PLASTIC ISLAND

Three Structures based on Transformed Ocean Plastic

Erik Hadin & Emily-Claire Nordang

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CHALMERS

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Master Thesis Autumn 2017

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THANK YOU

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Anna Peterson
Ingela Sörqvist
Helena Bredin
Lars Tysklind
Peter and Tabita
CMH Smides AB
Vink Essåplast Group AB
Dave Hakkens - Precious Plastic
Johanna and Tobias
Ingela, Kjell and Kerstin

ABSTRACT

Our oceans are deteriorating. By 2050 scientists believe there will be more plastic in our oceans than fish (MacArthur, 2016). This thesis investigates how this ocean plastic can be reused within architecture. The point of departure is finding an alternative use for this excess material and giving it a new purpose within the natural setting of where it was first found as waste, therefore aiming for a holistic approach to the material investigation and design proposal. The ocean plastic that the material investigation is based on is collected from the shores of the Koster islands in Sweden's first marine national park which is also the chosen site of the design proposal of a public diving centre. By showcasing the material's aesthetic and textural qualities in a design project, this thesis aims to change the perception of what once was waste to something with value.

The project is developed through a series of experiments made with recovered ocean plastic. By mapping and categorizing the types and magnitudes of plastics, the most abundant plastic rubbish in the Koster region have been determined and by means of testing and elimination, conclusions have been made on which plastics are able to perform architecturally. The method of transformation is through heat and compression. Model studies were conducted both digitally and physically with focus on how the material performs in terms of colour, texture, light and translucency, and how these properties of the material can be transferred into building systems. Studies on how local and global patterning in the material affects the overall geometry in addition to the relationship between the plastic object's former identities and degree of deformation informed the design proposal.

The investigations show that the two most common types of plastic found on the beach are PE (polyethylene) and PP (polypropylene). These plastics can be physically bonded together using heat and compression for the function of a building material in a small scaled structure. Some identity of the original plastic objects can be conserved within the new material, providing a direct visual connection to the problem of ocean plastic. The design proposal showcases 3 different building systems (module, block and panel) developed from the material investigations using ocean plastic. The first structure focuses on the contrasting textures from smooth and glossy to rough and jagged that can be achieved using compression moulding and a slump forming method. The second structure focuses on the degree of transformation and tells a visual story from whole plastic objects that slowly transform into smooth panels. The third and final structure focuses on the endless amounts of coloured plastic objects found in our oceans and has a construction system inspired by unusual geology of the site where layers of rock create strong linear patterns across the landscape.

This thesis endeavours to change the perception of ocean plastic as purely waste by displaying the qualities of transformed plastic in an architectural design. It provides insight to a field where this waste can be valued specifically for its origin from the ocean, hopefully incentivizing collection and reuse of the vast existing volumes of these plastics. The design project provides insight into the scale of this global issue by informing the approximate volumes of ocean plastic waste needed to build each structure in relation to the amounts of plastic entering in the oceans around the world annually. By doing so, visitors can directly link the global issue to something concretized and scalable, making the problem more tangible.

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01: BACKGROUND

BACKGROUND & DISCOURSE

To put it bluntly, the 'diminishment of biodiversity in our ocean is the single greatest threat to the survival of humanity' (Parley, 2017). By 2050 scientists believe there will be more plastic in our ocean than fish (MacArthur, 2016). Plastic makes up approximately 82% of all marine waste found in our oceans (Ospar, 2014) and the fact that plastic is a material developed by humans with an intentionally slow degradation process means that it essentially might never disappears by natural circumstance. Ocean plastics merely break down into micro and nano-plastics (< 5mm) which causes harm for the marine wildlife and the environment. This can even be problematic on a human scale as the plastics eventually end up in our digestive systems due to our diet (eating fish and other animals from the ocean). Evidence on how this impacts human health is still underdeveloped but researchers believe that ocean plastics can cause harmful effects for our heath.

In 2008 governmental aid towards cleaning the shorelines of Sweden was withdrawn and the cleaning was entirely dependent on individual municipalities and volunteers. In September 2017 the government announced a new budget to provide more aid to the cleaning of our oceans as a result of the 2015 UN summit where our world leaders came together and set up a total of 17 goals to protect the planet, of which #14 - Conserve and sustainably use the oceans, seas and marine resources (17goals.org).

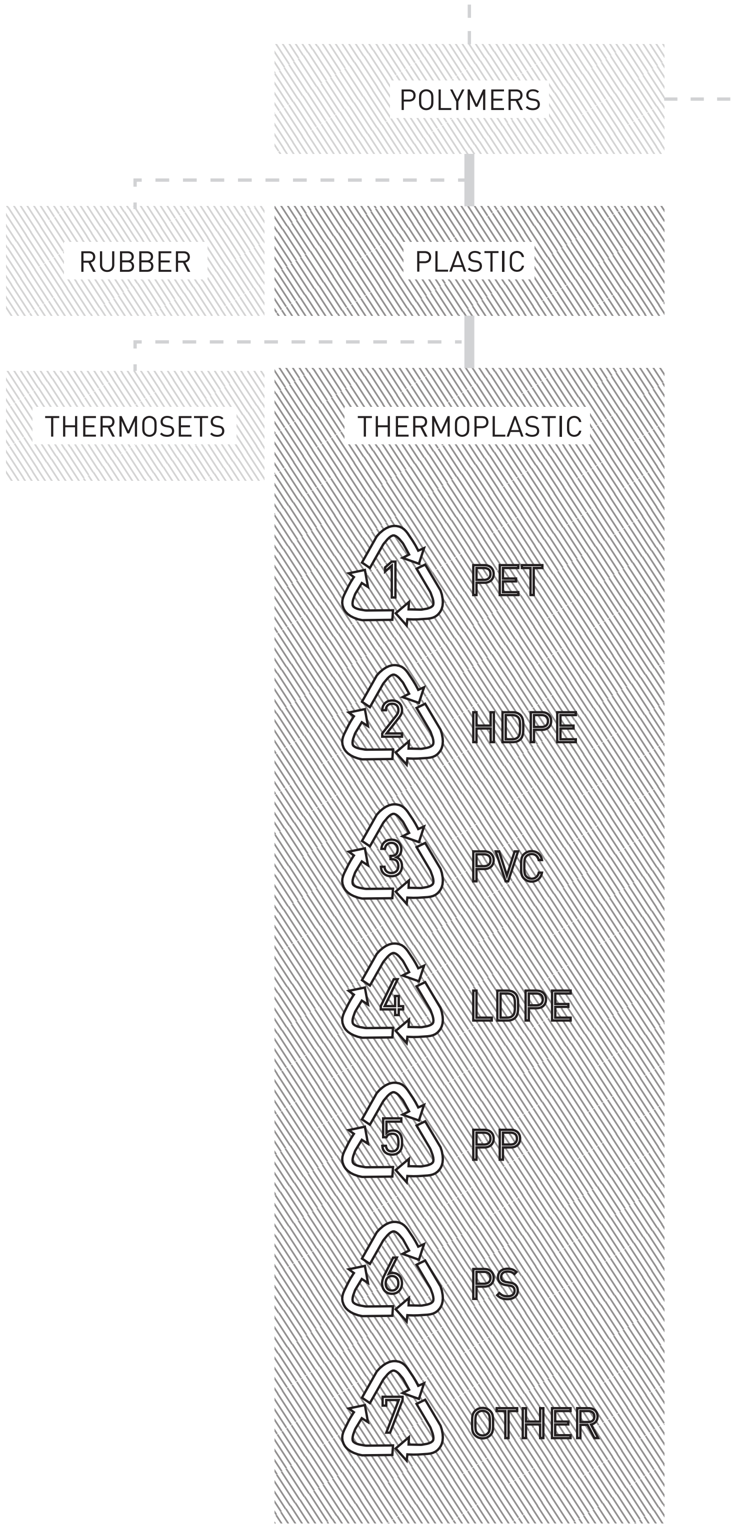
Kosterhavets national park was in 2009 declared Sweden's first marine national park. The area houses over 6000 species of underwater life, of which many (approximately 200) are unique to this particular area. Although the environment is protected in many ways, marine pollution remains a very relevant and current issue that destroys the wildlife (Länsstyrelsen Västra Götaland, 2014). In 2017, 17 tonnes of marine waste was removed from the islands shoreline by volunteers and the coast guard (Kustbevakningen). Out of this marine waste, around 80% is plastic (Svärd, 2013).

Can the perception of ocean plastic as purely waste material be challenged and is there potential in reusing this material in architecture?

The point of departure for this thesis lies in the marine pollution accumulated from Kosterhavets national park. The national park, while relatively new, already has a strong base of tourists visiting and returning every year to see and experience the idyllic archipelago and environment on the islands. While there have been some actions made to enhance the user experience of the park and provide insight to the wildlife, the design proposal of a diving center aims to provide access to a part of the island that currently is difficult to get to. The design proposal aims to highlight the plastic which exists in symbiosis with the 'natural' landscape while providing a meaningful architectural experience.

The findings from the material investigation on ocean plastic have informed the design of the diving centre in addition to providing insight to the scale of plastic pollution. By concretisizing and quantifying the amount of plastic used in the design compared to how much exists in the ocean, people may be able to grasp the scale of the issue. By doing so, the project can create an awareness and hopefully contribute to the discussion of marine pollution in a larger discourse while realizing the potential of reusing ocean plastic within architecture.

This thesis departs from design-based research rather than technical research and while some factors have been considered, the technical aspects have not been the focus.



PLASTIC

What is plastic?

Plastic is something most of us come in contact with every day. It can be found almost everywhere and has an infinite amount of different shapes and appearances covering every sector from health and food preservation to transportation and enhancing the digital age. It has become a part of our every-day life and something that is used for a huge range of different purposes. It has replaced other materials such as wood, metals, stone and glass in a lot of areas due to its cost, versatility, durability and ease of manufacture.

Plastic is however not a name for one single material, rather a common term for a wide range of materials. Like 'metal' is a general common term for a range of metals such as copper, gold, titanium etc, all with different visual aesthetics, chemical and mechanical differences, as is 'plastic' a general common term for a range of different materials with the common property that they are based on polymers. These polymer-based materials are generally combined with various additives, such as color and softeners to give the material its desired properties. Most of the polymers we use in plastic today are synthetically produced (Bruder, 2016).

Plastic as we know it had its breakthrough in the mid 1900's when the understanding of its chemical structure was discovered and has exploded in usage ever since. Naturally produced similar materials have however been found used for over 1000 years in ancient Chinese and Egypt civilizations (Klason, 2011).

Thermosets and Thermoplastics

There are mainly 2 categories of plastic; Thermosets and thermoplastics. Thermoset plastics can only be melted once which is when the molecular chains is bound together meaning it will not break when reheated. These plastics can therefore only be used once and can not be recycled.

Thermoplastics have the advantage that they melt and can be recycled multiple times when heated. Every time a thermoplastic is recycled its mechanical properties is slightly reduced. The majority of the plastics made and used today are thermoplastics and these can again be divided into more subgroups. These subgroups all have different chemical, mechanical, structural and visual properties and hence are used for different things.

'Polyethylene' (PE) is the most common thermoplastic with over 60 million tons produced every year. 'High-density Polyethylene' (HDPE), normally used in packaging and bottles and 'Low-density Polyethylene' (LDPE), normally used in plastic bags are the most common variations of Polyethylene.

'Polypropylene' (PP), 'Polyvinyl-chloride' (PVC), 'Polystyrene' (PS) and 'Polyethylene terephthalate' (PET) are a few other common subgroups. To easily separate the most common groups into recycling they are preferably marked with different numbers representing each group of plastic (Bruder, 2016). This marking is however not compulsory and is one of the factors that makes sorting and recycling a complex task.

Claes Oldenburgs 'Leopard Chair' (1963) is made primarily from vinyl, showcasing the ability of plastic to take on and imitate any form, surface or pattern. (Image credit: https://nga.gov.au/International/Catalogue)

PLASTICITY IN ARCHITECTURE

Plasticity; noun. *The quality of being easily shaped or moulded. (*Oxford dictionary, 2017).

Plastic, commonly regarded as a new or modern material within architecture has actually been around since the 1940s. The material plastic has some specific qualities such as light weight, weather resistance and forming characteristics that make them interesting for architectural applications (Plastics in Architecture p.10). Due to their material plasticity, plastics are often used and associated with complex shapes and forms when used in buildings, architecture, art and furniture.

There is a difference between plasticity in terms of a material property and plasticity in architecture. In the article Plasticity at Work (2002) by Silvia Lavin, she differentiates plastic, the material and plasticity, the adjective. The material in the molecular sense took form in the nineteen century, but plasticity however, as a concept has existed far longer, for example discussed by Vitruvius in his Ten books. *'Plasticity obeys no conventional formal or semilogical logic and instead exploits gaps in the discipline's stabilities to produce experimental sensibilities'.* Plasticity in architecture refers to the sculptural presence of a building. This can be the result of the planned functions, site limitations, the spatial sequences or the architects desire.

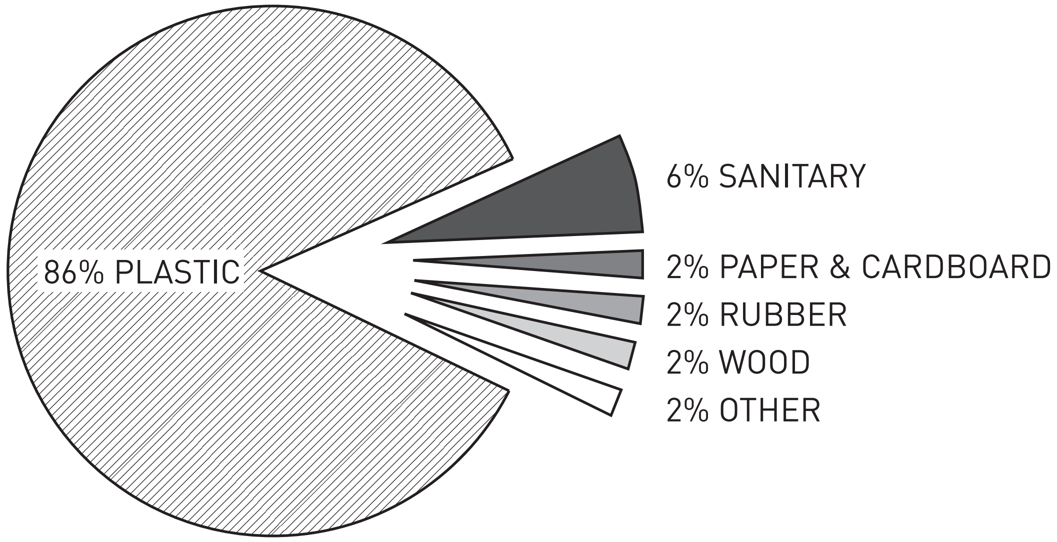
Lavin begins her article by referencing the work of Frank Gehry "Horse's head" as a good and perhaps obvious example of the generative possibilities of plasticity. It is a large scale, abstracted horse head, created from moulded fiberglass. The project has been used for several functions, starting with an idea for a house, then an installation, and finally ending up being used as a conference room. Lavin states *'The migration of this evolving form clearly defies the idea that form should follow function and exposes a kind of semi-autonomy in the relation to form and program'* and *'The very fact that a consistent morphology can serve so many different functions and not through the recourse to the neutrality of the generic- is a demonstration of extreme architectural plasticity.'* One can argue that plasticity in architecture relates to appearance, function and time.

Lavin goes on to refer to different projects that showcase some of the possibilities of plastic as a material and plasticity as an architectural concept. Claes Oldenburg's project, "Bedroom Ensemble" shows how plastic can be used imitate other objects, patterns and forms. In another example she talks about the formability within plastic and its possibilities to take any shape desired.

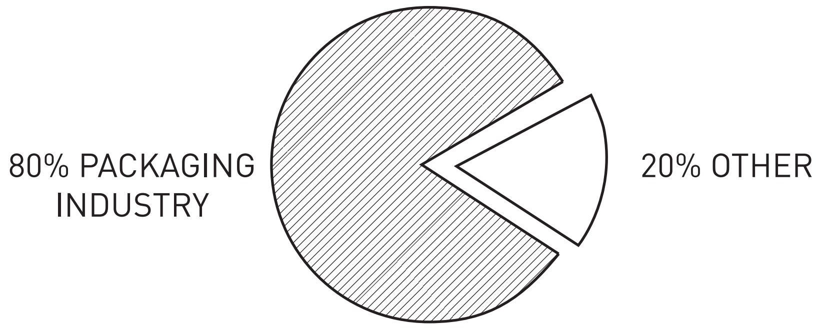
After referring to plastic in architecture in different scales, from furniture, installation to building, she concludes that architecture is 'unthinkable without its relation to decorative arts, industrial design and fashion. Plastic, moreover, is where all of these cultural practices collide'. *'Meaningful without signification, progressive but not avant garde, formed but without abjection, architectural but without hierarchy - plasticity is at the core of the contemporary architectural project.*'

Lavin claims that plastic can be found virtually everywhere *except* in architecture and that plastic as a material has not earned it's true typology such as glass can be identified with utopia, truth and lightness. There is no obvious way of how to use plastic. It has no universal grammar.

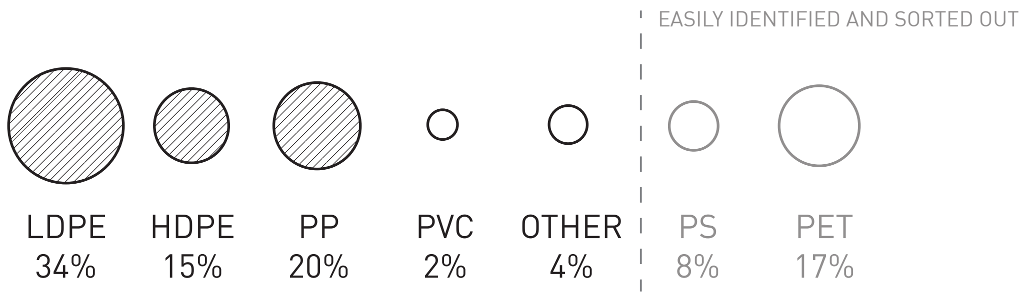
This thesis has the ability to relate to plasticity in both their meanings, on a material level but also as an architectural concept in terms of the way the buildings are designed and sculpted.



Marine waste found in northern bohuslän



Origin of plastic collected form Kosterhavet



Plastic types in the Packaging sector

OCEAN PLASTIC

Plastics in our oceans

The types of marine waste found in the ocean differs depending on the location meaning that the waste close to urban areas or areas in the end of inland streams will be different to the waste found on a remote island. One thing they all have in common is that they mainly exists of plastic it is likely that they come from areas far away from the point of collection or observation.

Every year, over 300 million tons of plastic is produced around the world of which over 50 tons is produced in Europe. 40% of this plastic is used in the packaging sector as mainly consumer products, which are often only used once before they are thrown away. In the packaging sector the majority of the plastic used is PE, PP, PET and PS (plasticseurope.com).

Worldwide, an estimated 8 million ton of plastic enters our oceans every year. Quality of waste management and size of population is strongly linked to the contribution of plastic marine debris and waste. Around 80% of the marine waste comes from land-based sources (Jambeck et al., 2015). Although Sweden has a well developed waste management system, our shorelines and beaches are greatly affected by marine plastic waste. Due to ocean currents around 80% of the waste found on Bohusläns shores is estimated to come from other countries than Sweden. (Svärd, 2013).

Plastic in Kosterhavet

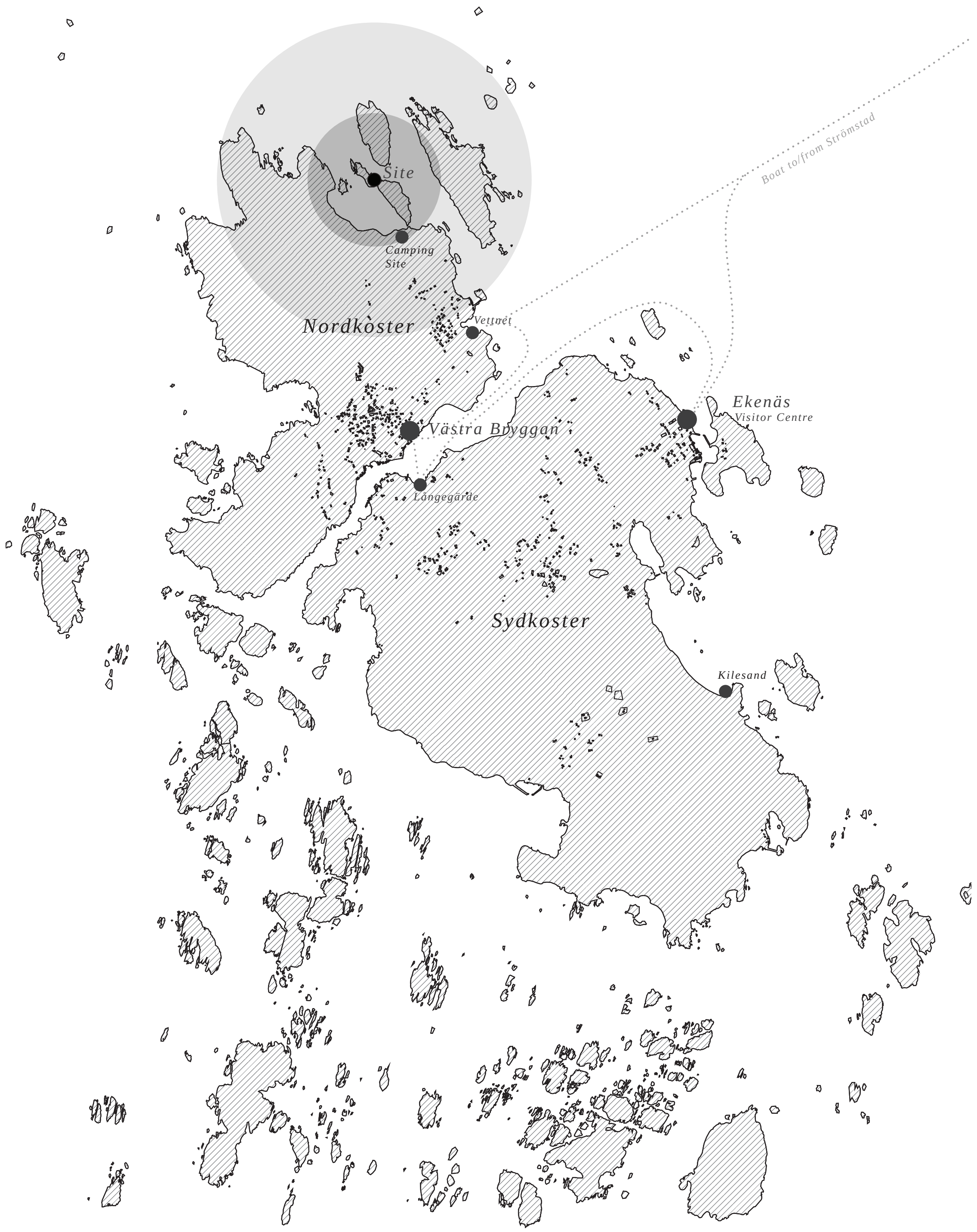
The Koster islands, located west from Strömstad on the west coast of Sweden is greatly affected by this problem. In 2017 over 17 tons of combustible marine waste was found and collected on the shores of the islands in Kosterhavet combined (Anita Tullrot, Länsstyrelsen).

To get a more detailed estimate of what types of garbage is found on our beaches, OSPAR commission have created reference beaches along the shorelines where they collect data on a 100m long beach, 4 times per year. Much like the rest of the world, over 80% of the waste found on Bohusläns beaches is plastic waste. The vast majority of this waste is from the packaging sector or fishing industry. Plastic pieces up to 50 cm, rope and nets, plastic capsules, jerry cans and bigger plastic pieces are some of the most common items found. (Svärd, 2013)

Collecting waste

Hypothetically, if hard plastic packaging was sorted out while cleaning up the shorelines and separated from PET-bottles and Polystyrene which are both relatively easy to differentiate due to their appearance, one would end up with a *majority of PE and PP plastics*. This conclusion was drawn early in the project and laid the grounds for the types of plastics used.

In collaboration with Ingela Sörqvist at Trossö Natur and individual efforts, this thesis had a starting point of *64kg* of ocean plastic to conduct plastic experiments with.



KOSTER MARINE NATIONAL PARK

Koster is a group of islands located 18 miles northwest of Gothenburg, Sweden. Koster is a popular tourist destination especially during the summer months for its idyllic archipelago.

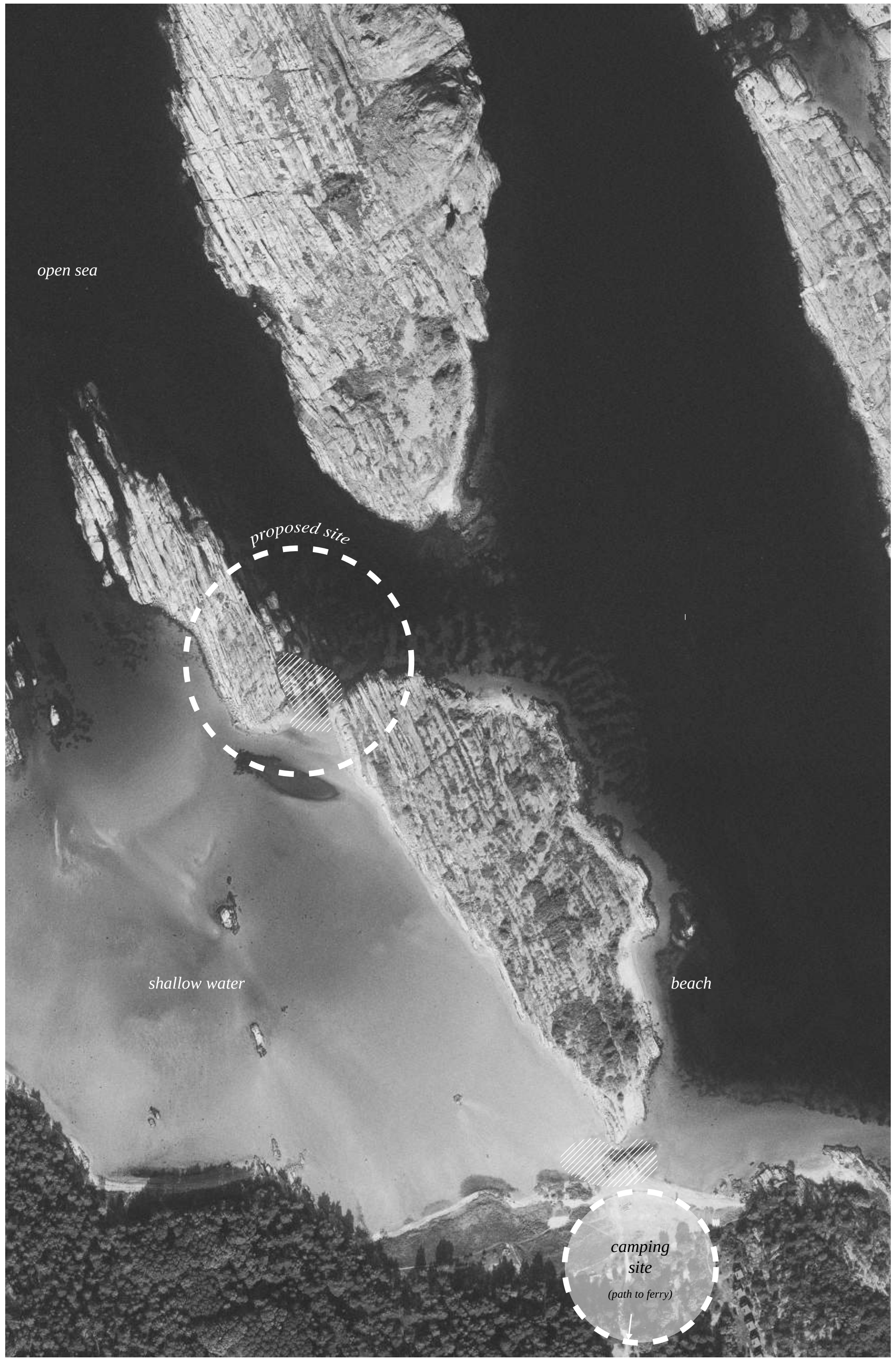
In 2009 the Swedish government declared the waters surrounding Koster a nationalpark and since then they have built a visitor center located on the south island at Ekenäs. Here, visitors can see an exhibition about the underwater life and what lives beneath the waters edge. The visitor center is a great starting point for tourists to see and understand the species, some of which only exist on and around Koster.

What was missing on Koster is something more that makes people want to go and explore the islands, particularly the North island which is less developed.

The design proposal that this thesis results in aims to attract visitors to a less visited part of the island, make it more accessible and get people up and close with nature and everything that this nature entails. For this project, it means highlighting the plastic which exists within the nature of the site.

All of the national parks in Sweden have a set of guidelines with certain criteria they should fulfill within the area. One of the criteria that Kosterhavet Nationalpark does not fulfill is a shelter or ‘vindskydd’ that visitors can use to take a break while out exploring the island. This project aimed to be an extension of the existing visitor center, where people who perhaps already have been to the visitor center and learned about the marine species can come and see, touch and swim with them. This led to the program of the design proposal which is a public diving centre.

There is already a snorkeling link set up on the southern island close to the visitor center, so this proposal introduces a new snorkeling link on the north island in addition to the diving centre. The design would be open for everyone all year around and have an educational purpose as well so that for example school classes could come and visit and learn about the problem of plastics in our oceans.



THE SITE

On the most northern part of the north island is where the chosen site is located. It is located on and in between two islands; Korsholmen and Lökepottan. These are two fairly flat islands that are relatively bare in terms of greenery with only small patches of grass and shrubs scattered along the island. Both islands carry the characteristics of a typical Koster islet, a solid base of gneiss with thick black lines, called dike swarms crossing over the islands made from black diabase giving the landscape a clear direction out towards the open ocean.

Before one reaches the islands there is a campsite that is open throughout summer and also happens to be the only site on Koster islands where camping is allowed. Here there are a few small off-grid cabins which are open for rent all-year round and are powered by solar power.

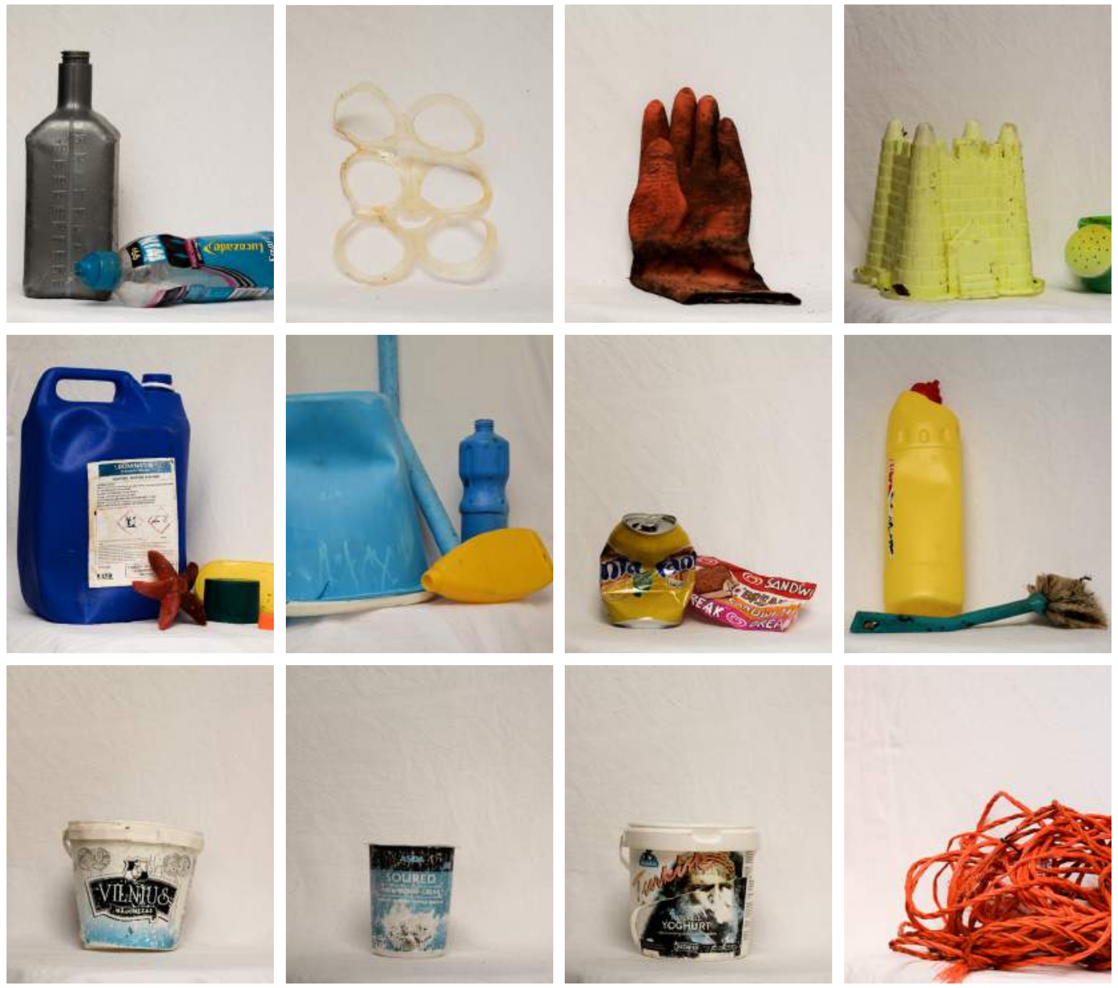
From the beach outside this campsite one must wade across the shallow waters during low tide to reach Korsholmen, walk along the shoreline and then wade once again over to Lökepottan. The tide plays an ever present role in how the accessible the landscape is and also influences how the site is perceived.

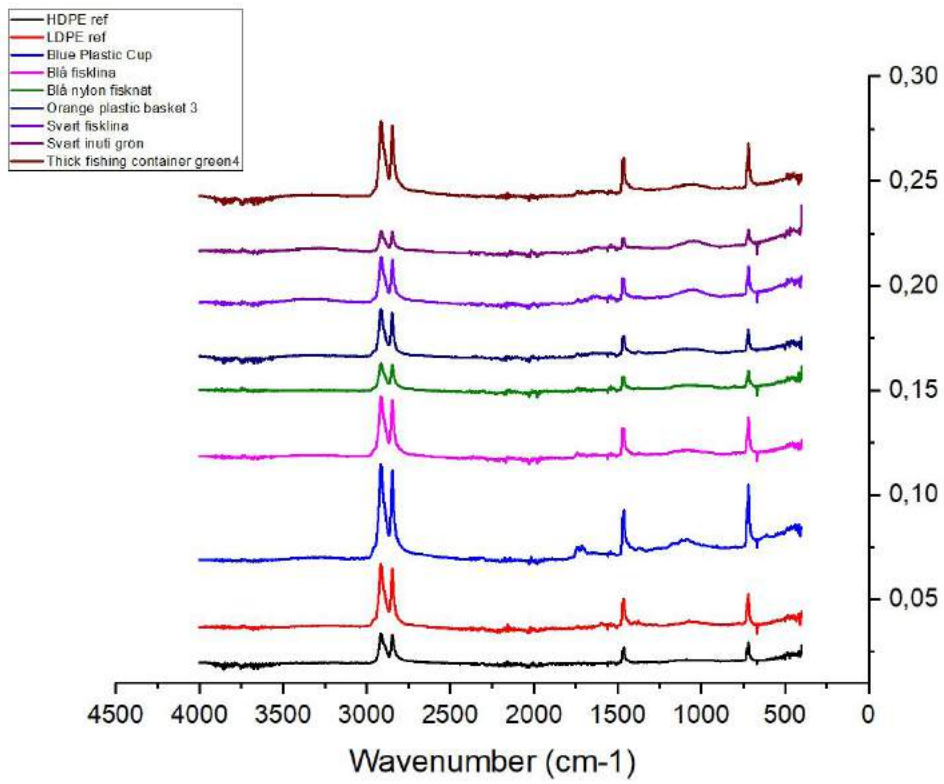
The area acts as an inlet to the great ocean outside the archipelago. It becomes a natural site for contemplation and reflection and where this project can become a landmark that symbolizes the great problem that our world is fighting with today, plastic in the ocean. The design plays on the contrasting elements of what is natural and 'not natural' and how they interplay.

Photos of the site

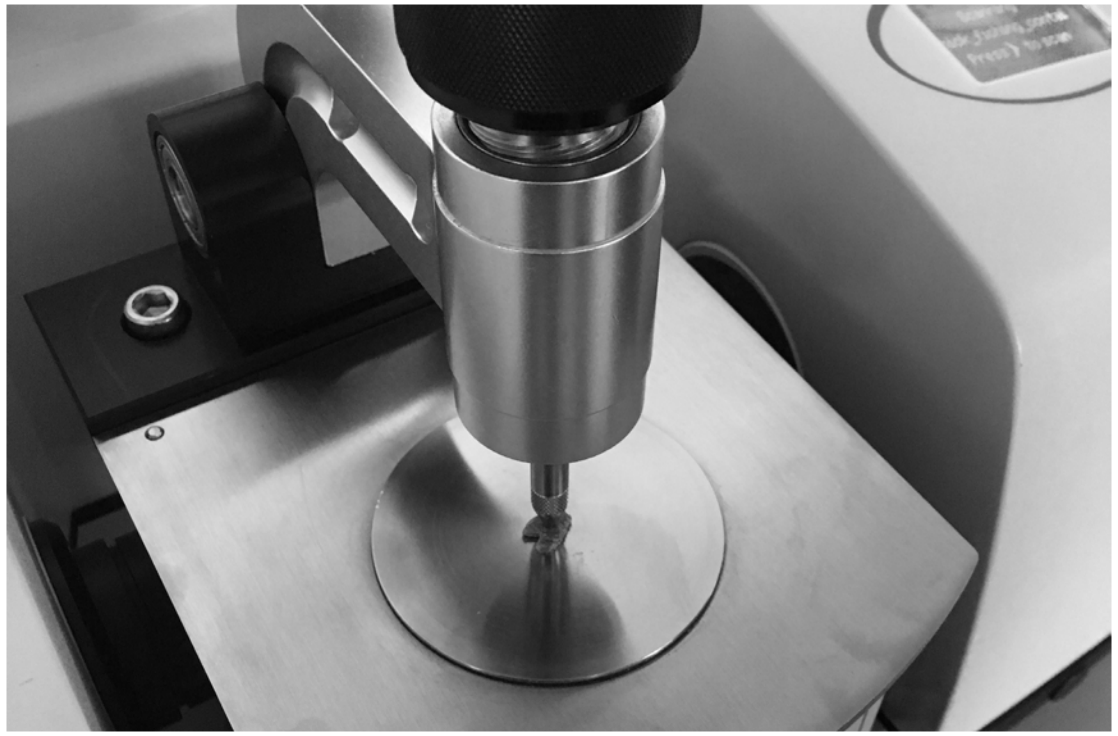
Marine waste found around the area of the site

Typical plastic objects found along the shores of Bohuslän





FTIR scan showing what plastic types object are by measuring the frequencies absorbed in a material.



FTIR (Fourier-Transform Infrared Spectroscopy) instrument testing a plastic granule collected from Koster.

SORTING PLASTIC

Out of all plastic that is produced annually worldwide, only 14% is recycled. Vast quantities of the waste unfortunately escapes into the environment and over 8 million tons of plastic enters our oceans every year. However, it is not only the environment that is hugely impacted by the lack of recycling and poor handling of plastic waste. The global economy loses between 80 to 120 billion USD every year and since the production of plastic is expected to double in the next two decades, the value of the recycled plastic must be reconsidered. Some companies are taking action against this and are trying to find a long term solution to reuse of plastic, but we are unfortunately still a long way from a global solution to tackling the economic, environmental and health impacts of ocean plastic (MacArthur, 2017) (Iñiguez, Conesa & Fullana, 2017).

Even though the plastic found in our oceans or on the beaches might be seen as free, it must still be collected and in order for it to be recycled it would have to go through an extensive process of sorting and cleaning in order to be used again with its original condition. Even then, due to the potential degradation of the plastic, the quality of the product could be difficult to ensure.

Helena Bredin, Project leader at Ren Kustlinje means that several initiatives are researching the potential of sorting and recycling ocean plastic are being carried out here in Sweden. They are trying to investigate how sorting affects the collecting process, how much extra time it consumes and what types of plastic might be of value to sort out and replace back into the flow of material. There is a small growing trend in bigger companies wanting to reuse ocean plastic, however, this is mainly for marketing purposes. Bredin means that the knowledge needed for sorting the collected plastic can be found in public and private companies, but there is a great scepticism around the value of the plastic due to its background and because of the inexpensiveness of producing new plastic material today.

For these reasons, a pragmatic way of viewing this plastic waste has been investigated in this thesis. There was an ambition to find a process which relies on sorting the collected plastic in a way that can be carried through without great material knowledge.

Only hard plastics were collected for the purpose of this recycling, and easily identifiable objects, such as for example PET-bottles, rubber and Styrofoam were separated during the collection. As mentioned in the "Ocean Plastic" section, if the other plastic types would be sorted out, the majority of the collected plastic would consist of Polyethylene(PE) and Polypropylene(PP). A small amount of other types of plastics would, however, inevitably end up in the collected material unless an extensive sorting system would be implemented. A number of FTIR (Fourier-transform infrared spectroscopy) scans were conducted in the Chemistry Department at Chalmers on the plastic collected at Koster in order to test this conclusion, and all tested objects showed up as either PE or PP.

The collected plastic waste would after or during collection be sorted by color, rather then by type with the exception of jerry cans, another easily identifiable object commonly found on the beaches. The jerry can is often white and semi-translucent and acted as a base ingredient in the experiments. The jerry cans in combination with plastics sorted by colour can achieve visual and architectural qualities. As PE and PP will not chemically bond, this thesis's investigations show that the will physically bond in the purpose of an architectural element

This thesis investigated what can be done to the plastic that has already entered our oceans, and that will continue to end up on our shorelines until a global, working solution has been found. This project is not a solution to the global pollution issue, but it provides insight to a field where this waste could be valued specifically for its origin from the ocean, hopefully incentivizing collection and reuse of the vast existing volumes of these plastics.

02: REFERENCES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GLOBAL INSIGHT

The Ocean Clean Up Project
There is still hope when it comes to ocean plastic. There have been several proposals for solutions that can help with cleaning up the oceans. One of these is the Ocean Clean Up Project (1), based in the US which will be launching its first fully functioning prototype in 2018. The project uses the oceans natural currents to its advantage to capture plastic debris in the ocean from the size of 1cm and upwards. The company estimates that if the project was launched at full scale, the plastic in the ocean would be reduced by 50% in 5 years (theoceancleanup.com).

Terracycle - Collecting and sorting waste
Terracycle (2) is a platform for recycling all types of waste. They host several free recycling programs that encourage people to collect waste and send it in to them for sorting and recycling. They encourage the motto 'reuse, upcycle then recycle' to encourage the least amount of energy used to prolong the life of an object, however in reality they end up recycling 97% of the waste they collect. They then sell this recyclable material to companies. They currently even have a program for collecting plastic waste from beaches that encourages individuals to clean up the beaches in their home towns.

Ocean Plastic in Design
This thesis is not the first researching ocean plastic and the potential of recycling ocean plastic into new objects and materials. This very current issue has sparked an interest for many companies and designers seeking to unveil new potentials with the materials.

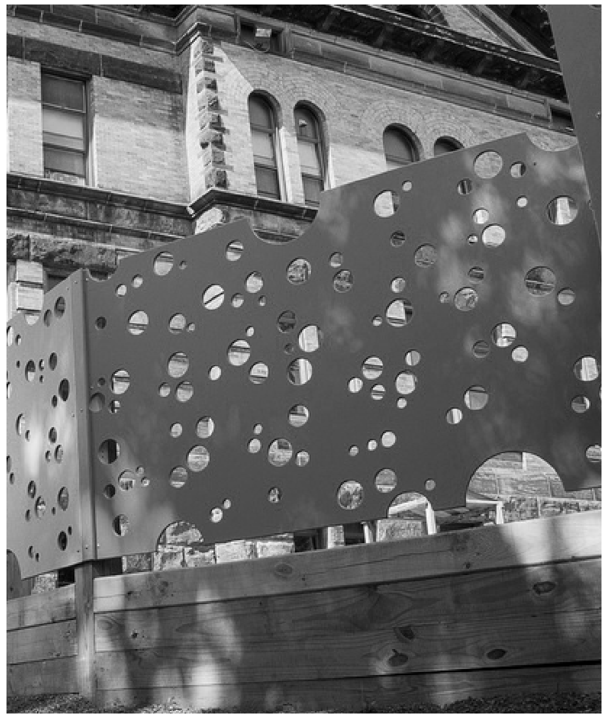
London-based *Studio Swine* (3) has developed a series of objects from ocean plastics that represent each of the ocean gyres where the plastic has been collected from. The objects act mainly as decorative pieces or function as pieces of furniture.

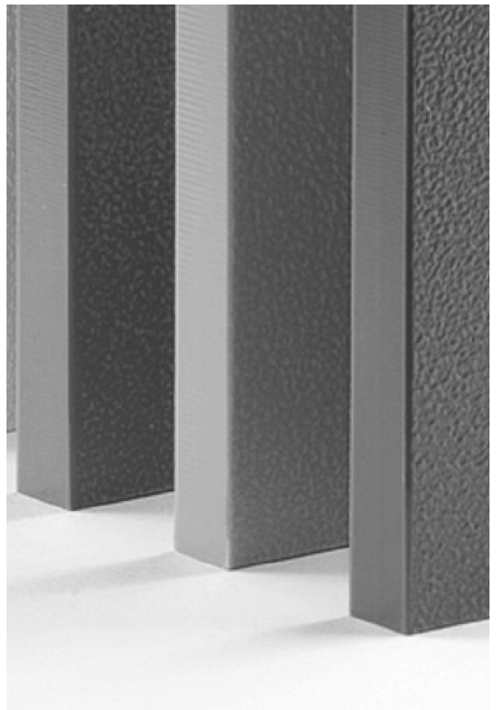
ByFusion blocks (4) are an invention that uses all types of plastic to create traditional building blocks used in buildings. Their focus has been on recycling normal plastic (not from the ocean) but currently they are also developing a program using ocean plastics. The building blocks are usually installed and then plastered or rendered on top, completely covering their former plastic appearance. The block is certified for building standards and has high thermal and acoustic properties (byfusion.com).

Using ocean plastic in fashion is also becoming more popular. Two examples of this are the *Norton Point* sunglasses (5) and the *Adidas* sports sneakers (6), both of which are produced using recycled fishing lines collected from the ocean.

Who owns ocean plastic?

Lena Gipperth (professor at the Law Department at the Gothenburg University specializing in environmental rights for marine and ocean management) says that it depends on the location of the waste. Each municipality is obliged to take care of the ocean waste in their area. A lot of money is invested in cleaning the shores so in terms of this thesis, Gipperth believed the municipality would be happy that there was an initiative to be taking care of it and putting it to use. The *owner* of the ocean plastic in this case is who ever picks it up. If, however, on a global scale, everyone saw the potential and value of the plastic in the ocean, an agreement may need to be implemented that regulates the amount of plastic that can be collected and what method is used (resembling the current fishing agreements in the fishing industry), in order to make sure that it is done in an ethical and environmentally responsible manner.





OCEAN HOPE

CONSERVED FORMER IDENTITY - 0% TRANSFORMATION

Ocean Hope is a sculptural project by Solveig Egeland. She collects garbage found on the beaches of Norway and has built them into a huts to create awareness of marine litter as an environmental issue. In this case, she does not transform the materials of garbage, only reuses them in a different way. The marine litter still keeps its clear former identity yet the function of it has changed. For example, fishing buoys - originally made for the function of easily locating sunken fishing nets, have in this case have become a decorative ornament on the building and has therefore lost its former function. Egelands method is to clad different huts in 'waste' of different, bright colours that attract attention by using an array of strange and interesting objects found on the beach. She uses all types of marine litter and highlights the global problem of ocean plastic, however she does not provide an architectural solution per say. This thesis on the other hand takes plastic objects and transforms them from their former function into a sort of building material, therefore giving them a new purpose. The former identities of the plastic objects in this thesis have varying degrees of loss, whereas Egelands are 100% conserved.

HDPE PANELS

MISSING FORMER IDENTITY - 100% TRANSFORMATION

Metem's panel range is an example of using recycled materials for architectural use. They use 100% recycled household HDPE plastic to create solid panels for a range of different uses. In each pound of plastic panel the company boasts that they use 8 recycled milk jugs. The panel comes in several solid, bright colours and can be used for a wide range of functions from indoor to outdoor and even in sanitary environments. These panels create a new use for the recovered plastic which otherwise would have been disposed of. In this case however they apply a 100% transformation to the initial product. There is no trace of the recovered milk jugs or other recycled objects that the product is made up of and it has completely lost its former identity. This investigation uses ocean plastic and applies varying degrees of transformation, with the intention of keeping some of the former identity of the plastic in order to raise awareness of marine waste as a global problem. If the ocean plastic was completely transformed from its former identity and formed a homogeneous coloured surface it would be difficult to differentiate from new or recycled plastics and therefore the awareness and change of perception of ocean plastics would be lost.

LEÇA SWIMMING POOLS

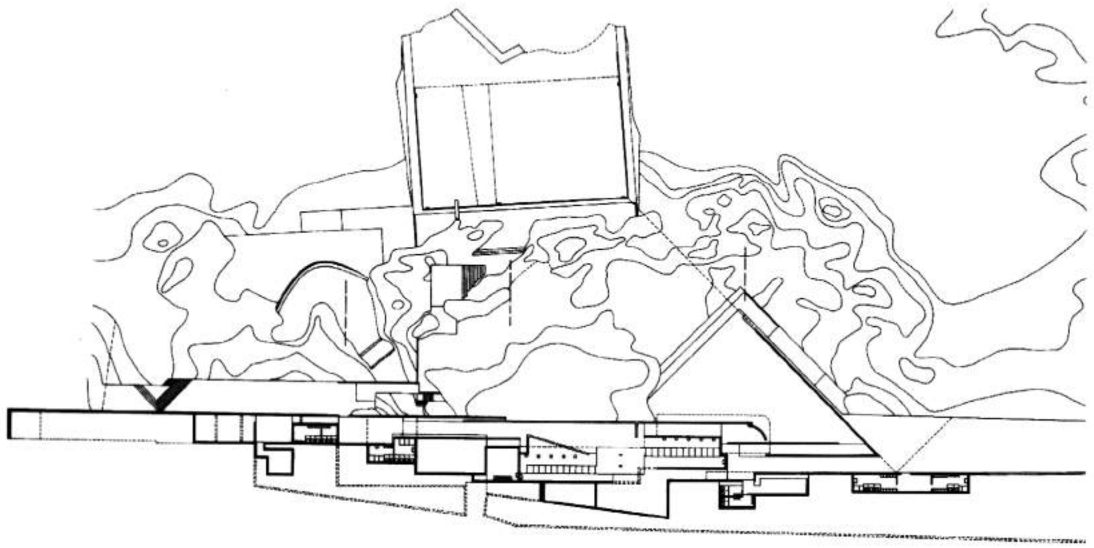
ÁLVARO SIZE VIEIRA - LEÇA DE PALMEIRA, PORTUGAL, 1966

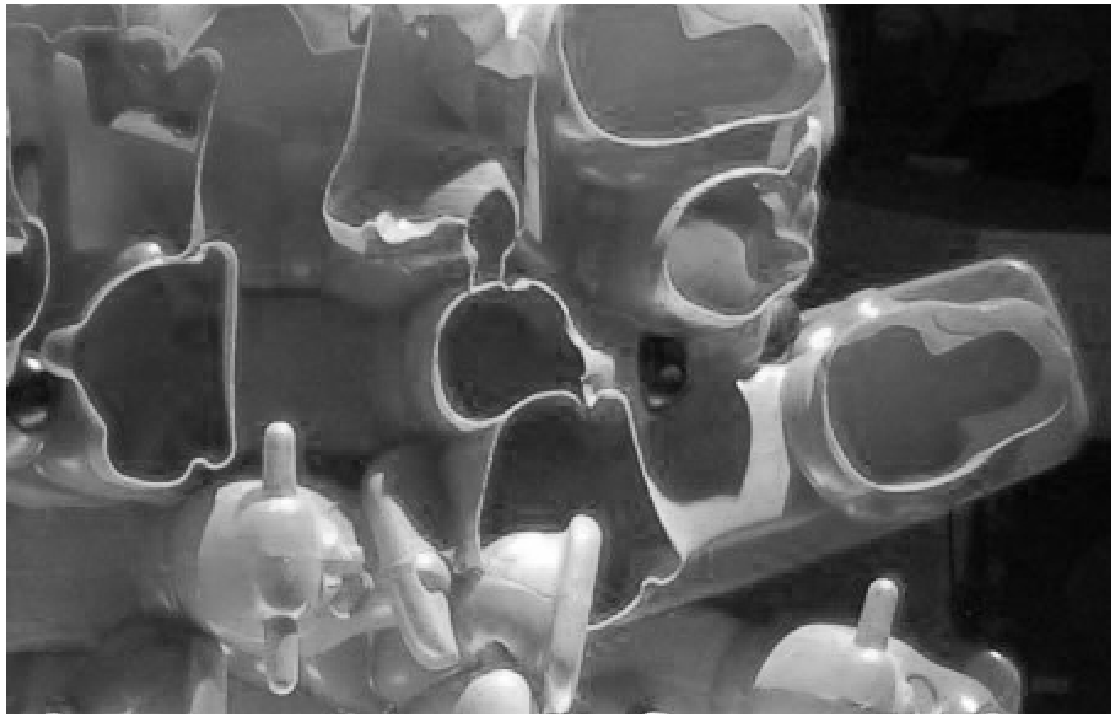
Leca Swimming Pools is one of Siza's earlier works but is undoubtedly one of the most famous. Despite the age of the project it still remains a fine example of the relationship between his architecture and the nature that surrounds it.

The project has two swimming pools, change rooms and a café. It is located right on the beach in Portugal. The facilities have been carefully sunken into the landscape to not obstruct the ocean views from the road behind, while the pools reach out into the ocean and promote a harmonious relationship between the natural rocks and man-made architecture.

Throughout the design, Siza carefully curates the way in which one would perceive the surroundings by selectively obstructing views and drawing focus from the view to other senses such as sound.

The boundaries between what is man-made and what is nature become blurred in this project as the landscape and architecture intertwine and promote each other. The details of the concrete carefully connecting to the landscape is respectful and polished. The architectural additions highlight the natural surroundings and make the natural surroundings more accessible while also providing an interesting experience for visitors.





DETROIT REASSEMBLY PLANT

T.E.A.M - DETROIT, 2016

"Detroit doesn't have a material problem; its material has an image problem. Recognizing architecture's capacity to work on and produce both materials and images, our project aims to reverse current perceptions of Detroit. Where others see an excess of ruins, we see an abundant resource for building materials."
- T.E.A.M

Having this as a starting point, T.E.A.M uses rubbles from otherwise discarded materials as a resource and transforms it into new architectural materials to create this Reassembly Plant.

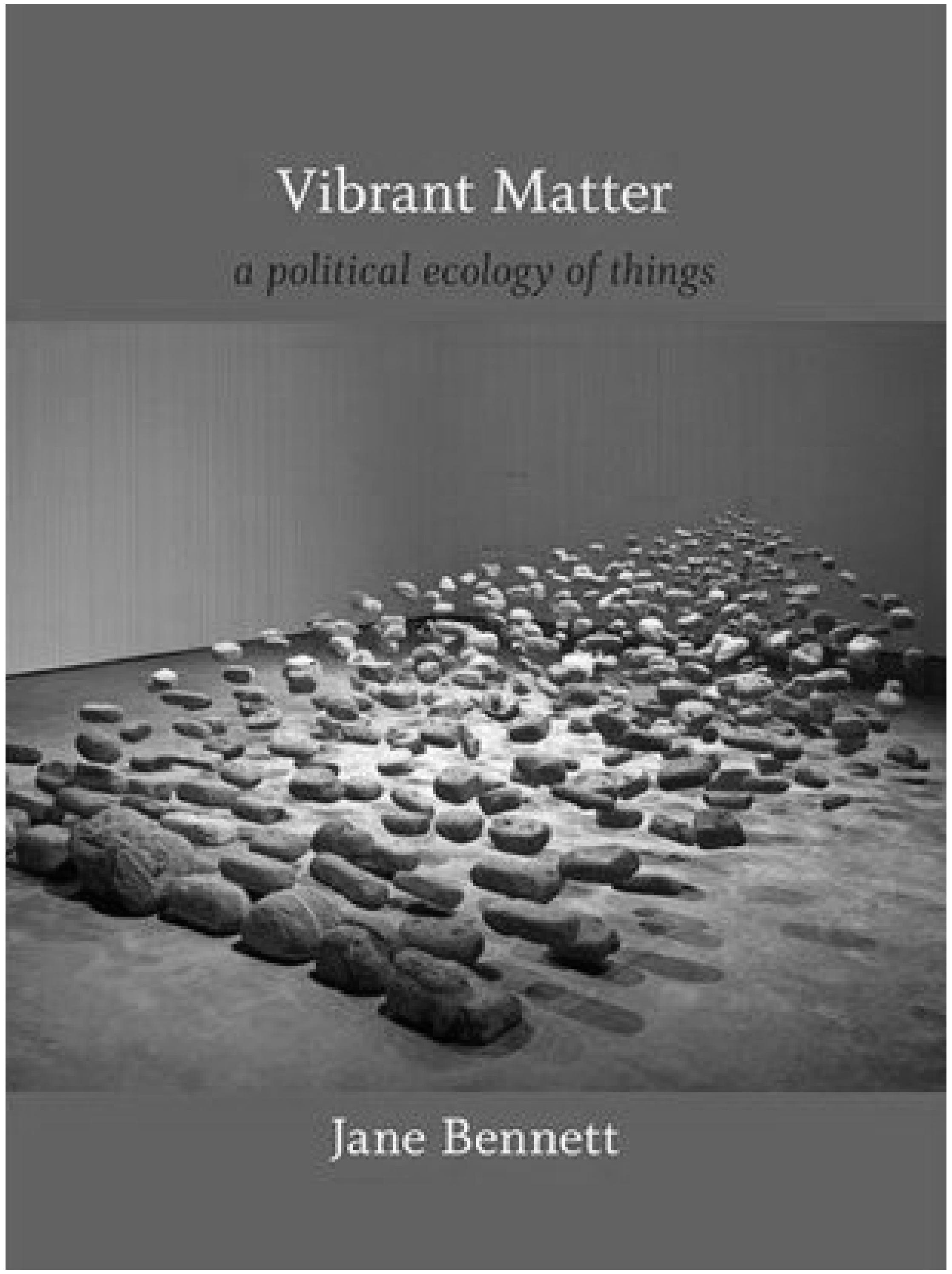
Although not realized, this concept is in line with what this thesis aims to do - to transform and see potential of otherwise discarded material.

TOY FURNITURE

GREG LYNN - VENICE, 2008

2008 Winner of Golden Lion at the Venice Architecture Biennial for Best Installation Project. In this project, Greg Lynn has used old children's toys and upcycled them into furniture pieces. The sculptural forms dwindle in the balance between transformation and original form. Viewers can see the objects former use and identity but it has been transformed and has now a new function and partially a new form.

The process for making the installation consisted of a few steps. Firstly the objects were 3D scanned and imported to a 3D modeling program. After organized into their desired positions, a robotic arm was programmed to cut out where the objects overlap. Once in position, the objects are hot welded together and result in structurally stable installations.



VIBRANT MATTER - A POLITICAL ECOLOGY OF THINGS

JANE BENNETT 2010

In her book Vibrant Matter - A political ecology of things (2010) Bennett explores the notion of 'things' and how we as human bodies percept non-bodied things.

The human brain uses perception in how we view everything in life. By perception, she means that the brain isolates the things that we see and in doing so only sees that which will provide interest for our needs. Perception in this sense means subtracting everything that will not provide interest for our needs.

In her book she refers to hoarders, people with a hoarding disorder meaning that they accumulate a supply of things that are hidden or carefully guarded in their homes. Bennett refers to hoarders having an 'extreme perception for things' and compares this to normal people having a 'normal perception of things'.

As an example of this, Bennett refers to the perception of a used bottle cap. A person with a normal perception would see this bottle cap as something with no function and therefore as rubbish. Hoarders on the other hand with 'extreme perception' sees and acknowledges the shape, colour and form of the bottle cap in great detail and there after feels and urge to keep it and protect it. Bennett urges people to think about how the world would appear if we bracketed off this discourse of psychopathology.

'How can we draw forward into the realm of perceivability aspects of material stuff that we usually screen off because of the categories we use to see them?'

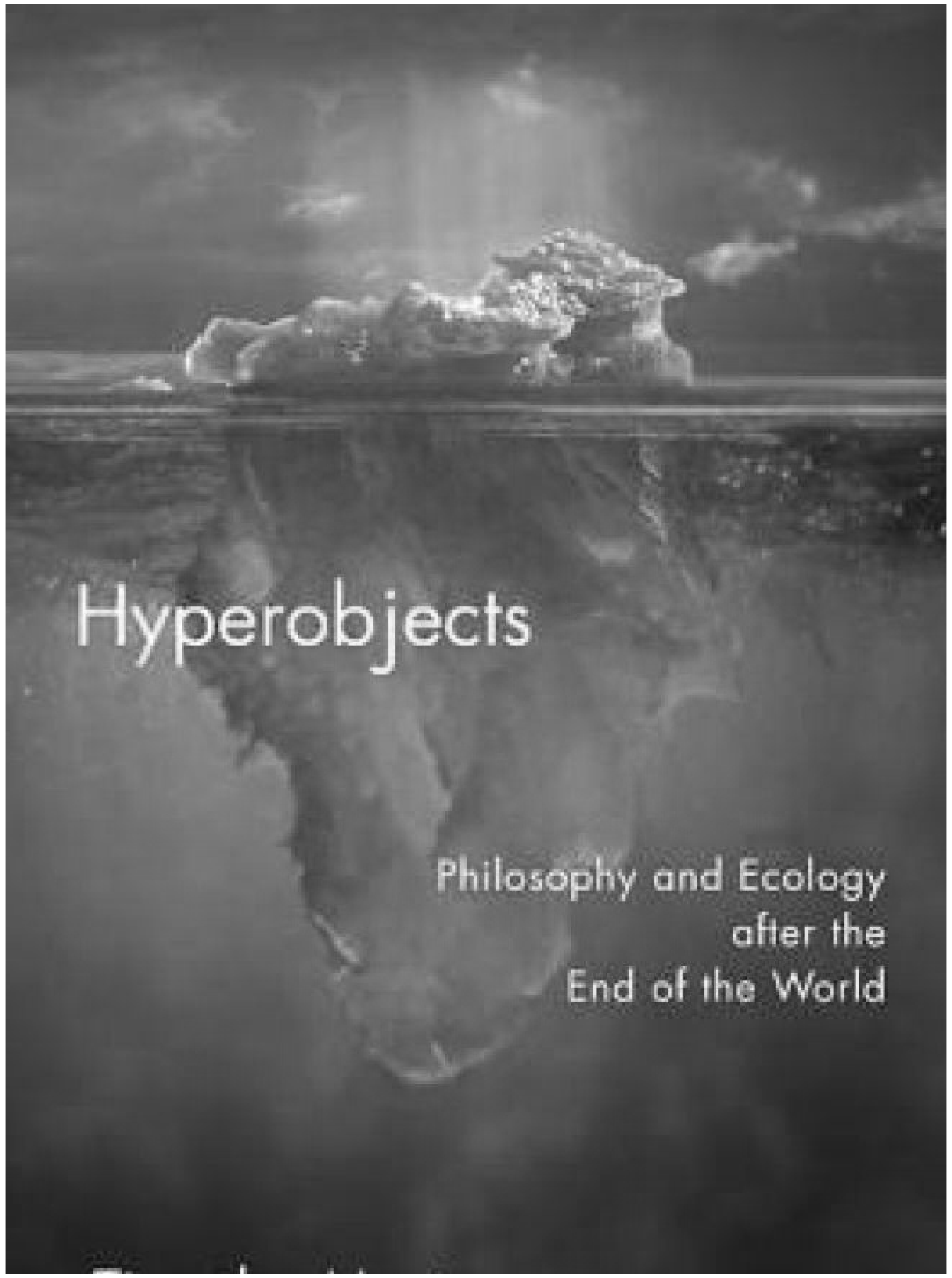
By doing so, we may look at non-bodied things for what they *can do* and *can become* rather than what the thing *is*. If we primarily focus on what the thing is (physical properties, political discourse), we have separated it from the potential of what it could become.

Bennett further draws forward the political implications of perceiving 'things' differently.

'How would political responses to public problems change were we to take seriously the vitality of (nonhuman) bodies?'

'How, for example, would patterns of consumption change if we faced not litter, rubbish, trash, or "the recycling," but an accumulating pile of lively and potentially dangerous matter?"

This theory becomes relevant in this thesis as it aims to highlight the potential of ocean plastic as something with value rather than the common perception of ocean plastic as waste. By showing the potential in a design project with architectural qualities, it may start to change the normal perception of the objects.



HYPEROBJECTS & ECOLOGY WITHOUT NATURE

TIMOTHY MORTON, 2013, 2007

‘We’re going to have to admit it; we’re stuck.’ We must love the toxic world in all of its ugly beauty - including perhaps and especially in art. We don’t have the option of leaving - Ecology without Nature.

For Morton the problem with the objective conception of nature is that it is set on a pedestal, something forever destined to remain ‘over there’, somehow separate from our daily lives. By romanticizing the notion of nature, are we really doing it a favour? If we are to take care of our planet for the next generations of human kind, we need to accept it for what it is right now, not what it once was or what it could be. Today, marine pollution *is* a part of nature. Unfortunately, it’s not just a layer on top of that can easily be removed, it is integrated into every part of our ecosystem. The question is, is this the way we want it to be? Morton introduces the concept of a Hyper Object, ‘objects that are so massively distributed in time and space as to transcend spatiotemporal specificity, such as global warming’. Big data, climate change and Styrofoam are three examples Morton mentions that are hyper objects.

One could argue that marine pollution and ocean plastic are hyper objects. Objects that are so immense and vast that the human brain has a hard time accepting and grasping them. One important standpoint for this thesis is the belief that people need to see, grasp, understand and accept ocean plastic for what it is before thinking of alternative solutions and starting to make changes. The design proposal in this sense becomes a symbol for what Morton would call a hyper object.

He uses the notion of ‘non-identity’ as the existential state of physical matter comprising the universe that exists beyond out attempts to rule over it, ‘in essence true nature in all of its terrifying, inanimate and resolute otherness’. ‘True nature’ as it is today contains plastic, it contains waste, it contains things that smell and objects that aren’t pretty.

The design proposal contretisizes the problem of ocean plastic in structures that encourage people to grasp the scale of the problem. By quantifying the amount of waste used in the building and comparing it to the annual amount of waste found in the area, a direct visual link is established that people can understand. For example, if one panel of transformed plastic uses 10kg of ocean plastic, it is equal to the amount of marine waste that drifts ashore in Kosterhavets Nationalpark every 3 hours (according to the data from Renkust 2015).

By transforming the plastic into a built form that can be touched, scaled, and experienced - the perception of ocean plastic and the amount of plastic in our ocean may start to become more graspable. Showing the identity of the plastic was an important factor in order for people to connect the plastic from what it once was to what it had become.

03: EXPERIMENTATION

INTRODUCTION

Role of Experimentation

The next section of this booklet consists of the experimentation phase. Here, the plastics have been transformed using a chosen method, heat & compression. The experimentation process was iterative, where each experiment was based on the knowledge gained on the previous result. There were two different machines used to conduct the experiments. The first, a conventional oven that was modified to suit the experimentation method, and the second, a scientific machine located at the Material Science Laboratory at Chalmers.

The aim of the experiments was to see what architectural qualities that the ocean plastic may possess. In order to be able to compare the results, a criteria was introduced that measured the differences between the experiment samples. A glossary of terms was set up and used to pin point the qualities of the samples and track the progress.

The aim of the experimentation phase was to see what kind of surfaces and forms that was possible to achieve using the collected plastic found in the ocean. The results in this section provided the grounds for the design development where the ocean plastic was put into an architectural system.

Compression Moulding

Compression moulding is one of many ways to form thermoplastic plastics and the method was originally developed in 1850 to mould rubber. In this case, the plastic is filled into a heated negative mould and a female mould is then applied using pressure to press the material into the desired form. Other methods of forming plastic include vacuum forming, injection moulding, extrusion, casting, foaming (Engelsmann, 2010, pg39).

This investigation used compression moulding. The choice was made early in the project and was, at the time, quite an intuitive decision based on the feasibility of being able to build a physical machine to execute the experiments. After learning more about plastic processes, it was understood that compression moulding is not the most efficient way of forming plastic. However, as it was discovered, compression moulding allows for mixing different types of plastic in addition to preserving some of the identities of the plastic objects.

Compression moulding has one major limitation that was considered in the design process of this thesis. The moulds cannot have overhangs or hooks as they cannot be removed from the mould. This means that the moulds need to be relatively simple (Process Industry Forum, 2015).

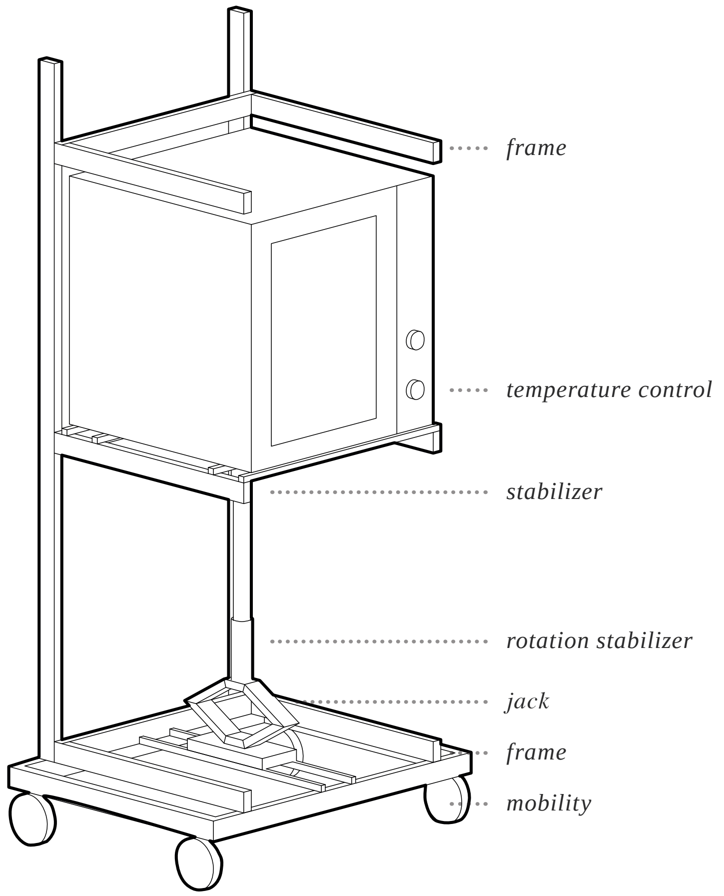


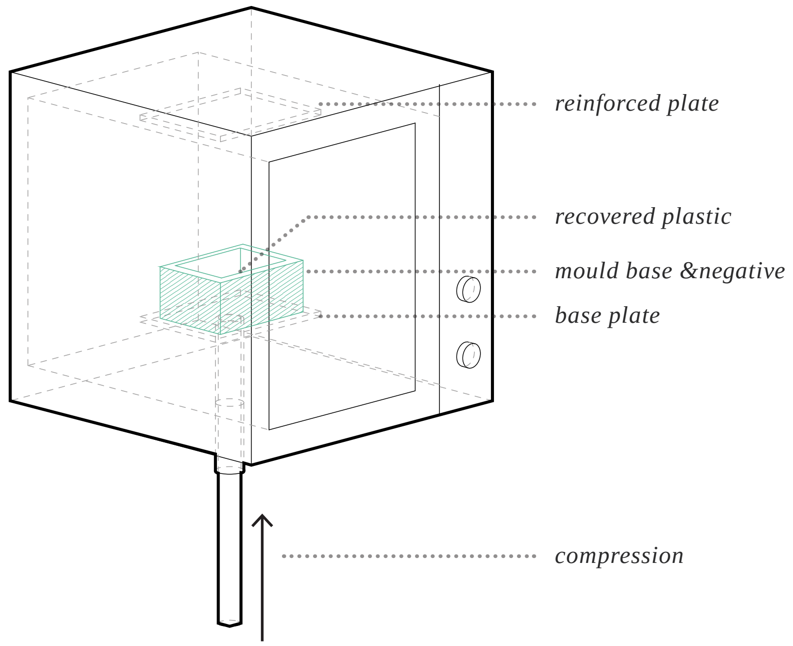


Collecting and cleaning ocean plastic from Koster islands. Ingela Sörqvist at Trossö Natur helped collect the 64kg of plastic waste for the purpose of this investigation.



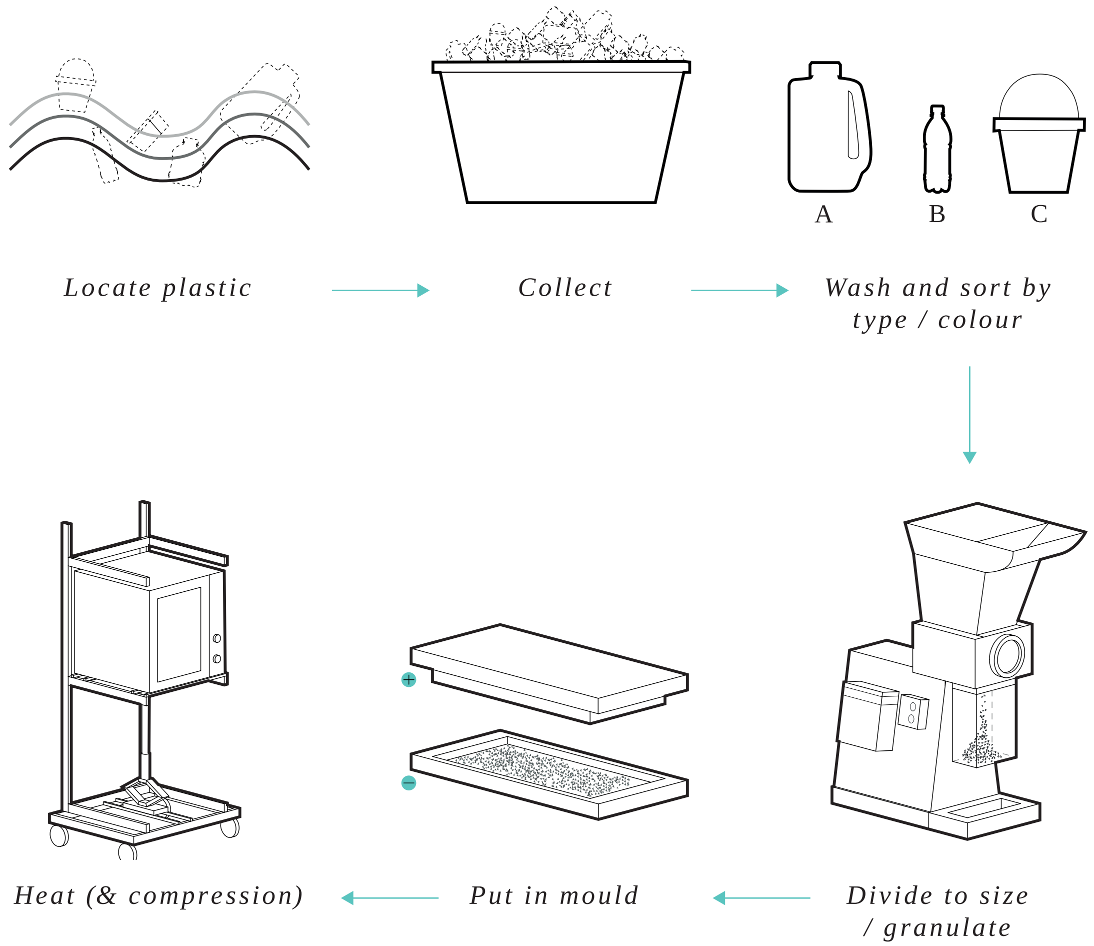

Building the machine used during the experimentation phase





Thank you to Dave Hakkens' Precious Plastic project that inspired this machine design.
Drawings of a similar machine & other machines can be downloaded from:
https://preciousplastic.com/en/index.html

METHOD



Photos of the compression moulding machine and set up.

Safety precautions

SELECTED EXPERIMENTS

GLOSSARY OF TERMS

Amalgamate; to mix or merge so as to make a combination; blend; unite; combine.

Blurred; to obscure by making confused in form or outline; make indistinct.

Brittle; having hardness and rigidity but little tensile strength; breaking readily with a comparatively smooth fracture, as glass.

Crackled; to form a network of fine cracks on the surface.

Crystallized; to form into crystals (a clear, transparent mineral or glass resembling ice).

Disorganized; to destroy the organization, systematic arrangement, or orderly connection of; throw into confusion or disorder.

Distorted; to twist awry or out of shape; make crooked or deformed.

Flaky; lying or cleaving off in flakes or layers (flake; a small, flat, thin piece, especially one that has been or become detached from a larger piece or mass).

Fragmented; existing or functioning as though broken into separate parts; disorganized; disunified.

Glossy; having a shiny or lustrous surface.

Gradient; the degree of inclination, or the rate of ascent or descent (computer gradient

Grainy: Resembling grain; the arrangement or direction of fibers in (wood),or the pattern resulting from this.

Granulate; to form into granules or grains. (Granule; a small particle; pellet).

Homogeneous; composed of parts or elements that are all of the same kind.

Irregular; without symmetry, even shape, formal arrangement, etc.

Jagged; having a harsh, rough, or uneven quality.

Layer; a thickness of some material laid on or spread over a surface.

Marbleized; the act, process, or art of coloring or staining in imitation of variegated marble.

Nebulous; hazy, vague, indistinct, or confused: cloudy or cloudlike.

Pixelated; to break up into visible pixels.

Pointillism; the technique of painting elaborated from impressionism, in which dots of unmixed colour are juxtaposed on a white ground so that from a distance they fuse in the viewer's eye into appropriate intermediate tones Also called divisionism

Porous; Full of pores (a minute opening or orifice, as in the skin or a leaf, for perspiration, absorption, etc.)

Random; constructed or applied without regularity.

Rugged; having a roughly broken, rocky, hilly, or jagged surface.

Scattered; distributed or occurring at widely spaced and usually irregular intervals:

Sharp-Edged; having a fine edge or edges.

Smooth; free from projections or unevenness of surface.

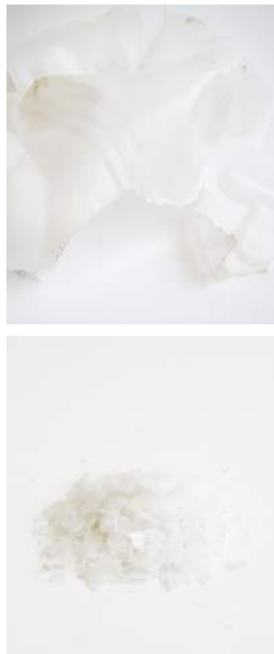
Texture; the visual and especially tactile quality of a surface; the characteristic physical structure given to a material, an object, etc., by the size, shape, arrangement, and proportions of its parts.

Translucent; permitting light to pass through but diffusing it so that persons, objects, etc., on the opposite side are not clearly visible:

Undulating; to have a wavy form or surface; bend with successive curves in alternate directions.

#1

#2



#3

#4

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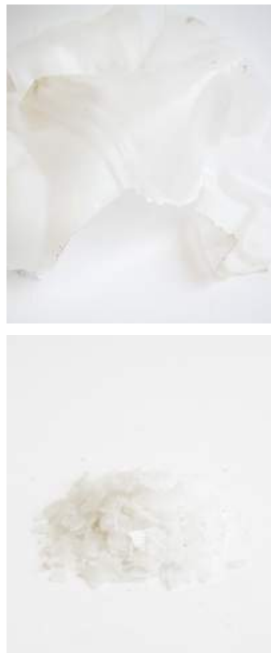
#6+7

#8

#8



							
experiment #	#1.1	#1.2	#1.3	#1.4	#1.5	#1.6	#1.7
visual appearance	crystallized fragmented flaky	marbleized pointillism layered	marbleized layered thick	layered distorted fragmented	jagged porous fragmented	crystallized semi-translucent flaky	semi-translucent homogeneous speckled
method of placement	random	random	random	random	random	random	random
translucency	2 / 5	3 / 5	2 / 5	4 / 5	4 / 5	3 / 5	3 / 5
identity / history	defined pieces	defined pieces	slightly visible pieces	defined pieces	defined pieces	none	none
texture	grainy but smooth	smooth	smooth	very rough	very rough	mild irregularities	polished
layers / depth	3 / 5	4 / 5	3 / 5	5 / 5	5 / 5	3 / 5	1 / 5
durability / strength	2 / 5	3 / 5	5 / 5	3 / 5	2 / 5	1 / 5	4 / 5
weather protection	3 / 5	5 / 5	5 / 5	2 / 5	1 / 5	1 / 5	5 / 5

							
experiment #	#3.1	#3.2	#3.3	#3.4	#3.5	#3.6	#3.7
visual appearance	fragmented pixelated porous	pointillism marbleizing layered	geometric direction gradient pointillism	jagged marbleized distorted	fragmented pixelated layered	fragmented marbleized distorted	pointillism colour block rigid
method of placement	specific	random	specific	random	specific	specific	specific
translucency	3 / 5	3 / 5	varied	4 /5	2/5	3/5	2/5
identity / history	weak	weak	weak	weak	some	some	some
texture	rough	smooth	smooth	varied	rough	smooth	varied
layers / depth	3 / 5	3 / 5	2 / 5	5 / 5	3 / 5	3 / 5	2 / 5
durability / strength	2 / 5	4 / 5	4 / 5	3 / 5	2 / 5	1 / 5	5 / 5
weather protection	2 / 5	5 / 5	5 / 5	3 / 5	3 / 5	2 / 5	4/ 5

							
experiment #	#2.1	#2.2	#2.3	#2.4	#2.5	#2.6	#2.7
visual appearance	cratered rigid glossy	layered blurred disorganized	nebulous layered dramatic	linear directional semi-translucent	linear layered	nebulous layered rigid	semi-transparent flexible disorganized
method of placement	specific	specific	specific	specific	specific	specific	specific
translucency	1 / 5	3 / 5	3 / 5	4 / 5	3 / 5	varied	3 / 5
identity / history	strong	strong	strong	strong	strong	strong	strong
texture	varied	smooth	smooth	smooth	smooth	varied	smooth
layers / depth	1 / 5	5 / 5	5 / 5	3 / 5	4 / 5	4 / 5	2 / 5
durability / strength	5 / 5	4 / 5	4 / 5	4 / 5	4 / 5	5 / 5	4 / 5
weather protection	5 / 5	5 / 5	5 / 5	5 / 5	5 / 5	5 / 5	4 / 5

							
experiment #	#3.8	#3.9	#3.10	#3.11	#4.1	#4.2	#4.3
visual appearance	pointillism gradient layered	pointillism marbleizing layered	identity marbleizing layered	pointillism gradient layered	milky layered nebulous	nebulous irregular bold	deformed identifiable folded
method of placement	specific	random	specific	specific	specific	specific	specific
translucency	3/5	3/5	3/5	3/5	3 / 5	1 / 5	varied
identity / history	some	weak	strong	weak	strong	strong	strong
texture	smooth	smooth	smooth	smooth	smooth	varied	varied
layers / depth	4 / 5	3/ 5	3/ 5	4/ 5	3 / 5	2 / 5	1 / 5
durability / strength	4 / 5	4 / 5	4 / 5	4 / 5	4 / 5	3 / 5	1 / 5
weather protection	5/ 5	5/ 5	5/ 5	5/ 5	5 / 5	5 / 5	1 / 5

EXPERIMENT #1.1

HEAT & COMPRESSION - THIN

Type of plastic	HDPE
Plastic Identity	Granules from bag #1 (01.09.2017) 0.5 Jerry can, 0.5 Milk bottle, 1 green bottle cap, 1 blue bottle cap
Origin of plastic	Recovered and collected from Koster
Amount	27g (13.5% of granule bag #1)
Status	Cleaned & Granulated
Method	Heat & Compression Oven
Temperature	140-150°C
Time	Turned off oven as soon as mold reached 140°C ca 90mins, then left to cool in oven 30 mins. With almost no change it was put back a second time around and left the mold under compression at 147°C for 40mins before letting it cool.
Thickness	6mm
Mould	Standard rectangle mould - 8 x 8x 4cm made in plywood, coated x2 with non-stick dry lube

Purpose
To test the heat & compression method using plastic granules.

Expected Outcome
The plastic will melt evenly in the tray. It is suspected there may be some issues removing the plastic from the mold but hope that the non-stick spray will help with the removal process. We are unsure of how even the edges of the mold will be and suspect that this will depend on how tightly we pack the mold with the plastic granules before we place it in the oven. Our hope is that it will produce an even, thick piece of melted plastic with colour variations due to the colours of the milk bottle, jerry can and bottle caps.

Actual Outcome
The plastic melted together and formed a relatively strong piece of plastic. The granules did not completely amalgamate as a homogeneous solid rather the grain boundaries are predominant and appear crystallized and fragmented. The edges appear flaky due to the degree of melting but this does not effect the strength. The plastic was relatively difficult to remove from the mould and force and a knife aided in removing it. Some plywood residue melted into the plastic and the wood fibers are what make the plastic appear yellow.

Conclusions
Going forward with a standard rectangular mould we can introduce baking paper to easily remove the plastic. More time is needed if we want the plastic to melt into a homogeneous solid. There is potential in using the coloured granules to produce aesthetic qualities in form of geometric order and patterning. We can also use the different degrees of melting to achieve different textures in the plastic.

EXPERIMENT #1.2

HEAT & COMPRESSION - MEDIUM

Type of plastic	HDPE
Plastic Identity	Granules from bag #1 (01.09.2017)
	0.5 Jerry can, 0.5 Milk bottle, 1 green bottle cap, 1 blue bottle cap
Origin of plastic	Recovered and collected from Koster
Amount	20g (10% of #1 granule bag)
Status	Cleaned & Granulated
Method	Heat & Compression Oven
Temperature	150°C
Time	Warmed up in oven then left 80minutes at 150°C, followed by cooling off in mould
Thickness	4mm
Mould	8x8x4cm plywood mould, coated with one layer of Gleitmo 980 (non-stick spray)

Purpose
To test the heat & compression method with increased time in the oven.

Expected Outcome
As we have increased the time in the oven, we hope that the plastic will melt more evenly and become one homogeneous solid. The new type of non-stick spray will hopefully provide an easier release.

Actual Outcome
The non-stick spray did not provide an easier release. Unfortunately the plastic was stuck very well to the mold, much worse than the first experiment (likely due to the increased time in the oven). Extreme force was needed to release the base from the mould but the positive mould followed and the mould was damaged. A chisel and hammer was needed to carve out the plastic piece from the mould and thereafter a plane was used to get rid of the plywood fibers that had melted into the surface.

The actual result of the plastic was however really interesting. A marbling effect emerged in the plastic and there was a strong 3-dimensional effect due to the layering of the granules. Small holes in the plastic where some of the plastic has dissapeared due to higher temperatures provide depth and casts small shadows on the object.

Conclusions
A better way to release the plastic from the mould is needed so that the mould isn't damaged in future experiments. Foil or baking paper is our next solution, although baking paper will only work on planar moulds so hopefully foil will be sufficient. The small outbursts of colour create a pointillism effect which we will keep developing. Going forward hope to start controlling the colours and patterns rather than just pouring it randomly into the mould.

EXPERIMENT #1.3

HEAT & COMPRESSION - THICK

Type of plastic	HDPE
Plastic Identity	Granules from bag #1 (01.09.2017) 0.5 Jerry can, 0.5 Milk bottle, 1 green bottle cap, 1 blue bottle cap
Origin of plastic	Recovered and collected from Koster
Amount	45g
Status	Cleaned & Granulated
Method	Heat and compression in oven
Temperature	150°C
Time	Warmed up to 150° and left for 80minutes then kept in oven to cool down.
Thickness	10mm
Mould	8x8x4cm plywood mould (negative base and positive base covered with aluminum foil for quick release)

Purpose
To test the difference from previous experiments when the amount of plastic granules is increased and see what potential lies in a thicker plastic object in terms of textures and visual qualities.

Expected Outcome
Since we are using much more plastic we expect the outcome to be much thicker. We hope that the heat and time spent in the over will produce an even, homogeneous plastic. The plastic granules used have been randomly poured into the mould and we expect there to be some variations in translucency like the previous experiments have shown. With increased thickness, we hope that the plastic is even stronger and more robust than the previous experiments. The possibilities with thickness is that we can start producing more interesting shapes that can be carved and moulded and still keep a strong structure.

Actual Outcome
Like expected, the plastic appears very strong and stable. The plastic melted entirely into one homogeneous object and has a glossy finish. The foil was very easy to remove and helped with the glossy finish. We originally thought that bag #1 only contained HDPE plastic granules but the result shows that the white plastic granules melted differently to the clear, blue and green granules. This leads us to believe that the white granules were LDPE (Low density polyethylene) which has a lower melting point Tm at 100-115°C. These white granules are what causes the marble effect seen in earlier experiments. Some grain boundaries are still apparent, particularly between the white and clear granules. The translucency decreases with the increased thickness of this object but layering is still apparent and the coloured granules are still visible although blurred even when placed further from the surface of the object.

Conclusions
Knowing that the plastic will still melt evenly even though the thickness was much greater gives us possibilities to scale up the design. Although thicker, the object still had translucent qualities when exposed to sharp light and highlighted the granules from the green and blue bottle caps inside the object. We believe that working with the semi-translucent jerry cans in combination with other colourful plastics has an interesting effect given that the objects still retain some of their former identity while captured in its new object with a possible new function. The marbleization effect has potential to be developed into imitations of the granite found on the chosen site at Koster.

EXPERIMENT #1.4

HEAT, NO COMPRESSION - SLUMP FORMING

Type of plastic	HDPE
Plastic Identity	Granules from bag #1 (01.09.2017) 0.5 Jerry can, 0.5 Milk bottle, 1 green bottle cap, 1 blue bottle cap
Origin of plastic	Recovered and collected from Koster
Amount	28g
Status	Cleaned & Granulated
Method	Heat in oven, no compression
Temperature	182°C
Time	Reaching maximum temperature after heating up in the oven over 25minutes, the oven was turned off and left to cool down.
Mould	8x8x4cm plywood mould and the base covered with aluminum foil.

Purpose
To test slump forming the plastic granules without compression to see how they react with pure heat.

Expected Outcome
We expect that the plastic will soften and melt but not form together into one mass. Its stability and strength will be weaker than the previous experiments. As we mounded up the plastic in different heights we hope that the outcome will keep some of the original shape but we believe that it will be compress naturally due to the heat and gravity.

Actual Outcome
The texture of this plastic was quite interesting as it had depth. The result was slightly burned as the temperature was a little too high and resulted in some brown tinges on parts of the plastic. The resulted plastic was surprisingly strong as the bottom of the plastic had formed a solid base even without compression. The result is a heavily textured, layered object. The granules have a visual appearance of fragmentation while the different degree of melting creates a distorted effect.

Conclusions
We will test using foil on the mould even when we use compression to see if that will help releasing the plastic since it worked when slump forming. The slump forming method produces a texture that has a lot of depth and is porous which creates visual transparency. The way degree of melting made the plastic granules distort from their original form. The porosity of the object can be controlled by modifying the amount of plastic granules in the mould.

EXPERIMENT #1.5

HEAT, NO COMPRESSION - SLUMP FORMING

Type of plastic	HDPE
Plastic Identity	Granules from bag #1 (01.09.2017) 0.5 Jerry can, 0.5 Milk bottle, 1 green bottle cap, 1 blue bottle cap
Origin of plastic	Recovered and collected from Koster
Amount	28g
Status	Cleaned & Granulated
Method	Heat in oven, no compression
Temperature	150°C
Time	Warmed up to 150° and left for 80minutes then kept in oven to cool down.
Mould	8x8x4cm plywood mould and the base covered with aluminum foil.

Purpose
To test slump forming the plastic granules at an even temperature without compression.

Expected Outcome
This experiment was very similar to the previous one, the only difference was the temperature and time. We expect there to be a more even outcome without any burnt plastic and we hope that the plastic will melt together and bond.

Actual Outcome
Even with prolonged time in the oven, the plastic almost looks the same as when we put it in. The plastic granules have only deformed slightly but just enough so that they have bonded together with each other. The plastic feels more brittle than the previous experiments as the bonding between the plastic granules has a smaller surface area. The porosity of the plastic granules (air space between each granule) when we poured them into the mould remains which lets light through and provides transparency. When placed in front of one eye and looking through the plastic we could see small patches of light and movement behind. This method could be interesting to pursue depending on the type of cladding needed for a certain function. For our project, perhaps this could be incorporated into the change rooms or when combined with strong light it could create shadows and patterns. The result has a jagged and rough texture, almost sharp. The bottom has a relatively smooth surface while the top is very rough and tactile. The visual appearance is fragmented and clear as each granule still obtains its original form.

Conclusions
Slump forming creates a plastic with more porosity and therefore more transparency. The original form of the plastic granules remains clear even after heating while a strong bond is created between each granule.

EXPERIMENT #1.6

HEAT & COMPRESSION - 1 MM

Type of plastic	HDPE
Plastic Identity	Granules from bag #2 (07.09.2017) 0.5 Jerry can
Origin of plastic	Recovered and collected from Koster
Amount	12g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab machine
Temperature	126°C
Time	Mould heated to 126°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Mould	10x10cm heated metal mould.

Purpose
To see how the plastic reacted when only heated to 126.5°C and using the scientific lab machine found in the Material & Science department at Chalmers.

Expected Outcome
This alternative machine to our oven is much more precise and calculated. Here we can see exactly how much pressure the plastic is going through while heated and the outcome is therefore much more precise. We are unsure if the plastic will melt at only 126.5°C. We are also not sure how strong the object will be seeing as the machine is limited to only a few mm thickness.

Actual Outcome
The plastic almost melted into one homogeneous object but we could see some grain boundaries where the plastic granules had not quite melted together. When we applied pressure to the object it crackled and became crystallized. The object is semi-translucent with defined, white crystallized grain boundaries. It resembles crushed ice melting. The texture is smooth on the bottom with slight irregularities on the top surface. The crystallized surface feels flaky and when bent the granules pop out like ice on the sea in a storm. The way that the object crackled means that it is not very strong nor water resistant as the water will seep into the cracks.

Conclusions
The plastic requires a higher temperature to melt entirely and not have stress cracks and visible grain boundaries. The stress cracks have on the other hand potential to creates interesting crystallization patterns. The white jerry can granules result in a semi-translucent material.

EXPERIMENT #1.7

HEAT & COMPRESSION - 1 MM

Type of plastic	HDPE
Plastic Identity	Granules from bag #2 (07.09.2017) 0.5 Jerry can
Origin of plastic	Recovered and collected from Koster
Amount	12g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab machine
Temperature	133°C
Time	Mould heated to 133°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Mould	10x10cm heated metal mould.

Purpose
To see if increasing the temperature melts the plastic entirely and doesn’t create stress cracks.

Expected Outcome
That the resulting object is solid and homogeneous with no patterning or cracks.

Actual Outcome
Like expected. As the result is homogeneous, small speckles of ocean debris caught up in the granules become apparent. The result is a semi-translucent, speckled solid. The only thing that differs from a new or recycled plastic are the speckled debris.

Conclusions
The plastic will melt at 133°C and form a homogeneous solid.

EXPERIMENT #2.1

MIXING PLASTIC - ORANGE GRANULES + BOTTLE CAPS

Type of plastic	HDPE
Plastic Identity	Granules from bag #3 + 2 bottle caps Orange plastic basket, yellow bottle cap (Loka) and red bottle cap (unknown)
Origin of plastic	Recovered and collected from Koster
Amount	49g
Status	Mix of Cleaned & Granulated + recovered bottle caps directly from Koster
Method	Heat and compression in oven
Temperature	150°C
Time	Warmed up to 150° and left for 80minutes then kept in oven to cool down.
Thickness	9mm
Mould	8x8x4cm plywood mould (mould is covered with aluminum foil on all surfaces for quick release)

Purpose
In this experiment we would like to see how original geometries (bottle caps) mix with granules and how the original geometries perform under heat & compression.

Expected Outcome
This time we are using orange granules instead of translucent white/grey ones. The bottle caps have been carefully placed in the bottom of the mould, one facing up and the other down. We hope that the granules will fill in the gaps between the bottle caps and form a solid object. We expect that the different colours of the plastic will blend together slightly since we believe they are of the same type of plastic. The former identity of the bottle caps will be very visible. The positioning of one of the bottle caps should result in a hole in the object the size of the negative space of the cap (although perhaps slightly compressed).

Actual Outcome
Our expected outcome was quite accurate. The result is a solid object with a subtracted area where the bottle cap is located and some slight melting between the different colours plastics. The subtracted area created a crater in the surface. Having used a larger amount of plastic granulate, we see a thicker, rigid result. The logo on one of the bottle caps is still visible and very much identifiable. The result has a glossy surface that reflects in light.

Conclusions
Using the same type of granulate provided an even, homogeneous, solid result. The effect that the bottle caps has on the object is that they are visible, identifiable and viewers can easily understand that this object has been recycled. The use of bottle caps can create negative spaces in the object which shows potential for how we can develop methods that modify the form of the plastic.

EXPERIMENT #2.2

MIXING PLASTIC - WHITE GRANULES + FISHING NET

Type of plastic	HDPE, Nylon?
Plastic Identity	Granules from bag #2 + Blue & Black fishing net White Jerry Can, Blue & Black Fishing net
Origin of plastic	Recovered and collected from Koster
Amount	10g granules + 3g net = 13g
Status	Cleaned
Method	Heat and compression in scientific lab machine
Temperature	132°C
Time	Mould heated to 132°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	2mm
Mould	10x10cm heated metal mould

<u>Purpose</u>
In this experiment we would like to see how the fishing net which is a different type of plastic to the white HDPE granules amalgamate.

<u>Expected Outcome</u>
We don’t think that the plastic will melt together since Nylon has a much higher melting point (220-265°C) but we think that they might still combine since we have strategically placed HDPE underneath and on top. There is a chance that the fishing net will pop out and easily be removed, which may produce a pattern in the subtracted areas.

<u>Actual Outcome</u>
The result showed that the fishing net did actually melt. Although we can’t be certain, it seems that the net may actually be Dyneema a product that we read up upon after the results from this experiment. Dyneema is a modern type of fishing net made from UHMWPE (Ultra High Molecular Weight Polyethylene). Being a polyethylene, it has the same melting point as our other plastic granules and therefore also melted.
The result is that the white granules melted evenly and captures the fishing line, freezing it in the position that it was placed before we applied the heat and compression. The result is that the lines become blurred and look very disorganized.

<u>Conclusions</u>
Knowing that the blue net will melt and that the other type of net binds together with the granules to create a solid, we can now start creating exact patterns and carefully choose objects that can be frozen and on display within our object. We can strategically create geometric orders and patterns that can produce different architectural qualities.

EXPERIMENT #2.3

MIXING PLASTIC - BLACK / WHITE GRANULES + FISHING NET

Type of plastic	HDPE, FISHING NET
Plastic Identity	Granules from bag #2, #8 + Blue & Orange Fishing Net White Jerry Can, Black water bottle/ Deodorant, Blue & Orange Fishing Net
Origin of plastic	Recovered and collected from Koster
Amount	12g granules + 3g net = 15g
Status	Cleaned
Method	Heat and compression in scientific lab machine
Temperature	134°C
Time	Mould heated to 134°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	2mm
Mould	10x10cm heated metal mould

<u>Purpose</u>
In this experiment we would like to see how the orange fishing net interacts with the HDPE plastic granules to see if it has the same effect as the blue and black nets.

<u>Expected Outcome</u>
The orange net should melt like the blue net melted in the previous experiment. We introduced black granules in combination with the white to see if we can get added depth and complexity in the design.

<u>Actual Outcome</u>
Like we had expected, the net melted into the white granules. The lines of the net became blurred but still retained its original shape. The black granules added depth and layering to the object and the outcome appears nebulous.

<u>Conclusions</u>
The orange net transforms under heat and compression. Blending white and black granules we achieved some dramatic layering and a nebulous appearance where the black granules melted and amalgamated with the white granules.

EXPERIMENT #2.4

MIXING PLASTIC - FISHING NET - LINEAR PATTERN

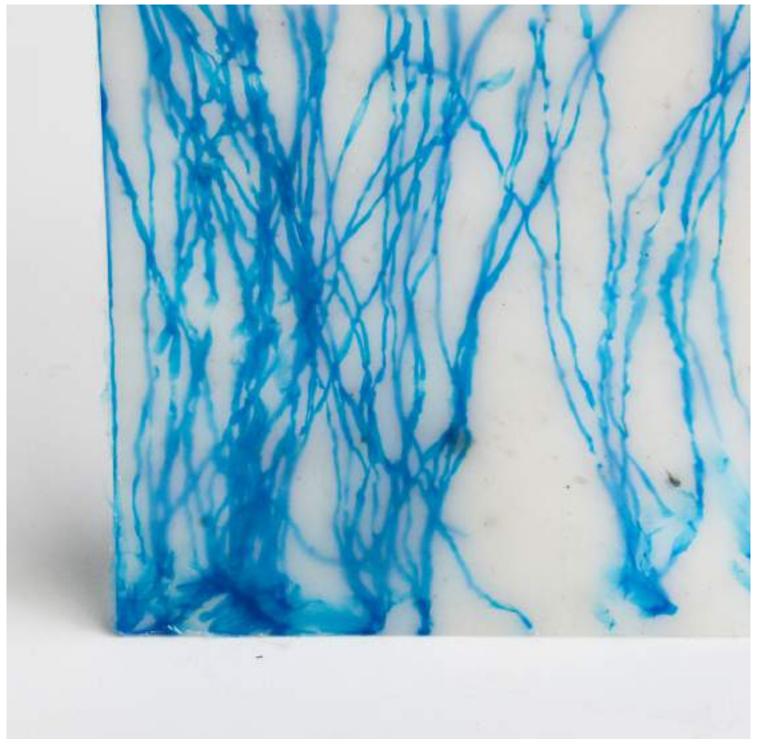
Type of plastic	HDPE, FISHING NET
Plastic Identity	Granules from bag #2, Blue fishing net White Jerry Can, Blue fishing net
Origin of plastic	Recovered and collected from Koster
Amount	12g granules + 3g net = 15g
Status	Cleaned
Method	Heat and compression in scientific lab machine
Temperature	130°C
Time	Mould heated to 130°C. Jerry can granules put in and compressed slightly first then released. Next the fishing net was carefully placed on the plastic and more granules was placed on top to seal them in. The mould was heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	2mm
Mould	10x10cm heated metal mould

Purpose
To see if we can change the properties/strength/graphical appearance of the plastic by layering fishing net with the granules in a linear pattern.

Expected Outcome
The outcome should be an object with a clear geometrical order - where the blue fishing net has melted into the jerry can granules. The fishing net will be visible due to the semi-translucency of the white granules and create a pattern. The lines will likely be blurred due to some melting of the net.

Actual Outcome
As expected. The fishing net became quite blurry due to the degree of melting. The lines are fuzzy and resemble the shape of the seaweed found on our site at Koster. Because the fishing line melted and deformed from its original shape, we don’t believe that the object has benefited from the fishing net in terms of strength.

Conclusions
The fishing net can be used as a way of forming graphical patterning inside the objects and in combination with the semi-translucent jerry can granules, they can form contrasting patterns and clear geometrical directions.



EXPERIMENT #2.5

MIXING PLASTIC - FISHING NET - GRADIENT PATTERN

Type of plastic	HDPE, FISHING NET
Plastic Identity	Granules from bag #2, Blue fishing net White Jerry Can, Blue fishing net
Origin of plastic	Recovered and collected from Koster
Amount	12g granules + 3g net = 15g
Status	Cleaned
Method	Heat and compression in scientific lab machine
Temperature	130°C
Time	Mould heated to 130°C. Jerry can granules put in and compressed slightly first then released. Next the fishing net was carefully placed on the plastic and more granules was placed on top to seal them in. The mould was heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	2mm
Mould	10x10cm heated metal mould

Purpose
To increase the amount of fishing net and see test a new graphical pattern where the fishing net is layered in a gradient with more at one end of the mould and less at the other.

Expected Outcome
The outcome will likely be a gradient blue and semi-translucent object with linear lines defined by the fishing net.

Actual Outcome
The lines are more contrasted than expected and therefore the gradient is not super clear. This has likely got to do with the placement of the fishing line into the mould. More precision when placing the net would likely give a clearer gradient result. The lines are more clear on one side than the other and this is because there was more white granules placed in the bottom than on top. This also means that the fishing lines are more blurred on top because they have been closer to the heat of the mould. The more fishing lines the more depth and dimensionality the result had.

Conclusions
The closer the fishing lines are to the surface of the mould, the more melted they become and therefore more deformed and blurry. The more white granules used decreases the translucency of the object, therefore the thicker the material the less translucent it becomes.

EXPERIMENT #2.6

FOSSIL BLOCK - BOTTLE CAPS + FISHING NET + WHITE GRANULES

Type of plastic	HDPE, FISHING NET
Plastic Identity	Granules from bag #2, bottle caps, fishing line White Jerry Can, Blue fishing net, blue bottle caps
Origin of plastic	Recovered and collected from Koster
Amount	89g
Status	Cleaned
Method	Heat and compression in oven
Temperature	150°C
Time	Mould placed in oven and heated to 150°C. Left in oven for 80minutes then left to cool in mould.
Thickness	5-70mm
Mould	8x8x4cm plywood mould covered in foil.

Purpose
By increasing the amount of plastic dramatically we can start to form a block instead of a panel. Using the jerry can granules we will be able to see the objects inside.

Expected Outcome
We hope that the translucency of the jerry can granules will allow us to see the objects that have been 'frozen' inside. All of the objects inside are also likely form HDPE plastic so some deformation should occur. We hope that the plastic will melt into a homogeneous solid even though the thickness has increased.

Actual Outcome
Unfortunately our oven had some mechanical problems and the base plate rotated under the pressure. This resulted in a very lopsided mould as the positive was pressing down on the negative on an angle. Nevertheless this gave us some interesting results as the plastic moulded around the positive. This showed us that the plastic is able to create angles and mould into precise areas without losing its strength. The thickness of the block was not an issue and produced a strong object. The objects inside are however less visible than we expected and one can hardly recognize the bottle caps inside the block. The time spent in the oven may perhaps have been too long. The visual result is nebulous and layered.

Conclusions
Seeing how the plastic is able to retain its melted shape even in articulated areas means that we have an opportunity to work with rather complex moulds and still produce a strong object. The HDPE allows us to hide objects but heating them too long risks deforming them to an extent that their former identity is lost.

EXPERIMENT #2.7

MIXING PLASTIC - LDPE GRANULATED + FISHING NET

Type of plastic	LDPE, FISHING NET
Plastic Identity	LDPE plastic bags, fishing line Clear plastic bag, Blue fishing net
Origin of plastic	Recovered and collected from Koster
Amount	5g
Status	Cleaned
Method	Heat and compression in scientific lab machine
Temperature	130°C
Time	Mould heated to 130°C, net & plastic bags inserted into mould and compressed for 45seconds.
Thickness	0.5mm
Mould	10x10cm heated metal mould

Purpose
To see how LDPE reacts with the fishing line. To see how the thickness impacts the translucency and stability.

Expected Outcome
We expect that the fishing line and the plastic bags will melt together. The fishing line will create a random, circular pattern due to how it was placed in the mould. The thickness of the material may mean that it will break.

Actual Outcome
The outcome is a very thin, very bendy material. It feels almost like a fabric that could potentially be used in furniture since its so thin and malleable that it might be able to be stitched. Despite its thickness its still strong and doesn’t tear.

Conclusions
LDPE and this fishing line melts together and bonds. The result is a strong patterned, almost transparent, thin material that is flexible yet durable.

EXPERIMENT #3.1

COLOUR & PATTERN - ORANGE / BLUE / WHITE

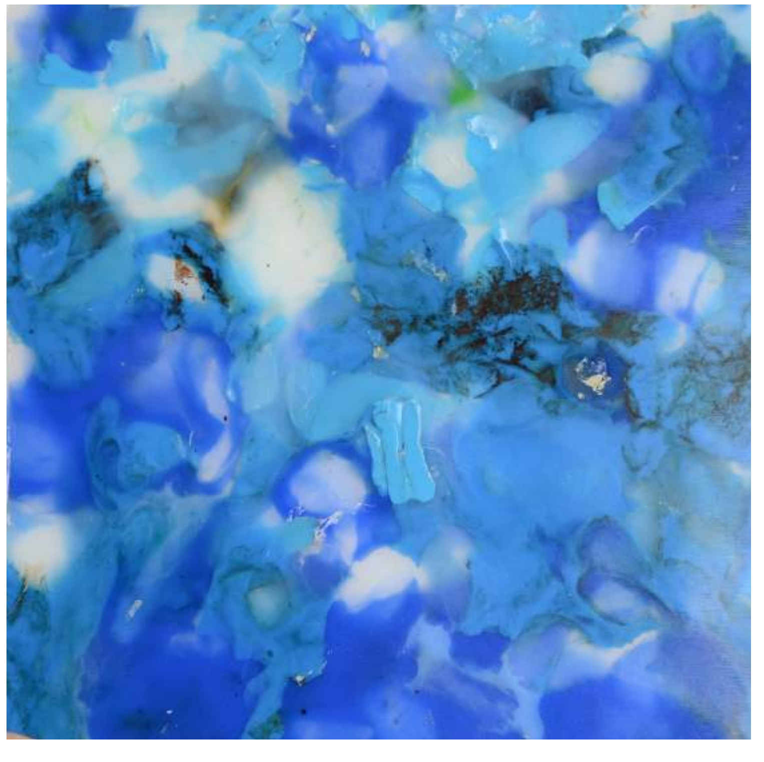
Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #3, #5
	Orange plastic basket, Blue Plastic Toy & Cup, White jerry can
Origin of plastic	Recovered and collected from Koster
Amount	29g
Status	Mix of Cleaned & Granulated + recovered bottle caps directly from Koster
Method	Heat and compression in oven
Temperature	150°C
Time	Warmed up to 150° and left for 80minutes then kept in oven to cool down.
Thickness	7mm
Mould	8x8x4cm plywood mould (mould is covered with aluminum foil on all surfaces for quick release)

Purpose
In this experiment we have purposefully poured in the different colours granules with precision, therefore predetermining the outcome of the pattern within the plastic.

Expected Outcome
We expect that the plastic will melt into a solid object and that the different coloured plastic granules will melt into each other. The result should be colourful and perhaps slightly translucent in the white areas.

Actual Outcome
The plastic didn't melt quite as we had expected. It was the first time using the blue and white plastic granules and they seem to have a different melting point to the orange granules. This produced an interesting result as the degree of melting varied within the object. The result is a heavily textured, fragmented, randomly porous and colourful object. The coloured granules that have not melted entirely appear pixelated. The surface transmits light through the porosity where the plastic has not amalgamated while still managing to create a merged surface with, relatively strong properties.

Conclusions
Aesthetically speaking, we thought that this was an interesting result and would like to pursue more experiments using colour and controlling the patterning and texture. The fact that the granules are possibly different types of plastic/additives proved to provide an interesting texture due to the varying degree of melting. This something that we otherwise wouldn't have gotten if we had used only the same types of plastic. The results provide insight on the how to create pixelated, fragmented visual appearances that can be developed to create architectural qualities.



EXPERIMENT #3.2

COLOUR & PATTERN - BLUE MIX

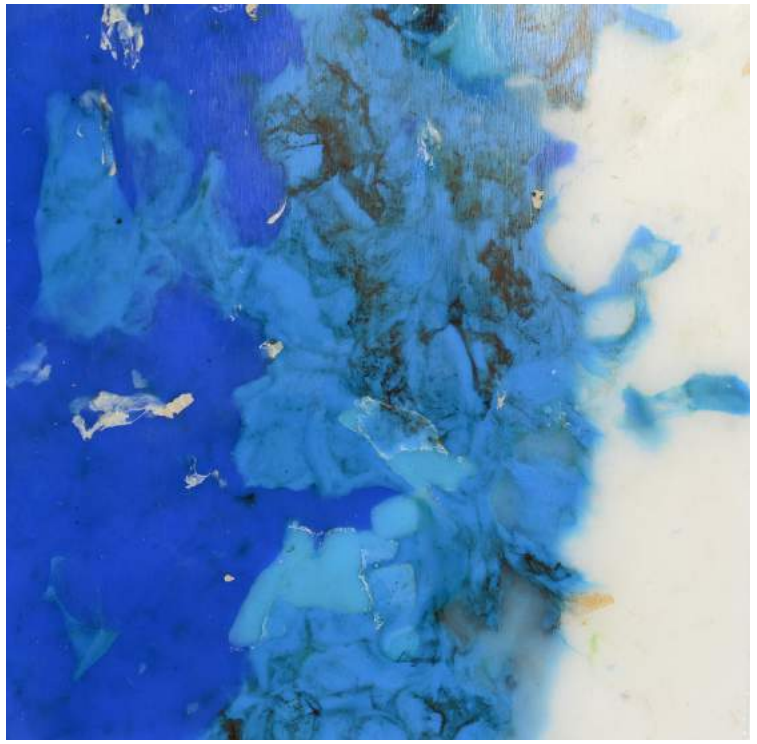
Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #5, #6, # 7 Blue Plastic Toy & Cup, White jerry can, Blue jerry can, Blue plastic bottle caps
Origin of plastic	Recovered and collected from Koster
Amount	15g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab
Temperature	134°C
Time	Mould heated to 134°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	1mm
Mould	10x10cm heated metal mould

Purpose
To test how the different colours blue plastics amalgamate with the white when randomly mixed in the mould.

Expected Outcome
From our previous knowledge from our test with only white granules, we know that the plastic can potentially melt completely together and form a new solid mass. Introducing the blue granules, we hope that the plastic will melt into each other and create patterns. The randomness means that we can not produce the exact same experiment again.

Actual Outcome
As expected, the different coloured blue and white granules blended together well and created a new solid mass. There was some debris left on some of the blue granules as a result from being in the ocean which become quite clear when heated. This is quite interesting as the new object now encapsulates both the new purpose of the plastic but also the old history of it being left at sea. The pattern has qualities resembling pointillism as well as marbleizing. Some of the granules have very clear forms and are easily identifiable, possibly because they are another type of plastic and don't react the same under heat. The white granules provide translucency which creates layering and depth within the object.

Conclusions
The random pattern is something that we cannot recreate, but perhaps we can achieve the same effect by using a calculated method? The colours are bright and create a pixelated surface, which could be recreated using the site at Koster as an inspiration. Perhaps the granite and rock surfaces could be reinterpreted and recreated using plastic granules?



EXPERIMENT #3.3

COLOUR & PATTERN - BLUE GRADIENT

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #5, # 7 Blue Plastic Toy & Cup, White jerry can, Blue jerry can
Origin of plastic	Recovered and collected from Koster
Amount	15g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab
Temperature	132°C
Time	Mould heated to 132°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	1mm
Mould	10x10cm heated metal mould

Purpose
To test how the different colours blue plastics blend together when positioned in a gradient pattern.

Expected Outcome
We already know that these plastics will melt together, this experiment is primarily to see the visual effect of the gradient. We hope that the boundaries between the different plastics becomes diffuse and blurry.

Actual Outcome
The resulting object was a solid, homogeneous mass that ranged from white to deep blue with a patterned section in the middle. The smooth gradient that we were hoping for has not quite been achieved since there is no blurry lines, rather solid sections. It appears more like layers stacked behind each other. The top and bottom edges are completely solid with no variations - which looks like new plastic. The middle section shows more pointillism achieved from the labeling on the blue jerry can as well as debris from the ocean left on the granules. Some parts have not melted completely which leads us to believe that they are not the same type of plastic. This became much more apparent when we sectioned off the different colours rather than mixing them together.

Conclusions
Even though we have tried to identify the plastic types, it is very difficult to be 100% certain unless the object has been clearly marked before we granulate it. This means if we mix different types of plastic together where we know that at least the majority of the plastic is HDPE (for example jerry cans), we are able to 'hide' some other types of plastic in the mixture and still get them to amalgamate into one solid object. A smooth gradient was difficult to achieve and the result was rather stacked with pixelated qualities due to the various types of plastic used in the middle section. The debris on the blue section created a marbled visual effect.

EXPERIMENT #3.4

COLOUR & PATTERN - BLUE MIX + SLUMP FORM

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #5, # 7 Blue Plastic Toy & Cup, White jerry can, Blue jerry can
Origin of plastic	Recovered and collected from Koster
Amount	15g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab followed by slump forming in our oven without pressure
Temperature	130°C
Time	Mould heated to 130°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down. Thereafter placed in oven with more plastic granules and slump formed at 140°C for 80minutes and cooled down in oven.
Thickness	7mm
Mould	10x10cm heated metal mould

<u>Purpose</u>
To test a form of post processing the compressed mould result by adding more plastic and slump forming it in the oven. The purpose will be to see how they amalgamate and if we can create a heavily textured surface on one side and a smooth surface on the other.

<u>Expected Outcome</u>
We know that the heat compressing will work and create a solid, marbleized pattern. We hope that when we add the plastic in the oven and heat it up again, the solid and the granules will mix together but still retain some of the texture. Therefore we should have a really smooth, marbleized side and a heavily textured, interesting tactile other side.

<u>Actual Outcome</u>
As expected we achieved a marbleized surface and a rough surface. We suspect however that the plastic may have been in the oven too long when slump formed or at a too high temperature as there was some degradation in the plastic.

<u>Conclusions</u>
It is possible to reheat the plastic twice to achieve post processing results. In this case we achieved sidedness with two contrasting surface textures: layered, jagged and rough versus smooth and marbleized.

EXPERIMENT #3.5

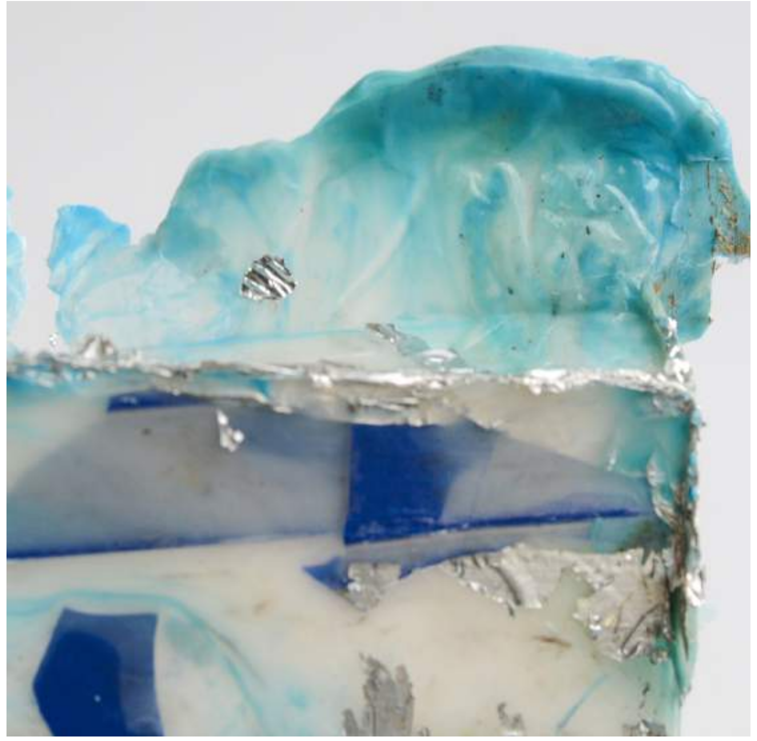
COLOUR & PATTERN - GRADIENT BLUE / GREEN + BOTTLE CAP

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #4, #5, #7, Bottle Cap, Green Fishing Net, Blue Fishing Net Blue Plastic Toy & Cup, White jerry can, Blue jerry can, Blue Plastic Toy, Fishing Net, Pepsi Bottle Cap
Origin of plastic	Recovered and collected from Koster
Amount	30g
Status	Cleaned & Granulated
Method	Heat and compression in oven
Temperature	140°C
Time	Oven and mould heated to 140°C, when oven reached 140°C it was compressed and left for 80 minutes then left to cool down in the oven.
Thickness	5mm
Mould	8x8x4cm plywood mould (mould is covered with aluminum foil on all surfaces for quick release)

<u>Purpose</u>
To see if we can create a gradient from blue to green with marbleization effect and how the bottle cap effects the visual identity of the object.

<u>Expected Outcome</u>
We expect that the plastic will amalgamate into one solid. Our hope is that we achieve a gradient from blue to green and that the transition is smooth due to the use of white granules in between. The bottle cap has been nestled down into the mixture with the logo from Pepsi max on the surface so our hope is that it will still be visible.

<u>Actual Outcome</u>
The plastic amalgamated but unfortunately we did not apply enough pressure so the surface contains grain boundaries and the marbleized effect we were hoping for was not achieved. The bottle cap did not melt at all which probably means it wasn't the same type of plastic. Even though it did not melt it has still been frozen into place



EXPERIMENT #3.6

COLOUR & PATTERN - MEDIUM SIZE PIECES

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, medium pieces from 3 different blue plastic items;
Origin of plastic	Recovered and collected from Koster
Status	Cleaned + Cleaned & Granuled
Method	Heat and compression in oven
Temperature	150°C
Time	Oven and mould heated to 150°C, when oven reached 150°C it was compressed and left for 80 minutes then left to cool down in the oven.
Thickness	1mm + spillage
Mould	8x8x4cm plywood mould (mould is covered with aluminum foil on all surfaces for quick release)

Purpose
To see if bigger pieces of plastic will melt and blend in the same manner as granulated pieces.

Expected Outcome
We assume that we will get a solid piece of plastic with bigger colored areas blending together. Similar to experiment #3.2 but bigger pattern.

Actual Outcome
The pressure applied was too great or the mould too disfigured from previous experiments. The plastic has spilled out of the mould and there is only a thin piece left in the actual mould. The plastic inside the original mould has gotten a marbleization and some bigger pieces that has not melted and has kept its original shapes. We assume that the plastic that did not melt was PP and has a higher melting temperature.

Conclusions
There is a significant difference in how the different types of plastic react to each other. Only a few pieces of other plastic gives a big difference in outcome than if all plastic is of the same type and all melts. As mentioned before this can be used in designing the experiments with having some pieces melted and some not. By purposefully selecting objects of PP and placing them with other HDPE objects, we can achieve defined patterns due to their differing melting points.

EXPERIMENT #3.7

COLOUR & PATTERN - LARGE SIZE PIECES

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, big pieces from 3 different blue plastic items, big piece from white jerry can, Blue/green fishing net
Origin of plastic	Recovered and collected from Koster
Status	Cleaned + Cleaned & Granuled
Method	Heat and compression in oven
Temperature	140°C
Time	Oven and mould heated to 140°C, when oven reached 140°C it was compressed and left for 60 minutes then left to cool down in the oven.
Thickness	6mm
Mould	20x20x0.6cm plywood mould with metal pieces as pressure (mould is covered with aluminum foil on all surfaces for quick release)

Purpose

As the last experiment with the normal moulds did not go as expected and we wish to try even bigger pieces, we laser cut a new mould measuring 20x20x0.6mm. This mould uses the metal plates in the oven as pressure and is simply there to withhold the plastic in a square shape. The aim for this experiment is to see how bigger pieces of plastic (5-10 cm) will amalgamate. We have added white granules from bag #2 as “filler” so that hopefully the outcome will be a solid plate.

Expected Outcome

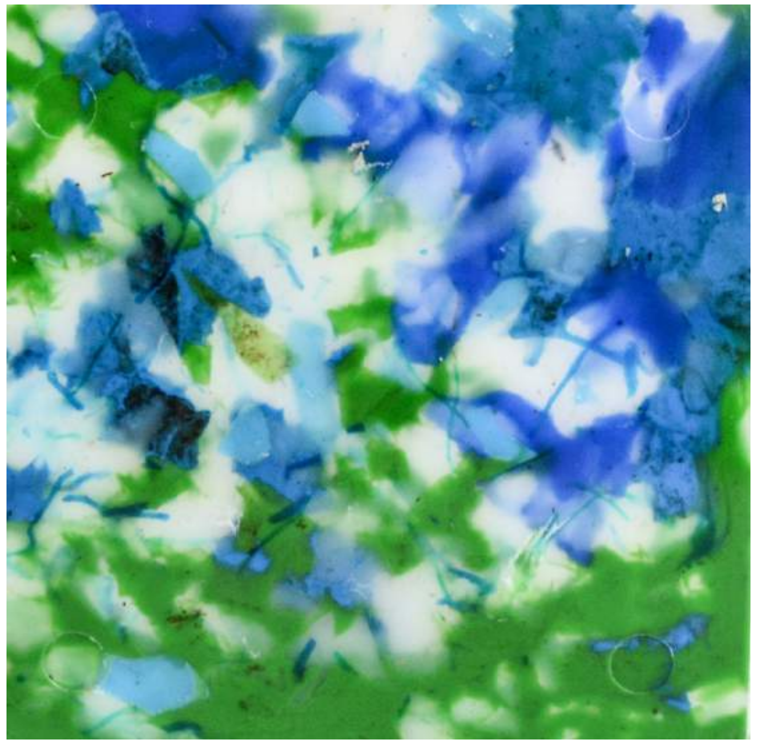
We assume that we will get a solid piece of plastic with bigger colored areas blending together. Similar to experiment #3.2 but scaled up into a bigger pattern.

Actual Outcome

The result was successful in that the pieces amalgamated as expected, however the object seeped out from the mould so we didn’t get the quadrilateral form we were aiming for. The object is very strong, there is a substantial increase in stiffness with the increased thickness of the plastic. The visual appearance resembles that of previous experiments #3.2 but scaled up. There are some holes where the plastic has not overlapped in the oven. This could easily be resolved with more precision when placing the objects in the oven.

Conclusions

Our findings so far using granules are able to be scaled up using bigger pieces of plastics and form larger geometries. Caution is needed when placing the objects in the oven to prevent holes in the results.



EXPERIMENT #3.8

COLOUR & PATTERN - GRADIENT GREEN / BLUE

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #4, #5, # 7 Blue Plastic Toy & Cup, White jerry can, Blue jerry can, Green Basket
Origin of plastic	Recovered and collected from Koster
Amount	16g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab followed by slump forming in our oven without pressure
Temperature	130°C
Time	Mould heated to 130°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	2mm
Mould	10x10cm heated metal mould

Purpose
To test different colours in a gradient from blue to green

Expected Outcome
We believe the plastic will amalgamate and create a solid object with a pixelated and fragmented appearance with a green blue colour scheme. The use of white granules will hopefully provide some translucency.

Actual Outcome
As expected. The gradient is however not very clear on such a small scale. We believe that when scaled up to an object twice the size it would be much more clear. Different shades of green plastic would also help create more depth and layers like the result of the blue granules.

Conclusions
More shades of the same colour will create more depth and layering and scaling up the object will likely result in a more clear gradient. The white granules are necessary in order to achieve translucency.

EXPERIMENT #3.9

COLOUR & PATTERN - ORANGE MIX

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #3 Orange Basket, Orange Toy, Orange Bottle Cap
Origin of plastic	Recovered and collected from Koster
Amount	18g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab followed by slump forming in our oven without pressure
Temperature	130°C
Time	Mould heated to 130°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	2mm
Mould	10x10cm heated metal mould

Purpose
To test a different colour scheme using orange granules from different recovered objects.

Expected Outcome
We believe the plastic will amalgamate and create a solid object with a pixelated and fragmented appearance with an orange colour scheme. The use of white granules will hopefully provide some translucency.

Actual Outcome
As expected the plastics amalgamated. The result proved more marbleized than we had expected due to the properties of the orange granules. This gave a crystallized effect which is enhanced when held up against light. The colours are vibrant and very contrasting to our previous blue experiments.

Conclusions
We are able to create objects with marbleized, crystallized effects using this method independent on which plastic colours are used.

EXPERIMENT #3.10

COLOUR & PATTERN - BLUE MIX + BOTTLE CAP

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #5, # 7 Blue Plastic Toy & Cup, White jerry can, Blue jerry can, Bottle Caps
Origin of plastic	Recovered and collected from Koster
Amount	16g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab followed by slump forming in our oven without pressure
Temperature	130°C
Time	Mould heated to 130°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	2mm
Mould	10x10cm heated metal mould

Purpose

To test how the bottle caps amalgamate with the granulate mixture using different blue & white granules.

Expected Outcome

We believe that using the scientific machine with more pressure, the bottle caps will be flattened along with the rest of the object into one solid. We hope that the identity from the bottle caps is still visible in the result.

Actual Outcome

The result of the bottle caps varies, but the consensus is that they melt completely together with the surrounding granules. They are hard to differentiate between the granules. The ‘Sprite’ logo however is very visible and directly relates to the history of the object. The result is subtle but rather sophisticated.

Conclusions

The text on the bottle caps and likely on other objects is printed with another type of plastics, therefore does not melt and remains visible when compressed with heat. Knowing this, we are able to go forward and purposefully select objects that we want to highlight within the result.

EXPERIMENT #3.11

COLOUR & PATTERN - GRADIENT BLUE / ORANGE

Type of plastic	Mixed
Plastic Identity	Granules from bag #2, #3, #5, # 7 Blue Plastic Toy & Cup, White jerry can, Blue jerry can, Orange Basket, Orange Toy, Orange Bottle Cap
Origin of plastic	Recovered and collected from Koster
Amount	18g
Status	Cleaned & Granulated
Method	Heat and compression in scientific lab followed by slump forming in our oven without pressure
Temperature	130°C
Time	Mould heated to 130°C. Plastic put in and heated under pressure for 10 min until max pressure was reached, then cooled down.
Thickness	2mm
Mould	10x10cm heated metal mould

Purpose
To test a gradient between orange and blue granules.

Expected Outcome
We believe the plastic will amalgamate and create a solid object with a pixelated and fragmented appearance. The gradient will likely be more obvious when placed in between experiments 3.9 & 3.10 in order to get a longer gradient span.

Actual Outcome
As expected.

Conclusions
We are able to create a gradient between two contrasting colours that creates a fragmented and pixelated appearance. The blue and orange granules create a strong contrast and the white jerry can granules allows all the different plastic colours and types to amalgamate.

EXPERIMENT #4.1

SOLID OBJECT COMPRESSION - MILK BOTTLE

Type of plastic	HDPE (100% certain because of markings on bottle)
Plastic Identity	0.5 milk bottle, folded into mould
Origin of plastic	Recovered and collected from Koster
Amount	45g
Status	Cleaned
Method	Heat and compression in oven
Temperature	150°C
Time	Warmed up to 150° and left for 80minutes then kept in oven to cool down.
Thickness	4mm (when compressed)
Mould	8x8x4cm plywood mould (negative base and positive base covered with aluminum foil for quick release)

Purpose
In this experiment we want to see how an original geometry (milk bottle) reacts under heat and compression and how much of the original geometry is identifiable.

Expected Outcome
For this experiment we did not use granules. This is to see what the plastic would look like if it was merely heated and compressed. The bottle was carefully folded with intentional folds so our intention is that those folds will remain visible and create a texture in the plastic. The original identity of the milk bottle will still remain although it has been compressed and moulded.

Actual Outcome
The outcome was less dramatic than we had expected as the plastic completely melted into a solid. The folds only become visible when held against a back-light and the result shows more diffuse shadows in a layered structure. The colour is milky and the object has a nebulous appearance.

Conclusions
If we had a lower temperature in the oven and perhaps less pressure, the folds would likely have been more visible and created more of an effect. Still it was beneficial to see how easily an object could be completely transformed from its original geometry and identity. Layering is achieved although diffuse and blurred because of the homogeneity of the object.

EXPERIMENT #4.2

SOLID OBJECT COMPRESSION - WATER BOTTLE + SOAP BOTTLE + MILK BOTTLE

Type of plastic	HDPE (100% certain because of markings on bottles)
Plastic Identity	0.5 milk bottle(clear), 0.5 water bottle (black), 0.5 soap bottle (yellow)
Origin of plastic	Recovered and collected from Koster
Amount	59g
Status	Cleaned
Method	Heat and compression in oven
Temperature	140°C
Time	Warmed up to 140° and left for 80minutes then kept in oven to cool down.
Thickness	0.5-5mm (when compressed)
Mould	No mould, the objects were just placed on the base plate covered with aluminum foil and compressed against the top plate also covered with aluminum foil.

Purpose
In this experiment we want to see how the original geometry of three different objects amalgamate without the boundaries of a mould.

Expected Outcome
We expect that the plastics will blend together into one solid and create layers of the different coloured objects. Depending on how the objects react under pressure, there may be areas where they don't connect. The outline of the result will be irregular due to the lack of mould defining the shape.

Actual Outcome
The result was an irregular shaped solid. It was thin enough to be flexible but still holds together very well. The colours have blended and created new shades between the black, yellow and white. The foil on the base and top plate has left some impressions in the new object which particularly on the black sections creates a sharp, defined texture. The colours are bold and striking while nebulous in some parts.

Conclusions
Even without the restrictions of the mould, the objects blend together well and create an irregular shape. The colours amalgamate and create new shades between the original colours, appearing nebulous. The thickness of this object allows it to still be slightly flexible.

EXPERIMENT #4.3

SOLID OBJECT COMPRESSION - MILK BOTTLE + BOTTLE CAP + KETCHUP BOTTLE

Type of plastic	Mixed?
Plastic Identity	0.5 milk bottle(clear), 1 orange bottle cap, 0.5 ketchup bottle (red)
Origin of plastic	Recovered and collected from Koster
Status	Cleaned
Method	Heat and compression in oven
Temperature	140°C
Time	Warmed up to 140° and left for 20minutes then kept in oven to cool down.
Thickness	5mm
Mould	An open rectangle mould, 5mm thick wood. One edge left open and three edges to define shape.

Purpose
In this experiment we want to see how the original geometry of three different objects amalgamate using a three edges rectangular mould. By doing so we can control some of the geometry and let one edge seep out and form organically under the heat and pressure.

Expected Outcome
We expect that the plastic will amalgamate but we are unsure if there is enough plastic to form a complete solid or if there will be holes in between where the plastic hasn't reached each other. We used a 5mm mould and 5mm stoppers so that the plastic doesn't completely compress. This was done in hope of containing some of the former identity of the objects and not flattening them 100%.

Actual Outcome
Unfortunately the plastic did not amalgamate as they were too far away from each other. They did however melt and the 5mm stoppers resulted in the geometries deforming to an extent where their identities are still recognizable. This technique was most successful on the milk bottle as there are clear folds in the plastic.

Conclusions
In order for this experiment to be successful we will need to fill the mould with more plastic and make sure that the geometries overlap in order for them to amalgamate. The 5mm stoppers were successful in blocking the plastic from deforming entirely and allowing for some of the original identity to be recognizable.

04: FINDINGS

EXPERIMENT FINDINGS

Experimentation Results

The experimentation phase was successful in discovering the potential of using ocean plastic in architecture through the use of compression and slump forming. Several qualities were discovered, particularly the ability to produce surfaces with patterns, layering, and depth thanks to the translucency of the jerry cans.

The endless amounts of colour is a predominant feature of ocean plastic which were used to create colourful plastic samples. The ability to create different textures depending on the amount of compression used was another interesting finding.

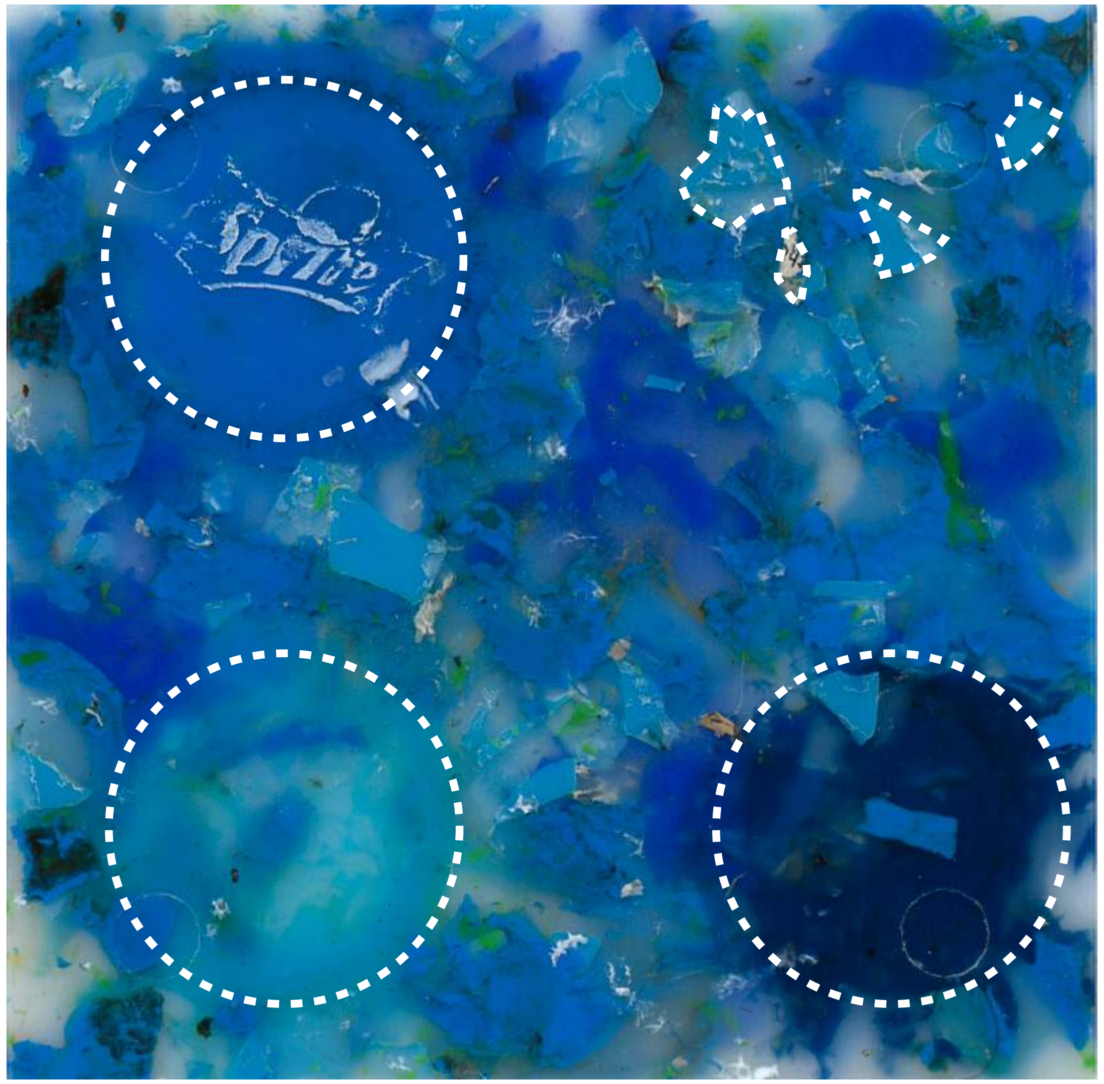
The identity of some plastic objects was able to be preserved thanks to the compression moulding method. If the method had been extrusion for example, this would not have been possible.

Base for Design Development

From here, the thesis focused on how to take the findings from the experimentation phase and use them in a bigger system. How could these plastic samples be applied in a bigger scale? How does the plastic effect an architectural space? What qualities/limitations would this entail?

Does the plastic need a secondary structure or could it stand alone and be stable? What kind of experience does the plastic give visitors and what kind of message does the plastic material send?

Those were some of the questions that drove the design proposal from a material investigation into an architectural project.



IDENTITY

Conserving some identity of the objects was a key factor that separates this project from what some other companies are already doing with recycled plastics. This was important in order for people to be able to realize that this plastic comes from the ocean and is not new plastic in order to change the perception and create awareness of marine pollution.

One important finding from the experimentation phase was that the identity of objects could to an extent be conserved even when transformed using compression moulding. The extent was defined primarily by the size that the granules or objects were cut into and the type of plastic. In the sample to the left, the identity of the sprite bottle becomes a predominant feature within the surface.

The white translucent plastic comes from the granulated jerry cans. Since these easily identified objects are made from HDPE, they formed a base in most of the experiments and bind all of the other plastic objects together into one solid. The semi-translucency of the jerry cans creates depth and layers within the plastic samples.

Another bottle cap in the sample is most likely made from LDPE and has melted entirely resulting in completely blurred edges. By using the chosen method - where plastic is primarily sorted by color and easily identified objects are subtracted - selected plastic types will likely be mixed - leaving some pieces melted and some intact but together forming a solid whole thanks to using translucent jerry cans to bind them together.

Different plastic types have different melting points. PE has a melting point between 110-135°C whereas PP has a melting point of around 165°C. This results in some plastic pieces still containing their original geometry while others completely deform and melt.

Apart from the identities that can be conserved, the surfaces achieve a fragmented, pixelated appearance that creates a complex surface that is peculiar and interesting to examine.

LIGHT & TRANSLUCENCY

Working with light

The conducted sun studies confirmed that daylight against the plastic samples can create intriguing, colourful spaces. Although the model studies did not take into account the scale of the plastic or the detailing, it was discovered that this is lighting effect is something with significant aesthetic value for the project.

Each experiment was photographed with back lighting and the results were consistent. What impacted the result of the translucency was the thickness of the material and the amount of white/semi-translucent granules (usually from jerry cans) used in the sample.

Dappled light

Another discovery during the experimentation phase was the possibility to create a dappled light effect when slump forming plastic granules. The plastic granules amalgamate due to heat and gravity but since there is no pressure involved, the result is still porous. The result is that light filters through the plastic and creates a soft, fragmented light (see following page for photos of dappled lighting effect).

Scaling it up

From the knowledge gained in the experimentation phase along with some research into fabrication possibilities, it is believed that the ocean plastic is able to be scaled up into full size panels, although the bigger patches of solid colour will likely need to be created with smalled granules and include 100% HDPE plastic in order to amalgamate. By doing so, patterns can be created in both the local and global geometries.








TEXTURE

Surfaces with texture

Another finding from the experimentation phase was the ability to create various textures depending on the method of transformation used. The results of the texture achieved by slump forming the plastic is very different to the textures achieved by compression moulding the plastic.

Highlighting these contrasting surfaces

These variations were seen as an asset that could be used in the design proposal and were developed into the design of modules used in the House of Texture.

Marbleization

The compression moulded plastics that used HDPE and LDPE often had a marbleized appearance where the plastics melted into each other and created a surface that resembled polished marble. This could be used for a range of applications where a smooth surface is desired.

Soft folds

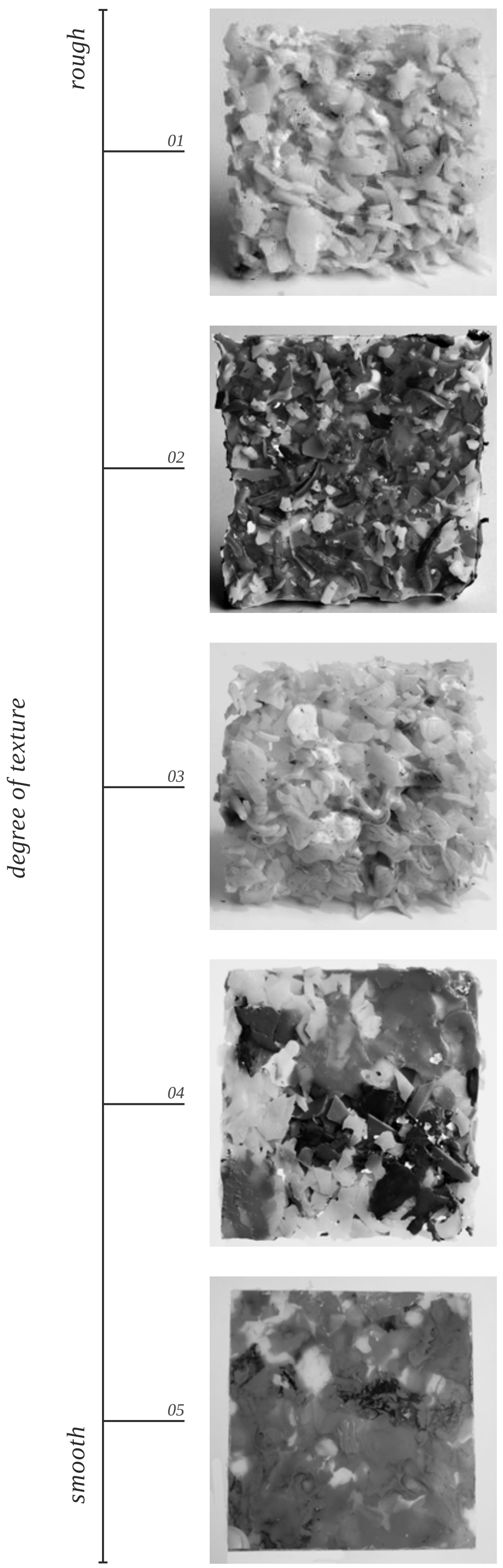
When slump forming larger objects such as whole or half jerry cans it was discovered that the plastic slowly melts and forms soft, undulating surfaces due to gravity. The results were glossy, almost wet looking surfaces.

Roughness

Through slump forming with smaller granules a rough and jagged surface is achieved. The surface is heavily textures with depth and layering from the granules. This provided a visually complex surface to look at along with an interesting tactility that was then translated into bigger panels in the design proposal of House of Texture.

Neutral colours

The use of white jerry cans and other white / semi-translucent ocean plastic objects as the majority of the material in each panel was a conscious design choice for these experiments. The aim was to draw focus on the different textures and the shadows they could create. The use of coloured plastics in this instance would likely draw more focus on the colours rather than the textures and surfaces.



TRANSFORMATION

Showing the transformation

After conducting a number of experiments with varying levels of transformation, an observation was made on how different the characteristics of the surfaces are depending on the different degree of deformation.

The photographs to the left show a range of experiments that have a gradual increased degree of transformation. Firstly half a jerry can was placed in the oven as a solid form and left for approximately 10 minutes. The result was that the jerry can melted but the original geometry was still identifiable.

The following experiment was similar but the jerry can was left for longer and there were two jerry cans that were fused together with the heat. The result was the jerry cans created folded textures that overlapped each other with a soft, silky appearance.

The rest of the experiments consisted of the same method but each time the pieces were cut smaller and smaller. Each experiment showed an increasing depth in the texture and layering.

This technique became the backbone for one of the designed structures on site whereby the degree of transformation/deformation *became* the design. House of Texture clearly shows visitors the transformation from a discarded plastic object on the shore to a new material and the qualities achieved through this method in terms of the different textures (rugged, porous, glossy), and the light transmitted through the material. The jerry cans could be stacked and sculpted to form a structure that transitions slowly from an easily identified waste product (jerry can) to a finished, polished panel.

COLOUR

The fourth and final important finding that drove the design proposal to the finished result was the ability to take advantage of colour. There are endless amounts of different coloured objects found in the oceans and landing on the shorelines made clear by all of the colourful sampled created.

This property was seen as an asset due to the fact that using colour in the design proposal would also make the structures stand out in the landscape and assist in making the building a statement. This property was therefor developed into the design proposal of the House of Colour.

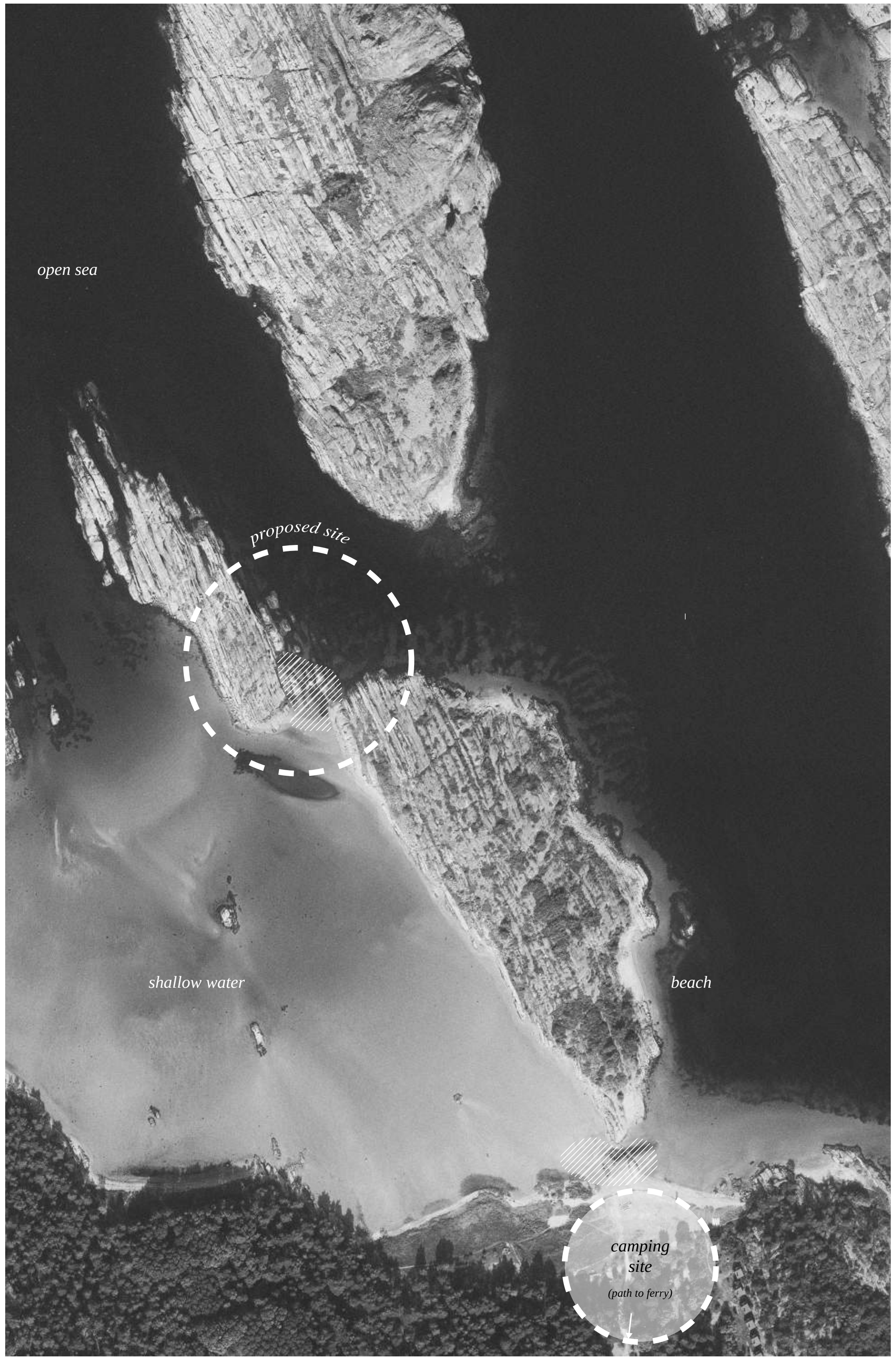
It was found that by sorting the plastic primarily by color rather purely by type one can create a vast colour palette that can be used when compression moulding. One can then control the visual appearance and create patterns and gradients within the surface depending on the desired outcome.

Each experiment to the left was carefully planned in order to achieve the desired result. The granules were first sorted by colour, then weighed and positioned in the mould before being compression moulded.

Applications

There are many ways to use these colourful surfaces and they are not limited to the architectural sector although that has been the main purpose of this investigation.

05: DESIGN RESEARCH



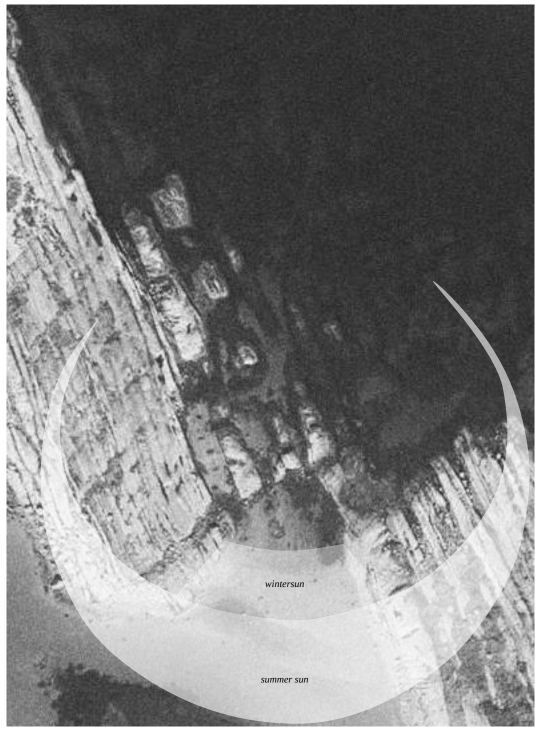
SITE CONDITIONS

The conclusions of the experiment phase led to the decision to split the program of the diving centre into three separate structures that each highlight different qualities that can be achieved using the transformation methods (texture, degree of transformation and colours). By separating the structures entirely they do not compete with each other and each structure has 4 facades that one can see from different angles, both from land and from water.

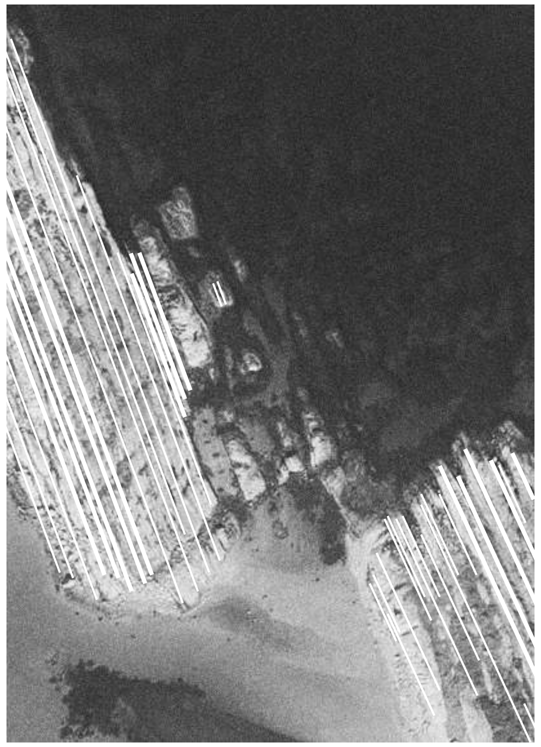
The snorkeling potential is great throughout the area which is why this particular site was chosen as it would provide access for more people to come and experience.

There is a very strong sense of direction apparent within the site. The dike swarming creates a strong orientation towards the open sea that the design proposal harmonizes with rather contrasting to.

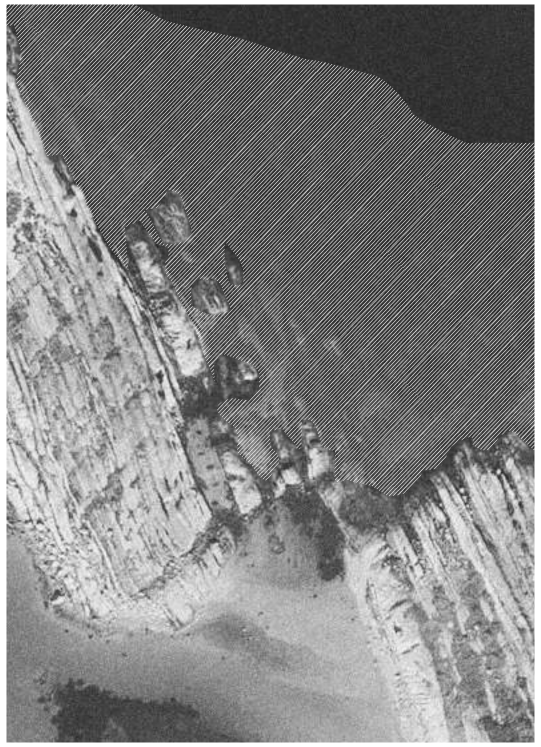
The positioning of the designed structures was defined by the foundation type used along with the program and sequence in which one would visit the area.



Sun projection - summer - winter



Dike swarming - clear orientation



Areas with good snorkeling / diving opportunities

Using a solid white colour on a strong global geometry accentuates the form of the geometry - complementing each other

Using the plastic texture with a high amount of detail both on the global and local scale conflicts with the form of the geometry and reduces the effect of the global form

LOCAL & GLOBAL GEOMETRIES

New plastic is like a blank canvas with endless amounts of possibilities to be formed to any desirable shape and create any kind of surface, limited only by the chosen forming methods. This thesis however departs from ocean plastic, which, unlike new plastic, already has a defined identity and history. While the method of compression and slump moulding takes advantage of plasticity in the material, the goal was to keep (to some extent) the identity and history of the ocean plastic which is a unique departure point for plastic in architecture. Therefore, the derived prototypes departed from this characteristic when being formed, rather than starting with a blank canvas.

The project aimed to create a system that best suited the plastic material created using the chosen method of transformation aimed to accentuate the qualities achieved.

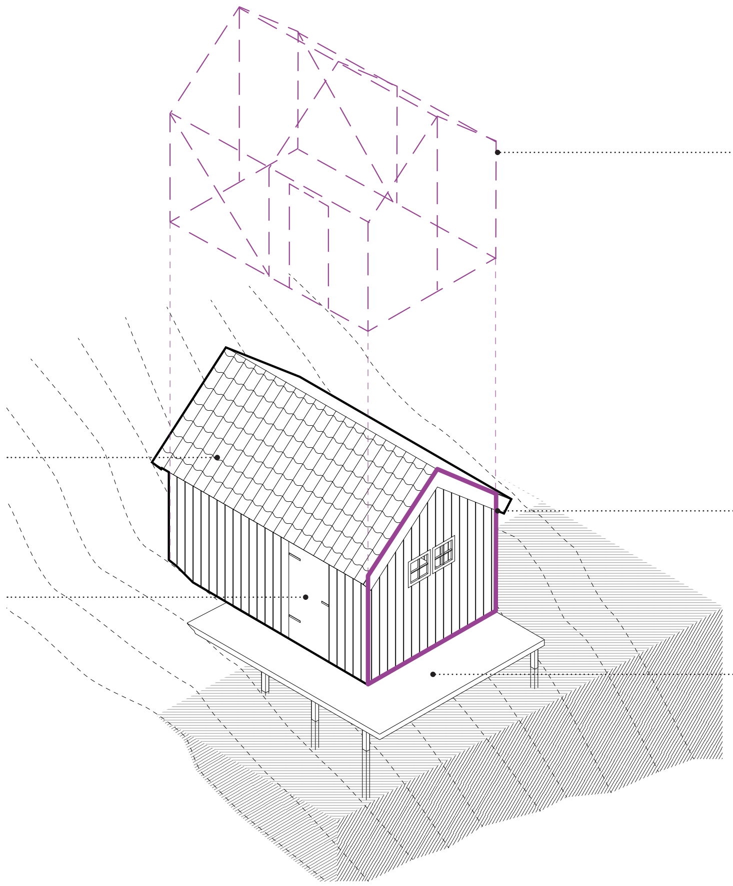
What kind of geometries would best suit this material? One of the properties of plastic as a material that is its plasticity. Tests were conducted by applying the textures created from the experiments firstly to a planar surface and then to an undulating surface then comparing them to a plain white surface to see how what impact they had on the local and global geometries.

The results showed that the undulating surface did not benefit from the patterning of the plastic. The geometry and the patterning conflicted with each other.

Where the plain white surface achieved an interesting shadow and depth, the patterned plastic cancels out the undulating geometry and the focus became the patterning.

Digital tests were also conducted to see how the scale of the patterning has an effect on the geometry. The results showed that scale does have an impact on the global geometry, as does the distance from which one would perceive the object. Here it was found that if the pattern is smaller, the geometry is less conflicted and can still be perceived quite clearly.

These studies concluded that big, flat surfaces best accentuate the bold, colourful patterning and textures of the plastic. Here, the identity of each plastic piece and granule could be appreciated more due to non conflicting geometries.



KOSTER SJÖBOD

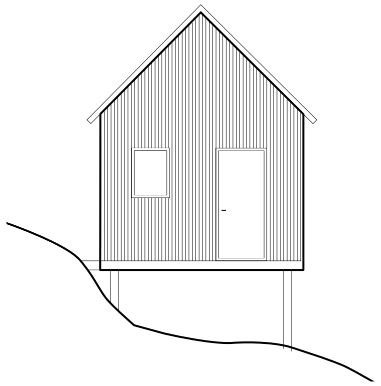
Typical typology

The “Sjöbod” or boathouse is a very common typology found along the coasts of Sweden, Koster in particular. These small scale structures are very typical for the area although their function has changed over the last few decades. Originally used primarily to store fishing equipment and other necessary objects to aid the work force, they are now more commonly used for leisurely purposes or storage.

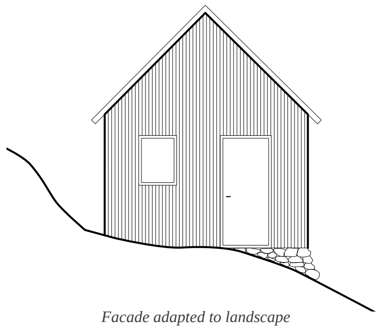
Structure

The structure of the boathouses on Koster uses a standard stud system clad in vertical weather boards and usually covered with ceramic tiles on the roof. The floor joists are often balanced on a stack of rocks used as their foundation. Alternatively they protrude our over the water edge and are built on pillars that are sunk into the sand or rock beneath. The cladding is commonly custom cut to adapt to the site.

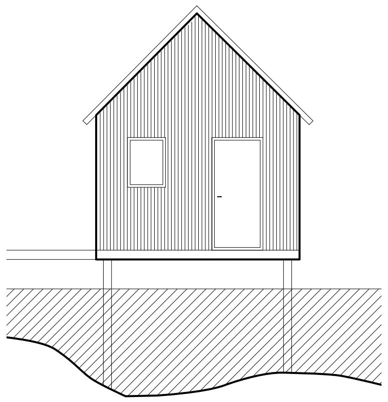
SJÖBOD ANALYSIS



Stones and pillars elevate structure from land



Facade adapted to landscape



Pillars in water

Elevated structure from land

To meet the uneven rock below the sjöbod often uses a simple method. One can often see how stones stacked on top of each other have been used to create an even foundation for the house to stand on. This can also be done with wooden pillars or even concrete pillars, or commonly seen - a combination of all of these.

This elevates the structure from the landscape, leaving it almost hovering over the granite rock. In the design proposal, the method of the elevated structure above the landscape has been translated, but uses slimmer structural steel pillars to enhance the effect of a hovering structure in the landscape.

Adapted to landscape

Another way to handle the unevenness of the rocky landscape of Bohuslän is to adapt the actual facade to the ground. Here the wooden siding is cut away wherever it would have collided. This leaves a highly adapted structure, looking almost like it's one with the ground, melting into the surrounding.

The plastic panels and blocks that are created in this project can easily be adapted to the site and melt into the uneven ground. Using the 3d model built up using photogrammetry, one can digitally manipulate the plastic and create a custom fit that adapts to the landscape.

Pillars in water

A third way to ground the Sjöbod is in or partly in the water, normally in combination of a small pier creating an outdoor space outside the house. By using pillars, either in wood, concrete or by stacking stones, the house is protected from the salty water and sits just above the surface. Sitting just above the water the structure is reflected in the rippling surface of the ocean and with the tides the relationship to the sea changes throughout time.

Three foundations

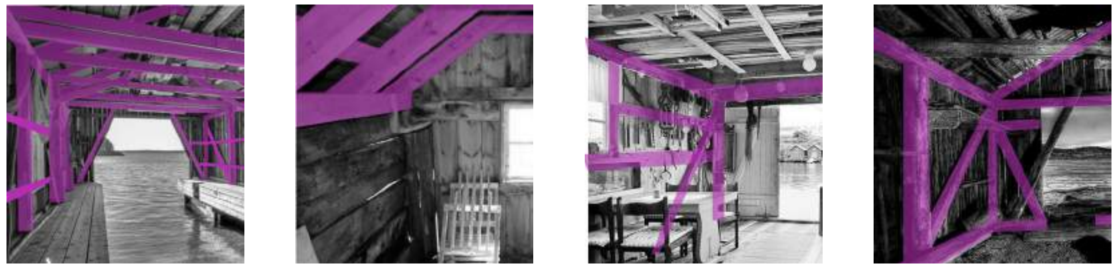
These three foundation types have been translated and used in the final design proposal.

Recognizable profile

Small openings in the facade

Simple outdoor space - often not sheltered

Big simple surfaces as the facade



Interior tectonics

SJÖBOD ANALYSIS

Recognizable profile

The Sjöbod has a recognizable profile. Looking at the short side, it resembles the stereotypical shape of a house. A gable roof with a small overhang, small openings and a consistent facade of vertical wooden siding. The angle of the roof varies, but it is almost always a gable roof. The volume of the building is simply an extrusion of this side facade, resulting in a simple form. Looking at a sjöbod from the side it is a simple, unbroken, facade with the same vertical siding. Smaller openings for windows or doors occur but it depends on the orientation of the building and if there are closely built adjacent boathouses. A pair of double doors is also a common trait on one facade that relates to the working environment when used for storing larger things or when the sjöbod is used as a workshop.

Scale

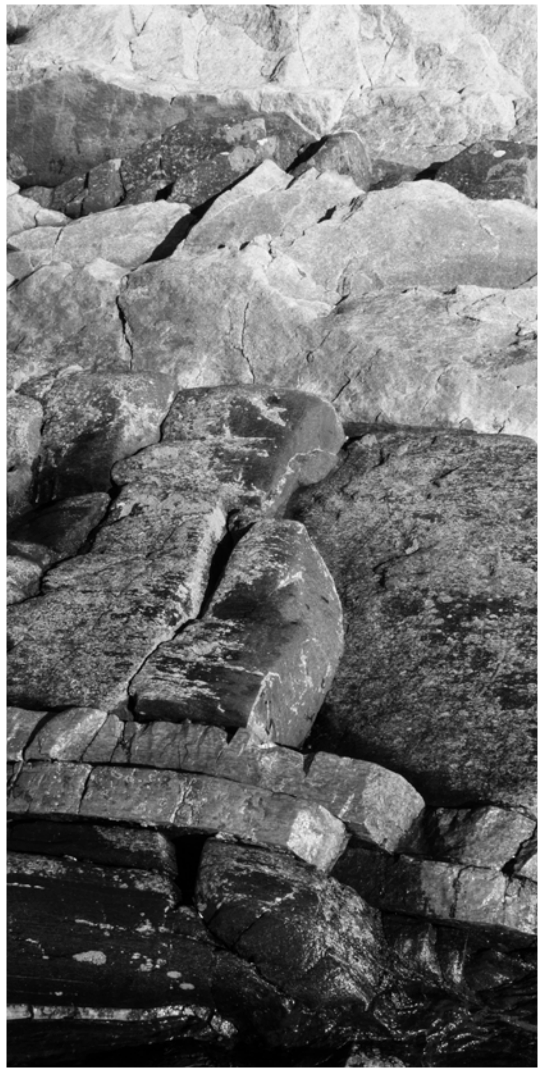
The scale of the building is quite iconic, usually spanning anywhere between 10m^2- 80m^2. If the building is larger than this, it usually typically considered a sjöbod anymore, rather it becomes more of a boatyard or larger storage facility. The scale is important in this projects contemporary translation and is one of the reasons behind the decision to break up the structures into 3 separate buildings rather than one larger one.

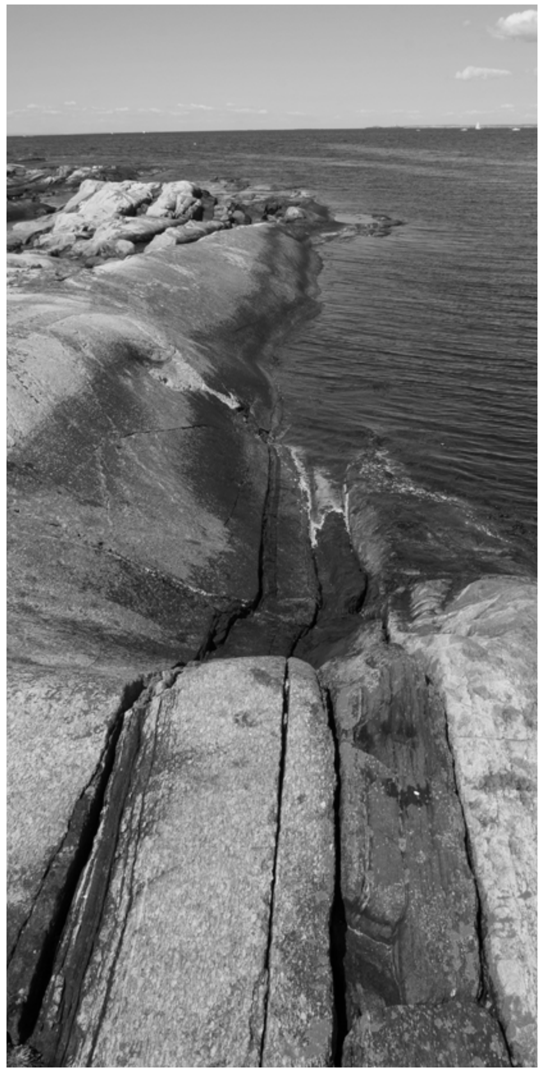
Big Surfaces & Simplified Volume

The simplicity of the form and the scale of the openings in the typical sjöbod means there are large areas of undisrupted facade and roof. This is something that is borrowed and translated into the design in order for the materiality of the plastic to take focus. A simple form and large surfaces allows for the plastic facade to be the focal point of the design. The digital studies conducted concluded that a simpler form allows for the patterning of the plastic to be in focus whereas a more complex form took focus away from the material.

Tectonics

The typical sjöbod is uninsulated. This means that the tectonics of the building are very prominent in the interior space. One can easily understand how the structure is built as it is so visible. Here, the material - wood - and the limitations of wood, determines the construction method. As this project is based on plastic, there is more flexibility to experiment with the structural aspects and have the potential possibility of creating something that is structural in itself. What is concluded from the sjöbod here is that tectonics can play a key part in the design and how the spaces are perceived.





The rock slate on site has a very strong linear direction and is made up of layers of rock, often varying in colour and thickness.

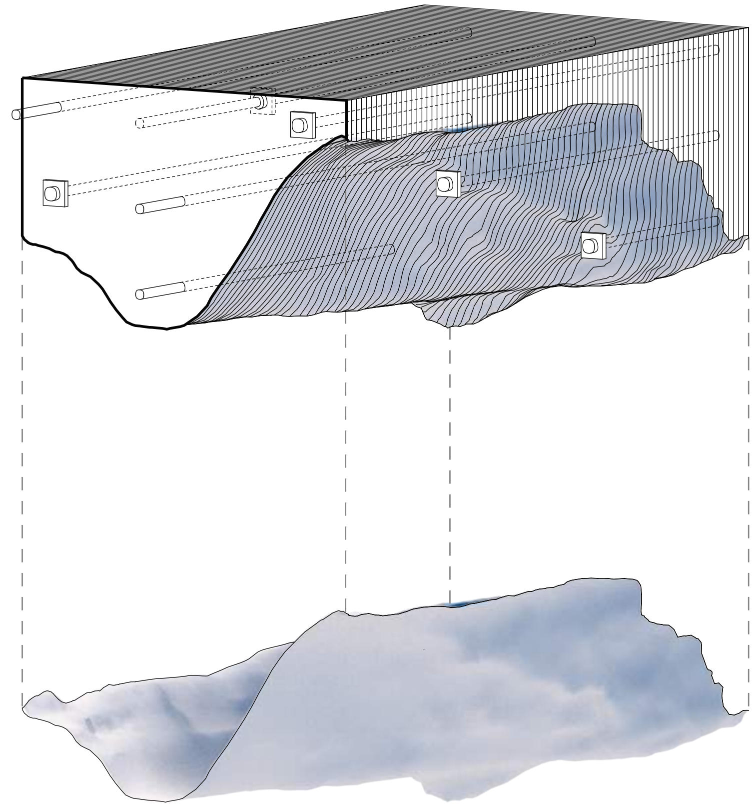
DIKE SWARMING

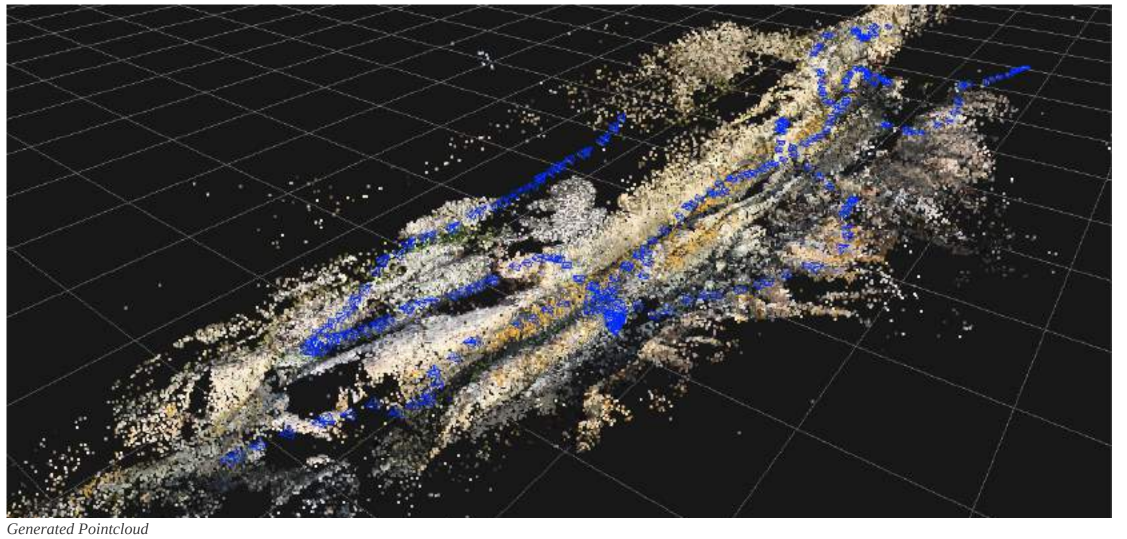
Dike Swarming on Koster

One of the strongest characteristics of the chosen site is a geological phenomenon called dike swarming. Dikes are sheets of rock that have over the past millions of years formed in the fracture of a preexisting rocks usually due to tectonic activity. The dikes appear in long linear lines with a clear orientation, embedded within the continental crust. These lines run along Koster islands, creating a sense of direction out towards the open sea.

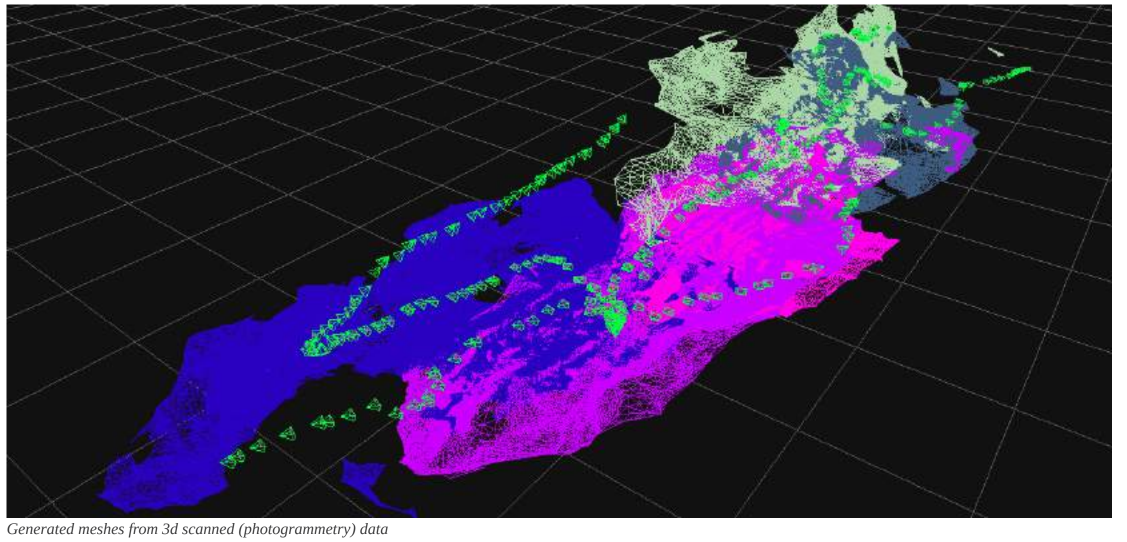
Translating landscape to plastic

Inspired by these tightly stacked of rock layers, plastic slates could be compression moulded and stacked, creating our new walkways that connect to the landscape.
Instead of the traditional way of using rocks to build up a flat supporting foundation, a detailed 3d model (based on photo photogrammetry) combined with CNC-techniques enables the possibility to form the plastic sheets to the existing landscape. This creates a custom shape sheet that fits onto the uneven landscape and an even floor. This technique allows the use of different colours of recovered ocean plastic in layers and is forgiving in terms of tolerances as the construction allows for the panels to have different thicknesses.

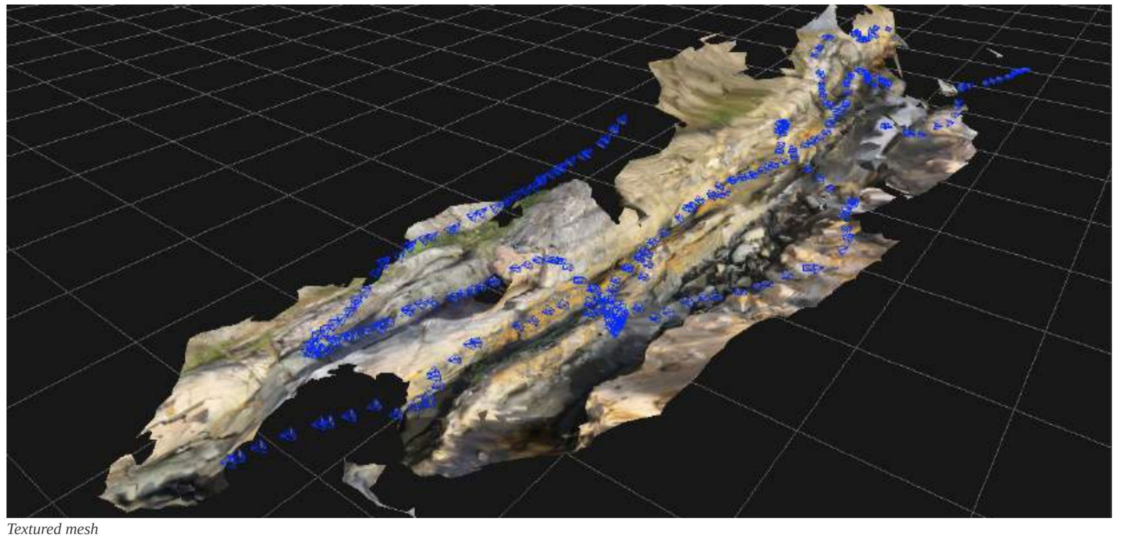




Generated Pointcloud



Generated meshes from 3d scanned (photogrammetry) data



Textured mesh

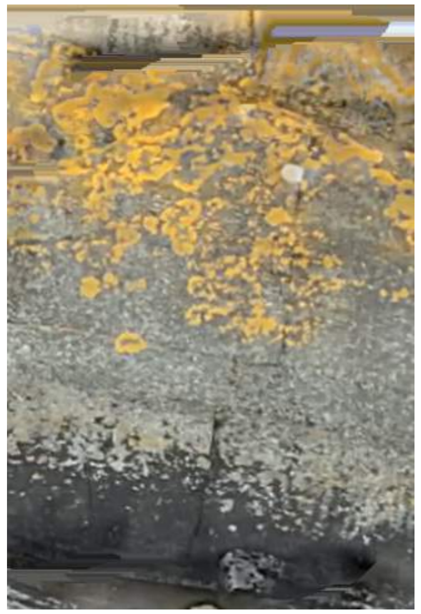
PHOTOGRAMMETRY : SITE MODEL

Photo of site

Photogrammetry model render

Render combined with site photomontage

DECONSTRUCTED PHOTOGRAMMETRY


06: FINAL DESIGN

THREE STRUCTURES

Based on the knowledge gained on the material experiments, site visits, model studies and interviews with stakeholders such as the diving club - the final design proposal was established.

The design of the diving centre is split into three structures that each highlight different qualities that can be achieved with transformed ocean plastic using compression and slump moulding.

The three structures are anchored into the landscape with different foundation types borrowed from the boat house typology that was analyzed. Other characteristics from the boat house have been borrowed such as the simple profile, the scale, modest openings and large, uninterrupted surfaces in the facades. This allowed the material to become the intriguing, distinguishing part of the design while the overall structure remains familiar. This play on strange versus familiar is a common theme throughout the design.

The three houses are named : House of Texture, House of Transformation and House of Colour. By dividing the proposal into three structures, the aim is to highlight the potential that ocean plastic has in various ways, therefore broadening the perception of what ocean plastic could become.

The structures are separated in the landscape, positioned in such a way that reflects the sequence in which one would visit the space. Each structure houses a different function but together they form the diving and snorkeling center that could be open all year round and could be run by the Naturrum at Sydkoster.

The method of fabrication varies within each structure. Heat is the common factor that is always utilized, whereas the mould, the amount of compression and the size of the plastic pieces varies depending on the desired outcome. The result of the investigations was the design of a module using compression moulding, blocks using the original geometry of the objects found on the shores, and panels that have been stacked in a way that was inspired from the geology of the site.

THE WALKWAY

Connection to the mainland
The walkway adapts to the existing landscape and provides access to places previously not accessible, encouraging a closer experience of the islands and under water life. Approximately 178 tons of ocean plastic is rescued to create this colourful walkway, which is how much plastic that ends up in our oceans around the world every 11 minutes.

HOUSE OF COLOUR

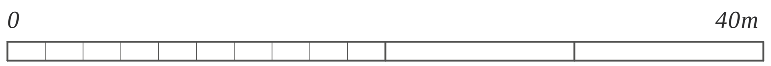
Sauna, Reflection & Showers
This structure highlights the range of bright colours of objects collected from the shores. Approximately 39 tonnes of ocean plastic makes up the panels of this building. This equates to the approximate amount of marine waste collected from Kosterhavets Nationalpark every 2 years.

HOUSE OF TRANSFORMATION

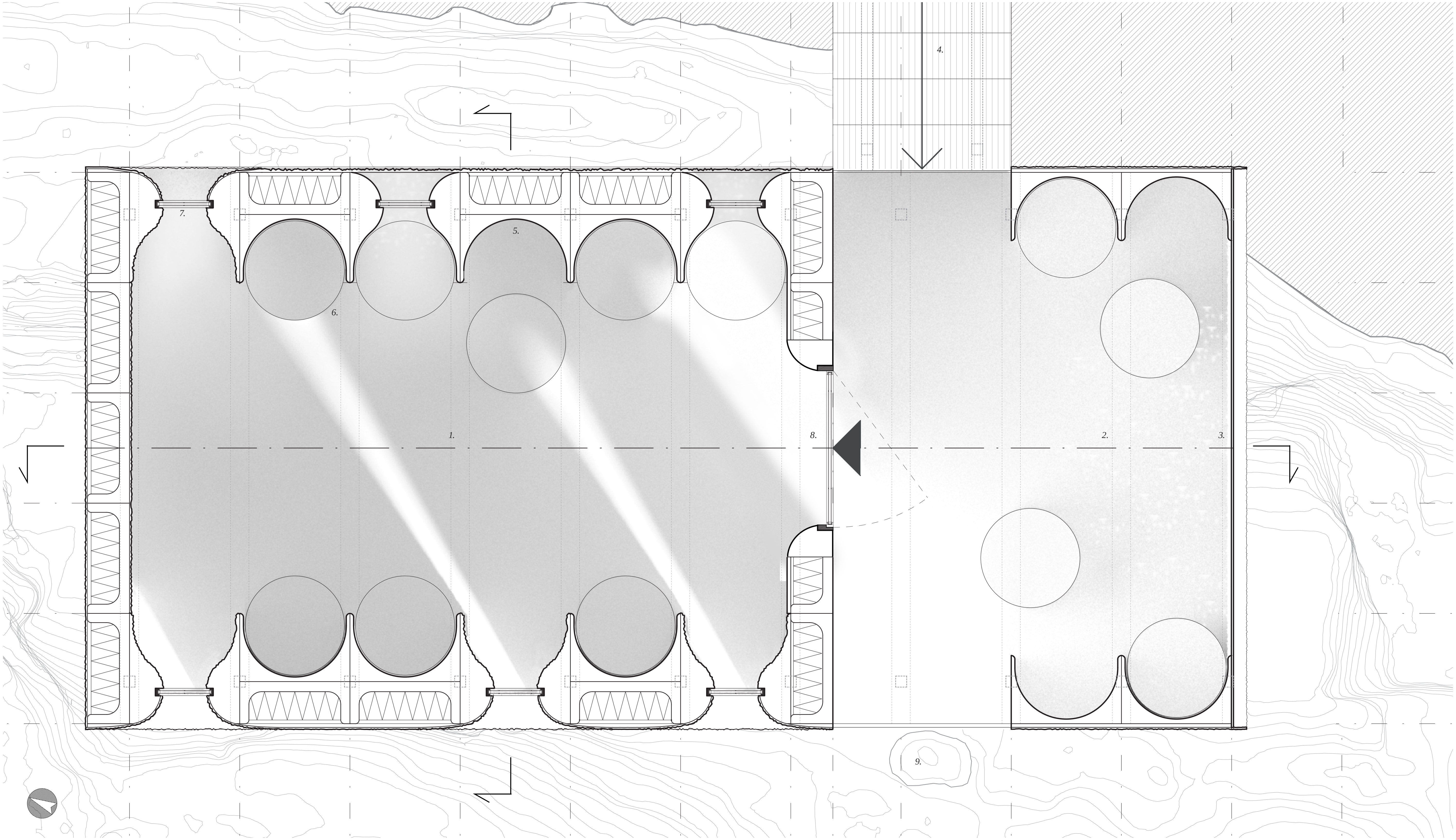
Introduction & Education Space
This structure presents a literal translation of transforming ocean plastic from waste into a building. Approximately 5000 recovered jerry cans from the ocean are rescued to create this structure.

HOUSE OF TEXTURE

Change room
This structure focuses on the different textures that can be created using compression and slump moulding methods. Approximately 10 000 kg of ocean plastic is recovered to create this building. 800 000 of these structures could be built every year from the plastic that enters the ocean world wide.

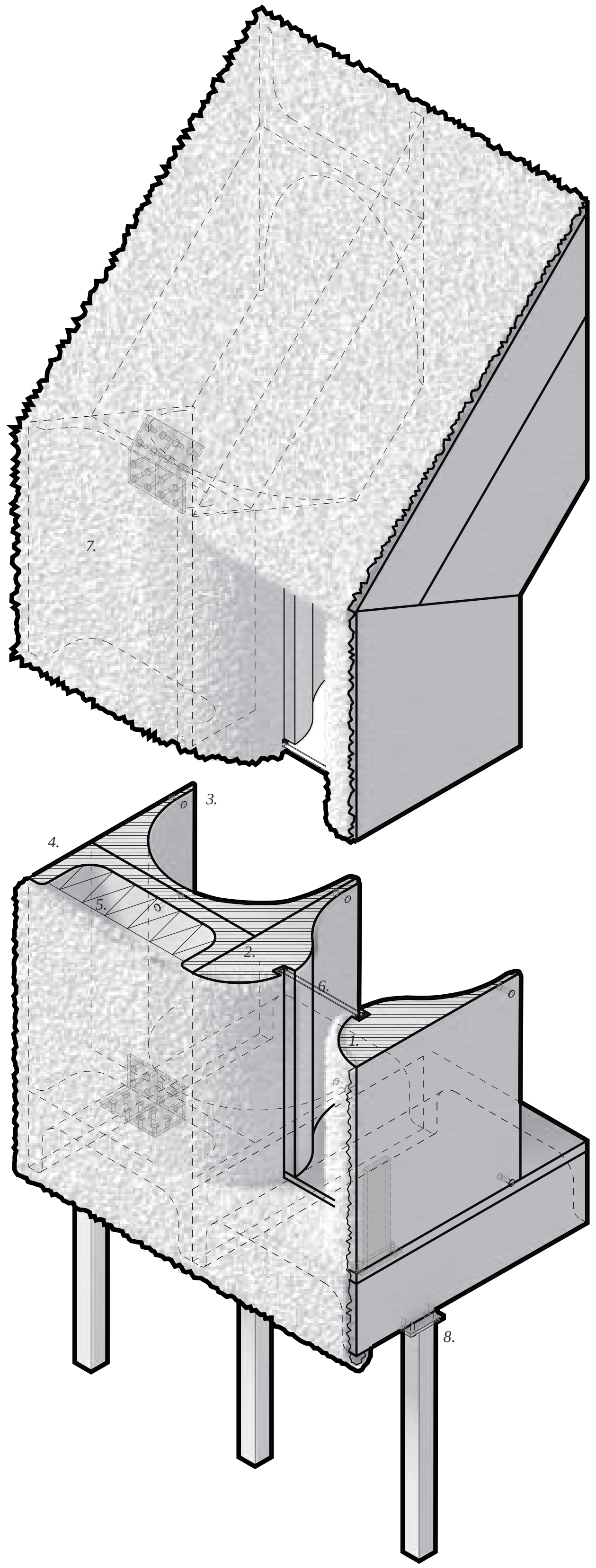


HOUSE OF TEXTURE

1. Climatized change room
2. Sheltered vestibule
3. Blue translucent wall made from thin compressed ocean plastic pieces
4. Stair to/from walkway
5. Changing pod (plastic module)
6. Movable furniture that fits into pods
7. Integrated glazing profile (plastic module)
8. Glazed entry door
9. Access to/from island via natural stone

0 2m



1. *Moulded profile 1 (Glazing profile)*
2. *Moulded profile 1 (Mirrored Glazing Profile)*
3. *Moulded profile 3 (Wall & Roof)*
4. *Moulded profile 4 (Wall, Roof & Floor)*
5. *Insulation*
6. *Glazing (Recessed in Profile)*
7. *Slump Moulded Shell*
8. *Steel Plate Foundation*

HOUSE OF TEXTURE

Housing a change room and shelter - this is an elevated structure that hovers above the rock-face. The ocean plastics have been compression moulded into 3 modules that make up all the main elements of the building (the walls, roof and the floor). A separate shell is slump formed meaning that granules of plastic are positioned onto a conveyor belt and slowly run under heat which makes them bond together. The result of this process is long sheets of slumped plastic which can then be bent into the final shape while hot or reheated in selected areas. This shell acts like a veil that drapes over the building and tries to creep inside through the openings.

The focus has been on the contrasting textures created from the moulding techniques, whereby the compression moulded modules have a very smooth, glossy finish and the slumped surfaces have a rough and fragmented appearance.

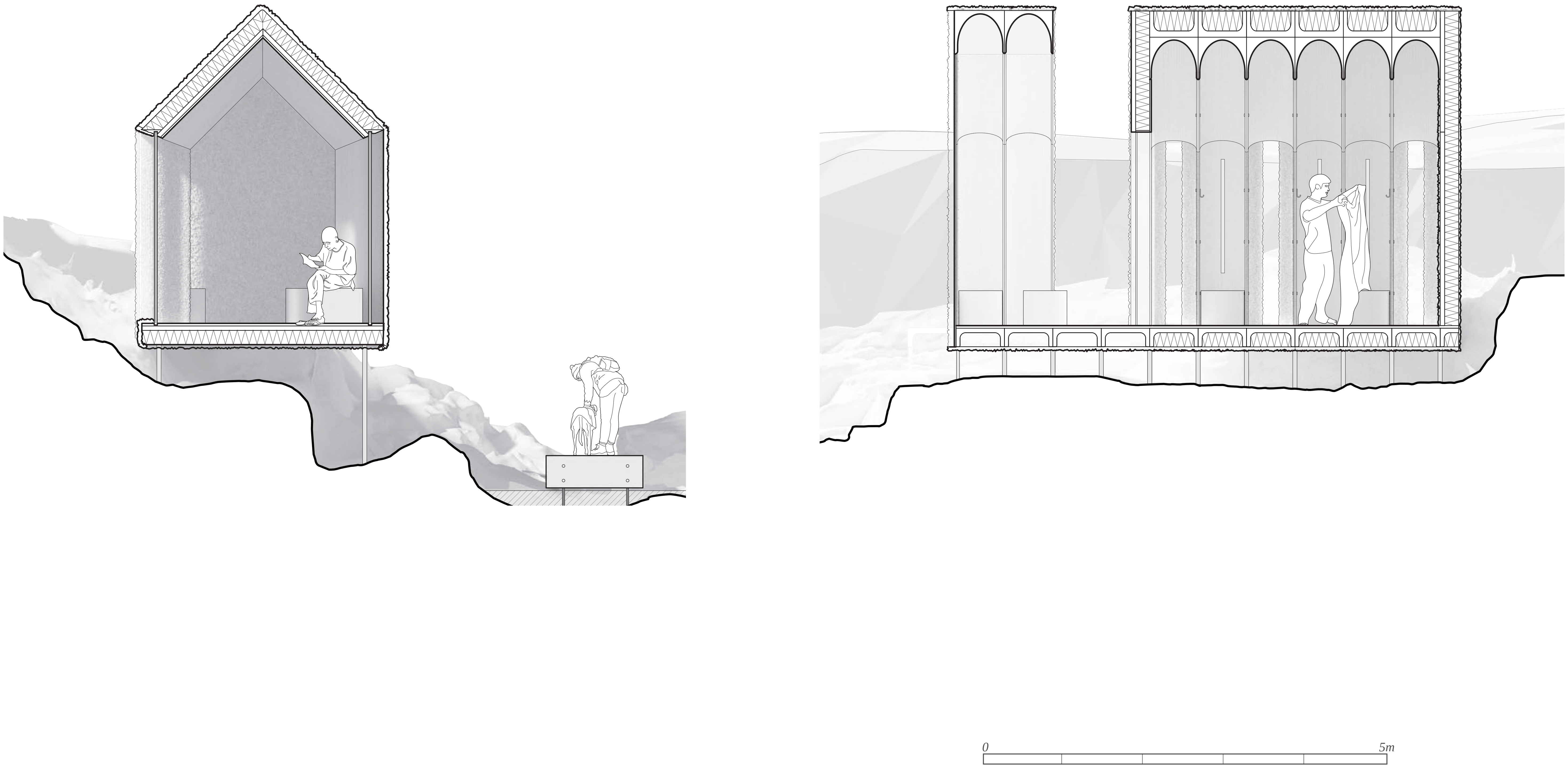
The main ingredient used in the making of these modules and the slump veil are white or semi translucent objects such as jerry cans, which, as previously stated, is one of the most common objects collected from the beaches of Koster.

The shape of the outer profile allows for insulation, meaning part of this building is climatized, while the side modules are designed to have integrated glazing where the frame is hidden and therefore blurs the boundaries between inside and outside. These openings create framed views of the surroundings. In terms of privacy, two of the windows facing the walkway have the slumped veil pass by the window, allowing a dappled light to enter the space but masking the visual connection.

The ribbed shape of the modules make them structurally stable while also creating a strong rhythm inside the space, inspired by the ability to see the tectonics inside a typical boat shed. These carved out spaces become small ‘changing pods’ where divers and visitors can get changed and keep their belongings.

The windows to the back of the space allow light to seep in and highlight the slump wall which is heavily textured in contrast to the smooth changing pods.

The outdoor space is like a vestibule and wind shelter that be accessed from either the stair from the walkway or from the surrounding landscape. The blue wall made up by compressed pieces of plastic, facing south, is back-lit from the sun which is based off our light studies where we used our physical samples and natural sunlight.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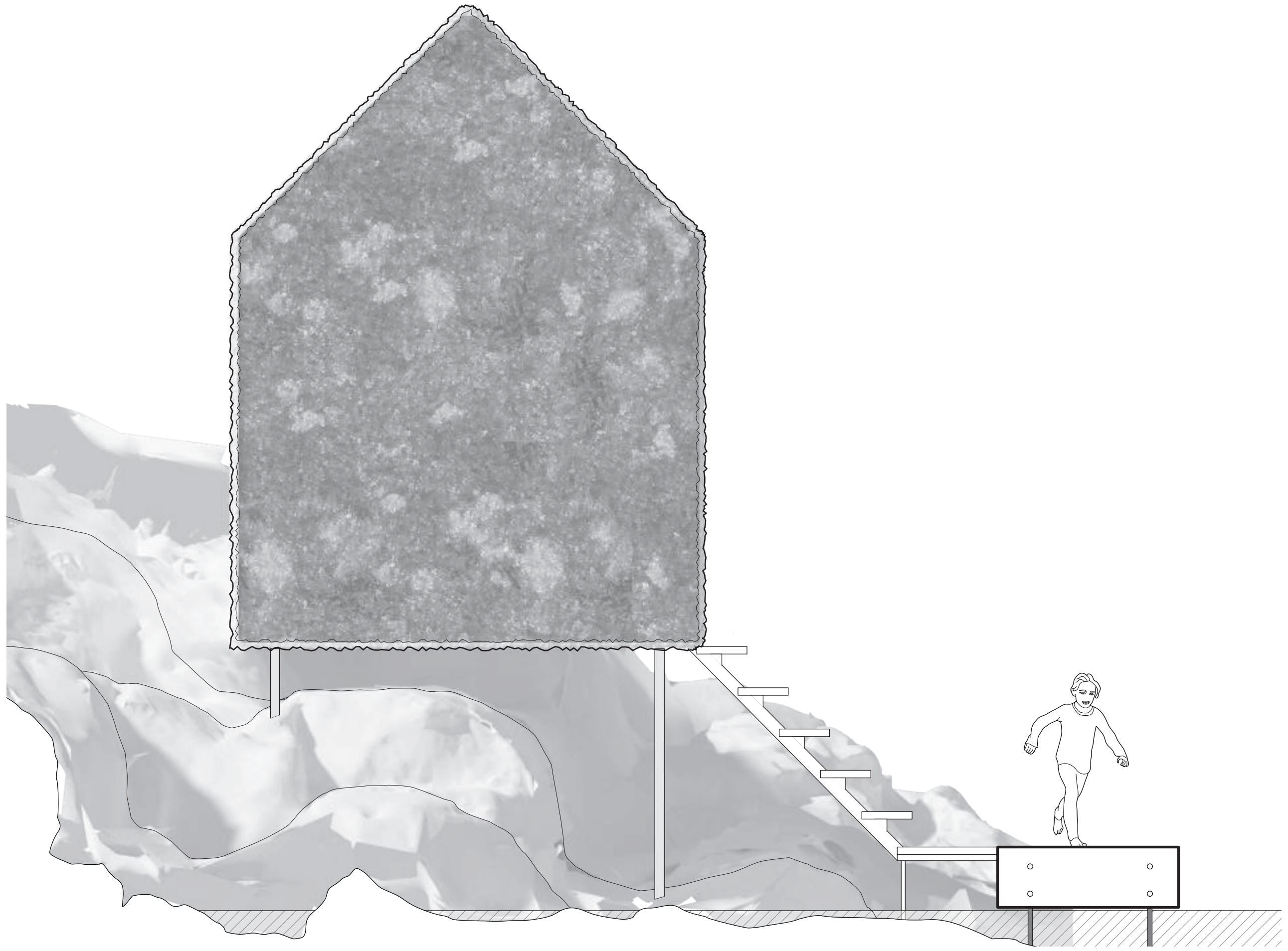

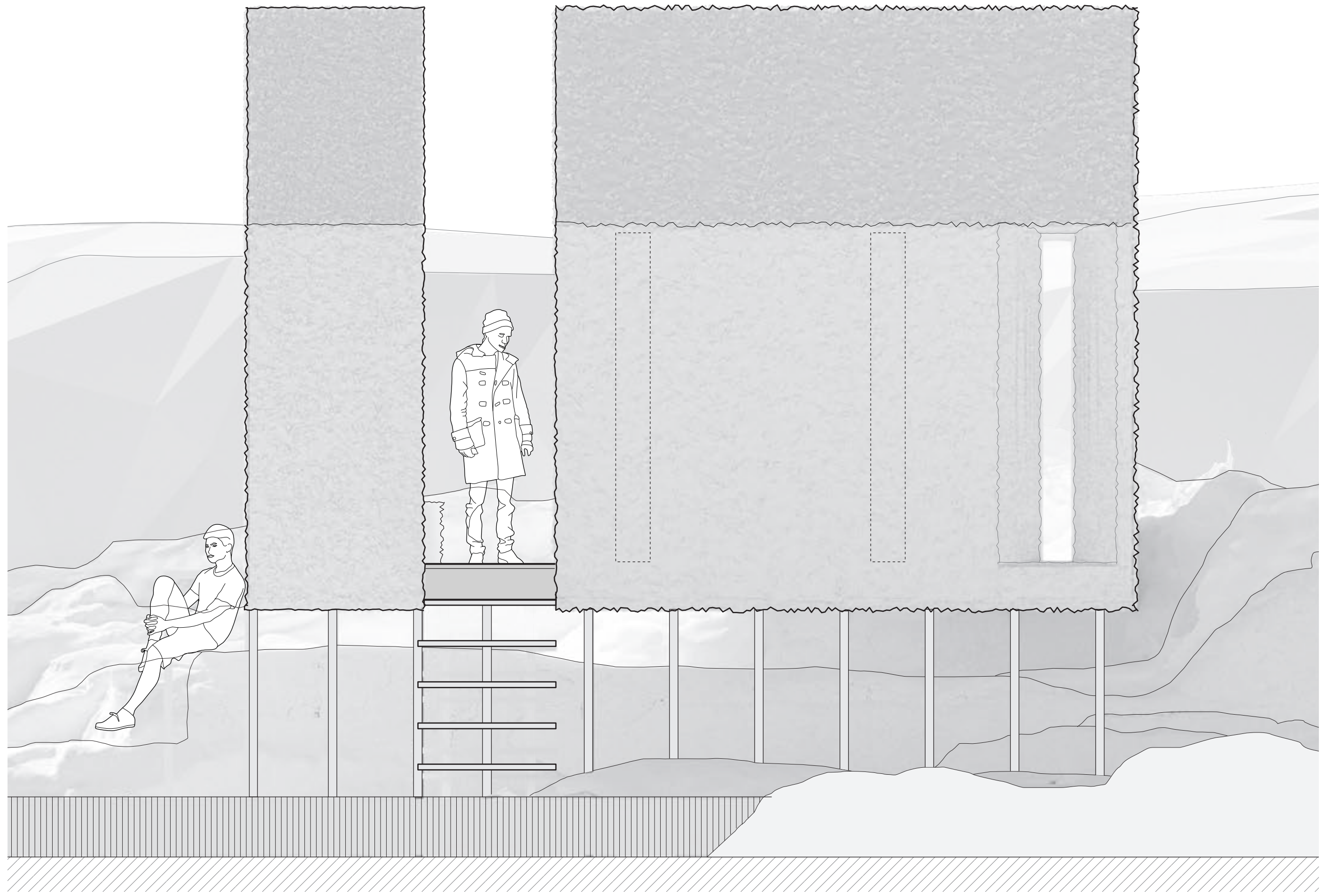

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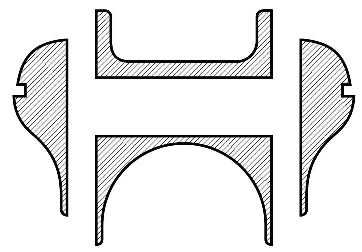
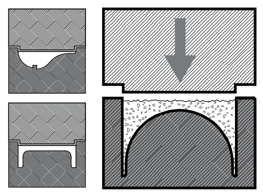
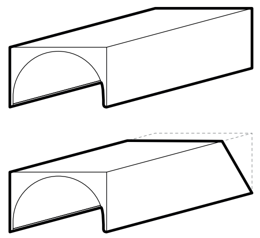


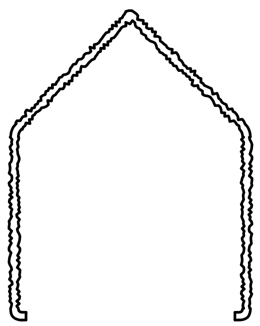


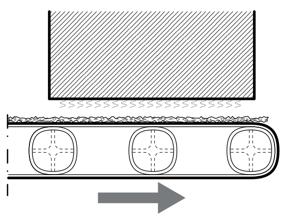
3 Moulds
Heat + Compression



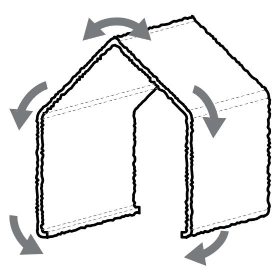
Standard profiles
or cut to finish

COMPRESSION MOULDED MODULES



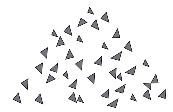


Position granules on heated
conveyor belt (no compression)

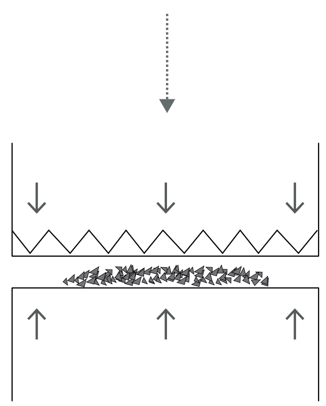


Heat to bend
into profile

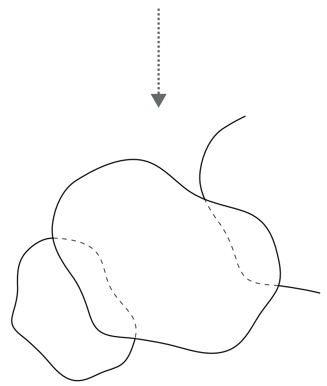
SLUMP MOULDED SHELL



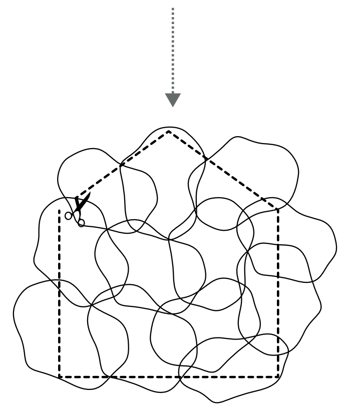
Granulated ocean plastic



Compression moulded
without mould



Resulting in irregular
shaped surfaces



Overlapped surfaces joined through
heat and compression and cut to
finish.

COMPRESSION MOULDED BLUE WALL

PROCESS

The process of designing this structure was iterative. It began with simple panels that relied on a secondary structure to make it stable. It was then developed further in order to eliminate the secondary structure and make the entire building out of plastic.

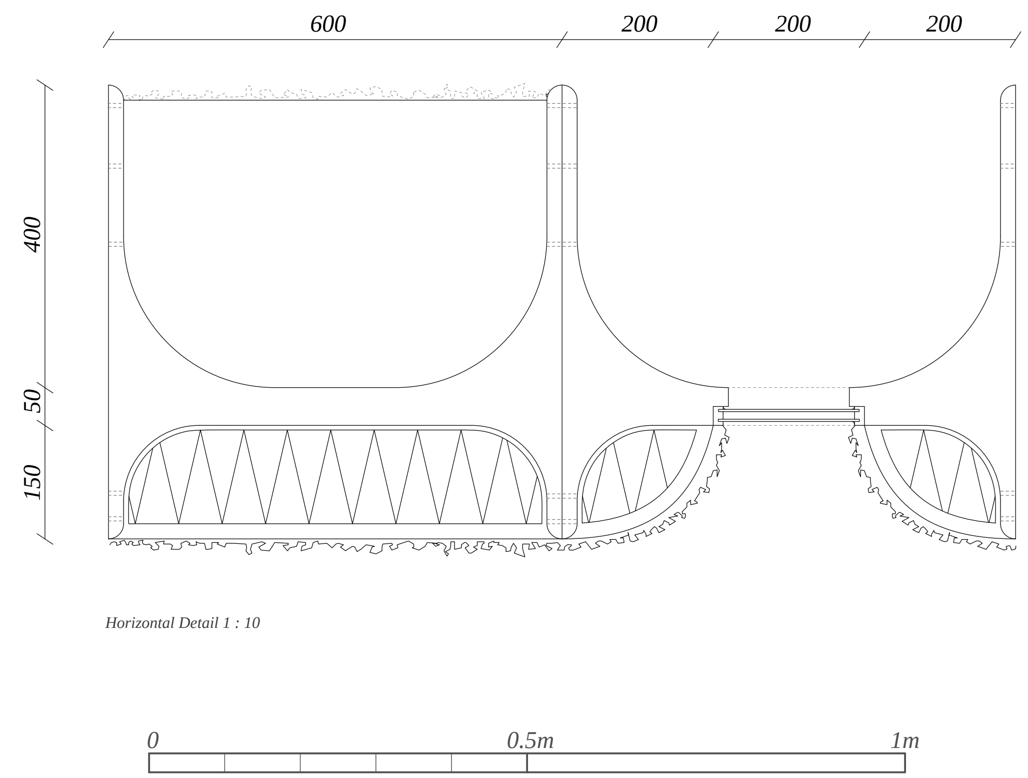
The following section shows some of the process of how the modules what factors defined the design decisions. Departing from a simple, flat panel, an investigation began to see what shape or a module would be ideal that would create a structurally stable system.

The aim was to try out what would happen if the interior panel was structural stable in itself by creating a profile that could stand by itself and take weight. The profile below has a strong shape that impacts the interior space and creates a repetitive rhythm. This related to the sjöbod which also has a very clear tectonic aesthetic within the interior of the space.

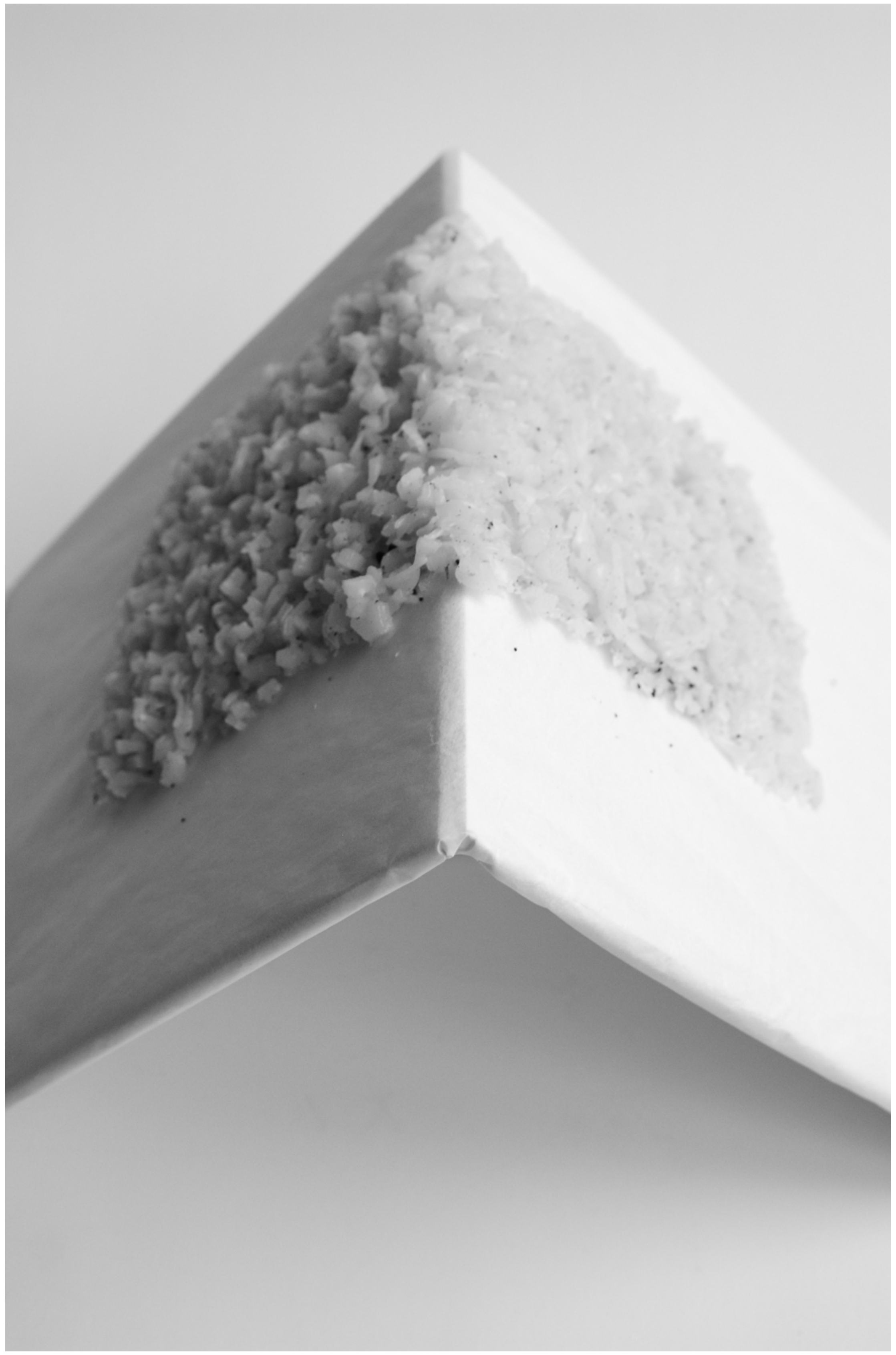
The window fittings and other openings were also considered into the design of the profile and how the light is perceived inside the space with help from these openings.

The detail below shows a 'H' profile in compression moulded plastic. The deep profile allows for insulation on the back side and on the inside the ribs become very distinct. The possibility to use the inside of these ribs as changing cubicles with seating is a possibility.

The slump panel acts as an outer shell that is 'hung' onto the construction. Tests on bending the slump formed panel when still hot worked well, setting the grounds for the concept (see next page). The slump panel could therefore possibly be bent in to meet the window openings, like drawn below, or it can run continuously past the opening like a translucent veil that allows for dappled light to come through.



Horizontal Detail 1 : 10



BENDING SLUMPED PLASTIC

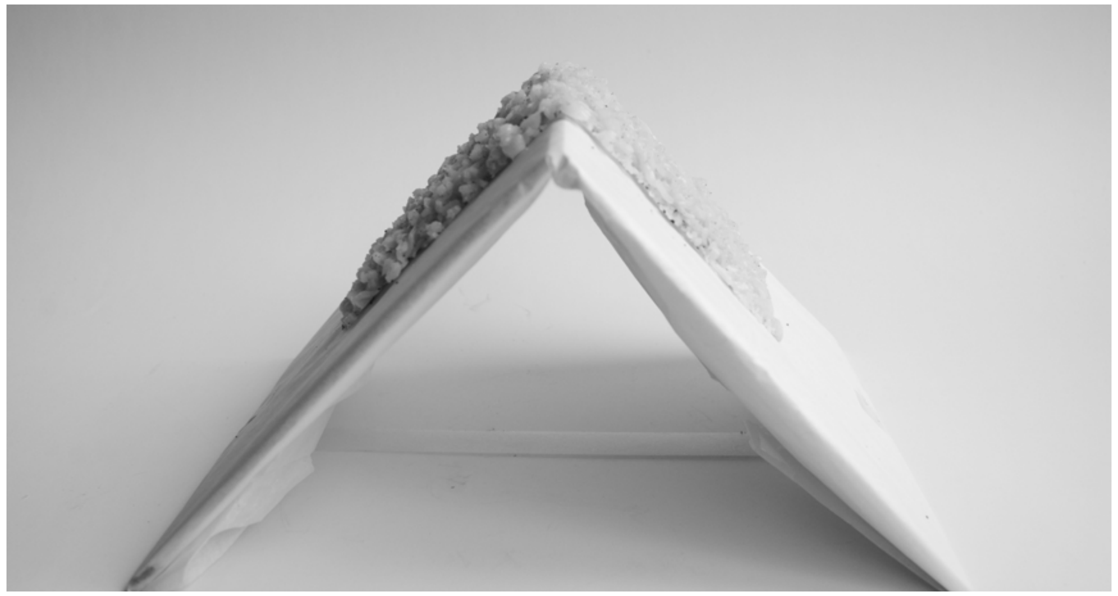
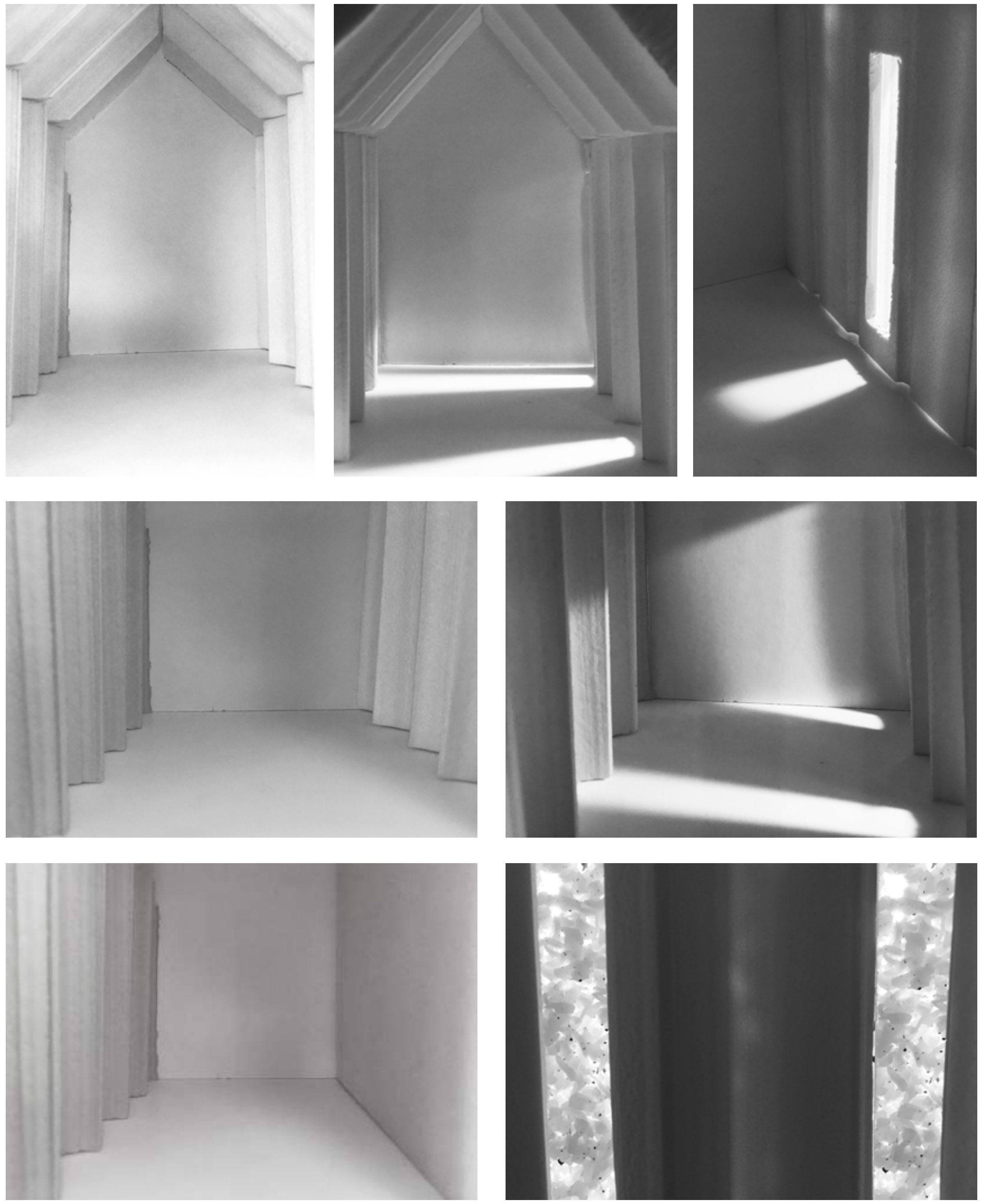
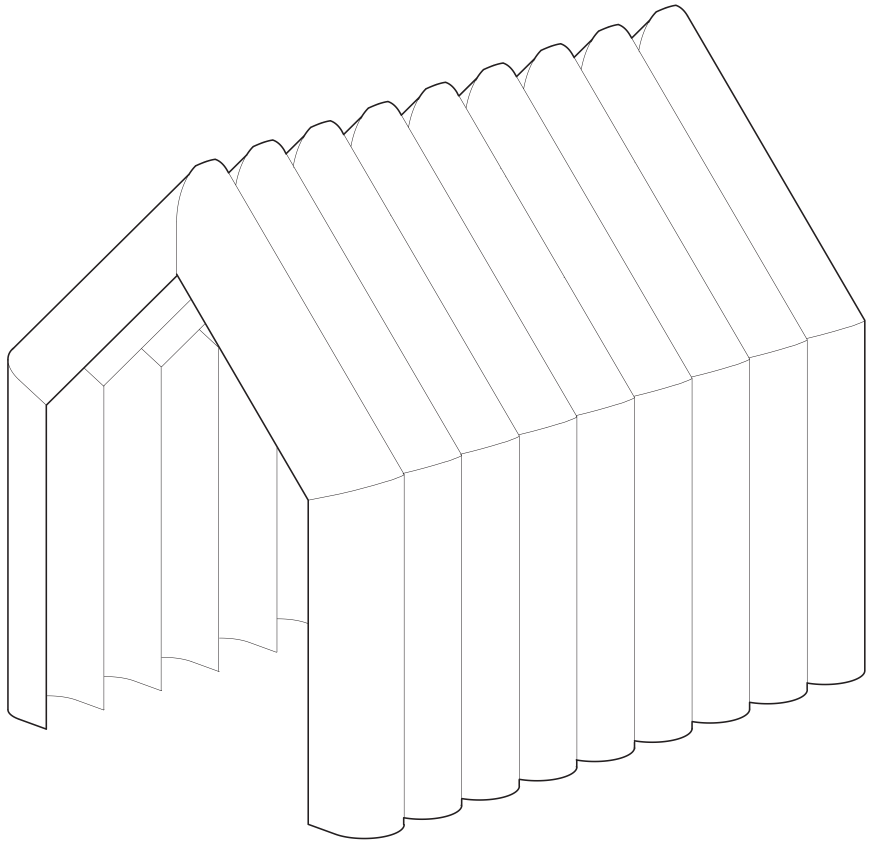


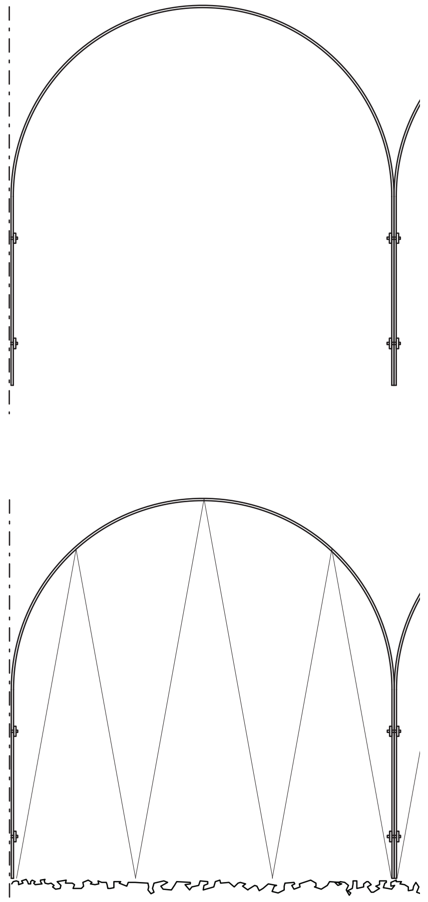
Photo of models. Here the plastic was heated in the oven on a flat surface for approximately 40minutes. When taken out of the oven, the plastic was bent at 90° and then left to cool. The result was successful in that the plastic remained in tact and feels strong. The crease creates a slightly curved profile unlike the sharp profile of wood.

PROFILE OPENINGS & DEPTH

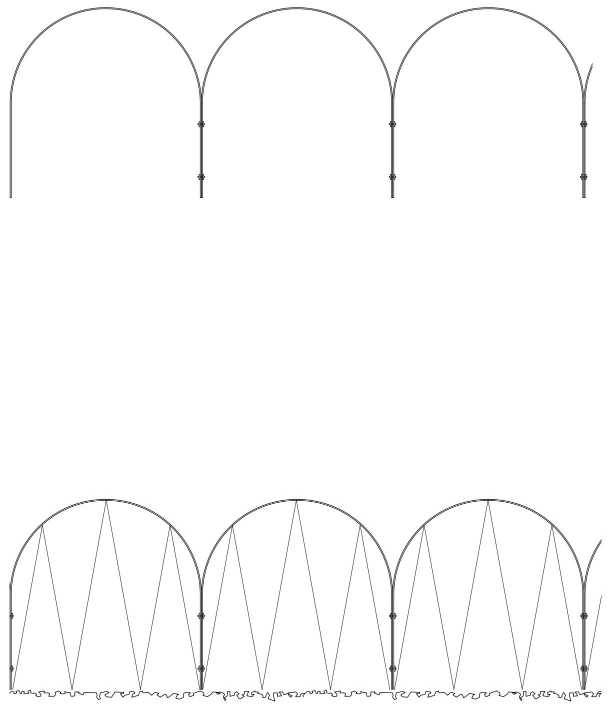


Testing the profile in a 1:20 model. A strong, predominant frame forms the space and creates a rhythm and repetitiveness. Introducing openings for light. Seeing how the light fills the space and creates strong lines. Testing one profiled wall and one straight wall. Introducing the outer shell of slump formed plastic as a veil outside the windows.





'Horizontal Detail 1 : 10 - Post bent panels



Horizontal Detail 1 : 20 - Post bent panels

BENT PROFILE VS MOULDED PROFILE

Formed compression mould or post-bending?

Considering the plasticity of the material, it would be possible for this profile to be shaped in different ways. Three possible ways were considered to form the plastic to create a ribbed, structurally stable profile. The first would be to use compression into a mould with that shape (which is the method most familiar with), alternatively one would forms a flat plastic sheet and then reheat and bend it into the profile afterwards. The last technique would be to create a planar plastic sheet which is bent without heat and held in place with for example a tension wire. The second and third techniques allows for a thinner profile which is likely to have more translucent qualities, however perhaps would not be as structurally stable.

Tests were conducted by reheating one of the experiment samples and bending it against a jig to make a 90° angle at both ends. The result was successful in that it was stable, although the surface was deformed where the plastic was bent and the glossy surface became matte and slightly rough. This method would rely on a separate profile to handle openings such as glazing and doors.

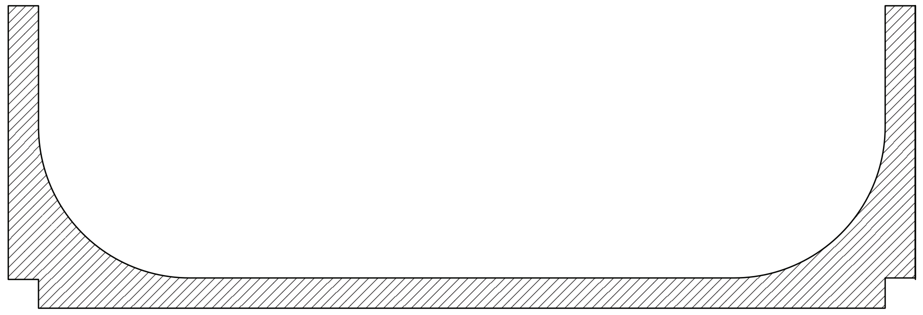
The chosen method of sorting the plastics, whereby hard plastics are sorted by colour and easily identified plastics such as PET bottles and polystyrene are eliminated, still leaves some uncertainty. As previously concluded, the majority of the plastics will be PE and PP but there is still a chance that other plastic types 'slip in' to the mix.

More experiments were conducted to test how to bend the plastic to achieve stability. When using an experiment samples that combine different types of plastic (PP and PE), there has been a tendency that the physical bond between the different granules cracks and weakens. The photos below show how the grain boundaries between the plastic granules appear, meaning that the plastic weakens. The PP granules almost pop out from the sample. This result, along with talking to the polymer experts at the Material Science department led to the decision that for best structural stability, the plastic will be formed into the profile using the first method, by creating a mould with the profile and using compression moulding. This means that the structure relies on physical mass and thickness rather than stiffness created by bending.

Structural capacity of bending sheets

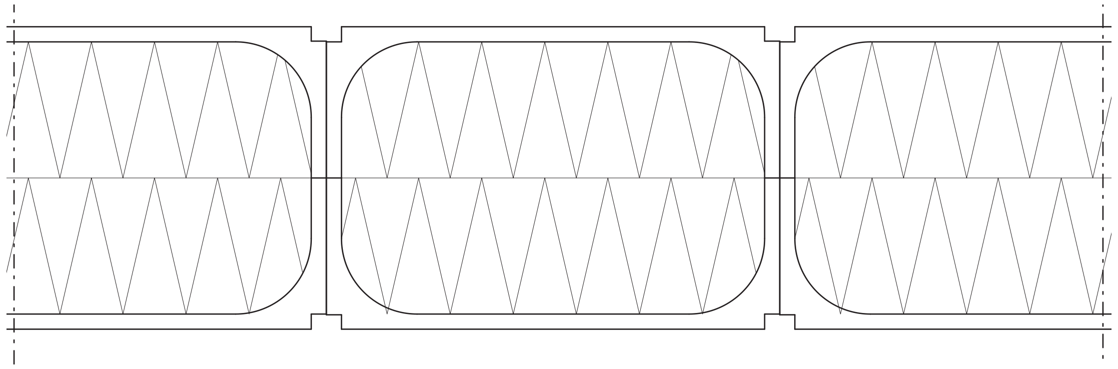
Bending the plastic sample using heat against and a 90° jig
The result - successful, although the plastic surface is tainted

Bending the plastic sample using a tension wire
The result - the plastic cracks and the grain boundaries imply weakness

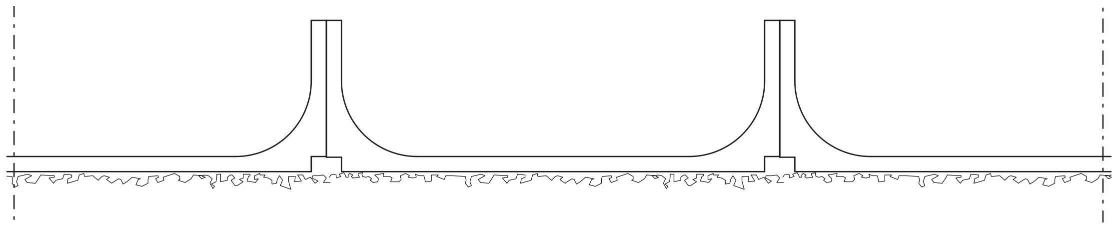


Cross profile - Repetitive module 1:5

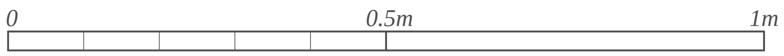
Module system - Window detail - 1:10



Module system - Floor detail - 1:10



Module system - Wall without insulation - 1:10



MOULDED PROFILE STUDY

Iterations of the repeated profile

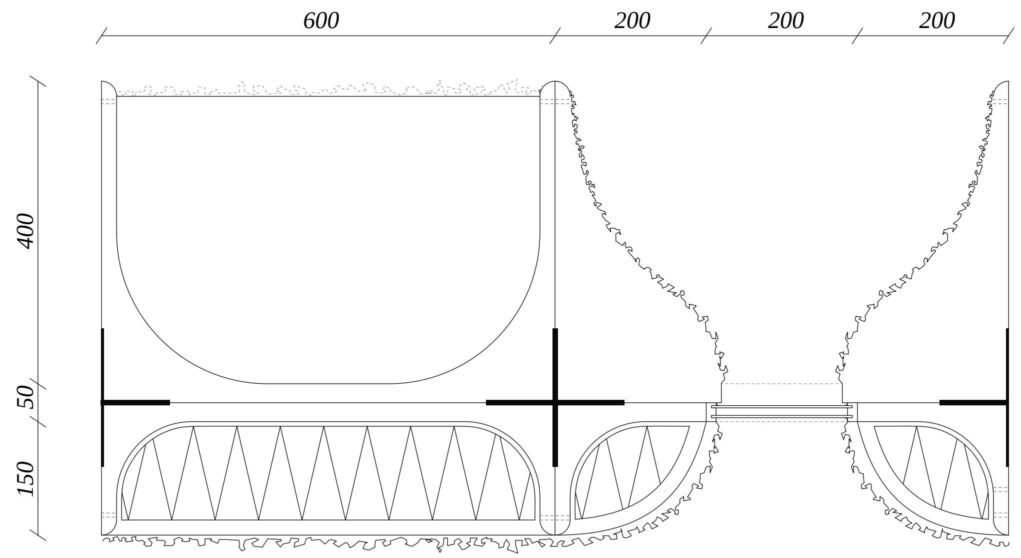
The aim of this study was to test using a module in different ways but having the same profile. By rotation it can be stacked differently to create different functions, for example window detail, floor or wall.

The ribbed profile in it self is stable and would create a structural stable system when stacked together and the ribs create a repetitive rhythm in the room. The visual tectonics are inspired by the sjöbod where the structure is prominent. The profile would be able to house insulation and other technical fittings.

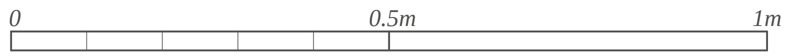
The first method and the detail shown on the previous 'H' profile however has some issues. It became clear that creating this form using compression moulding would be almost impossible due to its complex shape that extrudes in two directions. In order to successfully create this form, the mould would need to be filled vertically, which was deemed unreasonable due to the fact that the height is 2400-3000mm.

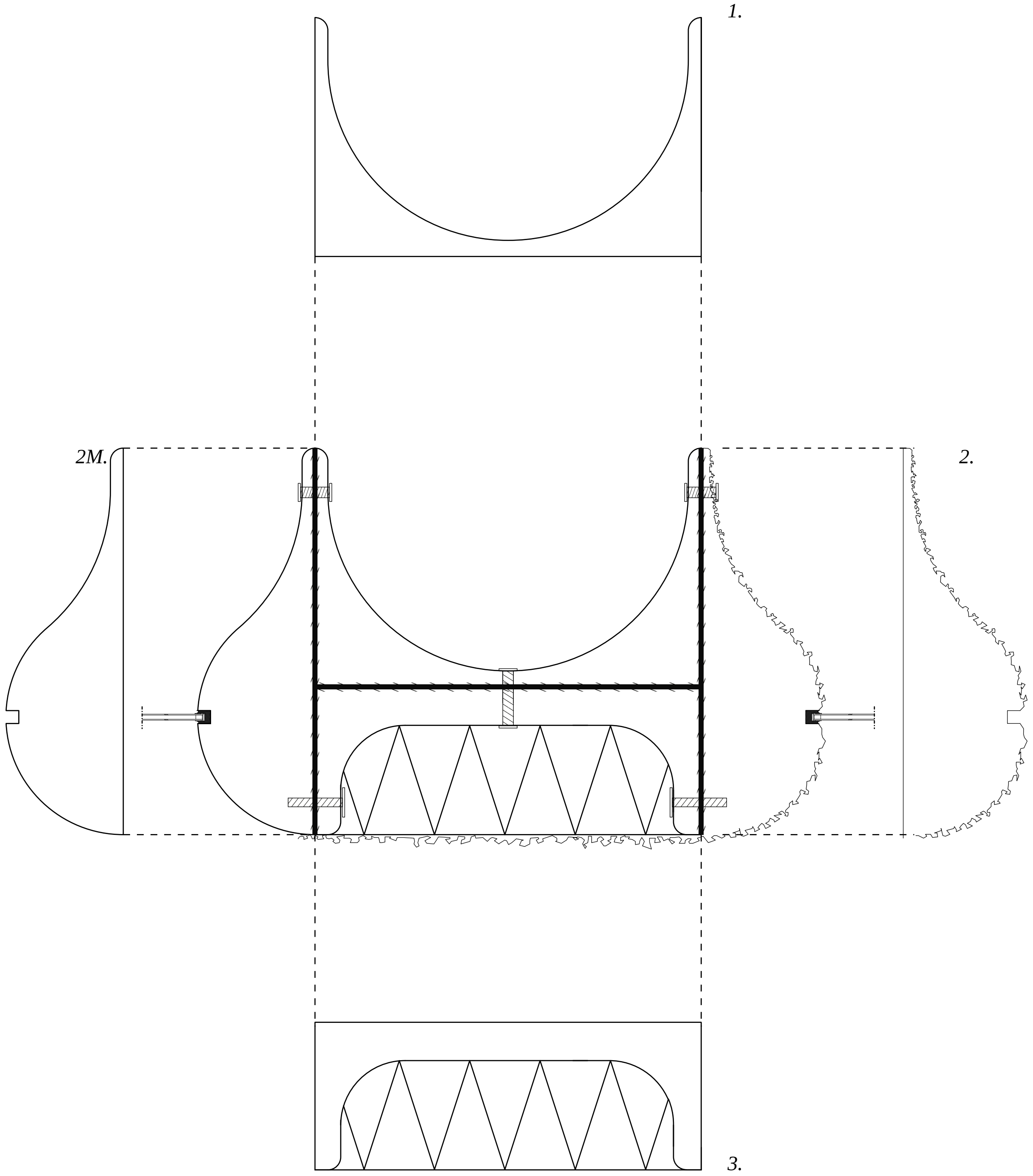
The detail below is an updated version of the previous 'H' profile but with some improvements. Here, the moulds have a more reasonable mould which from our knowledge believe would definitely be possible to make. The dark cross sections are the areas where the profiles could be glued together with a plastic adhesive or using heat the plastics could bond together by themselves. According to Greg Lynn, using adhesives to connect building elements together will likely have a huge impact on the way we build in the future, particular in bigger structures. If the modules were to use an adhesive, it replaces the need for screws, bolts and rivets (Howarth, 2016).

The detail below also shows how the slump formed exterior shell bends in to meet the window. This form is extended to the inside of the building as if the exterior slump formed shell seeps into the interior.

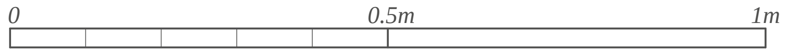


Horizontal Detail 1 : 10 - Compression moulded modules





Iteration of the module 3 pieces - 1:10



MOULDED PROFILE STUDY

3D PRINTED PROFILE

Scale 1:10 3d printed module

HOUSE OF TRANSFORMATION

HOUSE OF TRANSFORMATION

The second structures focuses on the transformation and deformation of the selected ocean plastics from former objects with a certain identity and function, to the new function that is has in our structure. This structure takes the concept of deforming and transforming the objects and translates it literally into a building that gradually transforms throughout the facade.
The driving idea behind this design is to very clearly tell the story of the transformation from waste to something with architectural potential while also highlighting the actual artifacts found in our ocean.

It is an open shelter that adapts to the undulating landscape and uses the natural rock as its floor. Here, divers can gather and discuss their plans before the dive or assemble their equipment. It can also be used as an educational space for example school classes visiting to learn about the marine life or ocean plastic.

Inside the space, it may feel quite cave like in one end with irregular shapes that transforms into an open, strict space at the other end, where the wall doubles as a white-board. The overall form has the same typical boat shed profile when seen from the walkway but is distorted when seen up close.

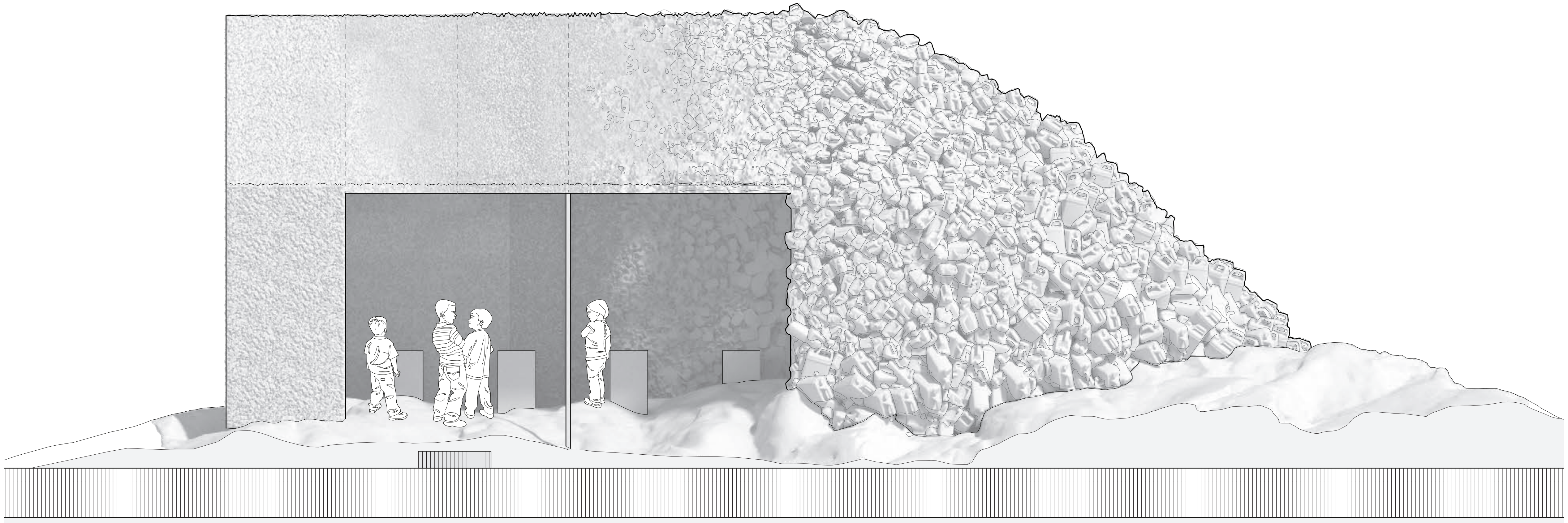
The concept behind the fabrication is that the jerry cans in whichever state they are in from whole, halves or smaller pieces - are heated against a flat surface, leaving each piece with a flat base. This base can then be assembled against another base - flat against flat. These are hot welded together on a thin mesh that is custom cut to the structural frame on which it is then assembled onto on site.

The structure opens up to the pathway and outdoor space. The walkway next to this building floats out into the landscape, filling in the void between the islands that today act as a barrier between this building and the main island and instead creates an open, outdoor gathering area.

To adapt all of the designed structures to the site, The 3D-scanned model of the site was used to adapt all of the three structures to the site and could be developed further if this were to be built.

In time, the idea is that this building will become an integrated part of the landscape since the algae and lichen growing on the rocks will gradually grow onto the structure. Ocean plastic is, arguably, already a part of nature as this project only moves these objects from the beach onto land. As Timothy Morton, says in his book 'Ecology without Nature' - 'We're going to have to admit it; we're stuck.' We must love the toxic world in all of its ugly beauty". He also states that we have a habit of putting nature on a pedestal and admiring it from afar. But by admiring and describing nature without plastic waste, are we not only ignoring the problem? How is this doing the environment any favours? This building would be a rather bold statement in the landscape, but in time, the plastic and landscape will likely live in symbiosis, and arguably, the plastic goes back to its original state of being a part of nature.

1. *Introduction & educational sheltered space*
2. *Deformed jerry cans*
3. *Supporting mesh*
4. *Hidden structural column*
5. *Slump moulded panel*
6. *Smooth panel - white board*
7. *Seating adapted to landscape*
8. *Walkway and step adapted to landscape*

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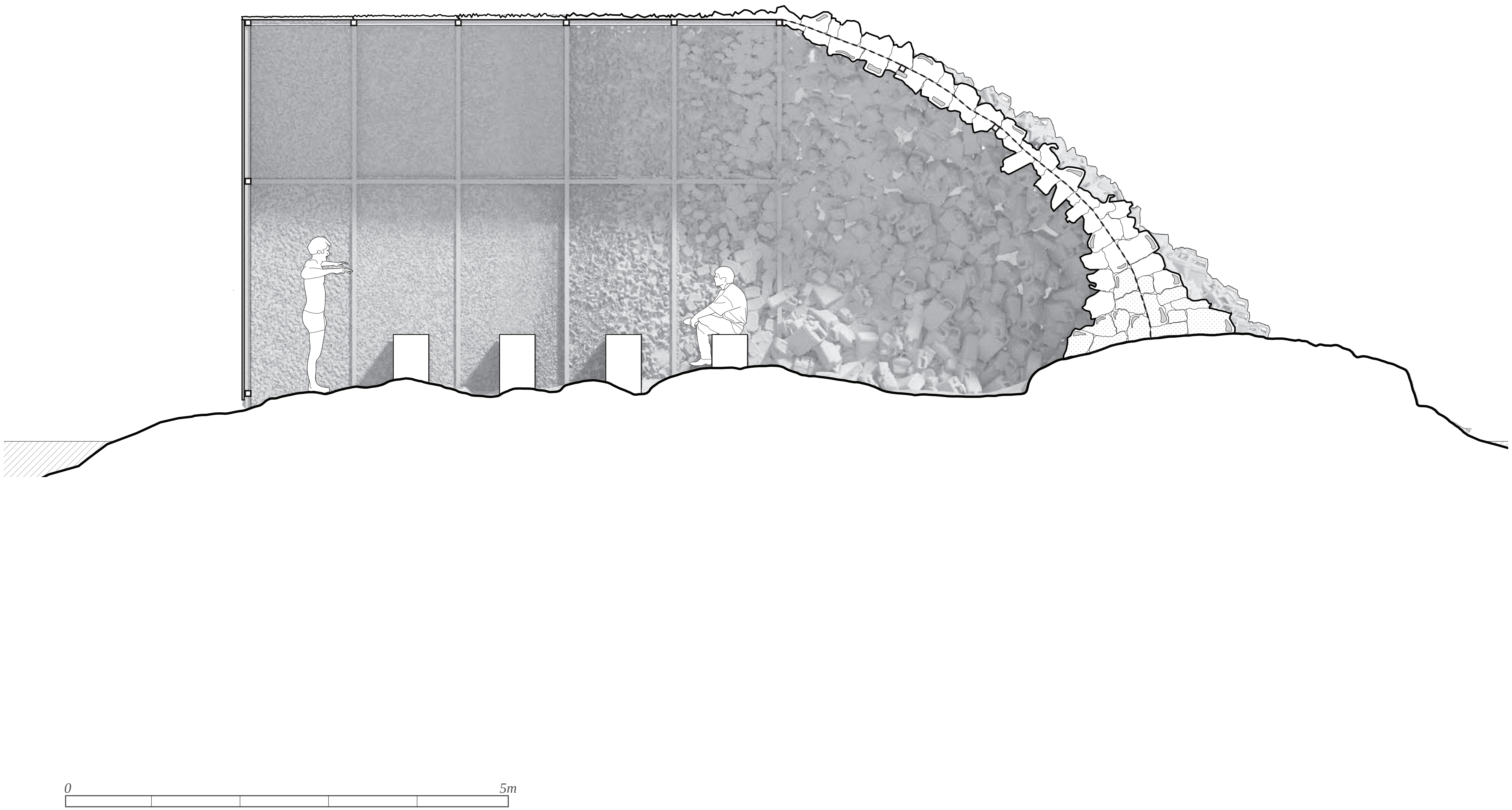
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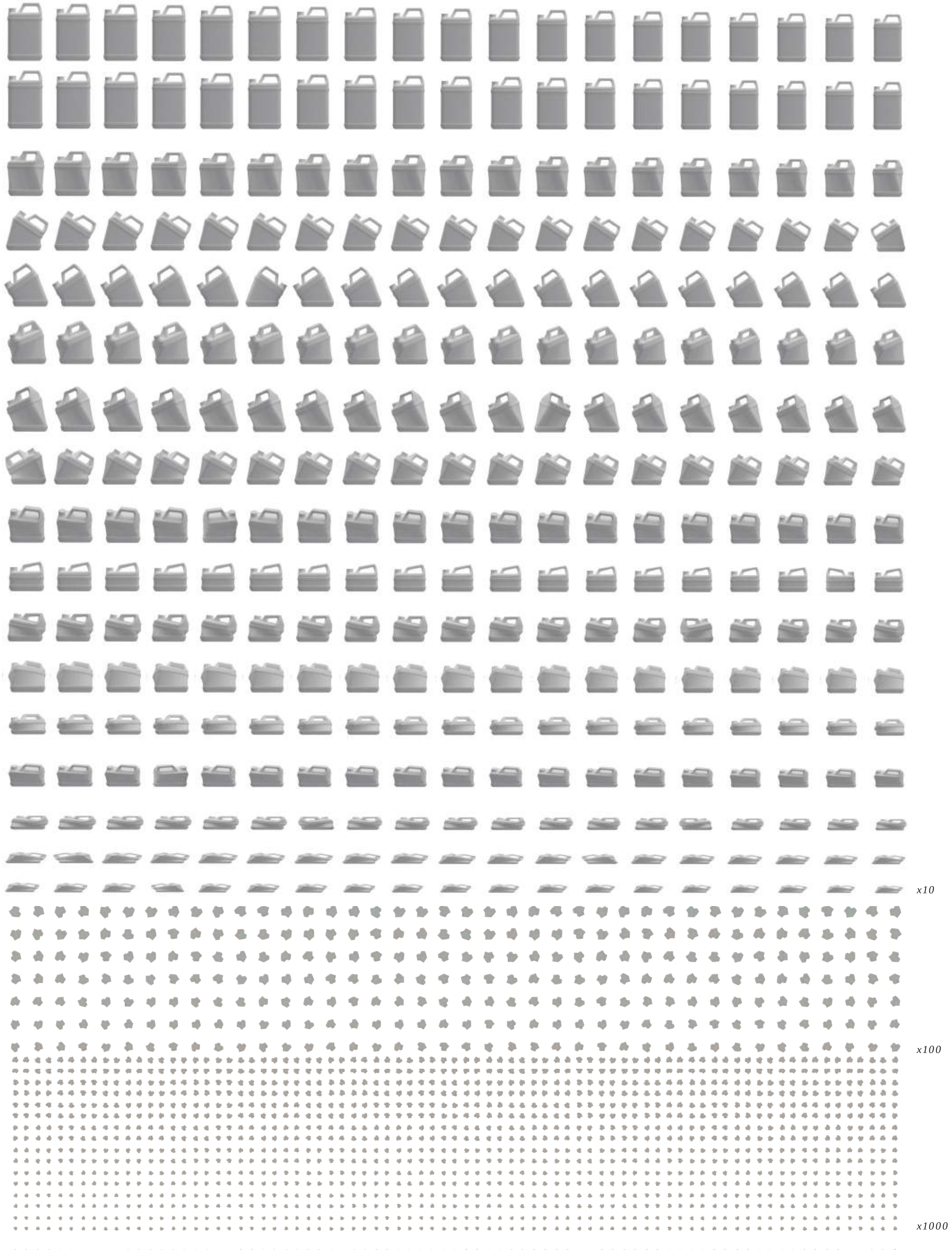
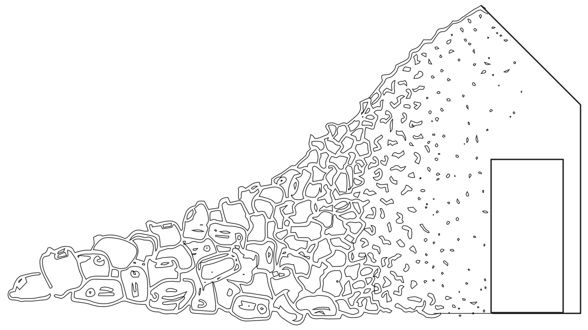
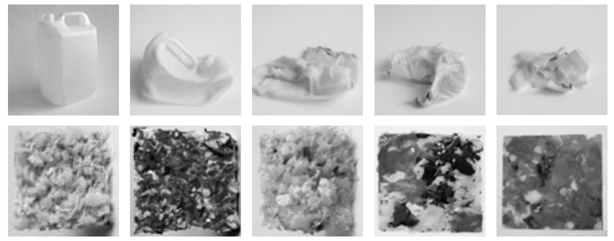
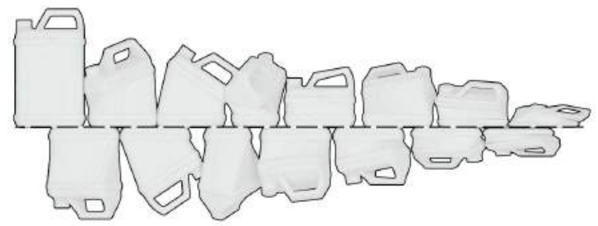




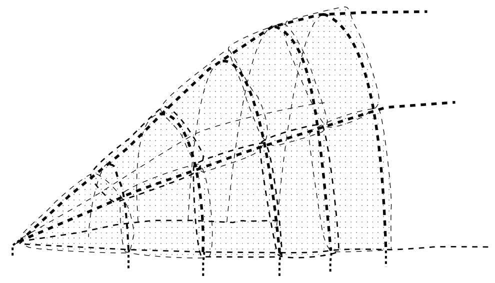
Transition from plastic waste into a building



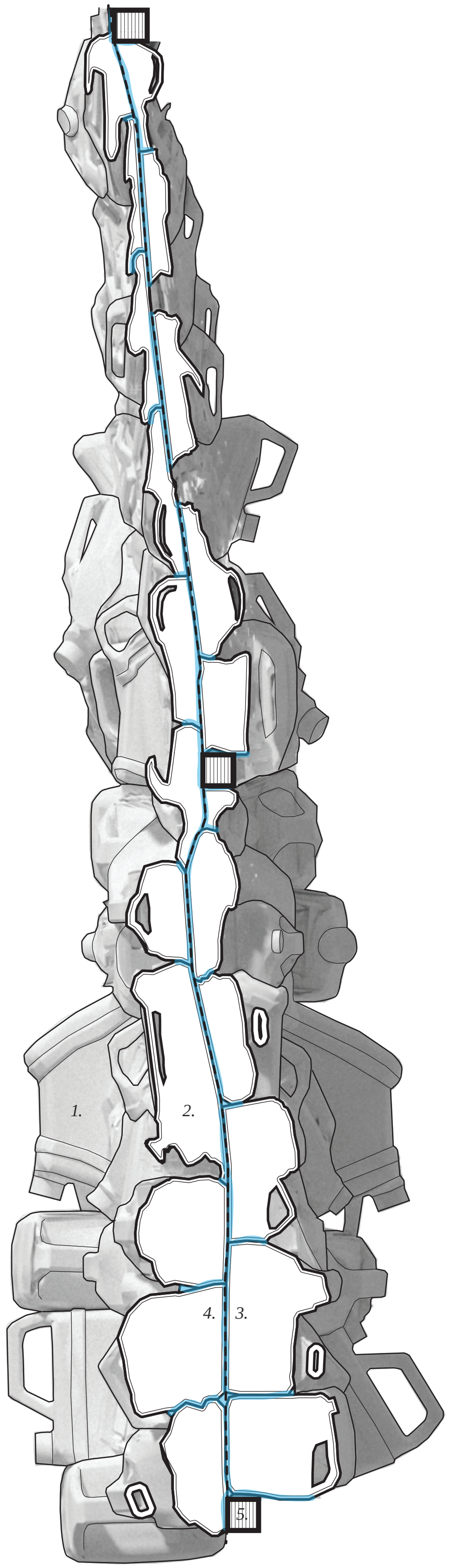
Whole / part of objects slump moulded with incremental degree of deformation

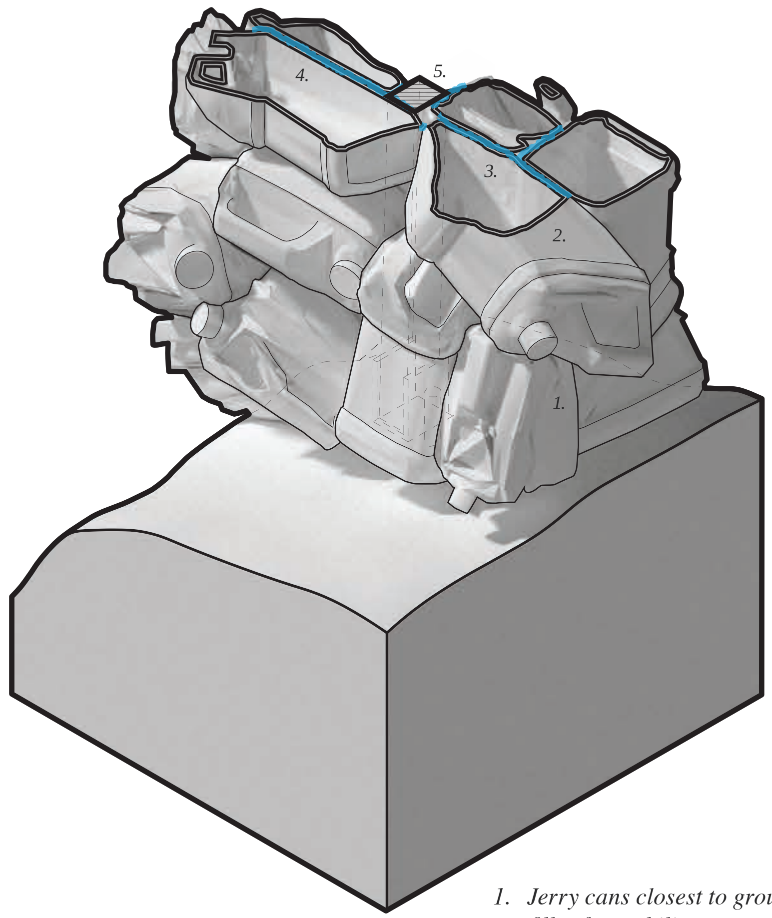


Objects organized by size and degree of deformation hot welded together with assisting mesh in sections

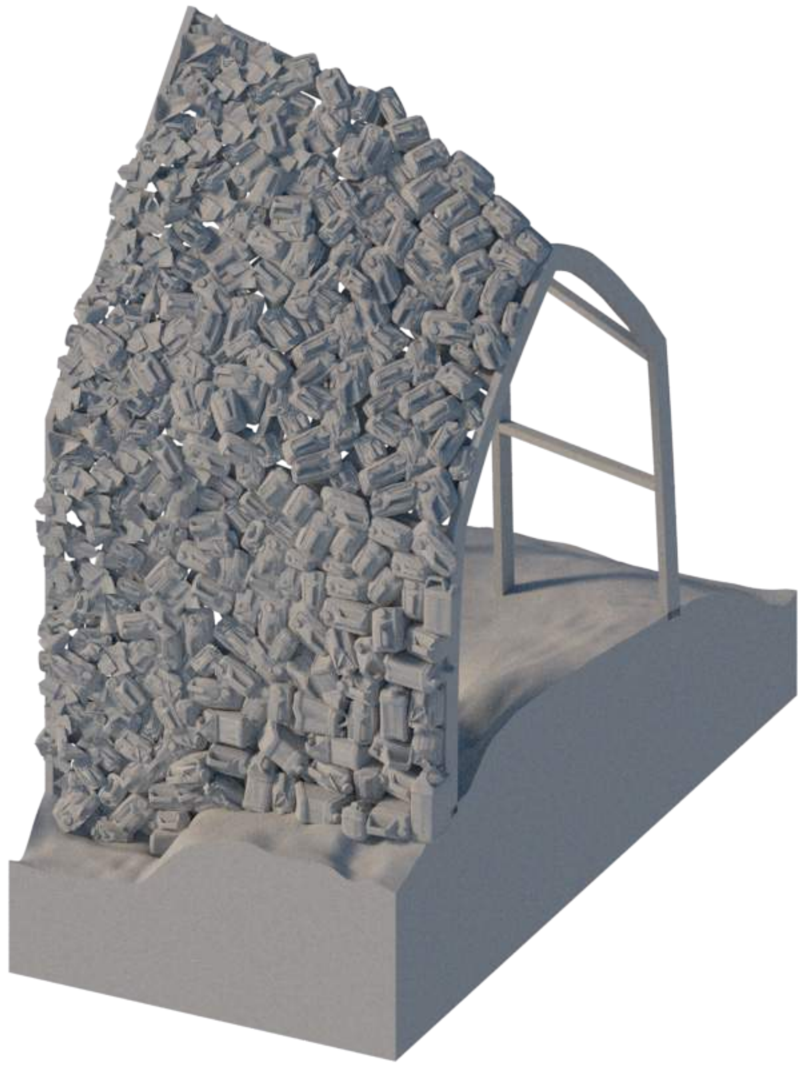


Mesh sections assembled onto structure (on site) and structural columns secured to landscape





1. *Jerry cans closest to ground filled with sand/ filler for stability*
2. *Deformed Jerry Can (degree of deformation varies)*
3. *Hot welded join*
4. *Assisting assembly mesh/net*
5. *Structural Column*



PROCESS

House of Transformation

In order to generate more feasibility for this construction, there needed to be more investigations into the assembly technique and rules or guides needed to be defined for how to stack the jerry cans together.

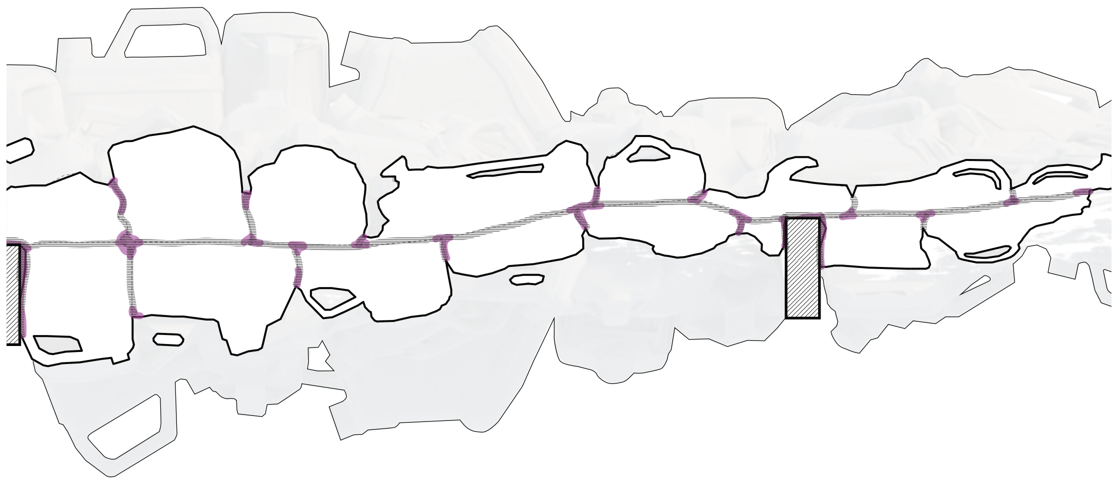
Using Rhino and Grasshopper, a representational model was created by mounding jerry cans. At first they were positioned randomly but after many iterations and studies, rules and guides were established in order to create feasibility and refine the design. Studies were conducted that tested different assembly techniques to see how they would alter the overall appearance, eg, stacking whole jerry cans at the bottom and then gradually deforming them the further up they are stacked.

Using Grasshopper, the number and size of jerry cans used in the structure could be defined and played with in order to create the final form. Although these studies were purely representational, the overall form could be adapted to use any types of objects found on the shorelines.

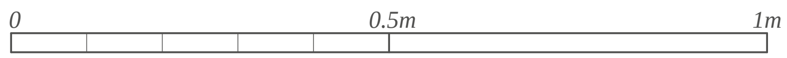
The studies resulted in a few options creating a gradient from bigger, whole jerry cans that gradually increase in deformation and become smaller along the facade, both in x and y directions.

To start with tests were carried out digitally, using quick renders to see the results. Once a few variations were established, the 3D printer was used to print an array of different sized and deformed jerry cans which were then manually assembled to test how this process would actually work if it were to be scaled up.

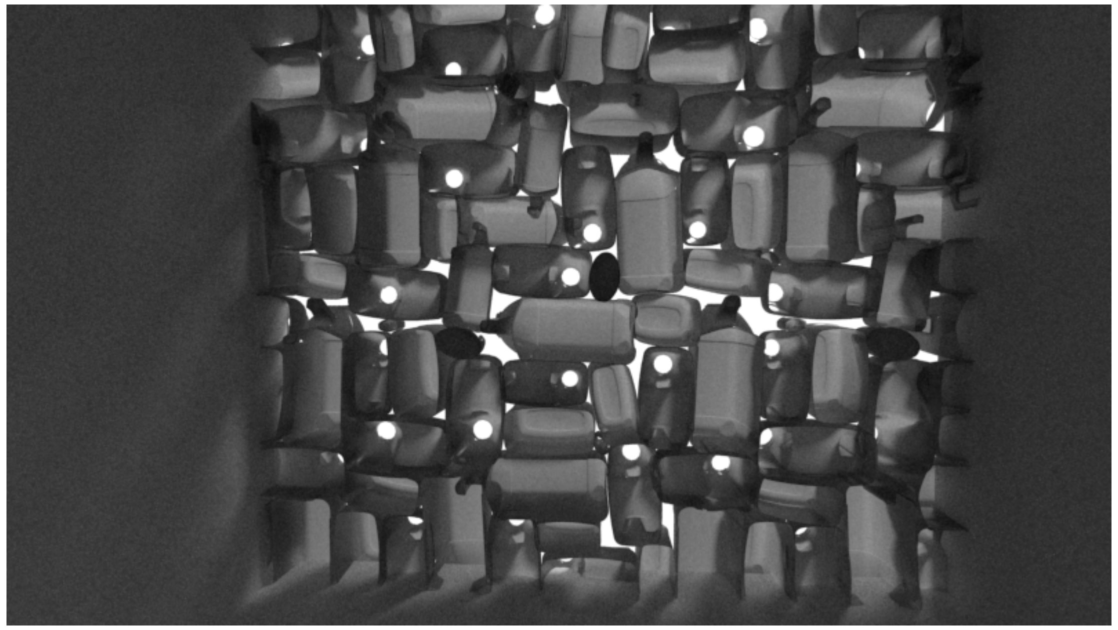
The technique used to deform the jerry cans, slumping, means that no pressure is involved. Since the object lies on a flat surface when heated, there will always be one flat surface of the object when the deformation is complete. By utilizing this effect and by stacking flat surfaces against each other, there will always be a sufficient surface that can be used to hot weld them together. By hot welding the pieces together stability is achieved and once a few pieces are welded together into a cluster, they can be mounted onto a grid structure.

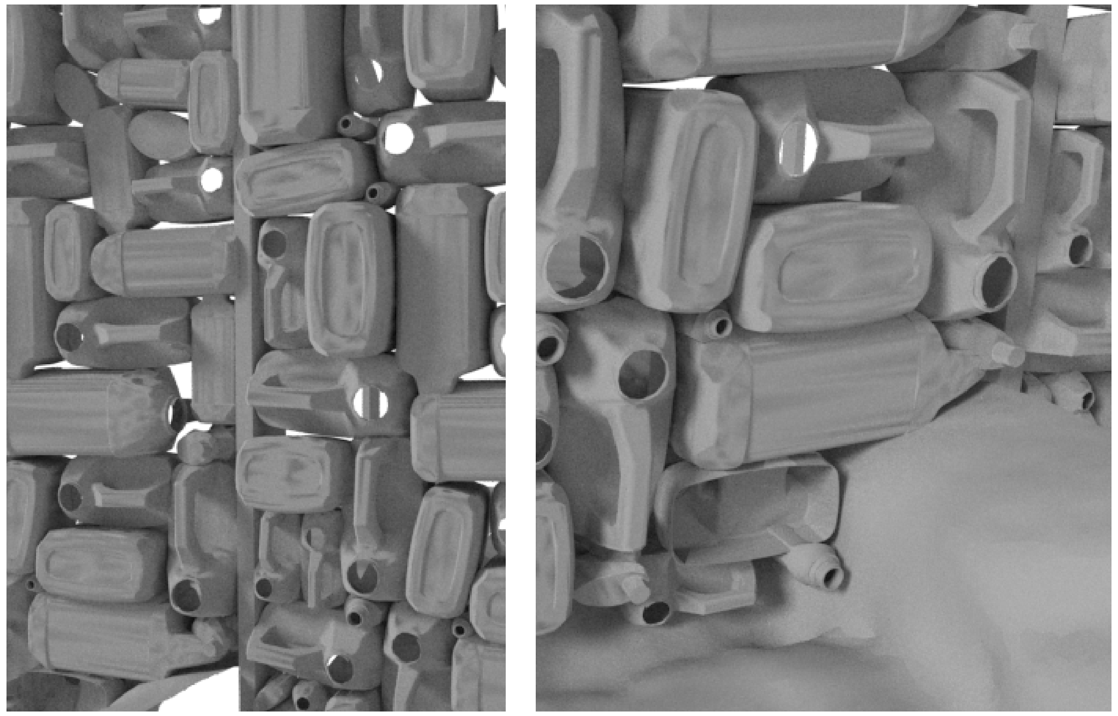


Horizontal Detail 1 : 10 - Flat surfaces achieved from slumping method are hot welded together with the next.

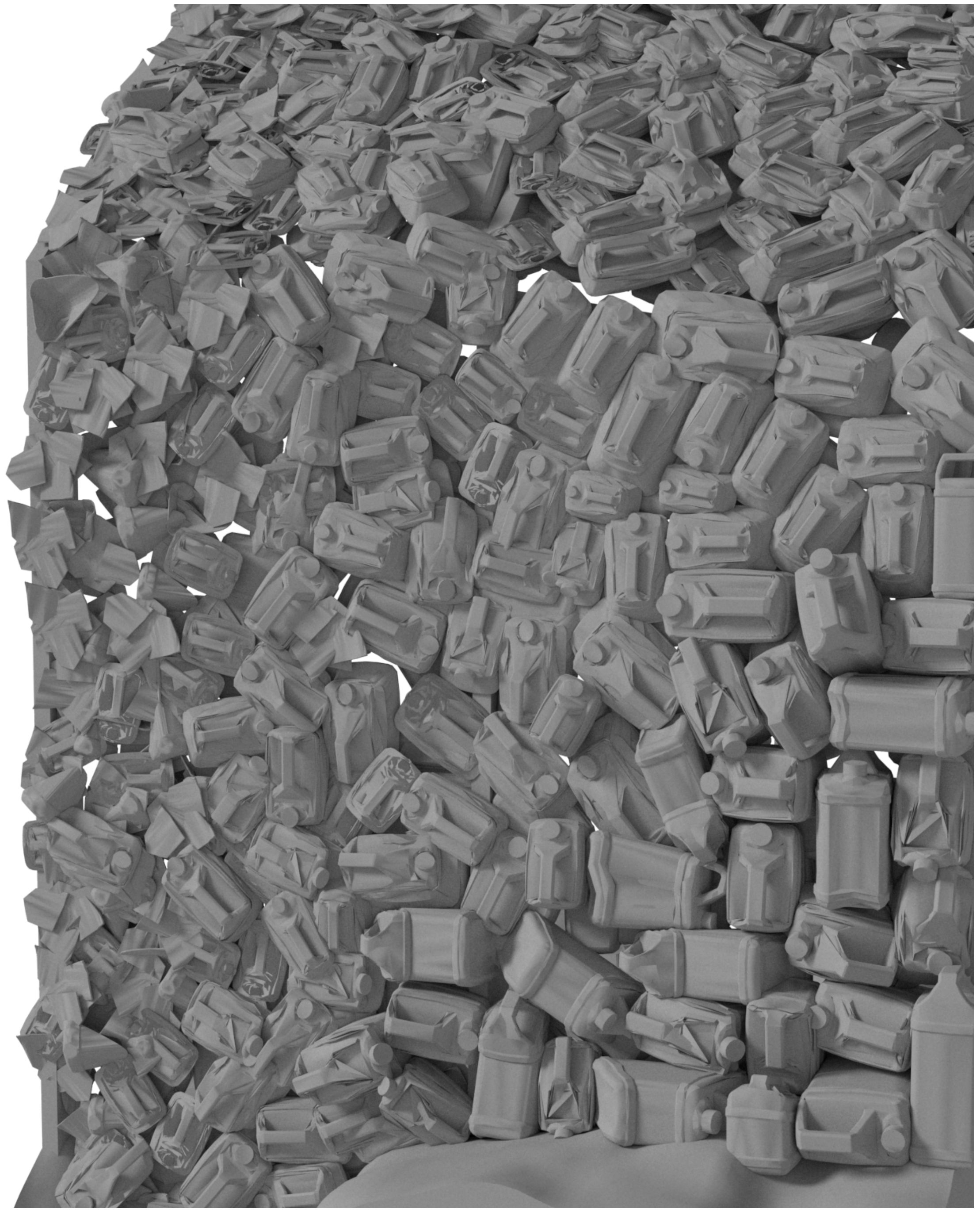


JERRY CAN STACKING SYSTEM

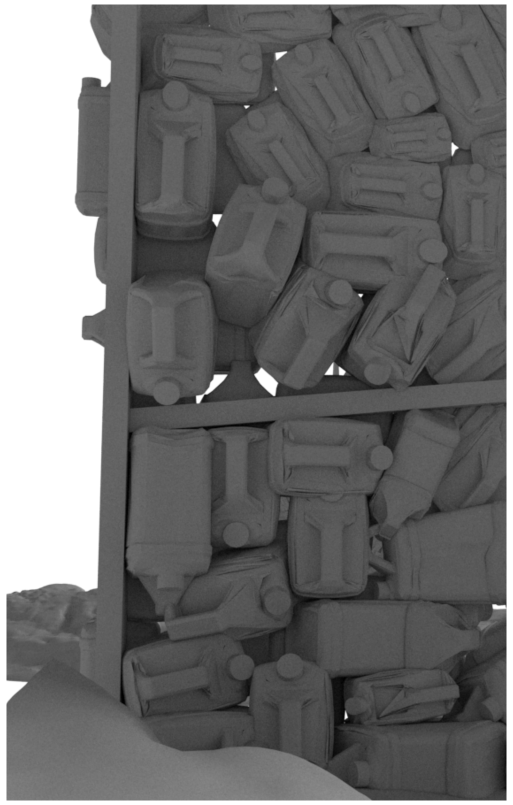




Testing different jerry can assembly systems. Stacking different sized jerry cans. Adapting them to the uneven ground where they will be positioned. Testing the lighting effect and different structural systems.



JERRY CAN STACKING SYSTEM



Quick renders testing different assembly variations and secondary structural systems.

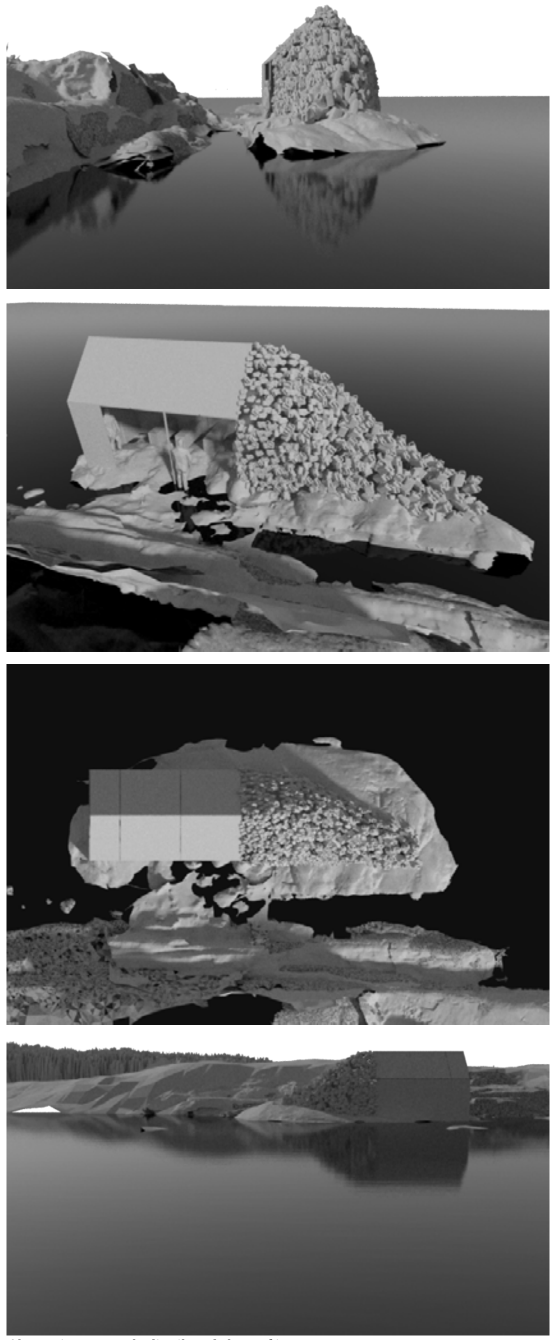
3D PRINTED MODEL

Scale 1:10 3D printed detail

FORM STUDY

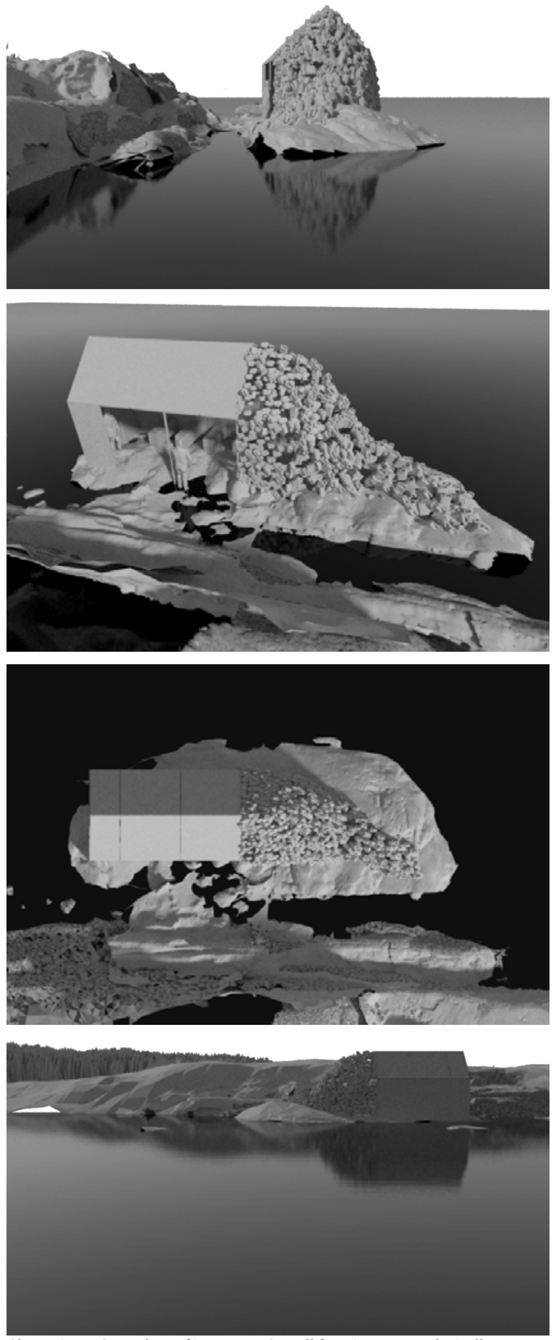
View from path (arrival) / *Overview in perspective* / *Plan view* / *View from the ocean*

Alternative 1



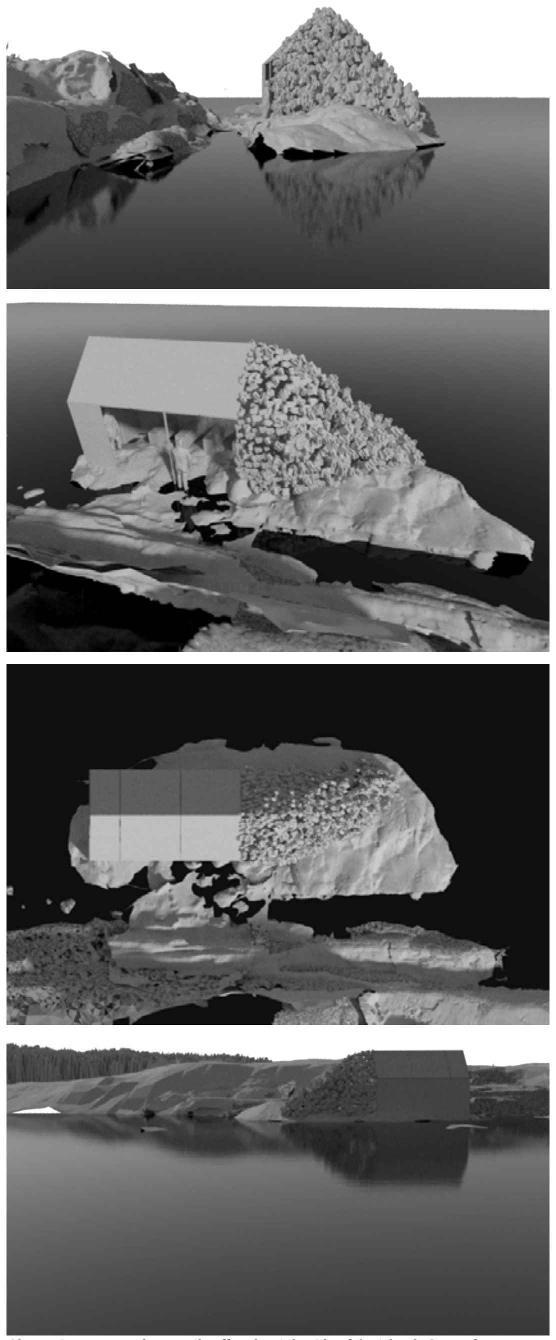
Alternative 1: Evenly distributed slope of jerry cans.

Alternative 2



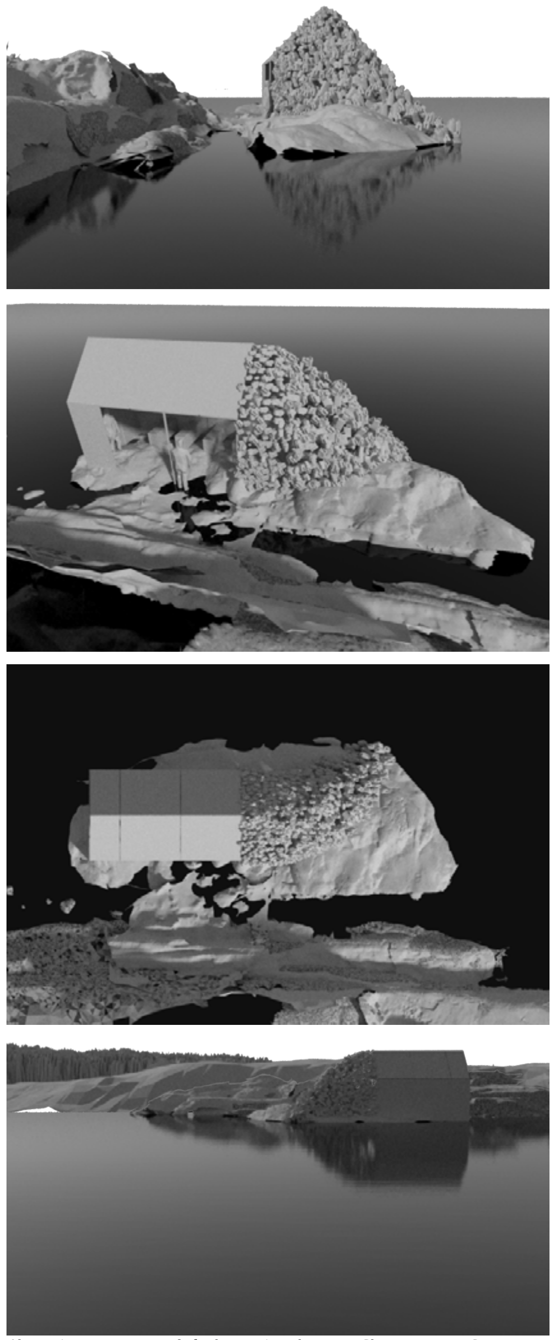
Alternative 2: Steep slope of jerry cans. Overall form is not as aesthetically pleasing. Tails off to the left side of the island.

Alternative 3



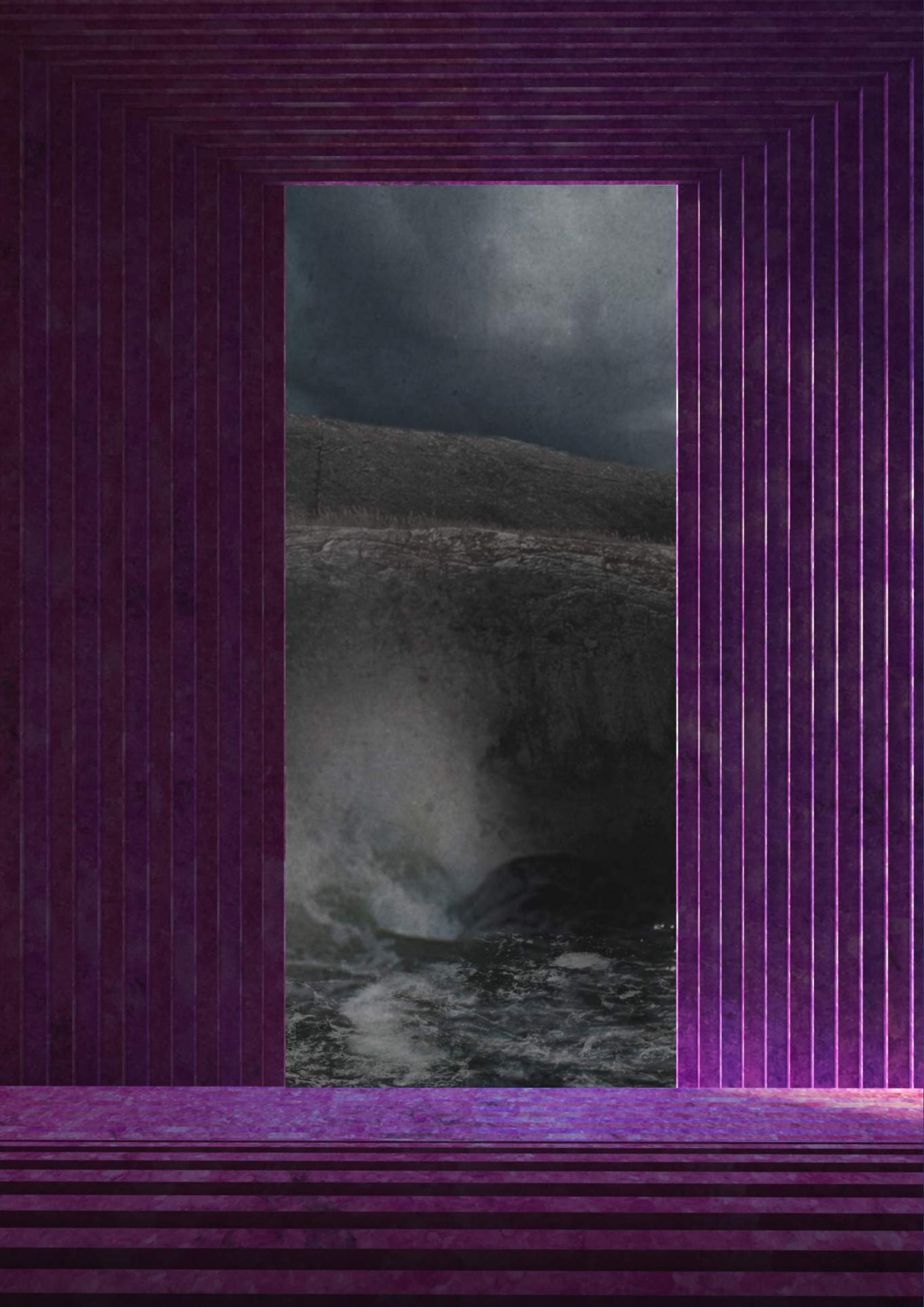
Alternative 3: Even slope. Tails off to the right side of the island. Grows from the waters edge. Outdoor space created in front of building.

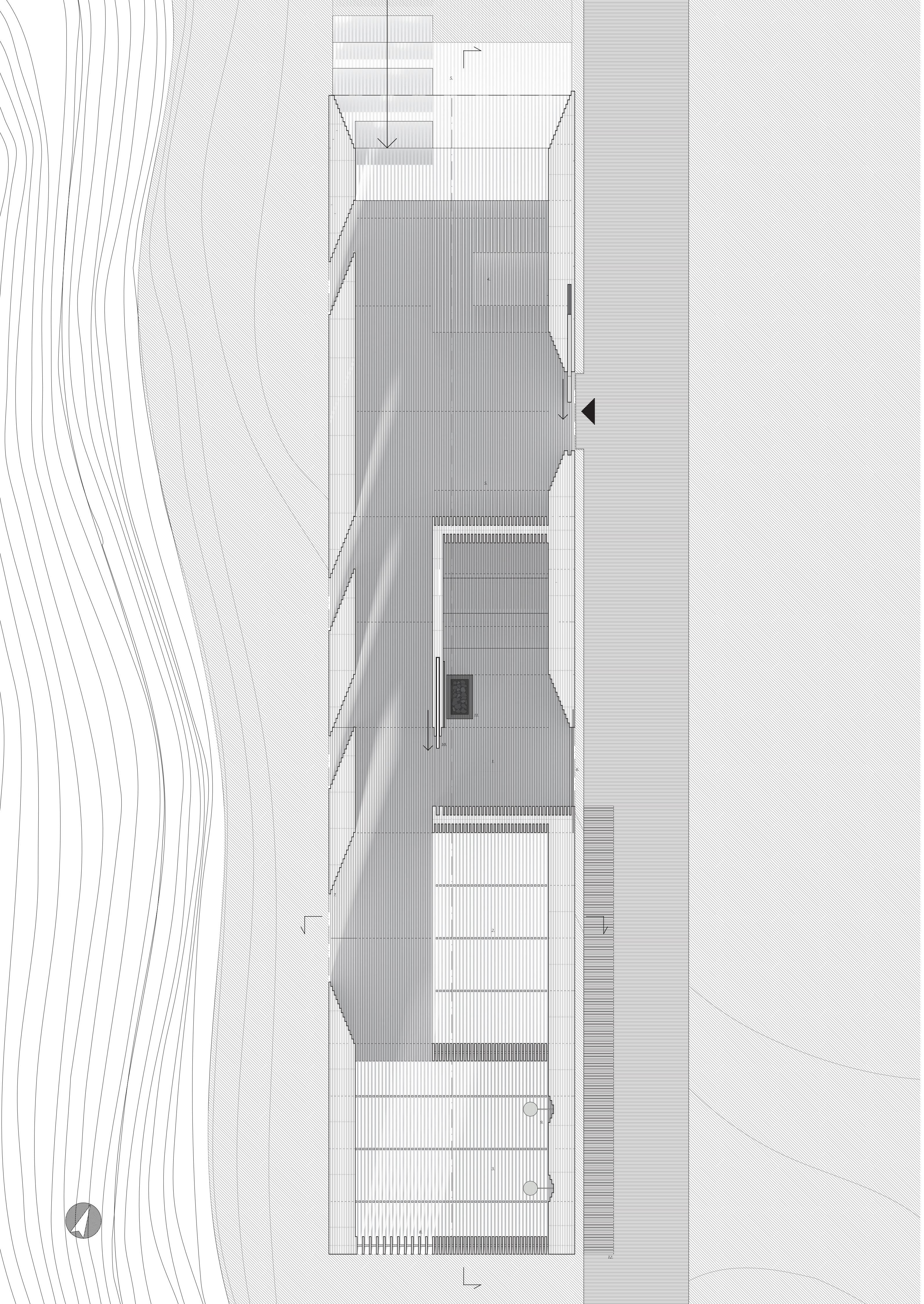
Alternative 4



Alternative 4: Form extends further out into the water. Clearer concept. Space in front of building opens up towards the path (path not shown in this plan).

HOUSE OF COLOUR



HOUSE OF COLOUR

In the last building, the potential of using the variation of colors found in plastic objects from the ocean is showcased. Instead of becoming a part of the landscape like the other two buildings will become over time, the intention is for the last building to create a bold contrast the surroundings, really making a statement in the landscape.

By sampling colors from the surrounding landscape and then inverting them digitally, a palette of colors to use was established (see colour studies on page 241), The building gradually changes color from one end to the other, dividing the building into different zones and creating different atmospheres using compression moulded ocean plastic panels.

The program of this structure is a sauna with shower and reflections spaces. The concept of this construction of the building comes from the local geological phenomena called dike swarming. Over millions of years different types of rock has been compressed into layers stacked next to each other, creating visible layers and long lines of rock across the islands. This is a very strong characteristic of the site today inspired the construction technique.

The plastic panels and stacked next to each other and joined primarily by tension rods meaning that the building could possibly be deconstructed and reused when its purpose has been fulfilled.

Furthest inside the building are the showers, more secluded from the public spaces. The floor and walls are connected with rebars and bolts that creates distances between each panel that lets light into the space as well as allowing water to flow through. Niches in the showers draw attention to the contrasting plastic colours and highlight the shower faucets.

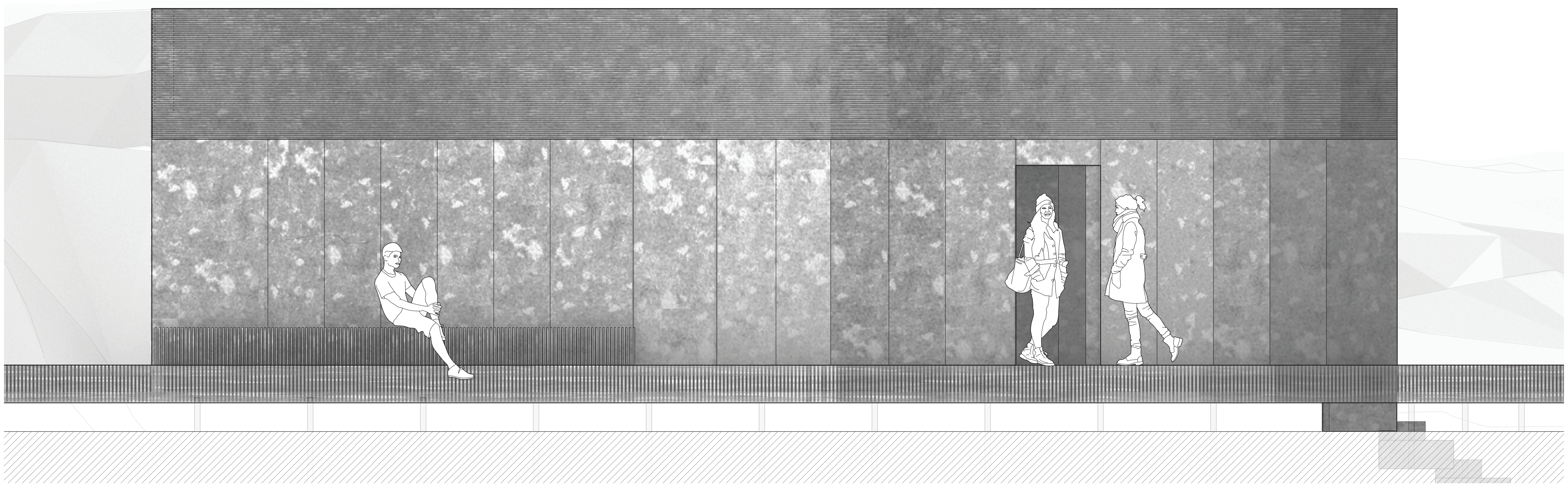
The stacking principle allows for layers to be peeled off to create openings and to frame views. This is used for example in the reflection area to draw focus to the environment outside and the waves crashing against the rock.

The panels are overlapped like a variation of the finger join where all panels lie in the same orientation. This allows for seating to be connected into the walls. The doors are also integrated into the walls as pocket sliding doors.

The building opens up completely to the ocean with a wide stair becoming a social area for eating and hanging out but also a natural entry/exit point to the water for divers and snorkelers.

1. *Sauna*
2. *Seating & Reflection space*
3. *Showers with ribbed floor allowing water to flow through*
4. *Social sitting space*
5. *Entrance bench*
6. *Thin translucent panel*
7. *Wall tapering to frame landscape*
8. *Ribbed wall*
9. *Shower niche in wall*
10. *Pocket sliding door*
11. *Sauna heater with protective sheet behind*
12. *Bench intergrated into walkway*

0 *5m*

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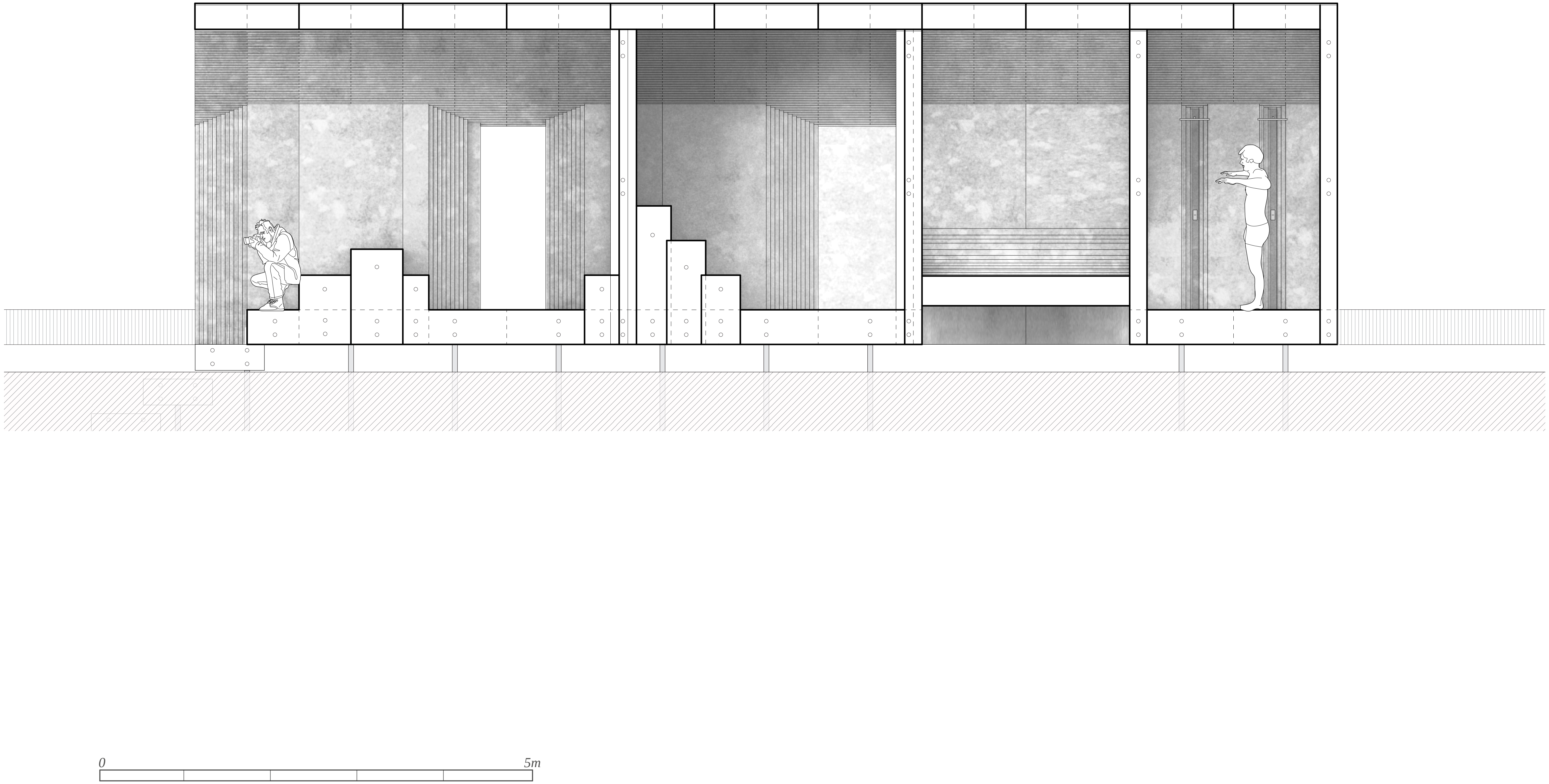

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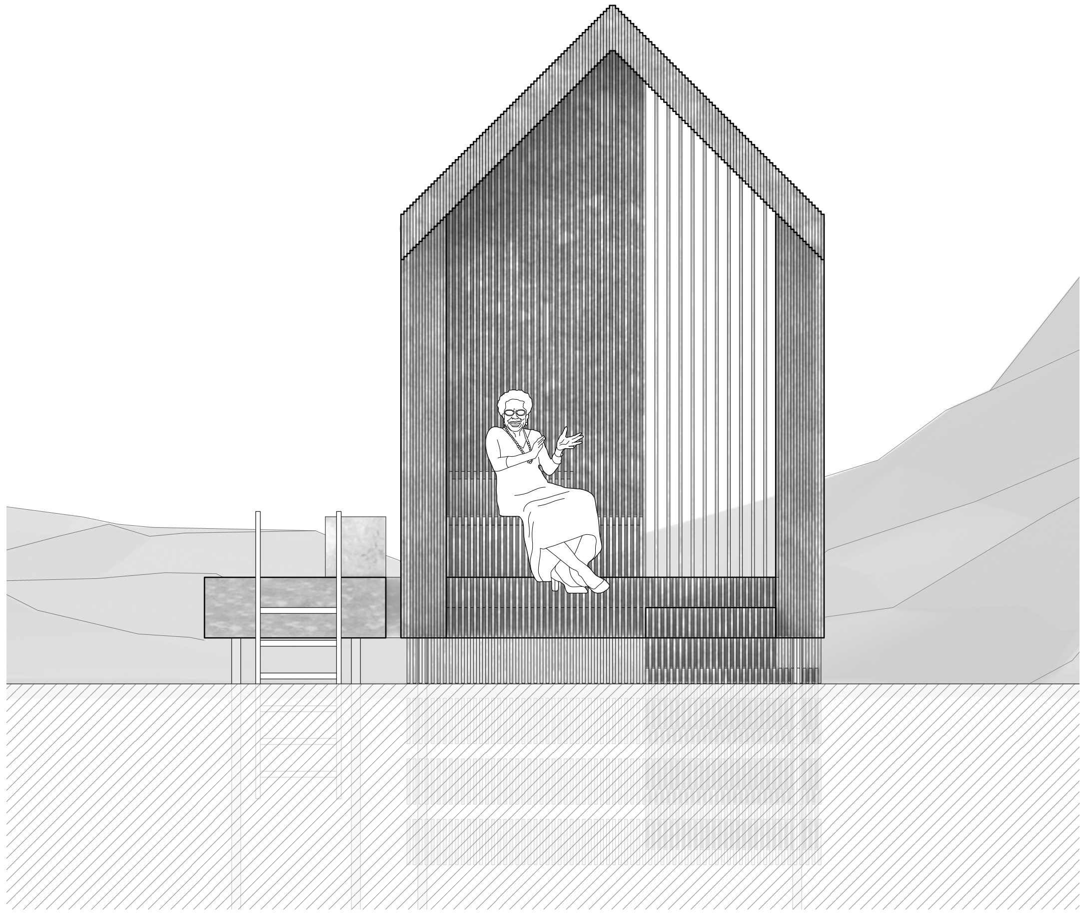

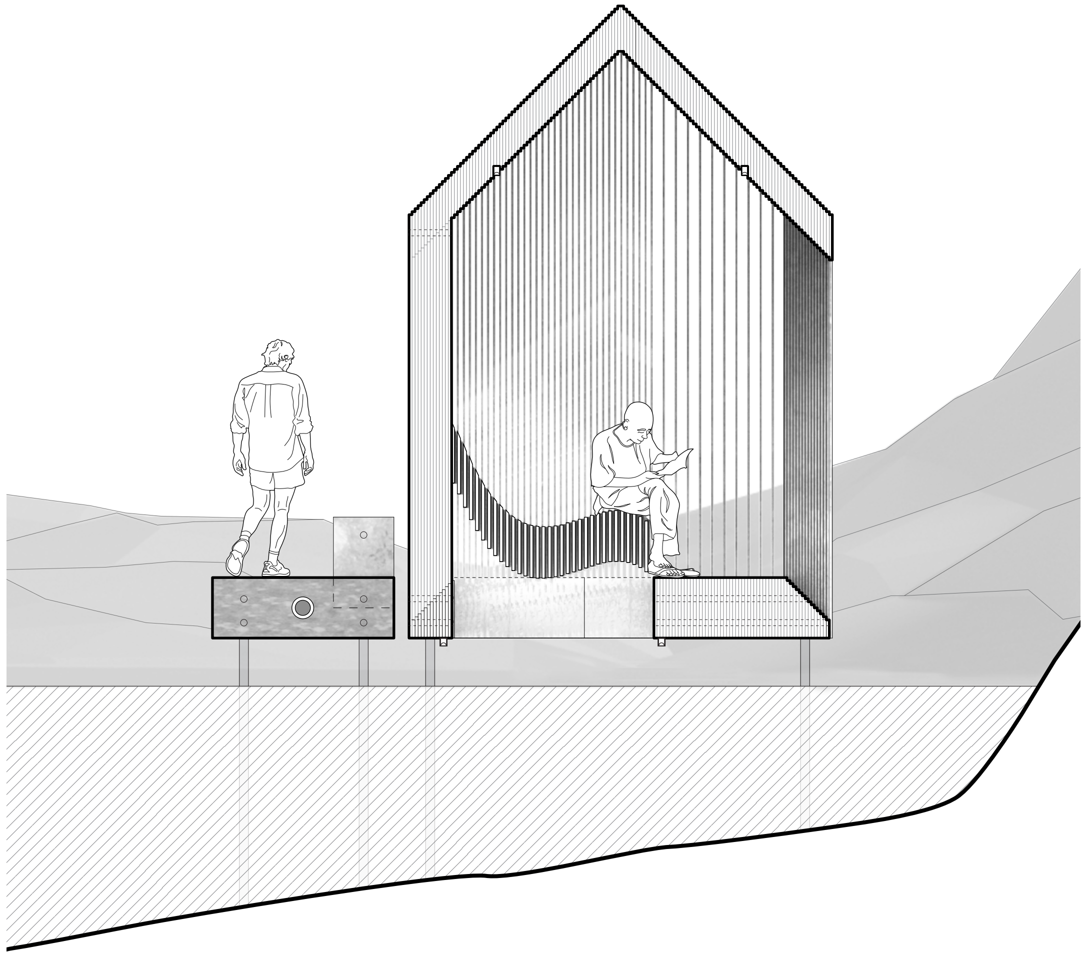


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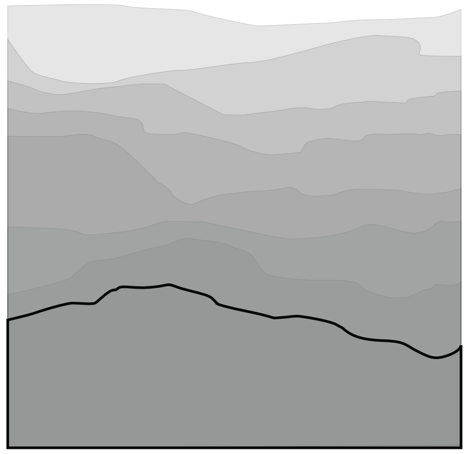
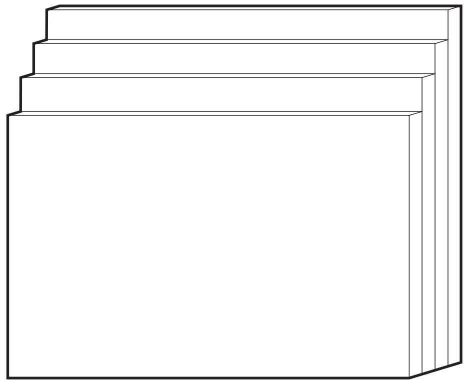
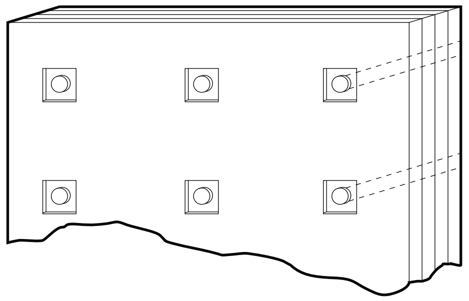


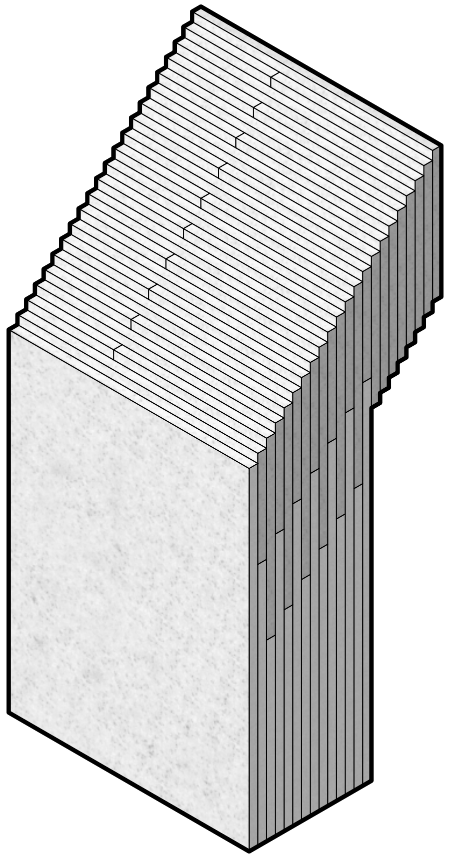
Construction and assembly inspired by the geological phenomena, dike swarming, found on site.



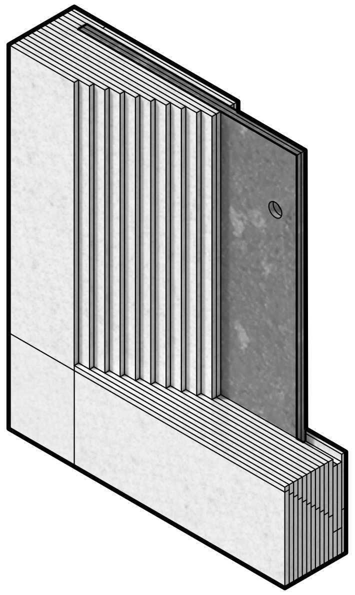
Compression formed ocean plastic panels are stacked like the rock slates in the walls, floor and roof constructions.



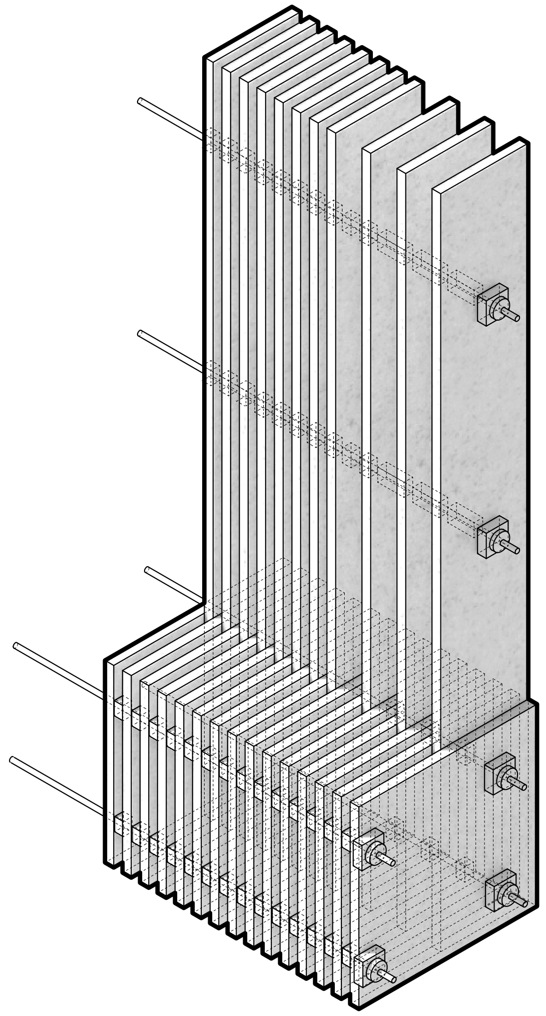
A similar principle is used for the pathway that connects all of the structures. Here they are custom cut to fit the landscape and are held together with tension rods.



Roof / Wall connection



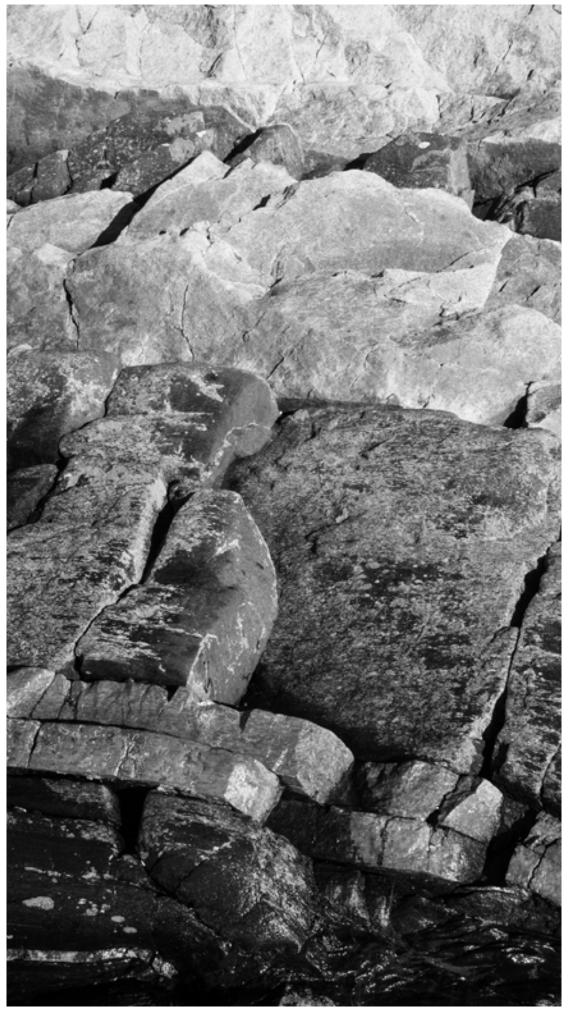
Integrated Door Detail
Peeling off layers



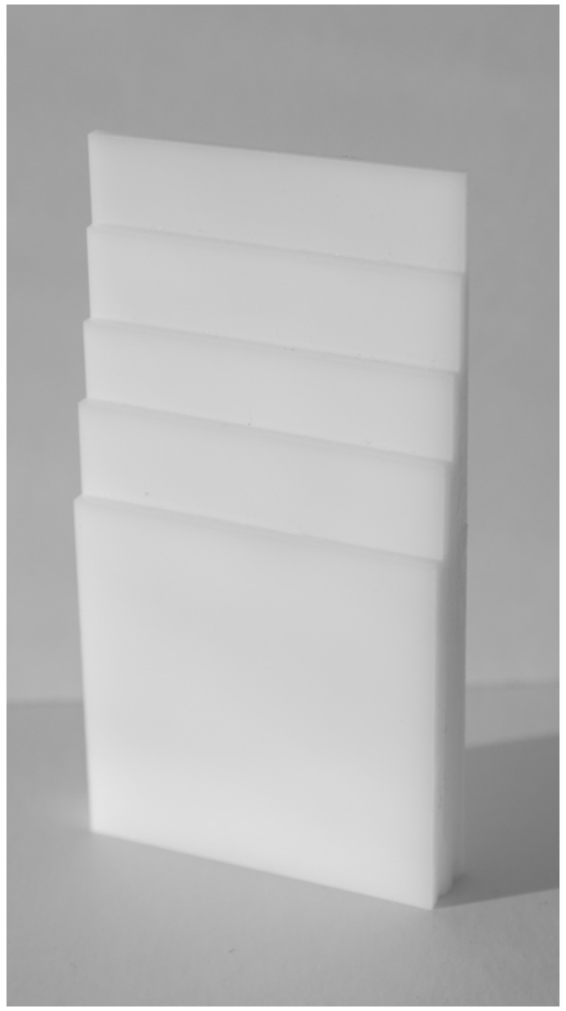
Ribbed Wall / Floor Join
(Shower detail)

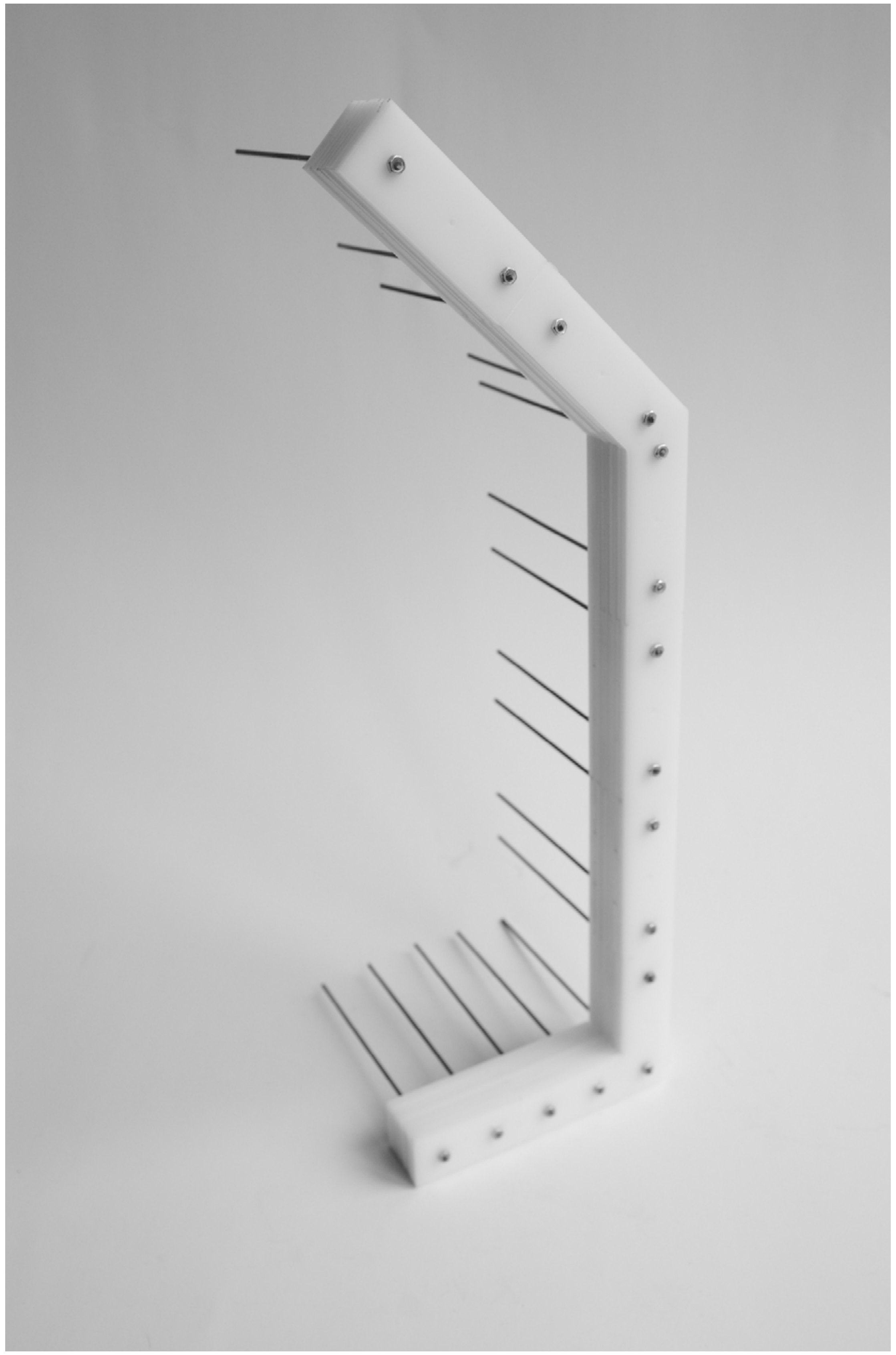
PROCESS


Dike swarming on Koster island. These photos are from the immediate Proximity of the site. Different colours and thicknesses of the rock characterizes the area.


Layers of different types of rock stacked by geological movement throughout time.

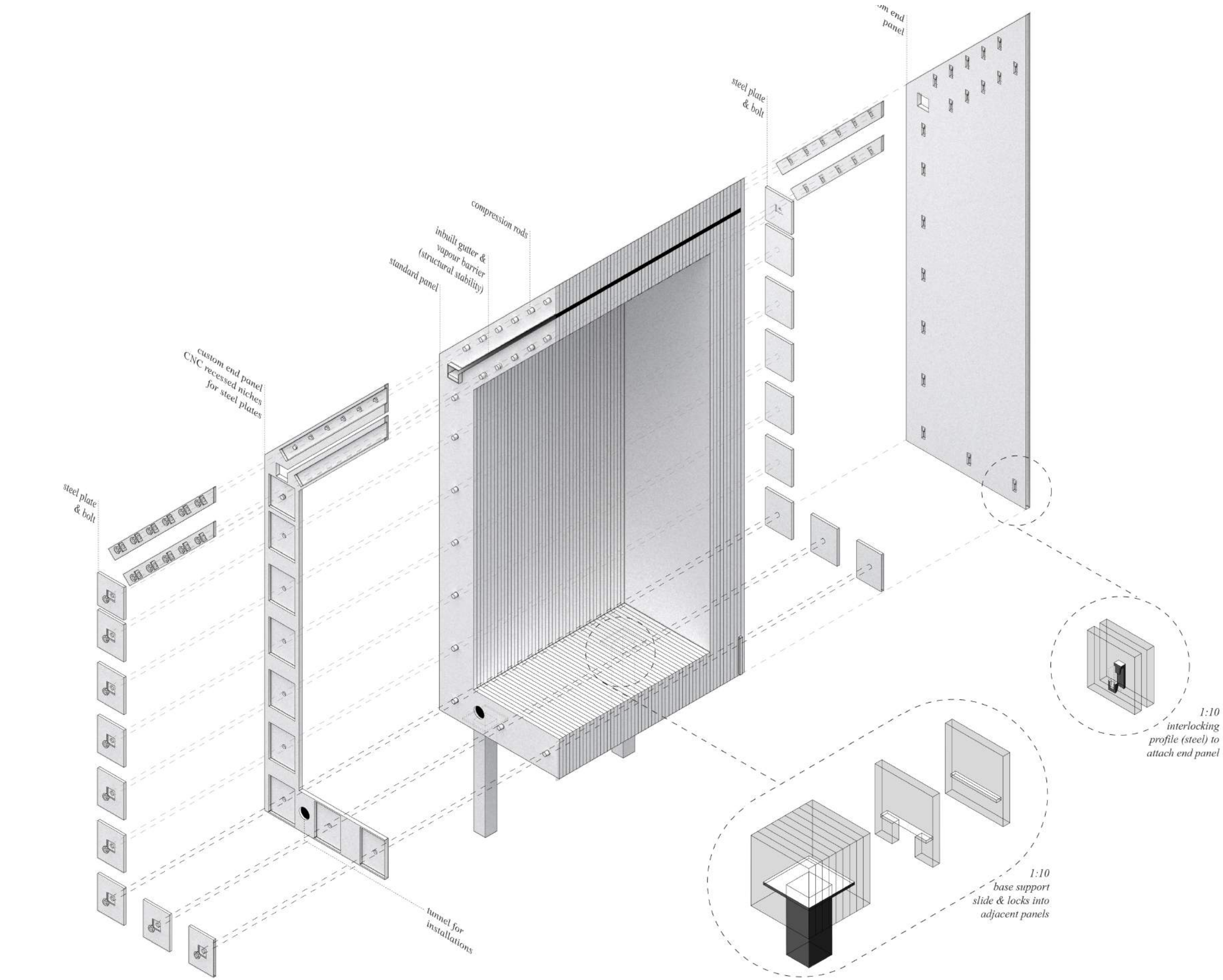

The most common types of rock is diabase and granite.


Physical model study of Stacked Sheets concept

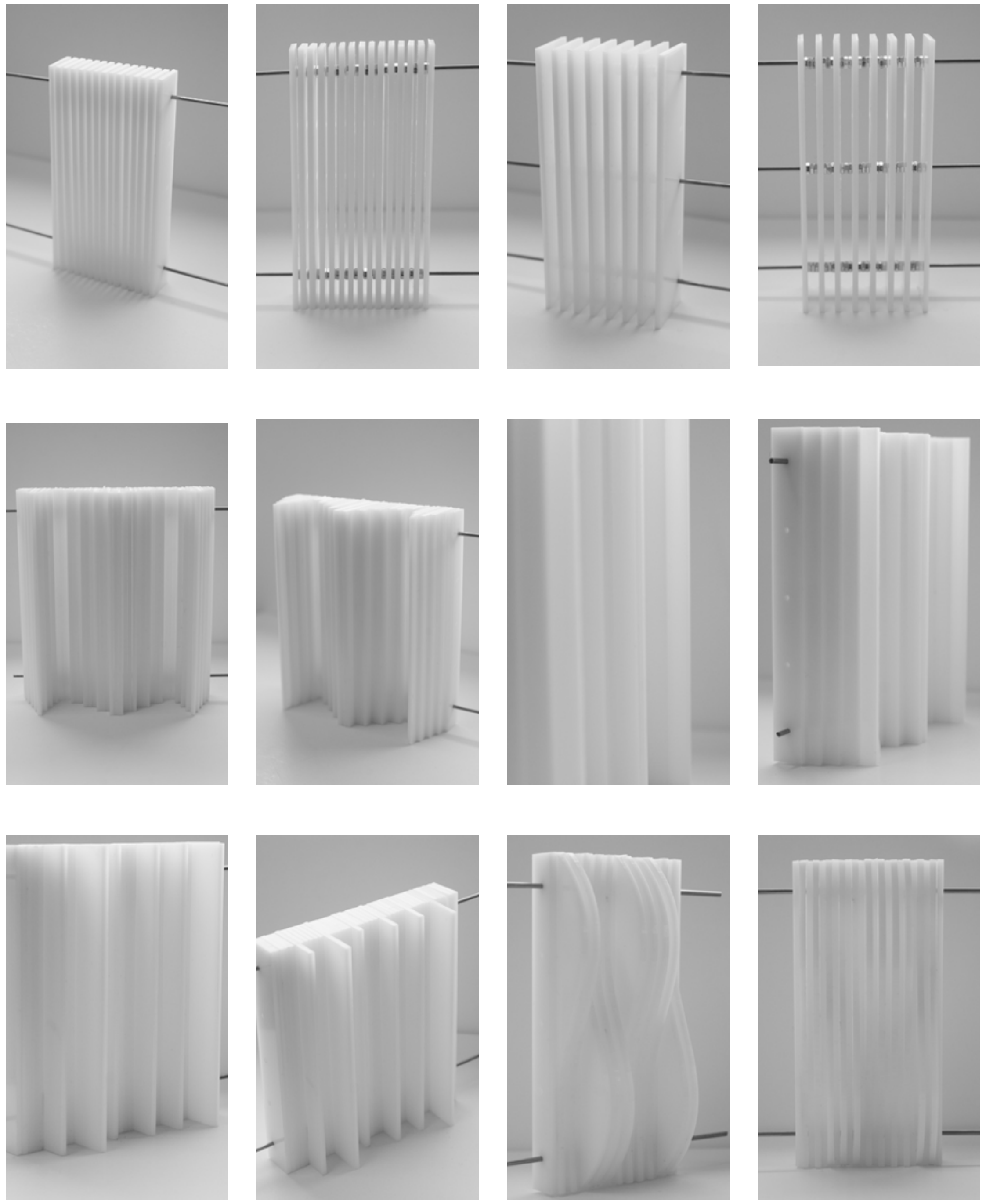


STACKING SYSTEM STUDY

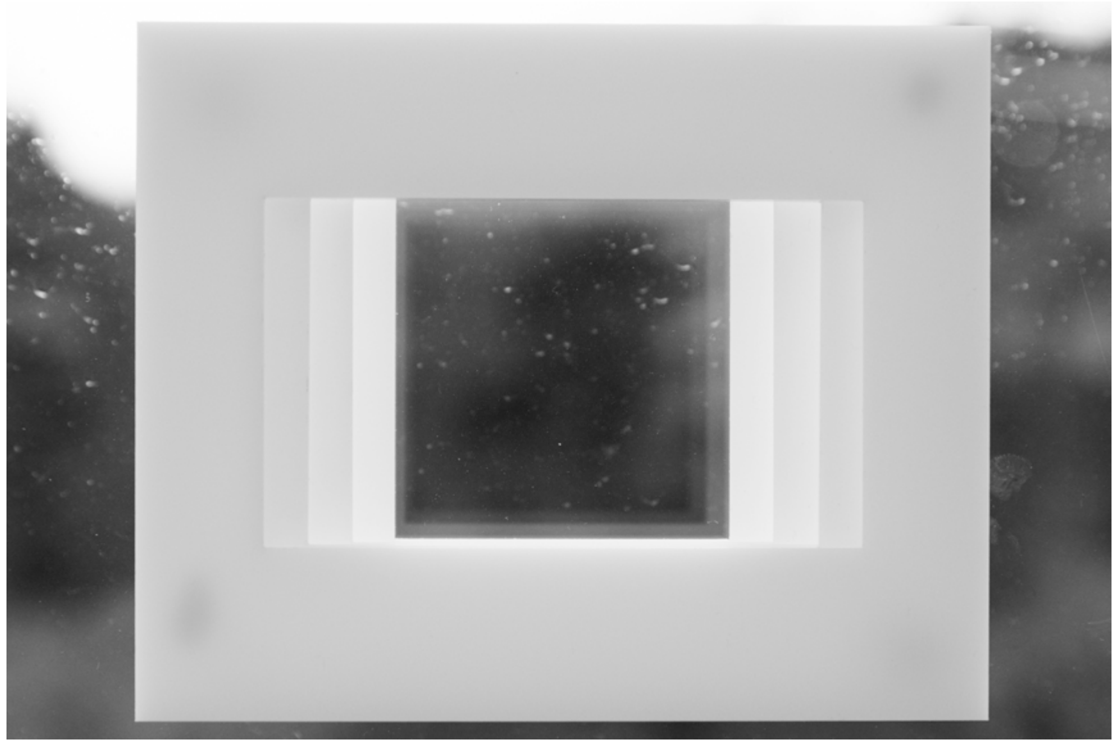
Scale 1:10 detail model. Early study of a different construction technique where the walls are made up of 6 different sized pieces that overlap.

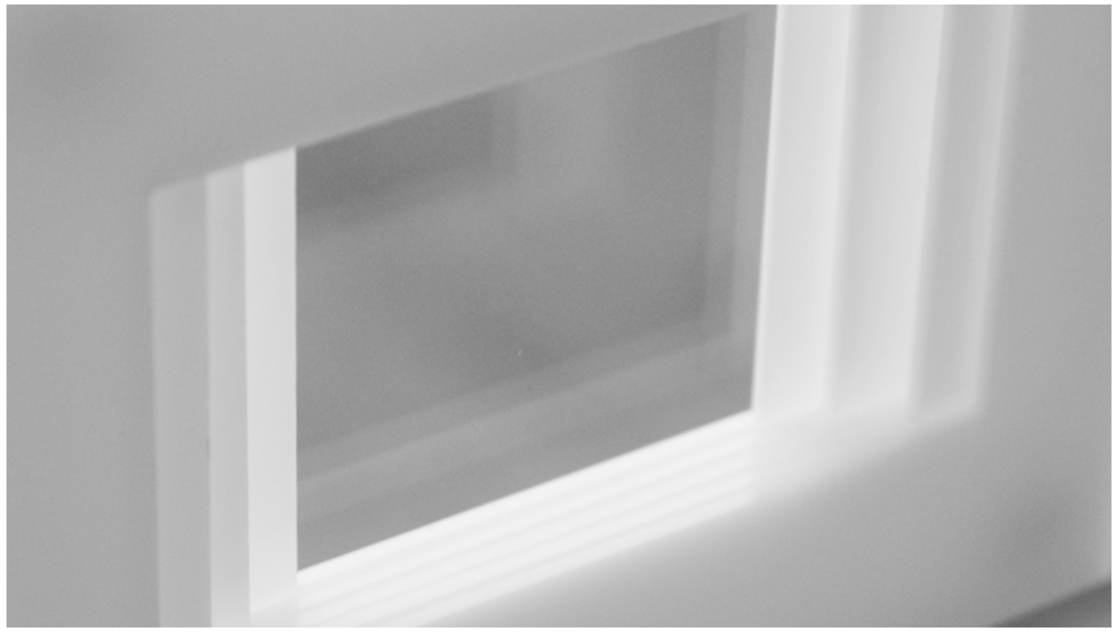


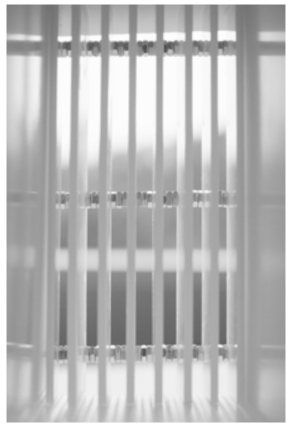
Early exploded axonometric view of how the panels could be contructed and help together with tension rods. The final proposal uses some of these details but all the panels were rotated to follow the same orientation, allowing for the peeling off layers principle.



PANEL VARIATIONS & RASTER







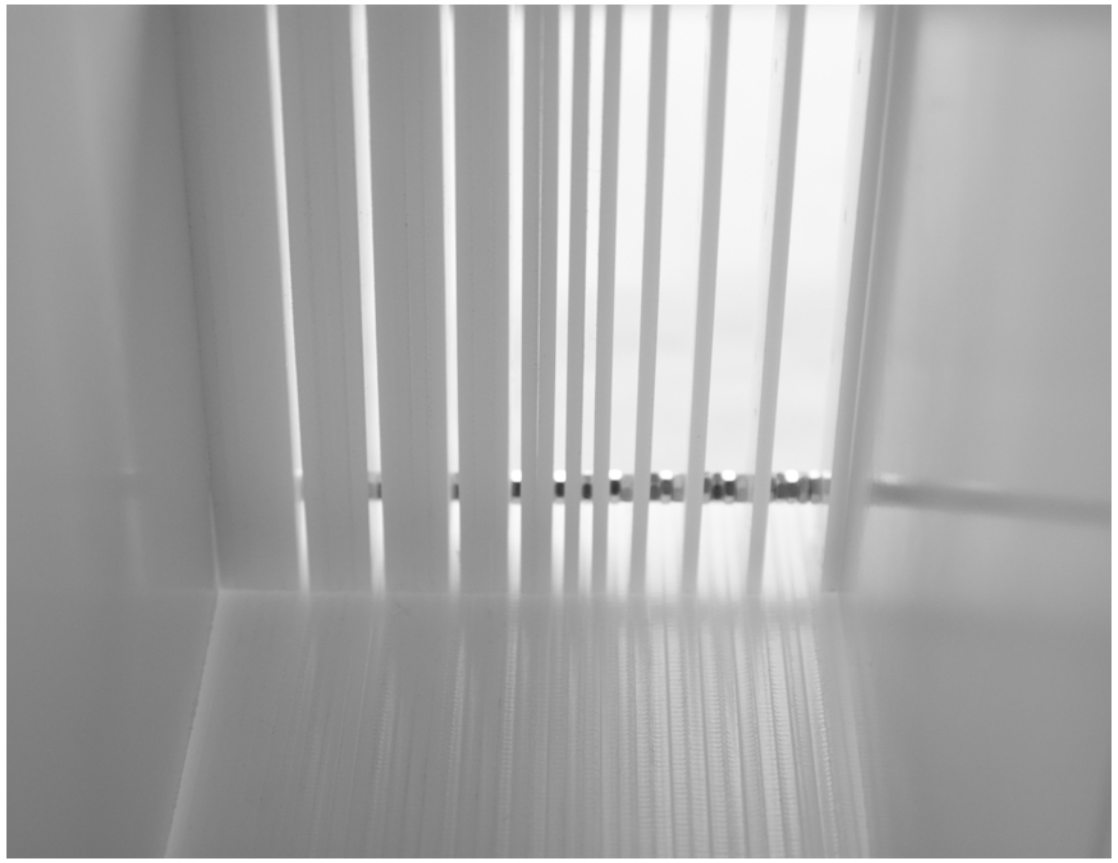
OPENINGS

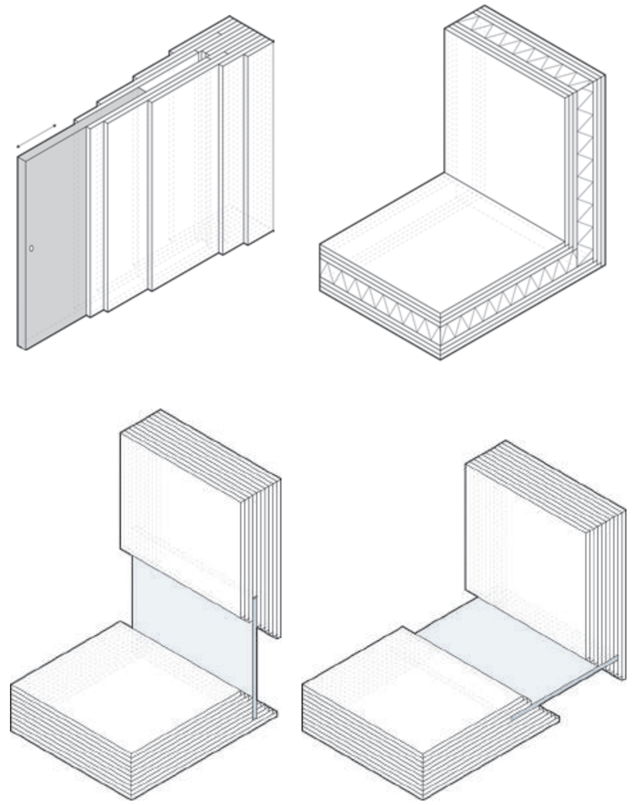
2 different methods

The stacking system allowed for the integration of openings that let in light into the space. Two ways of creating opening were tested - the first was where a panel is simply skipped and replaced with a spacer or bolt. The number or length of this bolt may also vary to produce the width of the opening but the panels stay consistent.

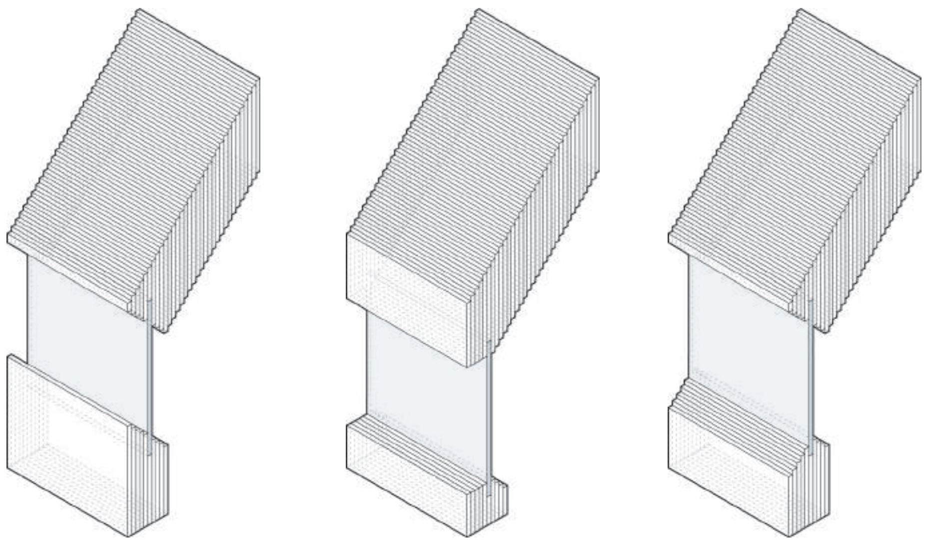
The other way of creating an opening that was tested was to have different lengths of panels that stack together. When stacked, they created openings that in this case don't go the full floor - ceiling height but are more like windows.

Model studies were conducted in order to try create a gradient in the openings, from less openings to more frequent and larger (photo below). The light seeping into the space increased in line with the openings increasing.





Door details, integrating insulation and different window opportunities were studied.



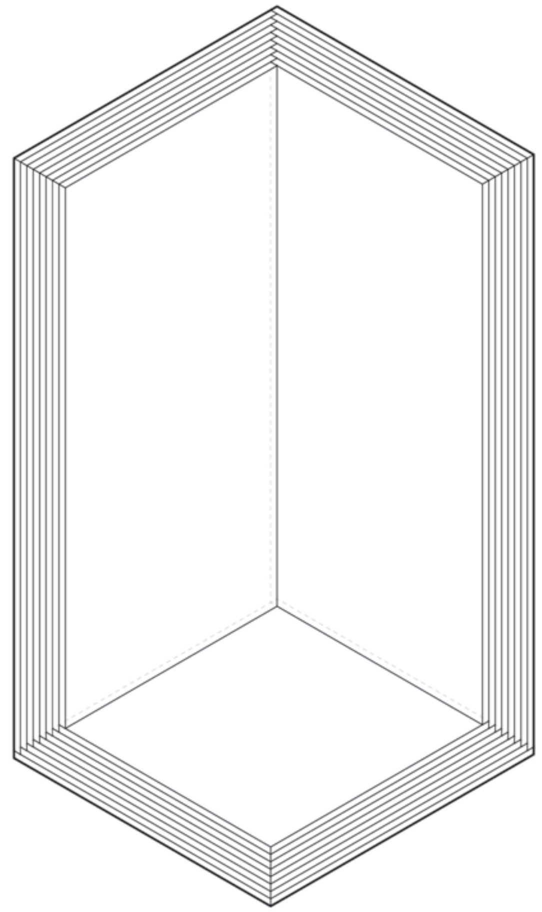
Different ways of integrating glazing with the stacking system that give different interior spaces and light.

STACKING SHEETS DETAILS

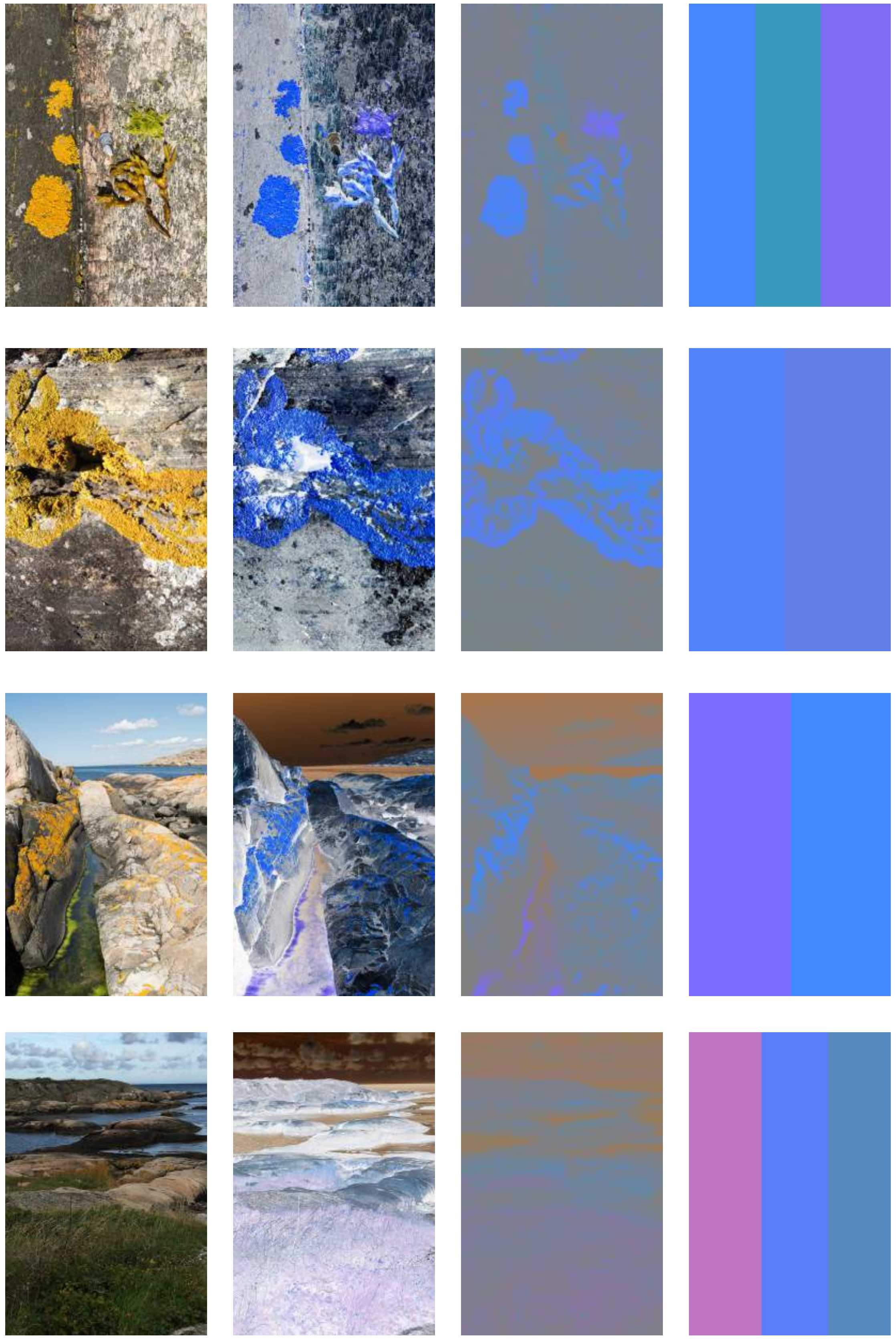
Studies were conducted to test possibilities of stacking the panels inspired by the dike swarming found on hits. One option investigated was that the sheets could be glued together in order to not have any visible connections or joins that compete with the surfaces. This would create thick walls that can be structural (resembling a CLT construction). These could be manufactured off site and assembled on site, similar to other pre-fabricated wall elements. Using adhesives was an option that was considered but not developed and the final design proposal considers the possibility of either using tension rods, glue, or heat and compression to join the panels together. Either of these options are viable but further investigations would need to be conducted in full scale to determine which would perform best with the transformed ocean plastic panels.

Subtracting layers

By subtracting layers and peeling back the panels, the structure has variation of thickness, translucency and colour. Direction and focus could be created in selected areas by subtracting layers. The stacking system allowed windows and sliding doors to be integrated into the structure.



Wall - Wall - Floor Detail



Original Site Photo | *Inverted Site Photo* | *Isolating Colours* | *Sampled Colours*

COLOUR STUDY

Collected plastic

The colours of the objects collected from the beach vary greatly and there have a wide range of colours to choose from. One thing that they all have in common is that they often are very bold, homogeneous colours from packaging or plastic toys.

The experimentation phase concluded that one can create a varied coloured surface with a pixelated, fragmented aesthetic by using different shades of granules from the same base colour, for example blue.

Inversion

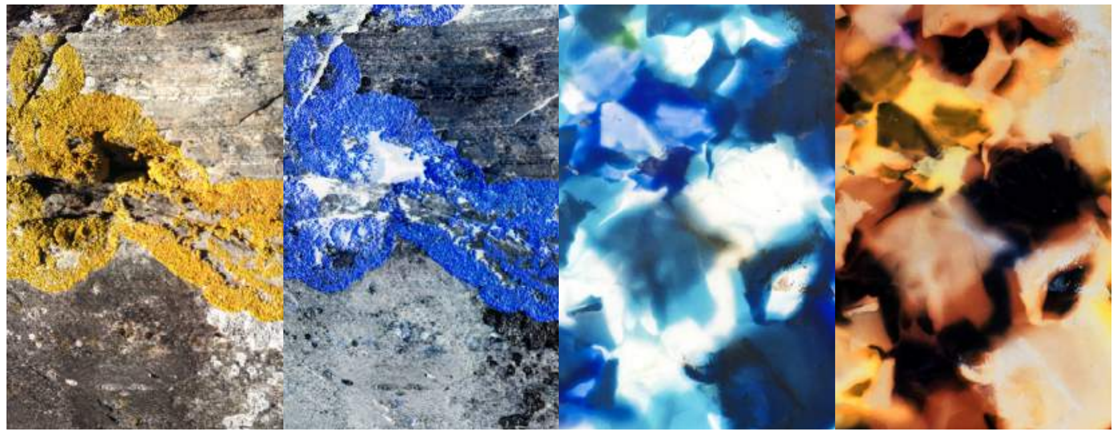
Using Photoshop, the inversion command was applied on photos from the site. Interestingly, the inverted images of the rock on site show bright blue, purple, green, orange and pink. These solid colours could then be isolated from the image by removing the black and white shades.

Contrast

The isolated colours strongly resemble that of the conducted experiments. One could conclude that the plastic colours are the polar opposite of the colours found on site. The plastic is as far away from the natural landscape of which the colour spectrum is physically possible.

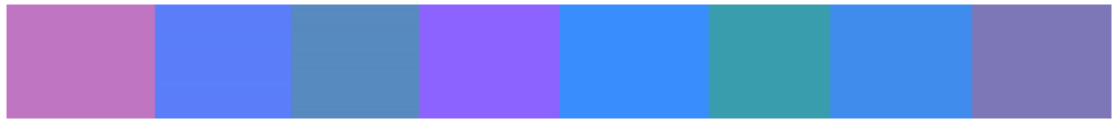
Camouflage

Some studies were conducted to try and recreate the colours from the landscape. While it is possible to find plastic in colours that resemble the site - browns, mustard yellows, cream and shades of grey - the reality is that most of the plastic that is collected is made from bright colours. From this conclusion, one can argue that it is smarter to use the majority of colours available rather than being too selective. Doing this allows more plastic from the ocean to be recycled and at the same time, the bold colours attract attention and make a statement.

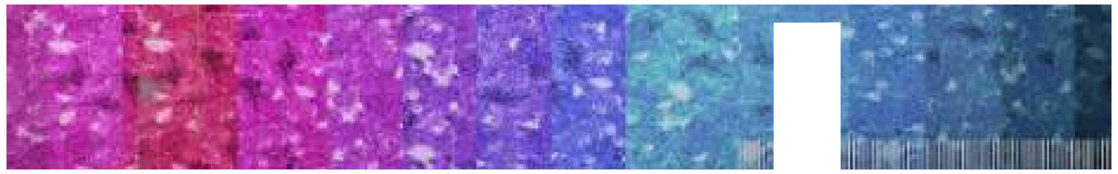


Original Site Photo | *Inverted Site Photo* | *Original Photo of Plastic Experiment* | *Inverted Photo of Plastic Experiment*

FACADE COLOR STUDY

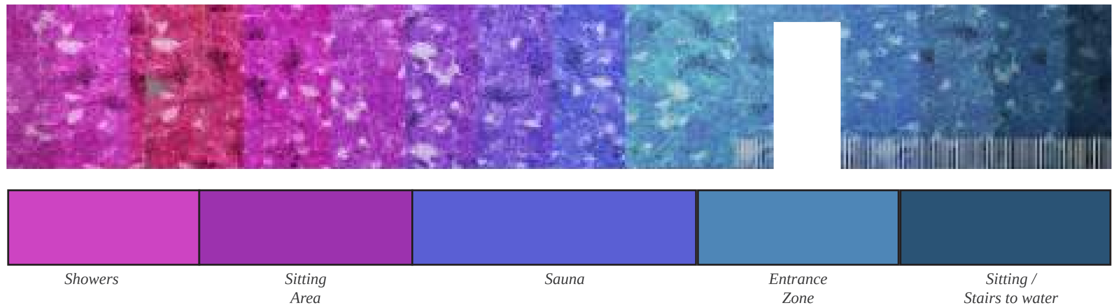


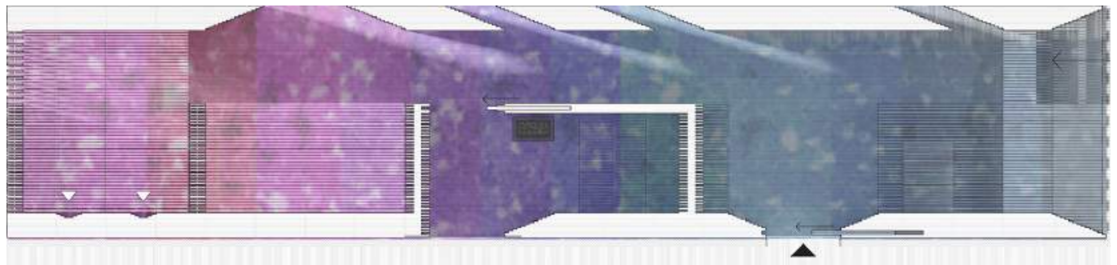
It was decided that this colour palette was most aesthetically pleasing as well as being most common colours picked from the colour inversion studies.



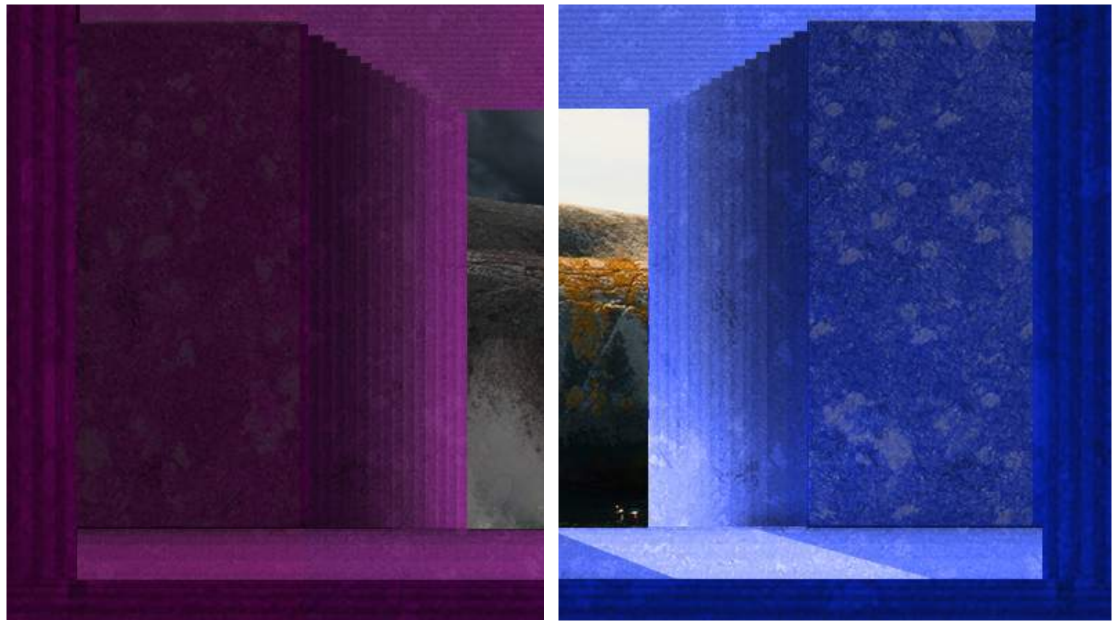
Several iterations were made of the chosen colours. A decision was then made to keep the gradient from pink to blue constant and not repeating the colours throughout the facade. This creates a more even gradient. The zones became more defined since there is no repetition of the colours.

Zones of colour in facade and in plan

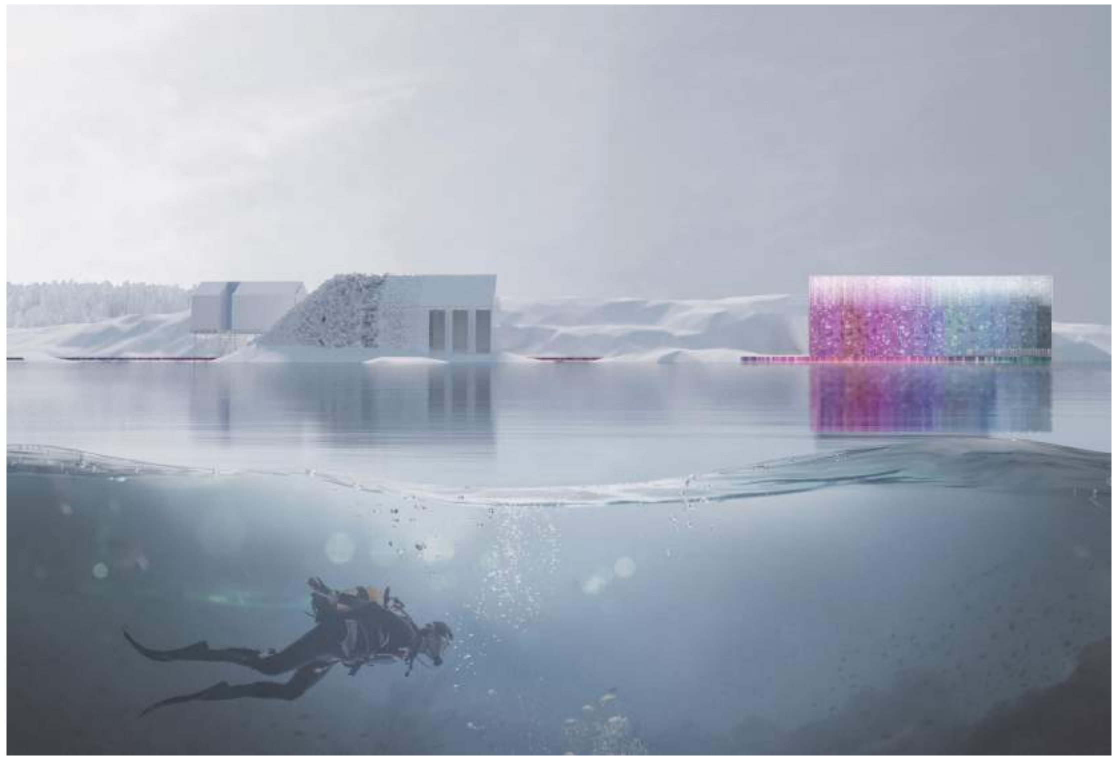




Plan in colour

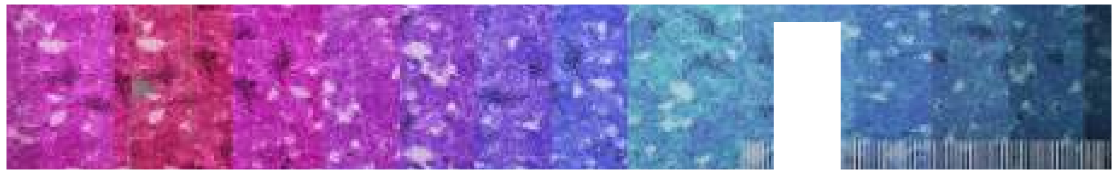


Testing how the colours impact the interior space of the sitting area.



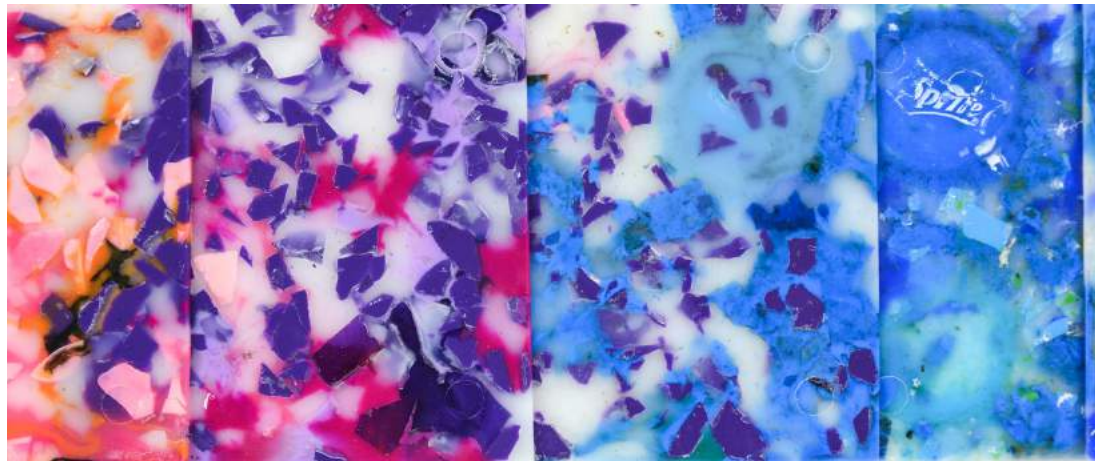
Testing colours impact on the exterior view from the water.

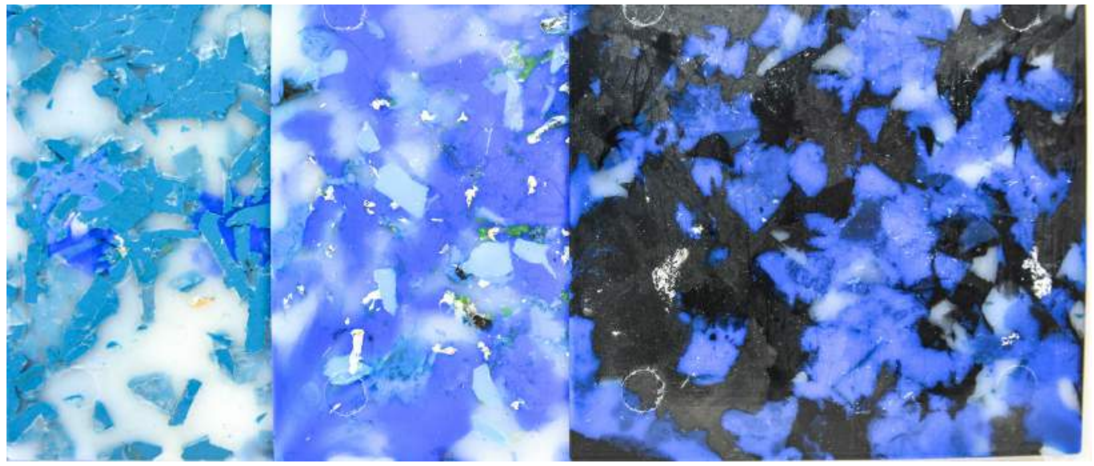
CREATING COLOURED PLASTICS



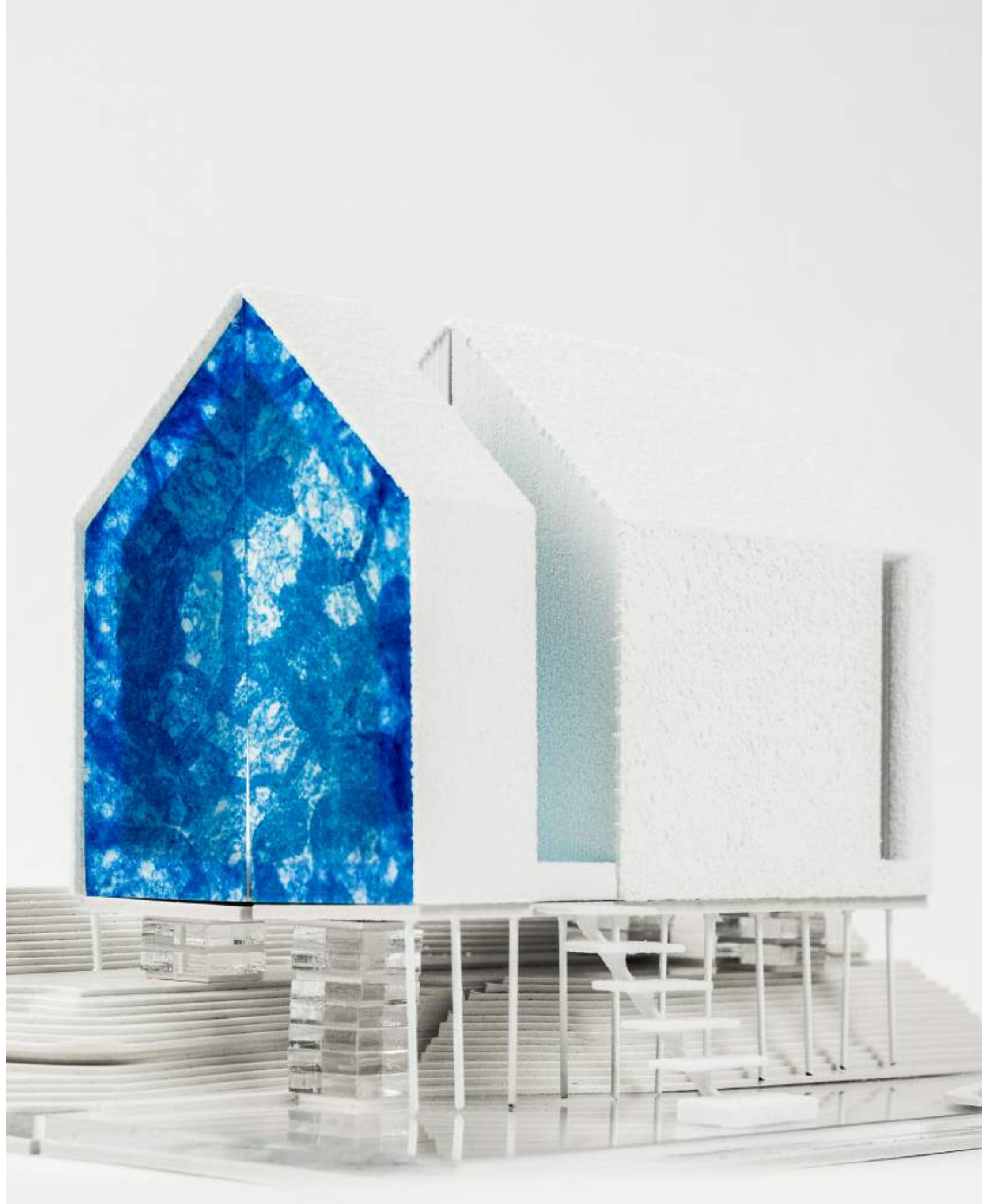
Chosen colour palette

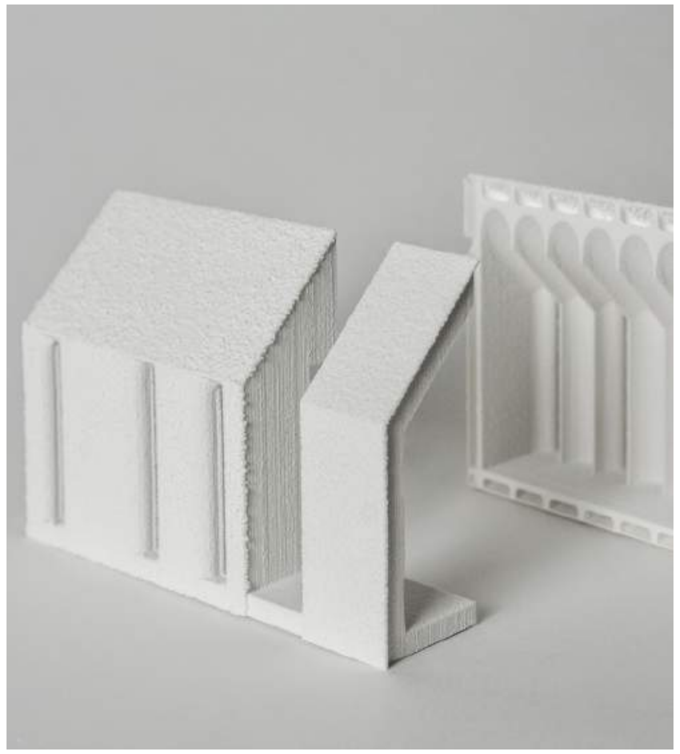
Recreating colour palette with transformed compression moulded ocean plastic

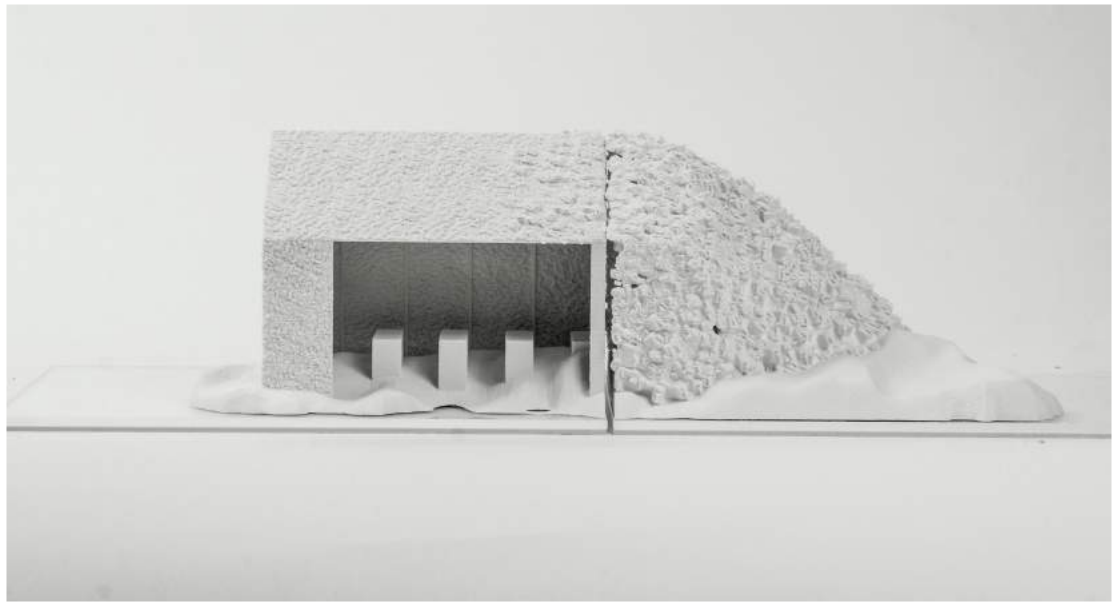


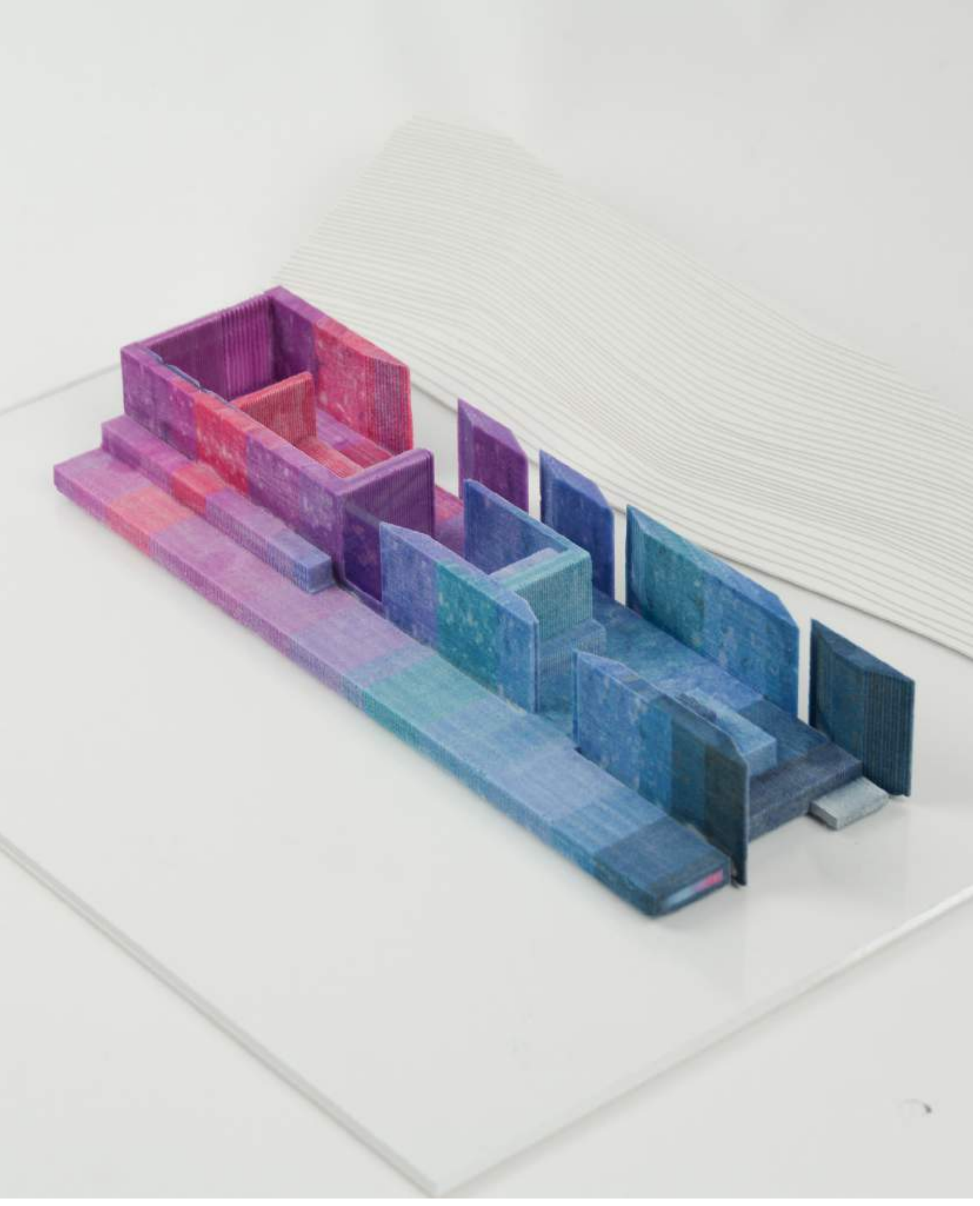


07: FINAL MODELS









08: REFLECTION

FINAL REFLECTIONS

This thesis investigated the potential of reusing plastic collected from our oceans and beaches. It aimed to change the perception of what once was waste into something with value within the field of architecture.

As one of the great difficulties when it comes to ocean plastic is sorting the plastic collected, this thesis tried to have an pragmatic view on the material gathered. Instead of using plastic that would be fully sorted and cleaned, we defined a method that uses easily identifiable objects and considered easy ways to sort the plastic such as by colors rather than by the types of plastic.

We found a number of qualities that be created when using compression moulding and slumping to create architectural elements such as the panels, blocks and modules used in the design of the diving centre. The colours, translucency, degree of transformation and textures are all qualities that were developed into these building elements.

One thing that became very apparent during this thesis is that there are endless ways of creating something with plastic as the material has no defined form or constructions method that dictates the way it should be designed with. This made decision making sometimes difficult as we felt there was endless possibilities of things that we could do.

We decided to focus on an architectural design approach rather than a purely technical one. Even though we tried to solve some technical details, if these structures were to be built there would need a more thorough investigations into the structural strength, fire resistance abilities and toxicity.

This thesis does not solve a the global pollution issue, but it provides insight to a field where this waste could be valued specifically for its origin from the ocean, hopefully incentivizing collection and reuse of the vast existing volumes of these plastics.

With this design we wish to highlight the global threat of our oceans in a more graspable, architectural context. This design takes plastic from the shores, transforms it, and puts it back - but with a new function and value, perhaps influencing the perception of what once was waste into something that could potentially be treasured.

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