TO TRANSCEND THE TIDE

TRANSITIONS IN ARCHITECTURE AND NATURE

Maria Lagging
Chalmers School of Architecture
Examiner: Morten Lund
Supervisor: Naima Callenberg

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ABSTRACT

If a place gets abandoned nature slowly starts to inhabit the space, sculpture it and leave traces in the landscape, traces of activity and events that tells a story of past and present.

What if an architectural structure change the experience of the tide and allow people to move and use these structures differently during different times of the day accordingly to the rising and receding water?

The aim is to examine how the flow of time, change and transitions in nature can become visible through architecture. The tide is a repeating phenomenon that can be seen with the eyes. It has affected historical events and cultural landscapes along the coastline of Normandy in France. Observations of different natural phenomena caused by the local landscape are translated into conceptualised design parameters to inform the architectural investigations.

To understand the landscape and map the high and low tide a drone was used to photograph, film and make a 3D-scan of the site using photogrammetry, a technic that uses the different angles in photos to create a 3D model. In addition time-lapse movies where made to observe the tide.

The site where the studies are conducted is located by the shores of the small coastal town Étretat, a site that holds many narrative motifs. Steep cliffs, shaped by the forces of the sea, surround the town. During certain times of the day the tide withdraws and let people cross the otherwise inaccessible shore. When the tide withdraws patterns on the seafloor start to emerge, some only visible from above.

The different patterns that cover the surface give an indication of how the water repeatedly has moved through the landscape. Small fountains are created where water trapped below the mountain rock is released through small holes in the porous chalkstone.

The shifting elements of the landscape have been used by the locals to fish and farm oysters. Dug out of the seabed the oyster farm of Marie-Antoinette used the freshwater springs that flow from the cliffs to create a certain blend of salt and freshwater. Through a series of structures these different narratives are investigated.

DISCOURSE

NATURE VS. THE ARTIFICIAL

It could be argued that even the most natural places have been affected by human activities and cultural landscapes. Through decades humans have transformed the surrounding environment to their needs directly or as a secondary consequence of their action. (Gruber, P, 2011, s.8 & Rockström, J, Klum, M, 2012, s.19).

With new technologies come new opportunities. The rapid development of new analyse tools change the way we understands our surroundings. This understanding may result in the possibility that something manmade can act as part of nature.

The main objective of this project is to develop a method to learn from observations of nature and to add to the discussion about the potential in the site itself where the visitor may by her- or himself observe and interact with nature. This is illustrated through a set of structures that may enhance the experience of natural phenomena in its natural setting.

TO ENHANCE PERCEPTUAL EXPERIENCE

Creating spaces that has the purpose to inform the visitor of the local natural values goes along the tradition of the Swedish Naturum, although the aim of this project is not to create a programmatic building for turism but rather self-informative structures for increased perceptual experience.

A Naturum is a visitor centre to enhance public understanding of nature conducted by the Swedish Environmental Protection Agency. Naturum are often placed in an area of high scientific value and extraordinary beauty. The intention of a Naturum is to enhance the experience nature and inspire the visitor to explore, and there by get a deeper understanding of the surrounding heritage and culture (Lauri, T, Isitt & M, Caldenby, C, 2013, S.15-21).

The aim to make the visitor engage with nature is practised in the way Naturum gives opportunity to explore and experience nature, although the contrast between the in- and outdoor experience is still using a traditional way of engaging with an exhibition where the visitor is an observer rather than someone who experience a phenomena.

To further develop the concept of the Naturum is to break this border. The body´s experience of a phenomena makes us connect emotionally and think in new patterns because it gives us the opportunity to understand something with our different senses such as touch, sound, smell, not just trough vision and mind.

The tide has always fascinated humans because of its beauty and destructive force. It is hard to imagine how such a beautiful phenomena can be dangerous. I feel humble when surrendered by nature's forces. It gives me a sense of calm to know that I am a part of a bigger system that is repeating in cycles yet differs in small details. You start to think in a different way, time goes slowly. Your thoughts start to wander and you notice the small patterns. Suddenly the bigger questions make sense.

TIDE
The word "tide" has its roots in Proto-Germanic and originates from the word "zeit "or time. During the fourteenth century the first literary references of the word being used to describe the behaviours of the rising and falling sea can be found along with the words for "flood" and "ebb" that originates in Old Norse and Indo-European language. (Aldersey-Williams, 2016, s. 20-21).

NEAP TIDE
Tide during first and third quarter moon. The amplitude of the tidal wave is lower than usual and occurs two times every moon cycle (National Ocean Service, 2018).

SPRING TIDE
Tide during new and full moon. The amplitude of the tidal wave is higher than usual and occurs two times every moon cycle (National Ocean Service, 2018).

HIGH TIDE
The maximum height of the tide that happens twice a day.

LOW TIDE
The minimum height of the tide that happens twice a day.

EBB
When water withdraws from the shores.

FLOOD
The inflow of water during the tide.

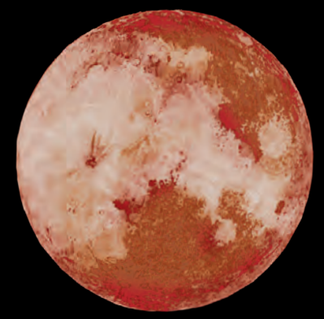
LOCATION

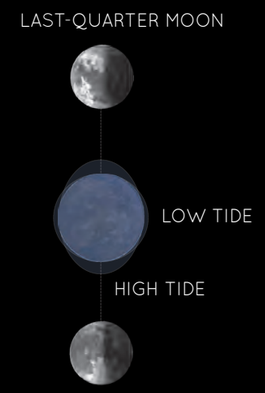
ENGLAND

Étretat

Sainte-Marguerite-sur-Mer

FRANCE





THE WANING AND WAXING MOON

The gravitational force caused by the position of the moon and sun explain the daily 12 h repetition of the low and high tide as well as the weekly shift between neap and spring tide (National Ocean Service, 2018).

TIME AND CYCLES

TIME AND TRANSFORMATION

DAILY CYCLES

REPEATING CYCLES OF LOW AND HIGH TIDE

WEEKLY AND MONTHLY CYCLES

NEAP AND SPRING TIDE- DEPEND ON THE GRAVITATIONAL FORCES OF THE MOON AND SUN

YEARLY CYCLES

SEASONS

DISPLACEMENT OF SAND AND STONES

50-100 YEARS

CHANGING CULTURAL LANDSCAPE

EROSION

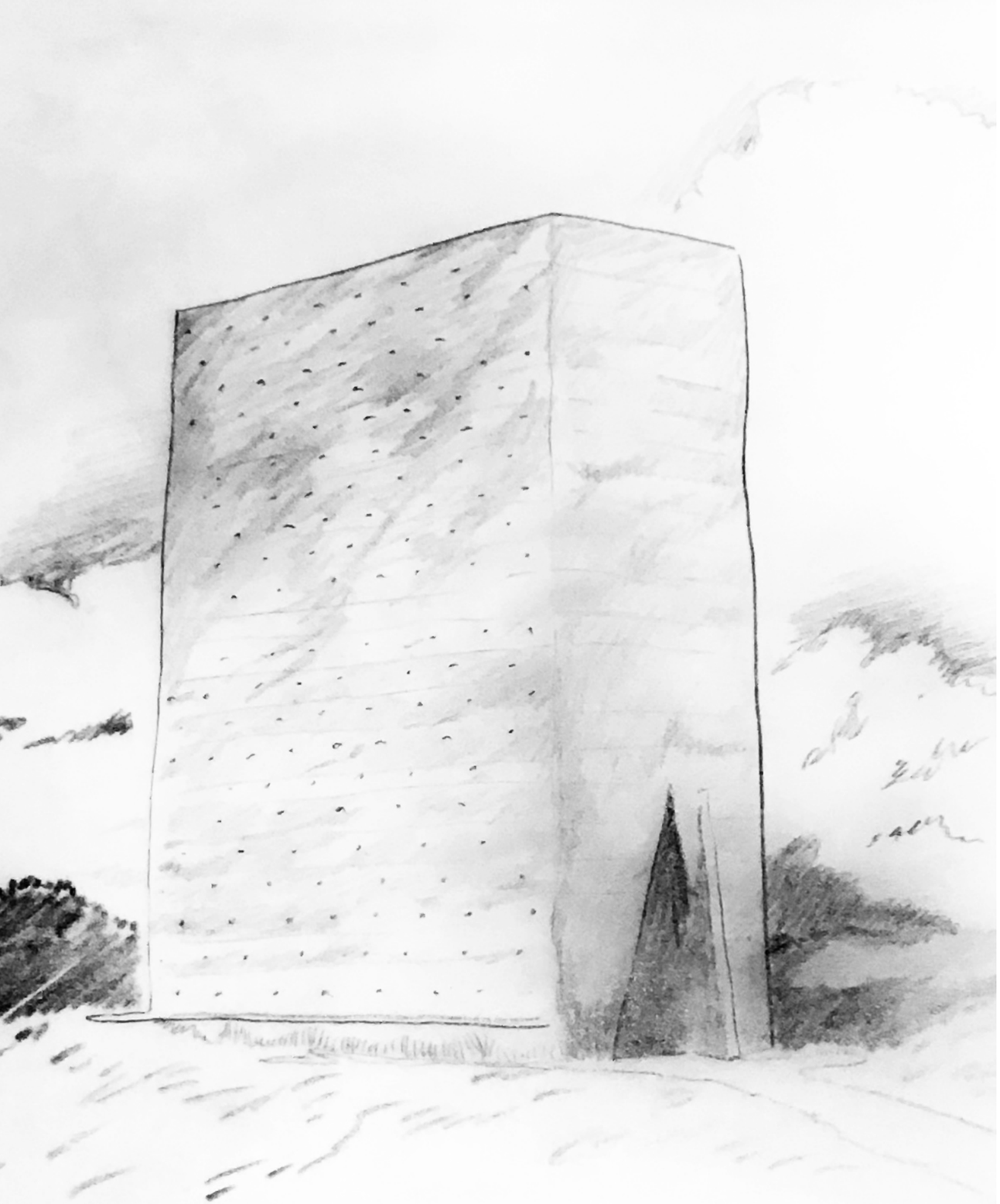
GATHERING OF SEDIMENT

1000> YEARS

WEATHERING OF ROCK

FOSSILIZATION

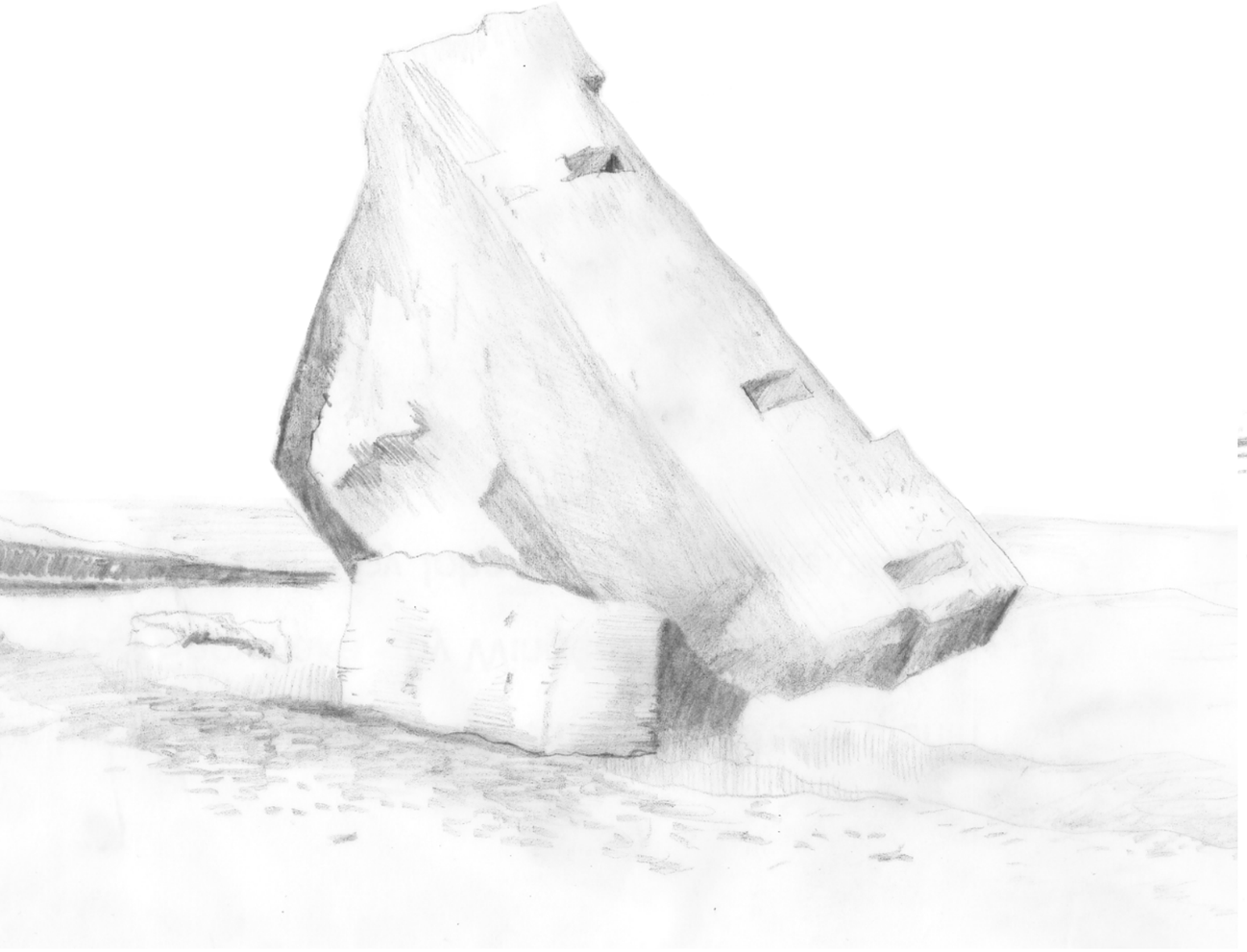
REFERENCES



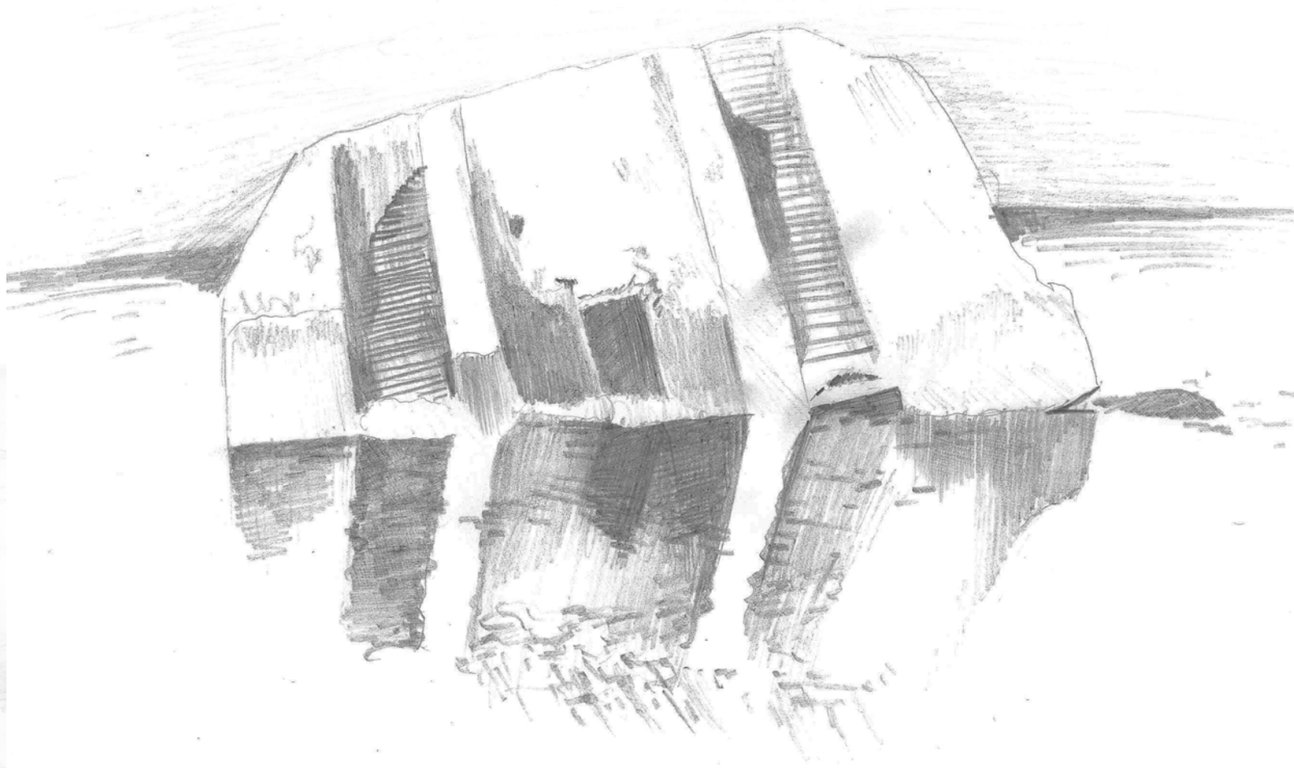
Bruder Klaus Field Chapel

Peter Zumthor

Placed on a field in Germany the Field Chapel stands as a landmark tall and lean. One of the most notable aspects of the church is the method of construction. 112 tree trunks were used to build a frame for the concrete. When the concrete dried the wooden frame was set on fire, leaving a void and burn marks where the wood once was, like a shell or fossil (Sveiven, M, 2011).



Sainte-Marguerite-sur-Mer, Upper Normandy, France



Wissant II, Nord-Pas-De-Calais, France.

The Last Stand

Marc Wilson

The Last Stand is a photo project made by photographer Marc Wilson that during four years have searched for traces of the Second World War in the landscape along the English Channel. The vacant bunkers and concrete formations have been left alone for nearly 80 years. Parts of these structures have ended up in the water because of erosion, standing like monuments of past traumatic events.

As the photographer said himself: "Some of these locations are no longer in sight, either subsumed or submerged by the changing sands and waters or by more human intervention. At the same time others have re-emerged from their shrouds." (Exley, R. 2015).

Sky Space, Oslo

James Turrell

Sky Space is an architectural art experience where the perception of light transforms the behaviour of a room. In the installation people experience a heightened awareness of the senses. The only contact with the surrounding environment is the window in the ceiling, connecting the room with the sky (Spector, N).

SITE

By the shore of the small coastal town Étretat a rocky and spectacular terrain is located where steep cliffs are shaped by the forces of the sea.

SITE OBSERVATIONS

During certain times of the day the tide withdraws and let people cross the otherwise inaccessible shore.

The maximum amplitude of the tide that occurs in Ètretat happens during the spring tide and reaches a height of about 8.9 m. The tide is dependent of the local landscape and the maximum height may very along the cost of Normandy. Because of the difference between the neap and spring tide, that shifts every week according to the position of the moon and sun, the amplitude and time of the low and high tide changes daily.

When the tide withdraws patterns on the seafloor start to emerge, some only visible from above. The different patterns on the surface give an indication of how the water repeatedly has moved through the landscape. Stones that fall down from the cliffs are moved back and forth by the tide, leaving scars along the seabed.

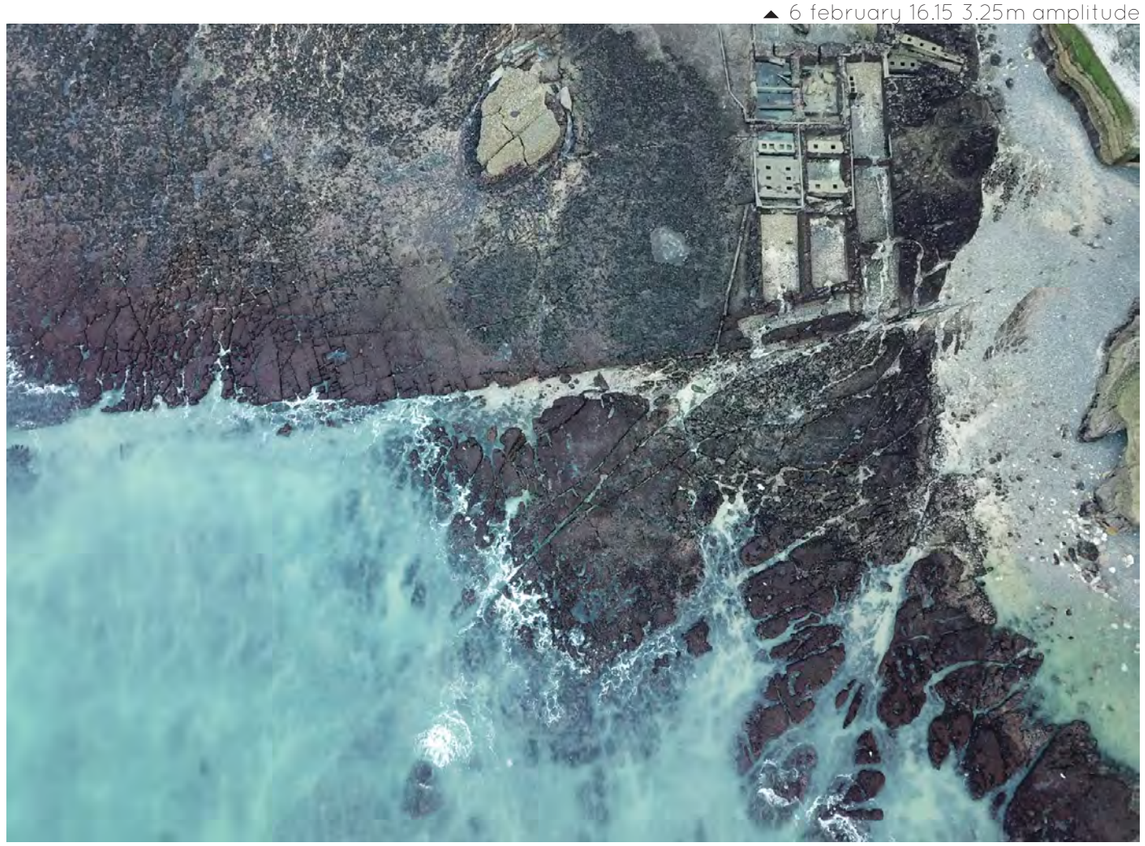
The height of the tide is easy to trace while it has left marks along the cliff walls in the form of growing algae. The inward carved formations in the cliff also strengthen this line.

The mountain is sculptured by freshwater streams on their way back to the sea. The sound of the small water streams occasionally sound louder than the breaking waves further away along the shoreline. Small fountains are created where the water that has been trapped below the rock flows back to the sea during the low tide.

Dug out of the seabed below the cliffs an old ruin of the oyster farm of Marie-Antoinette is located (Thomas, J. P, 2011, s. 26-28). The structure is easy to spot from above but walking along the seabed it suddenly appears like small ponds of water and pebbles of stone. During the high tide this structure is placed 5 m below the water surface. While observing the structure from the cliffs during the time the water withdraws the oyster farm first appears like a shadow below the water, minutes before it breaks the surface.

The different patterns that cover the surface give an indication of how the water repeatedly has moved through the landscape. Small fountains are created where water trapped below the mountain rock is released through small holes in the porous chalkstone.

▲ 6 february 16.15 3.25m amplitude



▲ 5 february 17.20 1.8 m amplitude

6 FEB 14.30

5 FEB 14.53

5 FEB 15.19

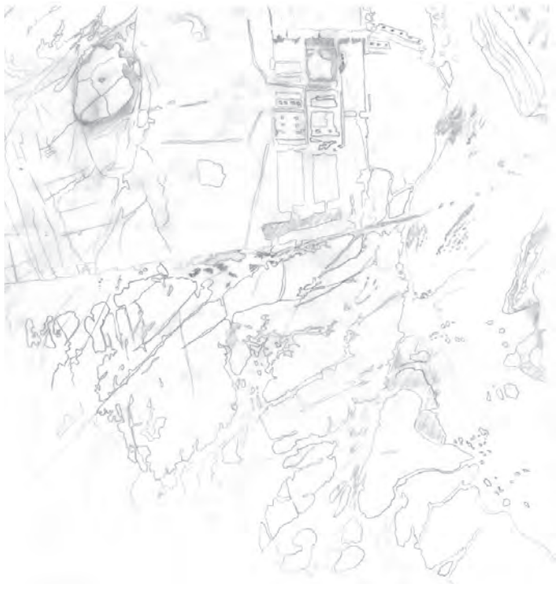
5 FEB 15.37

6feb 15.03

6feb 15.20

6feb 15.40

6feb 16.00



HISTORICAL STRUCTURES

The shifting elements of the landscape have been used by the locals to fish and farm oysters. Dug out of the seabed the oyster farm of Marie-Antoinette used the freshwater springs that flow from the cliffs to create a certain blend of salt and freshwater.

The old ruin of Marie-Antoinette's oyster farm is located on the seabed close to a cave. The structure was constructed 1783 and was used for 20 years. Later, in 1880 a fisherman reused the oyster park and provided Étretat with oysters until 1930. The oysters were imported from Cancale. (Thomas, J. P, 2011, s.26-28).

The structure was strategically placed so that the tide constantly brought fresh seawater two times a day during the high tide and made the oysters easy to collect during low tide. Channels was dug to provide the structure with freshwater from the springs that flow from the cliffs to create a certain blend of salt and freshwater. (Thomas, J. P, 2011, s. 26).

The fishermen used the tide to place their nets along the cliffs. It was a dangerous job and they could get trapped on the shores by the rising tide. The mayor of Étretat established a tunnel 1922 through the cave next to the oyster farm leading to the shore Jambourg on the other side of the cliffs (Thomas, J. P, 2011, s. 202). By the entrance of the tunnel in the cave a sign hangs with the words "Don´t panic, you are safe here". The cave gets flooded during the high tide and water blocks the passage to the town, but the upper part provides with a safe zone. The fishermen sometimes used the cave to camp when the work required it.

Close by the oyster farm, a small bunker-like house of concrete is placed in the cliff. This was also used by the fishermen, but only during the low tide. The structure is placed below the level of the high tide and gets flooded constantly. Today rocks that have been moved by the tidal waves fill the structure.

Geology

The stones tell a story of shifting climatic periods.

The layers of chalk and flint found in the cliffs are remains of the instable and shifting climatic periods 2 milion years ago, from dry and hot periods to colder periods with ice. A large content of silica can be found in the cliffs, which are the remains of corals and fungi with a silica-containing shell. Dust from Asia was transported to the area by strong winds and left like sediment. (Thomas, J. P, 2011, s.195).

By the filtration of water and formation of ice the porous limestone easily erode, leaving the sharp and dramatic cliffs and caves. (Thomas, J. P, 2011, s.197).

Marcasite or iron sulfide is also a common mineral. The marcasite in Étretat has been dated 88 million years old. (Thomas, J. P, 2011, s.198).

The pebbles of stones create the only protection against the forces of the sea. The town have been flooded several times. Tunnels have been built under the town to prevent flooding. (Thomas, J. P, 2011, s118-123.).

3D scanning

To understand the landscape and map the high and low tide a drone was used to photograph, film and make a 3D-scan of the site using photogrammetry, a technic that uses the different angles in photos to create a 3D model.

New technologies like photogrammetry has now become so well developed that a single user without much experience of 3D scanning can use their mobile camera to take pictures and get a complex 3D-model using programs like Autodesk's ReCap 360. This is just one of many programs using the technic today, from advanced program development companies to programs designed by private users. These tools may become useful for designers and architects, enabling higher precision in planning projects and more accurate landscape models for simulations and studies.

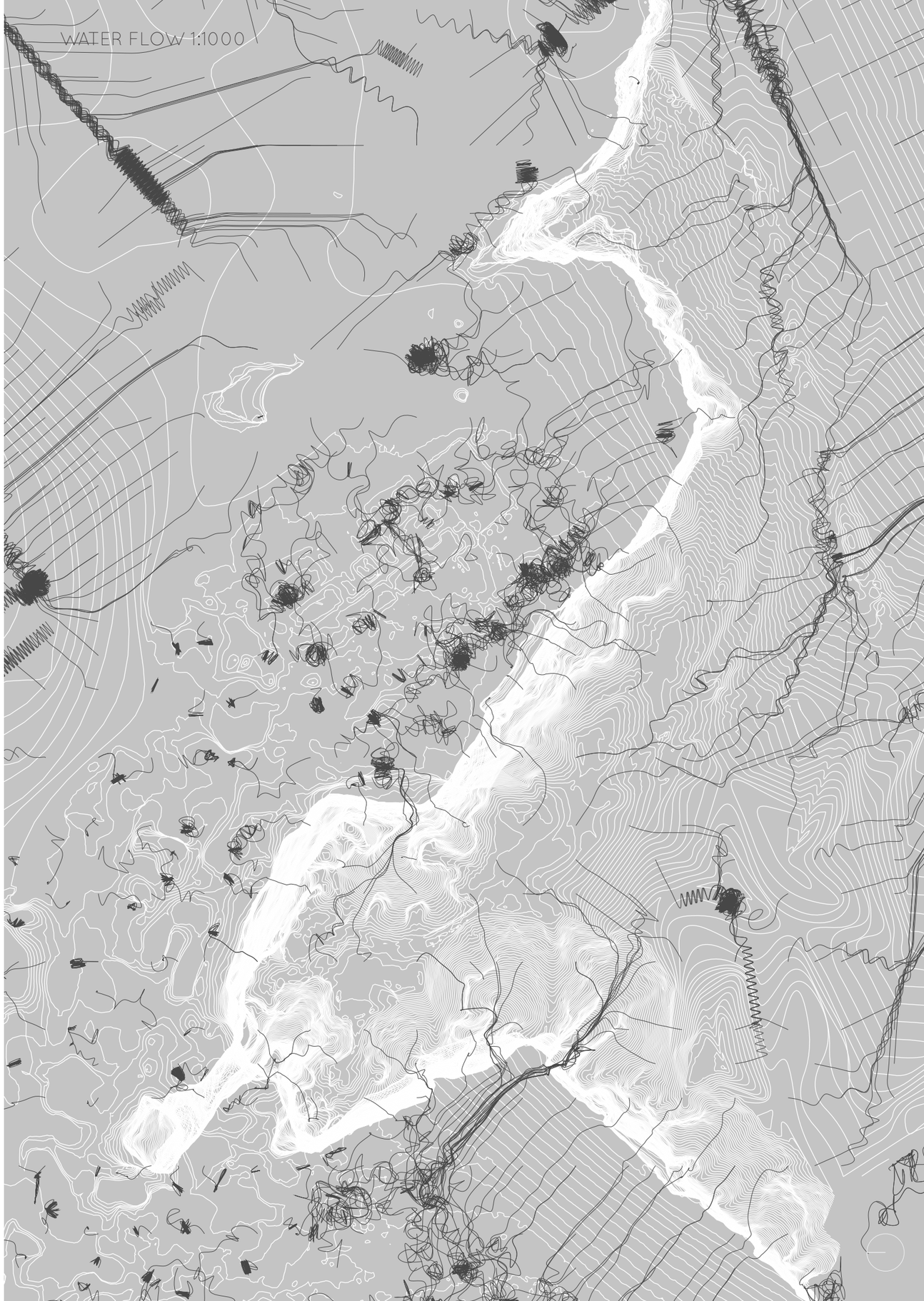
Photogrammetry uses the angles in overlapping photos to calculate the distance between reference points in the photos. The photos should be taken from different angles and cover the whole object.

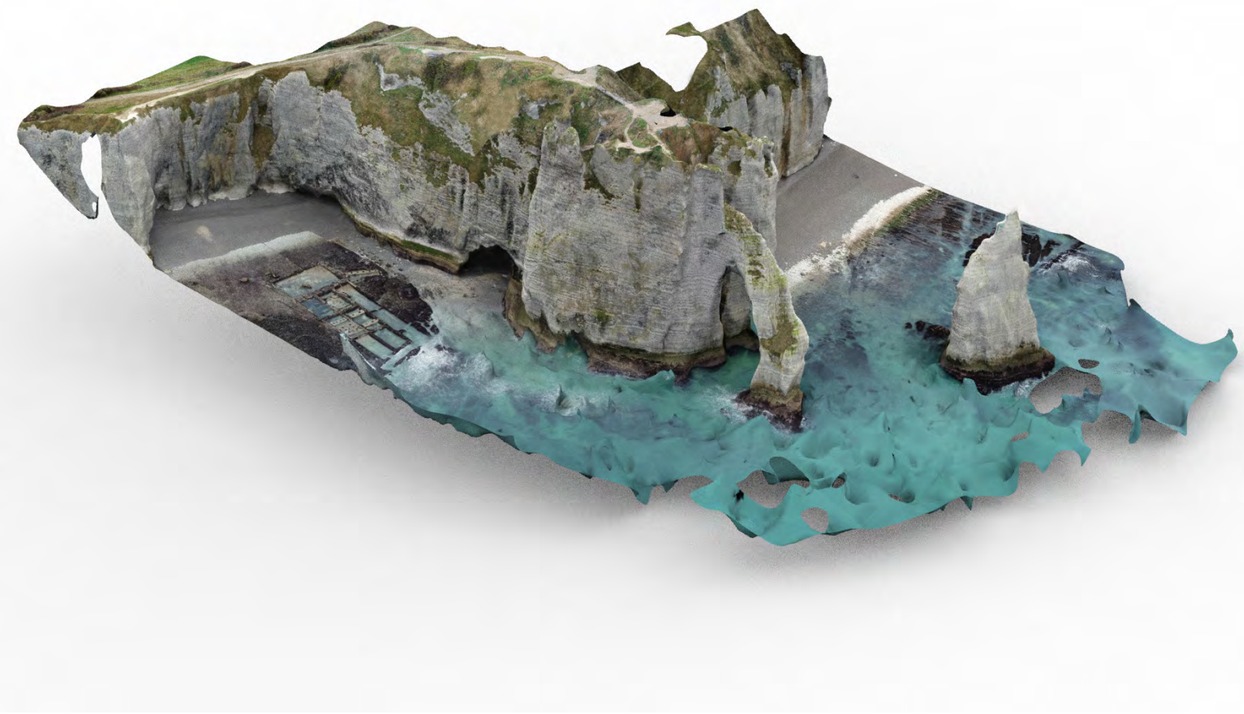
During the site visit in Étretat a drone was used to take pictures from a viewpoint otherwise hard to reach and also with the possibility to store the geolocation of the photo. Due to hard weather-condition and a time limit these photos was also compensated with photos taken with a mobile camera from the ground. The two different methods create different results. The photos taken from the ground made it possible to get a high resolution of the cliff surface but made it hard to get a good resolution of the ground surface.

The site had several difficult aspects that affected the precision of the 3d-scan. One was the height of the cliffs which reached 77m. Usually, to get a good level of details the amplitude of the drone should be 50 m. When scanning a large object like a cliff or a high building it is best to let the drone circulate around the object using point of interest (POI) to take pictures. To get a high resolution photos should be taken at different heights and angles, usually 30° and 45°.

The height affects the resolution but also the flight time. Flying on higher amplitude reduces the fight time. The battery time of the drone limits the size of the area that is possible to scan. The flight can be divided into several parts but should be conducted during the same time of the day to get the right light conditions.

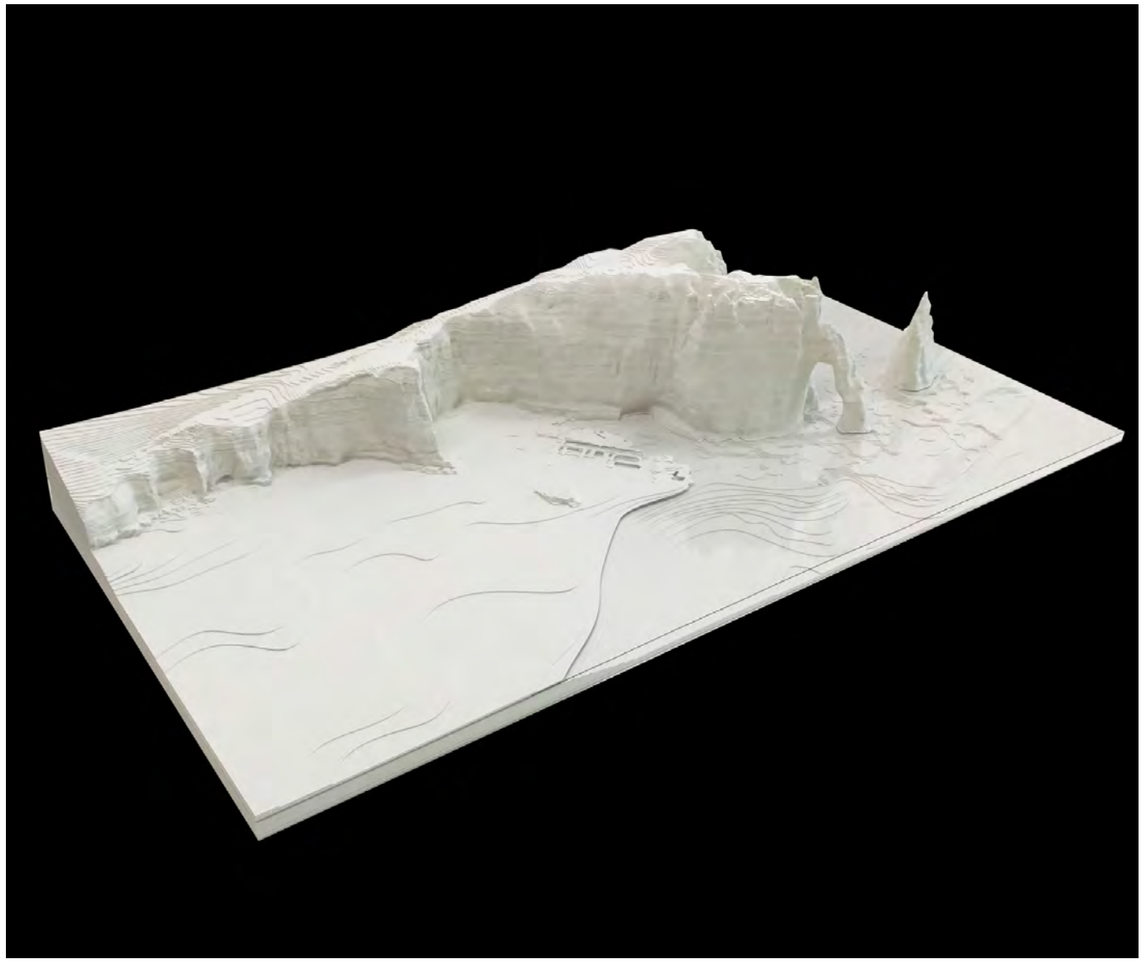
Vegetation and water is hard to 3D-scan because of the movement and transparency, which makes it hard to determine the depth of the object.


WATER FLOW 1:1000




30 °
45 °
30 °
45 °

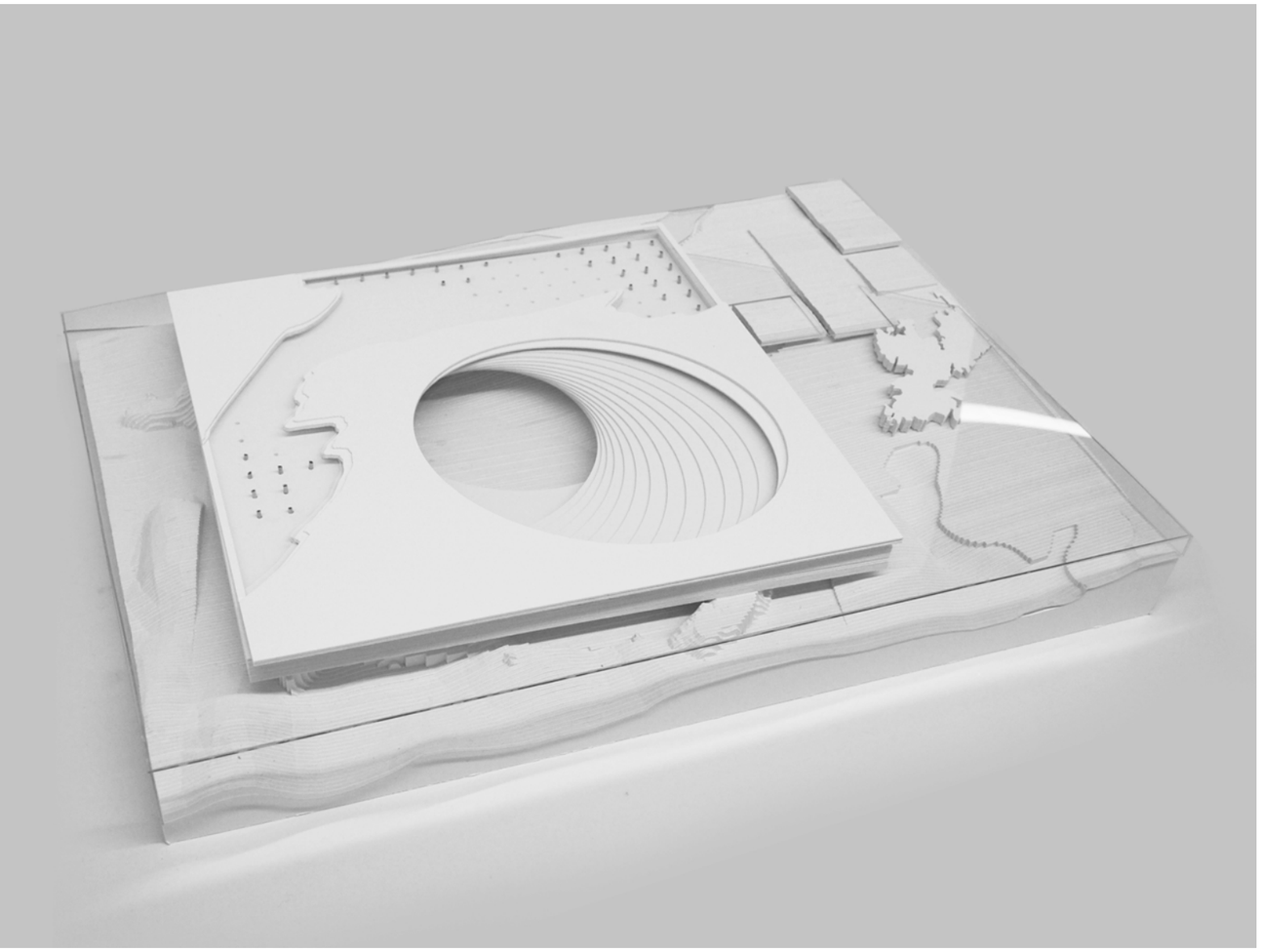

1:1000
HIGH TIDE
LOW TIDE

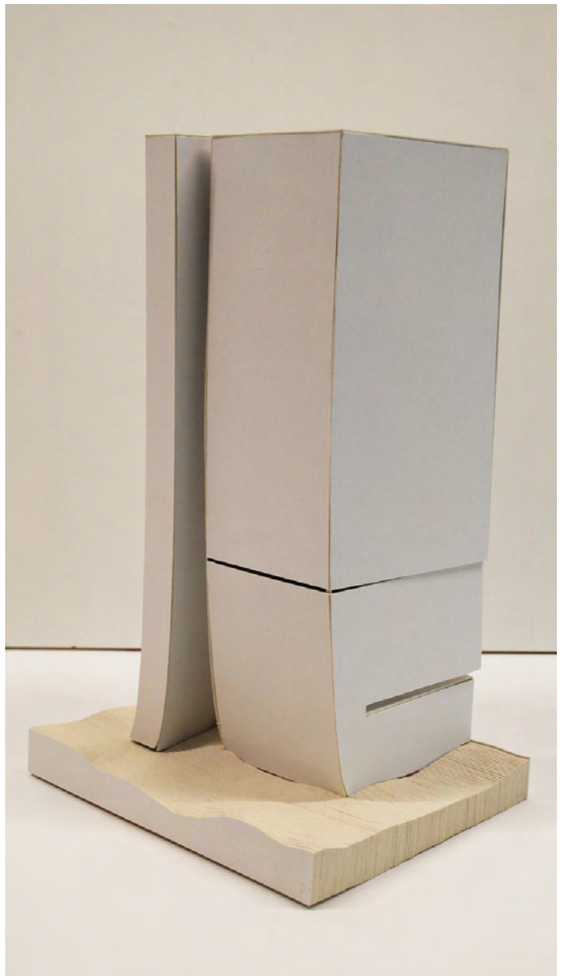


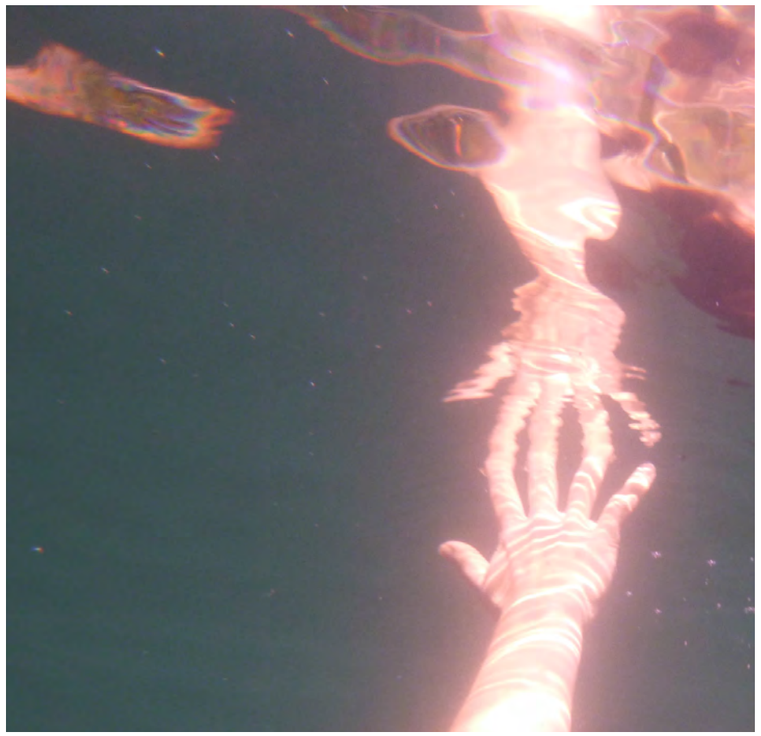
CASTED CONCRETE # 3

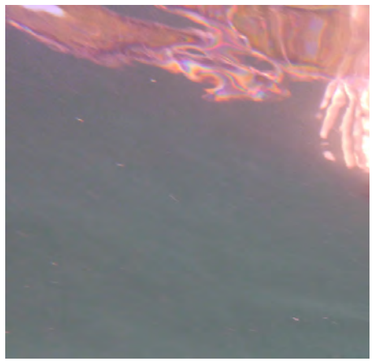
CASTED CONCRETE # 1

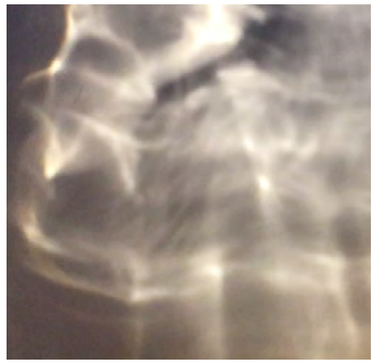
CASTED CONCRETE # 2





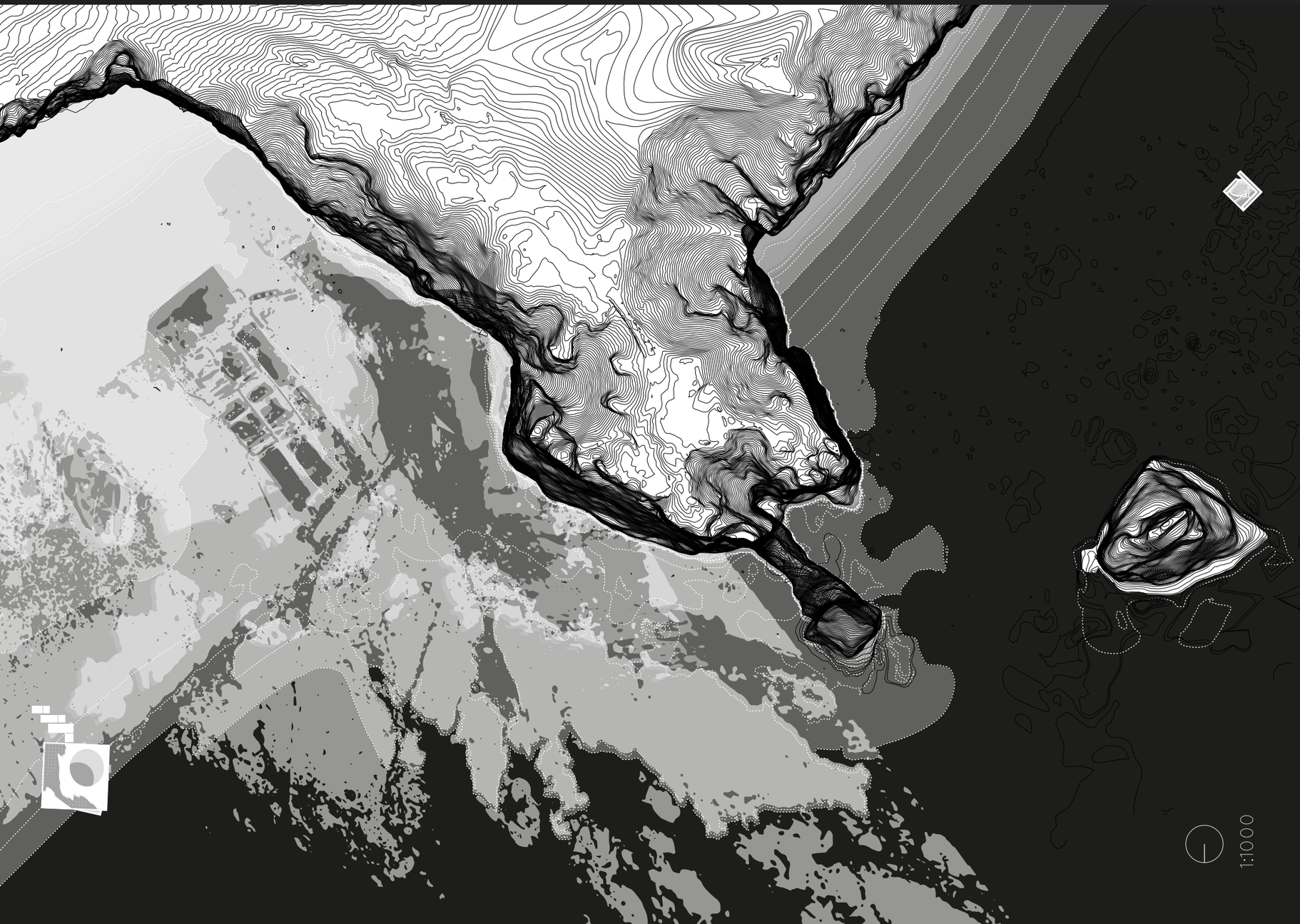






STUDIES OF WATER AND LIGHT

Photos taken under water show how water by its liquid form and transparency reflect and refract light, creating a dance of shades of colours on its surrounding objects.


1:1000

REFLECTION ACCORDING TO DESIGN ASPECTS

From the site analysis following aspects will inform the architectural interventions on the site. In different ways two structures will i interact with the tide, the narrative motifs from the site and illustrate the flow of time.

EMERGE FROM THE WATER

WALK ON AND DOWN THROUGH THE WATER

INWARD FALLING WATERFALL

1.

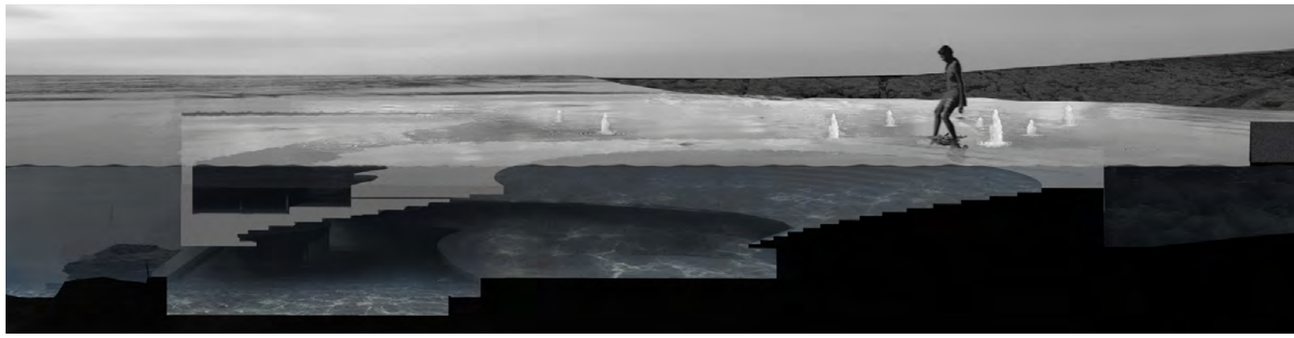
The first structure is placed close to the shore and can be seen from land. Like the oyster farm this structure will be placed 5 m below the water surface during high tide. When the water withdraws the structure gradually emerge from the water, like a shadow, later to stand freely on the seabed.

Two hours before the low tide it will be possible to reach the structure while it is still flooded by water. When walking on the structure the feet will get wet and you experience the light reflected by the water. Similar to the small fountains that can be found on the site, the water surface above the structure will start to effervesce when the trapped water below the mountain rock is released through small holes on the structures upper level.

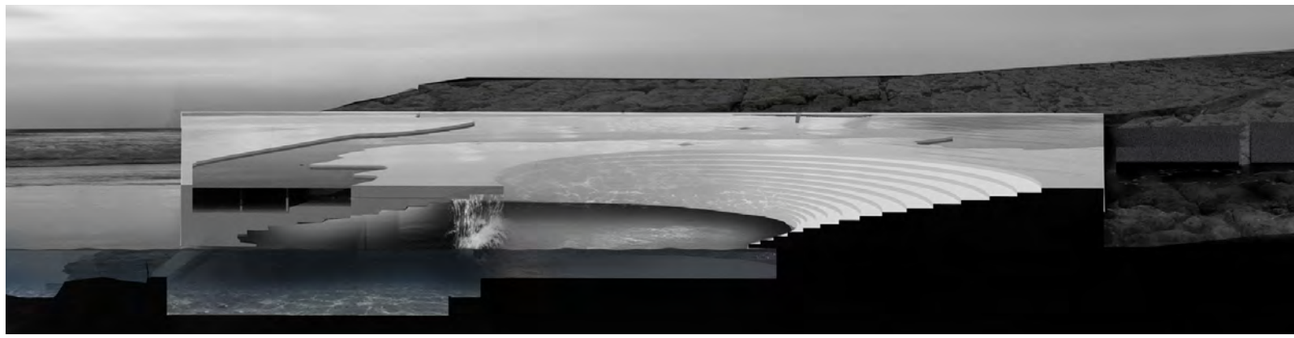
One hour before low tide it is possible to enter the structure from the top. During this time the water stored on the upper level of the structure is released through openings above the stair leading down to the lower level, creating an inward falling waterfall, pouring from the edge of the ceiling filling the structure with the sound of dripping water.

During the low tide the lower level of the structure can be reached. The lower level contains a pool and a resting area. Light is reflected on the water surface below the structure and creates a light play in the ceiling.

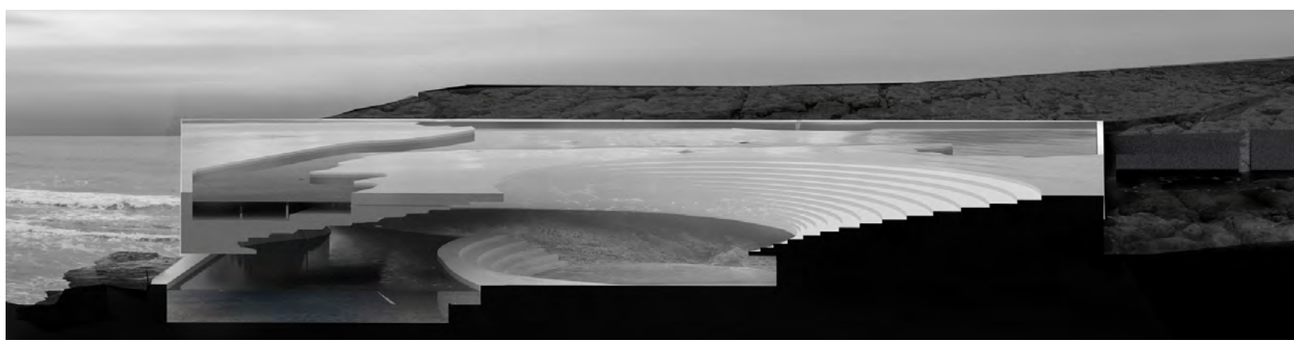
With time, algae growing on the surface will turn the colour of the concrete black.



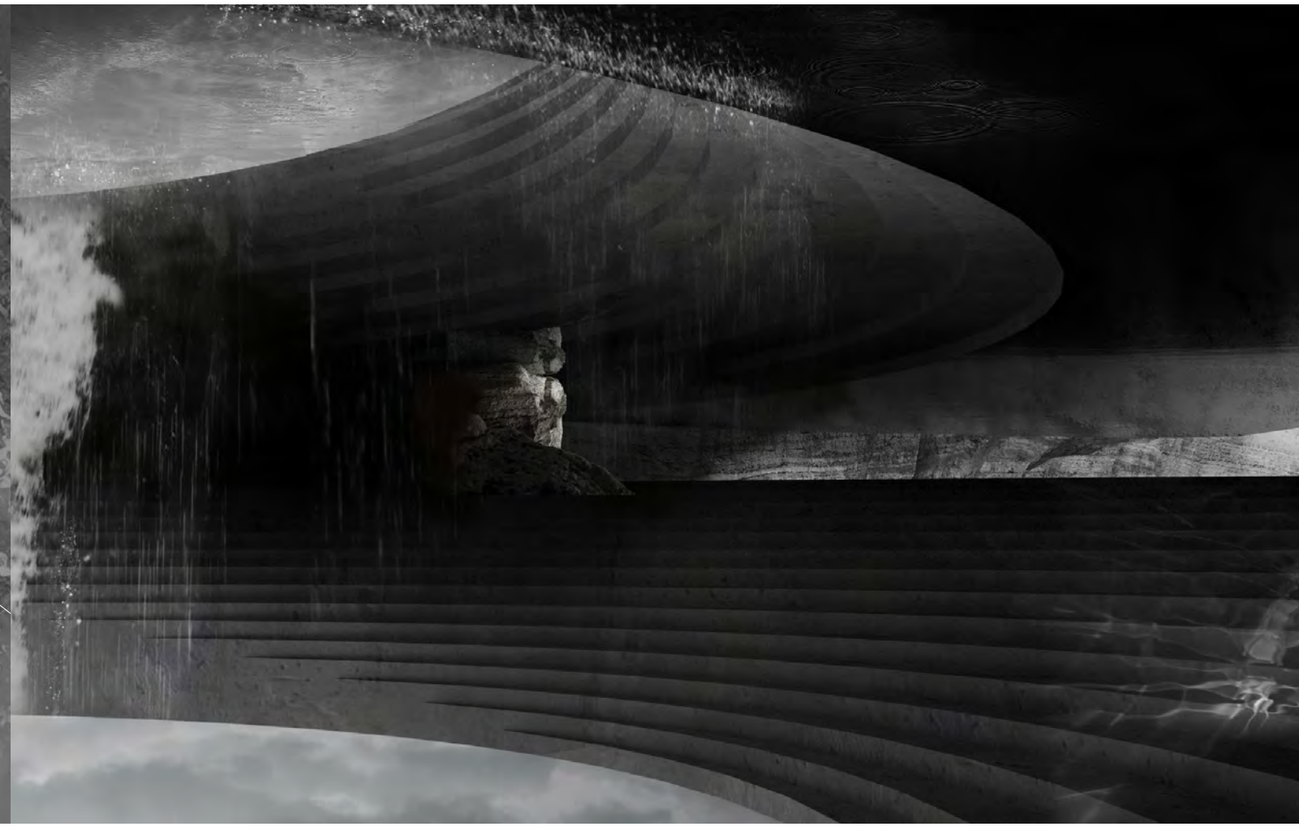
1:100 2 Hours before low tide small fountains are created where water trapped below the mountain rock is released through small holes in the structure



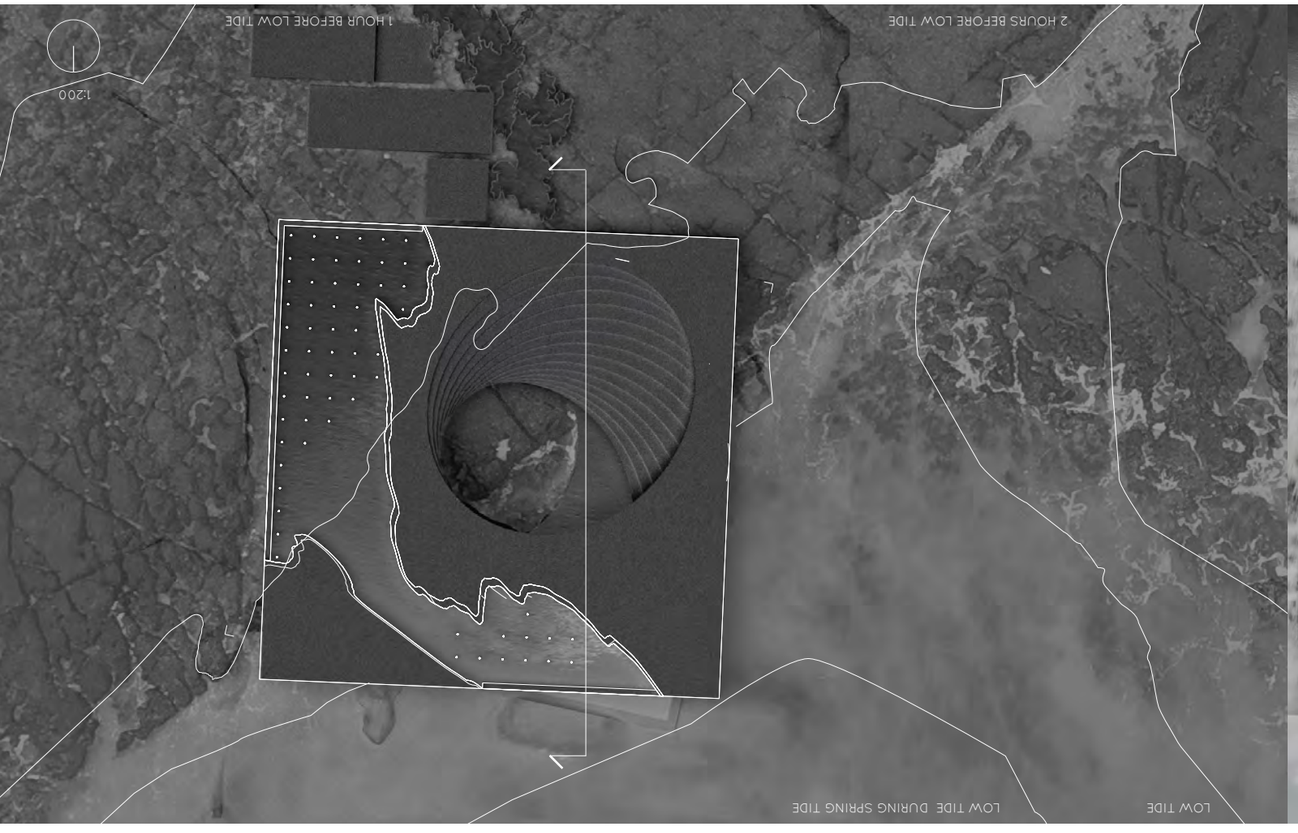
1:100 1 Hour before low tide



1:100 Low tide



LOW TIDE

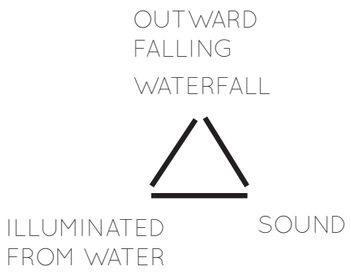

2 HOURS BEFORE LOW TIDE
1 HOUR BEFORE LOW TIDE
1:200
LOW TIDE DURING SPRING TIDE

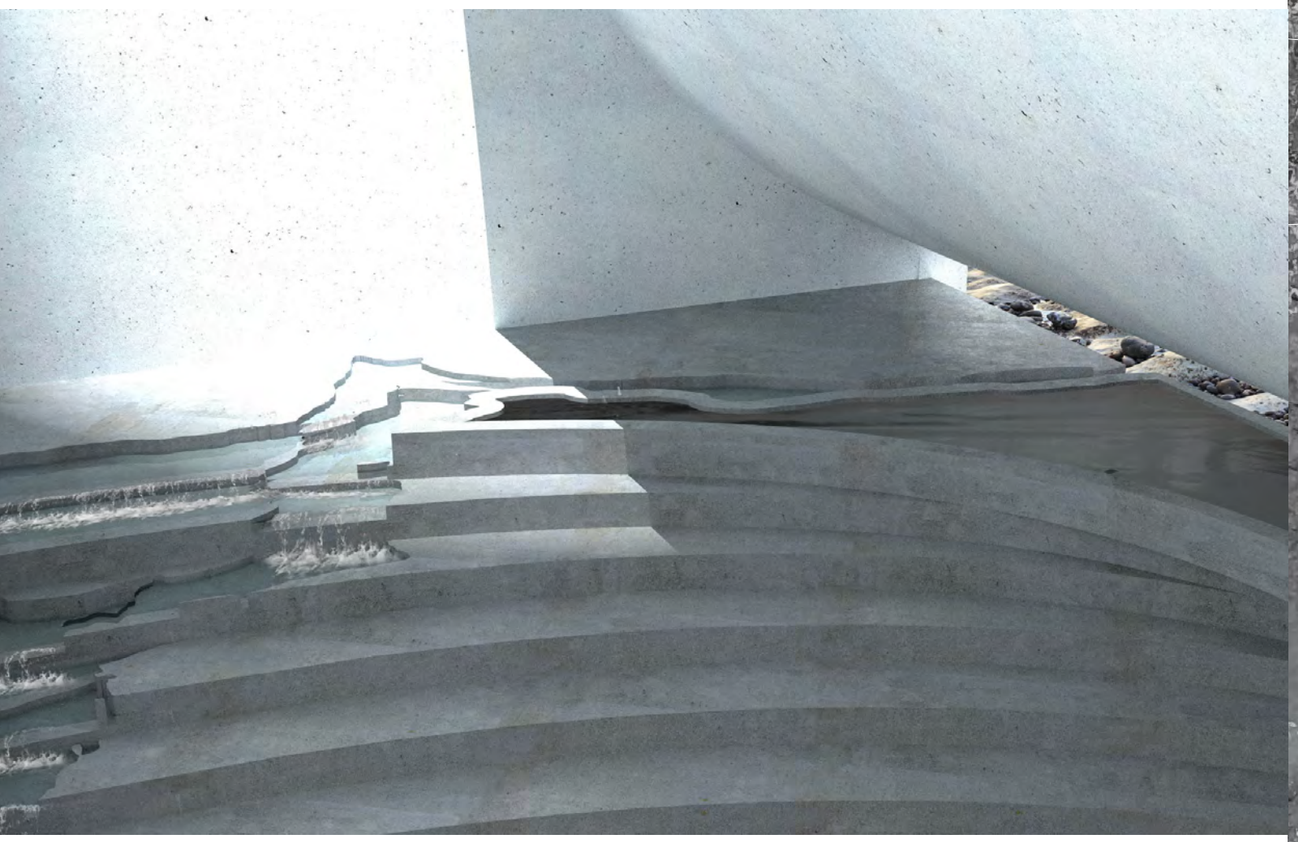
2.

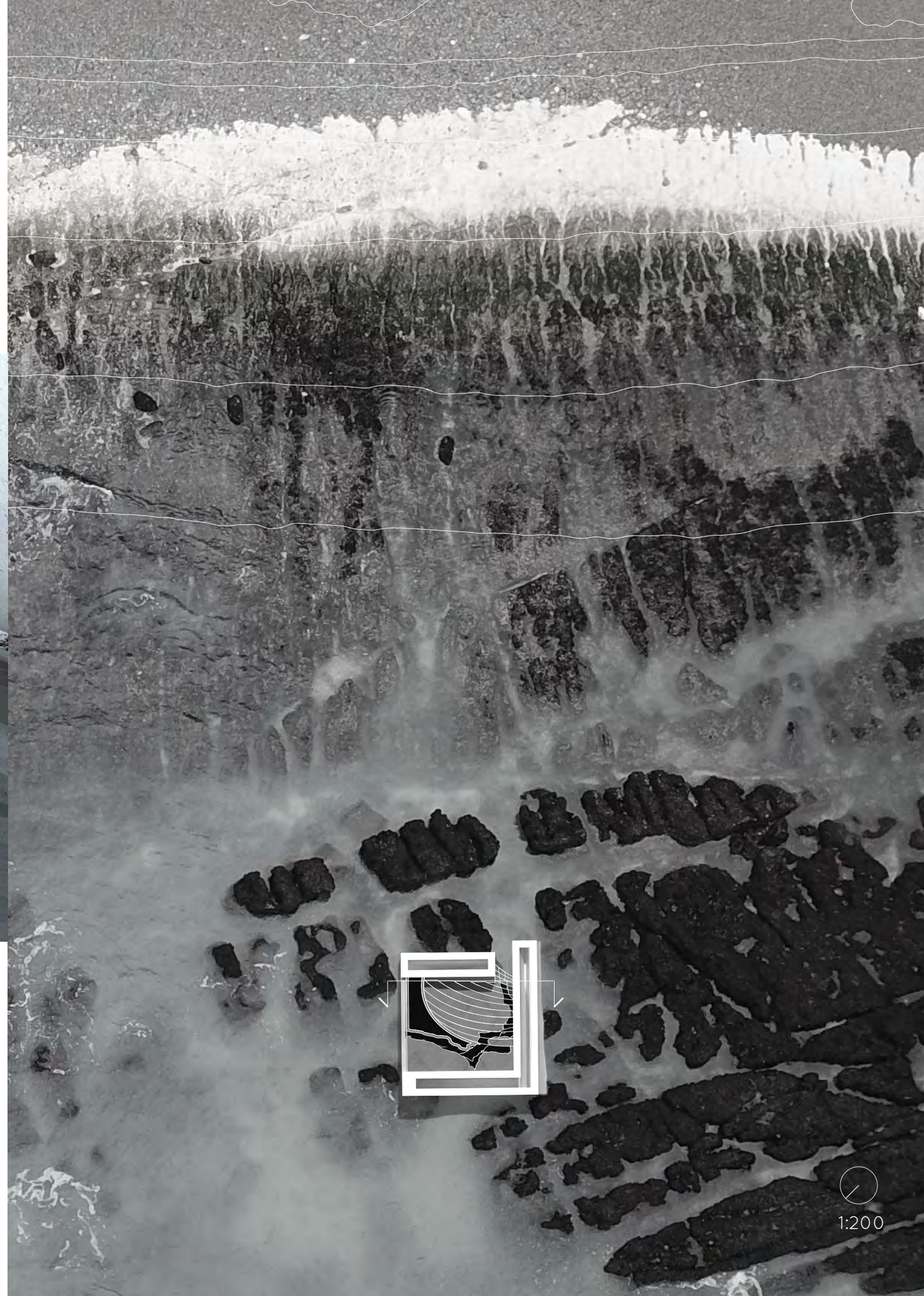
The second structure is placed on the shore that can be reached two hours before low tide through the tunnel in the cave. The structure is a tower that is visible from the cliffs. It will partly get flooded during high tide and store water in cisterns placed inside the walls to later let the water flow back to the ocean.

Four hours before low tide the seawater has receded the level where the first outlet is placed, creating an outward falling waterfall, letting water vapour down like a mist around its sides.

Two hours before low tide, when the shore is possible to reach by foot the second outlet is reached creating a waterfall on the inside.






1:200

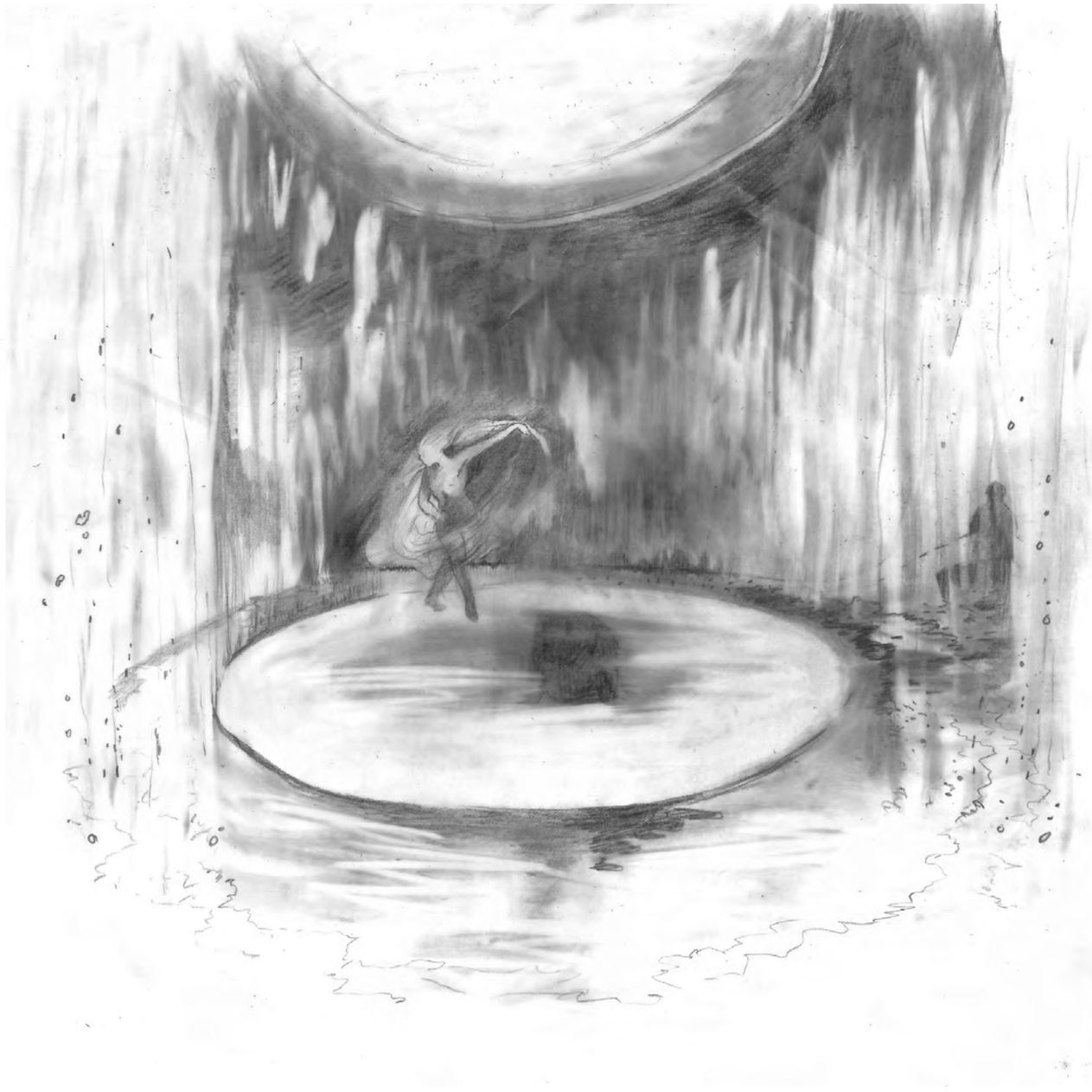
1:100 HIGH TIDE

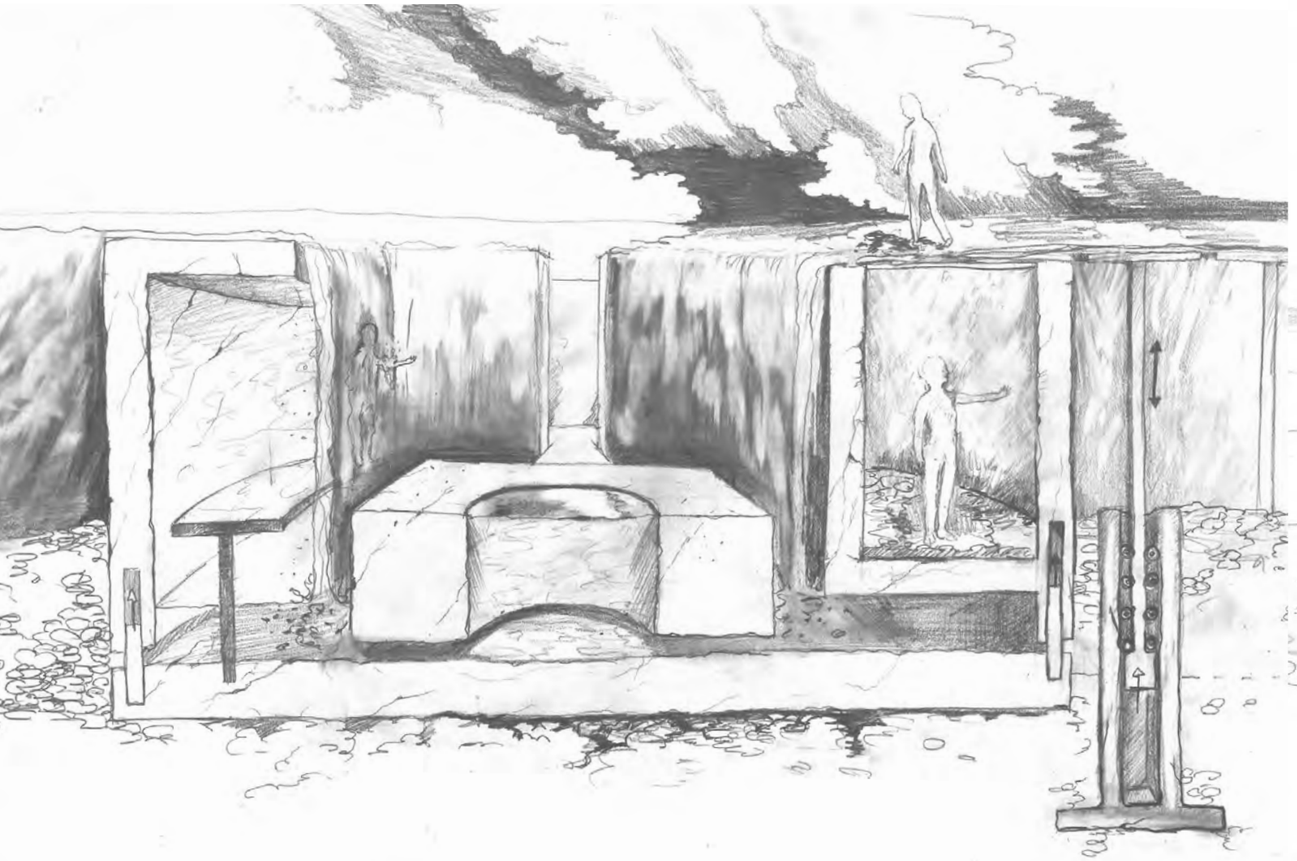
1:100 4 HOURS BEFORE THE MAXIMUM LOW TIDE

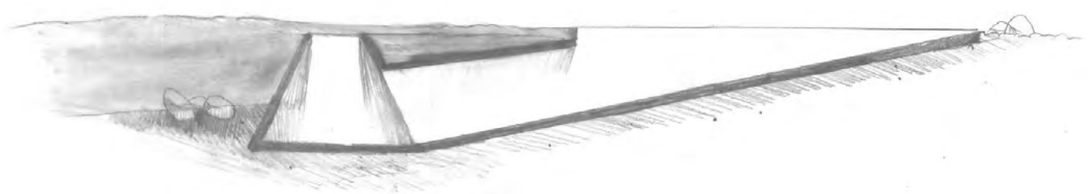
1:100 2 HOURS BEFORE THE MAXIMUM LOW TIDE

1:100 LOW TIDE

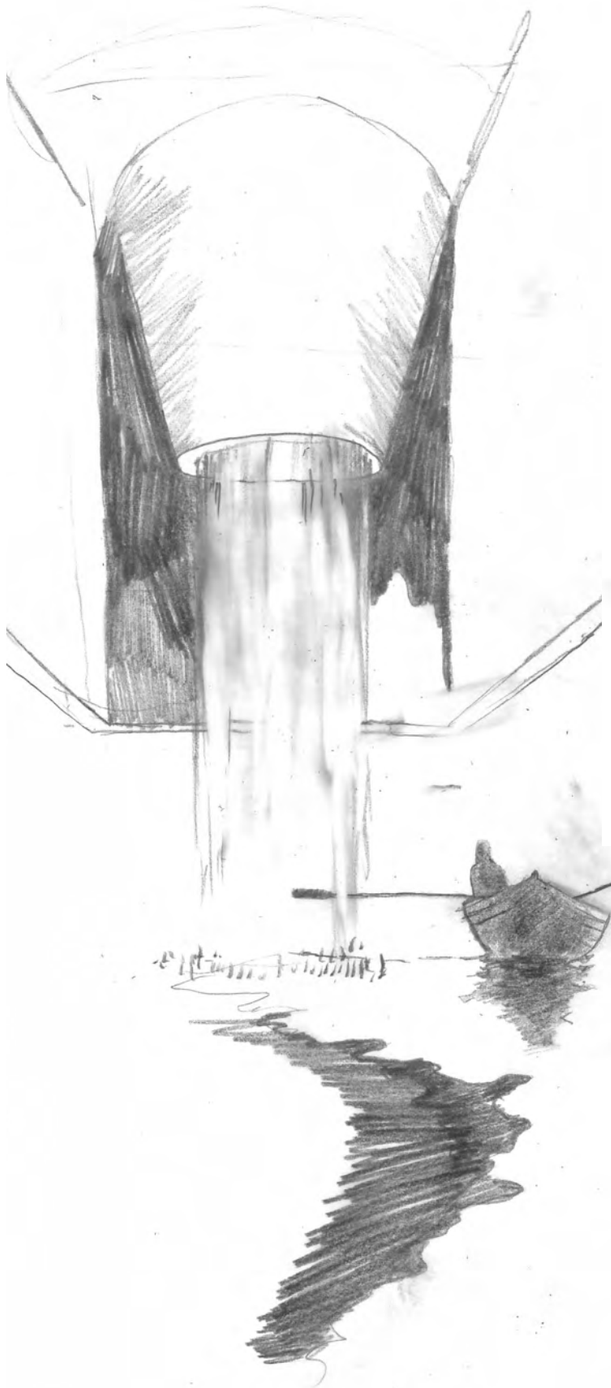
With time nature will regain the ownership of these structures. Water will grind and smoothen the hard surfaces. Ice will break and leave cracks in the concrete walls where algae, seaweed, pebbles of stone and sand will infiltrate in the gaps. The structures will later submerge in the ground and someday have a different meaning than they were originated for.

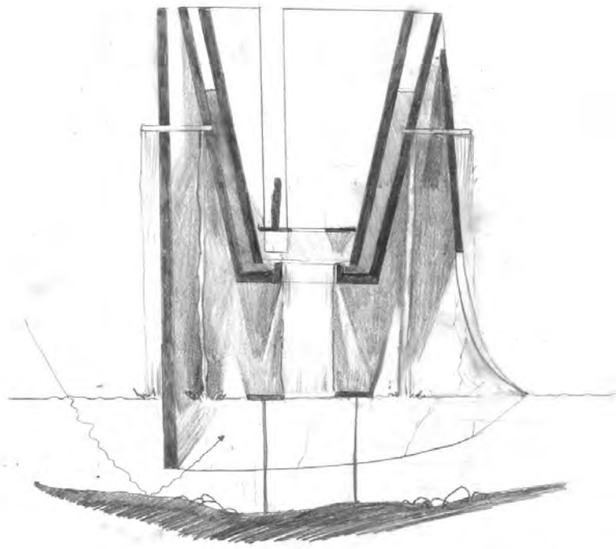







Water
sand to slow down the water





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Images

All pictures are the author's own images

CHALMERS