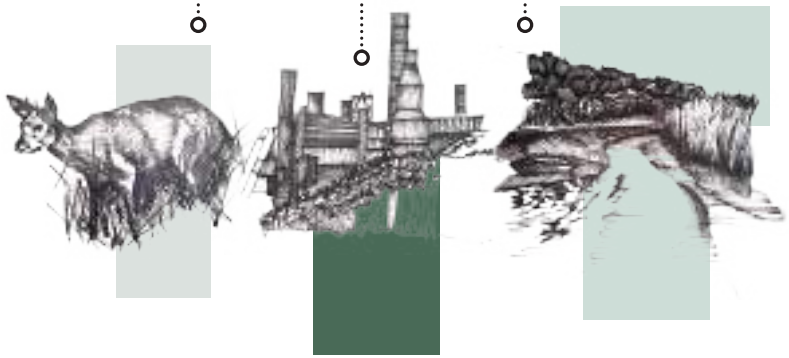
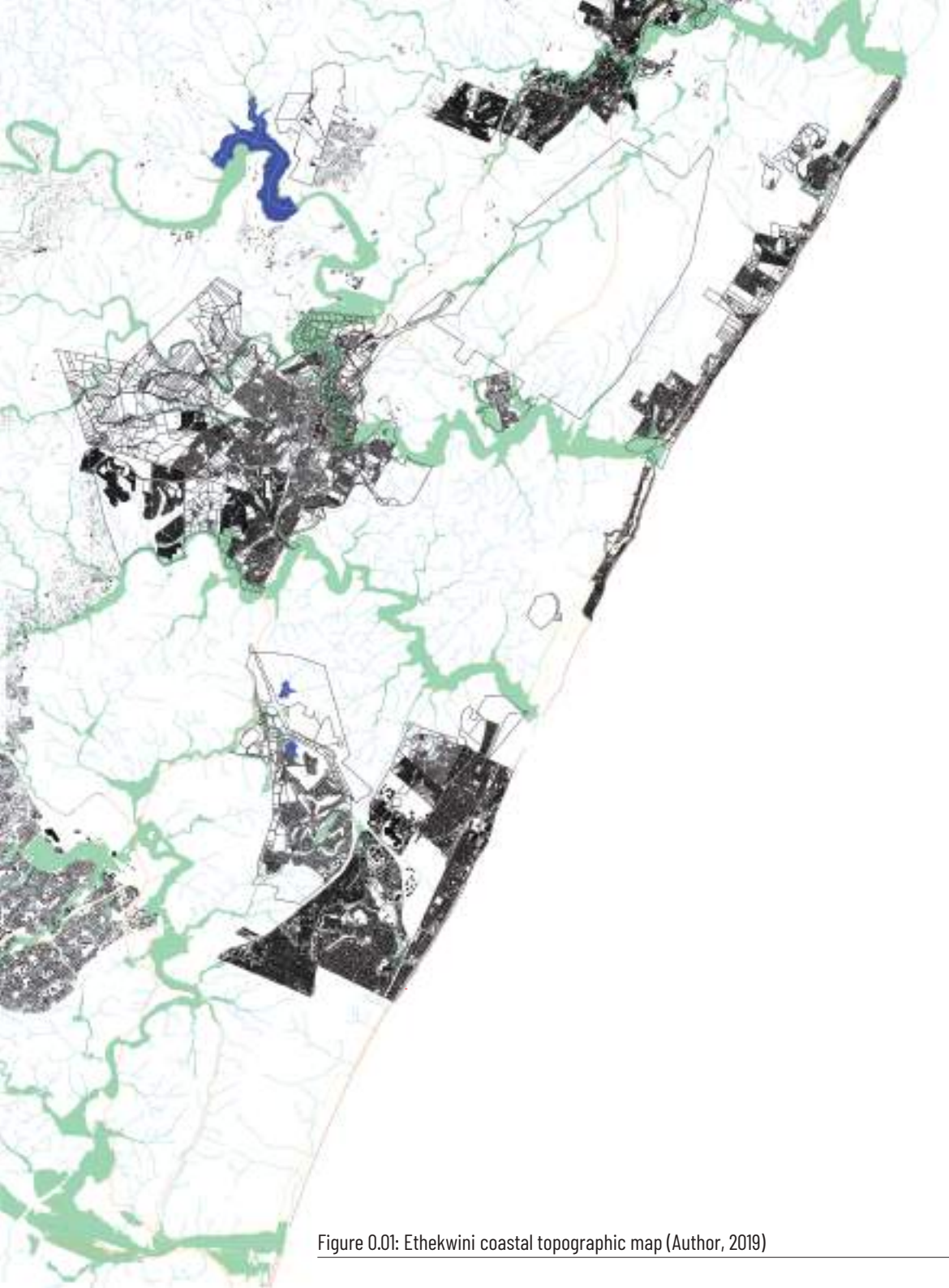
SUGARCANE

UMHLANGA

- "FROM THE REEDS"

An Urban Eco Sugarcane mill as precedent for future expansion, arbitrating the dislocated relationship of Conurbation, Production and Natural Systems





00.1

UMHLANGA *-From the Reeds*

An Urban Eco Sugarcane mill as precedent for future expansion, arbitrating the dislocated relationship of Conurbation, Production and Natural Systems

By **Tanner Harwood**

Submitted in fulfillment of part of the requirements for the degree

Faculty of Engineering, Built Environment and Information Technology

University of Pretoria

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Master of Architecture (Professional)

Figure 0.01: Ethekwini coastal topographic map (Author, 2019)

00.1

PROJECT SUMMARY

GPS Coordinates
29°42'16.52"S, 31° 5'58.37"E

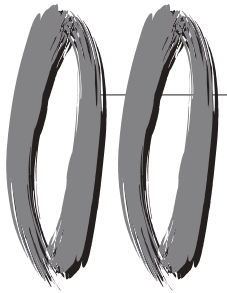
Programme
Eco-Urban Sugarcane Mill

Research Field
Environmental Potential

Client
Tongaat Hulett
KwaZulu-Natal Department of Environmental Affairs

Theoretical Premise
Using regenerative architecture as an antidote, acting individually to reconcile our dislocated relationship between nature, the built environment and Man.

Architectural Approach
Creating a new archetype for coastal design to catalyze coastal conservation and restoration.



00.1

PROLOGUE

An Introduction to the personality of Umhlanga from the author's perspective

I moved to Durban, Umhlanga specifically, in 1999, before the developments had struck the coastal edge. To the North, the Hawaan forest and Ohlanga Estuary existed independently from human intervention; to the west, sugarcane plantations rolled along the hills; to the East, the coastal edge existed without the promenade, where hotels allowed locals to use their amenities and access to the shore front in an effort to provide income for the hotel; and to the South, small houses existed on large plots with smaller holiday complexes among them for the periodic holiday goer. The Village existed as the central node for activity, where small shops catered for the locals' needs. Umhlanga was its own entity, independent from the City and outside interference.

In 2002 the first development, Umhlanga Ridge's Gateway took place on the Western sugarcane hills, becoming the initiator for the coastal developments we see today. Putting Umhlanga on the map, developments over the last two decades have steamrolled, seeing the largest urban development within South Africa.

Today I say to my mother that Umhlanga is becoming South Africa's Miami. Where consumerism has led to the small village becoming high-end commercial and residential development, losing what Umhlanga has always been known for, "The Village".

00.2

DECLARATION

In accordance with Regulation 4(c)
of the General Regulations (G.57)
for dissertations and theses,
I declare that this thesis,
which I hereby submit for the degree
Master 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 my thesis 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 acknowledged
in the text and list of references.

Author: Tanner Harwood

00.3

ABSTRACT

How can architecture create symbiotic relationships between the integrated social, economic, production and ecological realms which it resides, in order to remedy the currently dichotomous relationship?

Sugarcane milling in Durban has overrun landscapes, produced segregated urban environments through urban development and constricted natural ecosystems throughout the coastal edge. The dissertation is an exploration into a paradoxically regenerative, conservative and restorative approach to coastal planning and development, in an effort to restore the current dichotomous relationship between man, nature and industry and prevent the current projection to conurbation of the coast. Where planning has failed, architecture will individually respond and in turn influence future and present planning patterns.

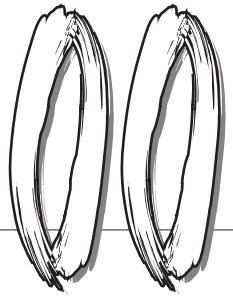
In an effort to redefine the industrial nature of Sugar production, the investigation is contextually placed on the periphery of the Umhlanga precinct, bordering a conservation Hawaan forest and Ohlanga estuary, within a currently operating sugarcane plantation- which is redefined through regenerative and restorative catalysts for currently fragmented landscapes.

The programme, which is placed within the framework of the Sibaya Precinct development, changes with the chronological development of the extended site- from a primarily Eco sugarcane mill, sustainably processing and producing sugar, as well as celebrating and conserving the adjacent estuary, to an indigenous plant seed-bank , used for the restoration of future developments taking place on exploited sugarcane plantations.

The architecture integrates social, conservation, productive and natural spaces, forming interdependent symbiotic relationships, remedying the current dichotomous dialogue between them.

KEYWORDS:

Sugarcane, milling, regenerative, conservation, restorative, dichotomous, conurbation, industry, production, indigenous, exploited, symbiotic



00.4

ACKNOWLEDGMENTS

To my fiancée, Nicole -

thank you for your ongoing years of support, patience and love. Thank you for believing in me and reassuring me everytime I felt stuck under a rock.. I love you endlessly..

To my parents, Lee and Paul -

ballies, this would have never been possible without your sacrifice, constant help, love, support, and faith in me, and for that I am forever grateful.. As always - Faith for this one...

To my future parents-in-law, Drew and Sandy -

Thank you for your on-going years of support, motivation, and love, as well as forcing me to work on weekends (even when the rugby was on and I wasn't too happy about it..) I really appreciate it!

To my brother, Rogan -

Thank you for always being there for me big bro, even though you're half a world away.

To my Gran - Walda

Thank you for all your sacrifices and support for me over the years. This dissertation would not have been possible without you.

To Dario -

Thank you for guidance throughout the year, and for sharing your knowledge and time with me. It goes without saying that I appreciate all your help.

To Prof. Arthur Barker-

Thank you for the year of hard graft, learning and laughs, it's been awesome!

and last but not least, to the Suidpunt Cool Kids -

Thank you for all the laughs, sighs, coffee crazes and banter. It's been and epic and mad year and I could not have asked for a better group to do it with.

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PREFACE

So what happened?

In the wake of the industrial era, Durban saw rapid change amongst its landscapes. British colonialists settled along the coastline in the hopes of a profitable influence of the sugar industry. Early settlement along the northern coast through mills such as the Mt Edgecombe, Huletts, Maidstone and others, initiated the intensification of the coastline. Where land had the possibility of sugarcane cultivation, it was considered a valuable asset and therefore privatised, limiting accessibility to the coastal edge and exploited natural systems for profit. "Most of the natural forests in the study area have been removed for the planting of sugar cane, which today, is the predominant vegetation type on the north coast" (Ahmad, 2005).

The 1960s saw an increase in the influx of holiday-makers which in turn influenced development of residential 'resort' towns, namely Umhlanga, Umdloti and Salt Rock. The creation of the M4 highway played a major role in accessibility of the coastal edge. "High population densities, linked with urban growth, expanding tourism and industrialisation pose major threats to coastal resources and biological diversity" (Ahmad, 2005).

The domination of the sugarcane industry in the privatisation of landscapes witnessed a change in the landscape uses to residential and industrial typologies. The industrial nature of milling saw technological advancement; shifting manual labour to machining the cane. This led to the surplus of labour, matched with a rapid increase in both the Indian and Black populations. The rapid pace of population growth needed to be catered for, leading to local industrialisation and high-density suburbs, such as Phoenix and Chatsworth, developing.

The nature of Durban's rapid expansion of population meant more land was in demand for residential and industrial development, this land being sugarcane plantations. The current perception of retaining coastal land for agricultural purposes is no longer a viable option. The attractiveness of developing land for residential purposes, yielding larger profit margins opposed to farming the landscapes, has led to Tongaat Huletts creation of a property sector in their industry.

(Clark, 1995) argues that the greater the level of economic development, the greater the threat to the environmental resources, as economic demand for a given resource will commonly exceed the supply.

This dissertation aims to unveil the negatives of both the sugarcane industry and the development patterns on coastal landscapes, and the way in which architecture may remediate the relationship between man and nature. The goal is to form a new archetype and expansion typology for coastal zones, namely the Sibaya precinct, in an effort to rectify current actions harming the coastal edge. It will use environmental theories in an effort to regenerate worn landscapes and propose a new paradoxical development scheme for future growth of the Northern Coast.

Figure 0.02: Tongati Mill (Author, 2019)

"One hundred and fifty years ago, the monster began, this country had become a place of industry. Factories grew on the landscape like weeds. Trees fell, fields were up-ended, rivers blackened. The sky choked on smoke and ash, and the people did, too, spending their days coughing and itching, their eyes turned forever toward the ground. Villages grew into town, towns into cities. And people began to live on the earth rather than within it."

- Patrick Ness, A Monster Calls

INTRODUCTION 01

Chapter 01 provides an insight into the project's contextual issues facing the urban, environonmental, architectural and socio-economic realms which have affected the design outcomes.

01 | *Introduction*

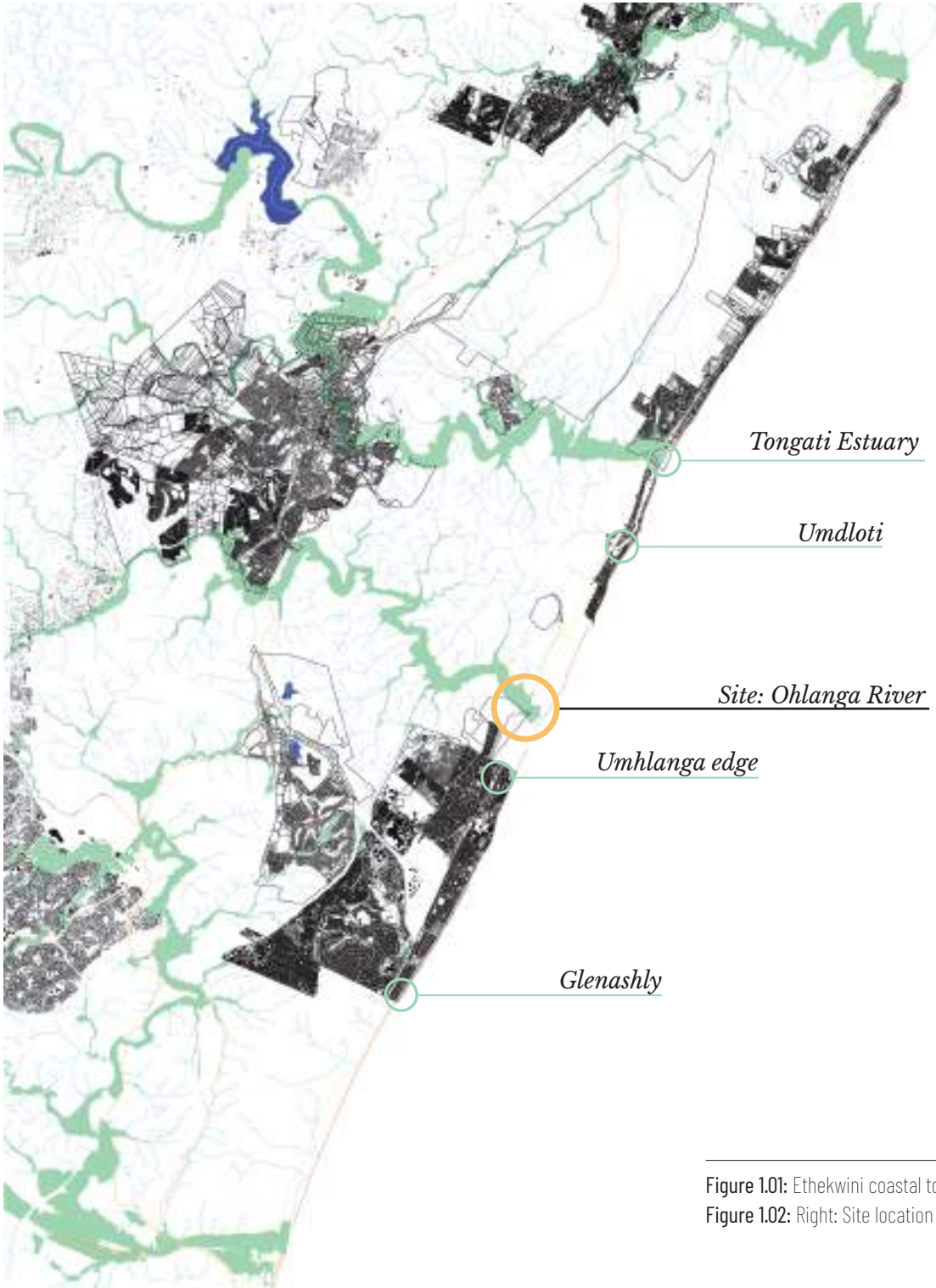
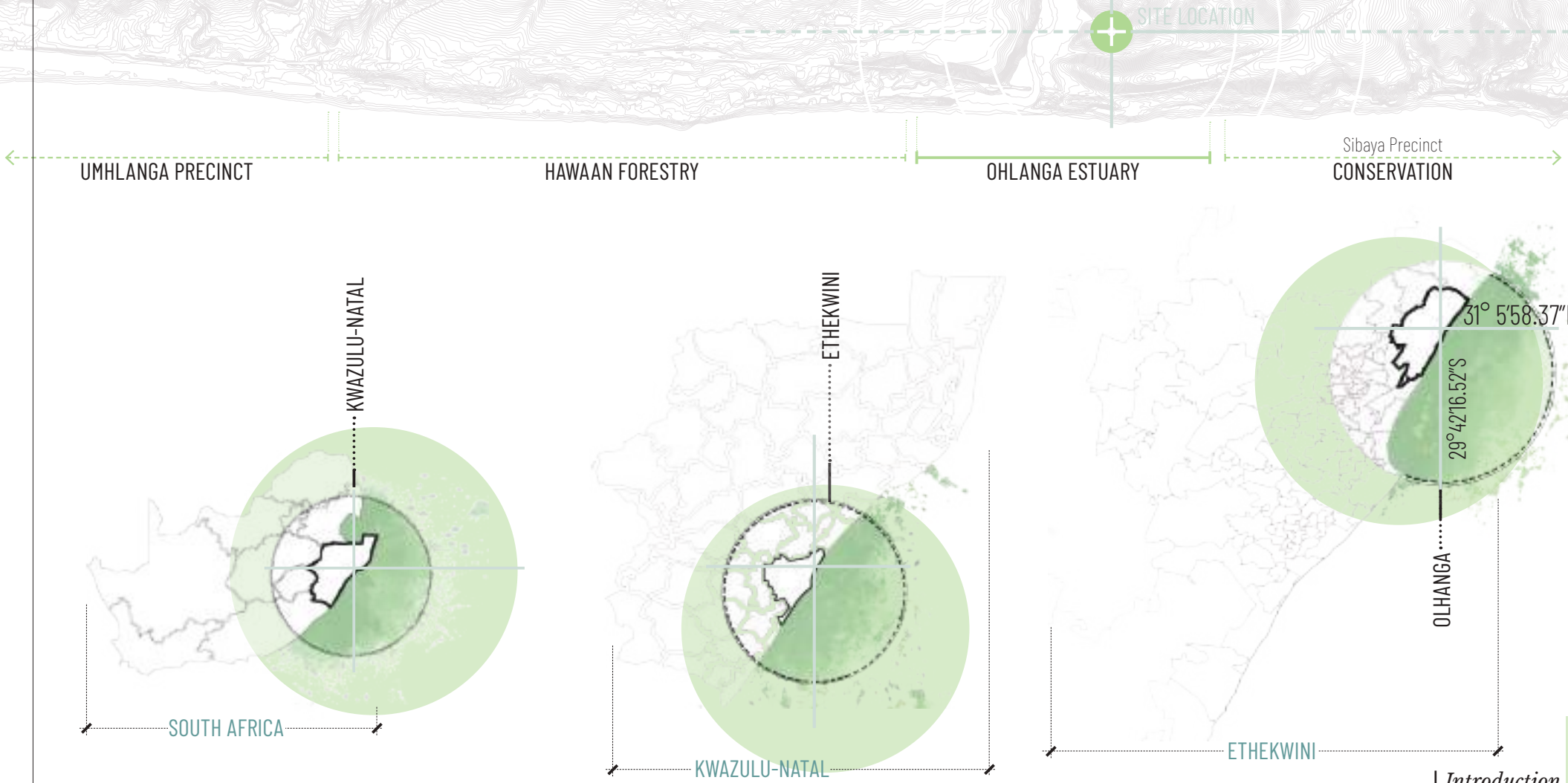


Figure 1.01: Ethekwini coastal topographic map (Author, 2019)
Figure 1.02: Right: Site location (Author, 2019)

01.1

SITE LOCATION

LOCATION OF THE OHLANGA ESTUARY + EXTENTS



01.2

ECOLOGICAL TERMINOLOGY

CREATING AN AWARENESS OF TERMINOLOGY USED FOR ECOLOGICAL THINKING:

Arable Landscape:
"Capable of producing crops; suitable for farming; suited to the plow and for tillage: arable land; arable soil" (English Oxford Dictionary, 2019).

Conurbation:
an extended urban area, typically consisting of several towns merging with the suburbs of a central city (Porter, 2004).

Cradle-to-cradle:
"Framework for designing manufacturing processes powered by renewable energy, in which materials flow in safe, regenerative, closed-loop cycles (Mang and Reed, 2012)

Ecoliteracy:
The ability to understand the natural systems that make life on earth possible, including understanding the principles of organisation of ecological communities (Lemons and Orr, 1992)

Ecological sustainability:
"a biocentric school of sustainability thinking that, based on ecology and living systems principles, focuses on the capacity of ecosystems to maintain their essential functions and processes, and retain their biodiversity in full measure over the long-term" (Lemons and Orr, 1992)

Ecology:
The branch of biology that deals with the relations of organisms to one another and to their physical surroundings. (English Oxford Dictionary, 2019).

Ecosystem:
A biological community of interacting organisms and their physical environment (English Oxford Dictionary, 2019).

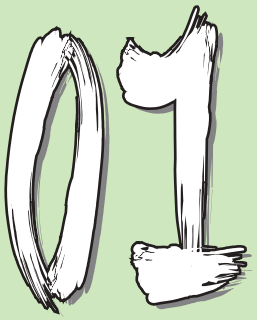
Infertile Soil:
The degradation of landscapes to the extent on which they are unable to cultivate crop due to the lack of nutrients.

Living systems thinking:
a thinking technology, using systemic frameworks and developmental processes, for consciously improving the capacity to apply systems thinking to the evolution of human or social living systems. (Mang and Reed, 2012)

Regenerative Design:
A use of strategies and technologies through the understanding of all systems involved in the inner-workings of the ecosystem which regenerates resources rather than depleting them.

Regenerative Development:
"a system of technologies and strategies for generating the patterned whole-system understanding of a place, and developing the strategic systemic thinking capacities to ensure regenerative design processes" (Mang and Reed, 2012).

Restorative Design:
A form of design which restores degraded systems to their original state through human intervention



01.3

ARCHITECTURAL TERMINOLOGY

CREATING AN AWARENESS OF TERMINOLOGY USED FOR ARCHITECTURAL EXPLANATION:

Anchoring:
Anchoring is a term using to describe the physical and metaphysical rooting of a building to the context of its setting (Archispeak, 2004)

Archology:
A compound of 'architecture' and 'ecology', arcology is an idealised vision of the city as organism (Archispeak, 2004)

Boundary:
Boundary as the interface between two places—a demarcation involving co-dependence of both separation and connection. (Archispeak, 2004)

Bricolage:
The French word bricolage refers to a basic form of recycling that involves the opportunistic adoption and reuse of existing materials and the secondary use of existing structures for other purposes. (Archispeak, 2004)

Celebrate:
To celebrate in the architectural sense is to mark a special event. Celebratory devices can include framing, orientation, gesture and marking (Archispeak, 2004)

Co-mingling space:
Co-mingling space refers to that part of a building or the built environment where people can spontaneously assemble, move about and mix together (Archispeak, 2004).

Commodification:
Commodification is a term that emanates from Walter Benjamin's influential, critical texts on modernity and city life. Commodities represent the dream world products of capitalist industrial production (Archispeak, 2004).

Composition:
Composition is a vehicle for bringing order to chaos; it involves the unifying of elements into a whole so that each ends up in its proper place (Archispeak, 2004)

Composite drawing:
A composite drawing occurs when two or more modes of drawing are brought together and are fused into a hybrid form of graphic representation (Archispeak, 2004)

Concept:
A concept is a general notion, an abstract idea, a mental picture that forms in the 'soup' of all the related aspects. An initial concept need say nothing about the form the design is to adopt; essentially, it expresses the idea underlying a design and functions as a signpost to guide the direction of the ensuing design journey. (Archispeak, 2004)

Context:
In its widest sense, the term context refers to all the issues and circumstances that surround a design of which the nature of the setting is the most tangible (Archispeak, 2004).

Continuum:
The fourth dimension, time, is a non-spatial continuum in which past, present and future occur in apparently irreversible succession. While space is the interval between point, surface and object, lapses of time are measured and marked by the intervals of recurring events.

Design genesis:
Design genesis refers to the birth of an idea.

Design intent:
Design intent is a clear and concise statement that expresses the objectives of the design team relative to a project or portion of a project.

Design rationale:
Design rationale is a term used to focus on the underlying reasoning behind a design intention.

Diagram:
A diagram is a drawing that, stripped of all superfluous and distracting data, shows the general scheme or outline of an idea or object and its parts.

Didactic:
Buildings that overtly teach can be considered to be didactic.

Edge condition:
Edge condition is important in architecture on many levels from the behavioural to the technical. In all of these senses, and in the natural world, it is a place of tension, of intensification and often of conflict.

Erosion:
The wearing away of one element due to the abrasion of another provides an attractive architectural analogy

01.4
INTRODUCTION

Democratic Urbanity|Sugarcane| Restored Landscape

Impact of the Sugarcane Industry on Coastal landscapes

Sugarcane farming has resulted in wetland loss, soil degradation as well as deterioration of water quality within the Eastern Coast of KwaZulu-Natal with specific natural resources such as the Ohlanga river being affected over the growth period. The following studies have assessed the impact of sugarcane farming on soil quality (Meyer, Van Antwerpen & Meyer 1996; Qongqo & Van Antwerpen 2000; Meyer 2011;), water quality and consumption (Southwick et al. 2002; Carminati 2008; Shabalala, Combrinck & Mc Crindle 2013), human health (SASA 2002; Mapanda et al. 2005) and impact on air quality aspects (Chessman 2004; Scott, Gautheir & Mudie 2014). The result being that sugarcane farming has a negative impact on the quality of the above mentioned resources, therefore a new farming technique may be considered and assisted through architecture to better the overall result of the production.

In Durban the 'sugar boom' happened to take place during the industrial era. Sugarcane farming has formed part of South Africa's major commodity market from its initialisation in 1824, which saw a major influx in coastal sugarcane farming for the export of sugar to global capitals. KwaZulu-Natal coast has played homage to colonisation for the farming of the fertile soils, which still exists physically through the plot layouts for sugarcane farming.

Sugarcane farming has shaped the coastline of Eastern KwaZulu-Natal, leading to the ownership of majority of land by a single corporation, namely Tongaat Hulett - refer to figure 3.58. Therefore the majority of the coastline is currently, slowly but surely being sold to the highest bidder with large developments in the form of business complexes, estates and shopping typologies becoming major assets. The natural landscape is partially negated by the influx of mass development along the coastline due to the fact that previous sugarcane fields are wiped clean, providing a blank canvas for development, and is therefore never restored to its previous natural state.

Urban development patterns along the East Coast

Urban sprawl along the coast differs from landlocked cities, where sprawl happens from a centralised point and spreads outwards in all directions. Coastal urban sprawl is characterised by the coast edge, where the formula of sprawl sees an outwards migration through lateral movement rather than a radial dispersion. Linear urban coastal sprawl of the East Coast sees opportunity for urban design as well as architecture to shape a more democratic coastline, bringing back the public realm to the coastal edge, where, more than often, one sees the coast edge privatised by developments which "possibly more often than not, are delivered by rich patrons or power elites and this has generally been in ways anything but democratically" (Wood, 2016) [1]. We see this in current developments, such as Umhlanga's Ridgeside development, the Pearls, The Oceans, the Sibaya precinct, as well as many others.

Urban vision in response to development influx

The urban vision proposes an adaption to current typological formations proposed for coastal areas, which delves into the rehabilitation of coastal sugarcane farms as well as wetland and forestry conservation areas through architecture in an effort to democratise and sensitise coastal development patterns. [2]

The urban vision focused on large scale effects of coastal influx in terms of commercial growth and residential growth, and the interference with both natural systems as well as previously settled communities. It aims to conserve the surrounding areas of the extended Umhlanga precinct to ensure further growth is democratically sensible and conserves and regenerates the affected landscapes.

> **"Good urban design isn't at all about designing prissy set-piece civic spaces, but rather making robust, nonprescriptive urban space and public environments in which people bring their lives and overlay and imbue these spaces with their meanings."**
> -Erky Wood

1
Erky Wood iterates the importance public domains often started as privatized endeavors which were adapted by the public, for the public. He goes on to relate these public spaces to St Mark's Square in Venice and the Ponte Vecchio in Florences.

2 Sugarcane plot restoration
The restoration of areas where sugarcane farming has led to the degradation of soils, wetlands, ecosystems and plant diversity.

Figure 1.03: Umhlanga Ridgeside Development Collage (Author, 2019)

01.5

GENERAL ISSUE

The Disconnect Between the Natural, Induced Natural and the Built Environment

> *"We should not take more from the Earth's crust than is slowly redeposited; nature cannot sustain a systematic increase of chemical compounds - we cannot emit more waste products than nature can process; the physical basis for the earth's productive natural cycles and biological diversity must not be systematically deteriorated; and there must be fair use of resources in order to meet human needs on Earth."* - (Robert, 1995)

Karl-Henrik Robèrt's Natural Step (Robert, 1995) extends to us that we as humans we are part of the natural ecosystem and should therefore be considered when viewing the holistic nature of our environment.

Non-sustainable, non-resilient patterns of urbanization, along with the neglect of inner-city areas as well as natural systems along the East coast, has resulted in the fragmentation of the city. The resilience of nature, matched with patterns of urbanization show the disconnect between nature and man, where natural systems are exploited for human gain.
Architecture's primary initiative has always been to alter climatic conditions in a manner which provides a constant shelter from the natural, where the human activity becomes the primary driver. However the nature of this initiative has led to the degradation of almost all natural systems along the coast.

As Robert has exclaimed, humans are part of the natural ecosystem and therefore we should design to be part of it.

01.6

URBAN ISSUE

Hierarchy of Intentions Within Coastal Typologies

The East Coast sprawl sees the coastline of KwaZulu-Natal becoming parcels of commodities which the highest bidder claims, often leading to negating the biophysical, humane and socio-economic structures which should play preference in the urban expansion.

> *"Coastal design has become infatuated with the aesthetic appearance of its streetscape, wide streets to accommodate free-flowing vehicular movement, separation of land uses, the development of the shopping mall as a concentrated retail area surrounded by parking areas, and often urban exclusion of the poor"* -(Watson, 2009)

Urban sprawl or 'growth of Peri-urban areas' are key spatial trends in the current city structure where sprawling development surpasses infrastructure provision (Olivier, 2017) and should therefore have great importance when architecture of place is considered. Umhlanga's current existence depends on urban sprawl to maintain current urban influx. The downfall of this expansion is the negating of natural systems in replacing the abundance of sugarcane plantations, which exploited its predessor of naturally conserved state, with the form of urban development.

Sugarcane has had a direct relationship with urban planning and the way socio-economic patterns have dispersed; where higher-income classes privatise the coastal edge, often limiting accessibility to the general public. This will continue as long as sugarcane plantations are developed as high-income assets.

The urban vision aims to conserve the surrounding areas of the extended Umhlanga region to ensure further growth is democratically sensible and conserves and regenerates the affected landscapes.

The urban vision focuses on the large scale effect of coastal influx in terms of commercial and residential growth, and the interference with both natural systems as well as previously settled communities.

How can architecture remediate the Urban Issues?

Through the architecture, which uses production as a place for engagement to encourage urban identity, economic expansion and social cohesion, results in a balanced socio-economic node, setting precedent for the further expansion of the Sibaya precinct and allows for a democratic space in which all feel welcome.

1 Watson refering to the formulated way in which urban expansion takes place- this is seen throughout Durban's greater expansion and is problematic when considering ecological spheres.

Figure 1.04: Site location in relation to context **(Author, 2019)**

01.7

ARCHITECTURAL ISSUE

The Dichotomy of Production, Human Nature, and Natural Systems

'Since life takes place, large and small localities belong to the experience of living, which is the architect's task to render visible.' - Norberg-Schulz

The degradation and dislocation of natural and urban systems has led to perception of architecture as separate from its natural environment. Focus can be placed on architecture and its use as a systemic tool to allow for participation of human interaction with natural cycles in specific localities. This will create a regenerative initiative for a holistic intervention which increases economic, social and environmental participation to induce architecture as the main driver for the regeneration of Periurban systems at play in Umhlanga.

The architectural intention will be used to enhance the existing systems within the local context. By using existing and future frameworks a sensitive architectural interventions will act as a systemic tool to feed into the existing and possible future systems at work within the larger district, allowing for various

Figure 1.05: Tongati Mill **(Author, 2019)**

present and future networks to not only exploit, but also participate in different social, economic and ecological systems. The architecture will use regional techniques and technologies to establish a language constant with its surroundings.

Social intentions through architecture

The social intention of the project is to link existing social networks currently thriving around the project as well as farther social structures influenced by existing networks to create social cohesion through public interaction. The aim of the regeneration is to enhance the socio-economic social cohesion, in a way which reverses the degradation of systems within the South African cities.

01.8

PROJECT OBJECTIVES

Overarching Objectives Derived from Informants

01.3.1 General Objectives and theoretical Intentions

•Create precedent for a paradoxical development initiative.

• Redefine the way in which Sugarcane farming exploits landscapes through over-farming and encroachment.

• Reimagine and challenge the current 21st Century architectural paradigm which sees architecture as integrated into a holistic regenerative system.

• Create architecture for awareness of conservation and rehabilitation through the multifaceted design of the Eco-mill.

01.3.1 Urban objectives

•Redefine urban expansion patterns through a paradoxical scheme in which landscapes are restored prior to urban development, thus creating zones in which novel construction may emphasise sensitivity towards nature rather than dominating over it.

• Where previous sugarcane plantations have privatised the coastal edge, the building will ensure a democratic planning scheme, opening the coast to all classes.

•Redefine the perception of sugarcane plantations not as blank canvases for urban development, but rather as an opportunity to restore fragmented landscapes through sensitive urban growth.

• Ensure the responsible and sensitive conurbation of the Umhlanga, future Sibaya and Umdloti node, through and paradoxical development scheme.

01.3.2 Landscape objectives

• Create a regenerative catalyst for landscape renewal and restoration through the introduction of an alternative agricultural sugarcane industry. Creating a node for public engagement, stable development growth, sustainable and localised production agriculture and an integrated systemic nature between industrial and natural landscapes.

• Connect urban environments to ecological systems through the celebration of existing conservation areas- introducing and engaging public interaction with previously inaccessible natural gems.

• Linking fragmented landscapes through architecture and landscape design.

• Reinstating nature as a stakeholder in design, ensuring a coexistence between the two opposing current dislocated trends in urban development.

• Introduce a sensitivity in the relationship of sugarcane farming natural systems and its current encroaching tendencies in current farming types. Possibly create an agricultural process in which both natural systems may coexist through a symbiotic relationship.

01.3.3 Architectural objectives

• Design a building as an regenerative extension of its landscape, in which it acts systemically to integrate industry sybiotically as part of the natural landscape.

• Redefine the current typology of the sugar industry as a 'factory' by means of integrating architecture and landscape, challenging the programmatic, processing, vernacular and spatial arrangements acting in a standard mill.

• Design a mill which challenges the current idea of production typologies as isolated from human or ecological interaction.

• Celebrate and engage with the natural systems surrounding the site through architecture.

• Create an architecture which redefines the patterns of urbanity and development through the engagement of integrated systems.

Figure 1.06: Ethekwini Green Zones (Google Maps, edited by Author, 2019)

01.9

RESEARCH QUESTIONS

The research questions arising from the contextual informants and background theory pertaining to the dissertation are as follows:

01.3.1 General questions

Is architecture the antidote to the perpetration of outdated and unsound planning practices?

Could the act of constructing our urban environments be a reverting factor in the sensitive coastal environment?

Could architecture be a means of rehabilitation?

Can the creation of an Urban mill act as a node for future expansion movement?

01.3.2 Main questions

Can architecture offer a mediation between natural and industrialized landscapes?

How can architecture become an icon for catalyzing the restoration of coastal landscapes?

How can architecture reinvent the sugarcane industry to allow for the celebration of both the heritage and work of the labouror?

01.10

RESEARCH METHODOLOGY

Hierarchy of Research Methodology

The research methodology combines quantitative and qualitative data and analysis in an effort to create a holistic understanding of the site and its extents. This has been completed using relevant methods listed below:

Theoretical Literature Study

A literature study was done in an effort to understand current and previous theories relating to the theoretic premise of the dissertation. In doing so, the project has been placed within the theoretical continuum, building off precedented work and giving substance towards the projects stance and argument.

Historical Analysis

To understand the contextual needs, a historical analysis is vital to reveal the contextual palimpsest on which the site exists on. It also bases the project in the precincts historical continuum. It will give insight into the rich heritage of Durban's landscape, revealing the intangible heritage of the site and its surroundings.

Macro Mapping

Macro mapping is completed in an effort to understand the current problems facing coastal urbanity as a whole. This helps justify both the site choice and urbanic response of the project, and allows the reader to engage with the larger context in a manageable format.

Micro Mapping

An in depth analysis of the site allowed for an educated decision as to where interventions could take place. It also allowed for contextual responses, which responded to the site rather than overruling it.

Development study

Current urban development patterns were studied in an effort to predict how and where future expansions would take place. This informed the architectural response and helped predict how future architecture should respond to its environment, rather than just existing.

Precedent Study

The project requires specific insight into existing precedents as it requires a complex framework from which the design may extend. In studying precedents, one will gain unknown knowledge of how to design in a situation unbeknown to them.

01.11

THEORETICAL APPROACH

Hierarchy of Theoretical Premises Established for Project

The current dilemma facing humans is one which involves our struggle with our environment and our incapability to conserve and restore said environment. The theoretical approach to the dissertation is one which aims to combine theories of systemic thinking in an effort to ensure all aspects of the project hierarchy are catered for.

The dissertation adopts four related architectural theories in order to help narrate the intentions of the work done. These theories address all the aspects currently acting independently of one another in a holistic manner, combining all theories under the overarching title of 'whole systems and living systems thinking'.

Systemic Thinking

Regenerative Theory

Regenerative theory views humans as part of the whole of an evolving system, viewing all aspects and processes of our environment as stakeholders. This ensures a healthy relationship through "co-evolution" in which humans become conscious of what connects them to nature. It aims to regenerate what we may take from earth's resources, creating a closed-loop system.

Eco-Systemic Thinking

Ecosystemic thinking, similar to regenerative thinking, views all systems as interdependent and related to one another. Therefore in order to solve a problem, one must consider the whole but in turn, understand the individual.

Urban Ecology

Urban ecology is the understanding of the relation of all living organisms with each other and their surroundings in the context of an urban environment. Therefore, understanding these relationships will help considerably when designing architecturally for the urban whole.

Karl-Henrik Robèrt's Natural Step (Robert, 1995) extends to us in that we, as humans, are part of the natural ecosystem and should therefore be considered when viewing the holistic nature of our environment.

DISCONNECT

The Disconnect Between the Natural, Induced Natural and the Built Environment

Regenerative Theory

Regenerative theory aims to restore the relationship between man and nature as post industrialisation efforts have fallen short. This implies a radical transformation in how we approach nature and the relationship thereof.

NATURAL CONSERVATION

LIMITED RESOURCE CONSUMPTION

"We should not take more from the Earth's crust than is slowly redeposited; nature cannot sustain a systematic increase of chemical compounds - we cannot emit more waste products than nature can process; the physical basis for the earth's productive natural cycles and biological diversity must not be systematically deteriorated; and there must be fair use of resources in order to meet human needs on Earth (Robert, 1995).

Eco-systemic Approach

In order to create entirely comprehensive architecture, capable of reintegrating into the surrounding urban context, Kirovová and Sigmundová (2014:433) propose that industrial sites be seen as ecosystems.

Industrial Ecology

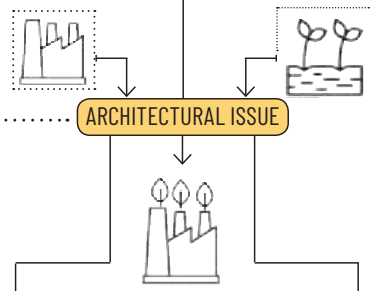
Industrial ecology is a science that studies industrial systems with the goal of finding ways to lessen their environmental impact.

NATURE — Relationship — BUILDING

GLOBAL ISSUE — GENERAL ISSUE — URBAN ISSUE — INDUSTRY — ARCHITECTURAL ISSUE

Regenerative Architectural Design

An ecological approach must be integrated with eco-efficient design, where buildings give back more than it uses, in an effort to reverse degenerative design.



DEMOCRATIC URBANITY

Hierarchy of Intentions Within Coastal Typologies

The East Coast sprawl sees the coastline becoming parcels of commodities which the highest bidder claims, often leading to negating the biophysical and socio-economic structures which should play preference in the urban expansion. Urban sprawl or 'growth of Peri-urban areas' are key spatial trends in the current city structure where sprawling development surpasses infrastructure provision (Olivier, 2017) and should therefore have great importance when architecture of place is considered.

COASTAL GROWTH PATTERN

FORMULATED CITY TYPOLOGY

Urban characteristics include a concern with the aesthetic appearance of cities, high-rise buildings with large open spaces between them, wide streets to accommodate free-flowing vehicular movement, separation of land uses, the development of the shopping mall as a concentrated retail area surrounded by parking areas, and often urban exclusion of the poor (Watson, 2009).

BALANCING DICHOTOMOUS RELATIONSHIP BETWEEN ARCHITECTURE, MAN AND THE ECOLOGICAL ENVIRONMENT

The degradation and dislocation of natural and urban systems has led to a perception of architecture as separate from its natural environment. Focus can be placed on architecture and its use as a systemic tool to allow for participation of human interaction with natural cycles in specific localities

Eco-systemic Design

Geddes derived that the city is a living organism and that the an understanding of a city's context is required before the problem of unsustainable growth can be understood. Eco-systemic design led to the emerging field of regenerative design

01.12

PROGRAMME DEVOPMENT

An Eco-Sugarcane Mill as an Urban Generator and Conservation Genesis for the Ohlanga Node

Durban has established itself as the sugar capital of South Africa however, in recent years, the development of the coastline has directly influenced sugarcane production as the plots form part of major assets due to their location. However, the continual farming over the past two centuries of the landscapes has left degraded soils and ecosystems. This results in not only a struggle for growing sugarcane, but excess toxic chemicals in the porous topsoils leaking into lower ecosystems. There firstly needs to be a change in the process in which sugarcane land is over farmed, and then addressing the relationship with the between our urban environments and nature.

The current development pattern of the Umhlanga precinct is fast and furious. A major influx of people has meant larger urban areas, which in turn need to cater for the commercial, residential and industrial growth. Due to the extreme pace at which growth is happening, the nodes of development often fall short in quality urban spaces.

The program has therefore been developed in such a way that the future development of the area will be catered for in a holistic manner. The building therefore offers new oppurtunities for the way in which development takes place, processing sugarcane existing along the Sibaya precinct, and when ready for development, replaces the sugarcane with indigenous wetland and forestry plants, in an effort to change the way in which developments wipe out existing natural systems. This allows for programme adaptation and appropriation as the intensity of needs fluctuate, in an effort to best suit the development and the context which surrounds the site. Therefore, the chronological development of the site has led to a linear program which adapts to the needs of its context over time. This places the contextual development as central to the program, where a relationship between nature, man and industry becomes imperative.

Figure 0.08: Ohlanga Fisherman **(Author, 2019)**

01.13

LIMITATIONS & DELIMITATIONS

Providing relevant assumptions, limitations and delimitations of the project going forward

Assumptions:

It will be assumed that:

1. The site on which the project is located is vacant going forward with the Sibaya precinct proposal but will form part of the urban vision for Tongaat Hulett's proposal as an edge node within the Sibaya precinct proposal.

2. The soils on which the project is based are stable and are suitable for foundations.

3. Zoning: There is no zoning that restricts a mill to be built on said site.

4. Water is used in both cleaning and processing the sugarcane. It is therefore estimated and assumed correct to say that the runoff of the extended site, plus minimal purified off-site water supply will satisfy the water demand of the mill. The exact amount is however unavailable.

5. Through a combination of hydro, solar and co-generated electricity, and the rough sizing of machinery needed, it may be assumed that these passive systems are enough to supply power to the mill.

6. Chlorinated water filtration is done off site, forming part of the infrastructure plan for the Sibaya proposal. Excess storm water is filtered on site through natural processes and is assumed to be usable for washing and processing of sugarcane.

Limitations

1. Site visits are limited as the site location is in Durban and therefore site conditions may be assumed if not covered under the limited site visits. The site analysis will also make use of the Ethekwini municipal topographic online sources, which may be inaccurate.

Delimitations:

1. Due to the time constraints and extensive urban design needed to place the project in the larger context (only exists as zoning currently); only the mill and close extents will be developed, but the project should be considered within its full potential of the future urban context. The rest of the site will exist as it currently is, with consideration for future development and will not be developed further in detail.

THEORETICAL APPROACH 02

Chapter 2 brings to light the theories related to the ever present 21st Century dilemmas facing society. The theory works in a hierarchy of global issues to local. The theories will be placed in precedents- both local and international- giving a tangible product to relate to intangible theories.

02 *Theory*

TERMINOLOGY:
Relating Terminology to Theory

Systems thinking:
Systems thinking is the process of understanding how systems behave, interact with their environment and influence each other. It is an approach to problem solving.

Ecological thinking:
Ecological thinking is the understanding of all systems at play within an active ecological system. It allows for holistic thinking when considering all parties concerned.

Holistic thinking:
Holistic thinking is seeing all parties as interconnected and reliant on one another. This sees an approach to design which is beneficial when all parties, internal and external, need to be considered.

Whole Systems thinking:
The thinking of how the entirety of the system works, by understanding the individual. Much like the above terms, it allows for an in-depth understanding of a design (or system) exists in its context.

02.1
UNSUSTAINABLE SUSTAINABILITY
21st Century: A City at Risk

02.1.1 Identifying the crisis in current sustainable thinking

> *"No problem can be solved from the same consciousness that created it. We have to learn to see the world anew"*
> - Einstein, 1995

21st Century crises have led us to believe humans as separate from our environments. This view sees the natural environment as separated parts, to be exploited by different interest groups. In less than a century, we have choked our resources, overpopulated our land, fished our seas and polluted our waters. The repercussions of our actions are finally materialising. "Cities and regions around the world are experiencing seasonal shifts, rising temperatures, fluctuations in rainfall patterns and precipitation (leading to drought and floods), changes in the severity and frequency of extreme events, and accelerated sea level rise" (Zimmermann, 2012). Rapid urbanisation has resulted in cities expanding at rates which are unsustainable, leading to fragmented systems and derelict cities. Our addiction to fossil fuels is far from over, but sustainable measures are in place which 'slow' down the rate of resource deterioration. However, this is not a viable solution.

The direct consequences of our consumption traits are visible in our landscapes. Specific to Durban's landscape, one views toxins in both the soil and natural water systems from a multitude of actions committed. Seasonal storm cyclones (becoming more frequent) regurgitate our pollutants filtered through the landscape to the river mouths in the form of decolourised shores, littered with pollution (Figures 2.03-2.05).

> The environmental crisis "stems from the prevailing power-driven ethos, the anomic individualism, which divert human concern into technological invention, scientific advancement, and unlimited material consumption and production" (Orhan, 2003).

The rate at which we are sustaining our action's outcomes, is a rate which ironically cannot be sustainable. The 'sustainable' implementations to slow down the rate at which our resources are deteriorating in an effort to do *less damage* to our environment, is not the answer to our dilemmas. Rather we should learn how one may participate within the larger whole, rather than viewing it as separated. "The shift from a fragmented to a whole systems model is the significant cultural leap that consumer society needs to make." (Reed, 2007)

This system of thinking is not new. It has been explored for years by many pioneers. The way in which the dissertation's theory is different, is its exploration into the combination of the four theories, and how where one theory may fall short, the other caters for.

02.1.2 Realigning Sustainable Thinking

The theory proposed for the Eco-Mill is one which attempts a holistic approach to embody the project. This shift in thinking uses the combination of systems thinking, in an effort to create an optimal theoretical premise for future development along the coastline. Where one theory falls partially short, the other theories will cater for.

> THE REALM OF THE BORN - ALL THAT IS NATURE - AND THE REALM OF THE MADE - ALL THAT IS HUMANLY CONSTRUCTED.- Kelvin Kelly

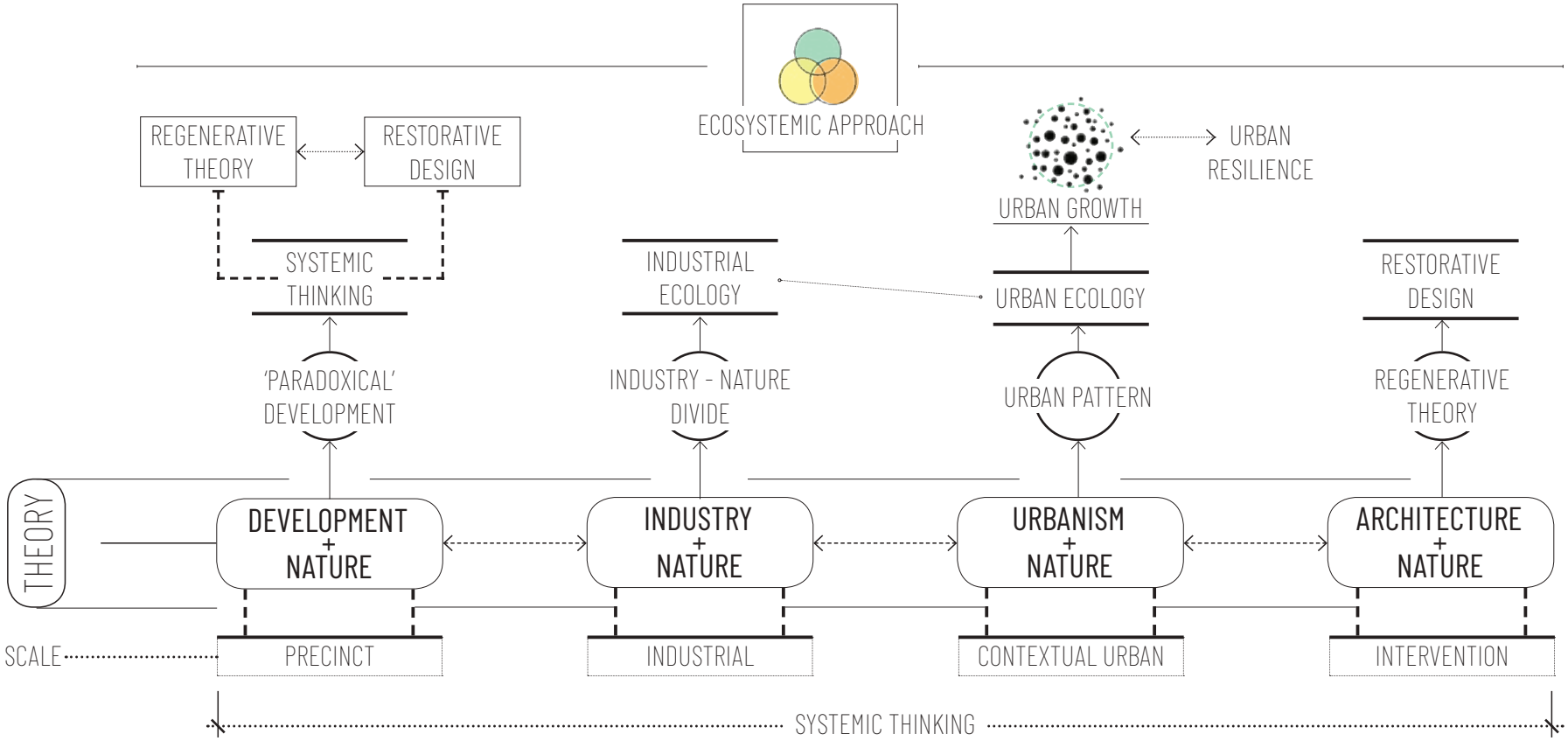


Figure 2.01: Iteration 02: Daylight Factor **(Author, 2019)**

Waste (non-processable material) is and will always only be a byproduct of human consumption. "Nature has no garbage problem because nothing becomes waste" (Kelly, 1994: 155). Nature has a cyclical flow, in which all materials return back to the primary stage of the closed-cycle. Humans have interrupted this cycle. The industrial nature or machine-like lifestyle quality requires an input, often resulting in an undesirable output, which is discarded into nature in the form of waste. Human induced waste has both tangible and intangible forms, of which both have an effect on the earth's natural systems.

Global population growth has reached a rapid pace which in turn has intensified the demand on resource production and consumption. This consumerism paradigm has stimulated a non-sustainable means of production, where the product is the only concern of the mass production, resulting in mass wastage.

The industrial epoch has led us into a production realm which is conducive to excessive waste and pollutants. The globalisation of industry has led to a production typology which cannot sustain its wastage. An irresponsible agenda has emerged, where the byproducts of our production are released back into our surrounding natural systems, resulting in polluted natural systems, which ultimately intervenes with the natural cycles at play. There is an opportunity for the reuse of our excessive waste by using an overarching systemic theory.

02.1.3 Redefining our landscapes through holistic thinking

Coastal architecture exists mainly isolated from natural environments. This is why the project reimagines a coexistence with nature, where theories pertaining to the above mentioned are used to engage with our landscape rather than isolate ourselves away from it.

02.2

PARADOXICAL REHABILITATION

Using a new 'paradoxic rehabilitative' concept for future coastal development

Rehabilitation of Landscapes Prior to Future Developments

In the wake of the Sibaya precinct proposal and urban developments within the Umhlanga node (refer to chapter 3), it has become apparent that a need for rehabilitation of exploited landscapes from sugarcane plantations back to indigenous coastal ecosystems prior to development is imperative. This is due to the fact that when development occurs along the coast, sugarcane fields are dug up and flattened without consideration to existing ecological systems within and surrounding the fields. Fragmented forestry has become apparent over the past century, due to the overpopulated farming lands. The human induced landscape breaks the areas of forestry, interrupting ecosystems at play. Without this link, ecosystems cannot sustain themselves due to their fragmented environment.

These sugarcane plantations reduce forest health, degrade habitats, from which fragmentation leads to loss of biodiversity, increases in invasive plants, pests, and pathogens, and reduction in water quality. When a forest becomes isolated through the forms of farming, roads or developments, the growth of plants and movement of animals is prohibited. "Fragmentation is a threat to natural resilience, and connectivity of forest habitats may be a key component of forest adaptation and response to climate change" (Snyders, 2014).

The Sibaya precinct proposal prolongs this fragmented landscape through the development of the sugarcane landscapes. Instead of rehabilitating the landscape, the development uses it as a 'blank canvas' landscape, negating the problem caused by industrialising the landscape initially. Whilst the new development may be more respectful of nature than its predecessors, it still falls short in its ability to rejuvenate the degraded landscapes and ecosystems. The project puts forward the notion that all new interventions on exploited landscapes should be conceptualised as rehabilitation projects which must undergo full restoration prior to development. This paradoxical concept forms part of the projects framework, in an effort to solve the conscious problem of fragmented ecosystems along the coastal region, caused by urban development, also allowing for remediation in the relationship between nature and the built environment. The concept seeks to:

- Locate and zone diminished landscapes where rehabilitation must take place to restore it back to its natural state.
- Locate and restore fragmented ecosystems through linking forestry areas.
- Zone areas on which development may take place rather the inverse of current practice where nature is zoned in between buildings.
- Ensures symbiotic relationships are created where architecture, nature, production and development rely on one another in a holistic approach.

This notion is formed as a response to previous dominance over the landscape in yesteryears. It seeks to form a balance between nature and man prior to development, rather than post-rationalizing it as is the case with majority of developments in present day and proposals going forward.

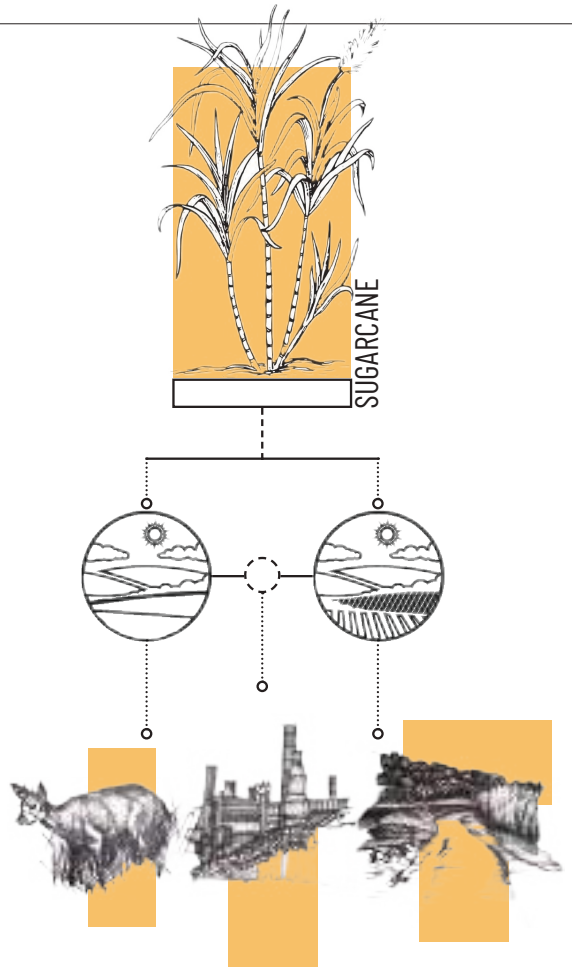


Figure 2.02: Relevant stakeholders **(Author, 2019)**

The 'paradoxical' initiative may become a new strategy for development in similar circumstances along the coast. The abundance of sugarcane plantations in prime real estate, leads us to believe the inevitability of further developments along the coastal edge.

Figure 2.03: Coastal destruction from flooding **(The Daily Sun, Edited by Author, 2019)**

Figure 2.04: Storm waste surge **(The Daily Sun, Edited by Author, 2019)**

Figure 2.05: Waste brought to shore by storm **(The Daily Sun, Edited by Author, 2019)**

The project undertakes two major influences in the destruction of natural landscapes namely, production typology and commercial development; and subverts their actions on nature to not only enhance the relationship, but help regenerate it to restore the dichotomous relationship.

Sugarcane Production and its Opportunistic Byproducts

Currently, there are two main methods of harvesting sugarcane, which both have significant drawbacks. Machine harvesting is energy-intensive, costly, and emits significant amounts of carbon. Manual harvesting is labour-intensive, dangerous, and often involves exploitative labour practices.

Harvesting leaves byproducts during the processing of the cane. These byproducts form from cane tops and leaves. Cane is burned in an efffort to lessen the excessive foilage around the stalk. Once processed, a product called bagasse is leftover. This fibrous husk may be used in a multitude of recycled materials as well as becoming an energy source. These options are discussed in later chapters.

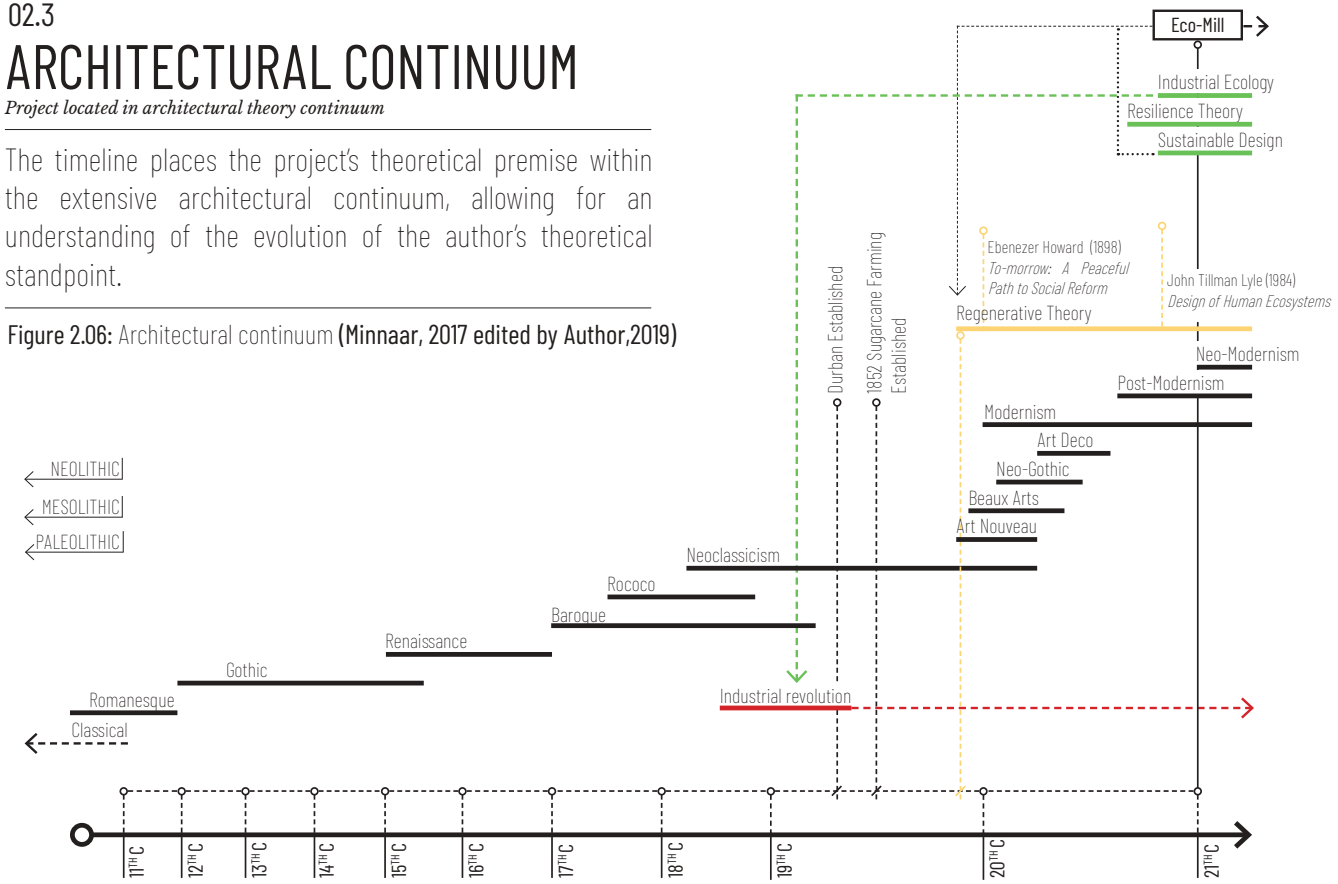
02.3

ARCHITECTURAL CONTINUUM

Project located in architectural theory continuum

The timeline places the project's theoretical premise within the extensive architectural continuum, allowing for an understanding of the evolution of the author's theoretical standpoint.

Figure 2.06: Architectural continuum **(Minnaar, 2017 edited by Author,2019)**



02.4

WHOLE + LIVING SYSTEMS THINKING

The system as a whole: changing the way we think

Degenerative Patterns In Linear Flows In Current Production

Throughout the 20th and 21st century, consumption through a linear pattern has lead to the degradation of landscapes. Materials are taken from the earth far quicker than they can be replaced, ultimately leading to the diminishing a said resource. "The one-way throughput system is a global system" (Lyle, 1994). In its very essence, the one-way system is a degenerative one, devouring its own sources for sustenance.

Barry Commoner (1990) argues that the dysfunction in our linear pattern lies in our means of production; to solve our pollution dilemmas, we must change our way of making things. "The palliative approaches taken so far in environmental regulation have not been adequate to deal with the fundamental structure of one-way flows that we have built not only into our means of production but into the very design of our cities and our landscapes- our fundamental sources of sustenance" (Lyle, 1994). The problems have become a manifestation of failure within the global infrastructure created over the past three centuries, which have created the idea of action without reaction.

Sustainability thinking still acts along a linear flow with a longer acting period. It is one which is a palliative approach, where it offers pain relief without curing the problem causing such pain.

The possible answer is rather than mitigating our impact, it is to create ecologically harmonious developments, which recognizes humans as not central to development, but rather as part of a larger system. This idea is not new, and can be seen in works by James Lovelock (1988), Eugene Odum (1993), Lewis Mumford (1961) and many others, who viewed the human downfall as their inability to function mutually with our life-supporting landscape. These thinkers advocated that in order to restore our landscapes a deeply integrated, and whole-systems approach is needed.

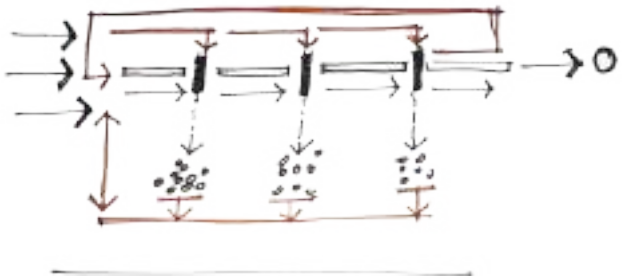


Figure 2.07: Understanding flows of a system **(Author, 2019)**

Opposing Palliative Design Through Holistic Systems Design

The dissertation looks at holistic design as viewing all systems at play as interlinked and concurrent with each other where the interdependence is vital in its symbiotic relationship.

The current dilemma we face is humans viewing themselves as separate from what surrounds us and our development, therefore we lack forward thinking towards the consequences of our actions. "Development is necessary to provide habitat and sustenance for our society, but development inevitably alters natural systems, usually for the worse" (Lylle, 1994)

Viewing systems as a whole ensures an outlook where there is mutually beneficial relationships between humans and nature through all facets of design. This relies on a place-based approach where through framing and understanding living systems' interrelationships, we may design holistically.

The green movement has, to an extent, only related within the human realm (and our needs), without taking into account the interrelationship of the whole. Reed (2007) extends to us that whole systems thinking recognizes that the entirety is interconnected, and moves us beyond mechanics into a world activated by complex interrelationships - natural systems, human social systems, and the conscious forces behind their actions.

This means we must replace our current linear systems of production with cyclical flows, which result in a closed-loop idea of production where our outputs relay back into the system. This results in an actual sustainable approach where all activities are ultimately balanced through the cyclical flows. This may be done in many practical theories which will be discussed.

Terminology:

One-way throughput system

Restorative Design

Locational Patterns

02.5

REGENERATIVE THEORY

Using inner working of ecosystems to regenerate rather than deplete

The Beginning

Regenerative theory was first established in the 1880s by Ebenezer Howard who wrote *To-morrow: A Peaceful Path to Social Reform* which expressed the idea of ecological thinking in human settlement patterns. "It sought to reconnect humans to nature, and featured use of natural rather than engineered processes to build the health of the system" (Mang, P. and B. Reed, 2012). Howard (1898) explains the Utopian city as living harmoniously with nature rather than separate from it, and using the natural as a tool for settlement design criteria.

Patrick Geddes published a work on urban growth patterns in 1915, which saw the mass movement of people into cities. "His was the first fundamentally organic understanding of cities, and had little liking for the chaotic growth that he saw resulting from industrialisation" (Lyle, 1994). Geddes study expressed a regenerative vision of the future, one which may seen as built from his predecessor, Howard. "Geddes, a biologist, saw cities as living organisms. He believed that addressing the problems of unsustainable growth required understanding a city's context — the surrounding landscape's natural features, processes and resources — and called for a solid analytic method for developing that understanding" (Reed, 2012). 1935 saw a new work proposed by Arthur Tansley, focusing on the concept of ecology as a means for design. "He proposed the term *ecosystem* as a name for the interactive system of living things and their non-living habitat" (Reed, 2012). The concern for natural systems and the impact humans have on these systems has became a vital in Tansley's work, whereby he focuses the ecosystem as a valuable framework for analyzing the effect of human activity on natural systems and resources. The 1980s saw Robert Rodale, an organic agriculture pioneer, advance the use of the word *Regenerative,* "calling for going beyond sustainability, to renew and to regenerate our agricultural resources" (Reed, 2012). Rodale saw the natural system as including the relationship of human activity, whereby the continuing of organic renewal was proportional to healthy soils, which equaled healthy food and therefore healthy humans. Rodale's work did not extend to the built environment, however, it did influence the principles of John Lyle's work.

In 1984, John Tillman Lyle published *Design of Human Ecosystems,* in which he proposed that "designers must understand ecological order operating at a variety of scales and link this understanding to human values if we are to create durable, responsible, beneficial designs" (Lyle, 1984). Lyle regarded human ecosystems as having a symbiotic relationship in which human and natural systems are not separate from one another.

Regenerative Systems within Development

> ***"The development of ecological understanding is not simply another subject to be learned but a fundamental change in the way we view the world."*** - John Lyle, 1994

As mentioned previously, development often results in the negative impact on natural systems. However, as we adopt a system where humans are part of nature, we can reasonably say that our development for human purposes, is not qualitatively different from alterations made by other species. But it must be said that in developing our landscape we inevitably interrupt a multitude of natural systems at play - ones which have taken years to form. Lyle (1994, pg. 20) reassures us, that nature in fact, is extremely resilient and adaptive. As we develop, nature responds by evolving to adapt, creating a new ecosystem.

Regenerative Systems Vs. Industrial Systems

Minaar (2017), uses Lyle's theories in her dissertation to explain the linear flow of the industrial system and compares it to that of the regenerative system flow. Both use a similar processes, but the outcome of the processes is drastically different.

On the one hand, the industrial system's processes result in a degenerative system, where, the outputs exist as byproducts and flow back into natural system, where they cannot be processed back into the natural system and only exist as pollutants.[1] The cyclical flow of the regenerative environment seen in figure 2.07 continually processes materials back into the larger system, ensuring the renewal of and regeneration of that initial input, thus becoming self-renewing and ultimately producing a sustainable yield.

The ultimate goal is to introduce Eco-efficient design technologies with ecologically based architectural approaches that reverse the degradation of both the Earth's natural systems and the human systems that inhabit and influence them.

1 The amount of waste outputs are considerably greater than the amount of initial material put in. This is due to the materials combining with natural resources diluting them.

02.6

ECOSYSTEMIC APPROACH

An ecosystemic approach to both design and systems

> *"Understanding a problem is to understand the relationship between the events and the context in which these relationships occur"* - Pilon, 2015

Changing the way in which we act requires a sufficient collective change, it is a change in our systematic approach to the entirety of our actions, thus altering the consequences.

An ecosystemic approach as a model for design sees the building, function and users as part of the larger systems at play. Rather than separate the design from nature, it acts by means of a symbiotic relationship, in which both entities benefit from one another. This approach sees the entirety as a system, in which all events have relationships, impartial of scale or magnitude, interdependent of one another. It relies on the idea of nature's cyclical flow of order. In an effort to create an architecture comprehensible of regeneration, all aspects facilitated in the design must be included. The industrial nature of the project should engage with the context, initiating restoration between the two.

Education in terms of this change is a significant facet when it comes to the 'collective' movement. Pilon (2015), extends to us that education is a great hope in our ability to adapt as a collective; "it can develop questioning, innovation and creativity, enable to recognize the powerful forces that drive unsustainable living and develop self-confidence and organisational skills". Therefore educating the collective cannot be seen as separate from the systemic approach, but rather fully integrated thus to not fragment the idea of humans and nature or nature and industry.

02.7

BIOPHILIC APPROACHES TO DESIGN

Remediatative solutions for the disconnect

Regenerative Development as Overarching Framework

"Regenerative development acknowledges humans, as well as their developments, social structures, and cultural concerns, as an inherent and indivisible part of ecosystems." (Zari and Jenkin, 2009)

The goal of regenerative development is to restore the functions the ecosystem undertakes to function without the consistency of human intervention. The development creates new potential, where humans are able to evolve with the ecosystems they are inherently associated with.

Restorative Design as Overarching Framework

Our impact on our natural environment, and in the case of this dissertation, the landscape of the coastal edge, is recognized through restorative design. The negative impacts which the sugarcane industry has caused, which have resulted in polluted, degraded and damaged landscapes, may be returned to a state of acceptable health through restorative design through architectural intervention. Restorative design questions how we can restore landscapes through our developments in an effort to create a beneficial relationship between the two.

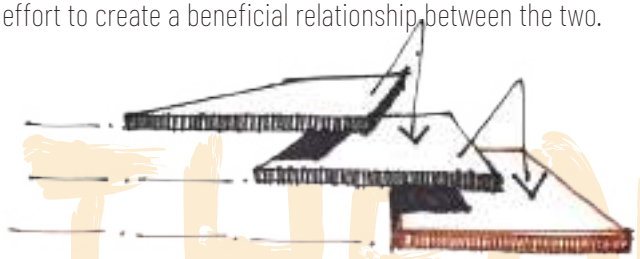


Figure 2.08: Overlapping Human systems into Natural **(Author, 2019)**

Resulting Framework

The difference between the two approaches is the role of the human in the process and the relationship with it. Regenerative design sees human activity as integrated with the larger whole of our ecosystem and aims for a symbiotic relationship. Restorative design sees the active improvement of our ecosystems through direct human intervention and management.

The proposed framework is one that combines the two, where each approach acts interdependently under the same roof. The goal of the project will be to create the 'ultimate' framework under which the relationship between man and nature can be renewed.

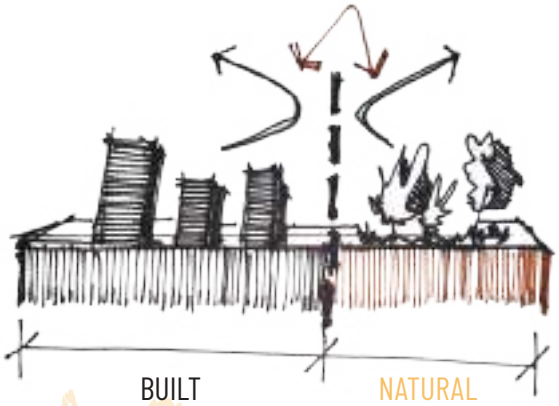


Figure 2.09: Integrating dislocated systems **(Author, 2019)**

02.8

INDUSTRIAL ECOLOGY

Viewing the industrial system as related to its natural context

Closed-Loop System

Industrial ecology aims to reduce the output of industrial systems which affect natural systems surrounding the project and in this case deals with the physical flows of matter and energy within the mill. "In an industrial ecosystem...the consumption of energy and materials is optimissed, waste generation is minimised, and the effluents of one process... serve as the raw material for another process" (Kelly, 1994: 156).

In the ideal industrial ecology, one may see "various enterprises have mutually inter-dependent relationships, with waste from one becoming the raw materials for another, within a holistically planned eco-industrial precinct." (CIB, 2014: 5) Therefore, industries form symbiotic relationships, where both parties benefit from a single action.

Previously, industrial production has acted in a linear-flow cycle, in which the byproduct has always been seen as waste. This linear flow has resulted in mass pollution in which majority flows back into natural systems, thus interrupting its currently sustainable cyclical flow. In South Africa, our waste lives in rubbish dumps, piled up by years of excessive consumerism.

"Industrial ecologists believe that the use of the natural ecosystem model, metaphor or analogy can be valuable and useful" in the understanding of industry production processes and finding and designing the connection of these processes (Korhonen, 2005). This understanding aims to reduce the excess waste in the realm of production by means of recycling matter back into the production process. Each process must be considered as part of a network of processes which are interdependent and interrelated of one another as part of the larger whole.

"The impact of this inevitable *entropy* can be absorbed by the organic sphere if the mechanical systems that generate it run at the pace and scope of natural systems" (Kelly, 1994: 157) This notion forms the backbone for the new programmatic layout of the mill. In which the processing of sugarcane is directly proportional to the restoration of natural systems taking the place of said sugarcane.

How Industrial Ecology is applied within the project:

Firstly, where possible, the excess waste will be placed back into its primary state - nature, where it may enter back into the cyclical flow and be processed back into the earth. This is done in an effort to enhance our direct relationship with nature and our impacts within its spheres. The aim of reducing the building's industry waste to the extent where it may be sent back to nature, is to restore balance between nature and man. Rather than existing in isolation from nature, the design will exist within the natural systems surrounding the building.

Secondly, where materials produced from processing are not compatible to enter straight back into nature, the project implements it back into the cyclical flow of the system. Excess waste materials are used for construction materials, such as bagasse-crete; used to create energy to power further processing; or decomposed further to fertilise agricultural and natural landscapes.

The concept of creating a minimal waste environment sets precedent for further development of the coastal areas, and bring awareness to impacts on our natural environments.

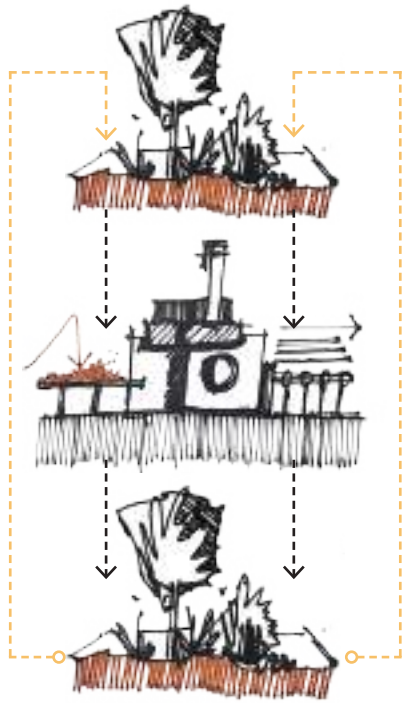


Figure 2.10: Cyclical Flow **(Author, 2019)**

URBAN ECOLOGY

Creating democratic urban spaces along the coastal edge

Coastal Development for the Riches

In the early 20th century, master planning and zoning, as tools to promote urban modernist ideals, were enthusiastically adopted by middle and commercial classes who were able to use them as a way of maintaining property prices and preventing the invasion of less desirable lower-income residents, ethnic minorities and traders. (Watson, 2009)

Coastal development sees the edge belonging to higher income classes, where lower income classes are shifted further inland. This has derived from inherited apartheid patterns of development where urban spaces are not cohesive to all forms of socio-economic classes. "Planning systems in place have been either inherited from previous colonial governments or have been adopted from Northern contexts to suit particular local political and ideological ends" (Watson, 2009). The solution to this dilemma is considering how one may evolve urban environments to be inclusive to all socio-economic classes, or better yet, see the urbanic environment as an interdependent ecosystem, where all parties play a role. This solution sees the theory of urban ecology as imperative to understanding the relationships formed in urban environments, and their effect as to how space is perceived in a hierarchical economic and social manner.

The notion of cities as ecosystems can be traced back at least to the 1960's and the thinking of Howard Odum and Ian McHarg. and thus is not a new conceptual approach to city planning. There is, however, a difference in consideration towards the project when considering urban ecology, which sees it in two lights, the first of which relates to Grimm's trail of thought as to how the concept of ecology of cities has to do with how their aggregated parts sum, that is, how cities process energy or matter relative to their surroundings. (Grimm et al, 2000:574)

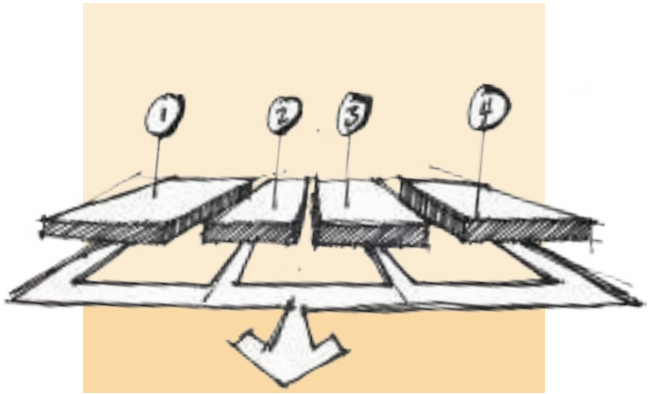


Figure 2.11: The sum of urbanic systems **(Author, 2019)**

Secondary to this, is a more micro-analysis whereby urban ecology studies the relation of living organisms with each other and their surroundings in the context of an urban environment. This theoretical premise allows for insight into how one may apply architecture as a means to balance the socio-economic spheres and in the case of the mill, how it establishes precedent for future urban coastal expansion.

The application of urban ecology as a theoretical premise within the project, sheds light as to how one may design architecture as the 'individual' to have an affect of the urban 'whole'. Thus allowing precedent to be set for neutral future expansion of cities and urban environments.

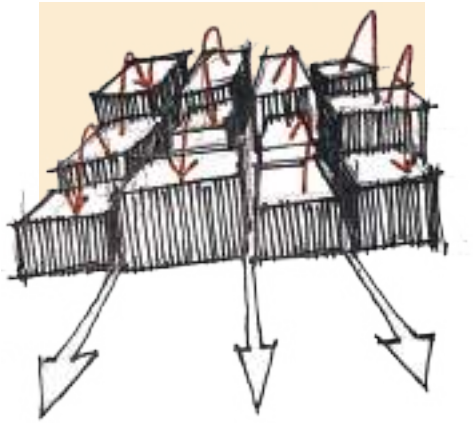


Figure 2.12: Relationship of living organisms **(Author, 2019)**

02.10

THEORETICAL PRECEDENTS

Guiding principles and informants for precedent choice

Dilemmas which the theoretical premise aims to address:

1_ SOCIO-ECONOMIC INFLUENCE ON TYPOLOGICAL FORMATION

The development of the coast over the past two decades has led to an imbalance of socio-economic hierarchy, disassociating certain social classes to public realms,.

2_ SUSTAINABLE PRODUCTION AND PROCESSING OF SUGARCANE THROUGH ARCHITECTURE, AGRICULTURE AND LANDSCAPE PRODUCTION.

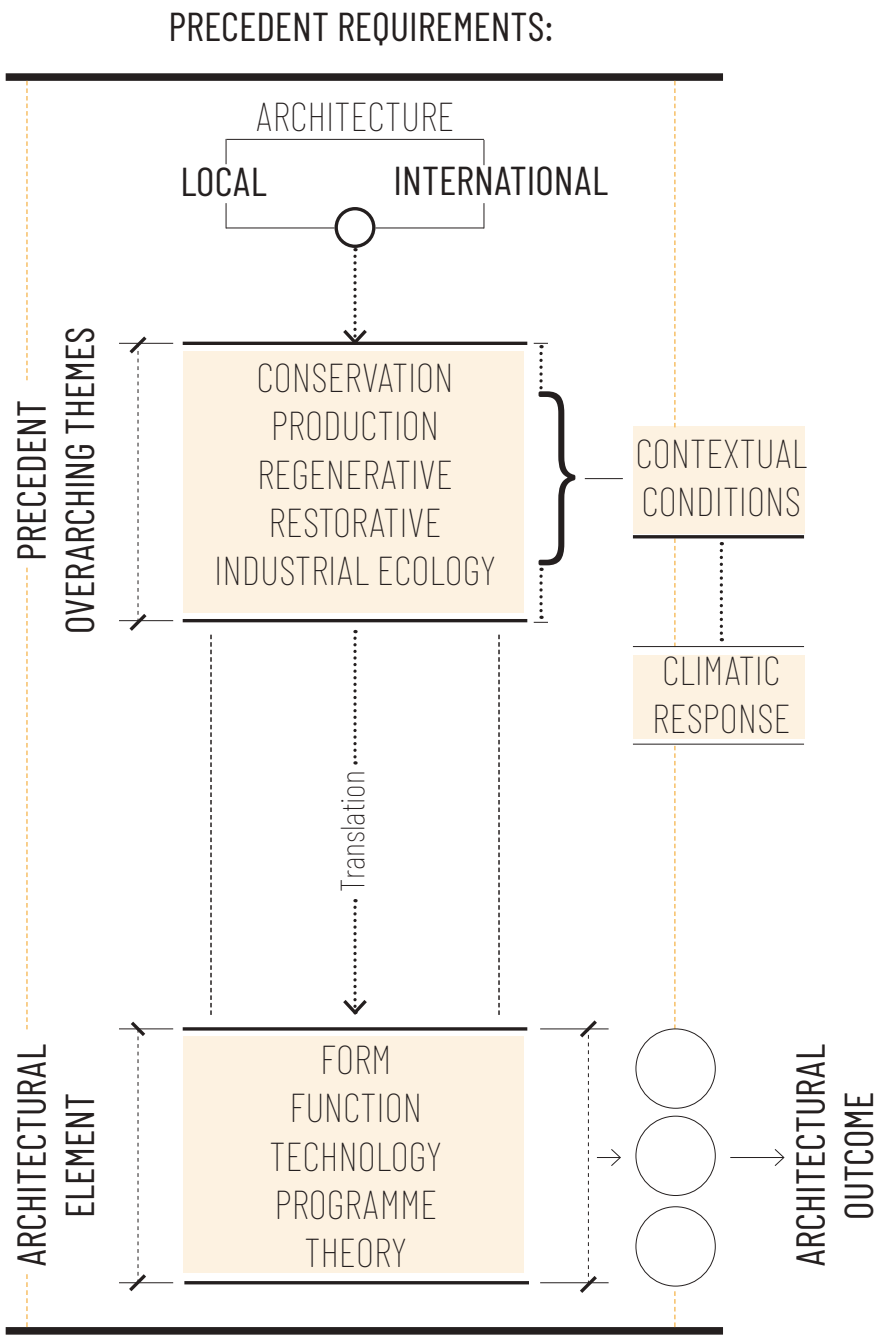
The current production of sugar sees major wastage of possibly renewable resources. The aim of the project is to harness the resources, using them effectively through primary energy functions or secondary functions such as packaging.

3_ OFFSETTING WETLAND LOSS VIA REHABILITATION THROUGH ARCHITECTURE:

The rehabilitation of wetlands sees the architecture forming part of the landscape, rebuilding and revitalising the degrading Ohlanga river. Farming along the river sees a multitude of excess chemicals leaking into the wetland, effecting the ecological and environmental standards along the river peripheries.

4_ SOCIO ECONOMIC SPREAD INFLUENCE:

Past trends of socio-economic structuring has led to the segregation of spatial typologies specific to the Eastern coast. Where inner cities see Urban-Sprawl outwards, coastal cities experience a lateral movement of socio-economical bursts, focusing on the restructuring of new assets adjacent to, rather than around, the degrading periphery. This has led to segregated coast line where majority of the beach edge is owned by the higher earning class or large capital developments.



THEORETICAL PRECEDENTS

Using theoretical premises from precedented projects to establish a basis for theoretical premise

INDUSTRIAL ECOLOGY | REGENERATIVE AGRICULTURE

Lyle Centre for Regenerative Studies | John T. Lyle

The centre is located on the California State Polytechnic University in Pomona, California and acts as precedent for the relationship between architecture, agriculture, horticulture and sustainable development. The centre aims to sustain a regenerative system which caters for the holistic approach to the design.

Each opportunity for byproduct utilisation is offered by the design, creating a closed-loop system in which each system is interdependent on the next. The figure to the right traces the flow of all critical elements passing through the building, showing the complex interrelationships of the centre's various systems. The cyclical flows oppose the trend of linear production in typical development strategies of current day. Where one system's byproduct is seemingly discarded in traditional systems, Lyle uses it as the start of the next clyclical flow. In 1984, John Tillman Lyle published *Design of Human Ecosystems,* in which he proposed that "designers must understand ecological order operating at a variety of scales and link this understanding to human values if we are to create durable, responsible, beneficial designs" (Lyle, 1984). This is evident throughout the entirety of the design.

The theoretical approach Lyle has taken may be the key in initiating a completely self-sustaining system approach for the project's intentions. The closed-loop cyclical flow will form the basis for production in the mill.

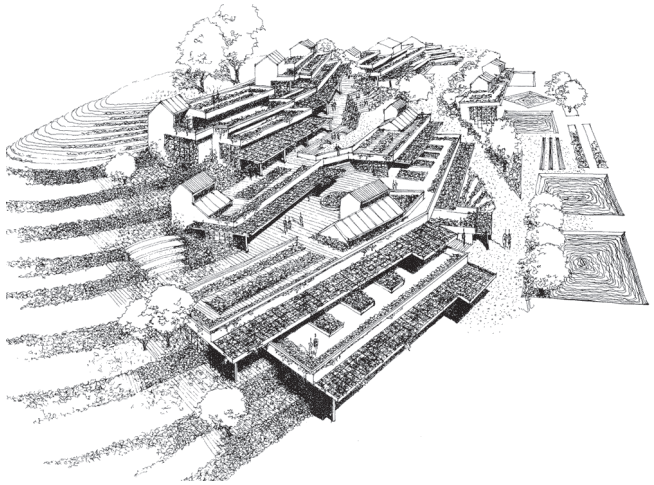


Figure 2.13: Regenerative Centre Perspective **(Lyle, 2019)**

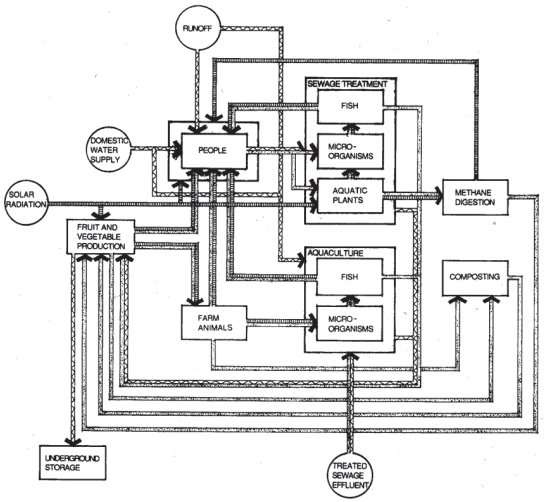


Figure 2.14: Systems Diagram **(Lyle, 2019)**

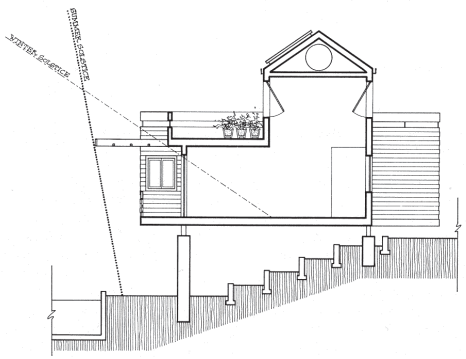


Figure 2.15: Climatic Analysis Section 01 **(Lyle, 2019)**

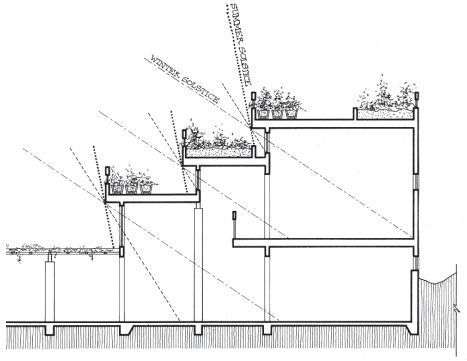


Figure 2.16: Climatic Analysis Section 02 **(Lyle, 2019)**

Figure 2.17: Relevant stakeholders **(Holder, 2012)**

Figure 2.18: Relevant stakeholders **(Holder, 2012)**

THEORETICAL PRECEDENTS

Using theoretical premises from precedented projects to establish a basis for theoretical premise

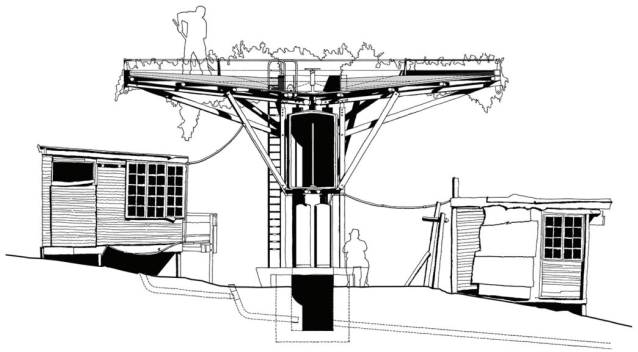
INDUSTRIAL ECOLOGY | REGENERATIVE AGRICULTURE

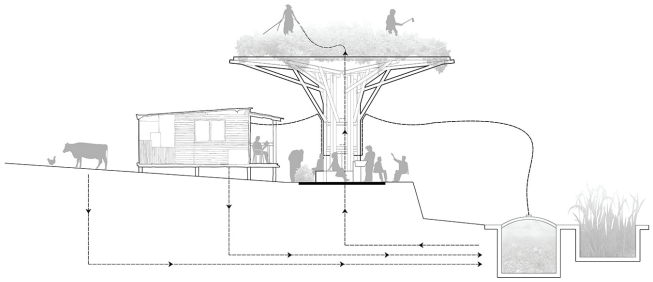
Productive (Re)public | Noero Architects

The project never took fruition in built form, however, is worth a mention for the theoretical premise of the project.

By understanding the limited capacity of oil as a resource, and its potential depletion during the 21st century, Noero architects propose an intervention to reduce South Africa's reliance on imported oil sources. At the same time, the project becomes a regenerative urban catalyst in the Hamberg location in Cape Town, Western Cape. (Noero Architects, 2013: Online)

The project relied on an understanding of the context as a means to gather information on how to collect and harvest biological waste to generate power. The design became a regenerative catalyst for the urban area by providing the surrounding areas with basic resources such as potable water and power. The idea was to provide a base point for informal settlements to gather around, feeding this hybrid architecture and in turn receiving the byproduct resources.





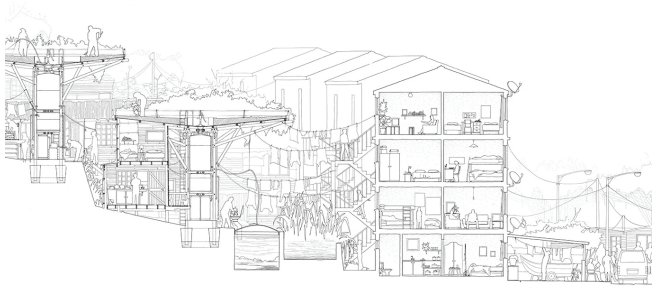
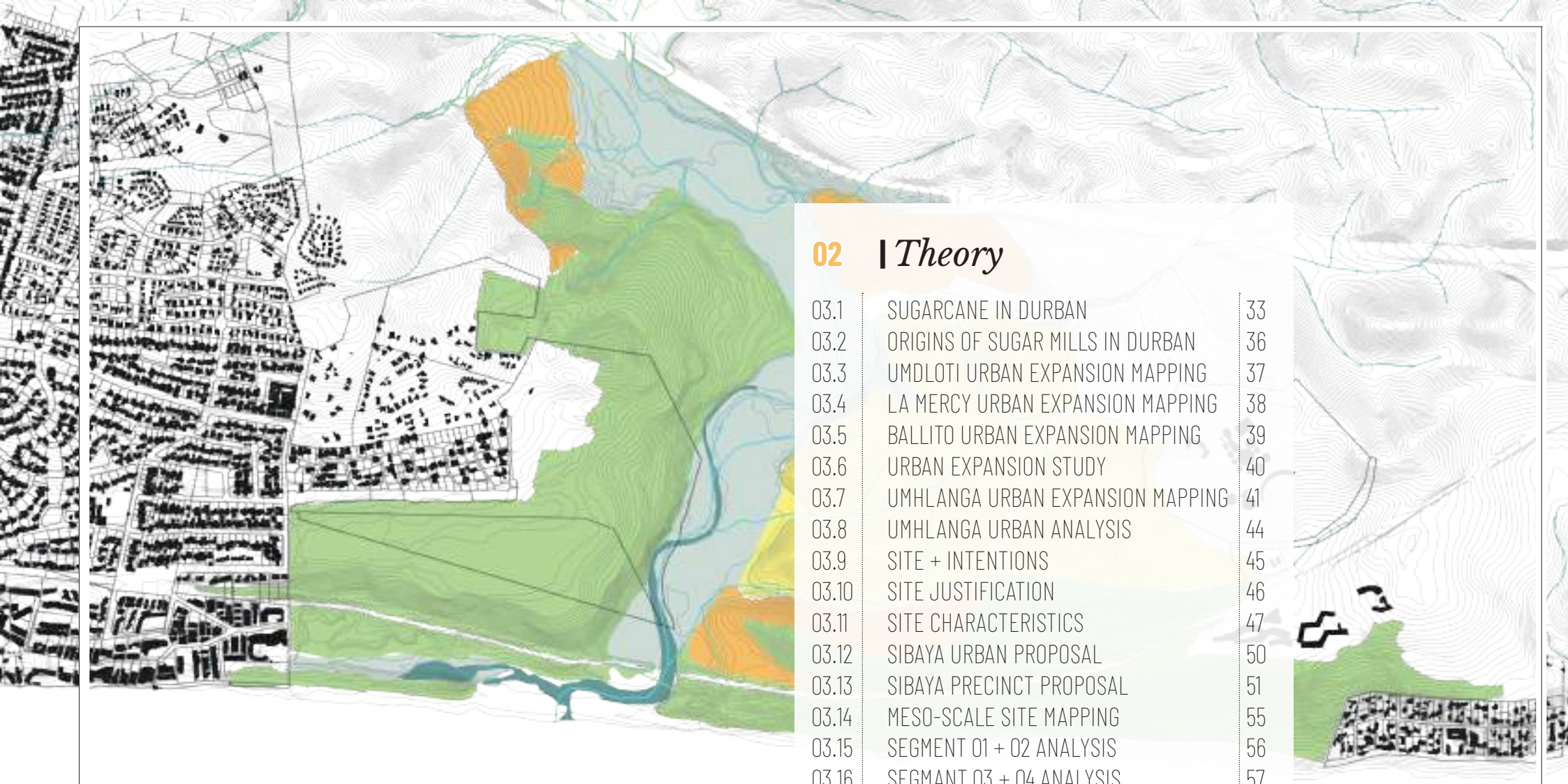


Figure 2.19: Top: Section through unit (Noero Architects, 2013)
Figure 2.20: Middle: Regenerative nature of Unit (Noero Architects, 2013)
Figure 2.21: Bottom: Unit within context (Noero Architects, 2013)

CONTEXT 03

Chapter 03 allows the reader insight into the site's contextual backdrop, from historic influences, to site conditions, providing a holistic understanding of the project's influences.



02 *Theory*

Figure 3.01: Extended site zoning **(Author, 2019)**

03

03.1

SUGARCANE IN DURBAN

A brief history of Sugarcane Milling in KwaZulu-Natal

THE ORIGINS OF NATAL'S EARLY CANE FIELDS

There has been speculation that sugarcane, perhaps more than a single species which we are accustomed to, was growing in South Africa for some time before the start of the sugar industry in Natal as well as the colonisation of the coastal region. Osborn (1964), recalls a letter sent to *The Natal Mercury* dated 18th July, 1867, wherein A.B Kennedy of the Umgeni Sugar Coffee and Produce CO., Ltd., stated "My kafir-kitchen worker says he knew Kafir Moba before any white men were in Natal." [1]

In 1850, J. Leyland Feilden planted the first 'known' cane on his property in Umbilo. The cane flourished in the climatic conditions of the coast, so much so, "he soon imported 30000 of the 'most approved' cane tops from Mauritius" (Osborn, 1964, p.116).

The Zulus had little interest in farming white settlers' land. Desperate for labour, a public meeting was held to propose the import of indentured labourers from India. On 17 November 1860, the first contingent of 341 Indian labourers arrived in Durban aboard the SS Truro.[2] By 1904, there were over "1 300 employers of indentured Indians in Natal" (Du Bois, 2015, pg.92). By 1855 there were 12 sugar mills at work.

THE SUGAR RUSH

The value of sugar exported from the Natal sugar mills "in 1855 was £16", and the "value of sugar exported from Natal in 1856 was £483, or 30 times the 1855 figure." (Osborn, 1964, p.57) By 1892 there were thirty-seven mills in operation. By the 1920s, "with world sugar prices having risen threefold" (Lincoln, 1988, pg. 7), major sugarcane growers had established their name within Natal. "The sugarcane industry exploded, making the Port of Durban one of the British Empire's most important seaports. It soon was the busiest sugar terminal in the world" (SA History Online, 2011)

THE SUGARCANE INDUSTRY TODAY

The sugarcane industry has come from turmoil to become one of South Africa's major exporting produce. South Africa's sugar story is a story which is easily related to many of South Africa's industries, from which profit

TERMINLOGY

1 Kafir Moba
A type of cane used for eating and grinding into meals and medicine

2 Coolie Law No 14 of 1859
Made it possible for the colony to bring in Indian workers for a five-year contract in Natal

FIGURE LIST:

Figure 2. Sugar mill

Firgure 2. 1937 aerial image: Ohlanga river and Hawaan Forest

HISTORY

has come from the expense of others. South Africa produces 19.9 million tons of sugar cane a year, where majority of that comes from KwaZulu-Natal. "The sugarcane industry is estimated to provide 79,000 direct jobs and 350,000 indirect jobs, making it a significant percentage of the total agricultural workforce" (Khan, 2017). Having used indentured Indian labourers during in the genesis of the sugar industry, the Indian population has increased to the extent that Durban now plays homage to the largest Indian population outside of India. Sugar is currently produced and processed by six milling companies with 14 sugar mills operating in predominantly KwaZulu-Natal with a substantial investment in Mpumalanga. According to the SASA (South African Sugar Association) "Approximately one million people, more than 2% of South Africa's population, depend on the sugar industry for a living" (SASA, 2017). The current practice uses partially old techniques for sugarcane harvesting which may have come from the slowing of the sugar market which has been prevalent in previous years.

FUTURE DEVELOPMENTS FOR THE INDUSTRY

Since the influx of coastal nodes from the turn of the 21st century, the sugar industry has played a vital role in the development of the coastline. The chronological development of the coast has allowed for sugarcane farms to still function, as parts were sold and upgraded into commercial zones. This has been narrative of the Umhlanga region, with its 'boom' in the 90s. The last of the sugarcane fields are presently being developed, dislocating the node from its heritage, and the scale at which these developments are happening result in a dislocation from nature.

Figure 3.02: 1937 Aerial view, Ohlanga river **(Hulette Archives, 2019)**

1800

1824 — Fynn arrived at Port Natal on the Julia, landing in the bay near the site of present-day Maydon Wharf

1828 — 24 September, Shaka was murdered at his military camp at Dukuza, by his half-brothers Dingane and Mhlangana

1835 — Mpande was then proclaimed King of the Zulu, defeating Dingane

1835 — growing village was named D'Urban, after Sir Benjamin D'Urban

1838 — Piet Retief, together with a party of 69 men killed

1850

1852 — In 1852, the ship, the Jane Morris, sailed into the bay with a cargo of 15,000 cane tops from Mauritius

1852 — Oaklands Sugar Estate

1859 — Coolie Law No 14 of 1859

1859 — 341 indentured labourers from India to find employment as workers on Natal's cane fields

1859-1882 — Maidstone Sugar Estate

1860 - Present — Addington Sugar Estate

1861 — A second contingent of 310 indentured Indian labourers arrived in Durban

1875

1865 — Legislative Council passed a law that specifically excluded indigenous male residents of Natal from the franchise in general

1867 — The Durban to Umgeni railway line was opened

1869 — The first "passenger Indians" arrived in Durban. The appellation referred to Indian immigrant traders, artisans, teachers and shop assistants who paid their own passage to the Colony

1872 — The Coolie Consolidation Amendment Act No 12 of 1872 made provision for a Protector of Indian Immigrants

1872 — The firm of Hewlett & Sons Ltd was established. At first it dealt only in the production of tea, but it soon expanded into sugarcane farming, and in 1903 it opened its first sugar mill at Tinley Manor.

1878 - 1919 — Stuckeridge Sugar Estate

1900

1888 — The Registration of Servants Act No. 2 of 1888 was passed by the Natal legislature.

1896 — 17 April, The Tongaat Sugar Company successfully applied to the Natal Immigration Trust Board for permission to recruit indentured artisans from India.

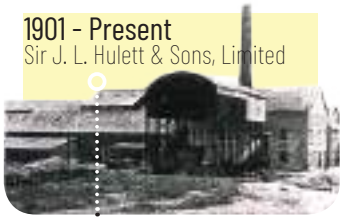
1911 — The last ship to bring indentured Indian labour to Natal, the Umlazi, arrives in Durban

03.2

ORIGINS OF SUGAR MILLS IN DURBAN

An early timeline of sugarcane mills in KwaZulu-Natal

1901 - Present
Sir J. L. Hulett & Sons, Limited



5 March, The Durban Land Alienation Ordinance, No 14 of 1922, was passed by the Durban Town Council, enabling it to exclude Indians from the ownership or occupation of property in designated White areas

1921

1940

1920

1923

1960

1971

1910 - 1938
Emoyeni Co-operative Sugar Co. Ltd.

1916 - Present
Umfolozi Co-operative Sugar Planters

31 May, The Mayor of Durban, Walter Gilbert, officially opened the third national conference of Indian organisations in the Durban Town Hall, which formally established the SA Indian Congress

The Natal Indian Congress was re-established for a third time

03.3
UMDLOTI URBAN EXPANSION MAPPING

2004

Figure 3.03: Umdloti Coastline 2004 **(Author, 2019)**

Umdloti in 2004 remained isolated from any urbanic development. Sugarcane fields bordered the North-Eastern edge of the district, resulting in the isolation of the area.

2018

Figure 3.04: Umdloti coastal zoning 2018 **(Author, 2019)**

Present day Umdloti sees massive development schemes on surrounding sugarcane plots. Urban developments are fast growing due to the high-value real estate seen in the area, as well as the vacancy of these landscapes, due to agricultural zoning.

- ORIGINAL BUILDING
- CONSERVATION AREA
- SUGARCANE PLANTS
- FUTURE DEVELOPMENT
- NEW DEVELOPMENT

03.4

LA MERCY URBAN EXPANSION MAPPING

- ORIGINAL BUILDING
- CONSERVATION AREA
- SUGARCANE PLANTS
- FUTURE DEVELOPMENT
- NEW DEVELOPMENT

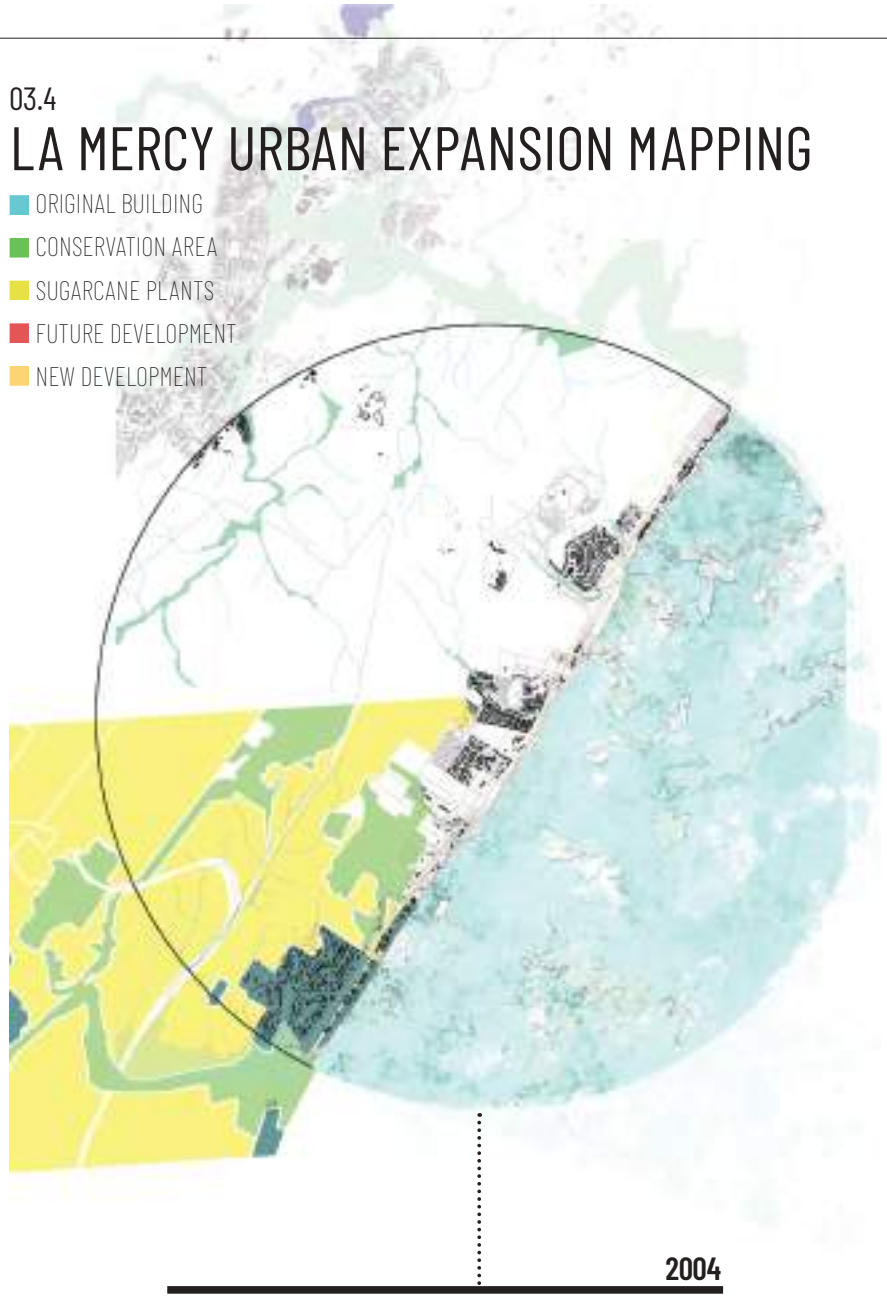


Figure 3.05: La Mercy coastal zoning 2004 **(Author, 2019)**

La Mercy existed in 2004 as bridging space between the larger suburbs of Umdloti and Ballito. The architecture was domestic in scale, which resulted from the the simple needs of its community. Sugarcane borders the suburb, with sparse areas of natural vegetation spread across the edges.

Figure 3.06: La Mercy coastal zoning 2018 **(Author, 2019)**

La Mercy present day exists fairly still in isolation, with larger architecture scales growing as a result of population densities increasing. However, the local layout is under threat due to the prediction of conurbation of the area, seeing mass influx high-end socio-economic classes.

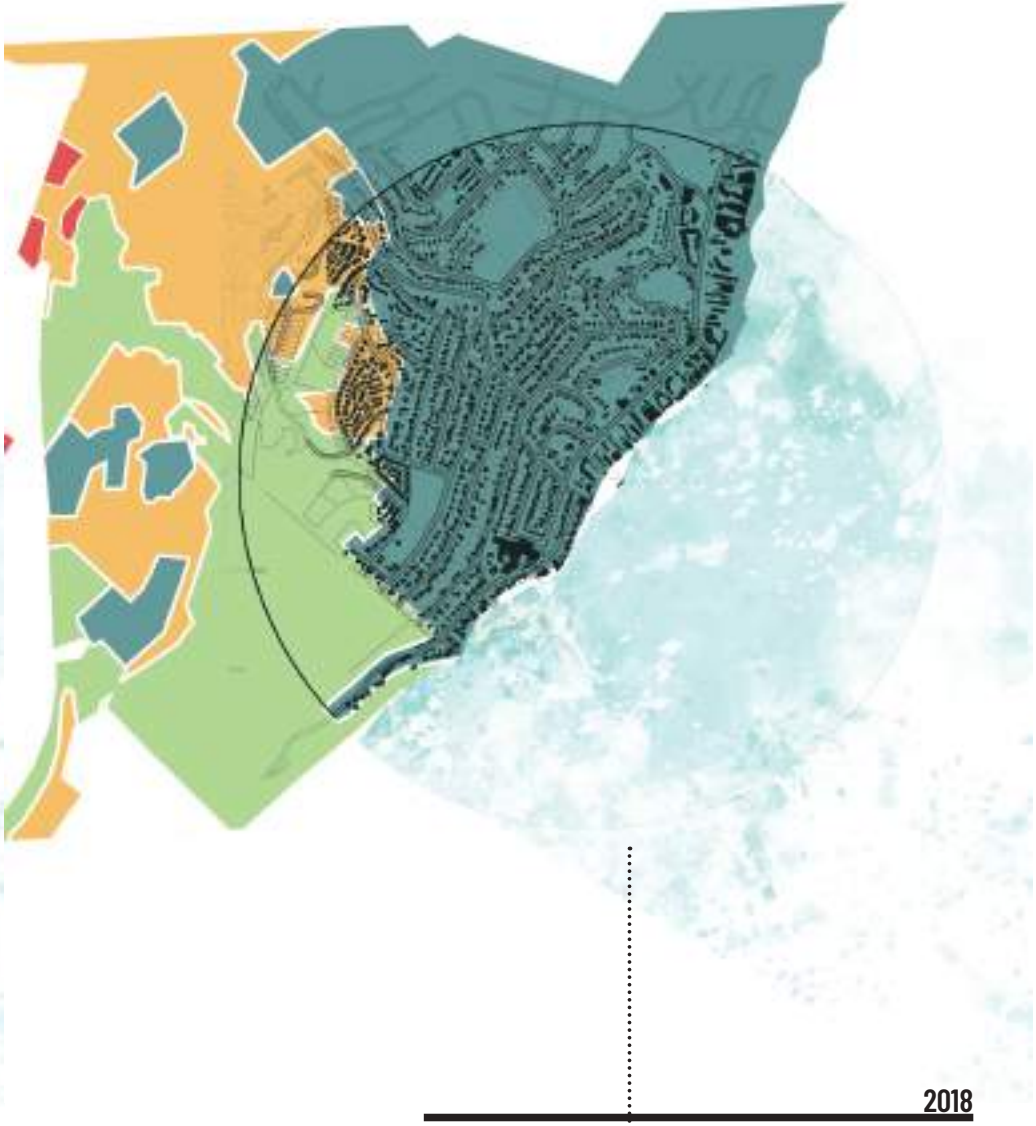
03.5
BALLITO URBAN EXPANSION MAPPING

ORIGINAL BUILDING
CONSERVATION AREA
SUGARCANE PLANTS
FUTURE DEVELOPMENT
NEW DEVELOPMENT

2004

Figure 3.07: Ballito Coastline zoning 2004 **(Author, 2019)**

Ballito's Northern edge existed as sugarcane fields in 2004, allowing for the suburb to still remain fairly remote. The scale of architecture remained domestic until the turn of the decade, which saw major investment in the area.



2018

Figure 3.08: Ballito Coastline zoning 2018 **(Author, 2019)**

Between the turn of the decade till present, Ballito's architecture and urban layout expanded dramatically. The investment into the pristine coastal condition lead to large urban spaces taking over the small domestic scale malls and public spaces. The sugarcane areas from 2004 have since been developed into upmarket estates and urban environments.

03.6

URBAN EXPANSION STUDY

CHRONOLOGICAL URBAN MACRO SCALE PATTERN ANALYSIS

The Role of Sugarcane in Chronological Development

In order for the urban vision to be established, the larger coastal region was analysed at a macro-scale to see the effects of urban development along the coastal edge. The mapping done showed the chronological relationship between sugarcane, future developments and conservation areas of major areas within KwaZulu-Natal. Sugarcane farms have and still do make up a massive area of coastal zoning, which now takes the form of a multitude of future development proposals for the Eastern coast.

The chronological mapping justifies the point of unsustainable growth patterns of our precincts and cities. From 2002, each node studied had drastically developed into major commercial and residential hubs, all of which, have previously been sugarcane plantations. Natural reserves and conservation areas are bordered by large scale developments which leave no buffer zone or transitional thresholds between the two - creating a visual and physical boundary. There is no consideration in the the effects of sugarcane on ecosystems as we see plots extending well into naturally zoned areas.

Where land has previously been used for sugarcane plantations, it has been farmed to the extent of becoming brownfield sites and continued farming has induced critical conditions for soils, wetlands and the ecosystems at play.

Urban expansion is happening at a rapid pace along the East coast due to major commercial and residential influx. The growth rate is directly proportional to the capital being invested into the coast line. This is leading to an anomaly to coastal urbanisation in the form of conurbation. Conurbation has taken place in major cities such as Cape Town, Pretoria and Johannesburg, but due to Durban's topographical and economic growth patterns, urban points have always been isolated from one another, leading to fragmented nodes with intermediate conservation and sugarcane plantations between, resulting in the iconic rolling hills Durban is known for.

The expansion study done revealed the extent to which Durban's suburban areas have grown in the last two decades. This has created a threat to natural areas along the coast, from which the project highlights the Hawaan Forest and Ohlanga River and estuary as central to this crisis.

The nature of the sugarcane industry is that it is largely owned by a single corporation, ensuring major commodity zones, such as the Sibaya precinct, are privately owned and therefore developed for private use. From this the Sibaya precinct model has been developed and aimed at connecting the entirety of the coastal edge between Umhlanga and Umdloti through private development.

The problem is not necessarly the idea of conurbation in its connecting sense, but rather the way in which it is being executed. Sugarcane farms in the last Century have impacted the environments in which they are situated drastically. Fragmented forestry has become apparent over the past century, due to the overpopulated farming lands. This induced landscape breaks the areas of forestry, interrupting ecosystems at play. Without this link, ecosystems cannot sustain themselves due to their fragmented environment. This induced landscape is then further interrupted through the development, pushing out what ever ecosystems still leftover. This is the problem presented by the traditional sense of conurbation and in the light of Durban's thriving natural habitats may be seen as an even more dramatic case.

Figure 3.09: Ridgeside Development aerial view **(Author, 2019)**

Figure 3.10: New Town Development **(Author, 2019)**

NOTES:

1 CONURBATION - RAPID EXPANSION OF ISOLATED URBAN NODES TO THE EXTENT OF BECOMING COMBINED

Figure 3.11: Umhlanga Coastline (Author, 2019)

Figure 3.12: 2003 Umhlanga coastal zoning (Author, 2019)

Umhlanga in 2003 existed as a smaller suburb of Durban city nicknamed adequately as the 'Village', where locals enjoyed the pristine beaches and the architecture typology which provided their basic lifestyles.

Figure 3.13: 2018 Umhlanga coastal zoning (Author, 2019)

Present day Umhlanga, is the fastest growing commercial suburb within South Africa. Major investment within the last 10 years, has seen the 'Village' grown into a typology which one may associate with Miami.

Figure 3.14: 2018 Umhlanga coastal income map (Author, 2019)

The coastal income map shows the increase in income per household as one moves closer towards the coastal edge. This increase shows how the wealthy migrate towards nodal areas, whilst less wealthy households are further spread.

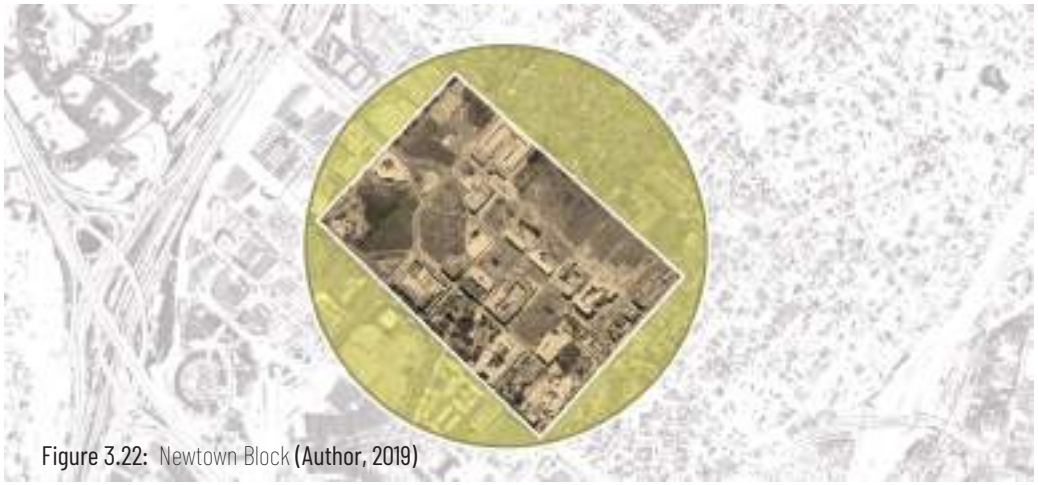


Figure 3.22: Newtown Block (Author, 2019)

NEW TOWN STUDY

UMHLANGA PRECINCT - AN URBAN STUDY OF THE NEW TOWN PRECINCT TYPOLOGY

Newtown is one of Umhlanga's latest development schemes in which a mixed-use urban layout was proposed. Newtown now thrives as a under its urban conditions partially due to its proximity to Gateway's major commercial influence. However, the manner in which the urban environment has been designed is condusive to pedestrian and vehicular movement. This ensures the streetscape is always active. The multi-use facet provides an environment where people are able to live and work within a small radius, again ensuring the vibrance of the street edge and larger node.

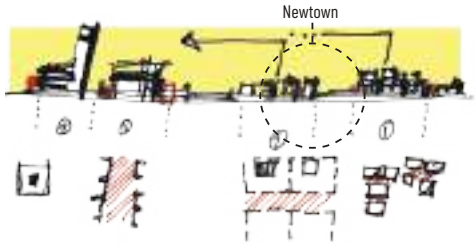


Figure 3.15: Coastal Building typology (Author, 2019)

Figure 3.16: Newtown Urban Typology (Author, 2019)

Figure 3.20: : Newtown Pedestrian + Vehicular Access (Author, 2019)

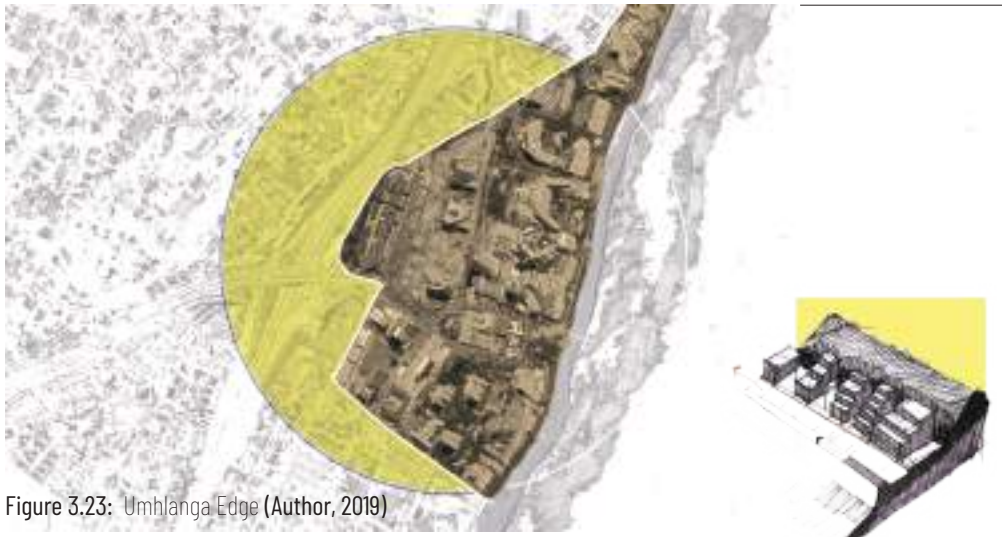


Figure 3.23: Umhlanga Edge (Author, 2019)

COASTAL EDGE STUDY

UMHLANGA PRECINCT - AN URBAN STUDY OF THE COASTAL EDGE TYPOLOGY

The coastal edge is problematic in its typology due to the privatization of large expanses of primary shoreline areas. This has led to the constriction of the coastline and the possiblities which it may have contributed. The Miami typology which is currently being developed is only condusive if everyone gets a 'slice of the pie' which in most instances is not the case. This has led to socio-economic fragmentation in the urban environments, where previously the coastal edge belonged majorly to the public.

Figure 3.21: Coastal Edge Mapping (Author, 2019)

Figure 3.19: Modular Zoning Areas (Author, 2019)

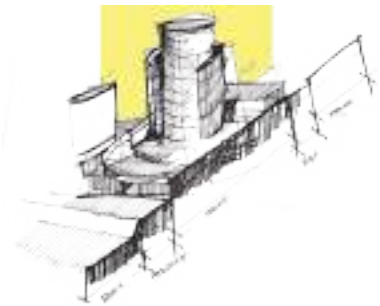


Figure 3.18: Current Coastal Interface (Author, 2019)

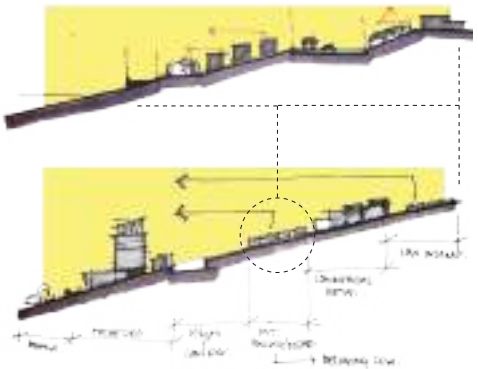


Figure 3.17: : Coastal Section (Author, 2019)

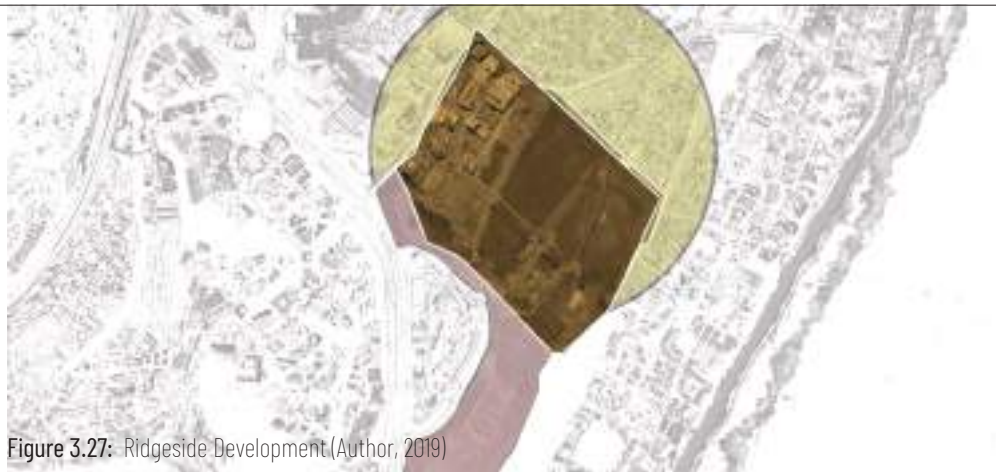


Figure 3.27: Ridgeside Development (Author, 2019)

RIDGESIDE URBAN TYPOLOGY STUDY

UMHLANGA PRECINCT - AN URBAN STUDY OF THE RIDGESIDE PRECINCT TYPOLOGY

Ridgeside is problematic in what has been proposed and the actual outcome of the development. The site on which it has been built was the last sugarcane plantation within the Umhlanga precinct - meaning there is little restriction on what can or can't be built. This has resulted in primarily large scale commercial properties, competing for the panoramic view of the coastline. The sensitivity in which the project has been executed in terms of conservation and context has been under-evaluated. The ten-storey buildings stand across the road from simple two-storey homes. In simple terms, the designers are trying to recreate a 'Sandton style' urbanity where contextually, it does not belong.

Figure 3.24: Ridgeside Commercial Properties Section (Author, 2019)

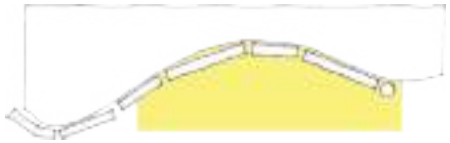


Figure 3.25: Linear movement (Ching, 2015)

Figure 3.26: Ridgeside Commercial Properties (Author, 2019)

03.7

UMHLANGA URBAN ANALYSIS

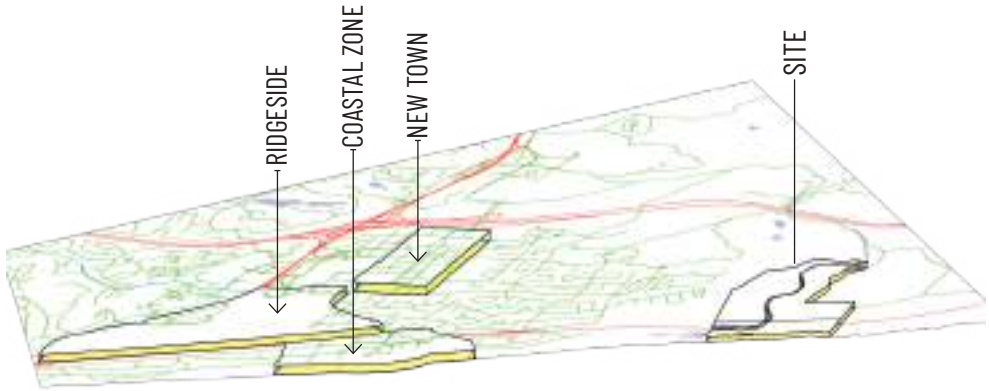


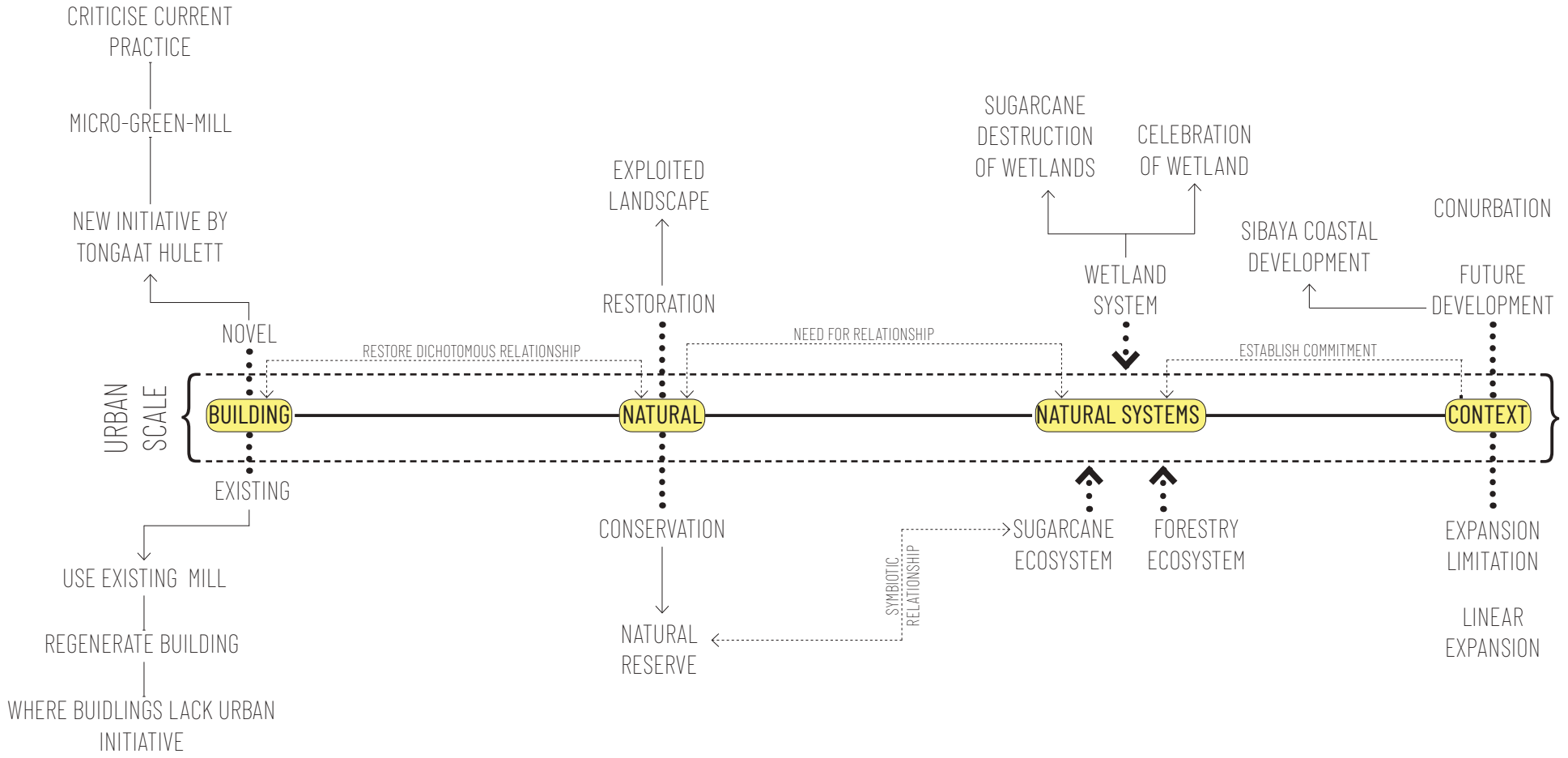
Figure 3.28: Location Map **(Author, 2019)**

Reason for Urban Block Study

The Study of urban nodes within Umhlanga was completed in order to understand the typology of current urban environments situated within the greater Umhlanga area. The study was completed using movement, form, socio-economic preferences, spatial layout and reaction to geographical topography as tools to distinguish their success in creating holistic urban environments. The nodes are also seen as the closest urban examples to the site, and thus may be seen as precedent to the possible urban environments outcomes which may develop around the site in years to come.

SITE + INTENTIONS

A COMPARITIVE STUDY BETWEEN SITE AND THE INTENTIONS OF THE DESIGN



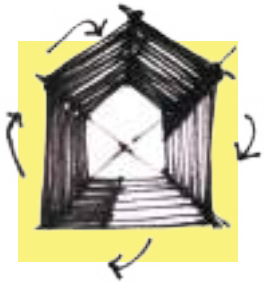


Figure 3.29: Rejuvenate building

Figure 3.30: Overreaching Fields

Figure 3.31: Regenerative Arch.

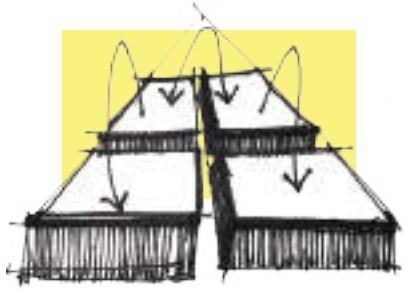


Figure 3.32: Relink Dislocation

03.9

SITE JUSTIFICATION

OHLANGA RIVER

MACRO COASTAL ANALYSIS

The analysis of current expansion development patterns along the coast, leads one to believe the inevitable future conurbation of coastal precincts, which if not designed properly, will constrict the coastal front.[1] Therefore the site of Ohlanga river, between Umhlanga and Umdloti has been considered as one of the vital buffer zones in the future growth of the coastal region. Figure 3.61 shows a current development proposal by Tongaat Hulett which is underway. The site spans the distance between two estuaries, namely Ohlanga and Tongati.

The macro scale mapping allowed for insight into new developments within coastal precincts and their inability to connect with nature, which stems from shortfall of urban design or the commitment of developers in respecting nature. The last of the sugarcane fields within Umhlanga are being developed currently, which through pattern analysis, shows future development will affectively expand along the coast, on the peripheries of affluential nodes, spreading majoritly northward towards La Mercy and Ballito. This formulated development can establish further expansion towards Stanger from Ballito.

The initiative to restore the various relationships between nature, man and industry will allow regeneration of landscape, and help restore the symbiotic relationship between man and nature. The idea to restore said relationship, established itself from the concerning lack of respect for natural systems at play on the varying peripheries of the coastal region through a variety of activities varying from commercial to industrial. This is an age-old agenda that has only ever been dealt with in minor detail.

The proposed project vision aims to mediate between industry and nature. The project zone was chosen by mapping nodes chronologically, viewing the expansion patterns and how they have affected the natural systems at play and how in future they will expand and do so. From this, the remaining periphery of Umhlanga was chosen as the larger acting zone for the urban vision to take place. The project will link to the current developments of Tongaat Hulett and form part of their proposal going forward. The dissertation seeks to form a relationship between the concurrency of nature, development and industry.

Various zones on the macro site were identified, allowing for an idea of where architectural initiatives may take place to restore landscapes and restore prevalent relationships between man and nature. Where natural landscapes have been exlpoited (to the extent that they become brownfield sites), it will become imperitive to restore them to their natural state. The further vision for the project is to establish a framework where exploited landscapes along the coast are restored prior to development, creating a 'remedial parisite'.

SITE: OHLANGA RIVER

The site is an existing sugarcane farm owned by Tongaat Hulett. Situated adjacent to the Ohlanga river on the Northern periphery of Umhlanga, it forms the boundaries between Umhlanga and Umdloti, using the Ohlanga river as the buffer zone. The same 'buffer' zone can be seen North of Umdloti, where the Tongati estuary separates Umdloti from Northern development. Mapping of the macro-site was done so by splitting it into six segmants (see Figure 3.64). This allowed for a managable scale for in-depth analysis to take place. The South-Eastern segment proved to have the most depleted landscape, where intervention has become a necessity.

TERMINOLOGY

1 Conurbation -
The extension of an urban area to the extent where several towns or precincts merge.

2 EMA
eThekwini Municipality's Environmental Management Department

3 Estuary
Estuaries are situated at the interface between the marine and freshwater environments, and as such are amongst the most dynamic, but also productive ecosystems on earth.

Figure 3.33: Location Map **(Author, 2019)**

03.10

SITE CHARACTERISTICS

OHLANGA ESTUARY + PERIPHERIES

VALUE ANALYSIS OF THE MACRO-SITE

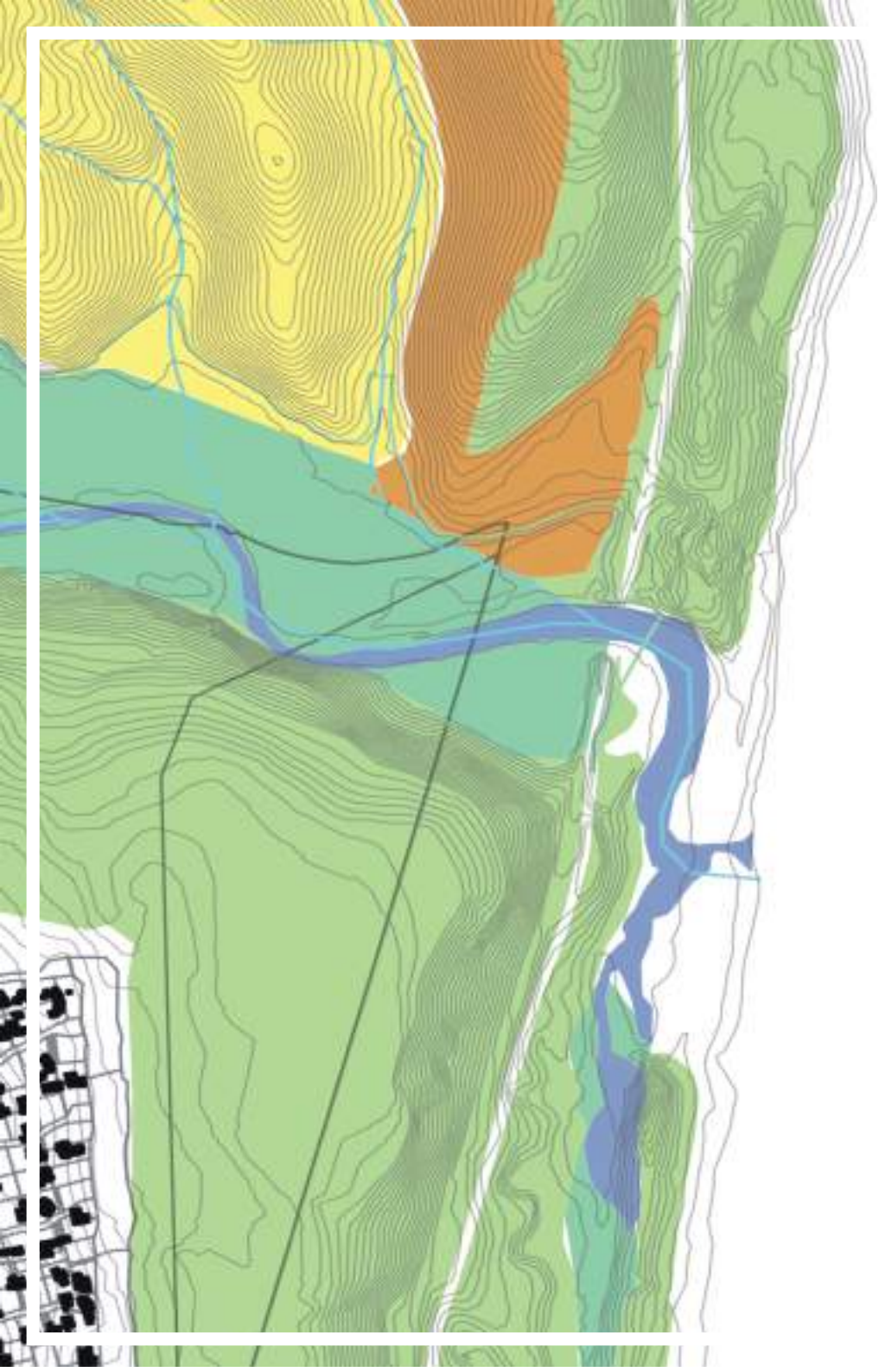
"The Ohlanga is the only system in the EMA that forms part of a proclaimed nature reserve, with the prominence of coastal forest and Phragmites australis (Common Reed) highlighting the conservation value of the system's surrounds." (Mclean, 2010)

Begg (1984) strongly emphasised the uniqueness and biological value of the forested areas in the vicinity of the Ohlanga estuary, where one will see the diversity of the forestry.

As regards human impacts, the earliest aerial photographs (1937) show an estuarine floodplain virtually entirely under sugarcane (Forbes & Demetriades, 2008.)

In recent years the normal pattern of extended closure which existed during the 80s has been progressively disrupted by the addition of treated waste water from the two treatment works in the catchment resulting in a greatly increased frequency and duration of breaching.

Other interesting references are to small patches of mangroves above and below the M4 bridge and to the presence of the freshwater plant Potamogeton pectinatus downstream of the same bridge.



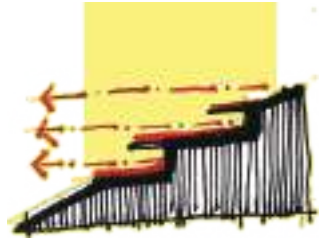


Figure 3.34: : Right: Initial site analysis **(Author,2019)**
Figure 3.35: : Left: Site macro zoning **(Author,2019)**

Figure 3.36: : Extended Site Aerial Photo (Google Earth image, edited by Author,2019)

Figure 3.38: : Sibaya Precinct in relation to Ethekwini zoning **(Author,2019)**

Figure 3.37: Land ownership **(edited by author from Ethekwini municipality coastal management plan, 2006)**

Figure 3.39: Extended site geographical conditions **(edited by author from Ethekwini municipality coastal management plan, 2006)**

03.11

SIBAYA URBAN PROPOSAL

CREATING A CHARACTER SKETCH ARCHITECTURE SHOULD RELATE TO.

MAKING THE DESIGN 'PEOPLE RELEVENT'

There is an interdependence of coastal urban development and the sugarcane industry as sugarcane fields are used for new development grounds for urban expansion. Tongaat Hulett, amongst others, has become a major contributor to developments along the coast over the past decade and sees their ownership of major lands assets (seen in figure 3.58) as an oppurtunity for drastic development of the coastal edge.

The Sibaya precinct as seen in the future development proposal in figure 3.61 will be used as the the contextual development driver for the project. The multifacet development sees the entire coast edge betwween Ohlanga river and the Tongati river being developed. The proposal sees the coastal edge transformed for upper class commercial and residential uses. The Sibaya precinct will border the existing Umdloti node, but allows for a bufffer zone between the two.

03.12

SIBAYA PRECINCT PROPOSAL

Proposal presented by Tongaat Hulett currently in the initial stages of development

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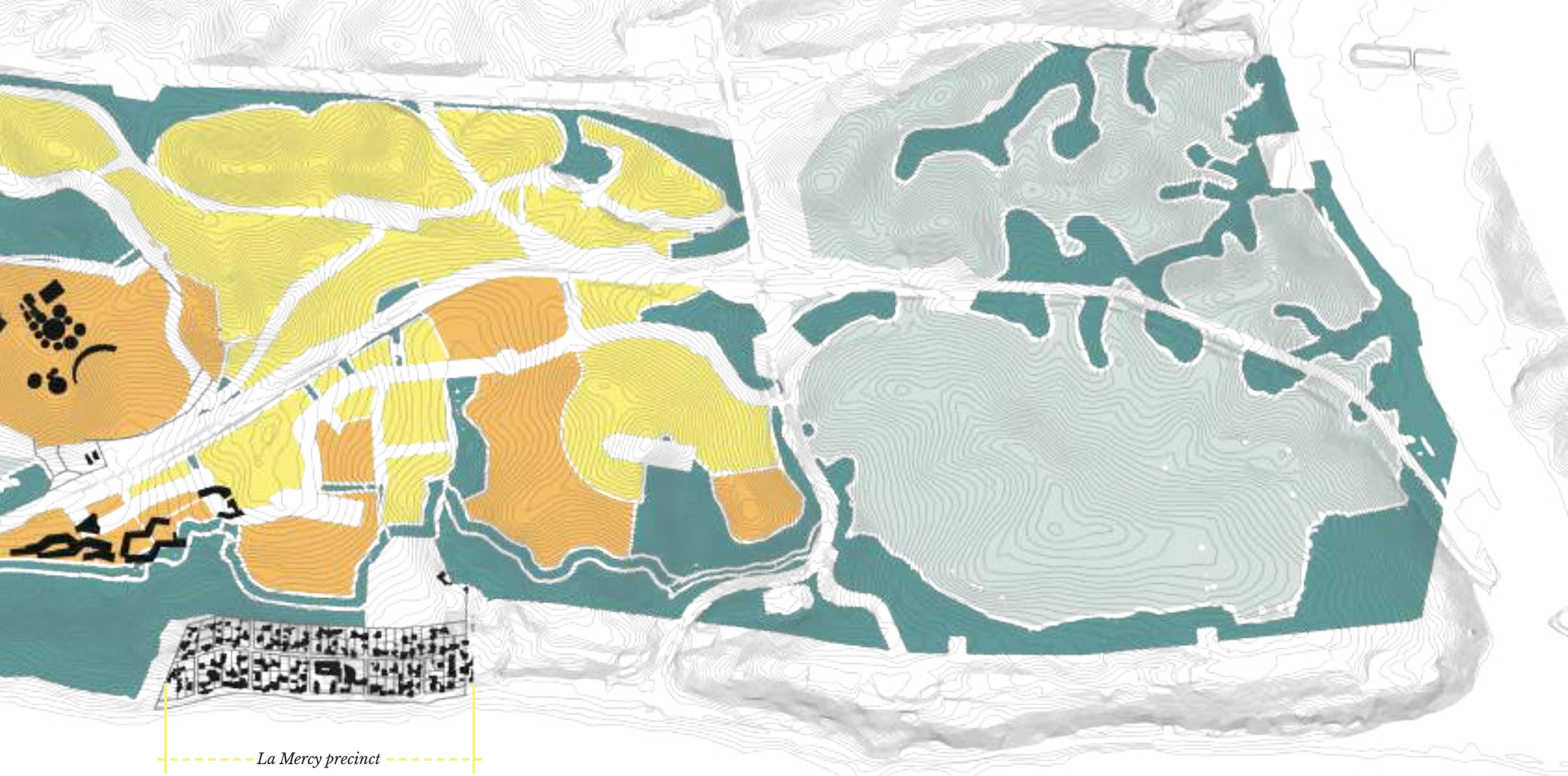
The 'new' Sibaya precinct is being developed at a rapid pace as a mixed-use development, providing a connection between the Periurban areas of Umhlanga and Umdloti. It currently exists only as a proposal by Tongaat Hulett in which it comprises of seven nodes, each different in function, in an effort to provide a holistic urban environment, catering for all aspects of the urban lifestyle.

There has been an initial sensitivity towards the natural systems surrounding the proposal - in which the planning proposes sixty percent of the land compromising of 'green' space. It also proposes what was once sugarcane will be rehabilitated and restored to its natural condition. This is however questionable due to the development companies predecessing projects which lack this 'sensitivity'. The site proposal is extensive- stretching from the Ohlanga estuary to the Tongati estuary, a total of 6km and an area roughly of 1000 hectares, connecting the two nodes of Umhlanga and Umdloti. This proposal will bring put into the practice the concept of conurbation, blending the boundaries of the urban areas.



SOLD SITES
AVAILABLE SITES
FUTURE RELEASE
OPEN SPACE

Figure 3.40: Tongaat Hulett Sibaya proposal mapping (Author, 2019)

Figure 3.41: 5 Minute Radius walking times **(Author, 2019)**

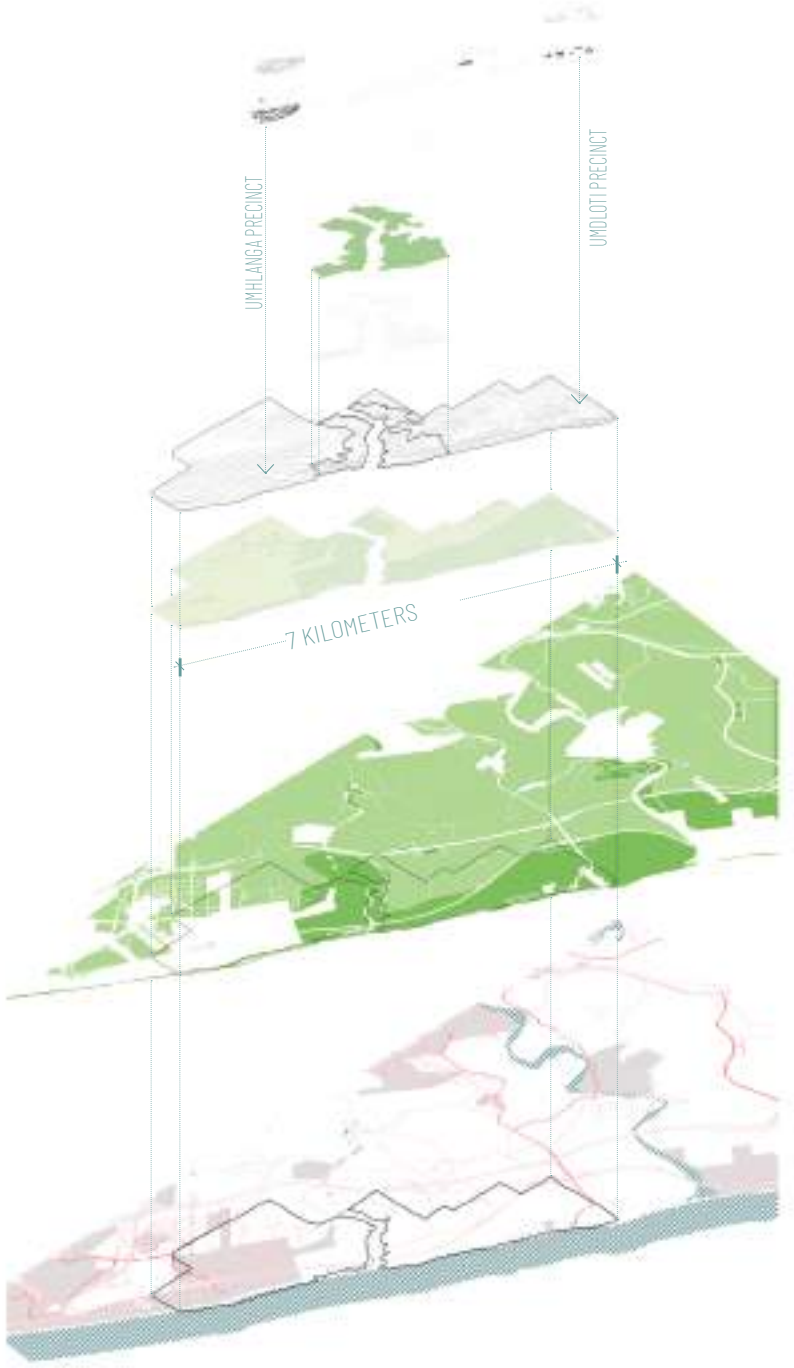


Figure 3.42: Urban Acting Zone **(Author, 2019)**

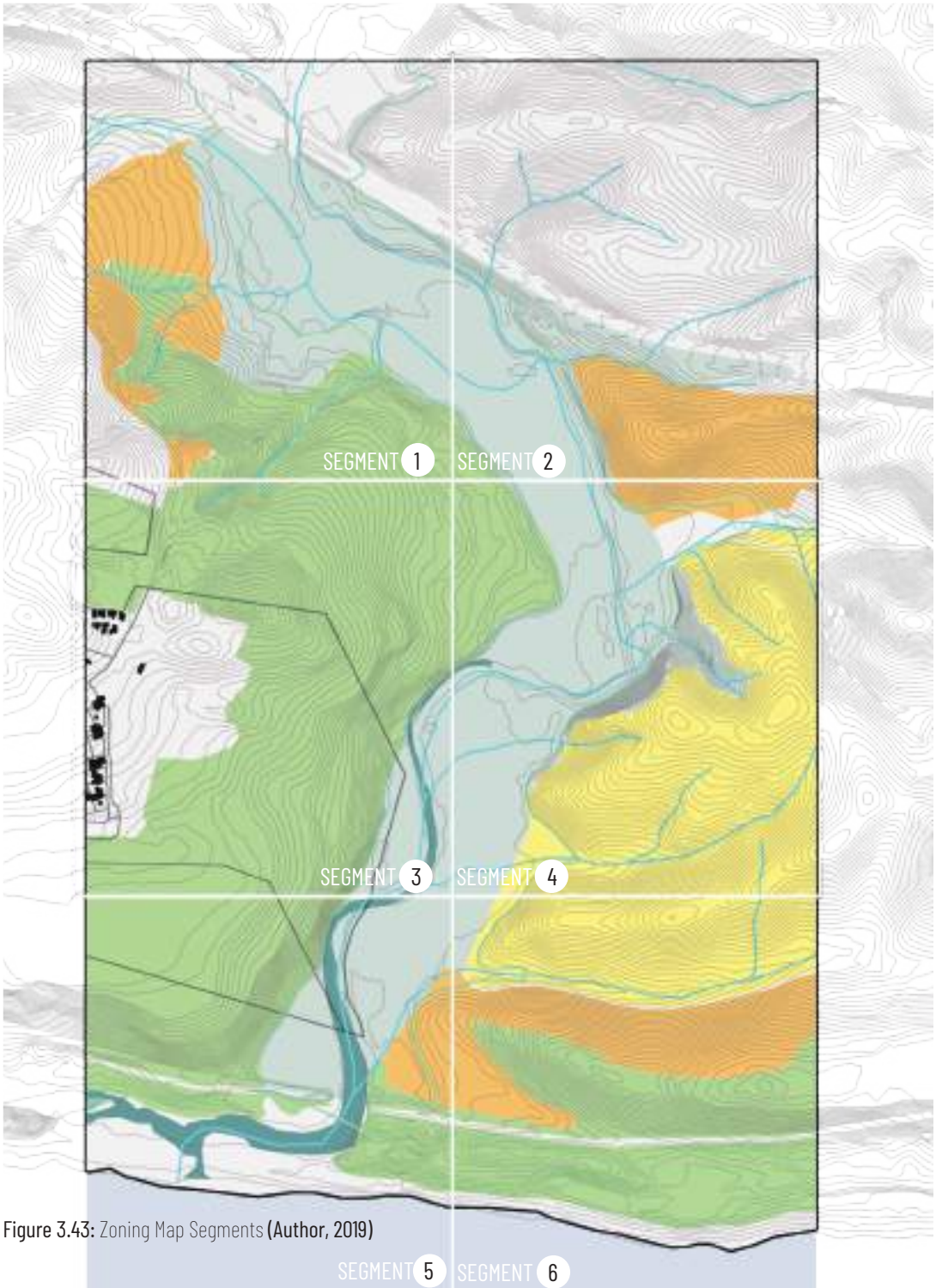


Figure 3.43: Zoning Map Segments (Author, 2019)

03.13

MESO-SCALE SITE MAPPING

An overarching meso-scale mapping, giving understanding to the entirety of the site topographical conditions

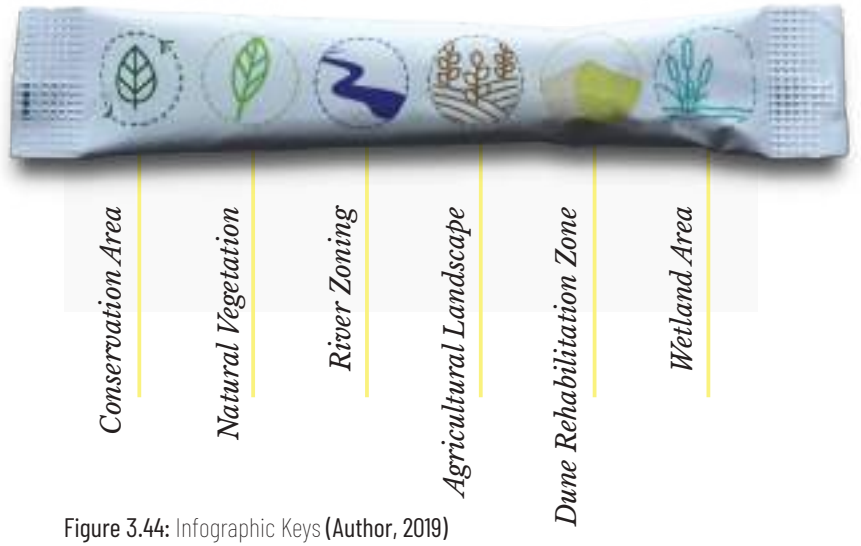


Figure 3.44: Infographic Keys (Author, 2019)

Figure 3.45: Hatch Zoning Key (Author, 2019)

03.14

SEGMENT 01 + 02 ANALYSIS

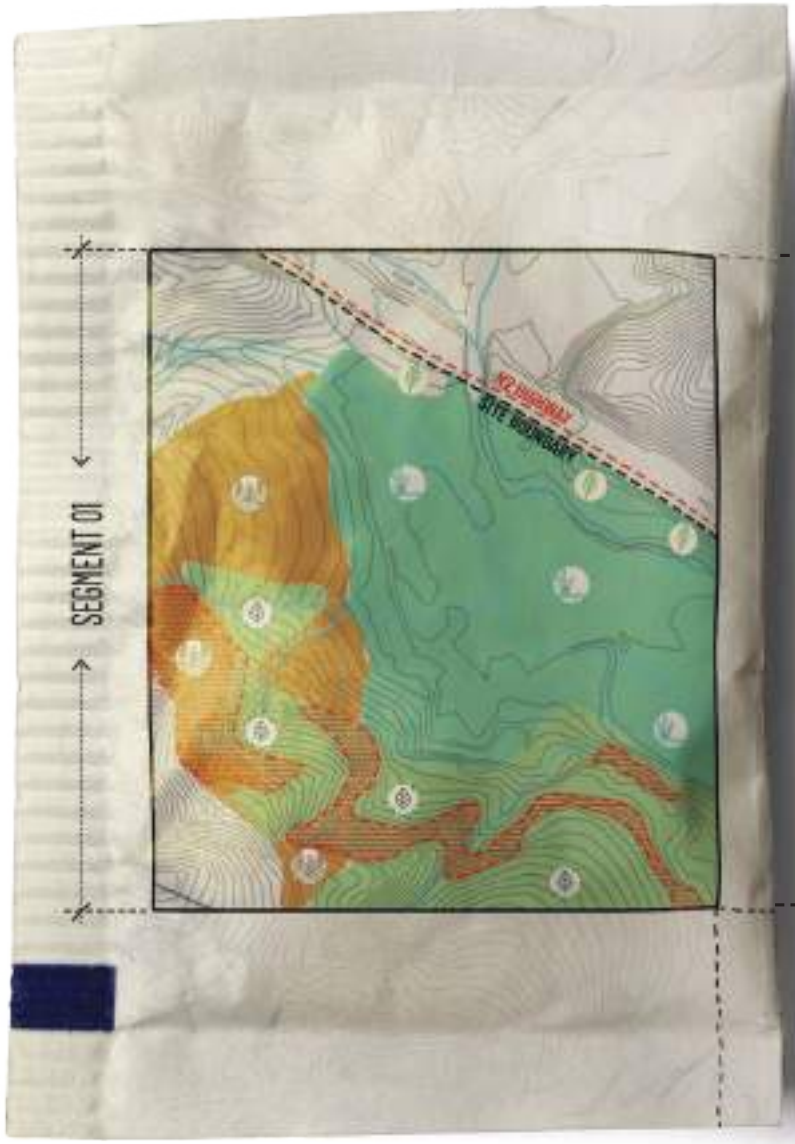


Figure 3.46: Segment 01 Analysis **(Author, 2019)**

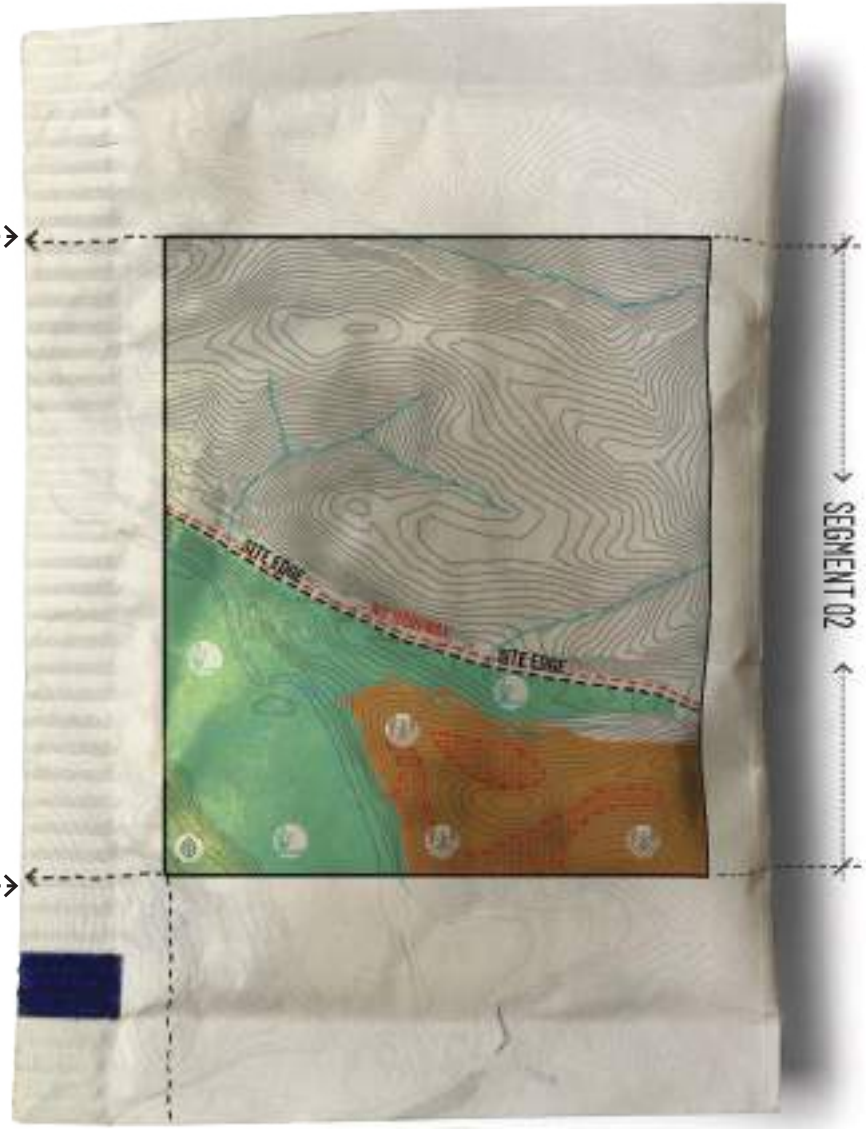


Figure 3.47: Segment 02 Analysis **(Author, 2019)**

SEGMANT 03 + 04 ANALYSIS

Figure 3.48: Segment 03 Analysis (Author, 2019)

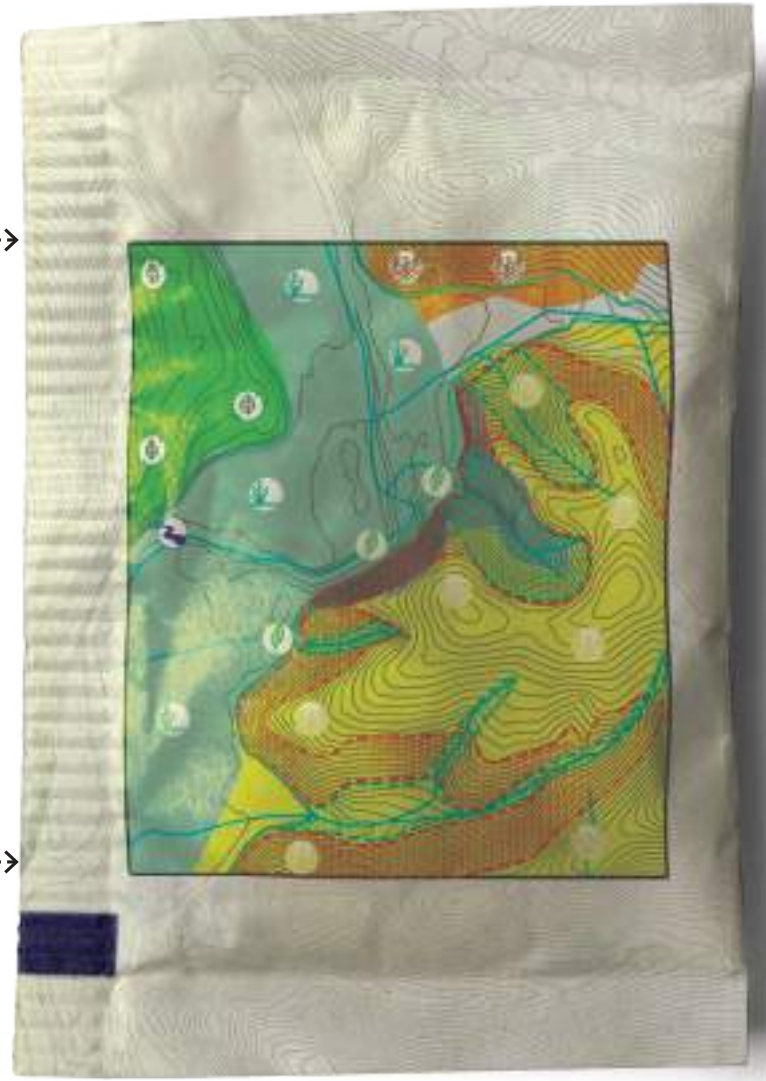


Figure 3.49: Segment 04 Analysis (Author, 2019)

03.16

SEGMENT 05 + 06 ANALYSIS

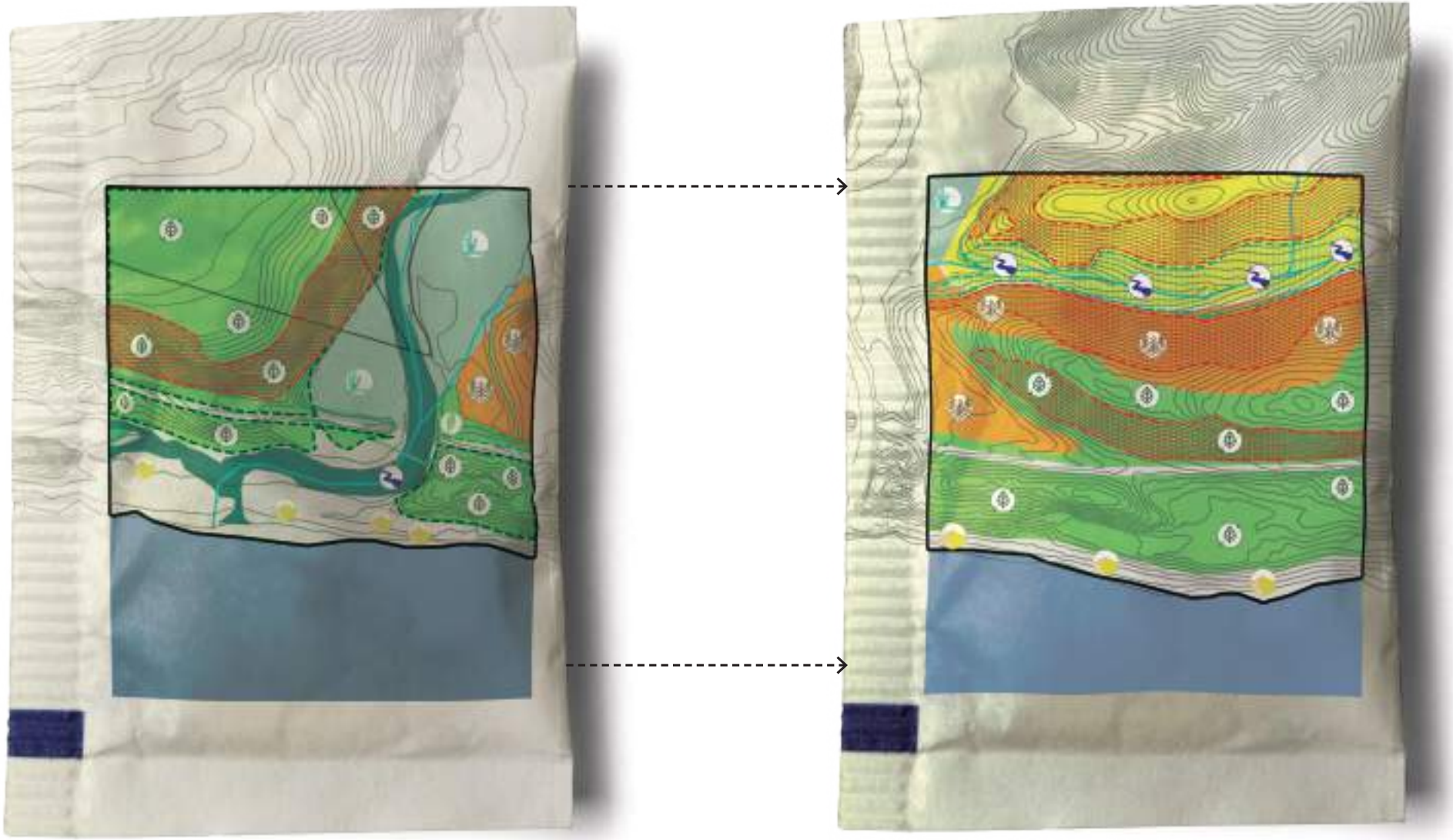
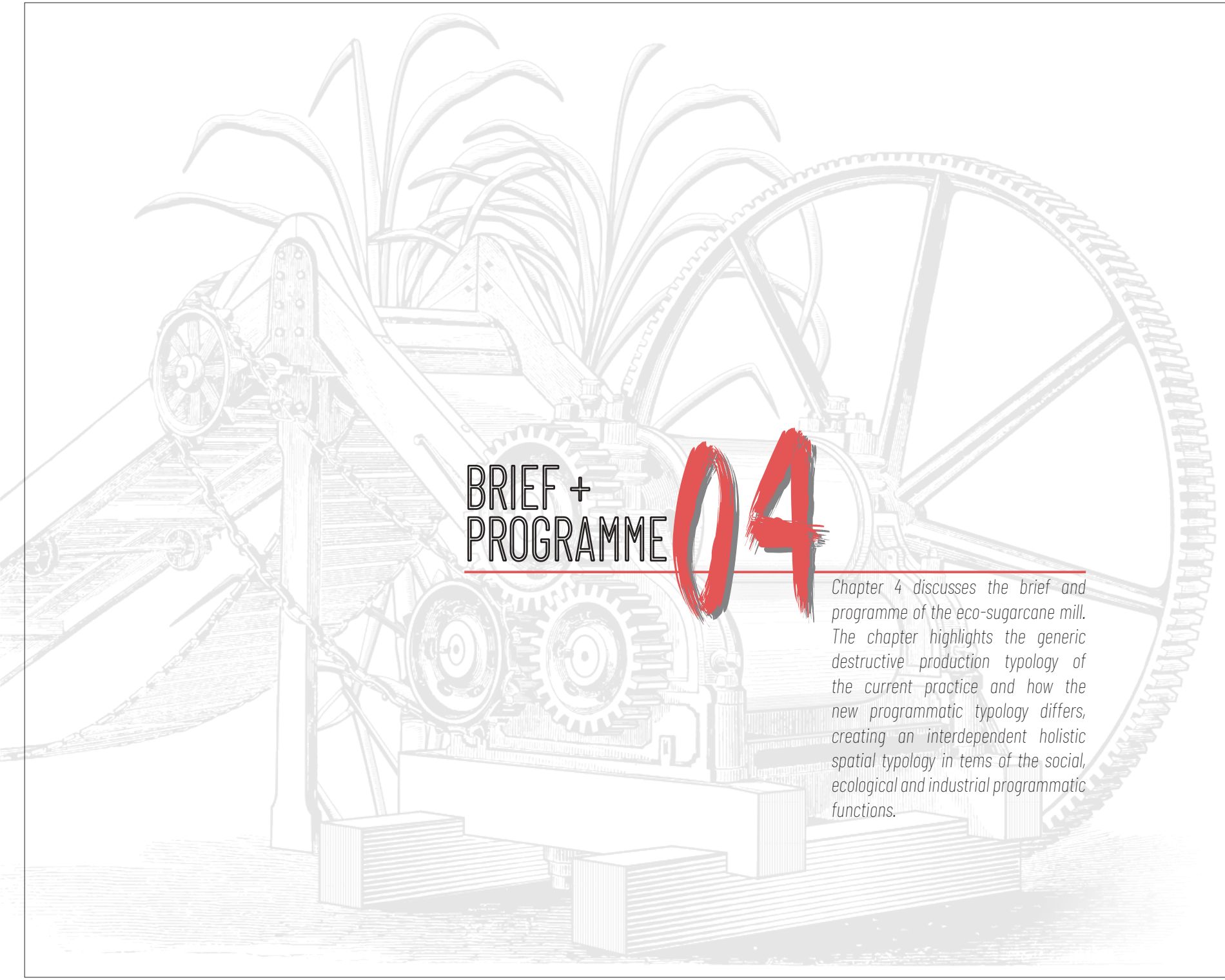


Figure 3.50: Segment 05 Analysis (Author, 2019)

Figure 3.51: Segment 06 Analysis (Author, 2019)

FIGURE

FIGURE



BRIEF + PROGRAMME 04

Chapter 4 discusses the brief and programme of the eco-sugarcane mill. The chapter highlights the generic destructive production typology of the current practice and how the new programmatic typology differs, creating an interdependent holistic spatial typology in tems of the social, ecological and industrial programmatic functions.

04 | *Programme*

04.1

DEFINING THE PROGRAMME

Reprogramming the generic mill to introduce a new archetype to the industry

MAKING THE SUGAR INDUSTRY ARCHITECTURE RELEVANT

An Eco-Sugarcane Mill as an Urban Generator and Conservation Genesis for the Ohlanga Node on the Umhlanga Precinct Periphery.

The programme is set to stimulate the interaction between nature, industry and the human interface. An Eco-Sugarcane Mill will act as the primary programme for the design, where the outcome is an eco closed-loop mill redirecting the current 21st century industrial typology of the sugar mill. Reprogramming the mill allows for secondary functions such as an indigenous plant seedling bank, rum distillery, restoration zones, wetland restoration and nature trails to act as generators for natural conservation and social incubators. All of which will act under a public domain, to help conserve, restore and celebrate the buffer zone of natural systems at play between the Umhlanga and Sibaya precinct.

04.2

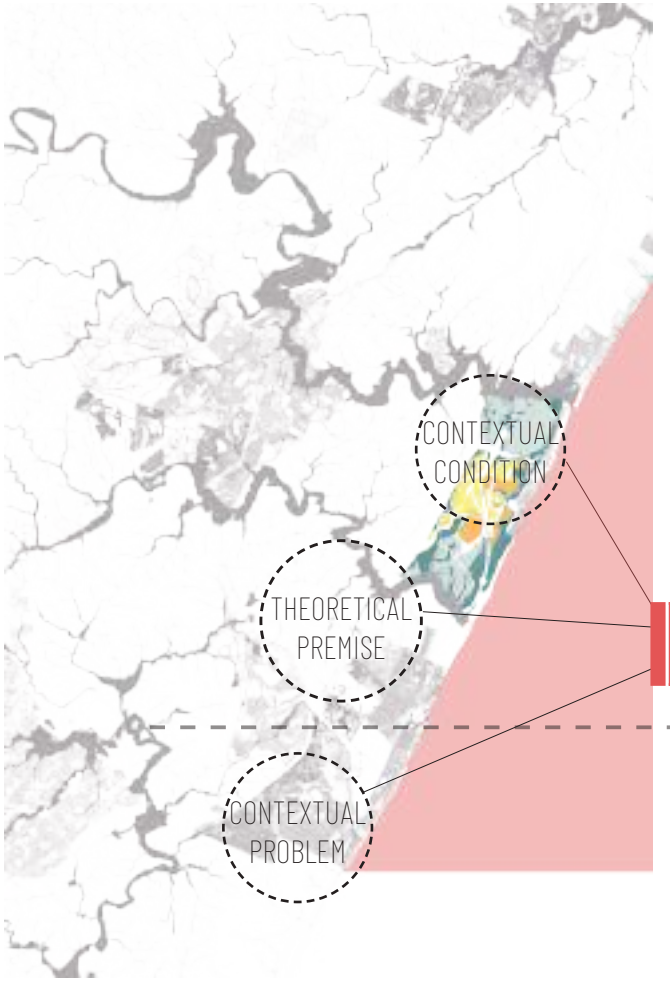
CATEGORIZED BRIEFS

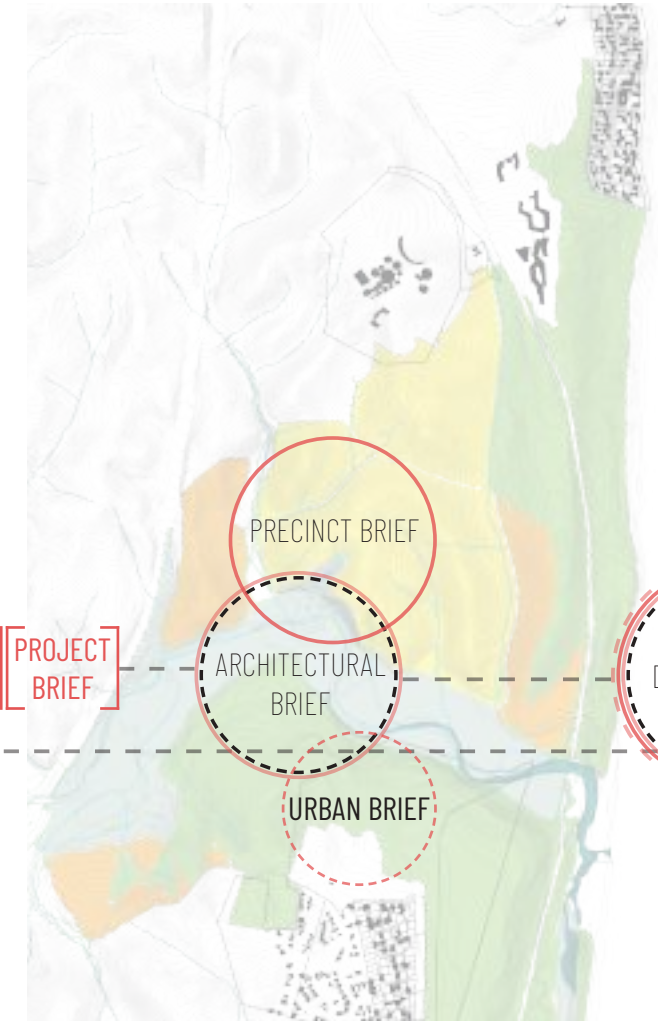
Relating the scales of intervention to their specific briefs

URBAN BRIEF : Durban: The North Coast - *The urban brief seeks to stimulate an alternative urban building typology, which caters for both the environment and urban expansion.*

PRECINCT BRIEF : Sibaya + Ohlanga Precinct : *The precinct brief serves as an alternate approach to coastal construction, where existing sugarcane fields are rehabilitated prior to development in an effort to restore natural systems disturbed by industrialising the landscapes.*

ARCHITECTURAL RESPONSE: The mill and site: *The architectural response will serve as the tactile result of the combination of all initiatives in an effort to restore the balance between man, nature and industry.*





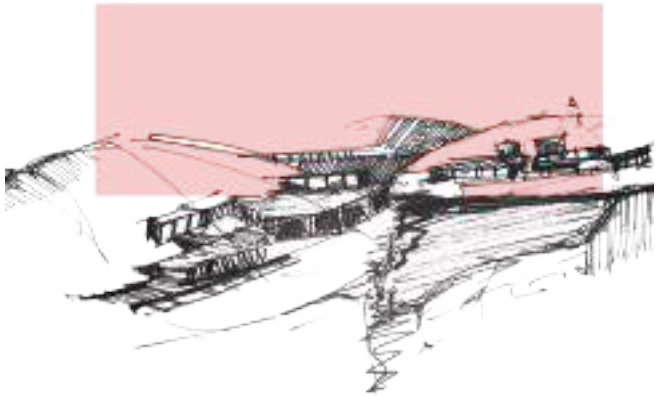


Figure 4.01: Left: Macro Client -Durban Coastal edge **(Author, 2019)**
Figure 4.02: Middle: Macro Site- Ohlanga Estuary **(Author, 2019)**
Figure 4.03: Right: Architectural sketch **(Author, 2019)**

04.3

CLIENTELE

Defining the Mill's Level of Users + Contributors

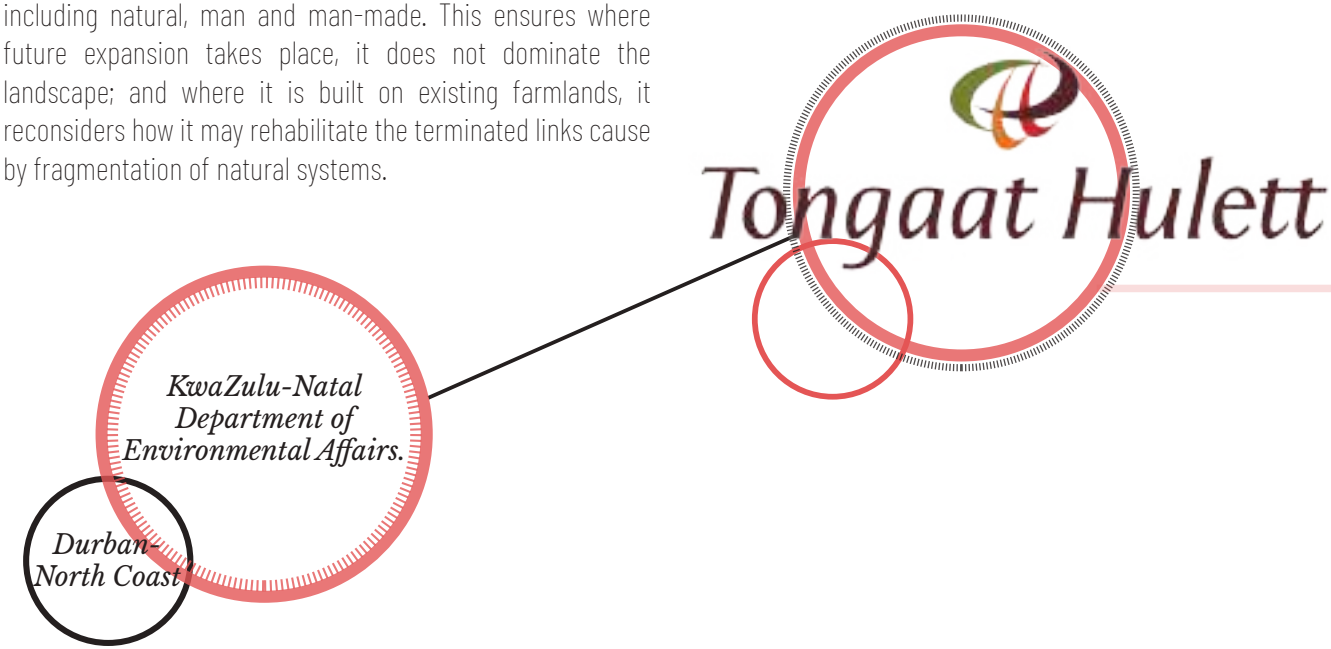
MACRO-CLIENT : KwaZulu-Natal Department of Environmental Affairs- *A stimulator for future expansion typological change, opposing the current deteriorative nature and introducing one which results in a symbiotic relationship*

Approximately 85% of the coastal wetland area in KwaZulu-Natal has been transformed into sugarcane fields leaving a few scattered patches of the wetlands (Begg, 1986). This sugarcane is being developed on at a rapid pace, at scales equivalent to precincts, establishing conurbation of Durban's coastal edge and restricting what is left of the natural resources.

A new development proposal for Durban's ever expanding nodes sees a new archetype, one which considers all stakeholders, including natural, man and man-made. This ensures where future expansion takes place, it does not dominate the landscape; and where it is built on existing farmlands, it reconsiders how it may rehabilitate the terminated links cause by fragmentation of natural systems.

MESO-CLIENT : Tongaat Hulett Developers + Sugar Industry: *An initiative by the organization to restore, regenerate and conserve both landscapes and urban environments, whilst stimulating the mediation of inequality within socio-economic classes.*

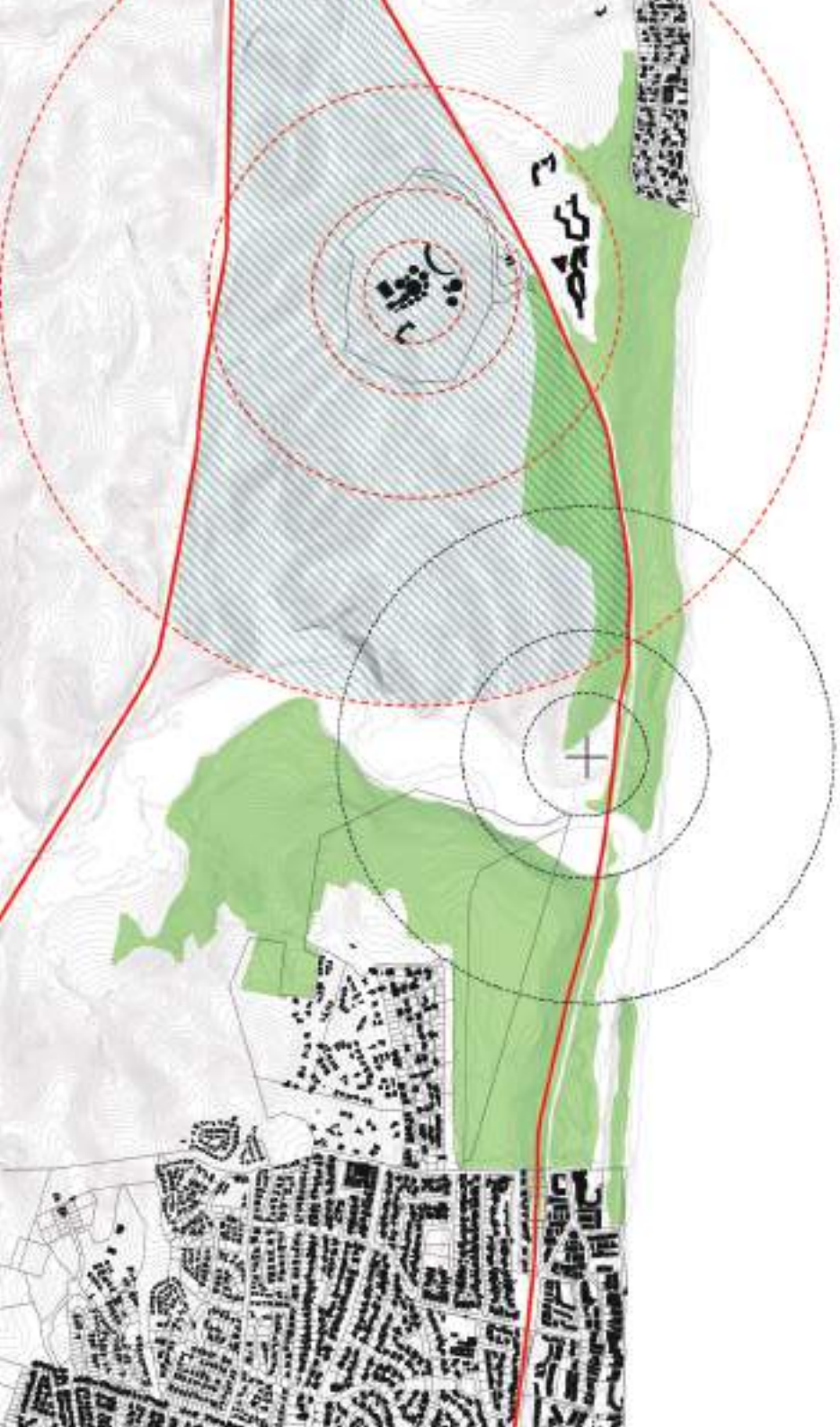
An Eco Mill as regenerative 'machine' for over-sourced landscapes, will be an initiative of Tongaat Hulett to restore coastal areas around the Sibaya Precinct. It will also act as an initiative to find sustainable agricultural techniques in which sugarcane may be farmed. The mill will act as a mediator between social classes, ensuring democratic urban spaces are created rather than becoming separated as we see in many urban spaces today.



MICRO-CLIENT: The Labourers, the Public + the Community: *Introducing the celebration of the labourer and the artistry of the sugar labourer, thus creating a spectacle inducing public engagement and socio-economic stimulation.*

The micro-clients are the users of the building. They are the workers, the public and the community surrounding the design. These are the immediate interact ors of the design and therefore are considered vital within the programmatic outline.

Figure 4.04: The sugarcane Labourer **(Author, 2019)**



04.4

CHRONOLOGICAL ADAPTABILITY

Reprogramming the generic mill to introduce a chronological relevance in relation to the contextual condition

DESCRIPTION OF ADAPTING THE MILL OVER TIME TO MAKE IT CONTEXTUALLY RELEVANT AND STIMULATE A REGENERATIVE CONTEXT.

The Mill will partially adapt over time as the need for processing the surrounding sugarcane decreases. The mill will process the entirety of the Sibaya Precinct's sugarcane fields (See Figure: 3.50 for macro sugarcane map) through manual labour. The programme of the project as a mill is therefore directly dependent to the rate at which development takes place within the Sibaya Precinct's time span. From this the initial sub-functions will then partially substitute the primary programme drivers, while the mill function will see the processing and rehabilitation of sugarcane from areas which are soon going to be developed.

The agenda of the programme is to educate and introduce regenerative and conservative urban living within the larger precinct, thus setting precedent for further expansion along the coastal edge. The new programmatic outline will be discussed fully later in the chapter.

Figure 4.05: Left: Current Expansion node Vs. Project intention **(Author, 2019)**

04.5

THE MILL'S PROGRAMMATIC TYPOLOGY

Discussing the Destructive Existing Typology with Relevance to Hulett's Current Mill.

Historic Influences on People

The sugarcane industry is one which has been built on the controversial dismay of many South Africans. This treatment resonates with many industrial processes which came about in the 20th century. The industrial era led to the replacement of manual labour with new automated technologies, in an effort to increase production to match the growing population's consumption requirements. In the present day sugar production realm, technological influences have cut out the majority of manual labour, which in turn has had major influences on the surrounding socio-economic structures.

One of Hulett's mills, the Maidstone Mill (Figure 4.07) processes 440 tons per hour through 2 parallel extraction plants[1], a substantial figure in South Africa's sugar market. This is however only possible with the use of advanced machinery, which requires an advanced technological understanding, leading to outsourcing of labour, leaving the immediate community to the labour intensive work, such as cutting and processing the sugarcane, a labour which has a remuneration not capable of providing for a stable lifestyle.

The project's intention is to celebrate the labourer's intensive work through the spectacle of displaying it to the public domain. Including the public into the movement phases of the sugarcane allows an opportunity of learning to take place through a didactic architectural type.

Figure 4.07: Left: Tongaat Hulett Maidstone Mill **(Author, 2019)**

1 Figure gained from Tongaat Hulett Web page

The existing programmatically biased typology

Architecturally, the sugar mill is a design which focuses on functionality as the aesthetic, resulting in factory-like compositions. This is a result of its industrial nature, whereby the architecture must be durable, relatively inexpensive for replacement, and generic for ease of replacement. One can see the generic factory forms in Figure 4.07, whereby functions are placed in a linear progression, to best optimize the production movement. The result is an environment which is spatially incompatible with the human aspect. The complex nature of the machining processes compiled within the mill seldom sees the interaction of people due to the spatial typology seen within the mill. The spatial layout of the mill requires redefining to adapt and take on the responsibility of human interaction. In

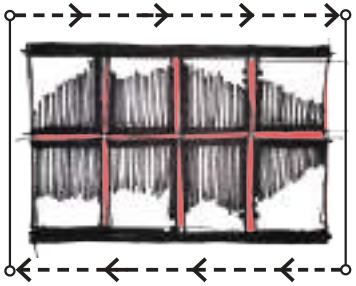


Figure 4.06: : Linear production typology **(Author, 2019)**

doing so, it will offer a harmonious typology, which celebrates the work of its labourers and engages with the public. The Eco-mill aims to reconcile a lost artistry and increase labour intensive work, which sees the labourer well remunerated for its efforts. It also allows for a sustainable work place, with links back to nature in an effort to reestablish a connection between industry and nature.

Making the Production Realm 'People Relevant'

By reestablishing the sugarcane mill's programmatic outline, the new programme will create an environment which allows for investment growth towards the conservation and rehabilitation of the coastal regions as well as provide socio-economic growth for the smaller districts surrounding the site. "Investment has offered an opportunity to rehabilitate degraded infrastructure and productive capacity, increase direct employment and supply opportunities for local land holders" (Dubb, Scoones. & Woodhouse, 2017). This investment creates opportunity for locals to stay within the area, rather than being forced out, often seen in cases of investment developments.

Making the production realm affiliated with public movement has not been done within any South African sugar mills, but allows for an innovative take on industrial tourism, adding investment to the area.

The exposing of the process will also create awareness for the artistry of manual sugarmaking. Thus celebrating the labourer and downscaling the mill's processes for public viewing.

04.6

A CURRENT LINEAR PROGRAMME

The dilemmas of linear production of the sugar mill.

The sugarcane industry has grown at such a rapid rate, that the mill has become a mass machine, in which a natural state product enters at one end, and exits as a rich commodity, resulting in the mill acting as a 'well oiled' machine, with little to no space for social interaction or engagement.

The linear process has the inability to provide for social movement through the building, as machinery and product movement results in inhumane spatial typologies. The result of the architecture is the industrial mill, where the architecture only speaks of production and a resilience to this production. The linear passage results in a cradle-to-grave of materials and has influenced the way in which people interact within the building itself.

The sugar process involves two phases, namely the milling of the cane and the sugar refining (See Figure 4.10). The first phase requires a multitude of linear machining processes to produce the sugar-juice. This juice is cleaned of any obscurities and sent further towards phase 2, where it is refined and crystalised into what we know as the white sugar on the shelves at our local shop. The machining of the cane is done using industrial scale machinery, which is unsafe for any untrained professional to be around. This results in zoned-off spaces within the mill, inaccessible to majority of the workers. Possibly the only place for interaction within the process is in the sugarcane fields, where workers gather in the fields, cutting crops and engaging with one another. This act should resonate within the mill as well.

The machinery used also requires massive power inputs to run, which in South African context, uncontrollably fluctuates when using municipal sources. And in terms of global context, the crisis of using fossil fuels as energy sources comes into debate when considering the way in which sugar is produced. The way in which we power the mill therefore needs to change to suit the sustainability factors we face.

The linear programme scheme results in wasted materials in the form of energy, organic byproducts and natural resources, all of which are currently discarded in unsustainable fashions and as Durban's iconic character profile, the sugar industry must evolve, incorporating a regenerative scheme, to act ethically within its context.

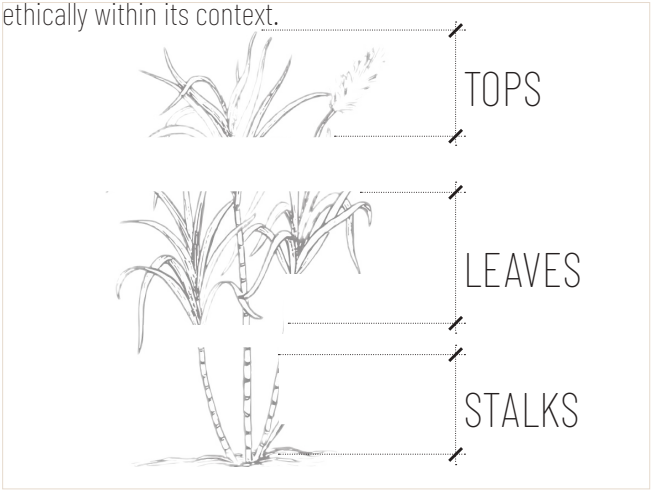


Figure 4.09: Three components of Sugarcane **(Author, 2019)**

Figure 4.08: Top: Sugarcane Workers **(Author, 2019)**

04.7

CURRENT LINEAR PRODUCTION MILL

Figure 4.10: Sugar Milling Process (Sugar Australia, edited by Author, 2019)

GENERIC PROGRAMMATIC OUTLINE - DEFINING ORIGINAL PROCESS

Defining current industrial sugarcane processing programmatic functions

SPATIAL NATURE	BUILDING ZONING	MAIN PROGRAM	SUB-PROGRAM	PROGRAM DESCRIPTION
Defining the spatial nature of the building between industrial - educational - social - ecological	*Refining building zones as a placemaker for site viewing*	*Distnguishing the main programmatic function of the building - from which a main architype is established in response to.*	*Distinguishing the partial programmatic function of the building - acting with, under or in relation to the main program*	*Creating an awareness of scale and type of main program acting within the structure - which in turn relates to the architecture of said space.*
Industrial - production and processing	①	1. Cultivation	1.1 Harvesting 1.2 Sorting 1.3 Weighing 1.4 Storage	Sugar cane is harvested by chopping down the stems. This may be done either through manual labour or using combines. Once cut, the cane is processed in which excess foliage is removed and weighed.
	②	2. Processing	2.1 Tippler zone 2.2 Weighing 2.3 Loading on conveyor 2.4 Excess Waste processing	The tippler zone is where large amounts of cane is moved into the processing area, from which it is loaded onto a conveyor. Excess waste is removed and stored for further byproduct processing.
	③	3. Washing	3.1 Washing conveyor 3.1.1 Excess waste straining 3.2 Wetland management 3.3 Shredding 3.3.1 Excess waste	The washing conveyor cleans the sugarcane stalks prior to crushing it. This removes and excess dirt and rubble. The excess waste water will be filtered back into the wetland system. Once clean, the cane is sent to the shredder where the initial juice is extracted.
	④	4. Milling	4.1 Shredder 4.2 Crusher 4.3 Milling 4.4 Clarifier 01 4.5 Clarifier 02	The cane is sent to a shredder, breaking the material up for ease of processing. Pairs of rollers feed the cane through a series of mills. This process separates the sugar juice from the fibrous material, called bagasse. Imbibition is the process in which water or juice is applied to the crushed cane to enhance the extraction of the juice at the next mill. The crushed cane exiting the last mill is called bagasse. The juice from the mills is strained to remove large particles and then clarified.
	⑤	5. Milling	5.1 Diffusion 5.2 Vacuum Pan 5.3 Centrifugal 5.4 Dryer	Clarified juice goes to the evaporators without additional treatment. The mud is filtered and the filtercake is washed with water. Evaporation is performed in two stages: initially in an evaporator station to concentrate the juice and then in vacuum pans to crystallize the sugar. Crystallization of the sugar starts in the vacuum pans, whose function is to produce sugar crystals from the syrup. From the crystallizer, the massecuite (A massecuite) is transferred to high-speed centrifugal machines (centrifugals), in which the mother liquor (termed "molasses") is centrifuged to the outer shell and the crystals remain in the inner centrifugal basket.
	⑥	6. Dry Storage	6.1 Sorting Room 6.2 Storage Room 6.3 Waste Processing 6.4 Waste Storage	The sugar is the transferred to a bulk dry sorting and storage, from which the sugar may be sent for further refinement.
	⑦	7. Crystal Growth	7.1 Affination Mixer 7.2 Centrifugal 7.3 Melter 7.4 Phosphation	The sugar crystals are sent to a melter and then to the clarification step. The phosphation uses phosphoric acid, lime (as lime sucrate to increase solubility), and polyacrylamide flocculent to produce a calcium phosphate floc.
	⑧	8. Sugar Refining	8.1 Decolourisation 8.2 Vacuum Pan 8.3 Centrifugal 8.4 Dryer 8.5 Grader	The next step is decolorisation, which removes soluble impurities by adsorption. The decolorised sugar liquor is sent to heaters (at some refineries), followed by multiple-effect evaporators, and then to the vacuum pans; this is the same sequence used in cane sugar manufacture. When the liquor in the pans has reached the desired level of supersaturation, the liquor is "seeded" to initiate formation of sugar crystals. In the centrifugal, the white sugar is retained in the inner basket and the liquor centrifuged to the outer shell. The most common sugar dryer is the granulator, which consists of two drums in series. One drum dries the sugar and the other cools the dried sugar crystals.
	⑨	9. Package Production	9.1 Fiberous material cleaned 9.2 Processing 9.3 Material production 9.4 Storage - dry 9.5 Management	
	⑩	10. Packaging	10.1 Material storage 10.2 Packing station 10.3 Package product storage 10.4 Loading +exporting zone 10.5 Excess waste movement	

PROGRAM REQUIREMENTS	AREA	BYPRODUCTS	BYPRODUCTS NEW PROGRAM
Distinguishing the programmatic requirements of the building to better understand how the architecture must respond.	*(m^2)*	*By products from both main program and sub-program from which the byproduct may be reimplemented.*	*New program derived from byproducts produced from sugarcane processing.*
N/A	N/A	N/A	Molasses: Molasses is the only by-product obtained in the preparation of sugar through repeated crystallization. The yield of molasses per ton of sugarcane varies in the range of 4.5% to 5%. Molasses is mainly used for the manufacture of alcohol, yeast and cattle feed. Alcohol in turn is used to produce ethanol, rectified spirit, potable liquor and downstream value added chemicals such as acetone, acetic acid, butanol, acetic an-hydride, MEG etc. The state government controls the export of molasses through export licenses issued every quarter. Molasses and alcohol-based industries were decontrolled in 1993 and are now being controlled by respective state government polices. Nearly 90% of molasses produced is consumed by the industrial alcohol manufacturers and the remaining 10% is consumed by the potable alcohol sector. Bagasse: Bagasse is a fibrous residue of cane stalk that is obtained after crushing and extraction of juice. It consists of water, fiber and relatively small quantities of soluble solids. The composition of bagasse varies based on the variety of sugarcane, maturity of cane, method of harvesting and the efficiency of the sugar mill. Bagasse is usually used as a combustible in furnaces to produce steam, which in turn is used to generate power. It is also used as a raw material for production of paper and as feedstock for cattle. By making use of bagasse sugar mills have been successful in reducing dependence on State Electric Boards, for their power supply as it can procure up to 90-95% of its total power requirement through captive generation from steam turbines. Fly ash: Fly Ash is the residual output from the boiler furnace after bagasse has completely burnt out. This fly ash is used as a substitute for firewood. It is rich in potassium and is also used by local farmers for cultivation. Press Mud: Press mud, also known as oliver cake or press cake, is the residual output after the filtration of the juice. It is mixed with spent wash from the distillery and cultivated to produce high quality bio-manure.

04.9

REDEFINING THE SUGAR INDUSTRY

Redefining the Programmatic Outline of the Mill to Incorporate the User Into the Production

INTEGRATING HUMAN AND INDUSTRIAL LABOUR

The current sugar production realm relies heavily on an industrial production typology, excluding majority of the original manual labour influence. This has led to the mill becoming spatially insignificant for human interaction. The typology is therefore limited to its sole purpose, production.

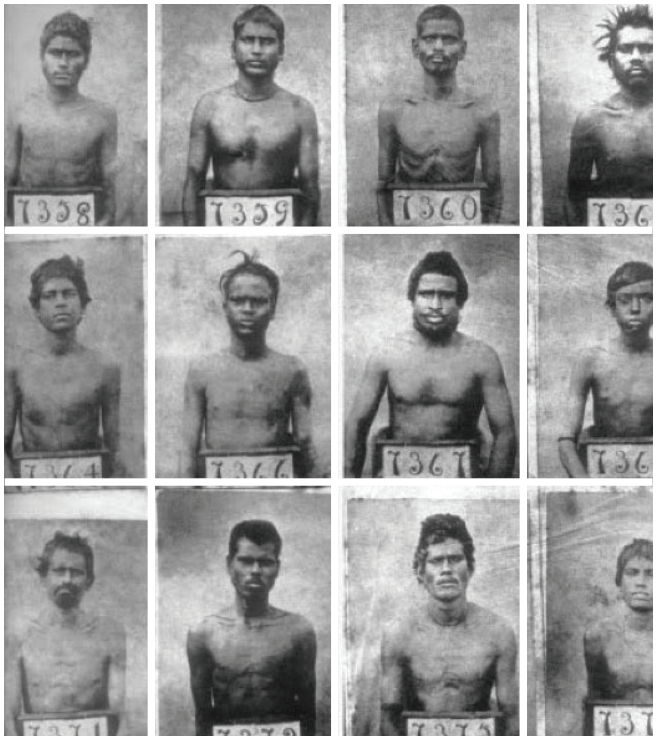
The project therefore looks to redefine the industrial typology of the mill in an effort to bring human interaction back to the milling process. The traditional production of sugar was a process which brought social and cultural stimulation. The artistry in producing the sweet product was a spectacle, often requiring more than one set of hands and always gathered a crowd.

The 'spectacle' notion becomes a vital programme driver in reshaping the mill's typology. The industrial nature of the mill is transferred by bringing the human back into the system. Therefore the architecture will change from an industrial typology to one which celebrates the enhances the manual labour of sugar making, which in past tenses, was seen in a different light.

ARCHITECTURE + CULTURAL REMEDIATION

Locating cultural remediation infrastructure within the design.

Figure 4.11: Indentured Labourors (SA History Online, edited by Author, 2019)



SUGAR CANE IDENTITY

The identity behind the historical sugarcane production and the artistry behind the process

PRODUCTION AS AN ART FORM- *'RE-BIRTHING THE LOST IDENTITY"*

Sugarcane has had a major influence within Durban's cultural identity from its genesis in KwaZulu-Natal in the early 18th Century up until present day.

Present-day sugar production uses a machining process called milling, as the mass quantities required for exportation are unobtainable through manual labour. However, the nature of the project (milling only a 'small' section of Durban's sugar fields) reintroduces a labour sensitive act behind sugar production in an effort to stimulate regeneration of the social, economic and localized production. The manual production of sugar may be re-imagined as the artistry which has been lost over the decades of sugar production, bringing light to an identity behind sugar's history.

Exposing the manual production, gives public insight into the labour intensive programme, providing identity to the workmanship of labourers, which is often overlooked.

In exposing the production an awareness towards the below may be established:

1_ The nature of our industrial landscapes
2_ Sugar's history and the cultural landscapes behind sugarcane
3_ The spectacle of sugar making
4_ Industrial tourism
5_ Intensity of sugarcane labour

INTANGIBLE MEMORY

Homage to the original sugarcane workers through visual labour + architecture

CELEBRATING WHAT WAS LOST THROUGH SUGARCANE

Sugarcane has an relatively intangible history, an industry built on the dismay of both the indentured Indian and African community. These sugarcane landscapes are therefore inevitably iconic as cultural landscapes- an idea not expressed by the sugar industry, to which we should pay homage for cultural remediation.

In reprogramming the mill to a labour-intensive production realm by bringing the human back into the system, an idea of intangible memory of previous manual slavery may be celebrated by the public through the artistry of sugar making, bringing back an awareness to the cultural landscape on which Umhlanga and Durban is developed on. This also allows for identity to also be brought to the current workers, whose labour often goes unnoticed by the public eye.

PRODUCTION VS. SOCIAL

How can architecture become a place-maker for social interaction in a production realm

USING THE MILL TO INTEGRATE SOCIAL ENGAGEMENT INTO A PRODUCTIVE REALM ENABLING A SYMBIOTIC RELATIONSHIP.

The project proposes subprograms of the mill namely the distillery and natural tourism which coexist with the production line of the sugarcane. These programmes offer a social sphere which publicizes the productive spaces, actively contributing to both the conservation and social integration of the node.

Whilst the site is currently inactive as an urban node, the project will generate an urban edge condition for the future Sibaya Precinct, which will be conducive to rehabilitating the environment whilst playing a vital role in creating a social democratic node. The programme uses industrial tourism as a generator for foot-movement. By creating a spectacle of the industrial process, one creates a social incubator, which previously, did not exist.

The use of the contextual surroundings and sugar byproducts, the subprograms not only allow for social interaction, but play a vital role in bringing awareness to the conservation of the area as well as the importance of sustainability in production and building.

INDUSTRIAL + ECOLOGICAL TOURISM

Architecture as a generator for socio-economic increase using the potential of industrial tourism

GENERATING AS DESIRABLE PROGRAMMATIC OUTCOME FROM A PREVIOUSLY DISTASTEFUL PROCESS.

The sugar production process is one which is unfamiliar to the public eye. The phases through which sugarcane must go through to become sugar we know, may be seen as each having a specific spatial quality, these spatial qualities or *genius loci* may be enhanced through the quality of both the context and the architecture. This may then celebrate the spatial quality of the programme and therefore enhance the idea of the manual and passive labour types within the building.

The essence of place celebrated by the architecture influences the publics' perception of industry, and may therefore become a desirable attraction to the public. The process brings a public facet to a previously private spatial typology.

The architecture exposes the production phases to the public, promoting production architecture as a much more accessible typology. The production line will act as public promenade through the site, using Durban's prevailing promenade typology as inspiration[1]. This 'promenade' will also extend into the landscape, providing access into both the wetland and forestry areas through elevated paths and nature trails, bringing the public into the natural ecosystems which were previously inaccessible, allowing for a celebration of our natural environments.

TERMINOLOGY:

Indentured labour

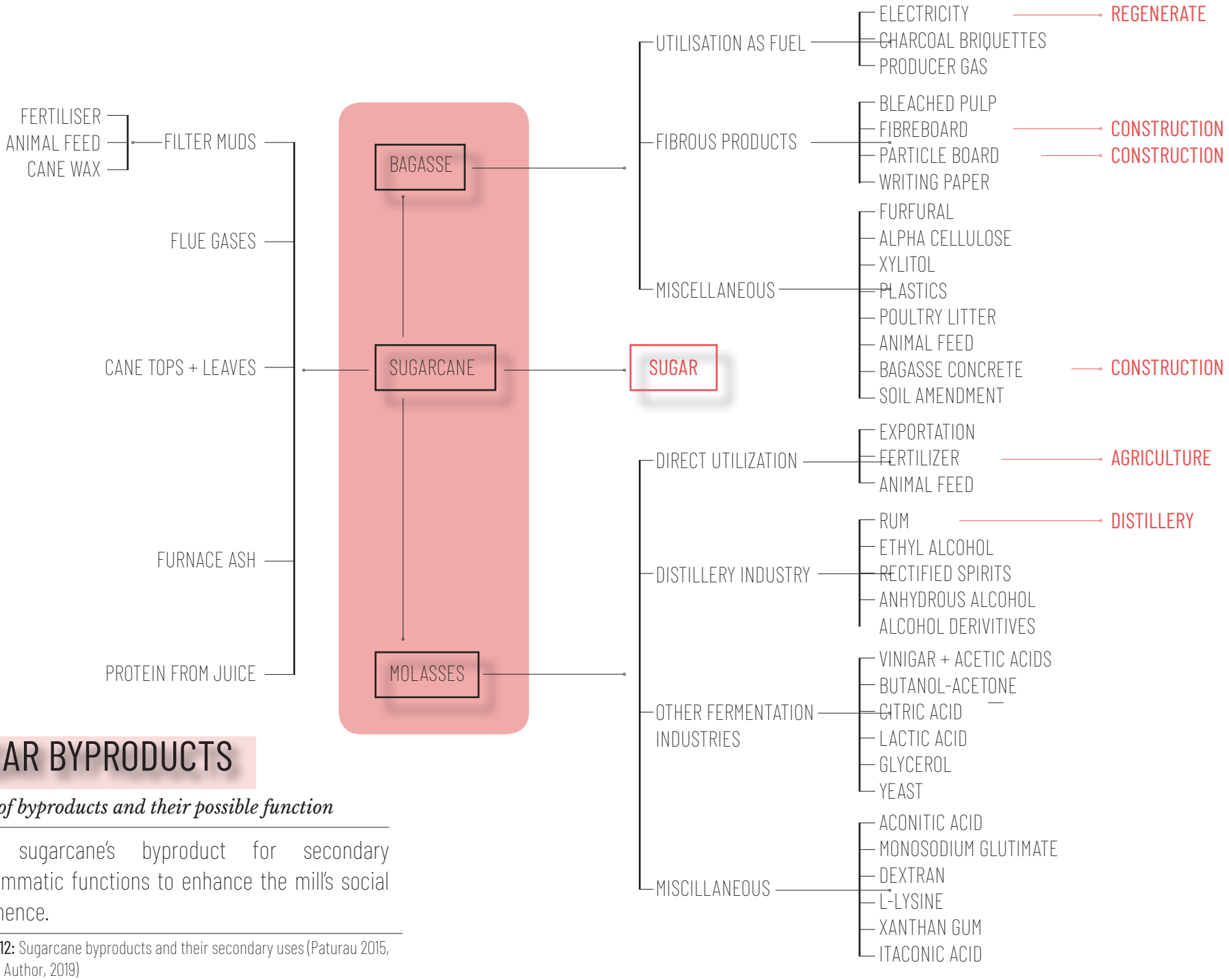
"An indentured servant or indentured labourer is an employee (indenturee) within a system of unfree labour who is bound by a signed or forced contract (indenture) to work for a particular employer for a fixed time." (SA History Online, 2011)

Genius Loci

The term genius loci as 'spirit of place', however, refers back to the original meaning of genius as 'essence'. Thus, in geography, landscape architecture and architectural design, genius loci is now accepted as denoting 'spirit or essence of place'. (Archispeak- Porter, 2004)

Notes:

1 Refering to the Durban promenade as well as the smaller Umhlanga and Umdloti promenades allowing for a boost in urban attraction and movement.



04.11

SUGAR BYPRODUCTS

Table of byproducts and their possible function

Using sugarcane's byproduct for secondary programmatic functions to enhance the mill's social prominence.

Figure 4.12: Sugarcane byproducts and their secondary uses (Paturau 2015, edited by Author, 2019)

04.12

SOCIAL ENGAGEMENT INITIATOR

Using The Regenerative Characteristic Of The Mill As A Generator For Social Engagement.

MAKING THE DESIGN 'PEOPLE RELEVANT'

The mill as a regenerative integrated system not only has an influence in ecological terms, but as a social engagement initiator through potential byproducts created by the mill.

The social attribute includes the rum distillery, using excess sugarcane molasses as the fermenting component. The rich social characteristics of surrounding areas seen in both Umdloti and Umhlanga will continue in the mill through the distillery. The rum distillery will create a node for public engagement as well as an opportunity where public interaction and production may coexist, adapting the perception of the mill as an industrial-only system.

The landscape surrounding the mill allows for an engagement with the natural and induced landscape, celebrating it for its recreational quality. The aim of the mill is not to traditionally separate the ecology, industry and urban settings, but rather entice a scenario which may see the coexistence and interdependency of one on the other. The hybrid nature of the mill, seeing integrated spaces, allows for holistic spaces to be created, where no programme overrules the other, and balance is achieved throughout.

Figure 4.13: Right: Umhlanga's vibrant social nature **(Author, 2019)**

04.13

ADAPTING THE MILL FOR FUTURE USE.

Re-centering the Mill's programme for contextual relevance as the need for sugar production decreases.

ENSURING THE LONGEVITY OF THE MILL THROUGH ADAPTABILITY

As discussed earlier, the mill's programmatic outline will adapt overtime to keep contextually relevant. This is done in conjunction with the Sibaya Precinct development, and the need for less sugarcane processing due to development.

The future programme will still see the production of sugar, but with the Sibaya area having been developed, will stretch outwards and process the sugarcane seen on further sites which are going to be developed on. The same principles for rehabilitating the sites will still apply. Therefore the mill's programmatic outline for rehabilitation, such as the seedling greenhouses and botanical study areas remain as main drivers, and may become primary programme drivers of the building for future consideration.

PROGRAMMATIC OUTLINE - REDEFINED

Redefining sugarcane process to bring human influence back into the industrial process

SPATIAL NATURE

Defining the spatial nature of the building between industrial - educational - social - ecological

Industrial - Production + Processing

- Safe working conditions
- Durable Materials
- Fireproof Material
- Waterproof Material
- Easily Cleaned
- Nonslip Flooring

BUILDING ZONING

Refining building zones as a placemaker for site viewing

①	1. Cultivation
②	2. Processing
③	3. Washing
④	4. Milling
⑤	5. Filtration
⑥	6. Clarification
⑦	7. Boiling
⑧	8. Crystallisation
⑨	9. Centrifuging
⑩	10. Drying + Packing

MAIN PROGRAM

Distinguishing the main programmatic function of the building - from which a main architype is established in response to.

1.	Cultivation
2.	Processing
3.	Washing
4.	Milling
5.	Filtration
6.	Clarification
7.	Boiling
8.	Crystallisation
9.	Centrifuging
10.	Drying + Packing

SUB-PROGRAM

Distinguishing the partial programmatic function of the building - acting with, under or in relation to the main program

1.1	Harvesting
1.2	Sorting
1.3	Weighing
1.4	Storage
2.1	Tippler zone
2.2	Weighing
2.3	Loading on conveyor
2.4	Excess Waste processing
3.1	Washing conveyor
3.1.1	Excess waste straining
3.2	Wetland management
3.3	Shredding
3.3.1	Excess waste
4.1	Shredder
4.2	Crusher
4.3	Milling
4.4	Clarifier 01
4.5	Clarifier 02
5.1	Diffusion
5.2	Vacuum Pan
5.3	Centrifugal
5.4	Dryer
6.1	Sorting Room
6.2	Storage Room
6.3	Waste Processing
6.4	Waste Storage
7.1	Furnace rooms
7.1	Bagasse kindle storage
7.2	Centrifugal
7.3	Melter
7.4	Phosphation
8.1	Decolourisation
8.2	Vacuum Pan
8.3	Centrifugal
8.4	Dryer
8.5	Grader
9.1	Excess fiberous material
9.2	Processing
9.3	Material production
9.4	Storage - dry
9.5	Management
10.1	Material storage
10.2	Packing station
10.3	Package product storage
10.4	Loading + exporting zone
10.5	Excess waste movement

PROGRAM DESCRIPTION

Creating an awareness of scale and type of main program acting within the structure - which in turn relates to the architecture of said space.

Sugar cane is harvested by chopping down the stems. This may be done through manual labour. Once cut, the cane is processed in which excess foilage is removed and weighed.

The tippler zone is where large amounts of cane is moved into the processing area, from which it is loaded onto a conveyor. Excess waste is removed and stored for further byproduct processing.

The washing of the cane is done manually, using filtered water from the wetland. The cane is moved through each phase by a water powered conveyor. The manual aspect ensures the sugarcane stalks are cleaned properly prior to crushing it. This removes and excess dirt and rubble. The excess waste water will be filtered back into the wetland system. Once clean, the cane is sent to the shredder where the initial juice is extracted.

The cane is sent to a shredder, breaking the material up for ease of processing. The shredder is powered by burning excess bagasse in a steam turbine. Pairs of rollers feed the cane through a series of watermills. This process separates the sugar juice from the fibrous material, called bagasse. Water is applied to the crushed cane to enhance the extraction of the juice at the next mill.

The juice is filtered through a fine mesh to remove any solids or left over sugarcane fibers. The juice is then filtered by allowing the juice to settle for a few hours. The tank should be fitted with a fine mesh mentioned above, filtering any excess bagasse and dirt. The juice should then be removed from the top, ensuring the settled matter is not disturbed. The juice is then sent to a boiling pan for reduction.

Prior to boiling, the juice is poured again through a fine mesh, removing any final materials. Clarification, if undertaken, is carried out during the boiling process by adding a small amount of vegetable or chemical matter to the juice. The clarificants do not react with the juice but coagulate during the heating process, trapping particles and contaminants and bringing them to the surface during boiling.

The sugarcane juice is boiled until the required concentration of syrup is achieved. The aim is to remove the moisture via vaporation, and finish before crystallisation occurs. The boiling uses a furnace, burning excess bagasse for kindle. The massecuite is removed from the pan for further processing. The boiling operation uses cascade type furnaces of various configurations.

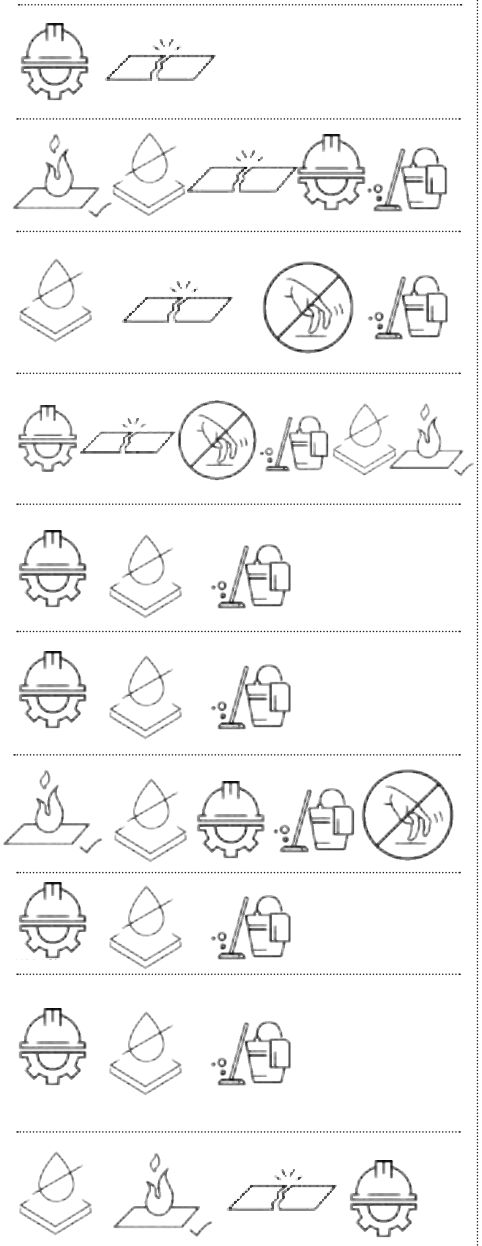
The massecuite is placed in U-shaped vessels where it is slowly rotated and allowed to cool for up to 48 hours. This technique is often referred to as crystallisation in motion. Rotation promotes even cooling of the massecuite which helps to achieve uniform crystal growth.

The centrifuge, a scaled-down version of those used in large-scale factories, consists of a perforated inner drum located inside a larger drum. The perforated drum is rotated rapidly, forcing the molasses to separate from the crystals. Water is sprayed into the spinning drum to assist in the removal of the molasses. The crystals of sugar are then removed from the centrifuge and transferred for drying. The molasses are collected and sent to the distillary, from which rum is produced.

The crystal drying process can be done in a number of ways. The passive use of solar drying is used in the project. The crystals are placed either in direct sunlight of by using diffused solar dryers. The dried product is then moved to the suitable packaging area for distribution.

PROGRAM REQUIREMENTS

Distinguishing the programmatic requirements of the building to better understand how the architecture must respond.



AREA

(m^2)

BYPRODUCTS

Byproducts from both main program and sub-program from which the byproduct may be reimplemented.

Excess foilage such as leaves, stalks and roots partially stripped during harvesting processes. May be left in field tp decompose into soil.

Excess foilage such as leaves, stalks and roots. May be collected and stored for further use in construction, energy or organic fertiliser.

Excess waste runoff may be collected and dried. The grey water may be sent through the constructed wetlands for basic filtration.

Milling reduced the cane to a fibrous material called bagasse. This may be used for construction and energy sources.

Excess bagasse may be filtered out by fine mesh and dried out for further use. Organic material not used for energy or construction sources may be decomposed and used as fertiliser.

Excess bagasse may be filtered out and dried for further use. Organic material not used for energy or construction sources may be decomposed and used as fertiliser.

Boiling requires a heat source, which may use bagasse as fire kindle. Once finished, bagasse ash is used in construction to create a cementeous material. Steam is condensated and sent into the wetland for filtration.

Excess molasses may be stored and used further in rum distilling.

Excess molasses and water may be sent to the distilling section of the building, whereby it will be used to distill rum which is served in the tasting area of the mill.

Excess heat may be collected and used to heat spaces which require set temperatures.

BYPRODUCTS NEW PROGRAM

New program derived from byproducts produced from sugarcane processing.

Molasses:

Molasses is the only by-product obtained in the preparation of sugar through repeated crystallisation. The yield of molasses per ton of sugarcane varies in the range of 4.5% to 5%. Molasses is mainly used for the manufacture of alcohol, yeast and cattle feed. Alcohol in turn is used to produce ethanol, rectified spirit, potable liquor and downstream value added chemicals such as acetone, acetic acid, butanol, acetic an-hydride, MEG etc.

The state government controls the export of molasses through export licenses issued every quarter. Molasses and alcohol-based industries were decontrolled in 1993 and are now being controlled by respective state government polices. Nearly 90% of molasses produced is consumed by the industrial alcohol manufacturers and the remaining 10% is consumed by the potable alcohol sector.

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By making use of bagasse sugar mills have been successful in reducing dependence on State Electric Boards, for their power supply as it can procure up to 90-95% of its total power requirement through captive generation from steam turbines.

Fly ash:

Fly Ash is the residual output from the boiler furnace after bagasse has completely burnt out. This fly ash is used as a substitute for firewood. It is rich in potassium and is also used by local farmers for cultivation.

Press Mud:

Press mud, also known as oliver cake or press cake, is the residual output after the filtration of the juice. It is mixed with spent wash from the distillery and cultivated to produce high quality bio-manure.

ZONING MAP / BUILDING FORMATION

ADD LOCATIONAL MAP

PROGRAMMATIC OUTLINE

REFINING BUILDING USES AND CREATING LINKS

SPATIAL NATURE	BUILDING ZONING	MAIN PROGRAM	SUB-PROGRAM	PROGRAM DESCRIPTION
Defining the spatial nature of the building between industrial - educational - social - ecological	*Refining building zones as a placemaker for site viewing*	*Distinguishing the main programmatic function of the building - from which a main architype is established in response to.*	*Distinguishing the partial programmatic function of the building - acting with, under, or in relation to the main program*	*Creating an awareness of scale and type of main program acting within the structure - which in turn relates to the architecture of said space.*
Social Incubators - Industrial, natural and social tourism facets  Well Lit Spaces  Durable Materials  Fireproof Material  Waterproof Material  Easily Cleaned  Nonslip Flooring	⑫	12. Tourism	12.1 Information Centre 12.2 'Lecture' area 12.3 Industry 'Promenade' tour 12.4 Public parking 12.5 Sugar(cane) tasting	Public promenade through the site introducing the public to every aspect of sugarcane processing. Public infrastructure will serve a dual purpose for product movement from stations.
	⑬	13. Social	13.1 Micro Rum Distillary 13.2 Picnic areas 13.3 View points	Public interface for the production aspect of the sugar industry - giving an understanding of the production typolgy.
	⑭	14. Educational	14.1 Wetland rehabilitation zones 14.2 Sugarcane information 14.3 Bird + Animal hides 14.4 Nature Trails	Celebrating the Ohlanga Estuary conservation through educating the public. Educating the public on the importance of rehabilitation of estuary zones for natural conservation and continuation. An initiative for ensuring the thriving of animal and plant systems, and encouraging the enhancemnet of the conservation areas currently existing
	⑮	15. Cultural	15.1 Historic 'timeline' 15.2 Mill Museum	Celebrating the Ohlanga Estuary conservation through educating the public. Educating the public on the importance of rehabilitation of estuary zones for natural conservation and continuation. An initiative for ensuring the thriving of animal and plant systems, and encouraging the enhancemnet of the conservation areas currently existing

SPATIAL NATURE	BUILDING ZONING	MAIN PROGRAM	SUB-PROGRAM	PROGRAM DESCRIPTION
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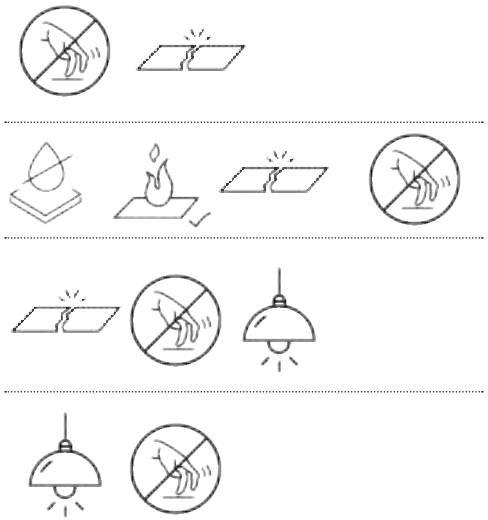
Production and Agricultural	⑯	16. Sugar Cultivation Study Centre	16.1 Agriculture labs 16.2 Product storage 16.3 Cultivation Study zones 16.4 Workers' infrastructure 16.6 Public interface	A centre in which the agricultural aspect of sugarcane is studied in an effort to minimilise the impact of the sugar industry on natural systems. An effort to create a system in which the cultivation of sugarcane and the conservation of natural systems may coexist.
	⑰	17. Nature Rehabilitation Study Centre	17.1 Horticulture labs 17.2 Workers' infrastructure 17.3 Animal Study 17.4 Seedling growth + Management 17.5 Storage	Create an environment in which the indigenous plant species may be grown, studied and dispersed into the extended site ensuring the restoration of landscapes prior to the development of the new precinct. Study on the impacts of sugarcane on natural systems and how they may coexist.
	⑱	18. Wetland rehabilitation Centre	14.1 Wetland rehabilitation 14.2 Water testing labs 14.3 Aquaculture study 14.4 Horticulture labs	Study the runoff of sugarcane topsoils into wetland zones and the impact it is having on the natural systems. Horticulture studies ensuring sustainable landscapes.

PROGRAM REQUIREMENTS

Distinguishing the programmatic requirements of the building to better understand how the architecture must respond.

AREA

(m^2)



PROGRAM REQUIREMENTS

Distinguishing the programmatic requirements of the building to better understand how the architecture must respond.

AREA

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ZONING MAP / BUILDING FORMATION

05

CONCEPT

Chapter 5 discusses the conceptual generators of the project, resulting in a conceptual approach which is solidified into an architectural concept.

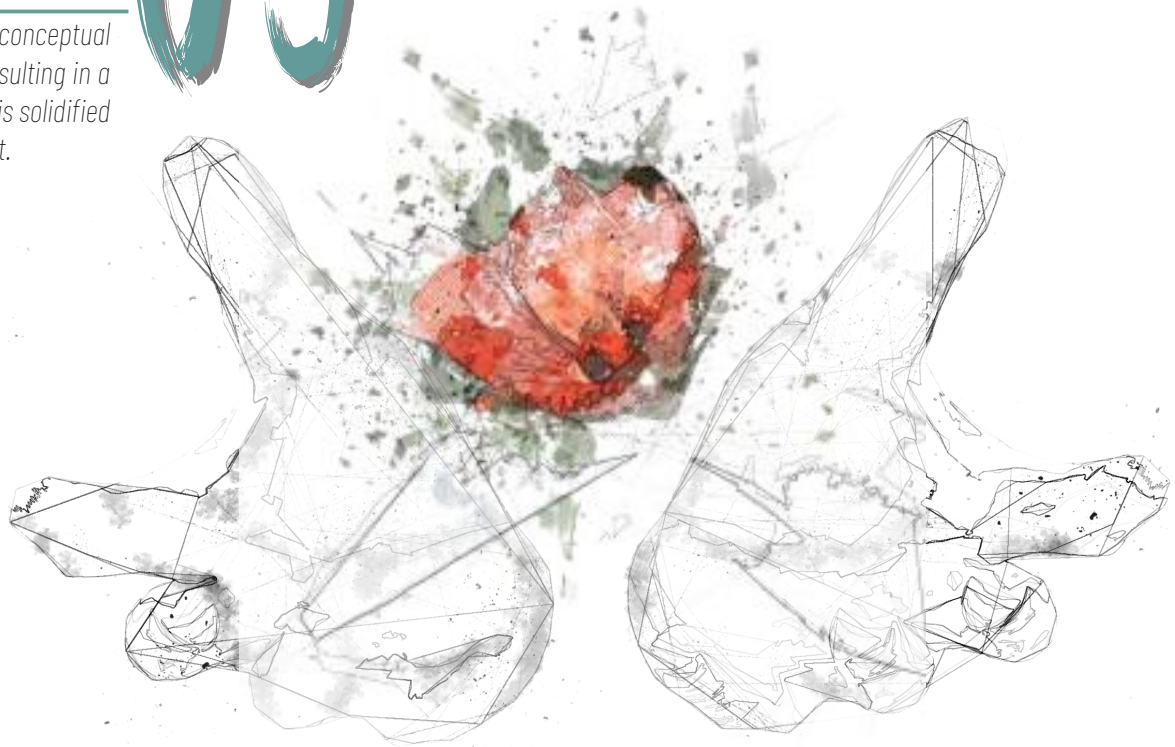


Figure 5.01: Left: Nurturing Nature **(Author, 2019)**

05 | *Conceptual Approach*

05.1

REASONING BEHIND APPROACH

The reason for the concept in relation to development along the East coast

The industrialised landscapes left in the wake of the sugar era have desolated natural systems, and typically with any industrial boom, comes the urban environment to sustain in. And in Durban's case, these urban nodes are reaching a state of conurbation, taking over from where the industrialised landscapes left off. "In the case of KZN, coastal development has gone through a number of phases, with development 'booms' being evident for different sections of coast at different times." (Palmer, Van der Elst, 2012)

Houghton (1994) states that globally, land use patterns are continually changing in response to human demands and needs, and with the attractiveness of coastal living at a high in current trends, one sees the flood of developments along the coastal sections. The developments are taking place where sugarcane farming has left off.

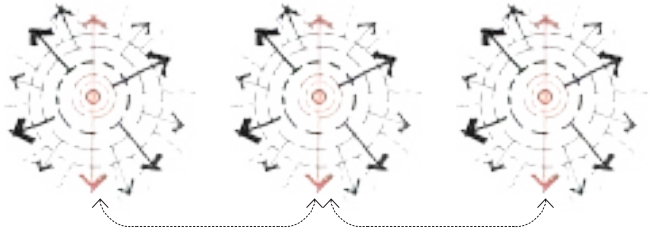


Figure 5.02: Expanding nodes **(Author, 2019)**

This constant threat to our natural systems is one which has resulted in Man's opinion as being over powering to nature, which is slowly revealing itself as to not being the case.

The reason for the concept in relation to the mill's processes and movement

With rapid industrial and agricultural development, large quantities of industrial and agricultural waste have been generated (Xu, Ji, Gao, Yang, & Wu, 2018)

The industrial nature of the mill's spatial typology sees the movement of product directly from one process to another, without seeing potential byproducts utilised. All byproducts within the movement of the product have the ability to be reused, if they are removed from the process prior to further machining.

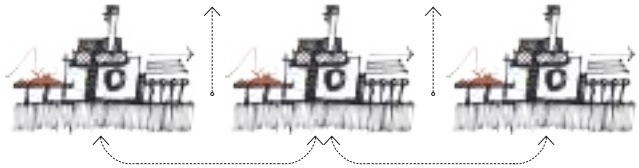


Figure 5.03: Current sugarcane processes **(Author, 2019)**

The sugar industries wastage is therefore much higher than what could be possibly attained in a closed-loop system. Sugarcane residues are generally used as a fertiliser or is disposed of in landfills, which has led to intensified environmental concerns. (Xu, Ji, Gao, Yang, & Wu, 2018)

One may view this as an abuse of power when it comes to Man's control over nature, and the result of a dichotomous relationship in all spheres concerning the two.

05.2

ORIGINS OF CONCEPT

How have previous agendas influenced the concept's direction

One may view fragmentation in architecture as an extension of the movement of *Deconstructivism*[1]. "The movement is characterised by fragmentation, an interest in manipulating the surface or skin of a built structure, and non-rectilinear shapes which appear to distort and dislocate elements of architecture, such as structure and envelope." (Alison, 2011)

Johnson (1988) iterates to us through the his MoMa Exhibition review, that a deconstructive architect is not one who dismantles buildings, but rather one who locates the inherent dilemmas within buildings, putting the pure forms of traditional architecture 'on the couch' and identifies the symptoms of a repressed impurity. Deconstructivist projects at the MoMa Exhibition made an early investigation into the structural compostion, and therefore "returned them to the social *milieu*[2]." (Johnson, 1988) The critique of deconstructivism therefore is its intensity on questioning traditional ideas, but then reforming back to the high functionality within the structure.

Figure 5.04: Gehry House model **(Johnson at MoMa Exhibition, 1988)**

1 Deconstructivism is a movement of postmodern architecture which appeared in the 1980s. It gives the impression of the fragmentation of the constructed building.

2 a person's social environment.

The project thus relates to deconstructivism in the way that it critiques how form is compiled, within its inability to holistically cater for all. The traditional sense of composition, hierarchical relationships and balance are broken to and in doing so creates its own sense of a unified whole. Fragmentation becomes a tool for consideration when designing holistically.

However, it must be said, the architecture of the project does not latch fully to the idea of deconstructivism, as the author views the extent to which the some notions are manipulated, seeing irrational thoughts materialising, into incompatible architecture. Therefore the idea of fragmentation and questioning the traditional scales of architecture, stemming from the ideas of deconstructivism, are taken forward in the project.

05.3

CONCEPTUAL APPROACH

Using the mill to regenerate natural, social and industry in a single archetype as a new approach to regenerative development.

The conceptual premise has been developed and validated as a reaction to the critical dilemmas highlighted in previous chapters. The concept's reaction has been divided into a macro / meso / micro hierarchy as a systematic tool for the mill's response to said dilemmas and the intentions meant for rectification. These intentions are then developed into conceptual ideas - the ideals for the mill. These ideals create the final conceptual premise going forward into the spatial creation of the mill, compiling the overarching conceptual spatial design drivers.

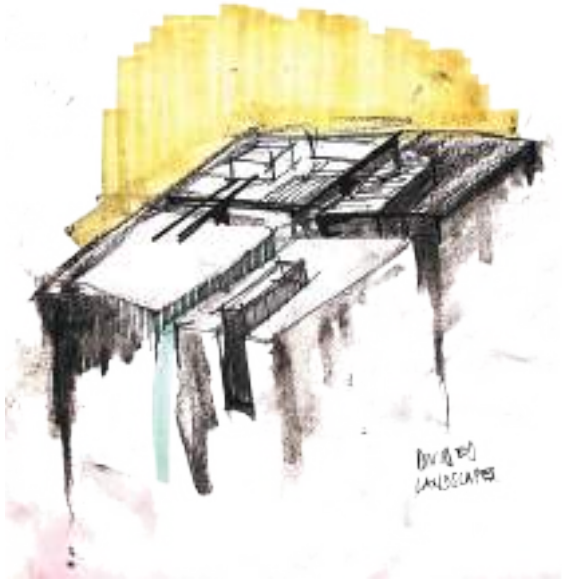


Figure 5.05: Fragmented Landscapes **(Author, 2019)**

05.4

CONCEPT DRIVERS

Deriving initial concept solutions to dilemmas revealed through site analysis.

Constricting Natural Systems for Human Development

Durban development (in both agricultural and built sense) has constricted our natural systems continually, such to the extent that they lack the ability to grow or evolve in their limited capacity. The below points are the initial conceptual solutions to dilemmas facing both the internal and external site:

1_ Farming overlapping landscapes

Farming plantations over-extend into natural systems, often overpowering them or altering their function. Guidelines are set in place to manage this, but they are not enforced and therefore agricultural landscapes grow freely without consideration for natural habitats.

A_ *a solution to this dilemma is to create buffer zones which relaxes agricultural landscapes and allows natural systems of the estuary and forestry to grow independently without being interfered. These buffer zones must be enforced by the nature conservationists existing in the Hawaan Nature Reserve.*

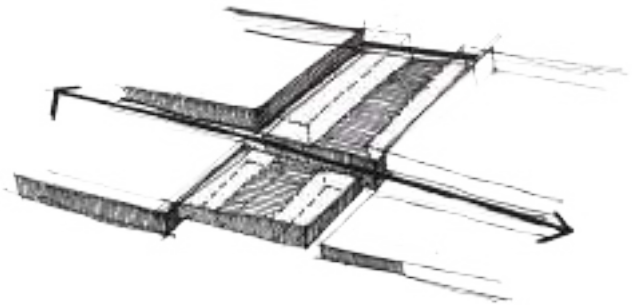


Figure 5.06: Industrialised Landscapes **(Author, 2019)**

2_ Over-farming to degradation

Over-farming has lead to earth quality reaching a perished state of no return.

A_ Over-farming landscapes is a typical problem with coastal agricultural landscapes. It is therefore part of the project proposal for over-farmed landscapes to act as connecting nodes for forestry and wetland areas. These areas will be rehabilitated and act as links to mend fragmented natural systems.

3_ Through Production to Pollution

Production in the larger sense always leads to product pollution. The current sugarcane industry sees its waste being used for biofuels, kindling for its furnaces or discarded into landfills.

A_ The project proposes a closed-loop system, in which all residues from production are reused in one way or another, resulting in minimal waste exiting into natural systems.

4_ Development expansion

Segregated development leads to over expansion projects, often culminating within and overtaking natural systems. These urban environments lack a relationship with the environment and often cause segregation within social classes due their socio-economic environments.

A_ Over expansion into natural systems must altered, in which the built environment must coexist with the natural. This will result in a healthier environment for both nature and man.

A_ The mill will democratise the urban landscape as it will attract all social classes by acting as a public node to the Sibaya precinct as well as celebrating the labourers in its programmatic outline.

5_ Human Byproduct "Leakage"

Almost all human products leave a pollutant in the form of a byproduct, which inevitably lands up back into our natural systems.

A_ The design of the mill ensures all byproducts are used and do not land up in any natural system.

6_ Factory as a Production Space

The mill is seen as a typology of machinery, often negating any human interaction and/or experience.

A_ The new intervention will challenge the way in which the mill is viewed. A reaction to the generic typology is established and the process within it are altered to suit the needs of experience.

7_ Dislocated landscapes

The natural systems are dislocated along the coastal edge due to urban environments and industrialised landscapes.

A_ To break away from the dislocation of natural systems, degraded landscapes will be restored back to their functioning natural state, and prior to inevitable development, landscapes will be zoned for rehabilitation and building. This will allow for a predetermined solution to link existing natural systems back to one another, relocating them.

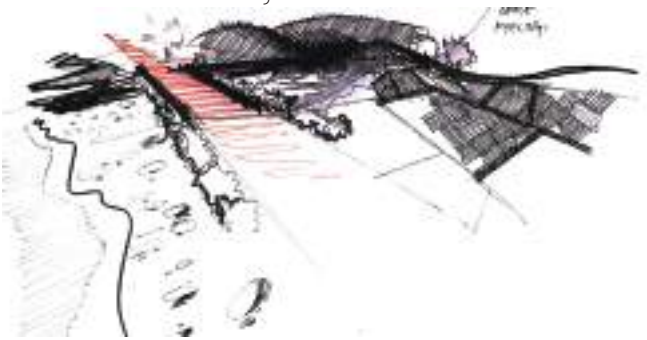


Figure 5.07: Landscape split by road **(Author, 2019)**

05.5

INITIAL CONCEPTS GENERATED

Seed for change : fragmented landscapes

The initial concepts generated throughout the year:

The below points became the initial driving concepts of the design, all of which now fall under the primary concept of fragmentations

Building as temporary known for a future paradox

The concept of a temporarry building was formed as a response to the permanence of man's touch on nature. This concept saw the building eroding over time, going back to nature, and possibly providing the support needed aquicker regeneration of the site, giving holistic influence to future development around the site.

Figure 5.11: Erosive shell (Author, 2019)

Natural landscapes act as 'heritage building'

This concept sees the existing pristine natural landscape as a heritage building, from which the architecture must respond to extremely delicately. In an environment where natural and industrial landscapes coexist, but lacks any buildings to react to, the landscape becomes the element to react to.

Farmlands in need of restoration

Extensive farming has led to degraded landscapes, where soils have become unfertile. These will need to be rejuvenated by rehabilitating natural systems to exist as links between the farmlands.

Building as Regenerators

Architecture becomes a catalyst in which the landscapes surrounding the building may be regenerated rather than removing and replacing it. The architecture will assist the regeneration and celebration of the landscapes.

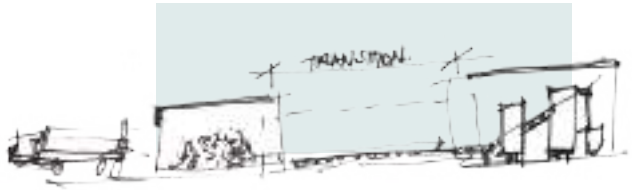


Figure 5.10: Transitional space between architecture (Author, 2019)

Fragmented landscapes remediate through subverted concept of fragmented building

The architecture becomes a way in which existing fragmented natural systems are reconnected, thus stimulating the rejuvenation of landscapes around the site.

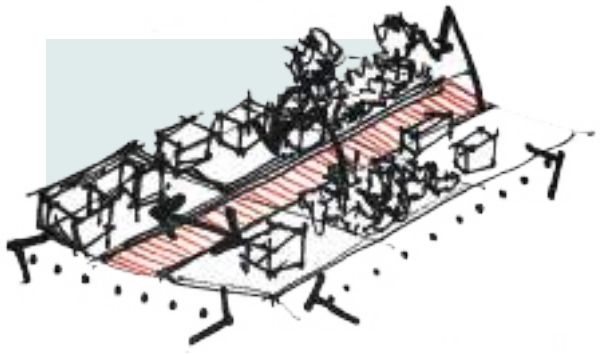


Figure 5.08: Linking architecture and nature (Author, 2019)

Fragmented architectural materials as temporary permanence of industrial programmed buildings

The evolution of the industrial era has left forgotten structures. The permanence of industrial structures in relation to their temporary function must be considered when designing the architecture - once evolved building becomes forgotten.

Set up strategy for future development - how to approach novel buildings within restored landscape

The architecture of the design must set precedent for future development, where novel architecture works symbiotically with both the natural and social context.

Architecture as threshold between nature and man

Slowly 'fragments' / disintegrates to reveal accommodating threshold between the two. This allows natural systems to move freely between spaces, rather than dislocating them completely.

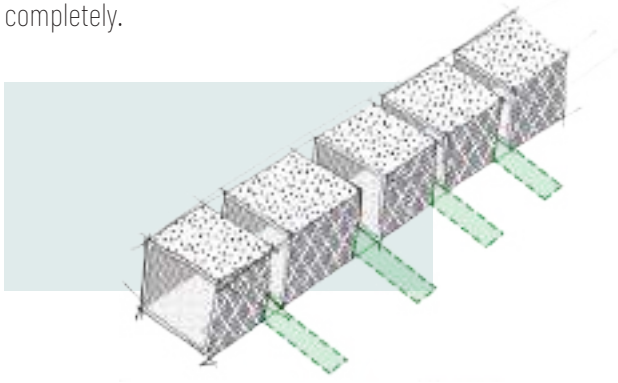


Figure 5.09: Fragmented Architecture (Author, 2019)

05.6

FRAGMENTING ARCHITECTURE

The concept of fragmenting architecture as a means to remediate dislocated systems within our built environment

REASON FOR FRAGMENTED LANDSCAPES

Industrialising Durban's landscapes has led to the fragmentation of natural systems as well as social classes. This idea has transcended into the built environment, where a dominance over the landscape sees the building isolated from it. The overarching concept derived withn the project sees the roles of development in the form of architecture being subverted, fragmenting the architecture, and allowing the dislocated systems to reconnect through regenerative architecture.

Architecture becomes a threshold between nature and man - slowing fragmentation and disintegrating the boundary to reveal an accommodating threshold, where architecture integrates into nature and nature integrates into architecture.

Figure 5.12: Boundaries between Man and Nature **(Author, 2019)**

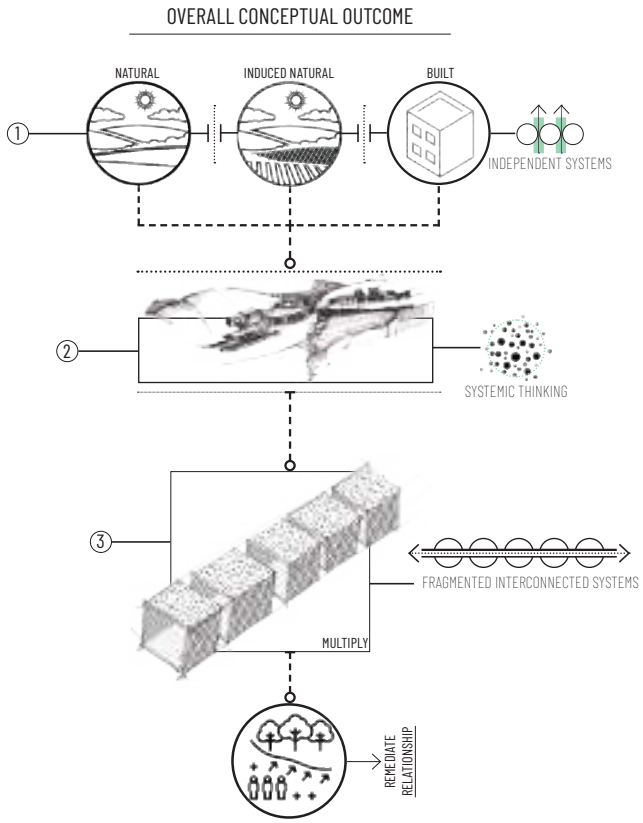


Figure 5.15: Conceptual Outcome **(Author, 2019)**

The urban analysis of future and current expansion proposals sees the exploitation of coastal landscapes, transformed from sugarcane plantations to urban environments, detrimental to the conservation and rehabilitation of existing natural systems spread along the coastal edge. This is a result of an imbalance between man and nature, where the industrialisation of coastal landscapes saw a dominance of one over the other, which is still apparent today within our built environment. Our current idea of building our landscapes to fit our buildings is an ancient notion, which has lead to the dislocation of man and true natural systems. Figure 5.25 Looks at the unnatural zoning established for coastal planning and the way in which it has constricted our natural ecosystems.

If the roles are to be balanced, a new relationship between man and nature is to be created, where neither are dominating, but rather coexisting within the greater holistic system. A new architecture for the coastal edge should be developed in which one considers the natural systems surrounding the site, prior to building within it. This output of this concept is an architecture which is fragmented, rather than one which fragments.

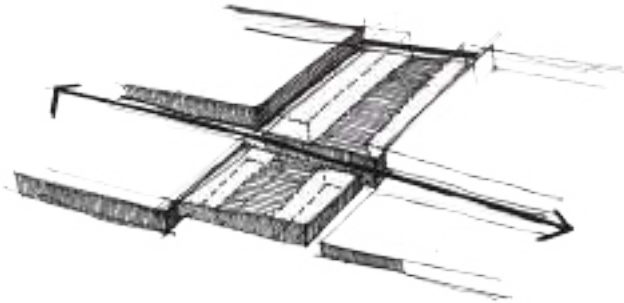


Figure 5.14: Industrialised landscape **(Author, 2019)**

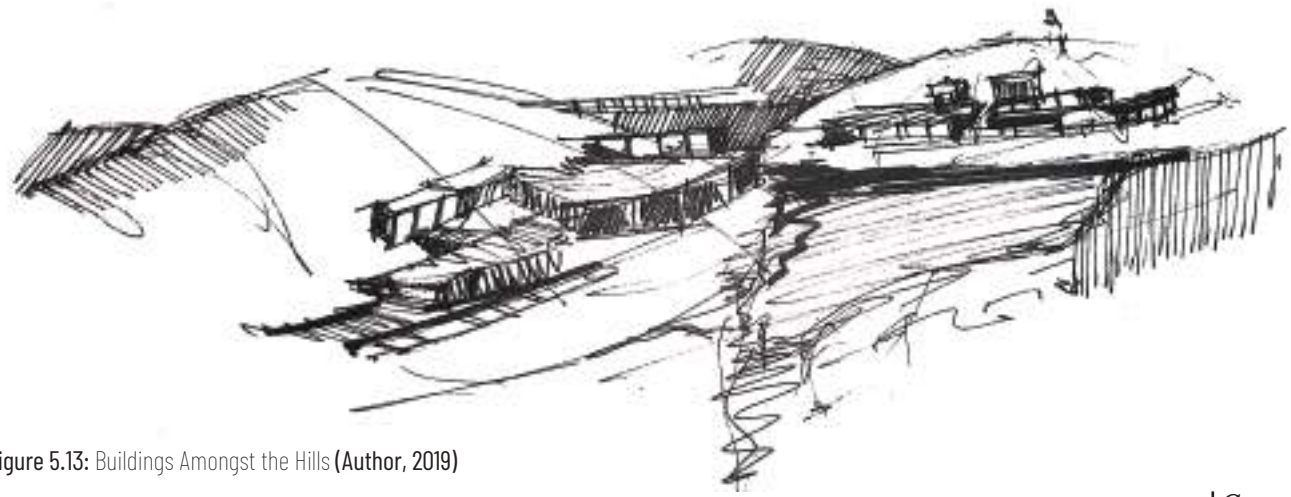


Figure 5.13: Buildings Amongst the Hills **(Author, 2019)**

05.7

INTENTIONS - MEDIATING THE FRAGMENTATION

Defining the agendas for the conceptual approach to the building- What is the ideal perception of the building?

The conceptual approach for the design is a response to the main facets harming and destroying our natural environments, namely, the way in which coastal urban areas are being developed; how easily pollution is introduced into nature by both the sugarcane industry and the general population; disregard for natural systems along coastal edges in both agriculture and the built environment; and the socio-economic imbalance as a result of sugarcane and the urban environment produced from it. The mill is an ideal example of how one may use the built environment through the concept of fragmentation to mediate the above dilemmas, creating precedent for further urban expansion and architecture, without having any negative impact on our envionment.

The ideal perception of the mill, sees an integration of man and nature through the synthesis of industrial, natural and social systems existing simultaneously, in a balanced formula.

The theories discussed in previous chapters use the understanding of systems as a way of balancing these dichotomous relationships. The conceptual drivers allow for the project to extend this idea into the built form. Architecture becomes the movement away from a dominating buit form, into rather a harmonious remediator, which sees systems of both natural and man integrated into a symbiotic relationship, where both 'parties' benefit from one another. The agenda for the architecture is therefore to rectify the approach to coastal development and farming, in an architecture which goes further than sustainable manners, but steps into the realm of regenerative systems.

Fragmentation is not new to architecture, and may be seen as the permeability of architecture towards nature and man. This idea stretches back to ancient times, and has been relayed by architectural thinkers over the centuries.

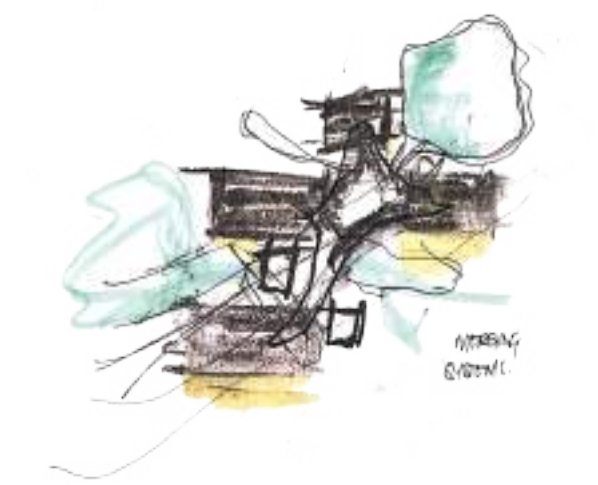


Figure 5.16: Integrating Fragmented Systems **(Author, 2019)**

Figure 5.17: Architecture as threshold manager **(Author, 2019)**

Figure 5.18: Conceptual Sketch - regenerating landscapes **(Author, 2019)**

05.8

TECTONIC VS. STEREOTOMIC

How are the intentions for the project achieved spatially?

The intention of regenerating the landscape surrounding the building is achieved through a sensitive design approach, which sees the architecture's stereotomic or tectonic form as a reaction to the landscape on which it sits.

- Degraded landscapes relate directly to a stereotomic type architecture, where the landscape is removed and replaced above the building and surrounding landscapes are terraced to help ensure growth and fruition.

- Pristine landscapes are related to tectonic architecture, allowing the building to sit above the natural landscape. This is done to allow for systems to take place both between and beneath the architecture. The building only touches the ground where necessary foundation points are needed. This is a simple idea, but will be very effective when designing around wetland areas.

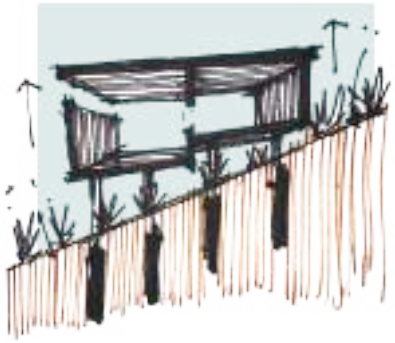


Figure 5.19: Tectonic Massing **(Author, 2019)**

Figure 5.20: Stereotomic Massing **(Author, 2019)**

05.9

ARCHITECTURAL CONCEPT

Defining the conceptual premise for design genesis

The intentions of the project mentioned previously, led to the overarching concept of fragmenting architecture as a means to rehabilitate and celebrate dislocated systems. The concept is based on using the cause of fragmentation of natural systems ie. the built environment and industrialised landscapes as means to mediate the isolation therefore subverting it, fragmenting it, and allowing for the rehabilitation and reconnection of dislocated natural systems to coexist with the built fabric.

In this, architecture becomes a platform on which to view this process, and so to it becomes a didactic architecture for future expansion. The three scenarios set up adjacently express current states at which the natural, built and industrial systems exist in isolation from one another. The far right concept expresses the new intent of the project, where all systems exist symbiotically in a closed-loop holistic system.

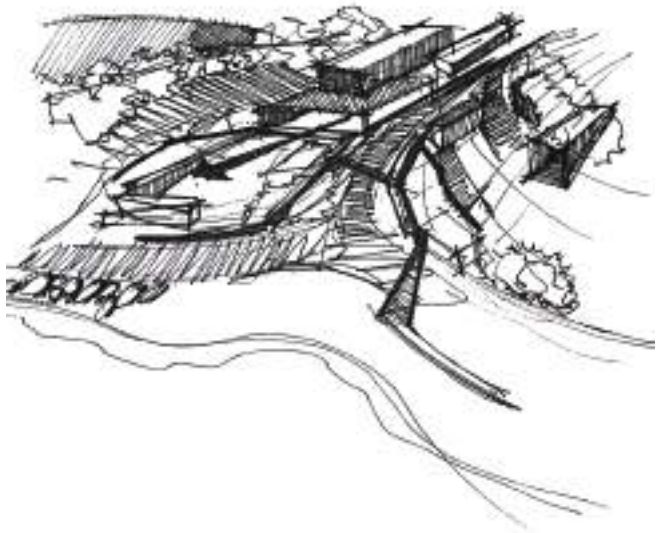
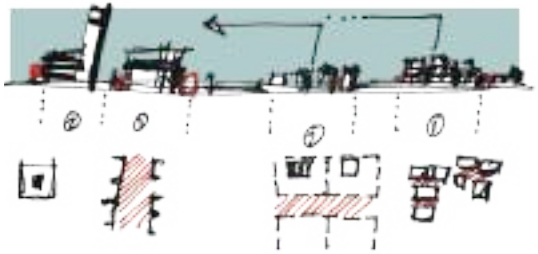


Figure 5.21: Existing Scenarios towards optimum conceptual scenarios (Author, 2019)

SCENARIO 01

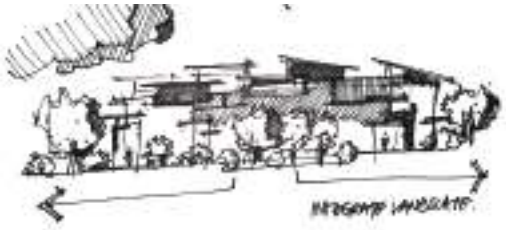
Scenario 01 is the existing pristine condition of the site, set to be developed on in the years to come.

SCENARIO 01



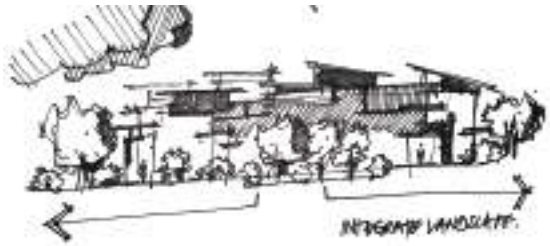
Scenario 02 sees the built environment as separate from its natural context, where any natural conditions are human constructs.

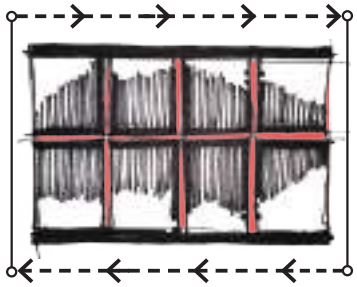
SCENARIO 01



Scenario 03 sees the human isolated from industry, allowing for zero interaction or evolution of industrial typologies or programmes.

OPTIMAL SCENARIO





05.10

CONCEPTUAL NOTIONS

Conceptual developments used throughout project

Architecture as part of production machine

Linear production typology as a promenade for both public and private movement - Procession of public becomes play on processing of sugarcane.

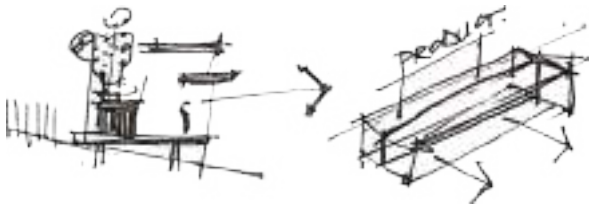


Figure 5.22: Production Promenade **(Author, 2019)**

Architecture creates a relationship between man and nature. Rather than dominating it, the architecture will frame and celebrate the natural systems surrounding the structure.

Figure 5.23: Symbiotic Relationship **(Author, 2019)**

Threshold - Symbolic of the "Between" of man and nature. The architecture of the mill becomes the 'between', allowing a relationship between man and nature to be established.

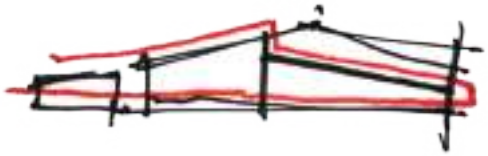


Figure 5.24: Movement between architecture and nature **(Author, 2019)**

Architecture as fragmented - Fragmented between Natural Systems- opposing current idea of fragmented forests dominated by development

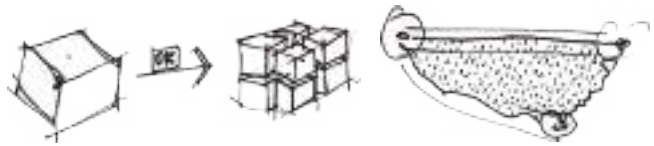


Figure 5.25: Fragmenting architecture **(Author, 2019)**

Haha Wall - Symbolic of Disconnect, which comments of disassociation of man and nature. The project looks at how architecture separates man and nature and how this can be inverted.

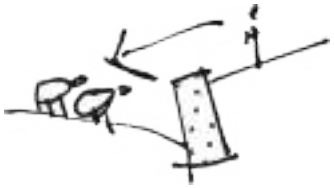


Figure 5.26: Haha Wall **(Author, 2019)**

Everything goes back to Nature - procession through building | Byproducts of Building | Comment on human pollution | Humans going back to nature for inspiration by evolution.

Figure 5.27: Architecture as threshold **(Author, 2019)**

Using natural typography as design facilitator - The design uses the topography of the site as a design generator.

Figure 5.28: Using the typology to direct design **(Author, 2019)**

Architecture as part of habitat/ecosystem - Boundary-less

Figure 5.30: Integrated architecture **(Author, 2019)**

Programme as massing decider - tectonic vs. stereotomic - good vs. bad - sensitive vs. insensitive. Architecture becomes a tool with which landscapes are recovered or protected.

Figure 5.29: Massing decider **(Author, 2019)**

DESIGN DEVELOPMENT 06

Chapter 6 discusses the design development in which the project has been refined through. The chronological order of iterations gives insight into how the project has evolved into what is seen as the final iteration of the mill.

06 | *Design Development*

06.1

ARCHITECTURAL PRECEDENTS

Conservation | *using a new 'paradox' concept for coastal development*

PROGRAMME | URBAN+CONTEXT | RELATIONSHIP

Wasit Natural Reserve Visitor Centre | X Architects

The designers of Wasit Natural Reserve were tasked with the unsolved problem of getting non-migratory birds back to the site, which exists in an urban context. The site now plays homage to 350 bird species, a landing zone for a further 33,000 migratebirds, and a breathing lung to Sharjah City.[1]

The centre is established on an urban periphery site in an effort to provide a continuation of protection for the natural environment, as well as to educate the people of Sharjah in the richness of the wetland ecosystem and birds which frequent the area. This has created an educational and relaxation haven for bird watchers, researchers and people of the city.

The architectural design aims to blend in with the surrounding context. Sub-terrainian passages lead to expansive views whilst minimizing the impact of the conserved terrain and submersing the viewer in the wetland.

Figure 6.03: Section through nature 'gallery' **(Author, 2019)**

1 "Wasit Natural Reserve Visitor Centre / X Architects" 22 Mar 2016. ArchDaily. Accessed 23 Apr 2019.

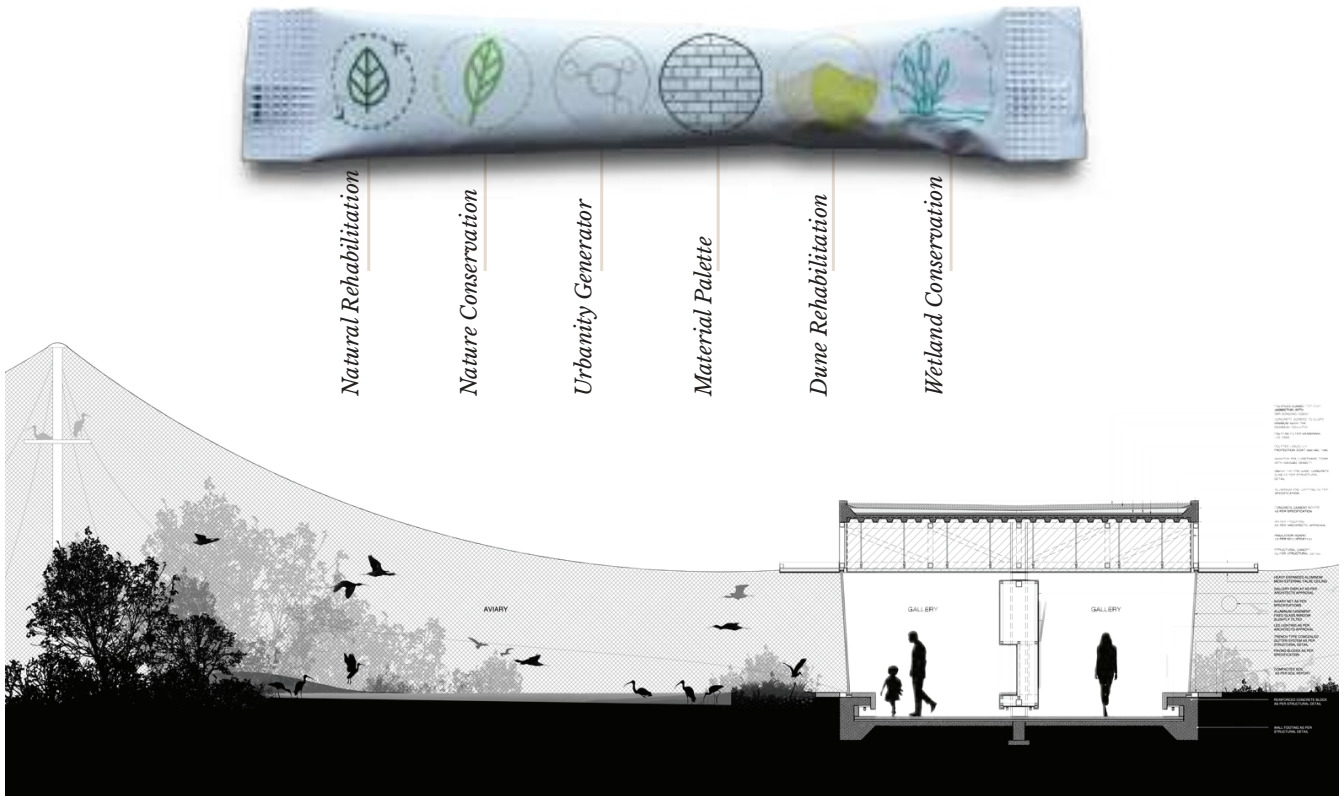


Figure 6.01: Section through exhibition space **(Archdaily, 2016)**

Figure 6.04: Extents of Park **(Archdaily, 2016)**

Figure 6.02: Aerial view of Wasit Natural Reserve extents **(Archdaily, 2016)**

ARCHITECTURAL PRECEDENTS

Using a new 'paradox' concept for coastal development

PROGRAMME | URBAN+CONTEXT | RELATIONSHIP

Qunli Stormwater Wetland Park | Turenscape

Qunli Stormwater Wetland Park is an urban landscape which is placed in a developing urban setting. The site is surrounded by dense novel development and is bounded by roads. The wetland was under threat due to the rapid pace of urban development and its water sources were diminishing as such. The city has since named the park as a protected regional wetland and restored previously shrinking water accessibility. The aim of Turenscape was to create an urban park to provide a multitude of ecosystems service for the new urban community[1]. The park ensured its survival through the celebration and activation with public engagement.

1 "Qunli Stormwater Wetland Park / Turenscape" 10 Nov 2013. ArchDaily. Accessed 23 Apr 2019.

Figure 6.07: Qunli Stormwater Wetland park Walkways **(Archdaily, 2013)**

Figure 6.06: Park's connection to city **(Archdaily, 2013)**

Figure 6.05: Qunli Stormwater Wetland park Vegetation**(Archdaily, 2013)**

Figure 6.08: Architecture of park **(Archdaily, 2013)**

ARCHITECTURAL PRECEDENTS

Creating an architecture

PROGRAMME | URBAN+CONTEXT | RELATIONSHIP

Brown Sugar Factory | DnA

The project is located in the small village of Xing which forms part of the Songyin Region. The region plays a large role in the cultivation and production of brown sugar- the village's primary income source. The design is placed on the edge of the city, partially submerged in the sugarcane fields but easily accessed on the opposite edge. The building takes advantage of the artistry of the sugar-making process. The completely transparent ground floor links the work zones to the neighbouring village streetscape. The design became multi-facet as the factory was only in operation for the cultivation period of three months and therefore needed to serve a bigger purpose. The building has therefore given rise to a new socio-cultural life[1]. The buildings transparency to the public realm gives a new identity to the industrial product typology.

1 "Brown Sugar Factory / DnA" 27 Apr 2018. ArchDaily. Accessed 6 May 2019.

Figure 6.09: Brown Sugar Factory **(Archdaily, 2018)**

Figure 6.12: Sugarcane juice boiling area **(Archdaily, 2018)**

Figure 6.11: Initial processing area **(Archdaily, 2018)**

Figure 6.10: Aerial view of Brown Sugar Factory **(Archdaily, 2018)**

06.2

PLANNING PRECEDENTS

Urban scale planning projects

Craft Urban Rail **|** Espace Libre

Espace Libre was tasked with connecting the city of Creil to the edge of the Oise, a France Regional Nature Park. It was a necessity for the designers to practice sensitivity when it came the landscape. The pathways and observation platforms were conscious of the natural ecosystems they were placed in, and rather than create new paths which cut into the landscape, the designers sensitively mapped where a natural pathway had formed, therefore impacting as little as possible.

Figure 6.14: Brown Sugar Factory **(Archdaily, 2018)**

Figure 6.13: Site Section **(Archdaily, 2018)**

06.3

CRAFTING THE MILL

How design informants influenced decision making.

Sugar milling has defined Durban's natural as well as its urban landscapes. The mill itself however, has never been integrated as part of the urban fabric.

The design is a reaction to this, in an effort integrate all systems into a harmonious design, rather than having them as separate.

The mill forms part of the future layout of the Sibaya Precinct as an integral node for the future urban development. The project is an amalgamation of responses relating to the theoretical premise, contextual response, climatic conditions and programmatic outline, resulting in an architecture which responds practically to present and future needs of the site and context.

The mill's design works with the concept of fragmenting architecture and systems, allowing external systems to not only integrate, but thrive amongst the previously dislocated environment. This is done as a response to current climate of coastal architecture formations, which isolates themselves from any form of their natural environment.

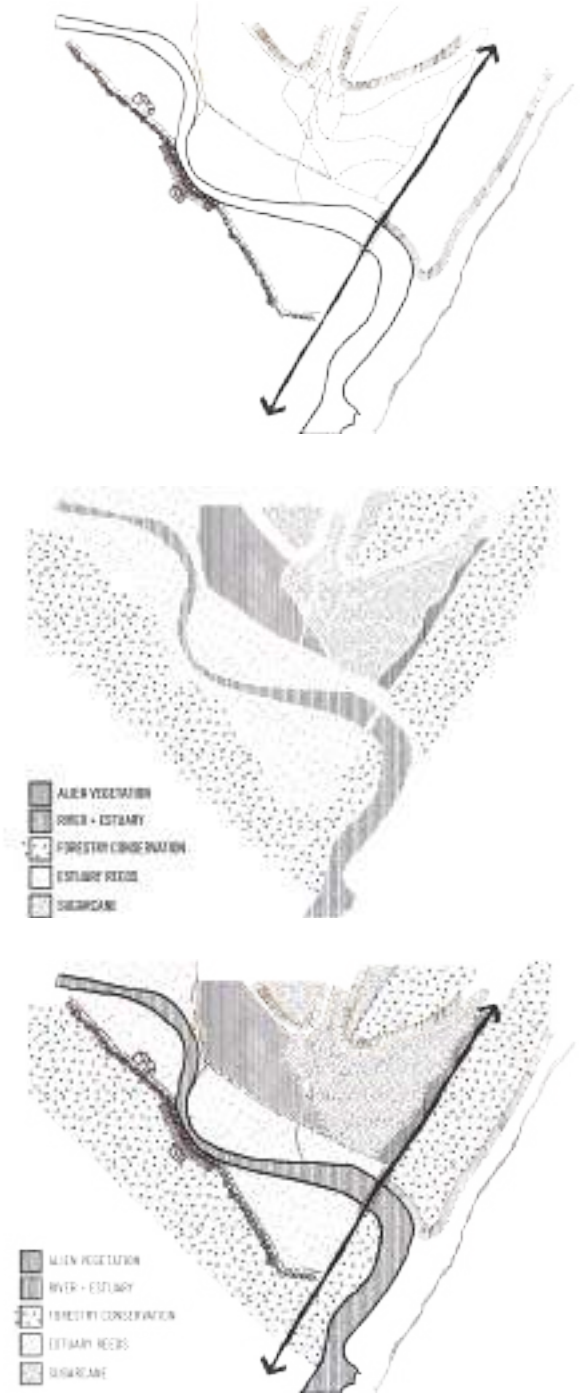


Figure 6.15: Site Vegetation Zoning **(Author, 2019)**

06.4

A DIDACTIC ARCHITECTURE

Celebrating and educating through exposing processes

The re-imagined mill creates a scale of processing which is small enough to accommodate public movement through majority of the passages between the areas of processing. The programme allows for a spectacle of production, one currently not available in the sugar industry, which is human driven, without the machinery used in larger sugar mills. The processing is therefore manual, providing safe spaces for public movement.

The architecture accentuates both the labour and heritage of the labouror, through the creation of the spectacle, which is the manual artistry of sugar making. Therefore the architecture becomes a frame for the process, which the public uses to view the industry.

The fragmenting of the buildings allows for natural systems to take place between the spaces, which is viewed all throughout the design. This brings attention to the user of the importance of holistic design, where nature and man may coexist. The building also extends into the landscape, where both public ad private users may move towards, allowing one to view the rehabilitation and conservation areas, and the way in which the agriculture and natural systems are each catered for in order to coexist.

Materials of the site are exposed in an effort to reveal the sustainability of construction and materials. This is done to create an awareness of material choice in the built environment, moving away from unsustainable materials.

06.5

THE ARCHITECTURE OF THE MILL

The influences of the mill's architecture explained

The design redefines the architecture of the generic mill, appropriating a new programmatic outline as well as guiding the design towards the project intentions of regeneration, conservation and rehabilitation. The industrial nature of the mill is fragmented to allow for a reinterpretation of the generic spatial typology, in which natural systems may integrate. The mill acts as a precedent for a new type of coastal architecture, breaking the current lineage of destructive architecture into what will create a node for the new Sibaya precinct and influence future expansion.

The dominance of the previous typology over its landscape is something that was to be re-imagined for the sake of future landscapes. Rather than cutting extensively into the landscape, the design subverts the formal spatial typology of 'the factory' into a dispersed building, contoured to the site, stepping along it, accommodating the slope rather than evading it.

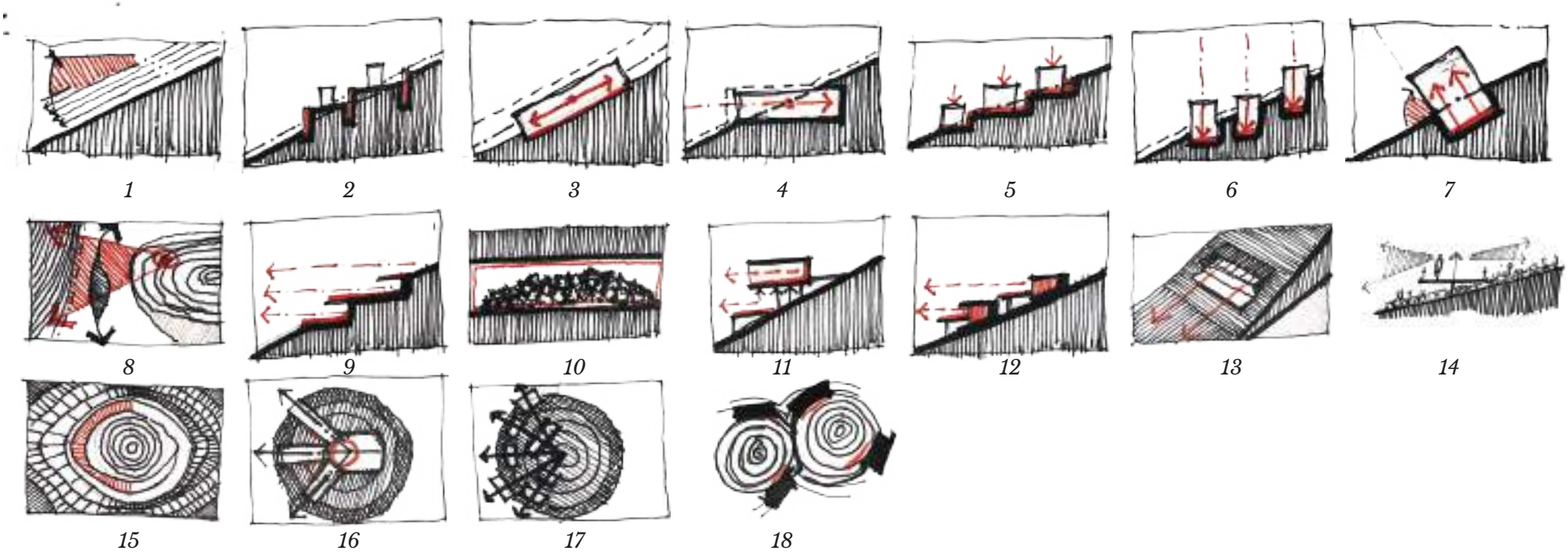
Designing in a built environment provides practical constraints which the design may respond to. The site in which the project is located is situated on an over-farmed area, without any built environment to respond to, and therefore the existing conditions on the site, namely the dirt roads, alienated zones and over-farmed landscapes provided the contextual conditions and restraints of the site.

The architectural skin and bones has been restrained to use sustainable and regenerative materials, from byproducts created during the sugarcane milling. This is done in hopes of using alternate materials, which exist currently only as waste, as replacements for materials which are not sustainable.

06.6

PHYSICAL DESIGN INFORMANTS

The influences of the site's conditions on design decisions



The design responds to physical topographical informants by engaging holistically with the landscape rather than trying to dominate it. The above sketches are a few examples of how one engages with the site in an effort to maximize the potential of the views, slopes and natural scenery. In doing so, the design interacts with the natural phenomena around the site, rather than acting in isolation from it. This is done in an effort to reestablish a relationship between coastal buildings, man, and nature.

Figure 6.16: Site Topographical Informants **(Author, 2019)**

Figure List:

Figure 01: Using the site slope to maximize the vistas, allowing for expansive views of sugarcane and conservation areas.
Figure 02: The use of retaining walls to allow for construction on sloped areas.
Figure 03: Using the slope as a design informant for building slope.
Figure 04: Cutting into the earth and replacing earth above.
Figure 05: Cutting into earth to form small platforms on which building takes place.
Figure 06: Digging into the earth, placing the building within the earth.
Figure 07: Slanted platform sunk into earth
Figure 08: Taking advantage of wetland and estuary sinks for expansive views.
Figure 09: Extending platforms from site for viewing and overlapping purposes.
Figure 10: Using the built for to frame conservation areas.
Figure 11: Raising the building to allow movement below and views over building in front.
Figure 12: Linking buildings via roof areas, allowing movement from one to the other.
Figure 13: Platforms in front of buildings engaging with nature.
Figure 14: Movement platforms between building, allowing user to engage with nature.
Figure 15: The crown of the hill as a radial layout informant.
Figure 16: Main building with extensions from central axis, extending in a radial manner.
Figure 17: Dispersed building formation allowing for independent views of extended site.
Figure 18: Designing amongst the hill as a means for layout.

06.7

‘NATURAL’ INDUSTRIAL LAYOUT

The spatial nature of an industrial program

The formal systematic layout seen in the industrial typology of the generic sugar mill limits any human interaction, and industrialises the landscapes surrounding the mill. The project rethinks the mill’s systematic layout, simplifying the programme from a machined process, to a manual process, bringing the human back into the process of sugar and creating a human link.

By deindustrialising the process, a mediating link between the dislocated industry and the human may be created. Instead of designing a mill to house the standard program, the project revisits the programme, to question whether through architecture, the formal industrial process can accommodate a much more fulfilling design typology, relocating the human in the process, and allow for interaction on both a public and private scale.

The new system on the design becomes a combination of human and material movement. In reducing the scale to a human process, the axis of the building can accommodate both the logistics of the sugarcane processing as well as the public and private movement through the building.

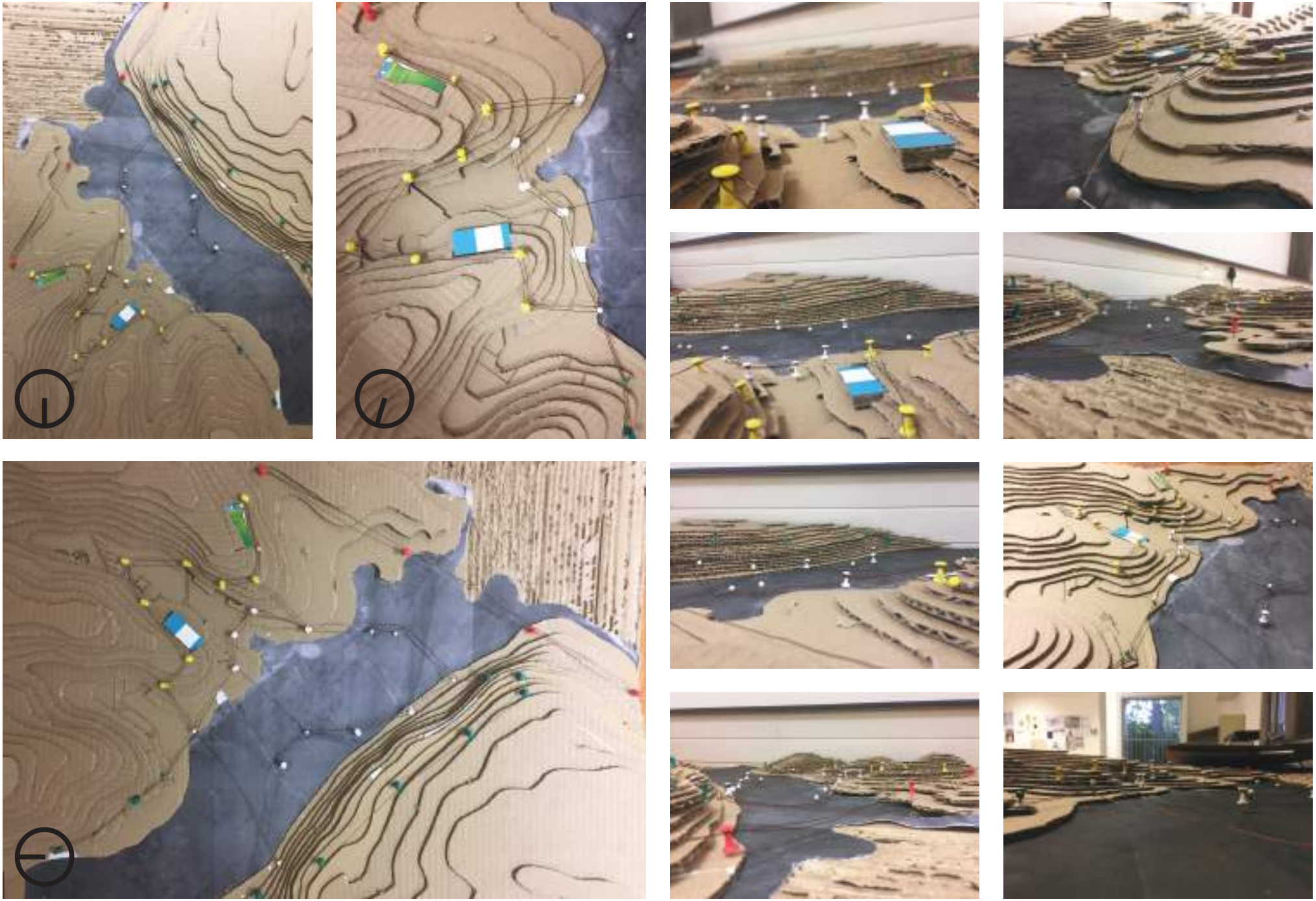


Figure 6.17: Site Maquette Iteration 01 (Author, 2019)

06.8

ITERATION 01

Discussion of iteration 01

Iteration 01 was an exploration of possible movement through the extended site, as well as placement of the project within the larger context. The maquette looks at possible nature trails through the site, forming part of the urban scale vision of the site in conservation efforts. The iteration revealed areas which were conducive for building, and allowed insight into the zoning of the site.

Figure 6.18: Site location in relation to context (Author, 2019)

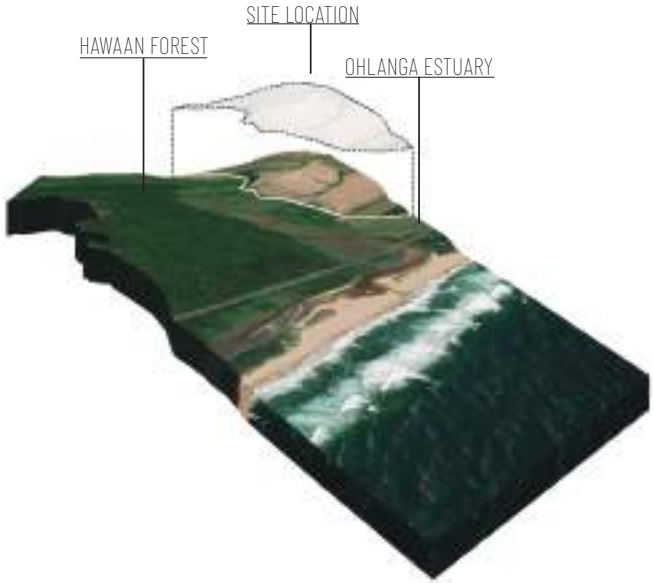


Figure 6.20: Coastal zoning (Author, 2019)

Critique of iteration:

The scale at which the intervention took place was not conducive for any architectural detail, but rather for zoning of the extended site and trail exploration. This gave insight into how the building should sit in relation to its context.

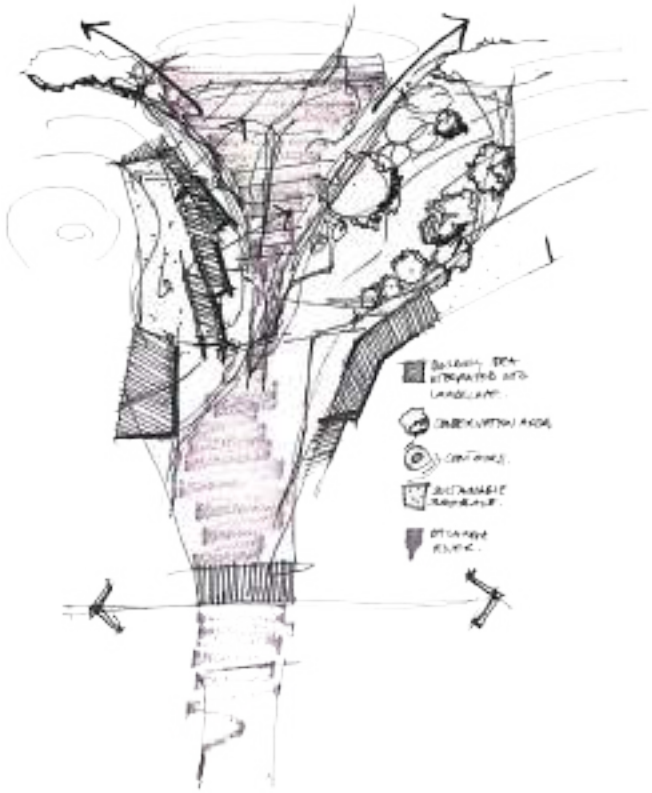


Figure 6.19: Conceptual sketch of site zoning (Author, 2019)

Figure 6.21: Iteration 02 Plan **(Author, 2019)**

06.9

ITERATION 02

Discussion of iteration 02

Iteration 02 was the first spatial exploration of the programmatic outline. The organic nature of the design sought to engage with the landscape and surroundings. The design repsonded to the landscape by using the natural contours for the layout. The building helps shape the landscape, allowing for water filtration through the building. The figures to the right became architectural expressions of the sketch plan, trying to establish an archtectural language for the site.

Critique of iteration:

The iteration's building and programmatic practicality lacked due to the spread layout and organic form of the design. In terms of the programmatic layout, the movement of product between functions was not plausible, as well as movement through the building becoming too complex. The architectural language also became to complicated, and therefore needed a new rational approach.

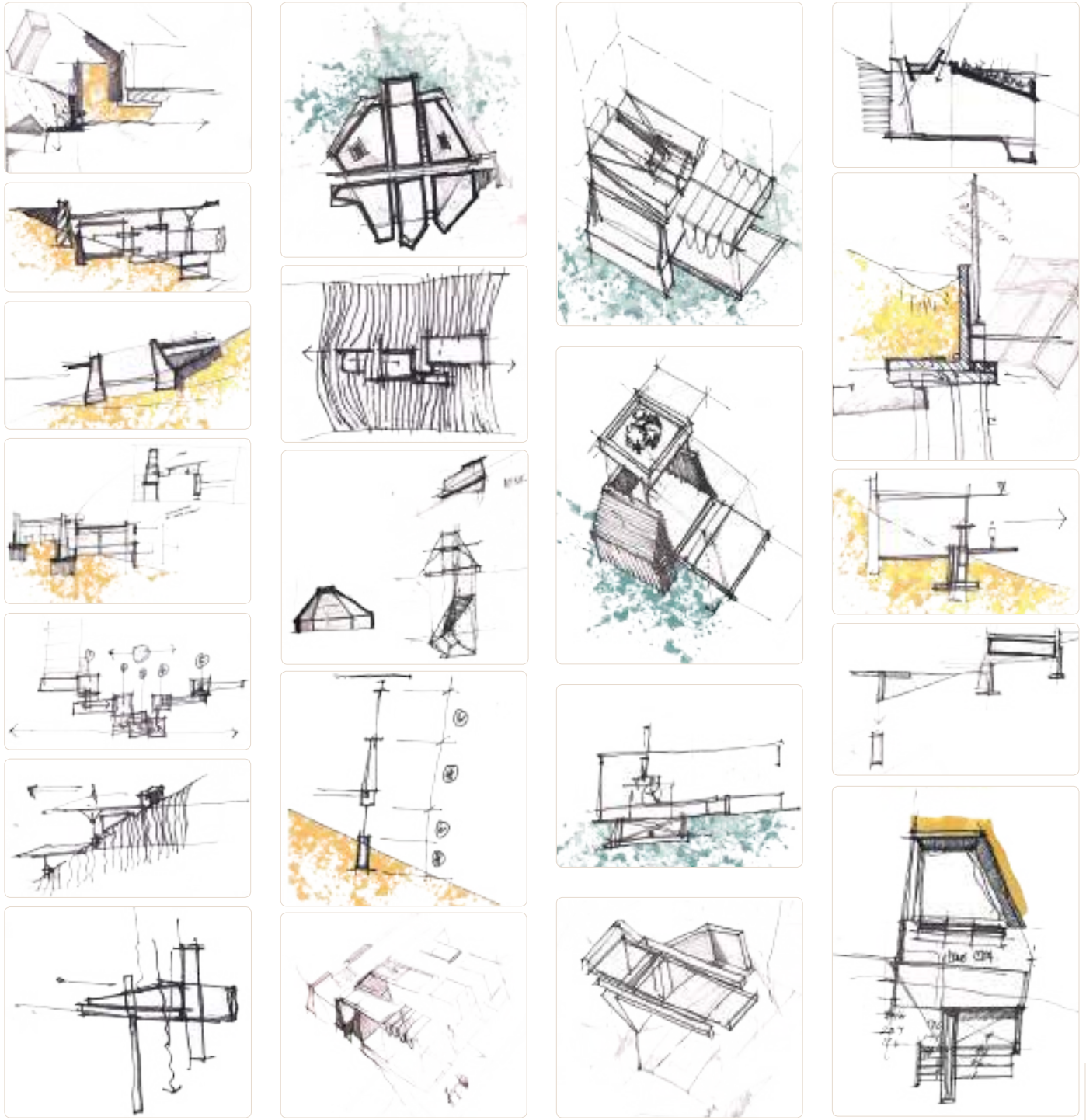


Figure 6.22: Right: Architectural expressions of Iteration 02 **(Author, 2019)**

Figure 6.23: Iteration 03 Plan **(Author, 2019)**

06.10

ITERATION 03

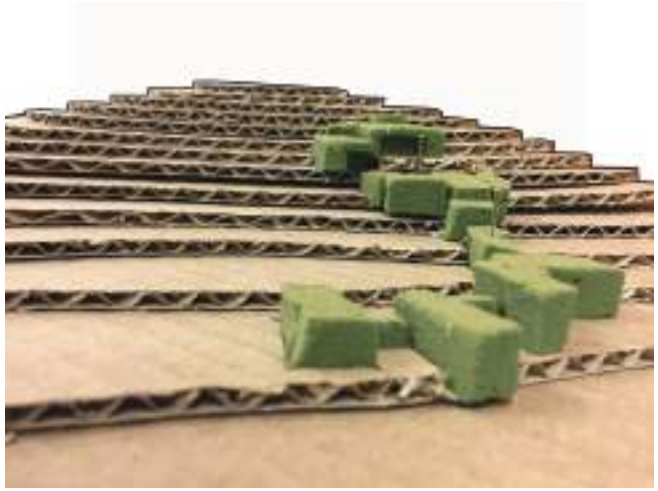
Discussion of iteration 03

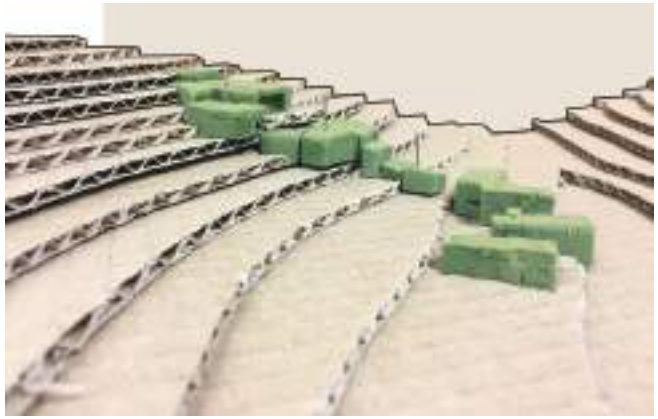
Iteration 03 attempts to apply logical construction to iteration 02. This resulted the development of a second maquette, gaining three-dimensional insight into the extent of the site and design.

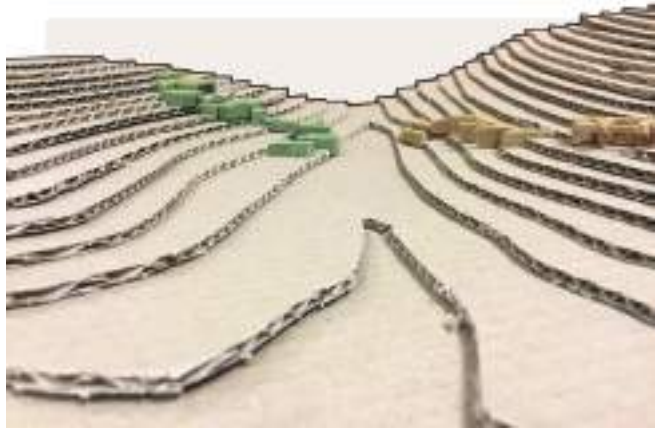
Critique of iteration:

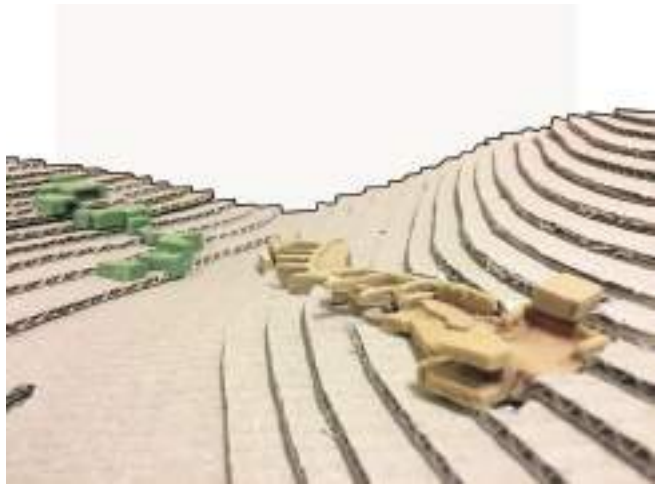
The organic shape proved problematic due to the convex and concave angles at which materials joined. In trying to resolve movement, the construction became too complex, resulting in impractical solutions. The architecture fluctuated too extensively between buildings, and therefore had to be simplified before the design went any further. The resulting programmatic outline, was however resolved through this iteration, and was transferred into further iterations.

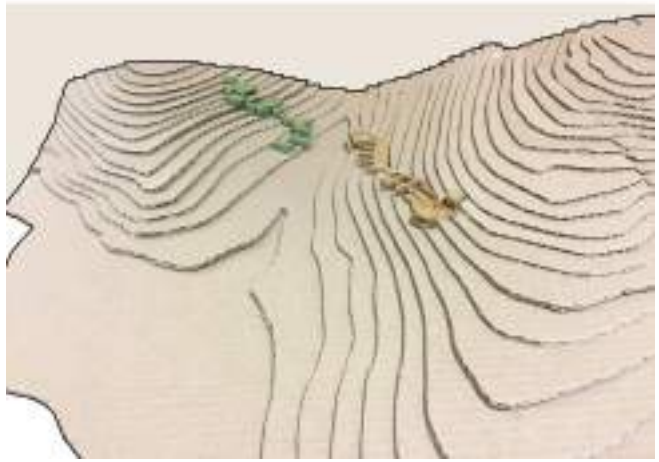
Figure 6.24: Iteration 03 Maquette **(Author, 2019)**











06.11

ITERATION 04

Discussion of iteration 04

Iteration 04 sought to create a more coherent design in terms of its practicality in layout and construction. This led to a more linear layout, but allowed for a progressive design where movement of product and users became more fluid. There were a multitude of iterations during this period, which led to the platform on which a final layout could take place.

The linear construction allowed for easier connection in both movement and construction, where previous designs limited these.

Critique of iteration 04:

The design became too compressed and lost the idea of fragmentation. This was restored in further iterations by allowing more natural space between buildings, allowing for existing natural systems to take place within.

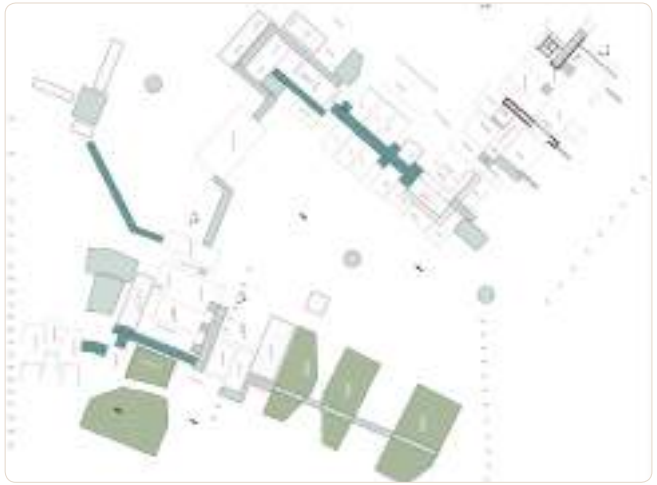


Figure 6.25: Iteration 02:D Plan **(Author, 2019)**

Figure 6.26: Iteration 02:A **(Author, 2019)**

Figure 6.27: Iteration 02:B **(Author, 2019)**

Figure 6.28: Iteration 02:C **(Author, 2019)**

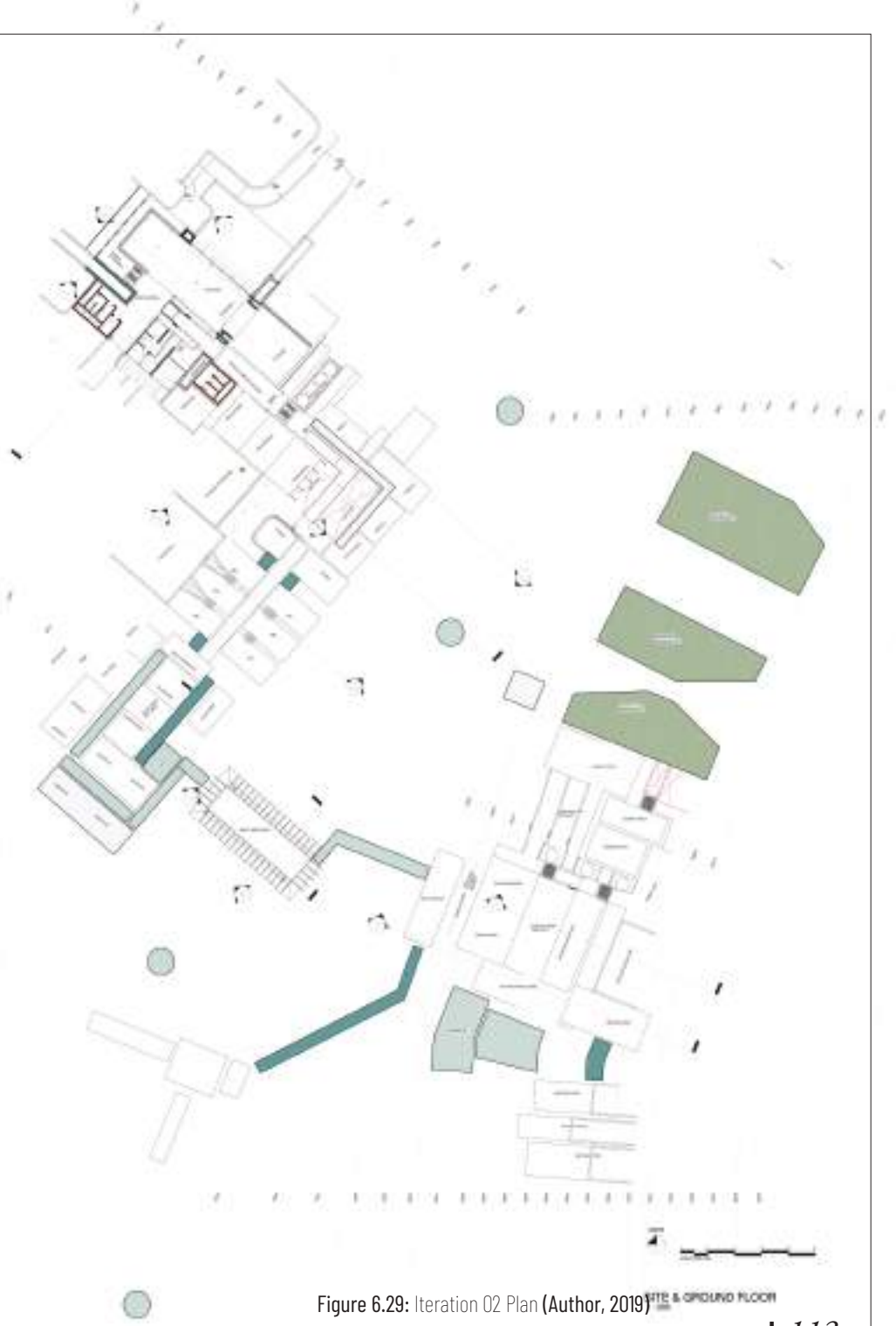


Figure 6.29: Iteration 02 Plan **(Author, 2019)**

06.12

ITERATION 05

Discussion of iteration 05

Iteration 05 started finalising the floor layout for movement and final product processing.

The second phase of the design, located towards the South-East corner was further refined, giving way to the architecture housing the final processing of the sugar and the areas in which both botanics and sugarcane are studied. The building uses the contours of the site for its form. Shaped around the contoured hill, movement runs laterally along the site of the second phase design. The architecture was again fragmented, with passages allowing for both private and public movement between spaces. This allowed for public movement through the entirety of the site.

Critique of Iteration:

Fragmented areas between buildings was too small, constricting services and systems running within them, therefore the spaces required redesign, allowing for more natural light and systems to exist within these spaces.

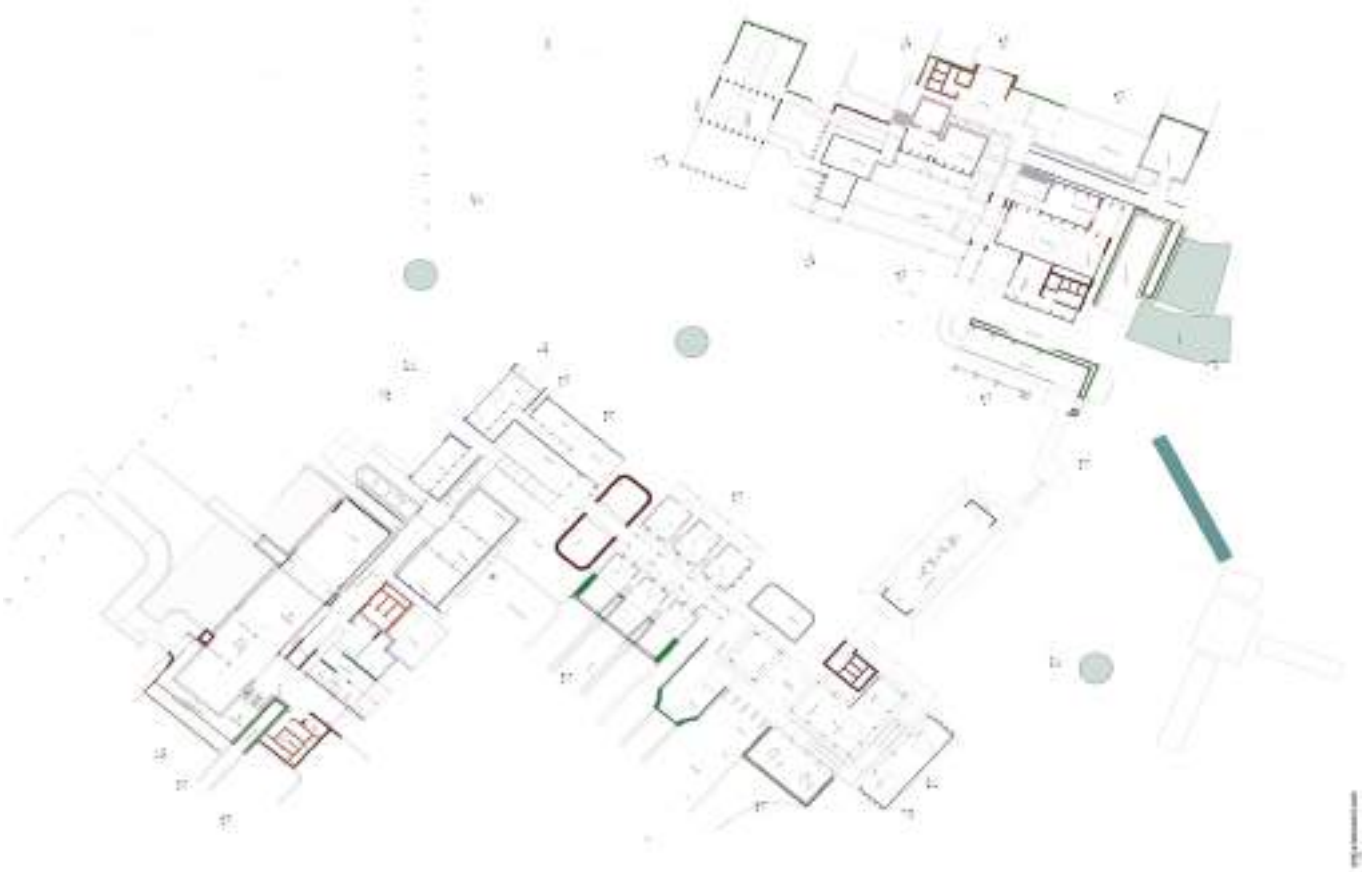


Figure 6.30: Iteration 02 Plan **(Author, 2019)**

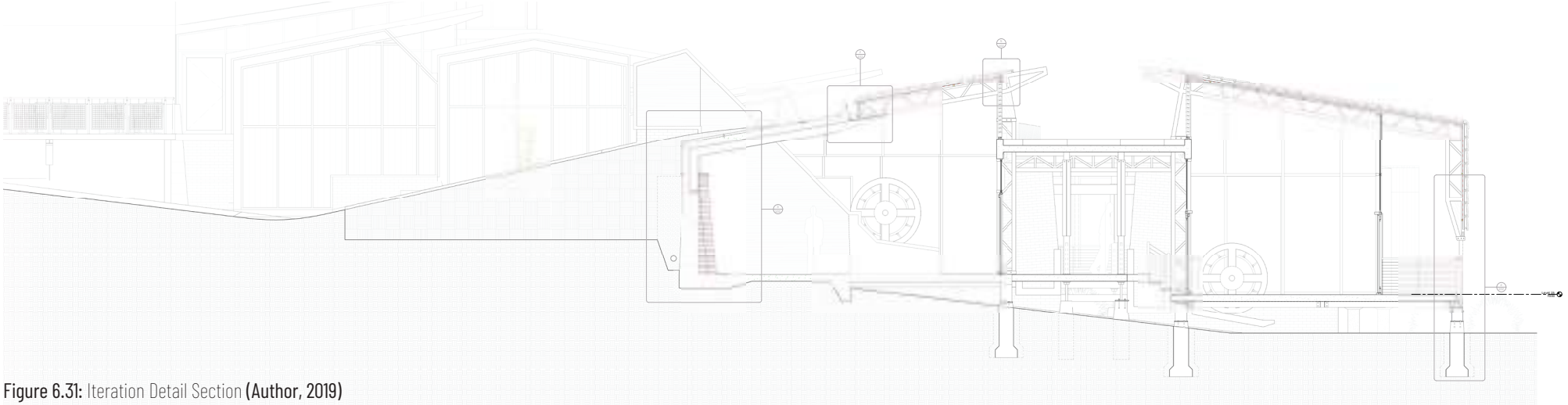


Figure 6.31: Iteration Detail Section **(Author, 2019)**

06.13

ITERATION 06

Discussion of iteration 06

Iteration 06 firstly sought to simplify the design where it had become over-complicated. Attention was also placed on natural systems taking place within the design, and their flow from one space to the next, and how architecture could facilitate this movement. Wetlands running between the buildings filter water through a natural stepping process at the top of the site. Catchment pits regulate the amount of flow, and pass the water through the building via permeable submersed piping to the next wetland for further filtration.

Secondly, interior 'cavity' spaces became larger, allowing more natural light to filter throughout the building. Where shading was required it was added.

Previously the design relied on elevators as a means of movement between levels. The new iteration uses more passive movement options, which are mainly ramps, placed between building functions within fragmented areas.

Critique of Iteration:

Exterior spaces extending from the mill need to be furthered to allow for interior spaces to lead outwards, extending the interior into nature. Extend movement into the wetland to allow a connection between the building and nature. Technification of the design became too complicated, requiring further detailed iterations to be developed.

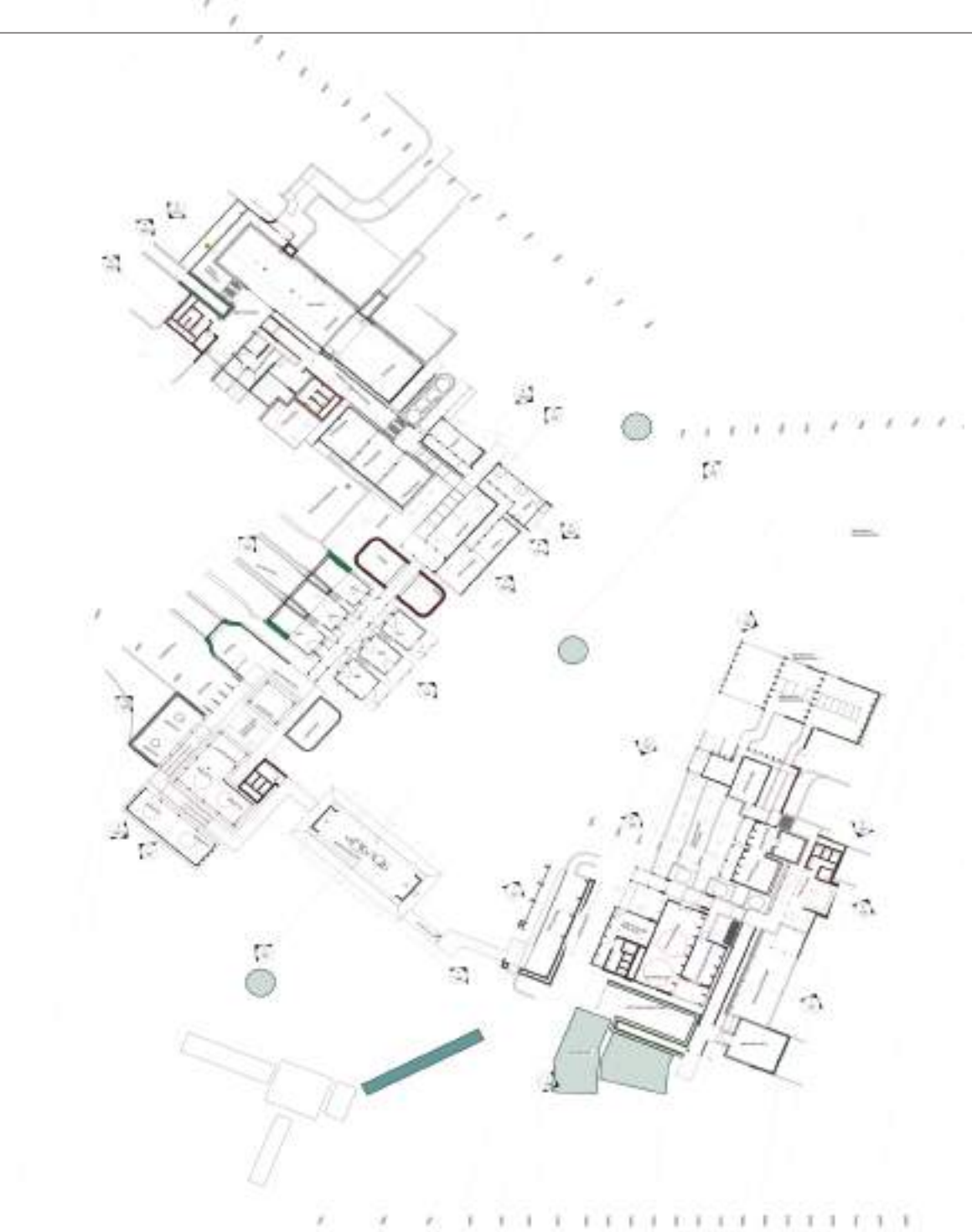
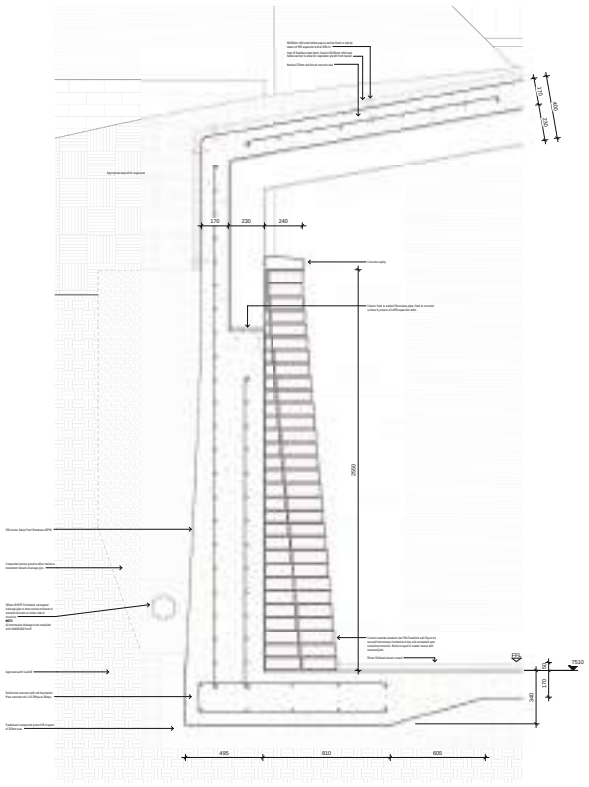


Figure 6.32: Iteration 06 Floor Plan **(Author, 2019)**



1-20 DETAIL SECTION - Callout 2
1 : 10

Figure 6.33: Iteration 06 Detail 01 (Author, 2019)

Figure 6.34: Iteration 06 Section Axo (Author, 2019)

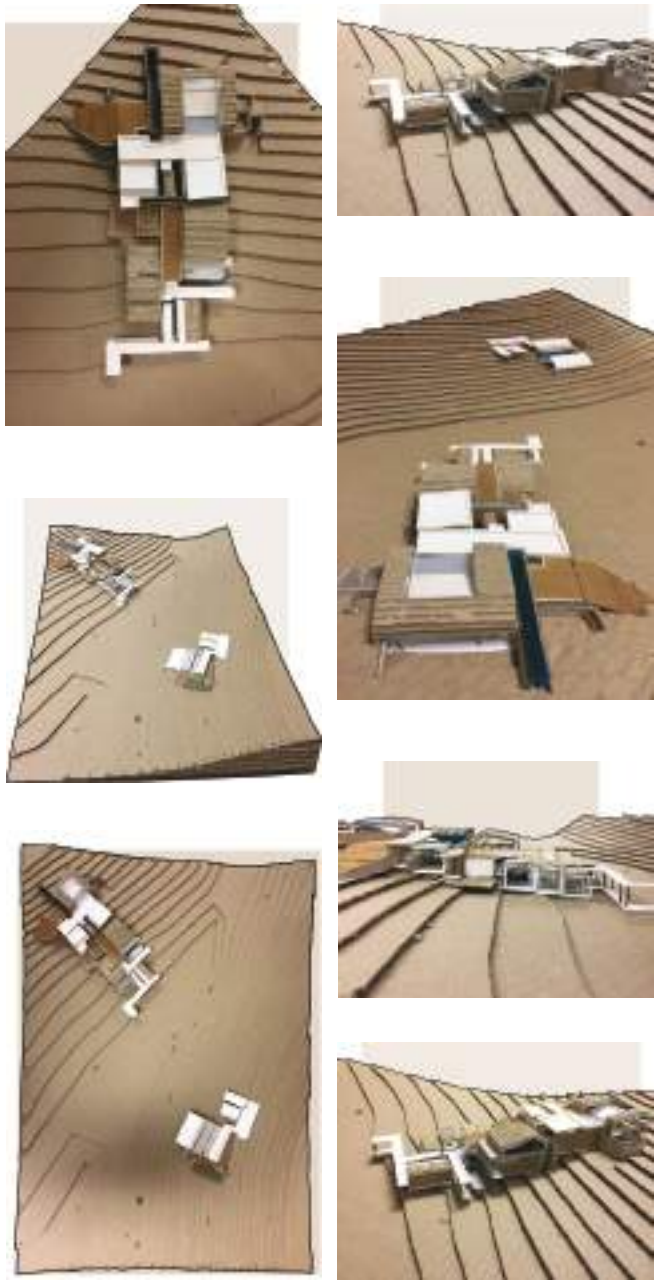
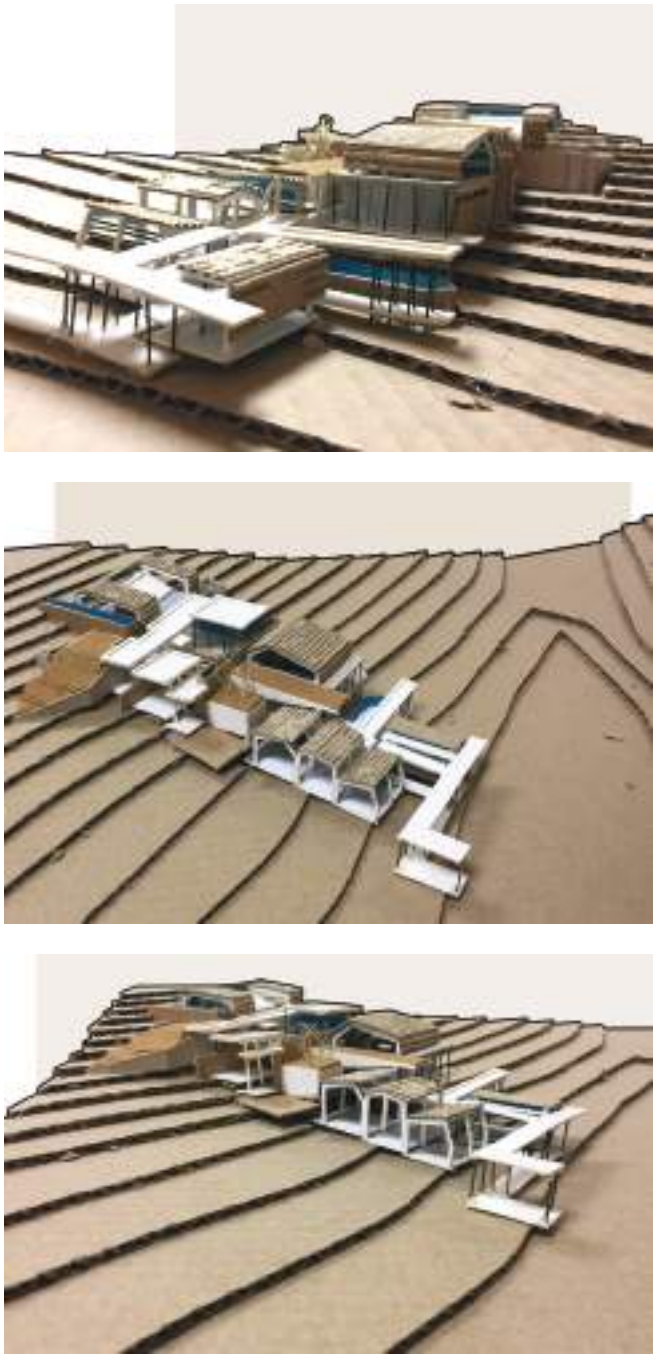


Figure 6.35: Iteration 06 Maquette (Author, 2019)



06.14

FINAL ITERATION

Discussion of final iteration

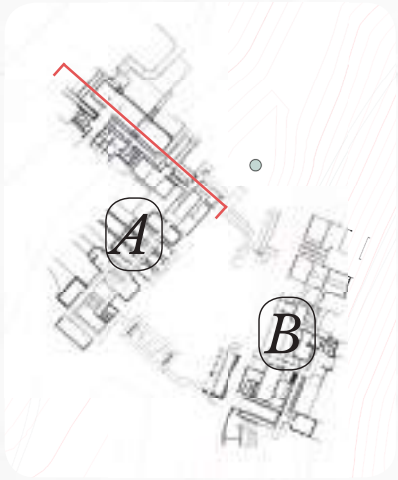
Figure 6.36: Final Ground Floor Plan **(Author, 2019)**

The iteration aimed at refining the design to its final stage. The design allowed for extra constructed wetlands to be added for further refinement of stormwater runoff. An extra greenhouse was added as the previous iteration's capacity for plant growth and storage was not large enough.

THE SITE

Contextual conditions of the mill

Figure 6.37: Site Plan (Author, 2019)



Building A

1:50 Section

Scale: Drawing not to scale

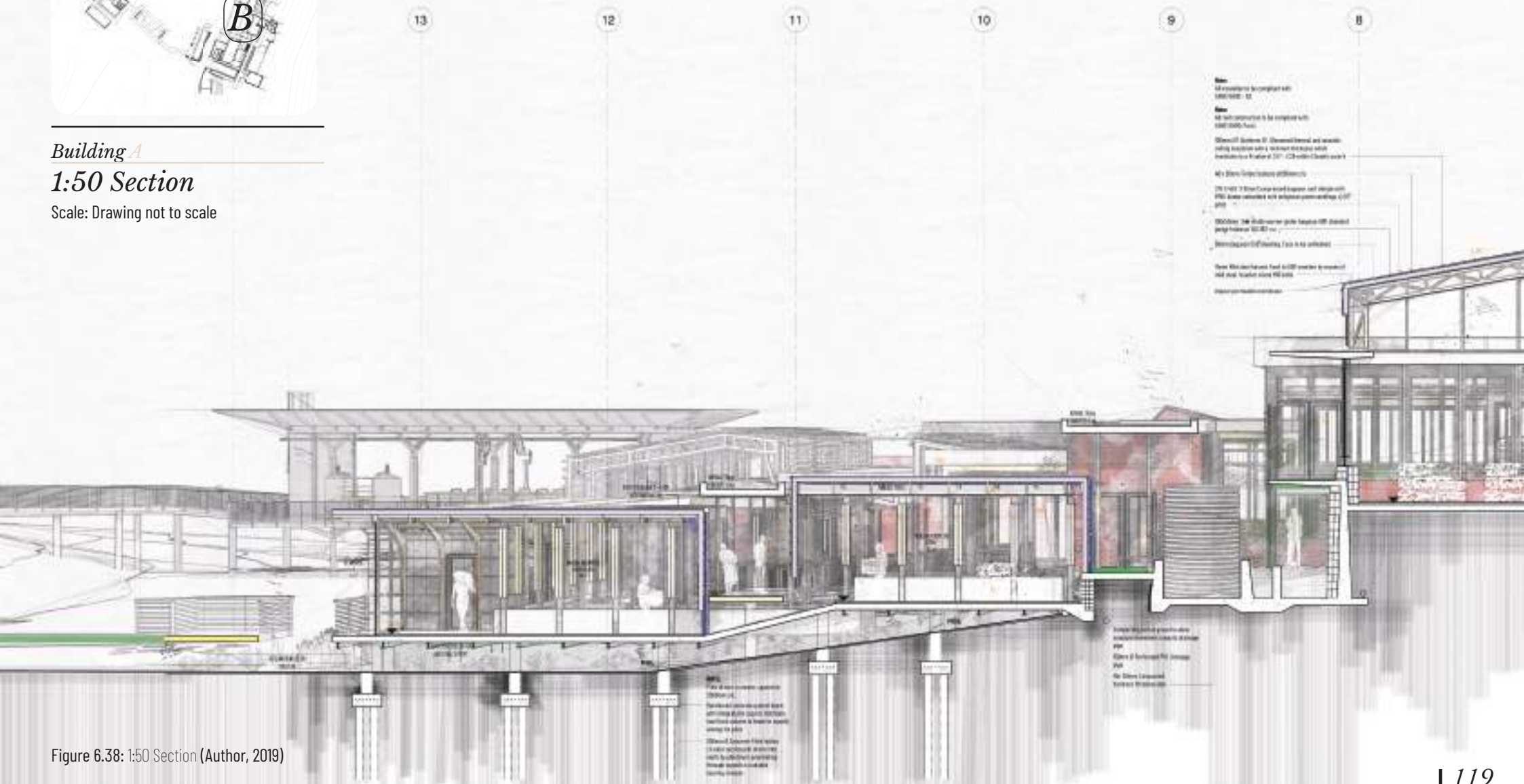
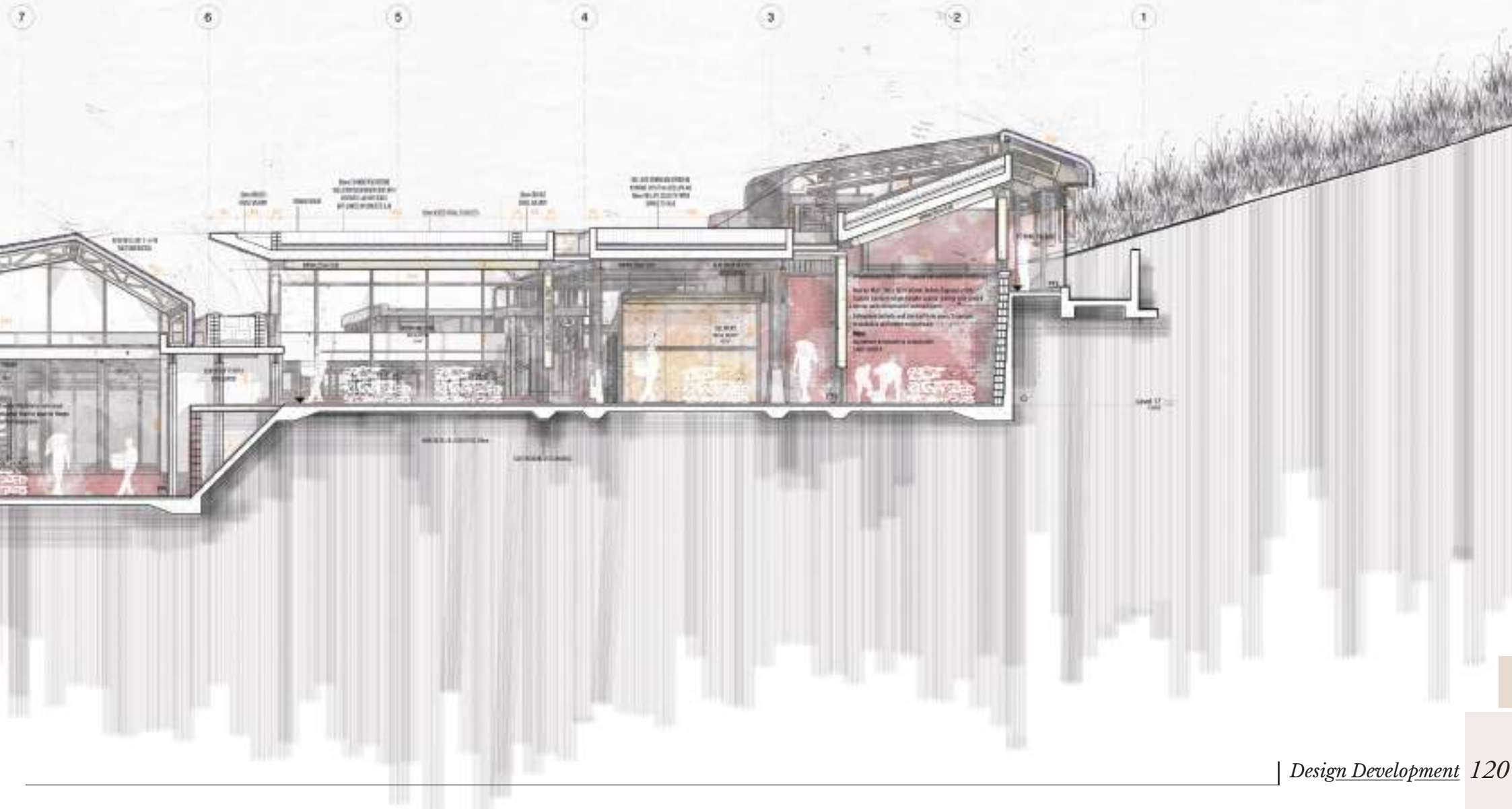


Figure 6.38: 1:50 Section (Author, 2019)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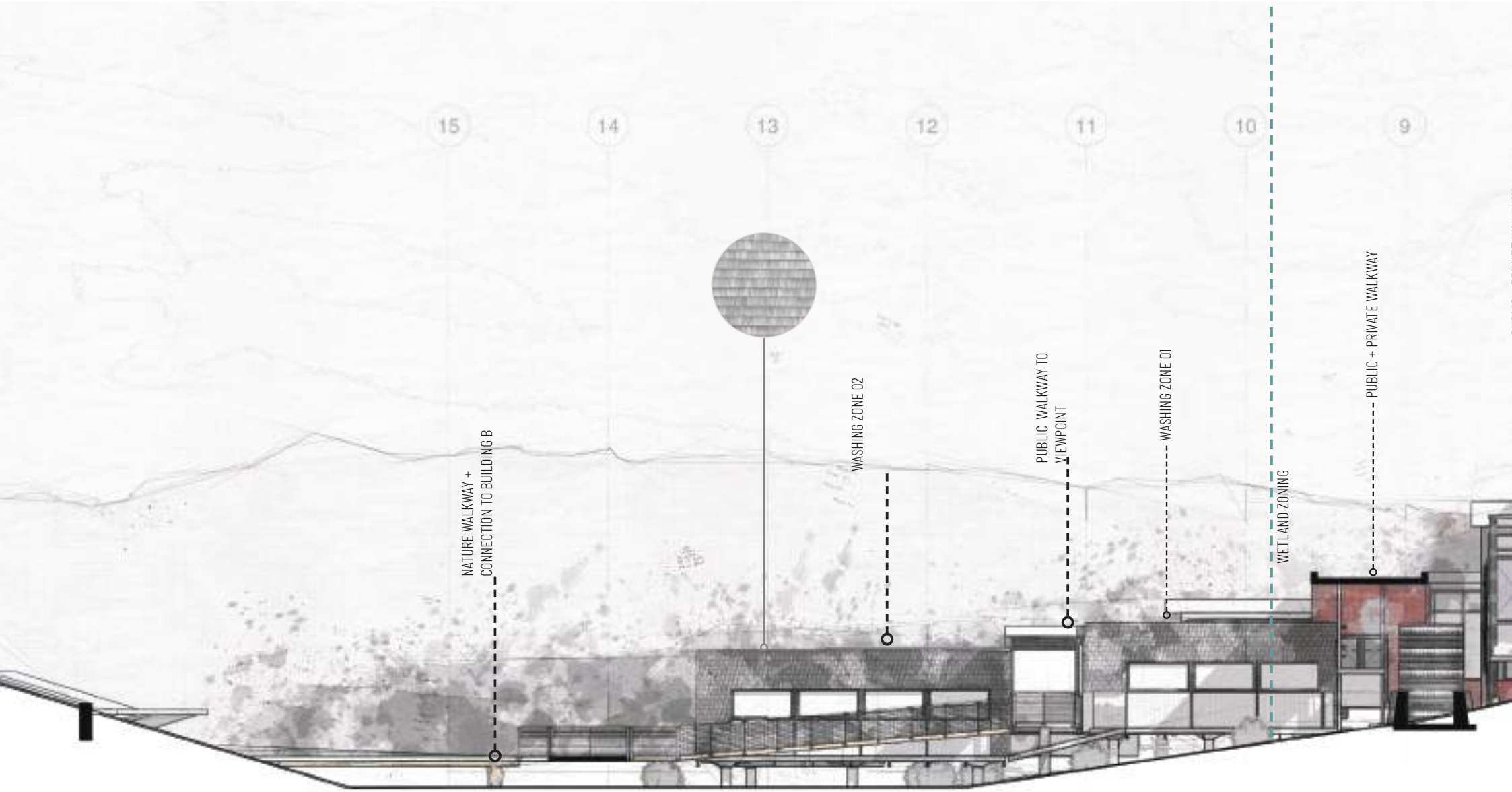


Figure 6.39: North-East Elevation **(Author, 2019)**

Building A
North East Elevation
Scale: Drawing not to scale

Building A

South West Elevation

Scale: Drawing not to scale

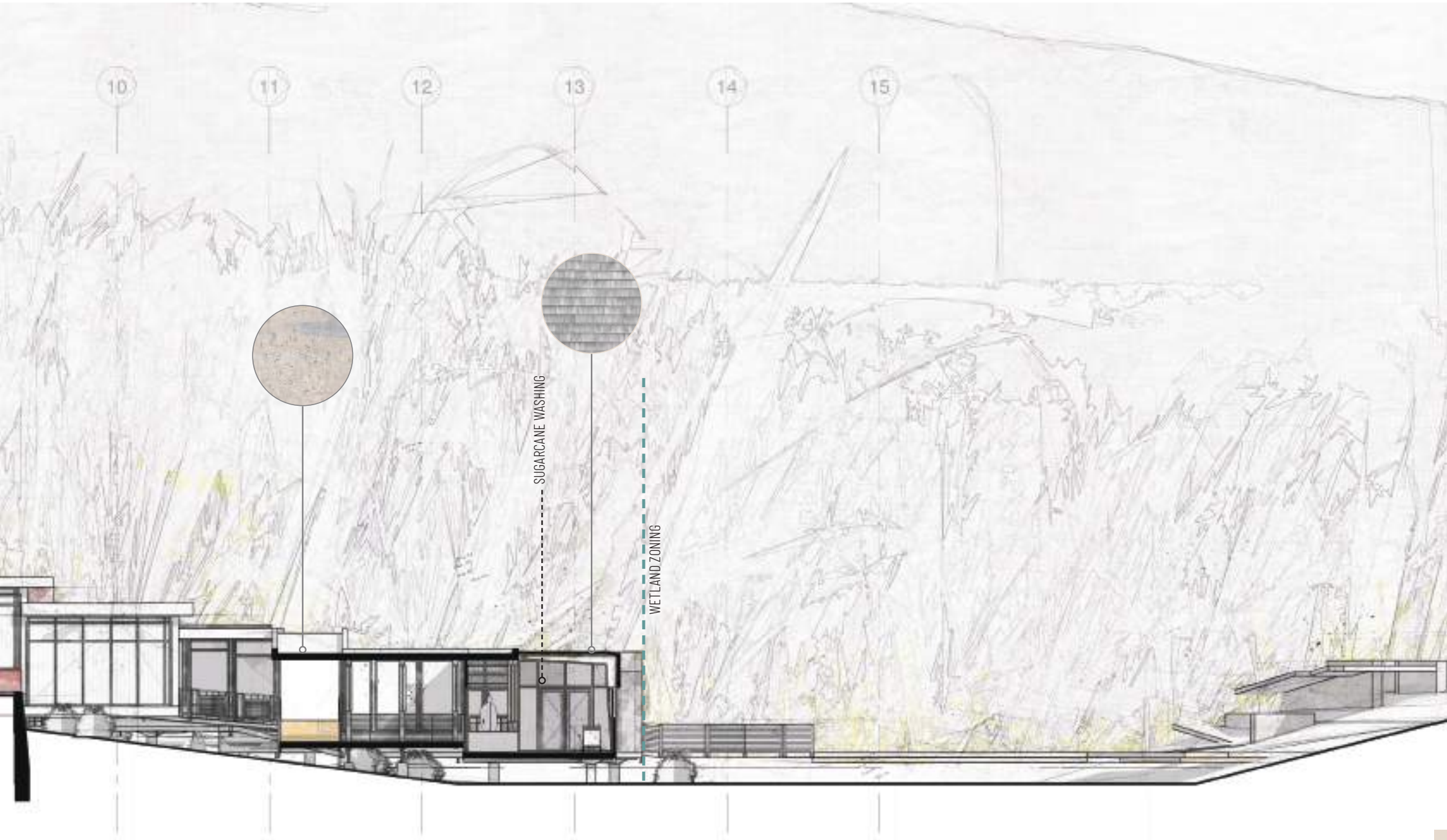
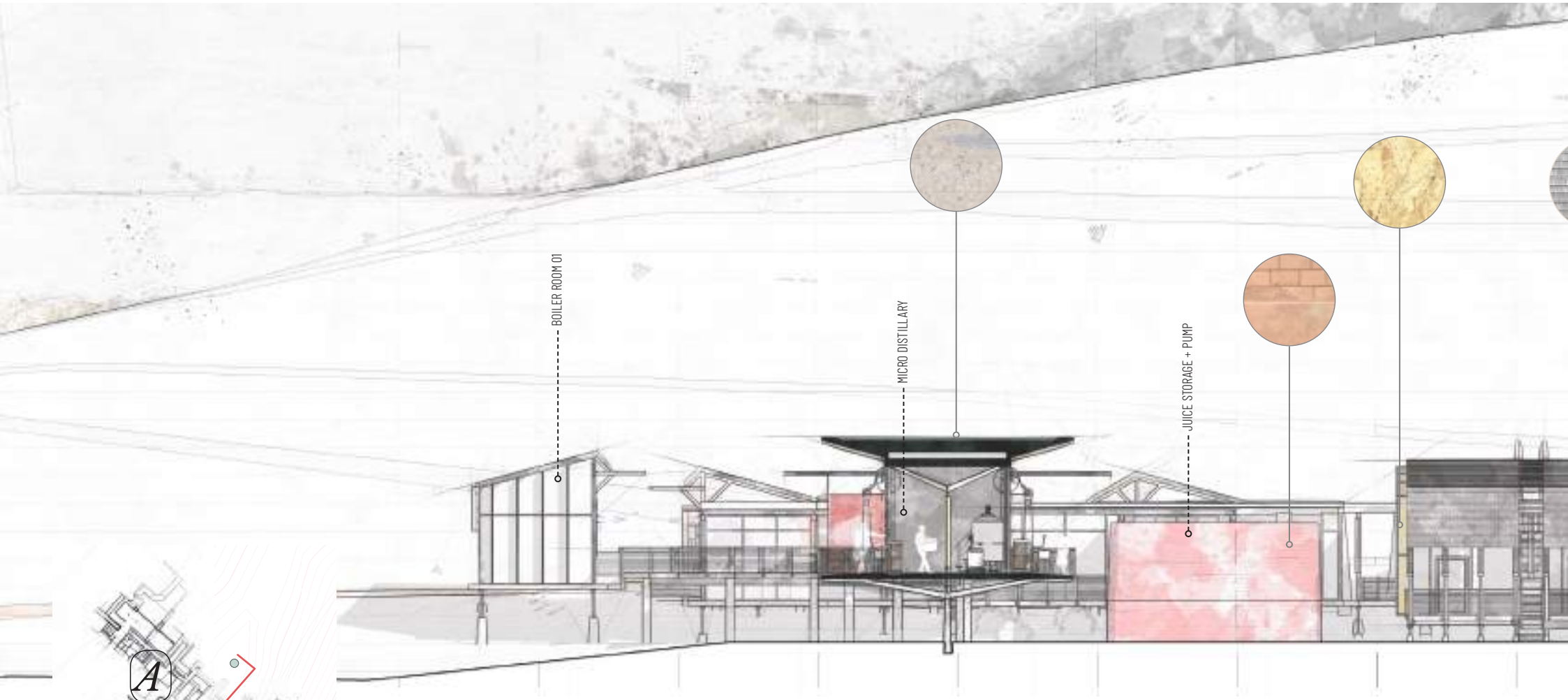


Figure 6.40: South-West Elevation (Author, 2019)



Building A

South East Elevation

Scale 1:100

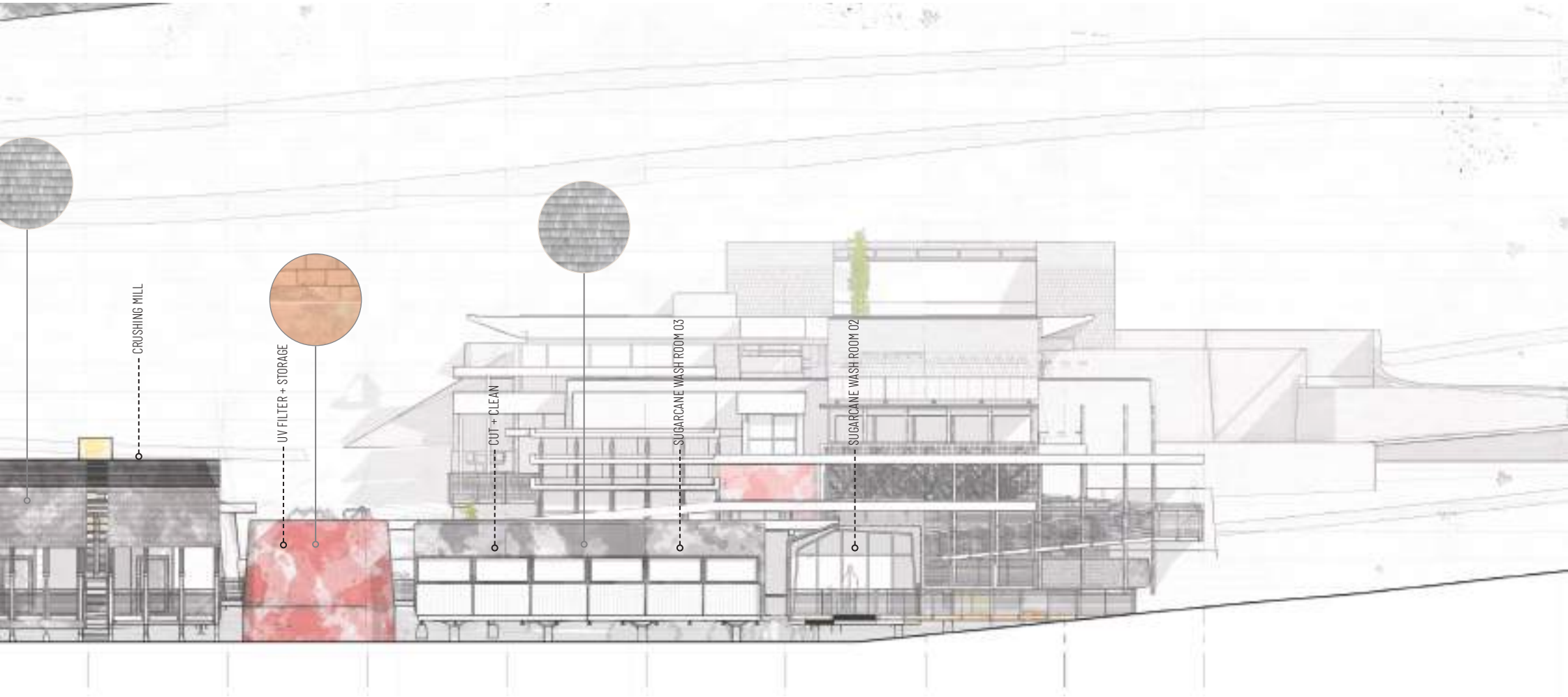
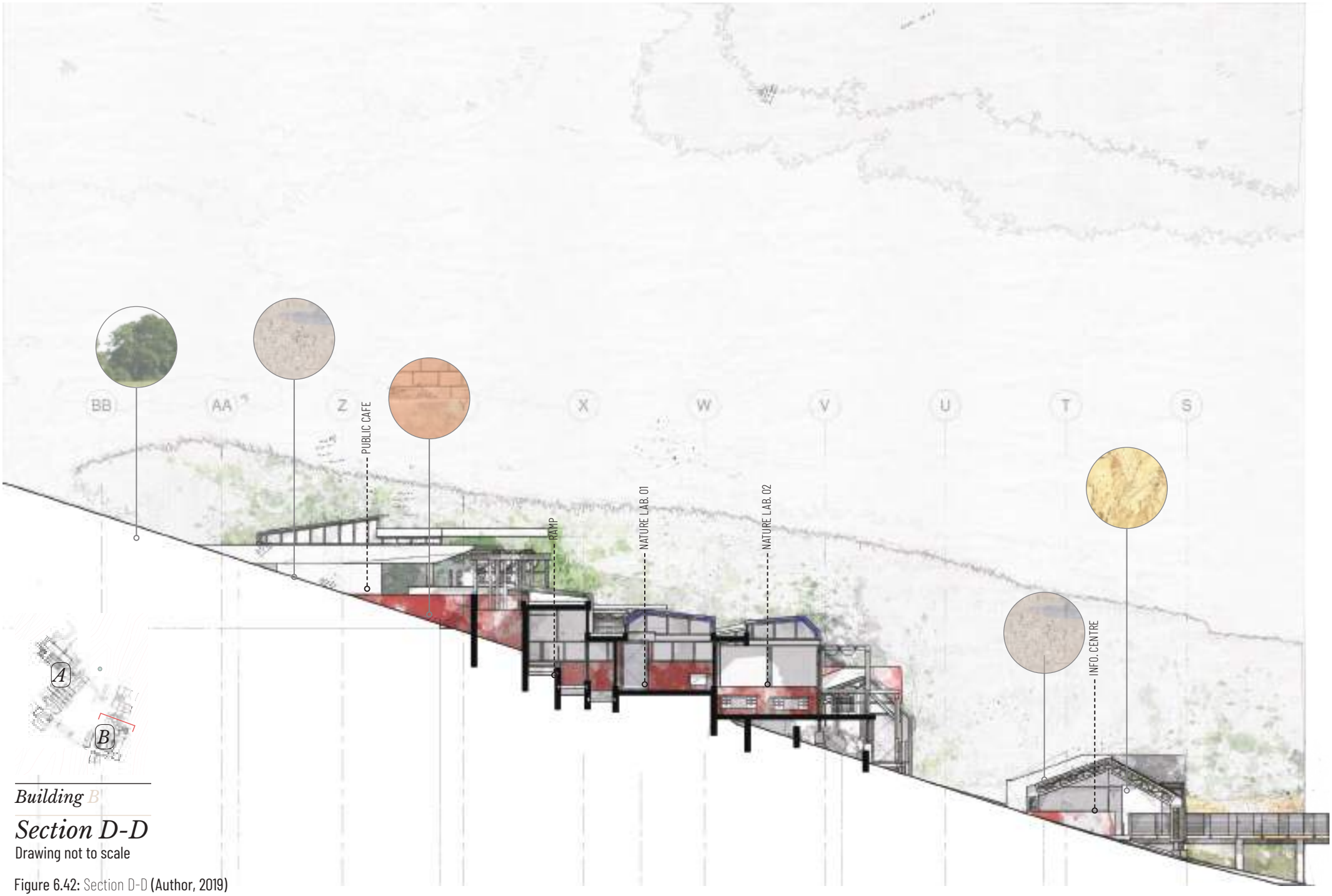


Figure 6.41: South-East Elevation (Author, 2019)

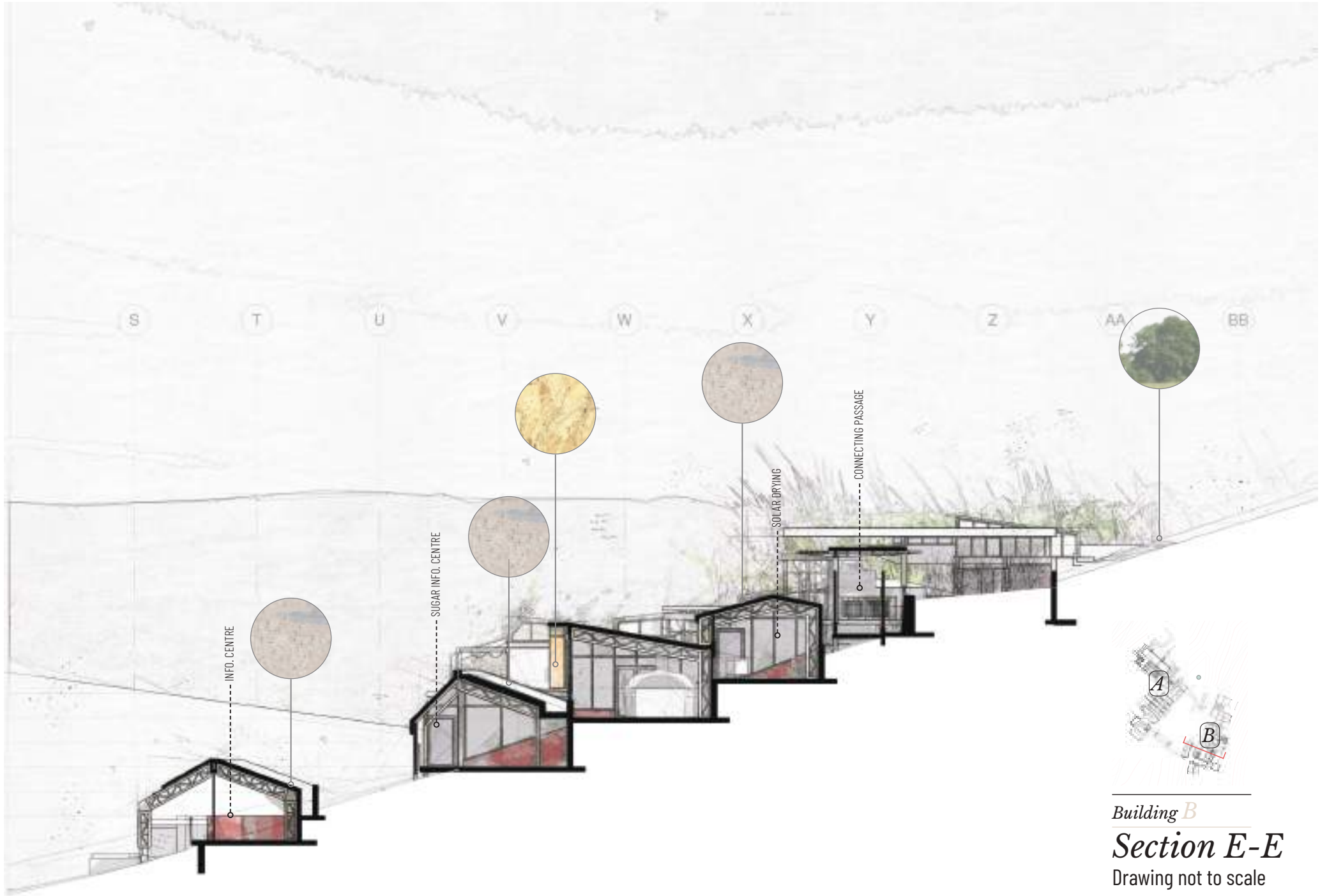


Building B

Section D-D

Drawing not to scale

Figure 6.42: Section D-D (Author, 2019)



Building B

Section E-E

Drawing not to scale

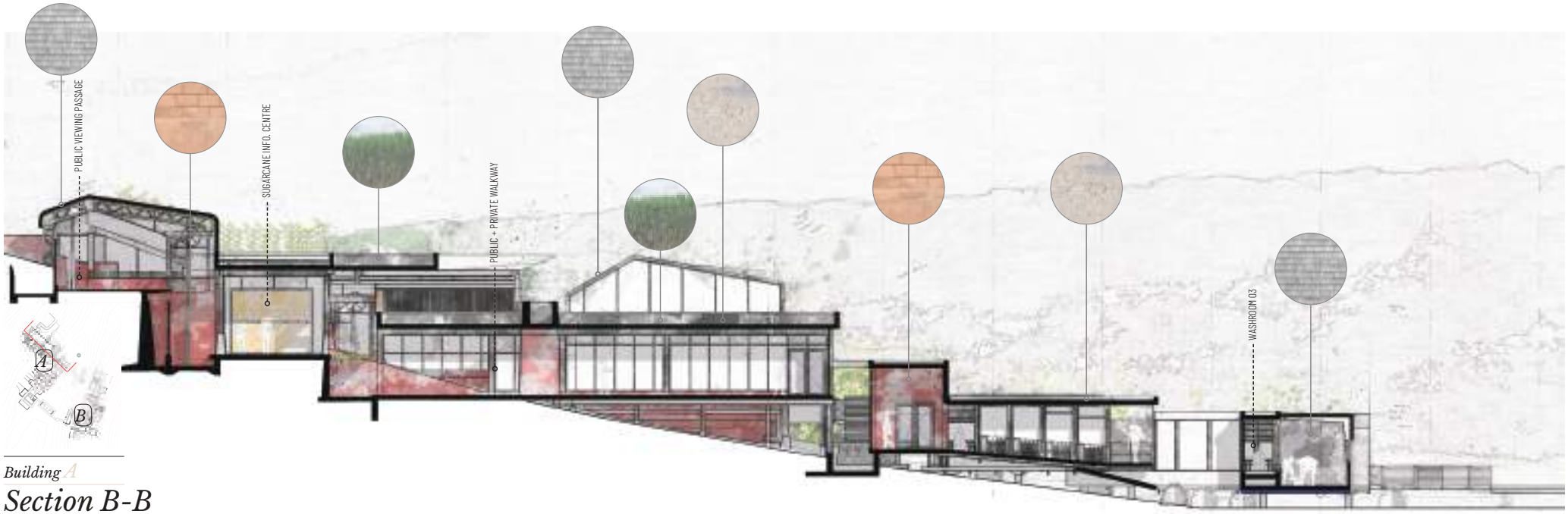
Figure 6.43: Section E-E (Author, 2019)

Building B

Green House Section

Drawing not to scale

Figure 6.44: Greenhouse Section (Author, 2019)

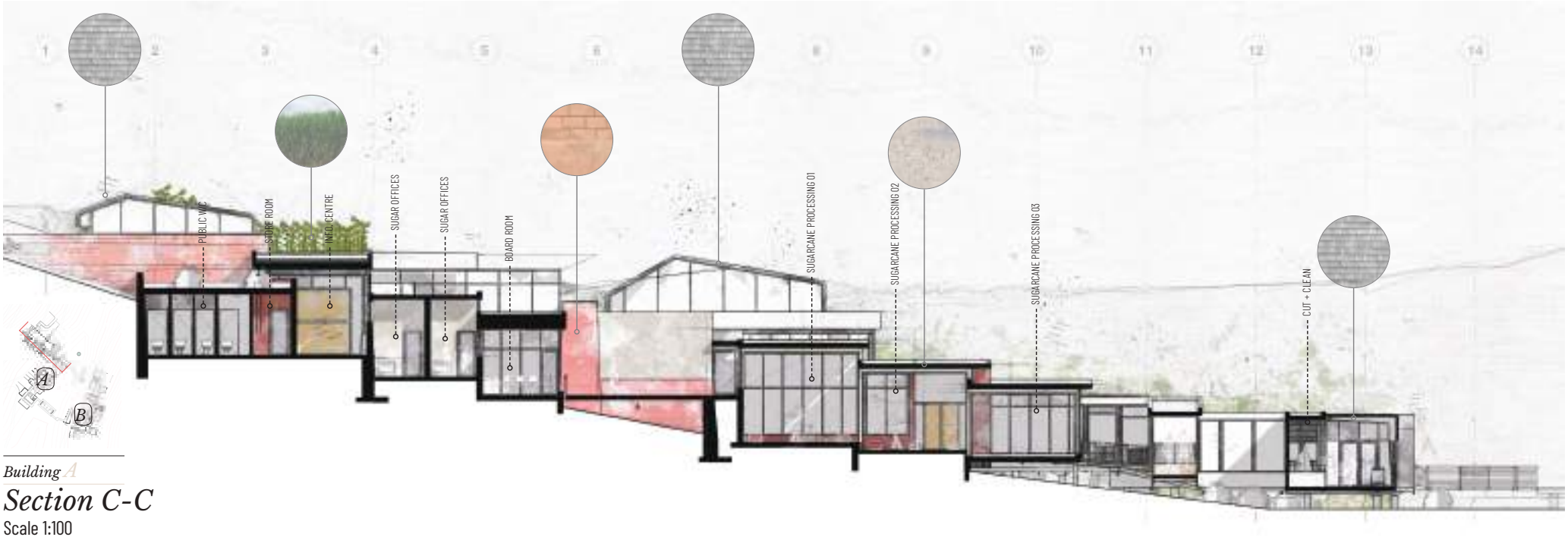


Building A

Section B-B

Scale 1:100

Figure 6.46: Section B-B (Author, 2019)



Building A

Section C-C

Scale 1:100

Figure 6.45: Section C-C (Author, 2019)

Building A

Section F-F

Drawing not to scale

Figure 6.47: Section F-F (Author, 2019)


I
H
G
F
E
D
C
B
A
MILL 01
JUICE PUMP
PUBLIC WALKWAY
PUBLIC LOOKOUT

TECHNIFICATION 07

Chapter 7 refines the details of the design through the technification of the structure. The technical concept is discussed in relation to the overall aim of the project, and how the designer has crafted details as a reaction to the space.

07 | *Technification*

07.1

THE TECHNICAL CONCEPT

Transition as a technical concept as a tool for decision making.

Transition

(noun)
the process or a period of changing from one state or condition to another (Stevenson, 2010)

Transition is explored through a multitude of lenses, in which one pays direct attention to the changing state of existence from one to the other, being it material, form, spatial, experience or product. This notion allows one to understand the moment[1] holistically, in order to design for it.

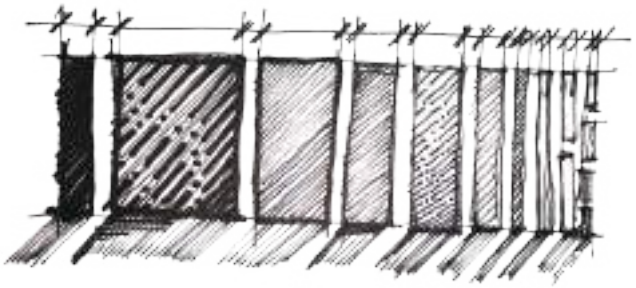


Figure 7.01: Transition of Materials **(Author, 2019)**

1 Used by architects to refer to an object or space (Stott, 2015)

Transition is derived from recreating the mill by re-imagining the architectural experience from which the industrial factory typology exists through five lenses of consideration, namely:

1 **Structure** - Form + Technology
2 **Materiality** - Aesthetic + Sustainability
3 **Natural & Built Systems** - Their coexistence
4 **Spatial Transition** - User Experience
5 **Product State** - Movement

Structure - *Form + Technology*

The stereotomic nature of the building exists as a reaction to the site, and the designs moral obligation to restore degraded landscapes by tying it back to the earth by embedding it within and replacing the 'lost' landscape above. The embedded nature gives anchorage to the design as the building emerges from the landscape.

The 'middle' suggests a transition of two forms i.e. the human-induced and the natural, where the two meet. Previously, coastal architecture has abruptly ended one, and begun the other, but the project proposes the middle, where architecture becomes the tool for the transition of the two and connects man back to nature.

Contrasting, the tectonic structure allows for space between the built and the natural, so both may coexist. The lifted lightweight materiality and construction suggests a respect to the existing, allowing passage below and between.

The architecture of the mill exists as an amalgamation of the three massing components of stereotomic - the 'middle' - and tectonic.

Materiality - *Aesthetic + Sustainability*

Materiality is seen as a way to connect architecture to nature and therefore man to nature. The building's exterior 'skin' expresses the natural exterior condition, through using a hybrid of natural materials, transcending the building with its ecological backdrop. The materiality transcends towards the interior, becoming more structural inwards, housing the production and socio-economic functions.

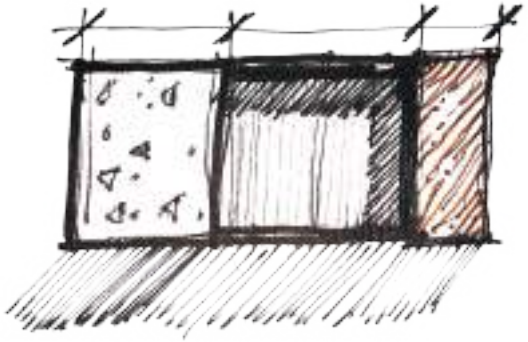


Figure 7.02: Material Transition Sketch **(Author, 2019)**

The materiality also aims to reduce the building's carbon-footprint and introduce alternate materials for sustainable construction means. The site also relies on the materials of the building to populate the surrounding wetland and forestry areas. This is done by impregnating external materials with seeds of indigenous plants, which then decompose once detached from the building.

Natural & Built Systems - *Their coexistence*

This concept forms part of the overarching design concept of fragmentation as a tool for integration of previously thought external natural systems. The idea of bringing natural systems into the buildings, such as interior courtyards, wetlands, drainage strips and sugarcane fields allows for a new experience through architecture. It also allows for these systems to coexist, where previously they were thought as separate. The building therefore also responds directly with the surrounding geography of the site, using it to enhance the architecture.

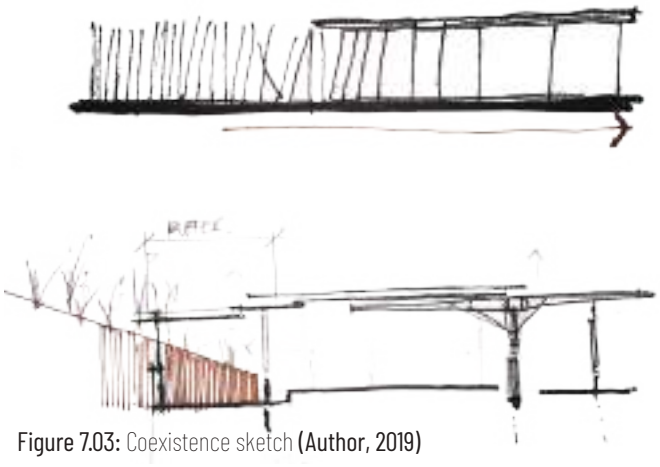


Figure 7.03: Coexistence sketch (Author, 2019)

Spatial Transition - *User Experience*

The building exists as a fragmented whole, therefore each space exists independently of one another, allowing for new experiences to be created between spaces. The spatial transition requires an understanding of material combinations and connections, allowing the user to understand the fragmentation of spaces without each space being too far dislocated from the next for it to not work.

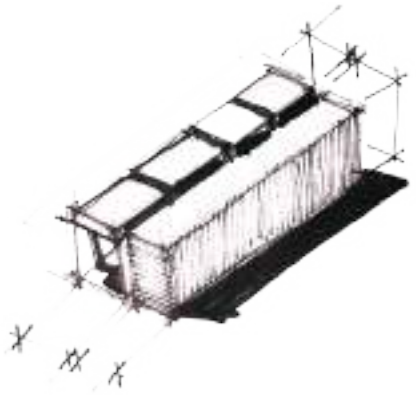


Figure 7.04: Spatial Fragmentation (Author, 2019)

Product State - *Movement*

The state of the product is understood throughout the design, using the architecture to assist in the transition of the material. The architecture integrates the product movement into its form, where normally this would be isolated to a separate space. This notion is set forward in an effort to expose the systems to the public, allowing for a didactic architecture type.

07.2

REGENERATIVE ARCHITECTURE

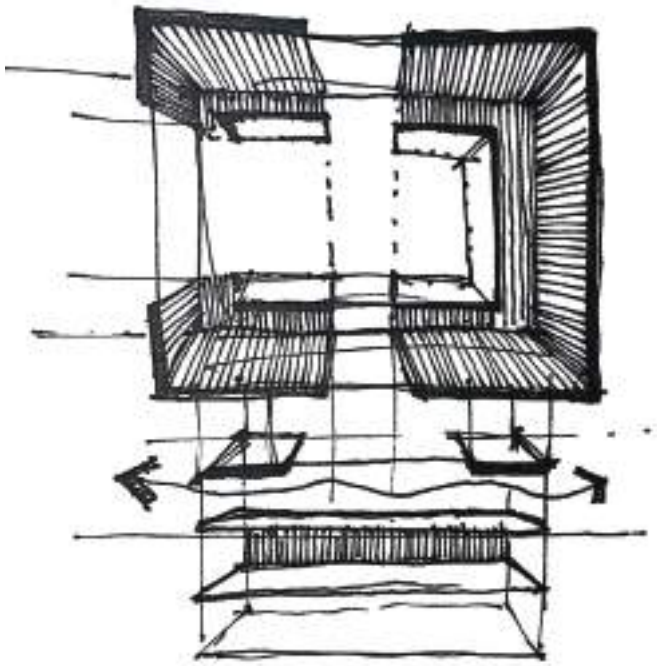
Establishing an alternate, sustainable material palette which is contextually relevant

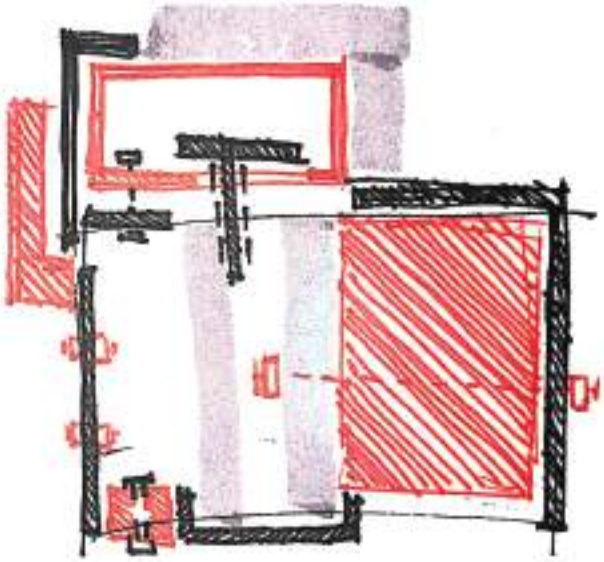
The project makes sustainability within the architecture contextually relevant with material choices, passive design choices and socio-economic sustainability. The theoretical premise discussed in chapter 02, describes the intentions of the project and must be considered when discussing how the project physically achieves the notions set out.

Standard construction materials are re-imagined, in an effort to reduce their footprint size, using contextually sustainable sources and construction which may be completed by using local labour. But the term 'sustainability' is a palliative solution which refers to managing our current consumption and production rates, which is evidently still not viable. The building and its materials therefore need to take on a regenerative demeanor, of which the architecture may contribute to the system rather than just exist as an isolated system within it.

This is achieved through the idea of the building as a regenerative tool through materials, building form, permeability and transparency of design. The design considers how the building can be part of the system rather than isolated within it.

Materiality becomes a vital role player in this sense. The external skin of the structure is fabricated with materials which are decomposable in their environment. This means they may be impregnated with indigenous wetland and forestry seedlings, and when the external material falls from the building, it may decompose into its landscape and serve a bigger purpose, whether it growing directly around the building, or transporting down the wetland towards the estuary, where it forms part of the larger ecosystem.





07.3

RECYCLED FABRIC

The considerations of aesthetic, conceptual, environmental and practicality in building material choice.

With rapid industrial and agricultural growth, large scale wastes have been generated, and more often than not, are disposed in an unsustainable manner. This poses a serious environmental concern as a build up of these materials causes mass pollutants and toxicities our landscapes. "Industrial byproducts, such as coal fly ash, silica fume, and blast furnace slag, have been successfully used in cementitious materials and have achieved sufficient social and environmental benefits" (Xu, Qing et al, 2018). Most agricultural byproducts are mainly used as biomass, animal feed and compost residues, but have not reached their full potential within building material production.

"The reutilisation of natural organic residues to obtain an applicable product is a very useful practice that generates many advantages in the evaluation of social areas, expanding baselines for economic applications, with a low cost product which is ecological and far less polluting, in order to create a country's sustainable development." (Silva, Rocca Lahr, Christoford, & Panzera, 2012)

The project aims to re-imagine the materiality of the mill in both the sustainable and regenerative sense, where materials are recycled from existing residues, and when deteriorated may degrade back into the landscape.

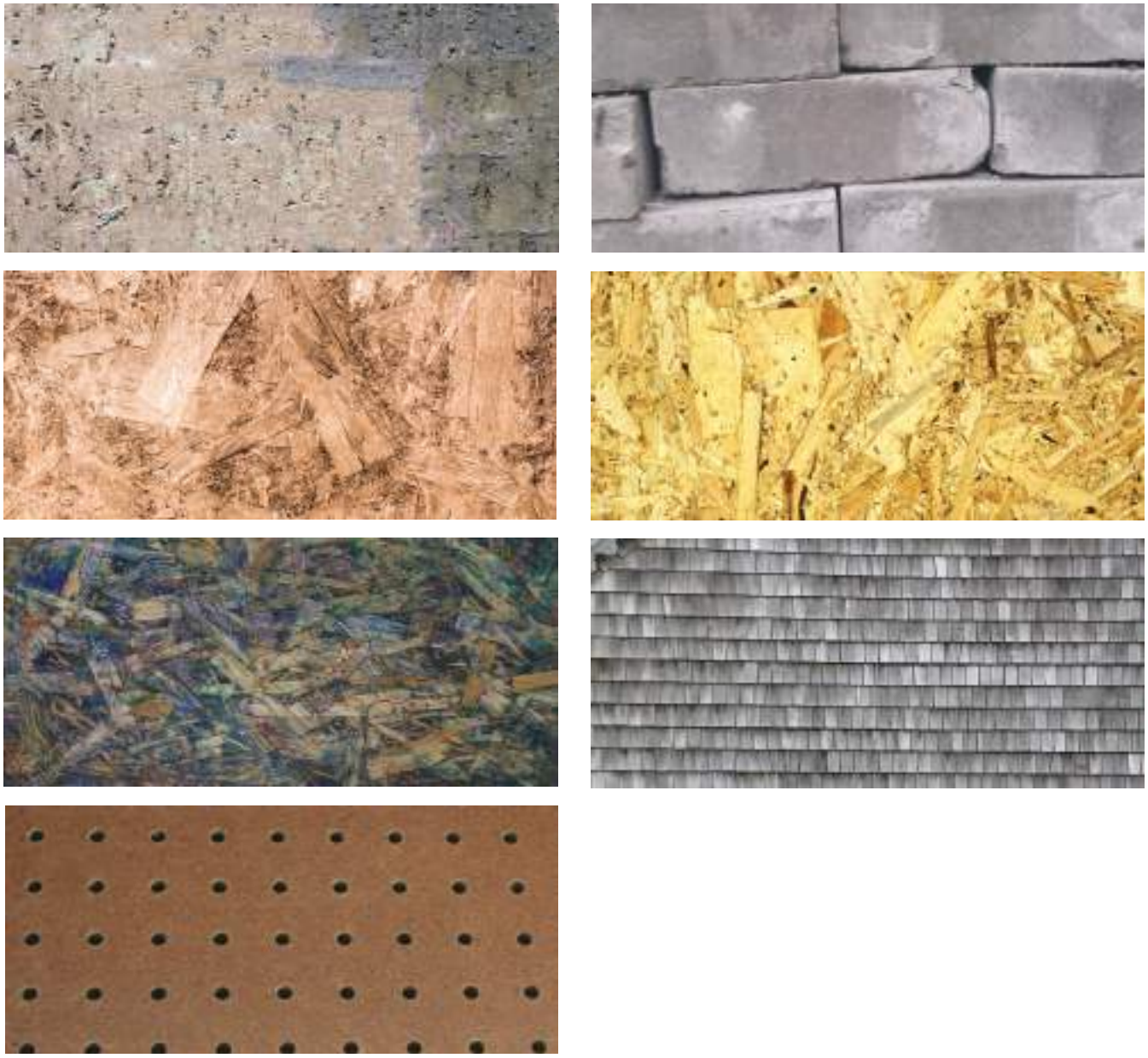


Figure 7.05: Recycled Material Palette **(Author, 2019)**

07.4

BAGASSE AS A BUILDING SOURCE

An alternative base for construction materials

Bagasse is an abundant organic material derived from the processing of raw sugarcane through means of milling. The lightweight, fibrous material is often discarded, used for biofuel or burned during the boiling process. There is a lucrative opportunity for it to be utilised in a multitude of building materials, thus decreasing waste and the carbon emissions produced when such materials are standardly produced. In an effort to create a closed-loop system for the mill, material residues which are in their final stages are used in the creation of new materials, thus closing the loop of production. Materials where sugarcane bagasse may be utilized in the project are as follows:

- Sugarcane Bagasse Oriented Strand Board (BOSB)
- Sugarcane Bagasse Ash (SBA) cementitious material in concrete
- Sugarcane Bagasse Ash (SBA) in unburnt bricks
- Sugarcane Biodegradable Plastics

These materials are used throughout the design as an initiative to reduce the use of non-renewable resources, as well as being contextually sustainable for construction along the coastal regions. This also falls under the response to construction along the coastal regions, where materials oppose the natural coastal typology rather than use it to its advantage.

The natural palette produced by the recycled materials will form the basis for the design aesthetic, in an attempt to blend with the natural landscape surrounding the site and celebrate its natural beauty.

Figure 7.06: Sugarcane bagasse Tongati Mill **(Author, 2019)**

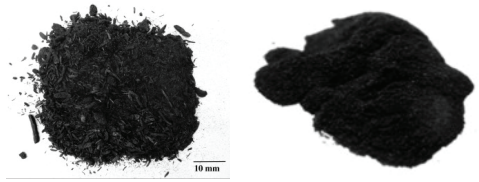


Figure 7.07: Sugarcane bagasse Ash **(Bahurudeen, 2014)**

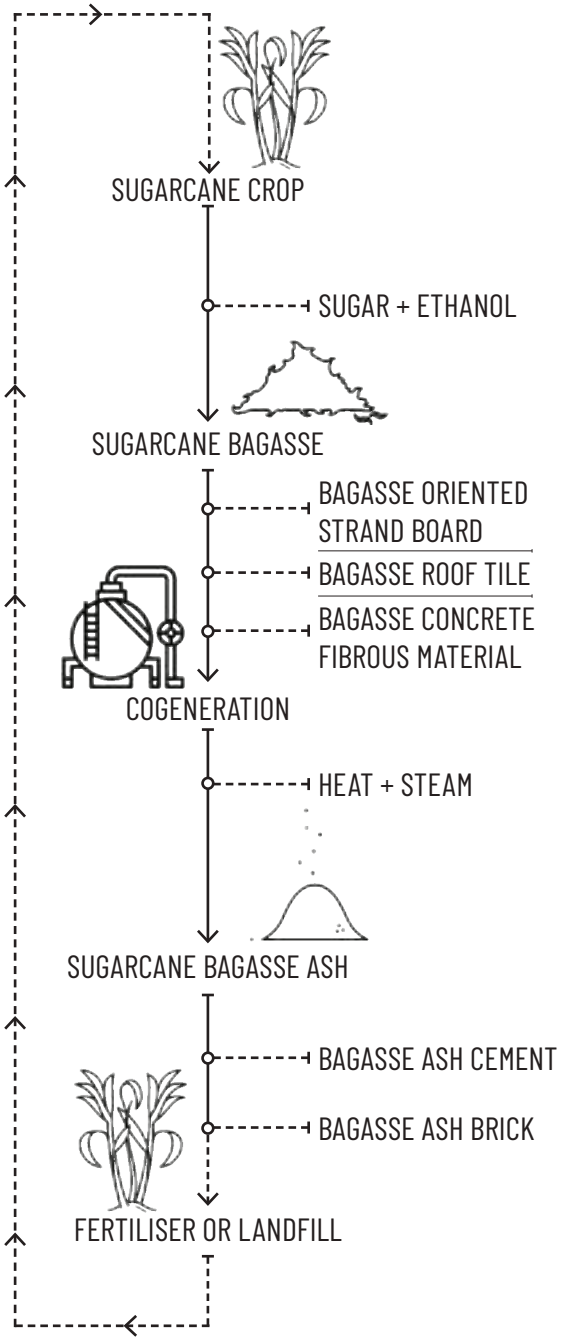


Figure 7.08: Sugarcane byproducts and uses **(Author, 2019)**

07.5

LIGHTWEIGHT BAGASSE-CRETE

An alternative material for standard structural concrete

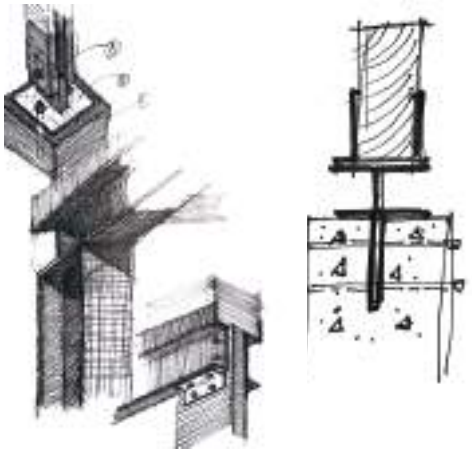
Cement is an essential binder ingredient in the manufacturing process on concrete. Cement production uses a considerable amount of raw material and energy as well as releasing mass quantities of CO_2. Considering the above, alternate solutions to reduce the carbon emissions and the environmental impacts of cement productions have been attempted of which one has been the use of sugarcane bagasse ash.

Bagasse is created once the sugar juice is extracted, and is often used as a "fuel in co-generation to produce steam and electricity" leaving a substance called sugarcane bagasse ash (SBA) (Xu, Qing et al, 2018) . "Each ton of burnt bagasse may generate 25–40 kg of bagasse ash" and considering the amount of sugarcane processed for sugar within the Durban region, a considerable amount of ash is available (Sales & Lima, 2010).

"Sugarcane bagasse ash is a by-product from sugar industries and can be used as supplementary cementitious material in concrete" (Bahurudeen, Marckson, Kishore, & Santhanam, 2014) . The use of SBA in concrete decreases hydration heat, improves concrete durability, and intensifies the interface between the cementitious matrix and the aggregate. This not only validates SBA as a building material but also in terms of waste management, environmental impact, cost reduction and renewable resource sustainability.

Figure 7.09: Sugarcane byproducts **(Author, 2019)**

Figure 7.10: Sugarcane bagasse-crete **(Author, 2019)**



07.6

BAGASSE OSB TIMBER

Creating an alternate for structural timber materials

Bagasse oriented strand board (BOSB) is a material similar to that of medium density fibre board (MDF) in that the chips in MDF are replaced by bagasse fibres and bonded with resin. The sugarcane bagasse is layered in internal and external layers. The external layers are imperatively orientated lengthwise in the same direction, whilst interior layers may be ordered randomly.

The BOSB panel requires a resin for binding, of which normal resin are non-biodegradable. The BOSB will use Lignin as a binder as it has potential to be used as a replacement of phenol in the synthesis of phenolic resins to formulate wood adhesives (Ferdosian, 2017). Lignin has many advantages in that it is resistant to moisture, mechanical resistance and most advantageous is that it results from a renewable resource and therefore the panel, compressed under either a medium or high temperature, increases its mechanical resistance and hardness, resulting in a structural BOSB.

Figure 7.11: Strands of sugarcane **(Author, 2019)**

Figure 7.12: Bagasse Oriented Strand Board **(Author, 2019)**

Figure 7.13: Ceiling BOSB **(Author, 2019)**

07.7

COMPRESSED BAGASSE SHINGLES

An alternative material for cladding material

07.** COMPRESSED BAGASSE SHINGLE

Compressed bagasse shingles are similar to the materiality of the BOSB, the only differences is that the bagasse shingle requires wax impregnation for waterproofing and the size of material is smaller for ease of molding.

The shingle is compressed into a 400x400xmm mold with the same Lignin resin used in the BOSB and a wax impregnation for waterproofing. A variation of wetland and forest seedlings are impregnated into the shingle for their respective location on site. This ensures that when the cladding material falls, its purpose reaches further than just being biodegradable.

The ease of replacing the shingle was also considered, as no additional fixings are required once the initial construction is completed. The natural composition of the material also ensures the mill's elevation is seen as a natural facade, rather than that of a uniform composition of materials such as Kliplok or steel sheeting.

Figure 7.14: Bagasse and Wood Chip Board **(Author, 2019)**

Figure 7.15: Bagasse Shingle Texture **(Author, 2019)**

07.8

COMPRESSED BAGASSE ASH BRICK

An alternative material for standard precast brick

The bagasse brick is conceptualized as an initiative by Corobrik in an effort to reduce clay consumption in the coastal region, by using bagasse ash which is abundant, in an effort increase the sustainability of construction by specifying the new brick type which will be manufactured using materials produced by the sugarcane processing.

Baggasse ash may be used to create unburnt bricks by combining sugarcane bagasse cement, river sand and water to produce unburnt brick material which may be compressed into precast brick form and dried. The strength of the brick is above the minimum requirement of 35Mpa and water absorption is above the minimum. SBA can replace natural clay and can be used instead of clay bricks in construction.

Bagasse bricks are moulded in the form of standard brick sizing of 220x110x75mm. Bagasse bricks are lighter in weight, have a better compression strength than clay bricks, and the thermal conductivity is lower than standard clay bricks (Ashish & Kumar, 2014). The resulting factors are less reinforcing is needed due to the strength of the brick, the building is lighter, therefore less foundations and less thermal insulation is needed as the brick has sufficient thermal insulation.

Figure 7.16: Bagasse Ash Brick **(Author, 2019)**

Figure 7.17: Modular Bagasse ash brick **(Author, 2019)**

Figure 7.18: Bagasse ash brick sketch **(Author, 2019)**

07.9

SEFAIRA RATING

Isolating the detail section for daylighting analysis

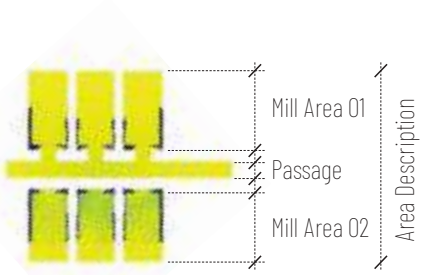


Figure 7.19: Sefaira areas **(Author,2019)**

Description:

Spatial daylight autonomy (sDA) :

Spatial Daylight Autonomy (sDA) describes how much of a space receives sufficient daylight. Specifically, it describes the percentage of floor area that receives a minimum illumination level for a minimum percentage of annual occupied hours. It is a climate-based daylighting metric, meaning that it is simulated using a location-specific weather file (Sterner, 2017).

Annual Sun Exposure (ASE):

Annual Sun Exposure (ASE) describes how much of space receives too much direct sunlight, which can cause visual discomfort (glare) or thermal discomfort. Specifically, ASE measures the percentage of floor area that receives at least 1000 lux for at least 250 occupied hours per year (Sterner, 2017).

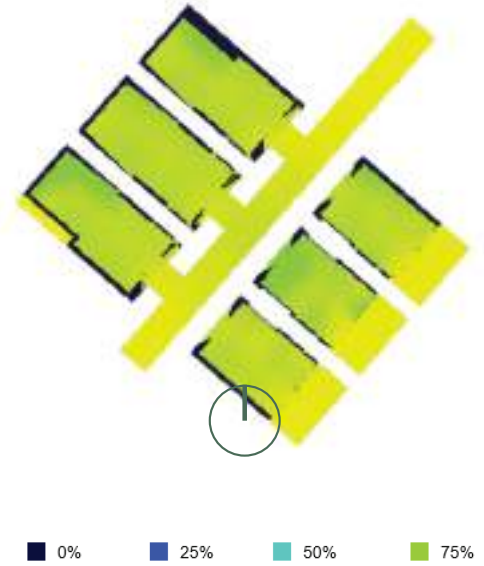
Comparison:

Each iteration is compared to the LEED v4 (Leadership in Enery and Environmental Design) to set a bench mark for what the building should abide to. The following are values provided by LEED used for comparison:

sDA:	Value > 75%
ASE:	Value < 10%

Values obtained from LEED v.4 2019

Iteration 01



Description:

Iteration 01 uses the revit standard model without any changes, to act as a platform from which to base and compare the new iteration on. The northern Mill Area 01 has expansive glazed areas, using only single-pane glass for weatherproofing. The Passage area is open to the exterior elements and is not in use throughout the day, therefore the space may be over-lit. Mill Area 02 contains single-pane glazing on all sides with only the outer edges being solid walls.

Result:

The outcome sees the iteration as too over-lit within the interior spaces. This is due to the largely glazed facades with minimal shading.

Solution to iteration:

The iteration requires more shading on the outskirts of the building as a whole. Smaller areas of glazing will result in better daylighting performances.

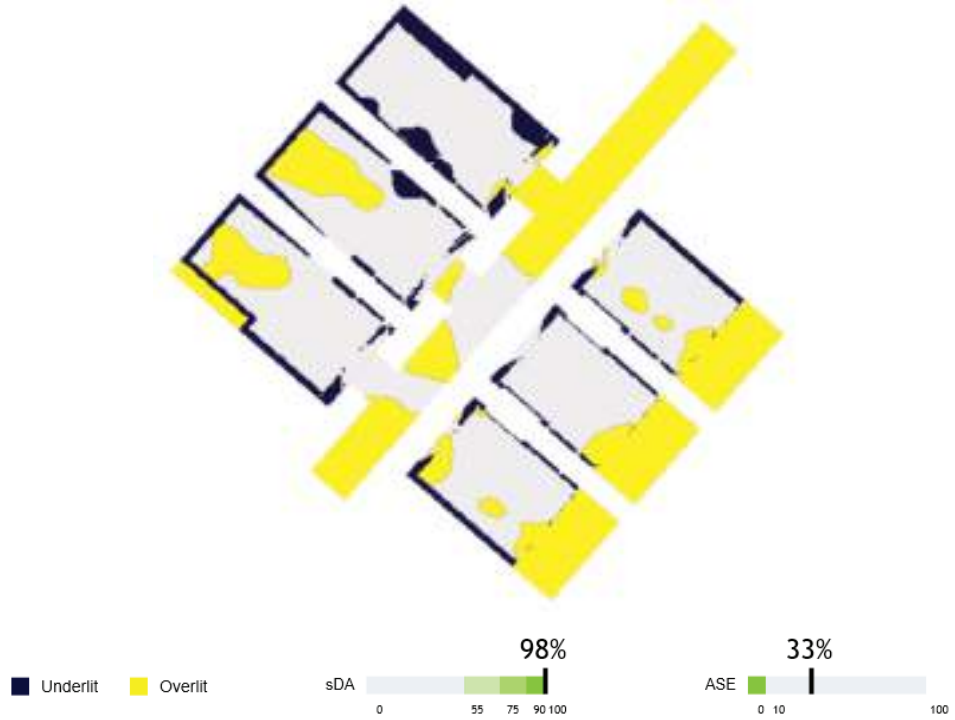


Figure 7.20: Iteration 02: Overlit and Underlit **(Author, 2019)**

Description:

Iteration 02 saw a change in both Mill Area 01 and 02. Mill 01 opted for smaller clerestory windows, and low-e glass sized at 600mm high x 1500mm wide, reducing the area of glass along the Northern edges. Mill Area 02 fluctuated the curtain wall panels, altering between a timber panel and a low-e glazing The passage stayed exposed, but was affected (for the better) by changes made to both Mill Area 01 and 02. The South-East edge of the building consist of three exterior 'patios' and therefore was consider when daylighting factors resulted as minimal shading was required for these areas due to their functions..

Result:

The design's sDA performed well, being 23% above the LEED's benchmark of 75%. Therefore no measures need to be set in place to rectify this. The ASE breached the 10% maximum benchmark set by LEED by 23%, which may result in discomfort for the user. To rectify this, the design should consider materials which do not create any glare, such as matte materials rather than any glossy finishes, but the initial option would be to provide more shading for the users, preferebly shading which may be moved by the user.

Benchmark Comparables:

	LEED Benchmark	Project Outcome
sDA:	Value > 75%	98%
ASE:	Value < 10%	33%

Values obtained from LEED v.4 2019

Figure 7.21: Iteration 02: Annual **(Author, 2019)**

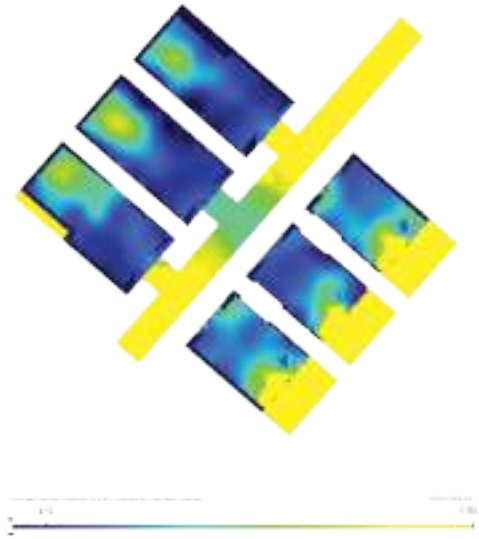


Figure 7.22: Iteration 02: Daylight Factor **(Author, 2019)**

SBAT RATING

Sustainable Building Assessment Tool (SBAT)

The SBAT aims to better building sustainability performance by highlighting how the new intervention increases sustainability (in the holistic sense) compared to when the intervention had not taken place. The tool aims to assess, and validate the performance of buildings and designs within their respective contexts.

The analysis done relates the new intervention to the future proposal of the Sibaya Precinct in order to picture the projects extents and vision for future use. Therefore the project is set out to compare the existing conditions where there is minimum built environment surrounding the site to the future of the site, which sees the new built Sibaya proposal taking place.

Results:

Current Condition

The analysis of existing conditions did not highlight any information that was unexpected. The natural state (farmlands) of the site lacks in its social, economic and environmental contribution in terms of society. The only main contributing factors to the site was its proximity (2-4km away) to built environments, where the social contributions were high, and therefore overlapped into the site area.

Future Intervention

The analysis of the future intervention saw an increase overall. This is due to future expansion of the Sibaya precinct as well as creating a node to connect the site to existing frameworks. The site's social, economic and environmental conditions drastically increase, creating a holistic environment for all users.

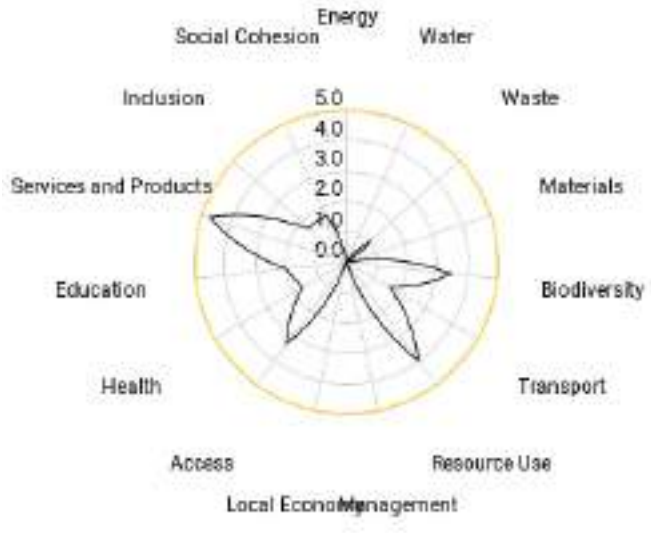
Existing Condition:

SUSTAINABLE BUILDING ASSESSMENT TOOL RESIDENTIAL
1.04

Achieved

SB SBAT REPORT 1.7

SB1 Project
Eco Sugarcane Mill
SB2 Address
Ohlanga Estuary Ext.
SB3 SBAT Graph



SB4 Environmental, Social and Economic Performance	Score
Environmental	0.9
Economic	1.8
Social	2.3
SBAT Rating	1.7

SB5 EF and HDI Factors	Score
EF Factor	2.1
HDI Factor	1.3

SB6 Assessment: SBAT assessment carried out by

Name Tanner	Date	26-09-2019
Assessor number		
Signature		

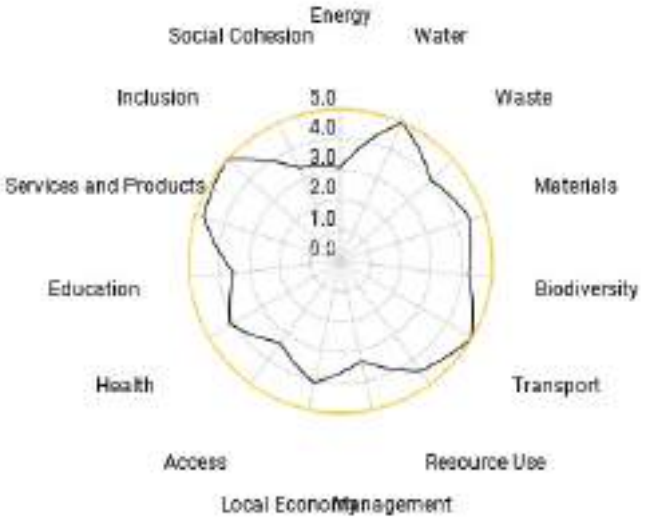
Post intervention:

SUSTAINABLE BUILDING ASSESSMENT TOOL RESIDENTIAL
1.04

Achieved

SB SBAT REPORT 4.1

SB1 Project
Eco Sugarcane Mill
SB2 Address
Ohlanga Estuary Ext.
SB3 SBAT Graph



SB4 Environmental, Social and Economic Performance	Score
Environmental	4.2
Economic	4.1
Social	4.1
SBAT Rating	4.1

SB5 EF and HDI Factors	Score
EF Factor	4.3
HDI Factor	4.2

SB6 Assessment: SBAT assessment carried out by

Name Tanner	Date	26-09-2019
Assessor number		
Signature		

Water Runoff Calculations For Site:

Tanner Harwood Last Updated: 21/11/12

1. Climate Data

Place: Durban

Position: 29°43'16.52"S, 31° 5'56.37"E
Height: 50m
Period: 2010

MONTH	Temperature: Highest Recorded	Temperature: Average Daily Maximum	Temperature: Average Daily Minimum	Temperature: Lowest Recorded	Precipitation: Average Monthly (mm)	Precipitation: Average number of Days >=1mm	Precipitation: Highest 24hr rainfall (mm)
January	38	27.7	20.6	8	124	14	100
February	38	28.1	20.9	11	113	11	95
March	35	27.6	19.9	11	125	10	84
April	33	26.1	17.5	9	71	7	72
May	29	24.4	14.4	12	58	3	40
June	25	22.9	11.6	9	30	1	32
July	26	22.4	11.3	8	33	1	18
August	31	22.9	12.9	7	46	2	15
September	34	24	15	7	64	3	43
October	36	24.2	16.8	12	98	9	108
November	36	25.4	18.2	7	110	12	67
December	35	27.1	19.8	7	110	15	50
YEAR	36	25.4	16.575	9	975	87	160

2. Yield

Yield (m³) = P x A x C (Where P=precipitation (m), A=area (m²), and C=run-off coefficient)

Area of Catchment: Per surface (Per surface)	Area (m²)	Run-off Coefficient
Roofing	2 729.00 m²	0.9
Paving	670.00 m²	0.8
Veldgrass	0.00 m²	0.4
Lawn	0.00 m²	0.4
Planting	8 400.00 m²	0.2
Gravel	0.00 m²	0.7
Dams water	0.00 m²	1
TOTAL:	11 799.00 m²	0.47

MONTH	Precipitation: Average Monthly (mm)	Area	Run-off Coefficient	Yield: P(m) x A(m²) x C
January	124 mm	11 799 m²	0.47	684 m³
February	113 mm	11 799 m²	0.47	623 m³
March	125 mm	11 799 m²	0.47	689 m³
April	71 mm	11 799 m²	0.47	391 m³
May	56 mm	11 799 m²	0.47	309 m³
June	30 mm	11 799 m²	0.47	165 m³
July	31 mm	11 799 m²	0.47	171 m³
August	46 mm	11 799 m²	0.47	254 m³
September	64 mm	11 799 m²	0.47	353 m³
October	95 mm	11 799 m²	0.47	524 m³
November	110 mm	11 799 m²	0.47	606 m³
December	110 mm	11 799 m²	0.47	606 m³
YEAR	975 mm	11 799 m²	0.47	5 374 m³

3. Demand (Irrigation and Domestic)

IRRIGATION DEMAND

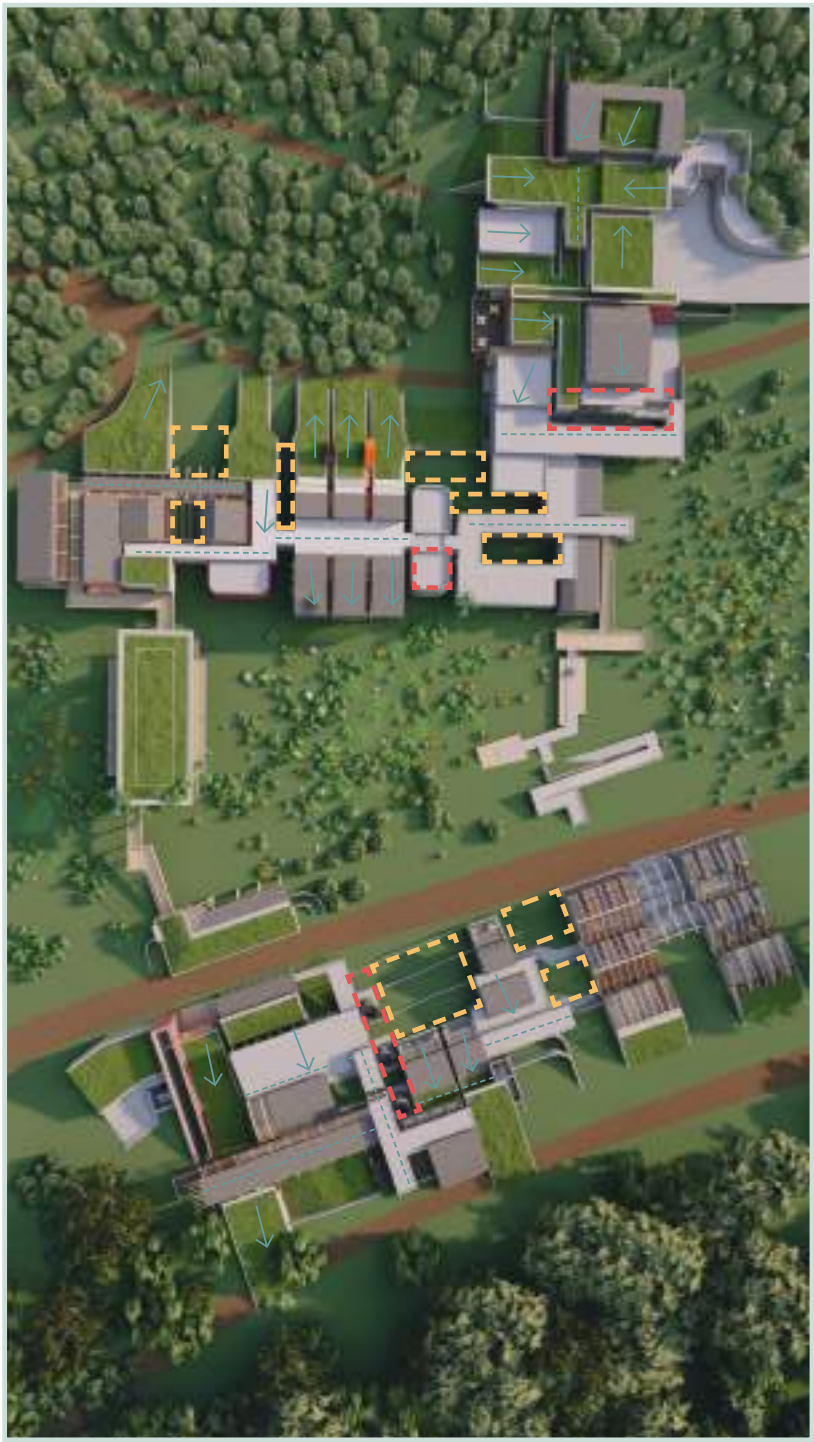
	Planting Area (m²)	Irrigation Depth per event (m)	Irrigation Depth per month (m)	IRRIGATION DEMAND (m³)
January	8 400 m²	0.080 m	0.177 m	1 488 m³
February	8 400 m²	0.080 m	0.160 m	1 344 m³
March	8 400 m²	0.080 m	0.177 m	1 488 m³
April	8 400 m²	0.080 m	0.129 m	1 080 m³
May	8 400 m²	0.080 m	0.080 m	744 m³
June	8 400 m²	0.080 m	0.080 m	720 m³
July	8 400 m²	0.080 m	0.080 m	720 m³
August	8 400 m²	0.080 m	0.085 m	744 m³
September	8 400 m²	0.080 m	0.129 m	1 080 m³
October	8 400 m²	0.080 m	0.177 m	1 488 m³
November	8 400 m²	0.080 m	0.171 m	1 440 m³
December	8 400 m²	0.080 m	0.177 m	1 488 m³
YEAR	8 400 m² (Average)	0.080 m (Average)	1.668 m (Total)	13 824 m³ (TOTAL)

3. Total Demand

	IRRIGATION DEMAND (m³)	DOMESTIC DEMAND (m³)	TOTAL WATER DEMAND
January	1 488 m³	0 m³	1 488 m³
February	1 344 m³	0 m³	1 344 m³
March	1 488 m³	0 m³	1 488 m³
April	1 080 m³	0 m³	1 080 m³
May	744 m³	0 m³	744 m³
June	720 m³	0 m³	720 m³
July	720 m³	0 m³	720 m³
August	744 m³	0 m³	744 m³
September	1 080 m³	0 m³	1 080 m³
October	1 488 m³	0 m³	1 488 m³
November	1 440 m³	0 m³	1 440 m³
December	1 488 m³	0 m³	1 488 m³
YEAR	13 824 m³ (Total)	0 m³ (Total)	13 824 m³ (TOTAL)

4. Water Budget Exercise = Safety Factor + Number of Tanks needed

	YIELD (from onsite runoff) (m³)	DEMAND (total onsite water demand) (m³)	Monthly Balance
January	684 m³	1 488 m³	-8.04 m³
February	623 m³	1 344 m³	-7.21 m³
March	689 m³	1 488 m³	-7.99 m³
April	391 m³	1 080 m³	-6.89 m³
May	309 m³	744 m³	-4.35 m³
June	165 m³	720 m³	-5.55 m³
July	171 m³	720 m³	-5.49 m³
August	254 m³	744 m³	-4.90 m³
September	353 m³	1 080 m³	-7.27 m³
October	524 m³	1 488 m³	-9.64 m³
November	606 m³	1 440 m³	-8.34 m³
December	606 m³	1 488 m³	-8.82 m³
YEAR	19 198 m³ (Total)	13 824 m³ (TOTAL)	



SYSTEMIC DRIVERS OF THE SITE

How does the building function

07.12.1 Water

Water forms an integral part of the design, where many of the processes in the building require water as either an energy source or a source of nutrition (planting). Water runoff is stored on site and moved towards processing points along the design.

Water is purified in both grey water stormwater runoff state. Soft site runoff is collected at points along the site and stored in both below and above ground tanks. The water is purified and used at sugarcane processing points.

Hardscape runoff is collected and moved towards exterior constructed wetland areas, where it is purified before entering the natural system.

Rainwater runoff from the roofs is stored in galvanised tanks at upper levels of the site. The runoff from the green roofs is partially cleaned through the natural layered roof system, and is further filtered through the natural wetland system between the building prior to being stored. The water accumulated from non-green roofs is processed separately through the constructed wetland systems around the building, prior to being implemented either back into the natural system or may be stored for further use on site.

Firstly all major runoff is filtered with a simple catchment system to remove any debris existing in the water. Excess materials are captured and returned to site where they may decompose into the soils.

Rainwater is collected and used for the washing of sugarcane, where after it is sent back into the constructed wetland system for basic filtration. Once filtered through the constructed wetland, the water is filtered back into the natural system, where it may run towards the Ohlanga estuary.

07.12.2 Grey Water

Water used within the building for purposes such as cleaning, washing and drinking undergoes a basic grease trap filtration before entering back into the natural systems. Operation of the grease interceptor (Figure 24) slows the flow of wastewater and allows the grease, fats, oils and solids to separate. These materials may then be separated a treated individually, whilst the cleaner water may be further filtered.

07.12.2 Potable Water

Potable water undergoes a filtration process which involves UV exposure. Water which is filtered basically may be stored underground, from where it may undergo further treatment. Ultraviolet water purification is the most effective method for disinfecting bacteria from the water. Water is passed through the UV water treatment system, where living organisms in the water are exposed to UV light which in turn attacks the genetic code of the microorganism and rearranges the DNA, thus eliminating the microorganism's ability to function and reproduce. The UV filtration is used in conjunction with both the bio-wetland filtration system as well as carbon block filters.

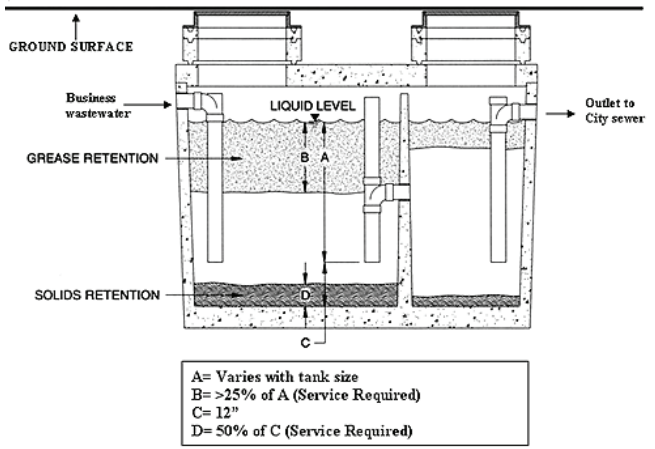


Figure 7.23: Grease Trap flow diagram **(Fountains Valley, 2019)**

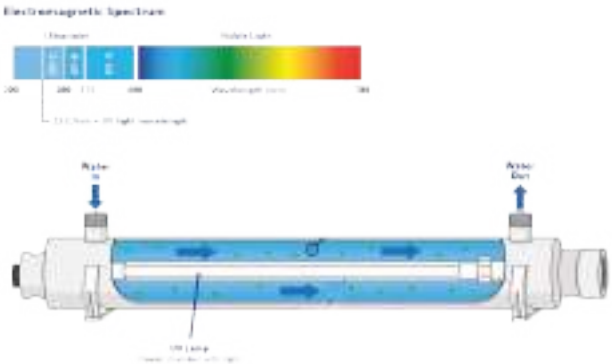


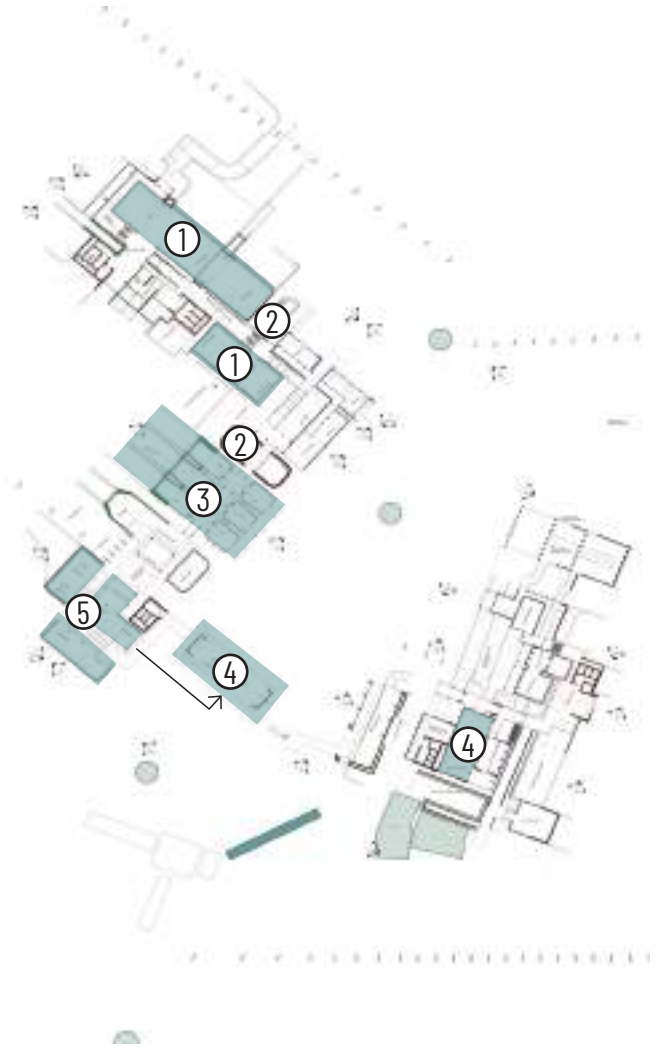
Figure 7.24: Basic Ultraviolet Filtration System **(LFA 2017, edited by Author)**

07.5.2 **Production Waste**

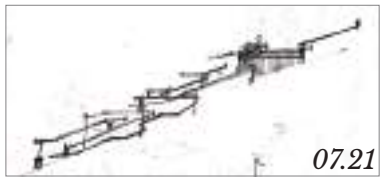
Production waste is the second systemic driver considered within the project. Organic waste is reused throughout the mill as an energy source for further production of sugar.

Bagasse from the crushing of sugarcane is reused in the boiling process of the sugar juice into syrup. Where bagasse is burned the excess ash is sent off site, where it becomes the base component for concrete and bricks to be used in construction. Where bagasse is not removed off site, excess material is moved to compost pits, where it decomposes into compost which is used for farming purposes.

1. Excess organic material such as leaves and roots are removed from the stalks of the sugarcane and stored in compost heaps for decomposition.
2. Waste water is moved towards the grease trap and furthered to the UV filtration system. The outccome is potable water whicch may again be used amongst the site.
3. Bagasse is collected and stored for further use as kindle for the boiling funaces.
4. Excess mollasses is stored and moved towards the distillery where it is used to produce rum.
5. Bagasse ash created by the furnaces is collected and sent to create bagasse-crete and bagasse ash bricks for construction.



TECHNIFICATION OF THE DESIGN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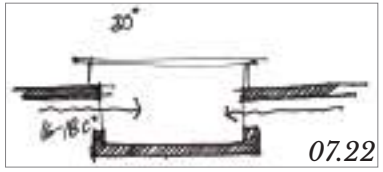

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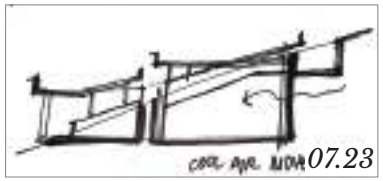

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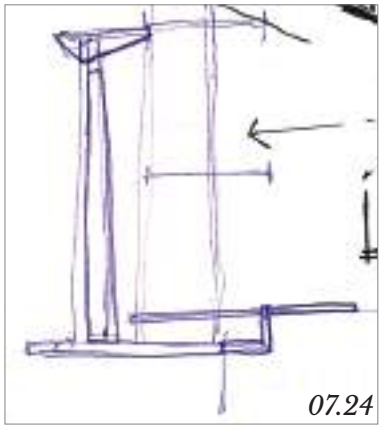
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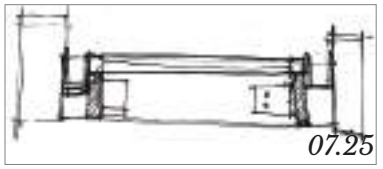
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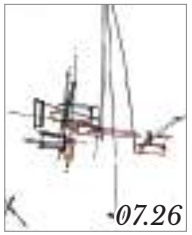
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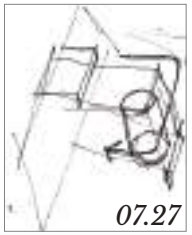
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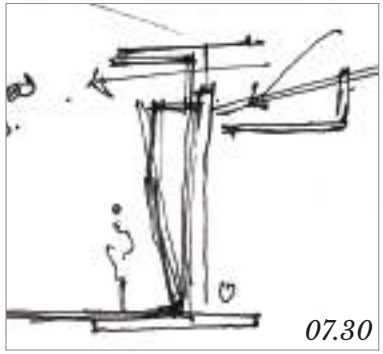
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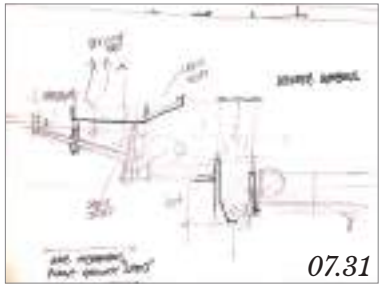
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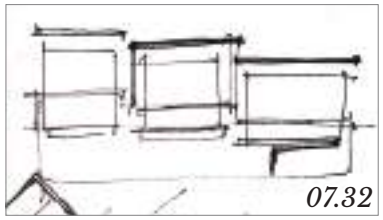
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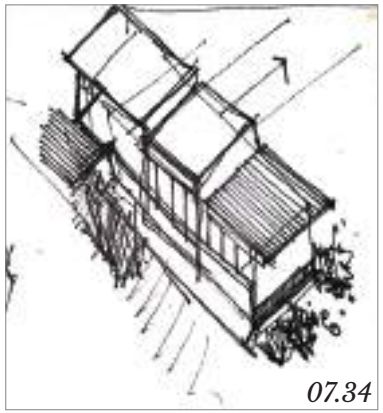
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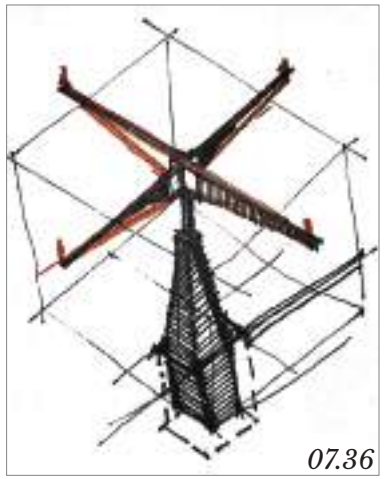
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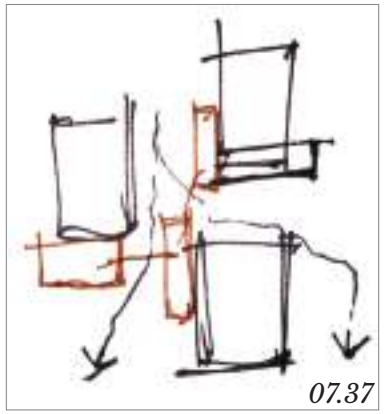
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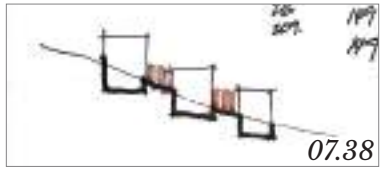
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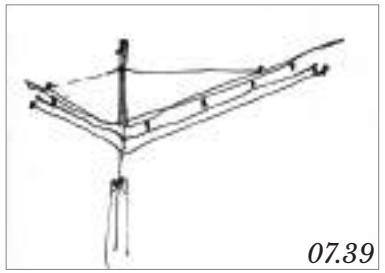
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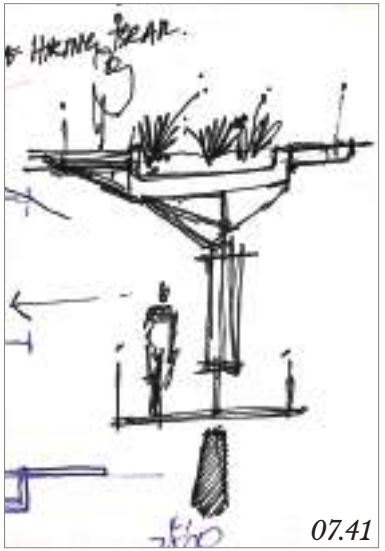

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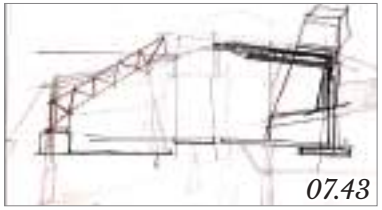
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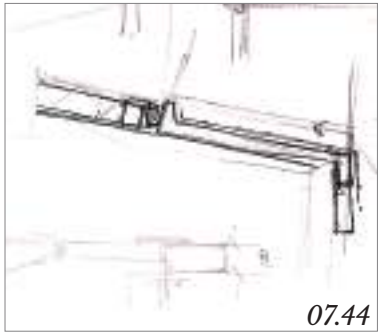
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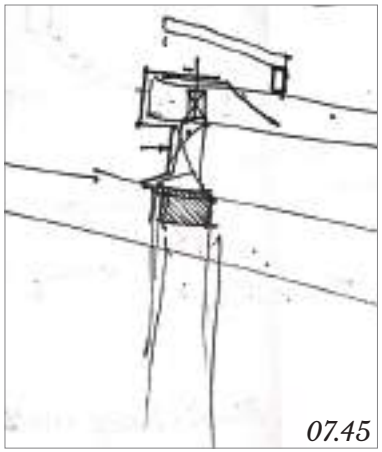
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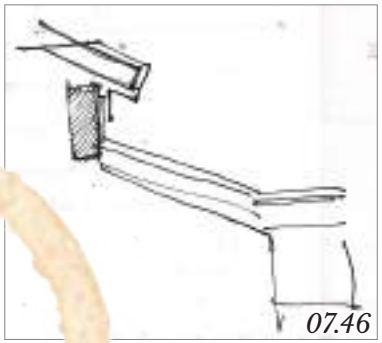
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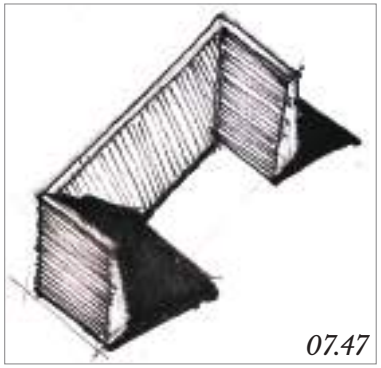
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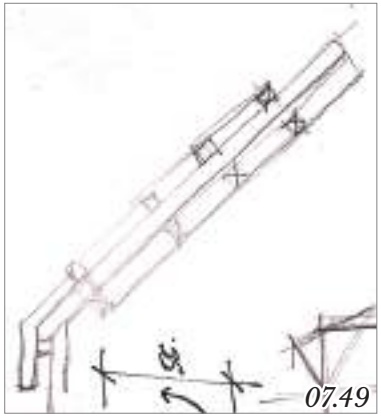
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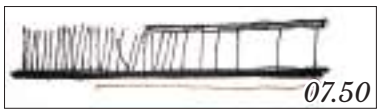
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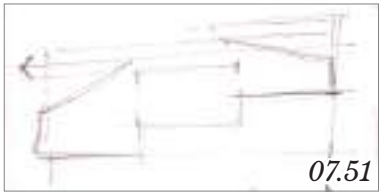
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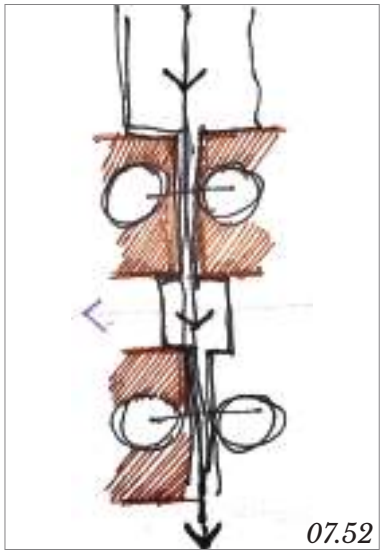
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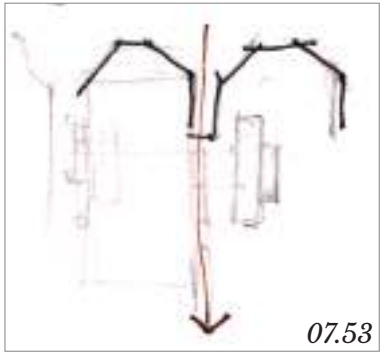
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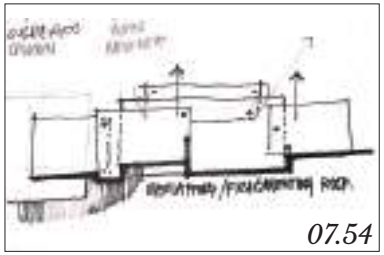
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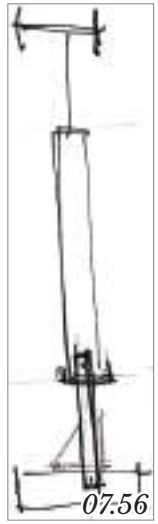
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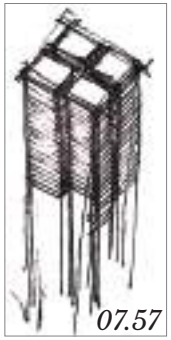
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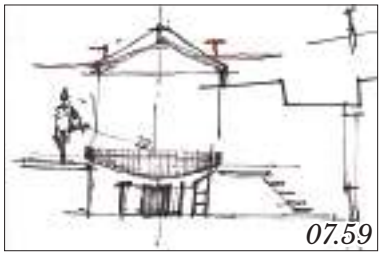
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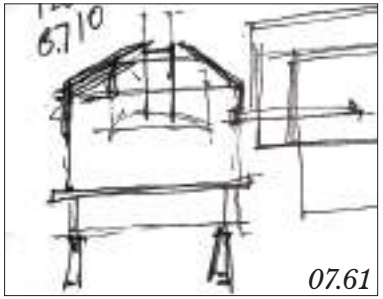
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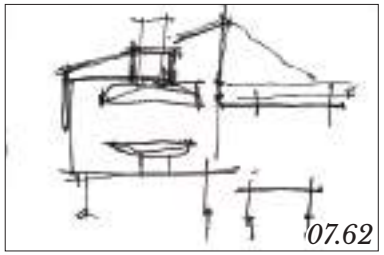
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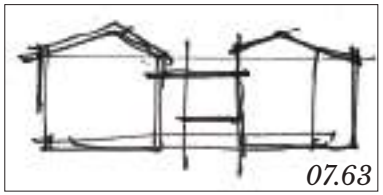
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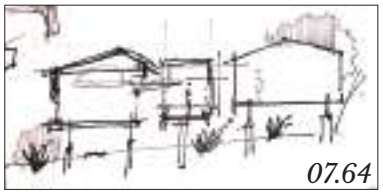
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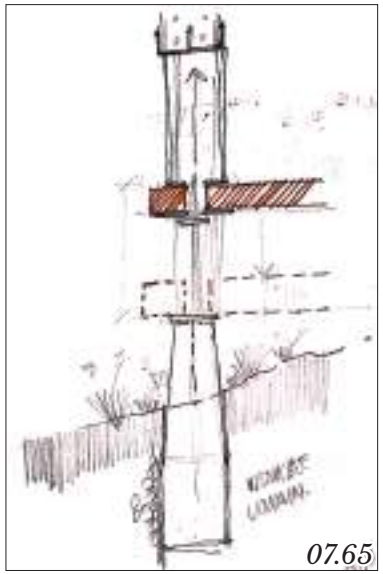
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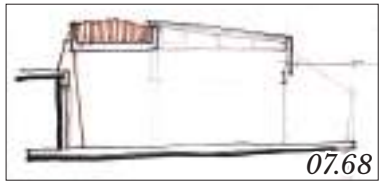
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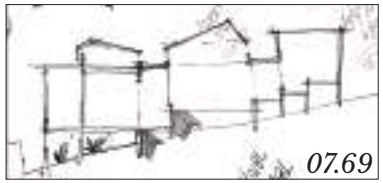
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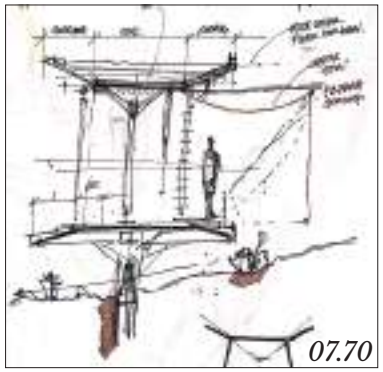
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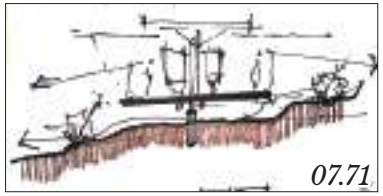
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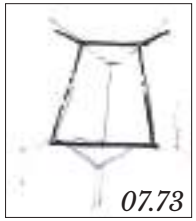
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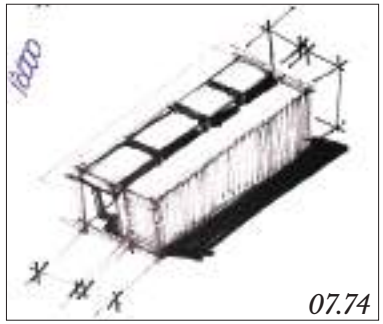
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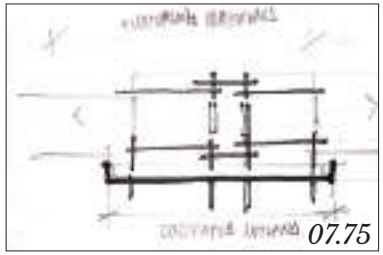
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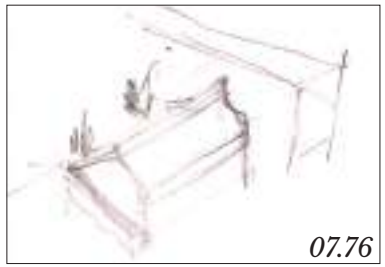
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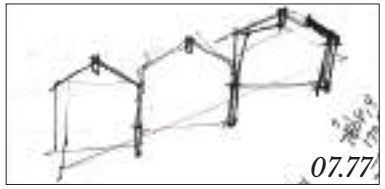
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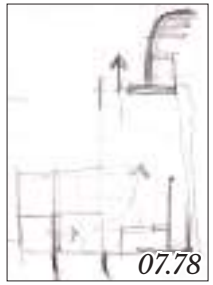
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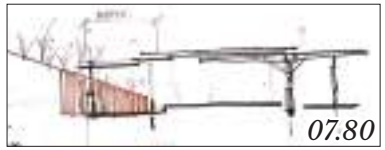
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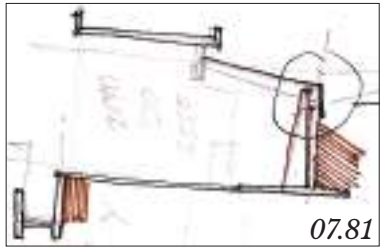
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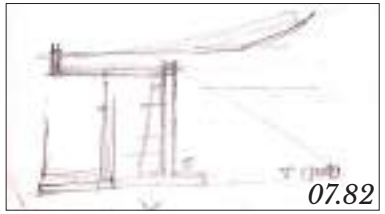
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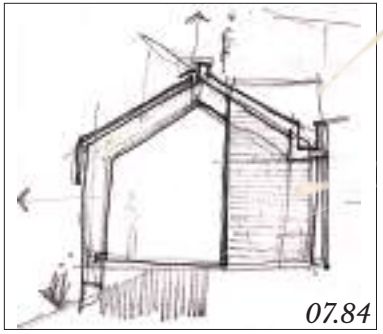
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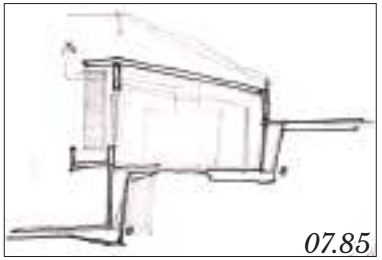
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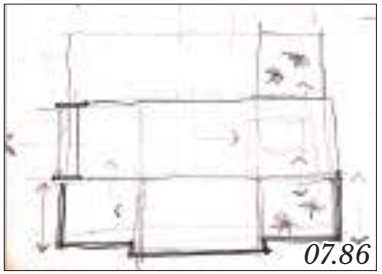
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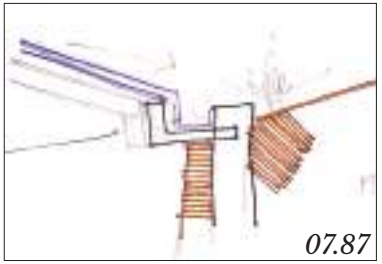
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Figure list:

07.12

TECHNICAL ITERATION 01

Discussing the first technical investigation

07.5.1 Technical Iteration 01 : Detail Section 01

The first technical iterations explored the concept of transition through materials and structure. Detail Section 01 was set at scale 1:20 in an effort to understand the detail of the design. Callouts were done of areas requiring further technical resolution.

Critique of Detail Section 01:

The section became over complicated with solutions which over-saturated the space. Too many materials were trying to join in limited spaces and therefore areas became crowded and practically became questionable. The solution to this would be to simplify material connections as well as the structural connections. In doing so, resolution for material choice and structure will be achieved.

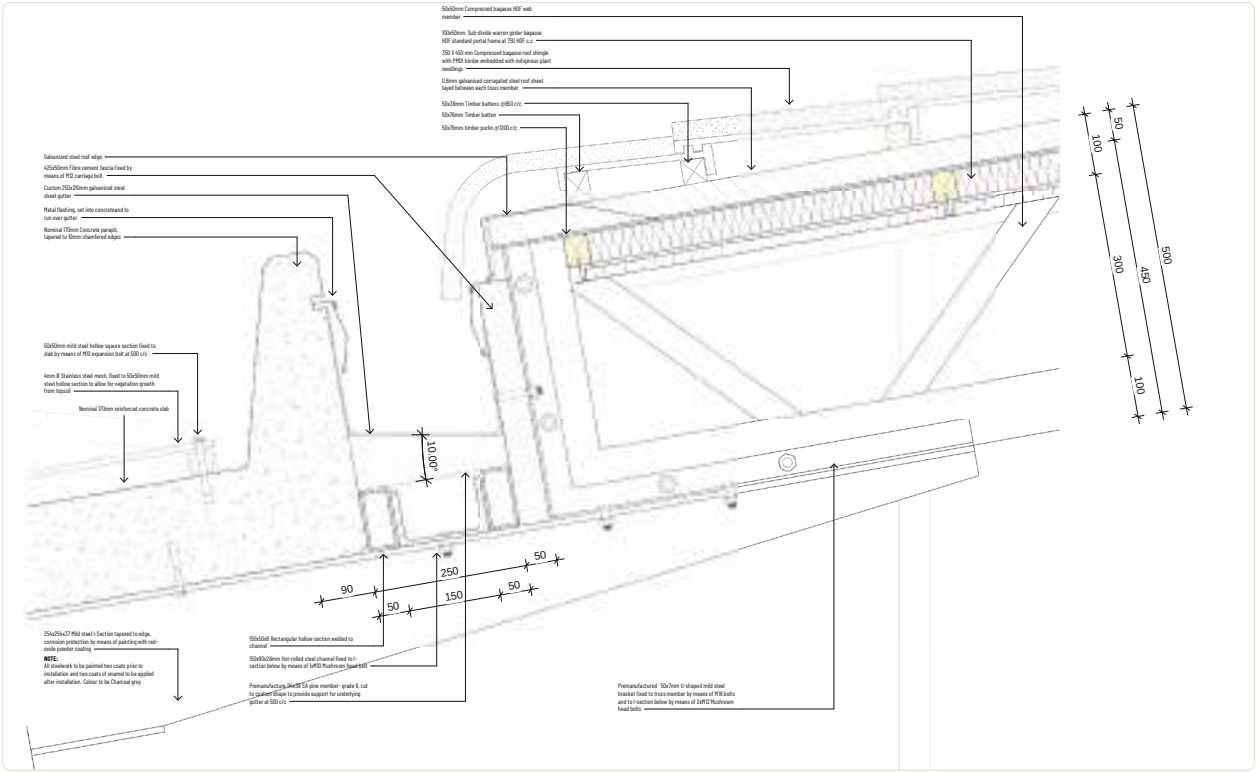


Figure 7.93: Detail Section Callout: 01 **(Author, 2019)**

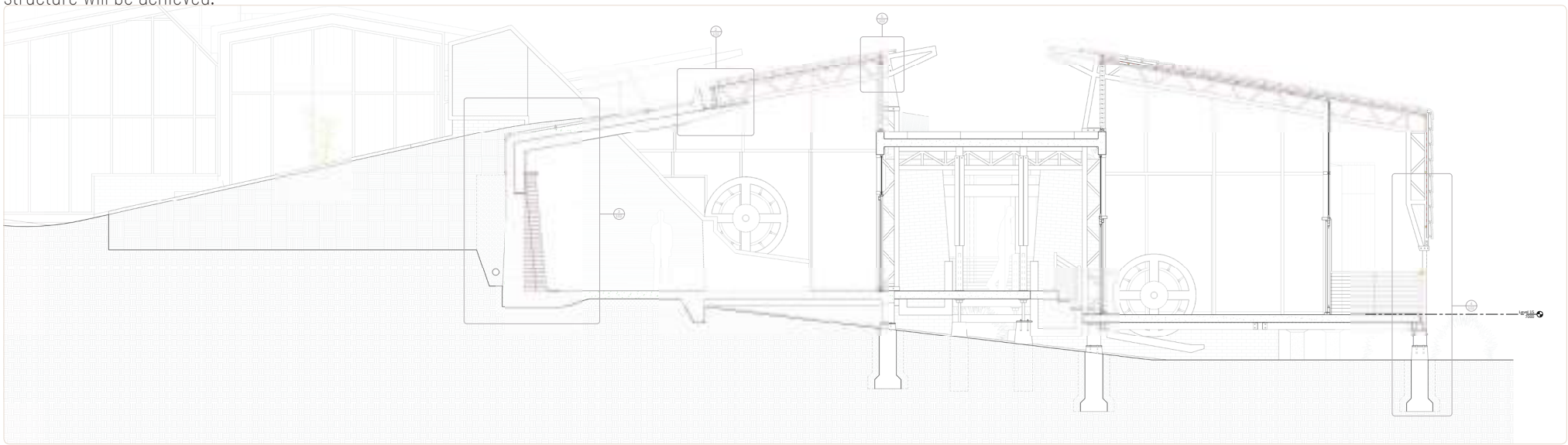


Figure 7.92: Detail Section 01 **(Author, 2019)**

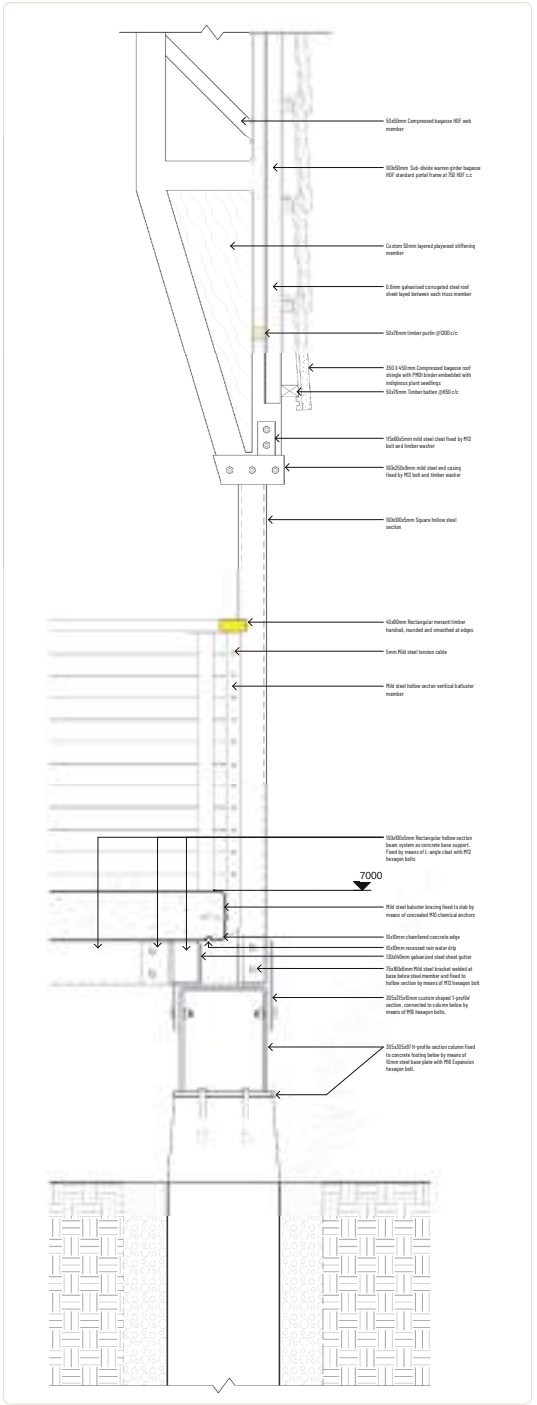


Figure 7.94: Detail Section Callout: 02 **(Author, 2019)**

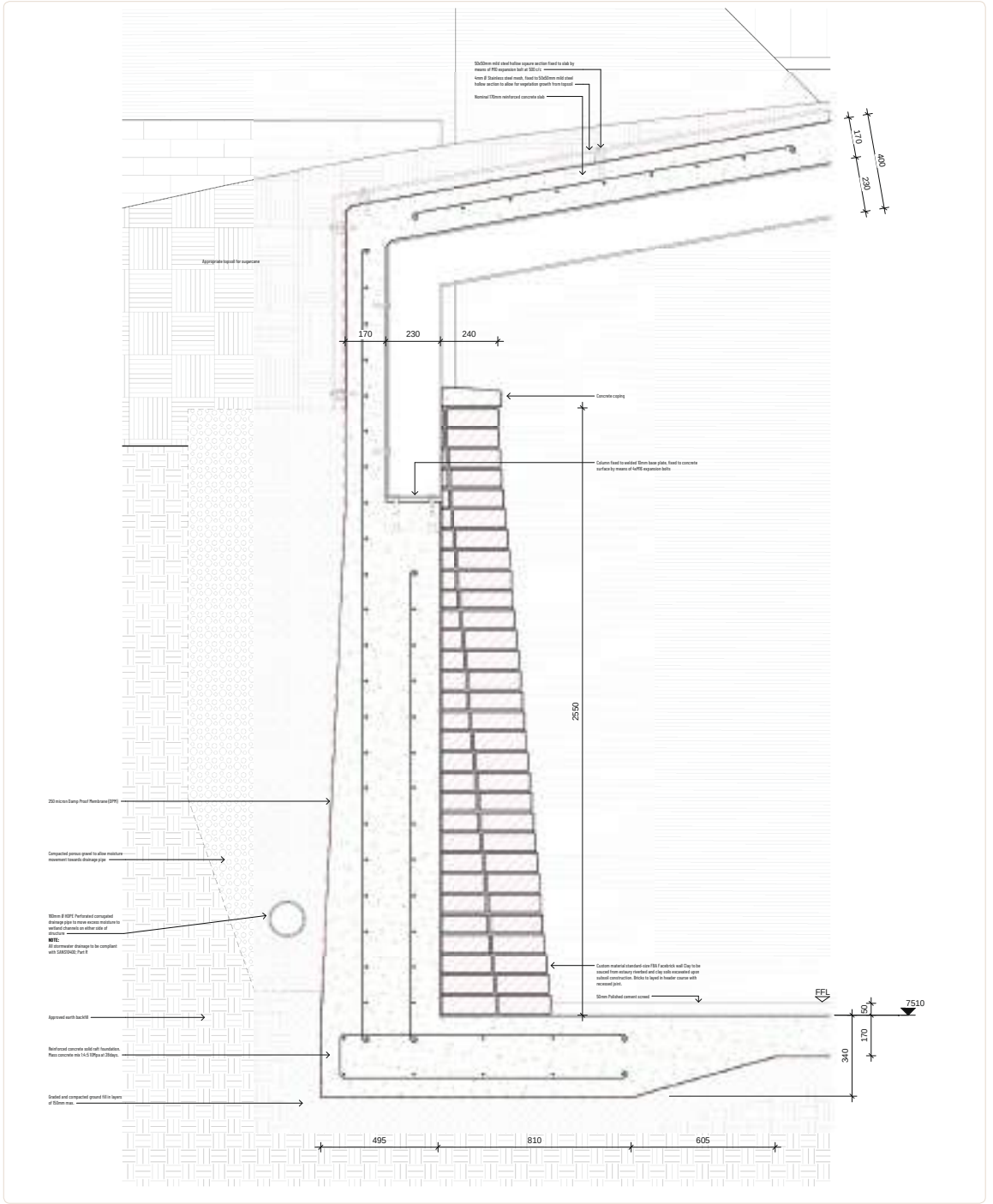


Figure 7.95: Detail Section Callout: 03 **(Author, 2019)**

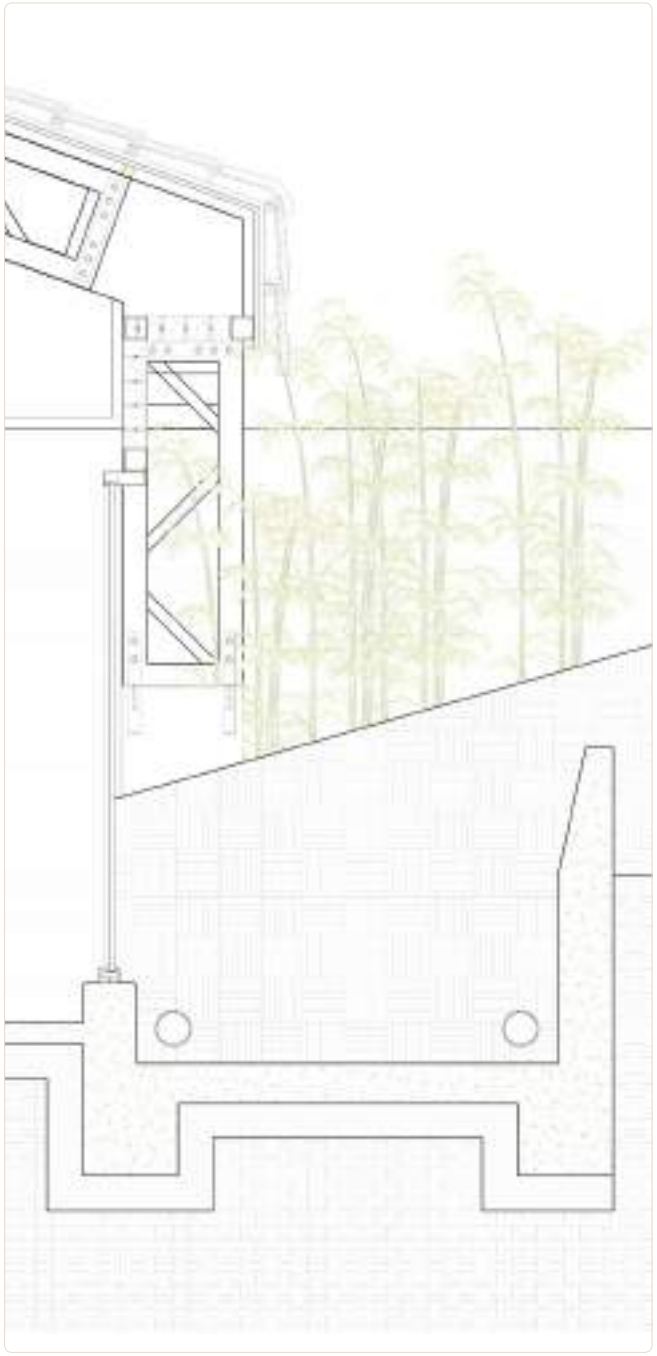


Figure 7.96: Planter Detail Callout 04 **(Author, 2019)**

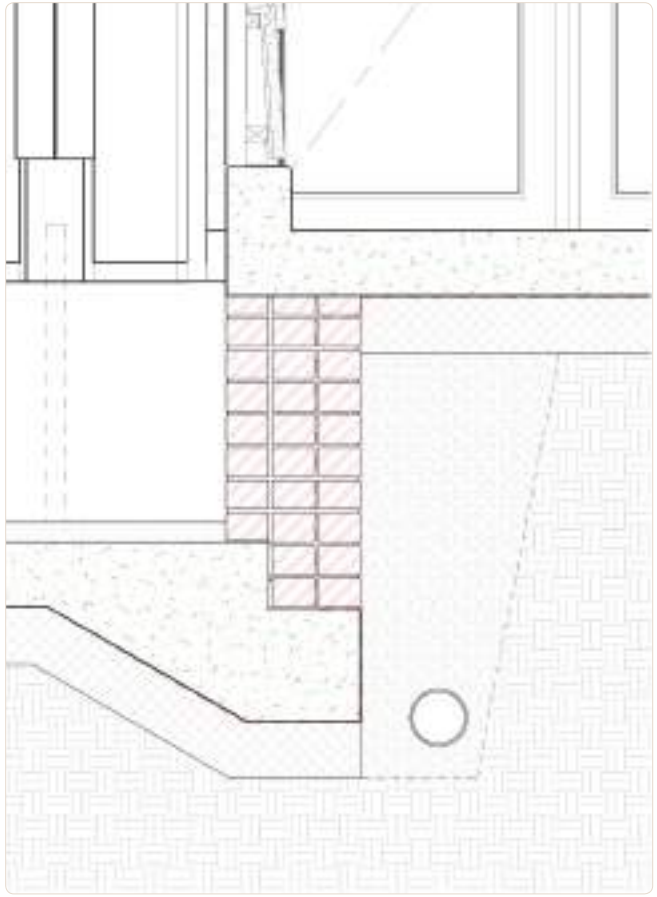


Figure 7.97: Retaining wall Detail Callout: 05 **(Author, 2019)**

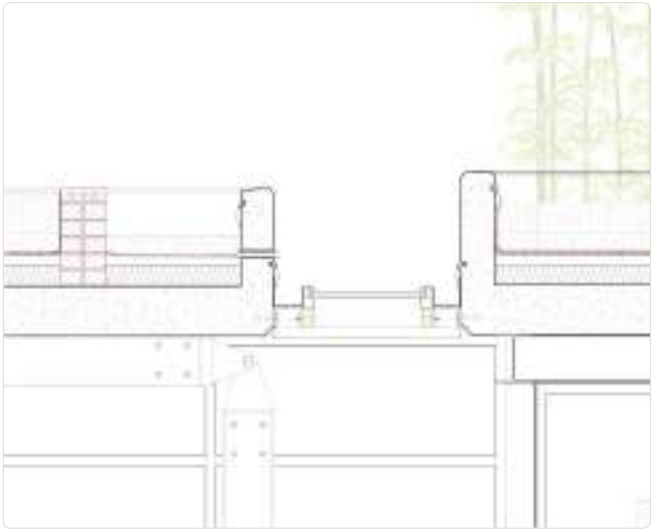


Figure 7.99: Structural glass walkway Detail Callout: 05 **(Author, 2019)**

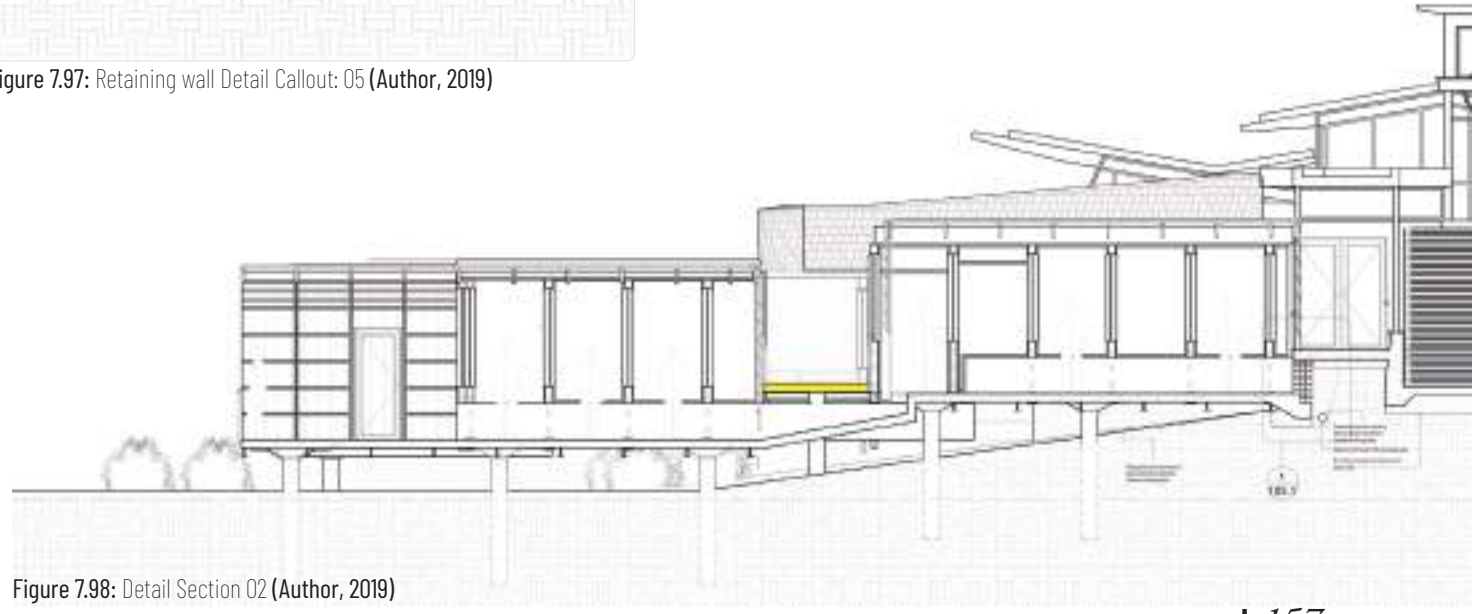


Figure 7.98: Detail Section 02 **(Author, 2019)**

07.13

TECHNICAL ITERATION 01

Discussing the first technical investigation

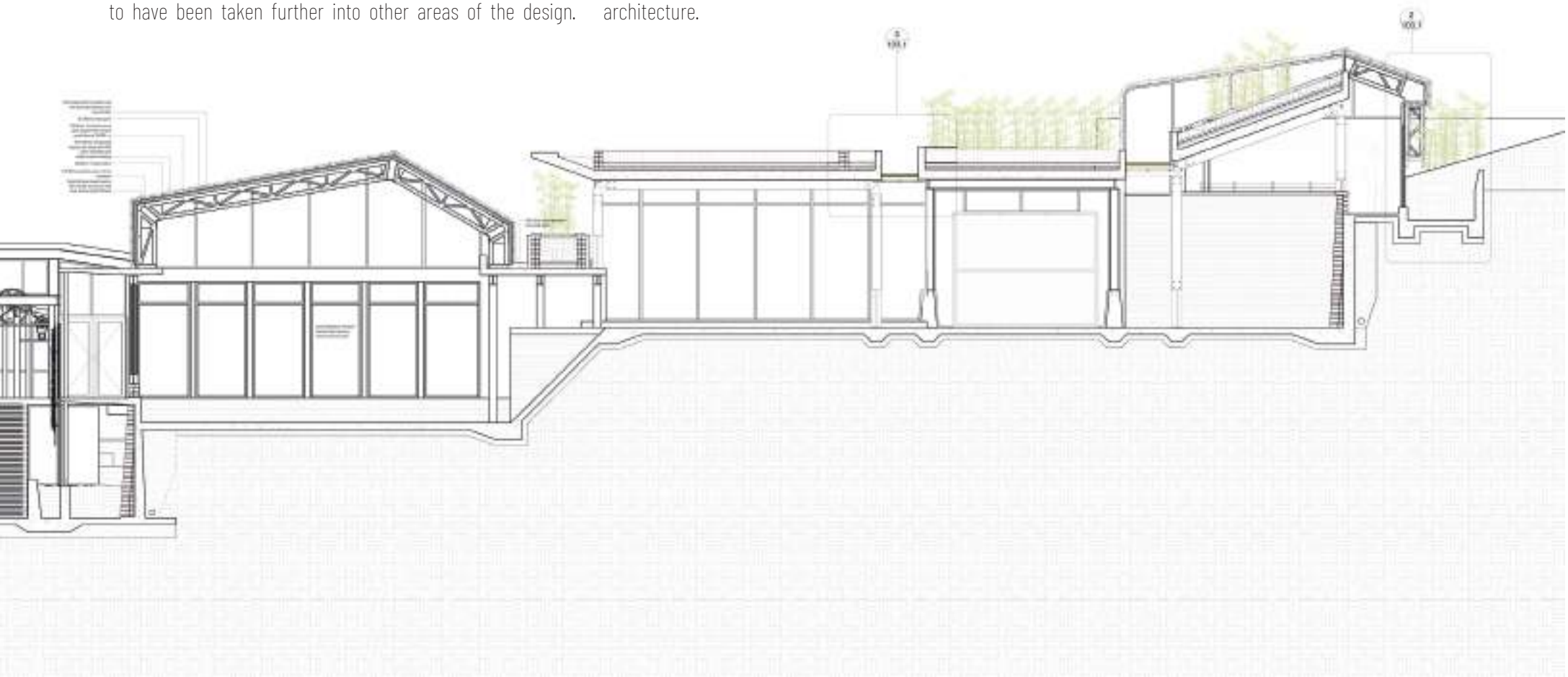
07.5.1 Technical Iteration 01: Detail Section 02

The first technical iteration of Detail Section 02 was completed at a scale of 1:50. The section was completed to give a complete understanding of the building transition along the North-Western slope of the site. The section also allowed for an understanding of majority of the construction methods employed within the project, which could then be assumed to have been taken further into other areas of the design.

The section explores the stepping of the design in relation to the natural slope, reconsidering the way in which coastal architecture utilizes sites of this topographical character. Where further detail was required, callouts at scales 1:10 and 1:5 were completed. These gave insight into how the building personified the conceptual drivers behind the building. From this section, one can start to consider how material choices influence the spatial quality and their influence on the architecture.

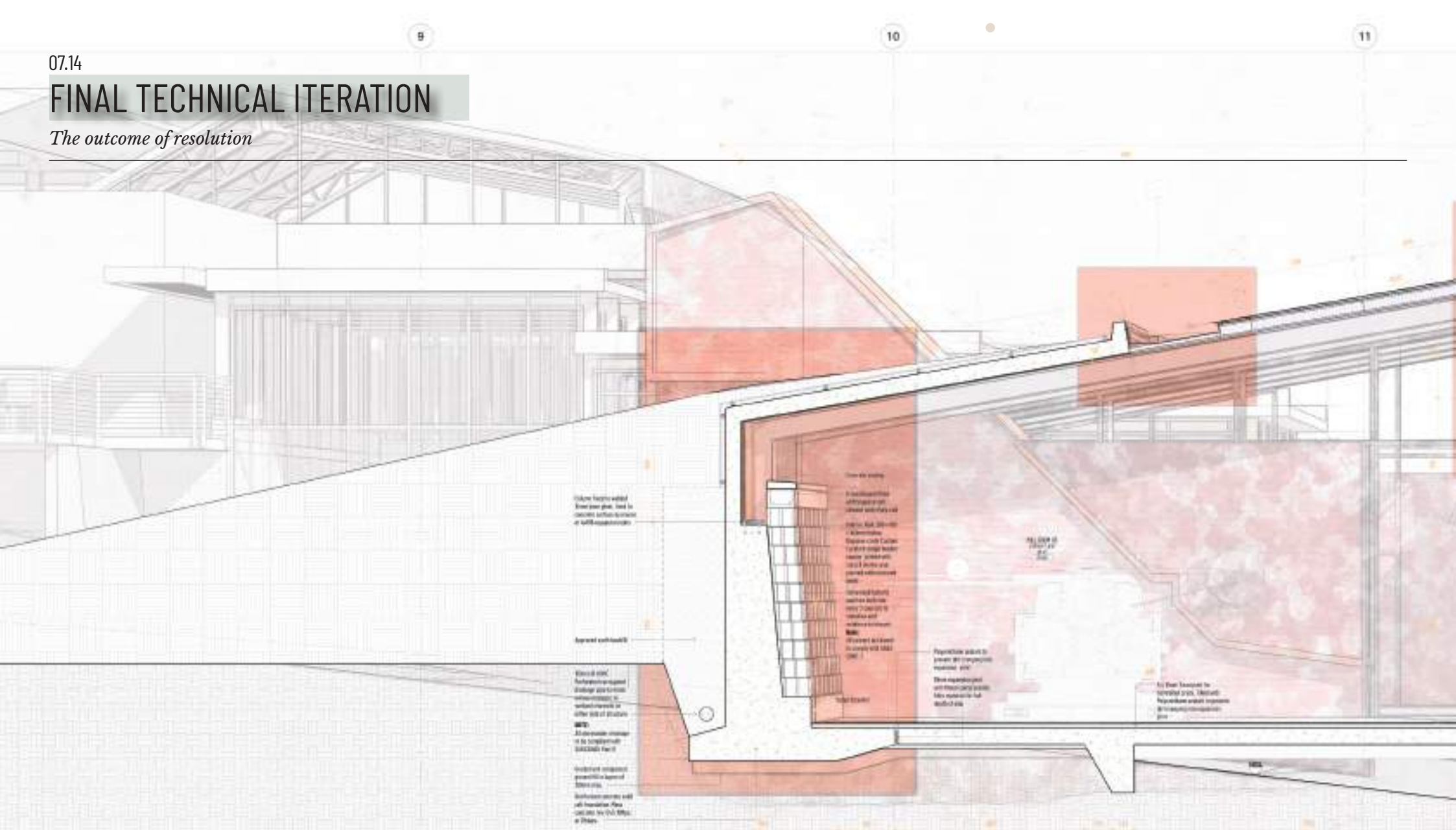
Critique of Detail Section 02:

The design once again became overcomplicated in terms of material and structural connections. This brought in the question of waterproofing where odd connections take place. The section responds well to the site, but the roof's stepping needed to be resolved and simplified for practicality reasons.



FINAL TECHNICAL ITERATION

The outcome of resolution



1:20 Detail Section

Scale 1:20

Figure 7.100: 1:20 Section (Author, 2019)

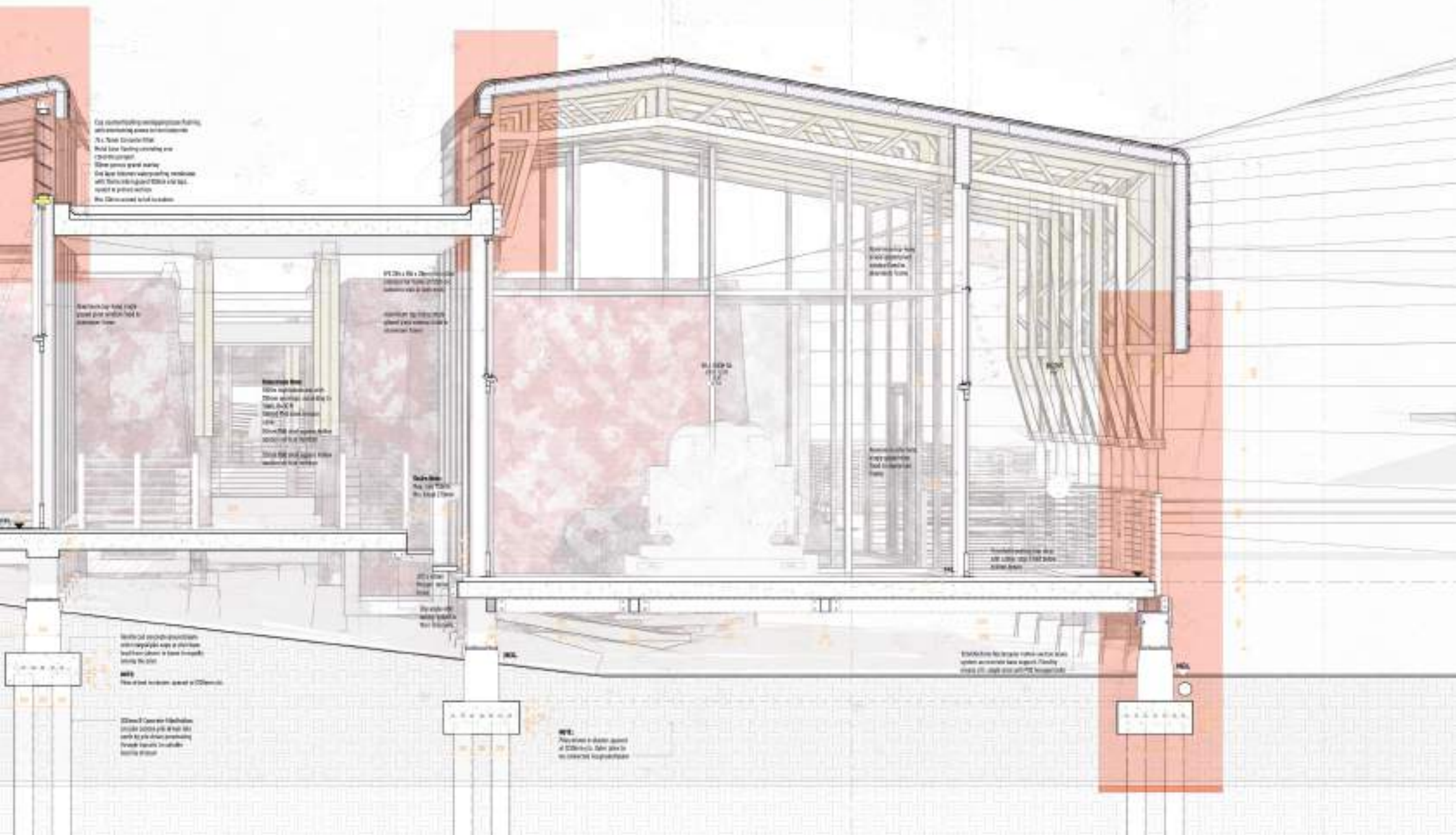
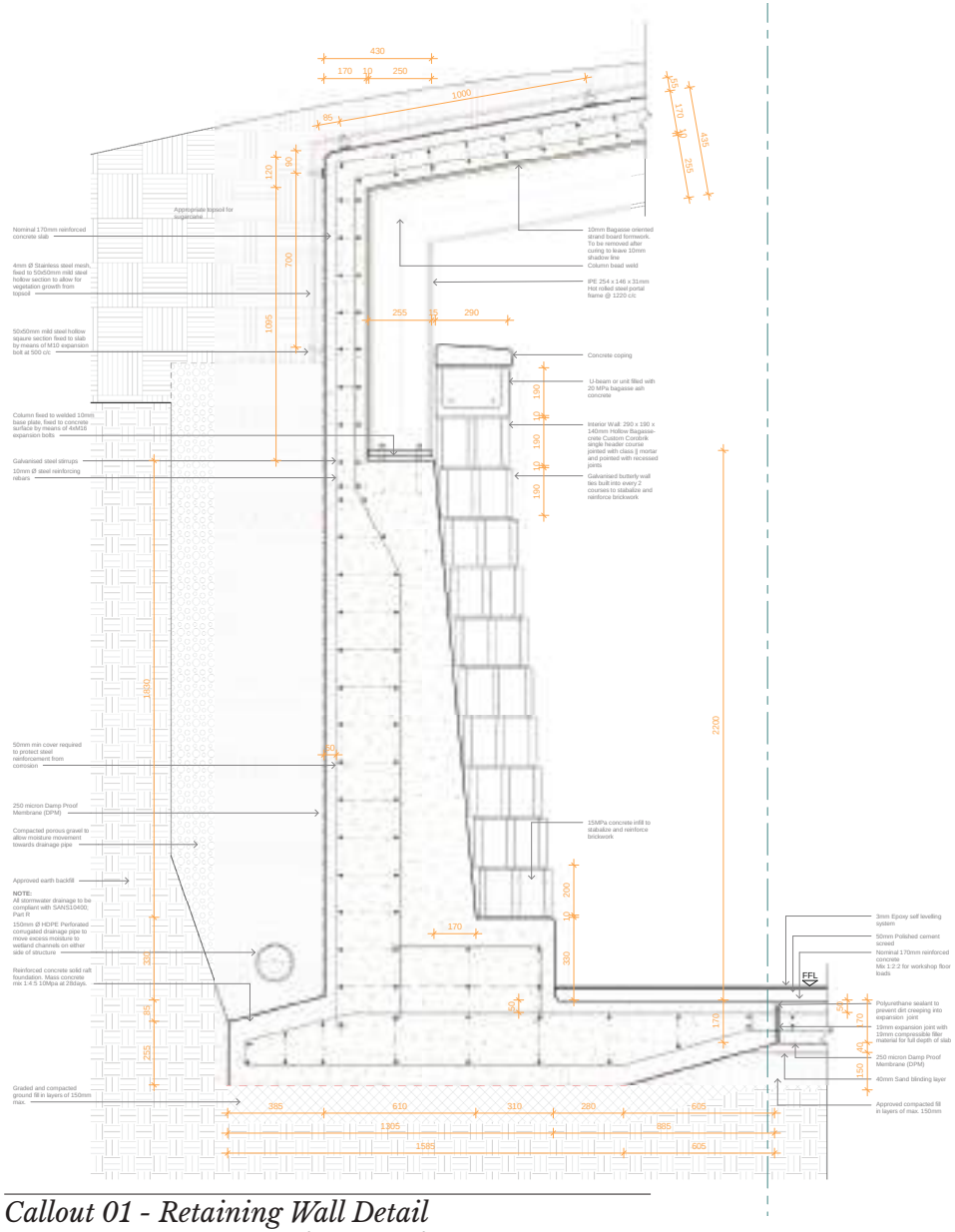


Figure 7.101: Structural Exploded Axo **(Author, 2019)**

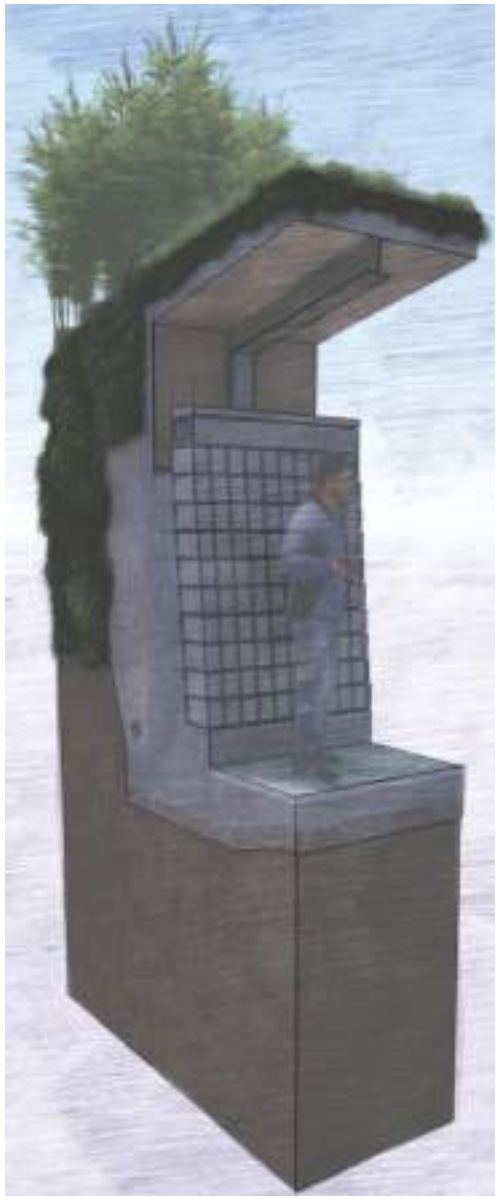
FINAL TECHNICAL ITERATION

Further refining the details of the mill

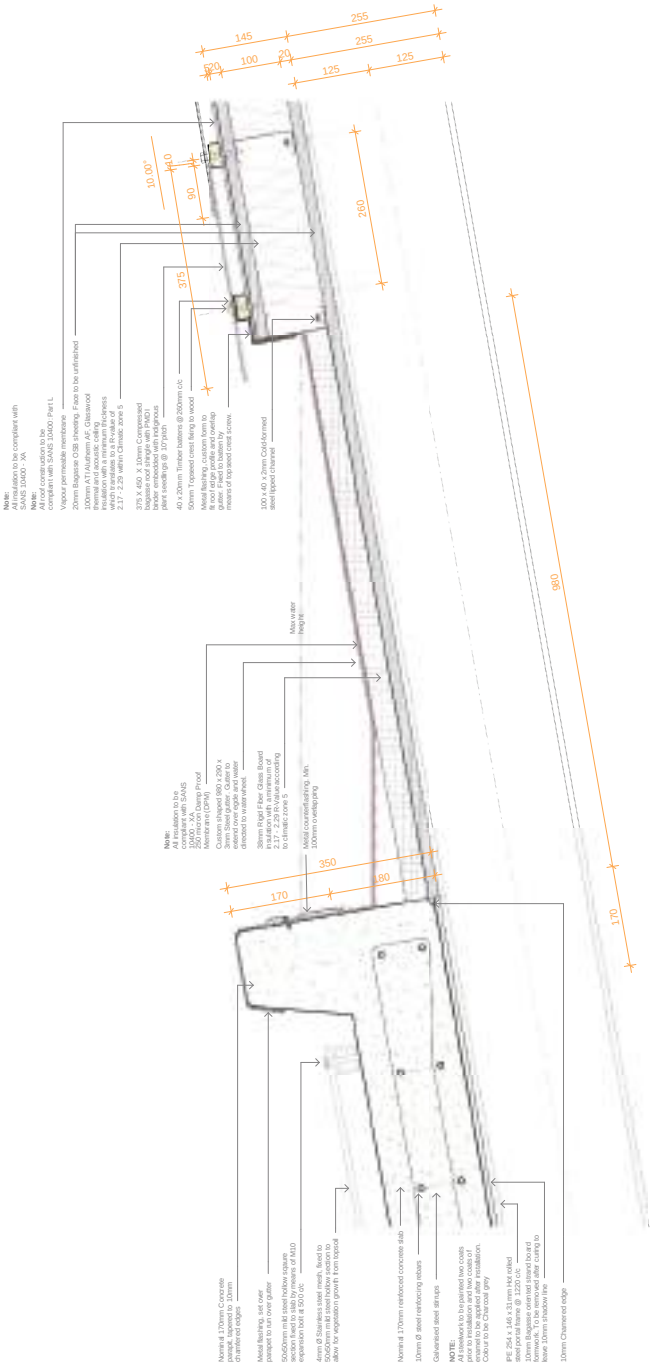


Callout 01 - Retaining Wall Detail
Figure 7.102: Retaining Wall Detail (Author, 2019)

Detailed Perspective - Mill Retaining Wall
Figure 7.103: Retaining Wall Perspective (Author, 2019)



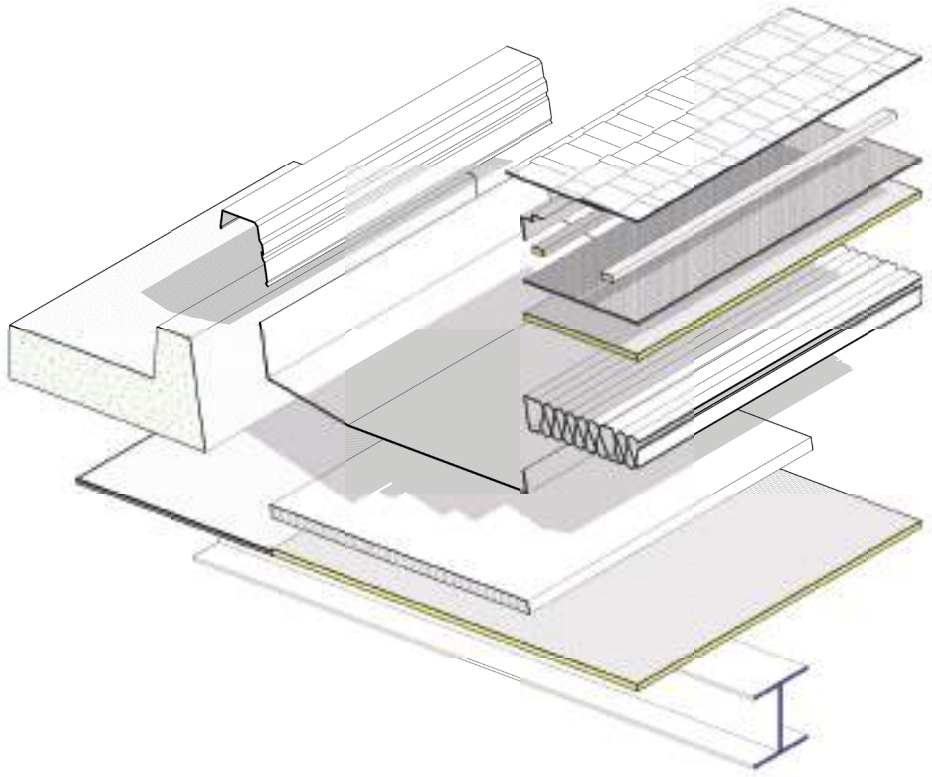
Detailed Perspective - Mill Retaining Wall
Figure 7.104: Retaining Wall Perspective (Author, 2019)



Callout 02 - Gutter Detail
Scale 1:5
Figure 7.105: Gutter Detail (Author, 2019)

FINAL TECHNICAL ITERATION

Zooming in on the Mill



Exploded Axonometric - Gutter Detail
Figure 7.106: Gutter Detail Axo (Author, 2019)

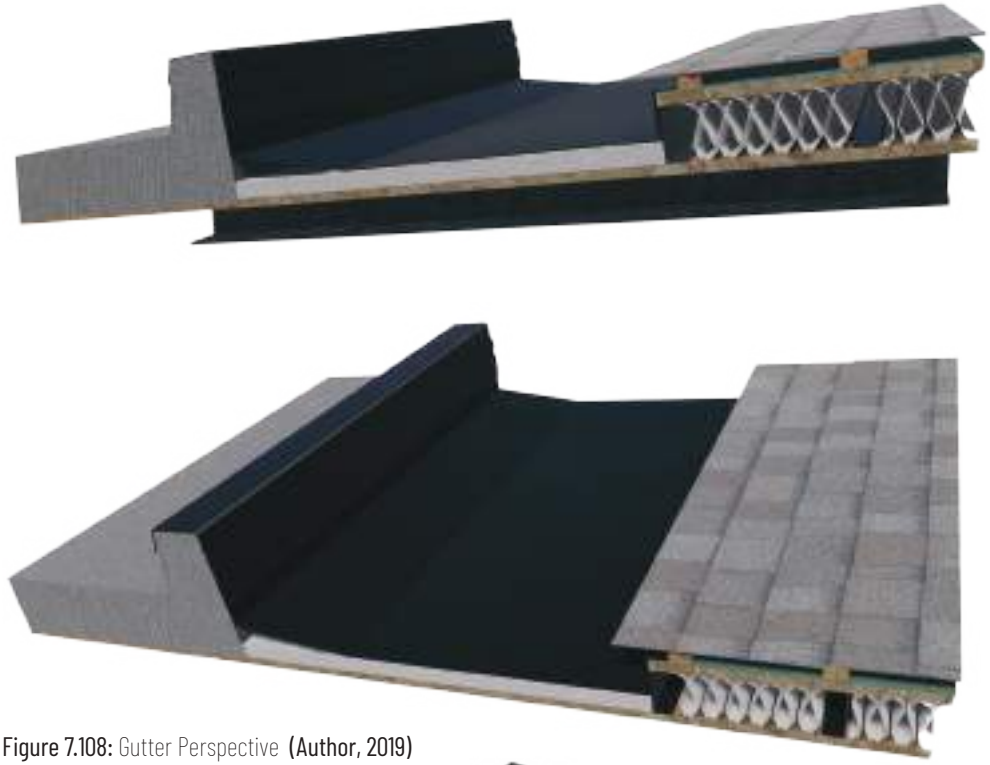
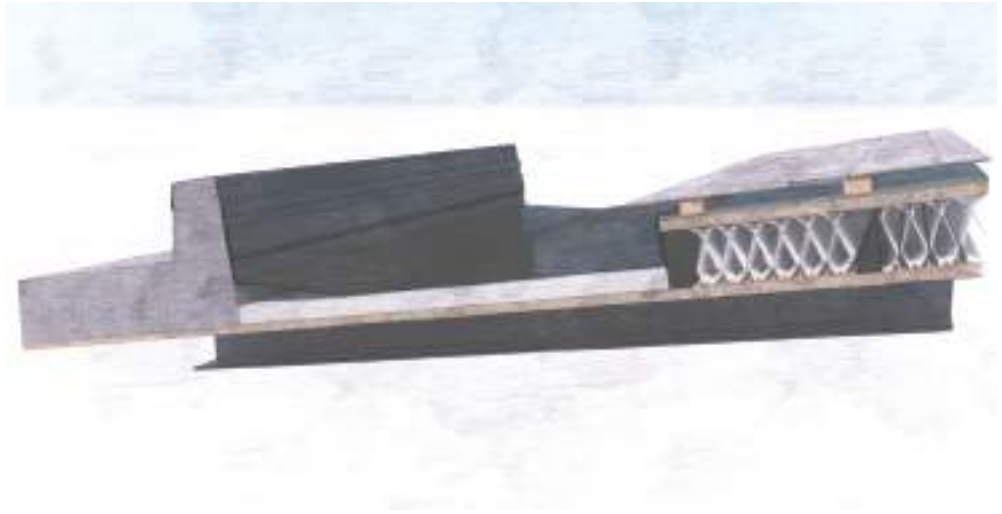


Figure 7.108: Gutter Perspective (Author, 2019)

Detail Perspectives - Gutter Detail
Figure 7.107: Gutter Perspective (Author, 2019)

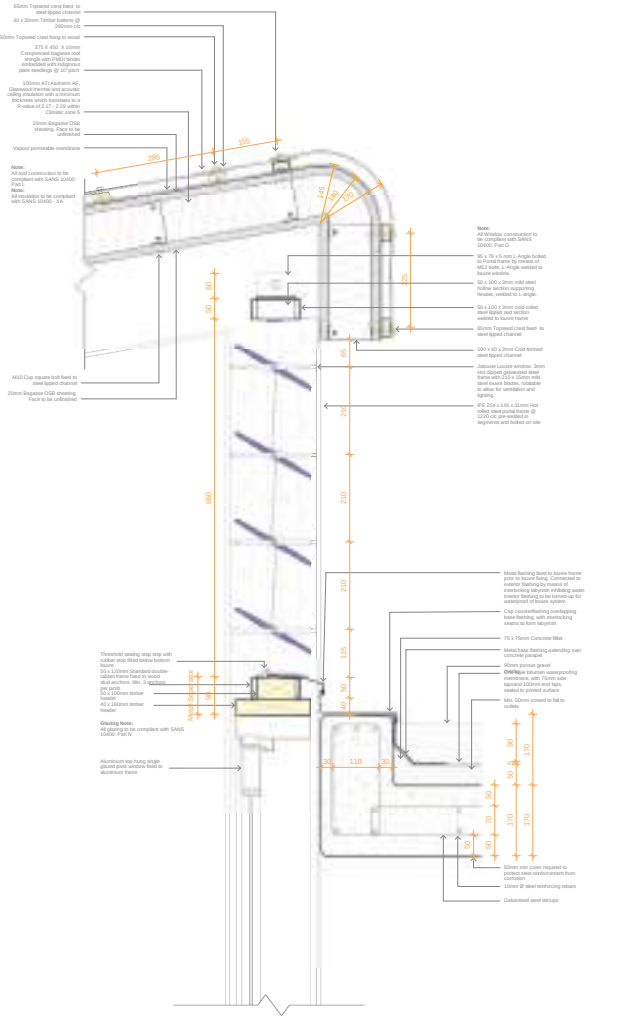
Figure 7.109: Gutter Perspective (Author, 2019)



Detail Perspectives - Gutter Detail
Figure 7.110: Gutter Perspective (Author, 2019)

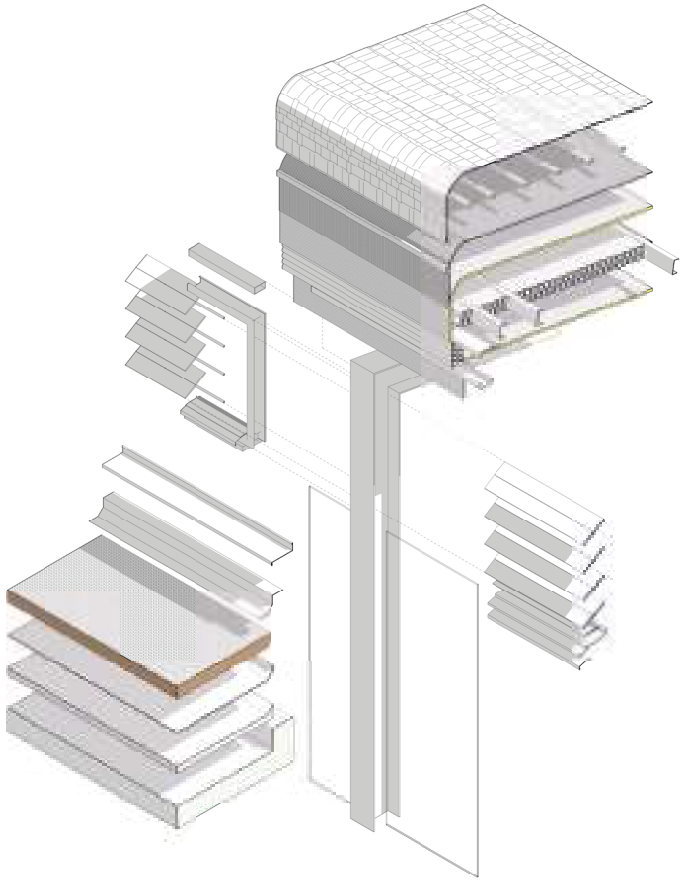
FINAL TECHNICAL ITERATION

Zooming in on the Mill



Callout 03 - Louvre Detail

Figure 7.111: Louvre Detail 01 (Author, 2019)

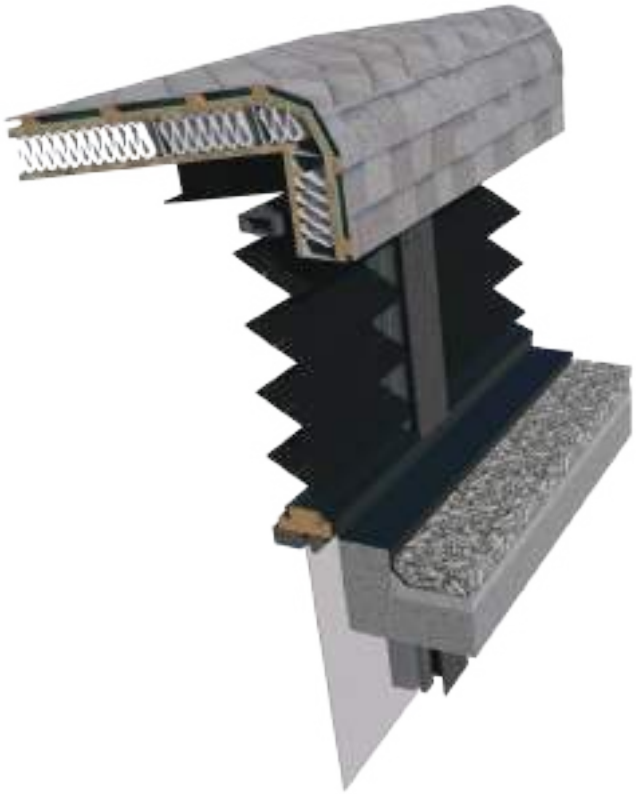


Exploded Axonometric - Gutter Detail

Figure 7.112: Louvre Exploded Axo (Author, 2019)

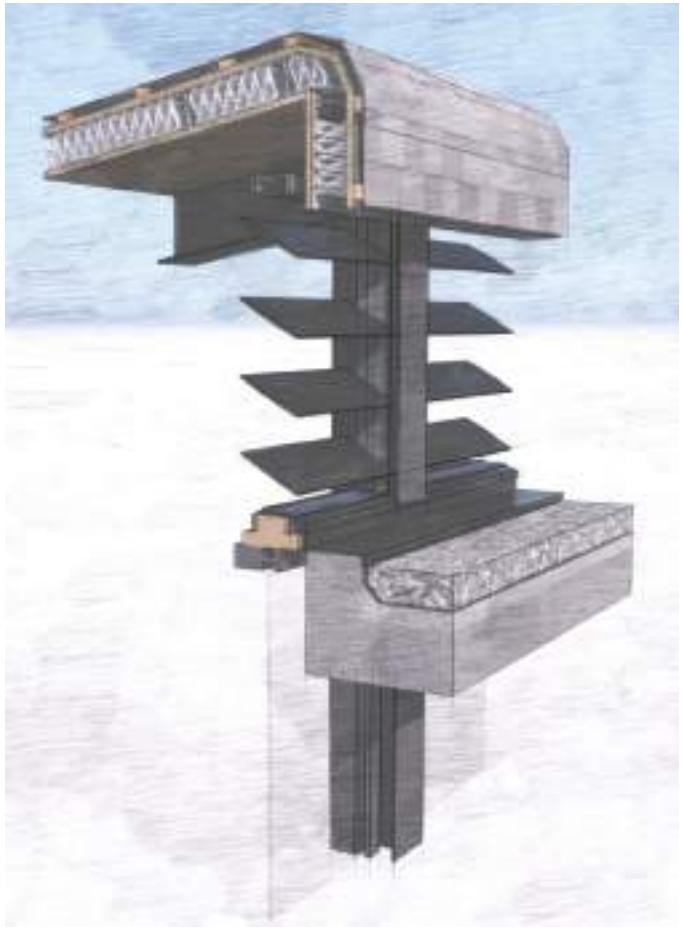
Detail Perspective - Louvre Detail

Figure 7.113: Louvre Detail Perspective (Author, 2019)



Detail Perspective - Louvre Detail

Figure 7.114: Louvre Detail Perspective (Author, 2019)

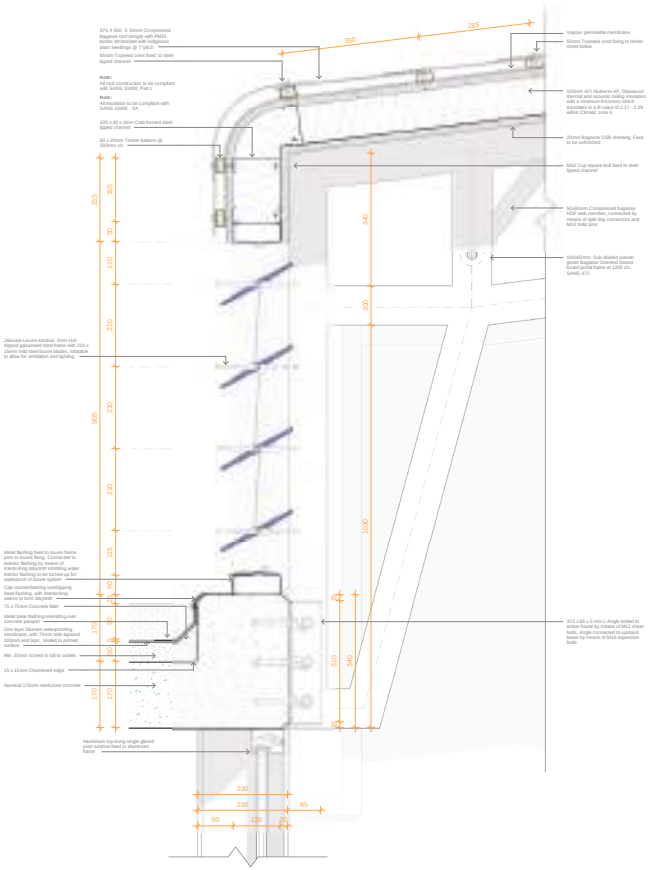


Detail Perspective - Louvre Detail

Figure 7.115: Louvre Detail Perspective (Author, 2019)

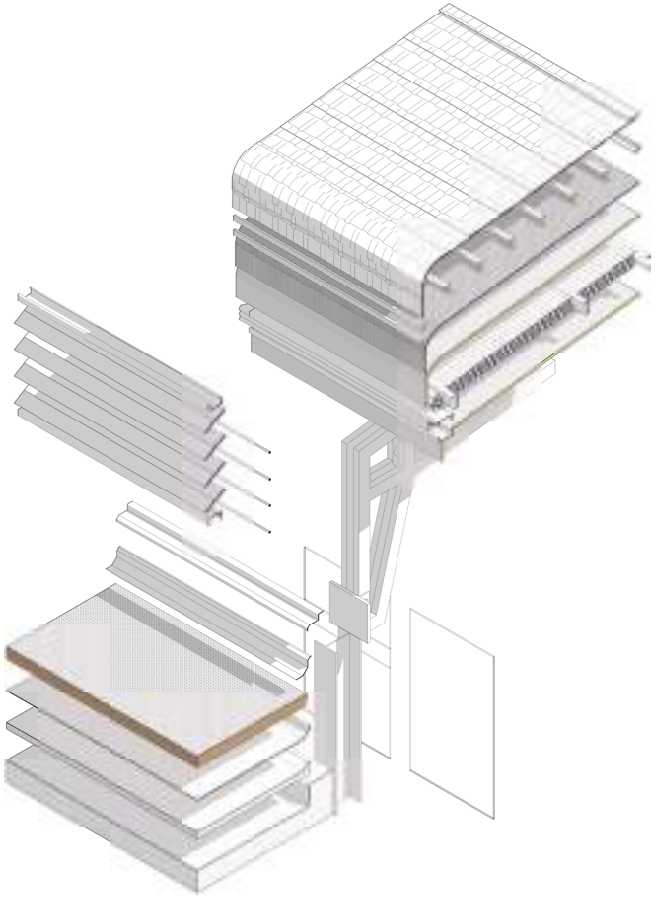
FINAL TECHNICAL ITERATION

Zooming in on the Mill



Callout 04 - Louvre Detail

Figure 7.116: Louvre Detail 02 (Author, 2019)



Exploded Axonometric - Gutter Detail

Figure 7.117: Louvre Exploded Axo (Author, 2019)

Detail Perspective - Louvre Detail

Figure 7.118: Louvre Perspective (Author, 2019)

Detail Perspective - Louvre Detail

Figure 7.119: Louvre Perspective (Author, 2019)

Detail Perspective - Louvre Detail

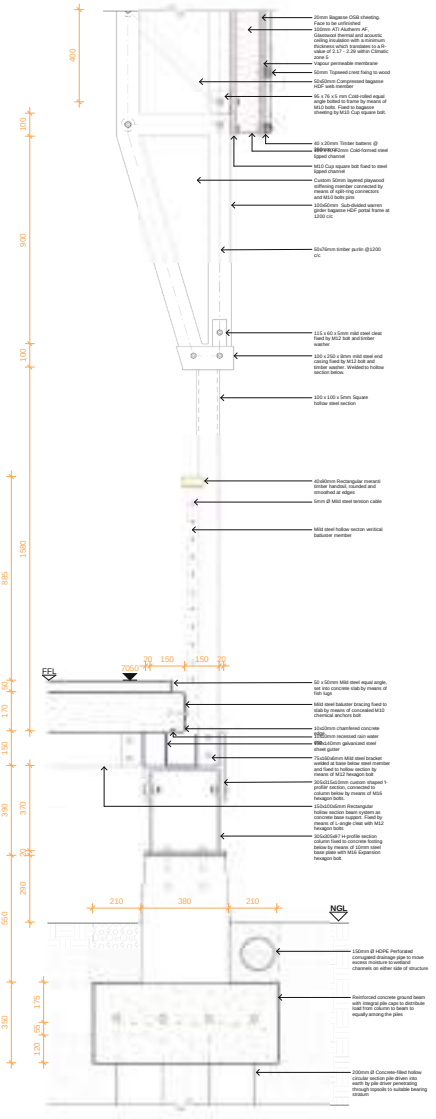
Figure 7.120: Louvre Perspective (Author, 2019)

Detail Perspective - Louvre Detail

Figure 7.121: Louvre Perspective (Author, 2019)

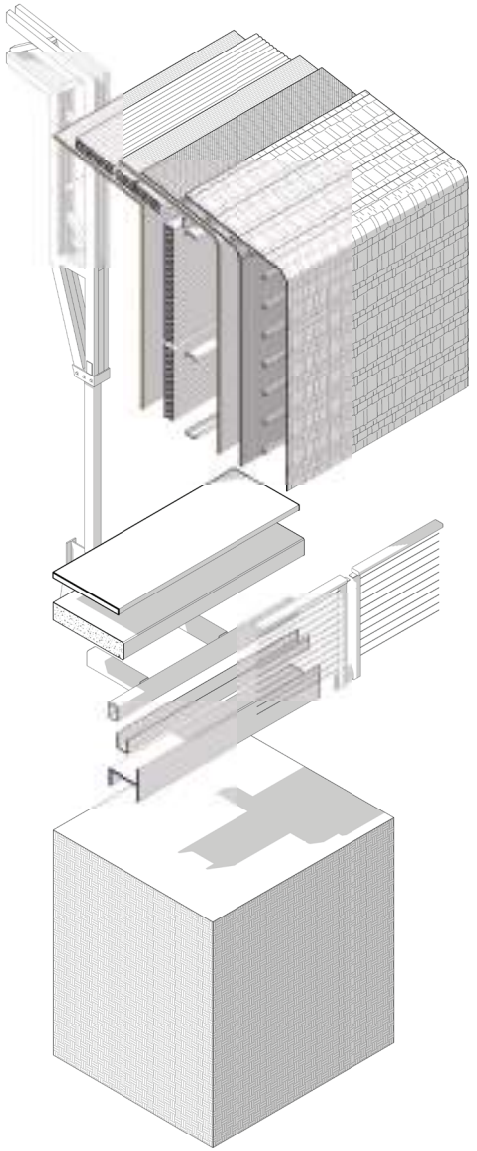
FINAL TECHNICAL ITERATION

Zooming in on the Mill



Callout 05 - The Mill Edge

Figure 7.122: Mill Edge Detail (Author, 2019)



Exploded Axonometric - The Mill Edge

Figure 7.123: Mill Edge Exploded Axo (Author, 2019)

Detail Perspective - Mill Edge

Figure 7.124: Mill Edge Perspective (Author, 2019)

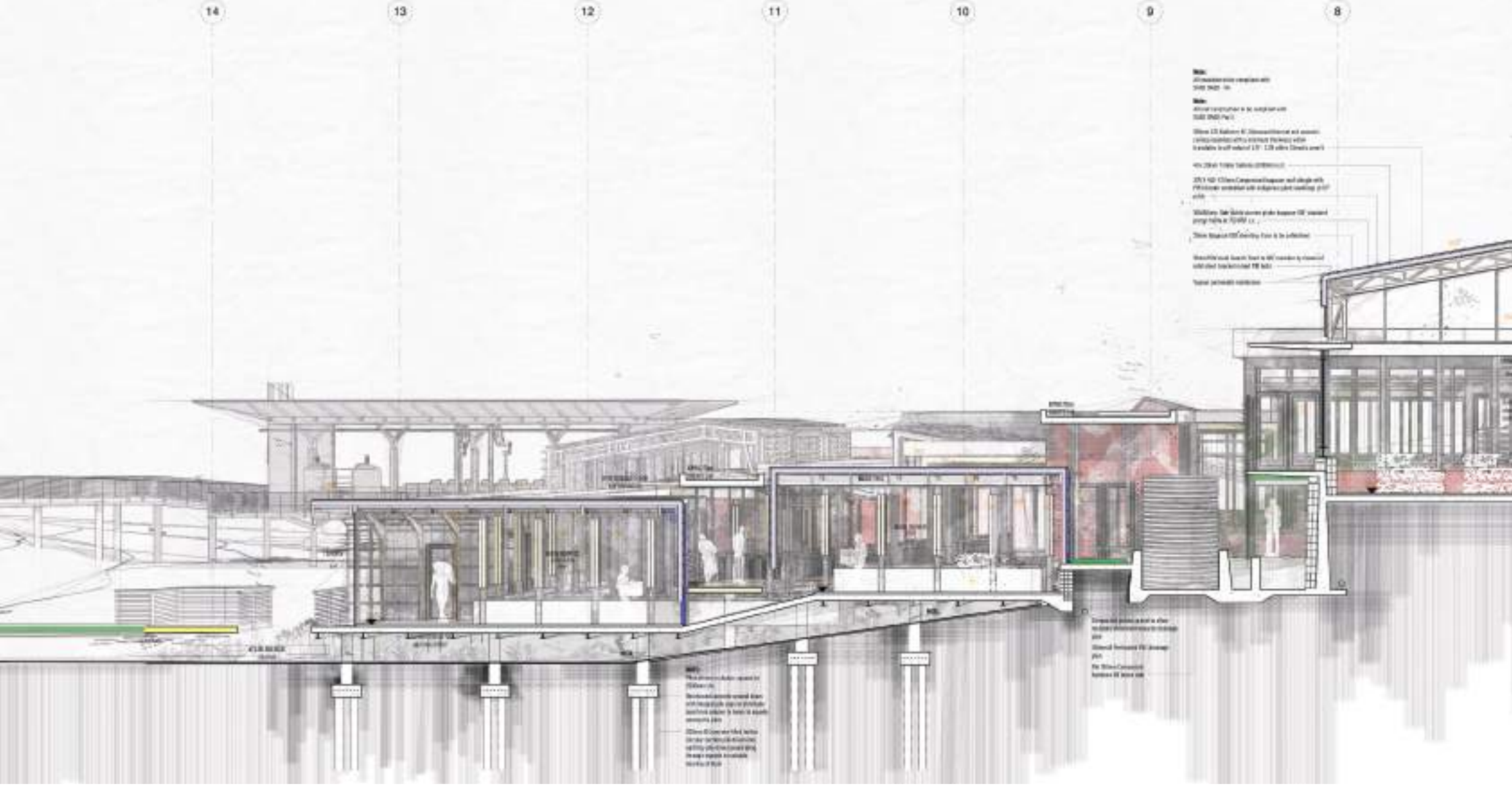
Detail Perspective - Mill Edge

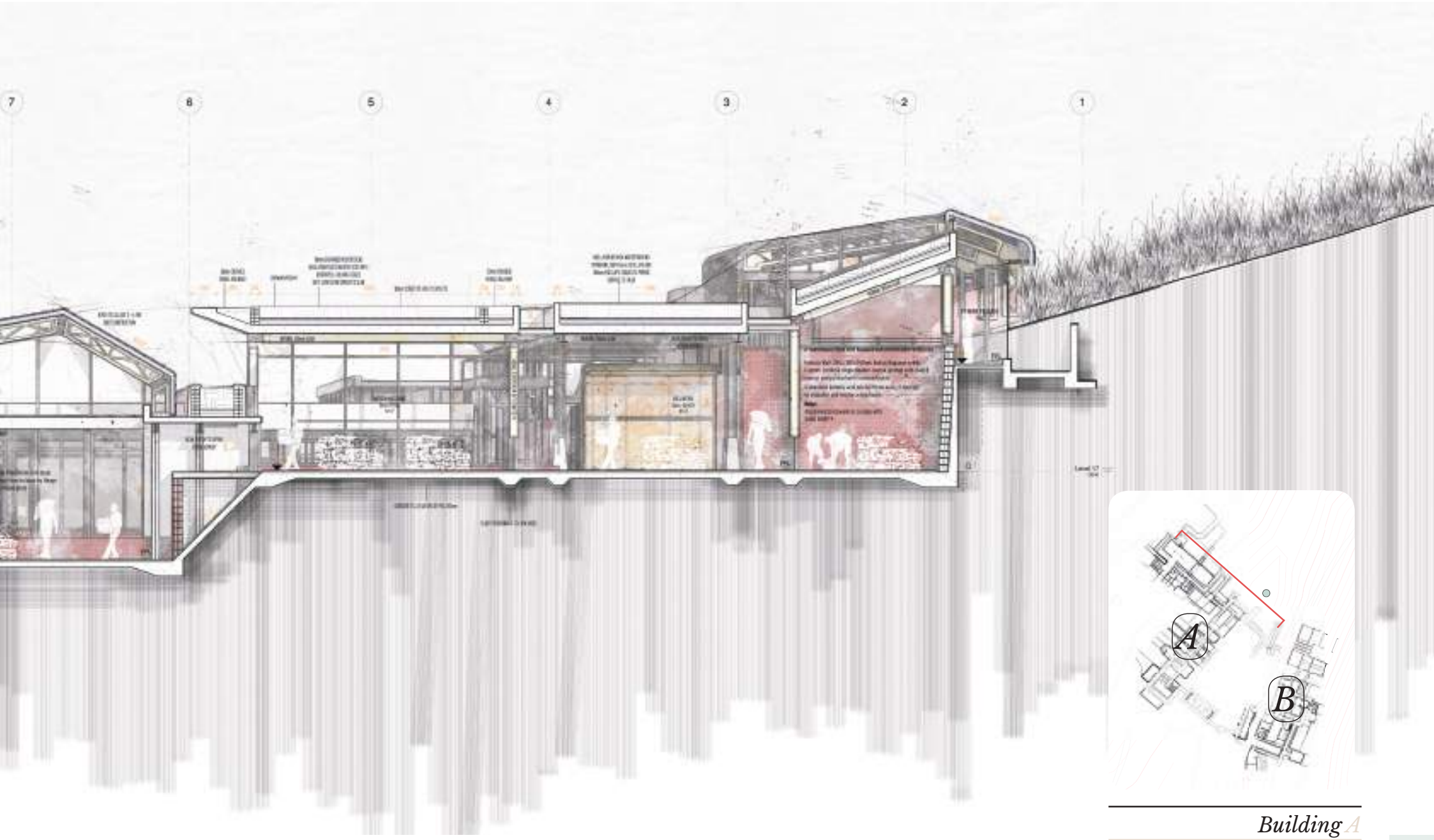
Figure 7.125: Mill Edge Perspective (Author, 2019)

1:50 DETAIL SECTION

A 1:50 Detail Section of the Mill

Figure 7.126: 1:50 Section (Author, 2019)





Building A
Section B-B

CONCLUSION 08

Reflecting back on the mill ...

08.1

IN CONCLUSION- A REFLECTION

Reflecting back on the intentions of the project

The dissertation's initial outlook was one which reflected urban scale dilemmas produced within the realms of developments, industrialized landscapes and industrial and urban pollution of natural systems along the coastal edge of Durban. The response was one which considered the above urban-scale dilemmas and responded individually through architecture as a means to mediate these problems at the root of their beginning.

The study of urban environments within the extended coastal region revealed the inevitable conurbation of coastal cities, and the detrimental effect posed by such affiliation.

The theory advocated an approach to architecture and urban design, which is well-rooted within the holistic nature needed for our past, present and future built environments. The nature of theory discussed allows the reader to understand that no single participating system overrules the other, but rather shows the need for a synthesized environment, which concerns and manages the entirety of the complex systems within the given site as a whole.

The Ohlanga site proved a challenging task when designing for. The lack of a built environment to respond to provided its own dilemmas in that one had to design for the future of the site, which saw the Sibaya proposal taking over. However I do believe the notions set out by the project allowed both sufficient restraint and guidance when approaching the conditions.

The architecture of the mill embodied the ethos of the dissertation throughout and each aspect of the design may be related back to the author's thoughts presented. Each design choice is a response to dilemmas posed by our impacts.

The goal of the project is far from complete, where research and conclusions still have much to be discovered in the realm of architecture's relationship to nature and man. But, I do believe the project is headed in the right direction of absolution as to how our environments may coexist in a symbiotic manner.

The dissertation has given me assertion in my beliefs of environmental conservation, rehabilitation and regeneration through architecture and the importance of doing so. A holistic approach is one which has the ability to create awareness in both the social and recreational realm of public spheres.

Thank you for taking the time to read my work, I hope you have enjoyed and found inspiration in reading through my thoughts and passion for architecture.

08.2

QUESTIONS POSED

Reflecting back on the intentions of the project

01.3.1 General questions

Is architecture the antidote to the perpetration of outdated and unsound planning practices?

Architecture does not exist in isolation. It exists within the larger whole, which one may be viewed as its urban environment. It will always respond to its context in one form or the other. The architecture of the mill uses this response to create a means of mediation towards the constricting nature of said unsound planning practice. Architecture thus becomes the antidote for the larger act of planning practices by addressing the primary individual dilemmas of planning at the root of cause in its direct context.

Could the act of constructing our urban environments be a reverting factor in the sensitive coastal environment?

The dissertation aims to change the way in which urban environments are created by changing the architecture within them. Unsound planning practices of our urban environments hinders our ability to design in the holistic sense, but a change in this would revert our inherited practices, allowing for future developments to take consideration when designing with our landscape. As to present developed states, one must consider how these space are adaptable to reconsider their relationship with their environment.

Could architecture be a means of rehabilitation?

Architecture does not exist in isolation, and therefore cannot be the only means to rehabilitation of our environments. However, architecture forms a vital part in synthesizing our relationship to our natural environment, and becomes a vital component in the rehabilitation, conservation and regeneration of our natural environments.

01.3.2 Main questions

Can architecture offer a mediation between natural and industrialized landscapes?

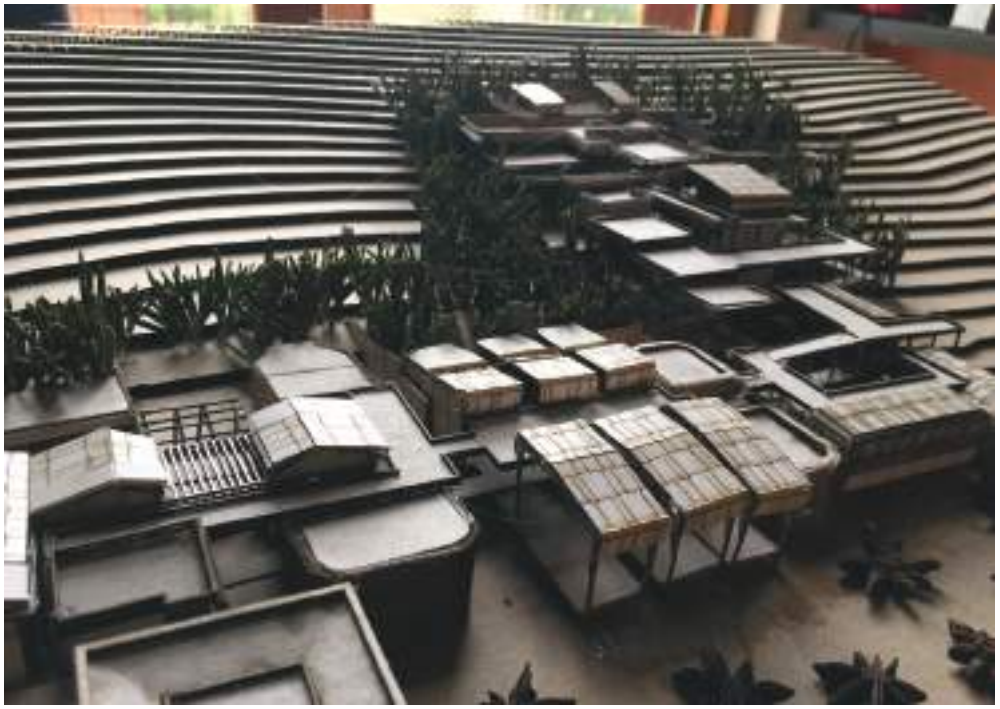
Architecture plays a vital role in creating an awareness of this imbalance and will help create a symbiotic relationship in which the two may coexist. The architecture only offers a platform for action, it is however, our responsibility to ensure these measures take place in order for our induced industrial landscapes do not overpower the natural systems at play.

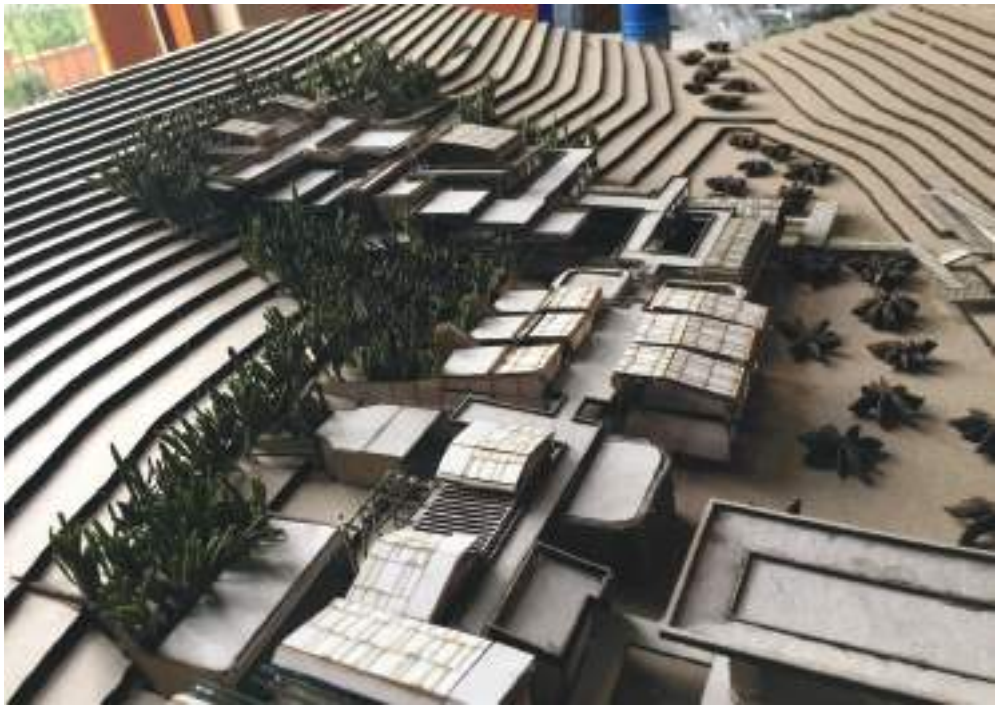
How can architecture become iconic for catalyzing the restoration of coastal landscapes?

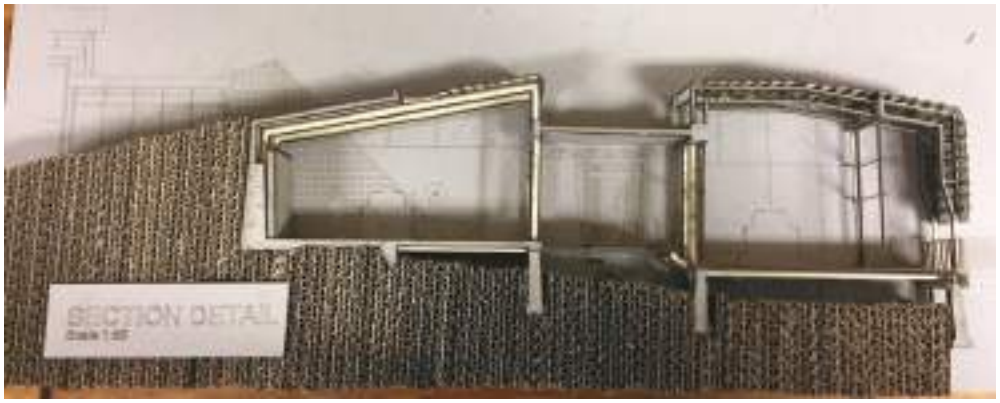
The mill becomes iconic in the way that one may design future urban environments, which have a direct association to the natural (and not man made) ecological systems and may even form part of the natural system taking place within the site. The disassociation of man from nature will be subverted into an interdependent relationship of man and nature, and nature and man.

How can architecture reinvent the sugarcane industry to allow for the celebration of both the heritage and work of the labouror?

The architecture of the mill uses the idea of spectacle to frame both the work of the labourer, as well as the historic influences of their work. In the inclusion of the public domain into the previously uninhabited mill, one may provide the platform for the celebration of the labourer through viewing their craft take place. Durban's rich heritage of sugarcane is fairly intangible to the public face, and thus the mill provides a space in which one may mourn the past injustices of the industry, remember the previous labourer, and celebrate the spectacle of the current work done by these labourers.






SECTION DETAIL

REFERENCE LIST 09

List of work cited during the year...

09.1

REFERENCE LIST

Works cited throughout the disseration

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APPENDICES 10

Additional work completed during the dissertation.

Tanner Harwood | 13004370

Umhlanga
-From The Reeds

An Urban Eco Sugarcane mill as precedent for future expansion, arbitrating the dislocated relationship of Conurbation, Production and their result on Natural Systems.

Fig. 01. Above; Image name or title (Author, 2017)

ABSTRACT

How can architecture create symbiotic relationships between the integrated social, economic, production and ecological realms which it resides, in order to remedy the currently dichotomous relationship?

Sugarcane milling in Durban has overrun landscapes, produced segregated urban environments through urban development and constricted natural ecosystems throughout the coastal edge. The dissertation is an exploration into a paradoxically regenerative, conservative and restorative approach to coastal planning and development, in an effort to restore the current dichotomous relationship between man, nature and industry and prevent the current projection to conurbation of the coast. Where planning has failed, architecture will individually respond and in turn influence future and present planning patterns.

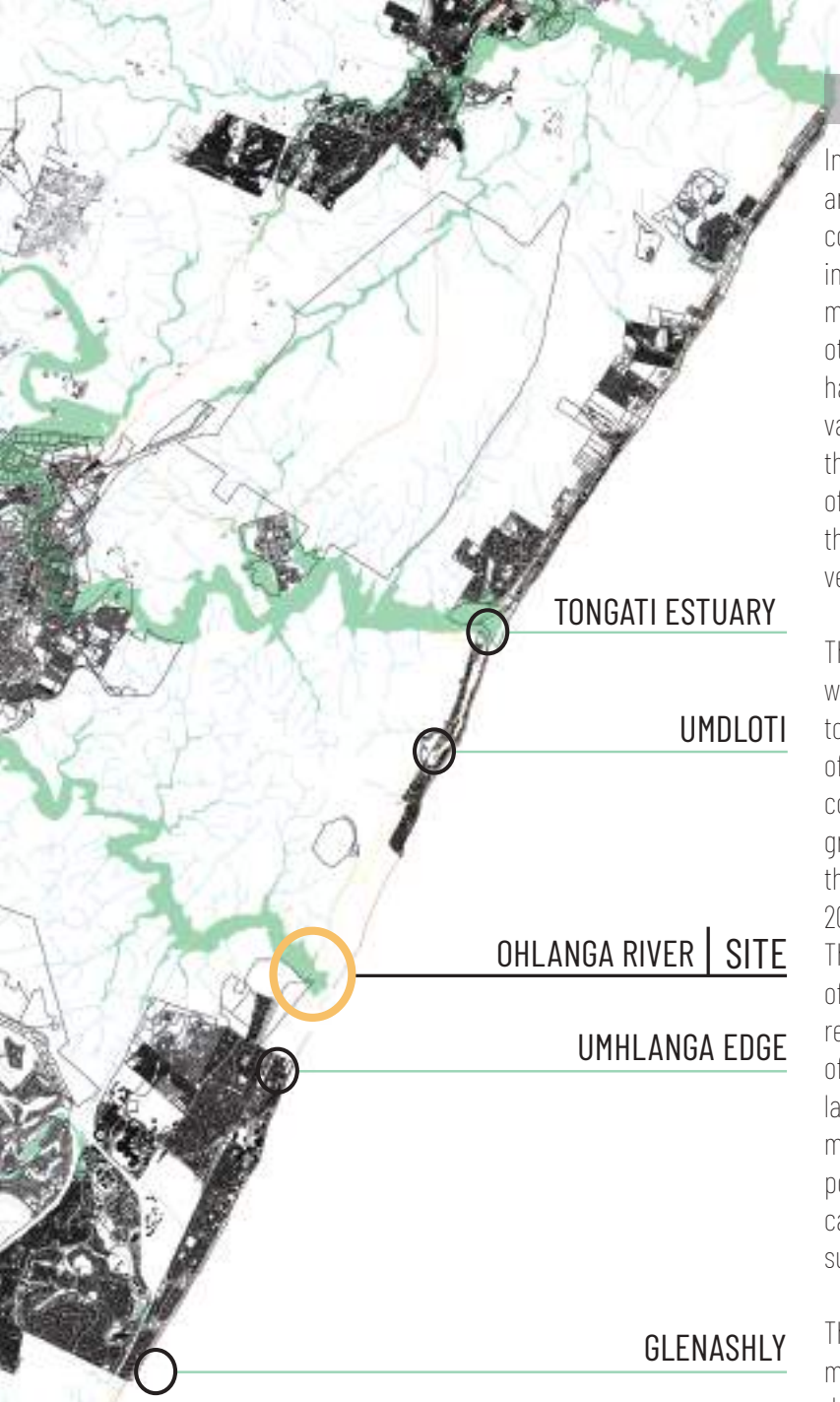
In an effort to redefine the industrial nature of Sugar production, the investigation is contextually placed on the periphery of the Umhlanga precinct, bordering a conservation Hawaan forest and Ohlanga estuary, within a currently operating sugarcane plantation- which is redefined through regenerative and restorative catalysts for currently fragmented landscapes.

The programme, which is placed within the framework of the Sibaya Precinct development, changes with the chronological development of the extended site- from a primarily Eco sugarcane mill, sustainably processing and producing sugar, as well as celebrating and conserving the adjacent estuary, to an indigenous plant seed-bank , used for the restoration of future developments taking place on exploited sugarcane plantations.

The architecture integrates social, conservation, productive and natural spaces, forming interdependent symbiotic relationships, remedying the current dichotomous dialogue between them.

ARTICLE

Articl completed as summary of project



PREFACE

In the wake of the industrial era, Durban saw rapid change amongst its landscapes. British colonialists settled along the coastline in the hopes of a profitable influence of the sugar industry. Early settlement along the northern coast through mills such as the Mt Edgecombe, Huletts , Maidstone and others, initiated the densification of the coastline. Where land had the possibility of sugarcane cultivation, it was considered a valuable asset and therefore privatized, limiting accessibility to the coastal edge and exploited natural systems for profit. "Most of the natural forests in the study area have been removed for the planting of sugar cane, which today, is the predominant vegetation type on the north coast" (Ahmad, 2005).

The 1960s saw an increase in the influx of holiday-makers which in turn influenced development of residential 'resort' towns, namely Umhlanga, Umdloti and Salt Rock. The creation of the M4 highway played a major role in accessibility of the coastal edge. "High population densities, linked with urban growth; expanding tourism and industrialization pose major threats to coastal resources and biological diversity" (Ahmad, 2005).
The domination of the sugarcane industry in the privatization of landscapes witnessed a change of landscape uses to residential and industrial typologies. The industrial nature of milling saw technological advancement, shifting manual labour to machining the cane. This led to the surplus of labour, matched with rapid increase of both the Indian and Black population. The rapid pace of population growth needed to be catered for, leading to local industrialization and high-density suburbs such as phoenix and Chatsworth developing.

The nature of Durban's rapid expansion of population meant more land was in demand for residential and industrial development, this land being sugarcane plantations. The current perception of retaining coastal land for agricultural purposes is no longer a viable option. The attractiveness of developing land for residential purposes, yielding larger profit margins opposed to farming the landscapes, has led to Tongaat Huletts creation of a property sector in their industry.

(Clark, 1995) argues that the greater the level of economic development, the greater the threat to the environmental resources, as economic demand for a given resource will commonly exceed the supply.

This dissertation aims to unveil the negatives of both the sugarcane industry and development patterns on coastal landscapes and the way in which architecture may re-mediate the relationship between man and nature. The goal is to form a new archetype and expansion typology for coastal zone, namely the Sibaya precinct, in an effort to rectify current actions harming the coastal edge. It will use environmental theories in an effort to regenerate worn landscapes and propose a new paradoxical development scheme for future growth of the Northern Coast.

Terminology:

Milling:
To grind, work, treat, or shape in or with a mill.
Ecosystem:
A system, or a group of interconnected elements, formed by the interaction of a community of organisms with their environment.
Regenerat(e)ive:
To re-create, reconstitute, or make over, especially in a better form or condition.
Restor(e)ative:
To bring back into existence, use, or the like; re-establish:
Dichotom(y)ous:
Division into two mutually exclusive, opposed, or contradictory groups.
Conurbation:
An extensive urban area resulting from the expansion of several cities or towns so that they coalesce but usually retain their separate identities.
Fragmented Landscape:
Fragmented natural landscapes due to farming landscapes dividing the natural systems

INTRODUCTION

DEMOCRATIC URBANITY | SUGARCANE | RESTORED LANDSCAPE

Impact of the Sugarcane Industry on Coastal landscapes

Sugarcane farming has resulted in wetland loss, soil degradation as well as deterioration of water quality within the Eastern Coast of KwaZulu-Natal with specific natural resources such as the Ohlanga river being affected over the growth period. Matavire, 2015, reviewed studies concerning sugarcane's impacts which assessed the impact of sugarcane farming on soil quality, water quality and consumption, human health and impact on air quality aspects. The result being that sugarcane farming has a negative impact on the quality of the above mentioned resources, therefore a new farming technique may be considered and assisted through architecture to better the overall result of the production.

In Durban the 'sugar boom' happened to take place during industrial era. Sugarcane farming has formed part of South Africa's major commodity market from its initialization in 1824, which saw a major influx in coastal sugarcane farming for the export of sugar to global capitals. KwaZulu-Natal coast has played homage to colonization for the farming of the fertile soils, which still exists physically through the plot layouts for sugarcane farming.

Sugarcane farming has shaped the coastline of Eastern KwaZulu-Natal, leading to the ownership of majority of land by a single corporation, namely Tongaat Hulett - refer to Figure 04. Therefore the majority of the coastline is currently, slowly but surely being sold to the highest bidder with large developments in the form of business complexes, estates and shopping typologies becoming major assets. The natural landscape is partially negated by the influx of mass development along the coastline due to the fact that previous sugarcane fields are wiped clean, providing a blank canvas for development, and is therefore never restored to its previous natural state.

Urban development patterns along the East Coast

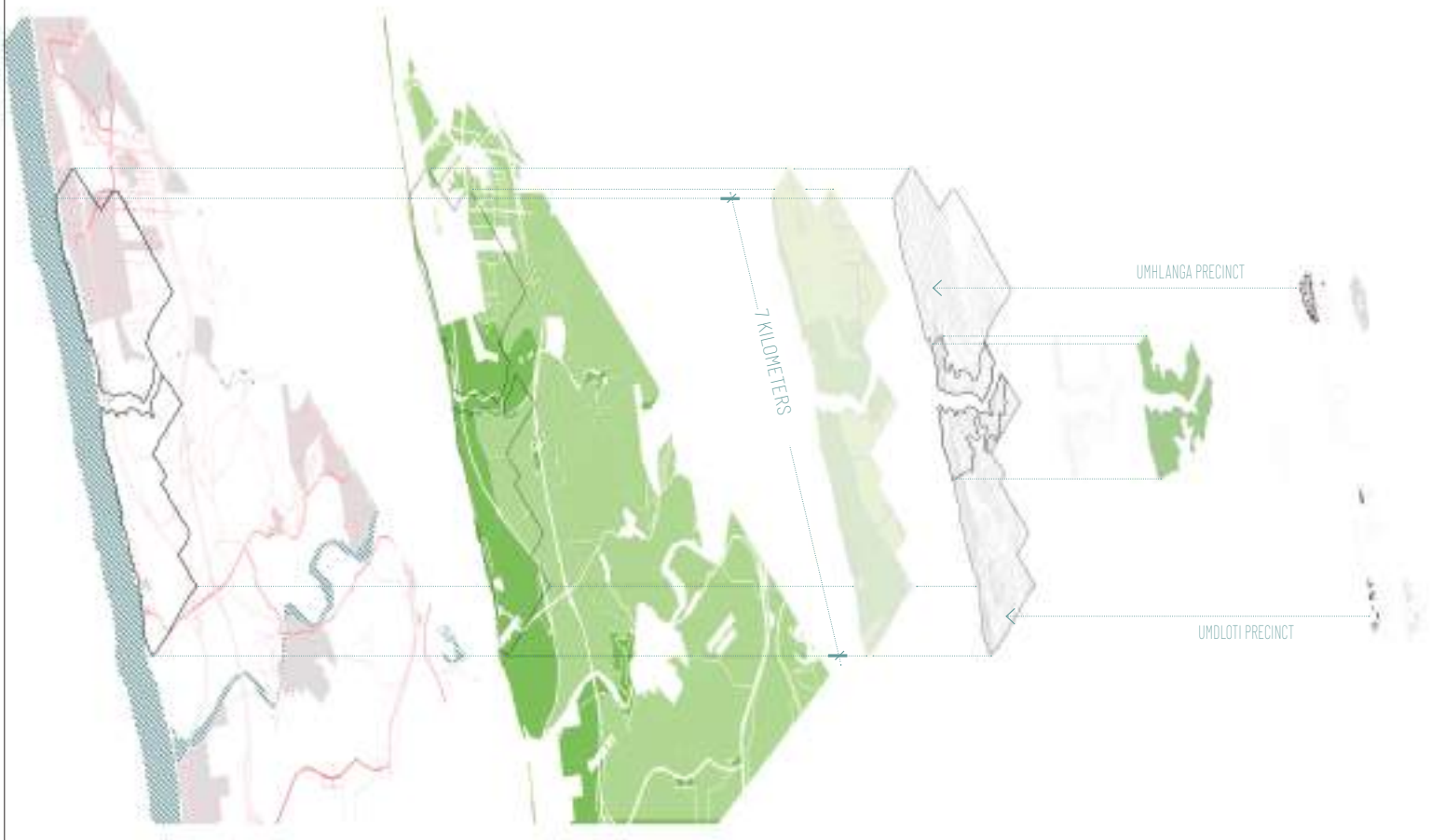
Urban sprawl along the coast differs from landlocked cities, where sprawl happens from a centralized point and spreads outwards in all directions. Coastal urban sprawl is characterized by the coast edge, where the formula of sprawl sees an outwards migration through lateral movement rather than a radial dispersion. Linear urban coastal sprawl of the East Coast sees opportunity for urban design as well as architecture to shape a more democratic coastline, bringing back the public realm to the coastal edge, where, more than often, one sees the coast edge privatized by developments which "possibly more often than not, are delivered by rich patrons or power elites and this has generally been in ways anything but democratically" (Wood, 2016). We see this in current developments, such as Umhlanga's Ridgeside development, the Peals, The Oceans, the Sibaya precinct as well as many others.

Urban vision in response to development influx

The urban vision proposes a adaption to current typological formations proposed for coastal areas, which delves into the rehabilitation of coastal sugarcane farms as well as wetland and forestry conservation areas through architecture in an effort to democratize coastal development patterns.

The urban vision focused on large scale effects of coastal influx in terms of commercial growth and residential growth, and the interference with both natural systems as well as previously settled communities. It aims to conserve the surrounding areas of the extended Umhlanga precinct to ensure further growth is democratically sensible and conserves and regenerates the affected landscapes.

> "Good urban design isn't at all about designing prissy set-piece civic spaces, but rather making robust, nonprescriptive urban space and public environments in which people bring their lives and overlay and imbue these spaces with their meanings."
> -Erky wood


7 KILOMETERS
UMHLANGA PRECINCT
UMDLOTI PRECINCT

GENERAL ISSUE

The Disconnect Between the Natural, Induced Natural and the Built Environment

"We should not take more from the Earth's crust than is slowly redeposited; nature cannot sustain a systematic increase of chemical compounds - we cannot emit more waste products than nature can process; the physical basis for the earth's productive natural cycles and biological diversity must not be systematically deteriorated; and there must be fair use of resources in order to meet human needs on Earth." - (Robert, 1995)

Karl-Henrik Robèrt's Natural Step (Robert, 1995) extends to us that we as humans we are part of the natural ecosystem and should therefore be considered when viewing the holistic nature of our environment.

Non-sustainable, non-resilient patterns of urbanization, along with the neglect of inner-city areas as well as natural systems along the East coast, has resulted in the fragmentation of the city. The resilience of nature, matched with patterns of urbanization show the disconnect between nature and man, where natural systems are exploited for human gain.

Architecture's primary initiative has always been to alter climatic conditions in a manner which provides a constant shelter from the natural, where the human activity becomes the primary driver. However the nature of this initiative has led to the degradation of almost all natural systems along the coast.

As Robert has exclaimed, humans are part of the natural ecosystem and therefore we should design to be part of it.

URBAN ISSUE

Hierarchy of Intentions Within Coastal Typologies

The East Coast sprawl sees the coastline of KwaZulu-Natal becoming parcels of commodities which the highest bidder claims, often leading to negating the biophysical, humane and socio-economic structures which should play preference in the urban expansion.

"Coastal design has become infatuated with the aesthetic appearance of its streetscape, wide streets to accommodate free-flowing vehicular movement, separation of land uses, the development of the shopping mall as a concentrated retail area surrounded by parking areas, and often urban exclusion of the poor" -(Watson, 2009)

Urban sprawl or 'growth of Peri-urban areas' are key spatial trends in the current city structure where sprawling development surpasses infrastructure provision (Olivier, 2017) and should therefore have great importance when architecture of place is considered. Umhlanga's current existence depends on urban sprawl to maintain current urban influx. The downfall of this expansion is the negating of natural systems in replacing the abundance of sugarcane plantations, which exploited its predecessor of naturally conserved state, with the form of urban development.

Sugarcane has had a direct relationship with urban planning and the way socio-economic patterns have dispersed; where higher-income classes privatize the coastal edge, often limiting accessibility to the general public. This will continue as long as sugarcane plantations are developed as high-income assets.

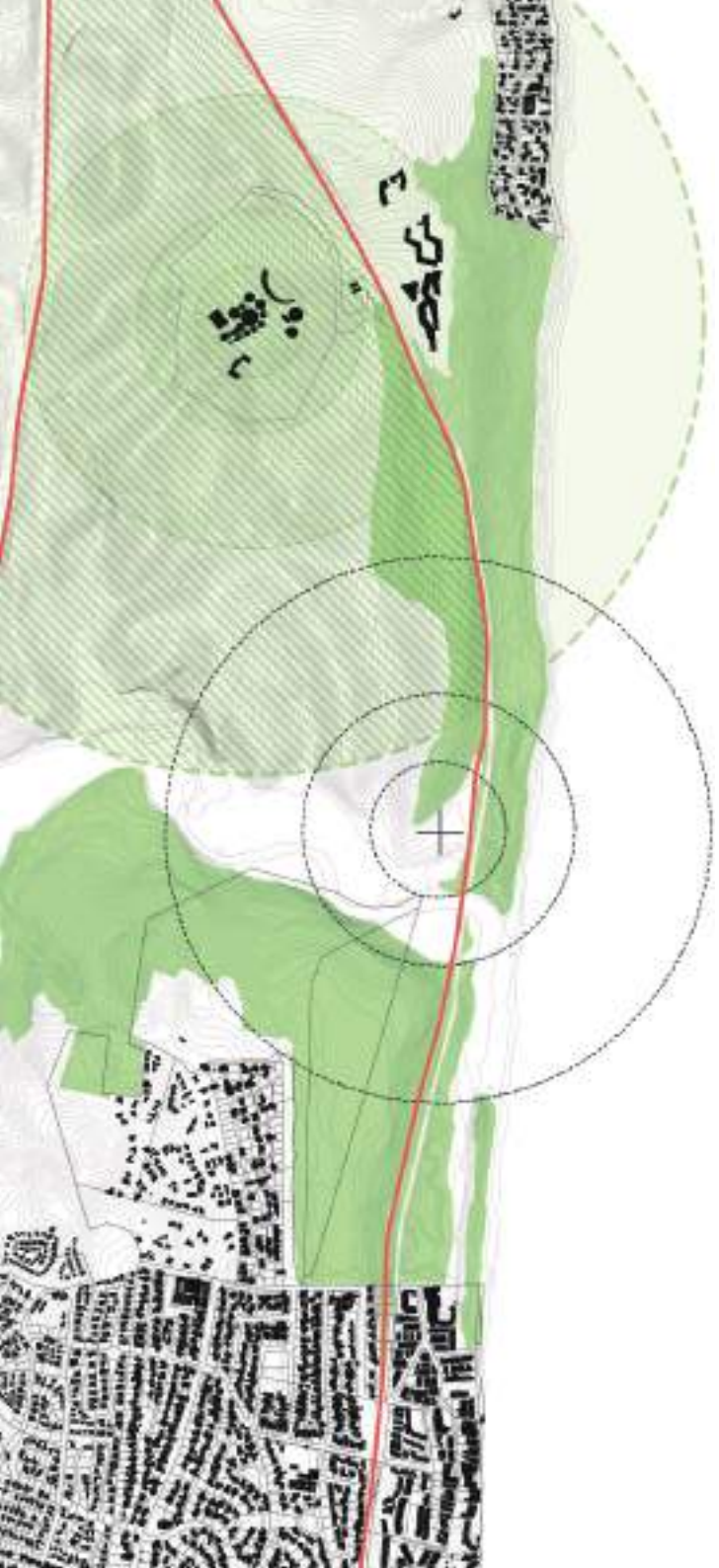
The urban vision aims to conserve the surrounding areas of the extended Umhlanga region to ensure further growth is democratically sensible and conserves and regenerates the affected landscapes.

The urban vision focuses on the large scale effect of coastal influx in terms of commercial and residential growth, and the interference with both natural systems as well as previously settled communities.

How can architecture remediate the Urban Issues?

Through the architecture, which uses production as a place for engagement to encourage urban identity, economic expansion and social cohesion, which results in a balanced socio-economic node setting precedent for the further expansion of the Sibaya precinct.

Fig. 06. Left; Current Umhlanga development archetype (Author, 2019)
Fig. 07. Opposite Right; Future node expansion point (Author, 2019)



ARCHITECTURAL ISSUE

The Dichotomy of Production, Human Nature, and Natural Systems

'Since life takes place, large and small localities belong to the experience of living, which is the architect's task to render visible.' - Norberg-Schulz

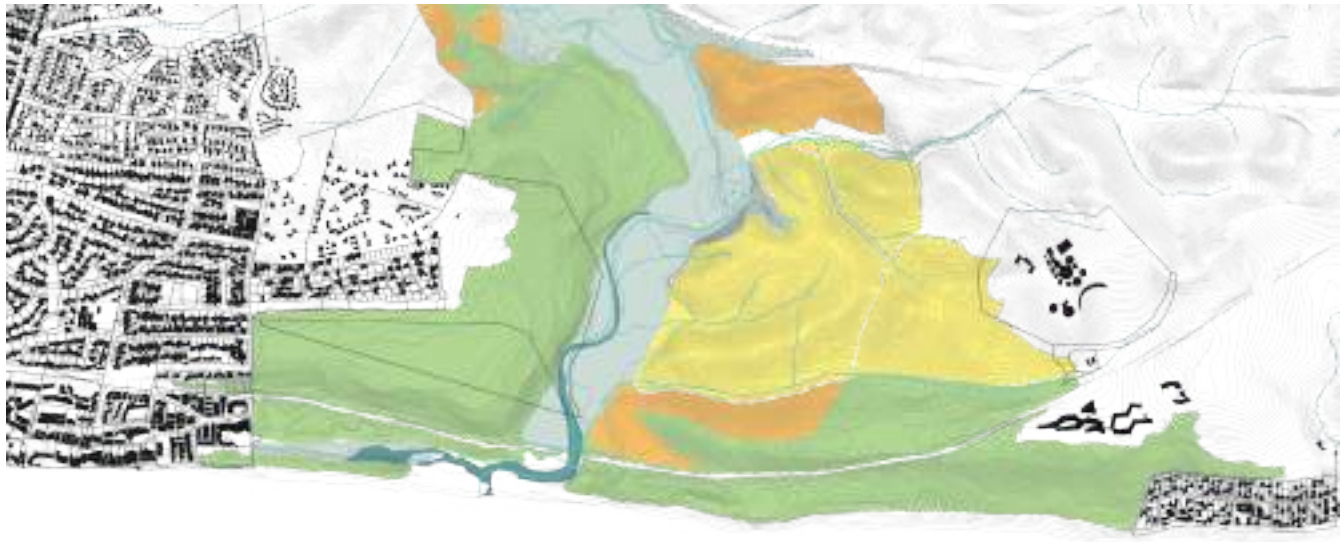
The degradation and dislocation of natural and urban systems has led to perception of architecture as separate from its natural environment. Focus can be placed on architecture and its use as a systemic tool to allow for participation of human interaction with natural cycles in specific localities. This will create a regenerative initiative for a holistic intervention which increases economic, social and environmental participation to induce architecture as the main driver for the regeneration of Periurban systems at play in Umhlanga.

The architectural intention will be used to enhance the existing systems within the local context. By using existing and future frameworks a sensitive architectural interventions will act as a systemic tool to feed into the existing and possible future systems at work within the larger district, allowing for various present and future networks to not only exploit, but also participate in different social, economic and ecological systems. The architecture will use regional techniques and technologies to establish a language constant with its surroundings.

Social intentions through architecture

The social intention of the project is to link existing social networks currently thriving around the project as well as farther social structures influenced by existing networks to create social cohesion through public interaction. The aim of the regeneration is to enhance the socio-economic social cohesion, in a way the reverses the degradation of systems within the South African cities. The project re-imagines the sugarcane process from one of machining to one which is made up of manual labour, bringing back a celebration of heritage as well as the artistry of the sugar-making process. This creates a spectacle of production, which previously has not been considered. In doing so, the "blue collar" worker may be celebrated and integrated in a process which previously would be a privatized spatial typology.

1 Watson referring to the formulated way in which urban expansion takes place- this is seen throughout Durban's greater expansion and is problematic when considering ecological spheres.



THE ORIGINS OF NATAL'S EARLY CANE FIELDS

There has been speculation that sugarcane, perhaps more than a single species which we are accustom to, was growing in South Africa for some time before the start of the sugar industry in Natal as well as the colonization of the coastal region. Osborn (1964), recalls a letter sent to *The Natal Mercury* dated 18th July, 1867, wherein A.B Kennedy of the Umgeni Sugar Coffee and Produce CO., Ltd., stated "My kafir-kitchen worker says he knew Kafir Moba before any white men were in Natal." [1]

In 1850, J. Leyland Feilden planted the first 'known' cane on his property in Umbilo. The cane flourished in the coastal climatic conditionst, so much so, "he soon imported 30000 of the 'most approved' cane tops from Mauritius" (Osborn, 1964, p.116).

The Zulus had little interest in farming white settlers' land. Desperate for labour, a public meeting was held to propose the import of indentured labourers from India. On 17 November 1860, the first contingent of 341 Indian labourers arrived in Durban aboard the SS Truro.[2] By 1904, there were over "1 300 employers of indentured Indians in Natal" (Du Bois, 2015, pg.92). By 1855 there were 12 sugarmills at work.

THE SUGAR RUSH

The value of sugar exported from the Natal sugarmills "in 1855 was £16", and the "value of sugar exported from Natal in 1856 was £483, or 30 times the 1855 figure." (Osborn, 1964, p.57) By 1892 there were thirty-seven mills in operation. By the 1920s, "with world sugar prices having risen threefold" (Lincoln, 1988, pg. 7), major sugarcane growers had established their name within Natal. "The sugarcane industry exploded, making the Port of Durban one of the British Empire's most important seaports. It soon was the busiest sugar terminal in the world" (SA History Online, 2011)

THE SUGARCANE INDUSTRY TODAY

The sugarcane industry has come from turmoil to become on of South Africa's major exporting produce. South Africa's sugar story is a story which is easily related to many of South Africa's industries, form which profit has come from the expense of others. South Africa produces 19.9 million tons of sugar cane a year, where majority of that comes from KwaZulu-Natal. "The sugar cane industry is estimated to provide 79,000 direct jobs and 350,000 indirect jobs, making it a significant percentage of the total agricultural workforce" (Khan, 2017). Having used indentured Indian labourers during in the genesis of the sugar industry, the Indian population has increased to the extent that Durban now plays homage to the largest Indian population outside of India. Sugar is currently produced and processed by six milling companies with 14 sugar mills operating in predominantly KwaZulu-Natal with a substantial investment in Mpumalanga. According to the SASA (South African Sugar Association) "Approximately one million people, more than 2% of South Africa's population, depend on the sugar industry for a living" (SASA, 2017). The current practice uses partially old techniques for sugarcane harvesting which may have come from the slowing of the sugar market which has been prevalent in previous years.

FUTURE DEVELOPMENTS FOR THE INDUSTRY

Since the influx of coastal nodes from the turn of the 21st century, the sugar industry has played a vital role in the development of the coastline. The chronological development of the coast has allowed for sugarcane farms to still function as parts were sold and upgraded into commercial zones. This has been narrative of the Umhlanga region, with its 'boom' in the 90s. The last of the sugarcane fields are presently being developed, dislocating the node from its heritage and the scale at which these developments are happening result in a dislocation from nature.

Fig. 08. Left Top; Current Zoning on site (Author, 2019)
Fig. 09. Right First; Umhlanga Figure Ground (Author, 2019)
Fig. 10. Right Middle Umhlanga 2019 Macro Zoning (Author, 2019)
Fig. 11. Right Middle Bottom; Umhlanga 2004 Macro Zoning (Author, 2019)

The Role of Sugarcane in Chronological Development

In order for the urban vision to be established, the larger coastal region was analyzed at a macro-scale to see the effects of urban development along the coastal edge. The mapping done showed the chronological relationship between sugarcane, future developments and conservation areas of major areas within KwaZulu-Natal. Sugarcane farms have and still do make up a massive area of coastal zoning, which now takes the form of a multitude of future development proposals for the Eastern coast.

The chronological mapping justifies the point of unsustainable growth patterns of our precincts and cites. From 2002, each node studied had drastically developed into major commercial and residential hubs, all of which, have previously been sugarcane plantations. Natural reserves and conservation areas are bordered by large scale developments which leave no buffer zone or transitional thresholds between the two- creating a visual and physical boundary. There is no consideration in the effects of sugarcane on ecosystems as we see plots extending well into naturally zoned areas.

Where land has previously been used for sugarcane plantations, it has been farmed to the extent of becoming infertile sites and continued farming has induced critical conditions for soils, wetlands and the ecosystems at play.

Urban expansion is happening at a rapid pace along the east coast due to major commercial and residential influx. The growth rate is directly proportional to the capital being invested into the coast line. This is leading to an anomaly to coastal urbanization in the form of conurbation. Conurbation has taken place in major cities such as Capetown, Pretoria and Johannesburg, but due to Durban's topographical and economic growth patterns, urban points have always been isolated from one another, leading to fragmented nodes with intermediate conservation and sugarcane plantations between, resulting in the iconic rolling hills Durban is known for.

The expansion study done revealed the extent to which Durban's suburban areas have grown the last two decades. This has created a threat to natural areas along the coast, from which the project highlights the Hawaan Forest and Ohlanga river and estuary as central to this crisis.

The nature of the sugarcane industry is that it is largely owned by a single corporation, ensuring major commodity zones, such as the Sibaya precinct, are privately owned and therefore developed for private use. From this the Sibaya precinct model has been developed and aimed at connecting the entirety of the coastal edge between Umhlanga and Umdloti through private development.

The problem is not necessarily the idea of conurbation in its connecting sense, but rather the way in which it is being executed. Sugarcane farms in the last Century have impacted the environments in which they are situated drastically. Fragmented forestry has become apparent over the past century, due to the overpopulated farming lands. This induced landscape breaks the areas of forestry, interrupting ecosystems at play. Without this link, ecosystems cannot sustain themselves due to their fragmented environment. This induced landscape is then further interrupted through the development, pushing out what ever ecosystems still leftover. This is the problem presented by the traditional sense of conurbation and in the light of Durban's thriving natural habitats may be seen as an even more dramatic case.

NOTES:

1 Conurbation - rapid expansion of isolated urban nodes to the extent of becoming combined

02.1.1 Identifying the crisis in current sustainable thinking

"No problem can be solved from the same consciousness that created it. We have to learn to see the world anew" - Einstein, 1995

21st Century crises have led us to believe humans as separate from our environments. This view sees the natural environment as separated parts, to be exploited different interest groups. In less than a century, we have choked our resources, overpopulated our land, fished our seas and polluted our waters. The repercussions of our actions are finally materializing. "Cities and regions around the world are experiencing seasonal shifts, rising temperatures, fluctuations in rainfall patterns and precipitation (leading to drought and floods) changes in the severity and frequency of extreme events, and accelerated sea level rise" (Zimmermann, 2012). Rapid urbanization has resulted in cities expanding at rates which are unsustainable, leading to fragmented systems and derelict cities. Our addiction to fossil fuels, is far from over, but sustainable measures are in place which 'slow' down the rate of resource deterioration. However this is not a viable solution.

The direct consequences of our consumption traits are visible in our landscapes. Specific to Durban's landscape, one views the toxins in both the soil and natural water systems from a multitude of actions committed. Seasonal storm cyclones (which are becoming more frequent) regurgitate our pollutants filtered through the landscape to the river mouths in the form of decolourized shores, littered with pollution. (Figures 14 & 15)

The environmental crisis "stems from the prevailing power-driven ethos, the anomic individualism, which divert human concern into technological invention, scientific advancement, and unlimited material consumption and production" (Orhan, 2003).

The rate at which we are sustaining our action's outcomes, is a rate which ironically cannot be sustainable. The 'sustainable' implementations to slow down the rate at which our resources are deteriorating in an effort to do less damage to our environment, is not the answer to our dilemmas. Rather we should learn how one may participate within the larger whole, rather than viewing it as separated. "The shift from a fragmented to a whole systems model is the significant cultural leap that consumer society needs to make." (Reed, 2007)

This system of thinking is not new. It has been explored for years by many pioneers. The way in which the dissertation's theory is different, is its exploration into the combination of the four theories, and how where one theory may fall short, the other caters for.

02.1.2 Realigning Sustainable Thinking

The theory proposed for the Eco-Mill is one which attempts a holistic approach to embody the project. This shift in thinking uses the combination of systems thinking, in an effort to create an optimal theoretical premise for future development along the coastline. Where one theory falls partially short, the other theories will cater for.

THE REALM OF THE BORN - ALL THAT IS NATURE - AND THE REALM OF THE MADE - ALL THAT IS HUMANLY CONSTRUCTED.
- Kelvin Kelly

Waste (non-processable material) is and will always only be a byproduct of human consumption. "Nature has no garbage problem because nothing becomes waste" (Kelly, 1994: 155). Nature has a cyclical flow, in which all materials return back to the primary stage of the closed-cycle. Humans have interrupted this cycle. The industrial nature or machine-like lifestyle quality requires an input, often resulting in an undesirable output, which is discarded into nature in the form of waste. Human induced waste has both tangible and intangible forms, of which both have an effect on the earth's natural systems.
Global population growth has reached a rapid pace which in turn has intensified the demand on resource production and consumption. This consumerism paradigm has stimulated a non-sustainable means of production, where the product is the only concern of the mass production, resulting in mass wastage.

The industrial epoch has led us into a production realm which is conducive to excessive waste and pollutants. The globalization of industry has led to a production typology which cannot sustain its wastage. An irresponsible agenda has emerged, where the byproducts of our production are released back into our surrounding natural systems. This results in polluted natural systems, which ultimately intervenes natural cycles at play. There is an opportunity for the reuse of our excessive waste by using overarching systemic theories. These theories will be discussed in full later.

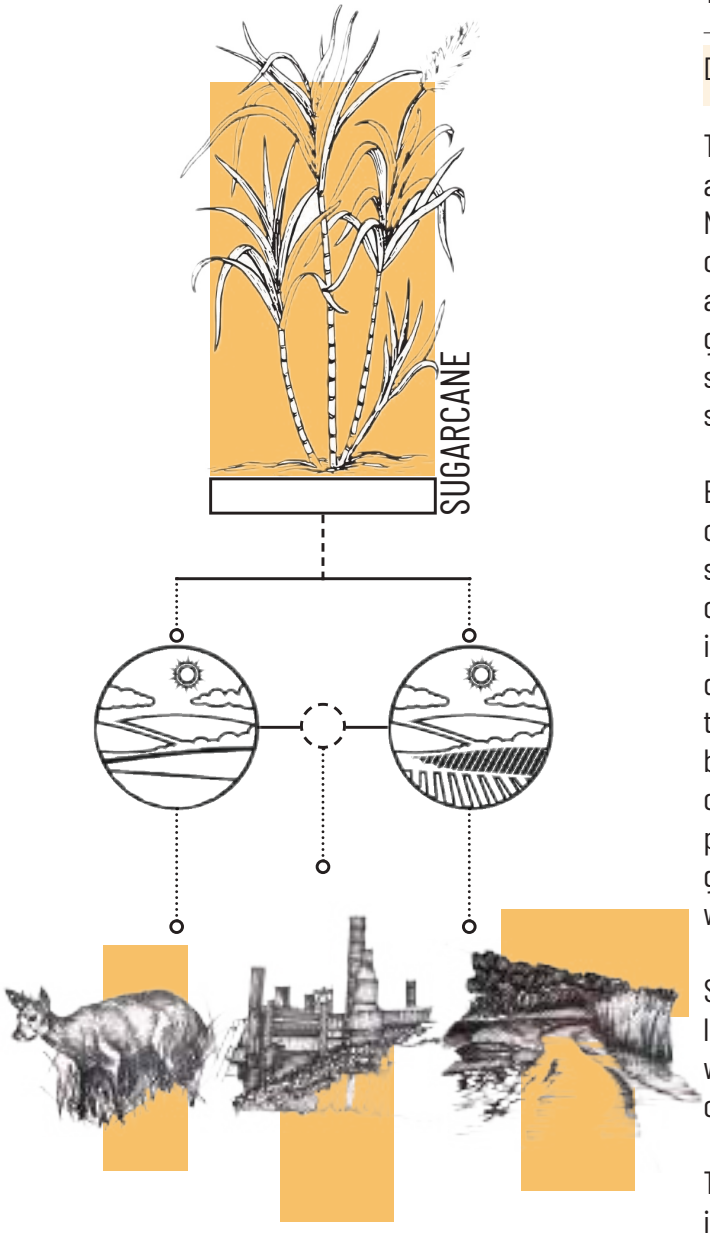
PARADOXICAL REHABILITATION

USING A NEW 'PARADOXIC REHABILITATIVE' CONCEPT FOR FUTURE COASTAL DEVELOPMENT

Rehabilitation of Landscapes Prior to Future Developments

In the wake of the Sibaya precinct proposal and urban developments within the Umhlanga node (discussed indepth later), it has become apparent that a need for rehabilitation of exploited landscapes from sugarcane plantations back to indigenous coastal ecosystems prior to development is imperative. This has due to the fact that when development occurs along the coast, sugarcane fields are dug up and flattened without consideration to existing ecological systems within and surrounding the fields. Fragmented forestry has become apparent over the past century, due to the overpopulated farming lands. The human induced landscape breaks the areas of forestry, interrupting ecosystems at play. Without this link, ecosystems cannot sustain themselves due to their fragmented environment.

These sugarcane plantations reduce forest health, degrade habitats, from which fragmentation leads to loss of biodiversity, increases in invasive plants, pests, and pathogens, and reduction in water quality. When a forest becomes isolated through the forms of farming, roads or developments, the growth



WHOLE SYSTEMS + LIVING SYSTEMS THINKING

THE SYSTEM AS A WHOLE: CHANGING THE WAY WE THINK

Degenerative Patterns In Linear Flows In Current Production

Throughout the 20th and 21st century, consumption through a linear pattern has lead to the degradation of landscapes. Materials are taken from the earth far quicker than they can be replaced, ultimately leading to the diminishing a said resource. "The one-way throughput system is a global system" (Lyle, 1994). In its very essence, the one-way system is a degenerative one, devouring its own sources for sustenance.

Barry Commoner (1990) argues that the dysfunction in our linear pattern, lies in our means of production; to solve our pollution dilemmas, we must change our way of making things. "The palliative approaches taken so far in environmental regulation have not been adequate to deal with the fundamental structure of one-way flows that we have built not only into our means of production but into the very design of our cities and our landscapes- our fundamental sources of sustenance" (Lyle, 1994) The problems have become a manifestation of failure within the global infrastructure created over the past three centuries, which have created the idea of action without reaction.

Sustainability thinking still acts along a linear flow with a longer acting period. It is one which is a palliative approach, where it offers pain relief without curing the problem causing such pain.

The possible answer is rather than mitigating our impact, it is to create ecologically harmonious developments, which recognizes humans as not central to development, but rather as part of a larger system. This idea is not new, and can be seen in works by James Lovelock (1988), Eugene Odum (1993), Lewis Mumford (1961) and many others, who viewed the human downfall as their inability to function mutually with our life-supporting landscape. These thinkers advocated that in order to restore our landscapes a deeply integrated, and whole-systems approach is needed.

Opposing Palliative Design Through Holistic Systems Design

The dissertation looks at holistic design as viewing all systems at play as interlinked and concurrent with each other where the interdependence is vital in its symbiotic relationship.

The current dilemma we face is humans viewing themselves as separate from what surrounds us and our development, therefore we lack forward thinking towards the consequences of our actions. "Development is necessary to provide habitat and sustenance for our society, but development inevitably alters natural systems, usually for the worse" (Lylle, 1994)

Viewing systems as a whole ensures an outlook where there is mutually beneficial relationships between humans and nature through all facets of design. This relies on a place-based approach where through framing and understanding living systems' interrelationships, we may design holistically.

The green movement has, to an extent, only related within the human realm (and our needs), without taking into account the interrelationship of the whole. Reed (2007) extends to us that whole systems thinking recognizes that the entirety is interconnected, and moves us beyond mechanics into a world activated by complex interrelationships - natural systems, human social systems, and the conscious forces behind their actions.

This means we must replace our current linear systems

of production with cyclical flows, which result in a closed-loop idea of production where our outputs relay back into the system. This results in an actual sustainable approach where all activities are ultimately balanced through the cyclical flows. This may be done in many practical theories which will be discussed.

Terminology:

Cyclical Flow
Revolving or recurring in cycles, in which at the end, the process starts again

Closed-Cycle
A closed cycle is a cycle in which all components are 'recycled' back into the system, ultimately negating the outcome of pollutants

Fragmented Systems
Fragmented systems are caused when intervention takes place, splitting the systems into two independent components, often resulting in the diminishing or partially diminishing of the system.

One-way throughput system
Often in production a one-way system is regarded as a process with a beginning and an end, from which the output is a product with byproducts which are discarded.

Restorative Design
Restorative design in relation to the project aims to restore the diminished landscapes surrounding the design through the landscape and architectural design.

REGENERATIVE THEORY

USING INNER WORKING OF ECOSYSTEMS TO REGENERATE RATHER THAN DEPLETE

The Beginning

Regenerative theory was first established in the 1880s by Ebenezer Howard who wrote *To-morrow: A Peaceful Path to Social Reform* which expressed the idea of ecological thinking in human settlement patterns. "It sought to reconnect humans to nature, and featured use of natural rather than engineered processes to build the health of the system" (Mang, P. and B. Reed, 2012). Howard (1898) explains the Utopian city as living harmoniously with nature rather than separate from it, and using the natural as a tool for settlement design criteria.

Patrick Geddes published a work on urban growth patterns in 1915, which saw the mass movement of people into cities. "His was the first fundamentally organic understanding of cities, and had little liking for the chaotic growth that he saw resulting from industrialization" (Lyle, 1994). Geddes study expressed a regenerative vision of the future, one which may seen as built from his predecessor, Howard. "Geddes, a biologist, saw cities as living organisms. He believed that addressing the problems of unsustainable growth required understanding a city's context—the surrounding landscape's natural features, processes and resources—and called for a solid analytic method for developing that understanding" (Reed, 2012). 1935 saw a new work proposed by Arthur Tansley, focusing on the concept of ecology as a means for design. "He proposed the term *ecosystem* as a name for the interactive system of living things and their non-living habitat" (Reed, 2012). The concern for natural systems and the impact humans have on these systems has became a vital in Tansley's work, whereby he focuses the ecosystem as a valuable framework for analyzing the effect of human activity on natural systems and resources.

The 1980s saw Robert Rodale, an organic agriculture pioneer, advance the use of the word *Regenerative,* "calling for going beyond sustainability, to renew and to regenerate our agricultural resources" (Reed, 2012). Rodale saw the natural system as including the relationship of human activity, whereby the continuing of organic renewal was proportional to healthy soils, which equaled healthy food and therefore healthy humans. Rodale's work did not extend to the built environment , however it did influence the principles of John Lyle's work.

In 1984, John Tillman Lyle published *Design of Human Ecosystems,* in which he proposed that "designers must understand ecological order operating at a variety of scales and link this understanding to human values if we are to create durable, responsible, beneficial designs" (Lyle, 1984). Lyle regarded human ecosystems as having a symbiotic relationship in which human and natural systems are not separate from one another.

Regenerative Systems within Development

> "The development of ecological understanding is not simply another subject to be learned but a fundamental change in the way we view the world."
> - John Lyle, 1994

As mentioned previously, development often results in the negative impact on natural systems. However as we adopt a system where humans are part of nature, we can reasonably say that our development for human purposes, is not qualitatively different from alterations made by other species. But it must be said that in developing our landscape we inevitably interrupt a multitude of natural systems at play- ones which have taken years to form. Lyle (1994, pg. 20) reassures us, that nature in fact, is extremely resilient and adaptive. As we develop, nature responds by evolving to

adapt, creating a new ecosystem.

Regenerative Systems Vs. Industrial Systems

Minaar (2017), uses Lyle's theories in her dissertation to explain the linear flow of the industrial system and compares it to that of the regenerative system flow. Both use a similar processes, but the outcome of the processes is drastically different.

On the one hand, the industrial system's processes result in a degenerative system, where, the outputs exist as byproducts and flow back into natural system, where they cannot be processed back into the natural system and only exist as pollutants.[1] The cyclical flow of the regenerative environment seen in figure 2.*** Continually processes materials back into the larger system, ensuring the renewal of and regeneration of that initial input, thus becoming self-renewing and ultimately producing a sustainable yield.

The ultimate goal is to introduce Eco-efficient design technologies with ecologically based architectural approaches that reverse the degradation of both the Earth's natural systems and the human systems that inhabit and influence them.

1 The amount of waste outputs are considerably greater than the amount of initial material put in. This is due to the materials combining with natural resources diluting them.

INDUSTRIAL ECOLOGY

VIEWING THE SYSTEM AS RELATED TO ITS NATURAL CONTEXT

Closed-Loop System

Industrial ecology aims to reduce the output of industrial systems which effect natural systems surrounding the project. "In an industrial ecosystem...the consumption of energy and materials is optimized, waste generation is minimized, and the effluents of one process... serve as the raw material for another process" (Kelly, 1994: 156).

Previously industrial production has acted in a linear-flow cycle, in which the byproduct has always been seen as waste. This linear flow has resulted in mass pollution in which majority flows back into natural systems, thus interrupting its currently sustainable cyclical flow. In south Africa, our waste lives in rubbish dumps, piled up by years of excessive consumerism.

"Industrial ecologists believe that the use of the natural ecosystem model, metaphor or analogy can be valuable and useful" in the understanding of industry production processes and finding and designing the connection of these processes(Korhonen, 2005). This understanding aims to reduce the excess waste in the realm of production by means of recycling matter back into the production process. Each process must be considered as part of a network of processes which are interdependent and interrelated of one another as part of the larger whole.

"The impact of this inevitable entropy can be absorbed by the organic sphere if the mechanical systems that generate it run at the pace and scope of natural systems" (Kelly, 1994: 157)
Where there is possibility, the excess waste will be placed back into its primary state- nature, where is may enter back into the cyclical flow and be processed back into the earth. The

ECOSYSTEMIC APPROACH

VIEWING THE SYSTEM AS A WHOLE

"Understanding a problem is to understand the relationship between the events and the context in which these relationships occur" (Pilon, 2015).

Changing the way in which we act requires a sufficient collective change, it is a change in our systematic approach to the entirety of our actions thus altering the consequences.

An ecosystemic approach as a model for design sees the building, function and users as part of the larger systems at play. Rather than separate the design from nature, it acts by means of a symbiotic relationship, in which both entities benefit from one another. This approach sees the entirety of the project as a system, in which all events have relationships, impartial of scale or magnitude, interdependent of one another. It relies on the idea of nature's cyclical flow of order.

In an effort to create an architecture comprehensible of regeneration, all aspects facilitated in the design must be included. The industrial nature of the project should engage with the context, initiating restoration between the two.

Education in terms of this change is a significant facet when it comes to the 'collective' movement. Pilon (2015), extends to us that education is a great hope in our ability to adapt as a collective; "it can develop questioning, innovation and creativity, enable to recognize the powerful forces that drive unsustainable living and develop self-confidence and organizational skills". Therefore educating the collective cannot be seen as separate from the systemic approach, but rather fully integrated thus to not fragment the idea of humans and nature or nature and industry.

BIOPHILIC APPROACHES TO DESIGNING

REMEDIATION SOLUTIONS FOR THE DISCONNECT

Regenerative Development as Overarching Framework

"Regenerative development acknowledges humans, as well as their developments, social structures, and cultural concerns, as an inherent and indivisible part of ecosystems." (Zari and Jenkin, 2009)

The goal of regenerative development is to restore the functions the ecosystem undertakes to function without the consistency of human intervention. The development creates new potential, where humans are able to evolve with the ecosystems they are inherently associated with.

Restorative Design as Overarching Framework

Our impact on our natural environment, and in the case of this dissertation, the landscape of the coastal edge, is recognized through restorative design. The negative impacts which the sugarcane industry has caused, which have resulted in polluted, degraded and damaged landscapes, may be returned to a state of acceptable health through restorative deign through architectural intervention. Restorative design questions how we can restore landscapes through our developments in an effort to create a beneficial relationship between the two.

Resulting Framework

The difference between the two approaches is the role of the human in the process and the relationship with it. Regenerative design sees human activity as integrated with the larger whole of our ecosystem and aims for a symbiotic relationship. Restorative design sees the active improvement of our ecosystems through direct human intervention and management.

The proposed framework is one that combines the two, where each approach acts interdependently under the same roof. The goal of the project will be to create the 'ultimate' framework under which the relationship between man and nature can be renewed.

FUTURE COASTAL DEVELOPMENT

MAKING THE DESIGN 'PEOPLE RELEVANT'

There is an interdependence of coastal urban development and the sugarcane industry as sugarcane fields are used for new development grounds for urban expansion. Tongaat Hulett, amongst others, has become a major contributor to developments along the coast over the past decade and sees their ownership of major lands assets (seen in Figure 19) as an opportunity for drastic development of the coastal edge.

The Sibaya precinct as seen in the future development proposal in Figure 18 will be used as the contextual development driver for the project. The multifaceted development sees the entire coast edge between Ohlanga river and the Tongati river being developed. The proposal sees the coastal edge transformed for upper class commercial and residential uses. The Sibaya precinct will border the existing Umdloti node, but allows for a buffer zone between the two.

SIBAYA PRECINCT PROPOSAL

PROPOSAL PRESENTED BY TONGAAT HULETT CURRENTLY IN THE INITIAL STAGES OF DEVELOPMENT

The 'new' Sibaya precinct is being developed at a rapid pace as a mixed-use development, providing a connection between the Periurban areas of Umhlanga and Umdloti. It currently exists only as a proposal by Tongaat Hulett in which it comprises of seven nodes, each different in function, in an effort to provide a holistic urban environment, catering for all aspects of the urban lifestyle.

There has been an initial sensitivity towards the natural systems surrounding the proposal- in which the planning proposes sixty percent of the land compromising of 'green' space. It also proposes what was once sugarcane will be rehabilitated and restored to its natural condition. This is however questionable due to the development company's predecessor projects which lack this 'sensitivity'.

The site proposal is extensive- stretching from the Ohlanga estuary to the Tongati estuary, a total of 6km and an area roughly of 1000 hectares, connecting the two nodes of Umhlanga and Umdloti. The Sibaya proposal will bring into the practice the concept of conurbation, blending the boundaries of the urban areas.
The initiative of the project is reinforce the idea of regenerative and sensitive design towards the existing fragment landscapes. The aim is to regenerate landscapes rather than flatten and rebuild them. When applying the above mentioned theories, a much more holistic approach to development may be taken, thus relieving much of the pressure off of our existing natural systems.

Fig. 18. Far Left; Sibaya Development Proposal (Author, 2019)
Fig. 19. Above; Land Ownership (Author, 2019)
Fig. 20. Top Right; Hulett Sugar Maidstone Mill (Google Earth, edited by Author, 2019)

THE MILL'S PROGRAMMATIC TYPOLOGY

DISCUSSING THE DESTRUCTIVE EXISTING TYPOLOGY WITH RELEVANCE TO HULETT'S CURRENT MILL.

Historic Influences on People

The sugarcane industry is one which has been built on the controversial dismay of many South Africans. This treatment resonates with many industrial processes which came about in the 20th century. The industrial era led to the replacement of manual labour with new automated technologies, in an effort to increase production to match the growing population's consumption requirements. In the present day sugar production realm, technological influences have cut out majority of manual labour, which in turn has had major influences on the surrounding socio-economic structures.

One of Hulett's mills, the Maidstone Mill (Figure 20) processes 440 tons per hour through 2 parallel extraction plants[1], a substantial figure in South Africa's sugar market. This is however only possible with the use of advanced machinery, which requires an advanced technological understanding, leading to outsourcing of labour, leaving the immediate community to the labour intensive work, such as cutting and processing the sugarcane, a labour which has a remuneration not capable of providing for a stable lifestyle.

The existing programmatically biased typology

Architecturally, the sugar mill is a design which focuses on functionality as the aesthetic, resulting in factory-like compositions. This is a result of its industrial nature, whereby the architecture must be durable, relatively inexpensive for replacement, and generic for ease of replacement. One can see the generic factory forms in Figure 20, whereby functions are placed in a linear progression, to best optimize the production movement. The result is an environment which is spatially incompatible with the human aspect.

Making the production realm 'people relevant'

There is opportunity within a production typology to create a spectacle through architecture. Where the current production is machine based, the project puts forward a more manual labour based process, which celebrates both the heritage and artistry behind the sugar-making process. Where everyday workers remained unacknowledged, the building will enhance them status through the creation of the 'spectacle'.

The project aims to highlight the intangible heritage of sugarcane's cultural landscape, which is currently diluted by the idealization of Durban's rolling green sugarcane hills.

Through this "investment may offer an opportunity to rehabilitate degraded infrastructure and productive capacity, increase direct employment and supply opportunities for local land holders" (Dubb, Scoones. & Woodhouse, 2017), thus enabling the coastline to become one which is more democratic compared to present day socio-economic patterns (Figure 12)

CONCLUSION:

Conurbation of coastal zones is seemingly inevitable at the rapid pace current development is taking place at. This has resulted in irresponsible practices throughout the chronological development of the coastline, which now manifests in urban expansion through architecture. One may view this in an optimistic manner, in which we can change our deteriorative ethos, to one which is regenerative, restorative and conservative to existing systems.

The way in which a design must interact with its natural context is therefore extremely important going forward. It must integrate itself into its landscape rather than dominate it, thus creating an interdependent symbiotic relationship between man and nature, in which both parties are fulfilled. The theories compiled above are ways in which the project will attain this initiative.

Regenerative theory considers the human as part of the integrated system, whereby our actions have a direct influence on our contextual systems. Where previously the industrial architecture dominated the landscape, the regenerative typology will aim to integrate human systems with natural systems.

The industrial ecology nature of the building will ensure the optimization of material use in both the construction and production realm, whereby the output may serve as a regenerative tool, or the effluents may be used as the raw material for another process, thus minimizing waste and creating a passive production realm.

The programmatic functions of the design are elevated to become a spectacle for interaction between public and private. Thus achieving a social node on which a democratic community may be moulded.

The overarching ecosytemic approach to the design ensure all stakeholders are considered equally, without one dominating the other. The result is a balanced system, stimulated by the architecture and enhancing previously not thought of systems.

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