

reefs in ruin

2020

# reefs in ruin

.tsitsikamma national park.  
M. ARCH PROF DISSERTATION 2020  
MICHKE JORDAAN





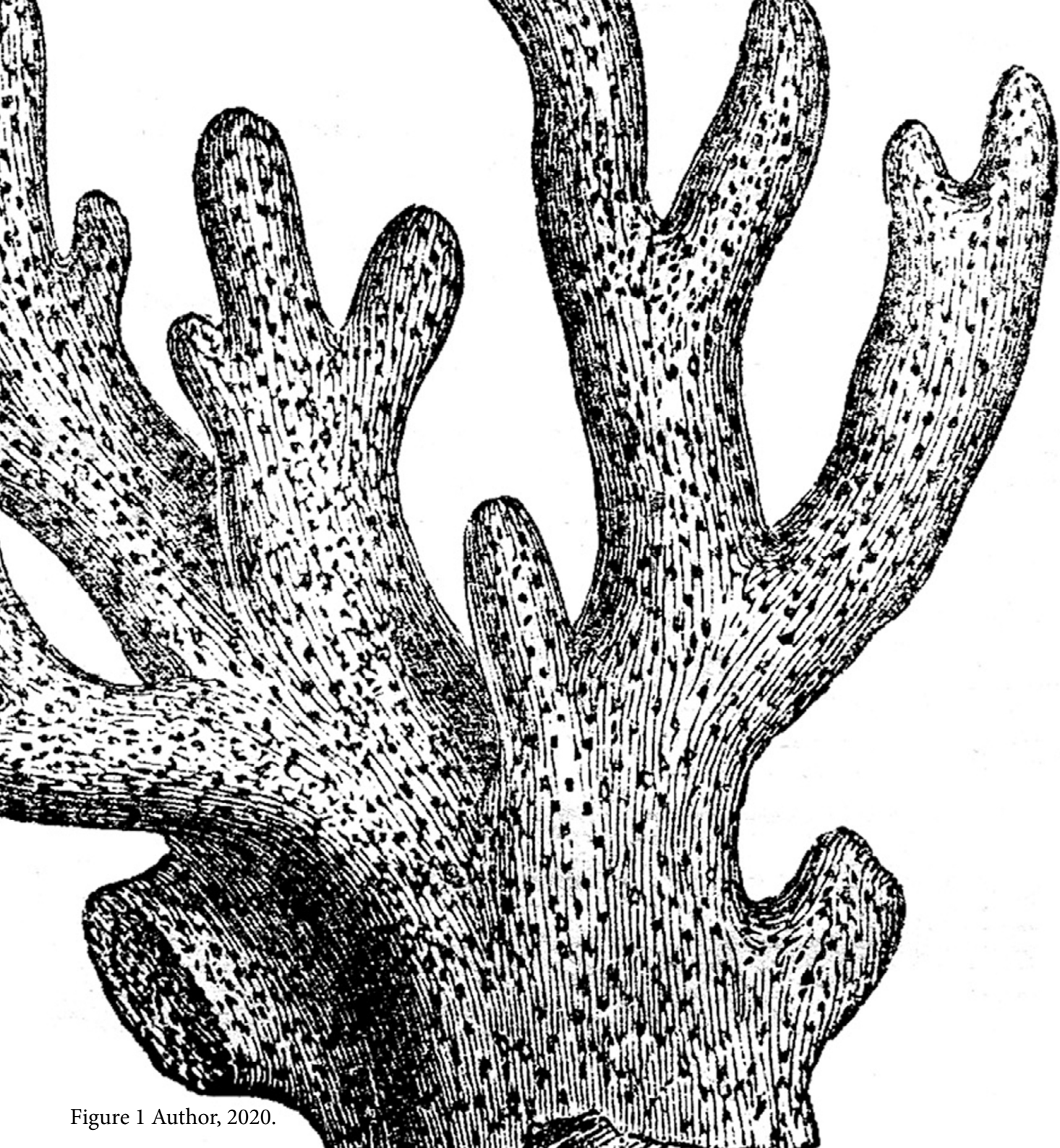


Figure 1 Author, 2020.

# acknowledgements

For my mom, Michelle, for all of your love and support throughout my studies, making this journey possible.

.....

Professor Jan Smit, Petria Smit, Hein Raubenheimer, Professor Jonathan Noble and Jan Nel for their expert advice, support and guidance throughout the year.

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Curtis, for your endless understanding and loving nature, and all of your support.

The Lord, Jesus, for guiding me and going before me. For His glory.

.....



# declaration

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**This dissertation is submitted in partial  
fulfilment of the requirements for the M.Ach  
Prof degree.**

Declaration of original authorship. The work  
contained in this dissertation has not been  
previously submitted to meet the requirements  
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my knowledge, this dissertation contains no  
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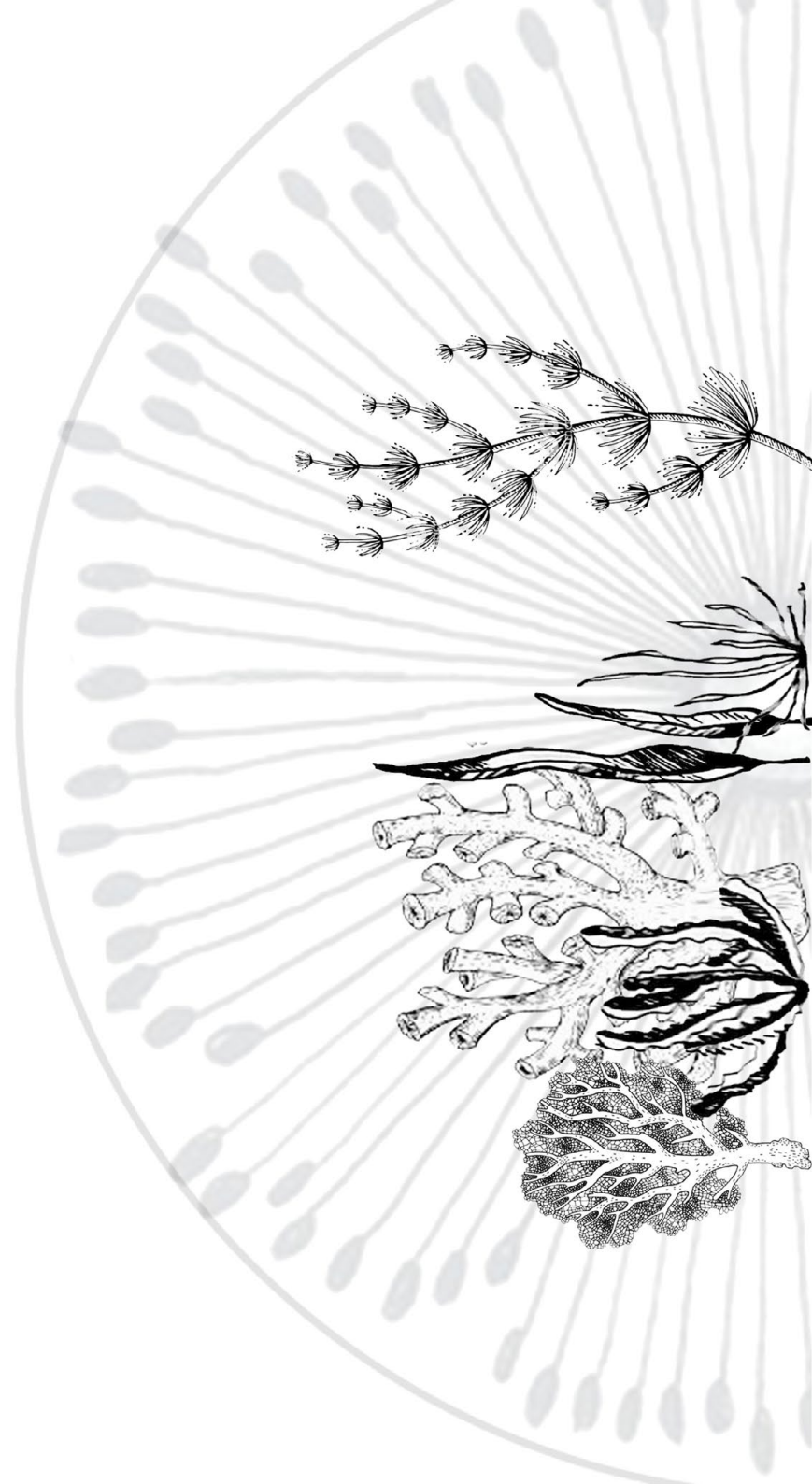
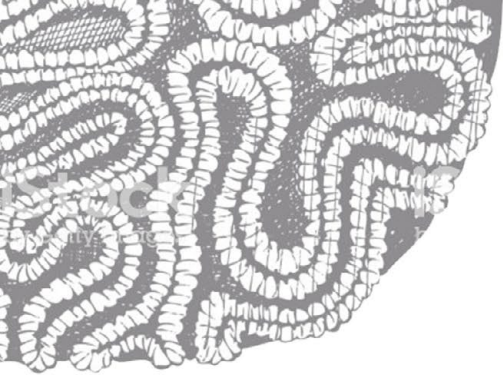


Figure 2 Author, 2020.

# preamble

This dissertation sets out to investigate the role of architecture as a mediator between destruction and growth with specific reference to the global effects of coral bleaching. The basis of this thesis is a personal interest in the effects of coral bleaching and the means of prevention and cure thereof. Coral bleaching events are ever increasing and need to be addressed. Oceans are one of our main sources of life and need to be preserved and protected.

In order to explore the means of architecture as a mediator between land and sea, I propose a Coral Reef Nursery and Rehabilitation centre in the Tsitsikamma National Park in the Eastern Cape, South Africa. Additionally, supplementary amenities of a restored restaurant, an aquarium and a re-established diving school are proposed.

This dissertation will start by introducing the proposed site and its relation to the imminent threats of coral bleaching (Part 01), after research and further explorations (Part 02) this dissertation will propose a final design (Part 03) followed by a full evaluation of the process and findings (Part 04).

# glossary

---

## **Coral bleaching**

When water is too warm, corals will expel an algae living in their tissues causing the coral to turn completely white.

## **Coral farming**

Coral farming is the process of carefully raising coral fragments and reintroducing mature coral into their original habitat, which has proven beneficial for revitalising the health of a reef community.

## **Ecological**

Relating to or concerned with the relation of living organisms to one another and to their physical surroundings.

## **Herbivore**

An animal that feeds on plants

## **Omnivore**

An animal that feeds on both plant and animal varieties.

## **Symbiotic**

Involving interaction between two different organisms living in close physical association.

## **Spawning**

To release or deposit egg cells.

## **Super-corals**

A coral species that can survive both extreme conditions and rapid changes in their environment

## **Zooxanthellae**

Algae which corals expel during the process of coral bleaching



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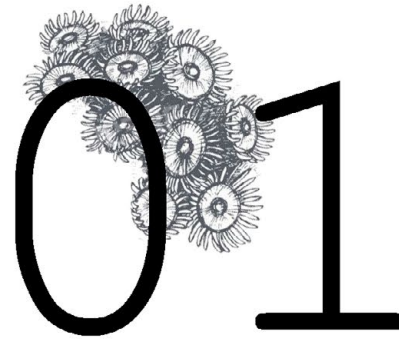
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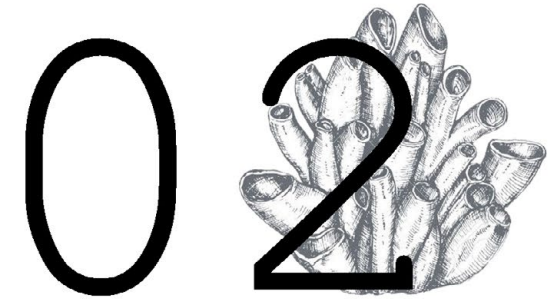
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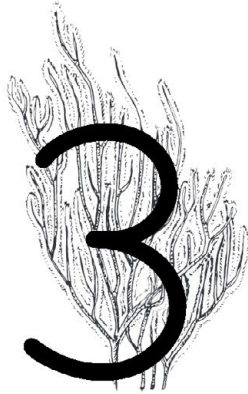
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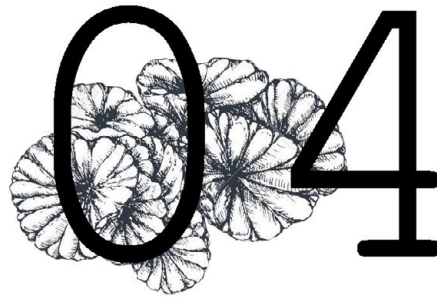
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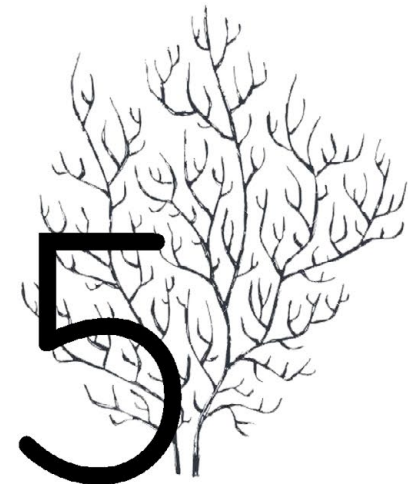
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# 00

## situating the investigation

this part of the document will introduce the reader to the site by means of an introduction as well as the project rationale



# 01 introduction

## 1.1. Why this topic and this site

This thesis aims at raising awareness and creating a centre for research for the future preservation of the Earth's very valuable coral reefs.

Therefore, through research, this project hopes to uncover a better understanding of the current world issue of coral bleaching and investigate ways in which architecture can assist in addressing this issue, specifically along the South African coast-lines.

An investigation into the causes of coral bleaching, which affect coral reefs and as a result, the various bio-diversities associated with such marine life will thus be conducted and implemented into a design proposal. Coral reefs produce two thirds of the Earth's oxygen, whereas trees only produce the latter third.

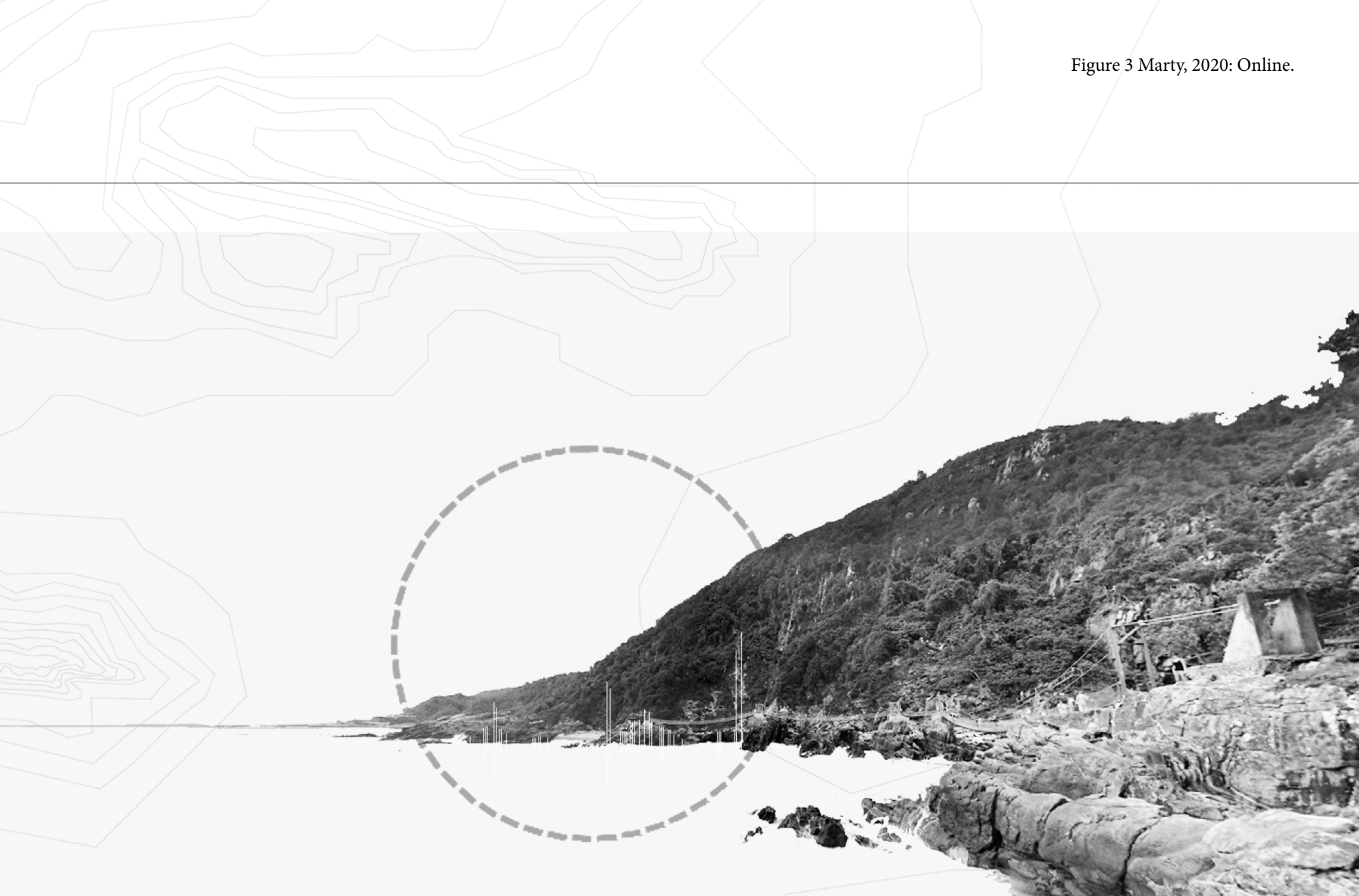
This is a major concern for life on Earth, should the coral reefs be depleted, so too will two thirds of the oxygen.

Thus, a Coral Reef Nursery and Rehabilitation Centre are proposed in the Tsitsikamma National Park, at Stormsrivier Mouth. Here coral can be farmed and transplanted onto bigger reefs, possibly even creating new reefs by means of artificial skeletons that are 3D printed on site. In this way the Earth's marine ecosystem is preserved and oceanic biodiversity is promoted.

Theoretical aspects such as the concept of eco-phenomenology and bio-mimicry are to be investigated and discussed later on.

This poses a problem for which coral farming can offer a solution. However, awareness needs to be raised on the issue as well as on the methods of coral farming and the possible implication thereof, specifically along the South African coast-lines.

Figure 3 Marty, 2020: Online.



# 02 project rationale

## 2.1. What is coral bleaching and why is it important to stop it?

The process of coral bleaching is when corals experience stress due to changes in their surrounding conditions; they expel symbiotic algae, called Zooxanthellae, which live in their tissues, resulting in the corals turning completely white in colour (NOAA, 2017: Online).

The changes in the coral's environment may be in temperature, light or nutrients (NOAA, 2017: Online). Notably, the coral is not dead if it is bleached. Corals can survive these bleaching events, but due to the changing environments they are under continual stress and are therefore subject to mortality (NOAA, 2017: Online).

Coral reefs turn from bright vibrant underwater worlds to desolate grey areas, that are void of life. The death of corals is devastating to the surrounding sea life as coral reefs support extremely biodiverse ecosystems on the planet.

Many marine animals are dependent on coral reefs for survival as they provide shelter to unsuspecting marine life, spawning grounds for fish and protection from predators (Hancock, 2020: Online).

They also support organisms in the ocean that are at the base of the oceanic food chains. Therefore, as these reefs die out, so do the marine ecosystems associated with them. Not only does the death of coral reefs affect marine life, but also human life. Coral bleaching impacts on the human's livelihood, food source security and safety. Coral reefs are natural barriers that absorb the forces of waves and storm surges which keep coastal communities safe (Hancock, 2020: Online). Bleached corals also complex the overfishing crisis by removing vital links in the food web and destroying spawning grounds for certain fish who do so in coral reefs.



In addition to this, unbeknown to most people coral reefs produce two thirds of the earth's oxygen, whereas trees only produce the latter third (Jamail, 2016: Online).

## 2.2. How exactly is it managed?

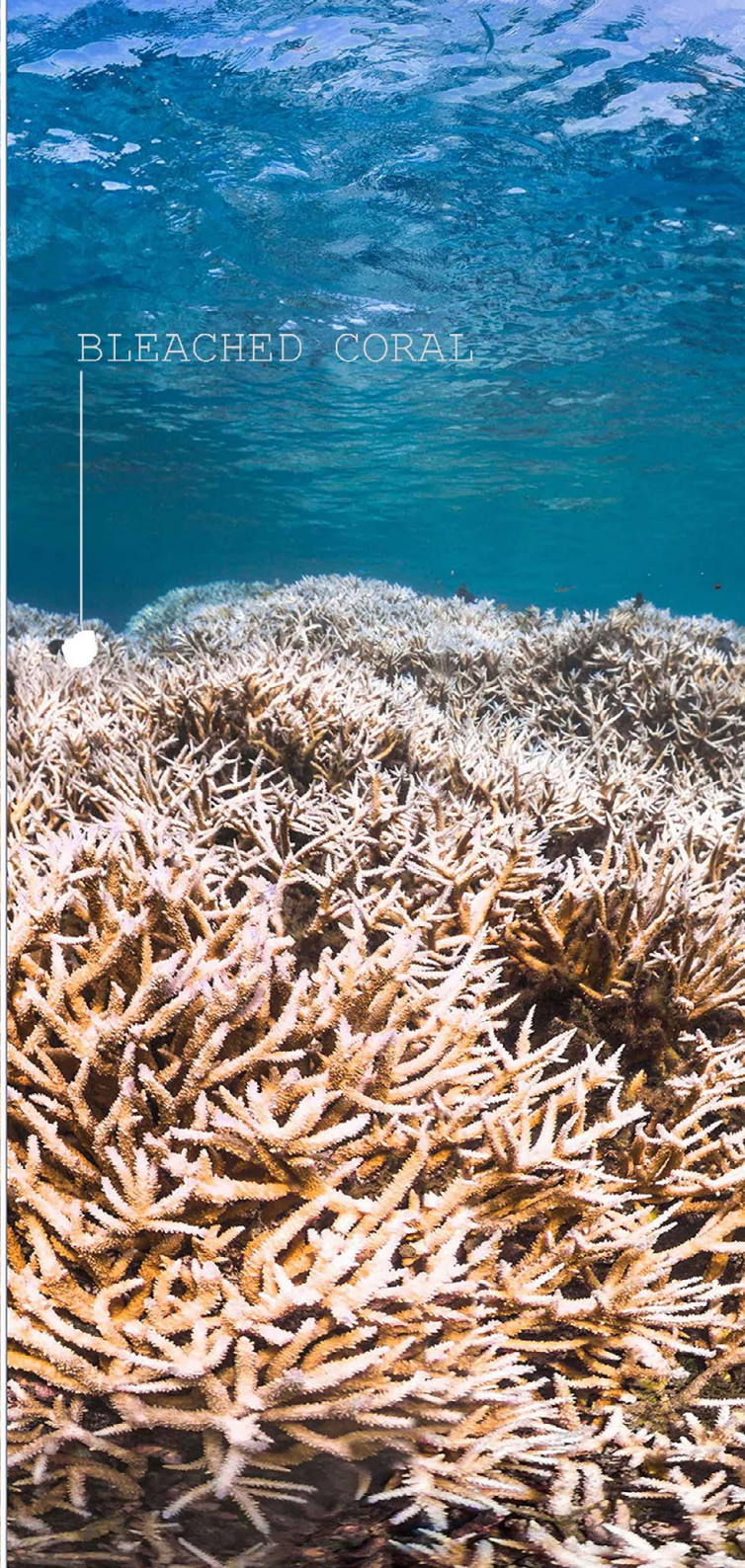
This is, therefore, a grave crisis that needs to be addressed. As afore-mentioned, coral bleaching can occur due to changes in the surroundings around reef's, such as temperature changes, light fluctuations and nutrient deficiencies. Research has been conducted worldwide by the National Oceanic and Atmospheric Administration Fund (NOAA), which studies various coral bleaching sites across the globe. Essentially, field studies are conducted, where corals are monitored and the surroundings recorded.

There is a major need for independent research on coral reefs and how through science we can restore them and breed so-called super corals that are resilient to changes in the environment.

Figure 4 Rosenfield, 2019 : Online.



HEALTHY CORAL



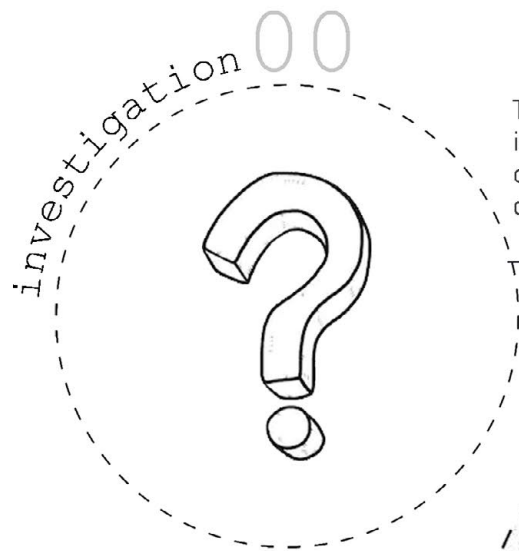
BLEACHED CORAL

Figure 5 XL Catlin Seaview Survey, 2015; Online.

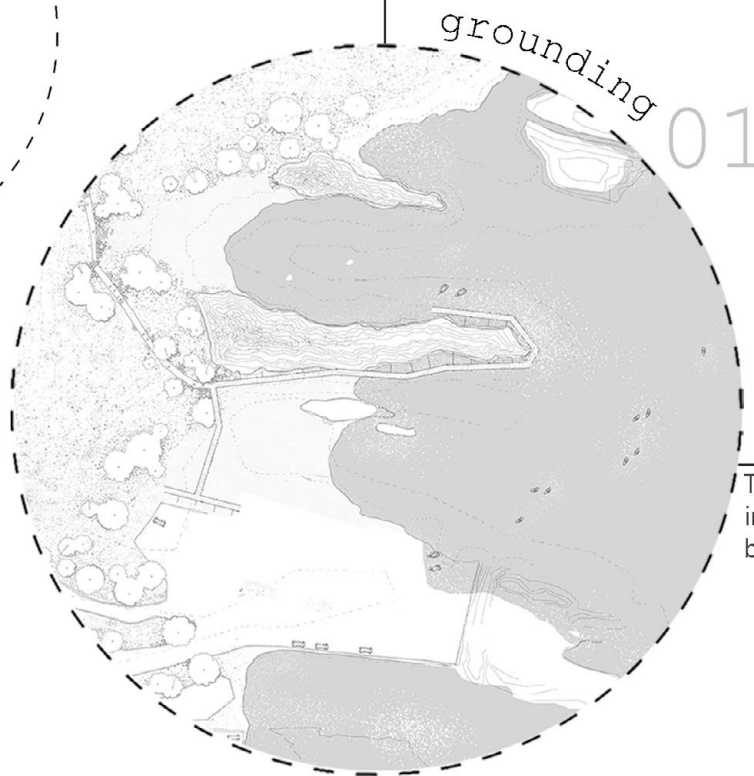


DEAD CORAL

# 03 document framework



This part of the document will introduce the reader to the clients, users and the general dilineation of the study



This part of the document will introduce the reader to the site by means of a site analysis

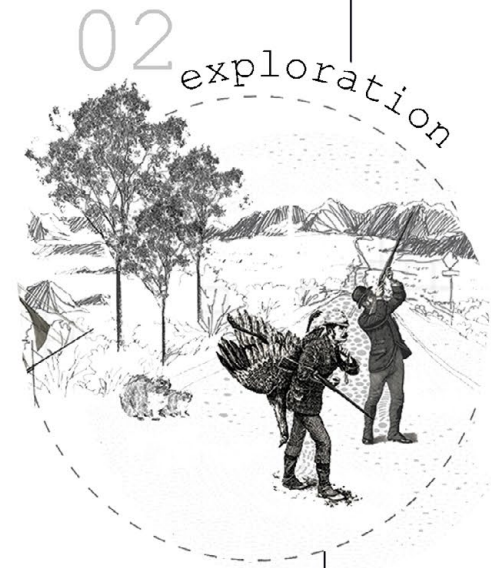
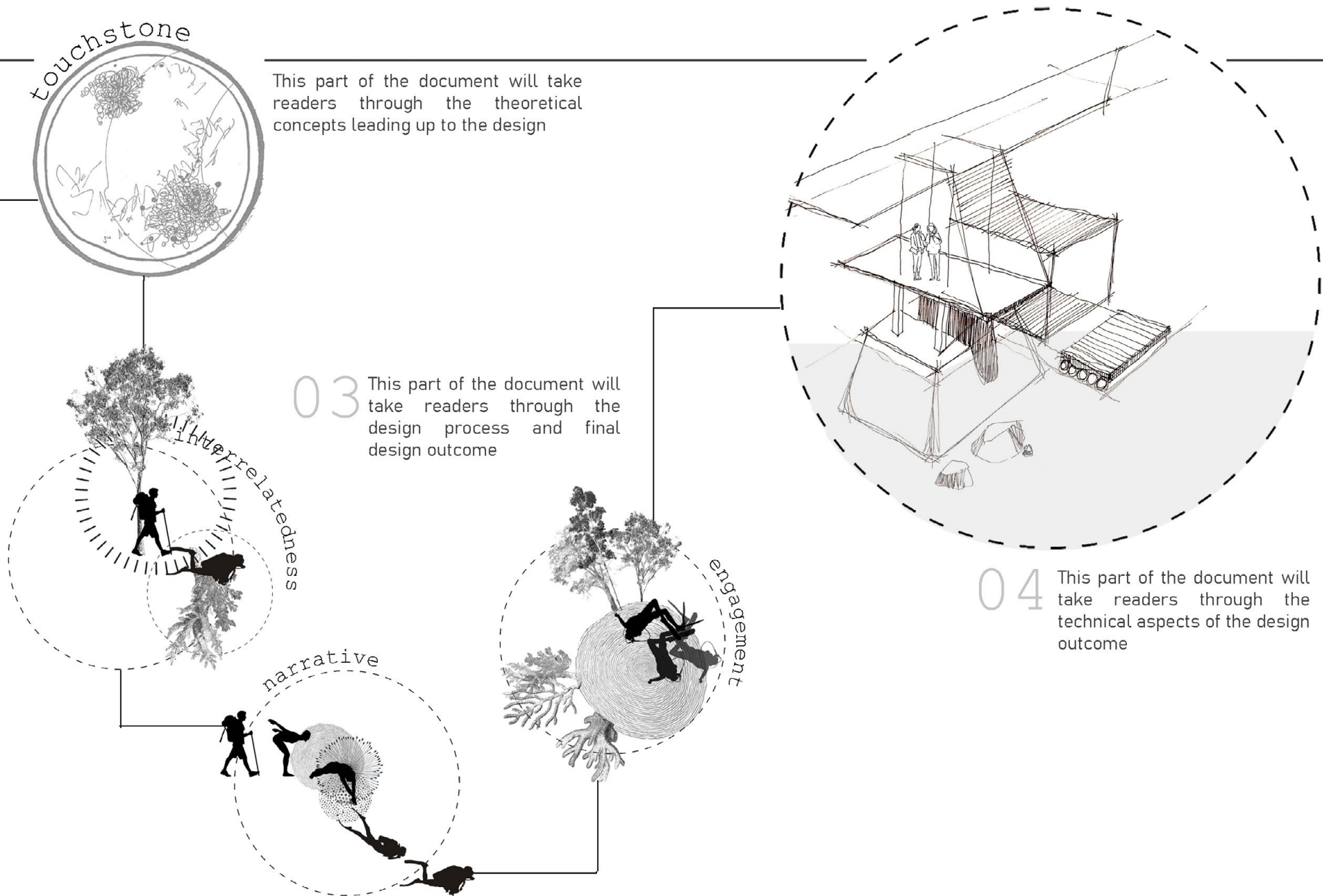


Figure 6 Author, 2020.







# 01 grounding

this part of the document will introduce the reader to the clients, users and the proposed site



# 01 problem statements and aims

## 1.1. Problem statements

Coral bleaching is an ever-growing issue affecting our marine ecosystems worldwide. These events of disturbance in nature are linked to overfishing, global warming and pollution, which all play a role.

If research is not done to alleviate the stresses on corals causing these mass bleaching events all corals will likely be extinct by 2050 (Zeitvogel, 2011: Online).

This is a problem that reaches far beyond just the tourist aspects associated with diving among these magnificent reefs.

It is estimated that approximately 4000 fish species and about 25% of marine life are dependent on the existence of coral reefs (Gibbens, 2020: Online). Making their preservation of vital importance for oceanic biodiversity and the overall health of our oceans.

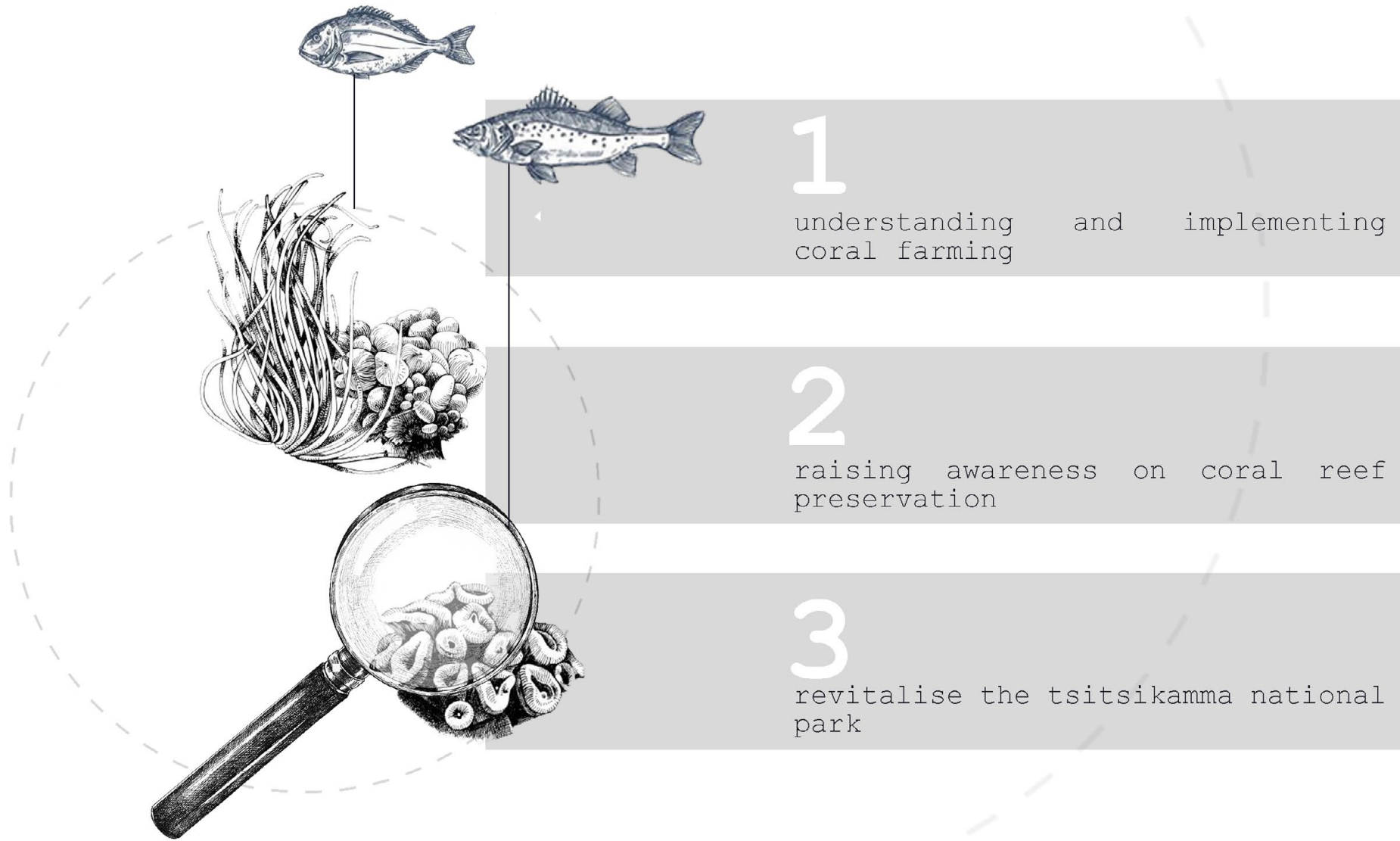
## 1.2. Project aims

Therefore, this project aims at investigating the current concern of coral bleaching, which affects corals reefs and as a result, the various bio diversities associated with such marine life.

The coral bleaching events pose a problem for which research and the process of coral farming can offer a solution.

However, awareness needs to be raised on the issue as well as the methods of coral farming and the possible implication thereof, specifically along the South African coast lines. Architecture can contribute to raising awareness on the topic by the introduction of amenities in various National Parks along the coastline.

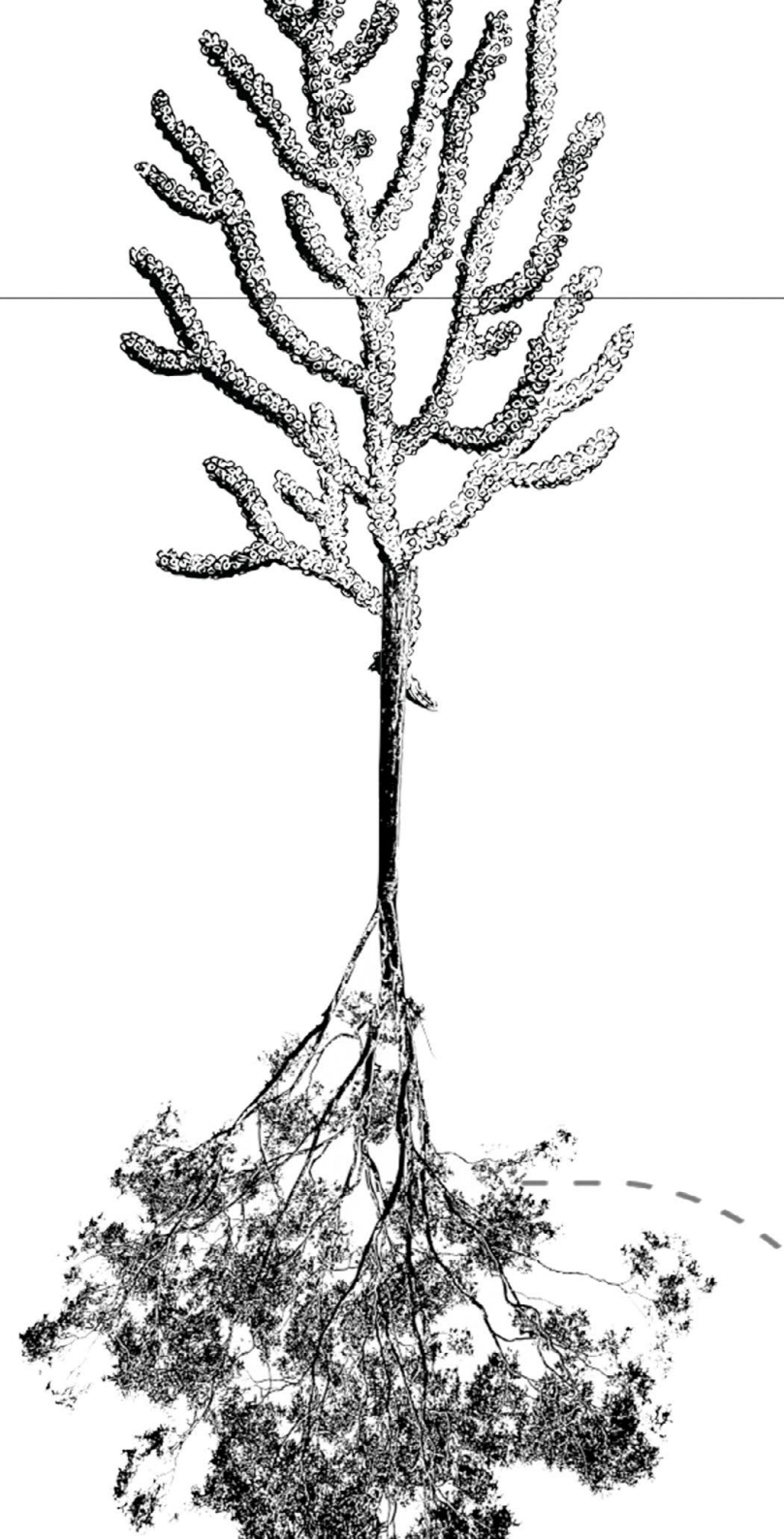
These amenities can range from small scale aquariums to coral reef farming laboratories which may act as tourist attractions, and as a result raise awareness on the issue of coral bleaching.



## 02 research question

how can an architectural intervention act as the mediator between land and sea, as well as between destruction and growth in relation to coral bleaching?

This research question investigates how architectural interventions can act as a mediator in the natural landscape. The question aims to prompt design concepts and initiate the design process.



## 3.1. Coral Reef Conservation Program

This project is a proposal for the Coral Reef Conservation Program, who helps develop the biodiversity of marine ecosystems worldwide. The program has sites across the world that have been studied and the dying coral reefs restored.

In 2018 alone, the program transplanted 26 000 coral specimens, which created a marine protected area of approximately 629 hectares, while creating 15 local jobs on their site in Indonesia.

The program studies the coral reefs, harvesting specimens and studying them, and then growing new resilient coral specimens. These specimens are then transplanted onto artificial reefs, growing the size of the marine protected areas, in this way creating architectural complexity in the ecosystems and ensuring the preservation of very valuable coral reefs.

This proposal will act as the South African branch in the research, preservation and restoration of coral reefs along South African coast lines.

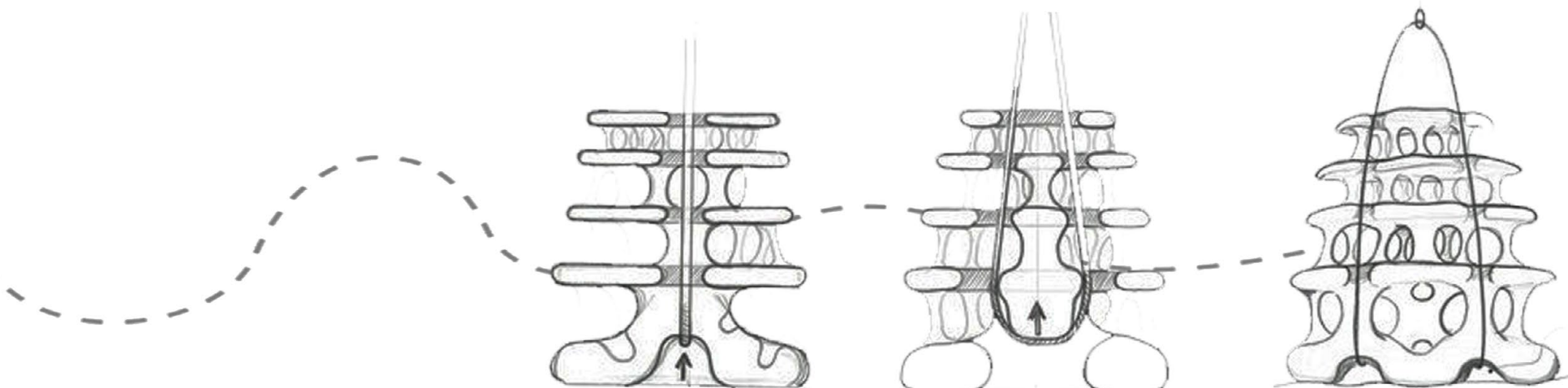


Figure 9 Goad, 2015: Online.

# 04 user analysis

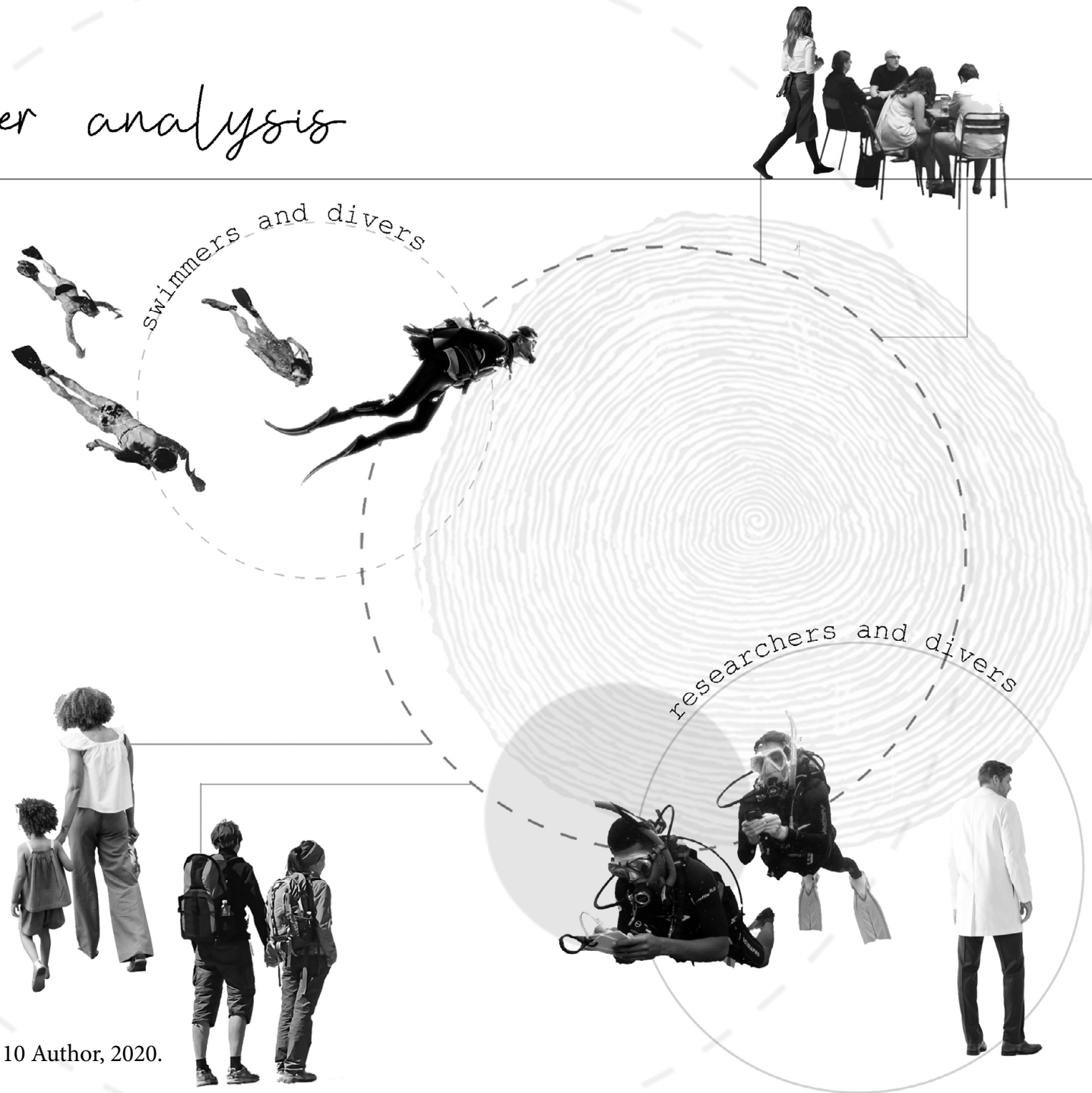


Figure 10 Author, 2020.

This project has various users that range from daily users to seasonal users. Essentially, the users can be divided into three categories; firstly visitors, who would visit the visitors centre, restaurant and diving training facility. Secondly, the support staff, who are employed in the restaurant and diving training facility. Lastly, the more permanent staff who work in the research laboratories and go out on diving excursions.

#### seasonal users

These users are visitors to the Tsitsikamma Nature Reserve who visit the Coral Rehabilitation visitors centre and restaurant. They could be hikers stopping by, visitors centre specific users or visitors who make use of the diving training facility.

#### support staff users

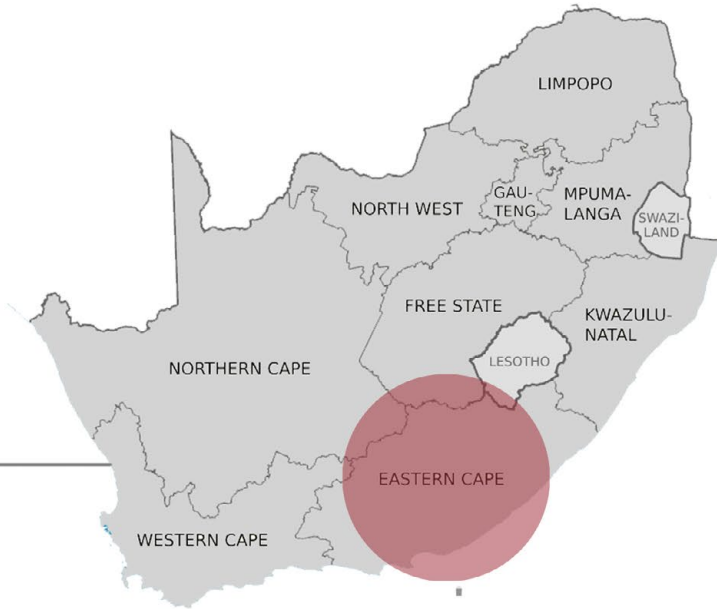
These users are support staff employed by the Tsitsikamma Nature Reserve. These staff members range from cleaners, restaurant staff and, diving instructors to the park ranger.

#### permanent staff users

These users are classified as permanent staff members and refer to the scientists and researchers that make use of the amenities provided to research and document the corals of the area. These users also include divers who transplant and harvest coral specimens.



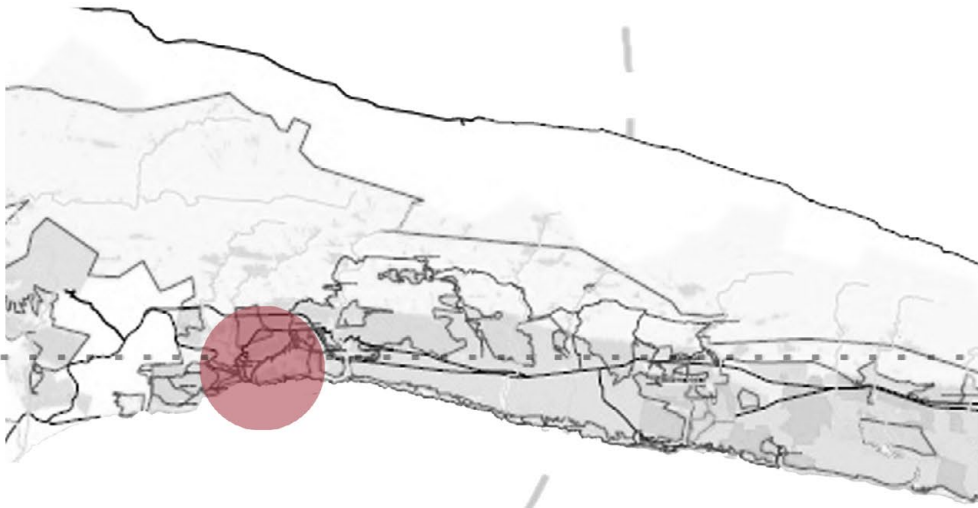
# 05 the site



SOUTH AFRICA

EASTERN CAPE

TSITSIKAMA  
NATIONAL PARK



STORMSRIVER  
MOUTH

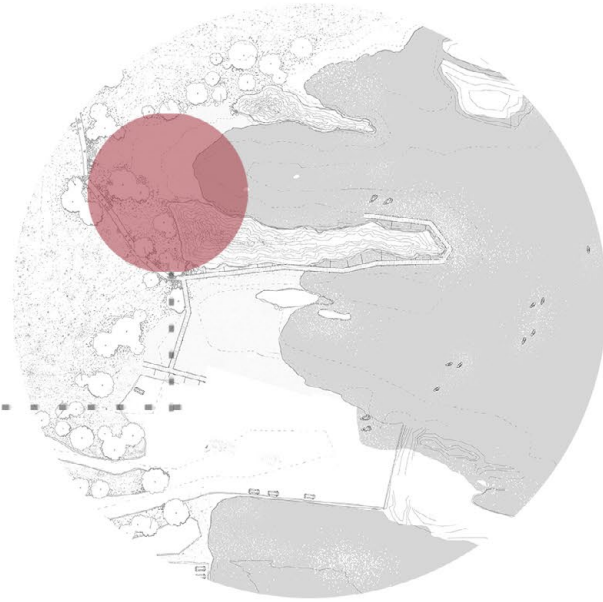


Figure 11 Author, 2020. 33

## 5.1. Why the Tsitsikamma National Park?

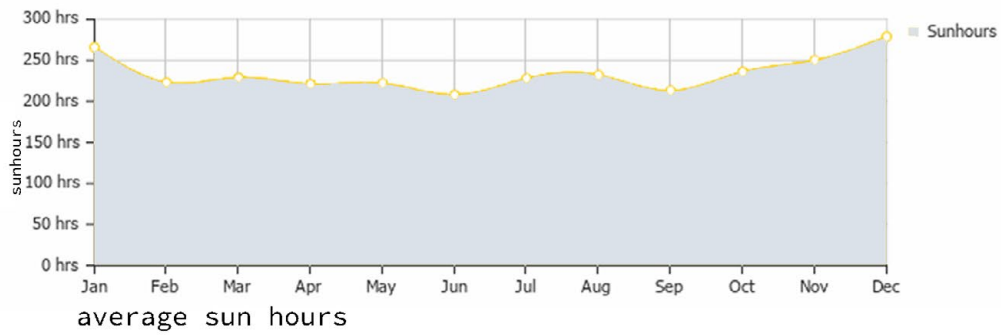
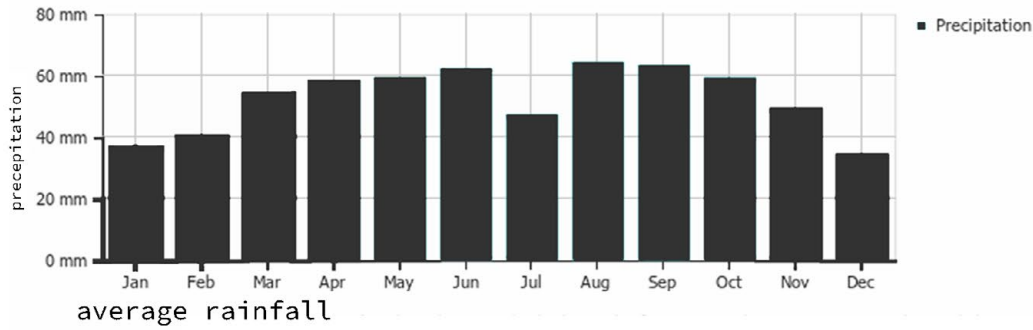
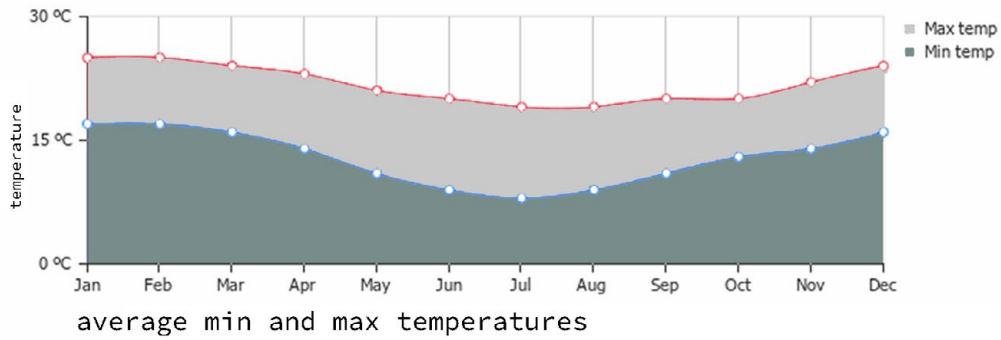
The Tsitsikamma National Park is part of the Garden Route National Park along South Africa's coastline. The reserve at Storms River mouth borders the Indian Ocean and is home to stunning coastal scenery, rivers, lush forests and importantly in this case coral reefs. The boundary of the Tsitsikamma National Park stretches about 5km out into the Indian Ocean, protecting within this radius, the inter-tidal life, reefs and deep-sea life. Within this boundary at Storms River mouth, are scuba and snorkelling trails where visitors can view the wonderful underwater world. However, in 2018 Untouched Adventures, an outdoor adventure centre in the reserve stopped offering guided tours to these reefs. In addition to this, the area has been classified by Allan Coral Atlas as an area to be watched for possible coral bleaching. The proposed site is situated along the Mouth hiking trail which ends up at the infamous suspension bridge. This hiking route is about a kilometre long and takes roughly an hour to complete.

The site is within close proximity to the Untouched Adventures facility, and the scuba and snorkelling trails. The area is home to a variety of lush vegetation that surrounds the site. In fact, the site is tucked away in the thick vegetation almost in the form of what could be seen as a so-called "private beach", which makes the site suitable in terms of privacy. This private beach is referred to as Mooibaai in the area.

The motivating factor of the site choice relating to coral, is that the coral reefs in the Tsitsikamma area have been classified as areas to be watched for coral bleaching by Allan Coral Atlas.

Naturally, prevention is better than cure and this area, specifically with relation to its water temperatures makes for a suitable site for scientific research and preservation studies.





3 6 Figure 13 Meteoblue, 2020: Online.

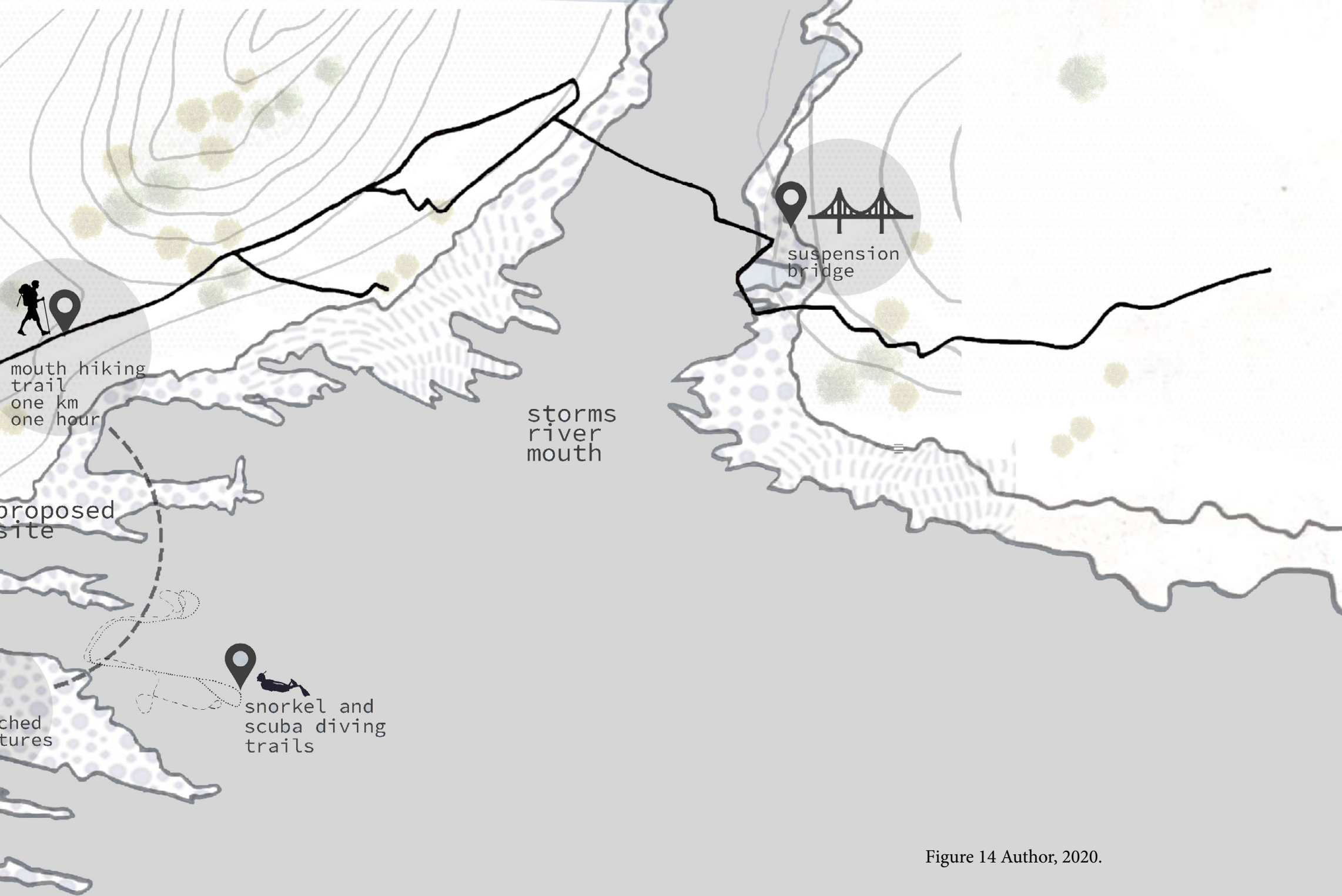


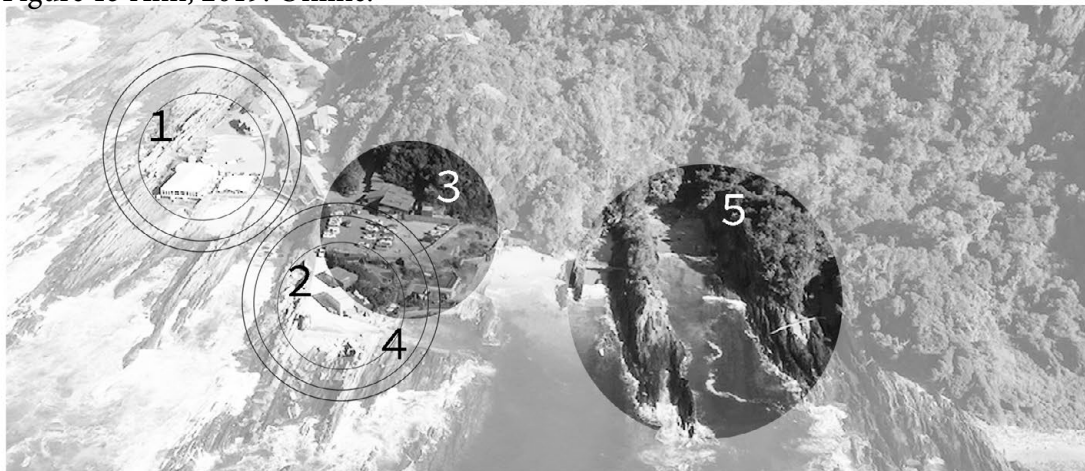
Figure 14 Author, 2020.

# 06 the current state of the site

The site has become rather run down after the restaurant burnt down in 2016. The fire destroyed the restaurant (3), however the devastation stretched even further, affecting local farmers who supplied produce used in the kitchen of the restaurant (Spies, 2016: Online). Currently, the site houses camping grounds and camping cottages as well as a make shift restaurant (1).

The Untouched Adventures outdoor adventure tourist attraction (2) is also on site, from which diving and canoe excursions through the National Park depart (4). However, along with the devastation of the restaurant, diving excursions also came to a halt. A major tourist attraction in the National Park is the Mooibaai Private beach (5) where visitors often go swimming.

Figure 15 Ann, 2019: Online.



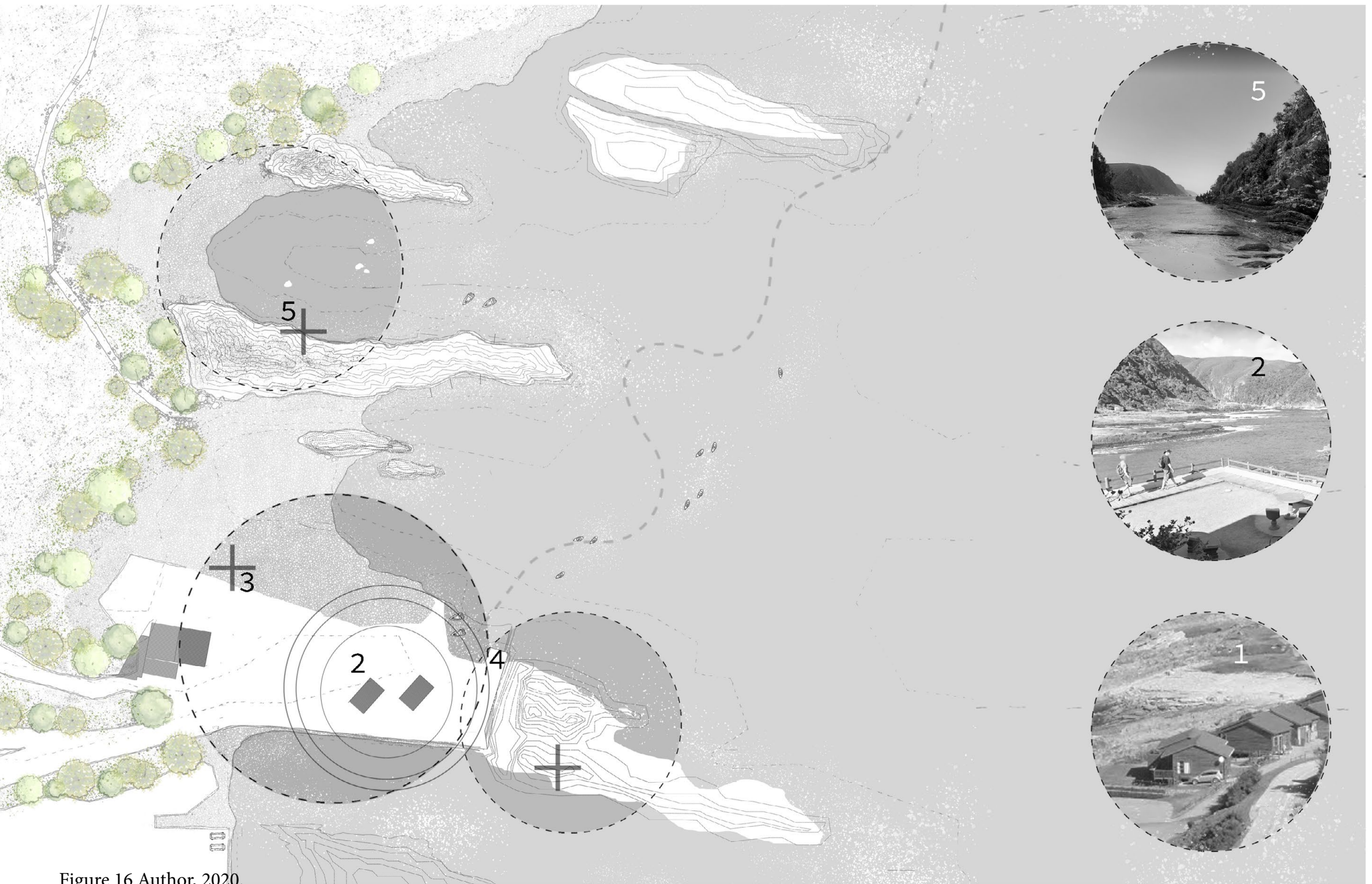


Figure 16 Author, 2020.

## Mooibaai beach

Figure 18 Cordula, 2019: Online.



## Restaurant ruins

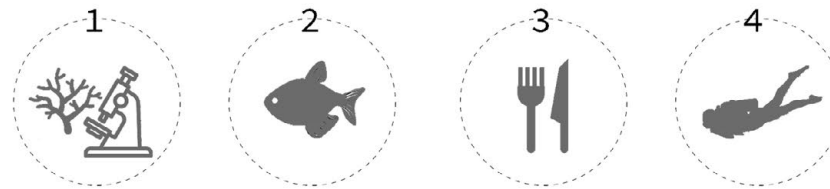
Figure 18 Jayne, 2017: Online.





# 07 proposed amenities

Figure 19 Spies, 2017: Online.



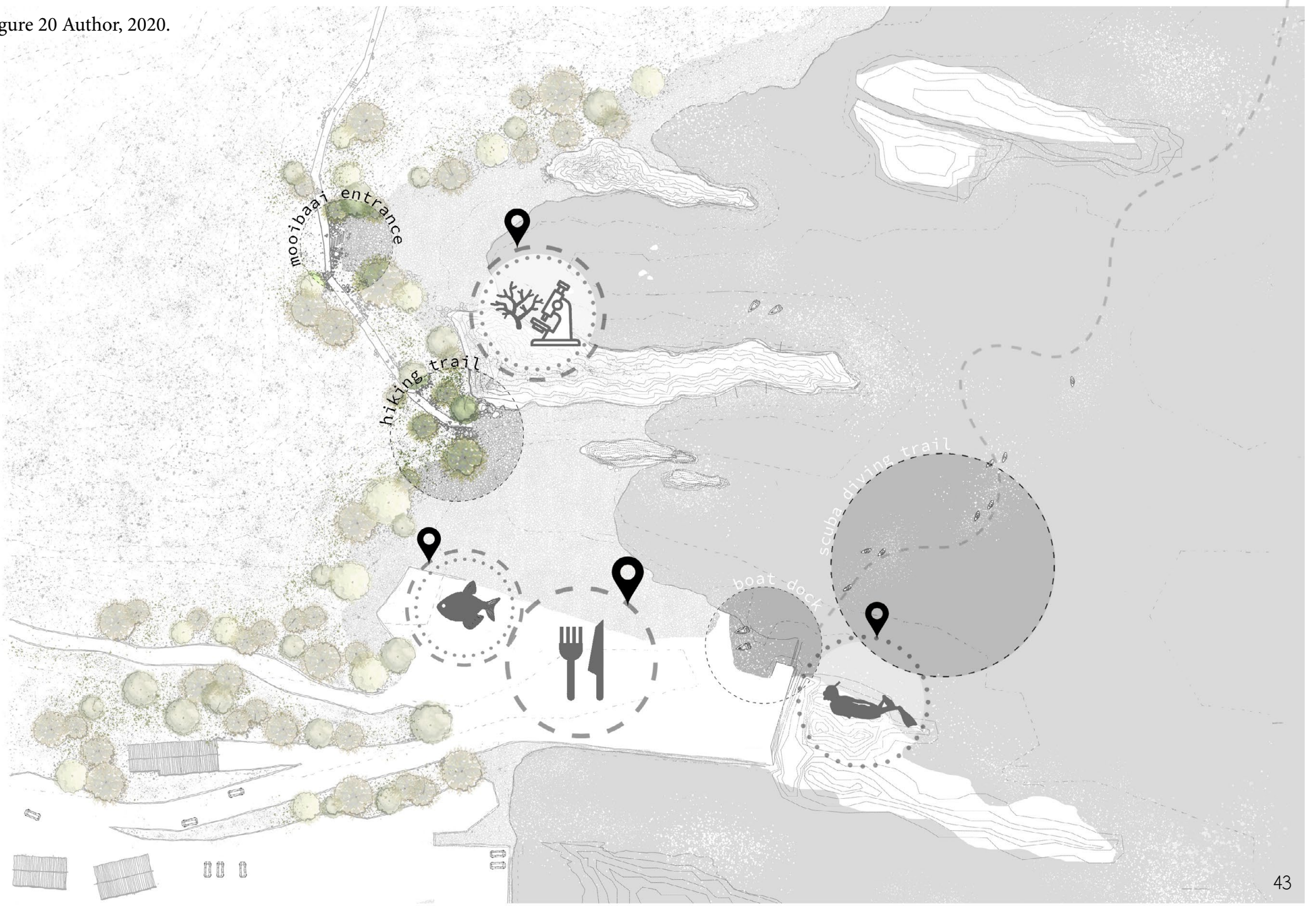
Firsly, a Coral Reef Nursery and Rehabilitation centre (1) is proposed in the Mooibaai beach. This laboratory will house a variety of functions to promote coral reef farming and reef restoration.

Inorder to reinstill the flow of tourists a restaurant (3) is proposed on the ruin site of the previously burnt down restaurant. Underneath this restaurant an Aquarium (2) will futher prompt tourists to visit the site.

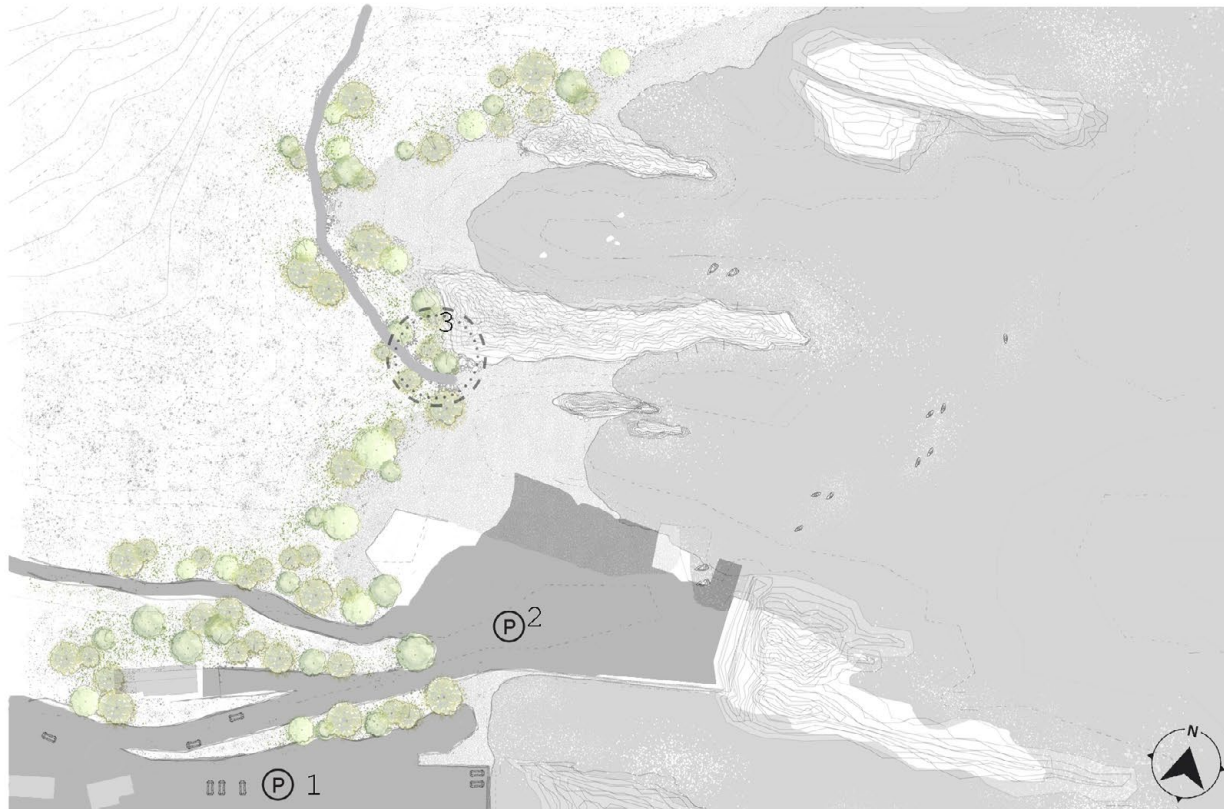
Due to the various events of disturbance as afore mentioned, the diving school, managed by Untouched Adventures, stopped offering diving courses and a diving school is proposed on site (4).

The proposal of these amenities will hopefully revive the devastated site and prompt new tourist flow in the National Park.

Figure 20 Author, 2020.



# 08 site analysis



## TRAILS AND ROADS

### ACCESS ROUTES

Currently, the site has a parking lot to the South for the current make shift tent restaurant (1), as well as the old restaurant ruin site which has been

flattened and used as parking (2) for beach goers and hikers. Access to the Mountain hiking trail leading to the suspension bridge can also be seen (3).



## EXISTING STRUCTURES AND

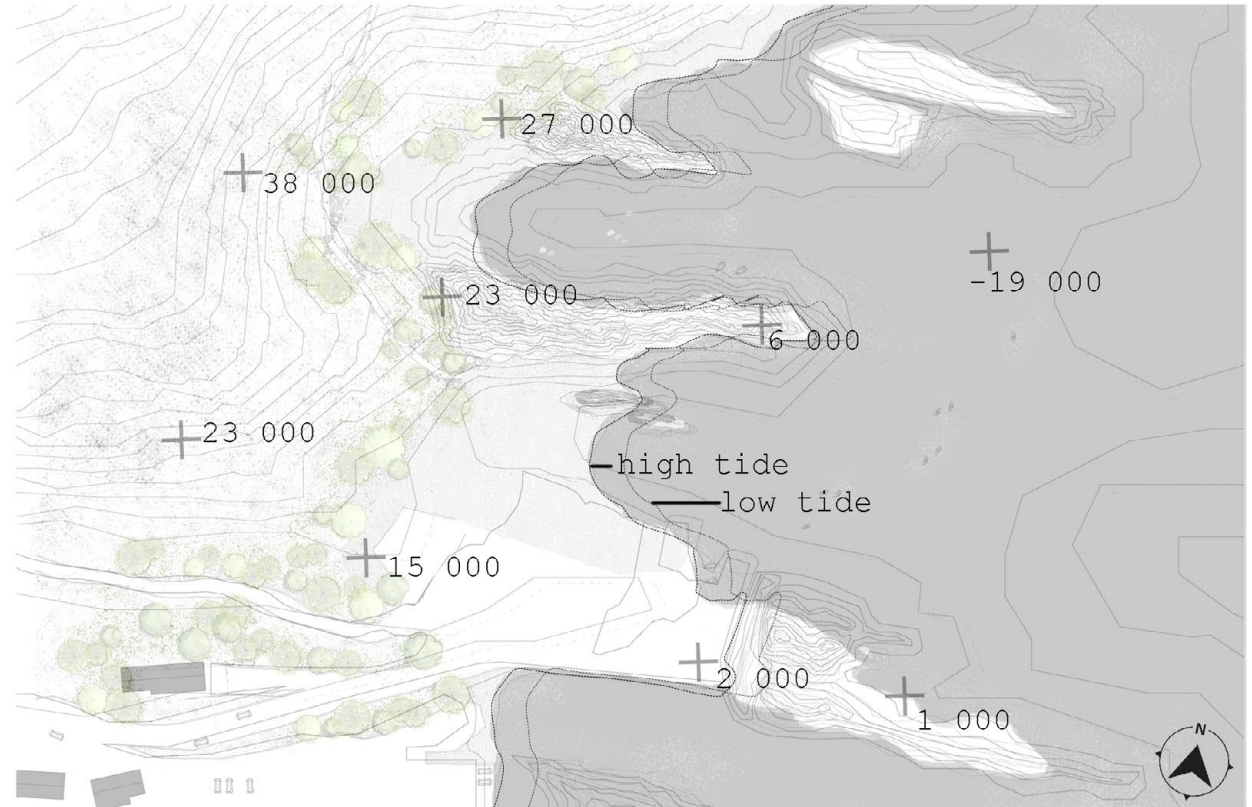
### STRUCTURE

In close range to the proposed site is a curio shop (1) and further South are camping cottages (2). The squared off



PROPOSED NEW SITE LAYOUT

areas on the site plan indicate the areas for development with the introduction of a restaurant (3), diving school (4) and coral reef research laboratory (5).

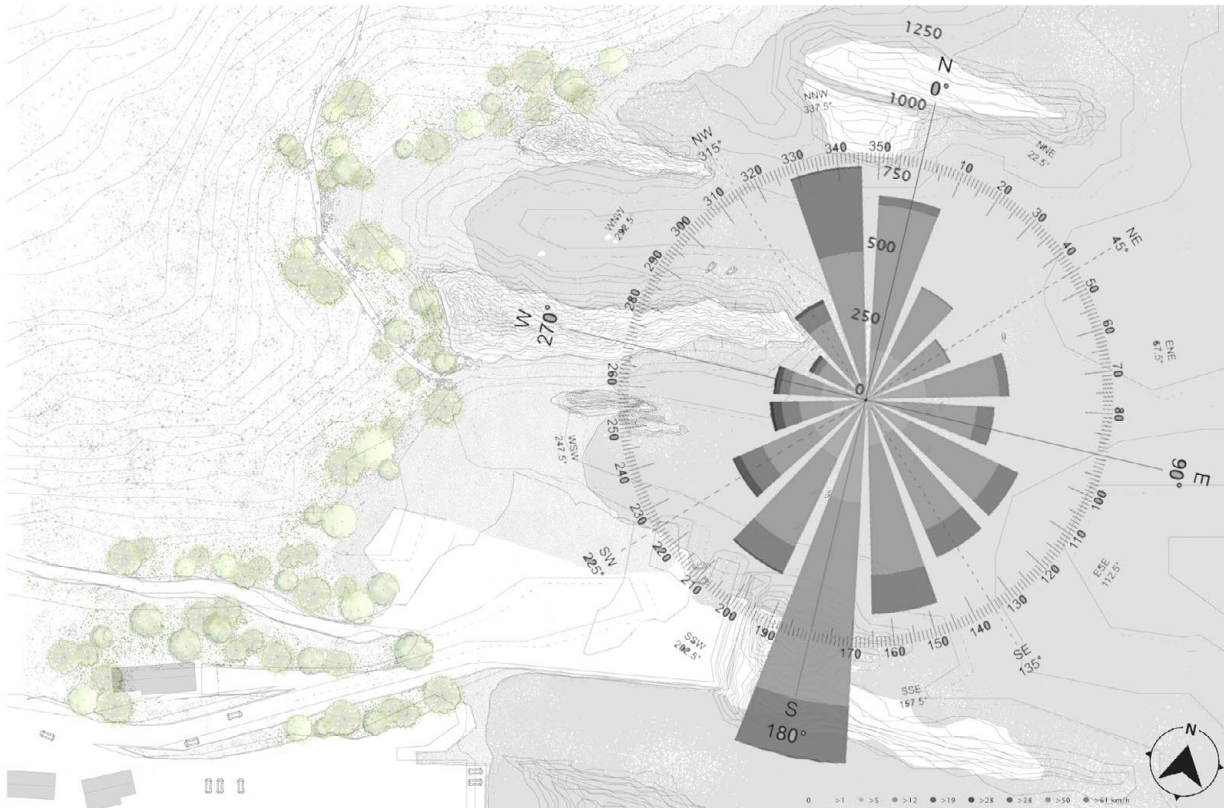


POINT HEIGHTS AND WATERLINE

TOPOGRAPHY

The site ranges from a high mountain to the West reaching up to 86m and the ocean reaching depths of up to 40m. The various heights of rock outcrops

and level differences are shown on the site plan above.

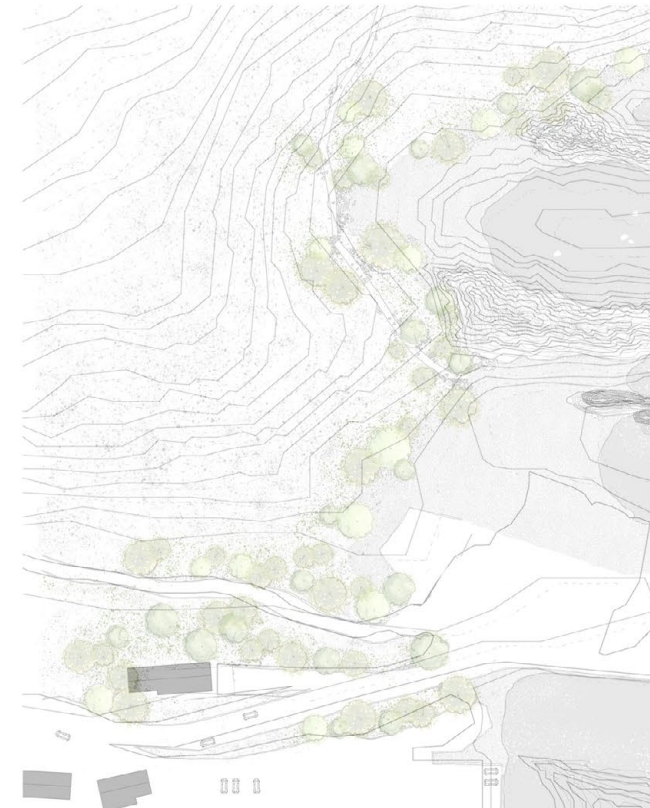


## ANNUAL WIND PATTERNS

### CLIMATE

The wind rose for Tsitsikamma National Park shows how many hours per year the wind blows from the indicated direction. Example SW: Wind is blowing

from South-West (SW) to North-East (NE). It can be seen that strong winds prevail from the South towards the site.

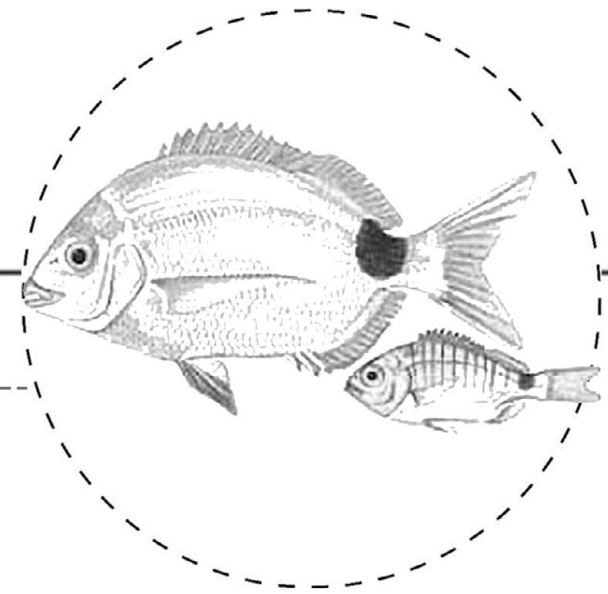


## DIVING AND SCUBA TRAIL

### MARINE PROTECTED AREAS

The Tsitsikamma National Park as a whole is a marine and forest protected area, specifically with regards to overfishing,

Figure 24-25 Author, 2020.



The inshore fish stocks in the Tsitsikamma National Park are managed and monitored by The South African Industry for Aquatic Biodiversity (SAIAB). Approximately 80% of the line fish species in the area are slow-growing, long-lived and have a high degree of residency in the area (SANPARKS, 2009: Online). Putting these species at risk or making them vulnerable to the exploitation of over-fishing. This creates the need for a safe and flourishing environment for the marine life as top priority for protection and preservation.

SAIAB conducts annual visits to the Tsitsikamma National Park, visiting various sites and collecting data on a variety of fields, including the marine life; fire management within the park; plant life and the overall biodiversity within the park. Stipulating what measures need to be taken to ensure the upkeep and growth of the national park.

and is part of the management of shore-angling fish along the South-Eastern Cape coast line (Cowley, 2010: Online).

To the right a typical data table can be seen which captures the data pertaining to fishing in the National Park.

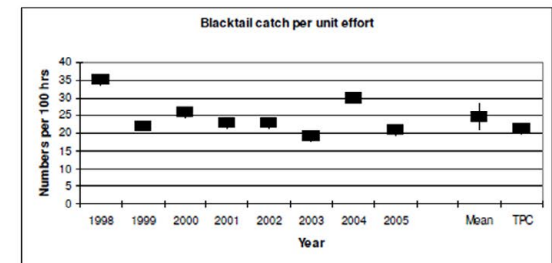




Figure 27 Cordula, 2019: Online.



Figure 28 Untouched Adventures, 2020: Online.



Figure 29 Ann, 2019: Online.



Figure 30 Google maps, 2020: Online.



Figure 31 Gaelyn, 2013: Online.



Figure 32 Untouched Adventures, 2020: Online.

Figure 33 Google Maps, 2020: Online.



Tsitsikamma National Park boasts stunning ocean views, lush forests and fynbos amongst the rocky outcrops and cliffs along the shoreline. The vegetation within the national park can be divided into three main categories: Terrestrial vegetation, semi-aquatic flora and aquatic plants.

The terrestrial vegetation of the area is found in the wet mountain forest, in steep kloofs and the coastal plateau. Topographical features that are typical of the Storms river mouth area. The vegetation consists of a variety of trees such as the *Searsia Chirindensis*, *Diospyros Whyteana* and the infamous *Celtis Africana* tree commonly known as a stinkwood tree.

In addition to the lush variety of tree species, there are also many variants of fynbos in the area, such as: short Asteraceae fynbos which is usually found close to the shoreline; and tall fynbos, usually found further inland. Semi-aquatic flora are plants that are found in low-lying areas adjacent to lakes and channels, including reeds, sedges and bulrushes (SANPARKS, 2009: Online).

ALOE  
SUCCOTRINA

SEARSIA  
CHIRINDENSIS

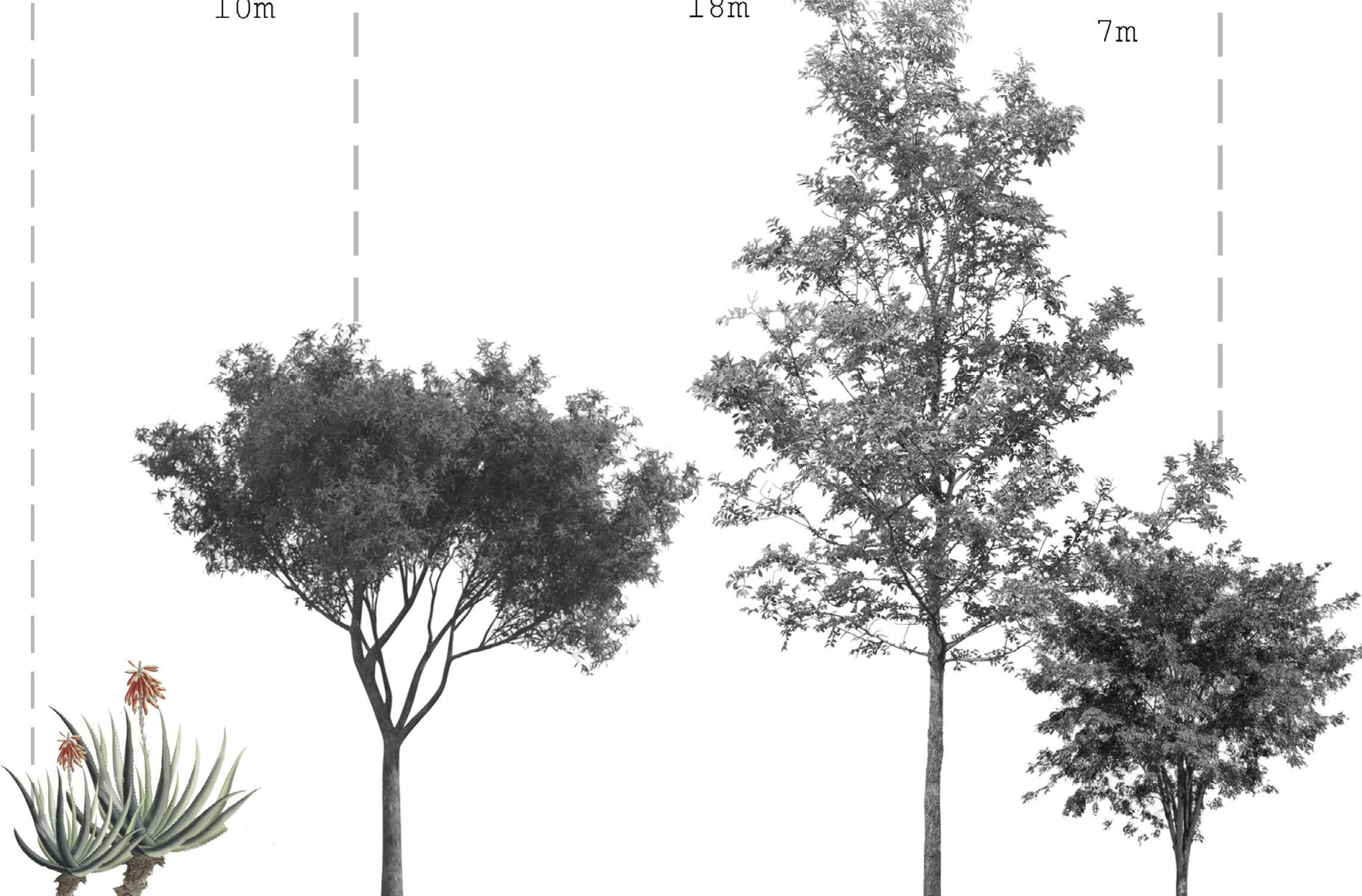
CELTIS  
AFRICANA

DIOSPYROS  
WHYTEANA

SA tree no 380  
10m

SA tree no 39  
18m

SA tree no 611  
7m



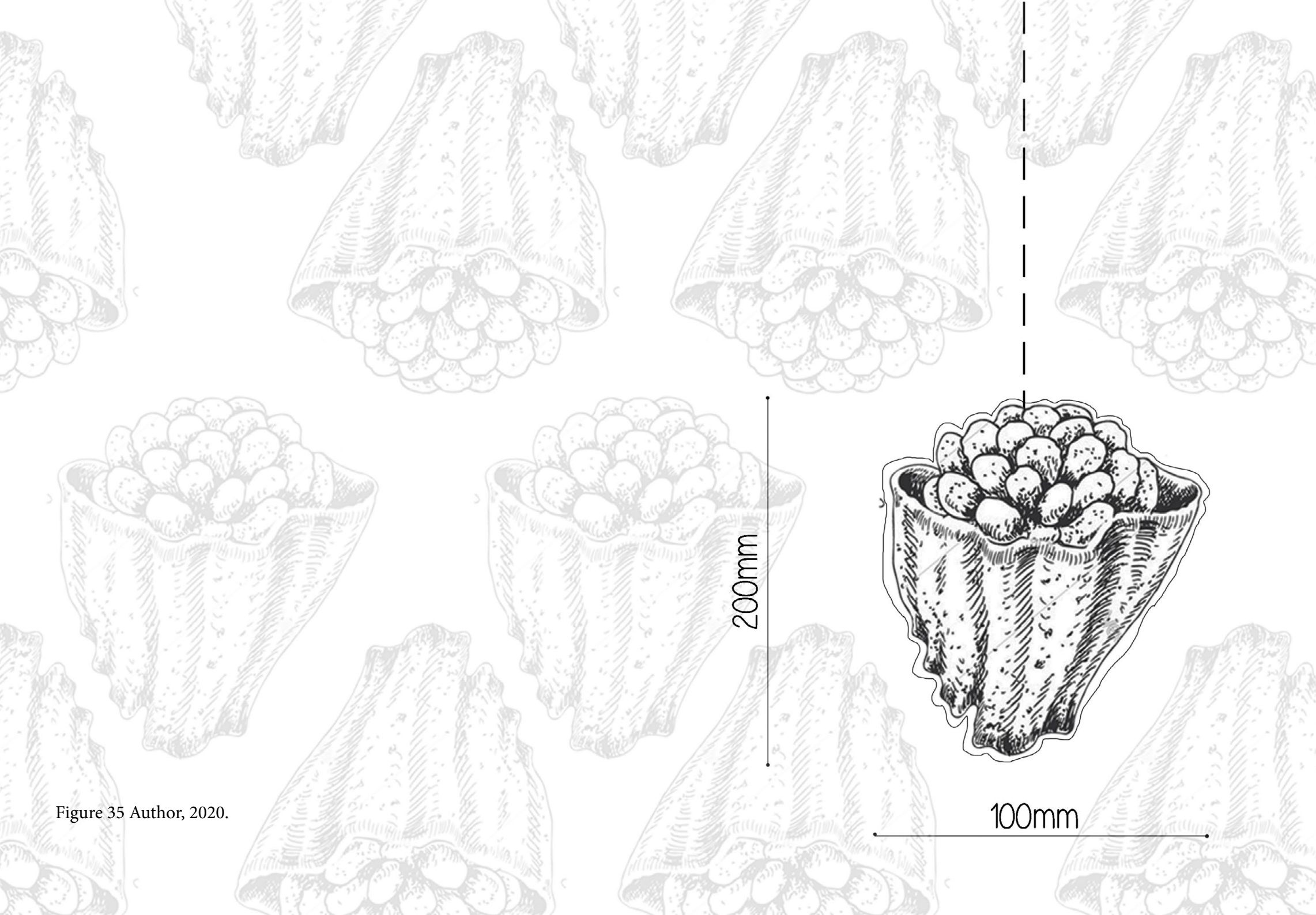


Figure 35 Author, 2020.

100mm

200mm

# 09 Types of corals in the Tsitsikamma area

## SYCOZOA ARBORENSCENS

SOCIAL FAN ASCIDIAN

### SHORT DESCRIPTION:

FAN-SHAPED AND LATERALLY FLATTENED ARRANGED  
IN VERTICAL ROWS

### SIZE:

200MM HIGH, 100MM IN DIAMETER

The *Sycozoa Arborensens*, also known as the Social Fan Ascidian is a type of coral species that grows in fan shaped colonies. Their colonies are laterally flat in nature and occur in vertical rows. Several lobes of these corals can grow from a common base (Jones, 2020: Online).

The colours of this type of coral varies from bright oranges, and deep blues to light hues of pink. This coral grows on vertical rock-faces with a strong water flow and can grow in depths of up 30m beneath the ocean's surface.

Care level:  
Difficult

Diet:  
Filterfeeder

Minimum tank size:  
340L

Temp:  
22-25°C

PH level:  
8.1-8.4

## PARECHINUS ANGULOSUS

CAPE URCHIN

### SHORT DESCRIPTION:

ROUND, DENSELY COVERED IN SHORTISH POINTED SPINES WHICH VARY IN LENGTH

### SIZE:

60MM

**Parechinus angulosus, commonly known as Cape Sea urchins, live in vast numbers on shallow reefs, feeding off kelp and algal debris. These sea urchins provide valuable protection to reefs and other oceanic species such as abalone or perlemoen (Unknown, 2020: Online). This is due to the prickly nature of sea urchins which acts as a defence mechanism to predators in the ocean.**

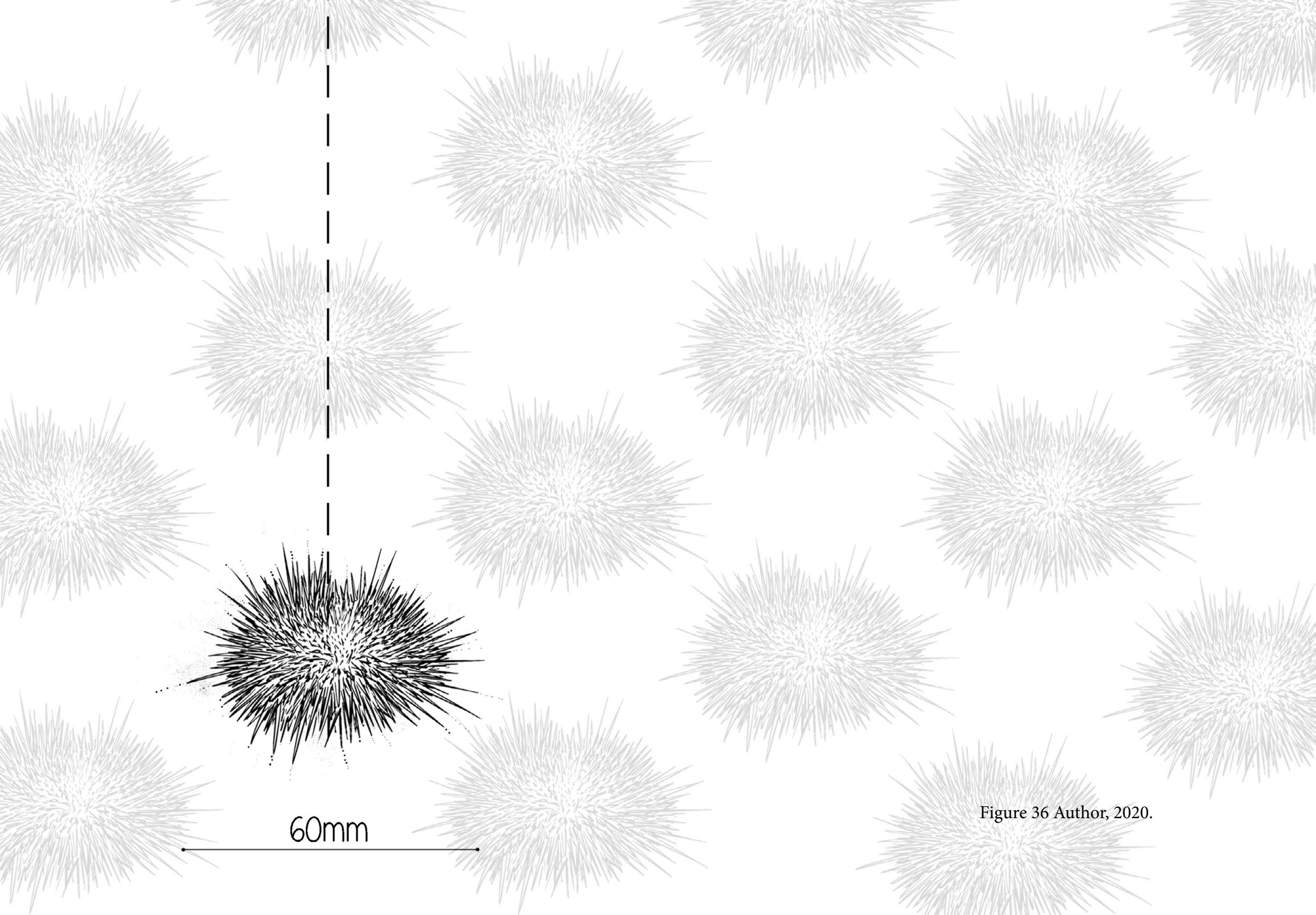
**Care level:  
Moderate**

**Diet:  
Herbivore**

**Minimum tank size:  
38L**

**Temp:  
22-25°C**

**PH level:  
8.1-8.4**



60mm

Figure 36 Author, 2020.

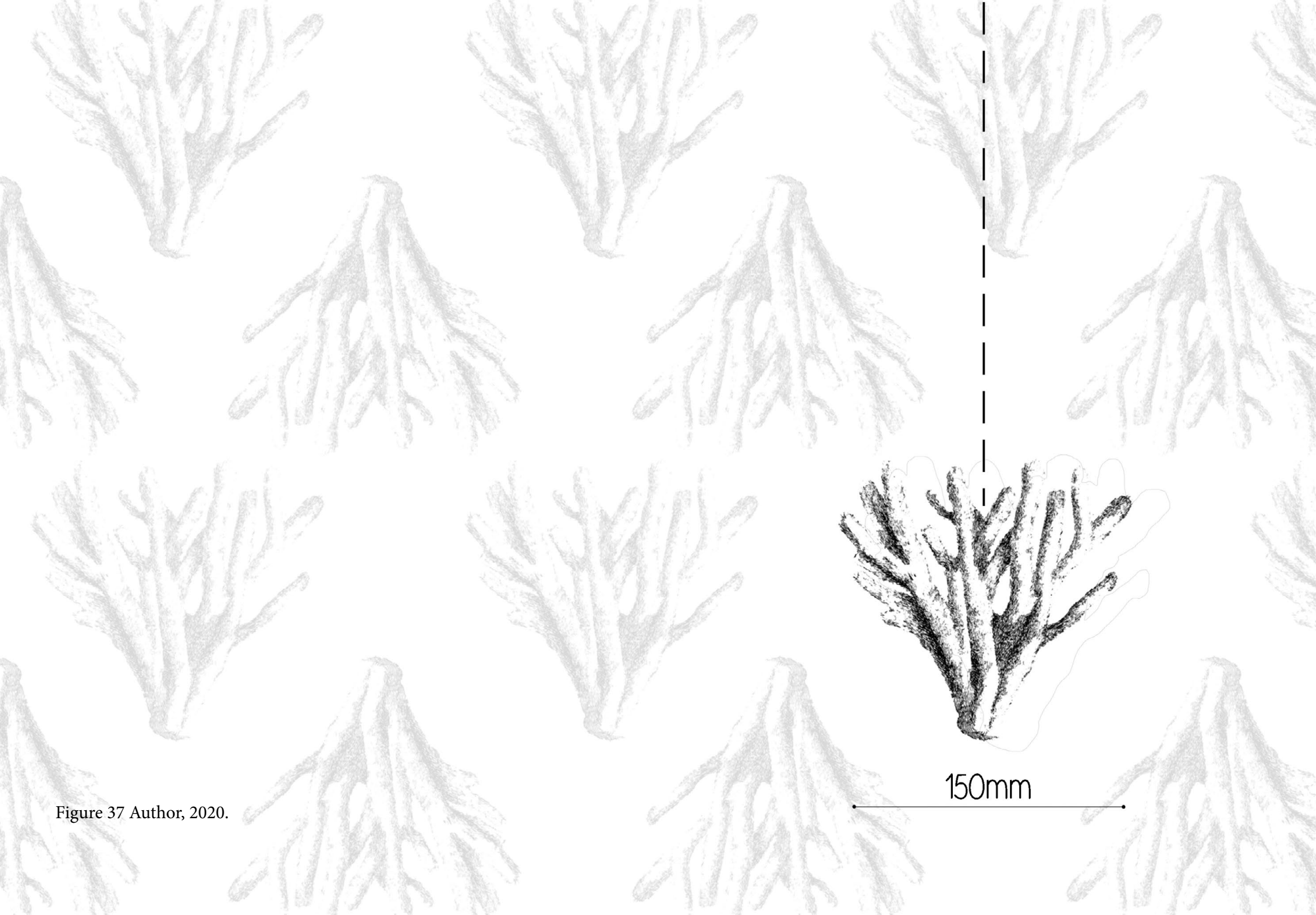


Figure 37 Author, 2020.

150mm

## ECHINOCLATHRIA DICHOTOMA

TREE SPONGE

### SHORT DESCRIPTION:

A BRIGHT RED SPONGE WHICH GROWS UPRIGHT AND BRANCHES LIKE A TREE

### SIZE:

150MM

The Echinoclathria Dichotoma, also known as a Tree Sponge is normally a bright red or orange in colour and has a form very similar to that of the typology of a tree (Aquarium Domain, 2020: Online).

The Tree Sponge is usually found on the lower lying parts of the reef and can also be found near a rock directly in the sandy bottom of the ocean floor. This type of coral thrives in areas with strong water currents and low-lying light levels.

Care level:  
Difficult

Diet:  
Omnivore

Minimum tank size:  
340L

Temp:  
22-25°C

PH level:  
8.1-8.4

## BALANOPHYLLIA BONAESPEI

SMALL CUP CORAL

### SHORT DESCRIPTION:

SKELETON COLUMNAR, UPPER SURFACE DIVIDED BY RADIATING SEPTA WHICH HAVE PRICKLY, TOOTHED INNER EDGES

### SIZE:

25MM IN DIAMETER AND 15MM IN HEIGHT

The *Balanophyllia Bonaespei* coral which is more commonly known as a Small Cup Coral is often found living in groups along a reef and is sometimes found in underwater caves. These corals are brightly coloured with near transparent tentacles and are beaded in appearance. These corals also prefer sub tidal areas and the darker overhangs on reefs (Branch, 2020: Online).

Care level:

Easy to Moderate

Diet:

Herbivore

Minimum tank size:

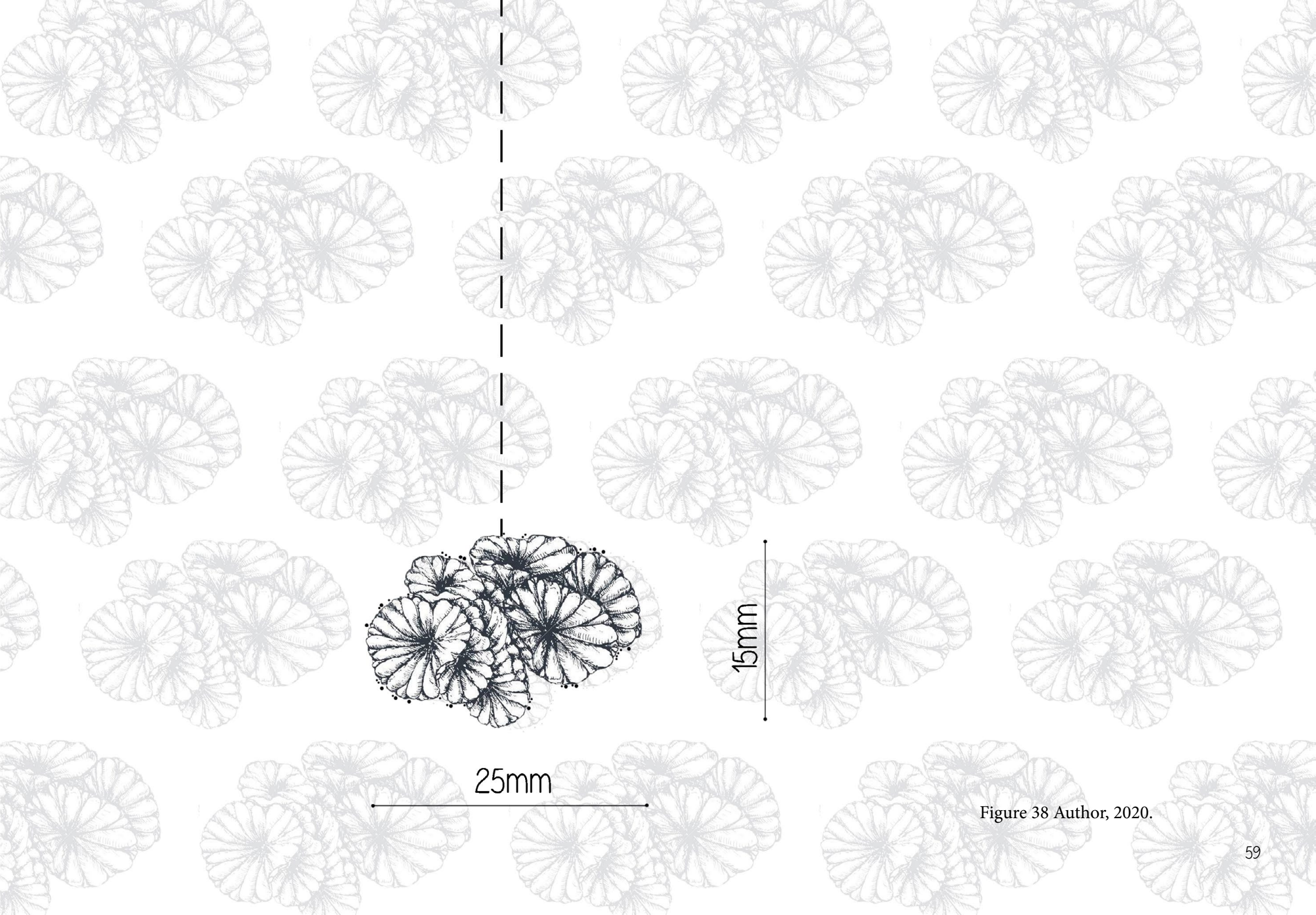
38L

Temp:

23-28°C

PH level:

8.1-8.4



25mm

15mm

Figure 38 Author, 2020.



Social Fan Ascidian. Figure 39 Kritzing, 2011: Online.



Cape Urchin. Figure 40 Kritzing, 2011: Online.



Tree Sponge. Figure 41 Swanepoel, 2011: Online.

Small Cup Coral. Figure 42 Kritzinger, 2011: Online.





# 02 exploration

this part of the document will introduce the reader to the analytics of coral reefs as well as the history of the site and the conceptual development



# 01 history of the site

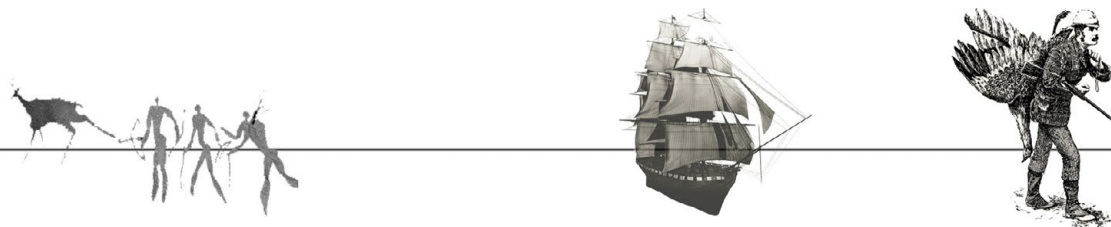
▶ 1800s



Figure 43 Author, 2020.



Figure 44 Author, 2020.



## 1.1. Precariousness of the place

### History of the area: events of disturbance

Tsitsikamma is a Khoi word which means “place of many waters” or an abundance of water (Stormsrivier Manor, 2020: Online). This is due to the high levels of rainfall experienced in the area which ultimately sustains the lush vegetation that is home to the large variety of animal life, both on land and in the ocean.

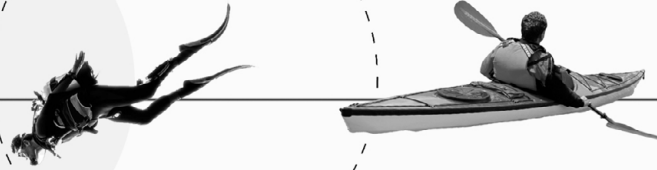
The area, is currently protected by SANPARKS, who works hand in hand with the local community and tourism establishments to protect and preserve the area. This was not always the case as the Storms River area, and larger context of the Tsitsikamma National Park went through various events of disturbance throughout history. The area has a long history of hunter-gatherer people who inhabited the area, taking only from it what they needed. However, as the years passed an increasing number of settlers entered the coast lines of South Africa, specifically known today

as the Tsitsikamma National Park.

With the arrival of settlers, the area was used as a docking point for boats, where large old Outeniqua trees were cut down, and transported via the Storms River, being shipped from the docking bay (Stormsrivier Manor, 2020: Online). The Yellowwood trees, were chopped down and used for timber in the construction of ships. Hunters tried to hunt in the dense forest, claiming the animal resources, however, it was rather difficult to move through the lush vegetation of the forest, which provided a challenge that only few hunters would undertake.

It was in 1841, when the Duthie family arrived at Storms River and established a hunting camp, the remains of which can still be viewed today, that area started to be capitalised upon (Stormsrivier Manor, 2020: Online).

This resulted in the area being opened up for even more travellers when Thomas Bain built a wagon road in 1854 from Plettenberg Bay to Port Elizabeth. This road was the main means of access



to the area until 1956 when the Paul Sauer Bridge was built on the N2 national road, which is still used to this day. With the completion of the road, naturally more development occurred in the area, which led to the current village of Storms River, in the Tsitsikamma National Park. (Stormsriver Manor, 2020: Online).

The area was expanded to include more hectares of land for preservation and protection between 1964 and 1987, with the seaward boundary being extended in 1996 (SANPARKS, 2020: Online).

Today, however, the National Park contributes differently to the economic development of the area than before. The Tsitsikamma National Park attracts many tourists due to the wide range of natural attractions and activities offered by the Reserve. As aforementioned, the area is protected by SANPARKS, specifically for example against over-fishing and hunting, which is not allowed in the area.

Although the area is protected there still is the lurking threats of global warming, which attacks the planet and its natural resources. The Tsitsikamma National Park has been classified as an area to be watched for coral bleaching by the Allan Coral Atlas, due to the rising water temperatures in the area.

These rising water temperatures caused by pollution and global warming in general can lead to the disturbance of the health of coral reefs in the area (NOAA, 2017: Online). This is a concern, as coral reefs are home to many fish species that are dependent on the reefs for shelter and spawning grounds. Ultimately, should the coral reefs die out, so will the other biodiversities such as fish life associated with them.

Not only does the death of coral reefs affect marine life, but also human life. Coral bleaching has an impact on the human's livelihood, food source security and safety. Coral reefs are natural barriers that absorb the forces of waves and storm surges

that keep coastal communities safe (Hancock, 2020: Online).

Bleached corals also complex the overfishing crisis by removing vital links in the food web and destroying spawning grounds for certain fish who use coral reefs to reproduce. In addition to this, unbeknown to most people, coral reefs produce two thirds of the earth's oxygen whereas trees only produce the latter third (Jamail, 2016: Online).

In order to safeguard the Tsitsikamma National Parks coral reefs there needs to be an intervention into the research done to protect this delicate ecosystem, to protect connecting ecosystems as well. This research is done by means of sampling corals and studying them under various conditions that may cause a threat to them in the natural environment.

Once these statistics are available, the corals can be bred to create super corals that are resistant to the threatening conditions.

Figure 45 Rogers, 2019: Online.





# 02 *an analogy with coral*

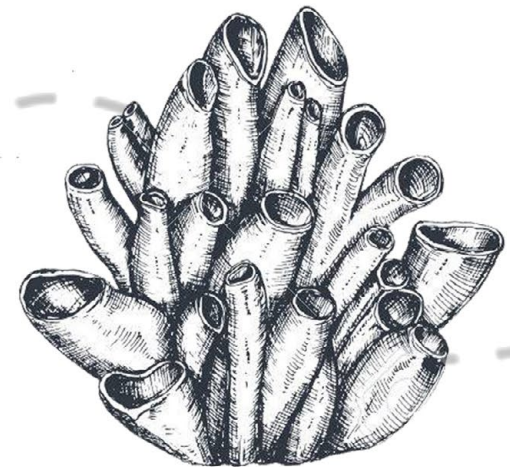
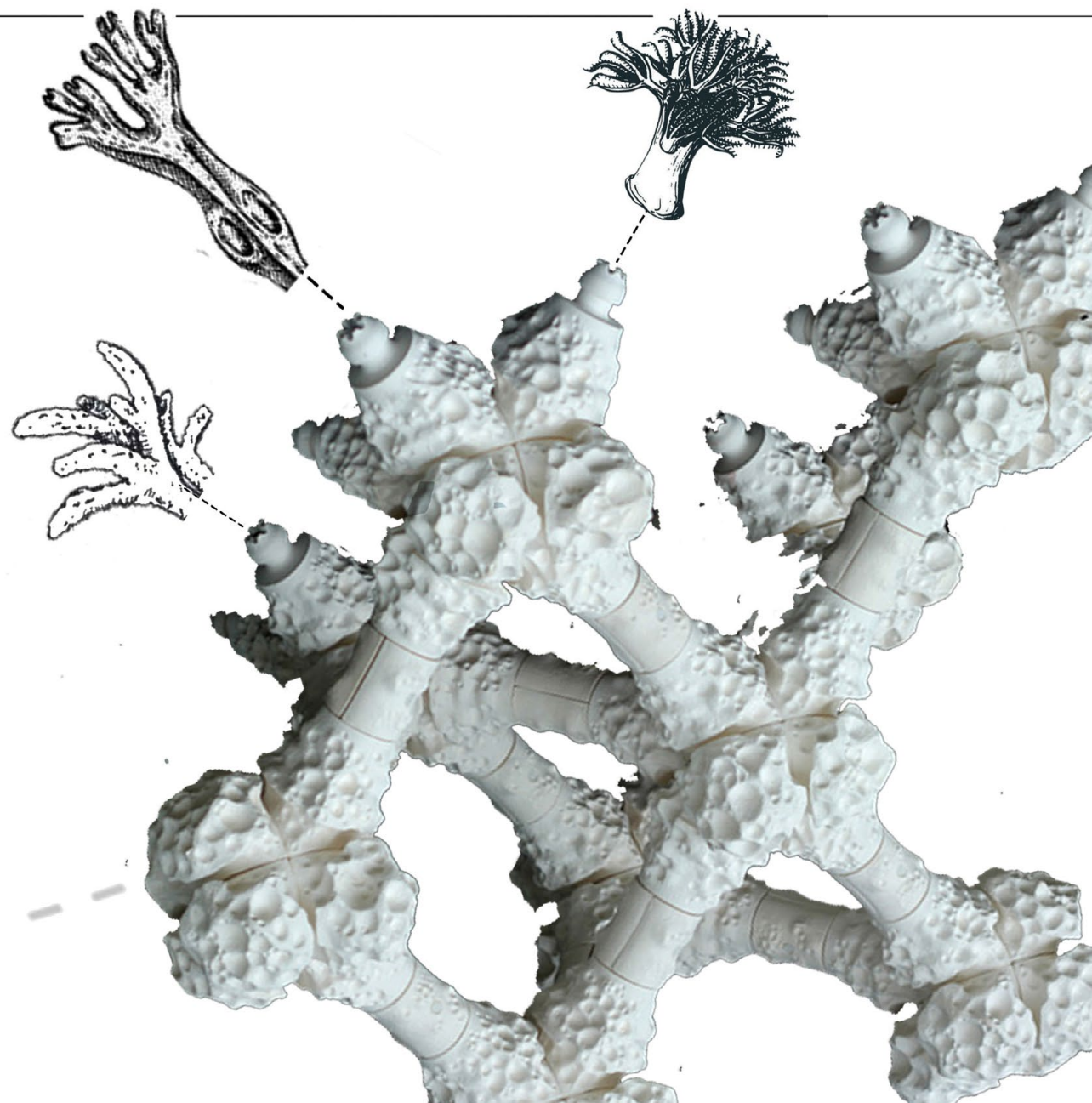


Figure 46 Author, 2020.



## 2.1. Coral reefs

It is important to understand the intricate nature of coral reefs and coral specimens themselves. To gain a deeper understanding, an analysis will firstly be done on the coral reef as a whole, then on varying characteristics of the individual coral species.

Corals are marine animals with a variety of reef complexities. The coral animal, called the polyp, secretes a cup-like skeleton called a corallite. Corallites are made of calcium carbonate. Many of these corallites cemented together creates an entire skeletal reef to which corals can attach themselves (Oliver, 1979: Online). This collection of corallites is referred to as a Corallum and can be seen on the image to the right.

Within the Corralite, is a radial divider called a Septum which grows vertically from the attachment base and assists in supporting the soft tissues of the individual coral polyps (Oliver, 1979: Online). These coral polyps contain algal cells which they use in some cases through photosynthesis to produce food for themselves when not “catching” food with their tentacles.

Figure 47 Rhewma, 20218: Online.

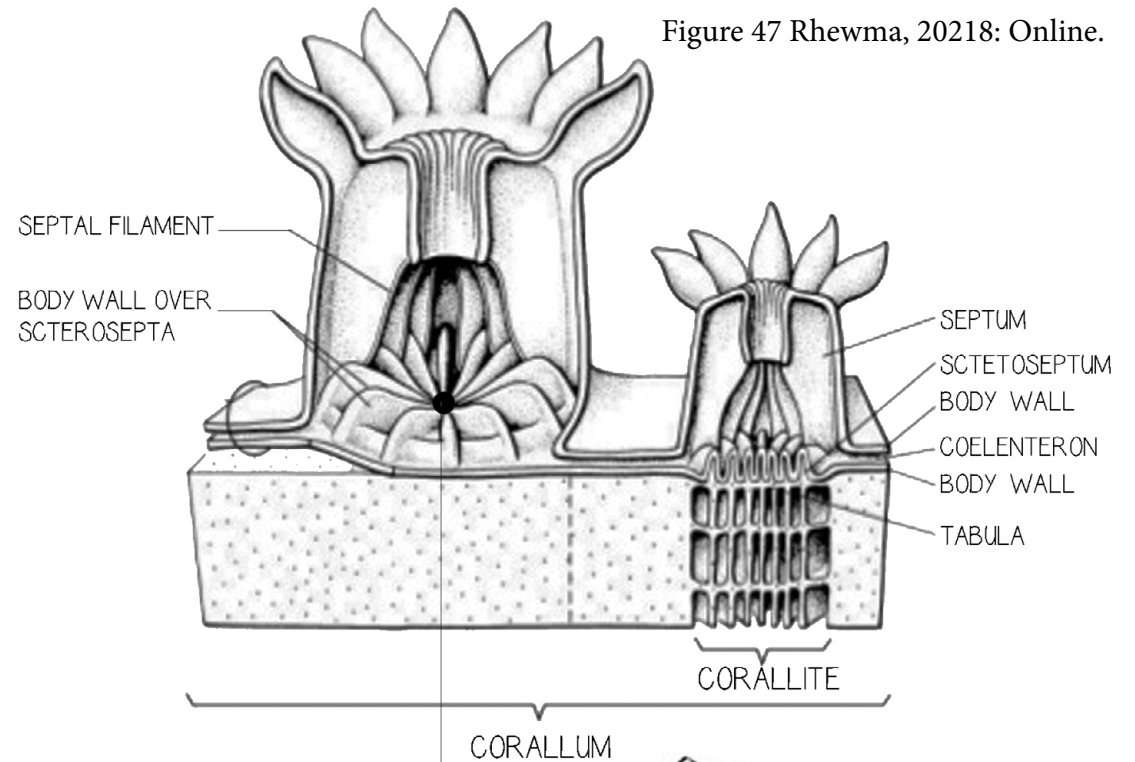


Figure 48 Weinbauer, 2000: Online.

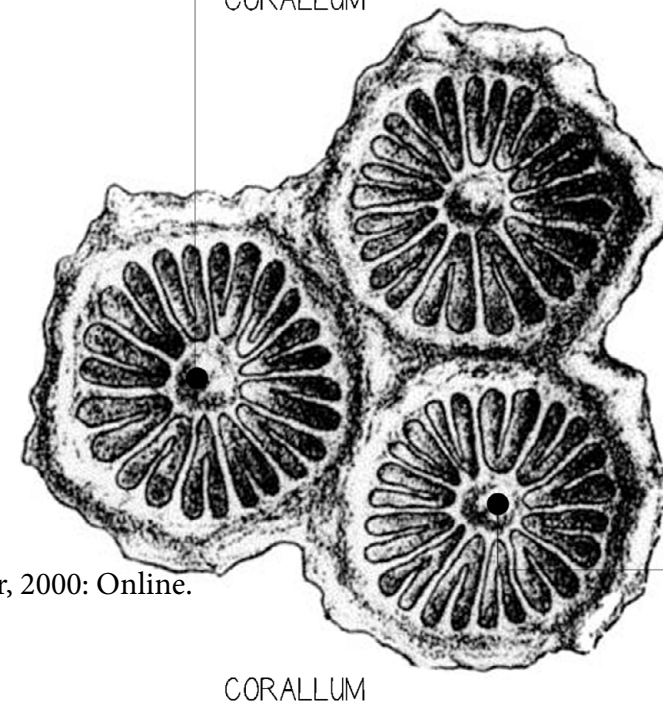
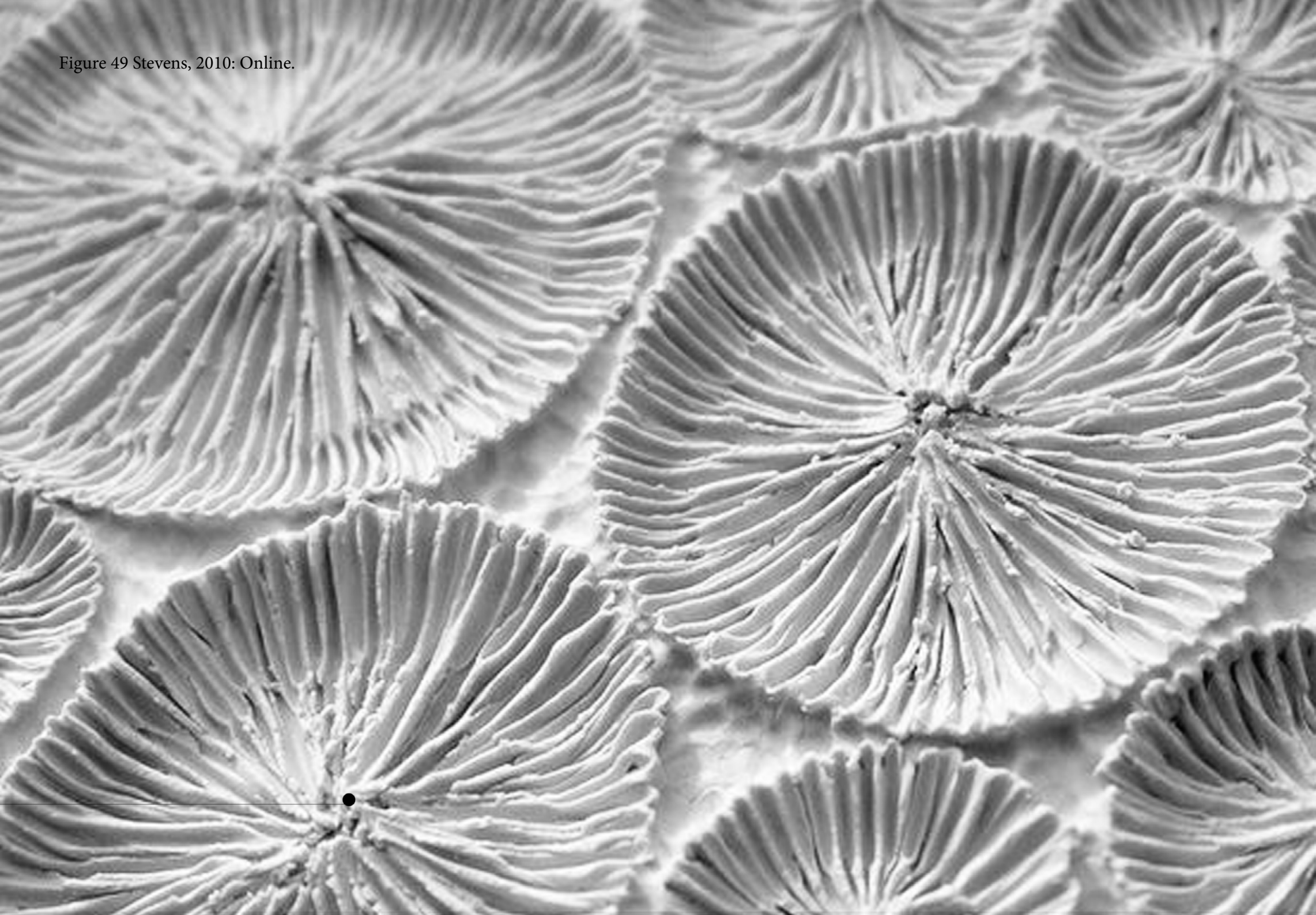
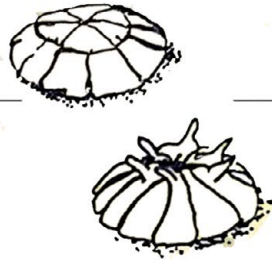
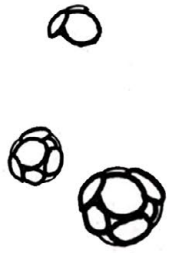


Figure 49 Stevens, 2010: Online.





## 2.2. How corals reproduce

It is important to gain a deeper understanding of coral reefs and their importance, to translate the corals characteristics into architectural principles. Understanding the life-world of a coral reef, of each individual polyp and as a result the experience human beings can have with these natural wonders, both physically and metaphysically. To better understand the complexities of coral reefs, it is important to understand their livelihoods. Corals are classified as animals and not plants (NOAA, 2020: Online), much like some land animals, they “hunt” at night by stretching out their long arms to catch particles floating by, thereby interacting with their surroundings. It is also important to notice that coral reefs have various levels of architectural complexities in their overall shape and form created in the reproduction process, whereby corals reconnect to and expand the reefs size and change the shape. Although human kind can interact with healthy corals year-round, corals only reproduce once a year in a mass event.

Corals can reproduce either asexually through a process called budding or sexually through a process called fragmentation (NOAA, 2020: Online).

In the process of budding the new polyps, ‘bud’ off from the parent polyps in order to form new colonies. However, in the process of fragmentation the entire colony (instead of just a single polyp) branches off to form a new colony. Taking a closer look at the budding process of reproduction, the corals release egg-sperm clusters from the parents’ polyps in the first stage.

These clusters float to the water’s surface where they break up into smaller cells. Here the inter-colony cells mix and fertilization occurs. This results in the occurrence of stage three where the newly formed embryos transform into larvae which are capable of settlement onto reefs for up to 3-4 weeks.



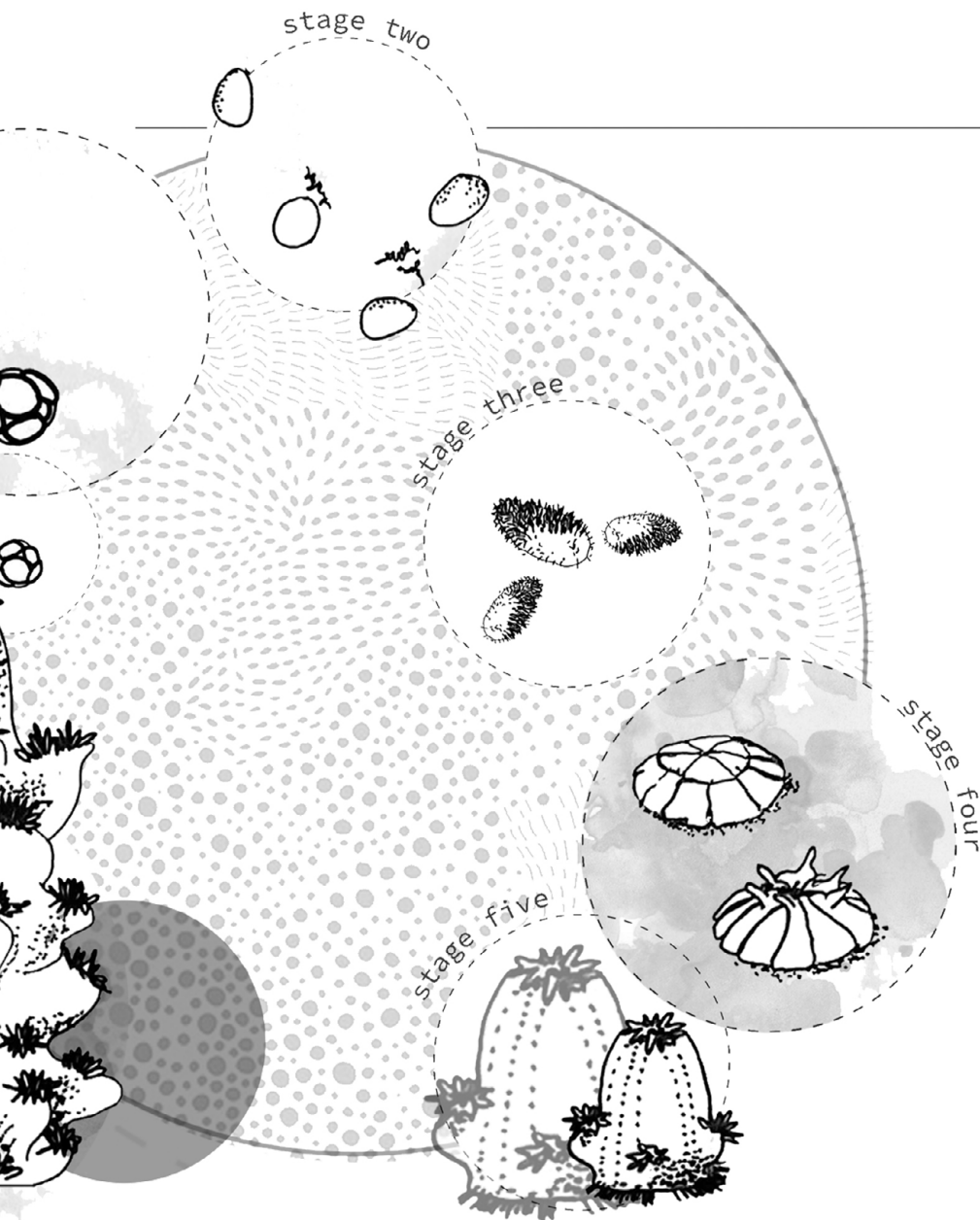


Figure 50 Author, 2020.

Next is stage four, where cells settle back down onto the reef structures and metamorphosis occurs. The juvenile polyp forms a mouth and tentacles in this stage.

Lastly, in the fifth and final stage the polyps grow exoskeletons which attach fully to the existing surfaces and reefs. Put simply, coral polyps go through three stages of metamorphosis, firstly release from the parent polyp, then the reconnection and settlement to a reef, and lastly growing an exoskeleton. Much like corals go through various stages during their lifetimes, humans too venture along various stages throughout the experience with nature in various physical and metaphysical ways. Humans have been fascinated with the ocean for many years but have only explored approximately five percent of the ocean (Emerson, 2 2016: Online).

The experience of man moving from an upright position on land to swimming parallel with the waters is a physical and metaphysical experience, sought after by many. Much like corals change in form to feed and reproduce annually, this is an experience in which man is fully immersed in his surroundings and, connected to the environment, a certain sense of interrelatedness is evoked within this process.



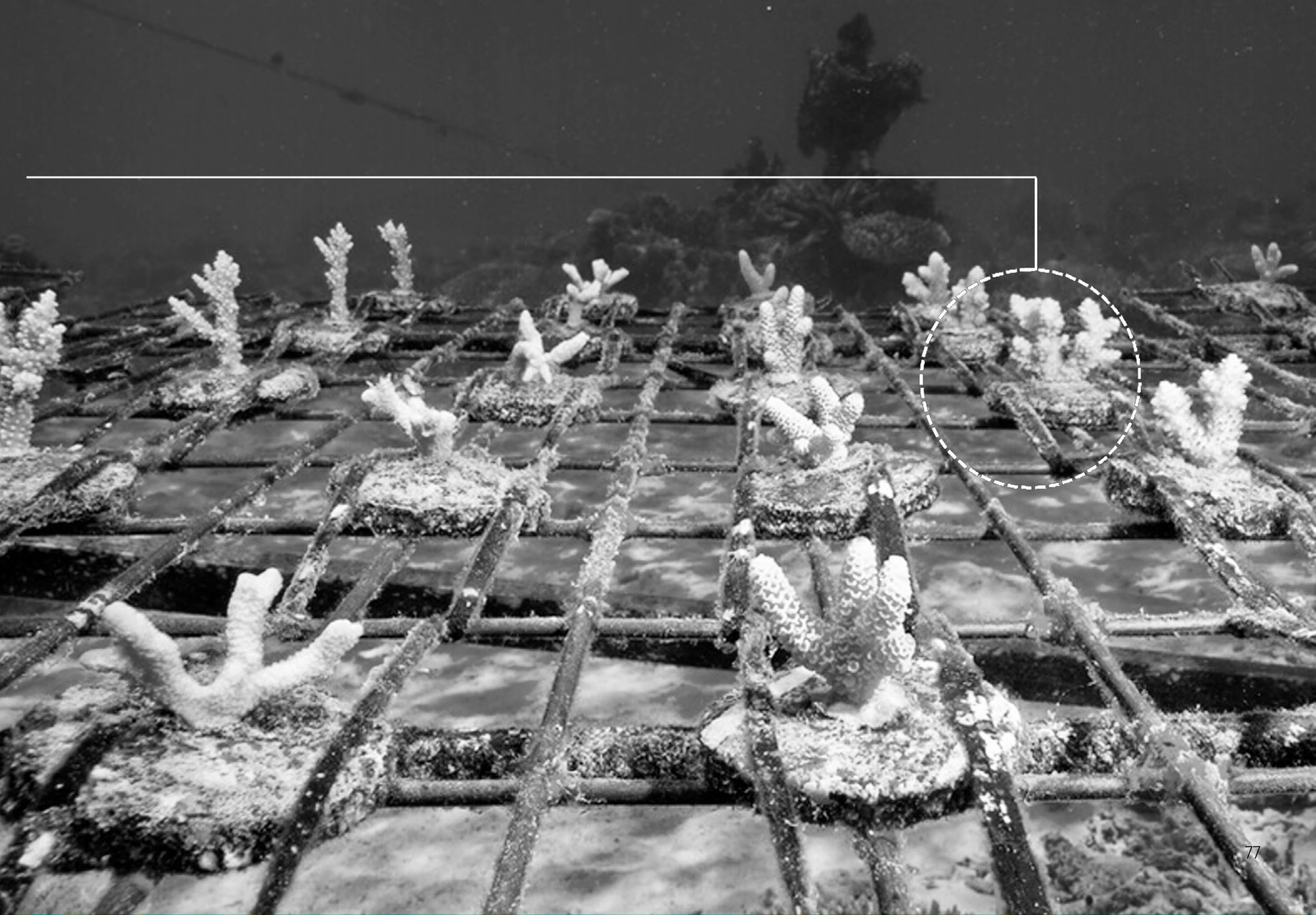
### 2.3. How corals are farmed

As important as it is to understand how corals reproduce, it is also important to investigate how these corals are farmed in the process of reef restoration. Coral farming or coral aquaculture is the process whereby small coral samples are harvested from oceanic reefs and propagated. These samples are researched to breed corals that are resilient to global warming at a faster rate. Corals that are resistant to temperature, light and PH level fluctuations are known as super corals.

Until recently, coral farms were mainly constructed under water. Looking similar to crops in a field, lined up in rows. Coral reef fragments or small coral specimens are placed on concrete discs and secured onto the underwater steel structures and are cared for until they reach maturity and are transplanted onto a dying reef.

However, this process is timeous as it may take months and even years for corals to reach maturity. Thus it is more suited for small-scale reef restoration projects (Glanzer, 2018: Online). A company called Coral Vita is researching new ways of coral farming through a process called micro fragmenting. In this process microscopic fragments are sampled from reefs and cultivated in laboratories where they grow up to 50 times faster than in the ocean.

Essentially, a wider variety of coral specimens can be grown in a laboratory set up. In addition to micro fragmenting the company uses a method called assisted evolution, a process which breeds super corals that are more resilient to the effects of global warming. It is possible to not only transplant coral specimens onto existing reefs, but also onto 3d printed reef elements. These 3d printed elements can be designed to suit the nature of the corals in shape and form.



These elements are printed in small puzzle pieces that are assembled under water in the ocean. Larger elements can also be printed to suit the oceanic environment. Overall, the possibilities for coral farming and the creation of coral reefs are fast growing, however, continued research and experimentation is needed to assist reefs across the world.

## 2.4. Reef Design Lab

Reef Design Lab is an Australian company founded in 2015 by industrial designer Alex Goad. The company functions as a multidisciplinary studio that works closely with various marine ecologists to develop habitat infrastructure for research as well as commercial applications.

Reef Design Lab focusses particularly on innovative design and manufacturing methods within coral reef habitats. Goad designed the first modular system while still at University in 2013. These modular systems are 3D printed using calcium carbonate which corals are more prone to attach to. An example of this can be seen on the right. This exhibition was on display at the Boston Society of

Architects 'Nature Structure' Exhibition 2018.

Goad designed the MARS – Modular Artificial Reef Structures – system which is as the name suggests a modular system that can be installed under water by hand in any shape and size imaginable using the modular pieces.

There are various means of 3D printing with calcium carbonate, as the possibilities are endless. Elements can be specifically designed and printed to suit each individual coral's needs.

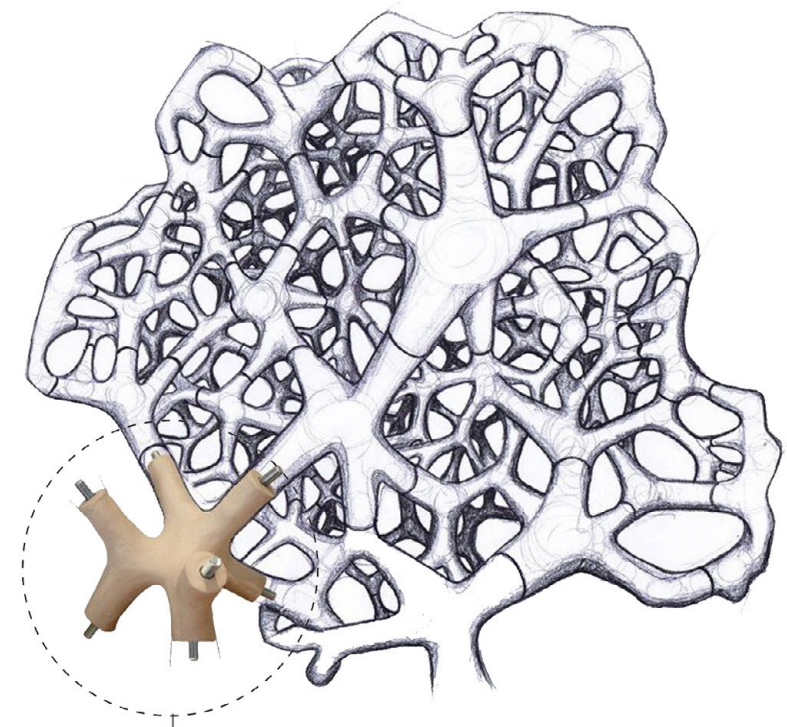
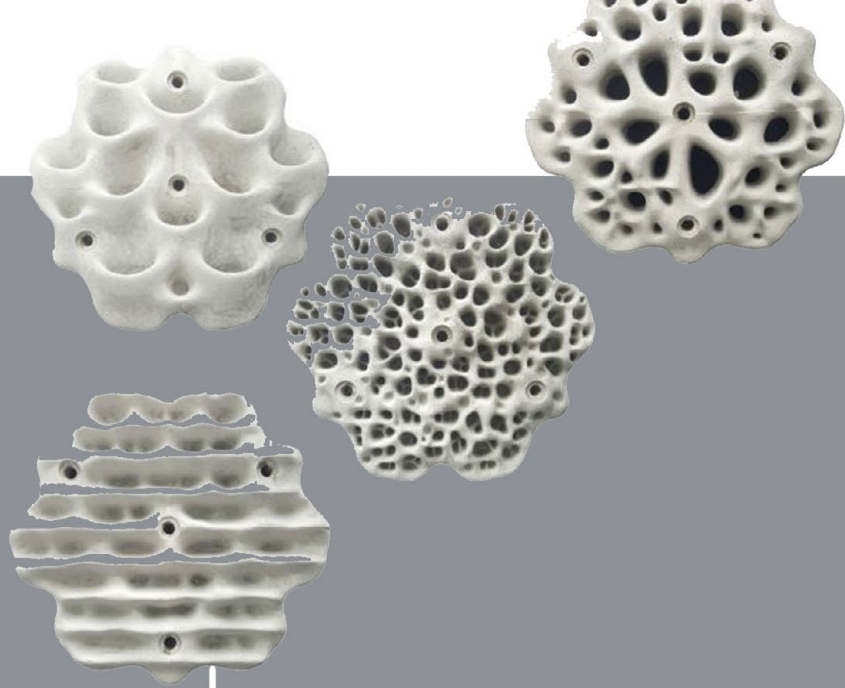


Figure 52 Reef Design Lab, 2017: Online.



**Poros and the Sea**  
The sculpture is made of recycled plastic bottles and is a tribute to the sea and the life that lives in it. It is a large-scale work that is made up of many small parts that are joined together to form a single, complex structure. The sculpture is made of interconnected, rounded, porous segments in shades of blue, green, and brown. It is mounted on a wall. To the right of the sculpture, there is a small, rectangular informational plaque with text.





## LIVING SEA WALLS

BY REEF DESIGN LAB

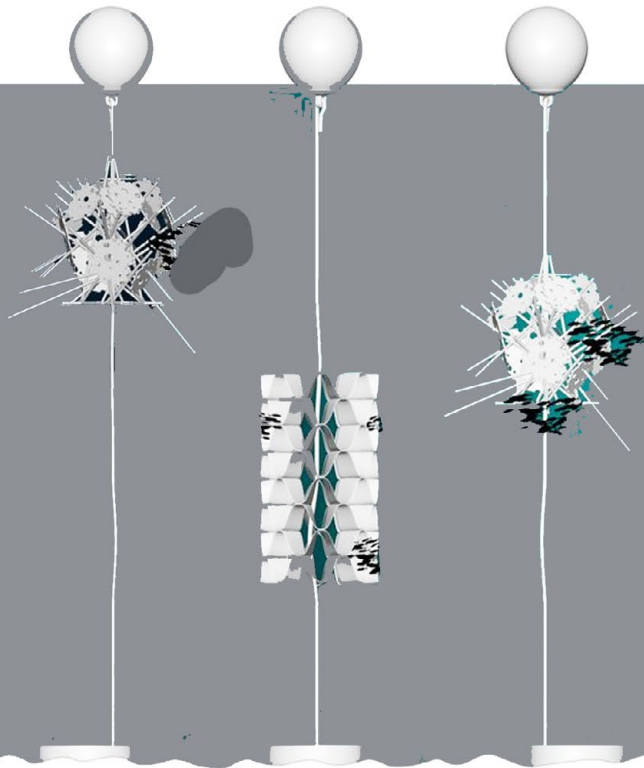
The living sea walls by Reef Design Lab are designed to investigate how 3d printed geometries can create habitats for native intertidal species which make seawalls. Sea walls are responsible for destroying some intertidal habitats and by attaching these panels onto the seawalls the habitats can be restored.



## EASY DROP CAVE UNIT

BY REEF DESIGN LAB

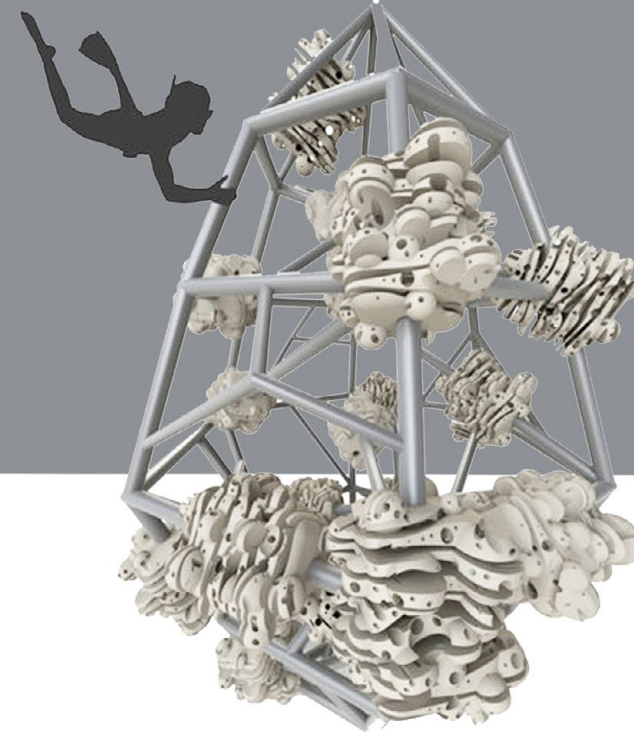
These units are made from marine concrete and each unit with a footprint of 100cm<sup>2</sup> can fit onto a standard sized pallet, making the installation process a simple one. These units are designed with a single reinforced lifting point, making the deployment of the unit an efficient process providing habitats for reef restoration.



### HANING/FLOATING PODS

BY REEF DESIGN LAB

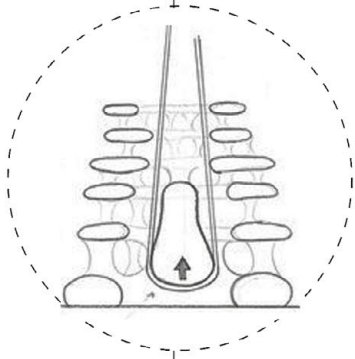
Reef Design Lab is currently working with researchers from Sydney to develop floating habitat pods which provide excellent habitat opportunities for species that flourish at various depths.



### DIVING HABITAT

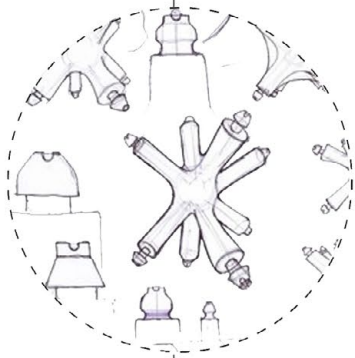
BY REEF DESIGN LAB

The increasing awareness and interest in marine life around the world has prompted Reef Design Lab to design scuba habitats that function as underwater playgrounds for both marine life and divers.



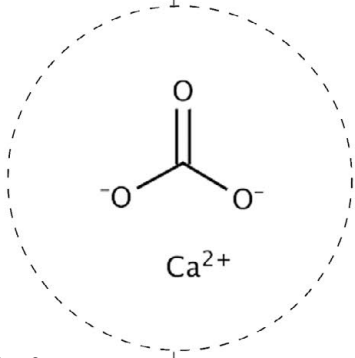
## 2.5. Lessons learnt from Reef Design Lab

Reef Design Lab is leading innovative research in marine life habitats that are designed specifically for each individual organism. Their research serves as a precedent study for how to design and construct modular systems in the Tsitsikamma National Park for the proposed coral reef nursery and rehabilitation centre.



This type of modular design can be implemented in not only the design of the reef systems but also the architecture, as the site is remote and would require a modular type of construction.

As shown in this study, concepts such as a single lifting point and sizing of materials are key factors to keep in mind. The use of marine concrete made of a calcium carbonate variety is also a very insightful point of reference.



“It is really difficult to come up with your own thing and really try to pursue it, but I think it is definitely worth doing, because otherwise you’ll always regret not really going forth with that idea and there’s nothing worse, regretting something you didn’t do.”

– Alex Goad

Figure 54 Reef Design Lab, 2017: Online.



# 03 touchstone

This touchstone aims at identifying the three current major influences on site and aims at assessing a means of connection between these influences. These three influences being the earth, man and the ocean.

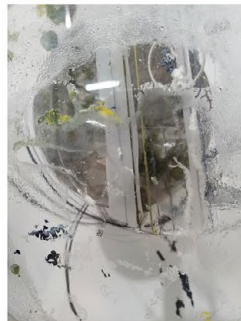
Experientially the earth is perceived as a mass with voids, inhabited by, nature. The ocean is a mystery with only 5% having been explored and discovered, the unique ecosystems are relatively unknown.



earth



man



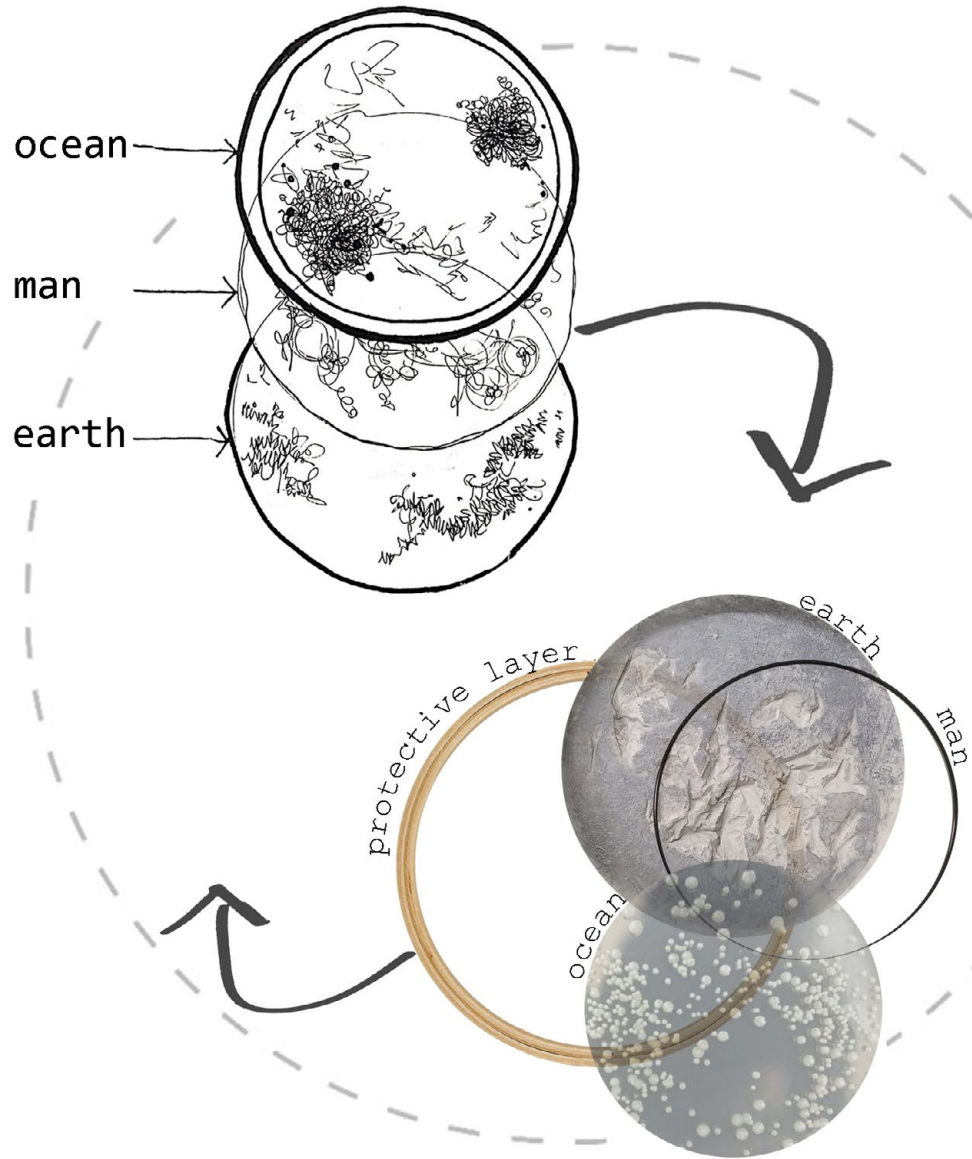
ocean

In this case, man is perceived as the mediator between earth and the ocean, stepping from dry land into cold waters embodying a new experience. These three elements were layered over each other to embody the experience.

Furthermore, a light was shone onto the installation, after which the shadows cast by it were drawn on a paper behind it using different mediums. This drawing represents the current metaphysical connection between earth and the ocean which is only experienced through the interaction of man.

Here the three separate elements are first positioned in a static way, one behind the other. The shadow cast here is rather monotonous. On the right the separate elements are positioned in a staggered way, resulting in the casting of a more dynamic shadow. This represents dynamic and ever-changing relationships in nature, and the connections between them.

Figure 55 Author, 2020.



# 04 conceptual development

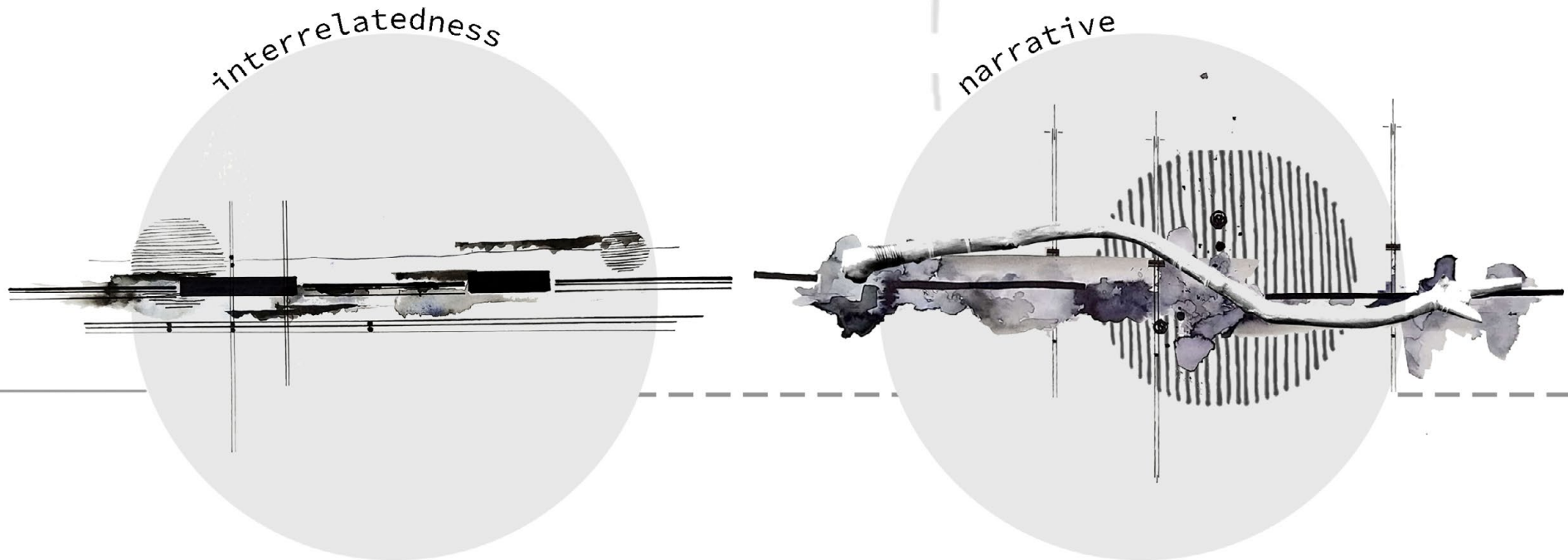


Figure 56 Author, 2020.

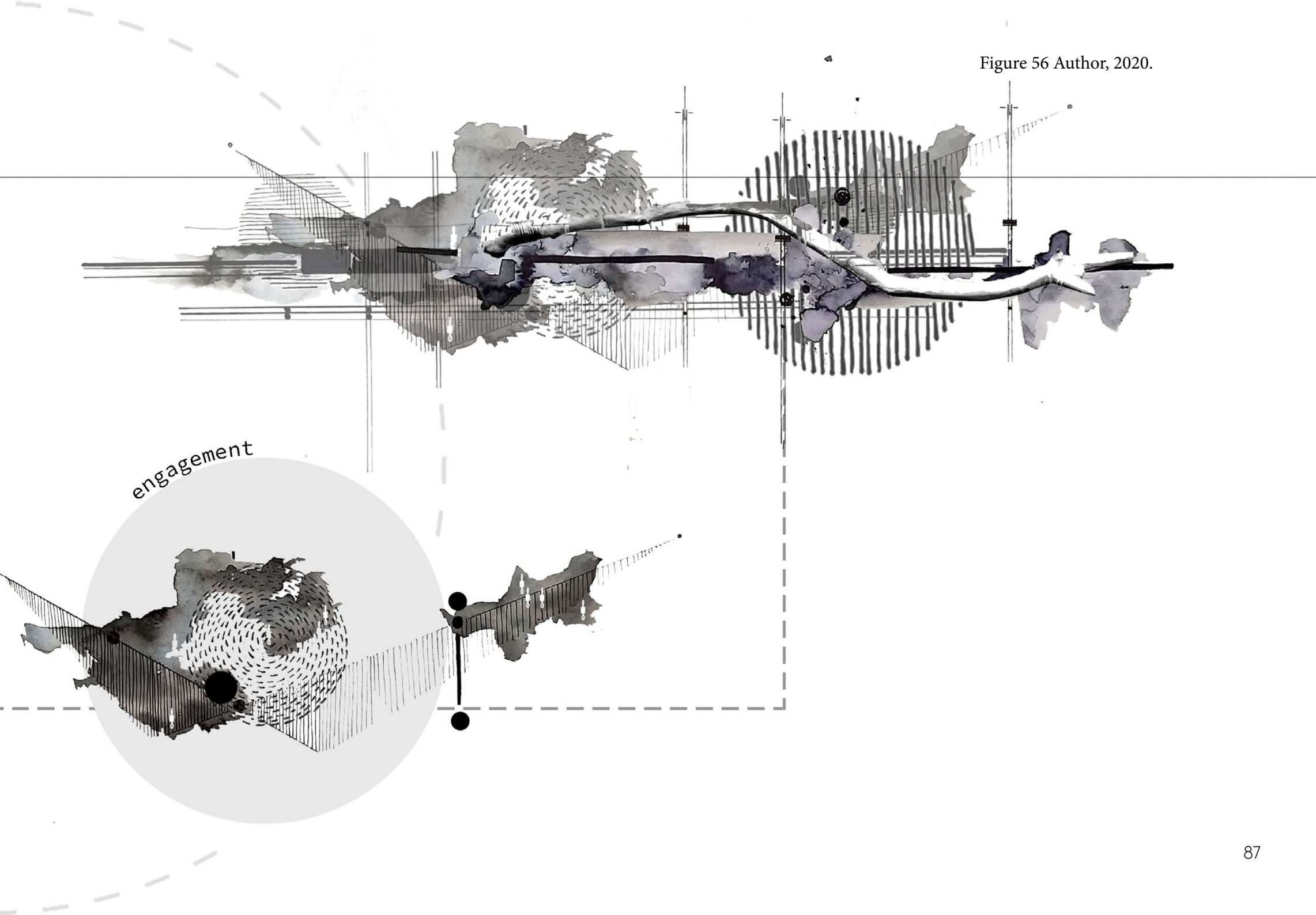
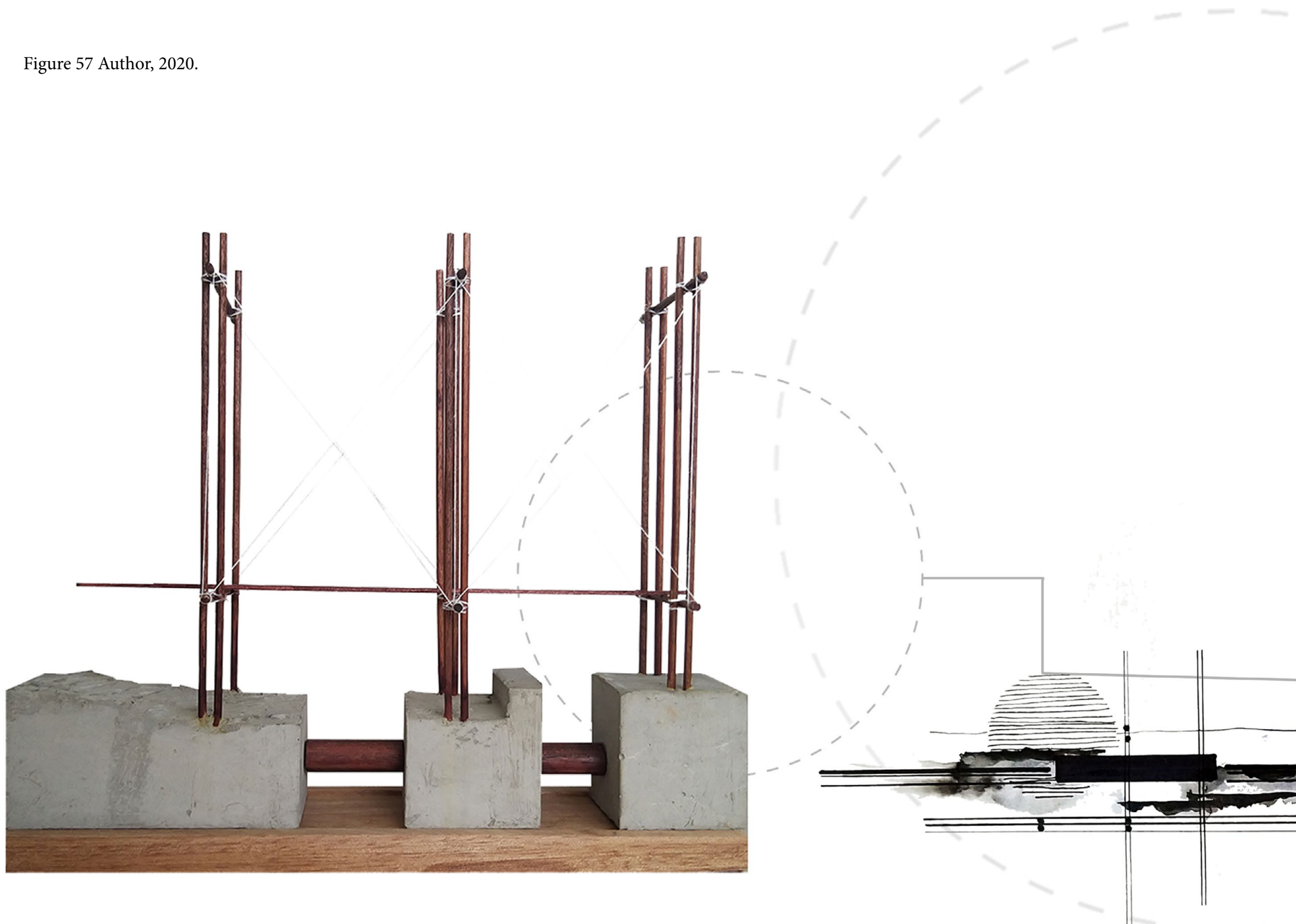


Figure 57 Author, 2020.



## 4.1. Interrelatedness

Bridge – connection – physical – metaphysical

The aim of this conceptual approach is to highlight the concept of physically, as well as metaphysically, bridging the gap between land and sea. There need to be points of anchoring on land and in sea, with a connection occurring between these points.

The physical act of connection will take place through an architectural intervention as well as through research done on the coral reef's preservation and enactment thereof. The metaphysical connection between the land and sea will be one of experience, the experience of seeing coral reefs dying and the experience of trying to find ways of reinstating life back to them.

The physical act of transplanting these corals will also be metaphysical as man will have to transform from a upright stance of walking to a horizontal mode of swimming in order to place these corals on man-made structures. This concept model aims at representing the physical as well as metaphysical connections and interactions that will take place year-round on the site. Therefore, the concept model portrays two aspects, the seen as well as the unseen. The seen aspect being the physical bridge structure with cross bracing support and the unseen aspect being the experience of crossing the so-called bridge structure and through such an act connecting land and sea.

## 4.2. Narrative

### Support – dependency – non-place

The aim of this conceptual approach is one of revealing the story of the site and what will eventually take place on the site, being on land as well as in the ocean. There is a man-made element and an organic element to the approach. However, these two parts intersect and form a connection in which the man-made supports the organic, with the organic being semi-dependant on the man-made. This narrative speaks specifically of the reproduction of coral. Once a year each coral (being a hermaphrodite), releases both sperm and egg cells out into the surrounding waters, the cells then connect in the ocean, a non-place, and then sink back down onto the existing coral reefs, attaching to them. In this way corals interact with the non-place.

This concept model aims at expressing the research that will be done year-round on land with the rare once a year occurrence happening both in the ocean on existing reefs and on land in the research labs.

Thus, land is made a non-place for coral, removing them from their natural habitat. Therefore the piece of drift wood is suspended from crane-like structures in the air, hinting to the non-place that coral finds itself in both in the process of coral bleaching as well as in the annual reproduction process. The narrative of coral and coral reproduction is expressed in this concept model.

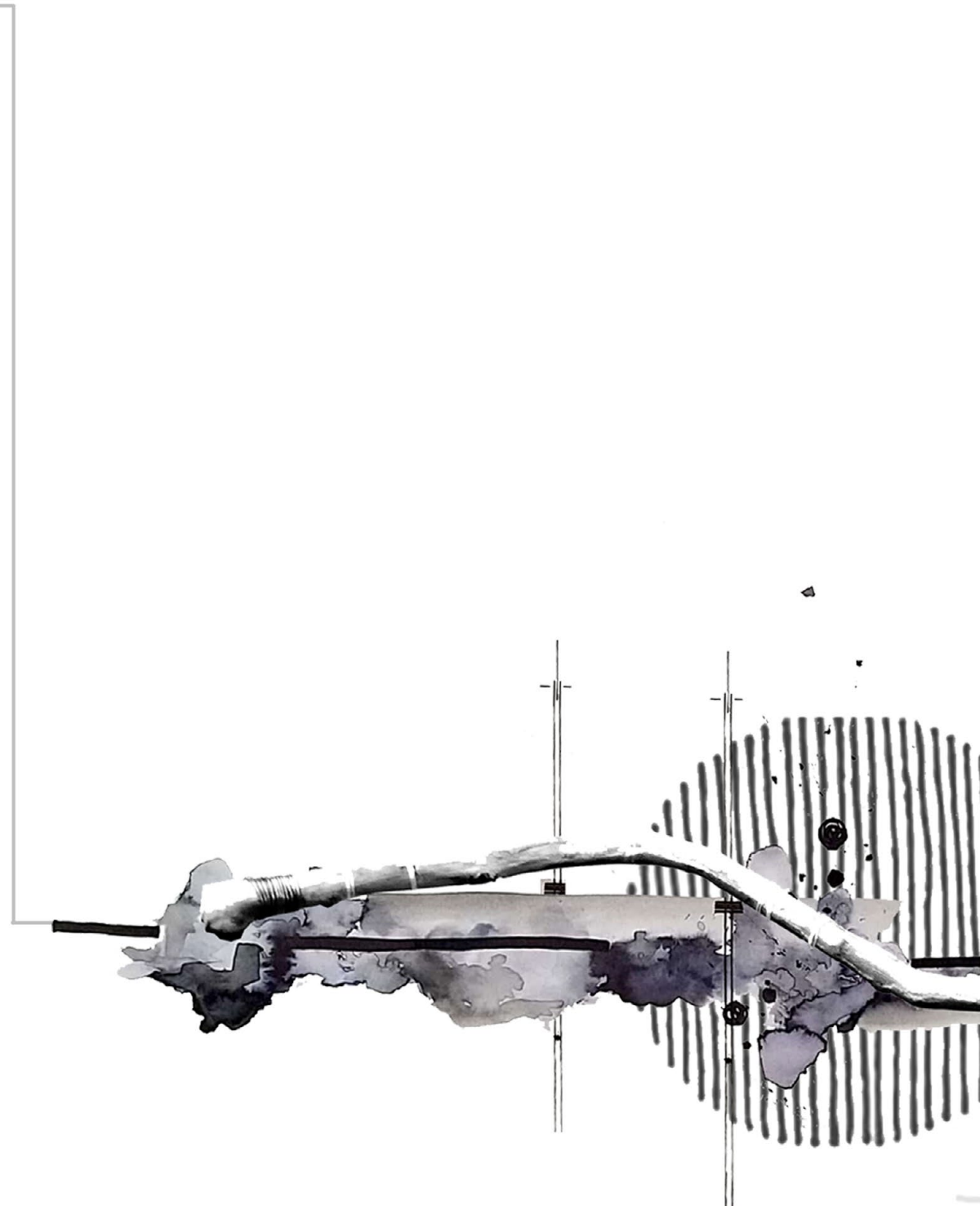


Figure 58 Author, 2020.

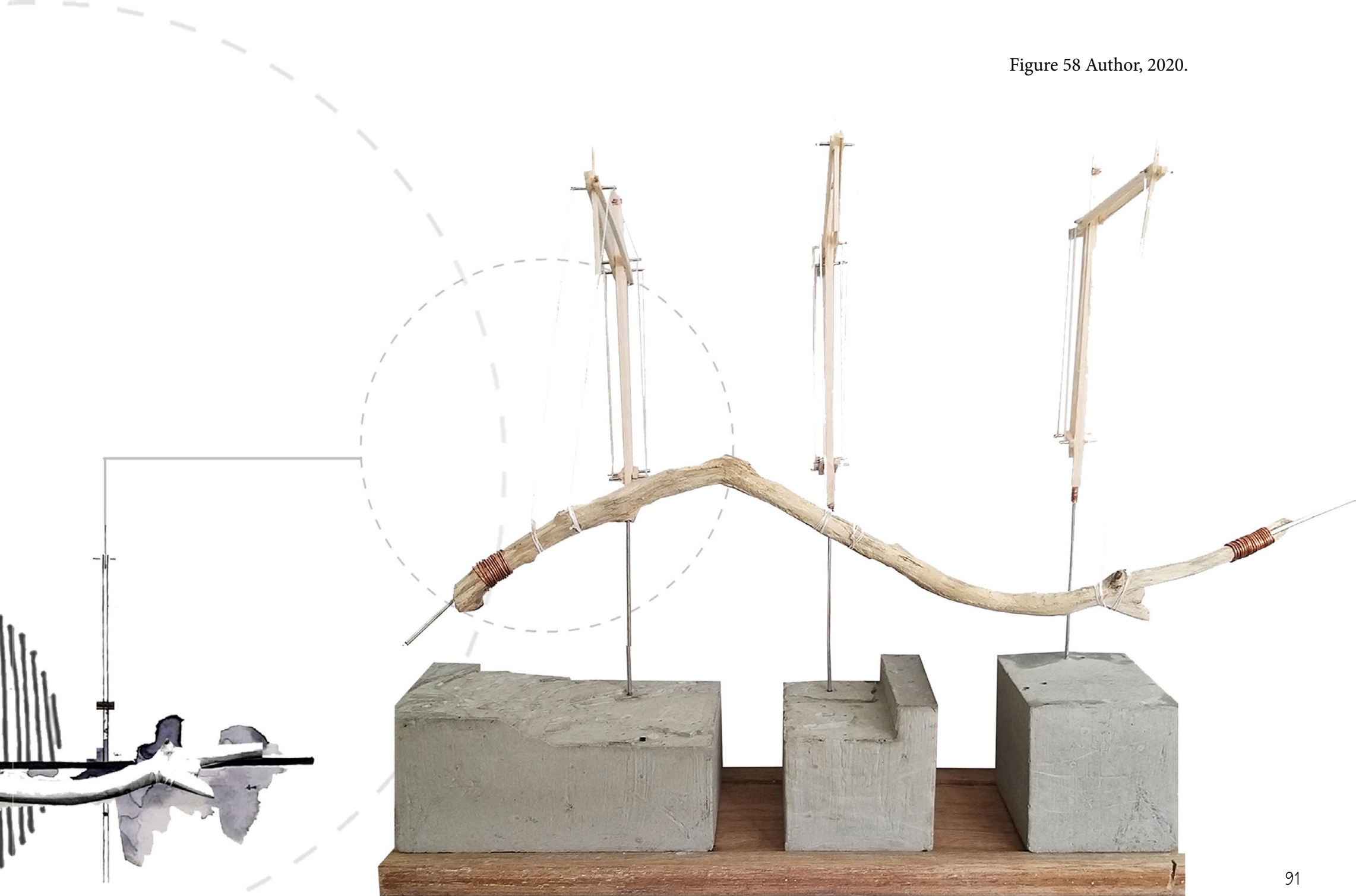
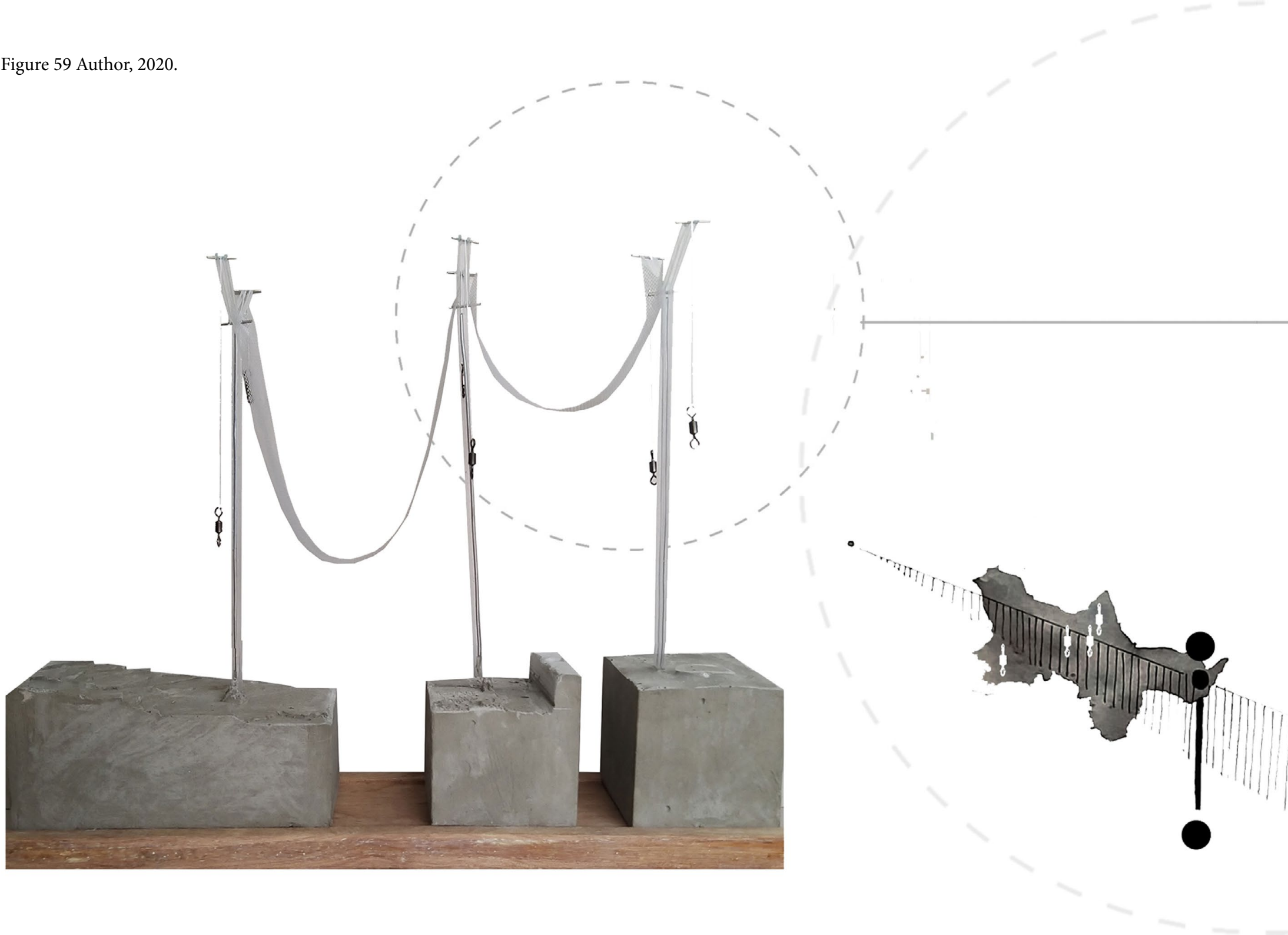


Figure 59 Author, 2020.



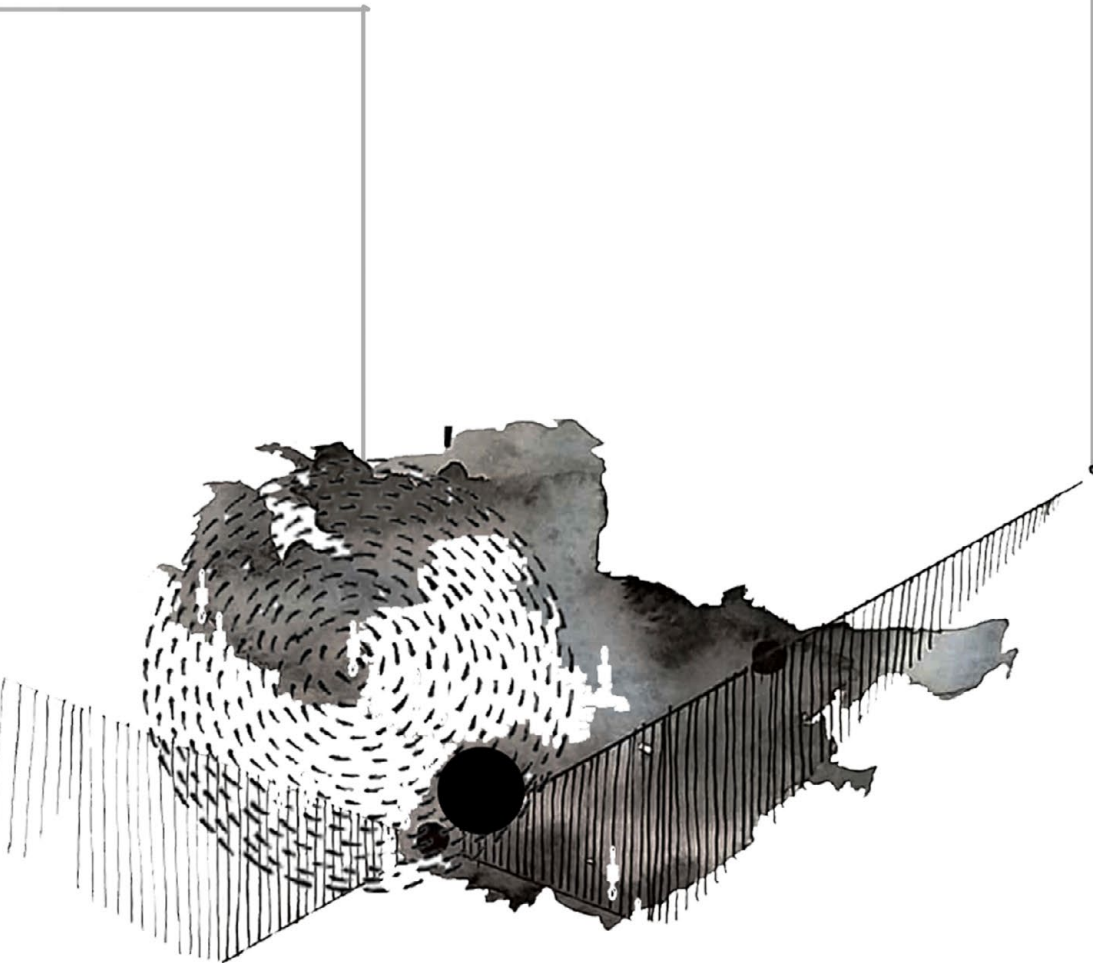
### 4.3. Engagement

Active – passive – interaction

In order for there to be both narrative as well as interrelatedness on the site there needs to be an active sense of engagement with the site as well as the activities taking place on the site. Supplementary to active engagements there may also be passive or consistent engagements.

There is a certain level of awareness that needs to take place and this can only be achieved through the engagement of the site and the research process through participation from the public as well as professionals. The active engagements can be connected by means of a series of passive engagements, so that through participating in passive engagements you reach active engagement points. This relates back to the research process that leads up to the annual celebration of the life of coral.

Therefore, this concept model aims to entice viewers to interact by means of pulling on a swivel in order to create a reaction on the opposite side of the static engagement or connection, this being the net piece.



## 4.4. Understanding narrative

### Steilneset Memorial

Peter Zumthor

Memorial park in Vardø, Norway 2011

Zumthor designed the Steilneset Memorial in memory of the 91 individuals who were convicted of witch craft and burnt at the stake. He did so by designing a 122m long pine scaffolding structure which houses a suspended silk cocoon. Within the cocoon, visitors walk along the 122m oak-floored passage past 91 windows. Each of the windows frames a hanging light which illuminates the individuals in memory. Each window is complemented by a plaque which divulges the personal story of that individual.

The landscape much like the proposed site at Stormsriver mouth, is vast with no physical indications of scale. The surrounding water and land with the ever-changing sky create a dominating horizontality on the site (Arkitektur, 2011: online). The memorial by Zumthor, compliments the horizontality of the site by introducing rhythmic proportions which introduce scale to the once empty site.

Zumthor used the strong winds present on site as a material. The 91 small windows are mounted in textile walls which undulate long with the silk fabric cocoon when the wind blows. In this way the windows move in the wind. This movement is contrasted by the wooden scaffolding which houses the cocoon. It is constructed by means of sixty frames, making use of the simplest means of a loadbearing structure.

There are no conventional wooden joints, however, where the beams cross, they are simply pressed together by a single screw. Making the structure as simple as possible. Therefore, the structure is reduced to simply what is required to resist the wind, which adds to, and subsequently, takes away from materiality and structure. In terms of narrative, Zumthor tells the story of the 91 individuals by giving each a designated space symbolised by the hanging light.

However, the narrative goes beyond this alone. The sheer length of the structure hints to the long walks the convicted might have taken to the site. The rhythmic structure that supports the moving, silk cocoon also hints to the fragility of human life suspended in a moment, in this case in the hands of their fellow people who chose to take their lives.

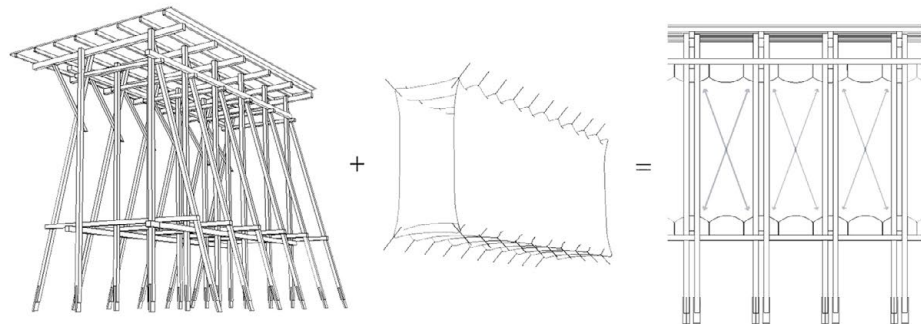
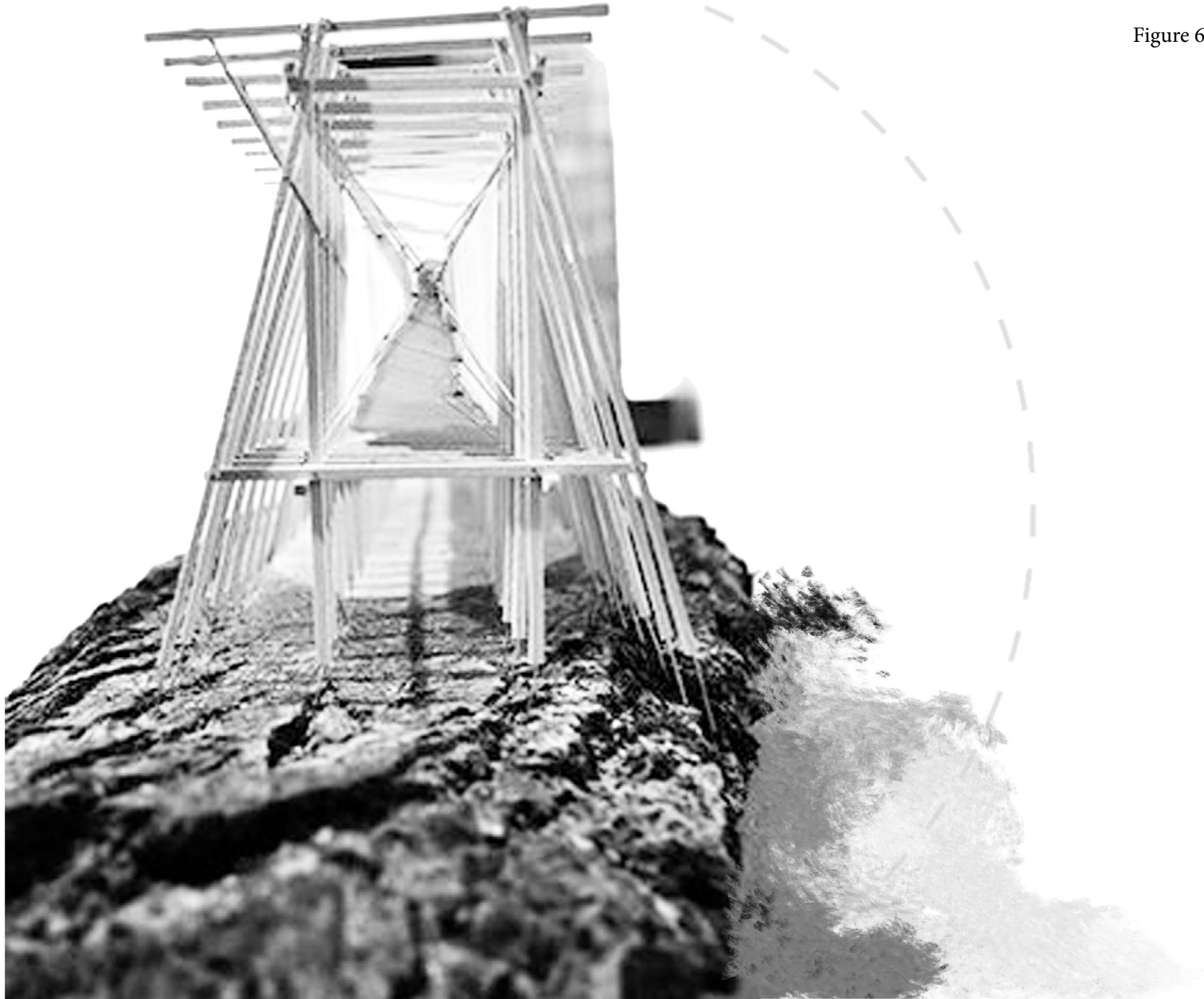


Figure 60 Arkitetur, 2011: Online.



## 4.5. Understanding engagement

Wind and Rain Bridge

Donn Holohan

Peitian Village, China 2016

The Wind and Rain Bridge is situated on the outskirts of the Peitian Village in the Fujian Province, China. This bridge was designed to be constructed without the use of mechanical fasteners, being that it is a repetitive interlocking timber structure which draws on the tradition of timber structures in the region.

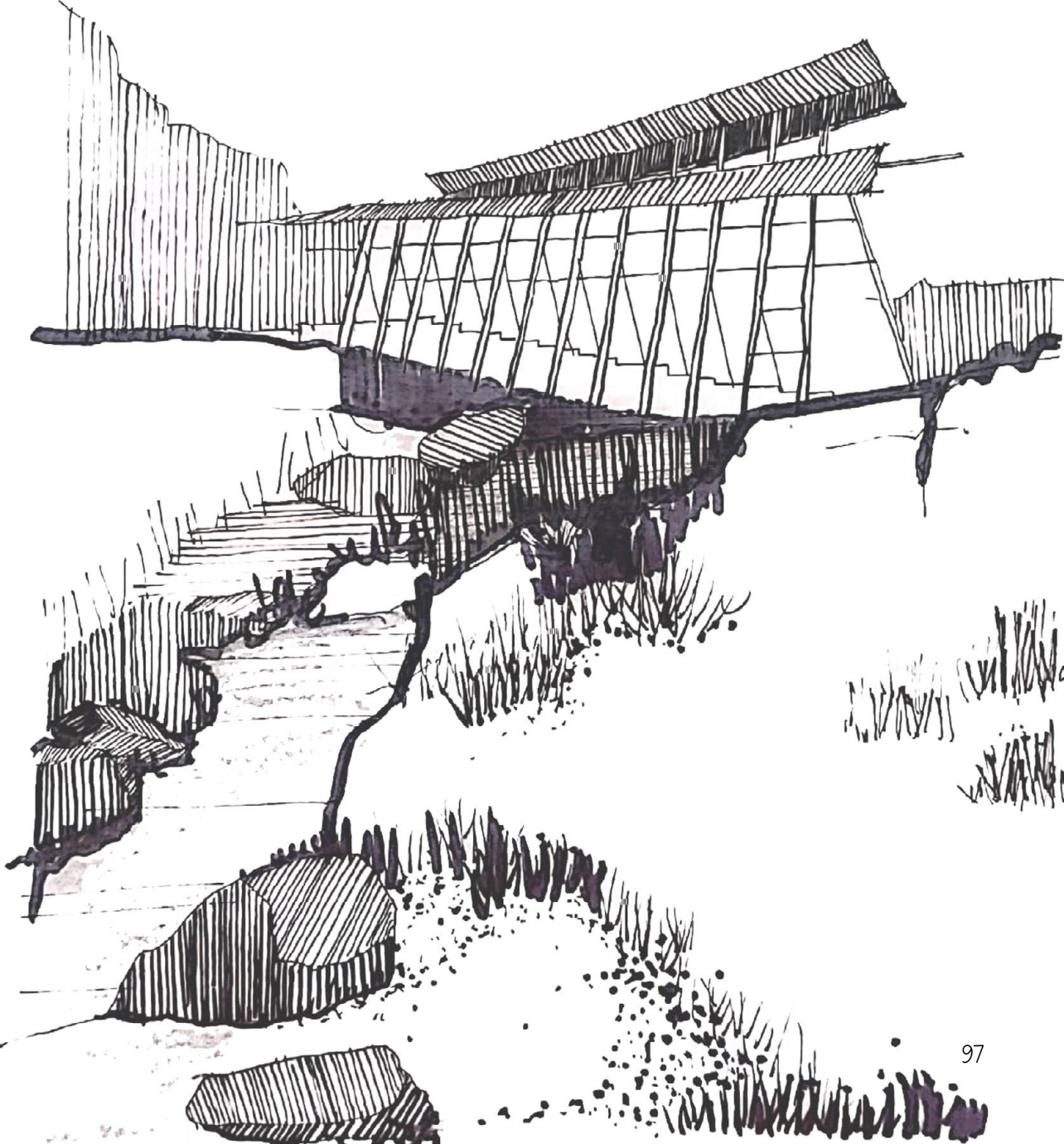
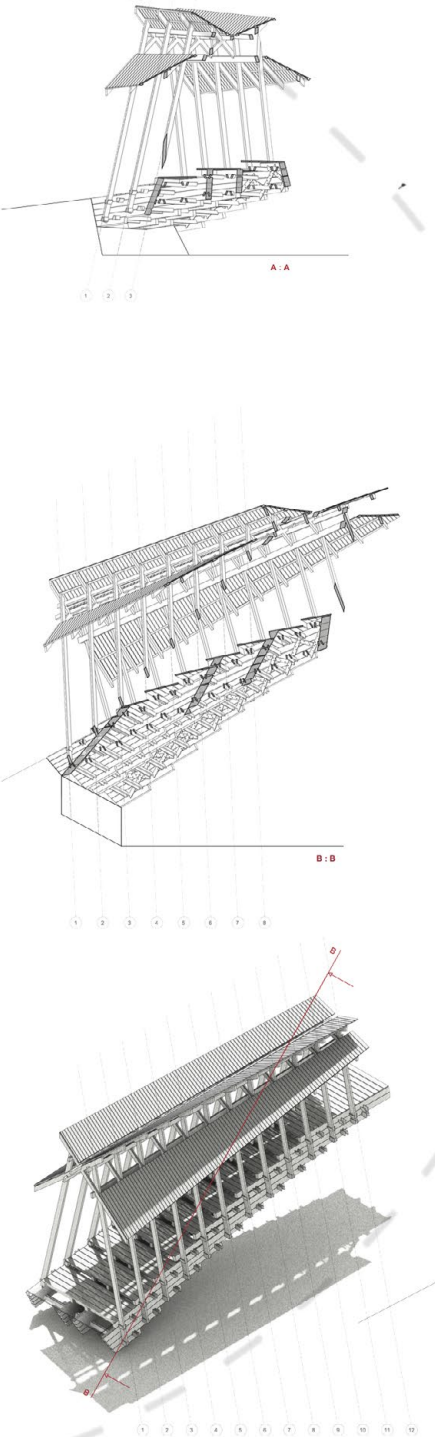
The bridge was constructed by some 70 students from the University of Hong Kong, as part of the introduction to an architectural design course. The construction was overseen by traditional carpenters with the end result being a community structure that restores the network of routes often destroyed by severe floods. The bridge thus creates a community space, where locals can gather socially and exchange goods. The bridge negotiates the ever-changing terrain due to floods and creates a place of safety from the ever-changing climate.

The landscape surrounding the Peitian Village can be classified as a romantic landscape. The area is lush, with dense vegetation and a river running alongside the village. However, this river tends to flood, particularly in rainy seasons, making it impossible for pedestrians to access farming land on the other side of the river.

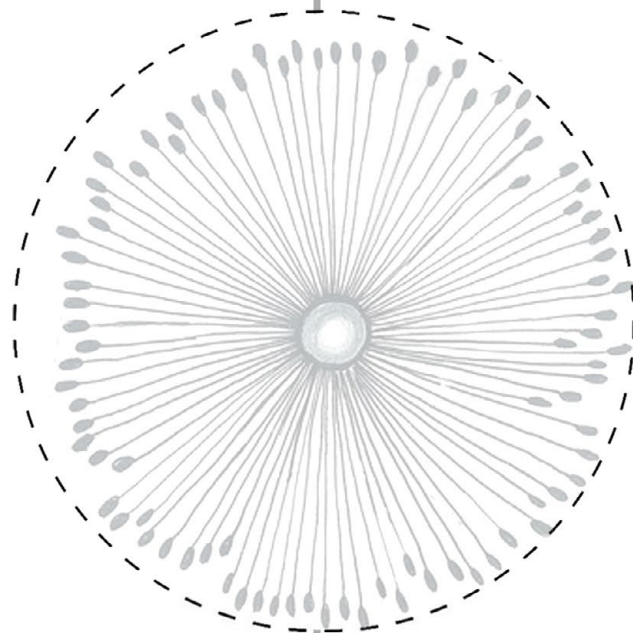
Integral to this design were the digital design methods, which created the means to plan and test the possible design solutions. In this way, finding the best solution for the complex assemblies employed by the traditional carpenters and students. The structure is constructed using a repetitive interlocking system of timber pieces.

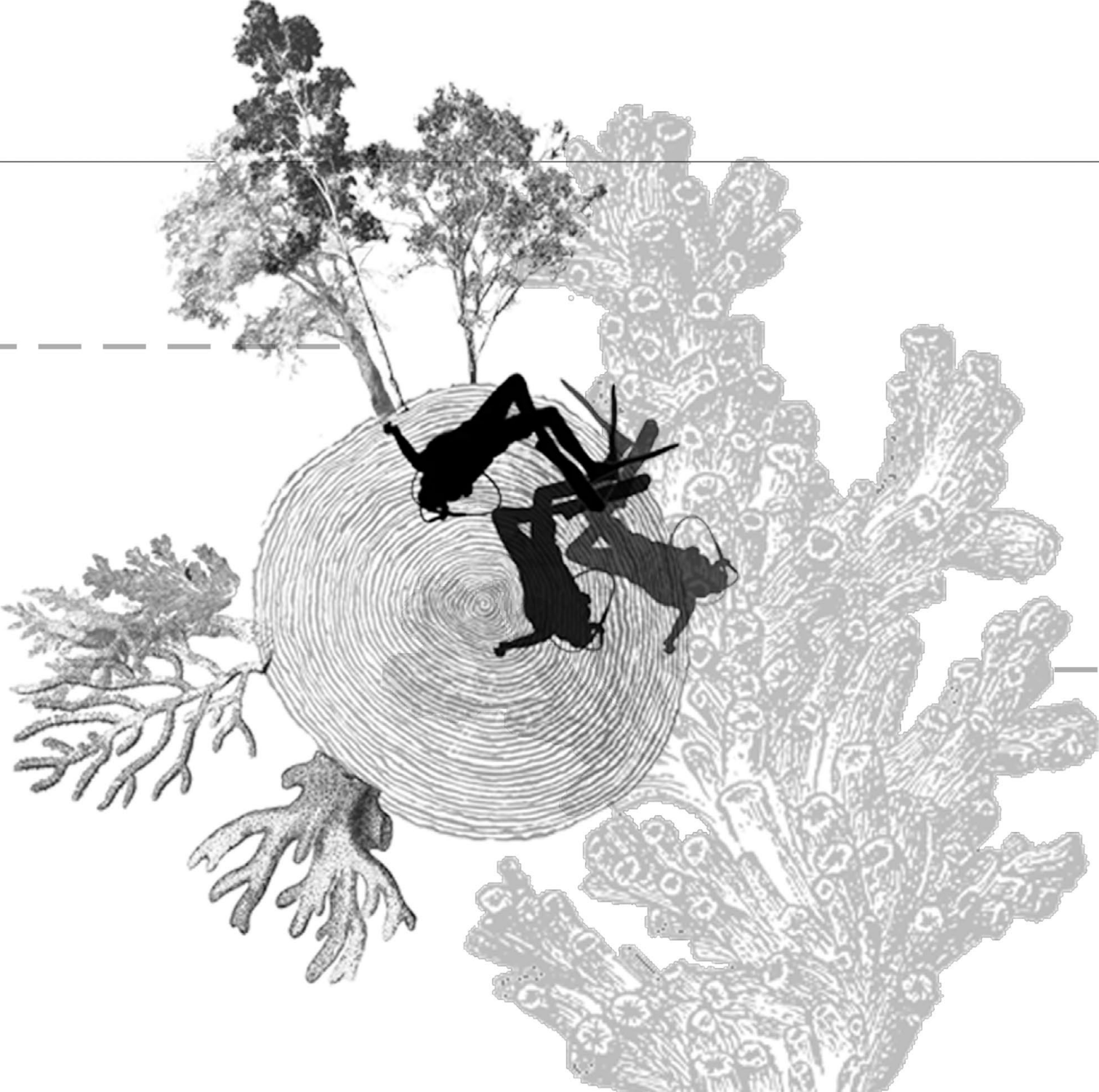
In terms of the concept of engagement, this structure creates a platform for users to actively engage with each other daily on the bridge. This active engagement is supplemented by the use of the structure in a more passive sense, being the means of connection to the adjoining farm lands.

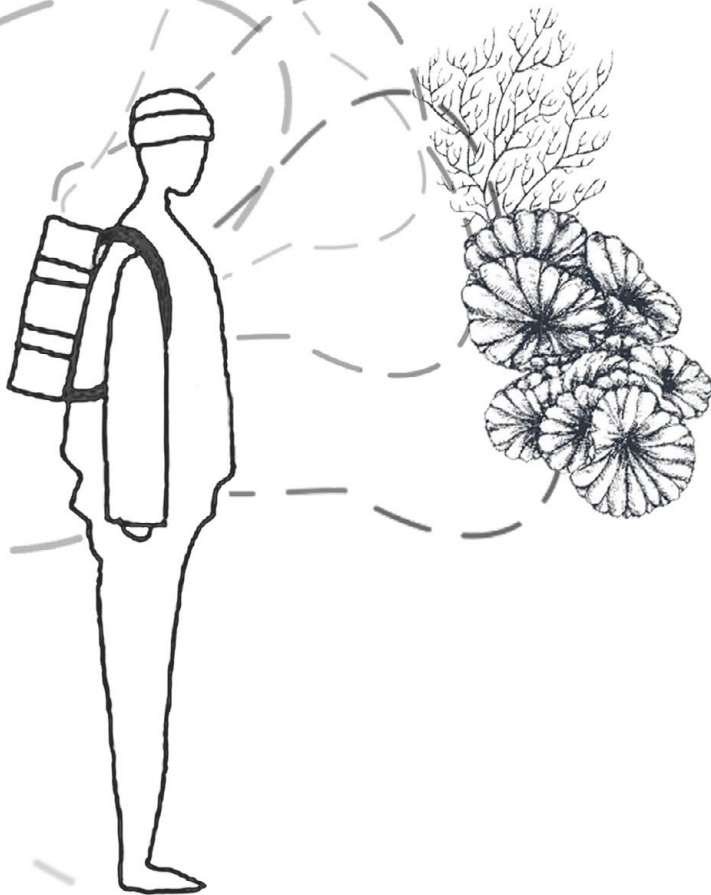
Figure 61 Author, 2020.



# 05 theoretical underpinning







## 5.1. Bridging the gap between eco-and phenomenology

In some sense philosophy can play a role in the way in which we orientate ourselves within the world, and even in nature. Often, without knowing it, we as human beings interact with our emotions when we encounter a new experience. In that moment, we come face to face with the metaphysical side of the experience and are left with the rich memories thereof. These experiences and memories can leave a lasting impression and, in some cases, spark inspiration. This can, in my opinion be referred to as a philosophical interaction of sorts.

This philosophical interaction can occur in the form of either physical or metaphysical experiences, being guided by philosophical principles. For example, Martin Heidegger, a philosopher whose main interest was ontology, also referred to as the study of being (Korab-Karpowicz, 2020: Online) which can be explained as there always being a certain mood present, which comes from either our physical surroundings or our internal afflictions or metaphysical minds (Wheeler, 2020: Online).

Heidegger argues that we ordinarily encounter objects which he refers to as equipment. We come across this so-called equipment in everyday tasks such as cooking

with a spatula for example. According to Heidegger, it is when using the equipment, like a spatula, that we form our most intimate relationship with the equipment (Wheeler, 2020: Online). Not by simply just viewing the equipment or by some theoretical study of it, but rather by experiencing it.

For example, hiking shoes or an oxygen tank only gain their true meaning once used in the act of hiking or diving. It is then that humans form their most intimate relationships with the objects. I believe this can be said for abstract encounters as much as for tangible objects, like the memories one is left with after a hike through the forest or diving in the depths of the ocean.

This concept of “being” is rooted in the principles of phenomenology. Phenomenology takes its starting point in somewhat of a return to the “things” or “matters” themselves, that is, the world as we experience it (Back to the Earth Itself, 2003: xi). In other words, phenomenology focuses in on the root of something, whether it be an experience or an object. Our experiences with nature, for example are birthed through the appreciation that we as humans have for nature and its beauty, like the appreciation for coral reefs when diving.

It is this very appreciation that triggers our sense of responsibility towards nature and its preservation. Here turning back to the “things” of nature themselves and our moral obligation to protect them (Back to the Earth Itself, 2003: xi). Therefore, due to the phenomenological experience with nature we re-orientate ourselves within nature, and our role towards nature and its preservation. This experience with nature and our resulting role of care towards it can be seen as an example of a philosophical interaction.

Nature can inevitably not be without such experiences stemming from its magnificent qualities. Neil Evernden has argued that the approach to strip nature of its experiential qualities’ leaves behind an unrecognisable abstraction (Back to the Earth Itself, 2003: xi). An abstraction that could never have inspired our initial appreciation for nature.

Thus, nature cannot be removed from experiences, as a mere object with no emotional attachments to it. Nature is an all-encompassing experiential world, rich with emotion. It is this emotion experienced within nature that brings about the afore mentioned moral obligation to protect nature.

This experience with nature, its beauty and splendour is defined as eco-phenomenology. Eco-phenomenology being birthed from an ecological thinking with phenomenology, essentially the interrelatedness between an organism and its surroundings and the meaning it holds (Wood, 2001: Online). Eco-phenomenology unveils our myopic relationship with nature, changing the relationship from one defined as anthropocentric to one concerned rather with nature in but a simple moment.

This moment of unveiling is what Edward Casey refers to as the “first moment of noticing” that is of critical importance for the future reflection on the experience (Back to the Earth Itself, 2003: xi). The future reflection being the basis of eco-phenomenology. Put simply, the idea of eco-phenomenology is the replacing of some of our deeply-engrained and destructive rituals which are detrimental to the environment, with new ways of thinking and experiences that can assist in healing the environment.

With the imminent threat of coral bleaching destroying not one, but many ecosystems, the concept of eco-phenomenology is very much applicable in this scenario.

Man came to the so-called “first moment of noticing” when the first mass coral bleaching event occurred in 1998 and the latest event occurring in 2017 along the Great Barrier Reef, with many more occurring in between (AIMS, 2020: Online).

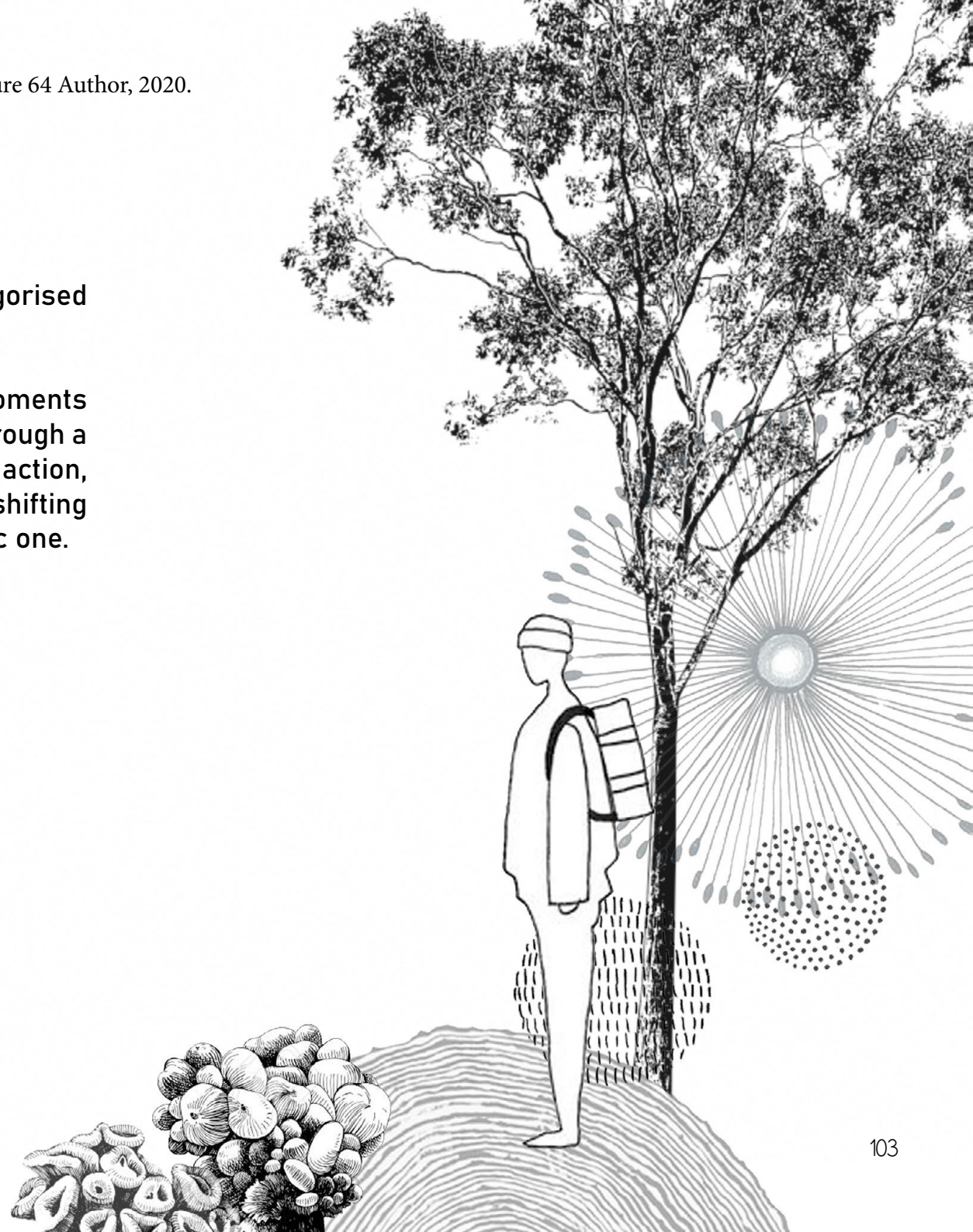
However, this pandemic does not just affect the Great Barrier Reef, as all coral reefs are susceptible to such bleaching events with the rise of global warming (NOAA, 2017: Online). This “first moment of noticing” has sparked world-wide research into the preservation and rehabilitation of coral reefs. Man has re-realised his moral obligation to nature through the experience of seeing it die before his eyes.

Therefore, man is the bridging element between eco-and-phenomenology. Man, through an initial moment of realisation can take action in the preservation of the earth's ecosystems. This action is both physical and metaphysical as man immerses himself into the process. The intervener between earth and sea is man who morphs to better navigate his surroundings. Man, morphs to better return to nature. From land to sea, from eco to phenomenology. These moments where man morphs in form, from walking upright on land to

Figure 64 Author, 2020.

swimming horizontally in the ocean can be categorised as moments of being.

Central to these philosophical interactions or moments of being is eco phenomenology. In which man, through a culmination of thoughts and memories springs to action, a pursuit of restoration and preservation. Man, shifting from the anthropocentric nature to an ecocentric one.



## 5.2. Moments of being stemming from eco-phenomenology

Naturally, to experience any moment of being, one's thoughts are central to the process. Before man can jump to any sort of action, thoughts first run through the mind contemplating the outcome and the inherent value thereof.

Heidegger has classified mankind's ways of thinking in two ways, meditative thinking and calculative thinking. Calculative thinking, according to Heidegger is the mindset that only recognises things that can be counted or measured, taking into account only quantity and not quality. A mode of thought in which the questions about existence become merely numbers and scientific representations (Kennedy, 2014: 35).

On the other hand, meditative thinking is a mindset that is capable of reflecting on the unquantifiable whole, as it contemplates all meaning associated with the whole (Kennedy, 2014: 36). This type of thinking appreciates the worth of a thing and its possibility of attaining additional worth. This way of thinking is tied to eco-phenomenology, where man has had his "first moment of noticing", which transforms into an appreciation of a thing, its value and possible additional value.

It is this type of thinking that occurs to the hiker as he overlooks the mountain ranges and imagines a meaningfulness in the landscape that far exceeds the value that might be attached to the personal benefits he receives from his journey. Being unable to describe the sheer brilliance of the scene in words. In essence meditative thinking allows for the mind to escape the physical body, assigning much greater value in the emotional sense than just the physical benefits of say exercise while hiking (Kennedy, 2014: 37).

Similarly, just as the hiker enters a meditative state of inexplicable thought so does the diver in the ocean deep. The diver enters into a world unknown to many, a world hidden, just under the transparent waters, so to say.

The diver-thinker has inexplicable emotional attachments to the surrounding scenes; the meaning of which he cannot put into words. There is a certain meaningfulness in the coral reefs that can never be fully grasped by his mere explanations thereof. There is a hope that the next time, there will be new discoveries to be made and that the corals will reveal themselves in a new way.

It is in these moments of meditative thinking that there are moments of being, of phenomenological experience; moments that are, both independent and intertwined with the diver. Meditative thinking, in being open to that which goes beyond our conceptual ideas, acknowledges our central inability to comprehensively state a thing's meaning.

This is the beauty of a thing, such as coral. In that no means of explanation can fully describe its beauty until it is experienced for oneself. The moment of noticing translates into a moment of being, where the organism and its surroundings create a life-world of experiences. Each life-world varying from the next life-world and each moment-of-being varying from the next moment-of-being.

The meaningfulness of a moment is however not dependent on man's experience with it, the meaningfulness of the coral reef is not decided by man, the meaningfulness springs from the sheer existence of the reef. Man, simply appreciates it.

Moments in nature can be "framed" and appreciated, this concept of framing or highlighting moments are translated into moments of architectural intervention.

This appreciation of nature has led to man's pursuit to draw near to it even when it may seem far. The creative nature of us as beings with life-worlds of experiences has culminated in the act of drawing near, mimicking.

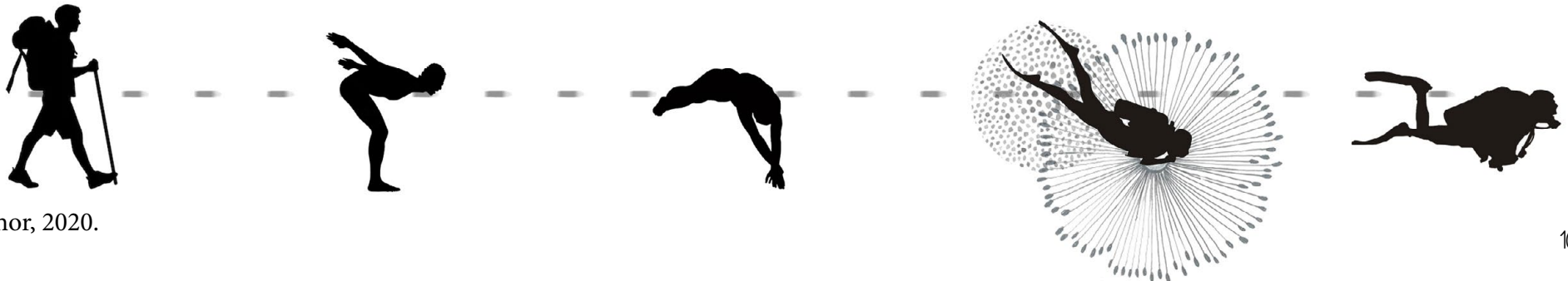


Figure 65 Author, 2020.

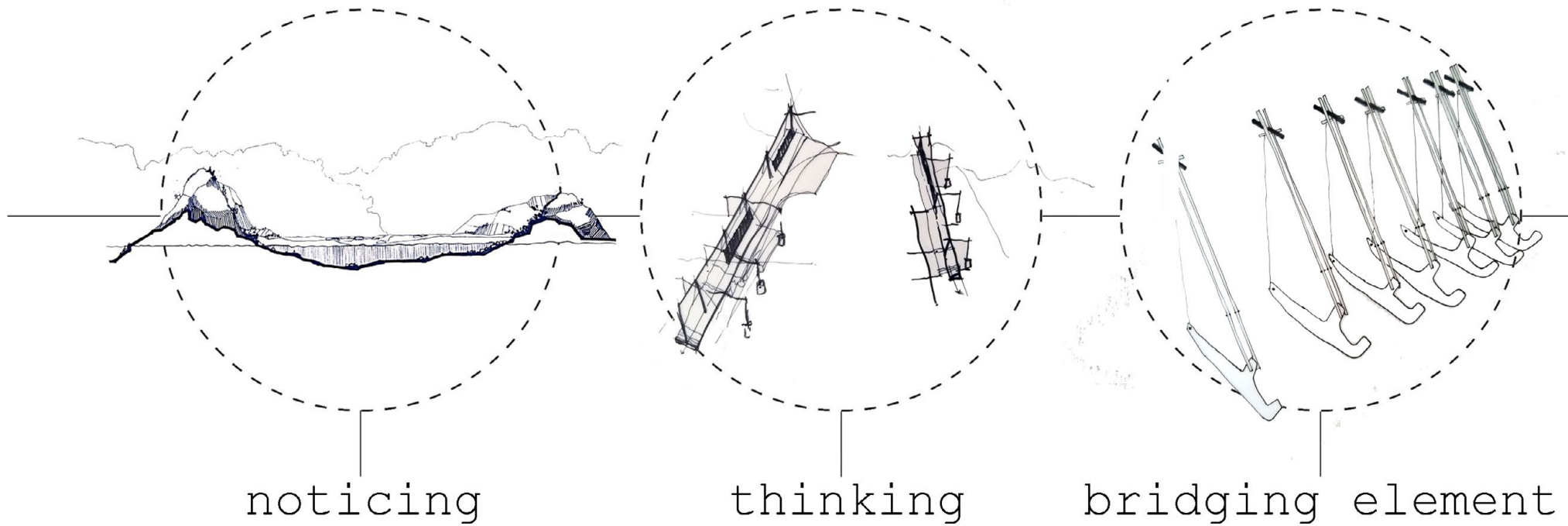


Figure 66-71 Author, 2020.

### 5.3. Bio-Mimicry as intervention

Man is born to create and often times borrows ideas from his surroundings. This type of borrowing or inspiration comes from the act of drawing near to the immediate environment.

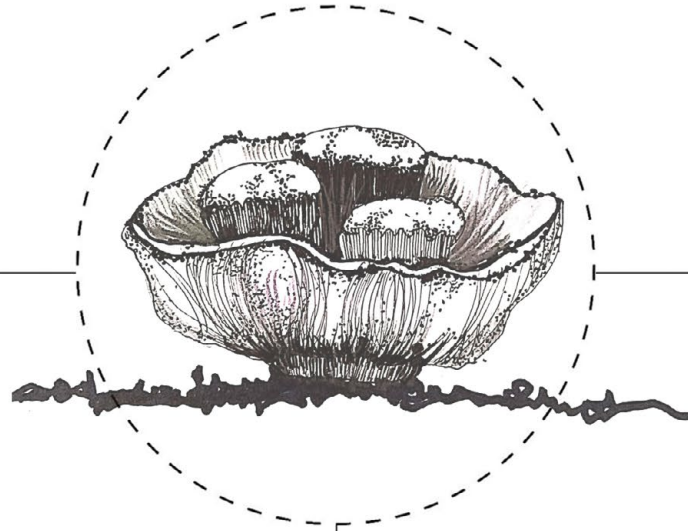
Bio-mimicry is a concept in design that draws near to sustainability and ideas of resilience from nature's patterns and solutions (Chen, 2015: Online). There has been much research done on this concept in the architectural field; for example, Wilfredo Méndez

Vázquez from the School of Architecture of the Pontifical Catholic University of Puerto Rico, investigated how structural components might borrow the form of bones. Analysing how different bones in the body grow and the shapes that they form.

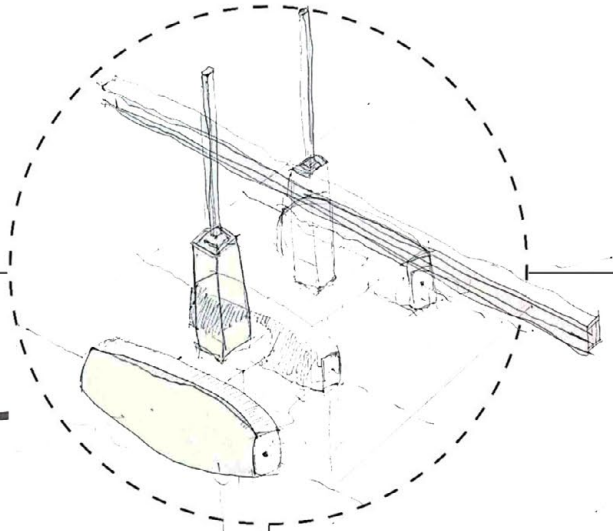
Similarly, coral reefs are investigated in the same way. Firstly, analysis of the way they grow, reproduce and form and secondly, translating these principles into architectural principles or moments of being.



reflection



meaningfulness



action

Coral reefs are underwater structures that provide shelter and breeding grounds to various types of marine life. The reefs are composed of calcium carbonate which is deposited through a combination of dead organisms into the water, which are then moved around by currents.

The binding material in the reefs that secures polyps to the structure comes from the attached occupants themselves. The reefs vary in size and shape depending on the density of the coral polyps and other organisms

attached to the skeleton of the reef. The skeletons of a coral reef have a generally high level of porosity which is due the skeletal material that is weaker than the organisms' skeletons that attach to it. The coral reef skeleton does not absorb nutrients, thus is more prone to fracturing. However, the coral skeleton, even though it is more delicate when compared to its occupants, has a strength comparable to concrete (Chen, 2015: Online).

A coral reef's adaptive nature allows for the reef to decrease its porosity by adapting its skeletal growth in areas that might experience higher stresses or forces from ocean currents by increasing its strength in these areas.

Coral is, therefore, a resilient animal in terms of its skeletal structure; however, it is the coral polyps themselves that are at risk of coral bleaching. When coral bleaching occurs, due to rising temperatures for example, the coral polyps expel an algae called zooxanthellae, which drains the corals of their magnificent colours.

At this stage the corals are not classified as being dead, rather just bleached. However, should the stress levels not subside and allow for the coral polyps to recover then the corals do die. Therefore, research needs to be conducted in further understanding how coral polyps can adapt themselves to changing conditions.

These concepts of a coral reef's skeletal structure and the polyps attached to it, as well as the corals livelihoods can be analysed and translated into architectural principles and moments of being. As a result, bio-mimicry principles are enacted into design elements.

As can be concluded from the above findings, man has an inexplicable relationship with nature, which prompts a sense of responsibility towards it and a sense of care

for it. Man, always returns to nature, drawing closer each time.

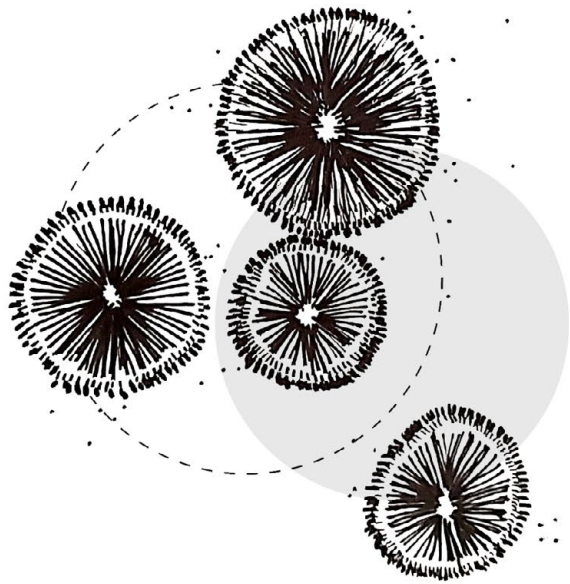
Nature is an all-encompassing experience, which often leads humans to question their experiences and the values they may hold. We can learn from these philosophical ideas and translate them into architecture, meaningful place making, which celebrates and preserves nature, specifically coral reefs in this case.

This type of philosophical study prompts design that draws near to nature and its possibilities. Learning from nature and adapting to nature which can be seen in Figure 72 to the right, where a manmade structure aims at accommodating the natural occurrence of the growth of corals.



Figure 72 Author, 2020.

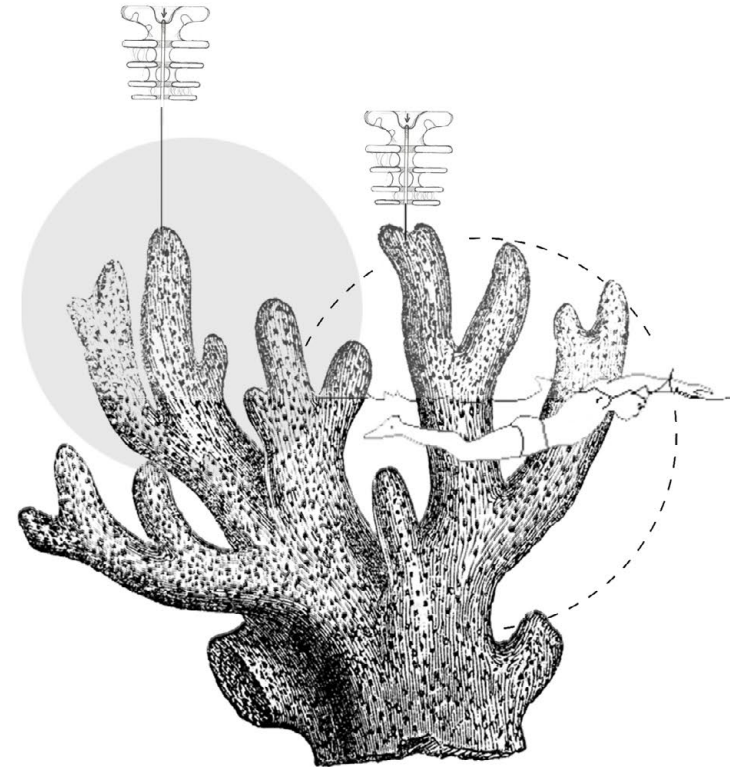
# 06 lessons learnt in the conceptual phase



## An analogy with coral

### UNDERSTANDING THE ANIMAL

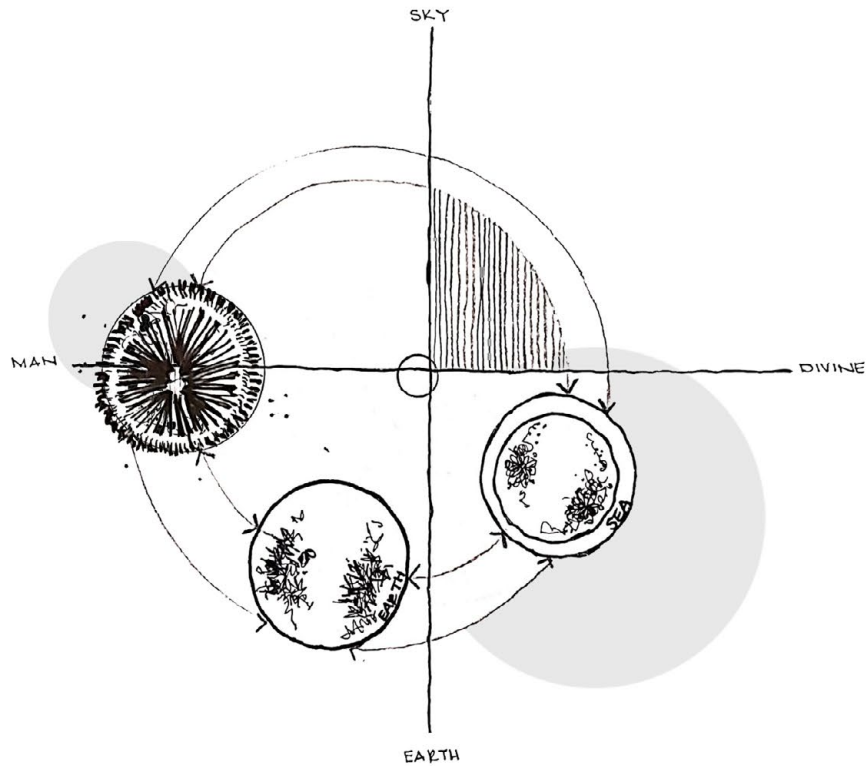
Coral polyps have various architectural complexities with regards to their structure and how densely they occupy a reef. Corals are magnificent creatures with many hints that can be employed as design principles.



## Coral farming

### THE POSSIBILITIES

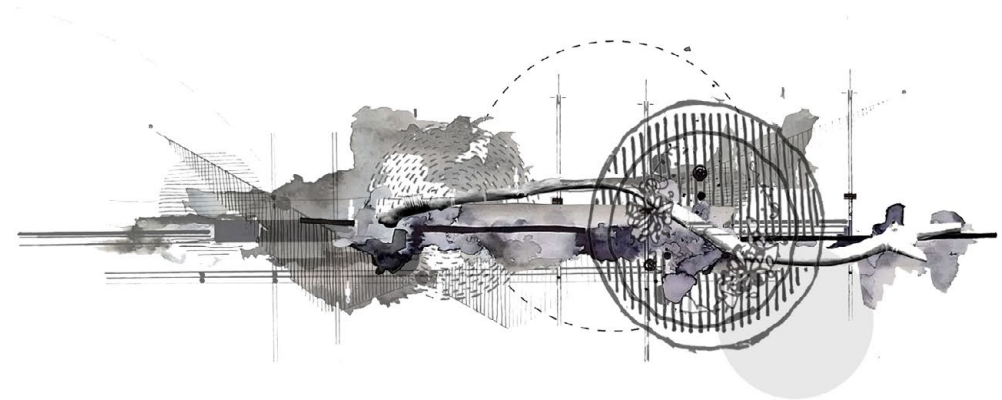
The various possibilities within coral farming and rehabilitation as well as the means of their construction are valuable lessons learnt for design development.



## Touchstone

### THE INITIAL STEPS

The touchstone prompts the theoretical underpinning, introducing the three "macro" elements on site; being the earth, the ocean and man who acts as mediator between them.



## Concepts models

### FURTHERING THE INVESTIGATION

The three concepts of interrelatedness, narrative and engagement further explore the three "macro" elements on a more indepth level, further applying theoretical concepts to them.





03

# design synthesis

this part of the document will take readers through the design process,  
theoretical discourse and final design outcome



# 01 *concept to form*

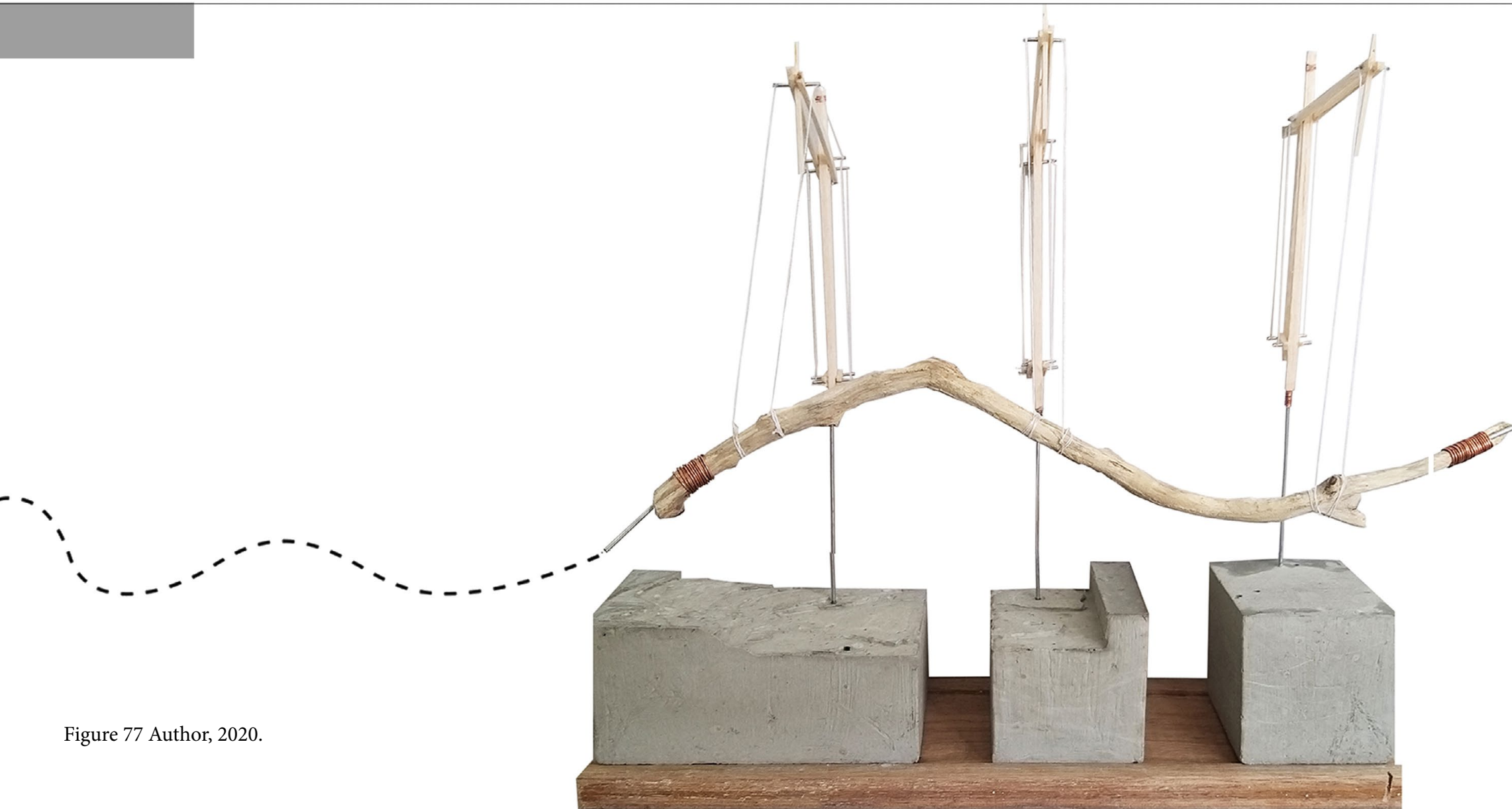
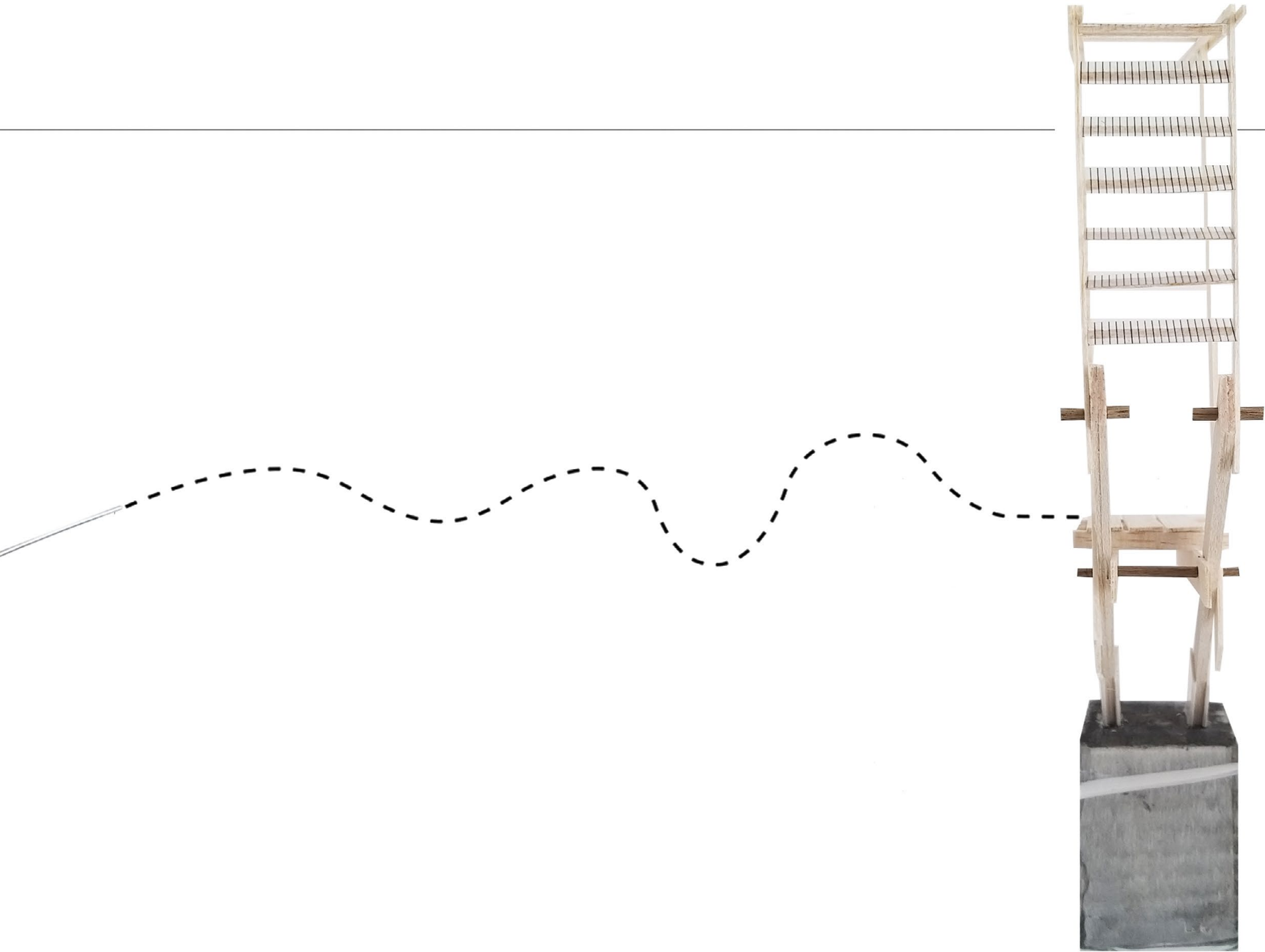


Figure 77 Author, 2020.



## 1.1. Investigating coastal management systems

### 1.1.1. An analysis of a dolos

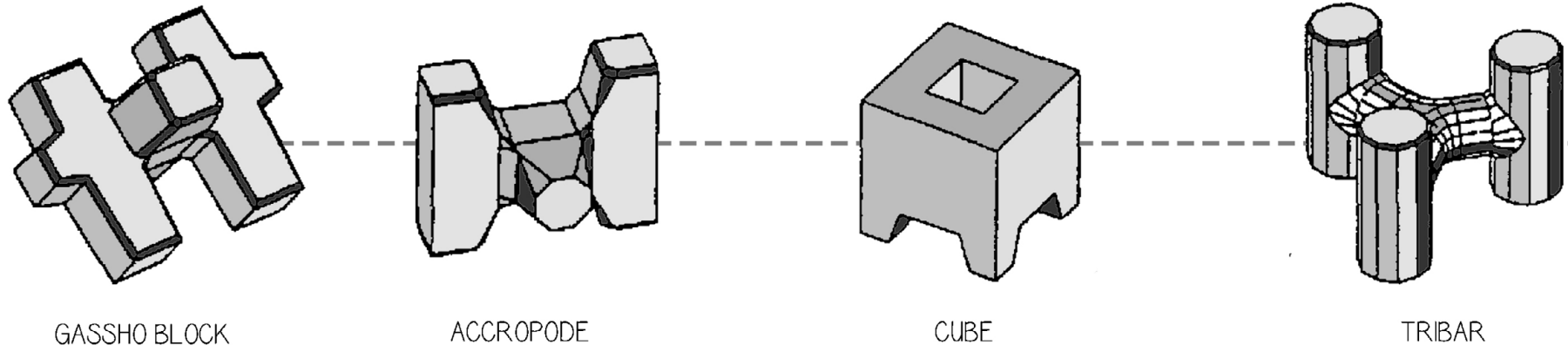
A dolos is a concrete block that comes in the form of various complex geometric shapes. These elements are used in large amounts as a form of coastal management. The various dolosse are placed on top of one another along coast lines to protect the coast lines against the forces of waves, dissipating and absorbing these forces (Opinion, 2016: Online).

The dolos was designed by draughtsman Aubrey Kruger, in 1963, with the first dolos being laid in East London in 1964 (Opinion, 2016: Online). The original dolos morphology was that of a twisted H shape, however today various designs are available and used across the world as seen below.

Dolosse are made by casting concrete into steel moulds and are in most cases unreinforced, however, steel fibres are sometimes added to the concrete mix for reinforcement (McKee, 2007: Online). Dolosse are usually placed along coast lines by means of a crane system that is placed either on land or on a boat.

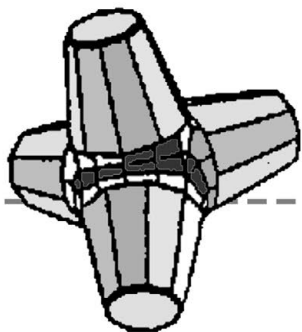
Dolosse are an interesting coastal study to look at due to their specific means of construction and placement. Dolosse due to their sheer size and robustness absorb forces exerted by the ocean, which is a valuable design tool to take into account when designing structures in and around the ocean. Another interesting key point about a dolos is its ability to be stacked in various layers.

Figure 78 Author, 2020.

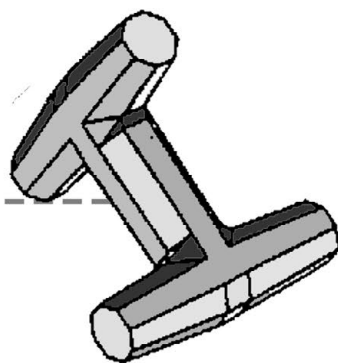


Therefore, the dolos is a diverse structure in terms of its design capabilities, and its means of construction and placement in the ocean are vital to this design investigation.

These concepts of the robustness of a dolos and its force absorbing qualities was investigated in the concept model as seen on the right where the dolos component acts as the underwater reef element onto which a structure can latch.



TETRAPOD



DOLOS

Figure 79 Author, 2020.

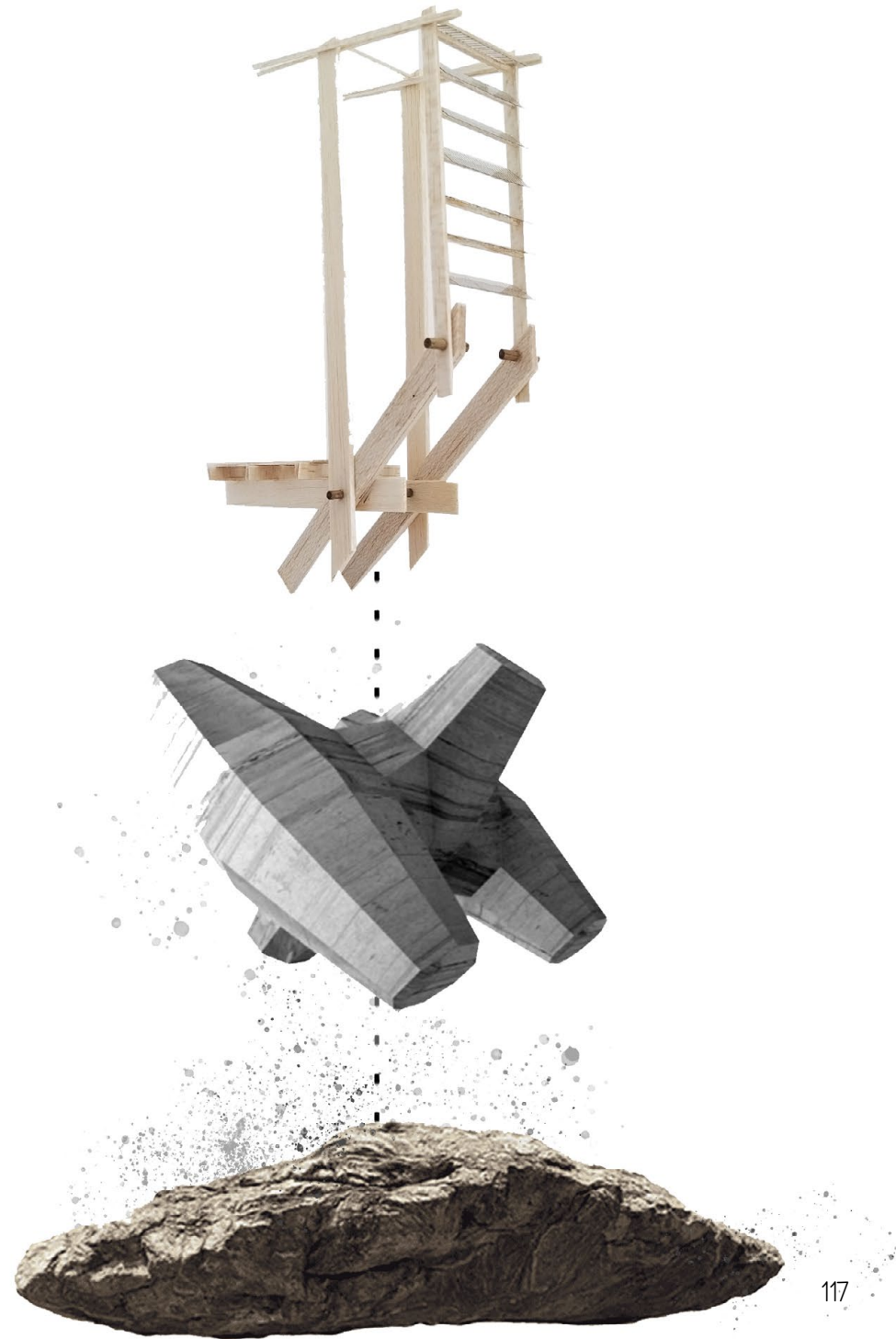
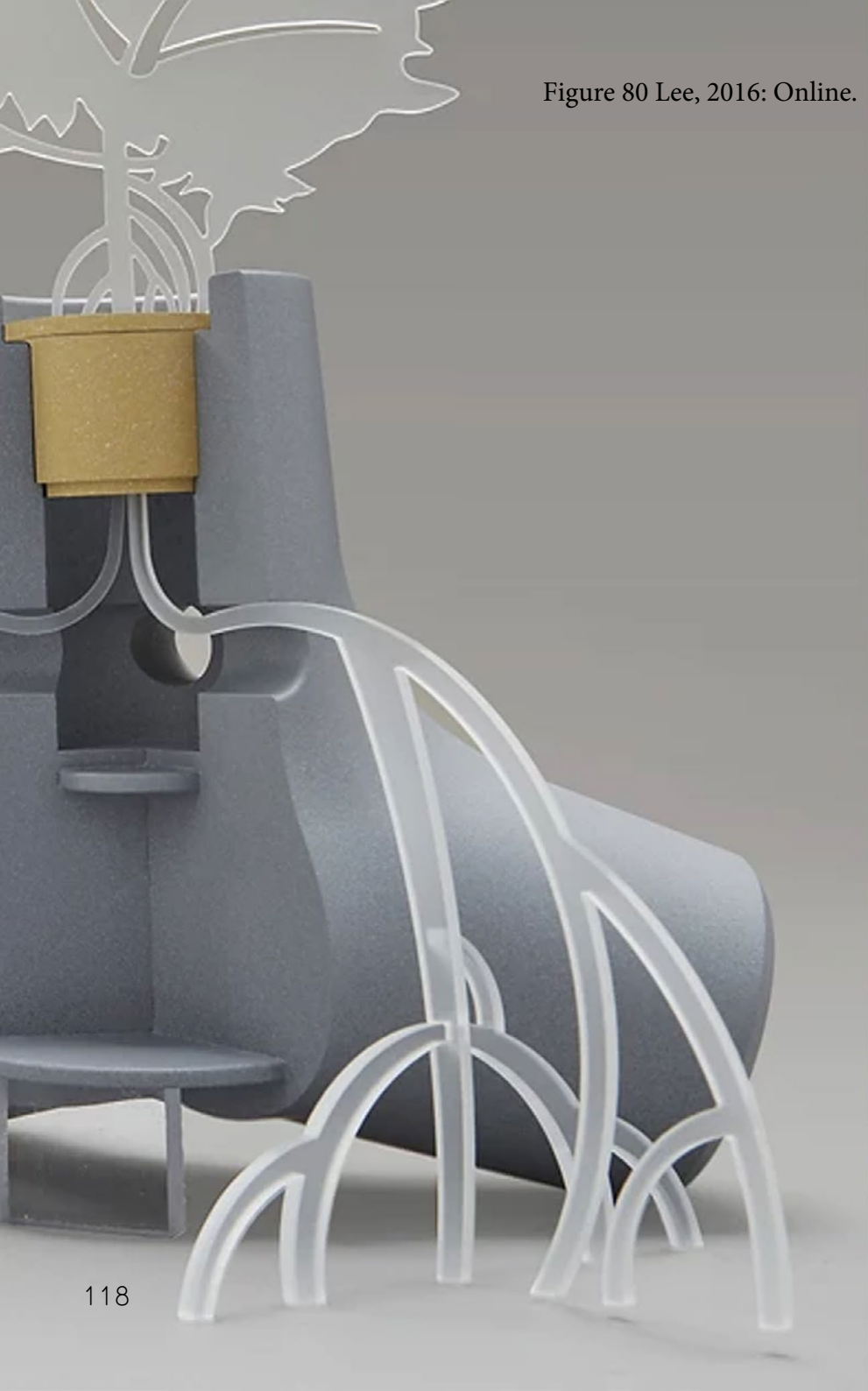


Figure 80 Lee, 2016: Online.



### 1.1.2. The dolos transformed

The TetraPot is a design inspired by the dolos, adapting the design to accommodate mangroves. The TetraPot is designed as a hybrid between artificial ocean defence methods as well as natural sea defences that occur naturally (Wang, 2016: Online).

This design adapts the morphology of a tetrapod dolos, leaving behind only the outer shell to allow for mangroves to grow within the structure. This allows for the mangrove roots to grow safely within the shell and allows for a dual oceanic defence system of a combination of the robustness of a tetrapod and the natural strength of the mangrove plant.

The TetraPot is partially hollowed out to allow for the insertion of a biodegradable pot for the initial stages of growth of the mangrove plant. With rising tides, the organic pre-seeded layers decompose allowing the mangrove trees to expand their roots system (Wang, 2016: Online). Over time the roots from surrounding plants will join, and reinforce the strength of this defence system.

On the right the process of the construction of a TetraPot can be seen. This process is relatively similar to how dolosse are made. This is a process that can be implemented in the design process of an artificial reef system.

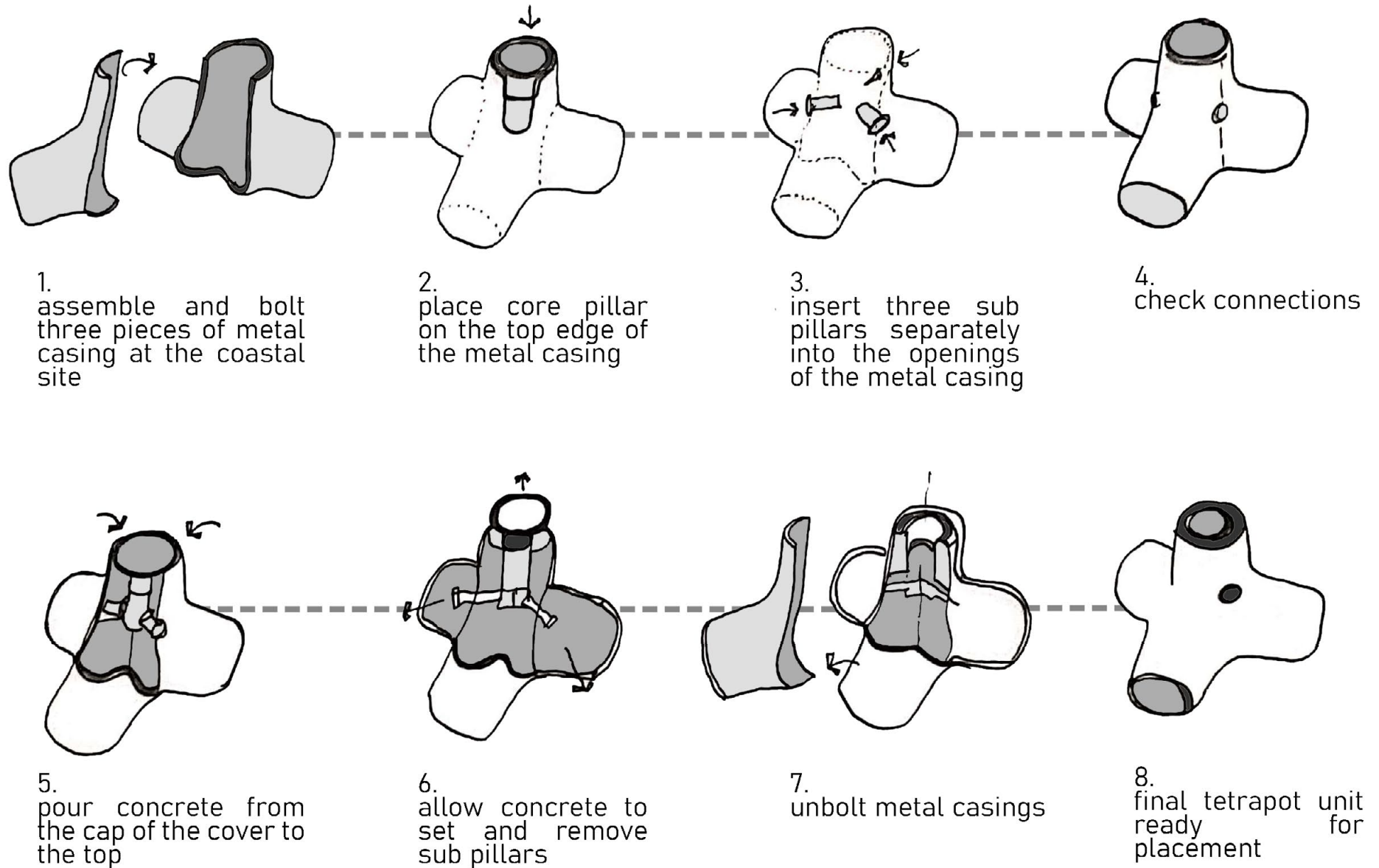
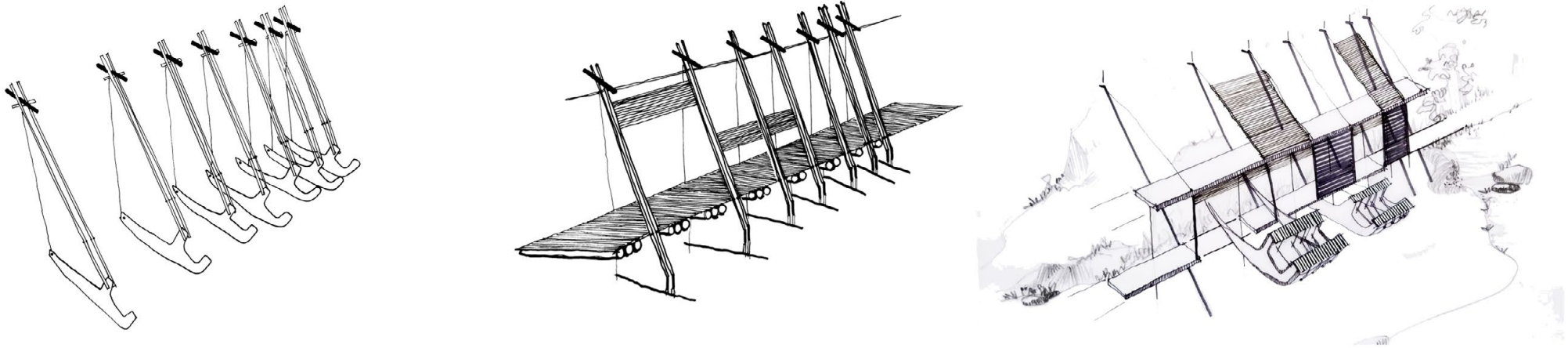


Figure 82 Author, 2020.



## 1.2. Exploring tectonics

### 1.2.1. Understanding how elements meet

This model investigates the connection of structural elements to the rock outcrops found on the Mooibaai site.

The model is comprised of three elements, each out of a different material. A 3d printed element, representing the 3d printed reef pieces that will be placed under the water level, shown by the white elements. The above water structure is represented by the timber material and then the naturally occurring landscape represented by the concrete element.

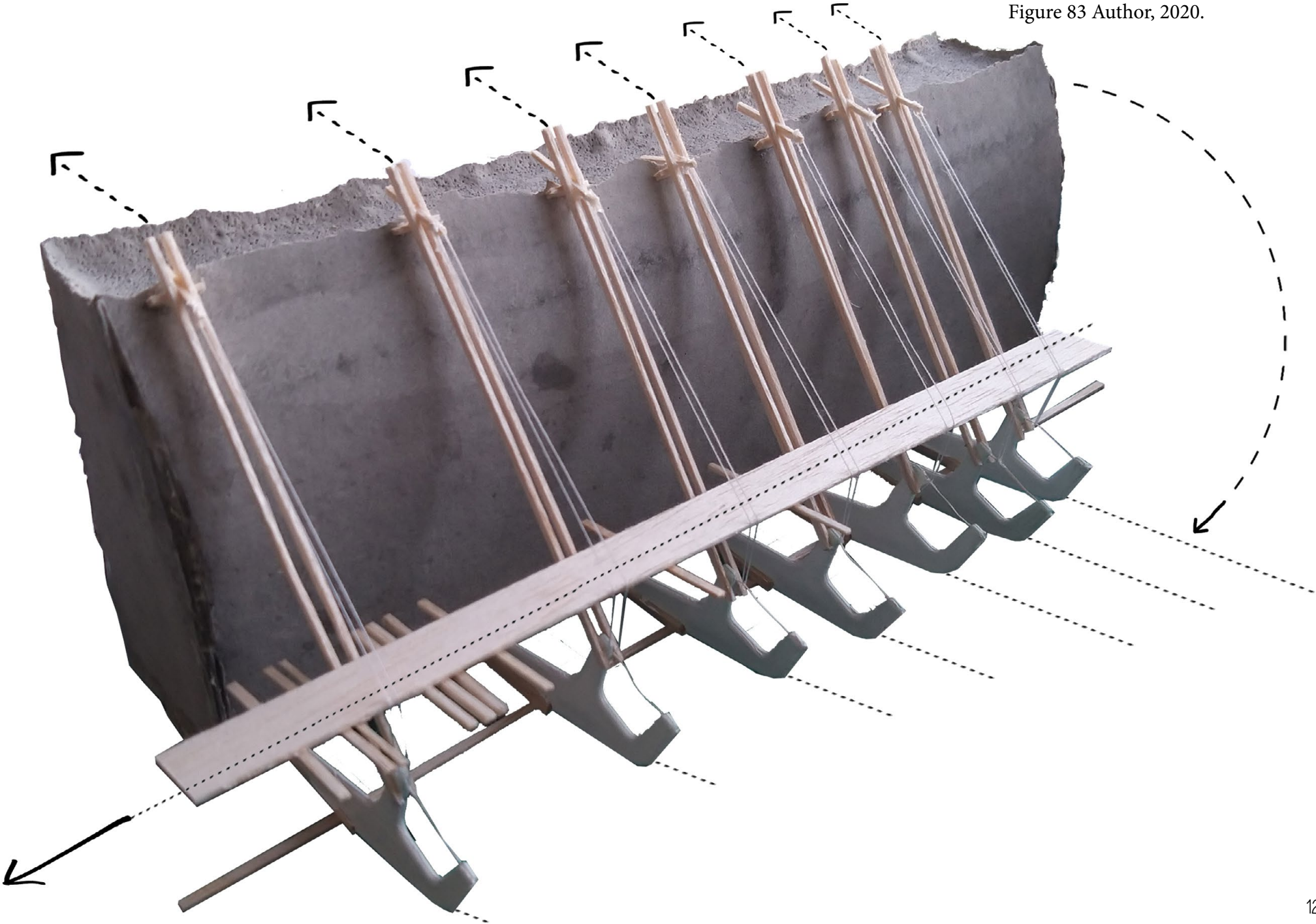
Exploring how the timber structure is suspended from the 'rock outcrop' and supported by the '3d printed reef' underneath.

This model explores how the various man made and naturally occurring elements can exist as a cohesive whole, the elements possibly being symbiotic.

The structure starts off as a skeleton structure that is fleshed out by means of skins over the structure, this can be seen in the sketches to the top.

This relates to how corals reproduce and attach to coral reefs. This concept of connection and separation takes lead from the theoretical principles discussed in the previous chapter, relating to the principle of eco-phenomenology.

Figure 83 Author, 2020.



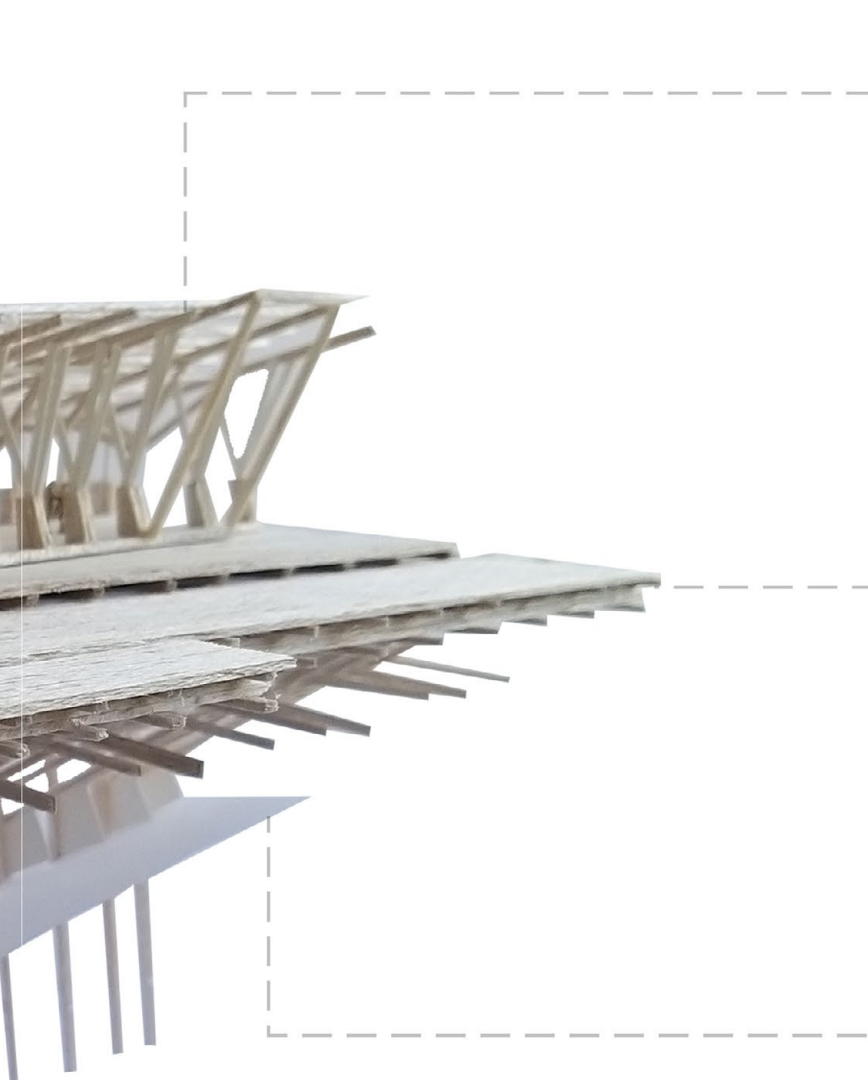
### 1.2.2. Investigating a symbiotic structure

This model investigates the conceptual and theoretical principle of bio-mimicry. This is done through investigating a structural system that employs similar principles researched in the reproduction phase of coral. When corals reproduce, as discussed in the previous chapter, they expel cells and essentially detach from the stationary reef. After the cells have combined in the waters above, they sink back down onto the reef, attaching onto it.

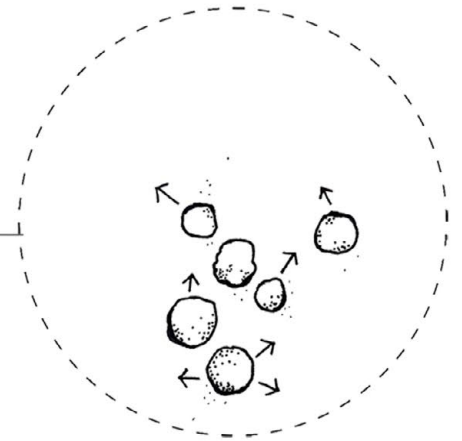
This process of coral reproduction was explored in this model by mimicking the process in the form of structural elements that can detach from each other and reattach. Theoretically this would occur as the tides rise and fall, allowing the building and the jetty element to detach from the underwater structure onto which corals could be transplanted.

This means of construction would allow for the structure to adapt to the changes in the ocean environment, much like coral farming aims to do when breeding super corals.

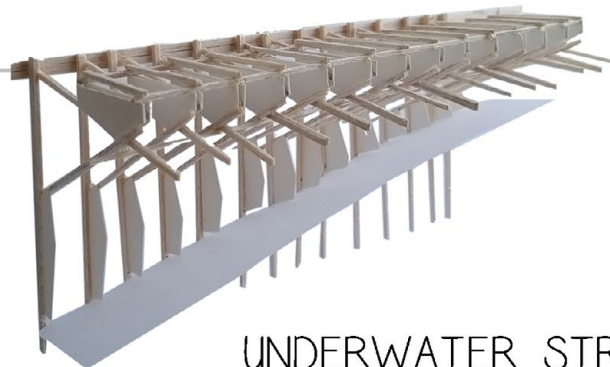




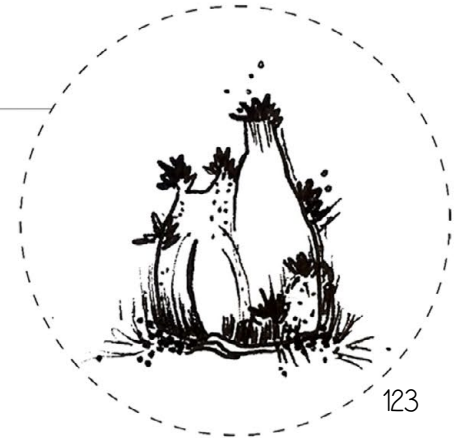
BUILDING



JETTY

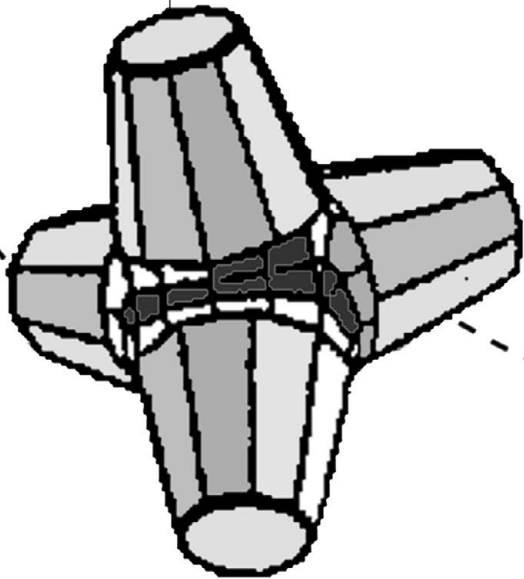


UNDERWATER STRUCTURE

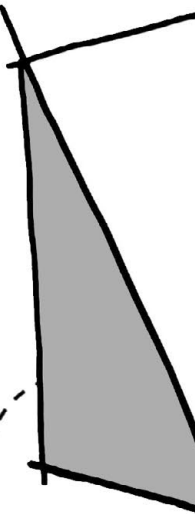
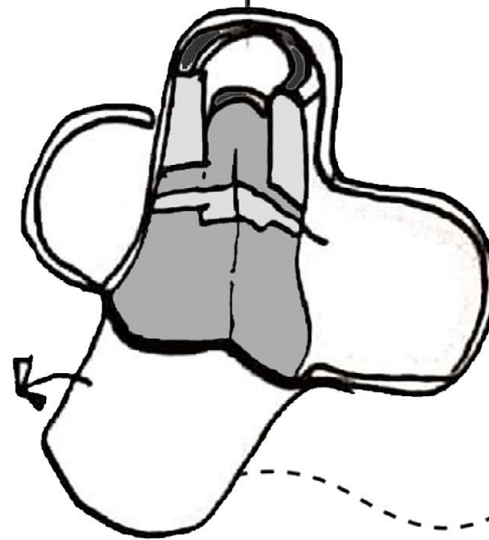
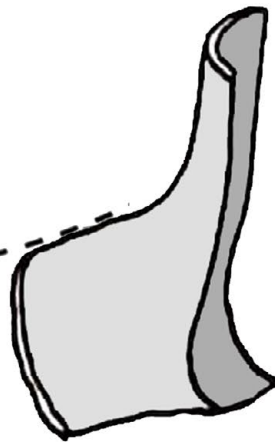


# 02 key concepts derived from investigation

robustness and strength of a dolos

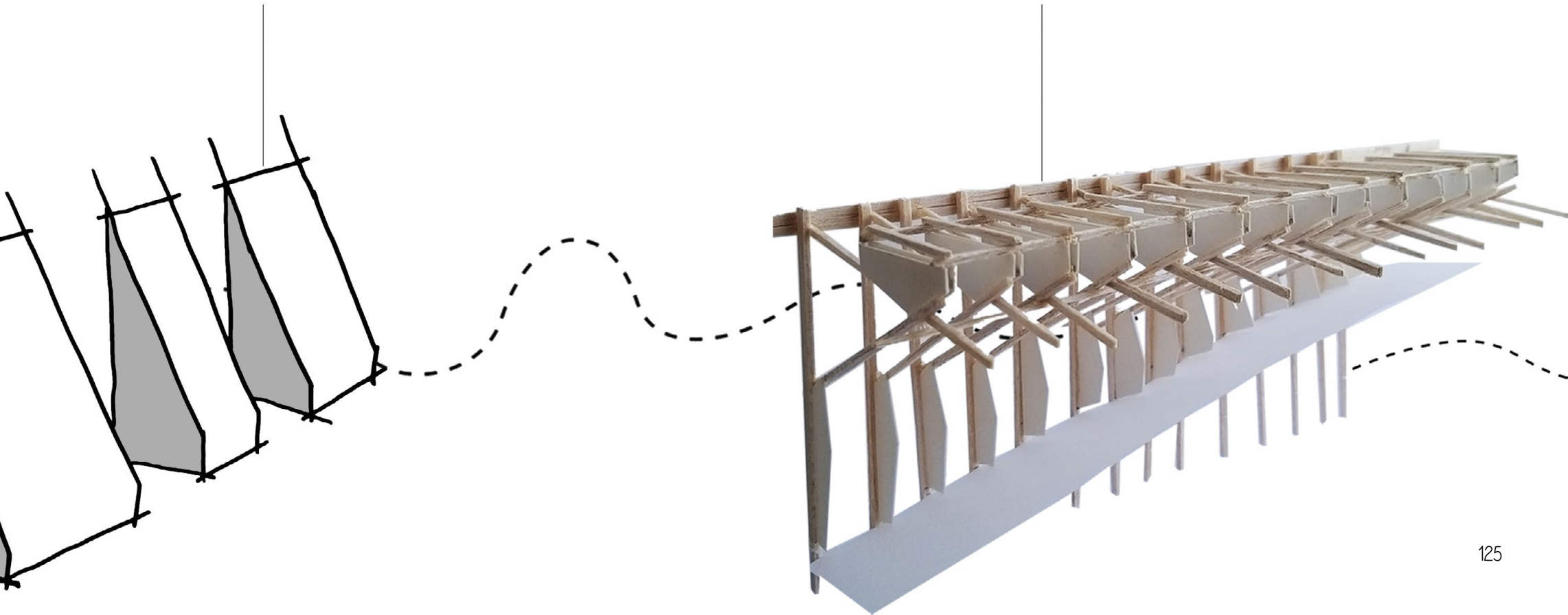


adaptability of a dolos



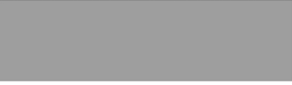
symbiotic structures within nature

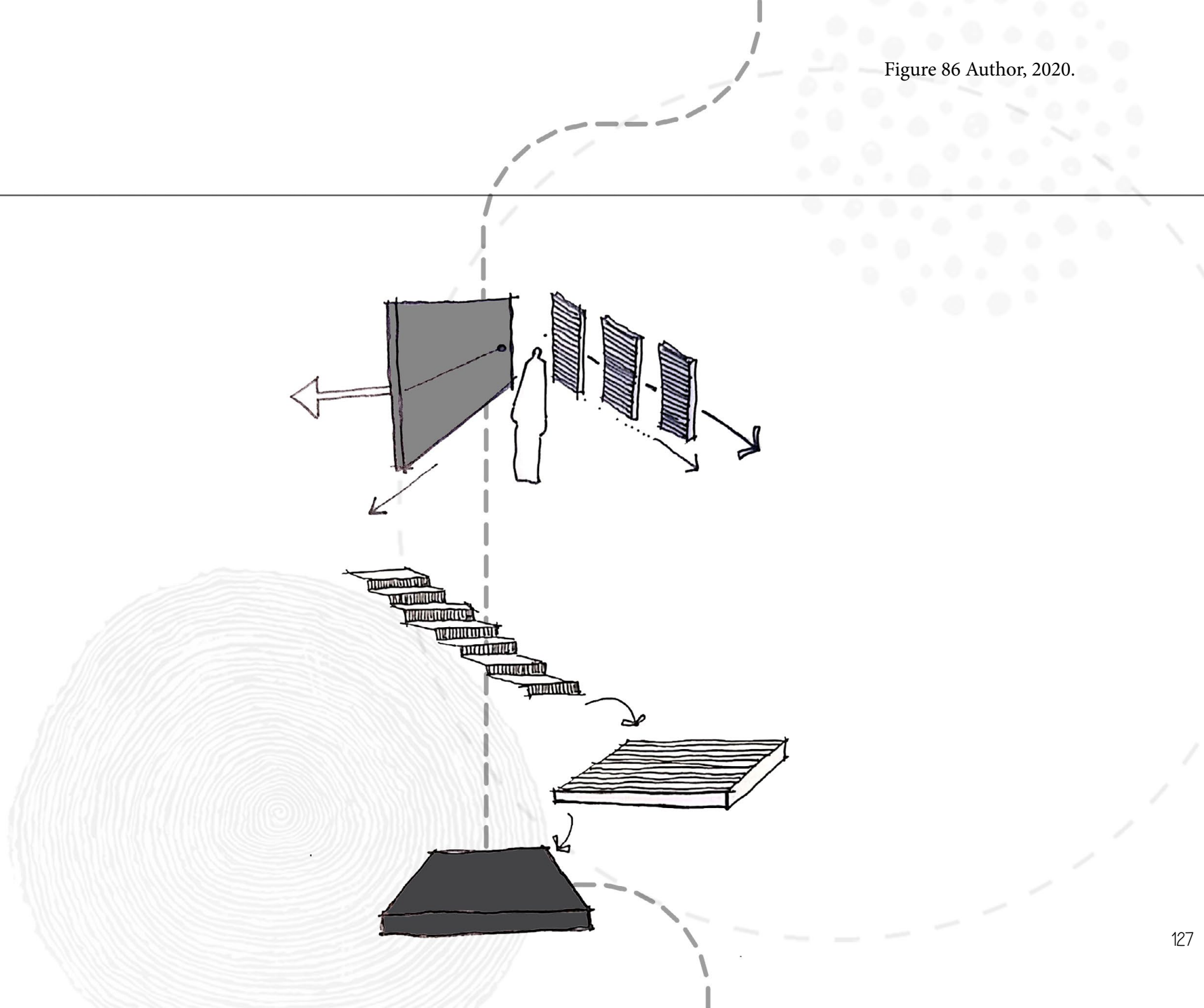
biomimicry as a design element



03 precedent studies

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### 3.1. A precedent study for designing in the environment

Bodrum Demirbuku Houses Club House  
Erginoglu & Çalılar Architects  
Year: 2017  
Area: 720m<sup>2</sup>

#### Location and Orientation

This project is situated in Bodrum, Turkey. Housing various lounges and meeting areas for visitors of the Bodrum summer housing complex to use. The site is a protected area surrounded by a 400m long sanded beach to the south which is directly connected to the green area to the north, only 100m away from the building. In this way the placement of the building brings the visitors into nature.

The projects surroundings bear similarity to the proposed site in Tsitsikamma, being between land and sea within a protected area. I believe I will be able to understand the architects approach to the site and building on a protected area through the study of this precedent.

#### Micro-Climate

Bodrum has a Mediterranean climate with a winter average high of 15 degrees Celsius and in the summer 34 degrees Celsius. In general, the summers are hot and humid and the winters are mild, but mostly sunny (Weather and Climate, 2020: Online).

#### Roof Choice

The structure is designed as a large platform that is shaded by a pergola, with the building inserted between the platform and pergola. The roof construction is a grid structure made out of light steel elements that are welded together. This grid structure is infilled with panels of timber slats which allow light to filter down onto the platform. The roof also has a more solid platform which acts as a rooftop lounge for visitors to use.

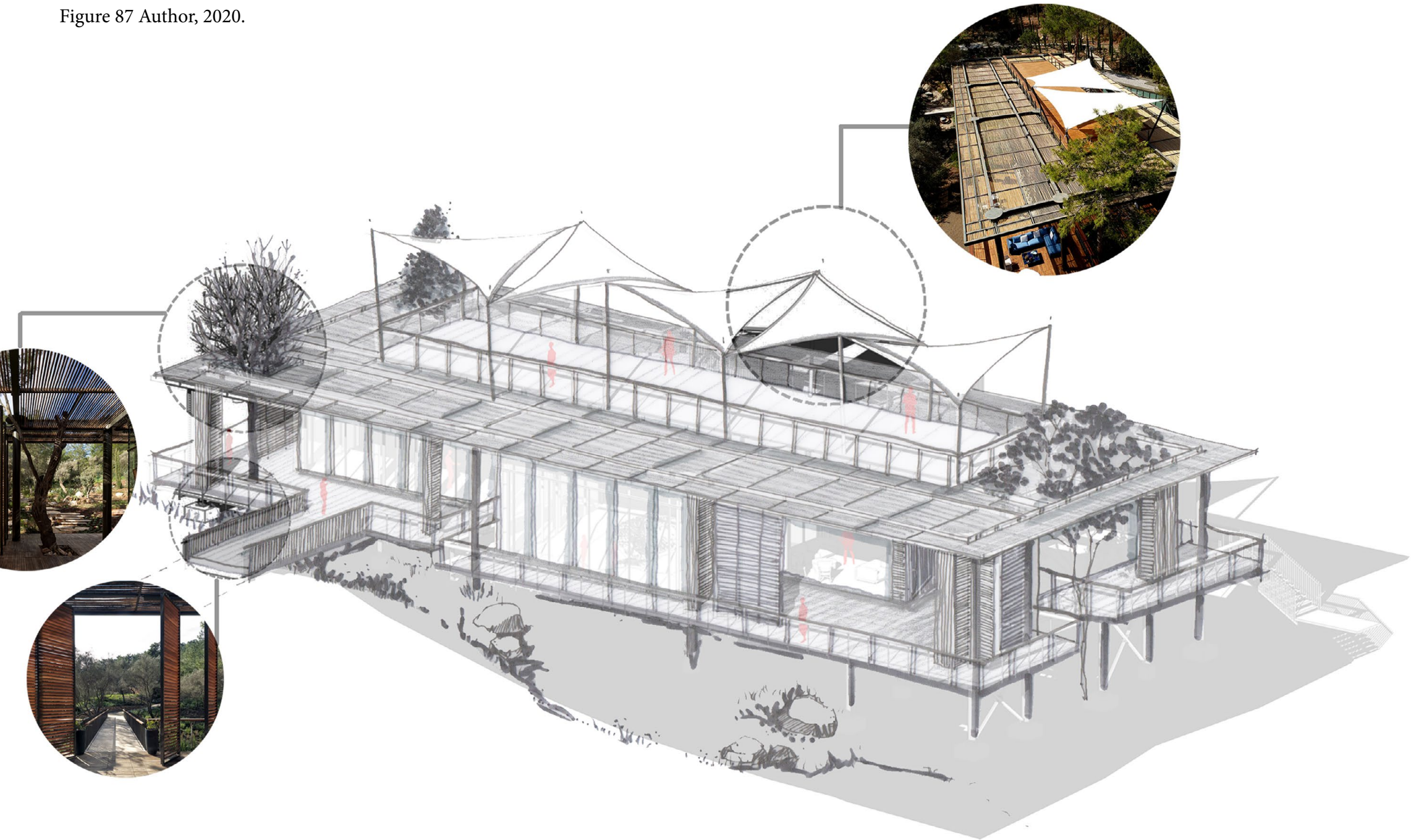
This platform on the roof is covered by suspended and tensioned canvases. Additional amenities include, sunbathing decks, a children's' play area and locker room facilities. The building allows for visitors to look out onto and access the surrounding beach and forest areas.

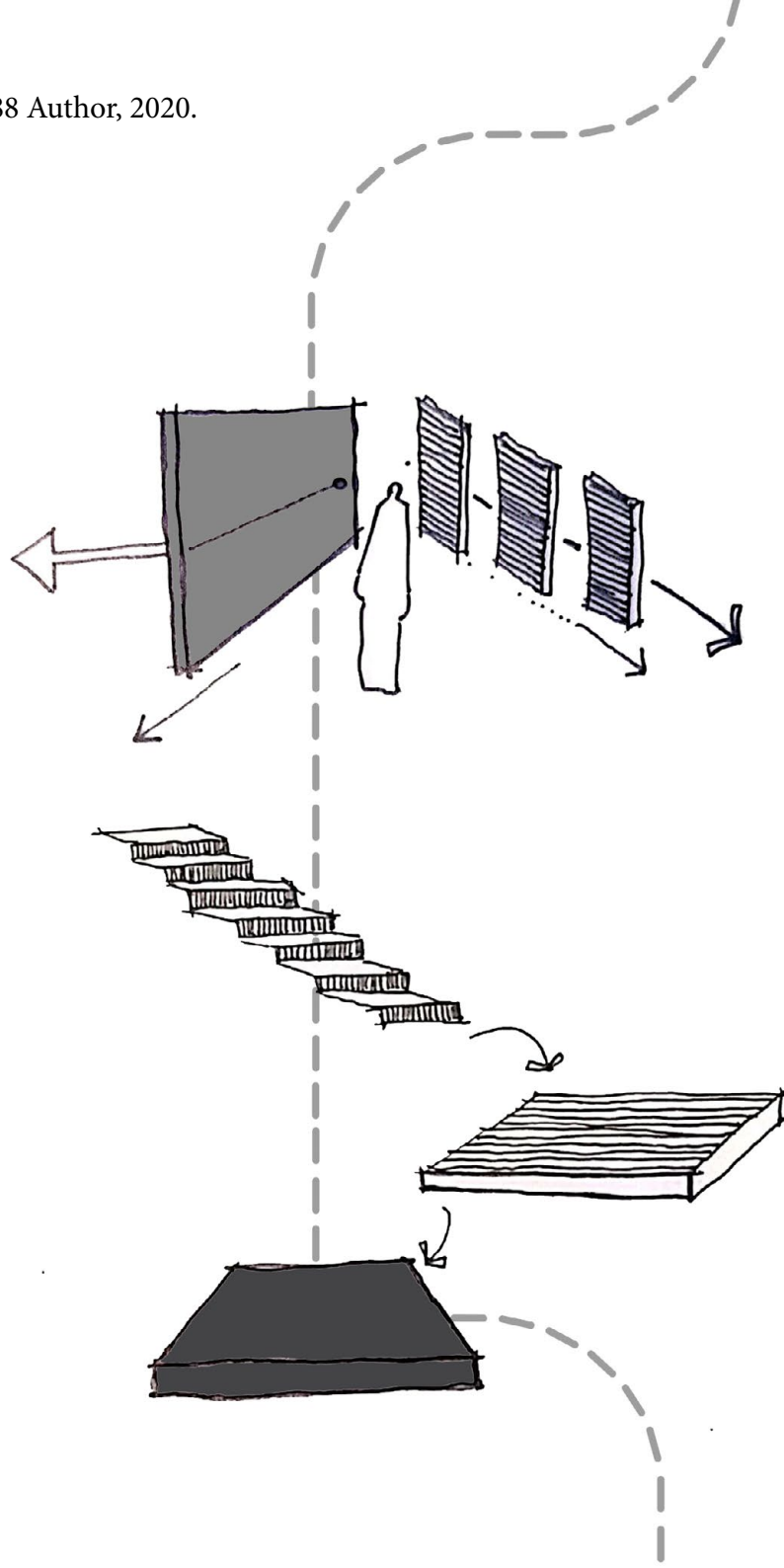
#### Function

The primary function of the building is for visitors to make use of the various lounges available to them, as this project serves as a beach front clubhouse. Additional amenities include, sunbathing decks, a children's' play area and locker room facilities. The building allows for visitors to look out onto and access the surrounding beach and forest areas.



Figure 87 Author, 2020.





### Morphology

The building reacts to the lush vegetation of the surroundings by being raised off the ground, touching the earth lightly. The building also allows for existing trees to penetrate through the platform. The building is covered in a breathable skin constructed of timber screens which allows for filtered light to enter into the interior spaces of some areas. These screens are retractable, allowing for the surrounding views to be opened up when desired, creating a pattern through their repetition on the façade.

### Circulation

Guests enter over a pedestrian bridge, onto the platform which surrounds the enclosed area. Visitors can move around the structure solely on the platform, using the external staircases to either access the beach below, or access the deck on the roof. Visitors can also make use of the amenities within the building which are situated along a central circulation spine.

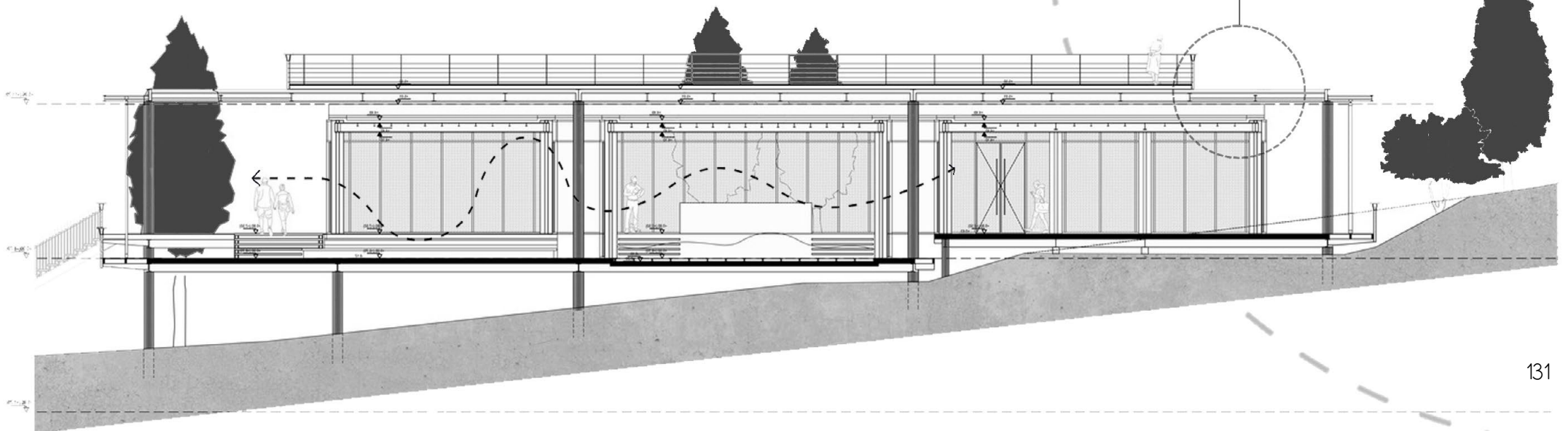
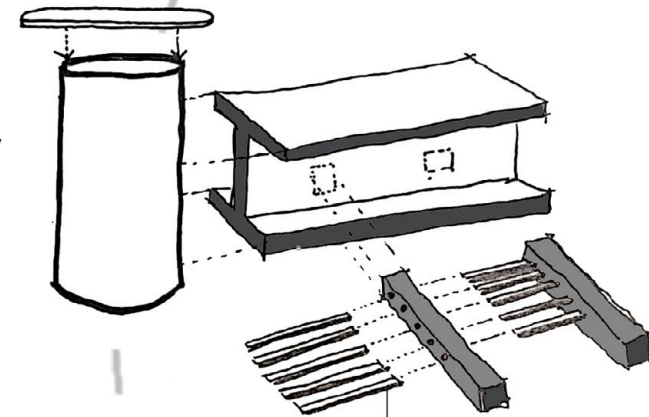
### Site Planning and Landscape Detail

The building sits along a sloping site, which levels down towards the beach to the south. The site was accommodated by raising the building on steel columns. According to the architects the structure can be completely dismantled, leaving behind only the platform. In this way allowing for future development and reuse. Additionally, to simplify the process, the architects used local materials to construct the building.

I believe this is a component of design that I can also implement into my proposal, due to the proposed function on-site possibly needing to change or adapt in years to come.

## Structural Details

The structure is comprised of a steel column and beam structure that acts as an exoskeleton for the internal building, which as mentioned before can be completely disassembled. The structure is raised from the ground and the columns are cross braced for support. The clubhouse, in this case, acts as the mediator between land and sea, allowing for the somewhat gradual descent to the beach below by walking down the external staircase and around a range of sun-bathing decks. The clubhouse allows for both a fully immersive experience out on the deck surrounded by the ocean, and a distant experience of appreciation of the landscape from the clubhouse itself. Through studying this precedent, I have learnt that a structure can adapt and change if need be. This can be achieved by designing elements that can be removed, or simply moved around. This is a very important factor in the world we live in today. With the rapid daily advances in technology and the declining overall health of the environment, there needs to be “recyclable” options for buildings to be reused and have a low impact on the environment, buildings that can adapt with the ever-changing environment. This ever-changing environment, being a key theme to my research in the proposal of a Coral reef nursery and rehabilitation centre.



### 3.2. A precedent study for connecting to the waters

Fluvial and Tourist Quay of Folgosa  
Saraiva + Associados  
Area: 400 m<sup>2</sup>  
Year: 2012

This project is located in Régua, Portugal. The project was a redesign and redevelopment of the quay with the addition of a tourist area and surrounding promenade.

The tourist area houses two buildings, a bar and is equipped with supporting amenities to the quay and other surrounding buildings. Essentially the structure is comprised of a metal structure which rests on reinforced concrete pilings.

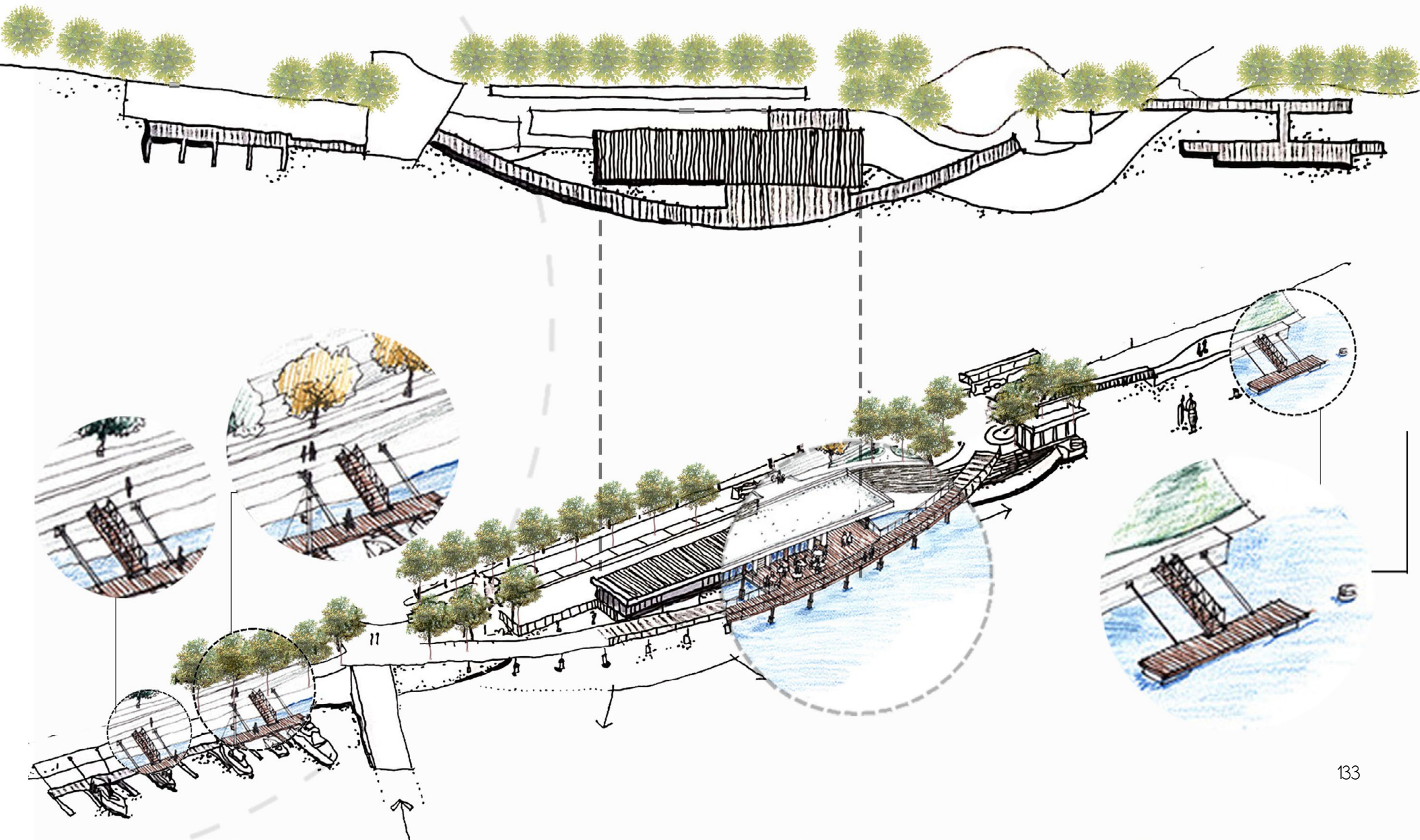
The building is accessed by means of the wide promenade which wraps around the structure looking out over the surrounding Douro river. This promenade connects the river quay and the tourist pier in the area and is part of the largest pedestrian route, allowing visitors and passers-by to enjoy the magnificent landscape.

A second building called Kiosk Support, emerges at the west end of the walkway. This building's functionality is multifunctional, newspapers and magazines are sold there and it serves as a tourist information centre.

The reason for this precedent study is to better understand how other communities have approached the connection between earth and the ocean, how architectural interventions can bring users closer to nature. Naturally the promenade grants access to the tourist centre, but allows for a more haptic approach to the amenities over the water, taking users over the river, to appreciate the views.

Additionally, the precedent study has various amenities like the boat docks that would be helpful in my own design.

Figure 90 Author, 2020.



### 3.3. A precedent study for accommodation

Coastal Biology Building and Marine Sciences Campus  
Esherick Homsey Dodge and Davis Architects

Area: 3700m<sup>2</sup>

Year: 2018

This project was designed to accommodate the research and teaching on coastal conservation, ecology and climate change in California.

This precedent study was chosen to better understand the functions associated with coastal conservation and the types of amenities needed for these studies. The project houses twenty-five researchers and their teams of students, there are twenty laboratories and forty-four offices, with a specialised seawater research lab. These research laboratories are accompanied by a coastal biology greenhouse, which is also on the site, where specimens are kept for studies.

To accommodate for the harsh coastal winds, the building was designed in an asymmetric "U" shape, creating a courtyard space where researchers can meet. This precedent study has broadened my knowledge about the types of amenities needed in the research on coastal conservation. These amenities and various functions can also be used in a coral reef rehabilitation centre. Specimen storage, specialised laboratories and offices will also form part of the program.





1. main entry
2. coastal biology building
3. coastal biology greenhouse
4. lab
5. office
6. analytical lab
7. equipment
8. environmental room
9. tank room
10. tray room
11. core seawater lab
12. meeting room
13. administration
14. seminar
15. mechanical
16. chemical and chemical waste storage

### 3.4. Understanding coral farming in a controlled environment

In addition to the urgent need to preserve the species, Coral farming has become a very profitable business opportunity for some hobbyists (Pinto, 2011: Online). This precedent study will investigate how hobbyist, Machado de Sousa from Portugal focusses on the requirements for farming corals in a controlled laboratory environment.

It is important to take note of the fact that De Sousa has various tanks for various needs. Firstly, there is a smaller 100l tank, where coral specimens are placed immediately after they have been attached to their concrete base plates. This tank has a constant flow of water to ensure the corals can adjust to their new environment.

A 650l tank referred to as the Fringing reef Tank, houses the coral "bank", with small coral fragments on concrete base plates. A 450l tank called the Nursery tank, is used to place corals for the first

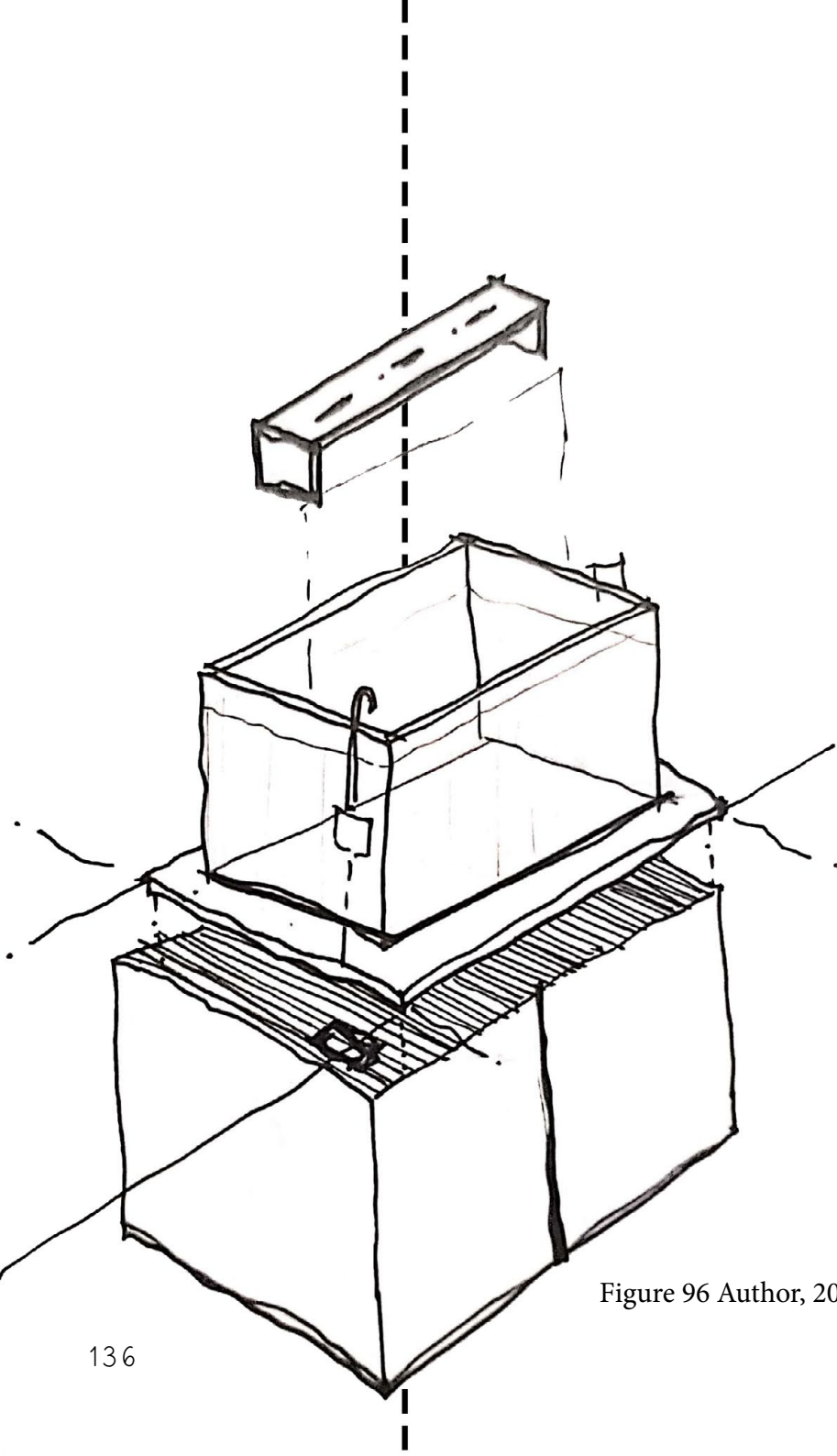


Figure 96 Author, 2020.

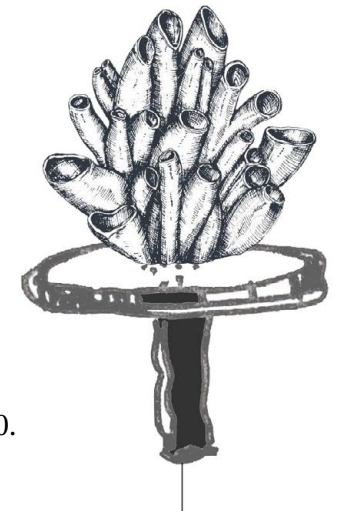


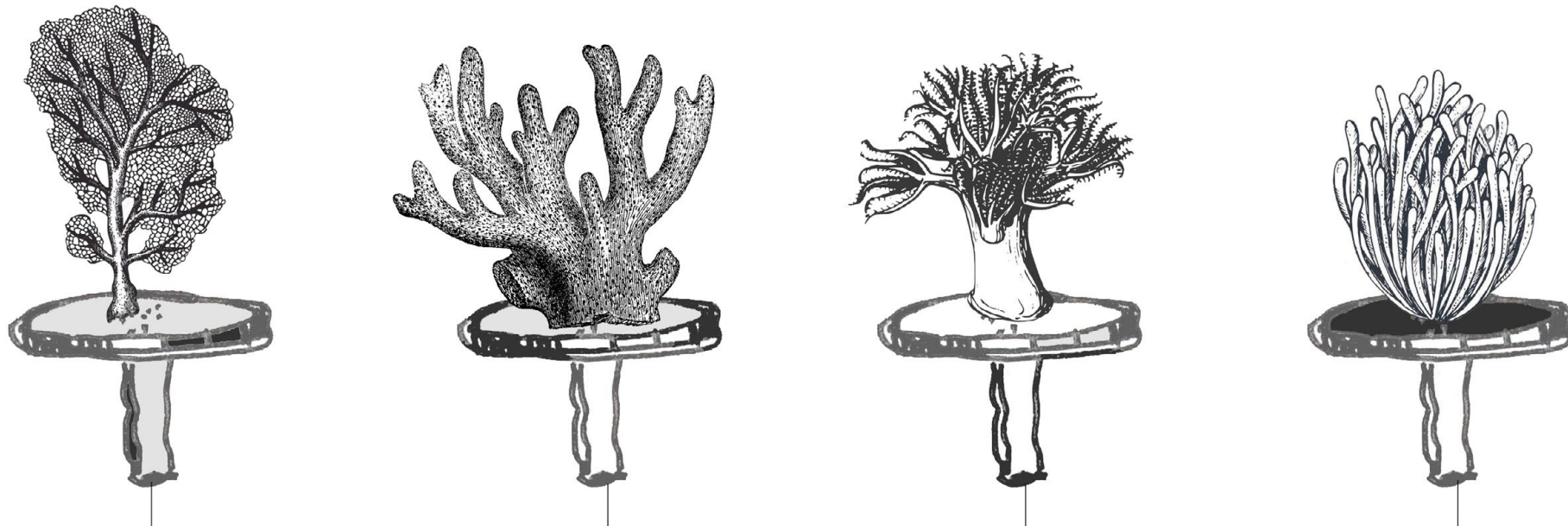
Figure 97 Author, 2020.

phase of reproduction after which they are transferred to another tank.

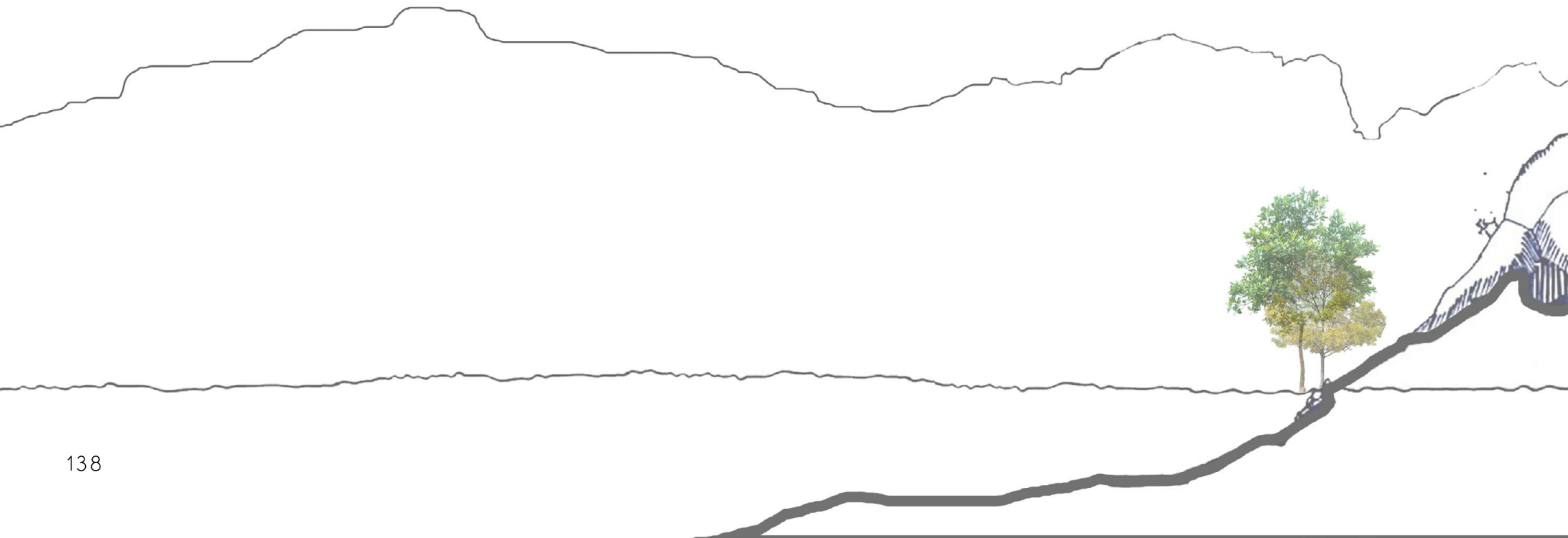
There are also the “Day care Tanks” which receive the “baby” corals from the nursery tanks. Various tanks are also in place to house corals that need specific treatments or observation.

The tanks each have a T5 lamp overhead to provide the correct lighting conditions for the coral specimens. A T5 lamp is essentially a fluorescent lamp used in aquarium set ups to allow for the ideal conditions as would be in nature.

This precedent study has been valuable in identifying the type and size of tanks needed for coral farming within a controlled environment and will allow for accommodation to be made in the accommodation list and planning of the coral reef laboratory and nursery in the proposed design.



# 04 accommodation list



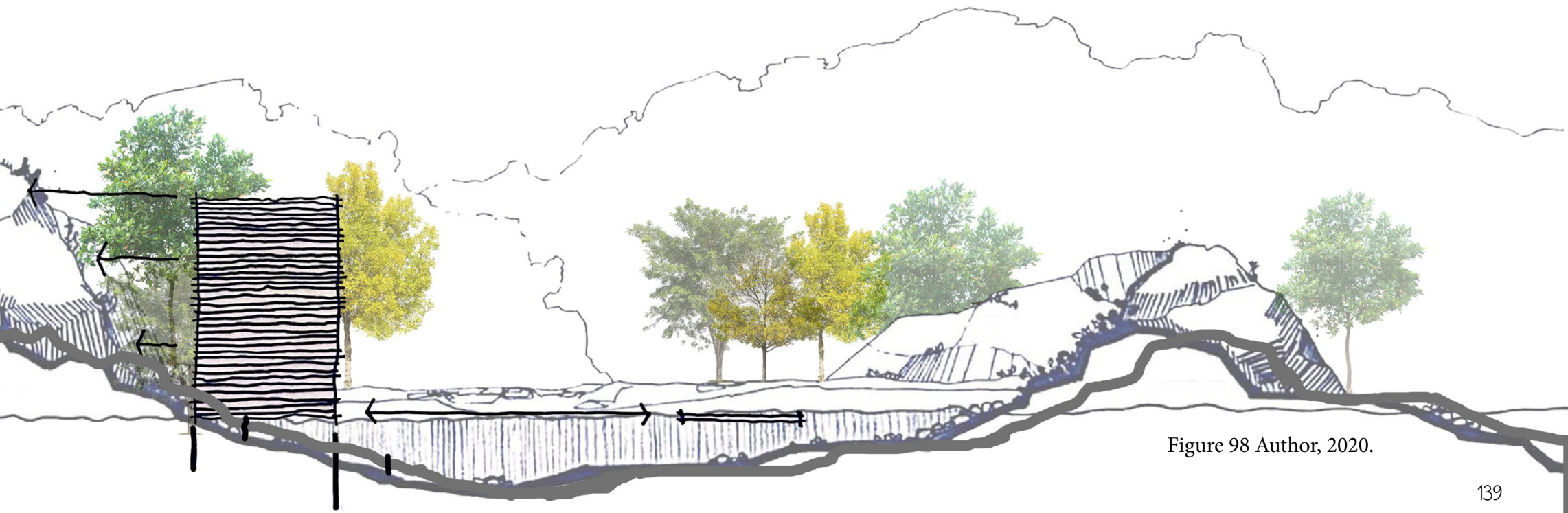
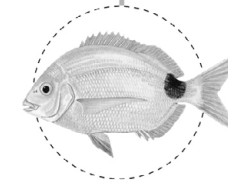


Figure 98 Author, 2020.

## Accommodation list

This accommodation list was compiled from a variety of research for the various amenities needed for the proposed design.

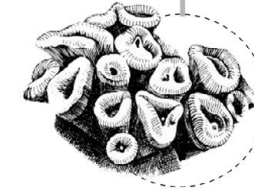
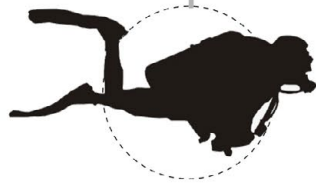


### Restaurant

Kitchen.....	75m <sup>2</sup>
Kitchen office.....	9.5m <sup>2</sup>
Dry food storage .....	14.5m <sup>2</sup>
Cold food storage.....	14.5m <sup>2</sup>
Bar.....	15m <sup>2</sup>
Staff room .....	16m <sup>2</sup>
Staff WC .....	2m <sup>2</sup>
Information centre.....	45m <sup>2</sup>
Seating space.....	1275m <sup>2</sup>
Outdoor seating .....	351m <sup>2</sup>
Indoor seating .....	924m <sup>2</sup>
Reception area .....	48m <sup>2</sup>
Service yard	
Male WC .....	20m <sup>2</sup>
Female WC .....	25m <sup>2</sup>
Disabled WC.....	3.5m <sup>2</sup>

### Aquarium

Reception .....	47m <sup>2</sup>
Exhibition space .....	263m <sup>2</sup>
Pump room .....	70m <sup>2</sup>
Beach level WC and change rooms .....	138m <sup>2</sup>
Male WC and changing rooms .....	62m <sup>2</sup>
Female WC and changing rooms .....	72m <sup>2</sup>
Disabled WC and changing rooms .....	4m <sup>2</sup>



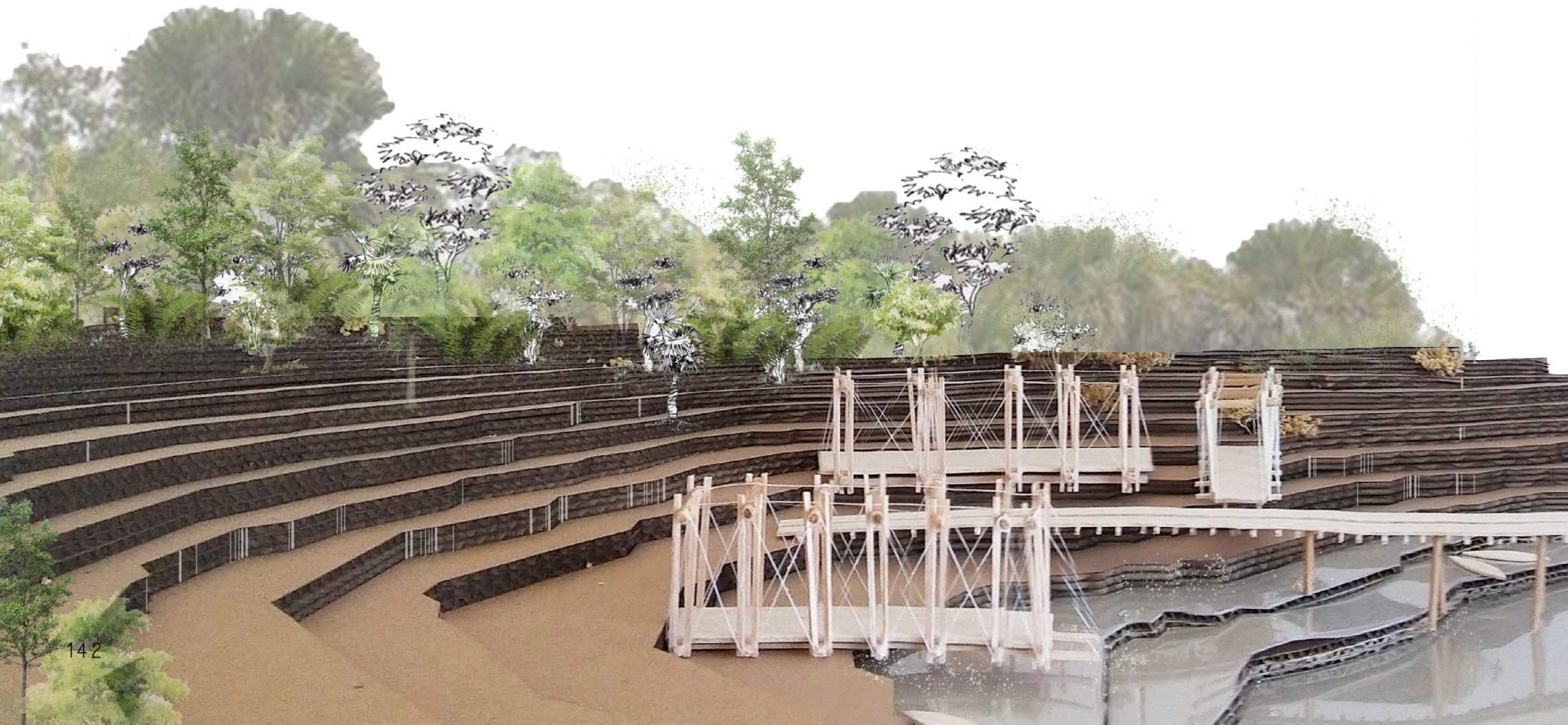
## Diving school

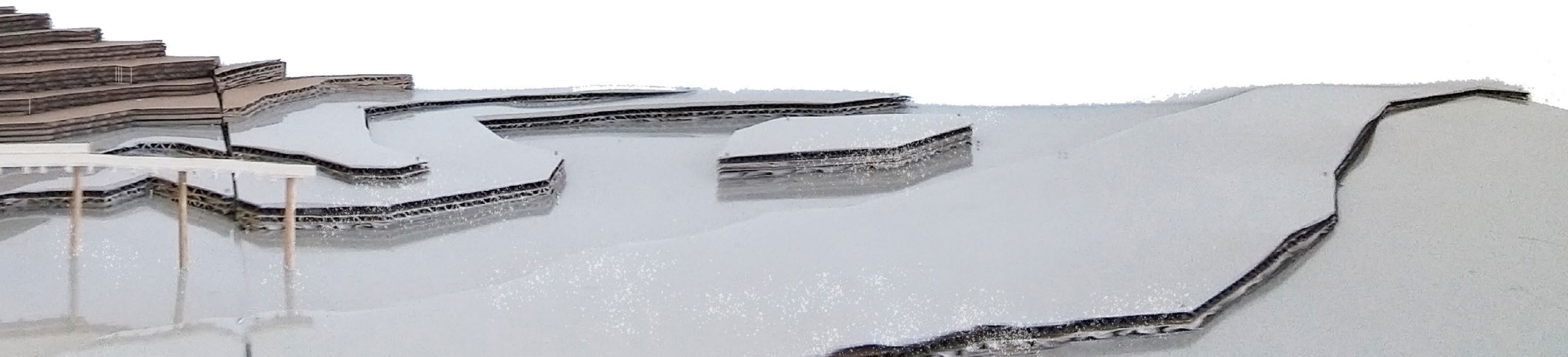
Diving classroom .....	100m <sup>2</sup>
Storage space .....	17.5m <sup>2</sup>
Diving gear rental shop .....	130m <sup>2</sup>
Diving gear washup.....	27m <sup>2</sup>
Male WC and changing rooms .....	40m <sup>2</sup>
Female WC and changing rooms .....	40m <sup>2</sup>
Pier bar .....	192m <sup>2</sup>
Deck area	
Diving pods	

## Research laboratory

Coral logging area .....	30m <sup>2</sup>
3D printing workshop .....	36m <sup>2</sup>
Microscope desk area .....	36m <sup>2</sup>
Oxygen tank refill station .....	30m <sup>2</sup>
Male/Female changing rooms .....	36m <sup>2</sup>
Open plan research desk space .....	64m <sup>2</sup>
Individual laboratory rooms .....	30m <sup>2</sup>
Coral specimen storage rooms .....	45m <sup>2</sup>
Reception .....	60m <sup>2</sup>
Boardroom .....	31m <sup>2</sup>
Staff room and kitchenette .....	40m <sup>2</sup>
Male WC Female WC .....	20.5m <sup>2</sup>
Office.....	18m <sup>2</sup>

# 05 design development





## 5.1. Site development

The design development process took lead from, and is an amalgamation of the conceptual development phase, precedent studies and the proposed accommodation list.

The geographical situation of the originally identified site of the Mooibaai private beach, as indicated at 1, was the start of the process. However, after much deliberation and design investigation, it was decided that this site was too small to accommodate all of the proposed amenities.

The Mooibaai site is now solely dedicated to the coral reef nursery and laboratory; and the restaurant, diving school and aquarium amenities are accommodated along the more publicly accessible ruin sites of the restaurant that unfortunately burnt down in 2016, as discussed earlier in this document under proposed amenities. The new proposed site for the restaurant and aquarium can be seen at (2) and the diving school at (3).

This decision to spread out the proposed amenities was done in order to preserve more of the Mooibaai site and re-establish the restaurant ruins with a new functional restaurant and aquarium. The diving school placement was decided upon due to the proximity of the existing boat harbour as seen at (4).

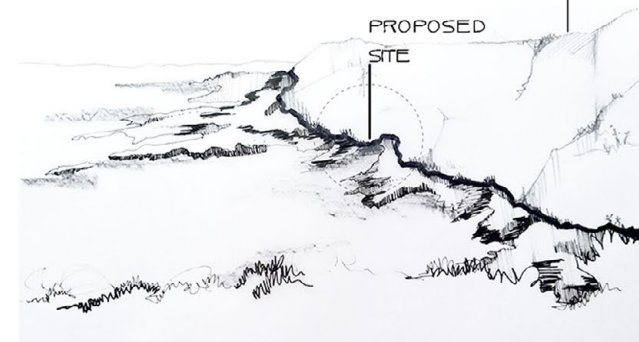
Figure 100-103 Author, 2020.



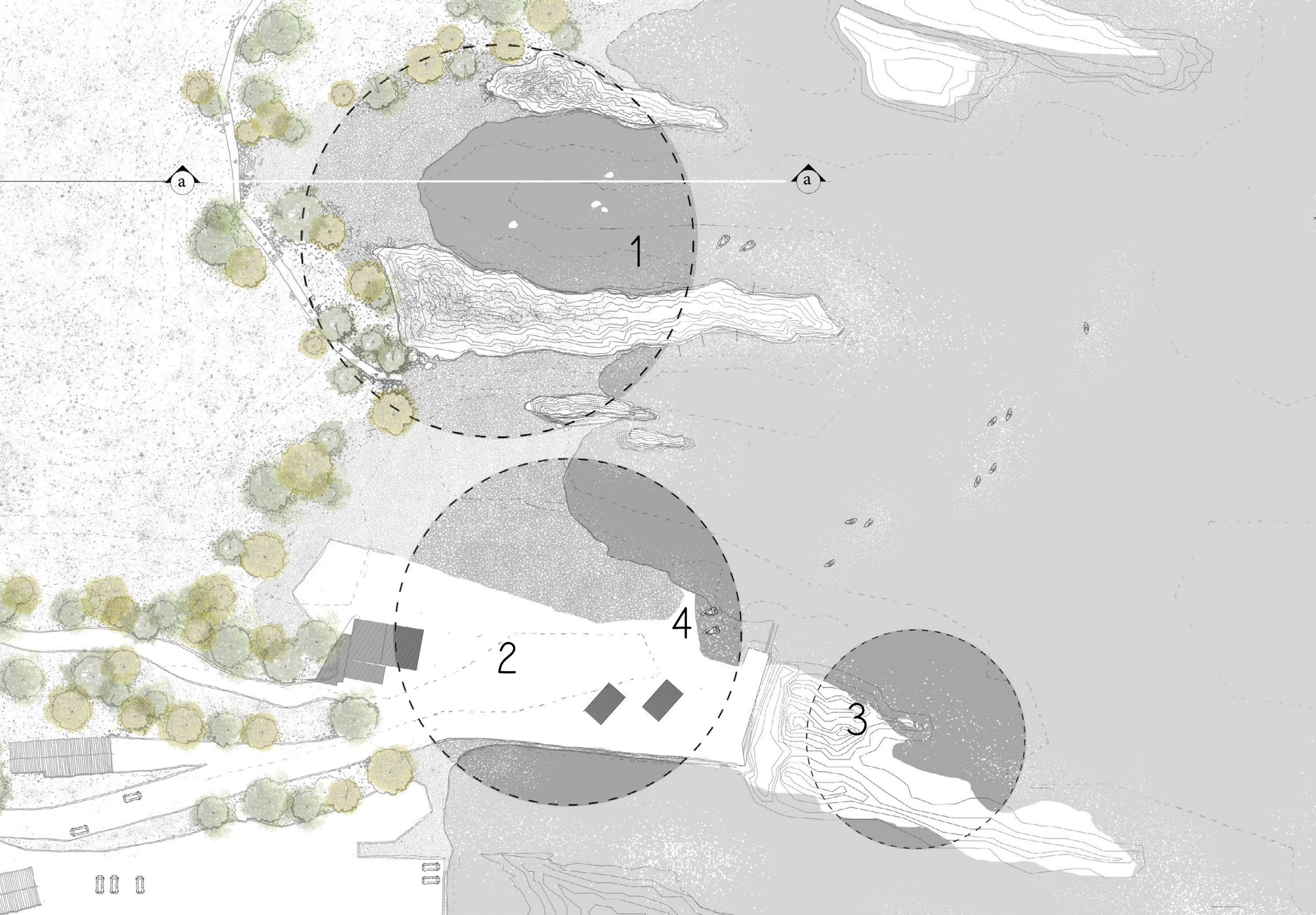
VIEW TO OCEAN



VIEW TO ENTRANCE



VIEW FROM HILL OVER THE SUSPENSION BRIDGE



## 5.2. Investigating the extended site

Upon doing the first conceptual investigation the concepts were transformed into design principles which could be placed in the Mooibaai site. Interrelatedness; Narrative and Engagement were applied to the site in various layouts, morphologies and design outcomes.

This process assisted in the foundation of what the design is to become, ensuring that each conceptual idea was translated into a design element and had an influence on the final design outcome.

This process of translating abstract conceptual ideas into three-dimensional design elements that relate to each other was an important part of the design process and is a process that was carried throughout the development of the proposed design.

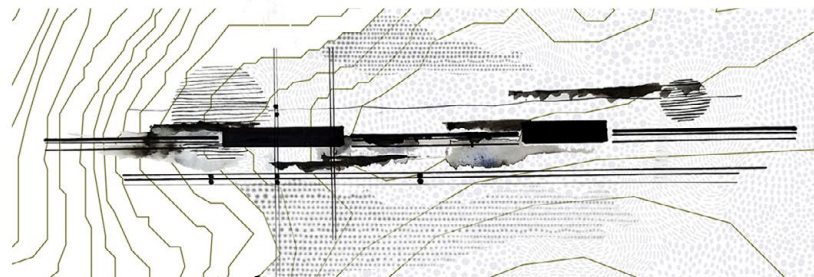
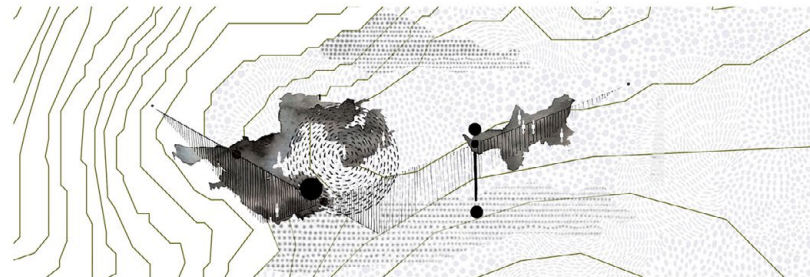
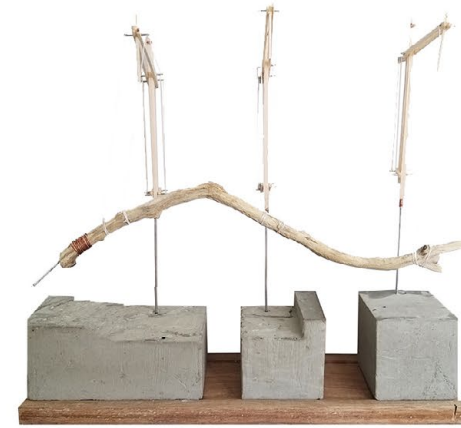
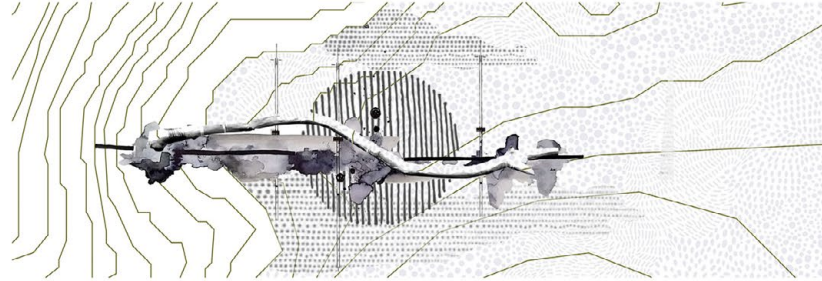


Figure 104-106 Author, 2020.



### 5.3. Towards a final design on the extended site

As the design process continued, much investigation was done on the morphology of the proposed structures and how each would connect to the earth and the ocean, taking lead from the principles of eco-phenomenology as discussed in the theoretical underpinning chapter. Investigating this form giving on both plan and section was a process that explored many outcomes.

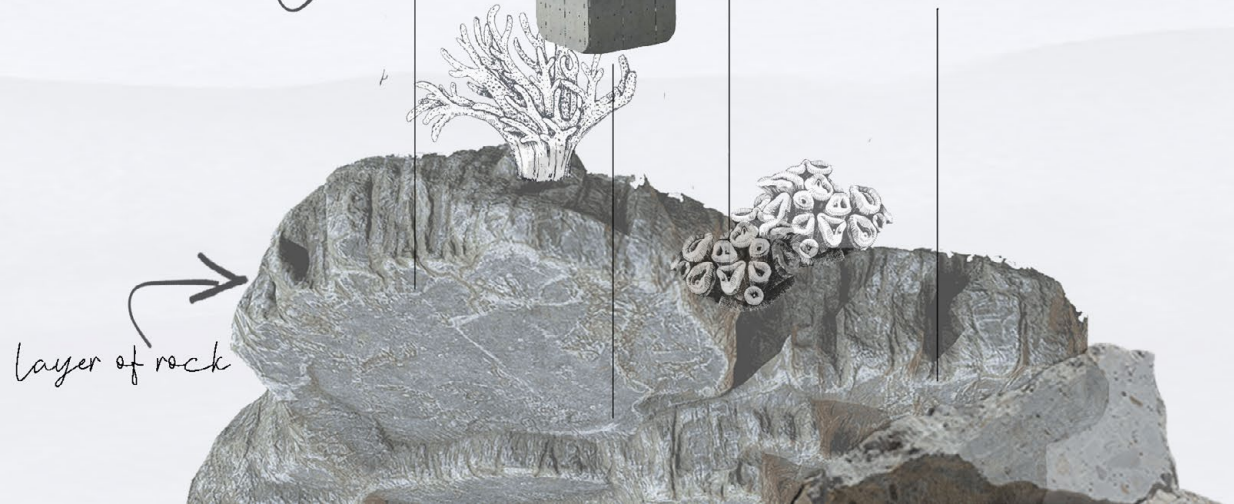
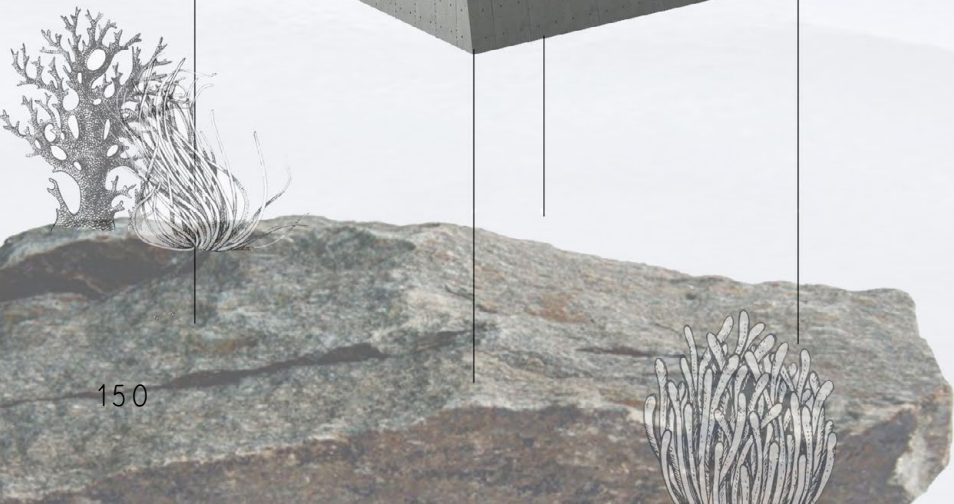
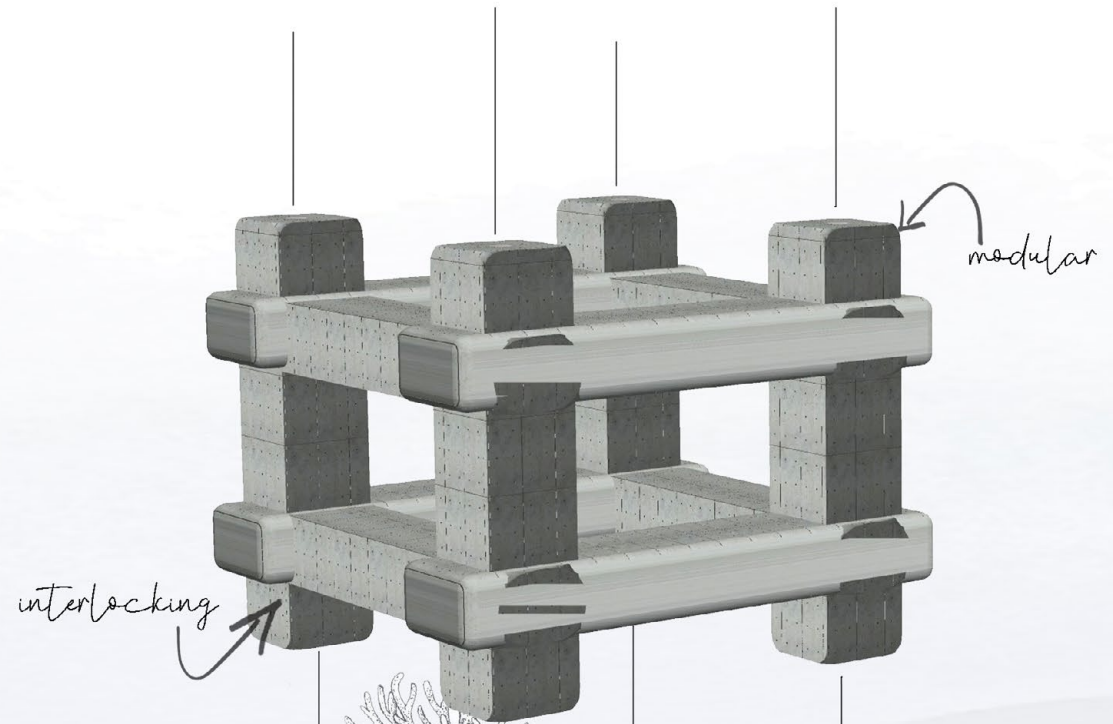
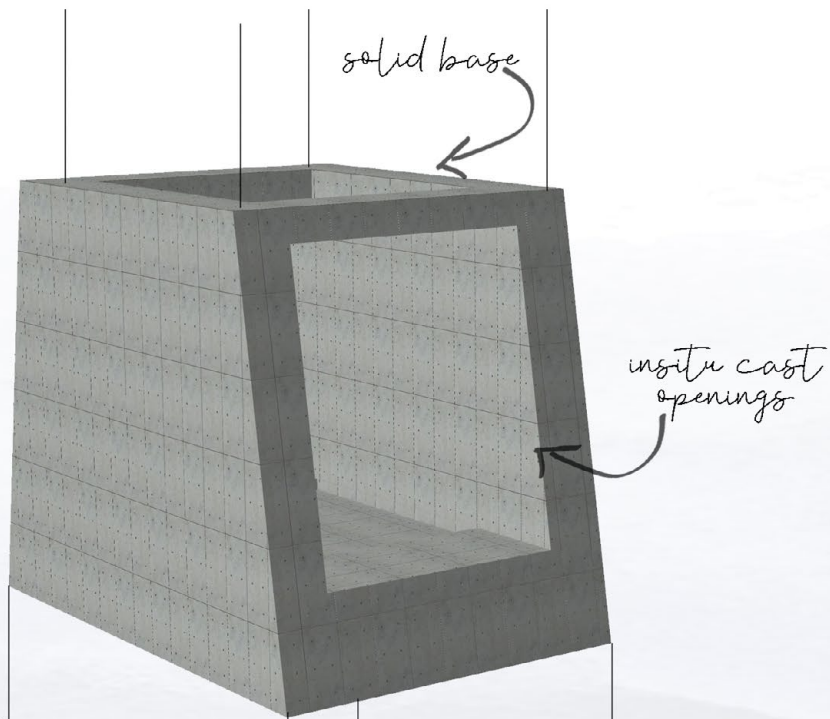
This process on plan took inspiration from the linearity of the naturally occurring rock outcroppings which surrounds the Mooibaai site and is prevalent in the low-lying rocks that appear as the tides shift. On section, a similar process of critical noticing took place in trying to understand how a structure would connect to the ocean floor and at just how many points to do so.

Much time was spent and many avenues researched in the development of the section, that explored the structure's connection to the ocean floor. Materiality was considered throughout and the artificial reef element that would form the base of the structure under the ever-shifting tides was the ultimate outcome of these investigations. The technical synthesis of this reef structure will be further explored later on in the document.



Figure 107 Author, 2020.





Here the design development of the base of the structure the connection points to the ocean floor can be seen. These connection points act not only as that, but also as the base for future artificial reefs as well as plinths for the structures which will house various functions to be attached to.

The process took lead with a solid mass with openings as seen on the far left. However, it was decided that the technical and construction implications thereof would be unrealistic due to the inaccessibility of the site.

Next a modular system was explored, as seen in the middle image, which could be placed in an interlocking fashion by a crane placed on an accessible part of the site. This design consisted of precast modular systems that are placed into the ocean. This systems sizing and methodology was approved and refined in an engineer crit.

Furthermore the design was refined as seen in the far right image, keeping the sizing of elements and modular concept in mind. The formgiving of the proposed design is inspired by the dollos as well as by bio-mimicry relating to corals, which include latching and the concept of a skeletal structure.

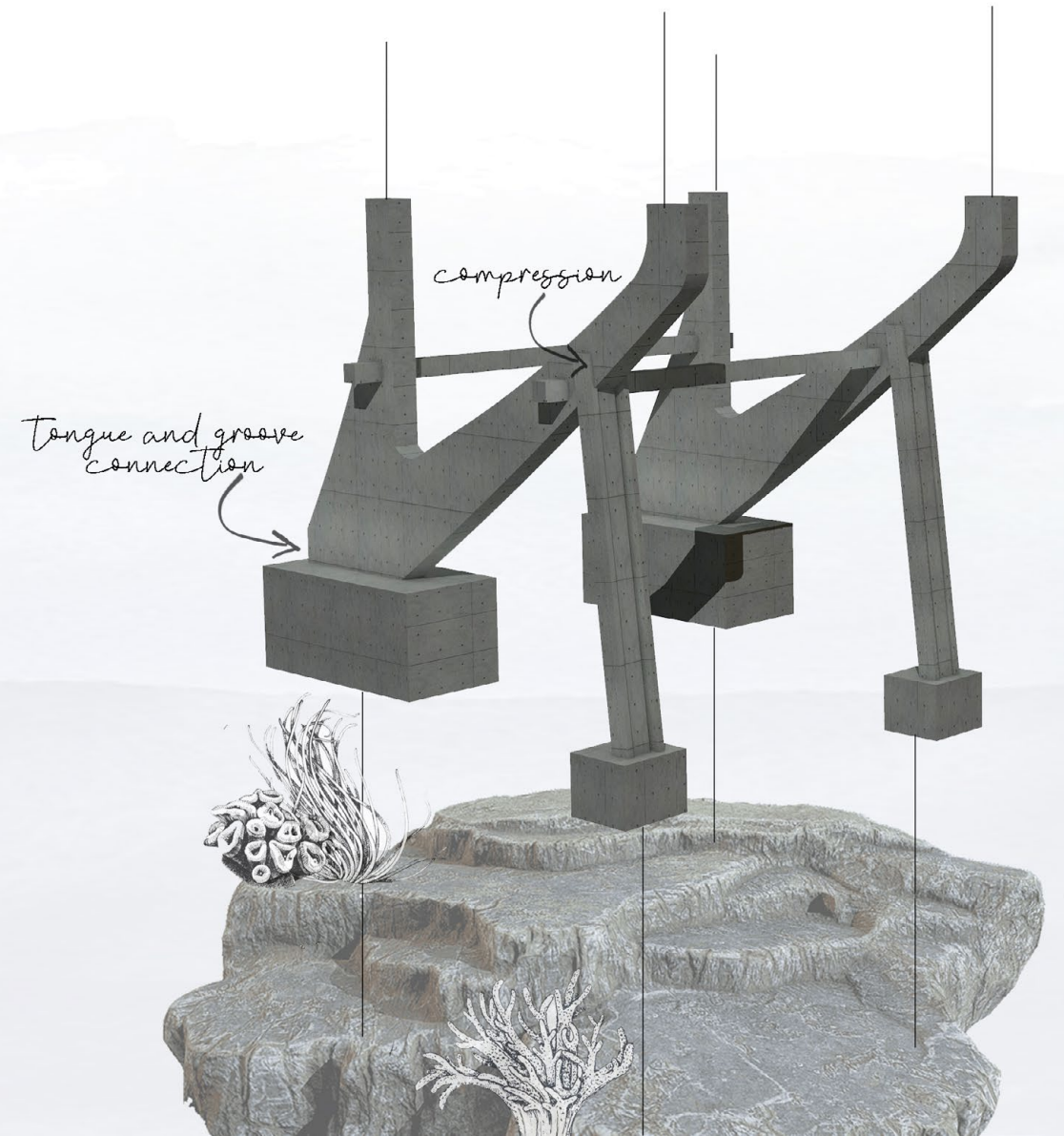


Figure 108 Author, 2020.

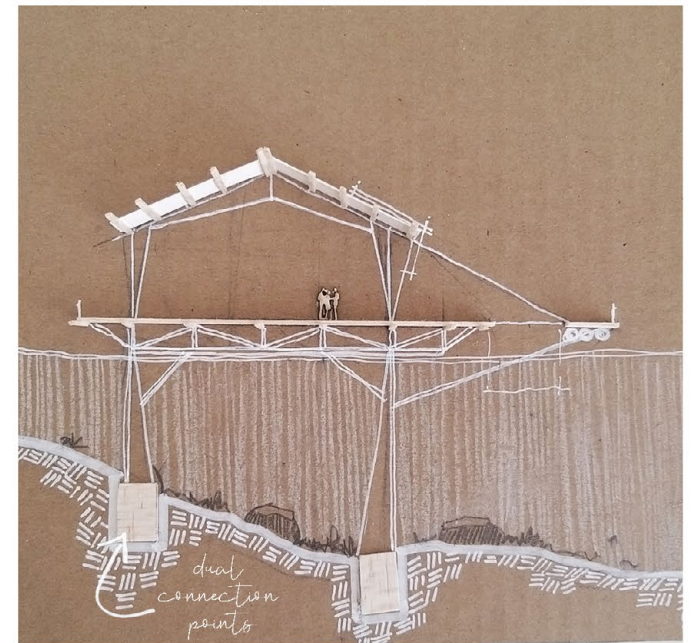
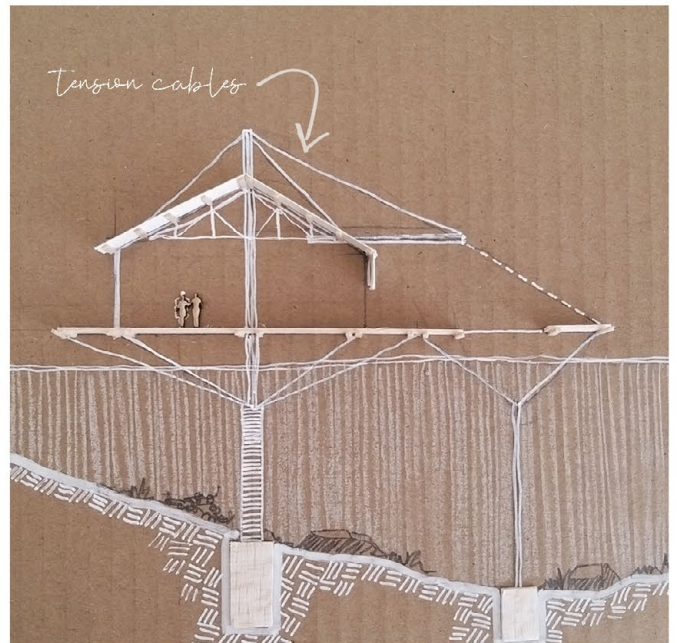
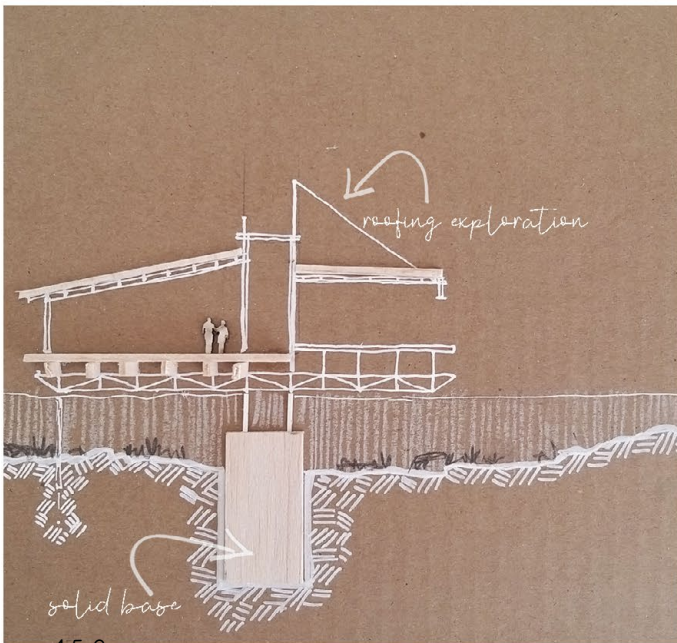
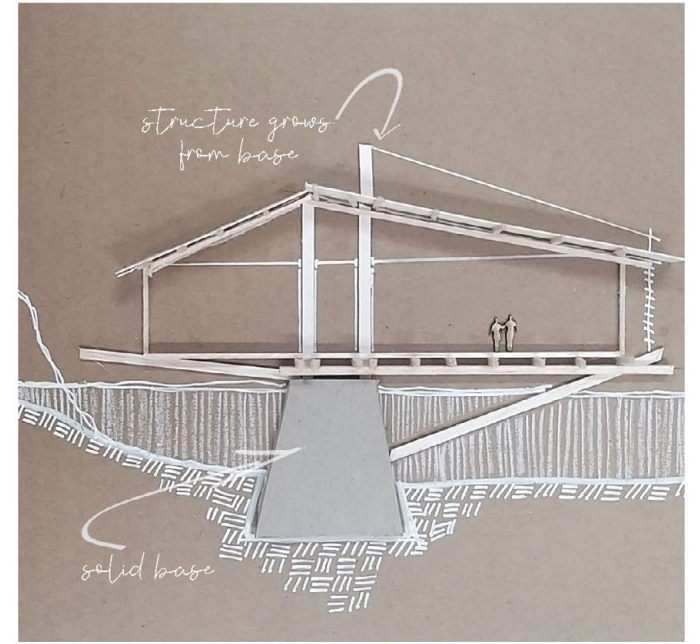
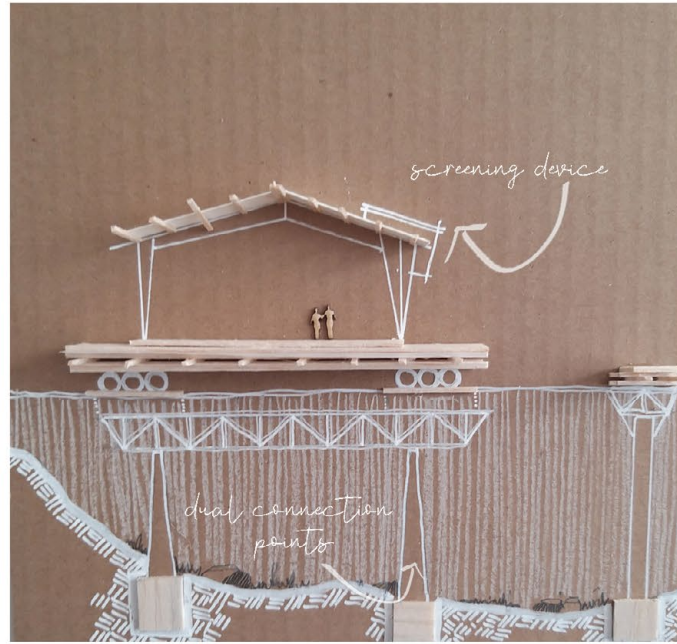
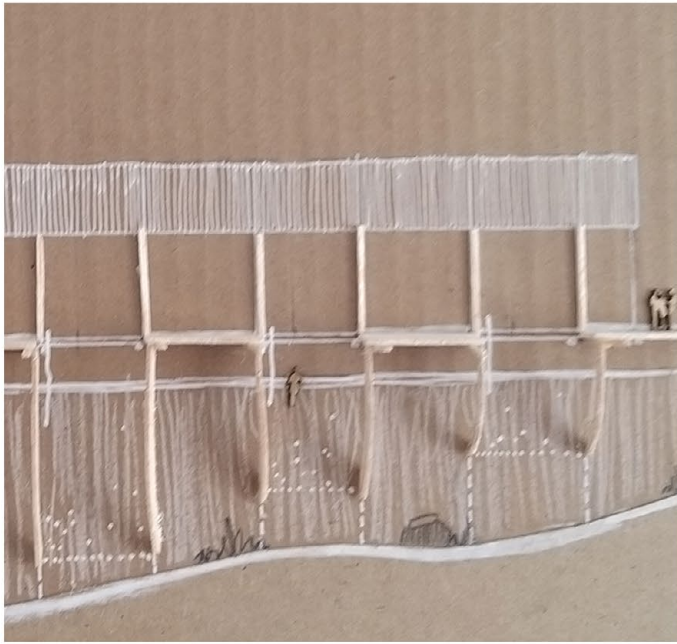
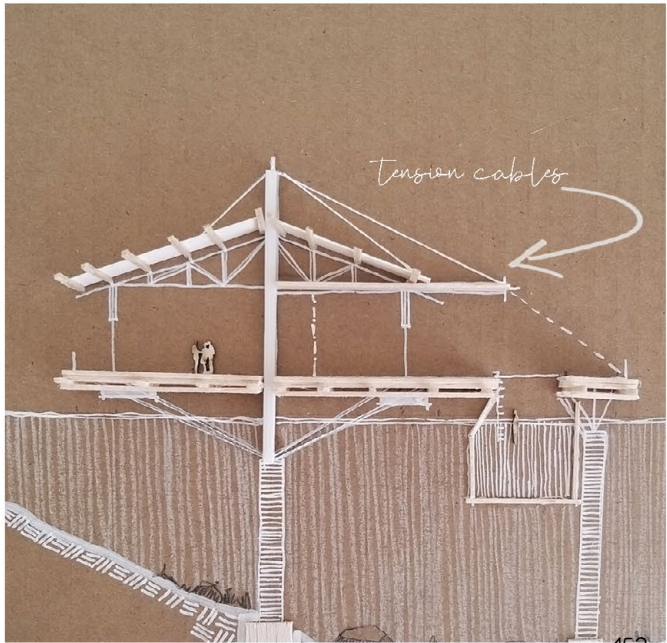
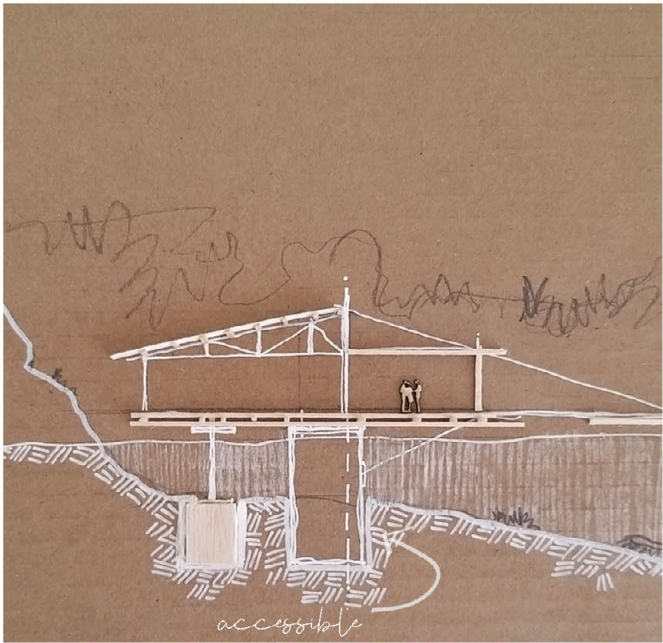
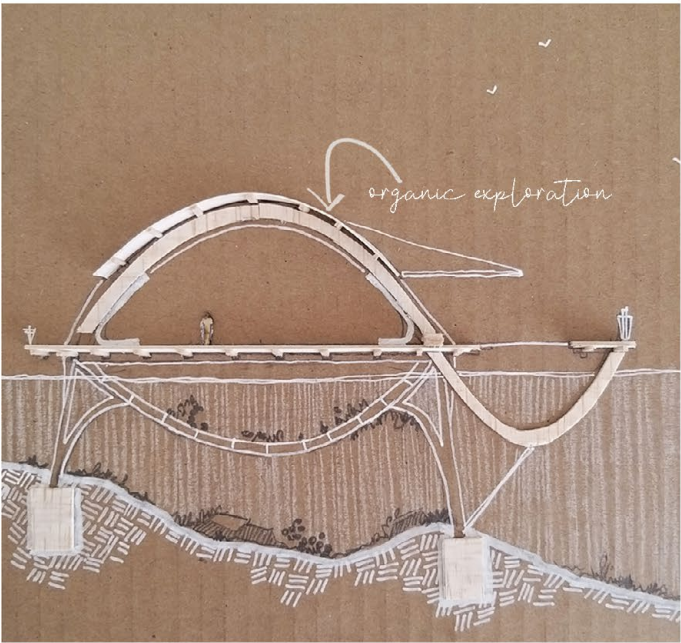
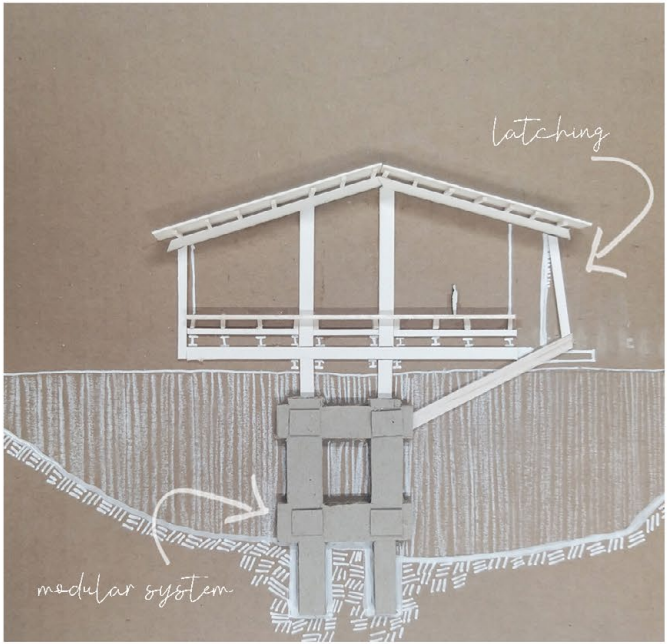
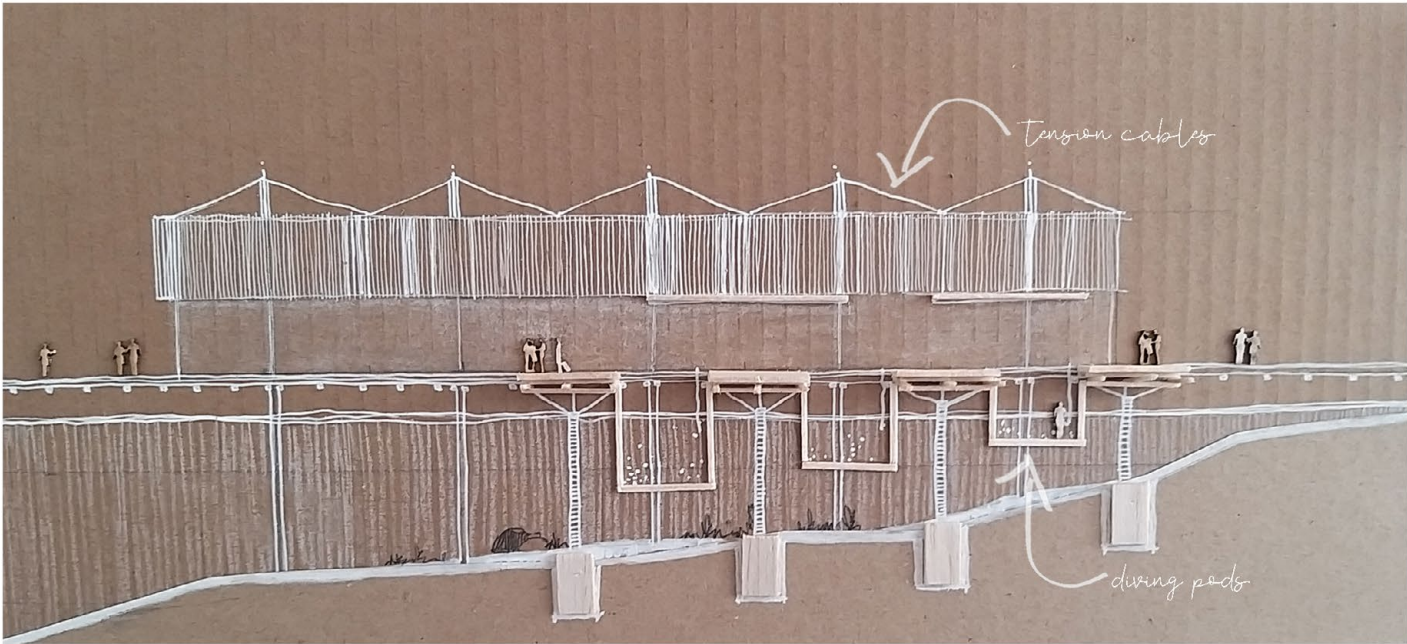
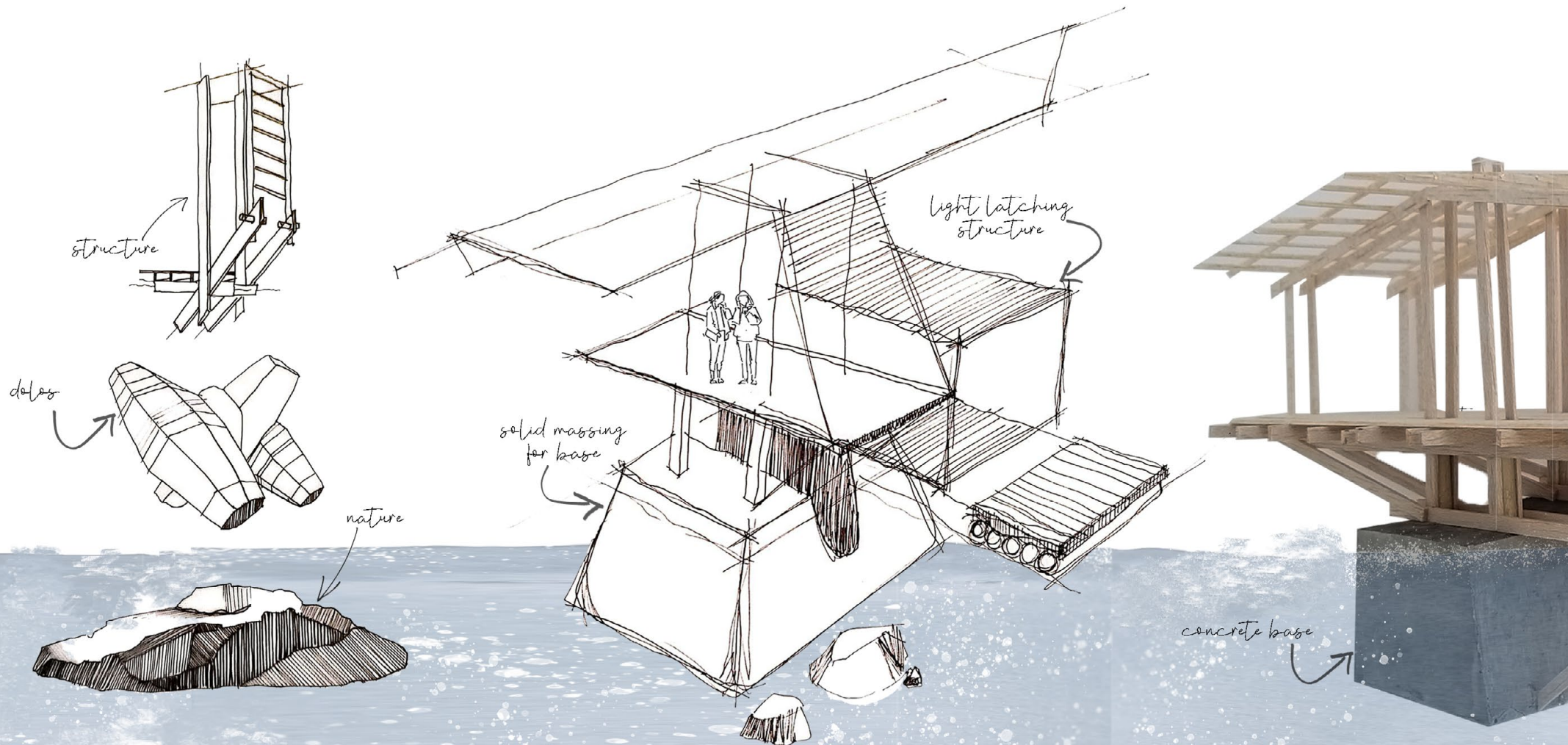


Figure 109 Author, 2020.



Below, the general design process highlights can be seen. These sketches and models document various points of design development and progress. From left to right, the design took lead conceptually with a dollos acting as the connection point between structure and nature, being refined to a more solid form in the second image. Materiality became prevalent and the formgiving of the structure above and below the waterline can be seen in the thrid and fourth images.



Overall, the design process was one of exploration and understanding each of the elements at play. The corals, construction methods, accommodation list and longevity of the proposed structures were all taken into consideration for the final design proposal. The following chapter will document the final design proposal and outcomes.

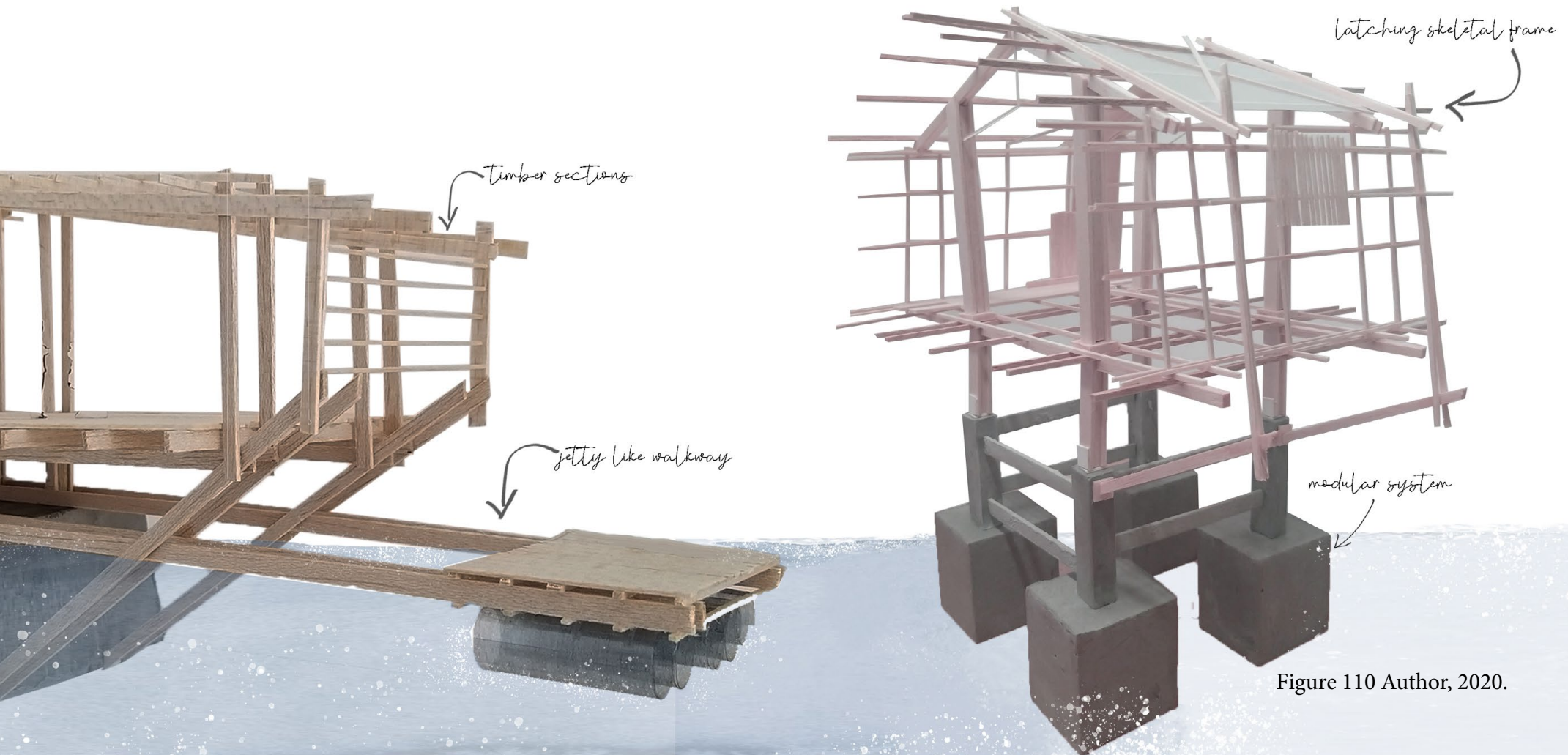


Figure 110 Author, 2020.

# 06 *towards a final design*

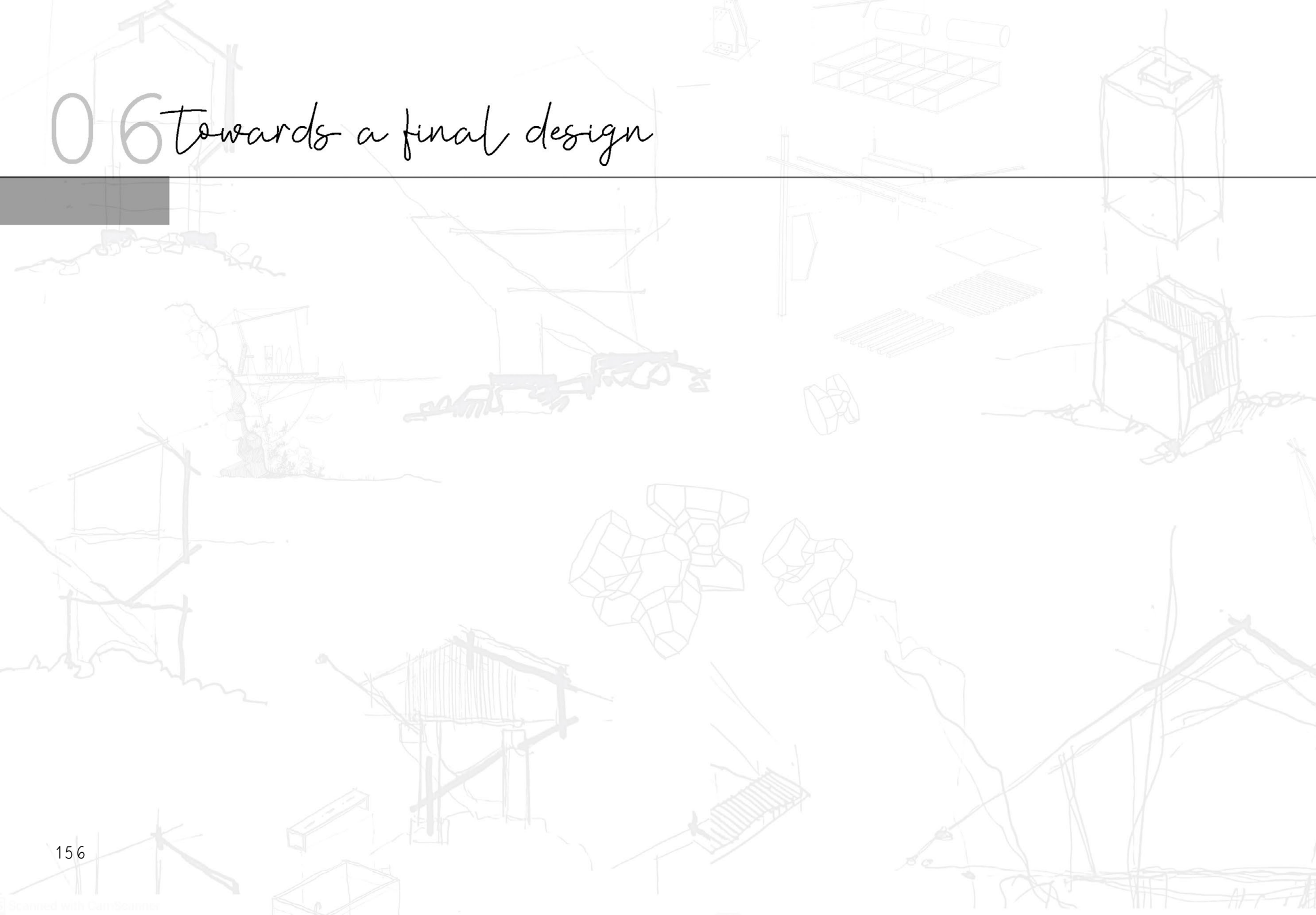
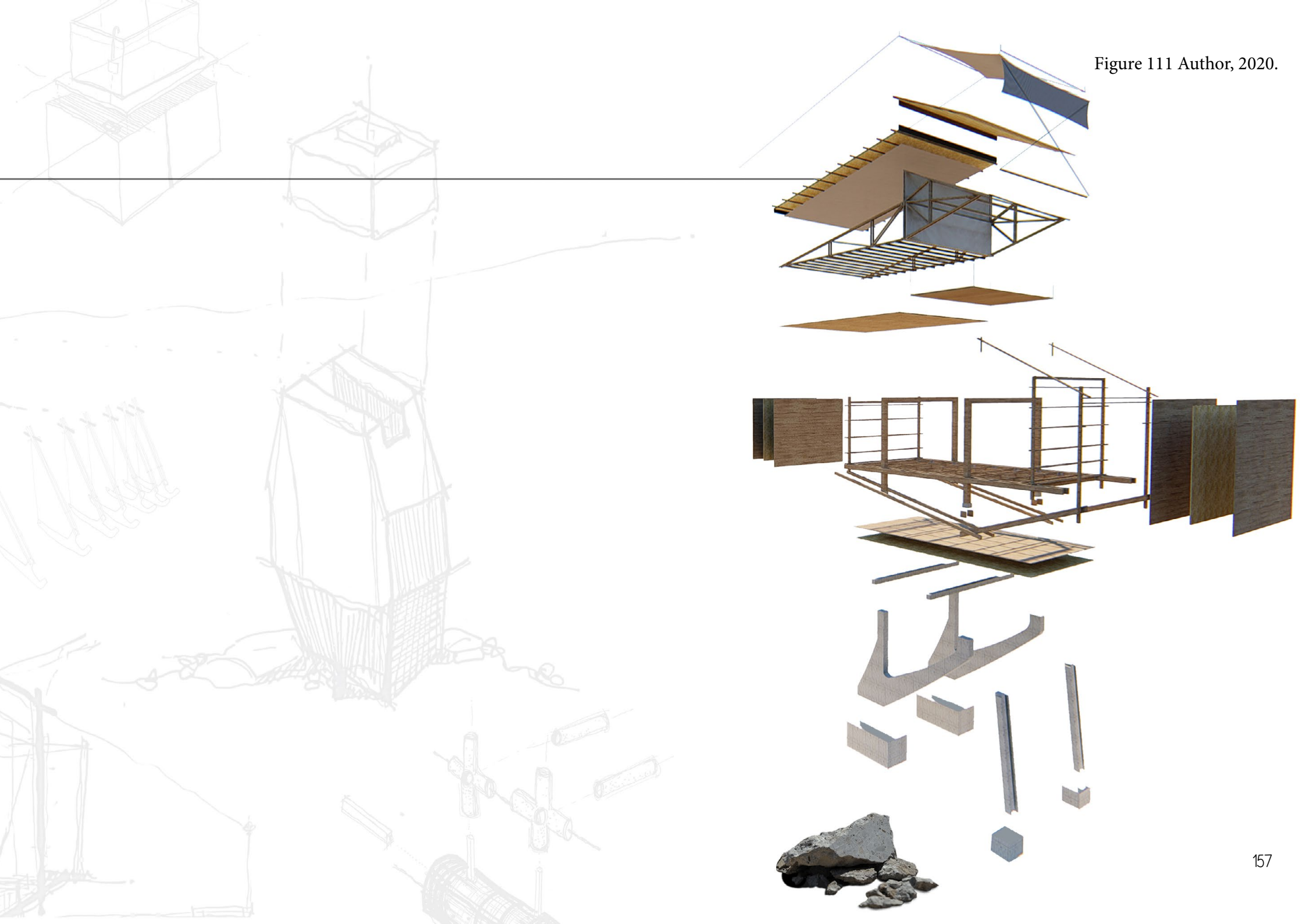
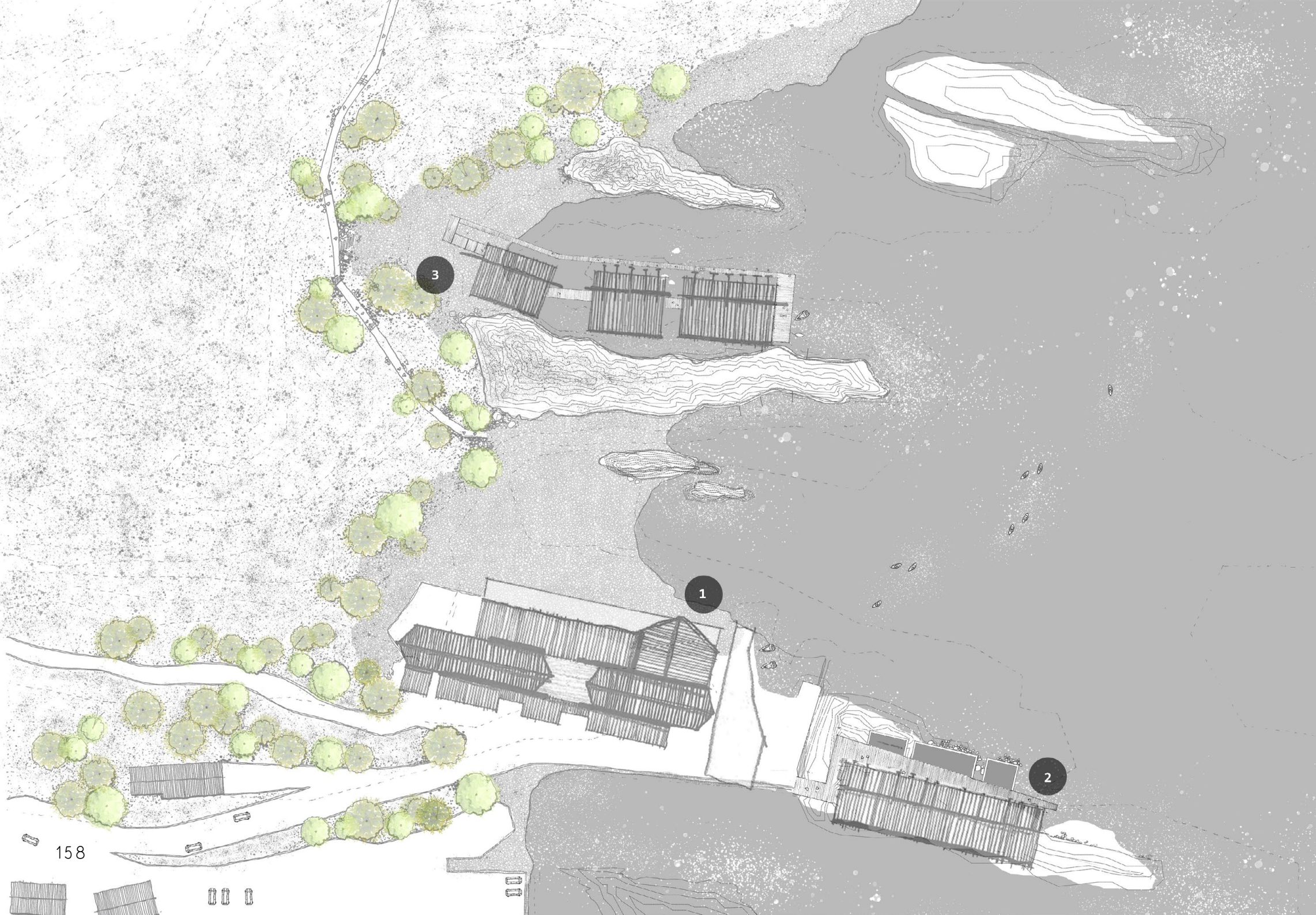


Figure 111 Author, 2020.





3

1

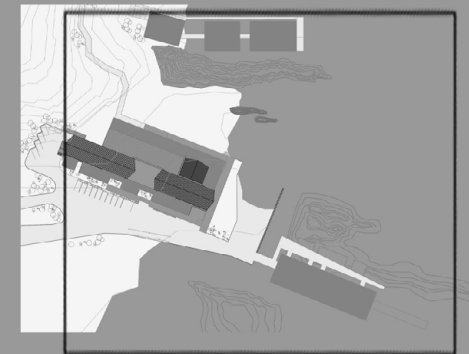
2



# SITE PLAN

This plan indicates the proposed new amenities.

1. Proposed new restaurant and aquarium
2. Proposed new diving school and pier bar
3. Proposed new coral reef laboratory



10m 20m 40m 60m 80m



Figure 112 Author, 2020.



RESTAURANT VIEWED FROM  
THE BOAT DOCK WALKWAY  
160

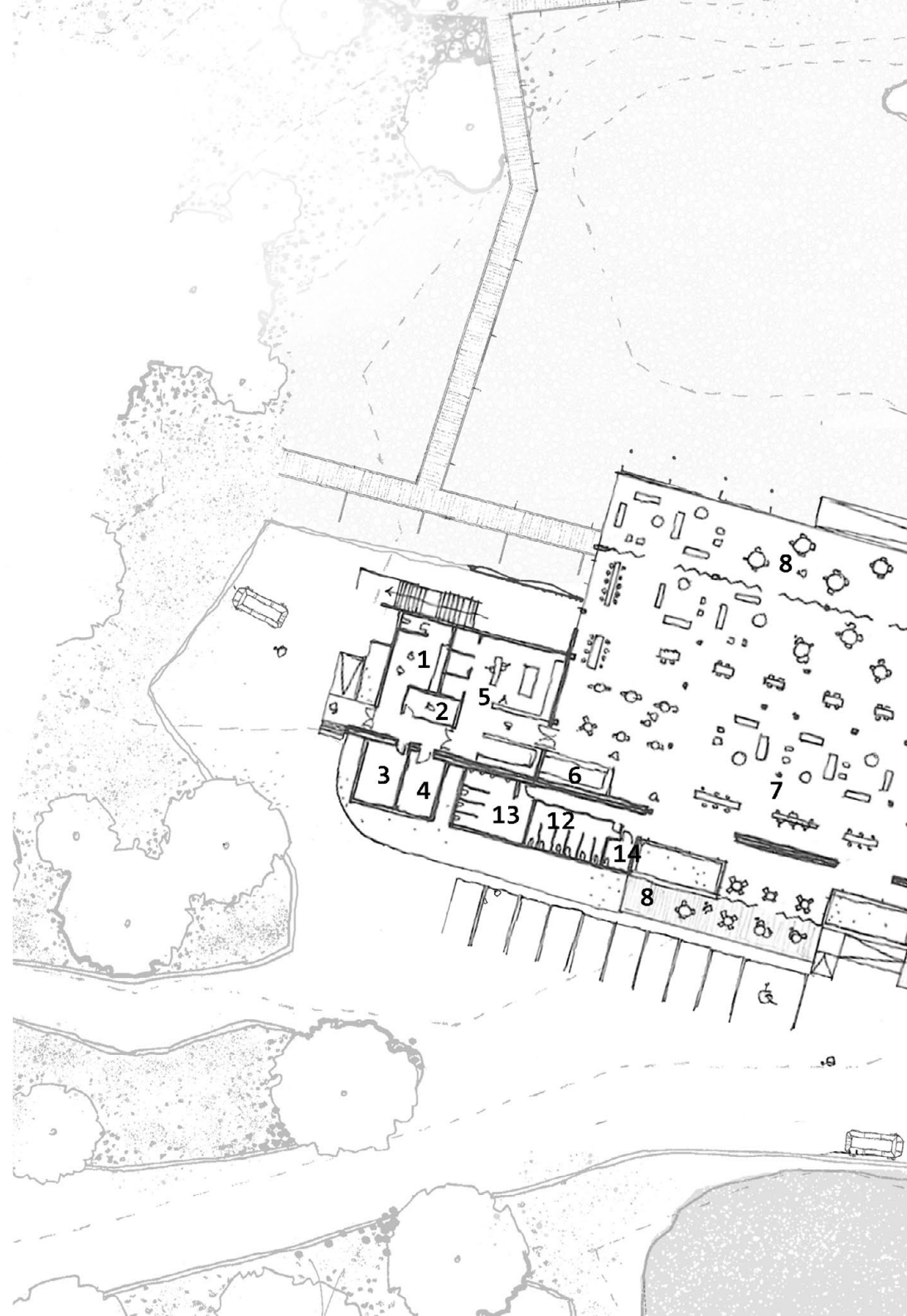


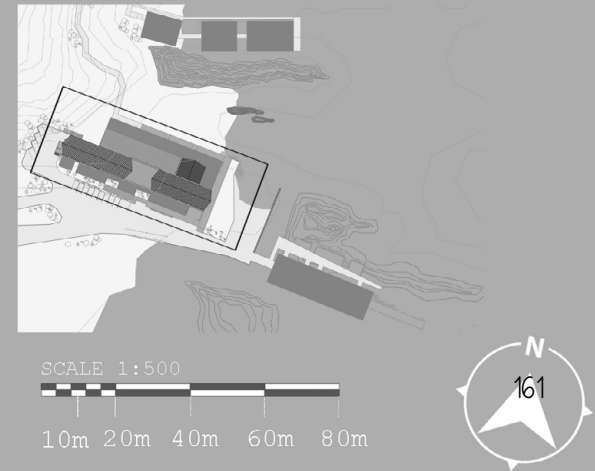
Figure 113 Author, 2020.

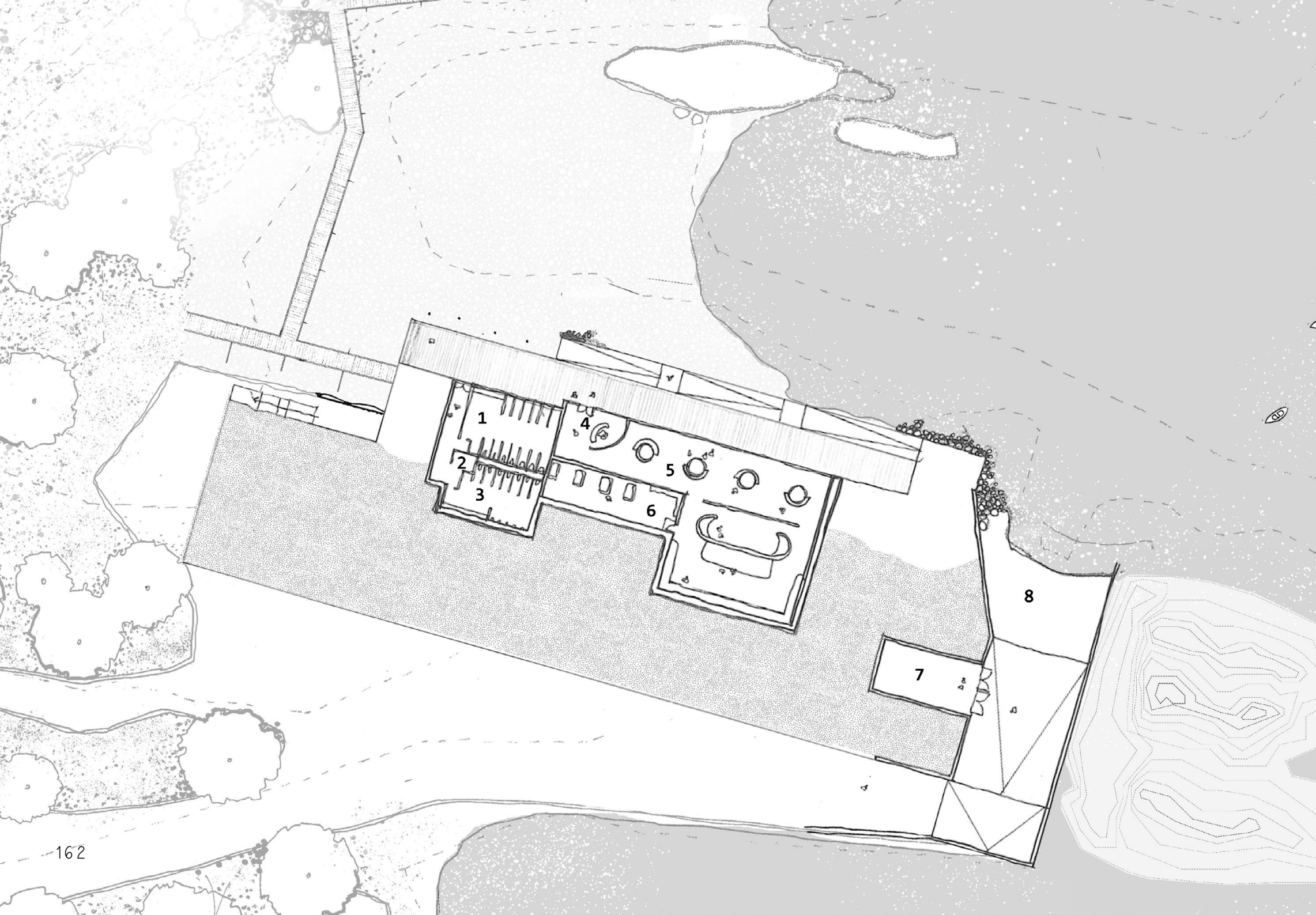


## RESTAURANT PLAN

This plan proposes a new restaurant in the Tsitsikamma National Park.

1. Staff room	16m <sup>2</sup>
2. Kitchen office	9.5m <sup>2</sup>
3. Cold storage	14.5m <sup>2</sup>
4. Dry storage	14.5m <sup>2</sup>
5. Kitchen	75m <sup>2</sup>
6. Bar	15m <sup>2</sup>
7. Interior seating	924m <sup>2</sup>
8. Outside seating	351m <sup>2</sup>
9. Reception	63m <sup>2</sup>
10. Reception	48m <sup>2</sup>
11. Information centre	45m <sup>2</sup>
12. Female WC	
13. Male WC	
14. Disabled WC	
15. Pedestrian walkway	
16. Existing green space	

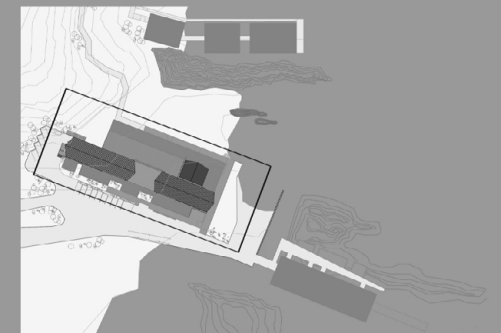




# AQUARIUM PLAN

This plan is situated beneath the restaurant on beach level and houses the aquarium and change rooms for beach goers.

1. Female WC	76m <sup>2</sup>
2. Disabled WC	4m <sup>2</sup>
3. Male WC	62m <sup>2</sup>
4. Aquarium reception	47m <sup>2</sup>
5. Aquarium display	263m <sup>2</sup>
6. Aquarium pump room	70m <sup>2</sup>
7. Boat storage	58m <sup>2</sup>
8. Boat dock	



SCALE 1:500

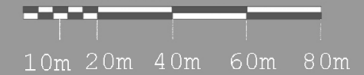
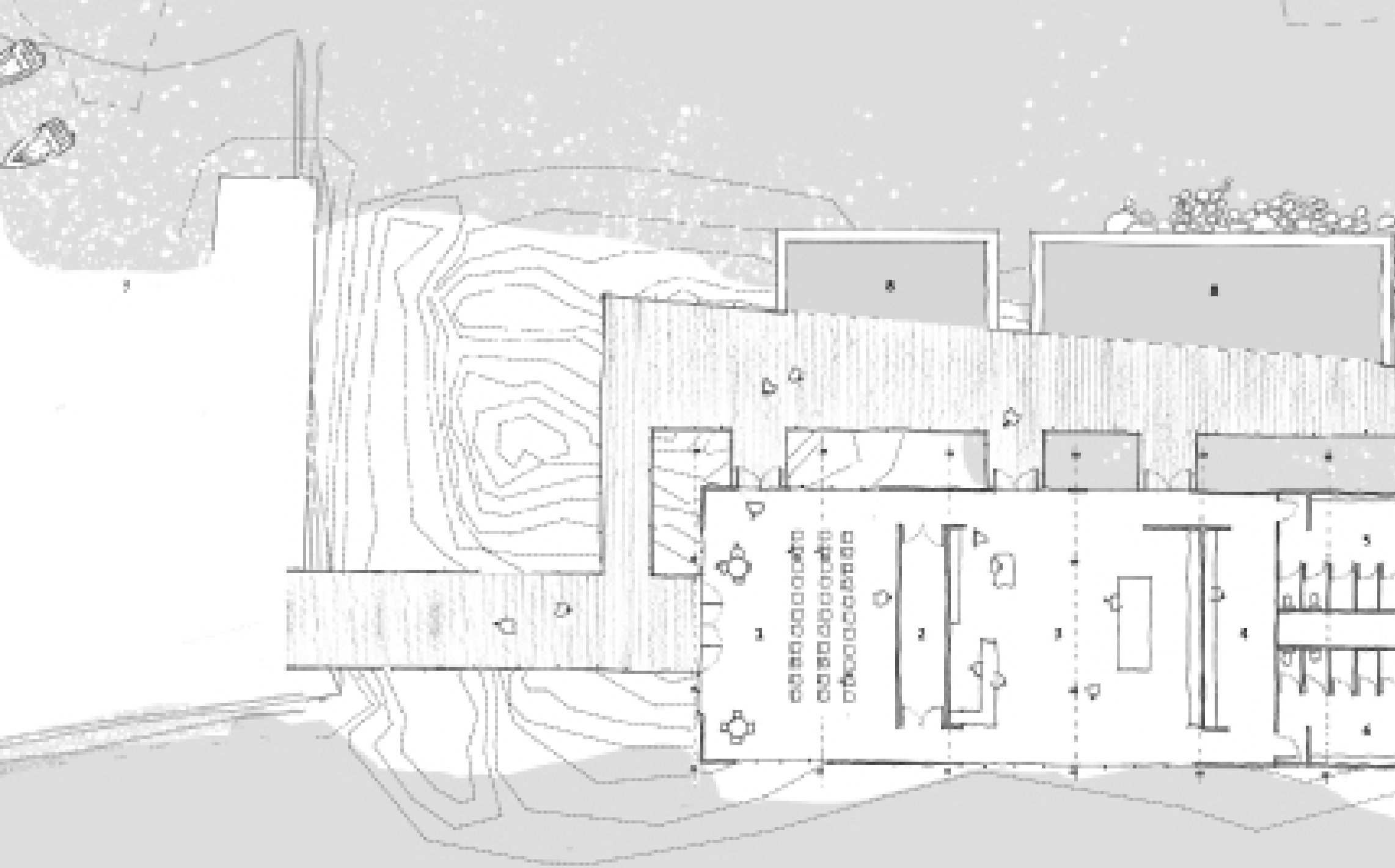
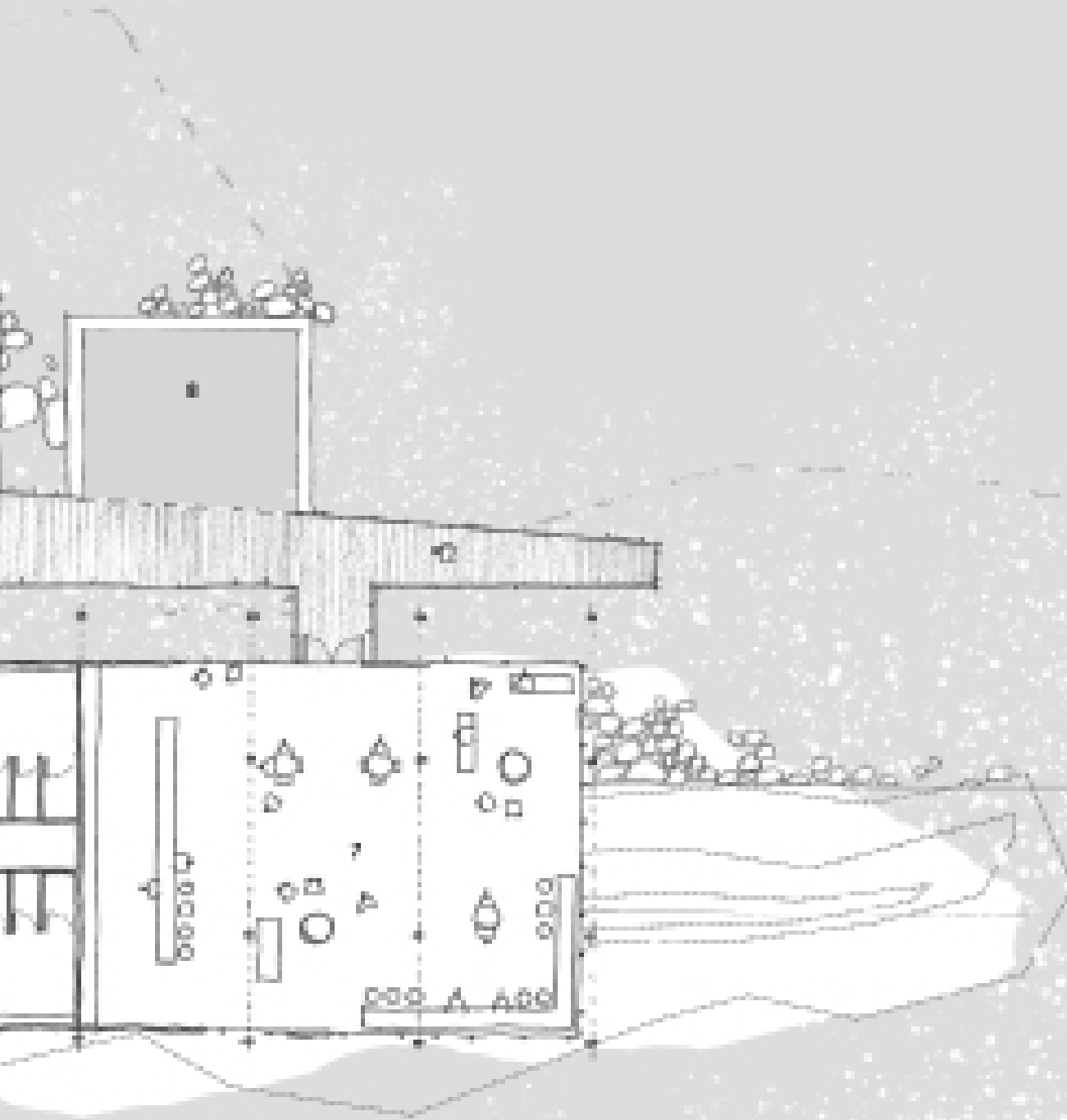


Figure 114 Author, 2020.





## DIVING SCHOOL PLAN

This plan houses the diving school, diving gear rental shop and the pier bar.

1. Diving school	166m <sup>2</sup>
2. Storage	17.5m <sup>2</sup>
3. Diving gear rental shop	130m <sup>2</sup>
4. Diving gear washup	23m <sup>2</sup>
5. Male changing room	40m <sup>2</sup>
6. Female changing room	40m <sup>2</sup>
7. Pier bar	193m <sup>2</sup>
8. Diving pools	
9. Boat dock	

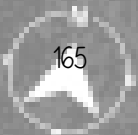


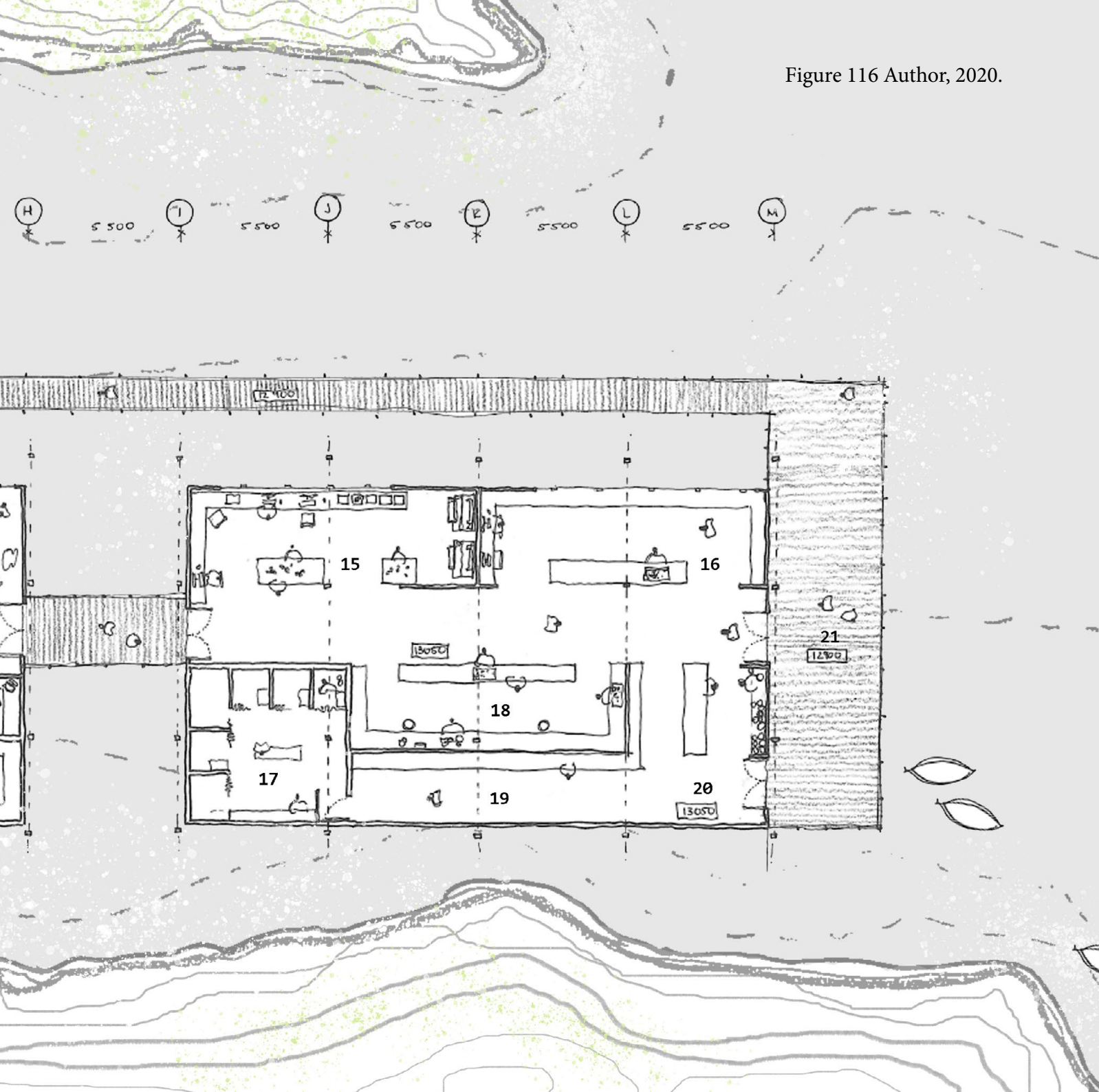
Figure 115 Author, 2020.



Figure 116 Author, 2020.

# LABORATORY PLAN

This plan houses the various amenities needed for the coral farming process as well as for research on coral farming and coral bleaching.



1. Reception	60m <sup>2</sup>
2. Boardroom	31m <sup>2</sup>
3. Office	18m <sup>2</sup>
4. Female WC	
5. Male WC	
6. Kitchen	20m <sup>2</sup>
7. Staff room	20m <sup>2</sup>
8. General office space	64m <sup>2</sup>
9. Temperature laboratory	10m <sup>2</sup>
10. Temperature testing room	15m <sup>2</sup>
11. Depth laboratory	10m <sup>2</sup>
12. Depth testing room	15m <sup>2</sup>
13. Light laboratory	10m <sup>2</sup>
14. Light testing room	15m <sup>2</sup>
15. 3D printing laboratory	36m <sup>2</sup>
16. Specimen sorting	36m <sup>2</sup>
17. Change rooms	36m <sup>2</sup>
18. Specimen logging	30m <sup>2</sup>
19. Equipment storage	26m <sup>2</sup>
20. Tank refill station	30m <sup>2</sup>
21. Deck level	



SCALE 1:200







OVERALL VIEW  
FROM WEST





OVERALL VIEW  
FROM NORTH WEST





RESTAURANT  
SOUTHERN VIEW



RESTAURANT  
DINING INTERIOR VIEW



RESTAURANT  
RECEPTION INTERIOR VIEW





EASTERN ELEVATION OF RESTAURANT 177  
SCALE 1:200



DIVING SCHOOL  
VIEW FROM NORTH EAST







PIER BAR  
INTERIOR VIEW

LABORATORY

Figure 118 Author, 2020.



LABORATORY NORTHERN ELEVATION

Figure 119 Author, 2020.







**⚠ DANGER**

**Oxygen**  
No smoking  
No open flames.

**Handling & Storing Cylinders Safely**

- 1. SECURE cylinders properly at all times.
- 2. STORE cylinders in cool, well-ventilated, fire-resistant areas in compliance with local, state and federal regulations.
- 3. PLACE cylinders where they will not be damaged by forklifts, knocked over or hit by falling objects.
- 4. CLOSE valves and TIGHTEN caps when not in use.
- 5. INSPECT cylinders for leaks and CHECK support brackets regularly for strength and integrity.
- 6. MOVE cylinders properly.

SECTION THROUGH LABORATORY

Figure 120 Author, 2020.







SECTION A-A  
THROUGH LABORATORY  
SCALE 1:50





DAY 36  
CONSTRUCTION PHASE





YEAR 01  
GROWTH PHASE

YEAR 06  
CORAL GROWTH





YEAR 15

CORAL GROWTH AND SITE RESTORATION





# 04

## Technical synthesis

this part of the document will take readers through the more technical parts of the design process and final outcomes thereof



# 01 *previous construction*

## 4.1. Construction in the Tsitsikamma National Park

### Storms River Mouth new foot bridges

Client	SANPARKS
Professional Team	Aurecon SA (Pty) Ltd
Main contractor	John Skinner Construction

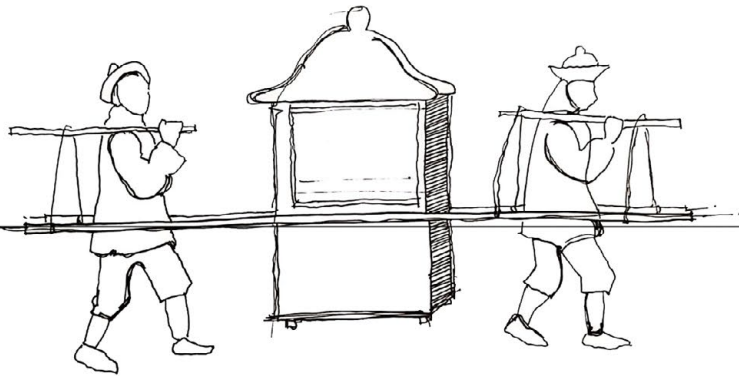
“Constructing pedestrian suspension bridges, while coping with heavy seas and high tides in an environmentally sensitive area that is virtually inaccessible for normal modes of construction, is what this unique project was all about.”

In 2007 a devastating bush fire, swept through the Tsitsikamma National Park, resulting in the devastation of the polywood tourist pathways and vegetation surrounding them. This left the various hiking trails and viewpoints inaccessible to tourists. As a result, new foot

bridges were built to restore access to the hiking trails which lead to the infamous, and still intact suspension bridge. Due to the great damage caused by the fire, an alternative route needed to be used to allow for the vegetation to grow back, but would also allow for minimal impact of the generally sensitive nature of the National Park. It was then decided to erect two new smaller suspension bridges along the ocean edge, which would connect the new walkways to the original system.

The major influence in the construction method used was the fact that all materials had to be manually carried, as access to the proposed site of the new suspension bridges were not accessible by vehicle, boat or even helicopter. In addition to the accessibility of the site, it was also in a harsh environment, surrounded by the ever-changing ocean. Therefore, the design needed to be carefully planned in order for future maintenance to be minimal and easily achievable in terms of site access.





The constraints of site access and future maintenance lead to the decision to make use of a suspension bridge system which was supported by cables, that were anchored into modular, galvanised steel structures with polywood walking surfaces and stainless-steel fittings where possible (SAICE, 2020: Online). The construction commenced with all the materials being carried by hand along the 1km long mountain hiking trail, which is relatively steep in places, with steps being the walkway, and, all while still being used by tourists.

In order for workers to easily carry the supplies to the site, the contractor manufactured unique carrying containers, similar to the old-style Sedan chair or Litter as it is also known. These carrying containers are carried by two people.

The heavy suspension cables that were used were carried by a long row of workers in a “snake” like fashion. Furthermore, the positioning of the tower bases needed to be carefully finalised on site after rubble and detritus

had been removed, taking into account the nature and stability of the rock spurs and the height above the surf in heavy ocean conditions and spring tides (SAICE, 2020: Online). The anchor pins were drilled in using a compressor which had been partially dismantled and also carried to the site.

Concrete aggregates and cement were carried manually to site, in 30 kg loads and stored in weatherproof containers at the easternmost (farthest) pier position.

Concrete was mixed with a small mixer which like the compressor, had to be partially dismantled and carried in. Water was obtained using a gravity siphon from the perennial stream near the start of the walkway, also 1 km from the site, and regulated by a simple garden tap at the outlet. Access from the eastern pier was created by erecting a scaffold and temporary walkway virtually on the beach.





Once the bases had been shuttered and cast, the structural steel towers were erected and the cables pulled into position using the temporary scaffold and walkway. Lastly, the walking deck, hand guide cables, side protection, and so on, were all fitted before the bridges were connected to the existing walkways with new polywood access routes.

As afore-mentioned, tourists still made use of the hiking trails and visited the National Park during the construction of these suspension bridges, making the control of the contractor's yard in terms of neatness and planning very important. There was interaction with the hikers walking along the existing walkways throughout the process. This led to many positive comments and reactions from the tourists and the workers often became subject of photographs taken home by tourists to show their families (SAICE, 2020: Online).

#### Unique challenges of the project

As with any construction there are some challenges that are unique to this project. The biggest challenge being the site access and as a result dictating a specific design and construction approach, resulting in innovative means of transporting materials to site; of course.

The removal of rubble, also had to be carried out manually.

This means of construction and community involvement in the project is inspiring and reassuring to the construction methods of my proposal of a Coral Reef Nursery and Rehabilitation centre in the National Park. Although the site may seem inaccessible and challenging, with some innovative system design this may one day be a reality.

# 02 technical synthesis report

## 2.1. What this project entails

This design has two types of construction outcomes, as one is primarily for structures on land and the other structures in the ocean. These two types of construction along with the location of the site resulting in some sense of inaccessibility, much research was done on how to best design appropriate structures for the proposed amenities on their respective sites. The proposed amenities total at 3243m<sup>2</sup>, which include a restaurant, aquarium, diving school, pier bar and a coral reef nursery and rehabilitation centre.

## 2.2. Environment and micro-climate

### 2.2.1. Locality and design proposal

The proposed design is situated in the Tsitsikamma National Park at Storms River mouth, a site that has been a tourist attraction for many years. However, in recent years the amenities have fallen into disarray as the restaurant burnt down in 2016, resulting in the additional closure of the diving courses offered due to the decrease in tourist activity. As recent as September 2020 the curio shop in the National Park also burnt down. This resulted in the proposal of the amenities

on site, reinstating the restaurant and diving courses offered, in the form of a diving school. These amenities will be supplementary to the Coral Reef Nursery and Rehabilitation centre.



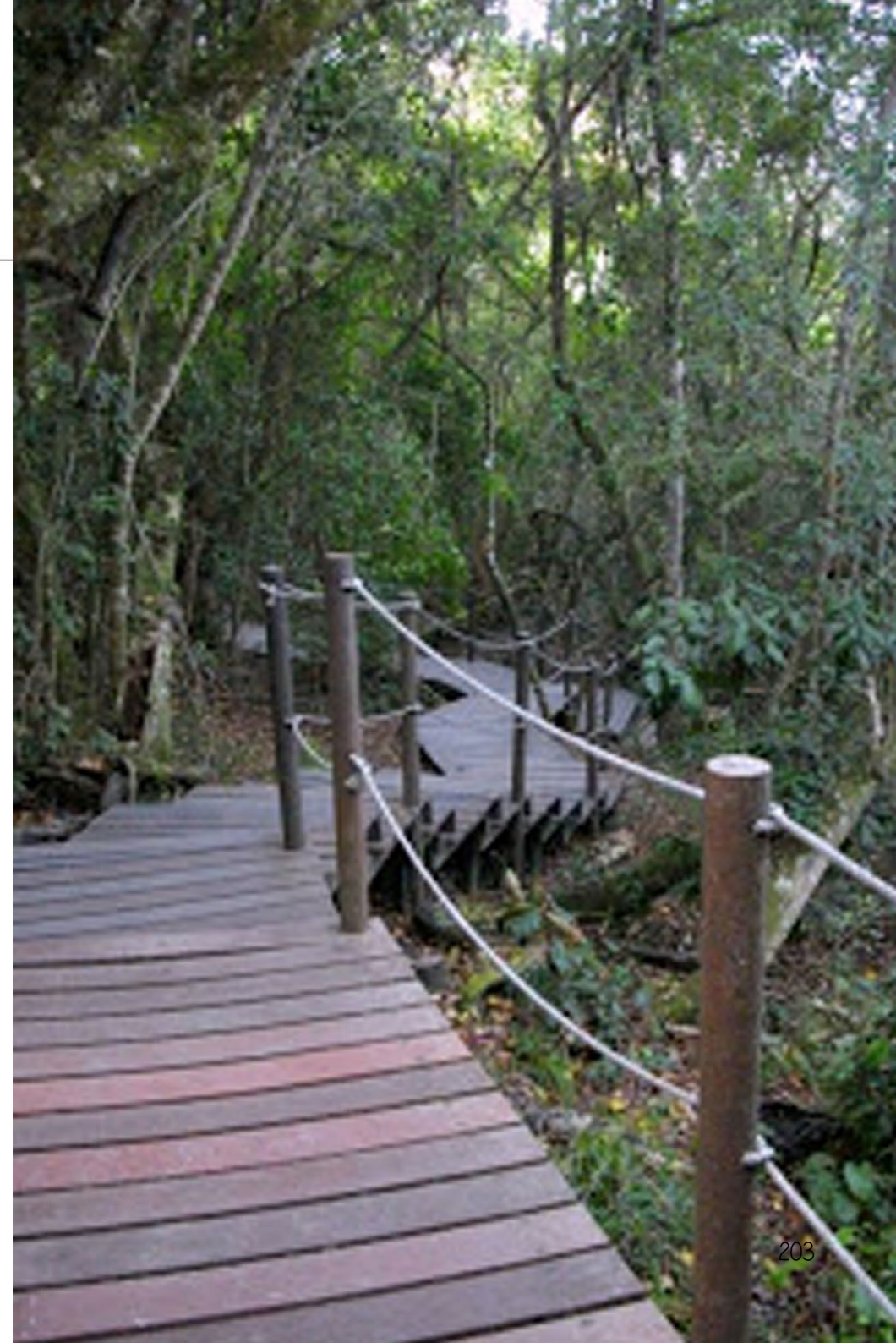
### 2.2.2. Site conditions and challenges

The identified sites for each of the amenities lie close to the lush vegetation and either border or step into the ocean. This calls for a sensitive approach to the design process as well as unconventional means of construction.

### 2.2.3. Site accessibility

The accessibility to the proposed sites of the restaurant and diving school are primarily accessible by vehicle and then by foot. However, the site specifically for the Coral Reef Nursery and Rehabilitation centre, identified as Mooibaai beach, is inaccessible by vehicle or boat, only being accessible by foot on the Mountain hiking trail walkways which can be seen on the right.

This calls for innovative construction methods which take lead from the precedent study of the construction of the suspension bridges in the National Park done earlier in this document.



#### 2.2.4. Introduction of vegetation to the site

The proposed design introduces a variety of new vegetation to surround the restaurant as well as preserving and adding to the vegetation of the existing green space. The vegetation which will be added with the construction of the design will be plants that have been already identified on site, such as aloe plants and ferns, all indigenous to the area.

In terms of “vegetation” in the ocean the introduction of the coral reef nursery will grow various corals such as cup corals and social fan ascidians, already prominent in the area, as well as new super corals bred in the laboratories.

These corals will be transplanted to the underside of the structures in the ocean promoting oceanic biodiversity and combating coral bleaching.



#### 2.3. The construction phases and process

##### 2.3.1. Building goals throughout time

The proposed design will occur in various phases of what is referred to as growth and destruction. The first of the amenities to be introduced in the growth phase will be the Coral Reef Nursery and Rehabilitation centre, due to the proposed sites accessibility, this process can be seen in the image on the right, after which the diving school and pier bar will be constructed and lastly the restaurant. This process of the construction of the various amenities was chosen due to site accessibility and construction methods and the placement of construction machinery, which will be discussed later on. In addition to this the restaurants construction takes place last as the current temporary restaurant can be made use of until the entire construction process is complete.

The only planned phase in the destruction phase would be the dismantling of the structure above the water level of the Coral Reef Nursery and Rehabilitation centre, and this would most likely occur when the need for research is no longer viable and the reef on the underside of the structure, under the water level has grown to its full potential. It is proposed that the materials from the structure's removal be used in the National Park for future projects or reparations of existing buildings, ensuring the materials do not go to waste.





## 2.4. Form and function

### 2.4.1. Functions within the proposal

The restaurant and aquarium underneath it on beach level, will be constructed of a concrete column and beam structure with masonry infill and a variety of timber screening devices and pergolas. The original restaurant that burnt down was constructed of timber logs which interlocked and canvas screening devices which provided shade.

It was decided to make use of a different construction method for this proposal which would have a longevity that surpassed that of the timber interlocking logs yet would still compliment the timber camping cottages on site as well as the proposed diving school and Coral Reef Nursery and Rehabilitation centre which are primarily in the ocean.

Figure 128 Author, 2020.

## 2.5. Circulation

### 2.5.1. Hiking

The Tsitsikamma National Park is well known for its hiking trails and stunning views across the ocean. These hiking trails form part of the proposed design as the Mountain hiking trail starts at the beach below the proposed restaurant and passes the Mooibaai site. These hiking trails consist of a variety of timber walkways and steps.

### 2.5.2. Boat

The existing boat dock which is situated between the proposed restaurant site and the proposed site for the diving school will be reimplemented as the boat dock from which diving and canoeing groups will commence.

### 2.5.3. Car

The proposed site for the restaurant and diving school are both accessible by car and parking for approximately 16 public vehicles, with one disabled parking, and a parking facility for tourist buses is available. From the parking area, users commence on foot.

## 2.6. Structural overview

### 2.6.1. Proposed construction methods

The proposed construction methods and use of materiality take two alternative routes for structures on land and structures in the ocean. The structure on land for the proposed restaurant and aquarium make use of a static column and beam construction with masonry infill. This construction is a “heavier” type of construction due to the locality on land.

The structures proposed in the ocean were derived from a variety of factors including research and site conditions, taking a “lighter” construction approach of modular systems which fit into each other, creating an interlocking structure which relies on gravity.

Having components that are more permanent, that is the structures under the ocean water line onto which coral specimens can be transplanted and more temporary components in the case of the Coral Reef Nursery and Rehabilitation centre, which can be detached after a certain number of years which are determined by the research process and its outcomes. These elements can be seen in the image on the right.

skeletal structure which provides cover and protection

light timber frame structure which latches onto concrete bases temporarily

permanent precast concrete elements for artificial reef growth

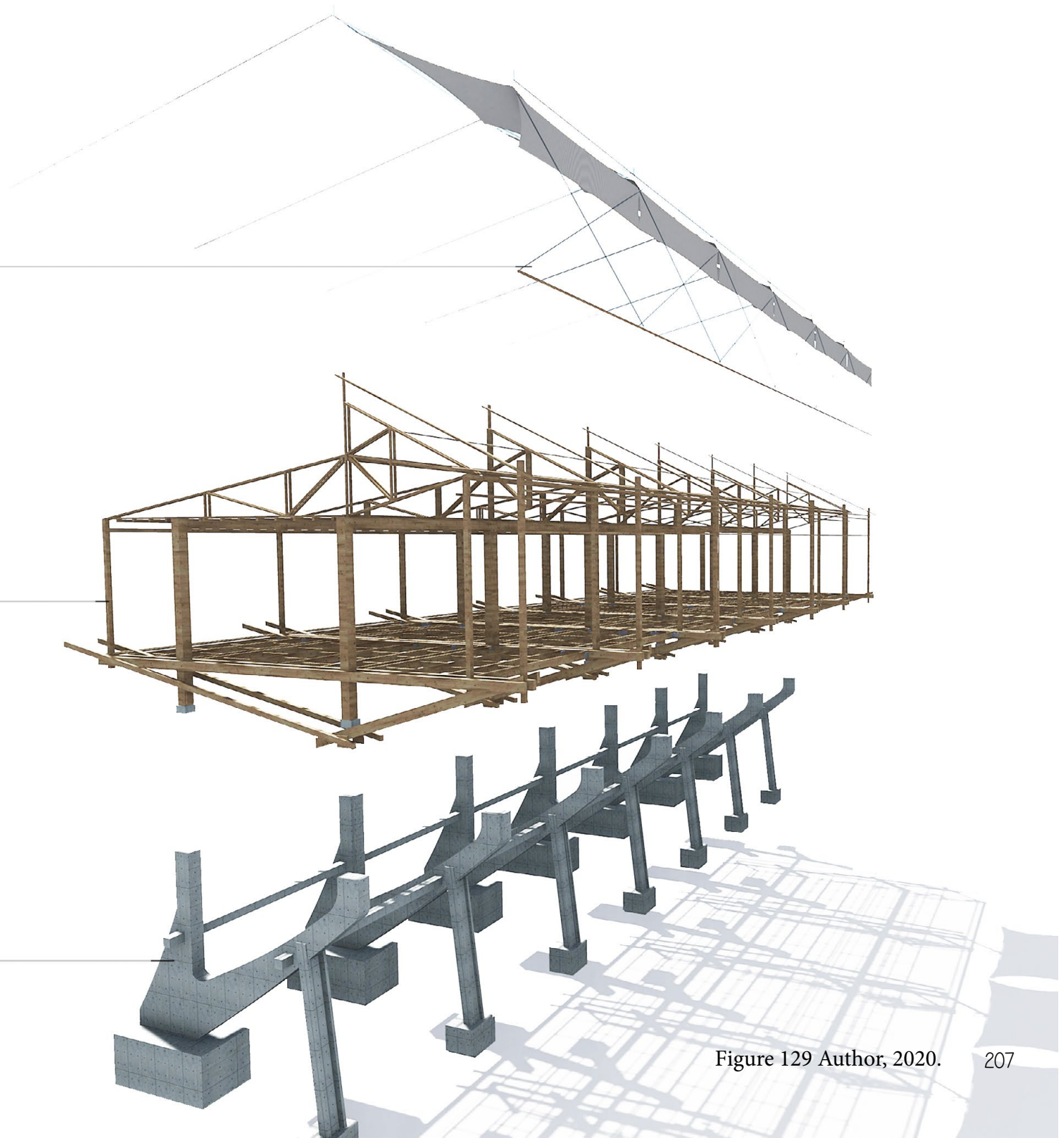


Figure 129 Author, 2020.

## 2.7. Structural detailing specifically of the Coral Reef Nursery and Rehabilitation centre and Diving school

### 2.7.1 Foundations

Firstly, a layer of rocks (1), referred to as a pioneer's layer, is laid in layers of 500mm to create a secure surface for insitu casting of the concrete bases (2) in the water. These bases are 1300mm x 1400mm concrete plinths which are cast insitu on top the pioneers' layer on the designated positions. A total of 28 such units are to be cast with an allowance made when casting for a tongue and groove connection of the precast elements.

The precast elements (3) are placed on top of the concrete plinths connecting in a tongue and groove fashion supported by secondary precast elements placed and connected in the same way.

### 2.7.2. Column and beam structure

A timber column and beam structure (4) are connected to these precast elements above the waterline, allowing for a rise in water level of up to 2 meters, with the highest rise in water level having been recorded at 1.7 meters in the area. This column and beam structure is comprised of 238mmx38mm laminated timber sections which are bolted together to form the columns and beams. The columns are spaced at 5500mm.

### 2.7.3. Flooring

The flooring (5) connects to the column and beam structure and is comprised of 240mmx13960mm timber sections

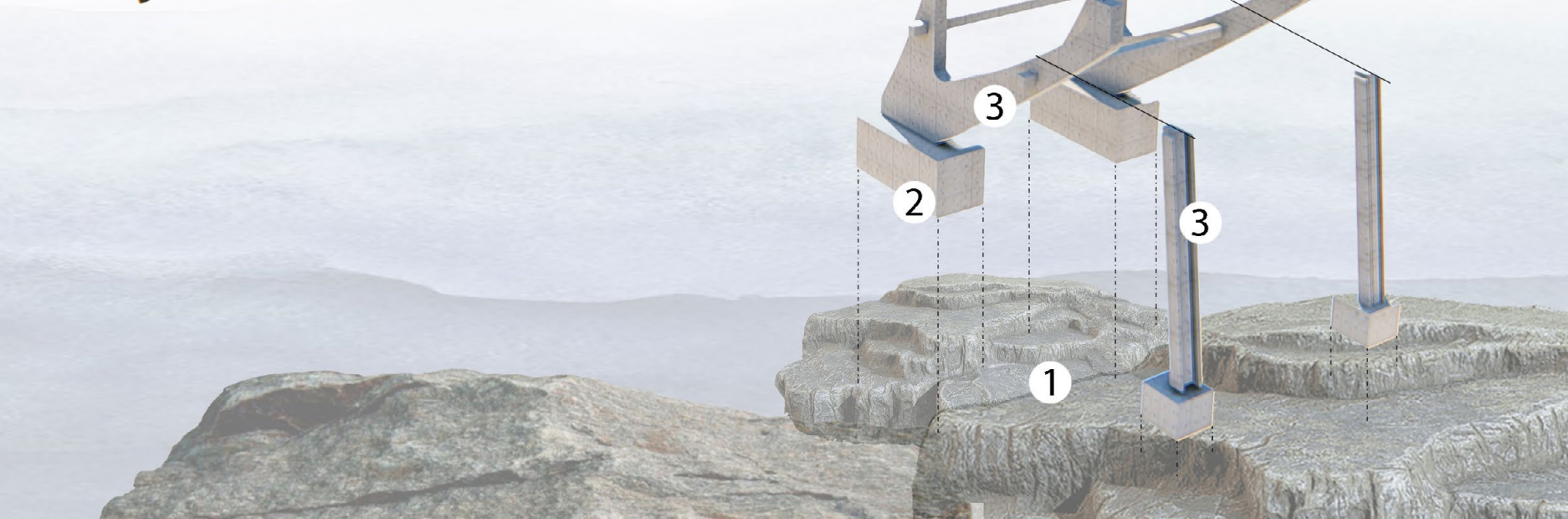
with bracing sections. The flooring components are placed between the 5500mm spaced columns and 45mm Isoboard insulation sheets are pre-cut to size and laid on top of the braced sections. On top of this interlocking tongue and groove timber floor boards are nailed down.

### 2.7.4. External walls

The external walls are timber sheets which are fixed to the timber column and beam structure to 38mmx75mm timber sections with 35mm Isoboard insulation sheets between the inner timber and outer timber sheets. A small gap is left between the outer timber sheet and the Isoboard insulation to allow for natural ventilation through the walls.

### 2.7.5 Roofing

The roofing component makes use of two means of construction. The roofing to the northern façade (6) of the structure is comprised of 35mm Isoboard insulation, covered by laminated timber sheets which are protected by canvas material which is stretched over this and kept down by suspension cables. This part of the roof is supplemented with a light suspended ceiling made of prefabricated reed panels. The southern facades roofing (7) is comprised of a 35mm Isoboard insulation, and purlins to which a PVC roofing membrane is welded together to form a continuous waterproof roofing system.



### 2.7.6. Skeletal screening

The afore mentioned canvas material screening element (8) which protects the timber roof is connected by means of tension cables to an external skeletal structure (9) which is connected to the precast foundation elements as well as the rock outcropping to the south of the structure.

## 2.8. Socio-economic factors

### 2.8.1. Social sustainability

In terms of Social sustainability, the project poses the renewal of tourist attraction amenities such as the restaurant and diving school along with the proposal of new amenities such as a pier bar and small-scale aquarium. It is the hope that these amenities will

revitalise the tourist flow in the Tsitsikamma National Park as well as the larger Garden Route area.

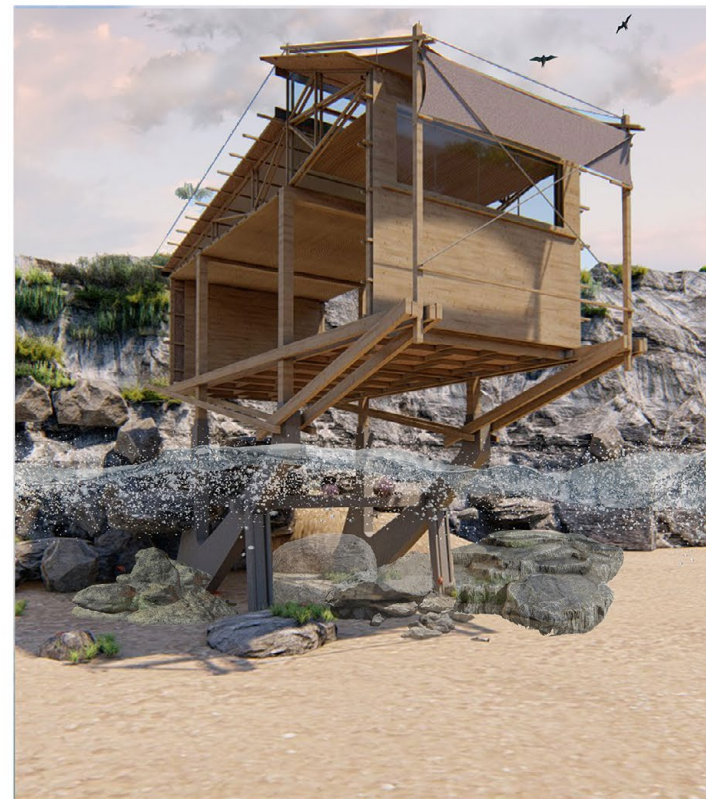
### 2.8.2. Economic feasibility

This project takes on the responsibility of employing many more staff members within the Tsitsikamma National Park due to the proposed amenities as well as branching out the park's involvement in the sustainability of the natural resources pertaining to oceanic life, therefore also employing staff with a scientific background. By reinstating the tourist amenities and providing new tourist attractions it is the hope that the Coral Reef Nursery and Rehabilitation centre will be able to run feasibly.

DAY 36: CONSTRUCTION PROCESS

YEAR 1: SECTION FINAL DESIGN OUTCOME

YEAR 6: CORAL GROWTH



### 2.8.3. Natural sustainability

This project proposes structures, which supplementary to tourist growth, will also grow the oceanic biodiversity of the Tsitsikamma National Park through means of the coral reefs which will over time grow on the underside of the structures in the ocean. This project poses to promote awareness and protection of the unseen coral reefs in the Tsitsikamma National Park.

### 2.9. Conclusion

The Coral Reef Nursery and Rehabilitation centre with supplementary amenities in the Tsitsikamma National Park, provides an array of functions and various structural investigations on a relatively inaccessible site. This project focussed on the exploration and

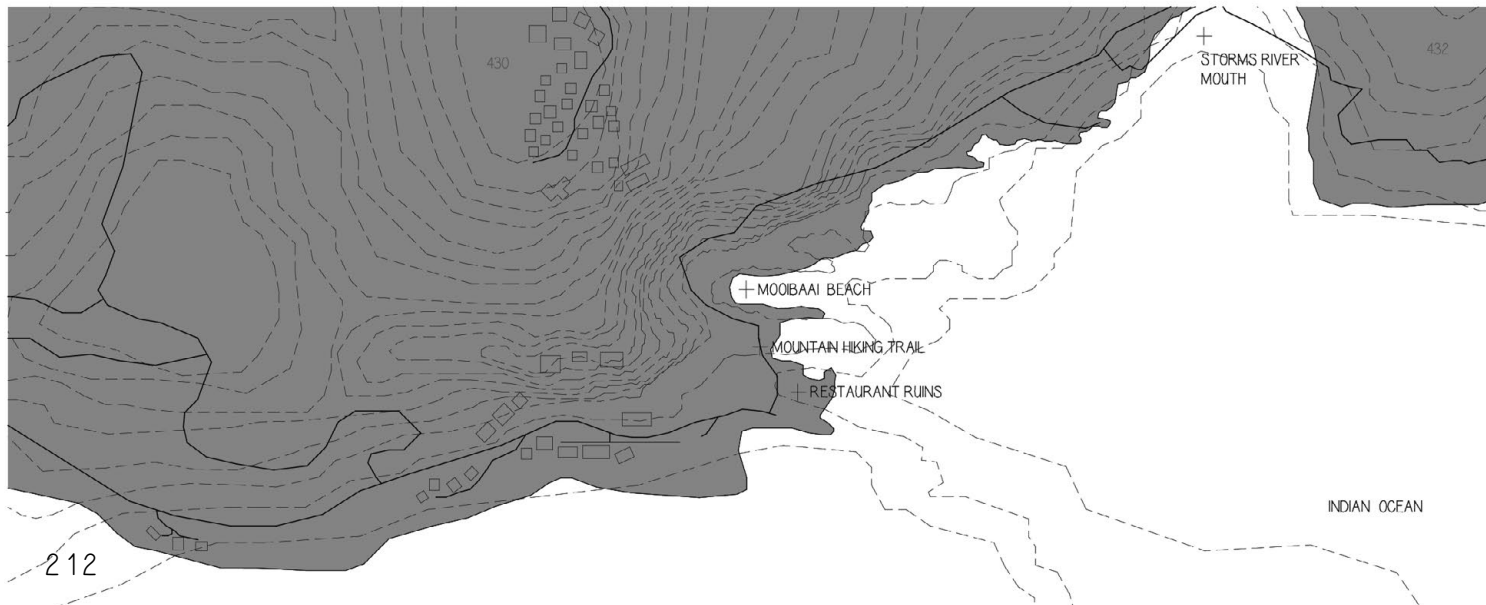
understanding of each of the users and proposed amenities and their relation to the site, exploring the best possible design outcomes for each. The structure was largely influenced by the type of construction methods which had to be used due to the location of the site as well as the complexity of the coral species which would eventually consume the underwater structures. Should the proposed amenities be constructed, the reaction of coral to the structures would be the gauge to which the success of the design would be measured. Ultimately the design proposal aims at raising awareness for the current global crisis of coral bleaching and researching a proposal to combat this.

YEAR 15: CORAL GROWTH AND TEMPORARY STRUCTURE REMOVED, LEAVING NATURE RESTORED AND REPLENISHED. Figure 131-134 Author, 2020.





MACRO LOCALITY PLAN  
SCALE 1:10000



MICRO LOCALITY PLAN  
SCALE 1:1000

SCHEDULE OF RIGHTS			
PROPERTY DESCRIPTION			
TRF/PORION 430			
SITE AREA: 37 440m <sup>2</sup>			
TOWNSHIP: TSITSIKAMMA NATIONAL PARK - STORMS RIVER MOUTH REST CAMP			
TITLE DEED NUMBER: 26064			
ZONING INFORMATION			
TOWN PLANNING SCHEME	CORAL REEF NURSERY AND REHABILITATION CENTRE		
USE ZONE	PUBLIC BUILDINGS: TOURISM		
AMENDMENT SCHEME NO.	B1		
ANNEXIT NO.	20		
DEVELOPMENT CONTROL MEASURES			
PERMISSIBLE	CONTROL		CONTROL
8 000	HEIGHT OF BUILDINGS		
20 %	COVERAGE		
18	FLOOR AREA RATIO	15 %	
			18
PARKING			
TOTAL PARKING BAYS REQUIRED	50 PARKING BAYS		
TOTAL PARKING BAYS PROVIDED	60 PARKING BAYS		
SURPLUS OF PARKING BAYS	10 PARKING BAYS		
SANITARY POPULATION SCHEDULE			
REQUIRED			
MALE			
WC	HWB	U	S
10	5	9	0
FEMALE			
WC	HWB	U	S
20	N/A		0
PROVIDED			
MALE			
WC	HWB	U	S
12	8	11	0
FEMALE			
WC	HWB	U	S
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THE INFORMATION PROVIDED ABOVE IS HEREBY CERTIFIED TO BE CORRECT AND PRECISE			
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DATE: 19/11/2020			
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NOTES

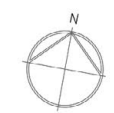
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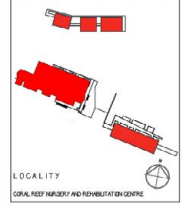
PROJECT:  
CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

TITLE:  
MACRO LOCALITY PLAN,  
MICRO LOCALITY PLAN,  
SCHEDULE OF RIGHTS

DRAWING NO: A101	REVISION: 4
DATE: 08.12.2020	SCALE: AS INDICATED
DRAWN BY: M. JORDAAN	STUDENT NO: 205044734
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REEFS N RUIN





SITE DEVELOPMENT PLAN  
SCALE 1:500

PURPOSE OF ISSUE:  
ISSUED FOR INFORMATION

PROJECT:  
CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

TITLE:  
SITE DEVELOPMENT PLAN

DRAWING NO: A102	REVISION: 4
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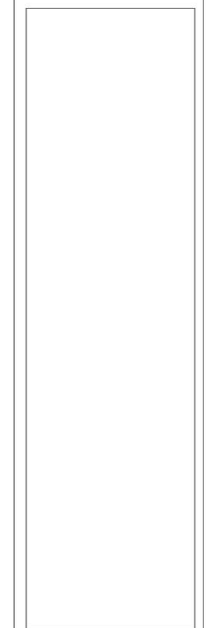
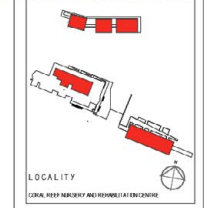
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DRAWN BY: M. JORDAAN	STUDENT NO: 2015044734
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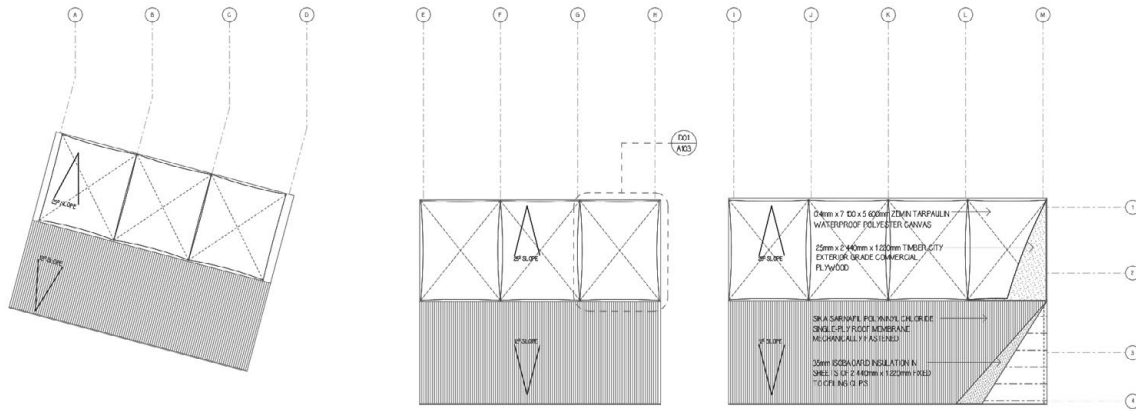
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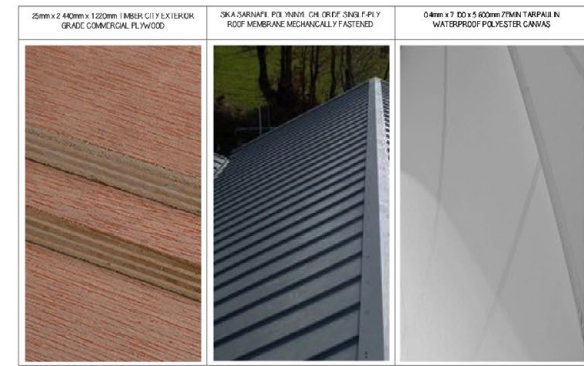




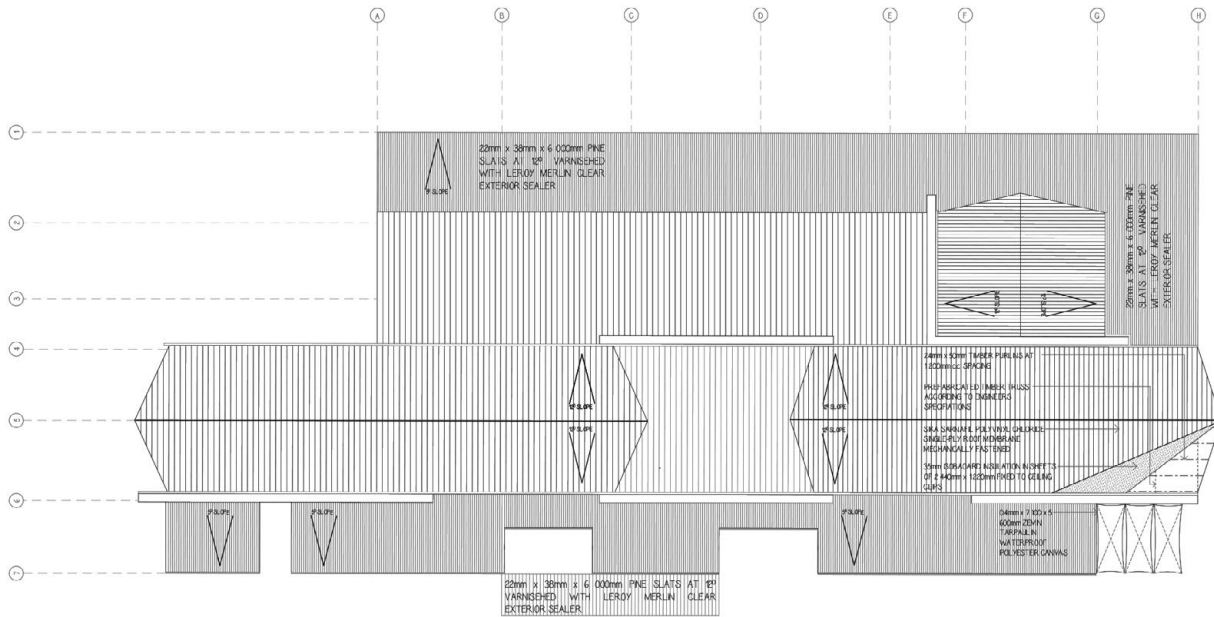
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DETAIL 1 - SKELETAL SCREENING DEVICE	
DRAWING NO: A103	REVISION: 4
DATE: 08.12.2020	SCALE: AS INDICATED
DRAWN BY: M. JORDAAN	STUDENT NO: 2015044731
SIGNATURE: 	
MICHKE JORDAAN march prof 2020 UNIVERSITY OF THE FREE STATE 014 235 5997 michke@baf97@baf97.com REEFS IN RUIN	



LABORATORY ROOF PLAN  
SCALE 1:200



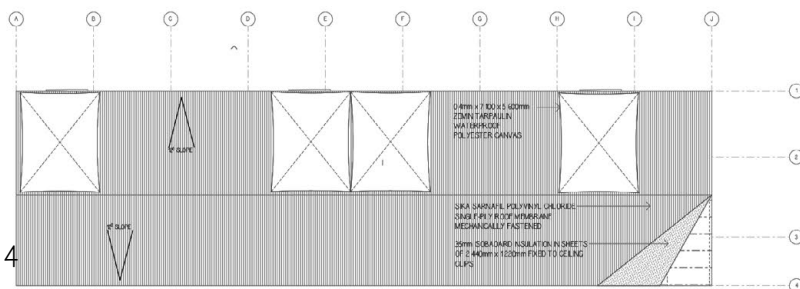
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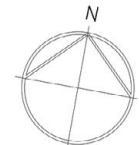
RESTAURANT ROOF PLAN  
SCALE 1:200

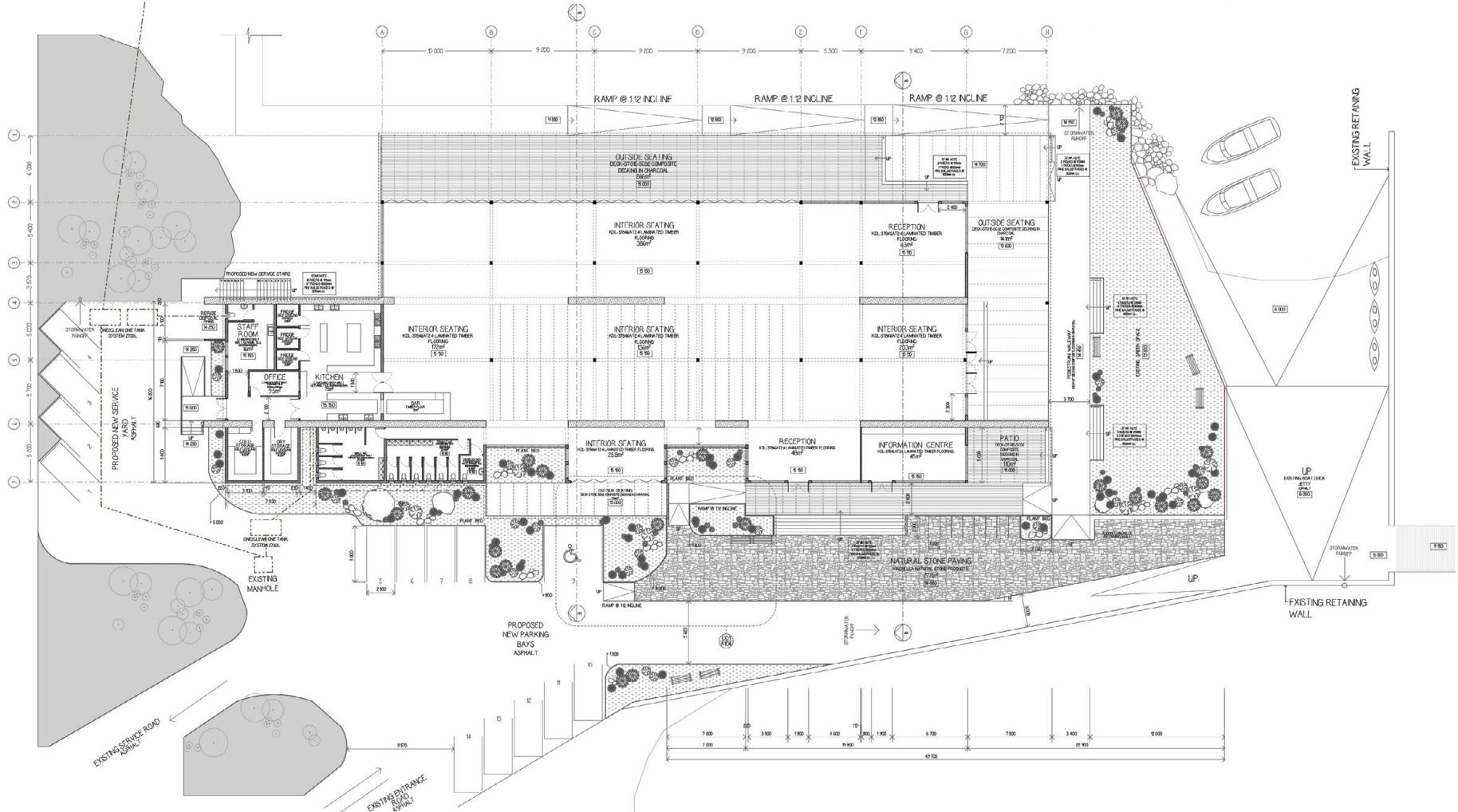


DETAIL 01A103 - SKELETAL SCREENING DEVICE  
NTS



DIVING SCHOOL ROOF PLAN  
SCALE 1:200





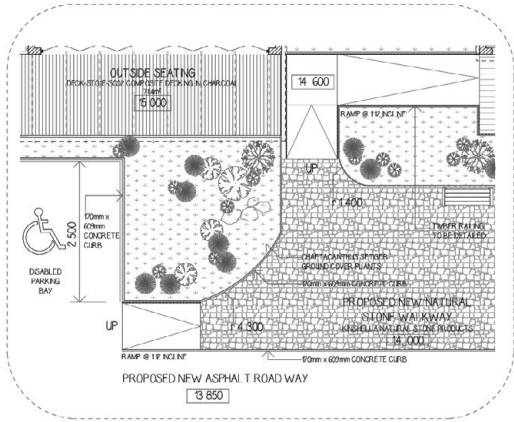
PROPOSED NEW RESTAURANT PLAN  
SCALE 1:200

STACKED STONE	CONCRETE FACED ROAD FACEBRICK	NATURAL STONE PAVING	TIMBER CLADDING	INTERIOR TIMBER FLOORING	ASPHALT	FINE SAND EXTERIOR FLOORING	EXTERIOR TIMBER FLOORING	TILES	CONCRETE FLOORING

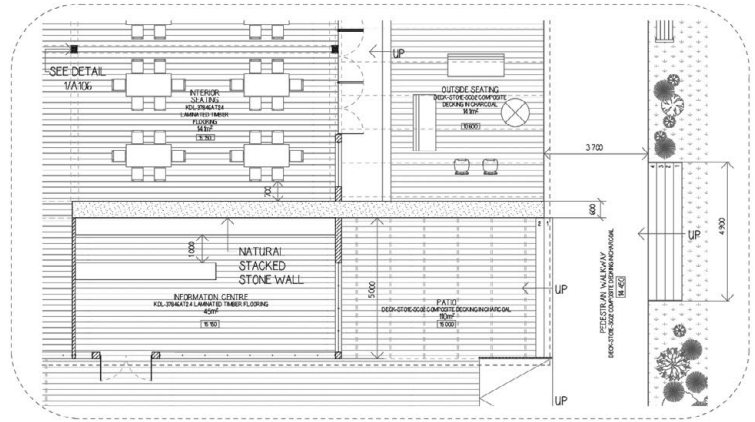
PROPOSED MATERIALITY KEY  
NTS

VIBURNUM	ALBIZIA	CATTAIL	CATS PAW	LAVENDER TREE	GRAPE VINE	OPEN FLOWERING SHRUB	POTTED TREE ON SITE

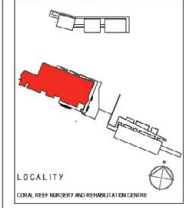
PROPOSED NEW SHRUBBERY KEY  
NTS



DETAIL 1/A103 - PROPOSED ENTRANCE OF RESTAURANT  
SCALE 1:100



DETAIL 2/A103 - RESTAURANT LEVEL DETAILS AND FINISHES  
SCALE 1:100



LOCALITY  
CORAL REEF NURSERY AND REHABILITATION CENTRE

NOTES  
SEWERAGE  
THE ONE 2 0 FAN TANK SYSTEM THAT IS USED ONLY REQUIRES ONE TANK WITH ONE CHAMBER THE SYSTEM USES LESS ENERGY AND WATER AND THERE ARE NO MECHANICAL ELEMENTS IN THE WASTE WATER THIS SYSTEM PRODUCES CLEAR WATER IN THREE STEPS WHICH CAN BE REUSED A LORRY BEARING VERSION IS USED IN THIS PROJECT DUE TO THE TRAFFIC FLOW IN THE PLACEMENT OF THE TANKS.

PURPOSE OF ISSUE  
ISSUED FOR INFORMATION

PROJECT  
CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

TITLE  
RESTAURANT PLAN, PROPOSED MATERIALITY KEY, PROPOSED NEW SHRUBBERY KEY, PROPOSED NEW RESTAURANT ENTRANCE PLAN, RESTAURANT LEVEL DETAILS AND MATERIALITY

DRAWING NO  
A104

REVISION  
4

DATE  
08 12 2020

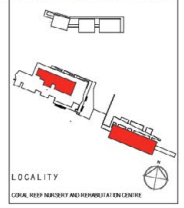
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AS INDICATED

DRAWN BY  
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REEFS IN RUIN



NOTES:

PURPOSE OF ISSUE:  
ISSUED FOR INFORMATION

PROJECT:  
CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

TITLE:  
PROPOSED DIVING SCHOOL PLAN,  
PROPOSED AQUARIUM AND BEACH CHANGE ROOM PLAN

DRAWING NO:  
A105

REVISION:  
4

DATE:  
08/12/2020

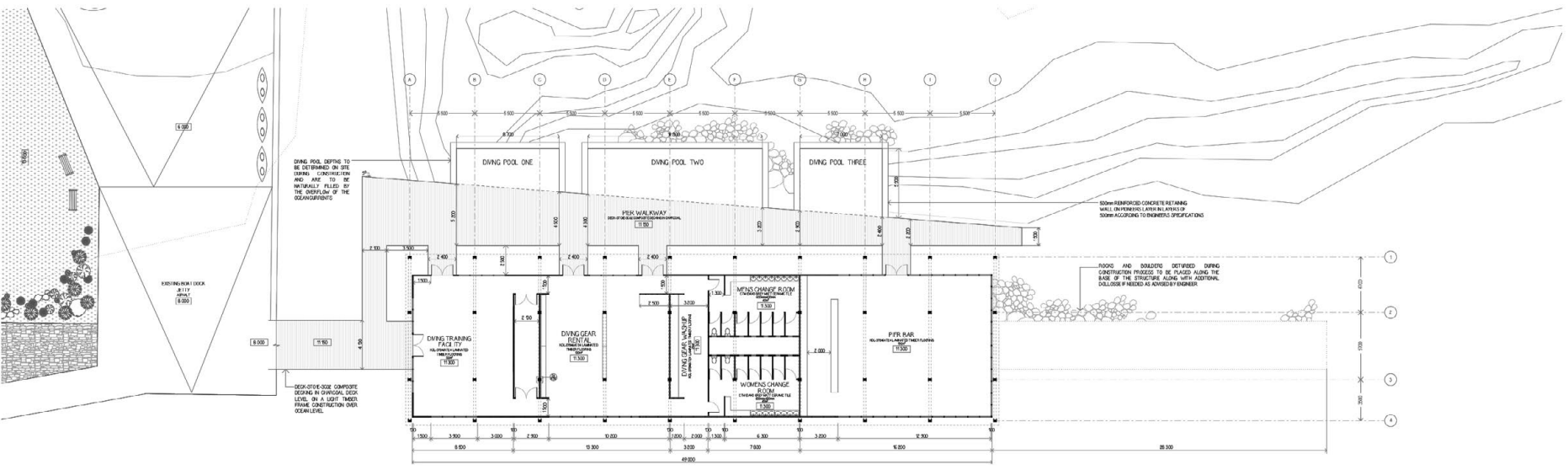
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DRAWN BY:  
M. JORDAAN

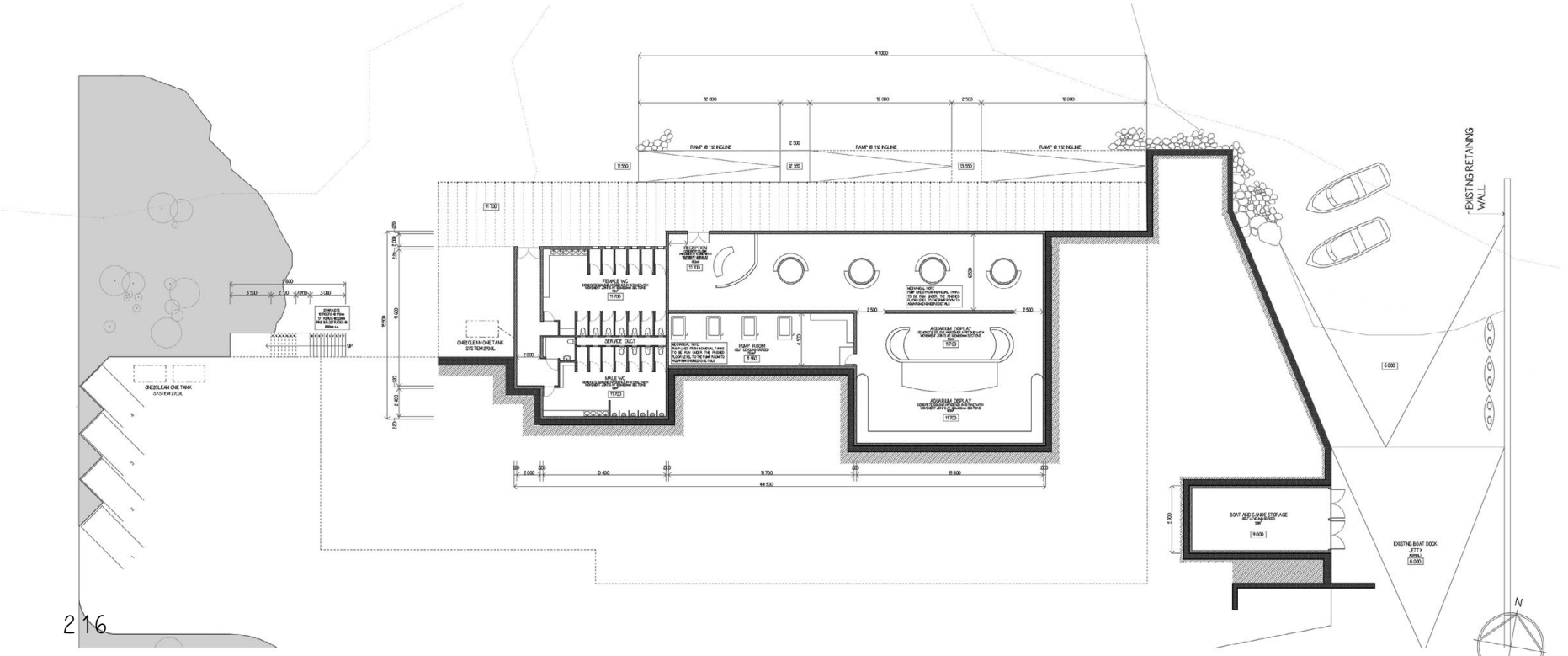
STUDENT NO:  
20504734

SIGNATURE:  
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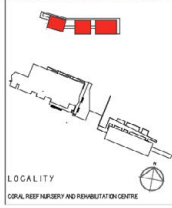
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034 234 1939  
mich@unifr17@gmail.com  
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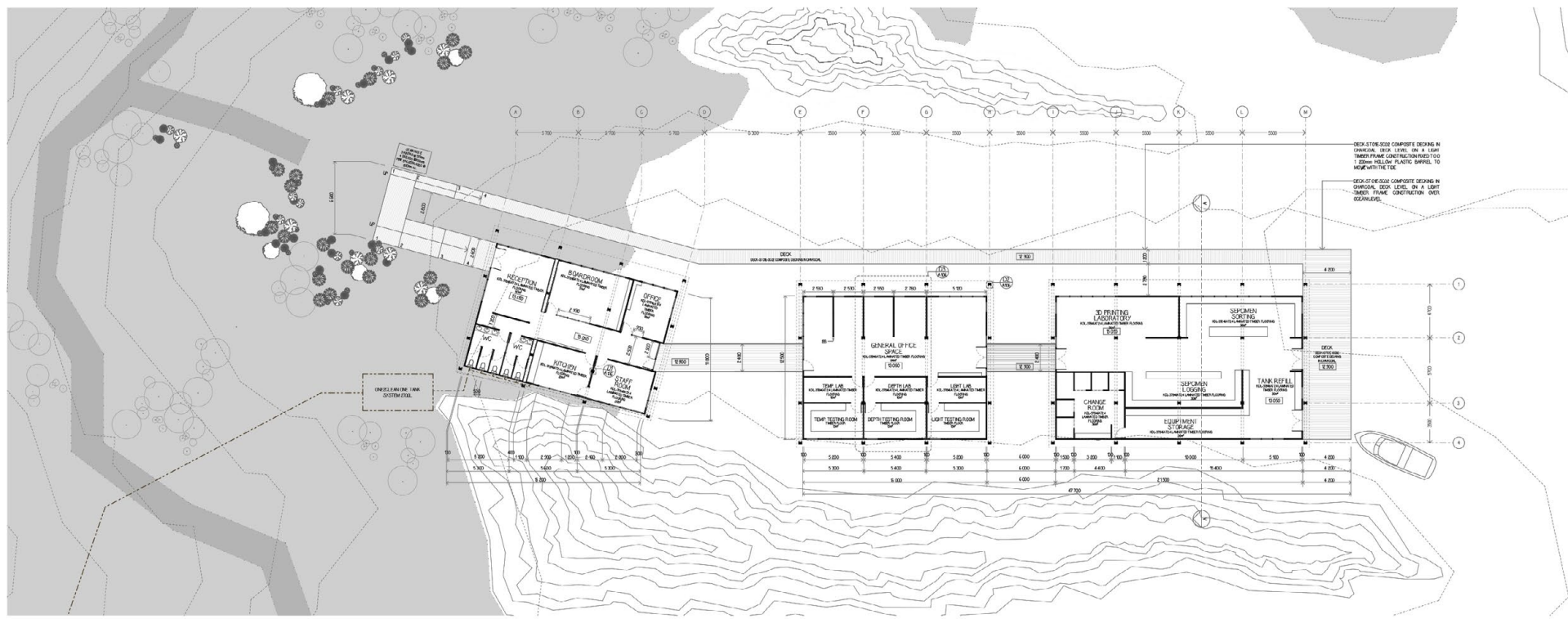
PROPOSED NEW DIVING SCHOOL AND PIER BAR PLAN  
SCALE 1:200



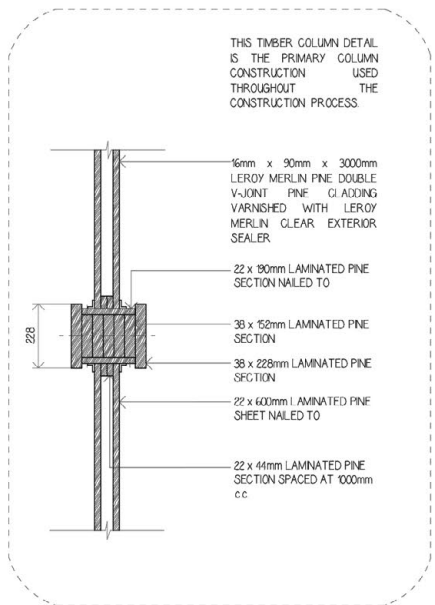
PROPOSED AQUARIUM AND BEACH CHANGE ROOMS PLAN  
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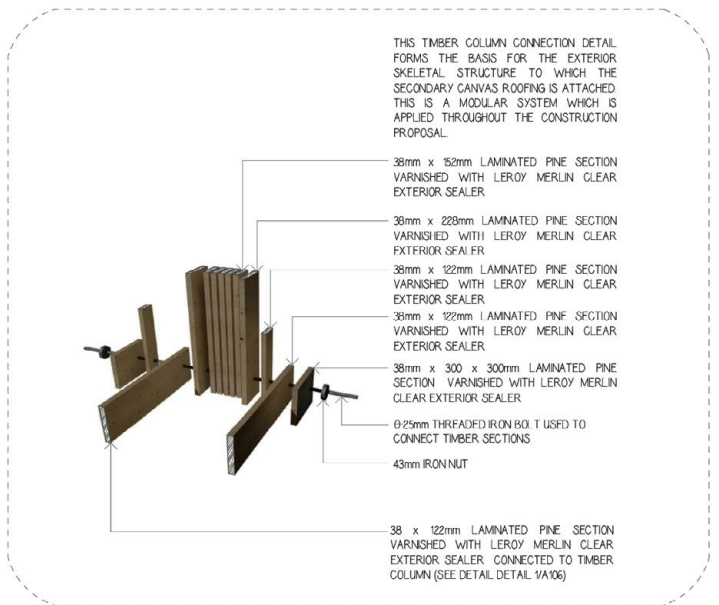
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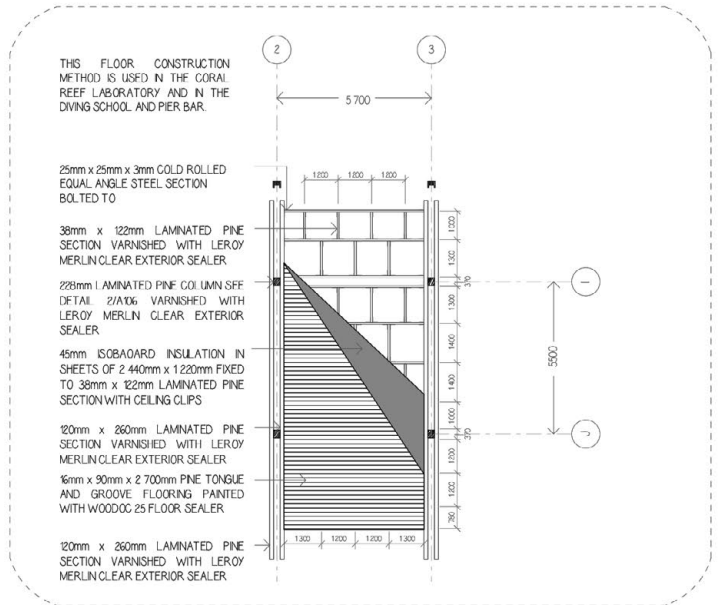
PROPOSED NEW LABORATORY PLAN  
SCALE 1:200



DETAIL 1/A106 - TIMBER COLUMN CONSTRUCTION FOR WALLS  
SCALE 1:10



DETAIL 2/A106 - TIMBER COLUMN CONNECTION DETAIL FOR SKELETAL STRUCTURE  
SCALE 1:10



DETAIL 3/A106 - CORAL REEF LABORATORY FLOOR CONSTRUCTION PLAN  
SCALE 1:100

PURPOSE OF ISSUE:  
ISSUED FOR INFORMATION

PROJECT:  
CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

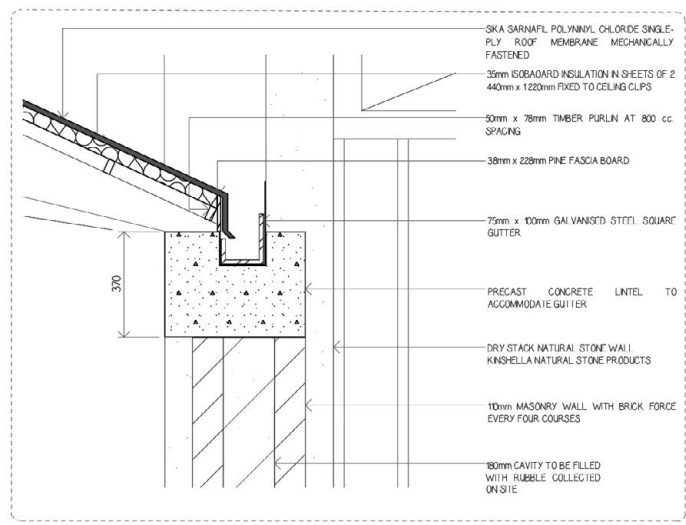
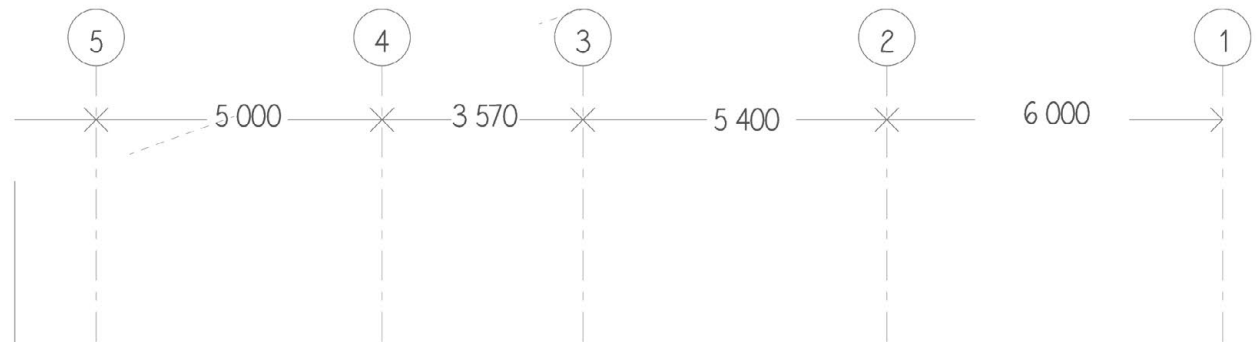
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DETAIL 1/A106  
DETAIL 2/A106  
DETAIL 3/A106

DRAWING NO:  
A106  
DATE:  
08.12.2020  
DESIGNER:  
M. JORDAAN

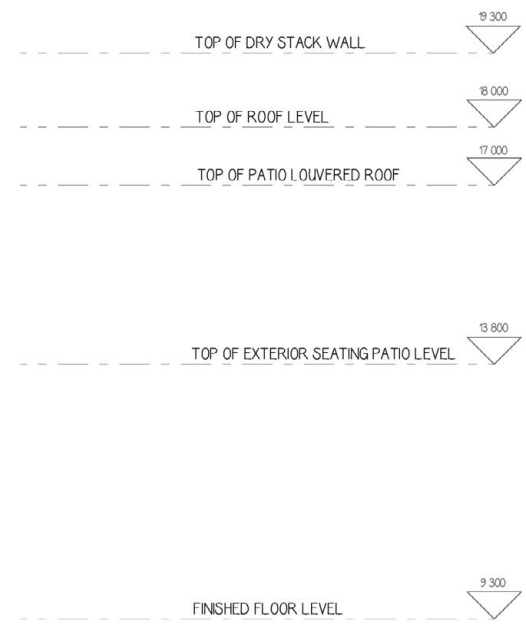
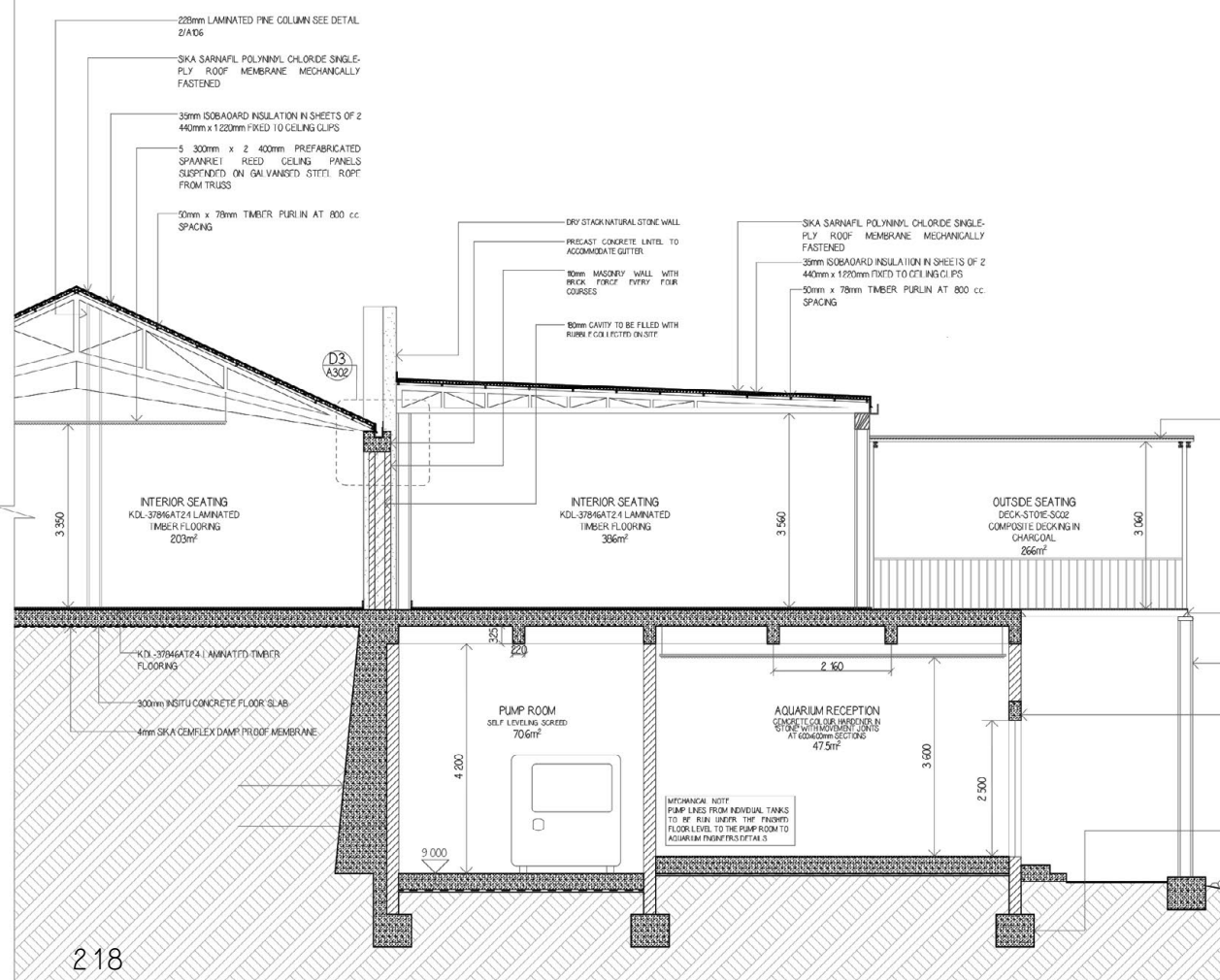
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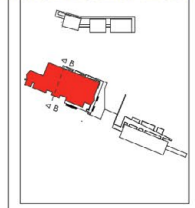




DETAIL 1/A302 GUTTER DETAIL  
SCALE 1:10



SECTION BB THROUGH RESTAURANT AND AQUARIUM  
SCALE 1:50



PURPOSE OF ISSUE:  
ISSUED FOR INFORMATION

PROJECT:  
CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

TITLE:  
SECTION AA THROUGH CORAL REEF LABORATORY  
DETAIL 1/A302

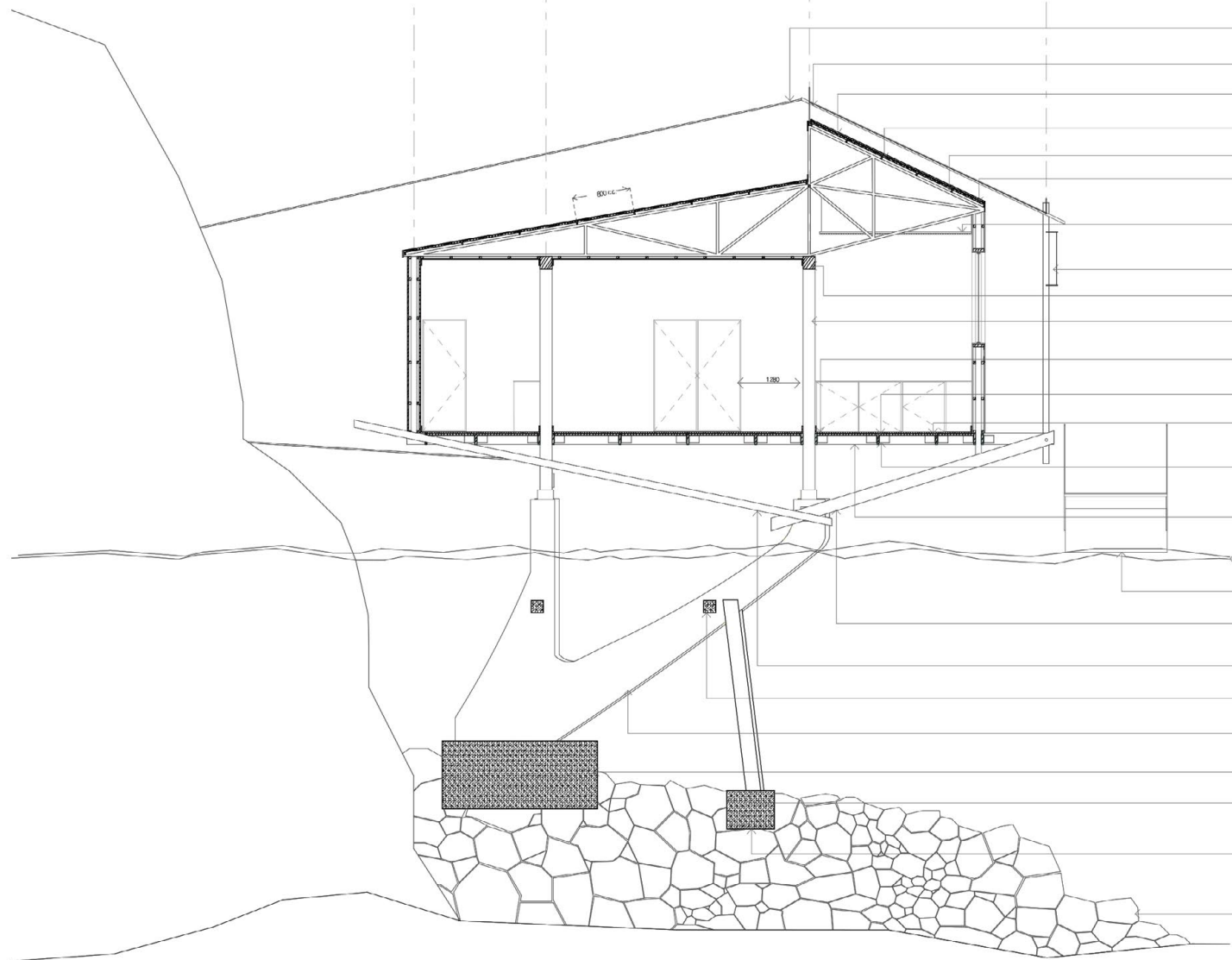
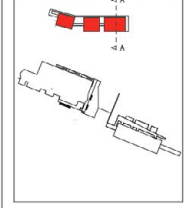
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DATE: 08.12.2020	SCALE: AS INDICATED

DRAWN BY:  
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- Ø 06mm STEEL WIRE ROPE GALVANISED
- 0.4mm x 7 100 x 5 600mm 25MIN TARPULIN WATERPROOF POLYESTER CANVAS
- 25mm x 2 440mm x 1 220mm TIMBER GUY EXTERIOR GRADE COMMERCIAL PLYWOOD
- 35mm ISOBOARD INSULATION IN SHEETS OF 2 440mm x 1 220mm FIXED TO CEILING CLIPS
- 50mm x 78mm TIMBER PURLIN AT 800 cc SPACING
- 3/4" SIKKA SARNAFIL POLYVINYL CHLORIDE SINGLE-PLY ROOF MEMBRANE MECHANICALLY FASTENED
- 5 300mm x 2 400mm PREFABRICATED SPANRETT RITD CEILING PANELS SUSPENDED ON GALVANISED STEEL ROPE FROM TRUSS
- 0.4mm x 600 x 5 600mm 25MIN TARPULIN WATERPROOF POLYESTER CANVAS
- 228mm x 228mm x 5 500mm LAMINATED PINE BEAM
- 228mm LAMINATED PINE COLUMN SEE DETAIL 2/A106
- 16mm x 90mm x 2 300mm PINE TONGUE AND GROOVE FLOORING PAINTED WITH WOODDOC 25 FL OOR SEALER
- 45mm ISOBOARD INSULATION IN SHEETS OF 2 440mm x 1 220mm
- 38mm x 220mm LAMINATED PINE SECTION VARNISHED WITH LEROY MERLIN CLEAR EXTERIOR SEALER
- 25mm x 25mm x 3mm COLD ROLLED EQUAL ANGLE STEEL SECTION BOLTED TO
- 38mm x 260mm LAMINATED PINE SECTION VARNISHED WITH LEROY MERLIN CLEAR EXTERIOR SEALER
- OCEAN WATERLINE
- JETTY WALKWAY
- 38mm x 122mm LAMINATED PINE SECTION VARNISHED WITH LEROY MERLIN CLEAR EXTERIOR SEALER
- 80mm x 80mm LAMINATED TIMBER SECTION
- 80mm x 260mm PRECAST CONCRETE BEAM
- 300mm PRECAST CONCRETE BASE ELEMENT
- 800mm x 800mm x 1000mm INSTU CONCRETE PLINTH
- 300mm x 3 960mm x 300mm PRECAST CONCRETE COLUMN SUNK INTO INSTU CONCRETE PLINTH
- 800mm x 800mm x 1000mm INSTU CONCRETE PLINTH
- PIONEERS LAYER IN A MINIMUM THICKNESS OF 500mm AS PER ENGINEERS SPECIFICATIONS
- THIS LAYER IS TO BE LAID TO ENSURE A LEVEL AND SECURE SURFACE FOR THE INSTU CASTING OF CONCRETE ELEMENTS ONTOP

NOTES

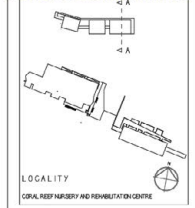
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CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

TITLE  
SECTION AA THROUGH CORAL REEF LABORATORY

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DATE 08/12/2020	SCALE AS INDICATED
DRAWN BY M. JORDAAN	STUDENT NO 2015044734
SIGNATURE 	

SECTION AA THROUGH CORAL REEF LABORATORY  
SCALE 1:50



LOCALITY  
CORAL REEF NURSERY AND REHABILITATION CENTRE

NOTES:

PURPOSE OF ISSUE:  
ISSUED FOR INFORMATION

PROJECT:  
CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

TITLE:  
CORAL REEF LABORATORY UNDERWATER CONSTRUCTION DETAIL  
STRUCTURAL EXTRAPOLATION OF CORAL REEF LABORATORY

DRAWING NO: AS01

REVISION: 4

DATE: 08/12/2020

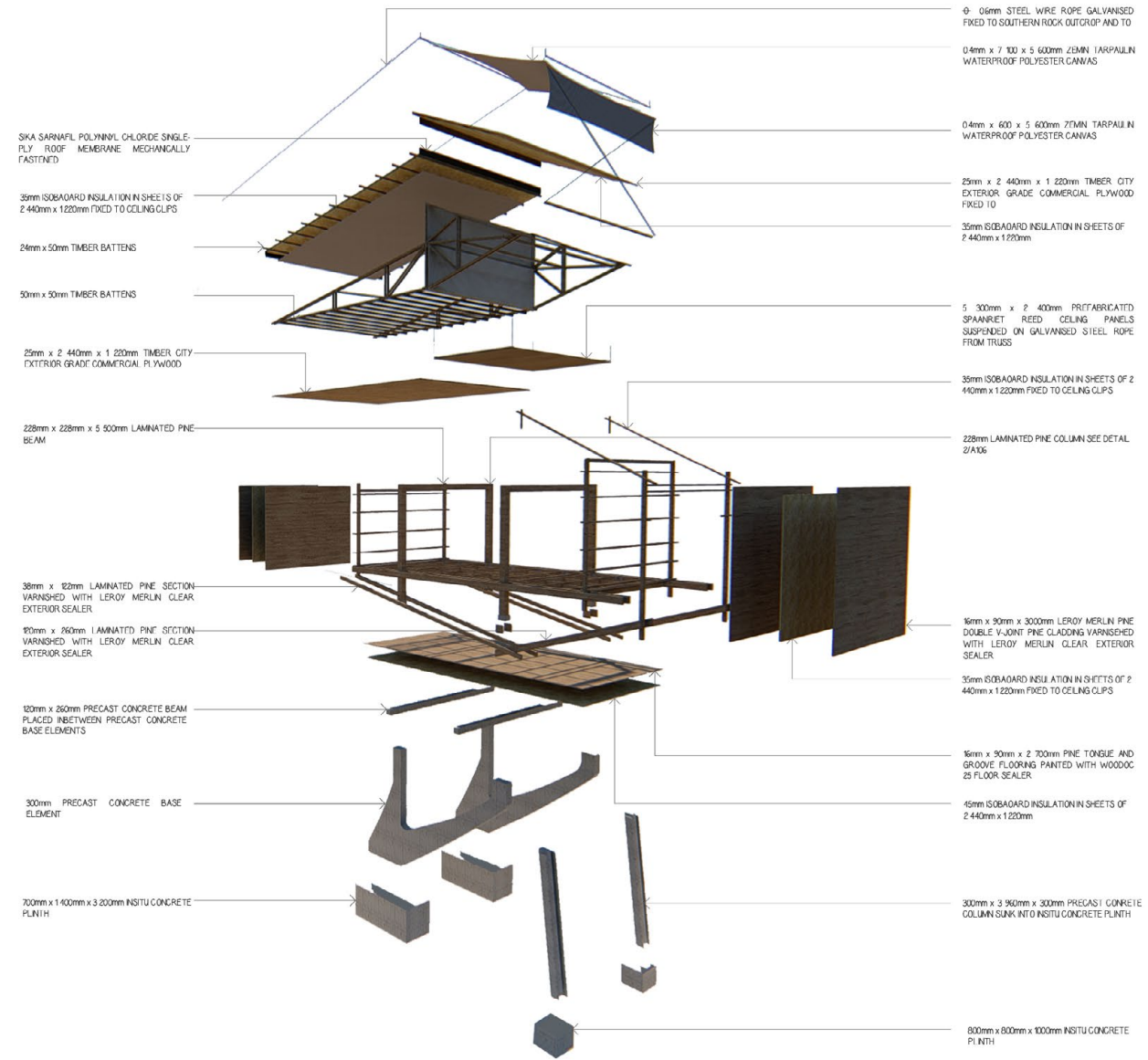
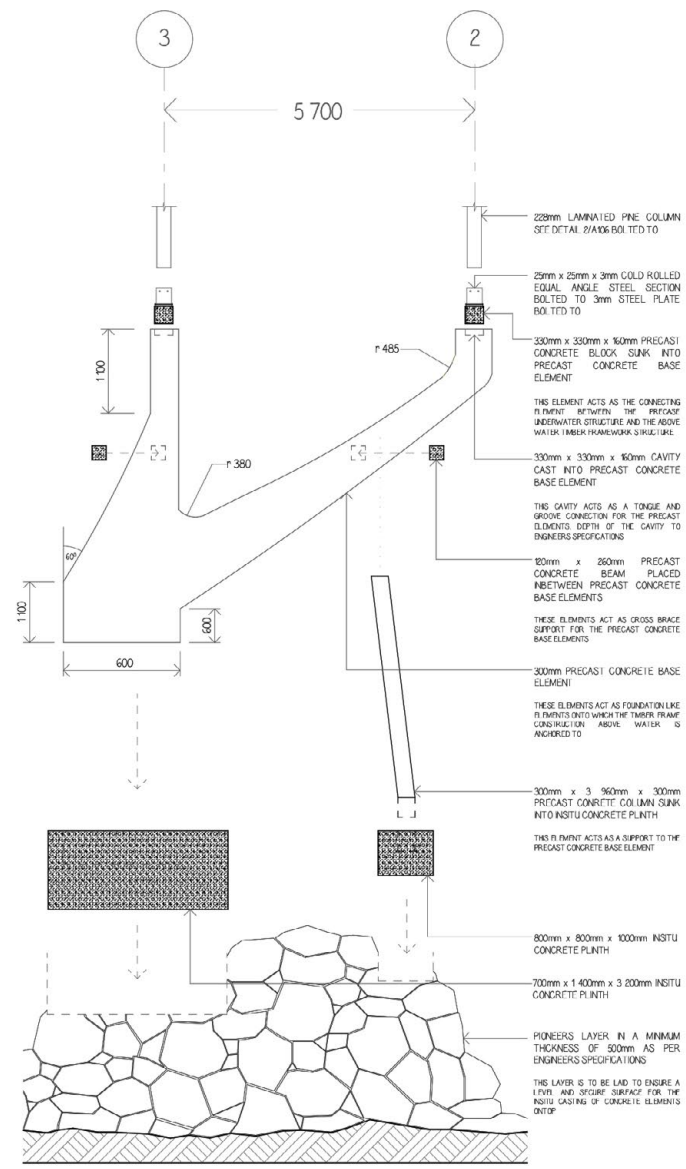
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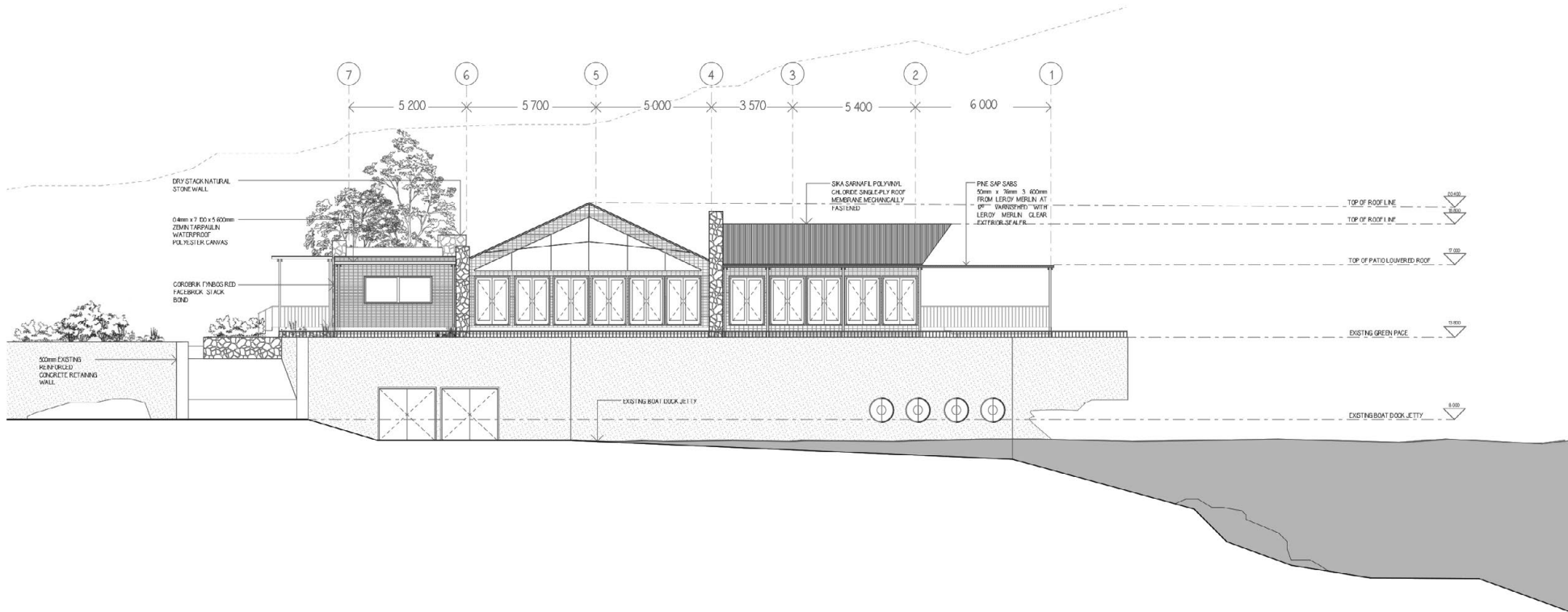
DRAWN BY: M. JORDAAN

STUDENT NO: 205044734

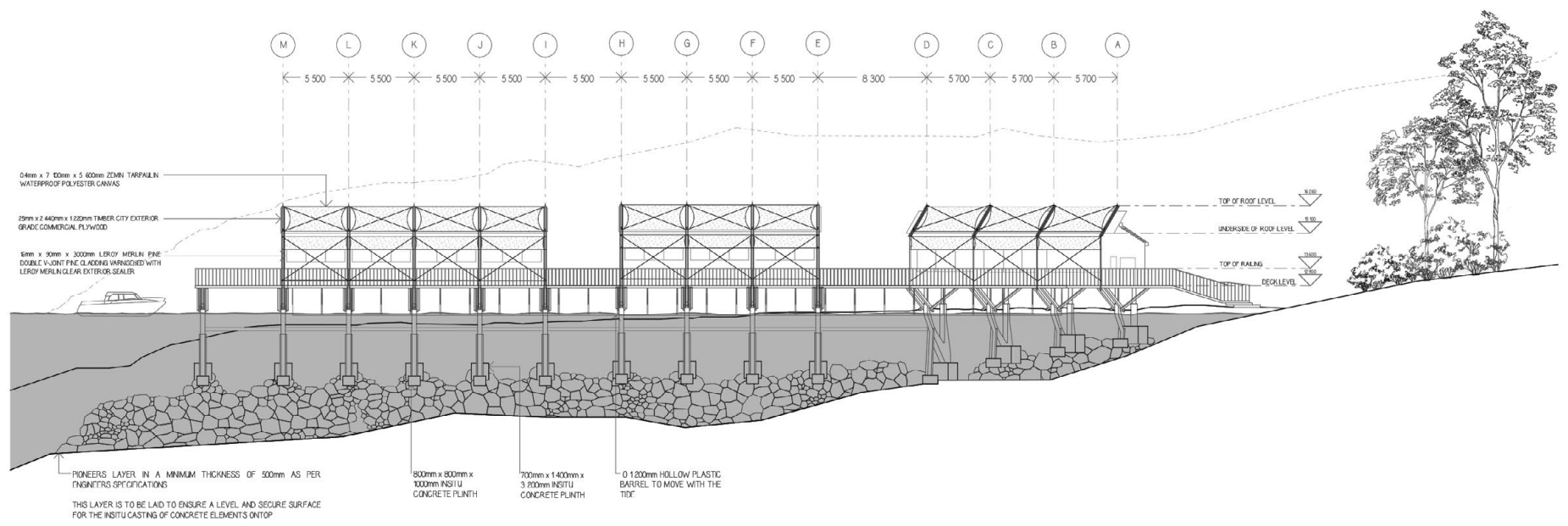
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REEFS IN RUIN





EASTERN ELEVATION OF RESTAURANT AND BOAT DOCK  
SCALE 1:100



NORTHERN ELEVATION OF CORAL REEF LABORATORY  
SCALE 1:100

PURPOSE OF ISSUE:  
ISSUED FOR INFORMATION

PROJECT:  
CORAL REEF NURSERY AND REHABILITATION CENTRE  
PROPOSAL IN THE TSITSIKAMMA NATIONAL PARK

TITLE:  
EASTERN ELEVATION OF RESTAURANT AND BOAT DOCK,  
NORTHERN ELEVATION OF CORAL REEF LABORATORY

DRAWING NO: A201 REVISION: 4

DATE: 08/12/2020 SCALE: AS INDICATED

DRAWN BY: M. JORDAAN STUDENT NO: 205044734

SIGNATURE: *[Signature]*

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# 05

## findings and conclusion

this part of the document will conclude on the findings and lessons learnt throughout the design process, analysing the outcome



# 01 reflecting on a years worth of research,

## 5.1. Reflecting on a years worth of research, exploration and design

M.Arch Prof., a year all architecture students dream about for four years. What their thesis topic will be, where their site will be and who they will share a cubicle with. These dreams and expectations have been prevalent throughout my four years of studies leading up to my masters year.

Reflecting back on a year's worth of research, exploration and design is a daunting task, but one which brings about time for pause and critical reflection, and of course celebrating some victories. This year was interesting to say the least. With the outbreak of the global pandemic everything changed. All of a sudden, I found myself alone in my room, very far from the shared cubicle I've been dreaming about.

This led to deeper reflection of my theoretical discourse of eco-phenomenology and bio-mimicry. Without noticing it and purely by chance, I was mimicking what I hoped my project would achieve, the growth of super-corals resilient to the causes of coral bleaching. I was, like the corals that will be cultivated in the proposed coral reef nursery, adapting to change and growing in resilience.

I believe I have learned a lot more about resilience during this year, than my four years of study put together. I believe this is due to the unplanned circumstances of this year as well as the choice of my thesis topic, which was chosen after watching the documentary *Chasing Coral* in late 2019 by chance. This documentary follows scientists and marine biologists trying to find the solution to coral bleaching and tracing the devastation thereof. This is a topic that intrigued me immensely and posed many questions, that I wanted to explore through means of an architectural investigation.

This posed my research question:

How can an architectural intervention act as the mediator between land and sea, as well as between destruction and growth in relation to coral bleaching?

Reflecting back on my research question after the process of research, exploration and design; I believe that architecture

# exploration and design

---

as an intervention has a role to play in the making of meaningful place, and through that becomes a mediator. In my opinion, architecture is a metaphysical experience that occurs in a physical place and in that way acts as a mediator of our experiences.

In this thesis, architecture acts as a mediator in relation to the connection of land and sea and the relationship between destruction and growth.

Design choices, construction methods, site choice and theoretical concepts all lay within the balance of destruction and growth. To build or not to build was a question often on my mind and one I still wonder about. However, with that being said and with all my research and final design outcome being the result thereof, I believe that to build is necessary. In this thesis, I believe that architecture can act as a mediator between land and sea with beneficial outcomes of reef restoration, therefore acting as a mediator between destruction and growth.

The architectural intervention of a laboratory to help research and prevent coral bleaching in the Tsitsikamma National Park, which is dependant on the artificial reef beneath it, speaks of this metaphysical connection and as a result poses a role for architecture as mediator.

Therefore, it is my subjective opinion that the exploration and design outcome was successful. As with anything there is always room for improvement and I know this project will stay in my heart and thoughts for a very long time. I have grown very fond of corals and I will forever be thankful to them for teaching me so much about architecture and so much about resilience.

Thank you for taking the time to read through my dissertation document and to follow my design process throughout the document. Your time and consideration is much appreciated!

Whatever good things we build, end up building us.  
Jim Rohn

# 02 list of figures

Figure 1 Author. 2020. Large Horn coral.

Figure 2 Author. 2020. Coral montage.

Figure 3 Marty, B. 2018. Suspension Bridge Tsitsikamma. Viewed 24 May 2020. Fine Art America. [Online] Available from: <<https://libraryguides.vu.edu.au/harvard/image-photograph-table-artwork>>.

Figure 4 Rosenfield, A. 2019. Coral bleaching. Viewed 28 September 2020. Common dreams. [Online] Available from: <<https://www.commondreams.org/news/2019/08/09/example-unknown-unknowns-study-detailing-almost-instant-mortality-corals-suggests>>.

Figure 5 XL Catlin Seaview Survey. 2019. American Samoa Coral. Viewed 19 August 2020. Mashable. [Online] Available from: <<https://mashable.com/2016/05/31/great-barrier-reef-mortality/>>.

Figure 6 Author. 2020. Document framework montage.

Figure 7 Author. 2020. Research question sketch.

Figure 8 Author. 2020. Tree mirror sketch.

Figure 9 Goad, A. 2015. Design process sketches. Viewed 25 August 2020. Reef Design Lab. [Online] Available from: <<https://www.reefdesignlab.com/3d-printed-reefs-1/>>.

Figure 10 Author. 2020. User analysis montage.

Figure 11 Author. 2020. Site specific sketches montage.

Figure 12 Stray Along the way. 2017. A Sandy beach at Stormsrivermouth. Viewed 19 August 2020. SATW. [Online] Available from: <<https://www.strayalongtheway.com/hiking-storms-river-mouth/>>.

Figure 13 Meteoblue. 2020. Weather charts. Viewed 23 May 2020. Meteoblue Weather. [Online] Available from: <[https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/tsitsikamma-national-park\\_south-africa\\_947761](https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/tsitsikamma-national-park_south-africa_947761)>

Figure 14 Author. 2020. Macro Site Plan.

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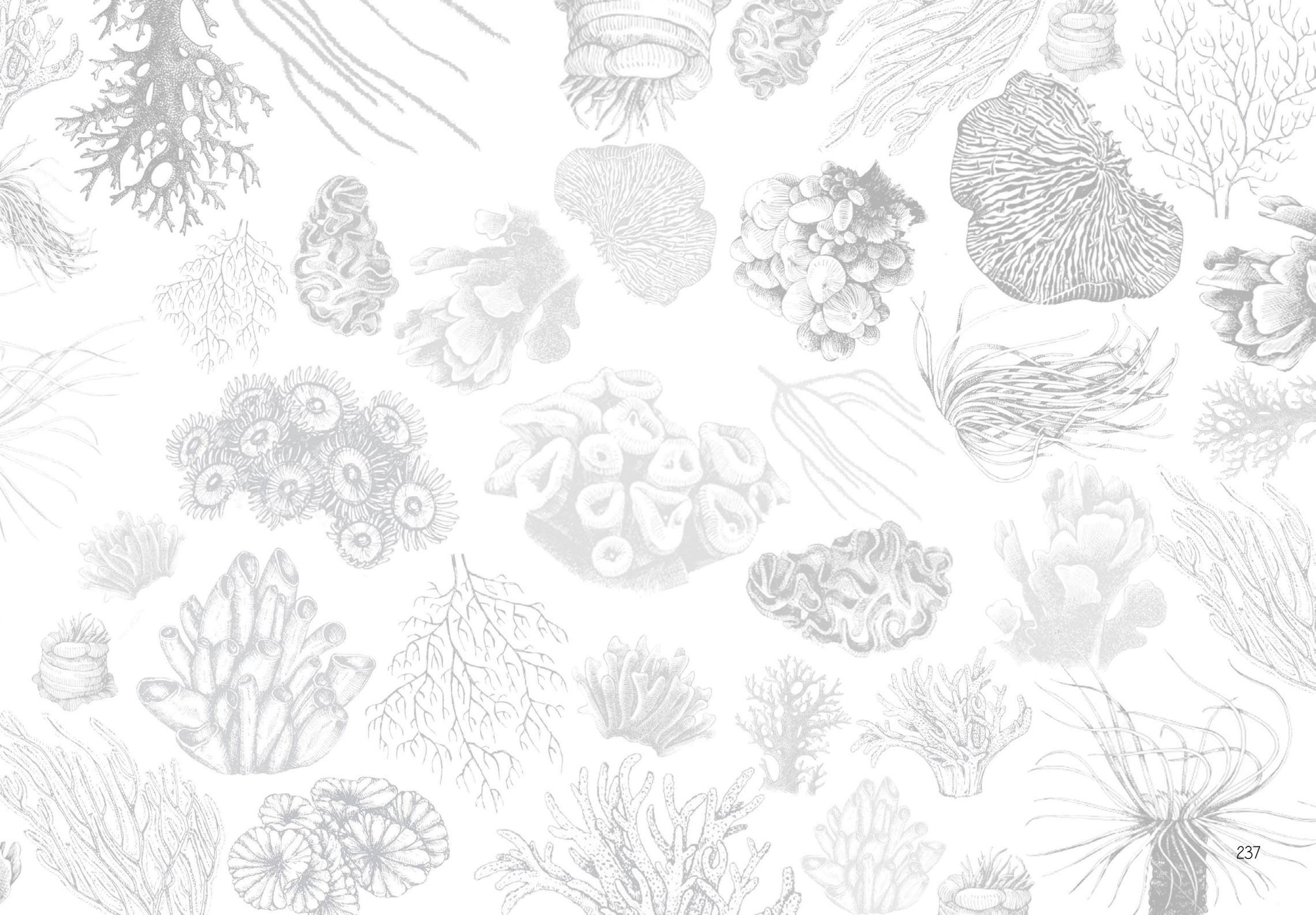
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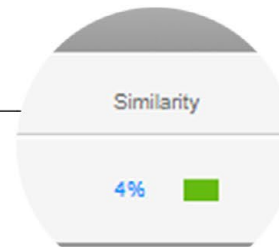


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