor plane (Author, 2017)

## 4.1.1. Conceptual Precedent

■ New within the Old

### THE POMBAL CASTLE VISITOR CENTRE

Project: Pombal Castle Visitor Centre

Architect: Comoco Architects

Year completed: 2012

Location: Pombal, Portugal

#### Project Description:

This seemingly stereotomic limestone-clad addition to the interior of a Romanesque fortress was introduced to serve as an information desk and an observation deck. Due to the building's presence within the old heritage artefact, the design was conceptualised to be neither 'ostensive or subdued' (Frearson, 2014).

#### Relevance:

The precedent displays the use of a new, contrasting intervention placed within the boundaries of a historic structure, which it serves to draw attention to by granting the visitor new viewing opportunities. This is done by activating the new intervention's roof plane as an observation deck.



Fig.4.5 Photograph showing use of new intervention as viewing platform (Guerra, 2014)



Fig.4.6 Photograph of the visitor centre at night (Guerra, 2014)



Fig.4.7 Photograph showing limestone monolith "staircase façade" (Guerra, 2014)

# { 2 }

## 4.2 The Gap

In his personal observations on Palimpsest design strategies, Verheijj (2016) mentions the idea of ‘dialogue’ as the coming-together moment of old and new that creates an awareness of time as one such strategy. “The gap” is a method of articulating this moment of “coming together”. Carlo Scarpa, a master of this technique, exemplifies this method very clearly in his design of Castelvecchio in Verona, where detailed connections between the old and the new are elegantly celebrated.

In this scheme, the idea of ‘the gap’ will be implemented as a coherent design approach on a macro and micro scale. At a larger scale, the treatment of the insertion of the new into the whole will be articulated by leaving a wide enough distance of natural ground between the insertion and the existing fort structure. Beyond its theoretical value, this strategy will serve to structurally stabilise the existing fabric. Additionally, this ‘buffer’ reinforces the idea of reinterpreting the fort’s original meaning, by becoming the interpretation center’s main circulation space, relating to the elevated walkways surrounding the inside of the fort curtain walls (fig.4.8).

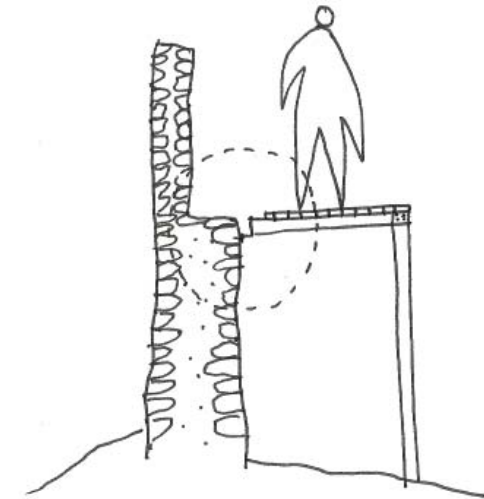
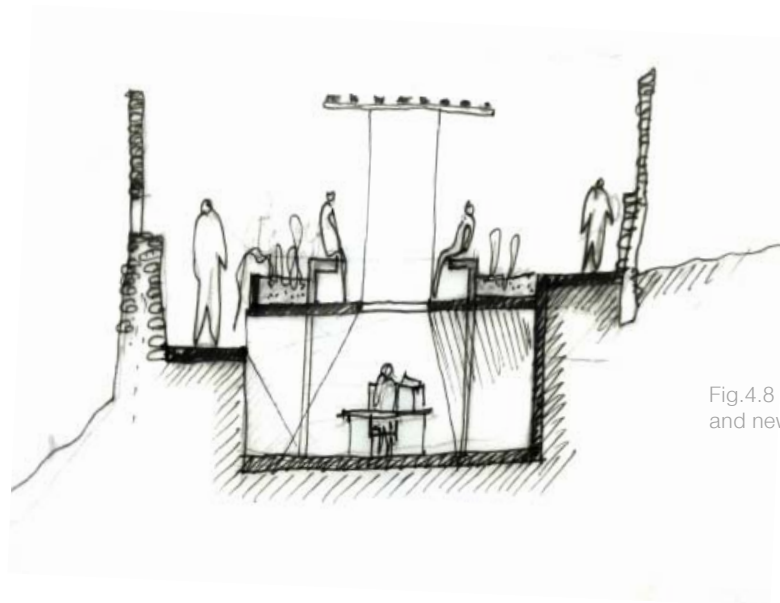
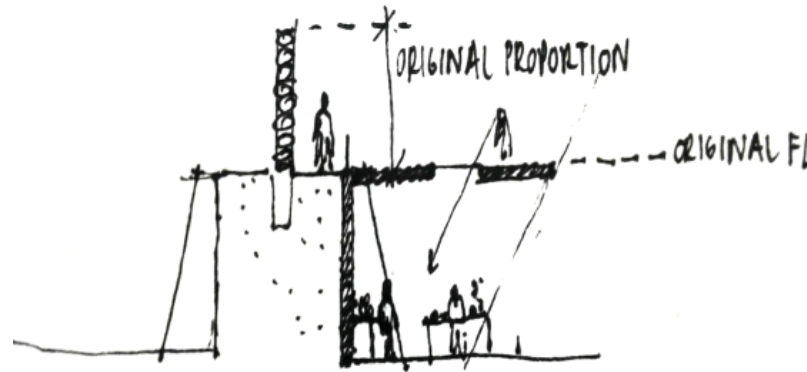


Fig.4.8 Sketch exploration of relation between the old structure and new submerged intervention (Author, 2017)

# { 3 }

## 4.3 Fort as Walled Garden

In trying to reinterpret the existing, it is important to respect not only the original function of the fort, but also to reinterpret the haptic qualities of the space. The fort, being a roofless structure, creates an inside-outside space with a natural ground covering, especially in its present state of neglect where vegetation has started to take over the fort wards (fig.4.10). A certain yellow-flowered grass with a prominent aroma creates a pleasant sensory experience as one enters the fort. It is these less obvious spatial qualities that become important characteristics in the conceptualisation of what the fort interpretation centre is to 'interpret'. This informs the treatment of the floor/ roof surface as a partly vegetated surface, further hiding the new intervention. A general strategy of feathering thresholds seeks to blur the boundary between inside and outside (fig.4.9).

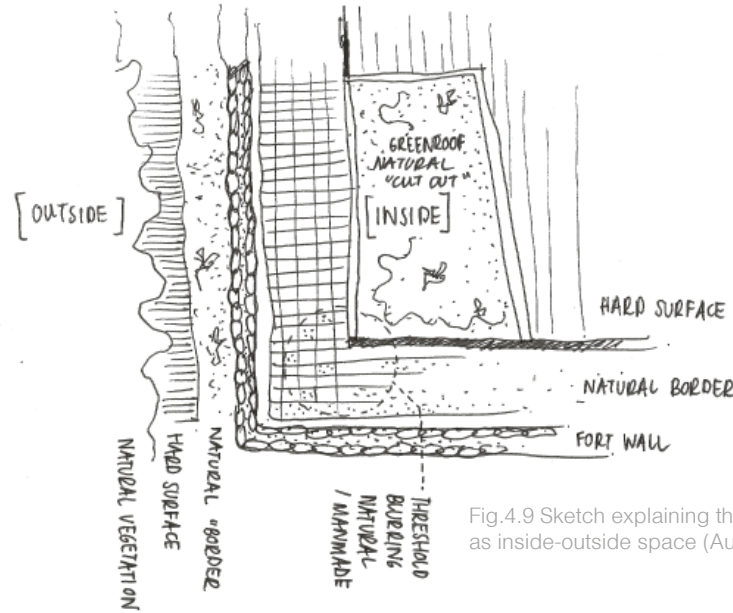


Fig.4.9 Sketch explaining the idea of fort as inside-outside space (Author, 2017)



Fig. 4.10 Photograph taken inside Fort Merensky showing vegetated interior (Author, 2017)

### 4.3.1 Precedent:

Project: Forum Homini Boutique Hotel  
Architect: Active Architects  
Year completed: 2005  
Location: Cradle of Humankind, Kromdraai

#### Precedent Relevance:

The Forum Homini Hotel design displays a conscious effort to not disturb the natural landscape through the use of vegetated concrete roofs, which seamlessly integrate with their natural surroundings (Joubert, O. (ed) 2009:102).



Fig.4.11 Hotel hidden within its surroundings (Active Architects, 2005)

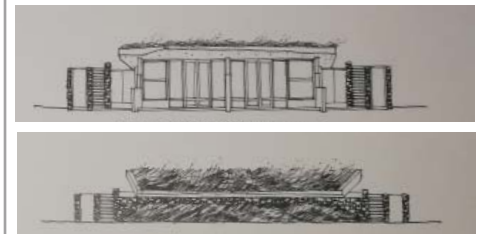


Fig.4.12 Front and back elevations of bedroom unit (Active Architects, 2005)

# { 4 }

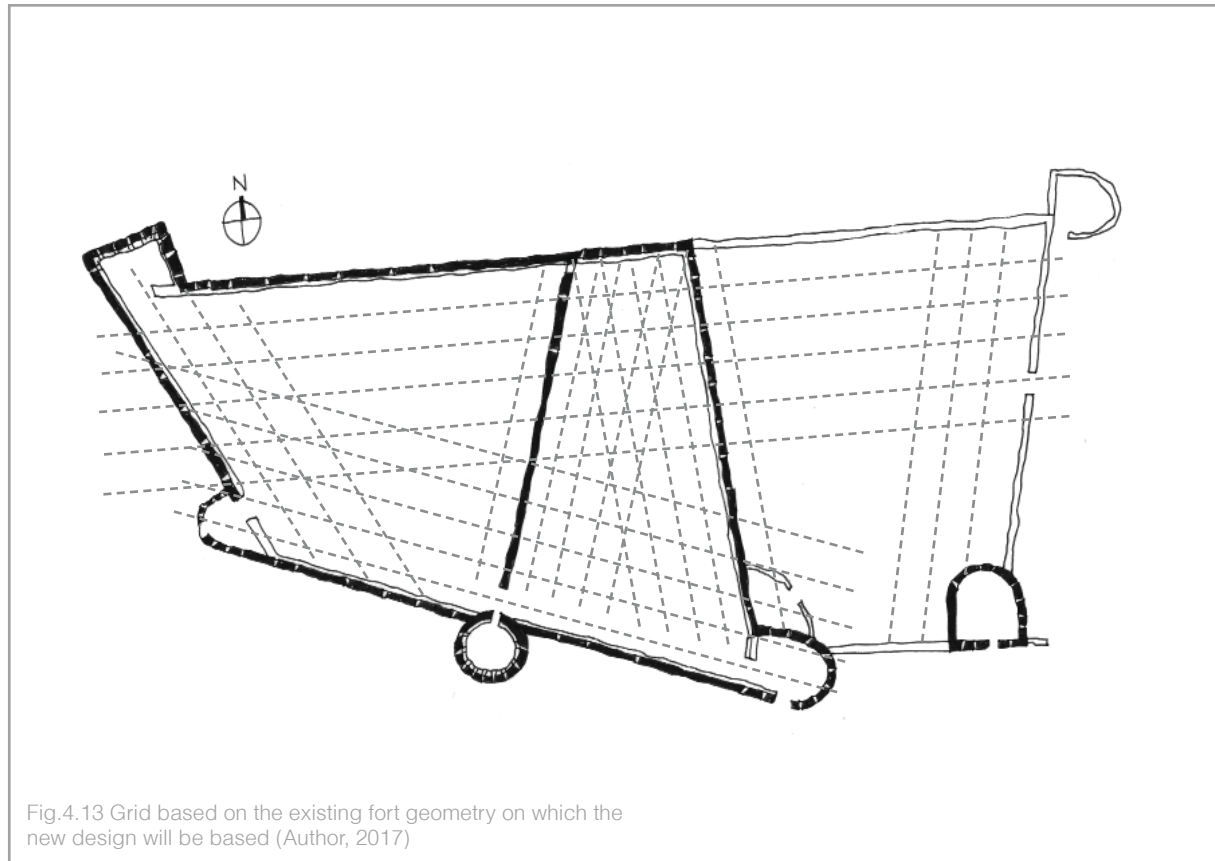
## 4.3 Fort Geometry: a response

The form and geometry of Fort Merensky can be seen as a result of the following factors:

- The site's gradually sloping topography ( $\pm 6\text{m}$  height difference over  $\pm 40\text{m}$  distance).
- The directions from which threats were expected, which determined the directionality of curtain walls and the placement of bastions.
- The availability of stone on site.
- The locals' skill in stone construction.
- The technology available: the fort was built by hand by the local population.

Considering the above factors, it can be said that Fort Merensky reflects a venacular architecture as it was a direct response to the local need, technology and material. Although the fort's form came about out of this basic set of circumstances, it can in retrospect be architecturally appreciated for its organic quality and interesting geometry.

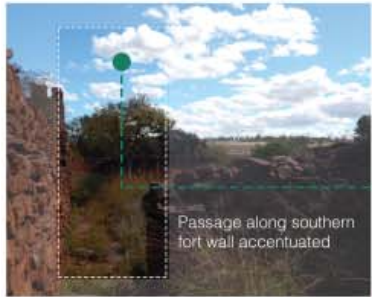
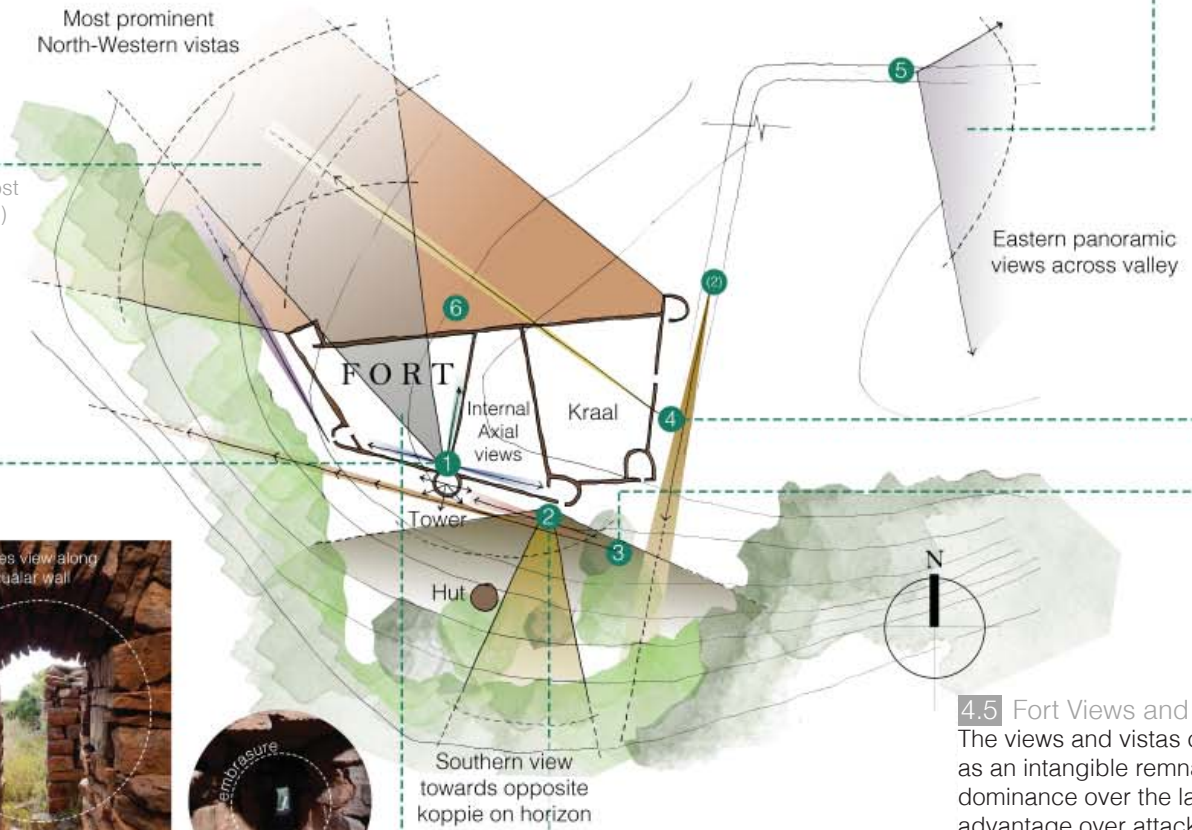
In order for the new intervention to respond sensitively to the existing structure's irregular geometry, the design will have to draw from these oblique angles in a harmonious composition (fig.4.13). This creates the challenging constraint of design space-efficient spaces within a non-perpendicular boundary.





{ 5 }

Fig.4.14 Diagram explaining the direction of the most prominent views created by the fort (Author, 2017)



4.5 Fort Views and Vistas

The views and vistas created by Fort Merensky can be seen as an intangible remnant of its past narrative, as visual dominance over the landscape provided a defensive advantage over attacking enemies. These visual opportunities should be prioritised in the new design as part of the fort's reinterpretation.

- Chapter 05 -

# DESIGN DEVELOPMENT



5.1 Initial Design Proposal

5.2 Design Iteration 1

5.2.1 Design Iteration 1 : Layout Plans

5.2.2 Design Iteration 1 : Vignettes

5.2.3 Design Iteration 1 : Sections

5.3 Tower Development

5.4 Retreat Cabin Development

5.5 Design Iteration 2

## 5.1 Initial Design Proposal

■ An externalised, physical connection to landscape

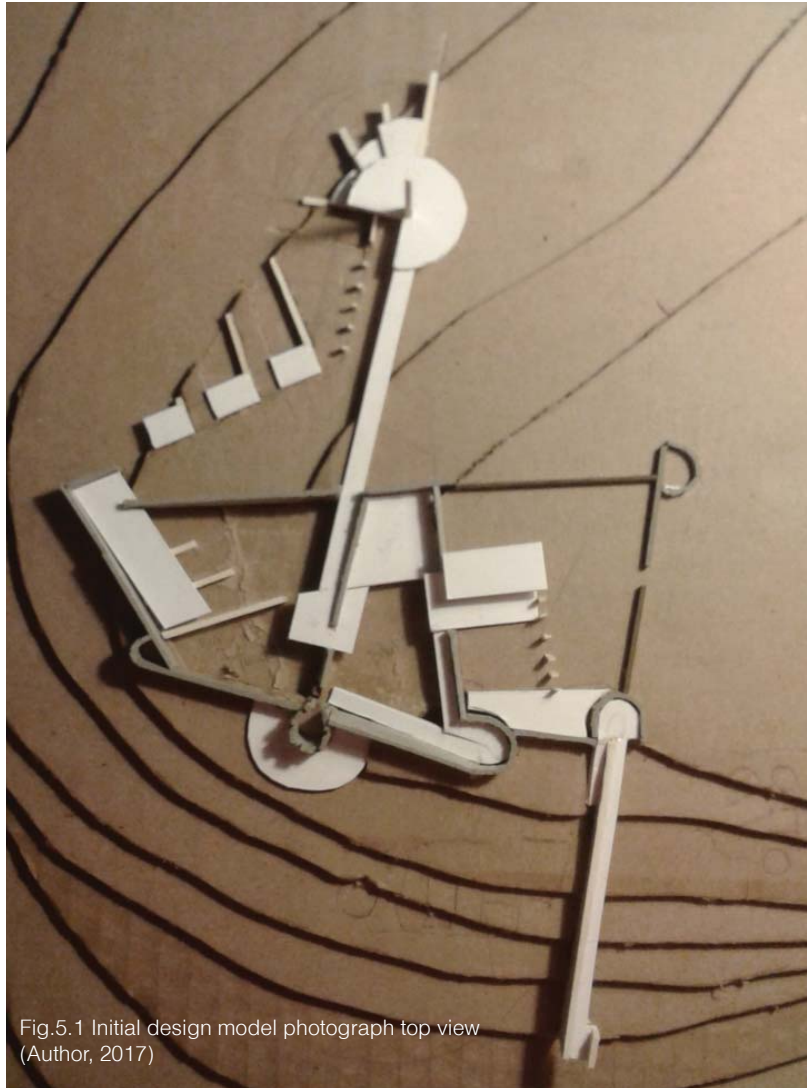


Fig.5.1 Initial design model photograph top view  
(Author, 2017)

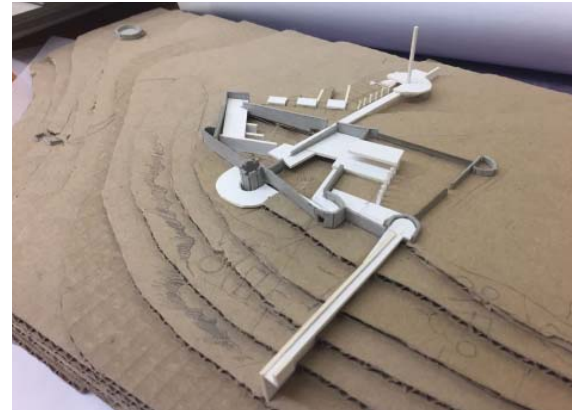


Fig.5.2 Initial design model photograph southeastern view  
(Author, 2017)

The initial design was based on creating an exaggerated visual experience and was formally expressed as such. The fort's characteristic southern façade was given the greatest preservation priority whilst the dominant north-western view informed the breaking up of the northern fort wall. This was done in order to direct movement from the least isolated to the most isolated, culminating in the moment that the visitor enters the observatory. This is reached through a series of filters, created by the circulation's interaction with the existing structure.

### > Critique

New intervention dominates the heritage artefact, especially the stereotomic southern protrusion that cuts into the landscape.

If the design is a response to historic meaning, it was felt that the fort's protective nature was neglected. If the fort's meaning is held in the fact that it is a device for granting the dweller visual dominance over the landscape without directly exposing them to it (which would make them vulnerable), should this not be celebrated and reinterpreted, as opposed to creating new viewpoints that physically protrude out of the fort? The design should be a more balanced response to the mediation of enclosing and exposing.



## 5.2 Design Iteration (1)

■ An internalised visual connection to landscape

The first iteration attempted to place a greater design emphasis on developing the fort's internal condition, which would display greater sensitivity towards the fort's historic narrative as device. This would be done by regarding the new design as a means to unlocking the

fort's existing potential for the notions of 'hiding' and 'revealing'. The general approach was to create points of activation within the existing bastions, which would be connected by the circulation spaces informed by the existing elevated walkways along the fort curtain walls.

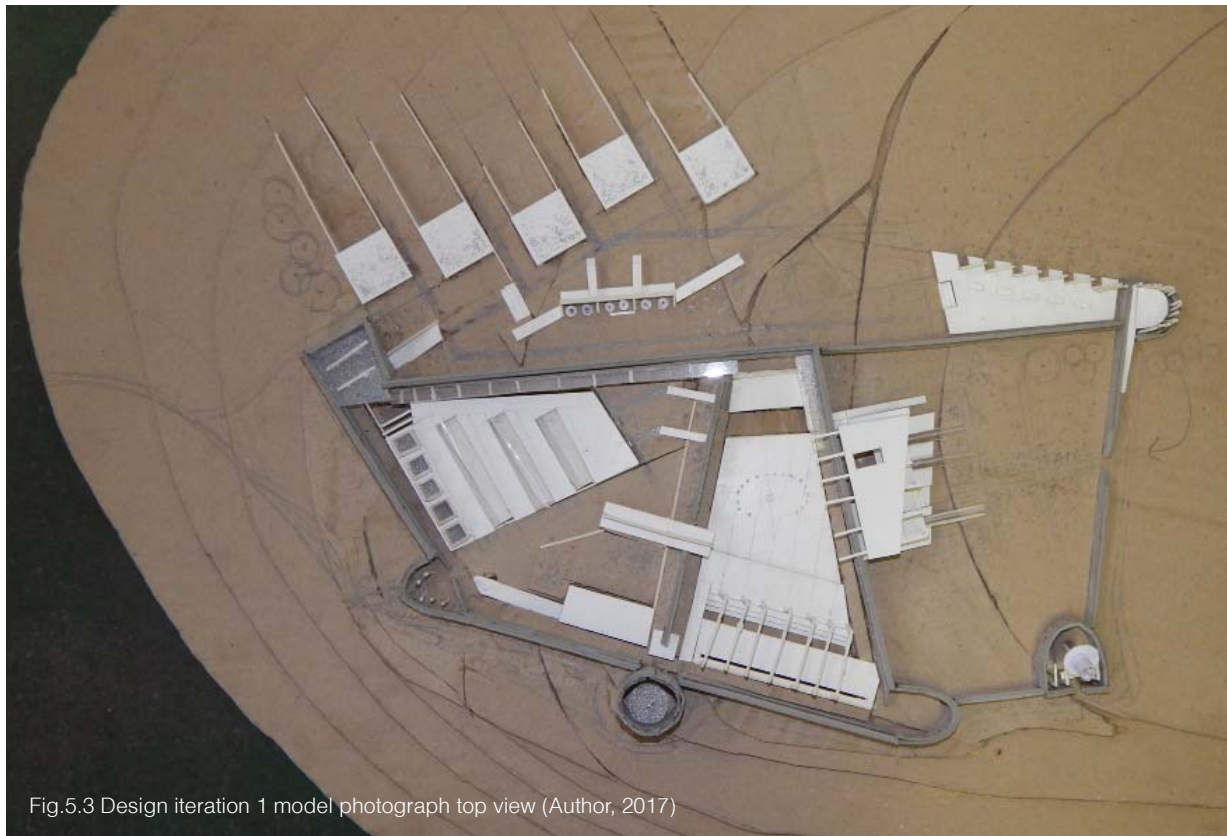


Fig.5.3 Design iteration 1 model photograph top view (Author, 2017)

Fig.5.4 Model Photo: fort southern façade (Author, 2017)

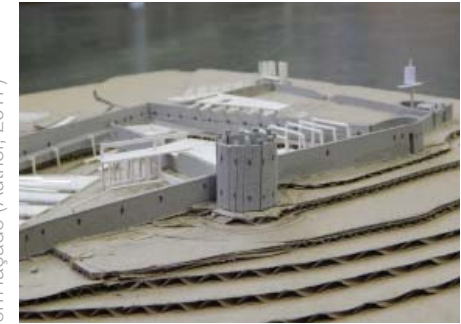


Fig.5.5 Model photo: Ward 1 (Author, 2017)



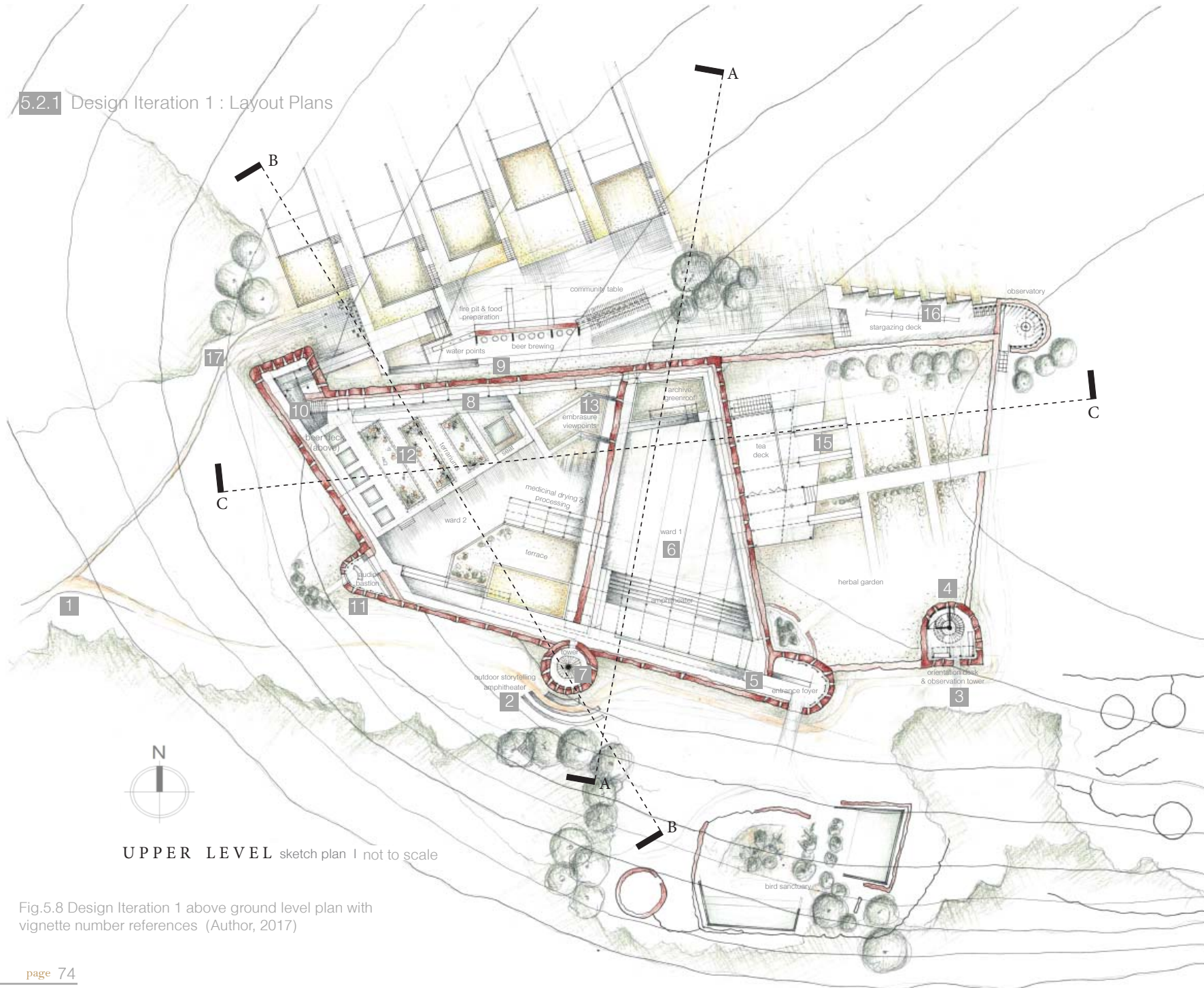
Fig.5.6 Model photo: northern fort wall (Author, 2017)



Fig.5.7 Model Photo: Retreat cabins (Author, 2017)

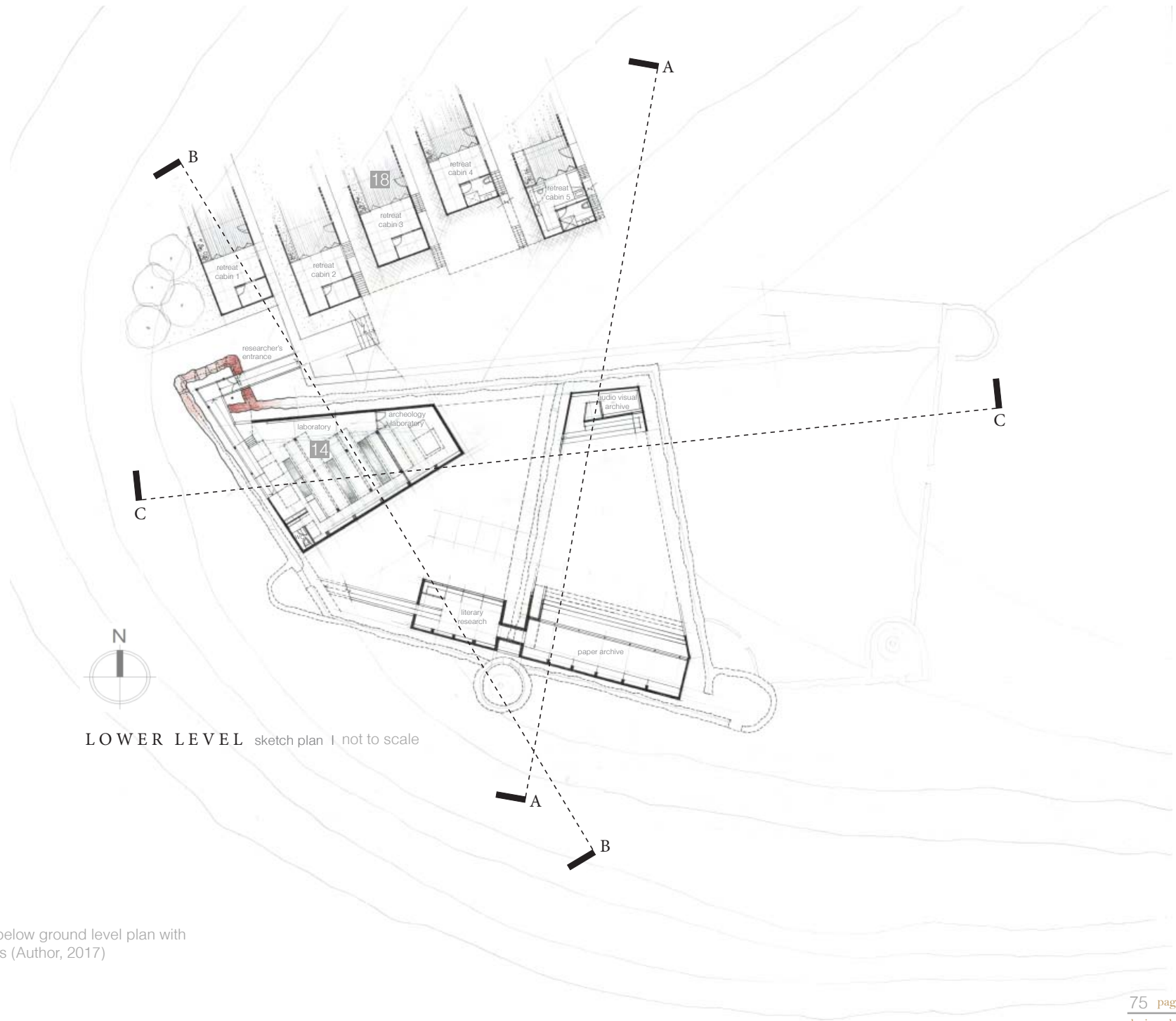


5.2.1 Design Iteration 1 : Layout Plans



UPPER LEVEL sketch plan | not to scale

Fig.5.8 Design Iteration 1 above ground level plan with vignette number references (Author, 2017)

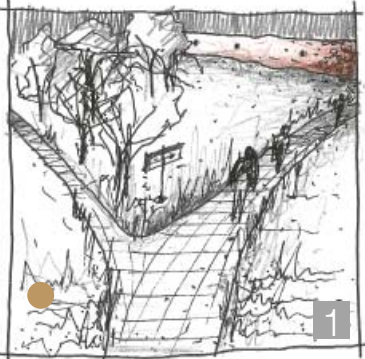


LOWER LEVEL sketch plan | not to scale

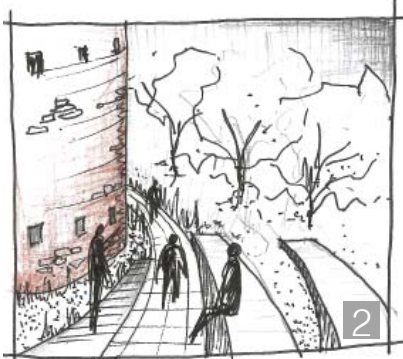
Fig.5.9 Design Iteration 1 below ground level plan with vignette number references (Author, 2017)

5.2.2 Design Iteration 1 : Vignettes

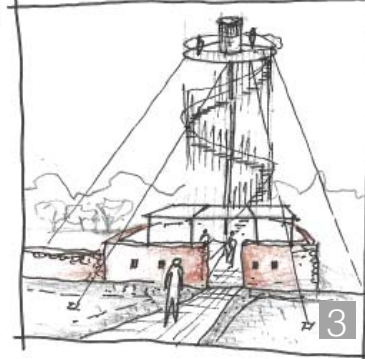
Introductory Experience



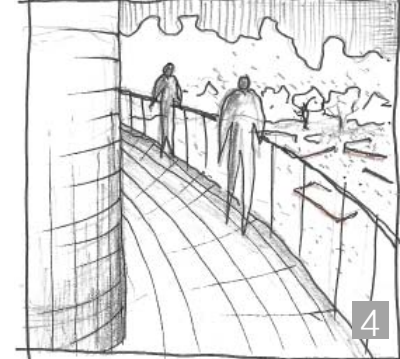
Pilgrim's Approach



Storytelling around the tower landmark



Orientation Bastion



View from orientation tower

Sunset Beer Deck

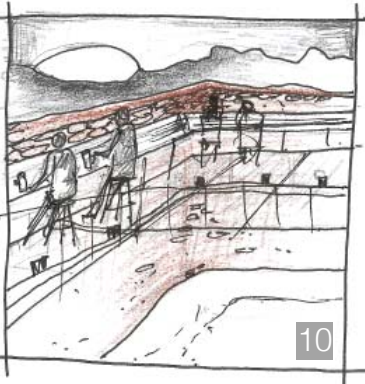
Audio Bastion

Terrariums

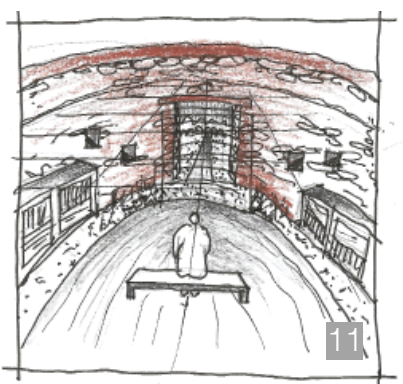
Embrasure viewpoints

Underground Laboratory

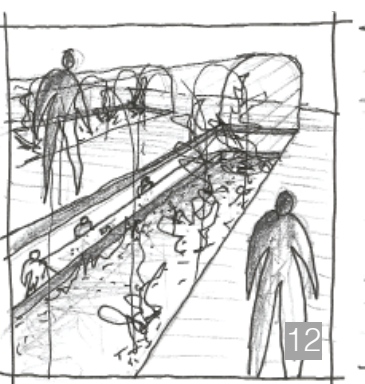
Fort Interior - Ward 2



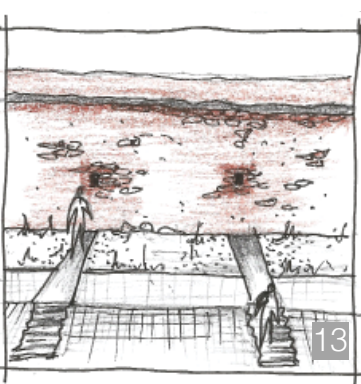
10



11

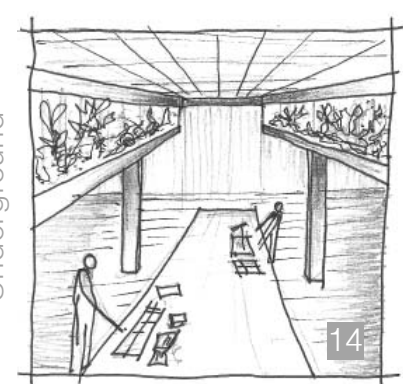


12



13

Underground



14

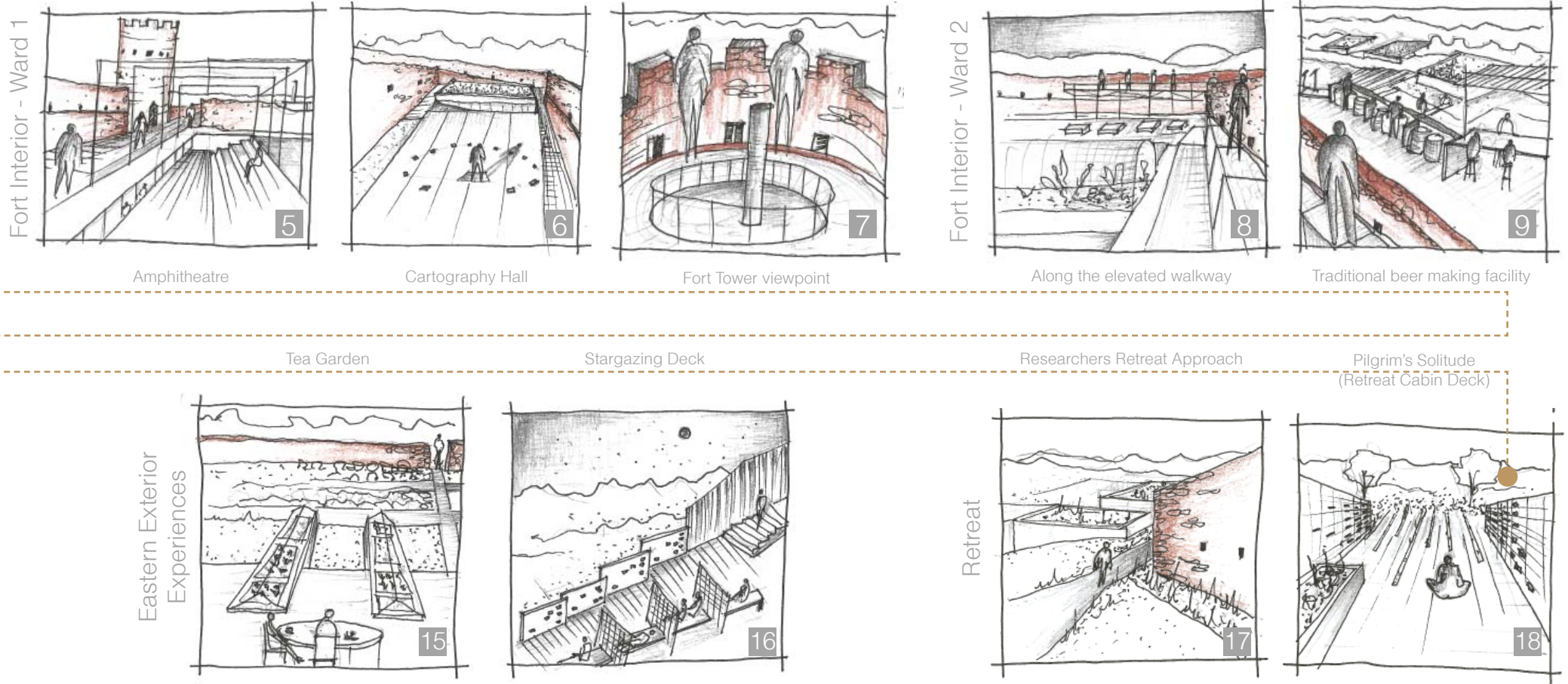
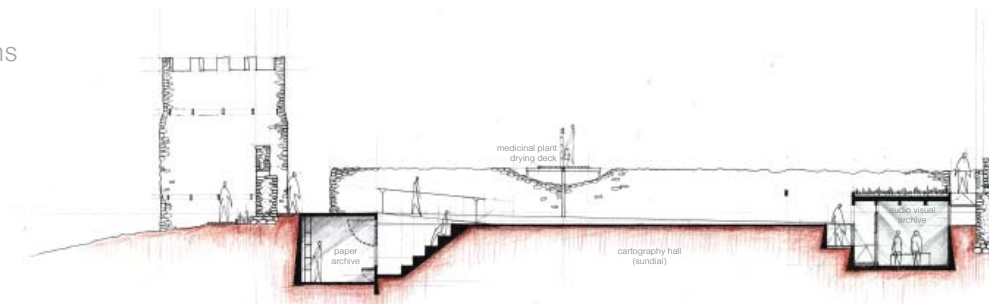
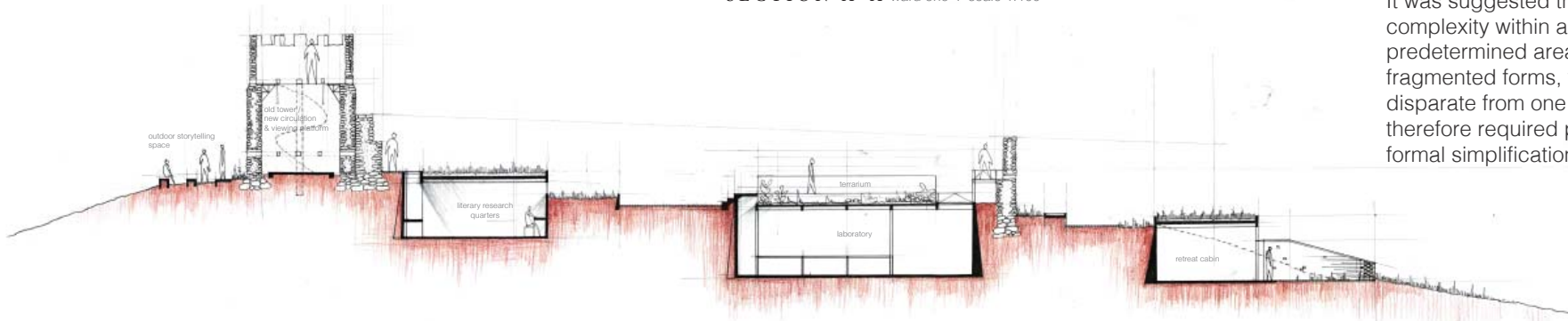


Fig.5.10 Vignettes (Author, 2017)

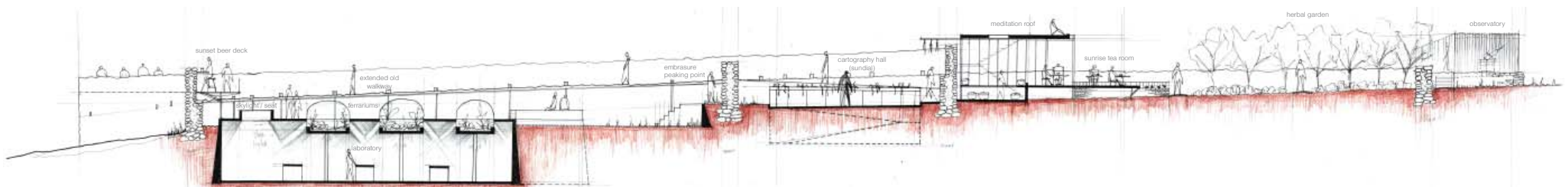
5.2.3 Design Iteration 1 : Sections



SECTION A - A ward one | scale 1:100



SECTION B - B ward two | scale 1:100



SECTION C - C longitudinal view | scale 1:100

> Critique

In the context of designing a museum typology, the design did not display a strong enough circulation hierarchy. Circulation needed to be 'narrated' through spatial devices that would grant the user greater legibility of movement through the space as an informative experience.

It was suggested that the programme's complexity within a limited, predetermined area created too many fragmented forms, which seemed disparate from one another. The design therefore required programmatic and formal simplification.

Fig.5.11 Design Iteration 1 Sections (Author, 2017)

## 5.3 Tower Development

Placement, Function and Appropriateness

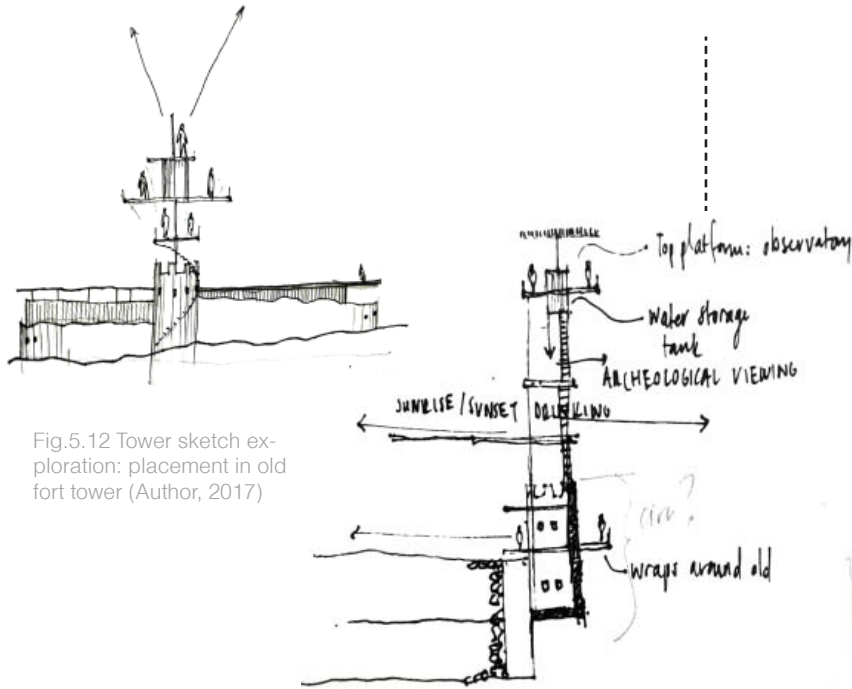


Fig. 5.12 Tower sketch exploration: placement in old fort tower (Author, 2017)

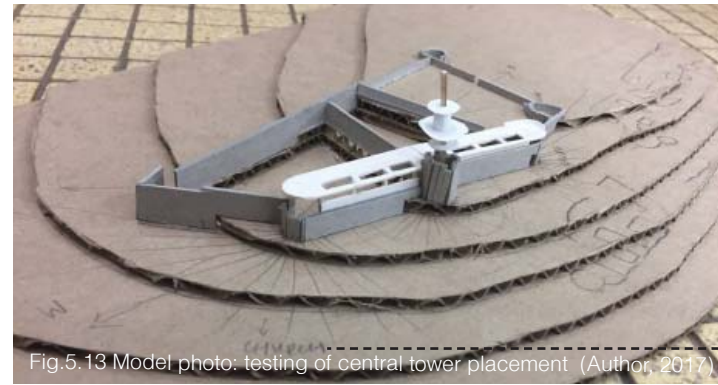


Fig. 5.13 Model photo: testing of central tower placement (Author, 2017)



Fig. 5.14 Model photo: testing of northeastern tower placement (Author, 2017)

Although the new intervention attempts to be as subtle as possible, the initial intention was to design one new vertical element that would be strategically placed in one of the bastions, as a monumentalisation of what the fort represents. This new element would be designed as a tectonic element that would contrast with the old fabric, creating a clear distinction between the old and the new. It would function as both an observation deck and water tower due to the fort's remote location.

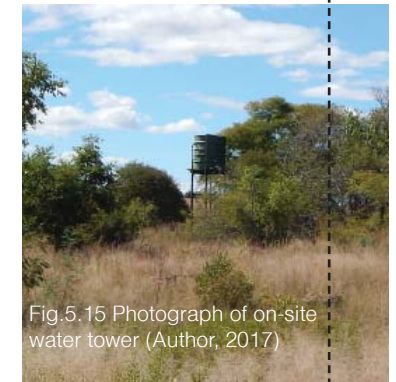


Fig. 5.15 Photograph of on-site water tower (Author, 2017)

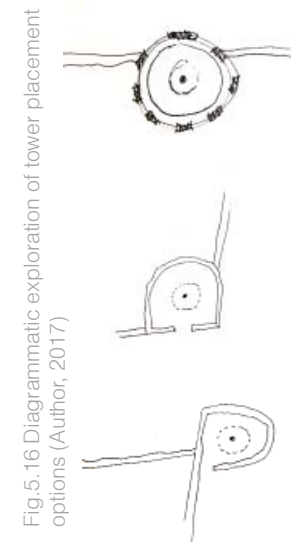


Fig. 5.16 Diagrammatic exploration of tower placement options (Author, 2017)

The following scenarios were tested:

[1] New tower within the fort's existing tower : a direct reinterpretation of the old.

[2] New tower in the south-eastern bastion : a higher topographical point, acting as "orientation" opportunity on the main façade, activating the kraal bastion

[3] New tower combined with observatory in the north-eastern bastion : the highest topographical bastion on the site, less invasive on the main façade

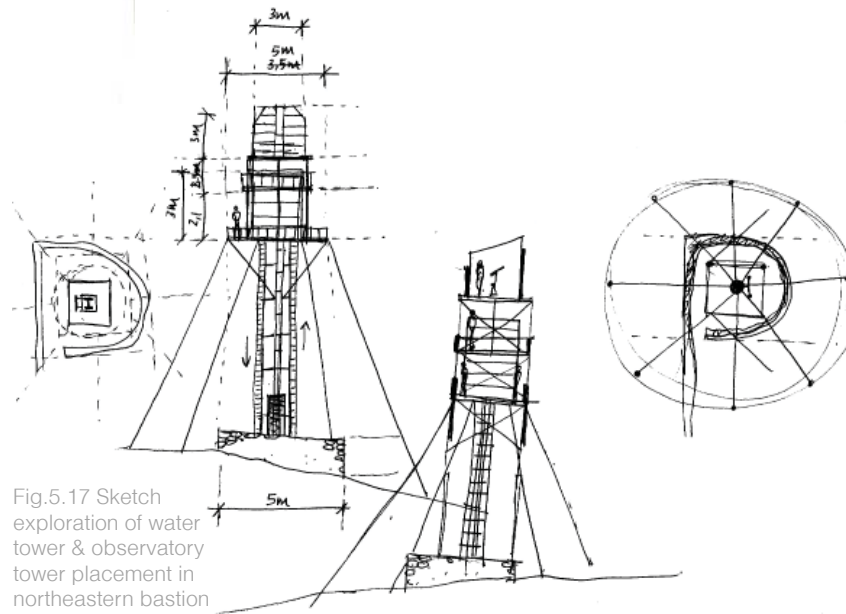


Fig. 5.17 Sketch exploration of water tower & observatory tower placement in northeastern bastion (Author, 2017)

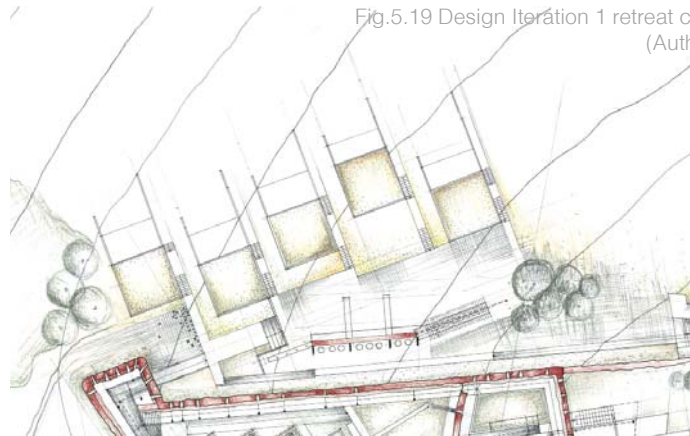
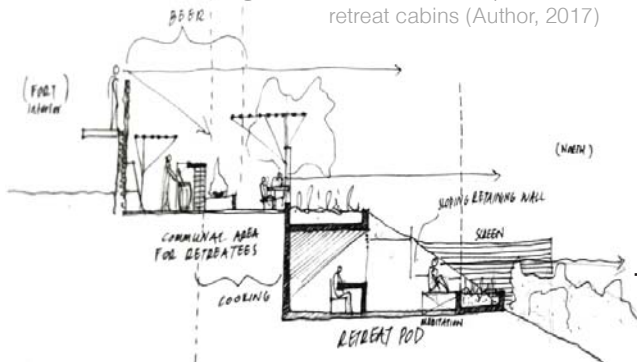
> Outcome  
After testing the different scenarios, it was concluded that the addition of a new tower would be too visually imposing on the existing fort's heritage fabric. The height and structural requirements for obtaining sufficient water pressure, made the type of structure required an inappropriate addition to the sensitive context. It was therefore decided to rather redesign the existing water tower, located further east of the fort in order to suit the water demand implied by the new programme.

## 5.4 Retreat Cabin Development

Degrees of Invisibility



Fig.5.18 Sectional sketch exploration of retreat cabins (Author, 2017)



development sequence

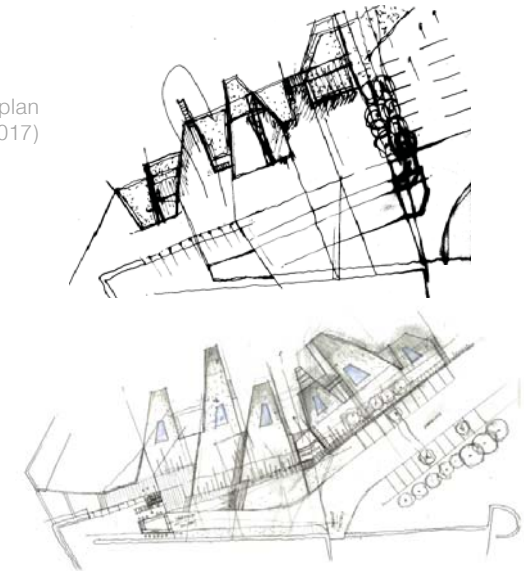


Fig.5.20 Retreat cabin iterated layout (Author, 2017)

The landscape around Fort Merensky is seen as inseparable from the heritage value of the fort structure itself, as it finds its historic meaning from its environment. The development of the researcher's retreat cabins on the northern slope, below the fort, thus had to be treated with equal sensitivity to the new intervention within the fort. The design aimed at creating architecture that would create as little visual disturbance

to the landscape, as possible. The design's refinement responded to this requirement formally and through the use of texture, making the retreat cabins "disappear" within their natural setting and avoiding forms that would compete with the strong geometry of the fort.

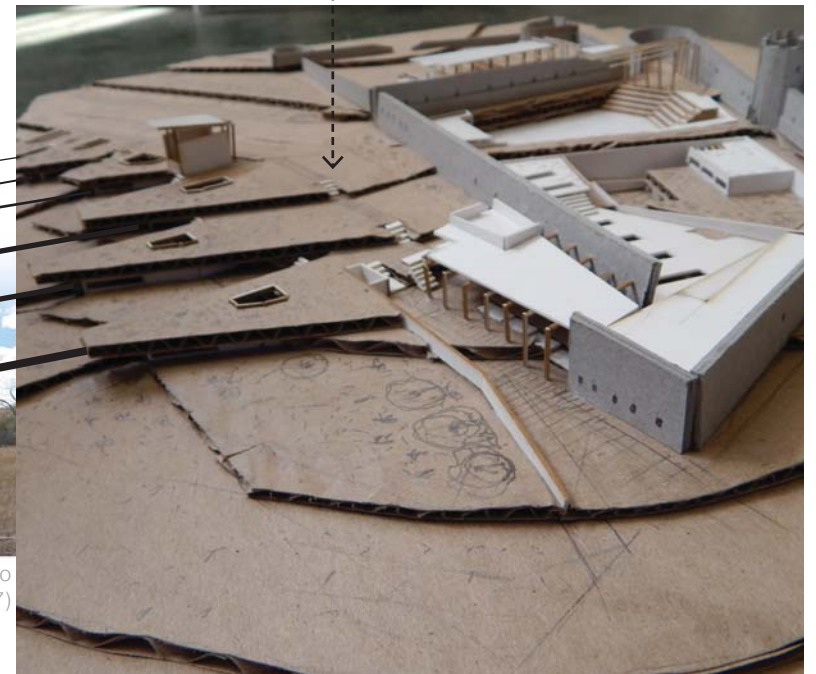


Fig.5.21 Collage illustrating retreat cabin views onto northwestern vista (Author, 2017)



## 5.5 Design Iteration 2

Towards greater simplicity



Fig.5.22 Design iteration 2 model photograph top view (Author, 2017)



Fig.5.23 Model photo: new entrance (Author, 2017)

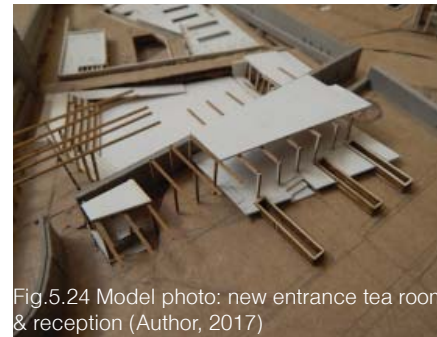


Fig.5.24 Model photo: new entrance tea room & reception (Author, 2017)



Fig.5.25 Model photo: iterated Ward 1 design (Author, 2017)



Fig.5.26 Model photo: iterated Ward 2 design (Author, 2017)

### > Entrances and Circulation

Circulation was simplified through the use of a main circulation spine from the primary entrance, culminating on the highest point at the beer deck. This main route provides opportunities for the visitor to wander off for additional exploring of the fort wards, yet guides the visitor from a clear beginning to an end, 'narrating' the interpretive experience. The main entrance was changed by creating a small opening in the kraal wall, which is hidden behind the south-eastern bastion, thereby not compromising the main façade. Movement is guided naturally by the bastion's curve (fig.5.23).

### > Tea Room and Reception

The tea room structure was extended to create a semi-outdoor tea drying area, which then extends into a small roofed reception that meets the visitor around the entrance bastion (fig.5.24).

### > Ward 1

The "orchestra pit" typology was replaced by the amphitheatre typology, activating the entire ward by changing the direction of viewing towards the stage (fig.5.25).

### > Ward 2

Ward 2 was simplified by using the space as a planted roof area, where visitors may linger, enabling different experiences of the fort through height variances created by the new intervention's roof protrusions. A sunken courtyard was added, which lets natural light into underground spaces and around which a ramp will wrap for increased floor area, making the underground spaces fully accessible (fig.5.26).



- Chapter 06 -

# TECHNIFICATION



6.1 Tectonic Concept  
6.2 The Excavation  
6.3 Technical Precedent  
6.4 Final Design  
6.5 Climatic Data

6.6 Water System  
6.7 Detailing  
6.7.1 Precedent: Scarpa  
6.7.2 The Connecting Moment

## 6.1 Tectonic Concept

Heritage as main tectonic driver

The main conceptual driver in the technification of the final design proposal, was based primarily on the creation of an architectural language, which would respond to the prominent heritage condition addressed by the dissertation.

The architectural language of the existing structure may be understood as a stereotomic condition created by the use of local stone walls, seemingly producing a man-made outcrop on the hill by raising the earth's material from the ground.

The existing structure presents a stark vertical contrast as the fort is a roofless structure, open to the sky. It can therefore be said that the fort enables an equally important relationship to both ground and sky.

The intention of the new structure is therefore to maintain this vertical contrast by adhering to the rules of gravity, which implies an architecture that is firmly rooted in the ground and grows out of it, becoming lighter, less permanent and ultimately invisible as it ascends into the sky.

This approach serves to implement the original design intention of 'hiding' the new intervention within the old. Hiding is achieved by retaining the original fort ground condition as far as possible and treating what is visible on the above-ground plane with great sensitivity, by introducing a tectonic language and creating obvious contrast between the old and the new.

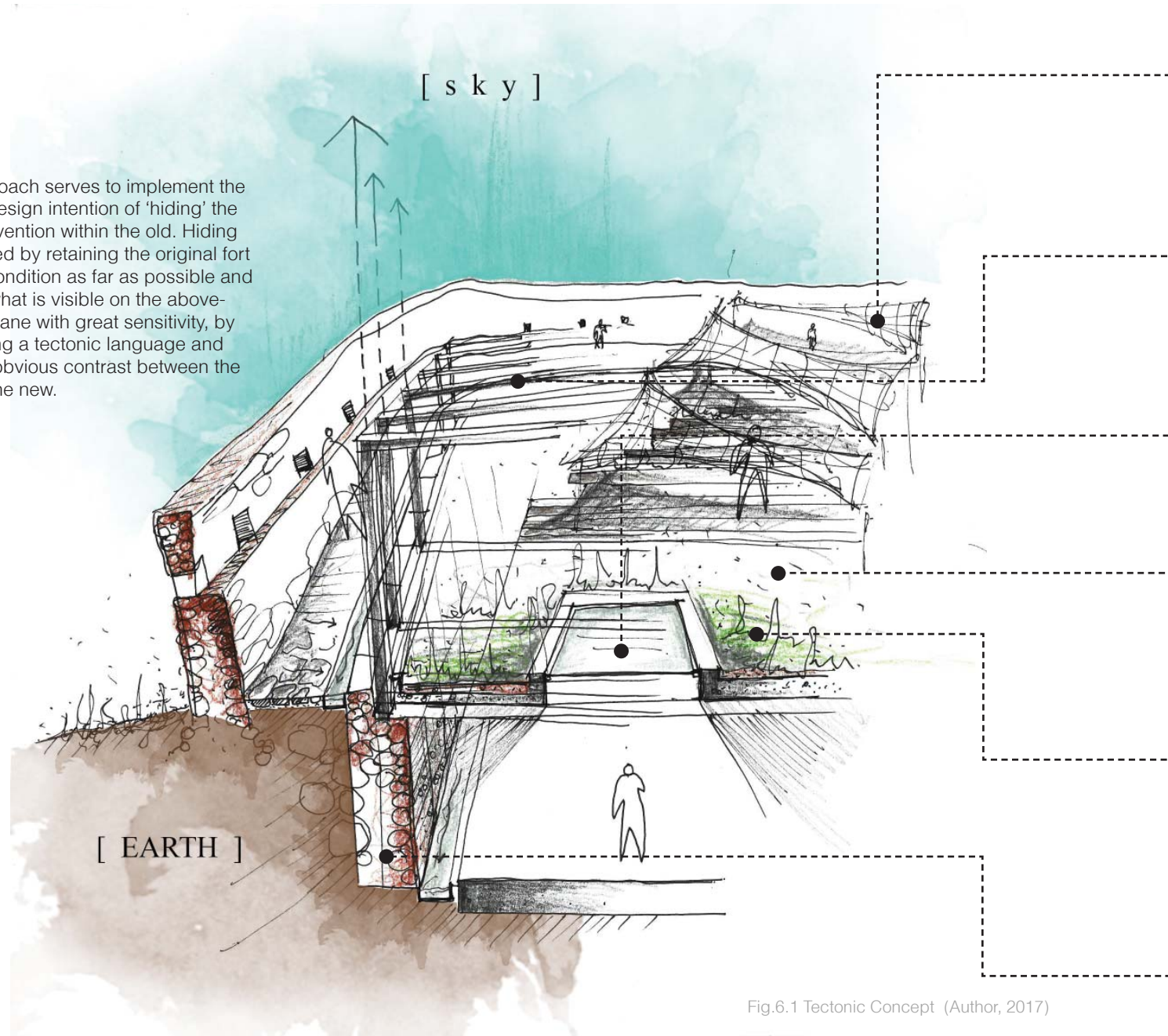


Fig.6.1 Tectonic Concept (Author, 2017)



Fig.6.2 Material choice based on tectonic concept (Author, 2017)

Suspended canvas shading devices act as the least permanent and lightest, final material layer. Due to the design intent of preserving the fort's roofless nature, these shading devices will only be strategically placed where visitors will linger on the open-air above-ground level. The canvas fabric will visually reflect the invisible movement of the air, which will cause weathering over time, making this last material layer relate to the sky.

Steel will be used as the main structural system, which will 'grow' out of the underground level to be exposed above-ground level. Here, its tectonic language will serve to create a contrast between the old and the new. Steel therefore acts as a binding element between these public and private zones.

In an effort to 'hide' the new within the old and create a contrast between the new and old where these two meet, the properties of glass provide an appropriate solution to realise this intention. This solid, yet transparent material allows for the definition of spaces (in the horizontal and vertical plane) without losing visual contact with the heritage structure and the exposed excavation.

Timber decking will be used as floor finish on the sunken habitable roof and deck areas for its inside-outside condition. In combination with the vegetated roof plane areas, timber is chosen for its natural quality, whilst providing a habitable floor surface, that when treated, is able to endure the exposure to the elements.

Green roofs act as a material layer that restores the natural ground surface, which was removed by submerging the new intervention into the excavation. The green roofs will be an intensive system vegetated by the local grass species, placed on a concrete slab in order to cope with the load imposed by the soil and water retained in the green roof.

Gabion walls filled with the excavated material form the first material 'layer' placed within the excavation. The gabions can be seen as a first phase processing of the natural ground material itself, thereby becoming man-made protrusions of the earth, yet made subtly distinct by the more rigidly shaped steel mesh basket.

## 6.2 The Excavation

### Geotechnical influences on design

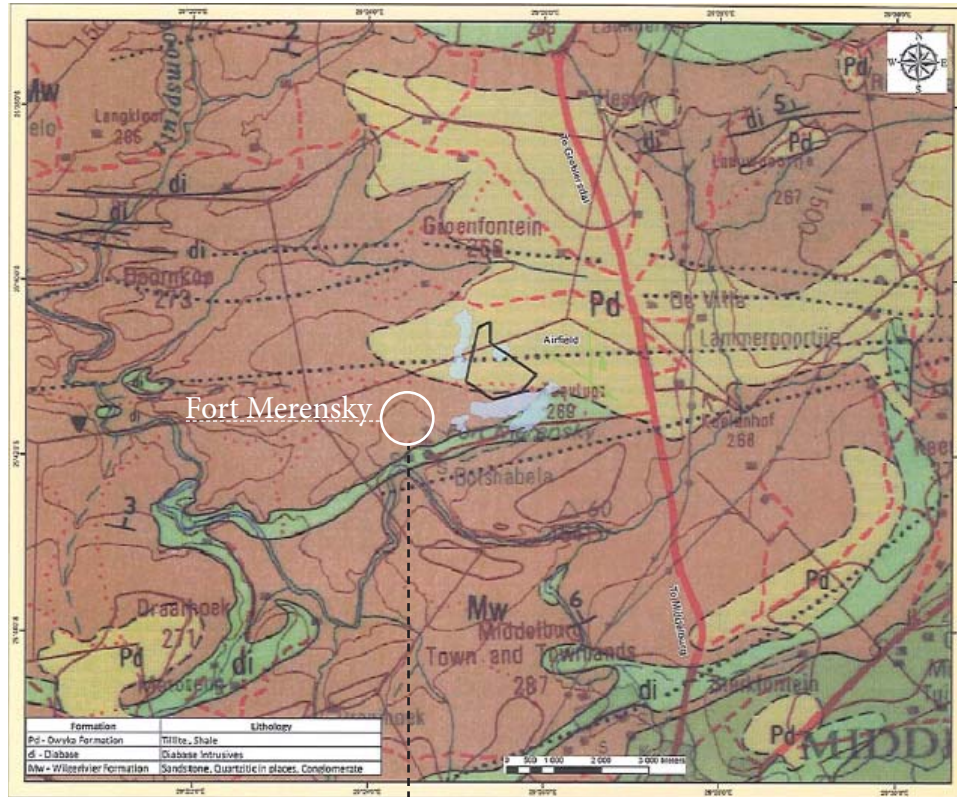


Fig.6.3 Site Geological mapping (Erasmus & van Rensburg, 2013:69)



Extract from the ICOMOS Charter on the treatment of excavations on historic sites:

“...Ruins must be maintained and measures necessary for the permanent conservation and protection of architectural features and of objects discovered must be taken. Furthermore, every means must be taken to facilitate the understanding of the monument and to reveal it without ever distorting its meaning.”

(ICOMOS, 1965:3)

In order for the new intervention to be submerged within the existing structure, the viability of this major excavation work was investigated. These findings significantly influenced the design in the technification phase of the dissertation.

The challenge created by this scenario is not only the stability of the ground conditions, but the process of excavating in close proximity to a heritage structure, without causing structural compromise. Another challenge posed by this is the fact that the fort is an enclosed structure, preventing the movement of heavy machinery in and out of the site.

A geotechnical survey done for the airstrip northeast of the historic core of Botshabelo reveals that Fort Merensky is located on the “**Wilgerivier Formation**” which is made up of **quartzitic sandstone** (fig.6.3) (Erasmus & van Rensburg, 2013:69 emphasis added).

Although in reality, a more specific geotechnical survey would have to be done on the proposed site, for the purposes of this dissertation, the following assumptions can be made based on the available information and visual assessment:

Unlike shale, also a sedimentary rock, sandstone has a slightly larger grain, which means that its strata is not as thin as shale, making a 90° structurally sound vertical excavation less viable. A 7-10° gradient will be accounted for in the design, assuming the presence of

smaller rocks on the upper levels. These will be stabilised by additionally stacking excavated stones onto the exposed sloping surface and securing these with a sand cement mixture. Excavating deeper than 0.7-2m, more solid rock conditions may be expected, which are stable enough without additional retaining structure. Seeing as the excavated surface will therefore be left semi-exposed as a tactile surface, measures to protect it from additional water erosion are taken by extending the new floor-roof plane as overhang and directing falls away from it.

From fig.6.4 it can be observed that significant erosion has taken place, minimising the amount of loose soil present, leaving the quartzitic sandstone exposed. It can be assumed that excavating in such rocky conditions will require mechanical assistance.

Rock breaking by **chemical expansion** would be a suitable method for this specific application, as the existing structure would be exposed to significantly less ground vibrations compared to alternative methods such as pecking, blasting or jack hammering.

This process entails the drilling of a series of holes along the desired line of rock splitting. Drilling may be done by handheld drill, thus avoiding the use of large machinery, which would have to be placed inside the existing structure by crane. A chemical expansion agent

is inserted into these drill holes and effectively causes the rock bed to crack along these weak points created in the rock. Although this line can be controlled up to a certain degree, irregularities will be caused due to the rock's natural grain. For this reason, a clearance factor of 500-700mm was allowed between the excavation line and the newly introduced structure's vertical elements. The clearance line would be able to cope with the exposed rock's irregular surface and would simultaneously allow space for service access.

The loose material will be excavated manually, creating an employment opportunity for the local population. For this intensive process to be carried out by manual labour, the sequence of excavation and construction becomes

an important consideration in the design. Excavation will start on the higher topographic level in 'ward 1' and unused excavated material not incorporated into gabion walls or as stabilising material on the exposed excavated surface, will be moved downhill to 'ward 2' where this process will be repeated. Any topsoil will be kept separate and reused as growing medium on the proposed green roofs, sensitively placing it back where it was removed from.

Strategically planned openings in the existing fort will be made in such a way that allows for access during construction, in places that have the least effect on the structure's inherent formal nature. An opening created on the southeastern side of the fort, which will allow access into ward 1 and would be hidden behind

the bastion, serves as the new main entrance. The opening on the lower north-western side of the fort, allowing access to ward 2, will ultimately be covered by the new suspended beer deck.

In order to secure the existing structure's stability, a general rule was applied to the design whereby the excavation depth had to be equal or more than the horizontal distance between the existing structure and the line of excavation. This in turn defined the new walkway width as the 'breathing moment' between the old and new. For this reason, the excavation depth was limited to 2-3m, allowing manual excavation whilst keeping the walkway narrow enough to imply its nature as circulation space.



Fig.6.4 Photograph showing the site ground condition (Author, 2017)

## 6.3 Technical Precedent

### The Exposed Excavation & Remediating Roof Plane

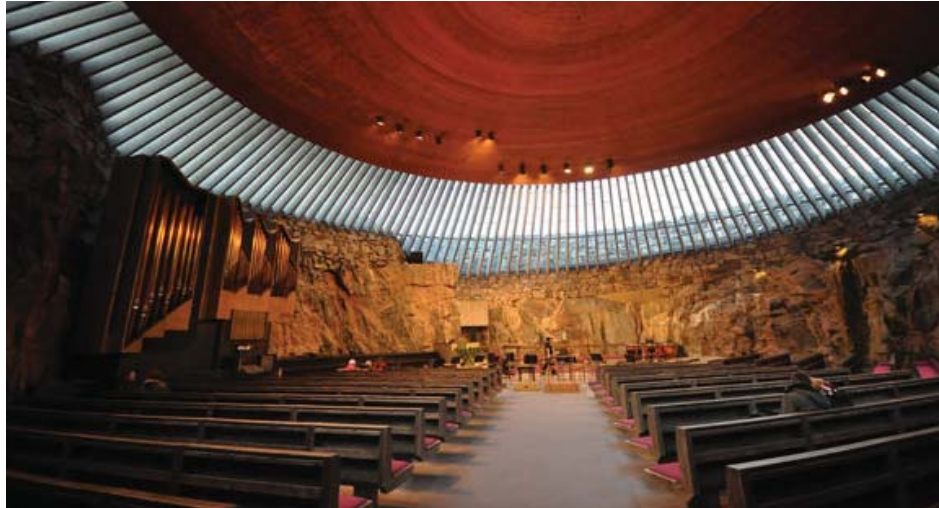


Fig.6.5 Tempeliahaukio Church interior (Atlas Obscura, 2017)

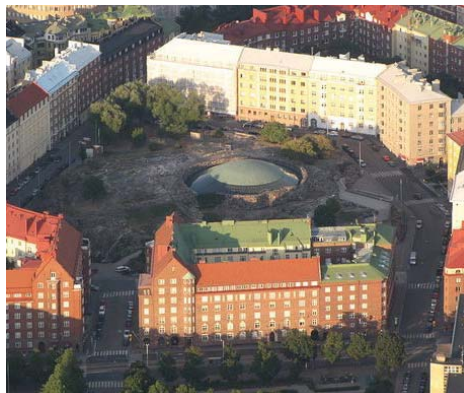


Fig.6.6 Aerial view of sunken church, showing how the roof functions to restore the excavated hilltop (Atlas Obscura, 2017)

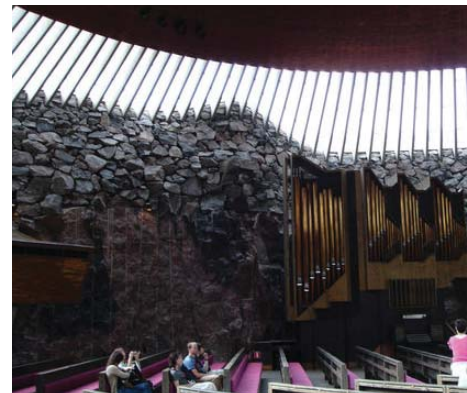


Fig.6.7 The combined construction between exposed bedrock and stacked boulders (Atlas Obscura, 2017)

Project: Tempeliahaukio Church (Rock Church)

Architect: Timo and Tuomo Suomalainen

Year completed: 1969

Location: Helsinki, Finland

#### Project Description:

This Finish Lutheran church, located in the Töölö neighborhood of Helsinki, is a very well known tourist attraction because of its unusual interior, created within a quarried hilltop.

A copper clad dome that seemingly floats on top of the natural rock walls restores the shape of the hill. Due to the exposure of the natural earth, water sometimes seeps through cavities in the rock, forming streams of water running down the interior walls, which contribute to the space's sensory quality.

The skylight, which defined the recess between wall and roof, creates a dramatic light quality at certain times of day (Atlas Obscura, 2017).

#### Relevance:

Similar to the dissertation's proposed design within the fort, the design intent of Tempeliahaukio Church is also to create 'hidden' architecture by placing the building within an excavation.

The most important lesson displayed by this precedent study is how the exposed excavation's permeable, organic natural state is embraced as part of the space's haptic quality.

**OUTCOME :** The dissertation design will adopt a similar approach to incorporating the irregular exposed excavation into the formal design, highlighting it with the new intervention, instead of concealing it so that it contributes towards the haptic quality of the underground space.



## 6.4 Final Design

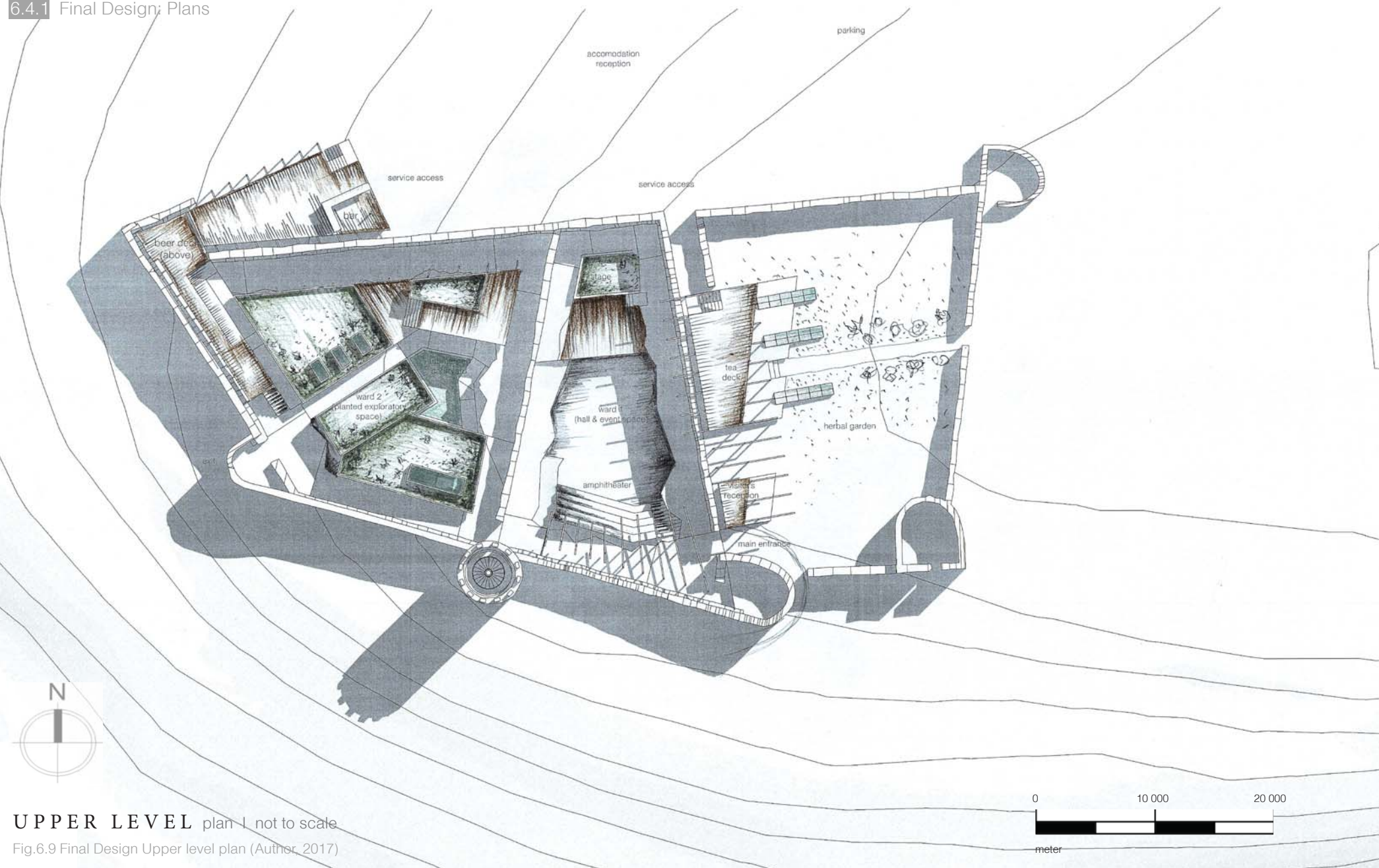
The submerged level: a response to an excavated condition



Fig.6.8 Lower Level plan with extruded details of ramp instances (Author, 2017)

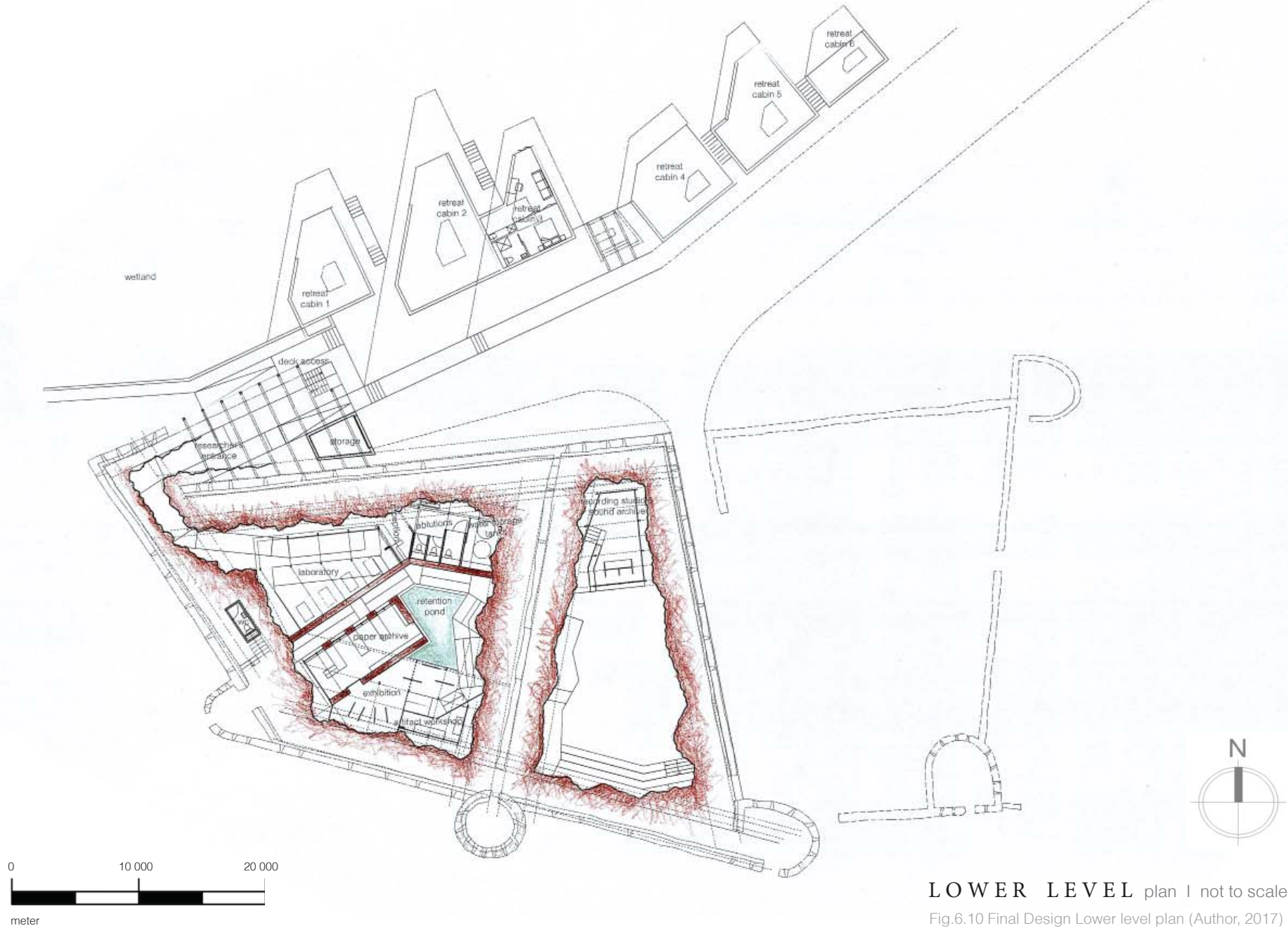
Figures 6.8 show instances in the final design where ramps act as gradual thresholds controlling the tactile proximity to the excavated surface. Ramps subtly pull away from the exposed vertical rock surface and are seamlessly 'wrapped' into the new structure, thereby facilitating the transition into a more sterile space. A visual connection is however still kept with the exposed rock through the use of a glass curtain wall system.

6.4.1 Final Design: Plans

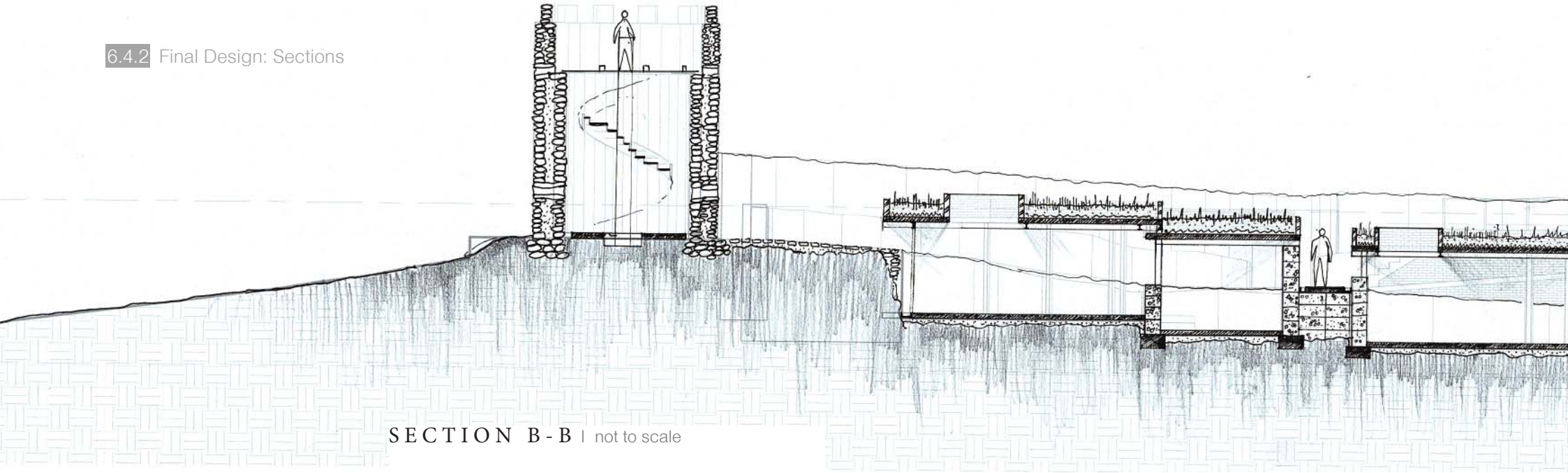


UPPER LEVEL plan 1 not to scale

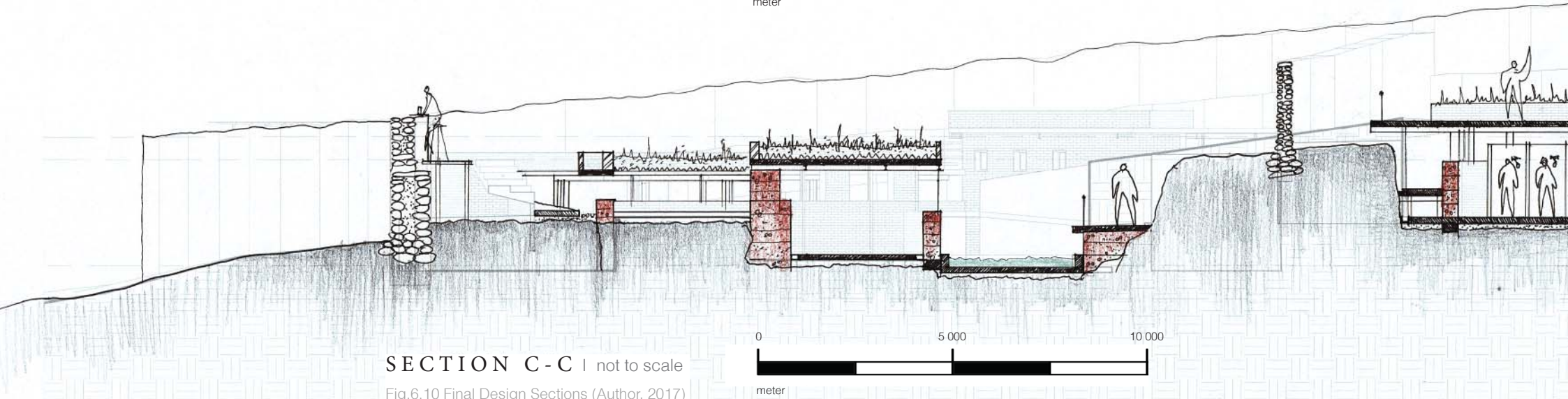
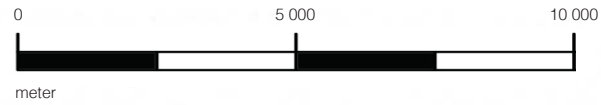
Fig.6.9 Final Design Upper level plan (Author, 2017)



6.4.2 Final Design: Sections



SECTION B - B | not to scale



SECTION C - C | not to scale

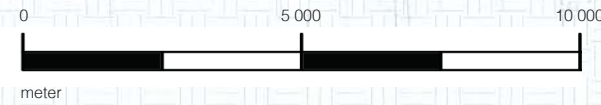
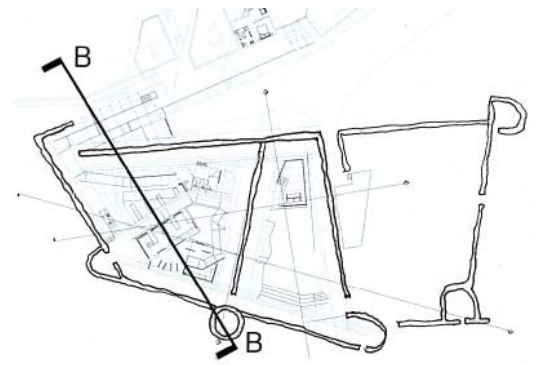
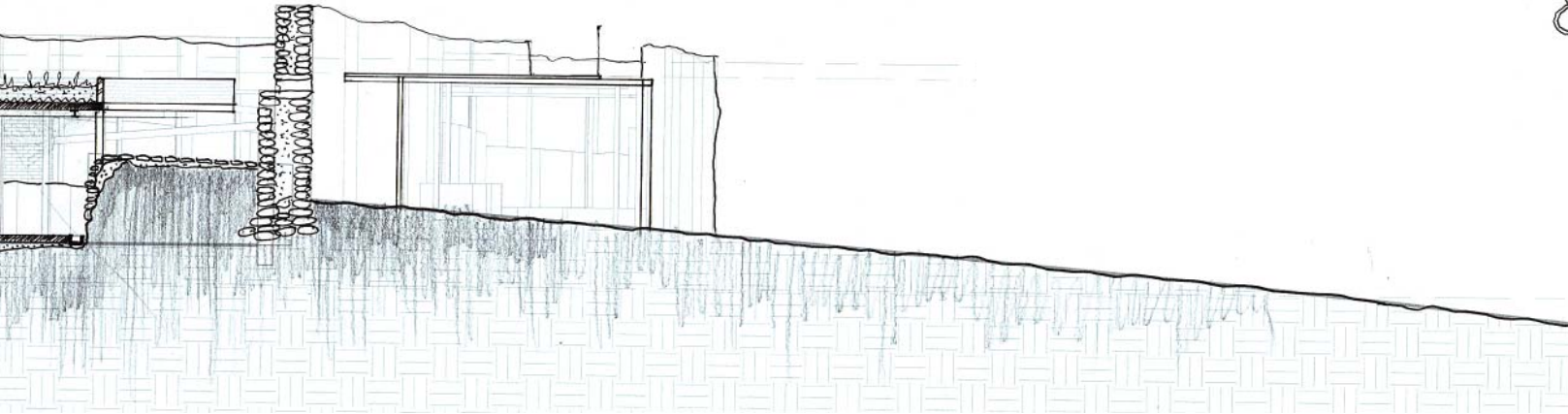
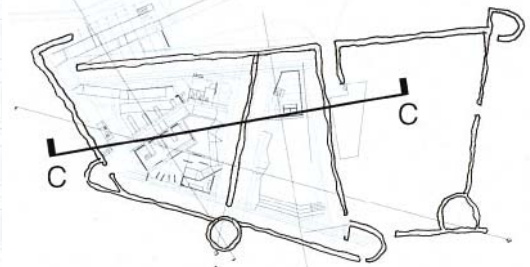
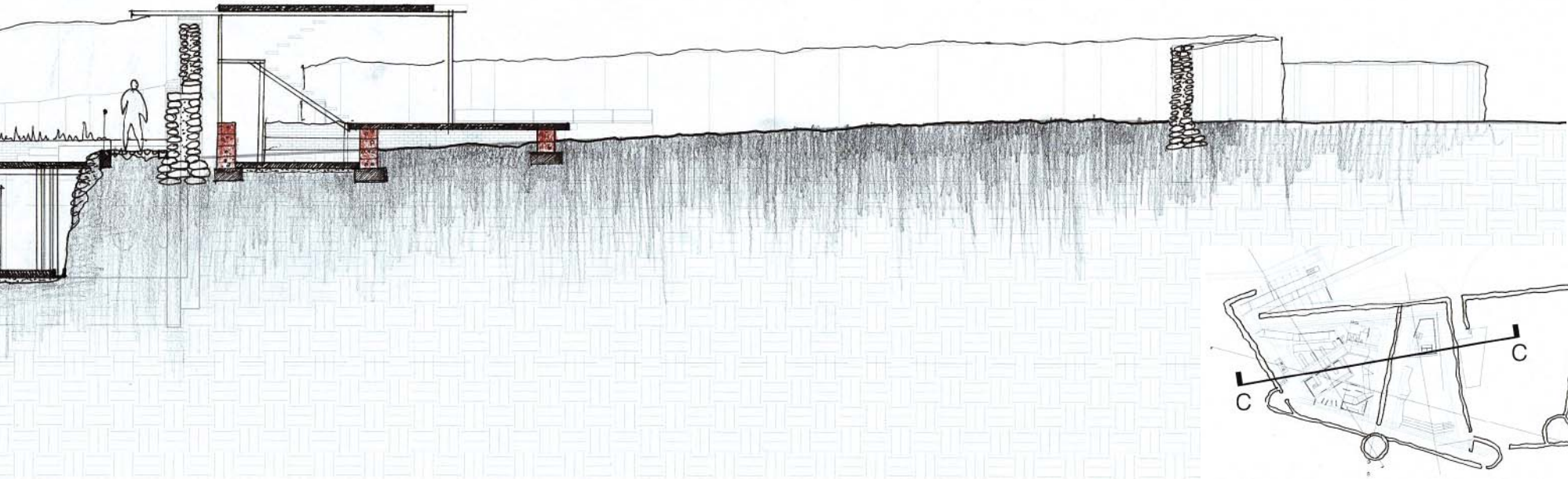


Fig.6.10 Final Design Sections (Author, 2017)



transverse section B-B  
plan reference



longitudinal section C-C  
plan reference

## 6.5 Climatic Data

### Solar and Rainfall Conditions

The site is located in the South African Highveld escarpment, classified as region H according to the Köppen system (Erasmus & van Rensburg, 2013:66).

The region experiences summer rainfall, which is considered to be a relatively low average annual rainfall of 735mm with regular thunderstorms.

The area has a temperate climate with summer temperatures ranging between 9 - 32°C and a winter range of -6 - 22°C.

The climate is dry as it has a high annual potential evaporation of 1500mm (Erasmus & van Rensburg, 2013:68). Evaporative cooling would thus be a viable passive cooling strategy.

The prevailing wind direction is north, northeast and south, with occasional strong winds during extreme storm conditions. Otherwise, wind speeds are fairly moderate, which does not make it a crucial influence on the climatic design considerations.

From the climatic data it can be deduced that the following environmental strategy would be an appropriate contextual response:

**Evaporative cooling based on the availability of summer rainfall in a dry climate.**

The design of an open stormwater system dealing with the open-air nature of the fort's above ground public level, simultaneously aiding in thermal comfort will be investigated.

### TEMPERATURE

Mean maximum & minimum temperatures

| Mean Monthly Maximum and Minimum Temperatures (°C) |               |               |               |             |
|--|---------------|---------------|---------------|-------------|
| Month  | Daily Maximum | Daily Minimum | Highest Temp. | Lowest Temp |
| January  | 27,2          | 13,7          | 32,0          | 9,1         |
| February   | 26,8          | 13,4          | 30,8          | 9,0         |
| March  | 26,8          | 11,4          | 30,2          | 6,4         |
| April  | 23,9          | 7,4           | 27,9          | 1,4         |
| May  | 21,3          | 2,2           | 26,1          | -2,9        |
| June   | 18,5          | -1,8          | 22,4          | -6,0        |
| July   | 18,4          | -1,7          | 23,0          | -5,8        |
| August   | 21,4          | 0,8           | 26,0          | -4,1        |
| September  | 24,0          | 5,3           | 29,2          | -1,3        |
| October  | 26,0          | 10,1          | 31,2          | 4,4         |
| November   | 26,2          | 11,8          | 31,8          | 5,9         |
| December   | 27,1          | 13,2          | 31,2          | 7,8         |
| <b>Yearly Average</b>                              | <b>23.9</b>   | <b>7.2</b>    | <b>28.4</b>   | <b>2.0</b>  |

Fig.6.11 Mean Monthly Maximum and Minimum Temperatures (Erasmus & van Rensburg, 2013)

### EVAPORATION

Mean monthly evaporation

| Month        | Evaporation (mm) | Rainfall (mm) | Monthly deficit (mm) |
|--------------|------------------|---------------|----------------------|
| January      | 160              | 132           | 28                   |
| February     | 140              | 103           | 37                   |
| March        | 110              | 88            | 22                   |
| April        | 110              | 42            | 68                   |
| May          | 85               | 19            | 66                   |
| June         | 70               | 7             | 63                   |
| July         | 75               | 9             | 66                   |
| August       | 110              | 8             | 102                  |
| September    | 140              | 22            | 118                  |
| October      | 160              | 63            | 97                   |
| November     | 160              | 124           | 36                   |
| December     | 180              | 118           | 62                   |
| <b>Total</b> | <b>1500</b>      | <b>735</b>    | <b>765</b>           |

Table 6.12 Mean monthly evaporation (Erasmus & van Rensburg, 2013)

### RAINFALL

Average monthly rainfall depths

| Average Monthly Rainfall Depths (mm) and Days Having a Rainfall of >0,1 mm |            |             |
|--|------------|-------------|
| Month  | Ave Depths | Ave Days    |
| January  | 132        | 13,8        |
| February   | 103        | 11,2        |
| March  | 88         | 9,5         |
| April  | 42         | 6,5         |
| May  | 19         | 2,9         |
| June   | 7          | 1,5         |
| July   | 9          | 1,7         |
| August   | 8          | 0,9         |
| September  | 22         | 3,7         |
| October  | 63         | 8,3         |
| November   | 124        | 13,0        |
| December   | 118        | 13,1        |
| <b>Total</b>   | <b>735</b> | <b>86.1</b> |

Table 6.13 Average monthly rainfall depths (Erasmus & van Rensburg, 2013)

### WIND

Mean monthly wind speed and direction

| Month          | N          |            | NE         |            | E         |            | SE        |            | S          |            | SW         |            | W         |            | NW        |            |
|----------------|------------|------------|------------|------------|-----------|------------|-----------|------------|------------|------------|------------|------------|-----------|------------|-----------|------------|
|                | n          | V          | n          | V          | n         | V          | n         | V          | n          | V          | n          | v          | n         | v          | N         | v          |
| January        | 161        | 3.0        | 287        | 3.2        | 44        | 3.1        | 92        | 3.3        | 122        | 3.6        | 96         | 3.3        | 109       | 3.7        | 48        | 4.5        |
| February       | 142        | 2.9        | 295        | 3.2        | 44        | 3.1        | 74        | 3.4        | 112        | 3.4        | 101        | 2.9        | 141       | 3.9        | 60        | 4.2        |
| March          | 152        | 2.8        | 304        | 3.3        | 36        | 3.1        | 54        | 3.1        | 100        | 3.4        | 104        | 2.9        | 139       | 3.4        | 63        | 3.5        |
| April          | 170        | 2.7        | 211        | 3.3        | 47        | 3.2        | 95        | 3.4        | 149        | 3.6        | 146        | 2.8        | 87        | 3.4        | 39        | 3.0        |
| May            | 172        | 2.6        | 166        | 2.9        | 59        | 3.4        | 89        | 3.7        | 162        | 3.9        | 167        | 2.9        | 67        | 3.0        | 51        | 3.3        |
| June           | 146        | 2.5        | 149        | 3.0        | 54        | 3.6        | 117       | 3.0        | 157        | 3.8        | 166        | 2.7        | 86        | 3.2        | 43        | 3.2        |
| July           | 162        | 2.5        | 184        | 2.9        | 51        | 3.9        | 99        | 3.9        | 142        | 3.6        | 143        | 2.8        | 79        | 3.4        | 53        | 4.2        |
| August         | 174        | 5.4        | 180        | 3.4        | 40        | 3.5        | 86        | 4.1        | 141        | 4.1        | 182        | 3.0        | 83        | 3.2        | 40        | 4.4        |
| September      | 197        | 3.2        | 223        | 3.8        | 27        | 3.5        | 70        | 3.9        | 131        | 4.3        | 171        | 3.3        | 84        | 4.0        | 41        | 3.9        |
| October        | 190        | 3.4        | 243        | 3.7        | 33        | 3.6        | 71        | 3.6        | 142        | 4.0        | 160        | 3.8        | 83        | 4.3        | 42        | 3.6        |
| November       | 174        | 3.2        | 225        | 3.6        | 28        | 3.1        | 68        | 3.1        | 185        | 3.8        | 154        | 3.5        | 92        | 4.1        | 40        | 3.9        |
| December       | 180        | 3.1        | 254        | 3.4        | 34        | 3.0        | 69        | 3.3        | 154        | 3.5        | 135        | 3.3        | 95        | 4.0        | 40        | 4.0        |
| <b>Average</b> | <b>188</b> | <b>2.0</b> | <b>227</b> | <b>3.3</b> | <b>41</b> | <b>3.3</b> | <b>82</b> | <b>3.8</b> | <b>141</b> | <b>3.8</b> | <b>146</b> | <b>3.1</b> | <b>95</b> | <b>3.7</b> | <b>47</b> | <b>3.8</b> |

n = average direction frequency per 1000 readings; v = velocity (m/s)

Table 6.14 Mean monthly wind speed and direction (Erasmus & van Rensburg, 2013)

## 6.6 Water System

### Grey Water Recycling & Storm Water Harvesting Potential

\*See APPENDIX for full set of water calculations

### D E M A N D

| ZONE                   | USE description                    | Area (m <sup>2</sup> ) / l per person  | Total (l) POTABLE demand   | Total (l) NON POTABLE demand   | Water Recycling Potential |
|------------------------|------------------------------------|--|--|--|---------------------------|
| Tea Room & herb garden | Irrigation                         | 410.1m <sup>2</sup><br>(square feet area x 0.623 = gallons)<br>= 10410 l<br>@ 3 x per week on average  | -  | 4461.5 l / day   | Runoff (Grey)             |
|                        | Tea Room (Food prep & Dishwashing) | 22.5 l / person<br>(avidwatersystems, 2011)<br>@ 50 people on average  | 1125l / day  | -  | Grey                      |
|                        | Tea Processing (Washing Herbs)     | 100 l / day  | 100 l / day  | -  | Grey                      |
|                        | 2 x WC's                           | 6 l / flush<br>x 50 flushes per day  | -  | 600 l / day  | Black                     |
|                        | 3 x hwb's                          | 0.5 l / person   | 25 l / day   | -  | Grey                      |
|                        | Mist Cooling                       | 5 hours / day (in use 75% of year)<br>51.1 LPH flow rate x 10 nozzles x 5 hours<br>( <a href="http://www.alloutcool.com/misting-nozzles.html">http://www.alloutcool.com/misting-nozzles.html</a> , 2014) | 2550 l / day<br>77562.5 l / month<br><b>1912.5 l / day</b> (on average)                      | -  | -                         |
| Ward 1                 | Mist Cooling                       | 5 hours / day (in use 75% of year)<br>51.1 LPH flow rate x 10 nozzles x 5 hours<br>( <a href="http://www.alloutcool.com/misting-nozzles.html">http://www.alloutcool.com/misting-nozzles.html</a> , 2014) | 2550 l / day<br>77562.5 l / month<br><b>1912.5 l / day</b> (on average)                      | -  | -                         |
| Underground Ward 2     | 7 x work bench basins              | 25 l / basin / day   | 175 l / day  | -  | Grey                      |
|                        | 3 x WC's                           | 6 l / flush<br>x 30 flushes per day  | 180 l / day  | -  | Grey                      |
|                        | 3 x hwb's                          | 0.5 l / person per hand wash (x 30 flushes)  | 15 l / day   | -  | Grey                      |
| Beer Deck              | 1 x WC                             | 6 l / flush<br>x 50 flushes per day  | -  | 300 l / day  | Black                     |
|                        | 1 x hwb                            | 0.5 l / patron<br>@ 50 patrons on average  | 25 l / day   | -  | Grey                      |
|                        | 1 Prep bowl (bar)                  | 7.5 l / patron (avidwatersystems, 2011)  | 3750 l / day   | -  | Grey                      |
|                        | 1 Sink (scullery below)            |  |  |  |                           |
| Retreat Cabins         | 6 x WC's                           | - (compost toilets)  | -  | -  | -                         |
|                        | 6 x hwb's                          | 9 l / person / day x 10 guests   | 90 l / day   | -  | Grey                      |
|                        | 6 x showers                        | 70 l / person / day x 10 guests  | 700 l / day  | -  | Grey                      |
|                        | 6 x prep bowls (kitchenette)       | 30 l / day / unit (x 6 units)  | 180 l / day  | -  | Grey                      |
| TOTAL DEMAND / day     |                                    |  | <b>10190 litres / day (total) :</b><br>5470 l / day inside fort<br>4720 l / day outside fort | <b>5361,5 litres / day (total) :</b><br>900 l / day (ablutions)<br>4461,5 l / day (irrigation) |                           |

Table 6.15 Water demand schedule (Author, 2017)

## YIELD

[ rainwater harvesting ]

| Runoff Surface  | Herb Plantation      | Green Roof            | Gravel Road         | Stone walkways & channels       | Concrete Floors      | Timber decking / roof covering | Glass (skylight)     | TOTAL                  | Weighted C    |
|---|----------------------|-----------------------|---------------------|---------------------------------|----------------------|--------------------------------|----------------------|------------------------|---------------|
| Area (m <sup>2</sup> ) (Inside Fort directed to retention pond) | 387.1 m <sup>2</sup> | 191.59 m <sup>2</sup> | -                   | 430.55 m <sup>2</sup> (inside)  | 215.63m <sup>2</sup> | 204,3m <sup>2</sup>            | 36,46m <sup>2</sup>  | 1465.63 m <sup>2</sup> | 0,57 (inside) |
| Area (m <sup>2</sup> ) (Outside Fort directed to wetland)       | -                    | 427.65 m <sup>2</sup> | 427,5m <sup>2</sup> | 252.04 m <sup>2</sup> (outside) | -                    | 83,4 m <sup>2</sup>            | 19,24 m <sup>2</sup> | 1209,83 m <sup>2</sup> | 1,9 (outside) |
| TOTAL Area (m <sup>2</sup> )                                    | 387.1 m <sup>2</sup> | 619.24m <sup>2</sup>  | 427,5m <sup>2</sup> | 682.59 m <sup>2</sup> (total)   | 215.63m <sup>2</sup> | 287.7m <sup>2</sup>            | 55,7m <sup>2</sup>   | 2675,46 m <sup>2</sup> |               |
| Runoff co-efficient (C)   | 0,2                  | 0,1                   | 0,7                 | 0,8                             | 0,9                  | 0,8                            | 1,0                  |                        |               |

Table 6.16 Rain water yield based on designed floor & roof surfaces (Author, 2017)

Due to the fort's exposed above-ground condition, the opportunity for water harvesting was identified. The movement of water became an important informant in the design of the 'dynamic roof plane' as a surface for directing and collecting rainwater.

After investigating the design's potential for water harvesting based on an analysis of water demand and the potential grey water harvesting from these sources, in combination with water collection potential of runoff surfaces, the following was deduced:

Based on the site's topography, the water system was divided into two separate

branches:

- 1) Water harvesting within the fort itself, directed towards the internal retention pond
- 2) Water harvesting from surfaces outside of the fort on the northern side of the site where the retreat cabins and accompanying infrastructure is proposed. Storm- and grey water will be directed towards a wetland on the lowest terrace of the site, which will serve to filter out impurities for non-potable reuse, i.e. irrigation and water closets.

The initial investigation outcome showed that the rainwater and greywater harvest-

ed inside the fort would not be enough to supply water for irrigation and water closets. The investigation was then iterated to test whether the rainwater and greywater harvested inside the fort would be enough to supply water to ablutions inside the fort only. This hypothesis was proved and showed that an annual surplus of 611,9 m<sup>3</sup> would be created, which may be directed to the wetland, supplementing the external water system for use in irrigation. Due to the space constraints within the predetermined fort boundary, it was seen that the limited water storage capacity would result in wasted harvested water. To relieve some of the water storage requirements, grey water would be directed directly into the wetland sys-

tem and only harvested rainwater would be used to supply the internal water closet water demand.

After several iterations, it was proven that all non-potable water demands posed by the newly introduced programme will be successfully met through the designed greywater and stormwater systems.



## INTERNAL fort water system

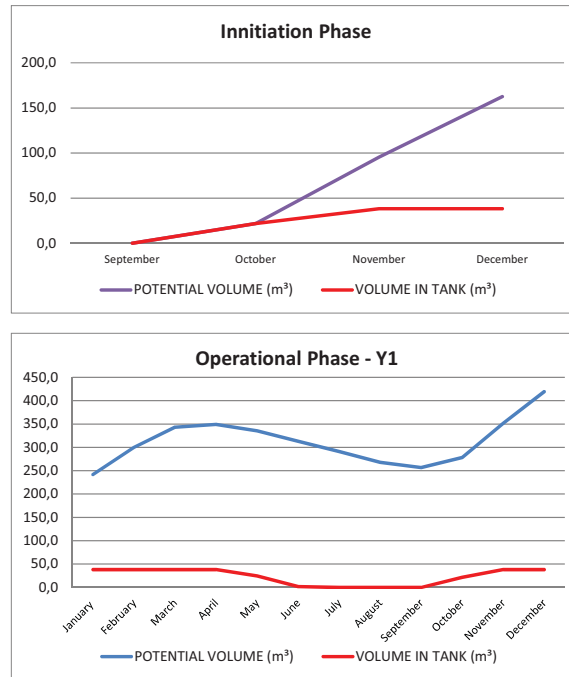


Table 6.17 Initiation and Operational phase of internal fort water system water storage tank volume (Author, 2017)



Fig.6.19 Above ground water storage tank (Jojo Tanks, 2017)

### CONCLUSION

Based on the retention pond's capacity of 13,27m<sup>3</sup> and an additional water storage tank capacity of 10m<sup>3</sup>, it was found that this will have to be supplemented furthermore by additional water storage tanks. In order to cope with the winter month's rainfall deficit, the following additional water storage requirements were found to be necessary:

= Add 3 x 5000l (underground) storage tanks, which will increase water storage capacity to **38,3m<sup>3</sup>**

Total water storage tanks required in addition to retention pond:

5 x 5000l (1,82m diameter x 2,255m height)

3 x underground and 2 x above ground tanks

## EXTERNAL water system

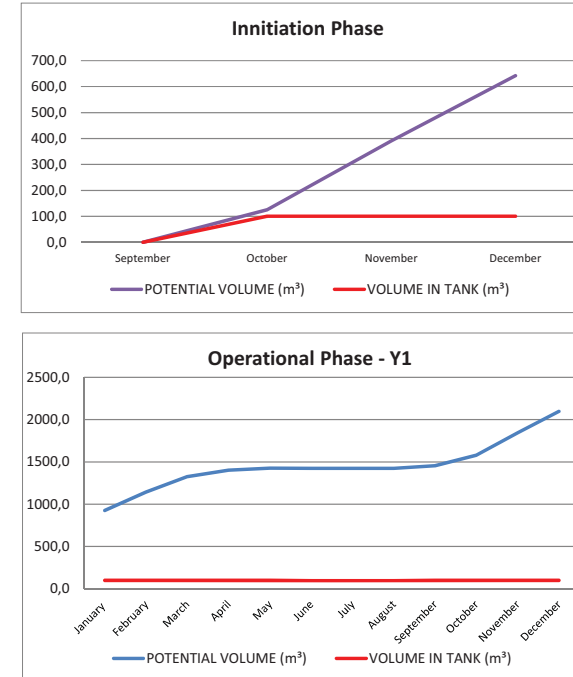


Table 6.18 Initiation & Operational phase of external fort water system water storage tank volume (Author, 2017)



Fig.6.20 Below ground water storage tank (Jojo Tanks, 2017)

### CONCLUSION

There are no limitations on the amount of space available for water storage tanks outside of the fort in the proximity of the proposed wetland. It was proven that a 100 m<sup>3</sup> storage capacity will satisfy all non-potable water demands throughout the whole year.

Total water storage tanks required:

17 x 6000l (1.9x3,33x1,98m)

underground water storage tanks

## 6.7 Detailing

The wall section

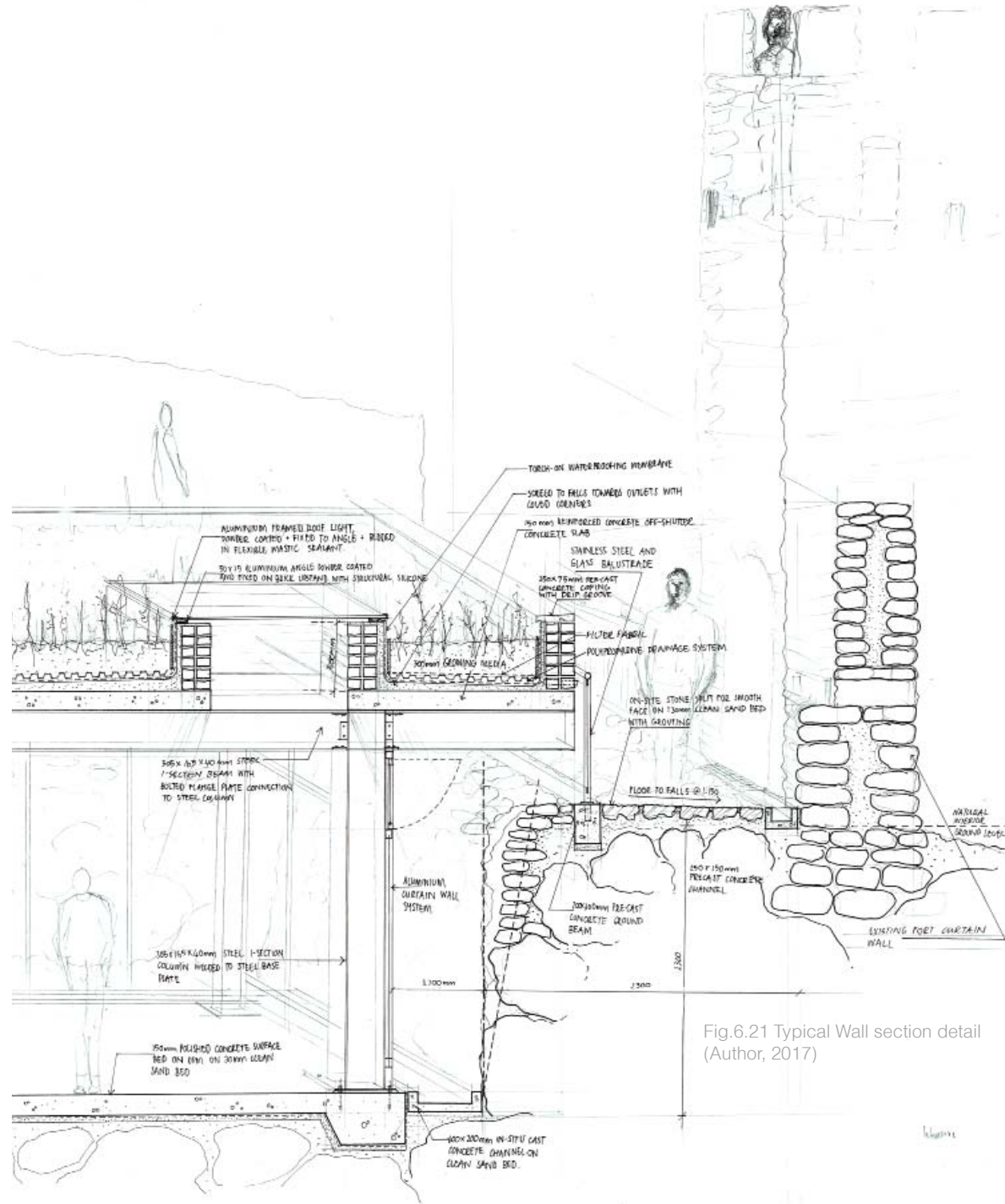


Fig.6.21 Typical Wall section detail (Author, 2017)

## Precedent

6.7.1 The 'coming together moment' as mastered by Carlo Scarpa

CONNECTIONS

&

WATER

*detailing*

Project: Castelvecchio Museum

Architect: Carlo Scarpa

Year completed: 1974

Location: Verona

Project Description:

Castelvecchio, a medieval military castle was renovated by Carlo Scarpa into a contemporary museum after being bombed, rebuilt and altered post-WWII (Veronissima, 2007).

In the design, Scarpa displays a skillfull treatment of a sensitive heritage structure met with a new intervention that is prominent in its own right, yet delicately crafted into a interwoven whole.

The new intervention, subtly, yet intuitively guides the visitor through the old castle, revealing poetic moments in the architecture where old and new meet, whilst narrating the artpieces displayed.

Relevance:

Scarpa's detailing of how the new meets the old can be described as touching the old lightly, allowing "a moment of breath" between the old and the new, which displays a sense of respect and sensitivity to the existing fabric, elegantly creating a clear differentiation between the two conditions.

Project: Fondazione Querini Stampalia

Architect: Carlo Scarpa

Year completed: 1963

Location: Venice

"...when I asked him [Scarpa] to keep the high water outside the palace... he told me, looking into my eyes, after a pause: inside, high water will be inside, as it is in the rest of the city. It is just about holding it, controlling it, using it as a bright and reflective material..." (memoir of Giuseppe Mazzariol, director of the Querini Stampalia Foundation from 1958 to 1973)

Project Description:

The renovation of this Venetian palace is based on the Venetian traditions of the bridge and the presence of water in the city, the portego, traditional Venetian palace space and the garden (metalocus.es, 2015).

Relevance:

Scarpa's sophisticated detailing in the treatment of water movement within the building adds to the appreciation of the old palace by using it to create a sensory experience, innovatively addressing the problem of flooding.

**OUTCOME:** By integrating the two ideas of Scarpa's 'connecting moment' and the use of water as sensory element in a heritage condition, a way of further drawing attention to the significance of old vs. new can be created in the dissertation's design.



Fig.6.22 Castelvecchio Museum - a breathing moment between the old walls and the new floor (archiobjects.org, 2017)



Fig.6.23 Castelvecchio Museum - sensitive placement of new ramp entering old opening (archiobjects.org, 2017)

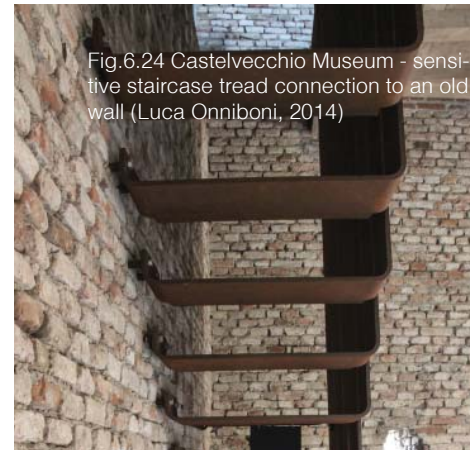


Fig.6.24 Castelvecchio Museum - sensitive staircase tread connection to an old wall (Luca Onniboni, 2014)



Fig.6.25 Fondazione Querini Stampalia - complementary relationship between water & new materials (www.metalocus.es, 2015)



Fig.6.26 Fondazione Querini Stampalia - water spout detail (www.metalocus.es, 2015)

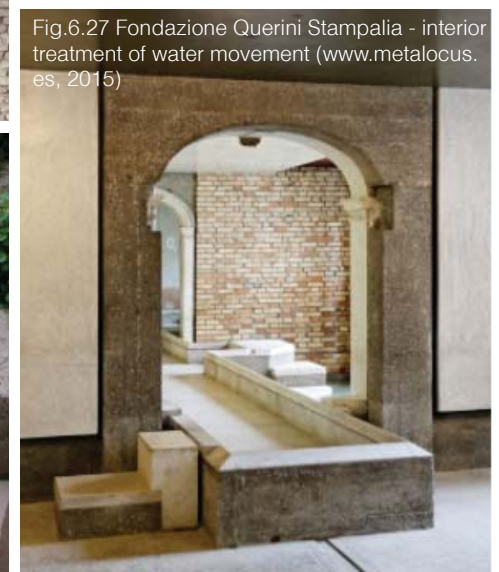


Fig.6.27 Fondazione Querini Stampalia - interior treatment of water movement (www.metalocus.es, 2015)

# Connecting Moments

6.7.2 The sensitive coming together of old & new

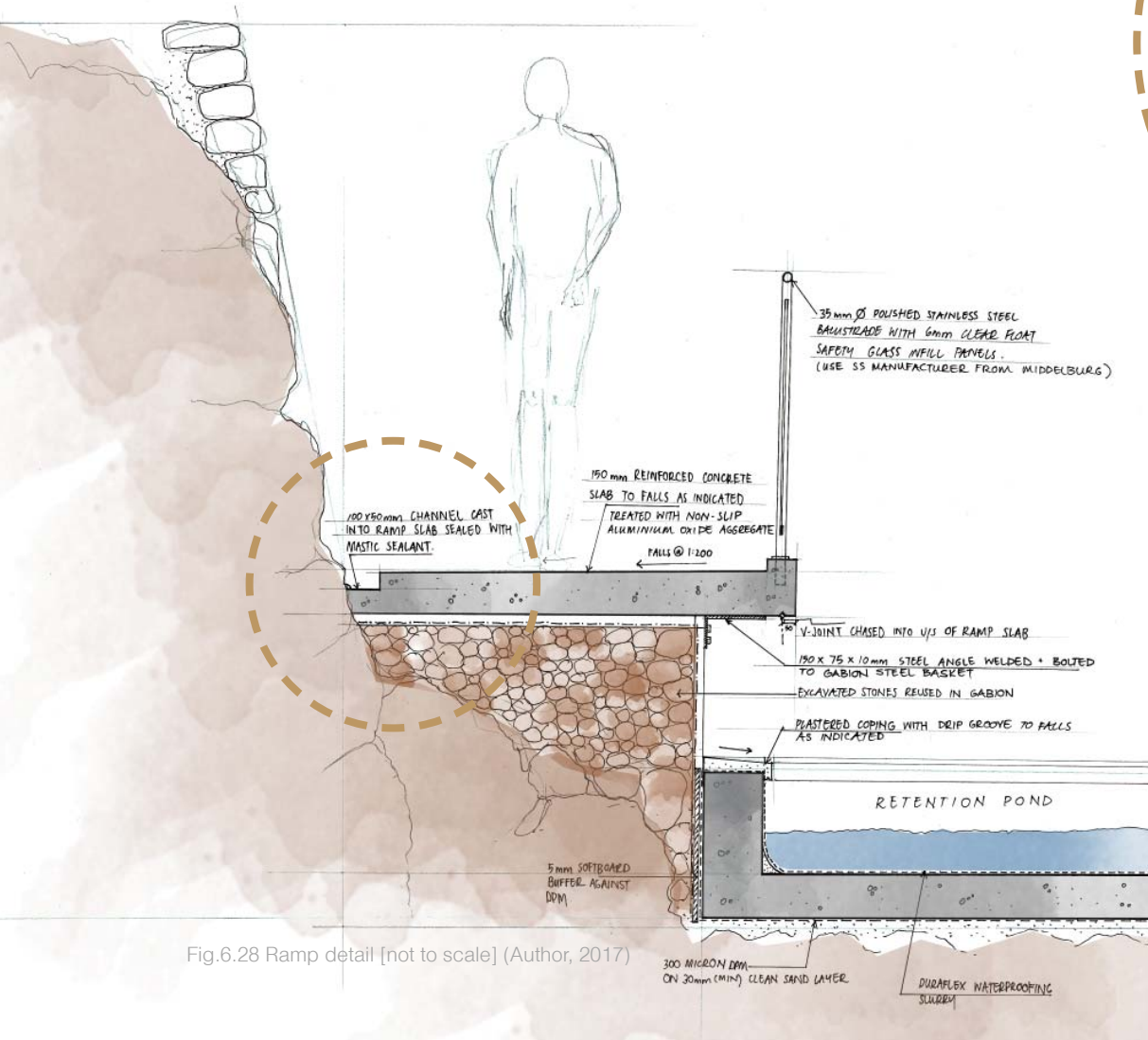


Fig.6.28 Ramp detail [not to scale] (Author, 2017)

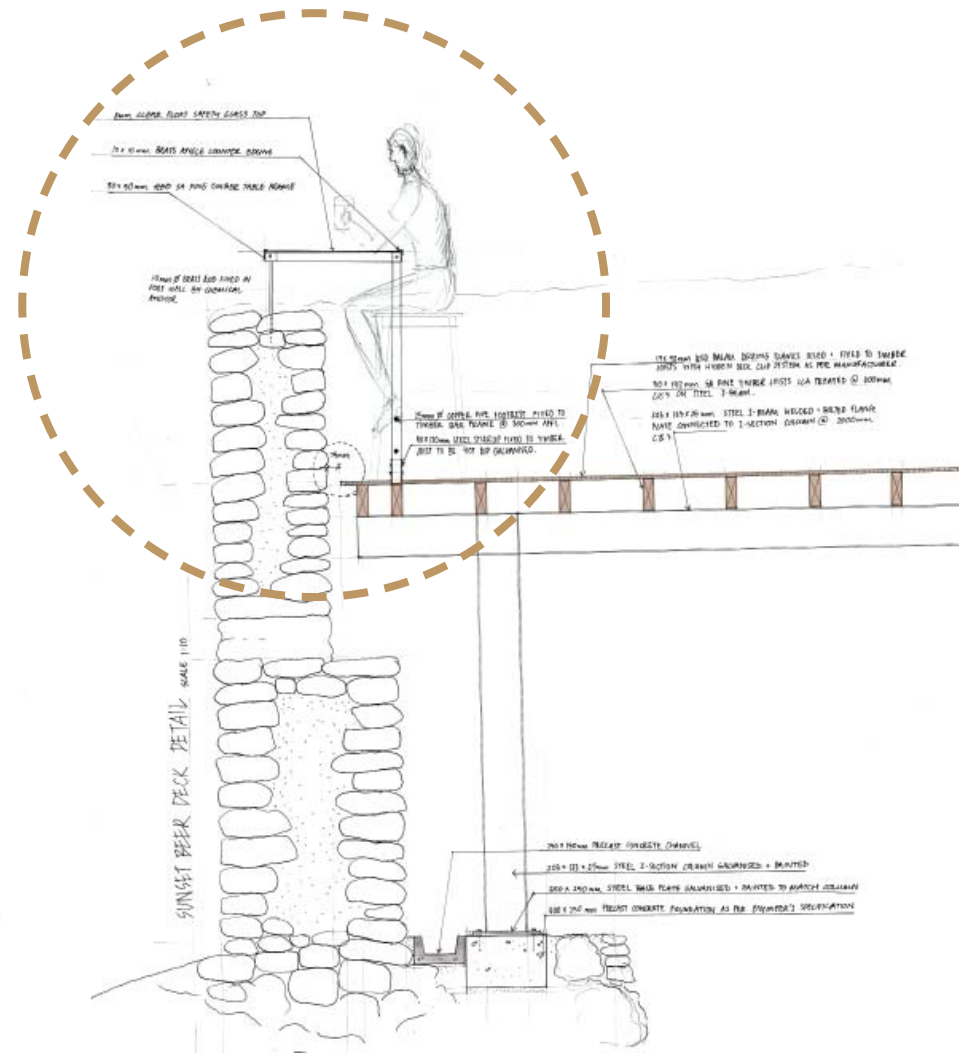


Fig.6.29 Beer deck connection detail [not to scale] (Author, 2017)

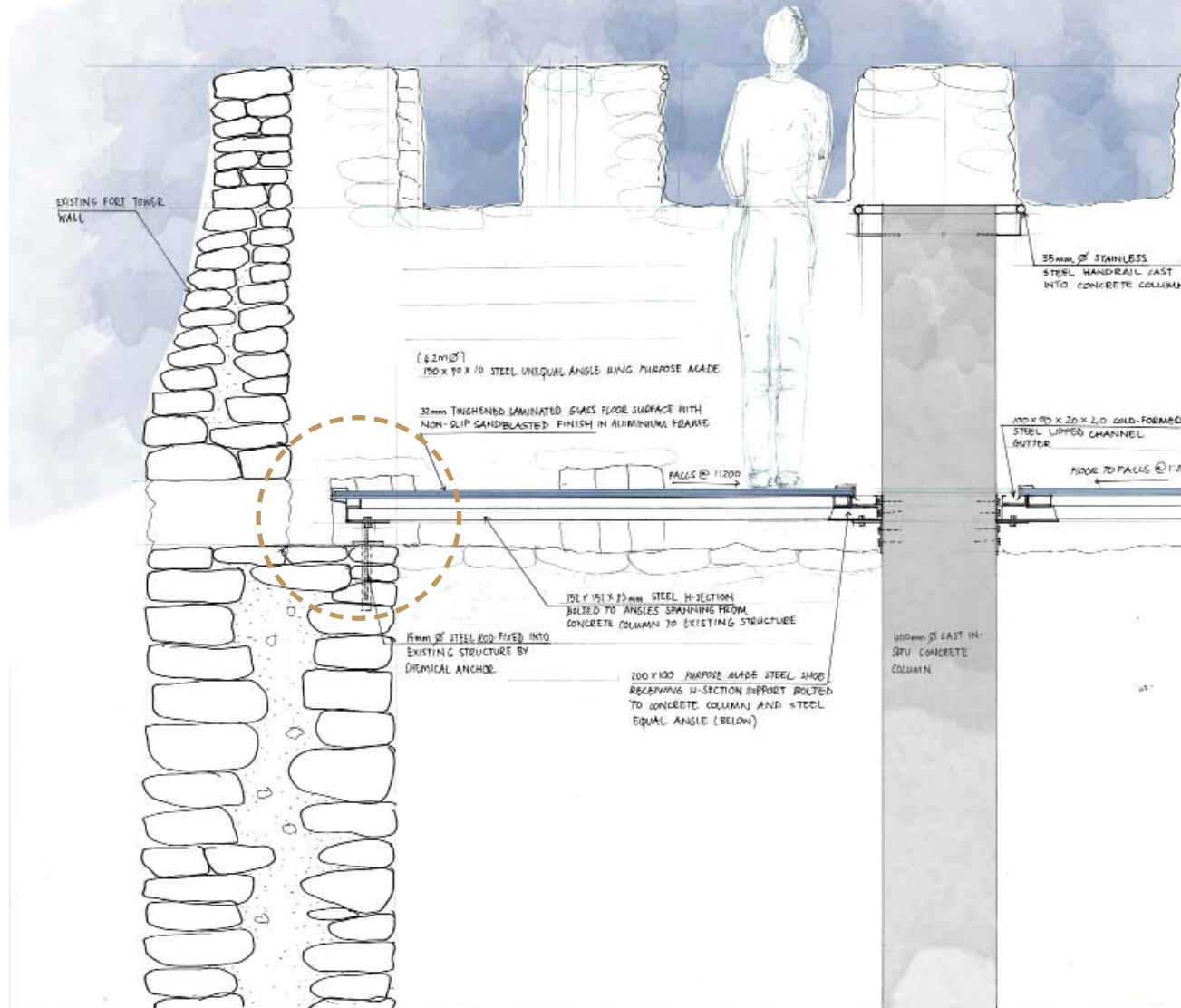
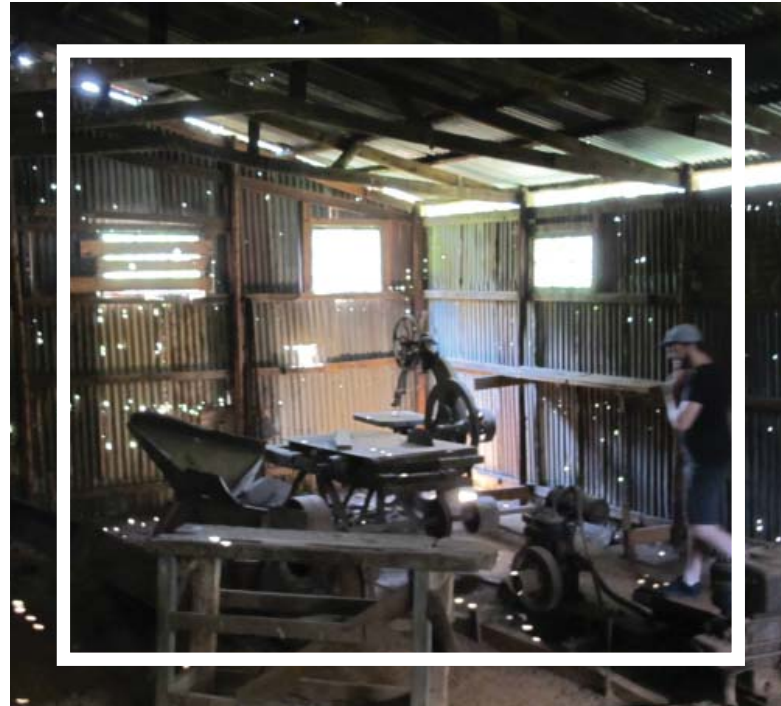


Fig.6.30 New viewing platform & old tower connection detail [not to scale] (Author, 2017)



- A -

# APPENDIX



## A.1 Water Demand

### A.1.1 Water Schedule

| ZONE                   | USE description                    | Area (m <sup>2</sup> ) / l per person  | Total (l) POTABLE demand  | Total (l) NON POTABLE demand   | Water Recycling Potential |
|------------------------|------------------------------------|--|---|--|---------------------------|
| Tea Room & herb garden | Irrigation                         | 410.1m <sup>2</sup><br>(square feet area x 0.623 = gallons)<br>= 10410 l<br>@ 3 x per week on average  | -   | 4461.5 l / day   | Runoff (Grey)             |
|                        | Tea Room (Food prep & Dishwashing) | 22.5 l / person<br>(avidwatersystems, 2011)<br>@ 50 people on average  | 1125l / day   | -  | Grey                      |
|                        | Tea Processing (Washing Herbs)     | 100 l / day  | 100 l / day   | -  | Grey                      |
|                        | 2 x WC's                           | 6 l / flush<br>x 50 flushes per day  | -   | 600 l / day  | Black                     |
|                        | 3 x hwb's                          | 0.5 l / person   | 25 l / day  | -  | Grey                      |
|                        | Mist Cooling                       | 5 hours / day (in use 75% of year)<br>51.1 LPH flow rate x 10 nozzles x 5 hours<br>( <a href="http://www.alloutcool.com/misting-nozzles.html">http://www.alloutcool.com/misting-nozzles.html</a> , 2014) | 2550 l / day<br>77562.5 l / month<br><b>1912.5 l / day</b> (on average)       | -  | -                         |
| Ward 1                 | Mist Cooling                       | 5 hours / day (in use 75% of year)<br>51.1 LPH flow rate x 10 nozzles x 5 hours<br>( <a href="http://www.alloutcool.com/misting-nozzles.html">http://www.alloutcool.com/misting-nozzles.html</a> , 2014) | 2550 l / day<br>77562.5 l / month<br><b>1912.5 l / day</b> (on average)       | -  | -                         |
| Underground Ward 2     | 7 x work bench basins              | 25 l / basin / day   | 175 l / day   | -  | Grey                      |
|                        | 3 x WC's                           | 6 l / flush<br>x 30 flushes per day  | 180 l / day   | -  | Grey                      |
|                        | 3 x hwb's                          | 0.5 l / person per hand wash (x 30 flushes)  | 15 l / day  | -  | Grey                      |
| Beer Deck              | 1 x WC                             | 6 l / flush<br>x 50 flushes per day  | -   | 300 l / day  | Black                     |
|                        | 1 x hwb                            | 0.5 l / patron<br>@ 50 patrons on average  | 25 l / day  | -  | Grey                      |
|                        | 1 Prep bowl (bar)                  | 7.5 l / patron (avidwatersystems, 2011)  | 3750 l / day  | -  | Grey                      |
|                        | 1 Sink (scullery below)            |  |   |  |                           |
| Retreat Cabins         | 6 x WC's                           | - (compost toilets)  | -   | -  | -                         |
|                        | 6 x hwb's                          | 9 l / person / day x 10 guests   | 90 l / day  | -  | Grey                      |
|                        | 6 x showers                        | 70 l / person / day x 10 guests  | 700 l / day   | -  | Grey                      |
|                        | 6 x prep bowls (kitchenette)       | 30 l / day / unit (x 6 units)  | 180 l / day   | -  | Grey                      |
| TOTAL DEMAND / day     |                                    |  | <b>10190</b> litres per day<br>Inside : 5470 l / day<br>Outside: 4720 l / day | <b>5361.5</b> litres per day<br>(Inside Fort including irrigation)<br>900 litres / day ablutions alone |                           |



### A.1.2 Non-Potable Water Demand

| MONTH               | Days | Water Demand (l) Including Irrigation | Water Demand (m <sup>3</sup> / month) | Retention Pond Evap Loss | TOTAL Water Demand | Water Demand (l) Ablutions only | Water Demand (m <sup>3</sup> / month) | Retention Pond Evap Loss | TOTAL Water Demand |
|---------------------|------|---------------------------------------|---------------------------------------|--------------------------|--------------------|---------------------------------|---------------------------------------|--------------------------|--------------------|
| January             | 31   | 5361.5                                | 166,2                                 | 3,03                     | 169,2              | 900                             | 27,9                                  | 3,03                     | 30,9               |
| February            | 28.4 | 5361.5                                | 152,3                                 | 2,65                     | 155                | 900                             | 25,6                                  | 2,65                     | 28,3               |
| March               | 31   | 5361.5                                | 166,2                                 | 2,09                     | 168,3              | 900                             | 27,9                                  | 2,09                     | 30                 |
| April               | 30   | 5361.5                                | 160,8                                 | 2,09                     | 162,9              | 900                             | 27                                    | 2,09                     | 29,1               |
| May                 | 31   | 5361.5                                | 166,2                                 | 1,61                     | 167,8              | 900                             | 27,9                                  | 1,61                     | 29,5               |
| June                | 30   | 5361.5                                | 160,8                                 | 1,33                     | 162,1              | 900                             | 27                                    | 1,33                     | 28,3               |
| July                | 31   | 5361.5                                | 166,2                                 | 1,42                     | 167,6              | 900                             | 27,9                                  | 1,42                     | 29,3               |
| August              | 31   | 5361.5                                | 166,2                                 | 2,09                     | 168,3              | 900                             | 27,9                                  | 2,09                     | 30                 |
| September           | 30   | 5361.5                                | 160,8                                 | 2,65                     | 163,5              | 900                             | 27                                    | 2,65                     | 29,7               |
| October             | 31   | 5361.5                                | 166,2                                 | 3,03                     | 169,2              | 900                             | 27,9                                  | 3,03                     | 30,9               |
| November            | 30   | 5361.5                                | 160,8                                 | 3,03                     | 163,83             | 900                             | 27                                    | 3,03                     | 30                 |
| December            | 31   | 5361.5                                | 166,2                                 | 3,41                     | 169,6              | 900                             | 27,9                                  | 3,41                     | 31,3               |
| <b>TOTAL ANNUAL</b> |      |                                       | 1958,9                                | 27,98                    | 1986,88            |                                 | 328,9                                 | 27,98                    | 357,3              |

### A.1.3 Potable Water Demand (Inside Fort)

| MONTH               | Days | Water Demand (l) | Total (m <sup>3</sup> ) |
|---------------------|------|------------------|-------------------------|
| January             | 31   | 5470             | 169,57                  |
| February            | 28.4 | 5470             | 155,3                   |
| March               | 31   | 5470             | 169,57                  |
| April               | 30   | 5470             | 164,1                   |
| May                 | 31   | 5470             | 169,57                  |
| June                | 30   | 5470             | 164,1                   |
| July                | 31   | 5470             | 169,57                  |
| August              | 31   | 5470             | 169,57                  |
| September           | 30   | 5470             | 164,1                   |
| October             | 31   | 5470             | 169,57                  |
| November            | 30   | 5470             | 164,1                   |
| December            | 31   | 5470             | 169,57                  |
| <b>TOTAL ANNUAL</b> |      |                  | 1998,7                  |

### A.1.4 Potable Water Demand (Outside Fort)

| MONTH               | Days | Water Demand (l) | Total (m <sup>3</sup> ) |
|---------------------|------|------------------|-------------------------|
| January             | 31   | 4720             | 146,3                   |
| February            | 28.4 | 4720             | 134                     |
| March               | 31   | 4720             | 146,3                   |
| April               | 30   | 4720             | 141,6                   |
| May                 | 31   | 4720             | 146,3                   |
| June                | 30   | 4720             | 141,6                   |
| July                | 31   | 4720             | 146,3                   |
| August              | 31   | 4720             | 146,3                   |
| September           | 30   | 4720             | 141,6                   |
| October             | 31   | 4720             | 146,3                   |
| November            | 30   | 4720             | 141,6                   |
| December            | 31   | 4720             | 146,3                   |
| <b>TOTAL ANNUAL</b> |      |                  | 1724,5                  |

## A.2 Water Yield

### A.2.1 Runoff Water Yield

| Runoff Surface  | Herb Plantation      | Green Roof            | Gravel Road         | Stone walkways & channels       | Concrete Floors      | Timber decking / roof covering | Glass (skylight)     | TOTAL                  | Weighted C    |
|---|----------------------|-----------------------|---------------------|---------------------------------|----------------------|--------------------------------|----------------------|------------------------|---------------|
| Area (m <sup>2</sup> ) (Inside Fort directed to retention pond) | 387.1 m <sup>2</sup> | 191.59 m <sup>2</sup> | -                   | 430.55 m <sup>2</sup> (inside)  | 215.63m <sup>2</sup> | 204,3m <sup>2</sup>            | 36,46m <sup>2</sup>  | 1465.63 m <sup>2</sup> | 0,57 (inside) |
| Area (m <sup>2</sup> ) (Outside Fort directed to wetland)       | -                    | 427.65 m <sup>2</sup> | 427,5m <sup>2</sup> | 252.04 m <sup>2</sup> (outside) | -                    | 83,4 m <sup>2</sup>            | 19,24 m <sup>2</sup> | 1209,83 m <sup>2</sup> | 1,9 (outside) |
| TOTAL Area (m <sup>2</sup> )                                    | 387.1 m <sup>2</sup> | 619.24m <sup>2</sup>  | 427,5m <sup>2</sup> | 682.59 m <sup>2</sup> (total)   | 215.63m <sup>2</sup> | 287.7m <sup>2</sup>            | 55,7m <sup>2</sup>   | 2675,46 m <sup>2</sup> |               |
| Runoff co-efficient (C)   | 0,2                  | 0,1                   | 0,7                 | 0,8                             | 0,9                  | 0,8                            | 1,0                  |                        |               |
| A x C   | 77.42                | 61.924                | 299.25              | 546.07                          | 194.067              | 230.16                         | 55.7                 |                        |               |

### A.2.2 Grey Water

| MONTH        | Days | Grey Water harvested inside fort (l/ day) | Total (m <sup>3</sup> ) | Grey Water harvested outside fort (l / day) | Total (m <sup>3</sup> ) |
|--------------|------|---|-------------------------|---|-------------------------|
| January      | 31   | 972                                       | 30.1                    | 2847  | 88.3                    |
| February     | 28.4 | 972                                       | 27.6                    | 2847  | 80.9                    |
| March        | 31   | 972                                       | 30.1                    | 2847  | 88.3                    |
| April        | 30   | 972                                       | 29.2                    | 2847  | 85.4                    |
| May          | 31   | 972                                       | 30.1                    | 2847  | 88.3                    |
| June         | 30   | 972                                       | 29.2                    | 2847  | 85.4                    |
| July         | 31   | 972                                       | 30.1                    | 2847  | 88.3                    |
| August       | 31   | 972                                       | 30.1                    | 2847  | 88.3                    |
| September    | 30   | 972                                       | 29.2                    | 2847  | 85.4                    |
| October      | 31   | 972                                       | 30.1                    | 2847  | 88.3                    |
| November     | 30   | 972                                       | 29.2                    | 2847  | 85.4                    |
| December     | 31   | 972                                       | 30.1                    | 2847  | 88.3                    |
| TOTAL ANNUAL |      |   | 355.1                   |   | 1040.6                  |

Conclusion:

Grey Water harvested inside fort : 1620 l / day - (40%) = 972 l / day

Grey Water harvested outside fort : 4745 l / day - (40%) = 2847 l / day

### A.2.3 Total Monthly Water Yield

| MONTH              | Ave Rainfall P (m) | RETENSION POND: Catchment Yield (m <sup>3</sup> ) (Yield = PxAxC [0,57] ) | Grey Water Yield (m <sup>3</sup> ) | TOTAL Water Yield (INSIDE) | WETLAND: Catchment Yield (m <sup>3</sup> ) (Yield = PxAxC [1,9] ) | Grey Water Yield (m <sup>3</sup> ) | TOTAL Water Yield (OUTSIDE) |
|--------------------|--------------------|---|------------------------------------|----------------------------|---|------------------------------------|-----------------------------|
| January            | 0,132              | (Eg. 0,132x1466x0,57) = 110,3   | 30.1                               | <b>140,4</b>               | 0,132x1210x1,9 =303,5   | 88.3                               | <b>391.8</b>                |
| February           | 0,103              | 86,1  | 27.6                               | <b>113,7</b>               | 236,8   | 80.9                               | <b>317,7</b>                |
| March              | 0,088              | 73,5  | 30.1                               | <b>103,6</b>               | 202,3   | 88.3                               | <b>290,6</b>                |
| April              | 0,042              | 35,1  | 29.2                               | <b>64,3</b>                | 96,6  | 85.4                               | <b>182</b>                  |
| May                | 0,019              | 15,9  | 30.1                               | <b>46</b>                  | 43,7  | 88.3                               | <b>132</b>                  |
| June               | 0,007              | 5,8   | 29.2                               | <b>35</b>                  | 16,1  | 85.4                               | <b>101,5</b>                |
| July               | 0,009              | 7,5   | 30.1                               | <b>37,6</b>                | 20,7  | 88.3                               | <b>109</b>                  |
| August             | 0,008              | 6,7   | 30.1                               | <b>36,8</b>                | 18,4  | 88.3                               | <b>106,7</b>                |
| September          | 0,022              | 18,4  | 29.2                               | <b>47,6</b>                | 50,6  | 85.4                               | <b>136</b>                  |
| October            | 0,063              | 52,6  | 30.1                               | <b>82,7</b>                | 144,8   | 88.3                               | <b>233.1</b>                |
| November           | 0,124              | 103,6   | 29.2                               | <b>132,8</b>               | 285,1   | 85.4                               | <b>370,5</b>                |
| December           | 0,118              | 98,6  | 30.1                               | <b>128,7</b>               | 271,3   | 88.3                               | <b>359,6</b>                |
| <b>ANNUAL AVE.</b> | 0,735              | 614,1   | 355.1                              | <b>969.2</b>               | 1689,9  | 1040.6                             | <b>2730,5</b>               |

## A.3 Water Budget

### A.2.4 Retention Pond Monthly Evaporation Loss

Retention Pond Volume:

18.96m<sup>2</sup> (area) x 0,7m (depth)

= **13,27m<sup>3</sup>** water retention capacity

### Retention Pond Evaporation Loss

| MONTH               | Evaporation Rate (m/month) | Total Loss (m <sup>3</sup> /month)<br>(Evaporation Rate x Reservoir area) |
|---------------------|----------------------------|---|
| January             | 0,16                       | 3,03  |
| February            | 0,14                       | 2,65  |
| March               | 0,11                       | 2,09  |
| April               | 0,11                       | 2,09  |
| May                 | 0,085                      | 1,61  |
| June                | 0,07                       | 1,33  |
| July                | 0,075                      | 1,42  |
| August              | 0,11                       | 2,09  |
| September           | 0,14                       | 2,65  |
| October             | 0,16                       | 3,03  |
| November            | 0,16                       | 3,03  |
| December            | 0,18                       | 3,41  |
| <b>ANNUAL TOTAL</b> | <b>1,5</b>                 | <b>27,98</b>  |

### A.3.1 Base Test:

| MONTH               | Yield (m <sup>3</sup> /month) | Demand (m <sup>3</sup> /month) | Monthly Balance |
|---------------------|-------------------------------|--------------------------------|-----------------|
| January             | 140,4                         | 169,2                          | -28,8           |
| February            | 113,7                         | 155                            | -41,3           |
| March               | 103,6                         | 168,3                          | -64,7           |
| April               | 64,3                          | 162,9                          | -98,6           |
| May                 | 46                            | 167,8                          | -121,8          |
| June                | 35                            | 162,1                          | -127,1          |
| July                | 37,6                          | 167,6                          | -130,0          |
| August              | 36,8                          | 168,3                          | -131,5          |
| September           | 47,6                          | 163,5                          | -115,9          |
| October             | 82,7                          | 169,2                          | -86,5           |
| November            | 132,8                         | 163,83                         | -31,0           |
| December            | 128,7                         | 169,6                          | -41,2           |
| <b>ANNUAL TOTAL</b> | <b>969,2</b>                  | <b>1986,88</b>                 | <b>-1018,4</b>  |

#### CONCLUSION:

Rainwater & grey water harvested inside fort is not enough to supply water for irrigation and ablution water needs

## A.3 Water Budget

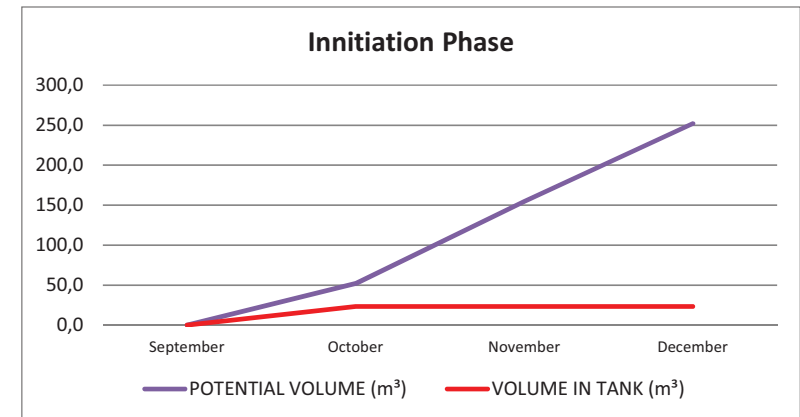
### A.3.2 Iteration 1:

#### Water Budget Initiation Phase (Water use Inside Fort)

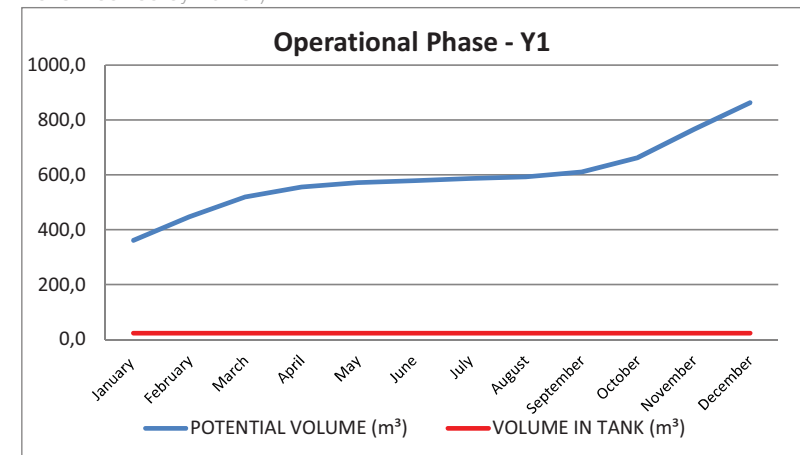
| MONTH     | Yield (m <sup>3</sup> /month) | Demand (m <sup>3</sup> /month) | Monthly Balance | Potential Volume (m <sup>3</sup> ) | Volume in Tank (m <sup>3</sup> ) |
|-----------|-------------------------------|--------------------------------|-----------------|------------------------------------|----------------------------------|
| September | 47,6                          | 29,7                           | 17,9            | 0,0                                | 0,0                              |
| October   | 82,7                          | 30,9                           | 51,8            | 51,8                               | 23,3                             |
| November  | 132,8                         | 30                             | 102,8           | 154,6                              | 23,3                             |
| December  | 128,7                         | 31,3                           | 97,4            | 252                                | 23,3                             |

#### Water Budget Year 1 (Water use Inside Fort)

| MONTH               | Yield (m <sup>3</sup> /month) | Demand (m <sup>3</sup> /month) | Monthly Balance | Potential Volume (m <sup>3</sup> ) | Volume in Tank (m <sup>3</sup> ) |
|---------------------|-------------------------------|--------------------------------|-----------------|------------------------------------|----------------------------------|
| January             | 140,4                         | 30,9                           | 109,5           | 361,5                              | 23,3                             |
| February            | 113,7                         | 28,3                           | 85,4            | 446,9                              | 23,3                             |
| March               | 103,6                         | 30                             | 73,6            | 520,5                              | 23,3                             |
| April               | 64,3                          | 29,1                           | 35,2            | 555,7                              | 23,3                             |
| May                 | 46                            | 29,5                           | 16,5            | 572,2                              | 23,3                             |
| June                | 35                            | 28,3                           | 6,7             | 578,9                              | 23,3                             |
| July                | 37,6                          | 29,3                           | 8,3             | 587,2                              | 23,3                             |
| August              | 36,8                          | 30                             | 6,8             | 593,5                              | 23,3                             |
| September           | 47,6                          | 29,7                           | 17,9            | 611,4                              | 23,3                             |
| October             | 82,7                          | 30,9                           | 51,8            | 663,2                              | 23,3                             |
| November            | 132,8                         | 30                             | 102,8           | 766,0                              | 23,3                             |
| December            | 128,7                         | 31,3                           | 97,4            | 863,4                              | 23,3                             |
| <b>ANNUAL TOTAL</b> | <b>969,2</b>                  | <b>357,3</b>                   | <b>611,9</b>    |                                    |                                  |



Graph 1. Water Tank Potential Volume vs. Water Tank actual volume based on 23m<sup>3</sup> capacity in the Initiation Phase (rain & grey water harvesting). (Pieterse, 2013 modified by Author)



Graph 1. Water Tank Potential Volume vs. Water Tank actual volume based on 23m<sup>3</sup> capacity in the Operational Phase (rain & grey water harvesting). (Pieterse, 2013 modified by Author)

#### CONCLUSION:

Rainwater & Greywater harvested inside fort is enough to supply water to ablutions inside the fort with an annual surplus of 611,9 m<sup>3</sup>, which may be directed to the wetland and used to aid irrigation.

Tank capacity is too little resulting in wastage of harvested water. As space is limited a possible solution might be to separate harvested rain water and grey water, directing grey water directly into wetland, relieving some of the water storage requirements.

## A.3 Water Budget

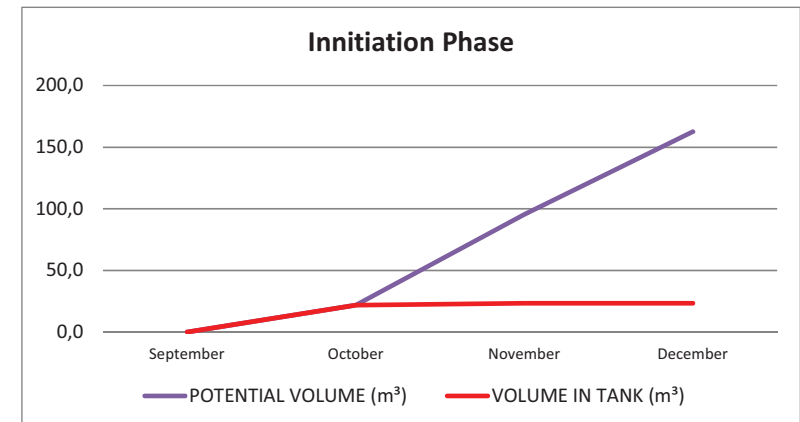
### A.3.3 Iteration 2:

#### Water Budget Initiation Phase (Water use Inside Fort)

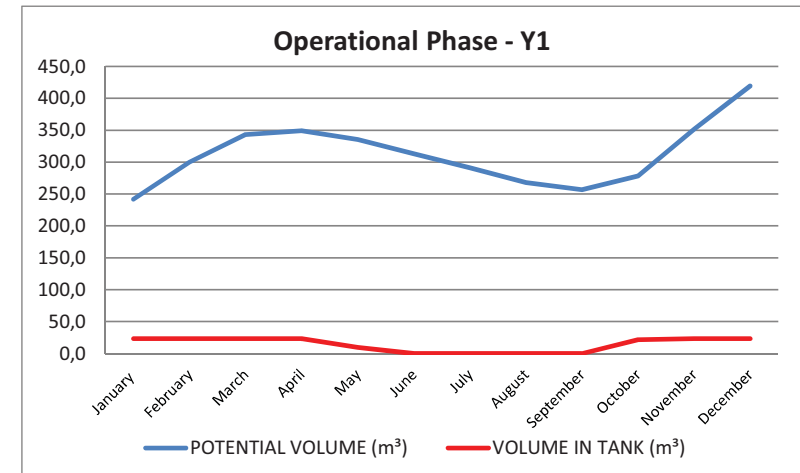
| MONTH     | Yield (m <sup>3</sup> /month) | Demand (m <sup>3</sup> /month) | Monthly Balance | Potential Volume (m <sup>3</sup> ) | Volume in Tank (m <sup>3</sup> ) |
|-----------|-------------------------------|--------------------------------|-----------------|------------------------------------|----------------------------------|
| September | 18,4                          | 29,7                           | -11,3           | 0,0                                | 0,0                              |
| October   | 52,6                          | 30,9                           | 21,7            | 21,7                               | 23,3                             |
| November  | 103,6                         | 30                             | 73,6            | 95,3                               | 23,3                             |
| December  | 98,6                          | 31,3                           | 67,3            | 162,6                              | 23,3                             |
|           | 273,2                         |                                | 151,3           |                                    |                                  |

#### Water Budget Year 1 (Water use Inside Fort)

| MONTH        | Yield (m <sup>3</sup> /month) | Demand (m <sup>3</sup> /month) | Monthly Balance | Potential Volume (m <sup>3</sup> ) | Volume in Tank (m <sup>3</sup> ) |
|--------------|-------------------------------|--------------------------------|-----------------|------------------------------------|----------------------------------|
| January      | 110,3                         | 30,9                           | 79,4            | 242,0                              | 23,3                             |
| February     | 86,1                          | 28,3                           | 57,8            | 299,8                              | 23,3                             |
| March        | 73,5                          | 30                             | 43,5            | 343,3                              | 23,3                             |
| April        | 35,1                          | 29,1                           | 6,0             | 349,3                              | 23,3                             |
| May          | 15,9                          | 29,5                           | -13,6           | 335,7                              | 9,7                              |
| June         | 5,8                           | 28,3                           | -22,5           | 313,2                              | 0,0                              |
| July         | 7,5                           | 29,3                           | -21,8           | 291,4                              | 0,0                              |
| August       | 6,7                           | 30                             | -23,3           | 268,1                              | 0,0                              |
| September    | 18,4                          | 29,7                           | -11,3           | 256,8                              | 0,0                              |
| October      | 52,6                          | 30,9                           | 21,7            | 278,5                              | 21,7                             |
| November     | 103,6                         | 30                             | 73,6            | 352,1                              | 23,3                             |
| December     | 98,6                          | 31,3                           | 67,3            | 419,4                              | 23,3                             |
| ANNUAL TOTAL | 614,1                         | 357,3                          | 256,8           |                                    |                                  |



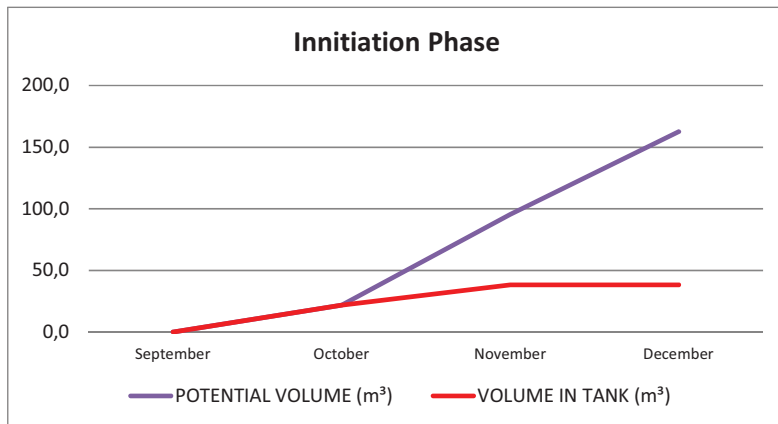
Graph 1. Water Tank Potential Volume vs. Water Tank actual volume based on 23m<sup>3</sup> capacity in the Initiation Phase (rainwater only). (Pieterse, 2013 modified)



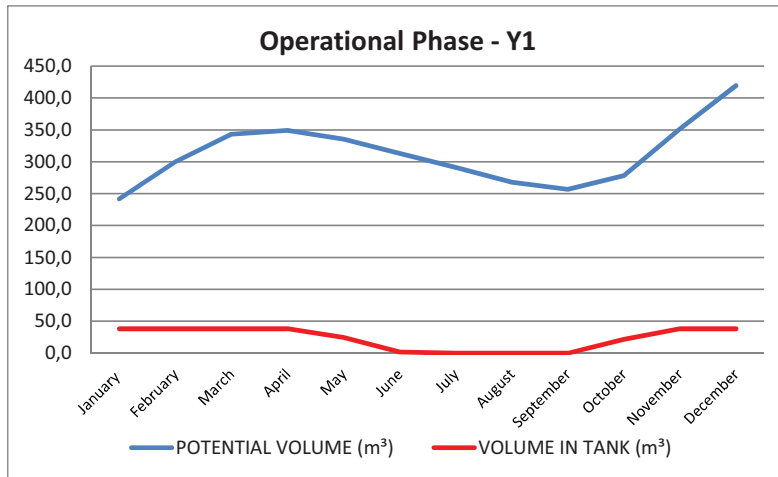
Graph 1. Water Tank Potential Volume vs. Water Tank actual volume based on 23m<sup>3</sup> capacity in the Operational Phase (rainwater only). (Pieterse, 2013 modified)

**CONCLUSION :** Tank capacity will have to increase as winter months will have a deficit. Although potential rain water harvested will be enough for feeding ablution requirements, not enough space is available inside the fort for the storage capacity this would entail.  
= Add 3 x 5000l underground storage tanks which will increase water storage capacity to 38,3m<sup>3</sup>, which will decrease the winter deficit and supplement with grey water harvested.

Total water storage tanks required in addition to retention pond: 5 x 5000l (1,82m diameter x 2,255m height)



Graph 1. Water Tank Potential Volume vs. Water Tank actual volume based on 38m³ capacity in the Initiation Phase. (Pieterse, 2013 modified by Author)



Graph 1. Water Tank Potential Volume vs. Water Tank actual volume based on 38m³ capacity in the Operational Phase. (Pieterse, 2013 modified by Author)

## A.3 Water Budget

### A.3.4 Wetland & Irrigation System

#### WETLAND & IRRIGATION WATER BUDGET

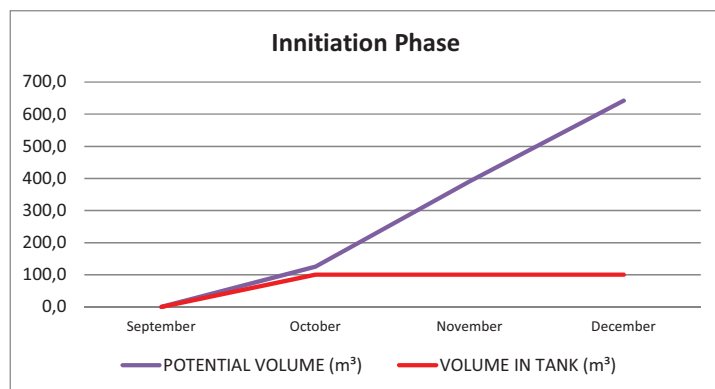
| MONTH               | Days | Water Demand (l) Including Irrigation | Water Demand (m³ / month) |
|---------------------|------|---------------------------------------|---------------------------|
| January             | 31   | 4461,5                                | 138,3                     |
| February            | 28.4 | 4461,5                                | 126,7                     |
| March               | 31   | 4461,5                                | 138,3                     |
| April               | 30   | 4461,5                                | 133,8                     |
| May                 | 31   | 4461,5                                | 138,3                     |
| June                | 30   | 4461,5                                | 133,8                     |
| July                | 31   | 4461,5                                | 138,3                     |
| August              | 31   | 4461,5                                | 138,3                     |
| September           | 30   | 4461,5                                | 133,8                     |
| October             | 31   | 4461,5                                | 138,3                     |
| November            | 30   | 4461,5                                | 133,8                     |
| December            | 31   | 4461,5                                | 138,3                     |
| <b>TOTAL ANNUAL</b> |      |                                       |                           |

#### Water Budget Initiation Phase (Water use Outside Fort)

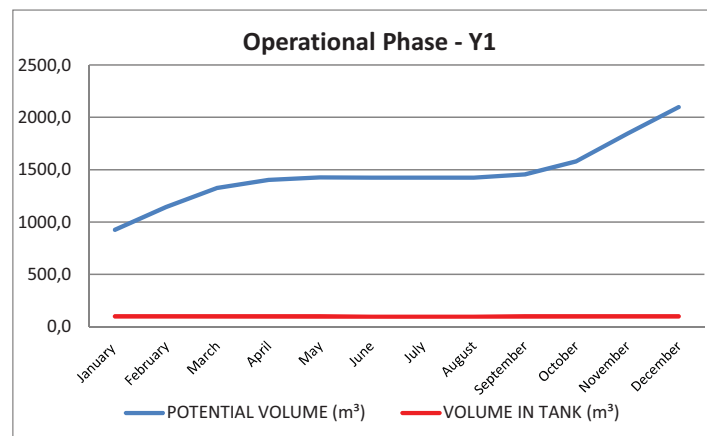
| MONTH     | Total Outside Fort Yield (m³/month) | Yield (m³/month) Fort Grey Water addition | TOTAL YIELD (m³/month) | Demand (m³/month) | Monthly Balance | Potential Volume (m³) | Volume in Tank (m³) |
|-----------|-------------------------------------|---|------------------------|-------------------|-----------------|-----------------------|---------------------|
| September | 136                                 | 29.2                                      | 165,2                  | 133,8             | 31,4            | 0,0                   | 0,0                 |
| October   | 233.1                               | 30.1                                      | 263,2                  | 138,3             | 124,9           | 124,9                 | 100,0               |
| November  | 370,5                               | 29.2                                      | 399,7                  | 133,8             | 265,9           | 390,8                 | 100,0               |
| December  | 359,6                               | 30.1                                      | 389,7                  | 138,3             | 251,4           | 642,2                 | 100,0               |
|           |                                     |   | 1217,8                 | 544,2             | 673,6           |                       |                     |

### Water Budget Year 1 (Water use Outside Fort)

| MONTH        | Total Outside Fort Yield (m <sup>3</sup> /month) | Yield (m <sup>3</sup> /month) Fort Grey Water addition | TOTAL YIELD (m <sup>3</sup> /month) | Demand (m <sup>3</sup> /month) | Monthly Balance | Potential Volume (m <sup>3</sup> ) | Volume in Tank (m <sup>3</sup> ) |
|--------------|--|--|-------------------------------------|--------------------------------|-----------------|------------------------------------|----------------------------------|
| January      | 391,8  | 30,1   | 421,9                               | 138,3                          | 283,6           | 925,8                              | 100,0                            |
| February     | 317,7  | 27,6   | 345,3                               | 126,7                          | 218,6           | 1144,4                             | 100,0                            |
| March        | 290,6  | 30,1   | 320,7                               | 138,3                          | 182,4           | 1326,8                             | 100,0                            |
| April        | 182  | 29,2   | 211,2                               | 133,8                          | 77,4            | 1404,2                             | 100,0                            |
| May          | 132  | 30,1   | 162,1                               | 138,3                          | 23,8            | 1428,0                             | 100,0                            |
| June         | 101,5  | 29,2   | 130,7                               | 133,8                          | -3,1            | 1424,9                             | 96,9                             |
| July         | 109  | 30,1   | 139,1                               | 138,3                          | 0,8             | 1425,7                             | 97,7                             |
| August       | 106,7  | 30,1   | 136,8                               | 138,3                          | -1,5            | 1424,2                             | 96,2                             |
| September    | 136  | 29,2   | 165,2                               | 133,8                          | 31,4            | 1455,6                             | 100,0                            |
| October      | 233,1  | 30,1   | 263,2                               | 138,3                          | 124,9           | 1580,5                             | 100,0                            |
| November     | 370,5  | 29,2   | 399,7                               | 133,8                          | 265,9           | 1846,4                             | 100,0                            |
| December     | 359,6  | 30,1   | 389,7                               | 138,3                          | 251,4           | 2097,8                             | 100,0                            |
| ANNUAL TOTAL |  | 355,1  |                                     | 357,3                          | 1455,6          |                                    |                                  |



Graph 1. Water Tank Potential Volume vs. Water Tank actual volume based on 100m<sup>3</sup> capacity in the Innitiation Phase. (Pieterse, 2013 modified by Author)



Graph 1. Water Tank Potential Volume vs. Water Tank actual volume based on 100m<sup>3</sup> capacity in the Operational Phase. (Pieterse, 2013 modified by Author)

### CONCLUSION :

There are no limitations on the amount of space available for water storage tanks outside of the fort in the proximity of the proposed wetland. It was proven that a 100 m<sup>3</sup> storage capacity will satisfy all non-potable water demands throughout the whole year.

Water storage tanks required: 17 x 6000l (1.9x3,33x1,98m) underground water storage tanks



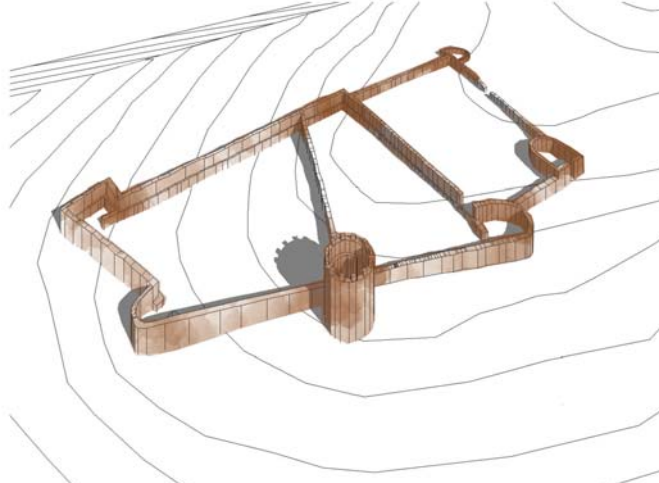
## A.2 Presentation Drawings

### A.2.1 Tectonic Hierarchy

1

EXISTING

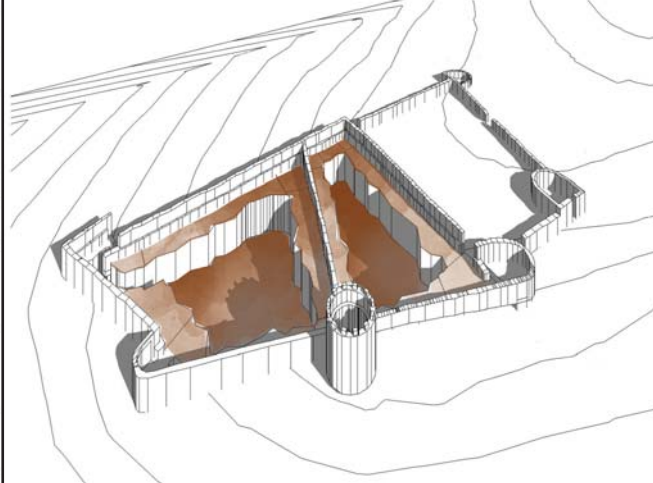
Due to the fort's lack on a roof, the opportunity exists to collect runoff rainwater from the impermeable and permeable floor surfaces along a



2

EXCAVATION + FORT WALL BREAKS

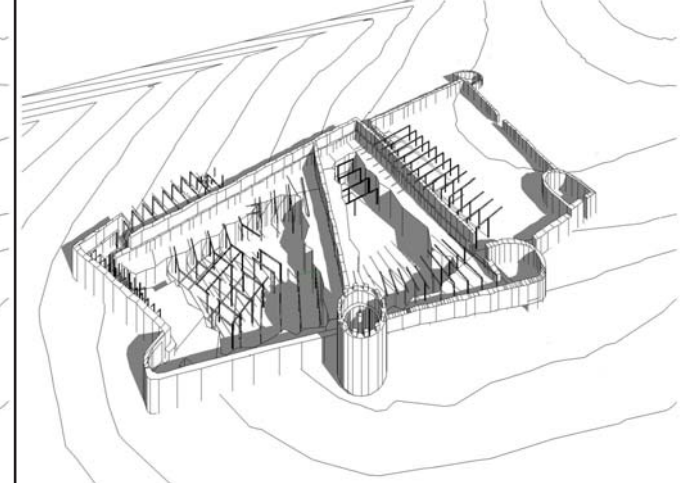
2-3m deep excavations in fort ward 1 & 2  
Minor breaks in the existing fort walls make the removal of excavated material possible



3

STEEL FRAMES

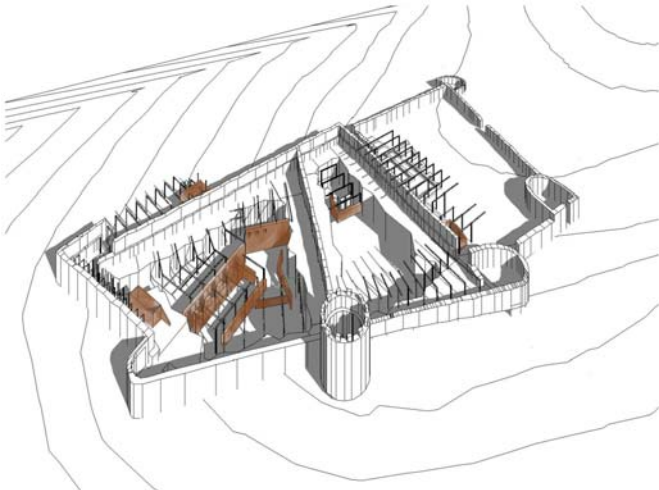
Steel column and beam system as primary structure mainly within the excavated wards



4

GABION WALL INFILL

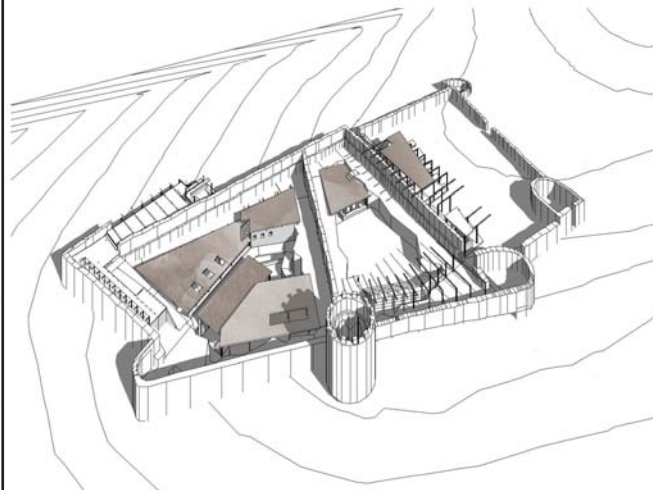
Gabion walls filled with the excavated material as wall infill, responding to the stereotomic subterranean condition



5

CONCRETE ROOF SLABS

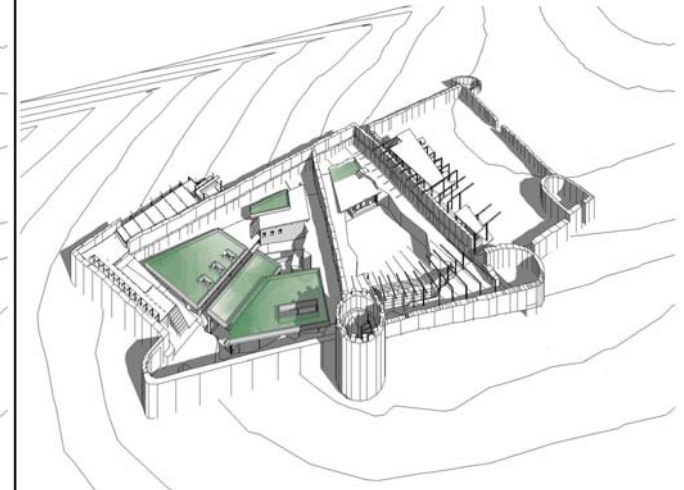
Off-shutter concrete roof slabs cast on top of steel frame 'restores' the natural ground level



6

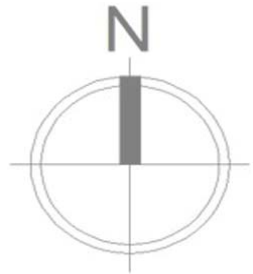
ROOF INFILL

Roof surfaces planted with local grasses gives the roof plane a greater connectedness to natural ground conditions and slows down the movement of storm water



# A.2 Presentation Drawings

A.2.2 Final Plans

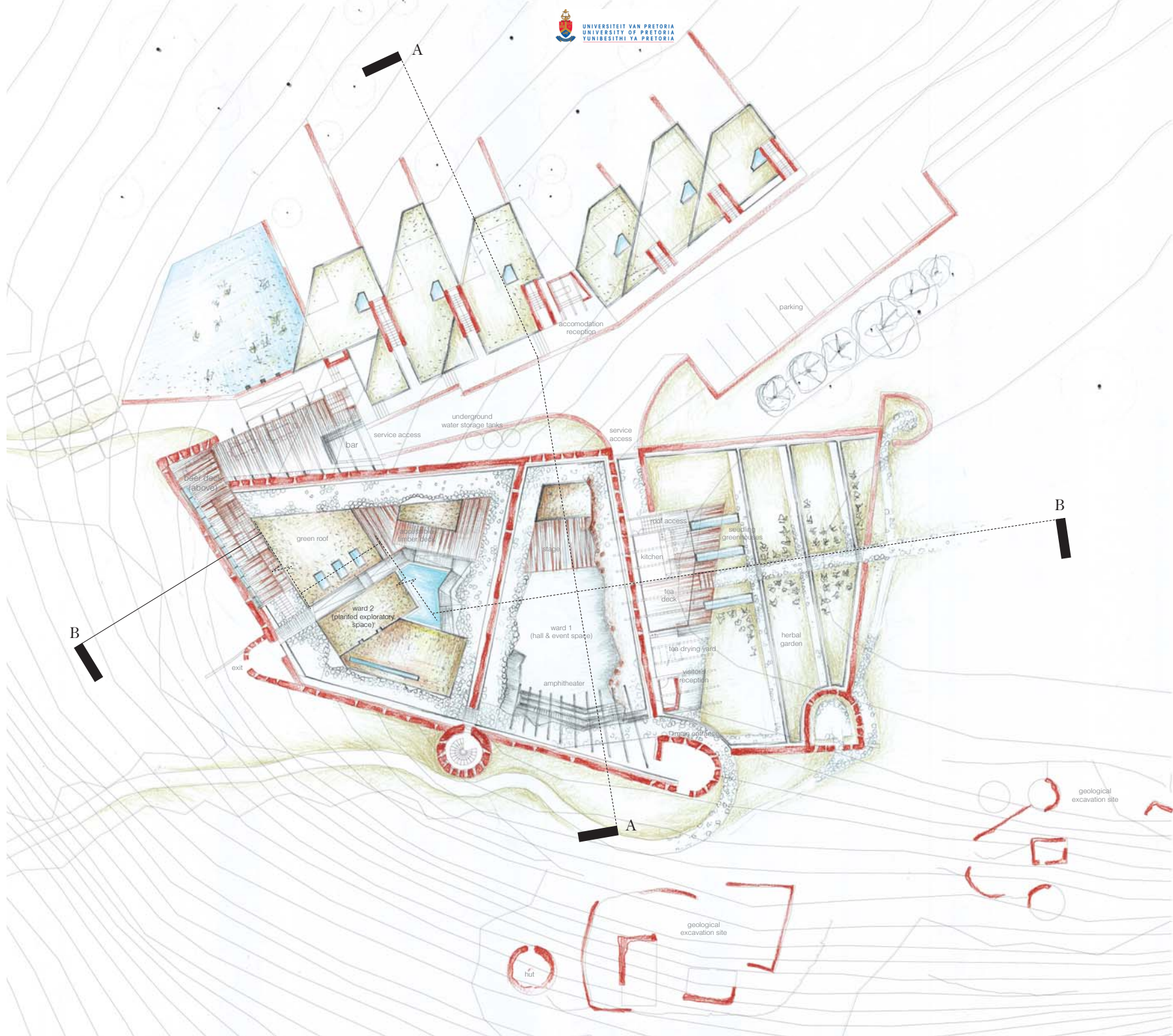


UPPER LEVEL

plan I scale 1:500

Above  
exposed interpretation





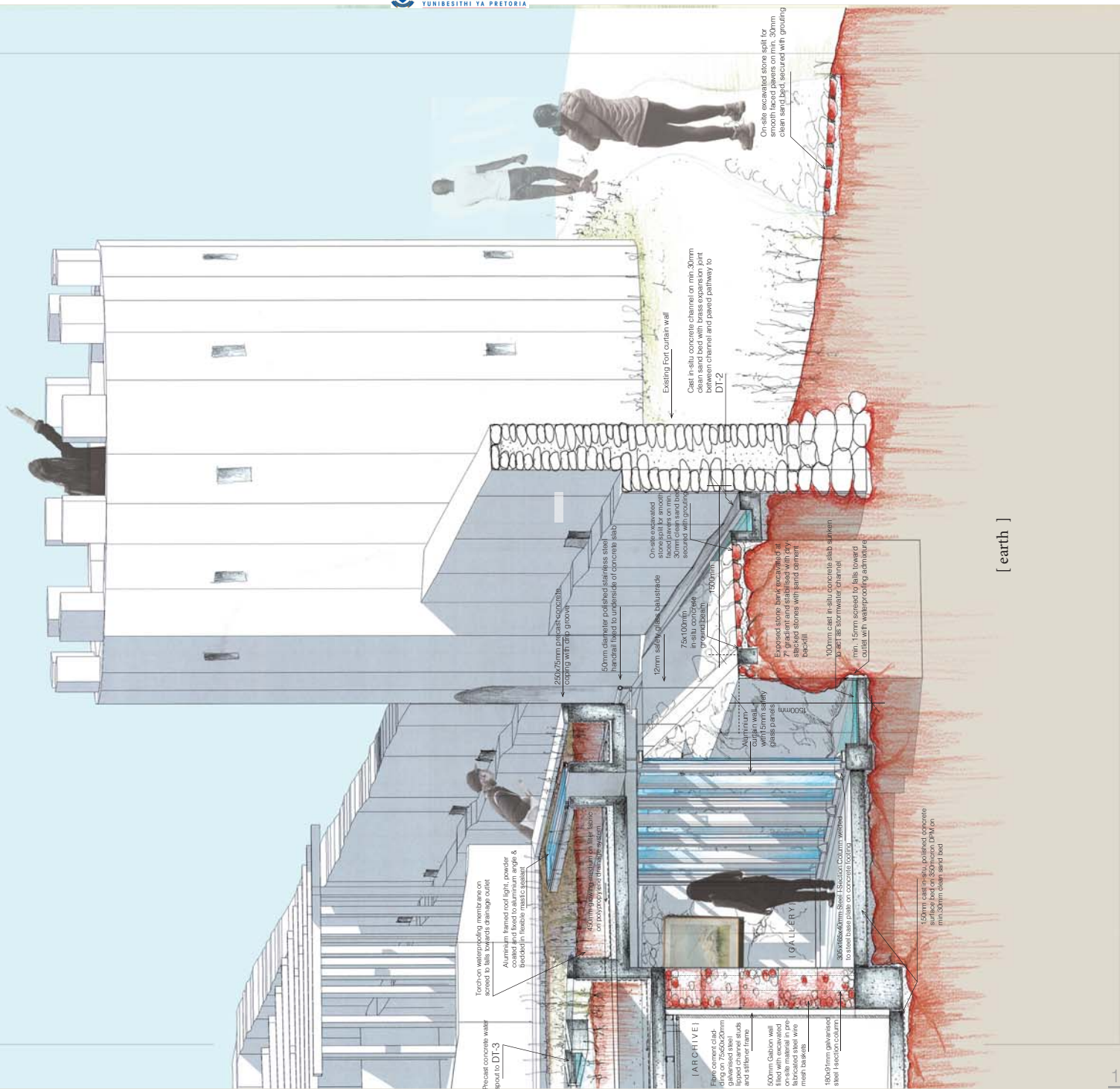
Below  
enclosed retreat



LOWER LEVEL  
plan | scale 1:500

A.2.3 Detail Section

] sky [



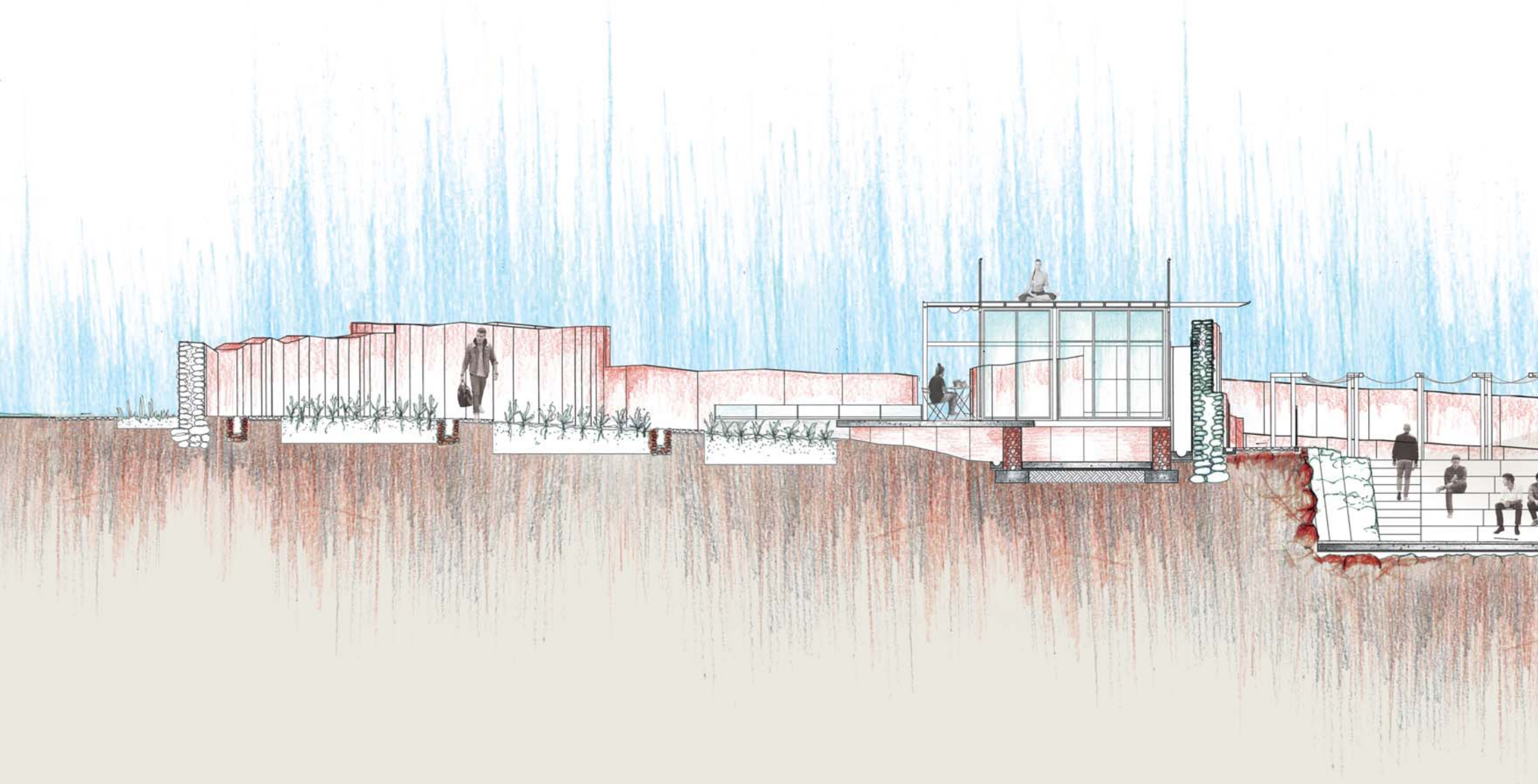
[ earth ]

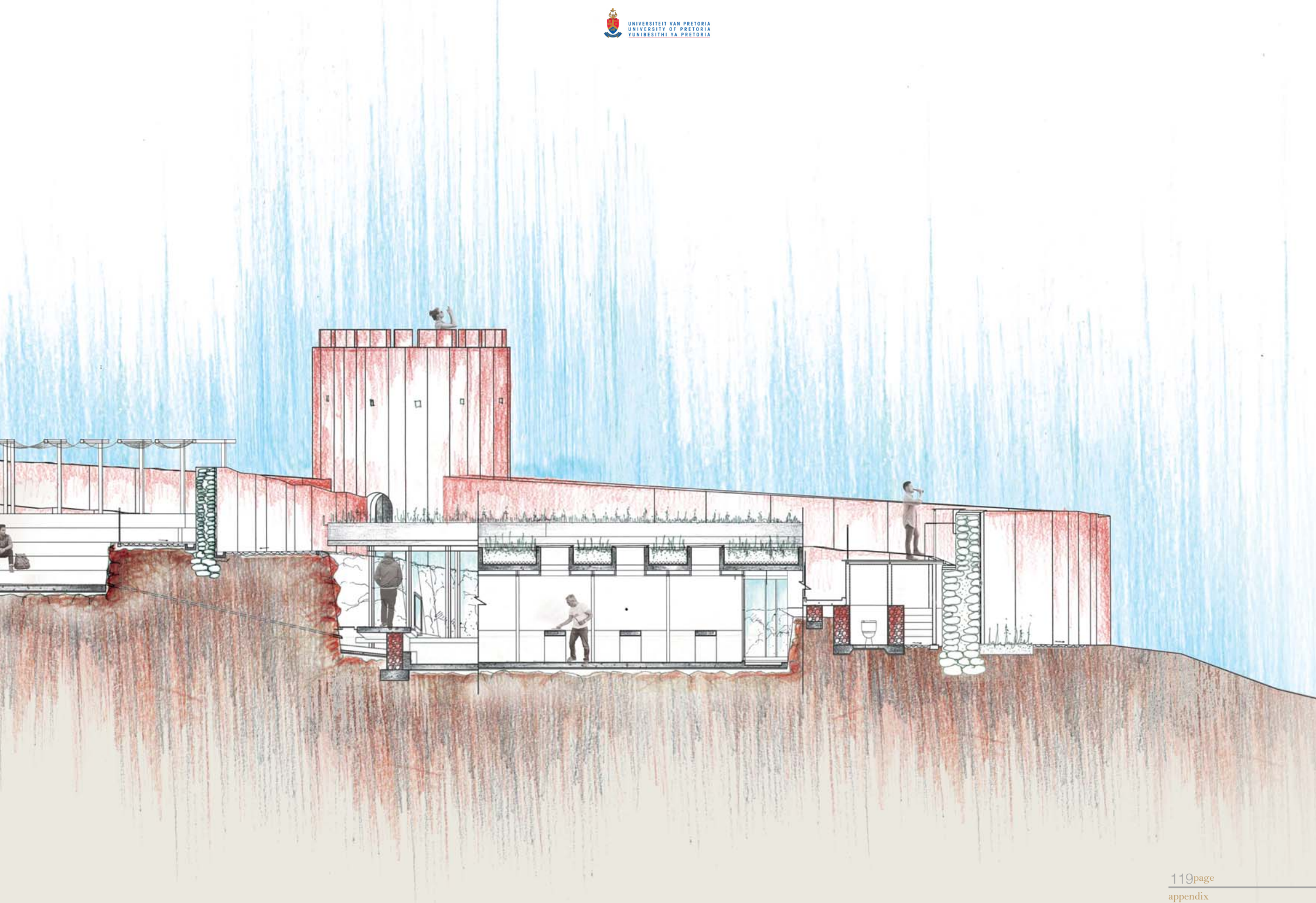
# Wall Section

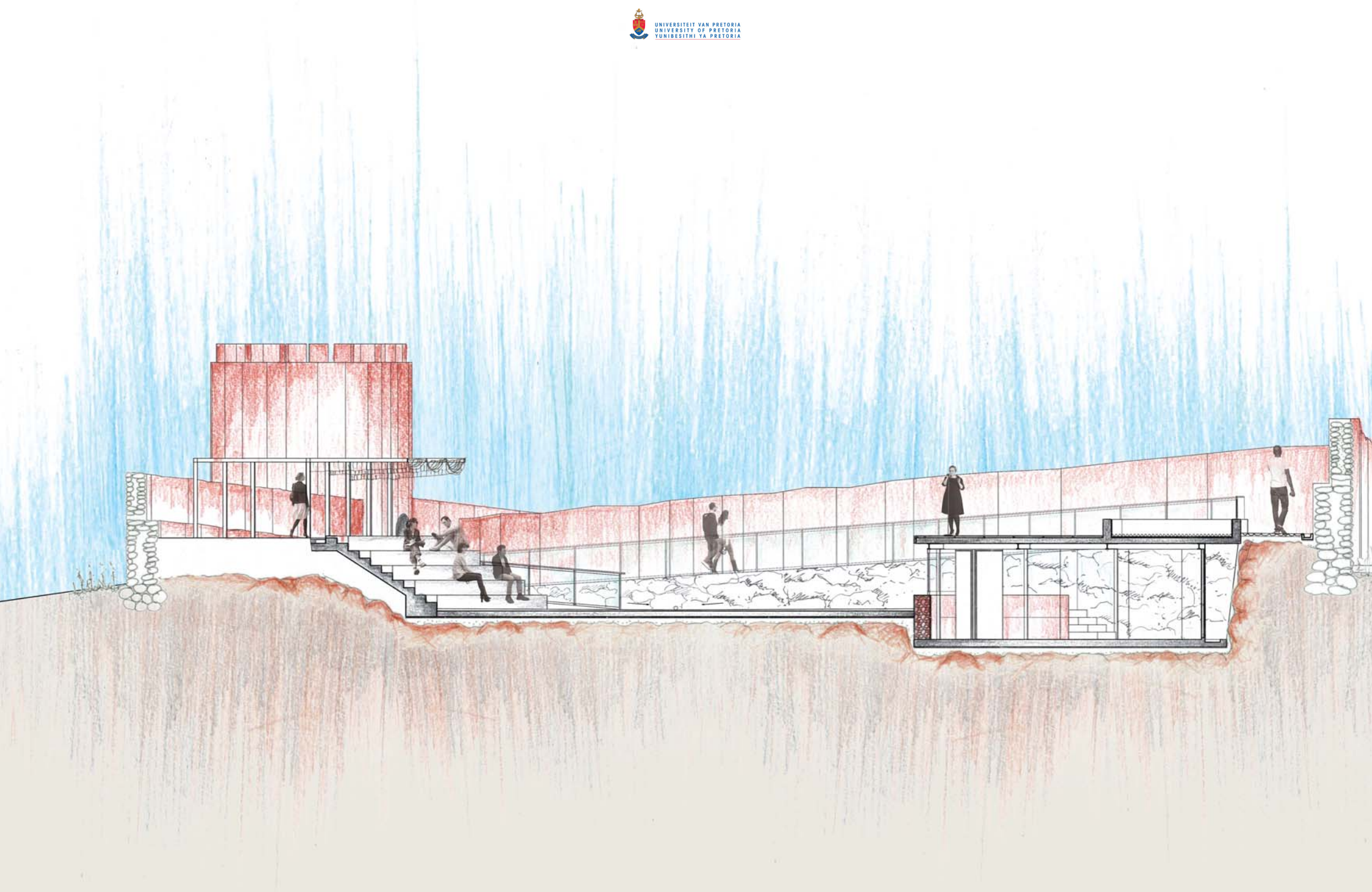
( image not to scale )

# A.2 Presentation Drawing

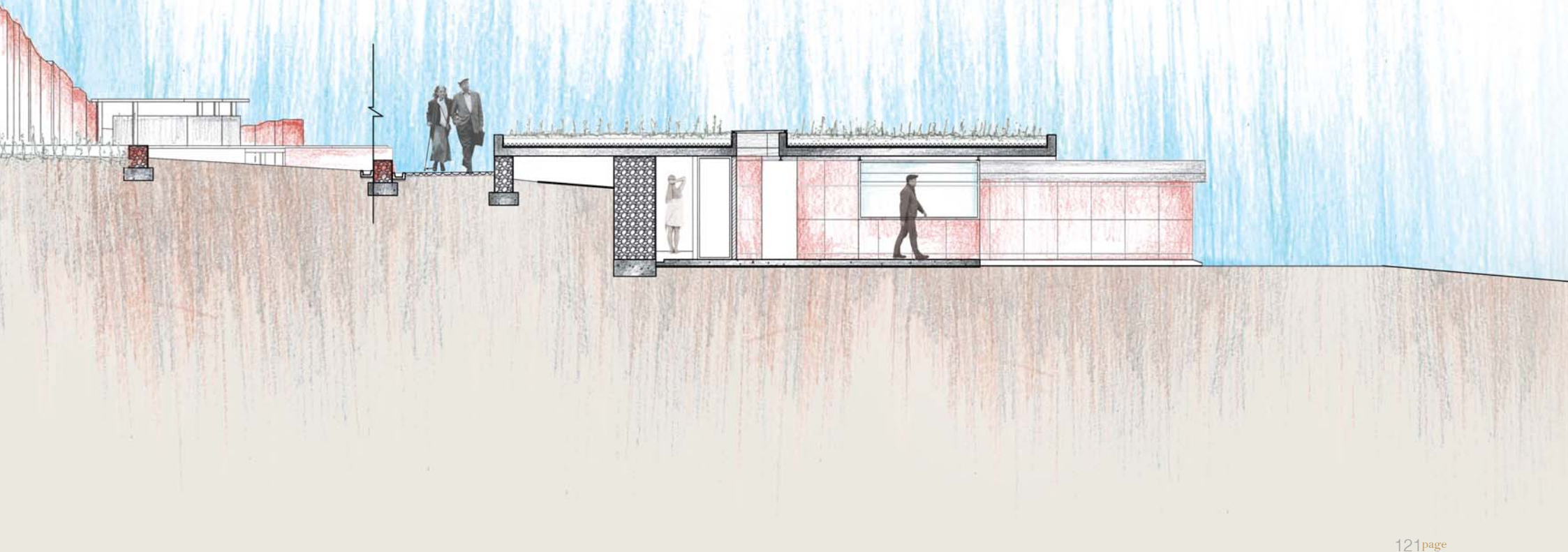
## A.2.4 Sections





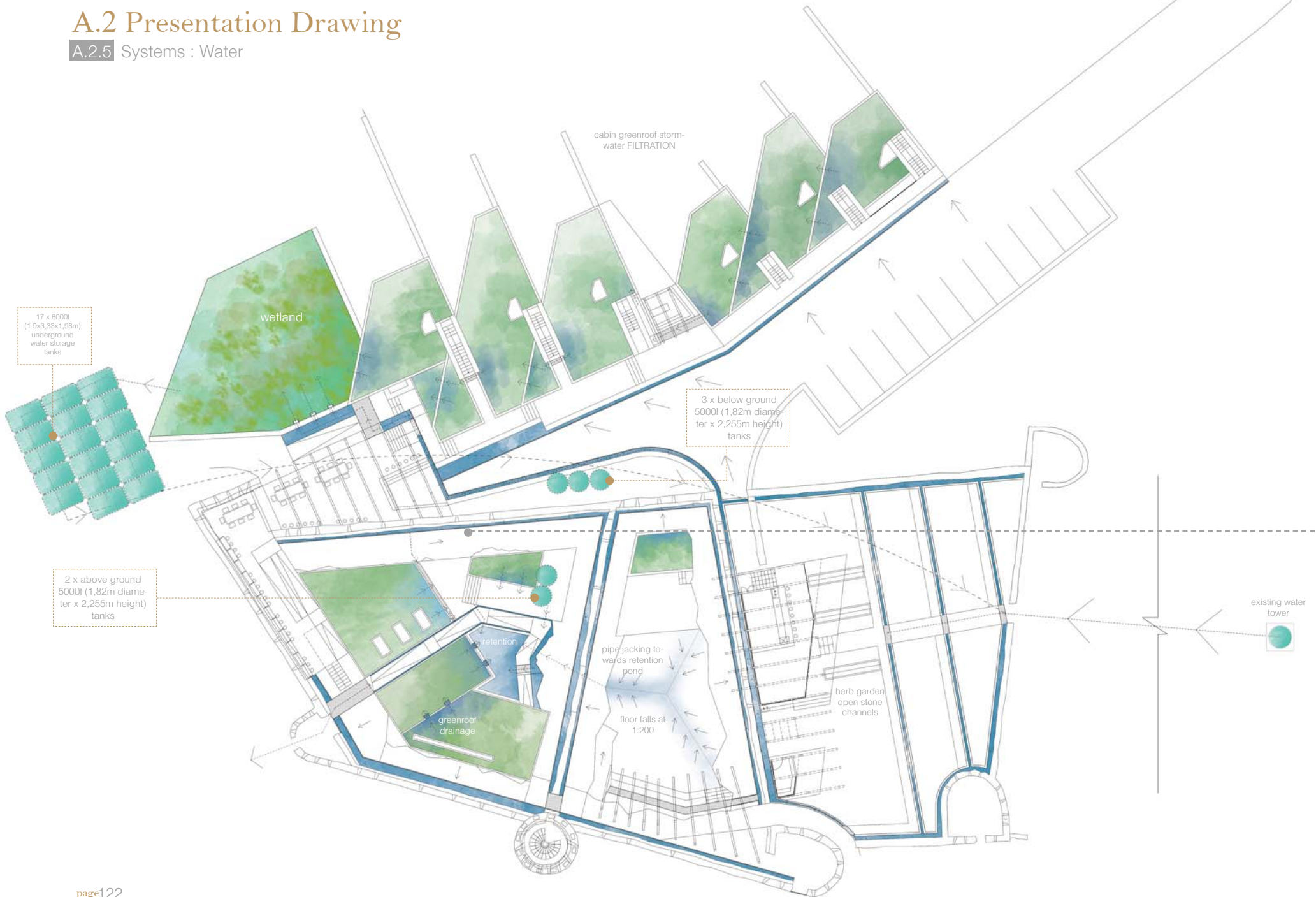


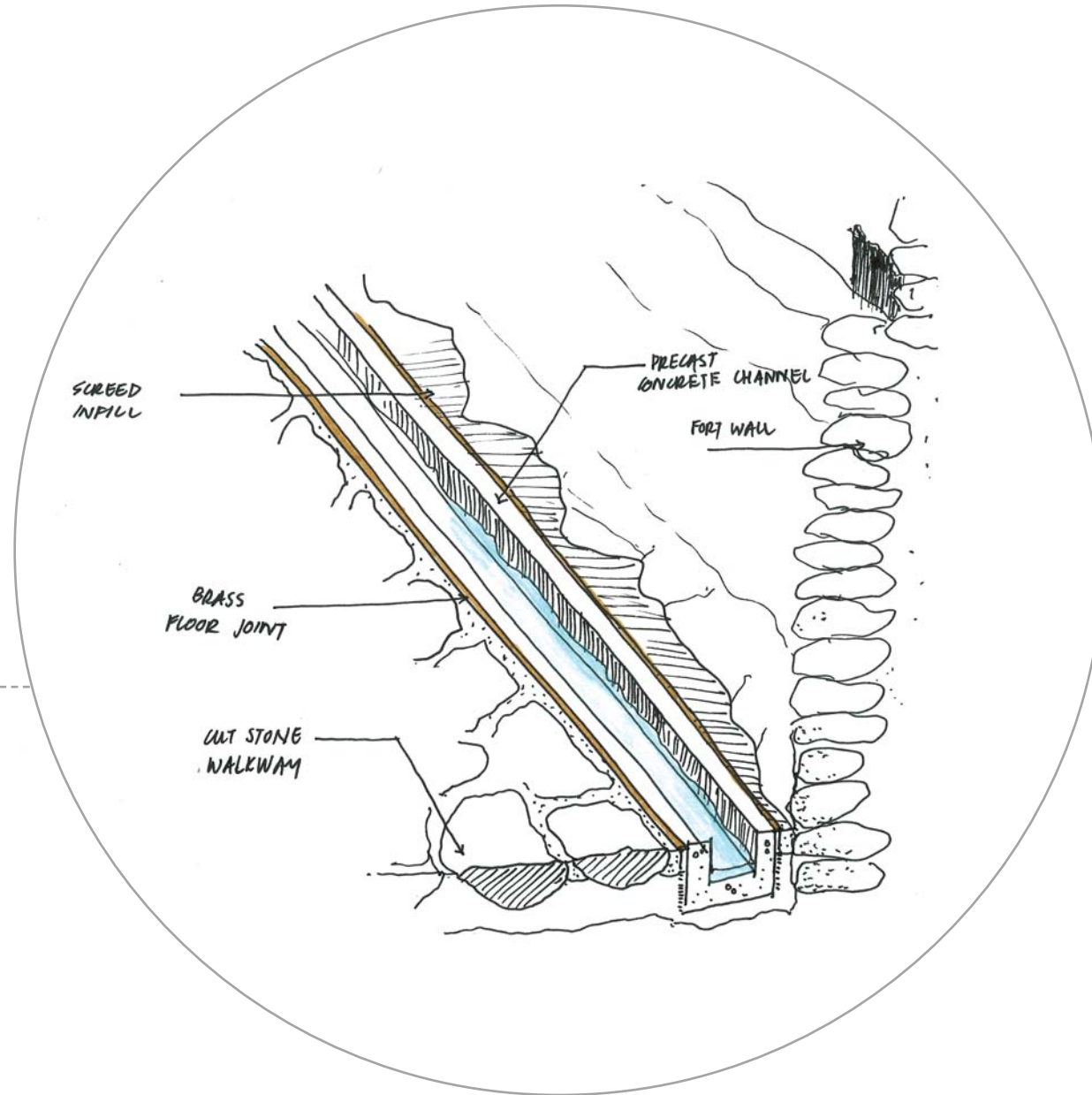




## A.2 Presentation Drawing

### A.2.5 Systems : Water





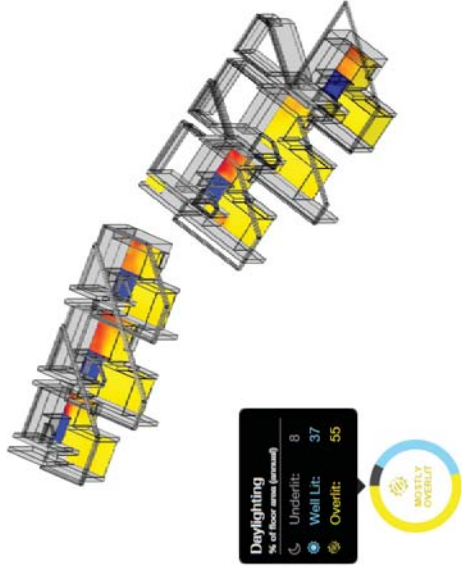
- DEFINITION OF 'THE GAP' BETWEEN OLD & NEW -

# A.2 Presentation Drawings

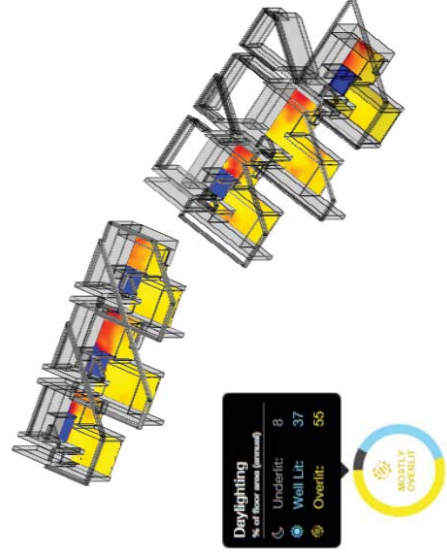
## A.2.6 Systems : Light

### CABINS

BASELINE TEST



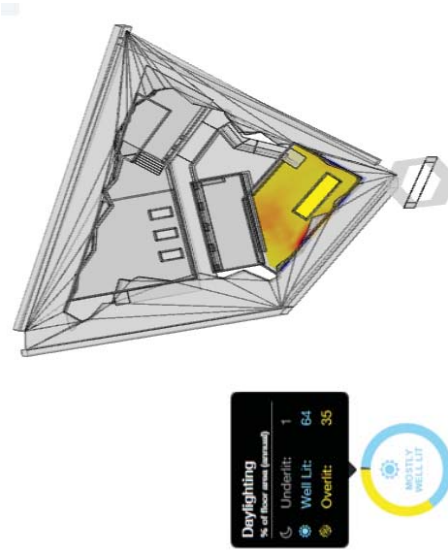
ITERATION



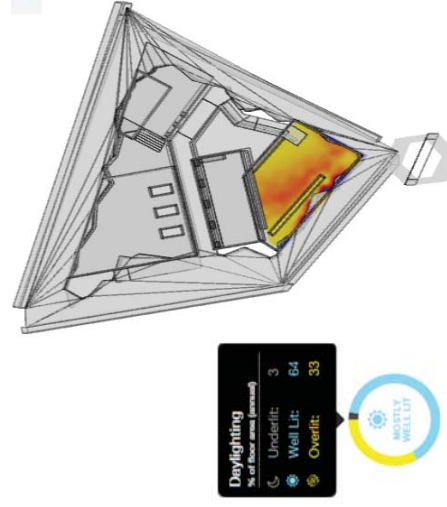
= ALL ROOFLIGHTS DECREASED IN AREA

### GALLERY

BASELINE TEST



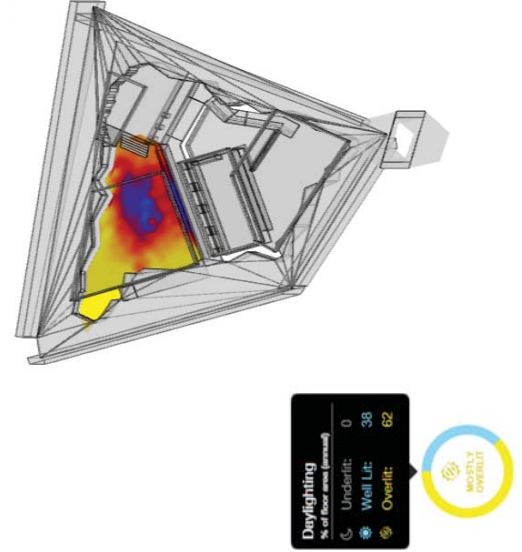
ITERATION



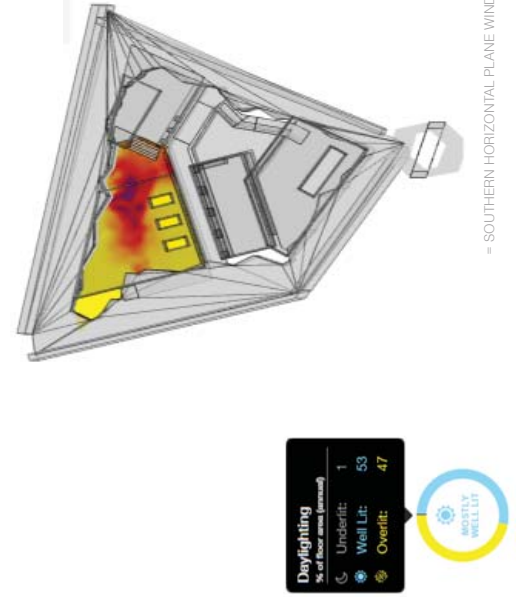
= ROOFLIGHT POSITION ALTERED & DECREASED IN AREA

### LABORATORIES

BASELINE TEST



ITERATION



= SOUTHERN HORIZONTAL PLANE WINDOWS REMOVED

## A.2 Presentation Drawings

### A.2.7 Perspective : The Approach



## A.3 Examination Record



