# SYNTEXTURE

natural-synthetic texture composites (re)formatting a national boundary

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CHALMERS

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Three natures. Frontispiece to l'Abbé de Vallemont's Curiositez de la nature et de l'art (1705).



# ABSTRACT

The concept of the 'third nature', reaching back to the Renaissance gardens, stands for the new built condition and unknown materiality. It takes a step further from the 'second nature' - its modification for human interest (e.g. forest replantation, agriculture) and two steps from the 'first nature' - wild in its form.

Nowadays, we observe the tendency to straighten the boundaries appearing on various scales, e.g. the nation or the city. In architecture, this may call for the new forms of the thresholds - the in-between conditions; the separators or the connectors between different spaces.

The purpose of this thesis is to explore relations between the man-made and the natural, in regards to the boundary. The investigation takes a form of a bridge connecting Haiti and Dominican Republic - two strongly contrasted environments. The bridge holds a function of a border control. Built partly of biodegradable materials, it disintegrates over time through the process of biological decay. The design intention is to refocus the formal act of passing the border into the stimulating experience of going from one condition to another, with various texture scales, transparencies, linearity or irregularity.

By series of experiments with mycelium - the vegetative part of fungus, the project investigates reactions of a living organism to different materials, fabricated geometries and synthetic dyes. The parallel track took digital studies of nature inspired textures, namely transformations of images into 3D surfaces, displacement and opacity masks. Digital textures were fabricated with cnc machine and used as molds for growing mycelium. They were also the point of departure for the bridge design.

This thesis introduces a new form of the threshold building, which, through the constant biological re-formation, questions the aspect of the boundary in the future.

KEY WORDS:

biotic & a-biotic, addition & decay, boundary, threshold, synthetic texture

THESIS QUESTIONS:

What are the potentials of applying natural-synthetic texture composites in architecture?

What kind of relations are created between fabricated and grown?

How can the Threshold affect the experience of passing the border?

What are the performative aspects of texture and how can they define the building design?

# DELIMITATIONS

IT IS NOT WITHIN THE AMBITION OF THIS MASTER THESIS PROJECT TO:

- come with a new biodegradable material solution based on mycelium
- provide specific data on controlled process of biological decay

# TABLE OF CONTENTS

# 1 : BACKGROUND

Understanding biodiversity.



# NATURALIZING ARCHITECTURE

According to Marie-Ange Brayer, the naturalization of architecture comes with readdressing the human-made and the natural. They are no longer in opossition to each other, but create the new artifact, which fuses the biological and the digital together.
'Natural and synthetic systems' narrate the process of creation, instead of designing the object itself.
Advances in digital tools enable architecture to track living systems and theirs transformative and responsive mechanisms, which results in creation of 'computational ecosystems'. Architects have growing interest in exploring their potential applications.
As Manuel De Landa states, boundaries between organic and non-organic worlds start to blur. Architecture becomes a hybrid and intelligent composite organism that interacts with the environment and is informed by its materials.
Works from 9th ArchiLab Exhibition 2014 present nature as a real environment for modelling systems to produce 'synthetic living objects' (Brayer, 2014).

## TOWARDS SYNTHETIC ECOLOGIES

Relationship between architecture and nature is often handled in a metaphorical way. How could ecological complexities, though, be engaged into creation of build environments in explicit way?
Alisa Andrasek and her practice approach is to learn from the complexity of nature, rather than mimic or depict nature. In her research, Andrasek uses nature processes and logics to rethink common solutions to certain architecture, design or urban challenges. Her approach to 'synthetic ecologies' is therefore oriented more towards the process rather than esthetics, even if the final outcome is often complex and organically shaped, which, as she notices, may be read as more 'natural' (Andrasek, 2014).

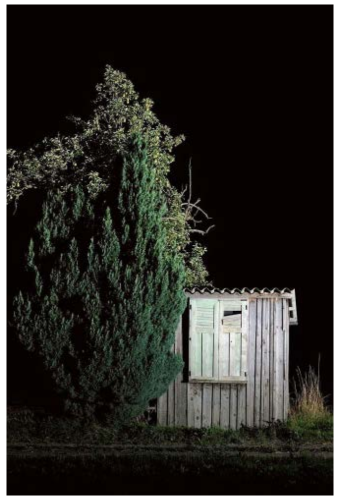
## UNDERSTANDING BIODIVERSITY

Contemporary environmental challenges and decrease of biodiversity call for reframing relationship between human and nature. Understanding biodiversity create better apprehension of the ways nature harmonize independent systems and provide services for human beings (Boeuf, 2017). Inspiration of nature biodiversity could enhance reestablishing diversity within the built environment.

## COLLABORATION WITH THE LIVING

Introduction of living organism into an artwork gives a chance for unexpected results to happen. For artist Michel Blazy, as working with living comes with the risk of failure, the crucial part is to provide conditions for emergence of matter. The artist strives to get to know the living and 'favor its development', so the form 'self-generates'. The artwork does not deliver a clear message, but rather provokes complex meetings and shares the experience of creation (Blazy, 2017).

Influences: Claudia Pasquero, Matias del Campo, Philippe Chiambaretta, Francois Roche, Alisa Andrasek



Photographs by Julien Lombardi.



# NATURAL VS ARTIFICIAL

'Naturalness is persuasive, artificiality is the contrary.'
*Aristotle*

NATURAL

Natural - existing in or derived from nature; not made or caused by humankind ('Natural').

ARTIFICIAL

Artificial or Synthetic (man-made) – emerging from processes involving human activity ('Synthetic').

Herbert A. Simon takes a step further and defines distinction between synthetic and artificial, where synthetic is an imitation of nature - same result, different formula - and artificial is a replication of nature - chemically created formula, not possible to distinguish from naturally occurring one (Simon, 1996).
According to determinism - the idea that all events are determined completely by previously existing cause - 'everything is natural and nothing is artificial', as everything in the world, also human-made products, is a result of the physical laws that the world is created with (Sheng, 1993).

DIFFERENCES BETWEEN NATURAL & ARTIFICIAL

The human-made environment is likely to be more regular, both in case of spatial organisation and change over time. Natural environments, in contrast, are characterized by irregularity. Zoomed-in perspective, however, reveals mathematical patterns that nature is built of, which can be applied to natural-like artificial environments (Kaken, 2006). One example could be scripts for pattern formation and organic-like textures.

ARTIFACT VS BIOFACT

Artifact or artefact, in archeology, refers to any object made or modified by human (e.g. pottery, tools, jewellery etc. ) and provides the information of the times it was created in. An artifact is a reflection of the culture. Biofact, in contrast, is an organic material, e.g. seed or bone, that was used or consumed by human, but not intentionally created ('Biofact[1]').
In biology, a biofact is a 'dead material of a once-living organism' ('Biofact[2]').
From philosophical point of view, a biofact can be explained as a biological artefact - 'a hybrid between artefact and living entity, or between concepts of nature and technology'('Artefact vs Biofact'). The last definition opens quite an interesting and complex conversation, especially considering current developments in technology.


Polina Alexeeva / Overgrown texture.


Carl Kleiner, Posture series.


Polyester.



# NATURAL VS ARTIFICIAL

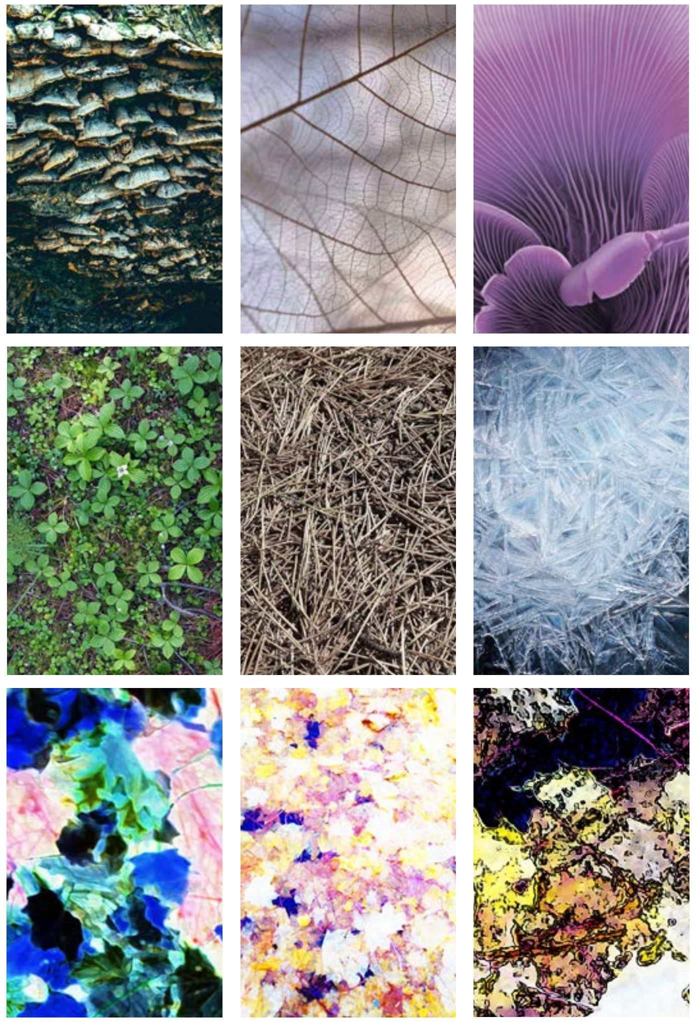
NATURAL? ARTIFICIAL?

Humanity causes irreversible changes in nature and has always been eager to have control over it. The degree of transformation of the environment reaches in average 50%, and 90% in urbanized areas.
Furthermore, advances in technology and digital tools make possible to track and control living systems, theirs transformative and responsive mechanisms on various different scales.
Therefore, is it hard to answer the what really is natural and what really is synthetic.

A: On the images created by Polina Alexeeva, the plantation is following the complex shape of designed object. The living element is made to follow the certain path and possibly avoid other, e.g. overexposed to the sun parts of the structure.

B: In his series, Carl Kleiner pushes the flowers into certain posture and way of performing; nature is arranged in geometrical manner.

C: Synthetic fibers, e.g. nylon or polyester, are produced through the process of chemical synthesis, in opposition to the natural fibers, such as cotton, silk, wool or hemp, which can be obtained from living organisms. Synthetic materials often have very different or enhanced properties in comparison to natural materials, e.g they are more durable, stretchable, waterproof or stain resistant. In opposition to natural, synthetic materials are non-biodegradable - they can't be broken down by living organisms.



1st line: Regular, homogeneous textures.
2nd line: Stochastic, inhomogeneous textures.
3rd line: Color modifications (Photoshop).



# NOTION OF TEXTURE

## DEFINITIONS

The surface of any visible objects is textured at a certain scale. Texture plays multiple roles in human perception of world and architecture. It provides complex information about an object and its size, shape, density, arrangement, proportions etc. (Zhou, 2006).
There are certain words describing texture: bumpy or smooth, rough, rugged, uneven, rutty etc. Particular materials evoke specific moods and refer to particular memories.
Texture forms an organized area phenomenon, as Haralick name it (Zhou, 2006), that can be deconstructed into 'primitives' with defined coordinates (Zhou, 2006). Each texture is composed of particular texture elements: objects, shapes or color patterns etc.

Textures could be divided into:
a) *tactile* (inform about the quality of materials);
b) *visual* (inform about color, orientation, density etc., give a particular quality to light);

by diversity & complexity
1) *regular* (formed by repetitive elements, organized into strong patterns);
2) *stochastic* (formed by less evident elements, organized into random patterns);
(majority of real world textures appear as mixes between regular and stochastic categories);

by spatial homogeneity:
I) *homogeneous* (repetitive structures);
II) *weakly - homogeneous* (local arrangement variation);
III) *inhomogeneous* (absence of repetition or self-similarity).

Specific tactile textures are predefined by manufacturing methods or natural composition. However, these may be redirected to produce variety of qualities that trigger the common understanding of specific material.

## PERFORMATIVE ASPECTS OF TEXTURE

Texture could also have sets of performative functions, applicable across all categories.
The project addresses texture performative aspects of:
- structure (wall, path)
- furnishings (sitting, alcove, niche, arch)
- camouflage (merging with the background)
- light & shadow.

Monteriggioni - medieval walled town.

Checkpoint Charlie.

The border fence in Tijuana, Mexico.

# BORDER CONTROL

## CONTEXT

Border controls are 'measures taken by the country to monitor its borders and regulate the movement of people, animals and goods' ('Border control[1]').

Land rulers have always inteded to determine who enters their terrtories, but border controls as such, were not quite a common phenomena prior to World War I (Keynes, 1920). Boundaries between rival countries in medieval ages were rather symbolic or consisted of lands with 'debatable' status. The well known example of physical borders were fortified walls surrounding town and cities, where the segregation of arriving people was taking place ('Border control[2]').

### PASSPORT

The travel document needed to pass the border in a way it has been used nowadays, goes back to the reign of Henry V of England, when his subjects used such paper to confirm the identity in foreign lands. During World War I, passports were indroduced by European governments for security reasons and as a way to control the emmigration of people with useful skills. This way of boarder control became a standard after the war ('Border control[2]').

### NATIONALITY AS A SYNTHETIC CONCEPT

An example could be United Kingdom and the process of decolonisation during the 20th century, resulting in a mass emigrations in the Global South. As a former colonial occupier, British nationality law introduced a distinction between different national groups. Those 'non-standard' categories derived from British attempts to balance complicated border control situation, but later has been widely criticized for the close relation to the holders' ethnic origins ('Border control[2]').

### CHECKPOINT CHARLIE

Built on the 13th August 1961, the Berlin Wall divided the city into the East part, controlled by Soviet Union and West part - by aliants - Americans, British and French. In order for the city to be operational, it was necessary to create a set of border passings. One of the most famous was Checkpoint Charlie. On the NRD (East Berlin) side, only the foreigners (tourists and diplomats) were allowed to pass the boundry. The controls here were very strict.
Located in the city center, Checkpoint Charlie witnessed many dramatic episodes of the Cold War.
The crossing was functioning until 1990. Today, the Museum of Berlin Wall with symbolic boarder checkpoint are located there ('Checkpoint Charlie').

### TYPOLOGIES

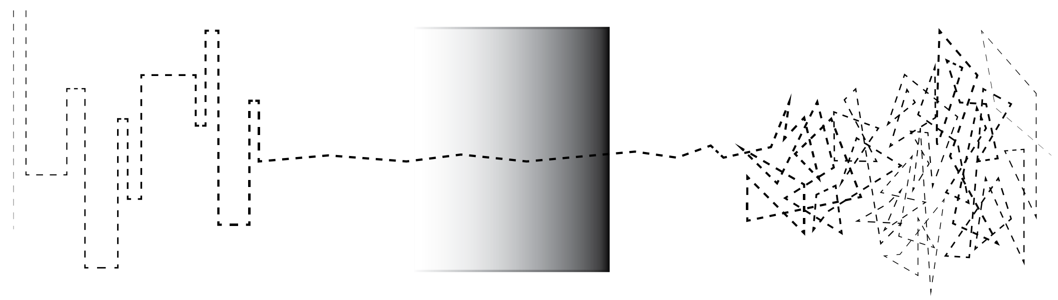
Selected examples of border control building typologies are: a watchtower, a gate, a barrier, a bridge (Brady, 2017).

### REFLECTION

Institution of border crossing may communicate contradictory messages of welcoming and surveillance. It also gives the very first impression of on-arrival country.
The border control as a building has a strongly technical function, with certain sets of rooms, facilities and devices, e.g. scanners, detector gates, crowd-control barriers etc. With constant technological development, will those devices still be valid in the future?

Farshid Moussavi, in exhibition 'Is this Tomorrow?' at Whitechapel Gallery, London argues that borders between countries are often sites of contention and blockers of diversity. Various check-points in cities increasingly affect urban spaces and build forms. (Moussavi, 2018). How they affect human perception of the space?

The borders have been a very controversial and sensitive subject nowadays. We are witnessing ongoing conflict on border wall between United States and Mexico as well as Great Britain negotiating the exit from the European Union after 46 years of a membership. It seems like we are in a quite unstable moment, where it is hard to predict how will the borders look like not in a very distant future.







# THRESHOLD

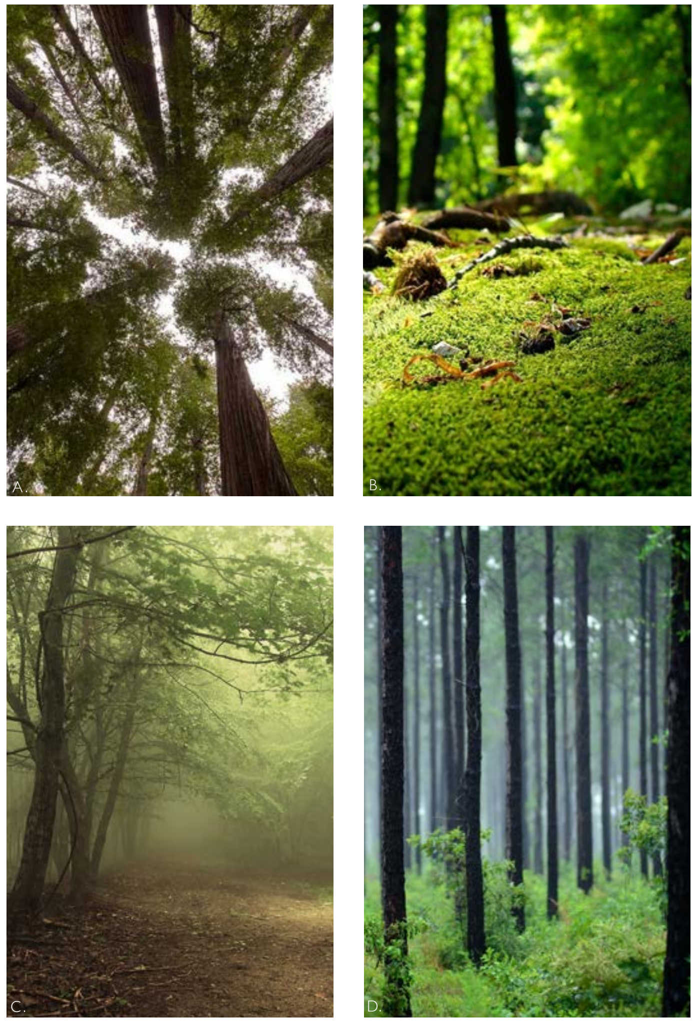
## THEORIES

Threshold can hold many various meanings and relate to different perspectives: physical, psychological, emotional, social, economic etc.
It may be 'the level at which event starts to happen or have an effect' ('Threshold[2]'). In architecture, threshold is often a separator or connector between different spaces.

In the book 'Betwixt and Between: Building Thresholds, Liminality and Public Space.' Quentin Stevens formulates many interesting definitions of thresholds, regarding public spaces and social life. According to Stevens, threshold bridges 'binary oppositions', blurres the boundaries, social categories and rules; allows the new possibilities. It may elevate the social status and frame 'escape from social convention'. Stevens refers to the latin word for threshold – limininality – which is an anthropological term for the progression from one social status to the another (Stevens, 2007).

'At thresholds, people may experience sudden exposure to new stimuli and new possibilities, to freedom, anonymity and risk.'
'The threshold is a constrained site which gathers people together, channeling their movement, focusing their attention and forcing them into close contact with others.' (Stevens, 2007).

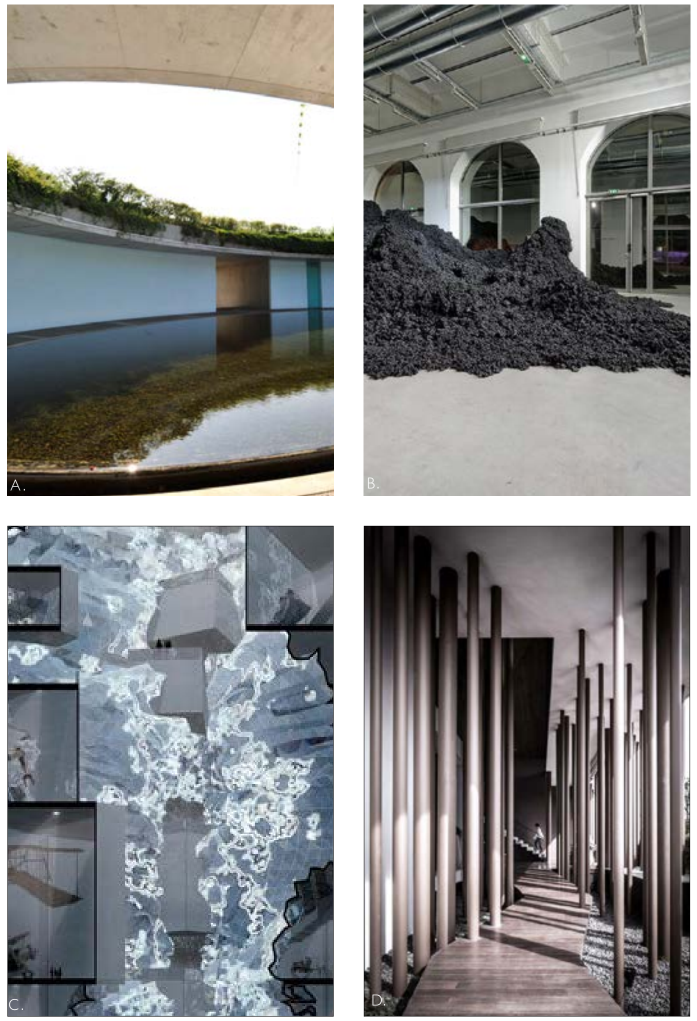
DIAGRAM (TOP): Threshold - a connector or a separator between two conditions; blurred borders.
A: Alice's Adventures in Wonderland I Lewis Carroll I 1865
'Alice opened the door and found that it led into a small passage, not much larger than a rat-hole: she knelt down and looked along the passage into the loveliest garden you ever saw.'




A: CEILING transparency, verticality, motion, light seeping through.
B: FLOOR diversity, softness, sharpness, complexity, curvy paths.
C: WALL atmosphere, horizontality blends with verticality.
D: WALL strong verticality.

# FOREST REPRESENTATION

## AS A DESIGN MOTIVE

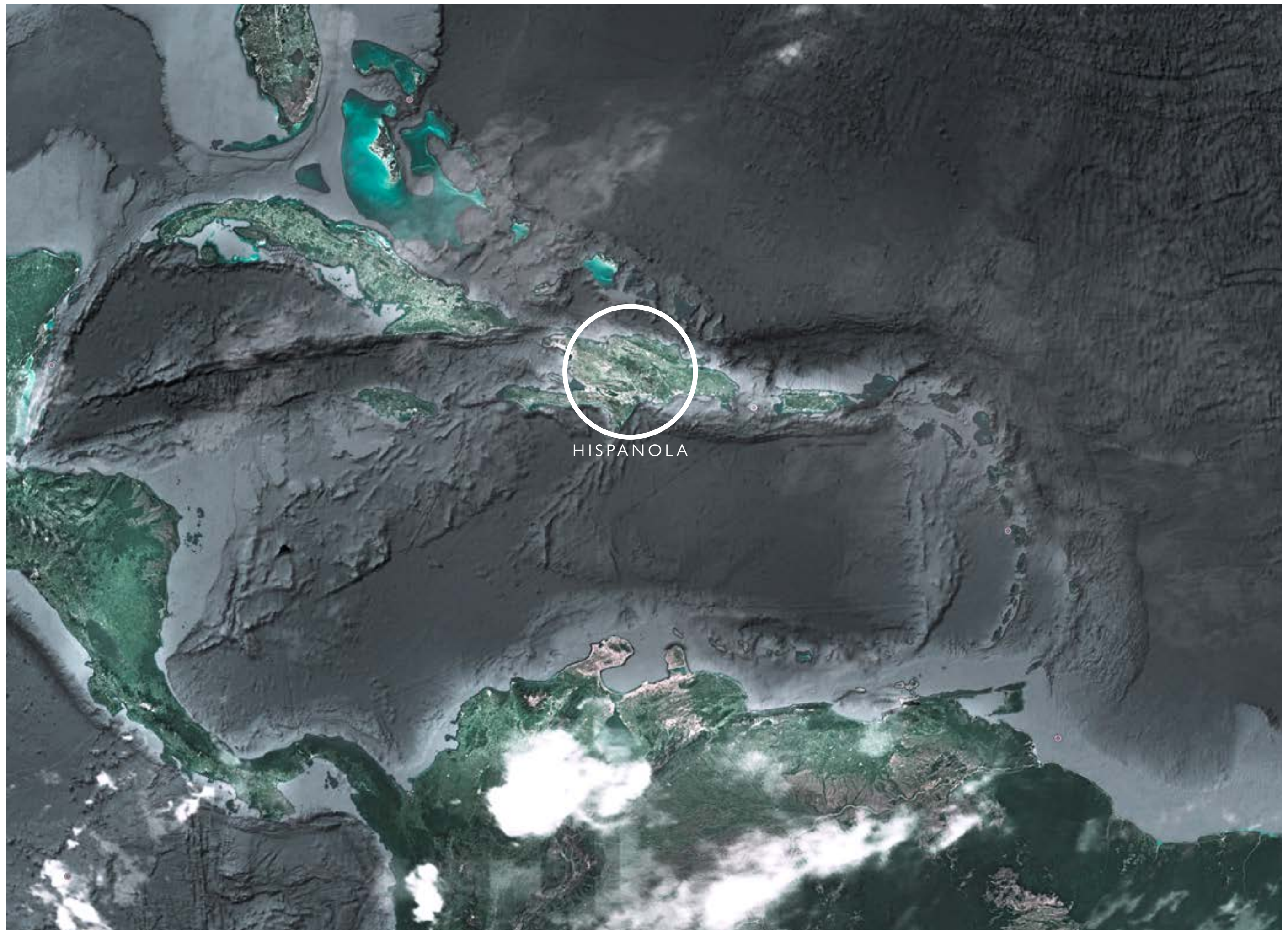



A: CEILING Benesse House/ Tadao Ando.
B: FLOOR New-Territories/ Francois Roche.
C: WALL Hseng Tai Lintner/ Space interaction, adventurous illumination.
D: WALL Burasiri clubhouse/ IDIN Architects.

One of the initial ideas for the Master Thesis was the digital translation of the complexity in natural textures. In addition to that, the translation of naturally occurring spaces was to follow. For example, the 'forest of columns' could be a hint for the space articulation,  but also for the structure solution.

# II: DESIGN


DIAGRAM: Existing border checkpoints between Haiti and Dominican Republic.



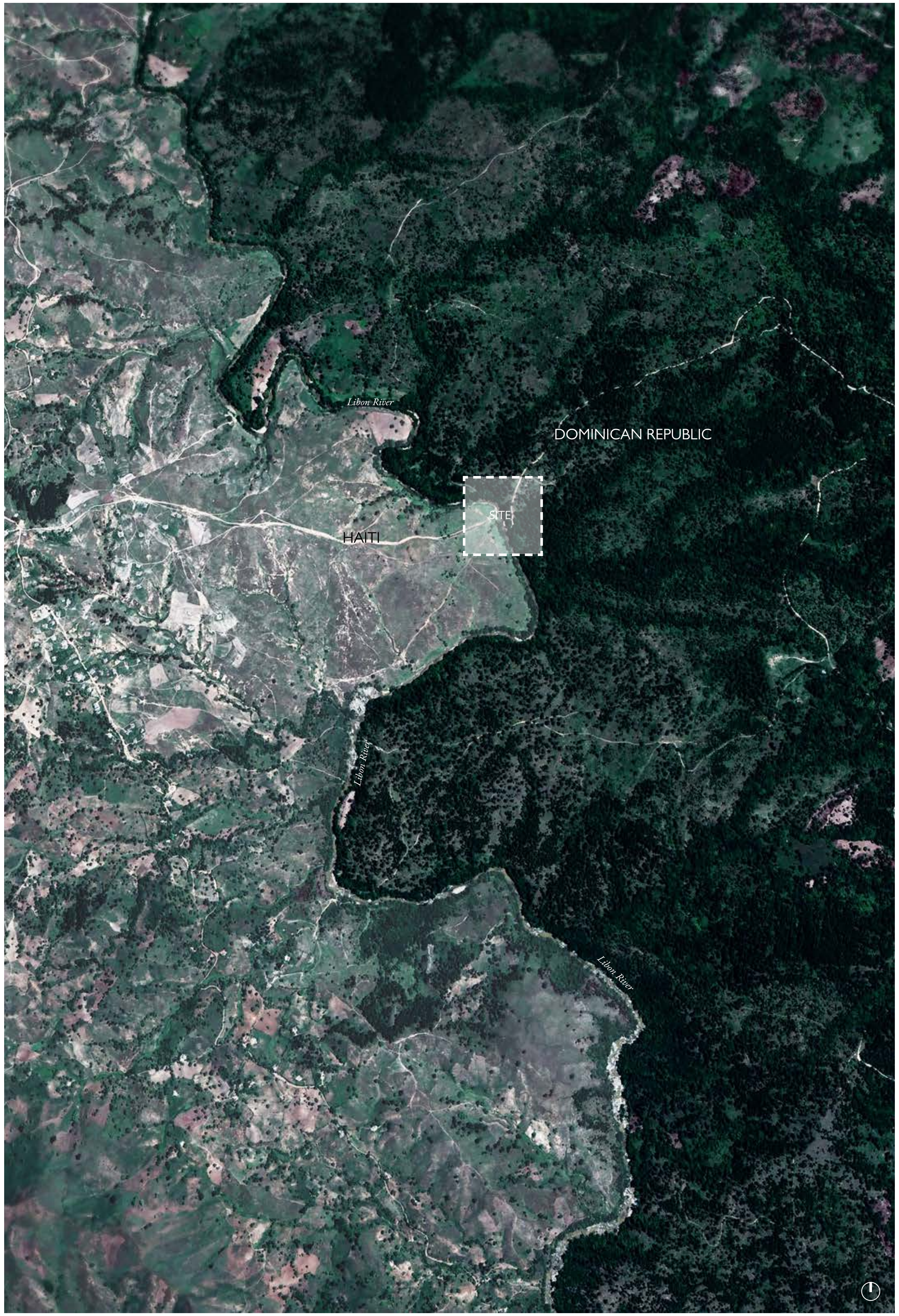

# THE SITE

## HISPANOLA ISLAND / BORDER BETWEEN HAITI AND DOMINICAN REPUBLIC

The initial driving force for the project was the interest in relations between the man-made and the natural. That also became a motivation for the site choice: Haiti and Dominican Republic are two highly contrasted environments.

Hispanola, an Island in the Caribbean, is divided into two countries: Haiti and Dominican Republic. Haiti occupies one third of the Island, to the west. Remaining area belongs to Dominican Republic. The border between the countries, party shaped by Libon River, sets a seam of two extremely different conditions: dense forests of Dominican Republic and bare fields of Haiti.

It took less than a century for Haiti to loose over 98% of its forests. Wood has been mainly used as a fuel. Biodiversity loss, desertification, water pollution, landslides are only few of negative consequences of deforestation that hit the country. Introduced in the 1980s, USAID's Agroforestry Outreach Program has proven ineffective due to the instable political situation and lack of funding.
The Dominican Republic, on the other hand, has had a more stable policies as well as more strict environmental regulations. The country has also developed forest preserving industries, e.g. ecotourism (Gibb, Pratt, Sessa, 2013).




# THE SITE

## PRECONDITIONS

Haiti and Dominican Republic are located in a humid equatorial climate zone. Characteristic for this region are two rainy seasons – in spring and autumn.
Temperatures in areas up to 600 m a.s.l. are typical for the equatorial climate, with no thermal extremes. In winter, the average temperatures are 23-25 °C, and in summer 27-29 °C. In mountain areas temperatures are lower: 18-19 °C.
In summer and autumn, the whole island is affected by hurricanes.

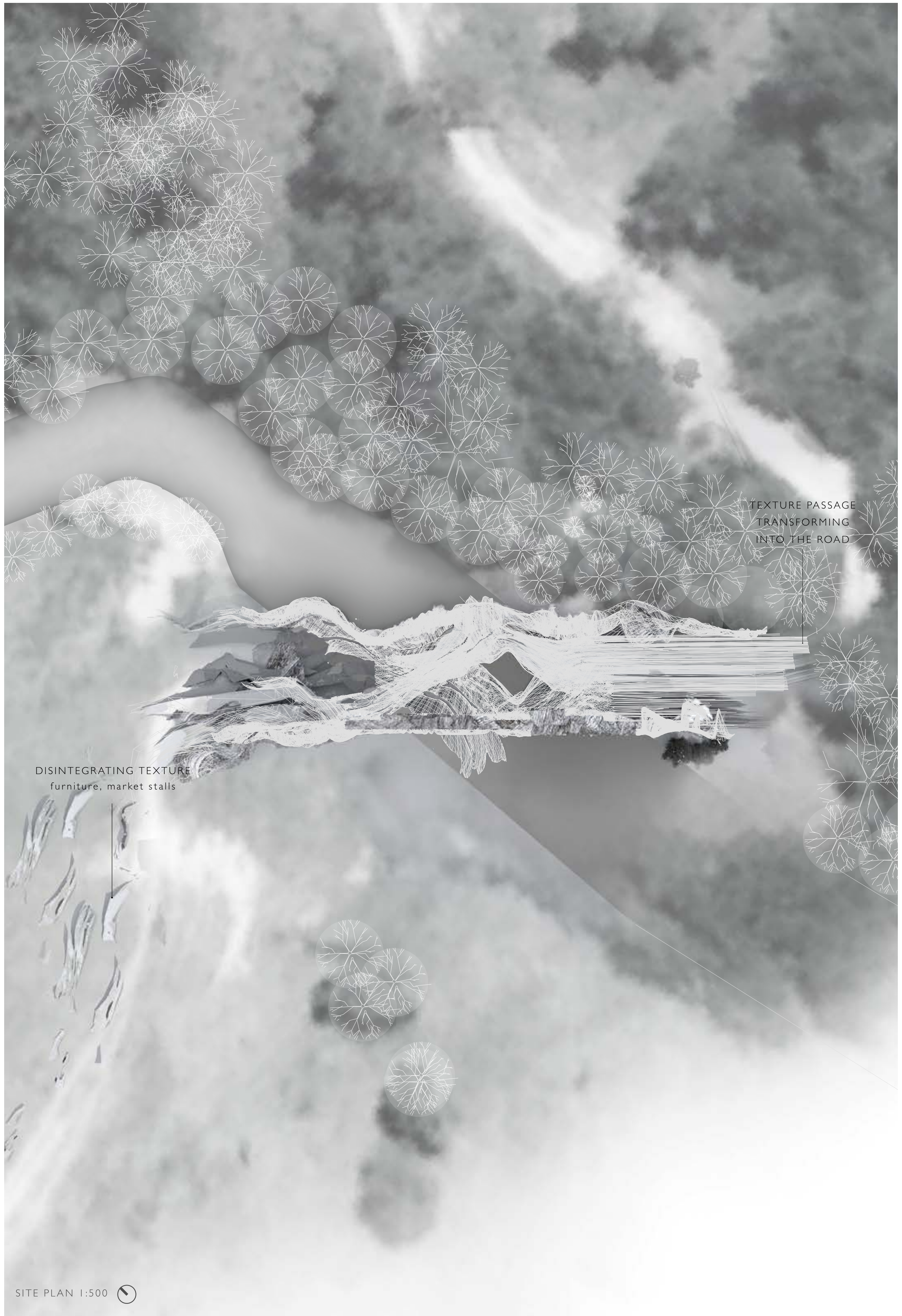
Humid equatorial climate with high humidity and stable temperature could provide an optimal environment for the constant mycelium growth.


# THE SITE

## STRATEGY

The chosen site is located in between two existing border passes: around 50 km to the south from Dajabon and 60 km to the north from Pedro Santana (diagram page 30). There is existing path on the site, going up to the Libon River and connecting two countries. A small settlement on the Haiti side is located approximately 1 km from the plot, and the town Restauracion 6 km away on the side of Dominican Republic. There is also a road connecting south and north of Haiti 1 km from the plot.

Considering all these factors, selected location may become a proper place for additional border pass, offering some additional functions, e.g. a market.




# THE BRIDGE

Boarder pass has a form of a bridge over Libon River (the width on the site approximately 20m), connecting Haiti and Dominican Republic.
The design aimed to refocus the formal act of passing the border into the stimulating experience of going from one condition to another, with various texture scales, transparencies, linearity to irregularity and opposite.
The bridge is a continuation of existing paths. It consists of walking and biking lines, as well as two walls. Those elements interact with each other and are all connected with one optimized support system.
The bridge form differs from one side to another. The paths transform from linear on the Dominican Republic side to branching and disintegrating on the side of Haiti, forming outdoor furniture and market stalls - a function commonly connected to existing border passes in between the countries. The bridge differs also with the scale of the texture and size of the openings: from more condensed to more open.

MARKET

stone paths disintegrate
into market stalls and funrniture

APERTURES IN THE WALL

framing the views while walking
down / up the path

PATHS

3d printed stone

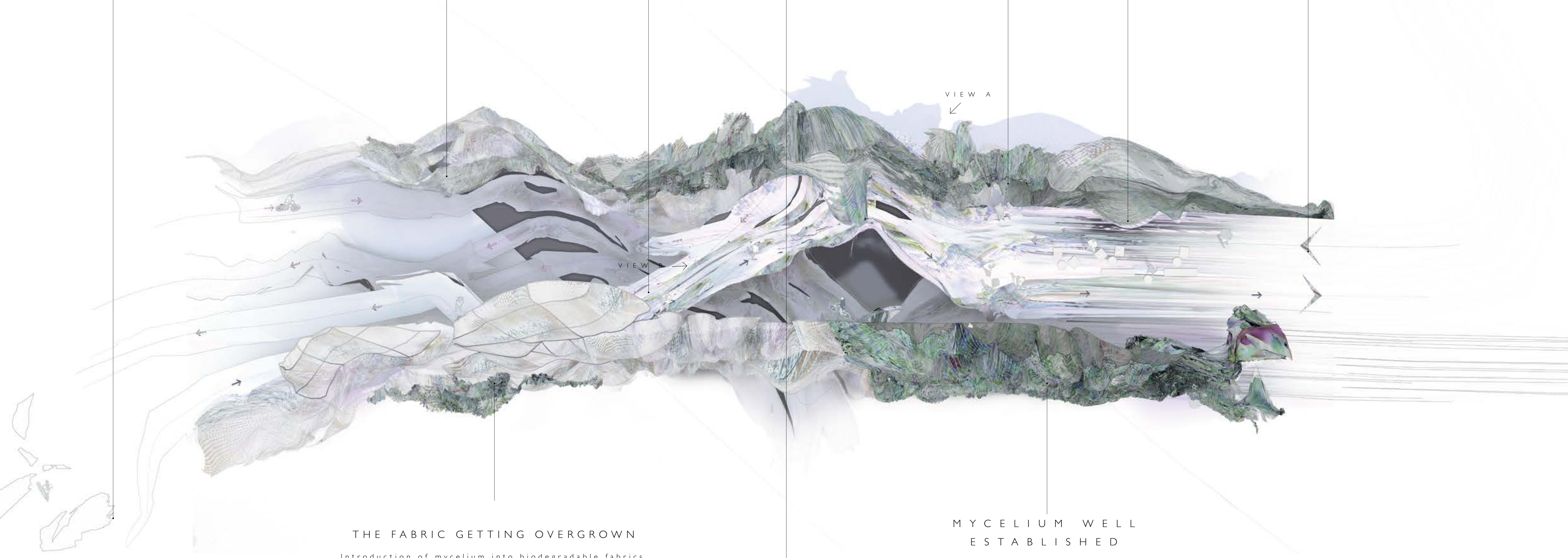
ALCOVE

shaped as a space in
between structure pipes

SITTING

IMPRINTS

signs indicating the movement directions
are imprinted into stone paths




THE FABRIC GETTING OVERGROWN

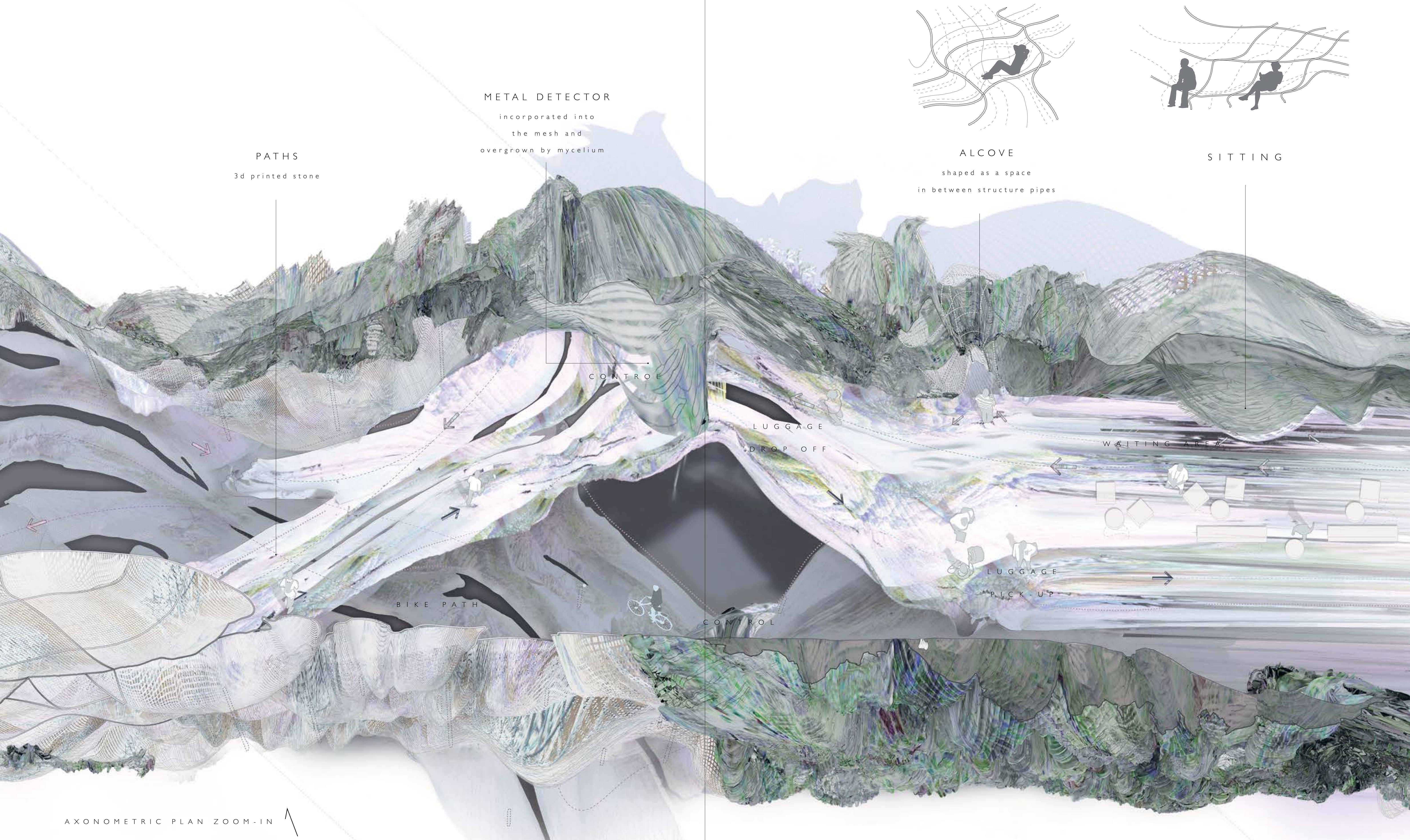
Introduction of mycelium into biodegradable fabrics.
High carbohydrate feed until it well establishes.

MYCELIUM WELL ESTABLISHED

After utilizing all provided carbohydrate, extra feed is cut off, which makes mycelium switch into 'starvation mode'. Mycelium starts to feed itself with the natural fibers.

VIEW C

AXONOMETRIC PLAN 1:50


ALCOVE
shaped as a space
in between structure pipes
SITTING
METAL DETECTOR
incorporated into
the mesh and
overgrown by mycelium
PATHS
3d printed stone
CONTROL
LUGGAGE
DROP OFF
WAITING AREA
LUGGAGE
PICK-UP
BIKE PATH
CONTROL
AXONOMETRIC PLAN ZOOM-IN

TECHNICAL FUNCTIONS

Submerged in the ground underneath level 1. Areas firstly defined, then overgrown by mycelium.

APERTURES

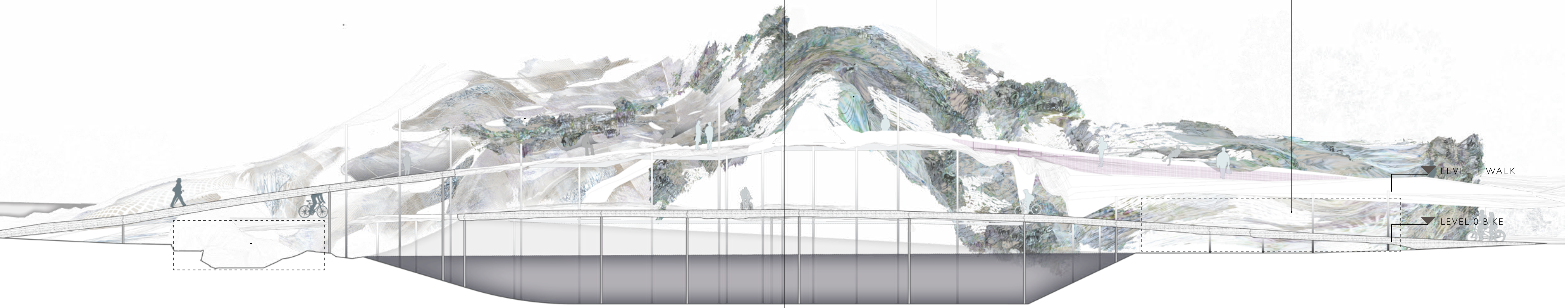
The apertures derive from structural organization of the geometry. Steel pipes split into 2 (alternatively 2 elements connected) to form the opening.

METAL DETECTOR

Incorporated into the texture, overgrown by the mycelium. Texture stretched to create an arch.

TECHNICAL FUNCTIONS

Submerged in the ground underneath level 1. Areas firstly defined, then overgrown by mycelium.



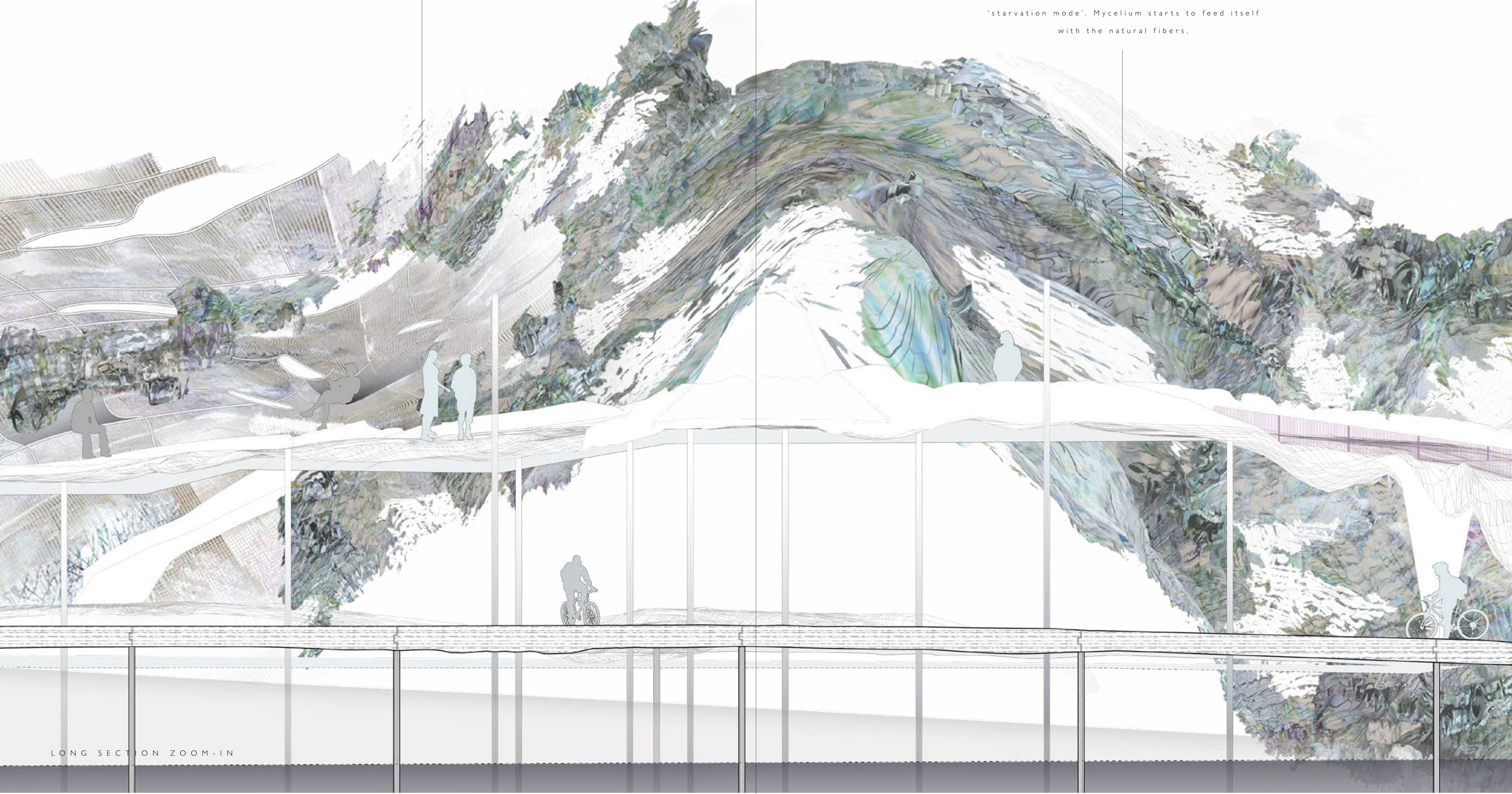

LONG SECTION

# THE FABRIC GETTING OVERGROWN

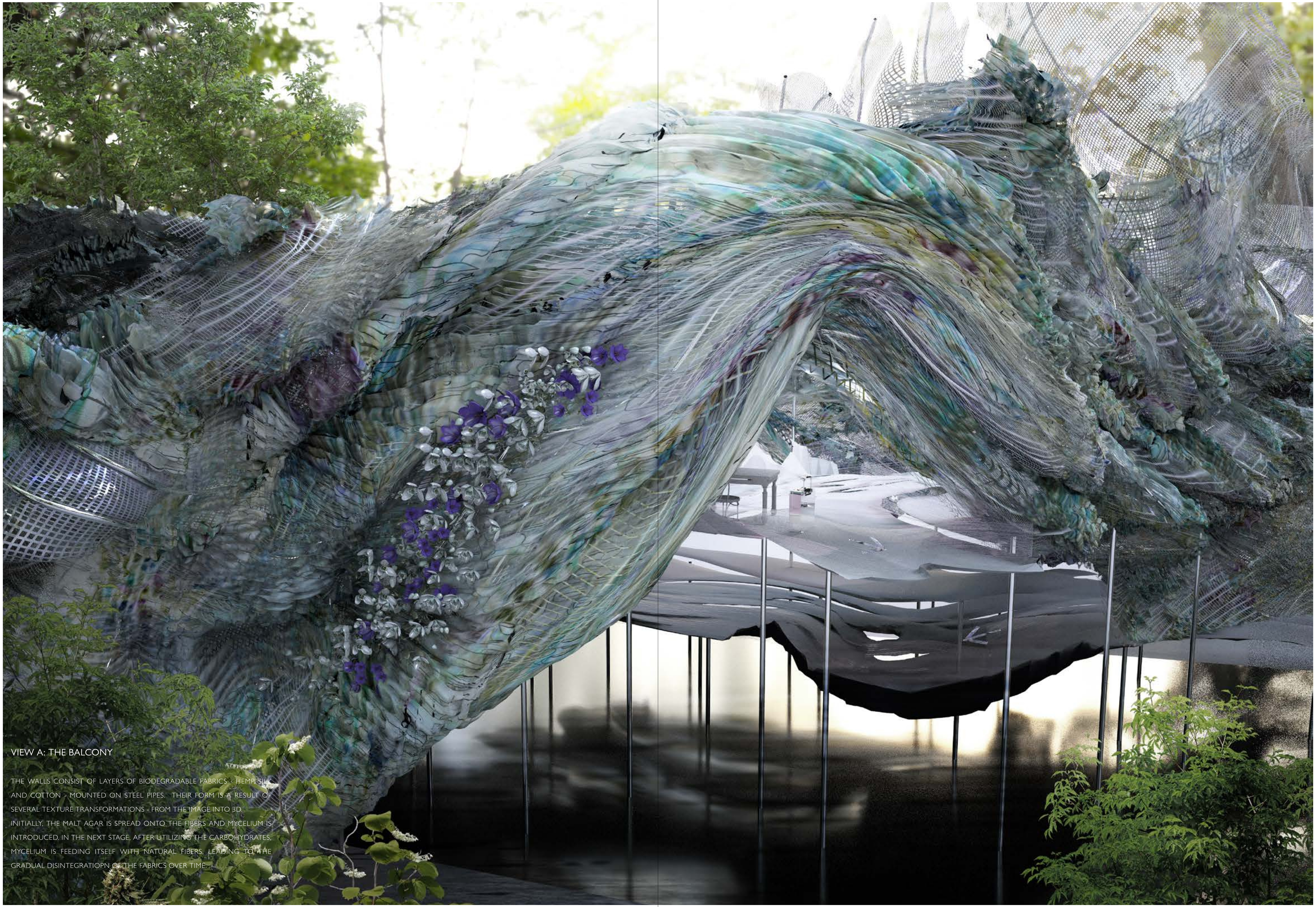
Introduction of mycelium into biodegradable fabrics.
High carbohydrate feed until it well establishes.

# MYCELIUM WELL ESTABLISHED

After utilizing all provided carbohydrate, extra feed is cut off, which makes mycelium switch into 'starvation mode'. Mycelium starts to feed itself with the natural fibers.

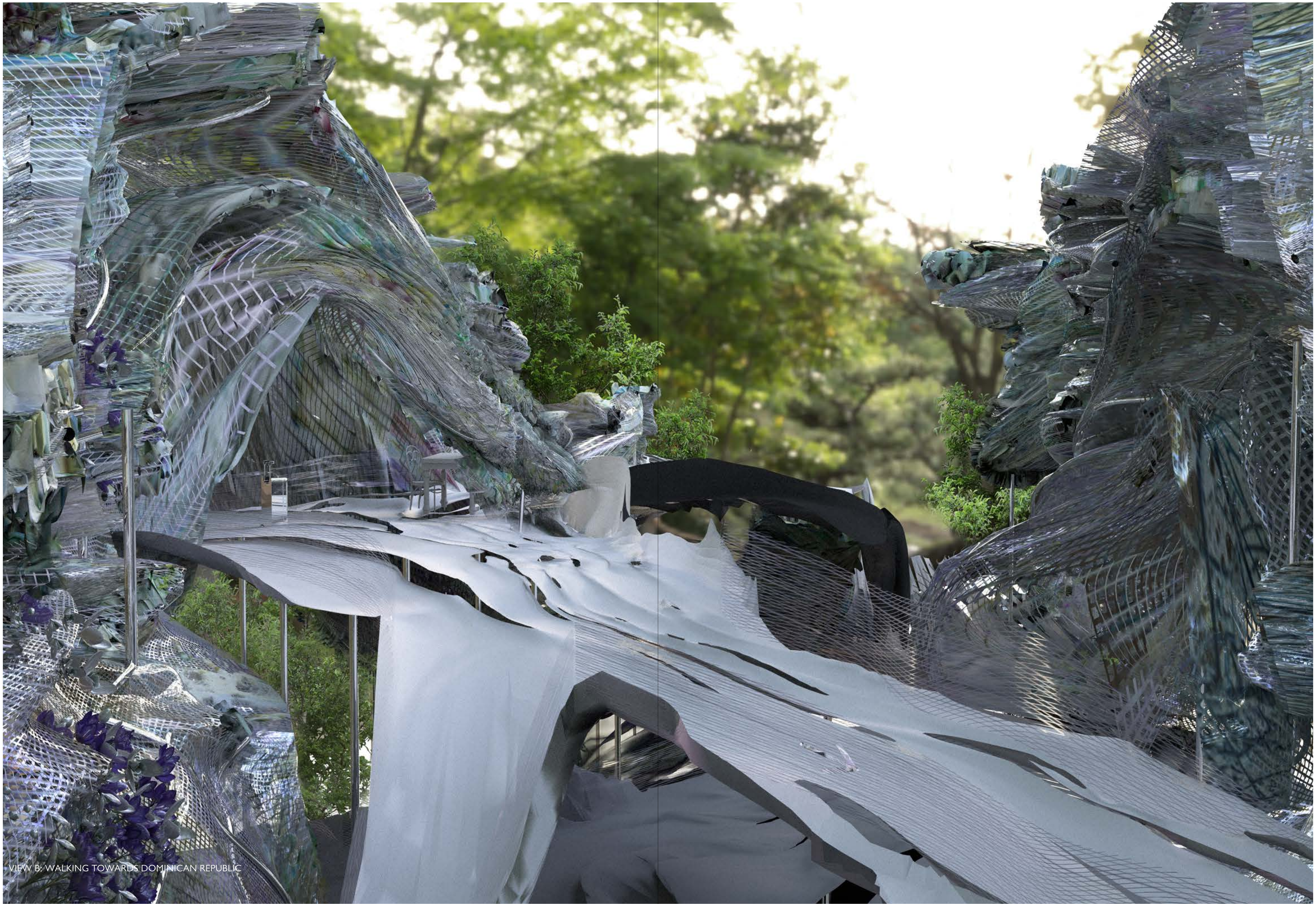


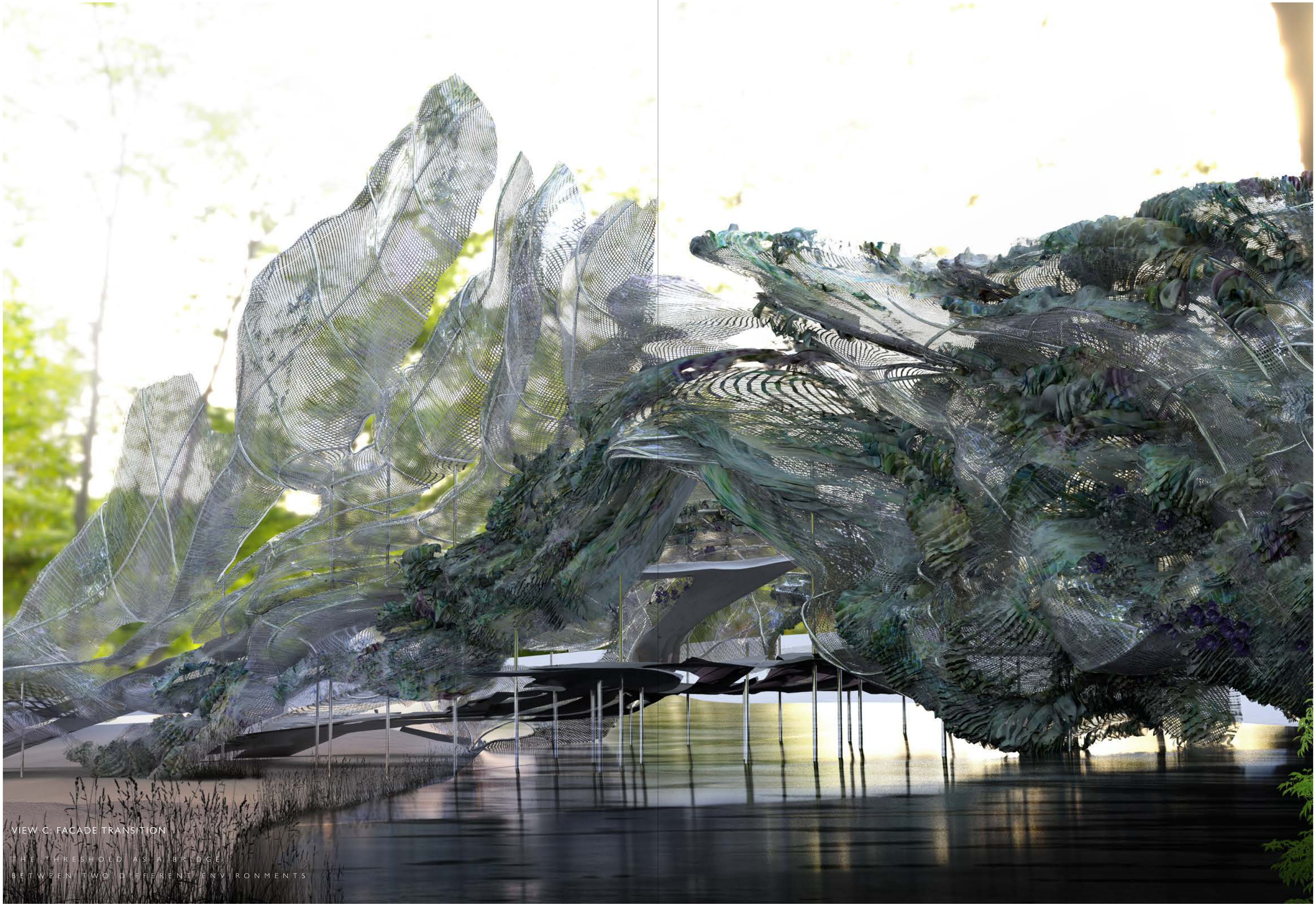
LONG SECTION ZOOM-IN



## VIEW A: THE BALCONY

THE WALLS CONSIST OF LAYERS OF BIODEGRADABLE FABRICS - HEMP, SILK AND COTTON - MOUNTED ON STEEL PIPES. THEIR FORM IS A RESULT OF SEVERAL TEXTURE TRANSFORMATIONS - FROM THE IMAGE INTO 3D.
INITIALLY, THE MALT AGAR IS SPREAD ONTO THE FIBERS AND MYCELIUM IS INTRODUCED. IN THE NEXT STAGE, AFTER UTILIZING THE CARBOHYDRATES, MYCELIUM IS FEEDING ITSELF WITH NATURAL FIBERS, LEADING TO THE GRADUAL DISINTEGRATIOPN OF THE FABRICS OVER TIME.


VIEW B: WALKING TOWARDS DOMINICAN REPUBLIC



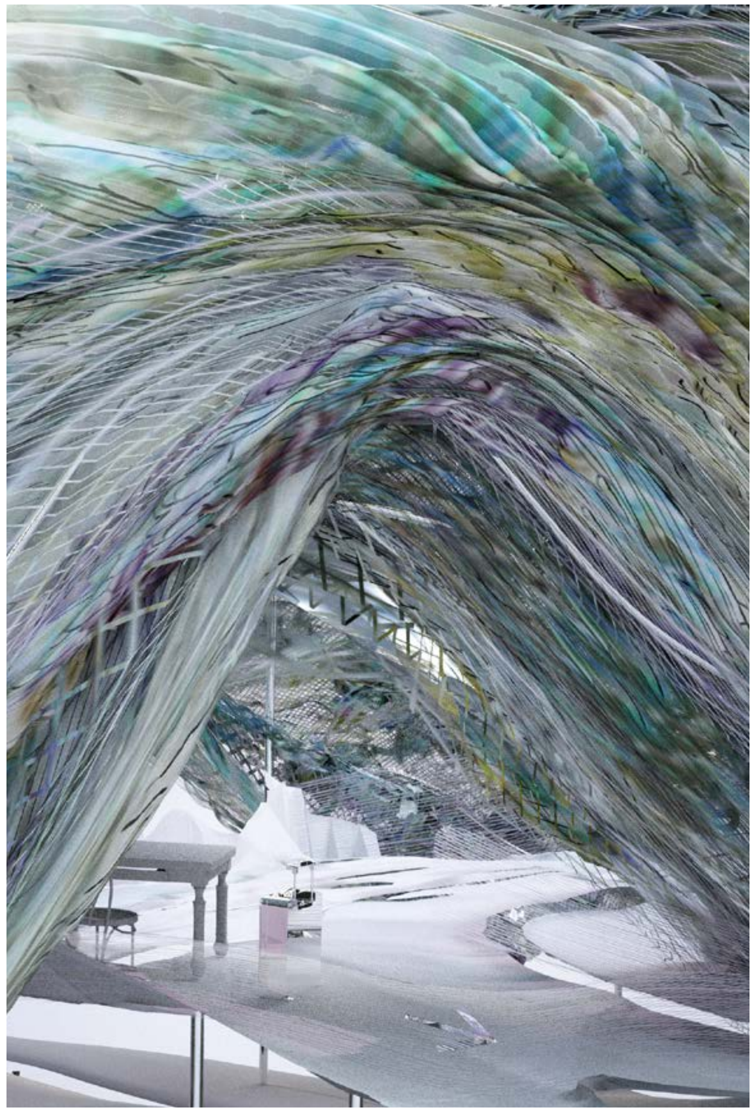
VIEW C: FACADE TRANSITION

THE THRESHOLD AS A BRIDGE
BETWEEN TWO DIFFERENT ENVIRONMENTS

# THE PATHS & WALLS

The paths are 3D printed with the stone. They have imprints indicating the movement through the bridge.

The walls consist of layers of natural fabrics: silk, cotton and hemp. Natural fabrics are biodegradable - they can be broken down by the living organism, such as fungus. Fabrics are mounted on the steel frames and connected to the steel columns, that support the whole structure. The distribution of the frames affected the apertures and enabled to create small spaces inside the walls, like alcoves and niches.



COTTON WIRE FABRIC
Factors: biodegradable (+), low rigidity (-), low resistance to green mould infection (-)

SYNTHETIC WIRE FABRIC
Factors: non-biodegradable (-)

HEMP FABRIC
Factors: biodegradable (+), decent rigidity (+), decent resistance to green mould infection (+)

# MATERIAL & FABRICATION

## FABRICS

The growing strategies for fungi were consulted with mycologists from Gothenburg University, Henrik Nilsson and Ellen Larsson.

### OVERVIEW

*Pleurotus Ostreatus* strain was chosen for the experiments. It is the wood decaying fungi and is considered to be relatively strong species. When well established on the medium, it produces enzymes that protect it from being attacked by other types of fungi, e.g. the green mould.

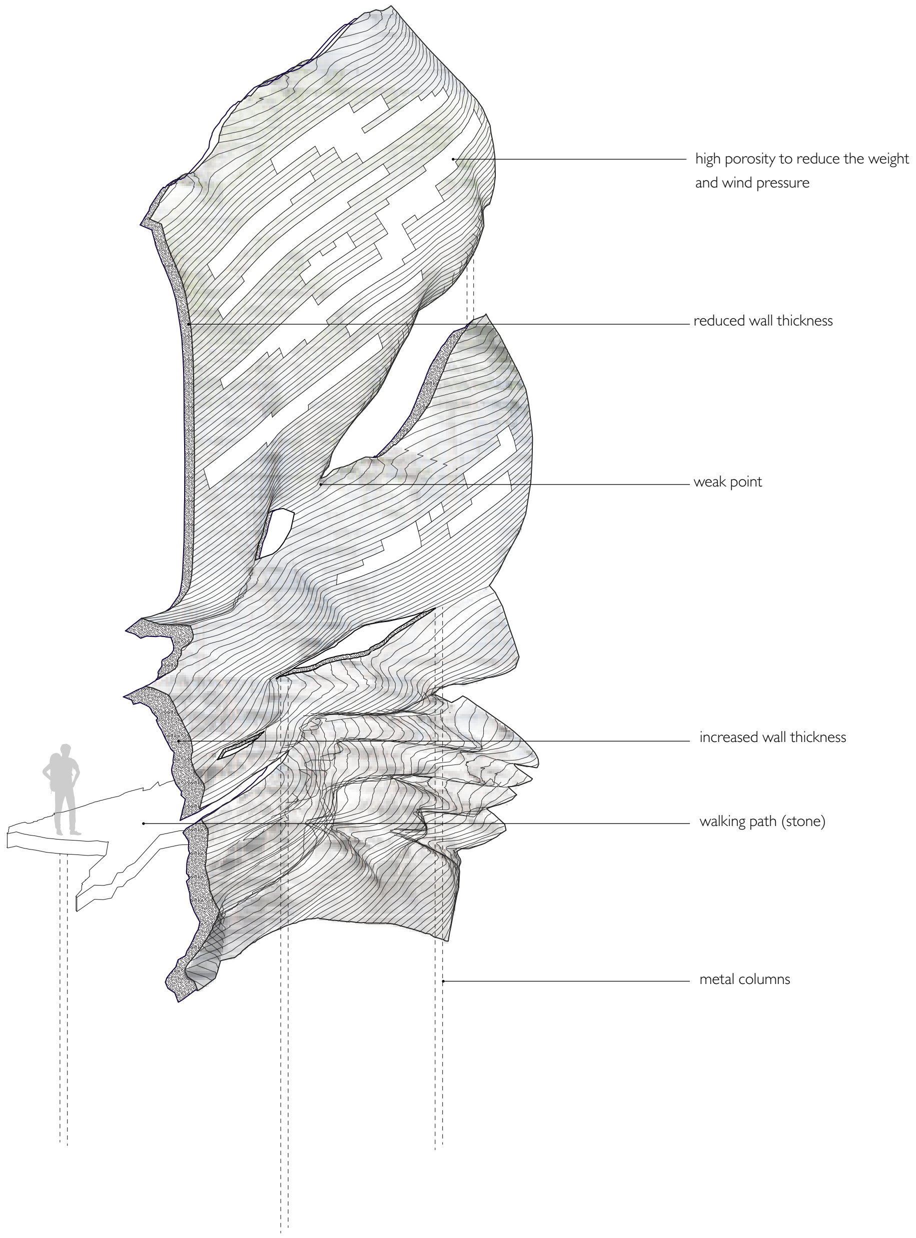
Even that the factor of sterile condition for growing the fungi was not to be a focus of the design performance in the project, there could be a possible solution for a real-life implementation.
Well established fungi is able to defend itself from the other living microorganisms, also in the open-air environment. It could be assumed, that the sections of the bridge wall were inoculated in a sterile condition. Mycelium would be provided with the nutrition and sterile water until it fully establishes. Then, it could be assembled on the site.

### MATERIAL

Materials that could meet the concept of decay over time were suppose to be natural and biodegradable. The considered options were silk, cotton and hemp. Silk is quite resistant to a biological decay and may possibly react to only certain species of fungi, not necessarily to the wood decaying *Pleurotus Ostreatus*. The cotton wire fabric could be a possible solution, however, when moist, it might be easily infected by green mould. It is also not quite rigid to keep the complex shape and need thoughtful fiber reinforcement. The hemp fabric was considered as the most appropriate material, which is relatively stiff, more resistant to green mould and apparently easiest to be disassembled by the wood decaying strain. That perhaps could be a choice in a potential full scale implementation, however in this project 's speculative approach they are all being used.
Potential use of non-biodegradable synthetic fabric could be the railing for the walking and biking paths - that element needs to last and function, especially after wall disintegration.

### THE STRATEGY FOR DECAY OVER TIME

1) Hemp fabric soaked into mixture of potato starch, agar (to add stiffness - potato starch looses its thick consistence when autoclaved in 112 degrees) and malt (extra nutrition) - become rigid and provide nutrition for mycelium.
2) Introduction of mycelium into hemp fabric. High carbohydrate feed until it well establishes.
3) After utilizing all provided carbohydrate feed is cut off, which make mycelium switch into 'starvation mode'. Mycelium starts to feed itself with natural fibers (moist is constantly provided from the river - part of wall is in the water + high moist weather conditions of the tropical climate).



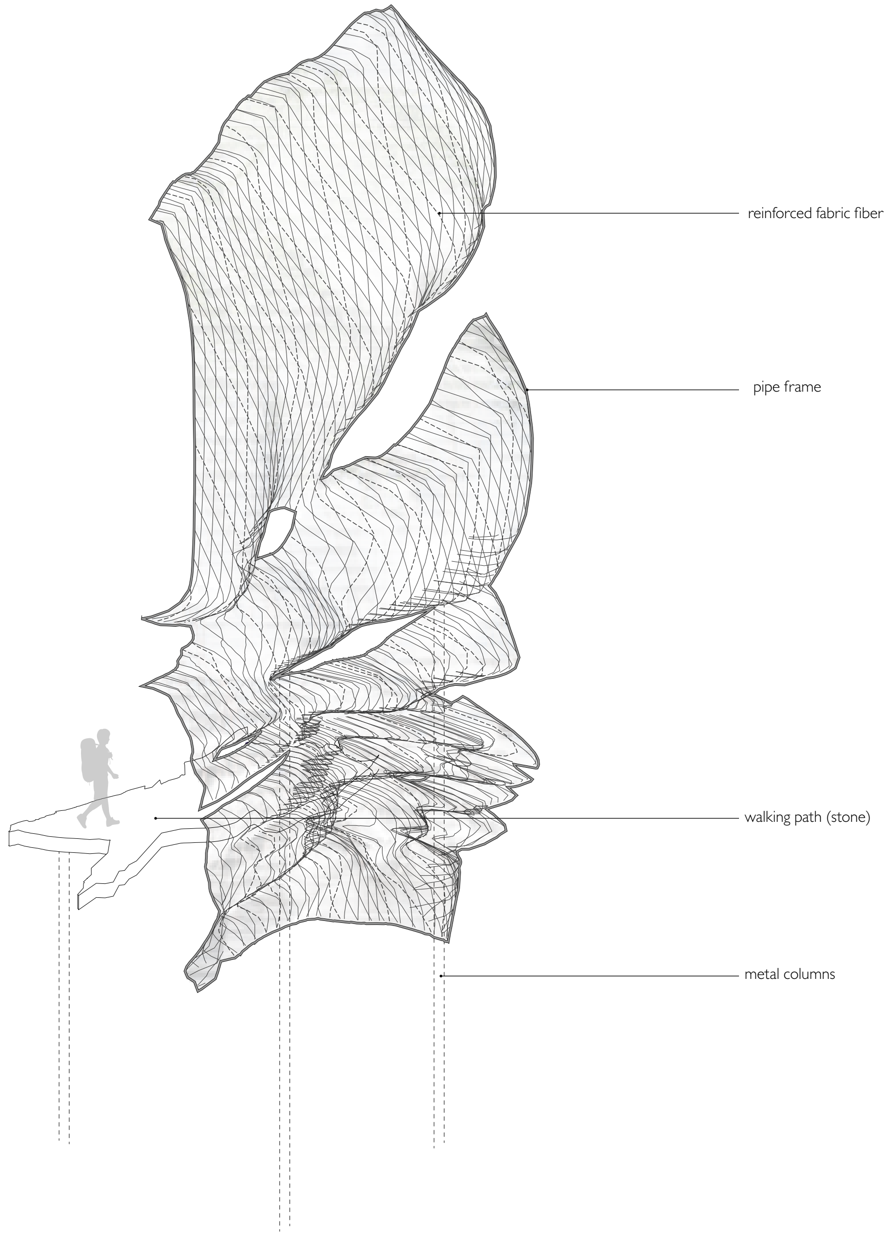

AXONOMETRIC SECTION THROUGH THE WALL 1 : 100

alternative a : 3D print with biodegradable material (potato starch)



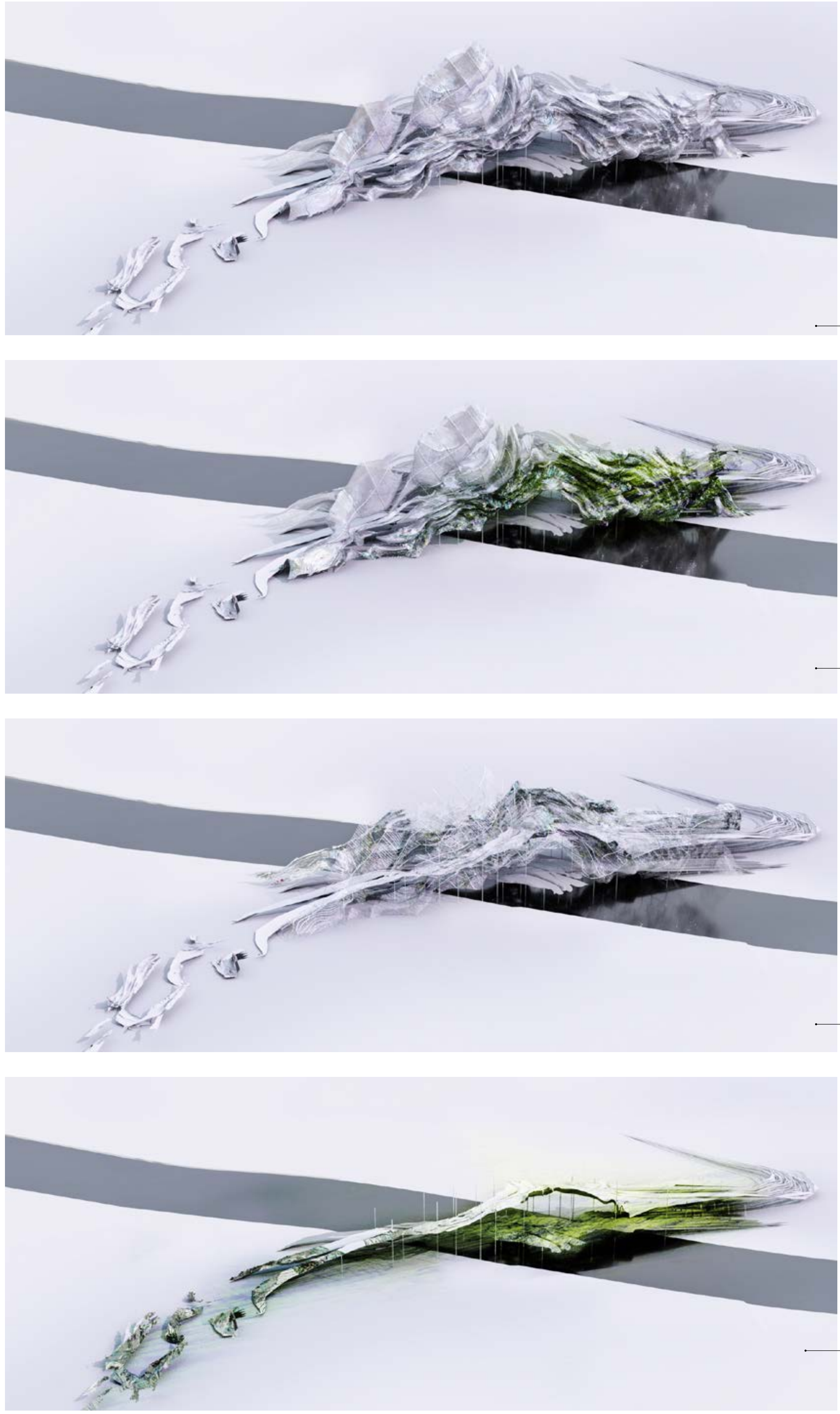
# MATERIAL & FABRICATION

## STRATEGIES




AXONOMETRIC SECTION THROUGH THE WALL 1 : 100

alternative b (selected) : reinforced wire fabric mounted on pipe frames



# T I M E L I N E

STAGE 1 I BUILDING PROCESS

Mounting frames with biodegradable fabric, walls and paths as a one structural system.

STAGE 2 I OVERGROWING

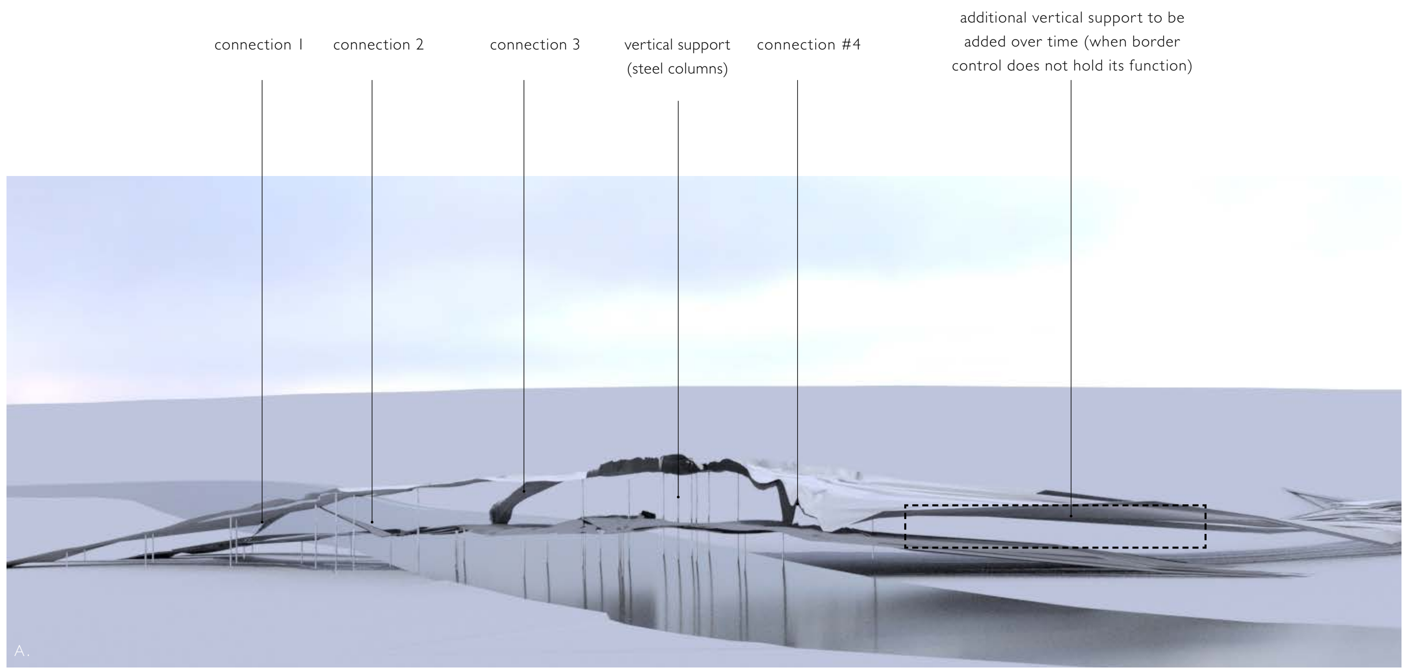
Agar medium distributed over fabric, mycelium introduction.

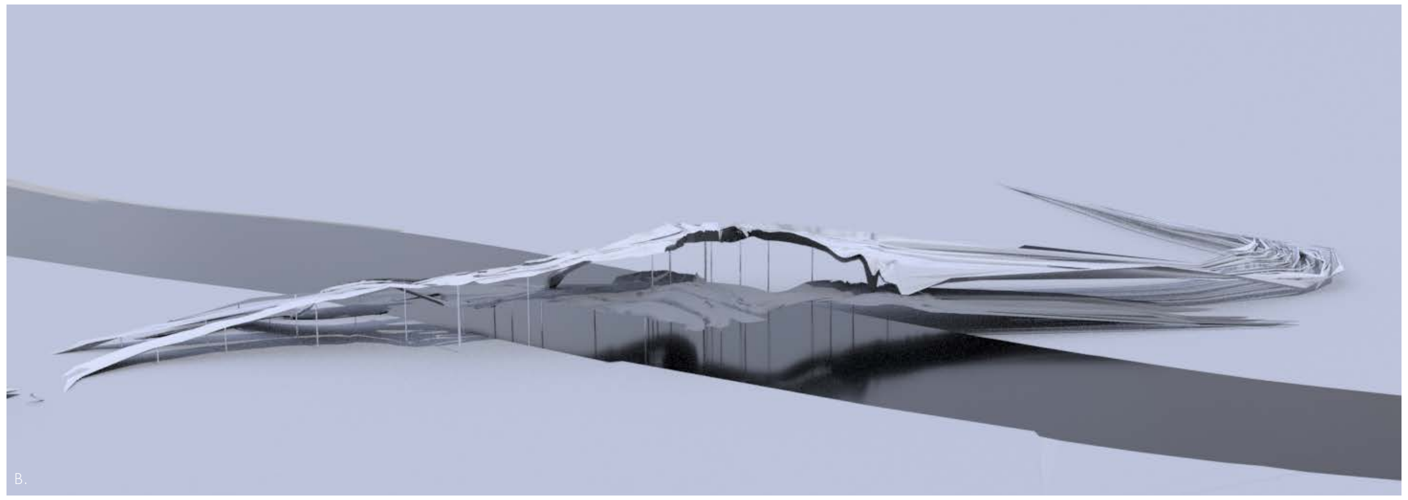
STAGE 3 I DECAY

Gradual wall disintegration.

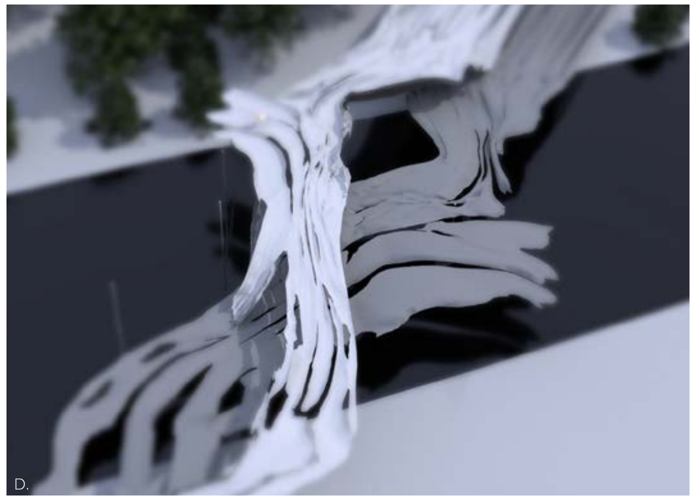
STAGE 4 I ONLY THE CONNECTION REMAINS

Open bridge and channel for nature; symbolic reforestation of Haiti.
Introduction of a car path.










# STRUCTURE

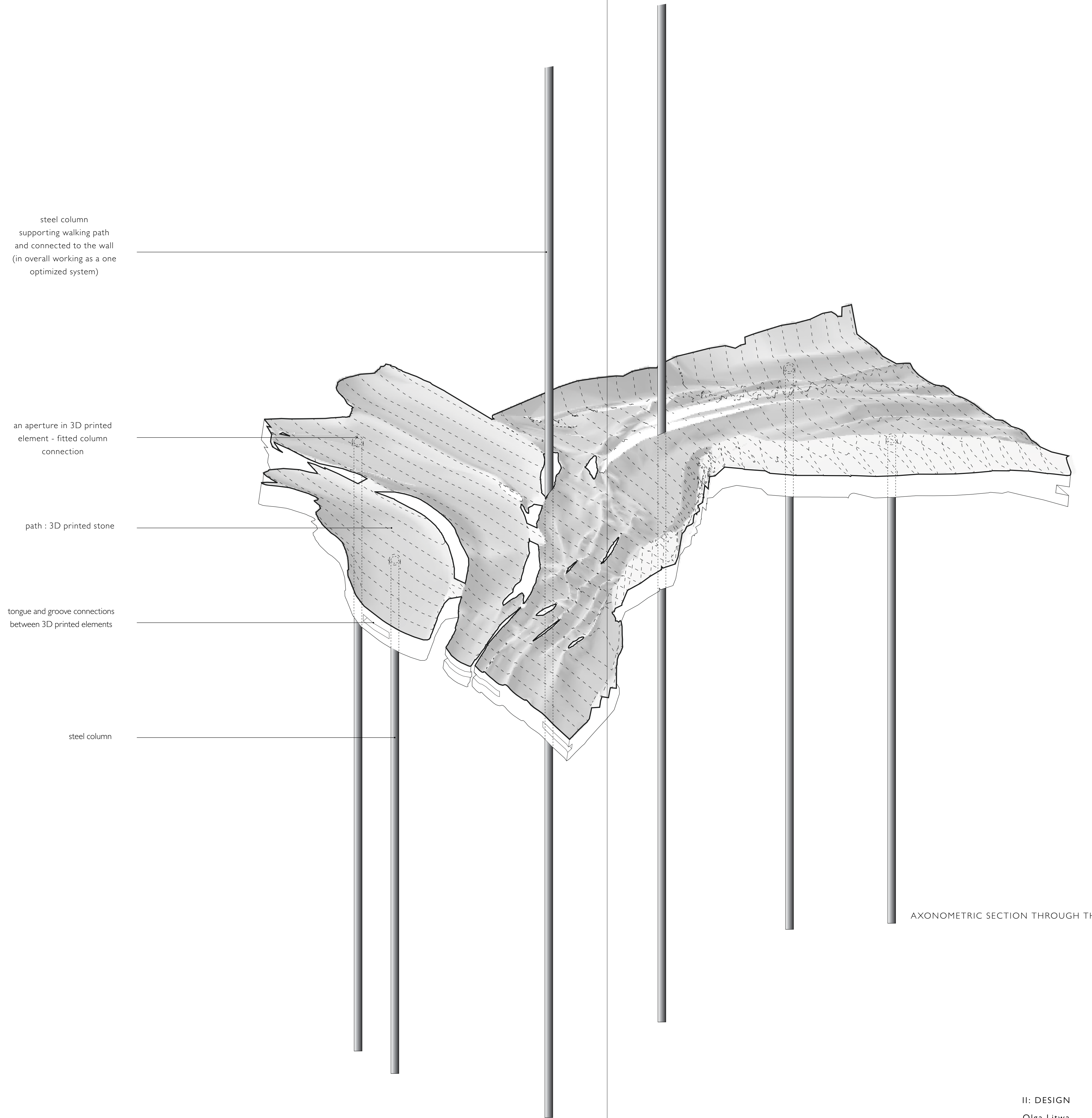
BRIDGE : PATHS

The paths are 3D printed with stone. Walking line is connected to the biking line in several places in order to optimize the structure. The vertical support consists of evenly distributed steel 'forest of columns'. The elements, together with walls, work as one structure system.

BRIDGE : WALLS

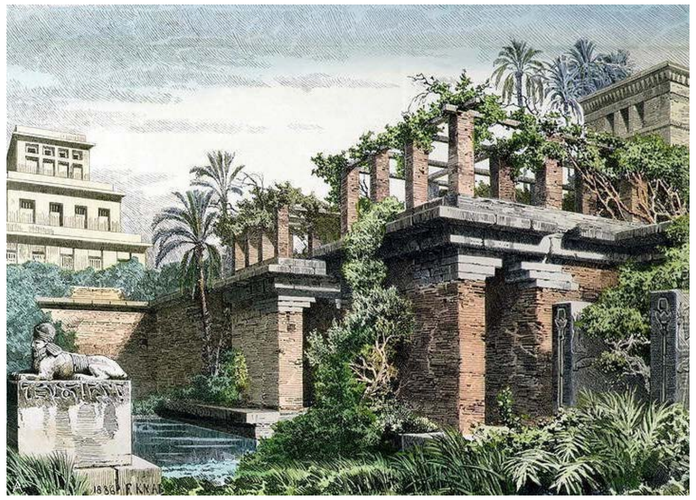
Fabrics are mounted on the steel frames and connected to the steel columns, that support the whole structure.

A, B - Structure system.
C - The bridge with mounted walls.
D- Remaining paths, after walls disintegration.




AXONOMETRIC SECTION THROUGH THE BIKE PATH, 1:100

# III: CASE STUDIES



B.

# CURATED GROWTH

## HISTORIC PRECEDENCE

### HANGING GARDENS OF BABYLON (A)

Concept of integrating the living with the artificial has been long present in the history of architecture.
Listed as one of the Wonders of the Ancient World, hanging gardens of Semiramis in Babylon were commited by King Nebuchadnezzar II.
The gardens were set on terrasses supported by a special construction, consisting of rows of narrow barrel corridors. Each terrasse was isolated with tar and lead surfaces, where drainage layer was placed and then covered by 2-meter thick layer of ground. Trees and bushes were watered by artificial hydration system. Channels and drains supplied the water from Euphrates River.
The gardens were set in VI or VII century b.c. Hanging greenery covering walls made an impression of hanging in the air.

### ENGLISH LANDSCAPE GARDEN

English Landscape garden revolutionized style of gardens on large estates and was a reaction against the formality initiated by the French Gardens like Vesailles.
Barocco gardens followed set of strict rules and were to demonstrate human control over nature, his power and wealth. XVIII century English garden broke the rigor of barocco, e.g. French gardens, and aimed to resemble natural landscape. Contrary to straight, symmetrical paths, landscape garden had curvy walkways and winding alleys that could be found in natural arrangements. Trees were planted in clusters, no longer in straight lines. Natural looking gardens, even with limited need for the maintenance, required a lot of planning and organization. Carefully selected long-living plants provided lively, changeable appearance of the garden through the circle of the seasons.

### VERNACULAR ARCHITECTURE (B)

Icelandic turf house is a characteristic building technique that uses turf blocks as a material. The technique was previously known in different parts of Europe and was adapted in Iceland mainly due to the lack of wood. It also provided a better insulation in a harsh climate.
The typical Icelandic turf house had a foundation made of flat stones. Wooden frames were holding the load of the turf - approximately 1-meter long blocks. They were often placed alternately with stone blocks.
Initially, the houses were long and had gable roofs. Over time the house was covered with grass, which provided better insulation and stabilization of the structure. The architecture style and technique evolved in various ways through over 1000 years of the turf houses being constructed.


A.


B.


C.


D.

# CURATED GROWTH

## LIVING ORGANISMS

FILATURES, BiotA Lab, BARTLETT SCHOOL OF ARCHITECTURE (A, B)

BiotA Lab connects architecture, biology and engineering. It is looking for novel methods of production and simulation in design and architecture. Works developed by students are undertaken between studio and laboratory : applications are designed with advanced digital tools; organism growth experiments and material tests are conducted under sterile laboratory conditions.
'Filatures' project: 3D printed scaffold for hosting mycelium growth – from the seed to evolved root system. The shape of the scaffold was based on mycelium growing patterns and their multiple transformations (A). The design proposal was the pavilion for bird watching in the forest of Hampstead Heath, London (B).

MYCELIUM COLOUR MODIFICATION (C)

Recent experiments revealed possibilities of color modification of mycelium.
Liquid watercolor introduced into malted agar mixture (medium for mycelium growth) was inserted into the hyphae system and resulted in blue dyed mycelium.

EcoLogicStudio/ CLAUDIA PASQUERO (D)

Claudia Pasquero, both within her practice EcoLogicStudio and academic environment, explores the notion of synthetic design that merges computational technologies with study of animal and plant colony behaviours.

'The slime mould is kept wet and food is dropped in the exact locations of present and future mining. The food is also coloured accordingly to the specific mineral content of the mine. As the mould expands to reach out for food it forms a network and begins dissolving and distributing the nutrients along it. A high-resolution webcam captures the mould's behaviour, morphology and the colour nuances at any moment in time; the image is then translated via digital code into a set of animated drawings and large-scale plans.' (Claudia Pasquero, Marco Poletto, 2014).

Outdoor labirynt - initial stage.

Indoors - plastic curtains.

Spidernetwood being overgrown over time.

# DESIGNING FOR TIME

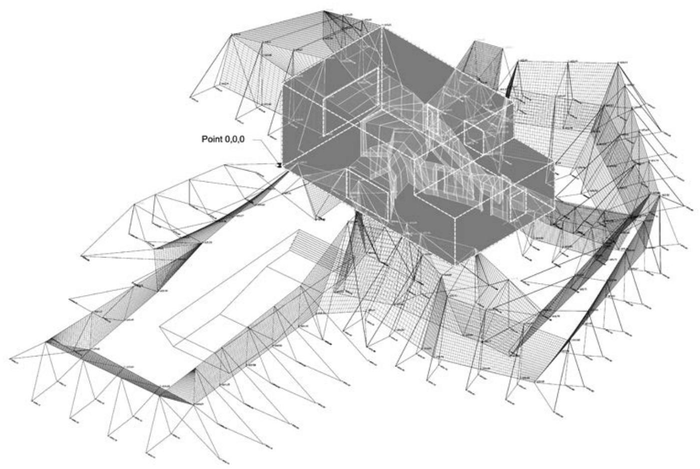
## SPIDERNETHEWOOD/ FRANÇOIS ROCHE / 2007 / NIMES, FRANCE

The house has was designed to become a labyrinth in the branches - that was predicted to happen in 5 years from building being set on the site, when trees on the site will fully grow. The 'habitation' - indoor part, is an extension of outdoor polypropylene-mesh labyrinth. It has intentional, non-designed form, simply taken from the nearest small shop. The concept focuses instead on the overtime house evolution, the growing aspect incorporated into man-made form. After 5 years the house has no longer facade; it disappears in the forest. Greenery - the living element that is an essential part of the project, makes it constantly changing or as the Architect names it, being 'under construction'.

Roche's take on juxtaposing the fabricated and the growing (living) has been a strong inspiration for this Master Thesis.

## A REPORT FROM BRUCE STERLING / 2030 / (C)

'The sturdy poles were moss-eaten, their guywires festooned with vines, and the trees on the site had grown huge. Given that the plastic mesh was integrated into the forest, the web-house was all parabolic arcs and delirious sagging.' ("Spidernethewood / R&Sie(n)").



Axonometric / Labyrinth organization.


11th Street Bridge Park / OMA.


Green Bridge / Thomas Heatherwick.



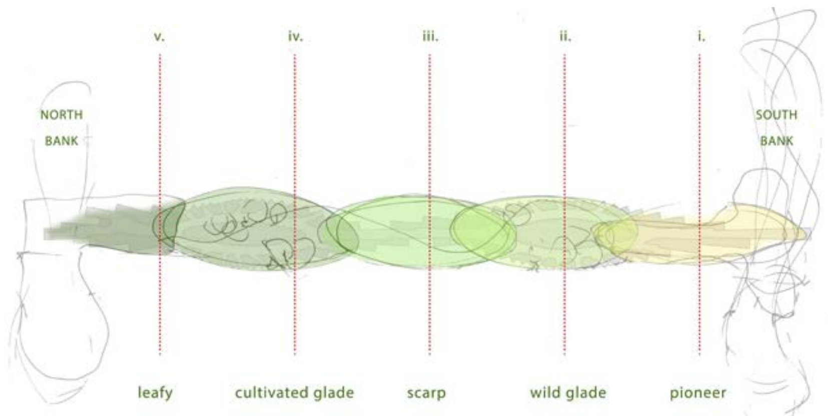
# LIVING BRIDGE

11TH STREET BRIDGE PARK / WASHINGTON DC / OMA / 2014 - ONGOING

11th Street Bridge Park by Office for Metropolitan Architecture is an example of a bridge design that steps out from its main function, which is providing the connection, and extend its role to a place for people gatherings. It provides a flexible space for markets, festivals and performances, as well as special zones for playgrounds, sports, relaxation and active learning all over the year. With its unique, recognizable design, the bridge adds a new definition to the image of the river and generates a direct connection with community in everyday life.

GARDEN BRIDGE / LONDON / THOMAS HEATHERWICK

Garden Bridge is a proposal developed by Heatherwick Studio and campaigner Joanna Lumley in 2013 for a connection between North and South London with a garden.
The Garden Bridge is to create a new form of landscape that will add to London's great and diverse heritage. The bridge will 'grow and nourish the connection', providing new space for activities.
Unfortunately, the 'dream of the Garden Bridge' was turned down due to complex issues regarding funding and maintenance.




Garden Bridge / Plantation diagram.

Kunsthal / View from the Maasboulevard.

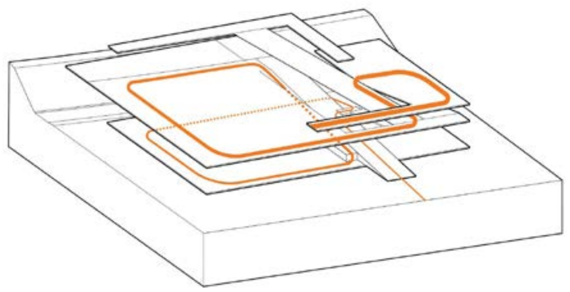
Kunsthal / Site plan.



# THRESHOLD

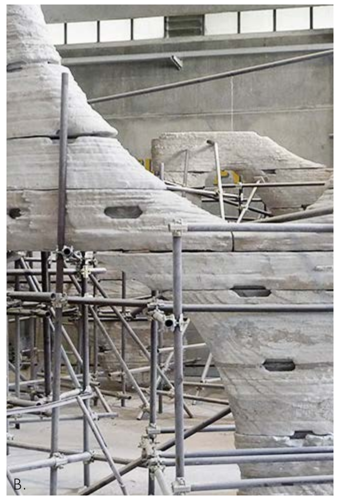
KUNSTHAL / ROTTERDAM / OMA / 1992

Located on a site of a 'dual condition' between busy Maasboulevard and Museum Park, the Kunsthal - museum and gallery - functions as a entrance to that highly valued cultural amenity in Rotterdam.
The building has an interesting and exceptional internal organization, camouflaged by a simple massing. It contains three large exhibition halls and two small galleries, which are seamlessly connected by sloping floor planes and sets of ramps. The building communication works as a 'continuous circuit' and interferes with a common sense (linearity) of destination. From a single viewing point the visitor is able to see through and experience several different spaces of the Kunsthal at the same time.



Kunsthal / Communication diagram.

A.



B.

C.

# MATERIAL & FABRICATION

## 3D PRINTING

D-SHAPE/ ENRICO DINI

Based in Buti, Italy, D-Shape is a innovative practice that 3D prints large-scale objects and buildings - including all structural elements, run by Enrico Dini.
D-Shape is introducing various different materials into the printing process: sand, gravel, recycled aggregates, cork, rubber, fiber additions. The practice is exploring different types of binders, e.g. synthetic and biodegradable, considering the indoor or outdoor target environment for the design. D-Shape strives to find the optimal solutions.
I had an opportunity to talk to Enrico Dini and briefly discuss the potential of 3D printing the bridge elements with potato starch and biodegradable binder that would enable material disintegration over time.

A: The world's first 3D printed reinforced concrete bridge / Madrid / 2016. Enrico Dini for IAAC.
B: Radiolaria pavilion / Italy / 2008. Made of an artificial sandstone material, 10m tall free-form structure does not feature any internal reinforcement.
C: Coral reef / Bahrain / 2008. 3D printed with sedimentary rocks originally formed from sea deposits, chemically bound with a patented ecological binder.


A.
Thyssen-Bornemisza Art Pavilion / Xefirtoarch.


B.
SCI-Arc Graduation Pavilion.


C.
SUR PS1 MOMA / Xefirotarch / Hernan Diaz Alonso.



# MATERIAL & FABRICATION

## FABRICS & MESHES

The selected strategy for the 'wall' elements of the bridge is a system of tubes working as frames for fabric elements. Below are some references of akin solutions.

### SCI-ARC GRADUATION PAVILION / OYLER WU COLLABORATIVE / 2012 (B)

The structure consist of painted steel tubes that create twisting, repetitious frame. Bright blue fabric is tightly stretched trough the frame. It forms curvatures and contrasts sharp structural elements.

### SUR / XEFIROTARCH (C)

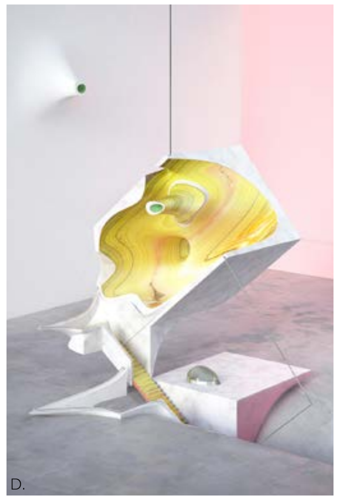
The freestanding aluminium structure is covered with stretchy polyurethane fabric. It is combined with the suspended, layers pieces of fabric. With the incorporated artificial lightning the overall design creates an interesting performance of various light and shadows definitions.

Several other practices have been currently exploring similar techniques. B + U Architects and their proposal for mixed used building in LA uses 'a high tech fabric enclosure system' that consists of many layers of fabrics with different opacities. Their 'Apertures' pavilion can be another example.


A.


B.


C.


D.

# TEXTURE & INTERIORITY

!NTIMACY/ ISAIE BLOCH (A-D)

'!ntimacy' series of interiors distort material based reading of the space. Although exposing familiar striations of bended agate or figured onyx, the project deforms the reality by overscaling textures or introducing colorful layers. Using common architectural elements (wall, column, ceiling), the projects attempts to create domestic, comfortable atmosphere which, however, has a strong twist.

KEY WORDS:
/ overscale, distortion, interruption, discontinuity / digital, non-material environment / textural qualities as the catalysts for human perception of the space / flirtatious ceiling / delusive softness / misleading, evasive /

Presented studies bring interesting aspect of texture personification - it can have a character, a posture, perform in a certain way or evoke strong feelings.

# IV: METHOD & PROCESS

## I. INITIAL TEXTURE EXPLORATION (CATALOGUE)

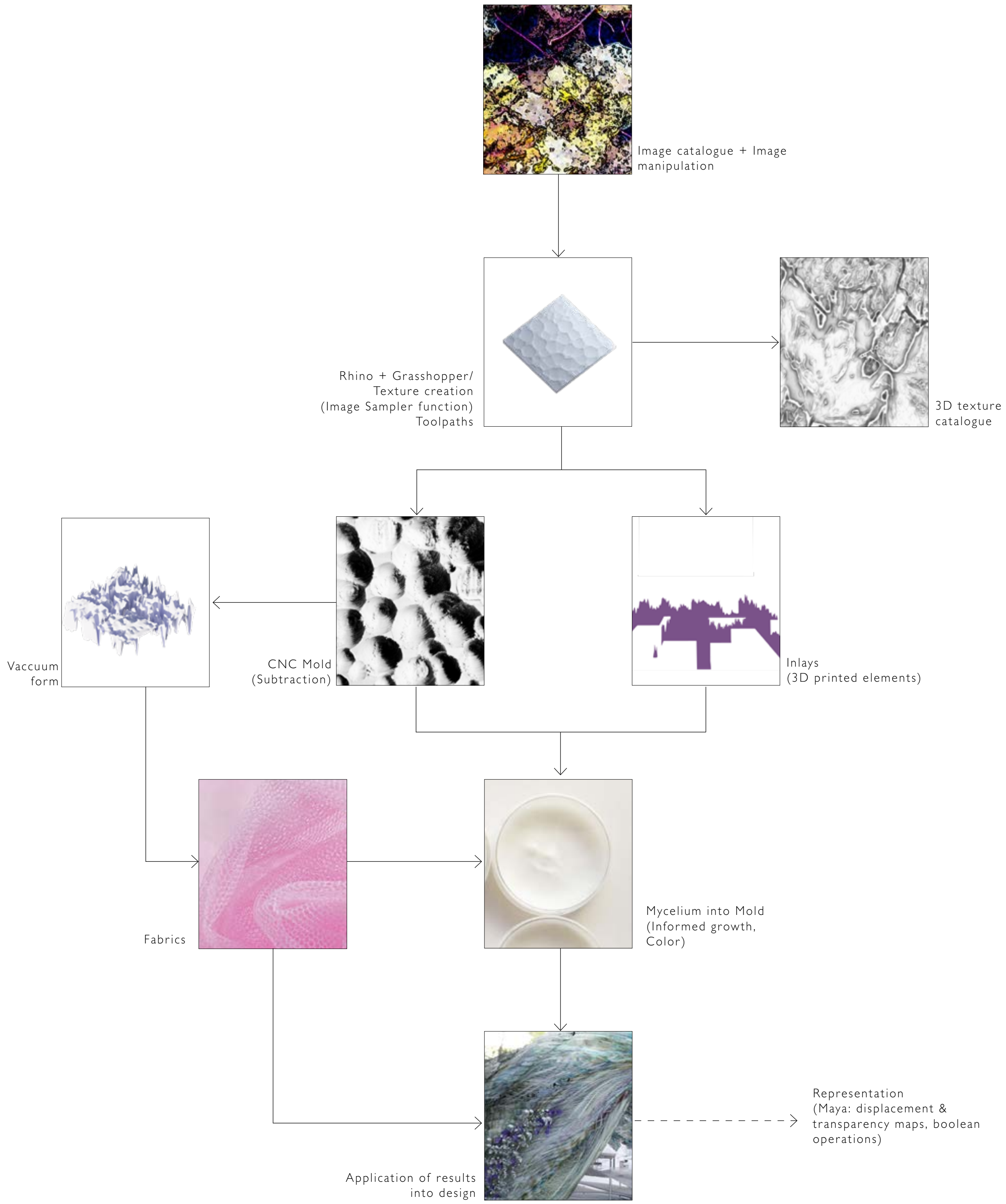
- Nature Inspiration (Image color manipulation)
- Geometrical Interpretation Rhino + Grassopper (Image sampler - color channels Toolpaths)

## II. MATERIAL BASED TEXTURE EXPLORATION (COMPONENTS)

- #1 Single
  - 1.1 Cnc Fabrication -Wood / Foam (Subtraction)
  - 1.2 Vacuum Form - Plastic
  - 1.3 3D print - Layering (Addition)
- #2 Composite
  - 2.1 Mold + Mycelium (Informed growth, Color)

## TECHNIQUES

- Subtraction (CNC)
- Inlay (3D print)
- Addition (Layering, Fabrics)
- Overgrowing/ Decay/ Inlay (Mycelium)



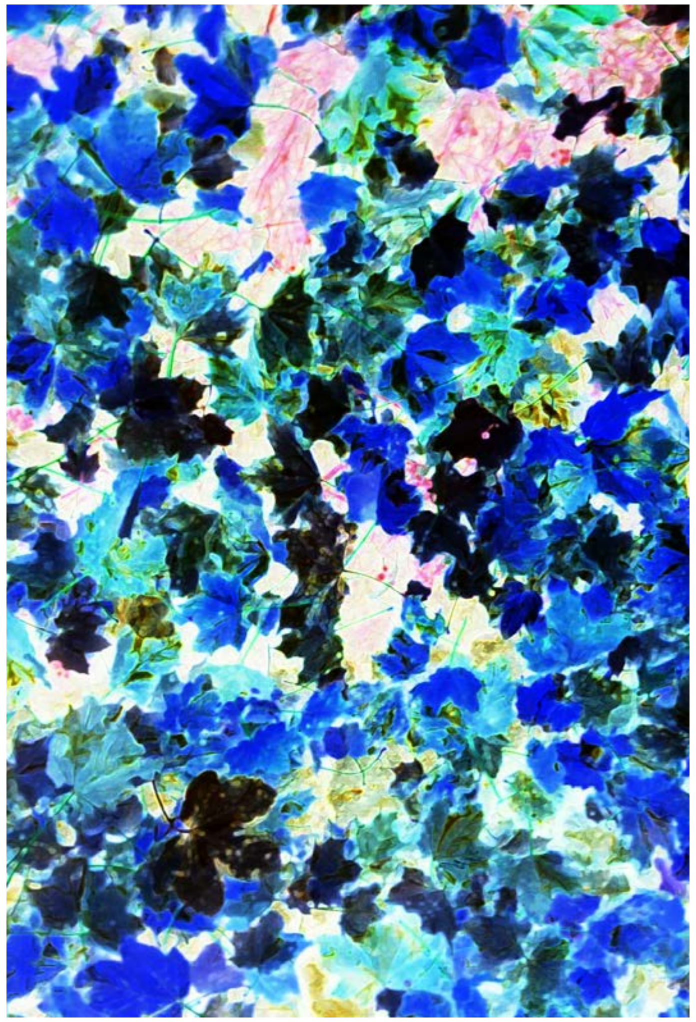
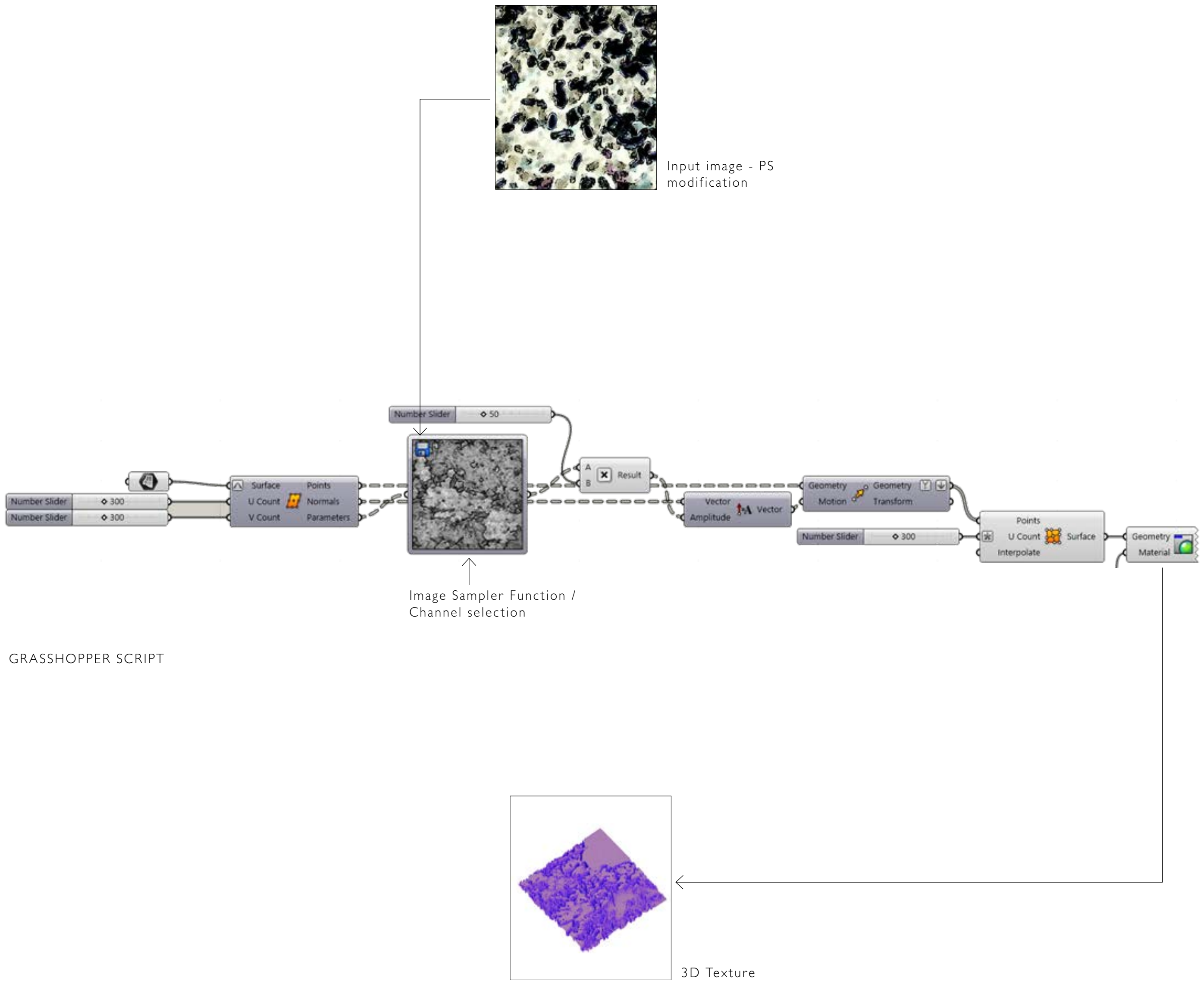


Image color modification (Photoshop).



# V: BASE TEXTURE

Studies of Nature Inspired Textures




GRASSHOPPER SCRIPT

# TEXTURE CATALOGUE

## METHOD

### DIGITAL STUDIES OF NATURE INSPIRED TEXTURES

In order to translate image into 3D texture the Rhino and Grasshopper software were used. Grasshopper *Image Sampler* function have several different channels to choose from. Depending on input image color and brightness, it will generate different geometry e.g. image's blue areas will be translated in a different way than image's red areas with Blue Channel etc.

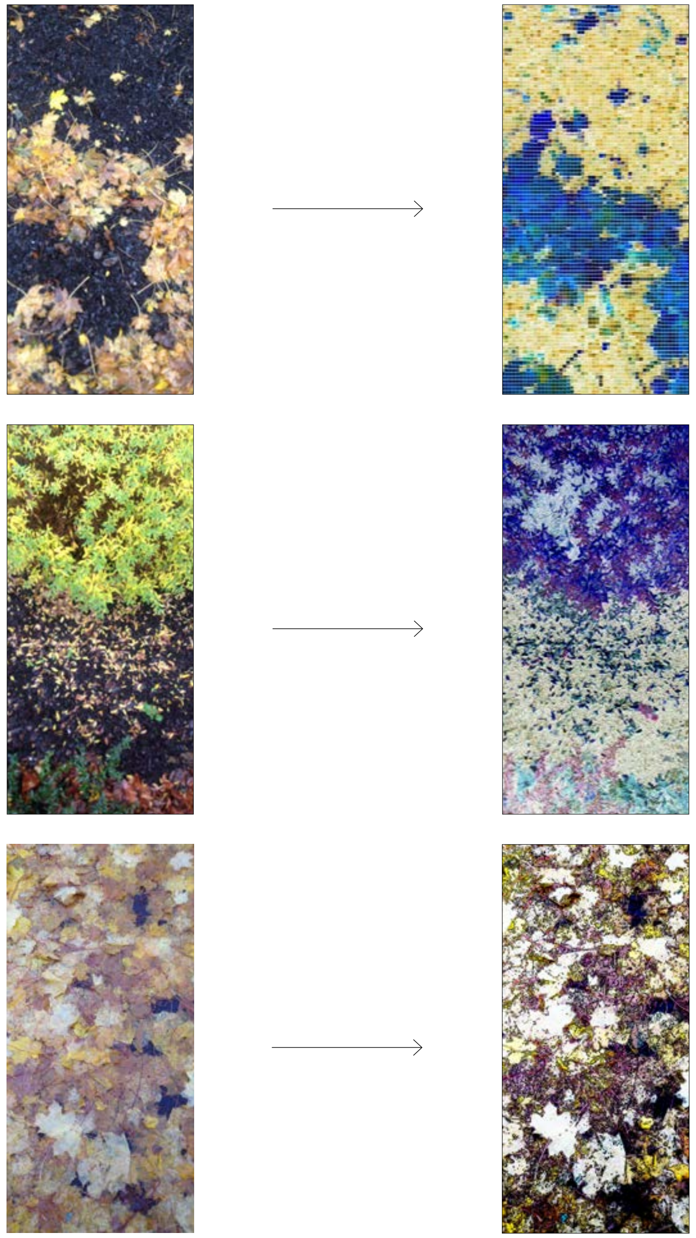
CONCLUSIONS:

a) Red, Green, Blue Channels; Color Brightness - very much similar appearance of the texture;
b) Alpha Channel; RGBA Colors - surface appears almost flat;
c) Color Hue, Color Saturation, Color Brightness - the most interesting and various results.

Texture catalogue was developed using a, b, c narratives.

### CONTROLLING PARAMETERS

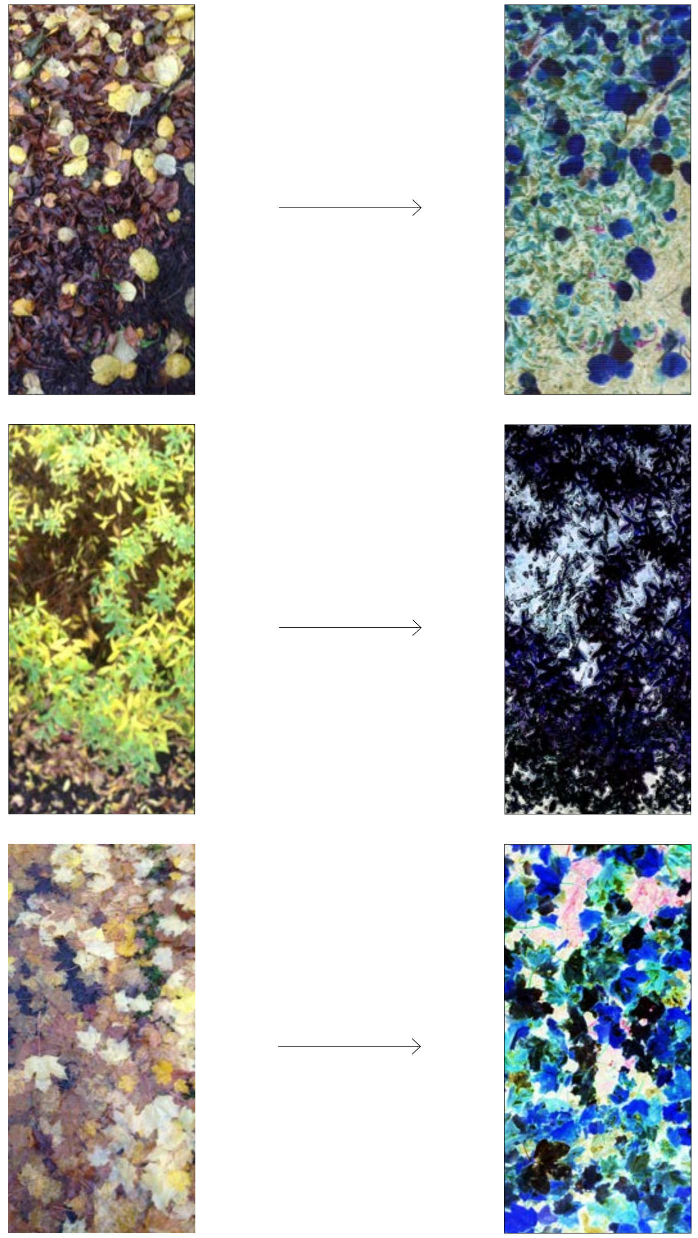
- Image Color & Articulation
- Brightness
- Channel selection in Image Sampler



Photographs of various natural floors.

Image modification (Photoshop).





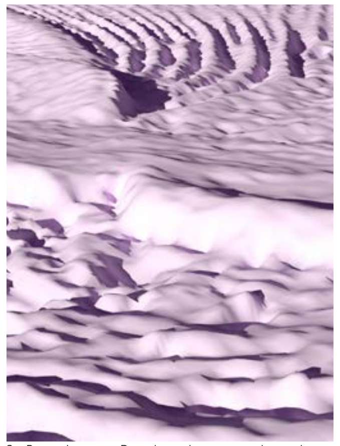
Photographs of various natural floors.

Image modification (Photoshop).

LINEARITY/
RADIALITY

1. Base Image: Regular mushroom lamella, color modification in PS.

BREAKING THE
LINE



2. Base Image: Rendered texture based on linear lamella mushroom pattern.

BREAKING THE
PATTERN

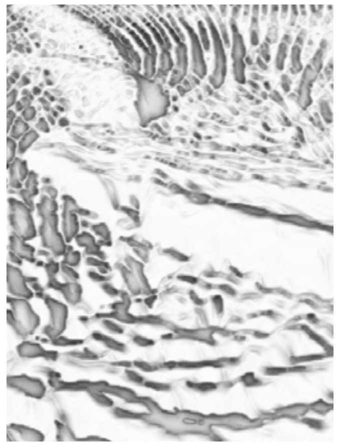
3. Base Image: Photo color modification created in the online app.



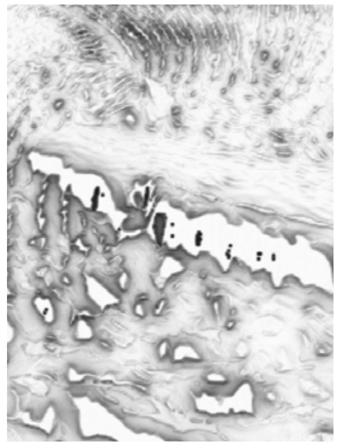
A. Color Saturation: Linearity deformed with irregular apertures.

B. Color Hue: Linearity of the pattern reflected with bubble-shaped apertures.

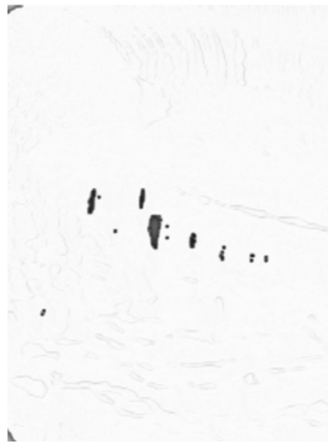
C. Red Channel: Linear, smooth, thin bridges, organic undisturbed curves, sequential, gradual.



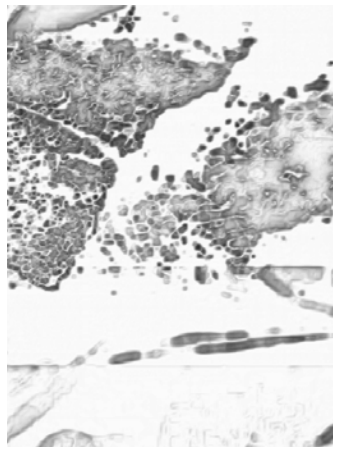
A. Color Saturation: High level of detail, organic outlines, irregular apertures.



B. Color Hue: Reduced detail, sharp outlines.

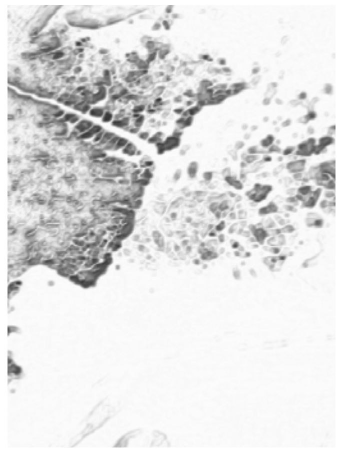


C. Red Channel: Very little detail, sharp outline.



A. Color Saturation: Irregular, small apertures.

B. Color Hue: Extruded parts have sharp, pixelated edges.

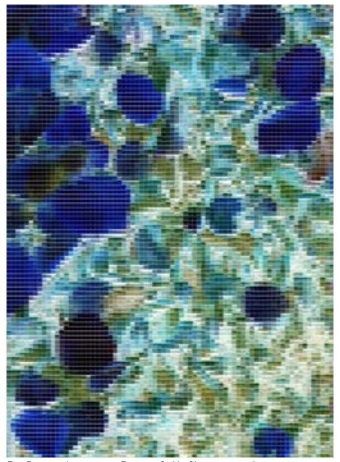


C. Red Channel: Bottom (not extruded) parts appear noisy, edges of extrusion are organic.

SOFT EDGE

4. Base Image: Parc fall floor, color invertion in PS.

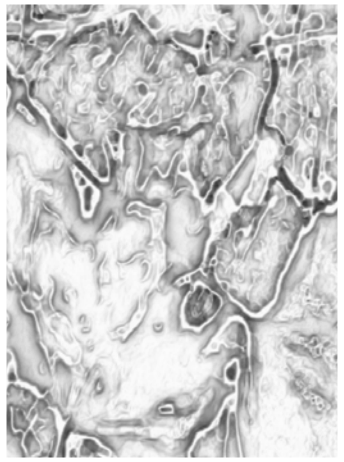
PIXEL



5. Base Image: Parc fall floor, color invertion and pixelization made in PS.

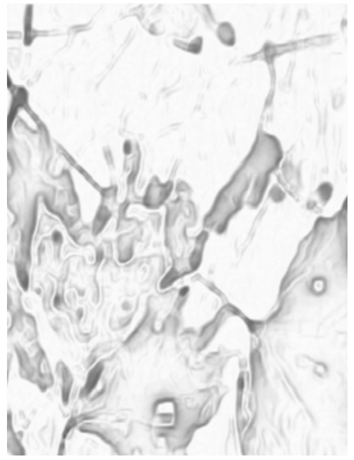
FRACTAL/ CLUSTER

6. Base Image: Parc fall floor, color invertion and pixelization made in PS.

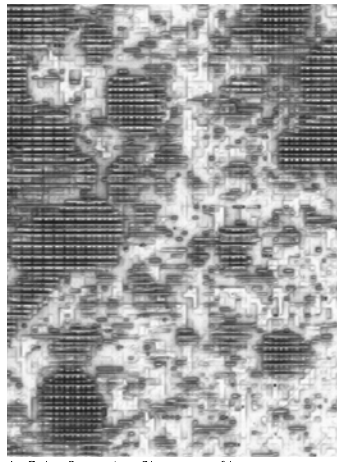


A. Red Channel: Intense texture, organic extrusions create bridges in various thicknesses and scales.

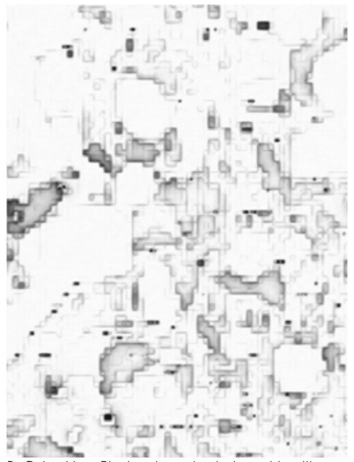
B. Color Hue: Minimal, flat extrusions, sharp edges.



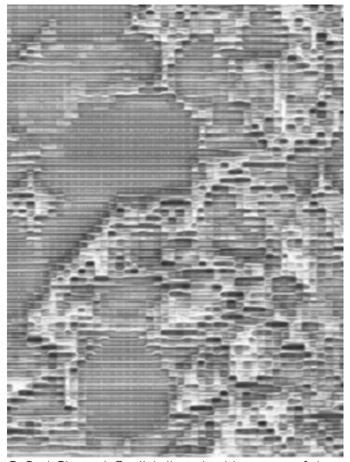
C. Color Saturation: Flat extrusions with organic edges, local organic interruptions of flatness.



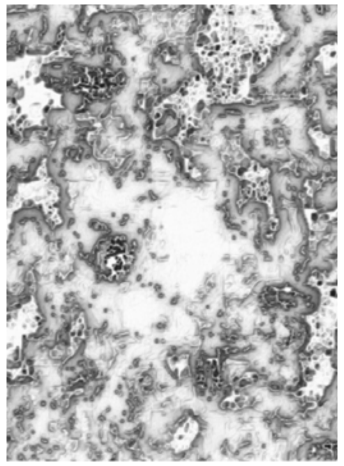
A. Color Saturation: Blue parts of image, contrasted with white lines appear well articulated and reflected in the texture with strong linearity.



B. Color Hue: Pixelated, mechanical, machine-like, level of apertures is well balanced and contrasted with flat parts of the texture.

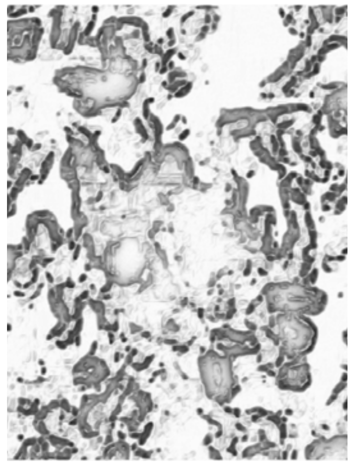


C. Red Channel: Explicit linearity, blue parts of the image appear flat while the rest of the image is more irregular.



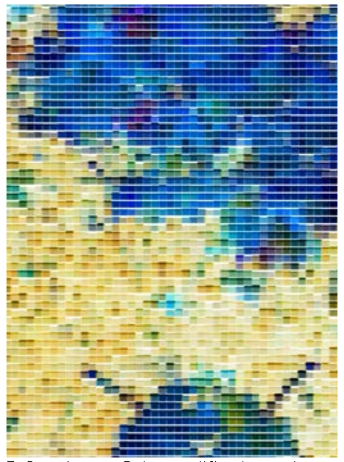
A. Color Saturation: Irregular, pitted extruded parts, lumpy irregular bottom, flat in the center.

B. Color Hue: Simplified extruded flat parts, apertures are grouped and spread evenly.



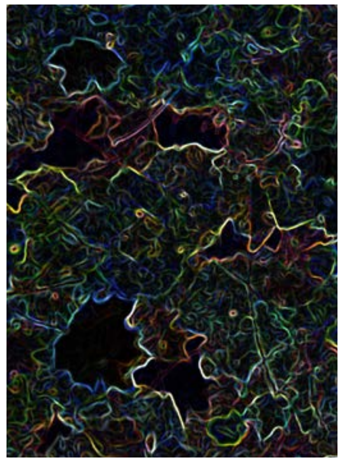
C. Red Channel: Extruded flat parts interrupted with organic apertures in two different sizes.

SHARP EDGE



7. Base Image: Color modification and pixelation of the image made in PS.

WAVES

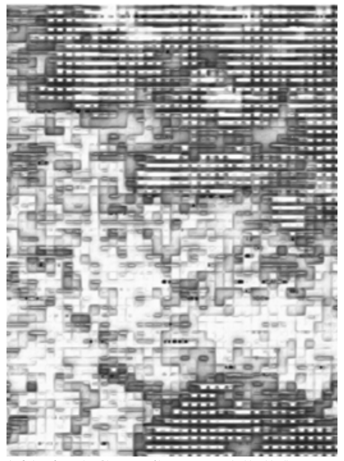


8. Base Image: Parc fall floor, color invertion and pixelization made in PS.

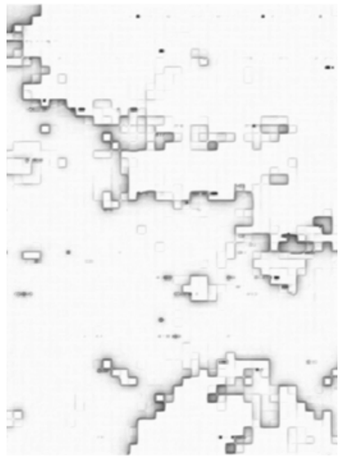
FLATNESS VS INTENSE POROSITY

9. Base Image: Parc fall floor, color invertion and pixelization made in PS.

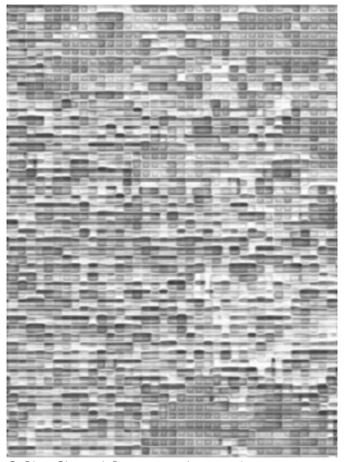




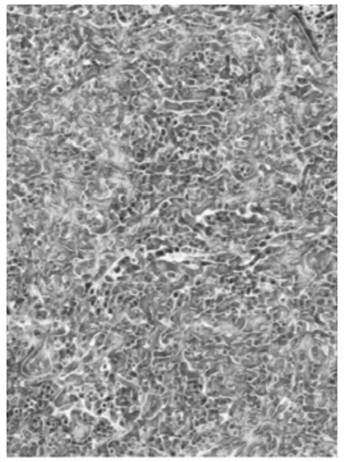
A. Colour Saturation: Blue parts of image, contrasted with white lines appear well articulated and reflected in the texture with strong linearity, yellow parts of the image appear in the texture as more evenly spread squares.



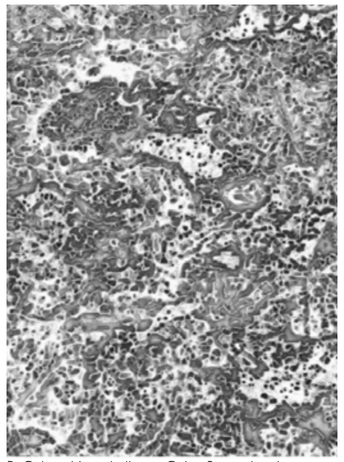
B. Colour Hue: Pixelated, mechanical, machine-like, level of apertures is well balanced and contrasted with flat parts of the texture.



C. Blue Channel: Bumpy, rough, rugged, uneven, pitted, lumpy, holey, messy; apertures have soft edges.

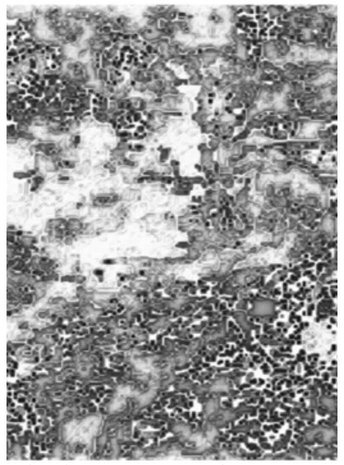


A. Color Saturation: concave & convex, positive & negative, overall continuous expression, organic, extrusions form thin bridges.

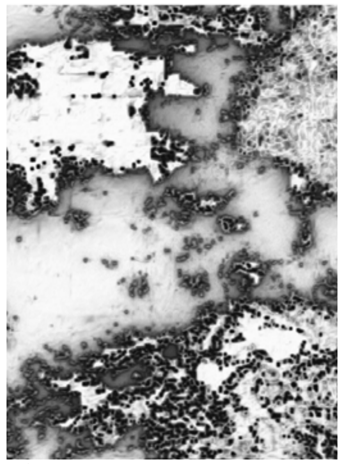


B. Colour Hue: similar to Color Saturation, but some of the extrusions create bigger islands with sets of small apertures.

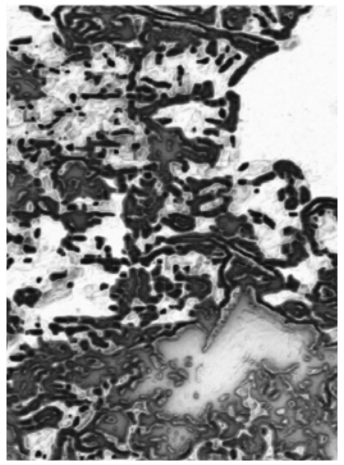
C. Green Channel: Soft clean bridges, texture well articulated, organic, irregular but coherent, even.



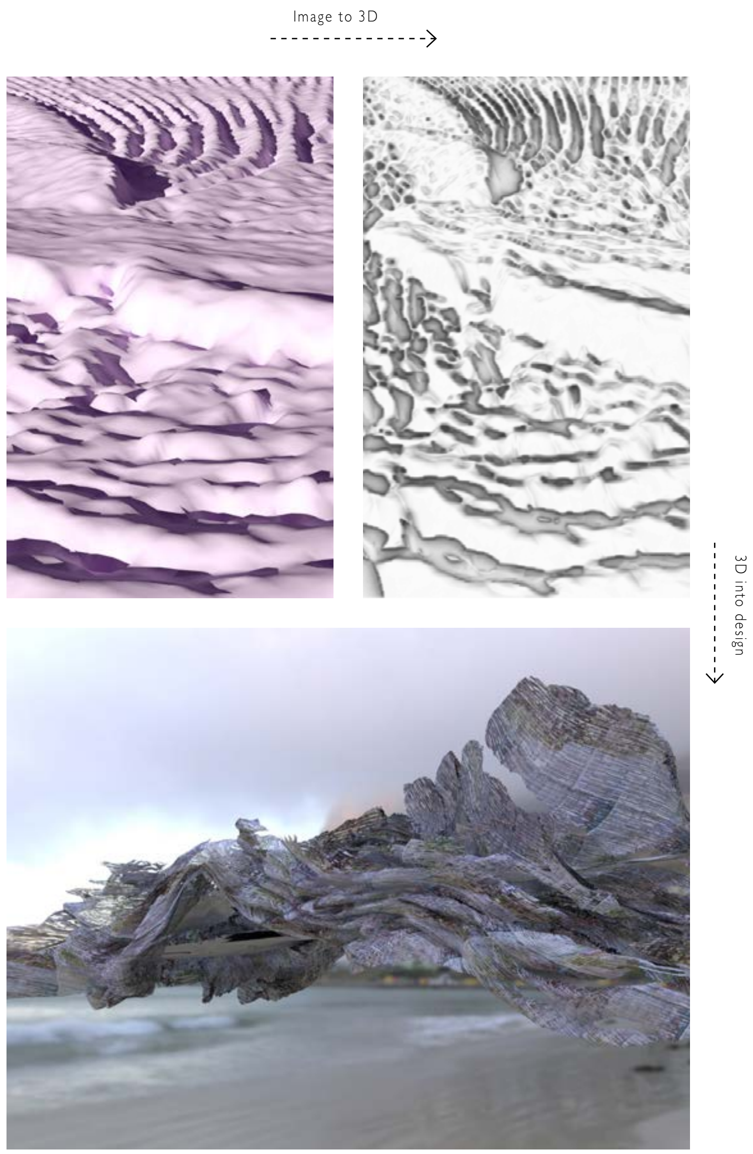
A. Color Saturation: Highest level of detail, texture appears noisy, extruded parts have bubble-like apertures, bottom parts (less extruded areas) appear more flat.



B. Color Hue: Texture bumpy areas contrasted with almost flat areas, apertures have rather sharp edges.



C. Blue channel: Evenly spread squared pattern.




# TEXTURE TRANSFORMATION

FROM AN IMAGE TO THE BRIDGE / 3 LEVELS OF TEXTURE

The texture transformation started with images representing different elements of nature (e.g. park floors) that were later transformed into the 3D surfaces (Rhino, Grasshopper). That result was transformed further - manual modification of meshes (Maya) led to the creation of the bridge structure. Single texture performs as one structure, e.g. wall or path. These elements represent one level of scale (Texture scale 1). Development and modifications of Texture scale 1 introduce another scale of texture - Texture scale 2 (furnishings, sittings, railings). Texture in scale 0 ocurres when the overall design of the bridge is placed in the context of the site.

Differentiating those 3 levels of texture has brought some hierarchy into complex forms and helped to understand and move forward the design development.

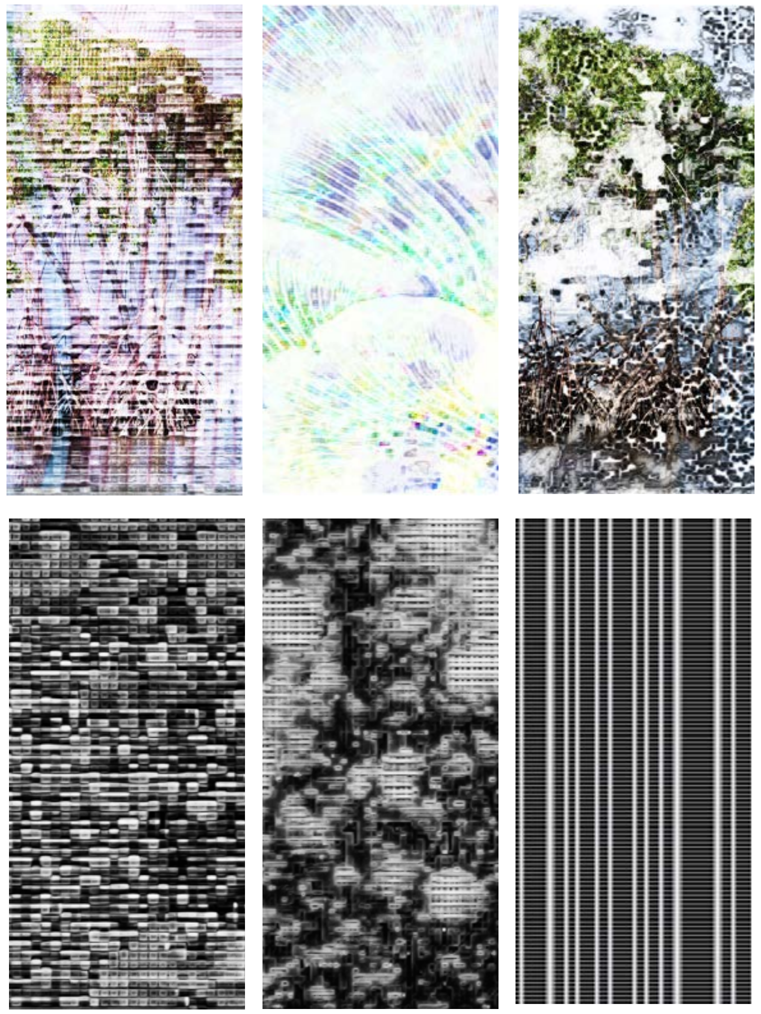
Sun rise, Dominican Republic.

Waving facade.



# TEXTURE TRANSFORMATION

## TRANSPARENCY & OPACITY MASKS



1st line: Textures used for the final renderings.
2nd line: Transparency & displacement masks used for the final renderings.

Deep texture: 3 layers with small offsets and applied different default textures, opacity & transparency masks were used to create the walls of the bridge.

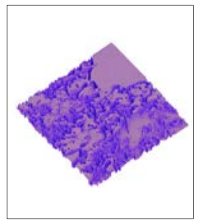
A.

B.

C.

D.

# TEXTURE FABRICATION

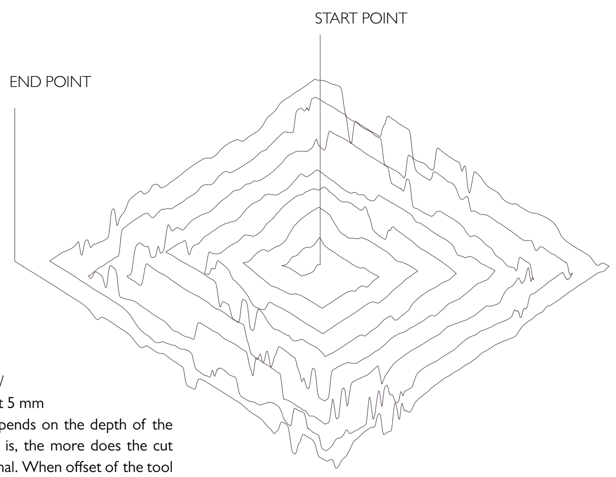


3D TEXTURE

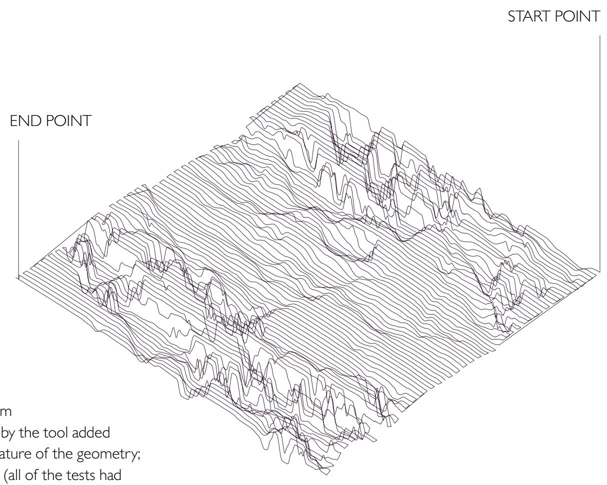
PHYSICAL TEXTURE

Generated 3D texture was exported into .stl model and translated with GibbsCAM software into code that CNC machine uses to cut the geometry. Models were fabricated in wood.

Fabrication made with CNC machine were to test levels of the detail possible to obtain with certain drill sizes, as well as different expressions and resolutions of the digitally made texture.
Fabricated pieces were a base for initial experimentations with mycelium - observation of the reactions of living organism towards different irregular geometries and wood types.




TOOLPATH #1/ CNC/
ROUGHING CIRCULAR/
Drill 4mm, round/ Offset 5 mm
Result: The outcome depends on the depth of the 3D model: the thicker it is, the more does the cut texture resemble te original. When offset of the tool is wider than the tool itself, texture has thin bridges, that expose the curvature.



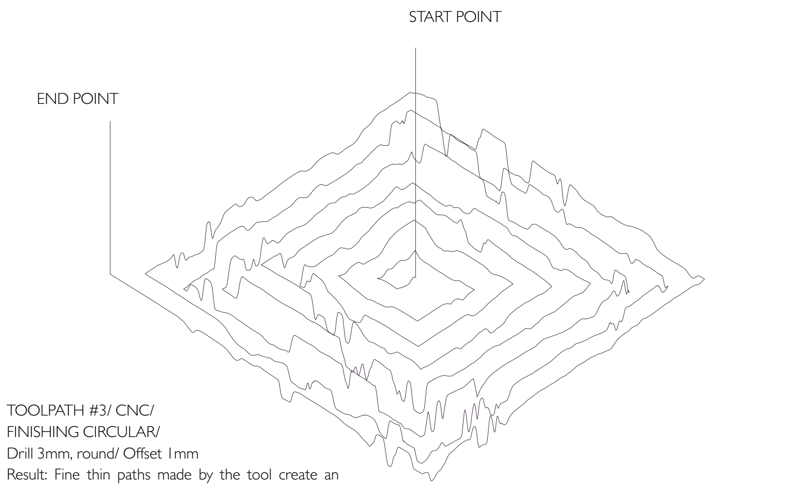

TOOLPATH #2/CNC/
ROUGHING LINIAR/
Drill 4mm, round/ Offset 3mm
Result: Explicit paths created by the tool added texture that expose the curvature of the geometry; the deeper the input texture (all of the tests had a thickness >5cm) the closer appearance of the physical texture to the digital model.



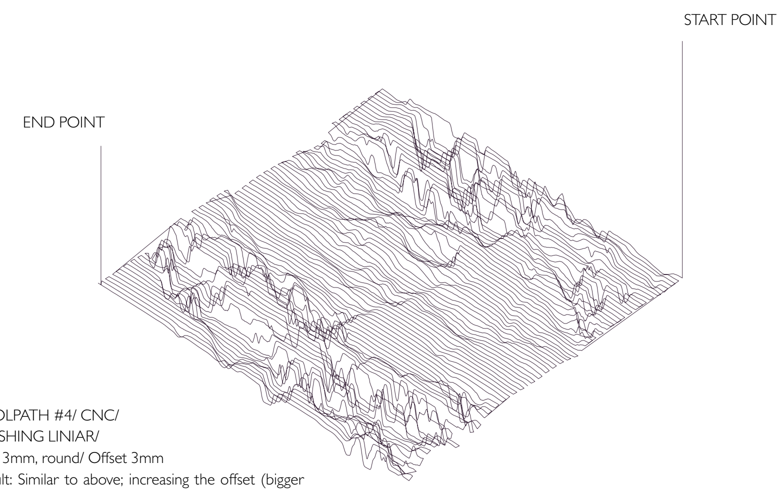
# TEXTURE FABRICATION

## TOOLPATHS

ROUGHING LINIAR/ Wavy paths.

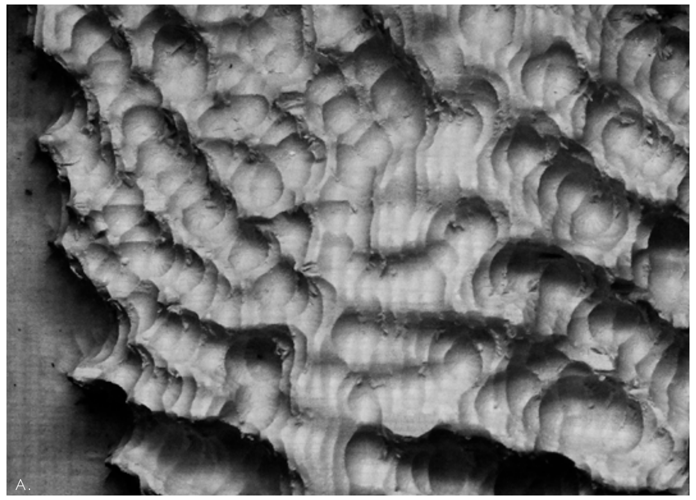


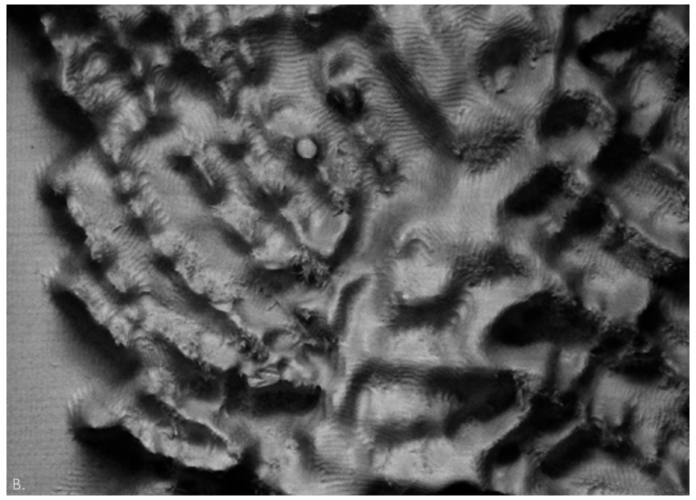

TOOLPATH #3/ CNC/
FINISHING CIRCULAR/
Drill 3mm, round/ Offset 1mm
Result: Fine thin paths made by the tool create an additional texture; physical outcome resembles a lot the input 3D geometry. The movement of the tool is clearly visible on the diagonals of the model.




TOOLPATH #4/ CNC/
FINISHING LINIAR/
Drill 3mm, round/ Offset 3mm
Result: Similar to above; increasing the offset (bigger than a tool width) leaves bridges and add another level of detail to the surface.

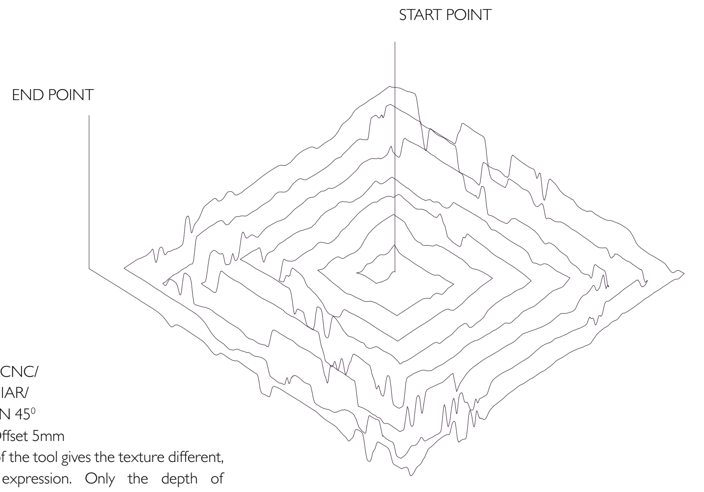




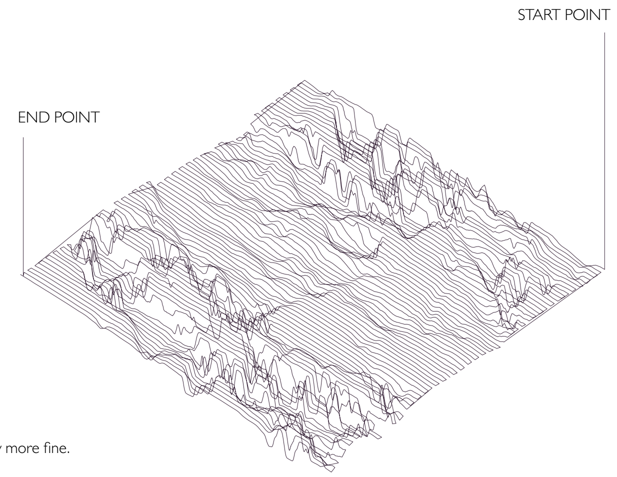




A: ROUGHING LINIAR/
Drill 4mm, round/ Offset 3mm
Result: Intriguing explicit paths created by the tool, added texture that expose the curvature of the geometry.

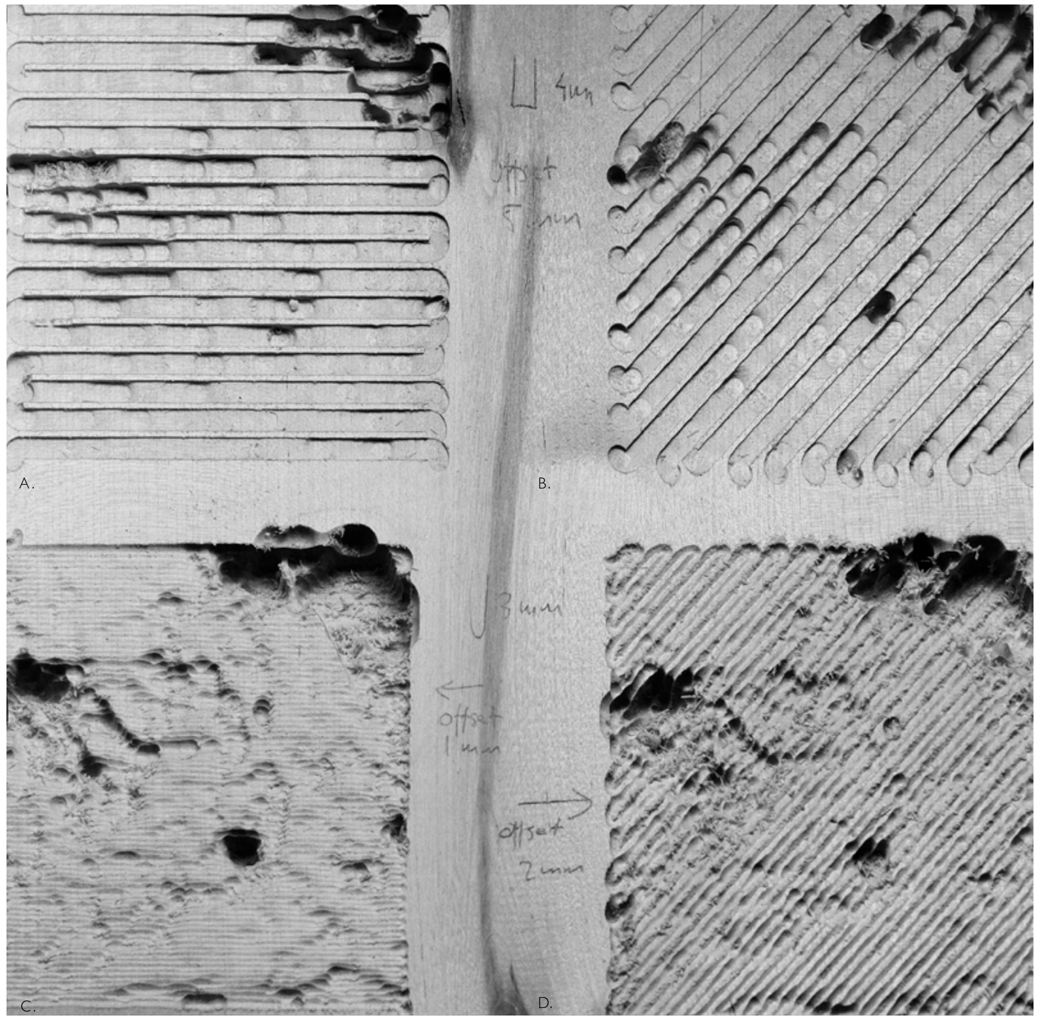
B: FINISHING CIRCULAR/
Drill 3mm, round/ Offset 1mm
Result: Finely detailed surface curvature, thin paths created by the tool add the extra texture.




TOOLPATH #5/ CNC/
ROUGHING LINIAR/
TOOL ROTATION $45^0$
Drill 4mm, flat/ Offset 5mm
Result: Rotation of the tool gives the texture different, more dynamic expression. Only the depth of apertures informs that input geometry was the same.

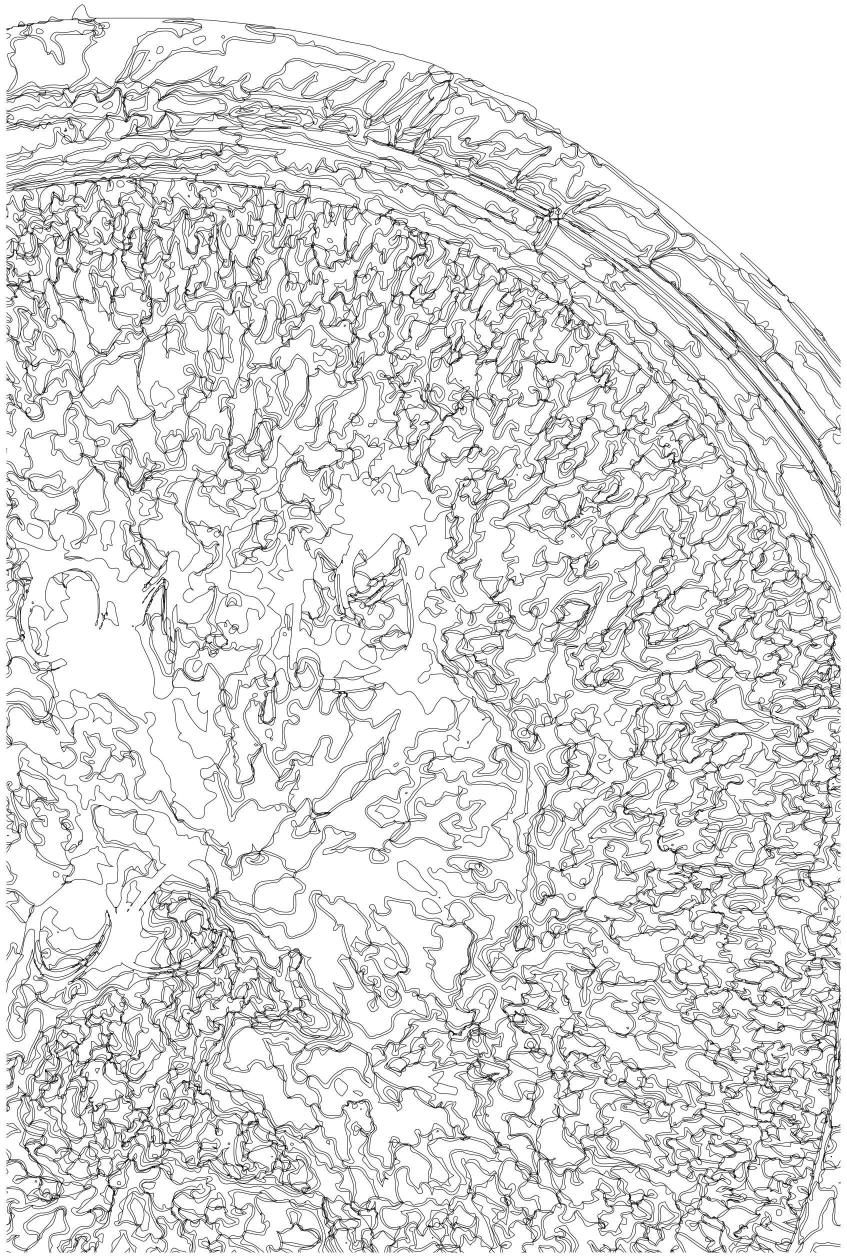



TOOLPATH #6/CNC/
FINISHING LINIAR/
TOOL ROTATION $45^0$/
Drill 3mm, round/ Offset 2mm
Result: Similar to above, but way more fine.




A: Roughing liniar/
Drill 4mm, flat/ Offset 5mm
C: Finishing liniar/
Drill 3mm, round/ Offset 1mm

B: Roughing liniar/$45^0$ tool rotation
Drill 4mm, flat/ Offset 5mm
D: Finishing liniar/
Drill 3mm, round/ Offset 1mm



Vectorized Photo of Mycelium Growing Pattern.



# VI: EXPERIMENTS

Mycelium Curated Growth & Mold Interactions

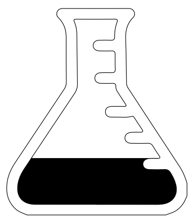




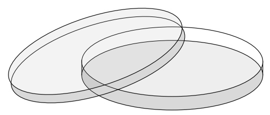
# WORKING IN LAB

For laboratory experiments, a wood-digesting strain of fungi called *Pleurotus Ostreatus* was used. It can be easily found in leafy forests with enough moisture. Considered as quite a strong and aggressive strain, taken out of its natural environment may however be easily contaminated by both mycological and non-mycological organisms. Taken from the strain, mycelium is at its most fragile state, before it has established itself on the substrate. Therefore it must be kept in a sterile environment, such as ventilated hood and sterile petri-dish. All used materials and instruments must be also sterilized in an autoclave and/ or sprayed with alcohol. After colonizing the substrate, mycelium reestablishes its resilience.

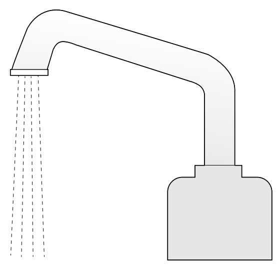
A: Working at MC2 lab.
B: Inoculation on the pink-dyed malted agar.
C: Samples under the ventilation hood.



GLASS BOTTLES



PETRI DISHES

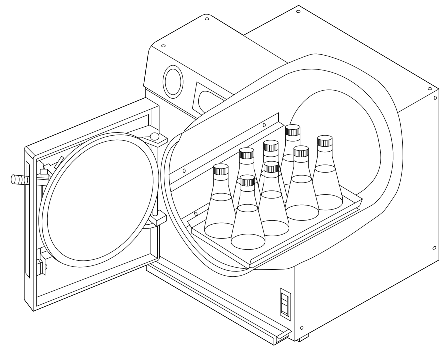


STERILE WATER SOURCE

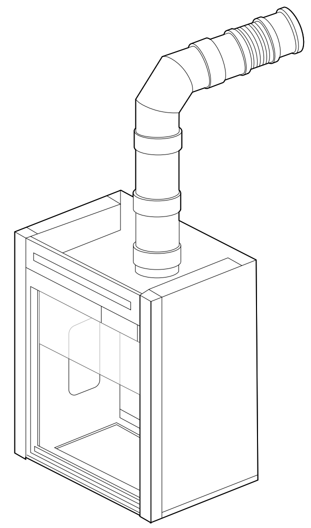


# WORKING IN LAB

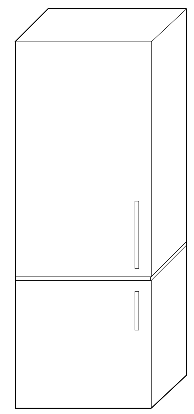
## EQUIPMENT



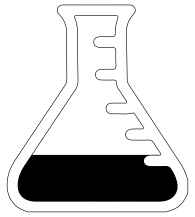
AUTOCLAVE



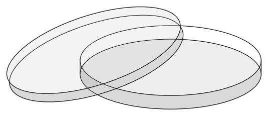
VENTILATION HOOD



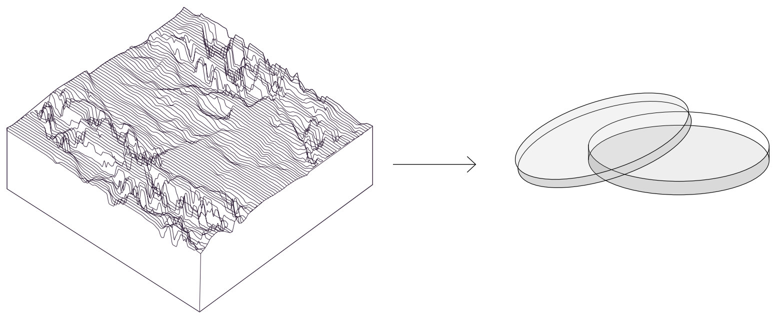
FRIDGE



I. ENCOURAGING MYCELIUM GROWTH
- 'WAKE-UP' BOTTLE
a. Autoclaved mixture: malt water 0.8%.
b. 5 ml liquid mycelium introduced into 100 ml of mixture.
c. Duration: 1 week.



II. MYCELIUM GROWTH IN PETRI DISHES
a. Autoclaved mixture: malt agar 2%.
b. Color experiments.
c. Duration of growth for 1 sample: 1 week.

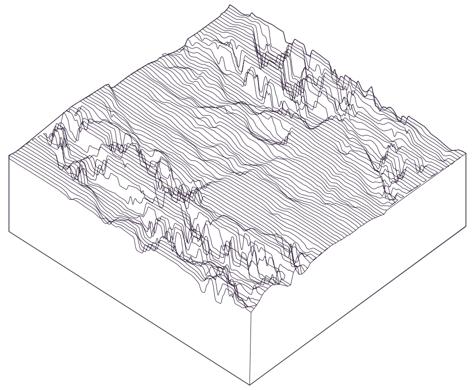


IIIA. MYCELIUM GROWTH OVER THE TEXTURE MOLD
a. Autoclaved pieces of geometries (plastic, wood) placed in the petri dish on the stabilized malt agar 2%.
b. Color experiments.
c. Duration of growth for 1 sample: depending on the size of the mold.

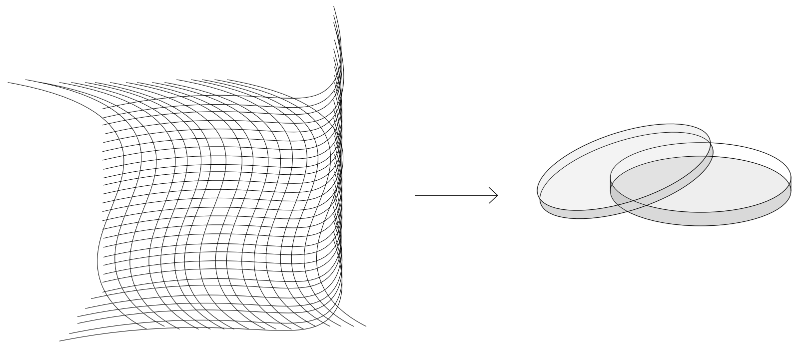


# WORKING IN LAB

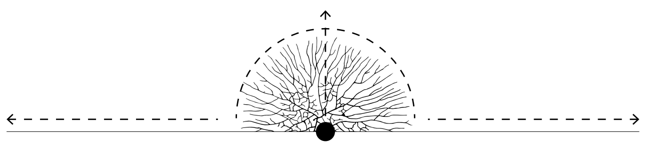
## METHODS



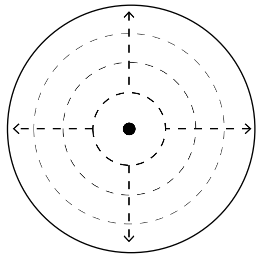
IIIB. MYCELIUM GROWTH ON THE TEXTURE MOLD
a. Needed high control of moisture in the piece.



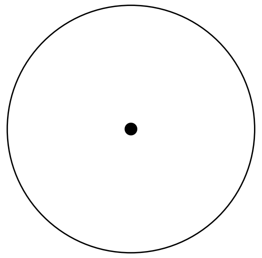
IIIC. MYCELIUM GROWTH ON THE FABRICS
a. Autoclaved fabrics (hemp, synthetic) soaked with malt agar 2% and placed in the petri dish.
b. Color experiments.
c. Duration of growth for 1 sample: 7-10 days.



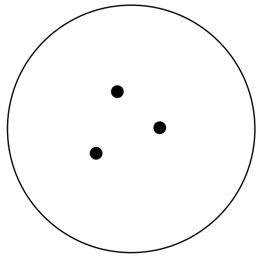
Mycelium Growing Pattern (front): 1-stly spherical, 2-ndly horizontal surface growth. When meeting the 'wall', slowly growing verically.



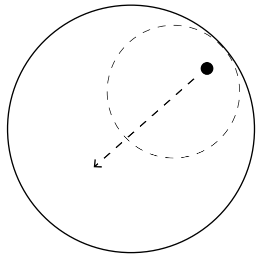
Mycelium Growing Pattern (top): radial manner, explicit rings.



Radial Growth from the center inoculation point.

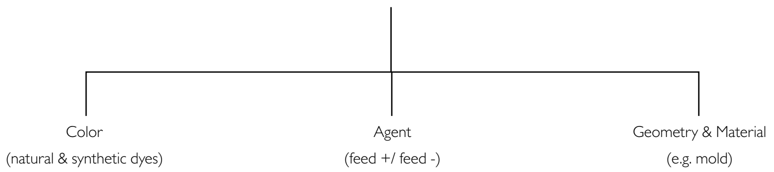


Radial Growth from inoculation points; creating a colony.



Radial Growth from inoculation points; growing vertically when meeting the barrier; spreading horizontally on the free surface.

CONTROLLING PARAMETERS






# EXPERIMENT OVERVIEW

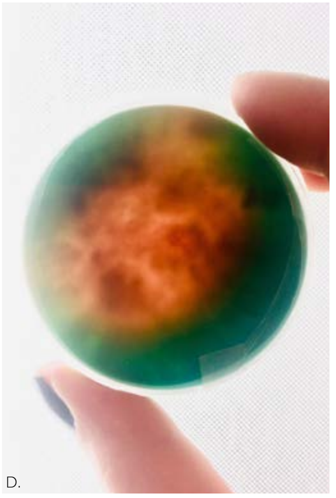
## MYCELIUM GROWING PATTERNS

| | COLOR | FEED+ FEED - | INSERTED GEOMETRY / MATERIAL |
|---|---|---|---|
| SET #1.1 | X | | |
| SET #1.2 | X | | |
| SET #1.3 | X | X | |
| SET #1.4 | X | X | X |
| SET #1.5 | X | | X |
| SET #1.6 | | | X |
| SET #1.7 | | | X |
| SET #2.1 | X | | X |
| SET #2.2 | X | | X |
| SET #2.3 | X | | X |


A.


B.


C.



D.

# EXPERIMENT 1.1

(15.01.19)

MYCELIUM BEHAVIOURS: GROWING PATTERNS & COLOR REACTIONS

MEDIUM: 2% malt agar

STRAIN: *Pleurotus Ostreatus*

EQUIPMENT: 5 x petri dishes 60mm diameter, lab glass bottle, syringe, needle, lighter (fire source), parafilm tape

ADDITIVE: forest green liquid watercolor

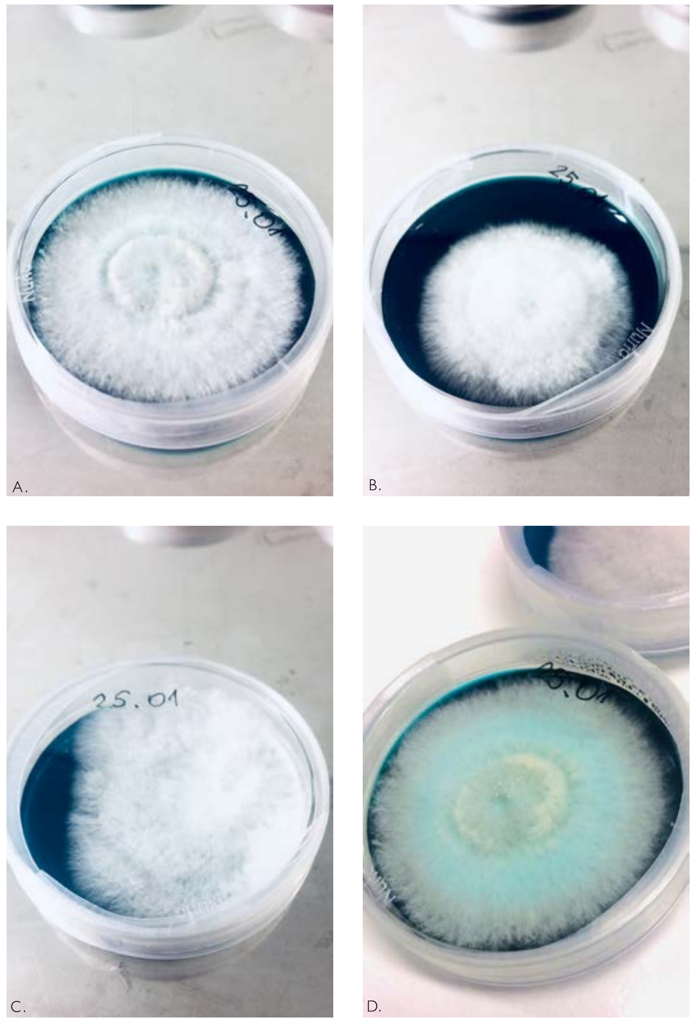
PROTOCOL:

Wear gloves, goggles, lab coat.
Sterilize all your equipment.
Autoclave bottle with malted agar.
Place sterilized equipment under the hood.
Pour agar into petri dishes, approximately half height, let it stabilize.
Use needle and syringe to inoculate petri dishes with mycelium prepared in 'wake-up' bottles. Sterilize needle under the fire each time you inoculate.
Close petri dishes with parafilm tape.
Label all samples, write notes in the lab diary.

DIARY:

After 5 days petri dished got covered with fluffy carpet of white mycelium (images A-C). The color of medium was not introduced into hyphae system.
After around 1 week in the fridge (low temperature stops growth) sample started to produce orange-red color from the center of inoculation (image D). That may be enzymatic catalysis reaction to the inserted dye. (After few more weeks agar medium in all samples became fully orange.)

After few more days in the fridge, blue color on samples became clearly visible. Assumed successful color insertion into hyphae system.




# EXPERIMENT 1.2

(25.01.19)

MYCELIUM BEHAVIOURS:  GROWING PATTERNS & COLOR REACTIONS

MEDIUM: 2% malt agar

STRAIN: *Pleurotus Ostreatus*

EQUIPMENT: 5 x petri dishes 60mm diameter, lab glass bottle, syringe, needle, fire source, parafilm tape.

ADDITIVE: Forest green liquid watercolor - added both into the malt agar mix and additionally poured onto the surface of stabilized agar.

PROTOCOL:

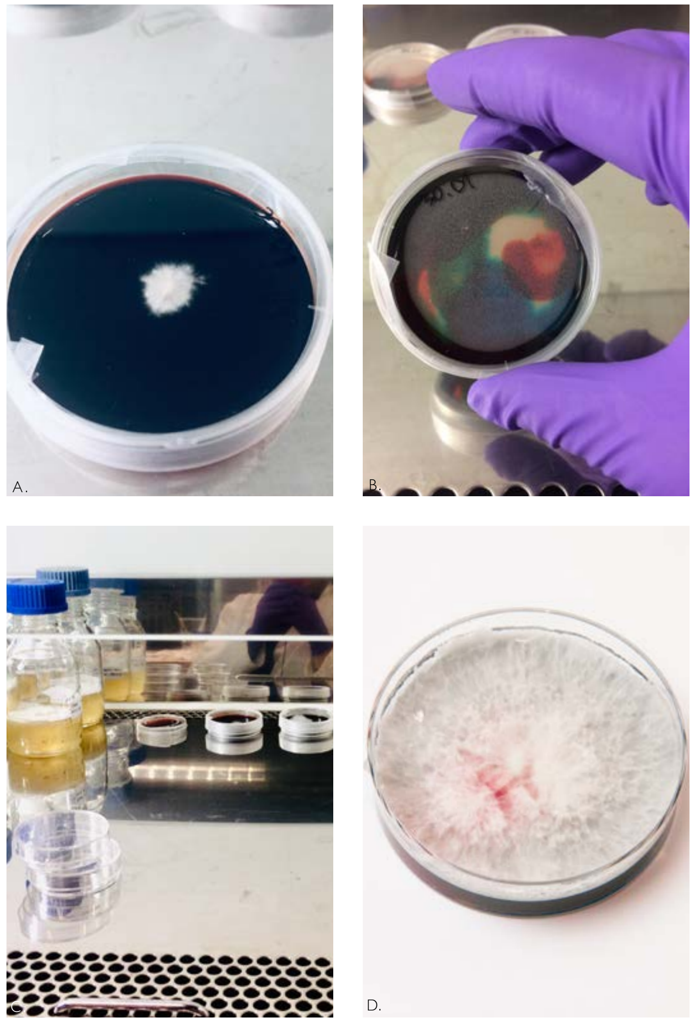
Wear gloves, goggles, lab coat.
Sterilize all your equipment.
Autoclave bottle with malted agar.
Place sterilized equipment under the hood.
Pour agar into petri dished, approximately half height, let it stabilize.
Use needle and syringe to inoculate petri dishes with mycelium prepared in 'wake-up' bottles. Sterilize needle under the fire each time you inoculate.
Close petri dishes with parafilm tape.
Label all samples, write notes in the lab diary.

DIARY:

After 5 days under the hood petri dished got covered with fluffy carpet of white mycelium (images A-C). The color of medium was not introduced into hyphae system. On samples with additionally poured color very delicate color appeared (assumed). Samples were covered with aluminium foil and placed in the fridge (low temperature stops growth).

After around 5 days in the fridge, blue color on 2 samples became clearly visible (image D). Assumed successful color insertion into hyphae system.

After few more days in the fridge, blue color appeared on the other samples. Assumed successful color insertion into hyphae system.



# E X P E R I M E N T   1 . 3

( 2 5 . 0 1 . 1 9 )

MYCELIUM BEHAVIOURS:  GROWING PATTERNS & COLOR REACTIONS

MEDIUM: 2% malt agar

STRAIN: *Pleurotus Ostreatus*

EQUIPMENT: 4 x petri dishes 60mm diameter, lab glass bottle, syringe, needle, lighter (fire source), parafilm tape

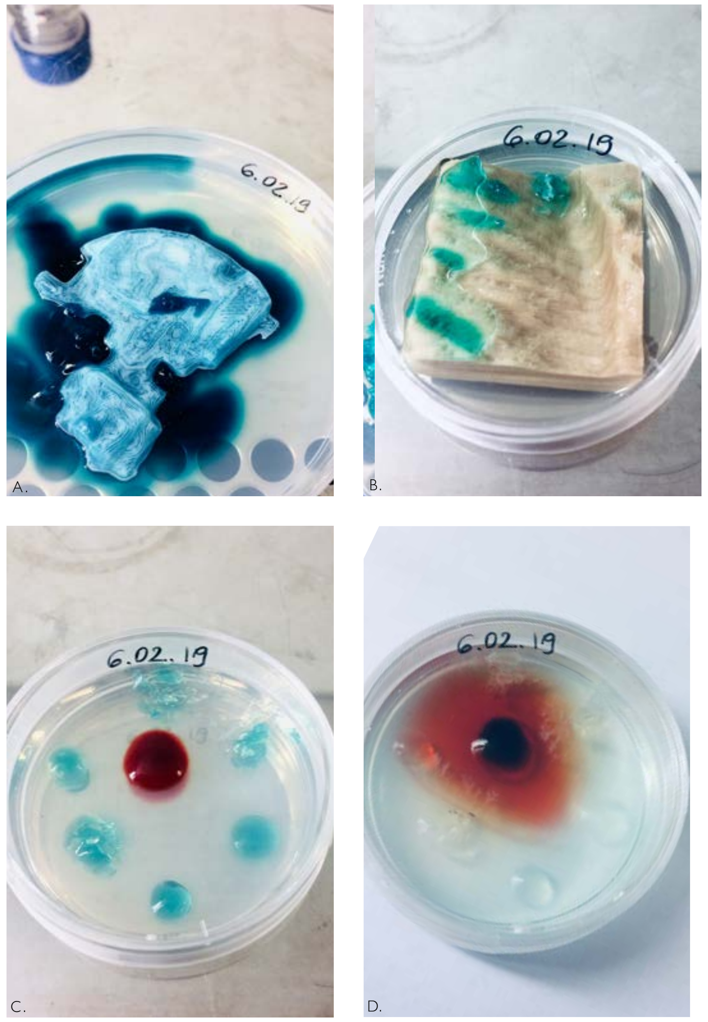
ADDITIVE: Congo Red dye (organic chemical compound used e.g. as a chemical pH indicator) added into malt agar mixture, additionally forest green liquid watercolor (autoclaved) poured onto the surface of stabilized agar - in 2 samples.

PROTOCOL:

Wear gloves, goggles, lab coat.
Sterilize all your equipment.
Autoclave bottle with mater agar.
Place sterilized equipment under the hood.
Pour agar into petri dished, approximately half height, let it stabilize.
Use needle and syringe to inoculate petri dishes with mycelium prepared in 'wake-up' bottles. Sterilize needle under the fire each time you inoculate.
Close petri dishes with parafilm tape.
Label all samples, write notes in the lab diary.

DIARY:

Two dyes evenly mixed together within the agar medium.
Samples with Congo Red grow slower than in previous set with watercolor.
11.10.2019 - samples fully covered with mycelium and put into the fridge.
No successful color insertion into hyphae system. No enzymatic reaction to the inserted dye.




# EXPERIMENT 1.4

(06.02.19)

MYCELIUM BEHAVIOURS: GROWING PATTERNS, COLOR REACTIONS & RESPONSES TO INSERTED GEOMETRIES AND MATERIALS

MEDIUM: 2% agar

STRAIN: *Pleurotus Ostreatus*

EQUIPMENT: Wooden geometry (pine) cut with CNC router, 2 x 3D printed plastic geometries, 2 x petri dishes 100mm & 2 x 60mm diameter, 3 lab glass bottles (1 for pure agar, 1 for feed +, 1 for feed -), syringe, needle, lighter (fire source), parafilm tape.

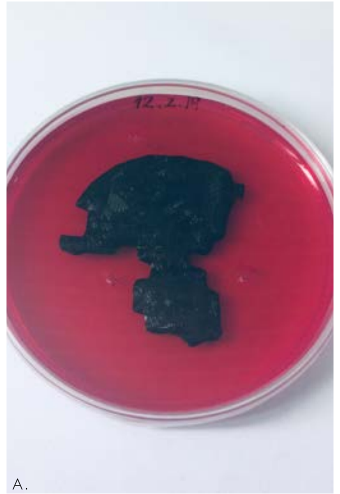
ADDITIVE: Feed + (malt and forest blue watercolor into 2% agar), feed - (salt and Congo Red dye into 2% agar). Forest blue watercolor separately poured on the top of stabilized agar mix of one sample.

PROTOCOL:

Wear gloves, goggles, lab coat.
Sterilize all your equipment.
Autoclave bottles with 2% clean agar and with dyes.
Place sterilized equipment under the hood.
Pour agar into petri dished, approximately half height, let it stabilize.
Insert sterilized geometries on the stabilized agar.
Insert feed + and feed - with syringe and needle.
Use needle and syringe to inoculate petri dishes with mycelium prepared in 'wake-up' bottles. Sterilize needle under the fire each time you inoculate.
Close petri dishes with parafilm tape.
Label all samples, write notes in the lab diary.

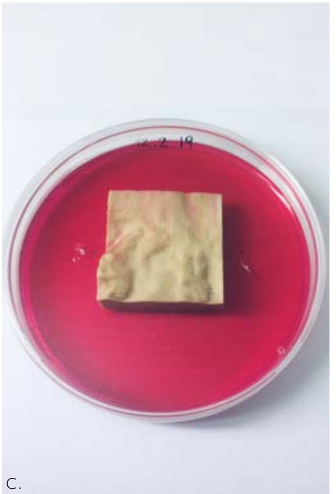
DIARY:

Samples were inoculated in at least 2 places around and on the geometry. Into the sample with the wooden element water was additionally poured on the top of the agar (in order for the wooden piece to stay moist).
11.02.2019 - Sample image C - dyes spread within the agar base. Mycelium avoids high concentration of salt.
Sample image A - additionally poured dye spread evenly within the agar solution. No growth observed. Assumed reason: the strain got burned with sterilized needle.
Sample image B - no growth observed. Mycelium doesn't react towards conifer wood.
In general, limited amount of food resulted in weak mycelium growth.



A.

B.



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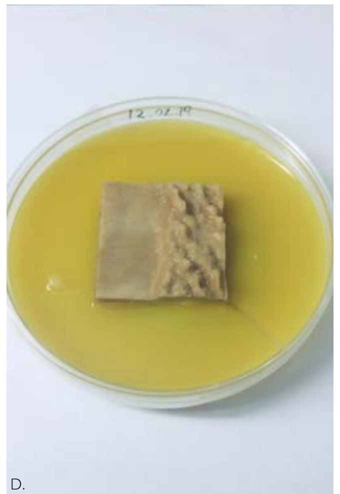


D.



# E X P E R I M E N T 1 . 5

( 1 2 . 0 2 . 1 9 )

MYCELIUM BEHAVIOURS: GROWING PATTERNS, COLOR REACTIONS & RESPONSES TO INSERTED GEOMETRIES AND MATERIALS

MEDIUM: 2% malt agar

STRAIN: *Pleurotus Ostreatus*

EQUIPMENT: 2 x wooden geometries (birch) cut with CNC router, 2 x 3D printed black plastic geometries, 4 x petri dishes 100mm diameter, 2 lab glass bottles, syringe, needle, fire source, parafilm tape.

ADDITIVE: Magenta liquid watercolor and yellow acrylic ink introduced separately into 2 bottles of 2% malt agar mix.

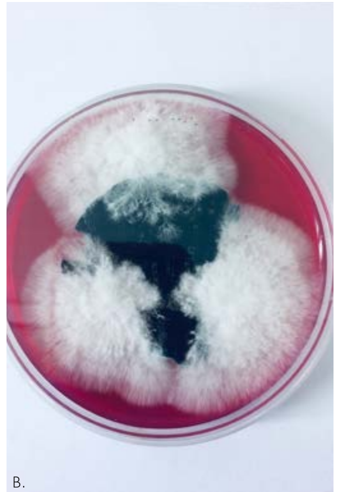
PROTOCOL:

Wear gloves, goggles, lab coat.
Sterilize all your equipment.
Autoclave bottles with 2% malt agar with dyes.
Place sterilized equipment under the hood.
Pour agar into petri dished, less than half height, let it stabilize.
Insert sterilized geometries on the stabilized agar.
Use needle and syringe to inoculate petri dishes with mycelium prepared in 'wake-up' bottles. Sterilize needle under the fire each time you inoculate.
Close petri dishes with parafilm tape.
Label all samples, write notes in the lab diary.

DIARY:

Samples were inoculated in at least 2 places around the geometry. Into the samples with wooden pieces additionally water was poured on the top of the agar (to keep the piece moist).


A.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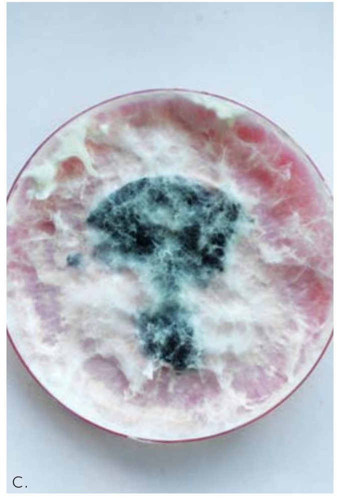
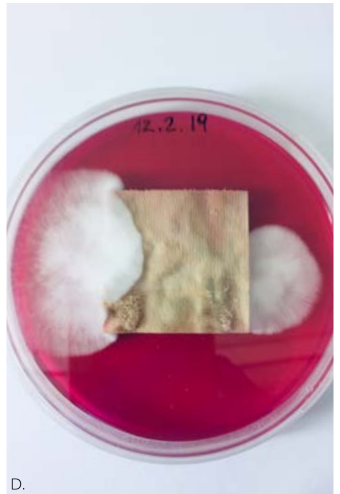

C.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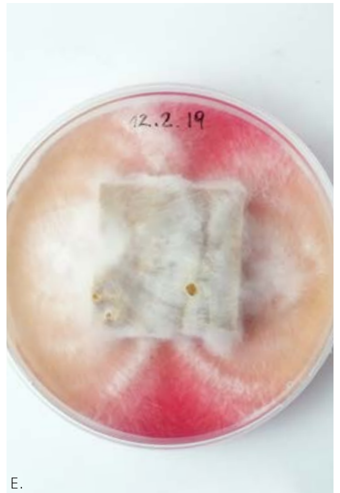

E.


F.


G.


H.


I.



# EXPERIMENT 1.5

(22.02.19 - 05.03.19 - 21.05.19)

SAMPLES AT DAY 10 (A, B, D, G)

Samples with added yellow acrylic ink into the agar medium grow faster than the ones with magenta watercolor.

Samples with 3D printed plastic geometries: mycelium creates a more loose and porous texture. The geometry is still visible, however the edges are blurred and dissolving. Mycelium does not grow under the geometry.

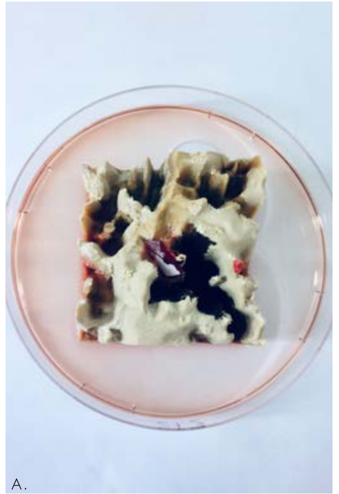
Samples with CNC cut wooden geometries: Mycelium grows over and under the geometry, creating a dense and smooth cover.

SAMPLES AT DAY 24 (E, H)

After around 1 week in the fridge (low temperature stops growth), in the sample with the wooden geometry mycelium starts to produce a peach color from the center of inoculation. That may be an enzymatic catalysis reaction to the inserted synthetic dye into the agar medium. Such reaction was not observed in the sample with the plastic geometry. (B)

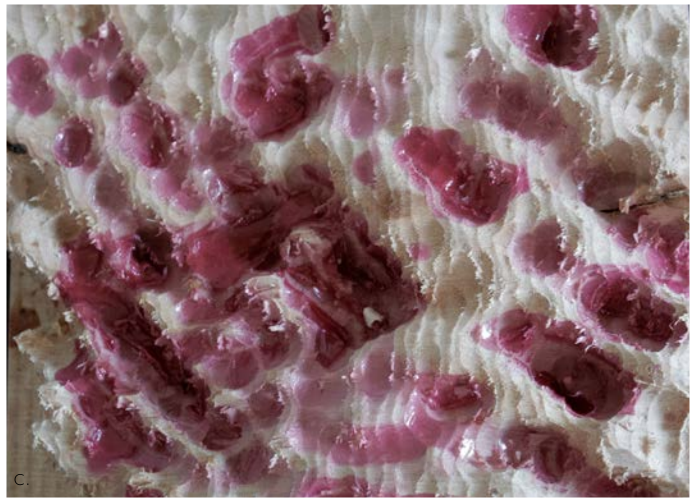
SAMPLES AT DAY 50 (C, F, I)

Samples were taken out from the fridge and mycelium continued to grow.
Samples with wooden geometries built up a very thick cover.



A.

B.



C.



# EXPERIMENT 1.6

(25.02.19)

MYCELIUM BEHAVIOURS: GROWING PATTERNS, RESPONSES TO INSERTED GEOMETRIES AND MATERIALS

STRAIN: *Pleurotus Ostreatus* (from the sample grown in the petri dish).

EQUIPMENT: 2 geometries CNC cut in wood, plastic box, steel lab knife.

ADDITIVE: Magenta liquid watercolor, 2% malt agar mix.

PROTOCOL:

Wear gloves, goggles, lab coat.
Autoclave wooden geometries, sterilize knife with fire.
Place sterilized equipment under the hood.
Insert sterilized geometries into the petri dish - keep in open. Pour sterile water onto geometries and into petri dishes.
Use knife to introduce a piece of mycelium (grown on agar medium) into the geometries.
Cover samples with aluminium foil.
Label all samples, write notes in the lab diary.

DIARY:

Samples were inoculated with the mycelium growing in petri dish - onto the geometry. Pieces were placed in a box with water and covered with the lid.
Even that the samples were kept moist, the mycelium did not grow over. It might be also the case of the wood species, that mycelium didn't react towards.

Geometry overgrowned by the green mould.



# EXPERIMENT 1.7

(03.03.19)

MYCELIUM BEHAVIOURS: GROWING PATTERNS, RESPONSES TO INSERTED GEOMETRIES AND MATERIALS

STRAIN: *Pleurotus Ostreatus* (from the sample grown in the petri dish).

EQUIPMENT: geometry CNC cut in wood 100mm x 100mm, plastic box, steel lab knife.

PROTOCOL:

Wear gloves, goggles, lab coat.
Autoclave wooden geometry, sterilize knife with fire.
Place sterilized equipment under the hood.
Insert sterilized geometry into the plastic box. Pour sterile water into box and over geometry.
Use knife to introduce a piece of mycelium (grown on agar medium) into the geometry.
Close the box and label it, write notes in the lab diary.

DIARY:

Tap water was added to the box. At day 3 mycelium has grown around 30mm, however after 2 more days it got infected with the green mould (most probably due to addition of non-sterile water). The box was removed from the hood, however kept aside to observe the process of wood decay.


# E X P E R I M E N T   2 . 1 a

( 1 6 . 0 4 . 1 9 )

MYCELIUM BEHAVIOURS:  GROWING PATTERNS, RESPONSES TO INSERTED GEOMETRIES AND MATERIALS

STRAIN: *Pleurotus Ostreatus.*

EQUIPMENT: synthetic mesh fabric, petri dishes 60mm diameter, scissors.

ADDITIVE: Magenta liquid watercolor introduced into a glass lab bottle with 2% malt agar mix.

PROTOCOL:

Wear gloves, goggles, lab coat.
Autoclave fabrics (cut in the pieces) and agar in the bottle; sterilize scissors with alcohol.
Place sterilized equipment under the hood.
Pour some liquid agar into the additional petri dish and soak a piece of fabric. Insert fabrics into the clean petri dish. (B)
Use knife to introduce a piece of mycelium from 'wake-up' bottle into the fabric.
Close petri dishes and protect with the parafilm tape.
Label all samples, write notes in the lab diary.

DIARY:
After around 1 week mycelium grows in-between the fibers , creating a smooth cover. (A, C, D)
Synthetic fabric is non-biodegradable, thus it cannot be broken down by a living organism over time.
Sample after 4 weeks of growing. (B)

A.

B.

C.

D.



# EXPERIMENT 2.1b

(02.05.19)

MYCELIUM BEHAVIOURS: GROWING PATTERNS, RESPONSES TO INSERTED GEOMETRIES AND MATERIALS

STRAIN: *Pleurotus Ostreatus.*

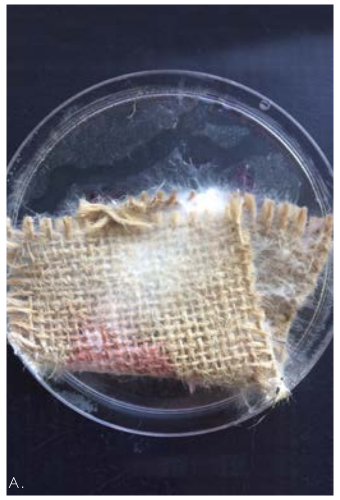
EQUIPMENT: synthetic mesh fabric, petri dishes 60mm diameter, scissors.

ADDITIVE: Magenta / forest blue liquid watercolor; glass lab bottle with 2% malt agar mix.

PROTOCOL:

Wear gloves, goggles, lab coat.
Autoclave fabrics (cut in the pieces) and agar in the bottle; sterilize scissors with alcohol.
Place sterilized equipment under the hood.
Pour some liquid agar into the additional petri dish and soak a piece of fabric. Insert fabrics into the clean petri dish. (A-B)
Use knife to introduce a piece of mycelium from 'wake-up' bottle into the fabric.
Leave the petri dishes open. Place them in the plastic box and close the lid.
Label all samples, write notes in the lab diary.

DIARY:
Unsuccessful attempt - mycelium didn't establish. Assumed lack of enough moist.
Applied agar dried out and gave an extra gloss to the fabrics.



A.

B.

C.

D.



# E X P E R I M E N T 2 . 2

( 0 2 . 0 5 . 1 9 )

MYCELIUM BEHAVIOURS: GROWING PATTERNS, RESPONSES TO INSERTED GEOMETRIES AND MATERIALS

STRAIN: *Pleurotus Ostreatus.*

EQUIPMENT: hemp fabric - both loose and shaped with a small steel wire, petri dishes 60mm diameter, scissors.

ADDITIVE: Magenta / forest blue liquid watercolor; glass lab bottle with 2% malt agar mix.

PROTOCOL:

Wear gloves, goggles, lab coat.
Autoclave fabrics and agar in the bottle; sterilize scissors with alcohol.
Place sterilized equipment under the hood.
Pour some liquid agar into the additional petri dish and soak a piece of fabric. Insert fabrics into the clean petri dish.
Use knife to introduce a piece of mycelium from 'wake-up' bottle into the fabric.
Close petri dishes and protect with the parafilm tape. Leave the sample with shaped fabric open - place it in the plastic box and close the lid.
Label all samples, write notes in the lab diary.

DIARY:
After around 1 week mycelium grows in-between the fibers , creating a smooth and very thick cover - both in the closed and open petri dishes. (A-C)
Hemp fabric is biodegradable, thus it can be broken down by a living organism over time. There was no enough time within this project to observe how long would such a process take.

There was also an attempt to use a potato starch as a feed for mycelium, instead of a malt agar. After autoclaving the thick mixture of potato starch (cooked with the water), it lost its consistence and became liquid. It was used to soak the hemp fabric with and later placed in the glass bottle. The green mould developed on the sample, due to the high level of moisture. (D)
Potato starch is still a substance that mycelium can proliferate on. Perhaps a solution to keep the thick consistence of the potato starch and create a better environment for mycelium would be mixing it with some agar. Such method was not tested in this project though.

A. B. C. D.

# E X P E R I M E N T   2 . 3

( 0 5 . 0 5 . 1 9 )

MYCELIUM BEHAVIOURS:  GROWING PATTERNS, RESPONSES TO INSERTED GEOMETRIES AND MATERIALS

STRAIN: *Pleurotus Ostreatus.*

EQUIPMENT: Vacuum form plastic geometry, synthetic mesh fabric, steel wire, scissors.

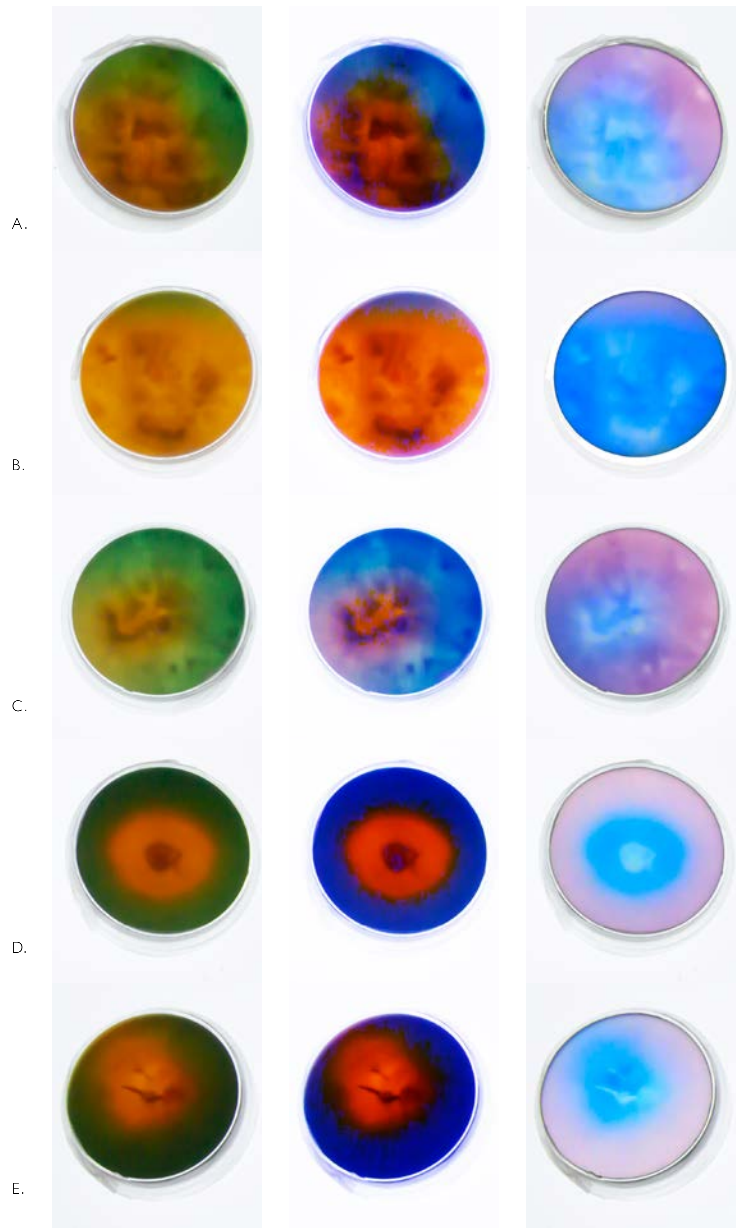
ADDITIVE: Glass lab bottle of  2% malt agar mix.

PROTOCOL:

Wear gloves, goggles, lab coat.
Autoclave fabrics (cut in the pieces) and agar in the bottle; sterilize scissors with alcohol.
Sterilize plastic geometry with alcohol (it would melt in autoclaving process).
Sterilize the the steel wire and spread it over the plastic piece. (B)
Place sterilized equipment under the hood.
Spread the fabric on the plastic piece. (C, D)
Gently pour some liquid agar on the fabric.
Use knife to introduce a piece of mycelium from 'wake-up' bottle into the fabric.
Place the model in the plastic box and close the lid.
Label the box, write notes in the lab diary.

DIARY:
Unsuccessful attempt - mycelium didn't establish. Assumed lack of enough moist.
Applied agar dried out and gave an extra gloss to the fabrics.
Due to the lack of time the attempt was not repeated.

Note: vacuum form was made over CNC cut foam piece of facade geometry. (A)




Original color reaction    Digital color modification #1    Digital color modification #2



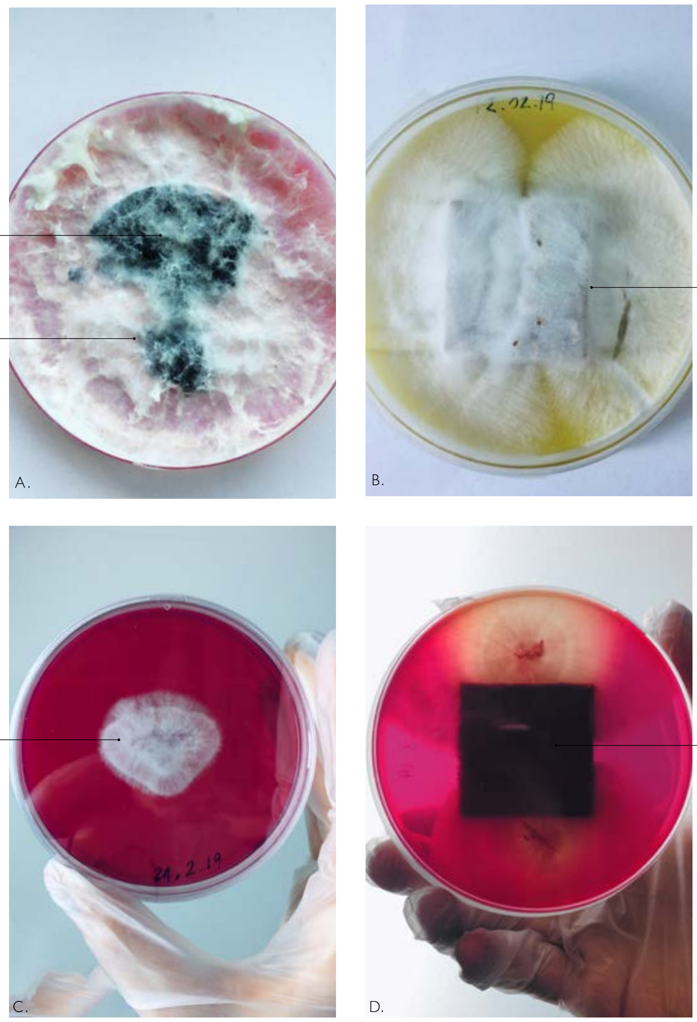
# F I N D I N G S

## MYCELIUM COLOR REACTIONS

A: SAMPLE 1 - gradient oriented towards one side of the petri dish.
B: SAMPLE 2 - color reaction through the whole medium.
C: SAMPLE 3 - subtle gradient oriented towards one side of the petri dish.
D: SAMPLE 4 - explicit ring around the inoculation point.
E: SAMPLE 5 - explicit ring around the inoculation point spreading towards one side of the petri dish.

Very first samples were inoculated into the forest green colored agar. Mycelium fully overgrown the petri dish and was moved to the fridge (low temperature stops the growth). After around 1 week in the fridge samples started to produce orange-red color from the center of inoculation. That might be an enzymatic catalysis reaction to the inserted dye (assumed metabolic reaction of mycelium to the artificial color introduced into the agar medium).
Note: after some period of time all the samples fully transformed the green agar into orange color.
In some further experiments mycelium inverted the magenta colored agar into sand yellow.

Color reactions became an inspiration and were introduced into the design proposal.






# F I N D I N G S

## MYCELIUM GROWING PATTERNS

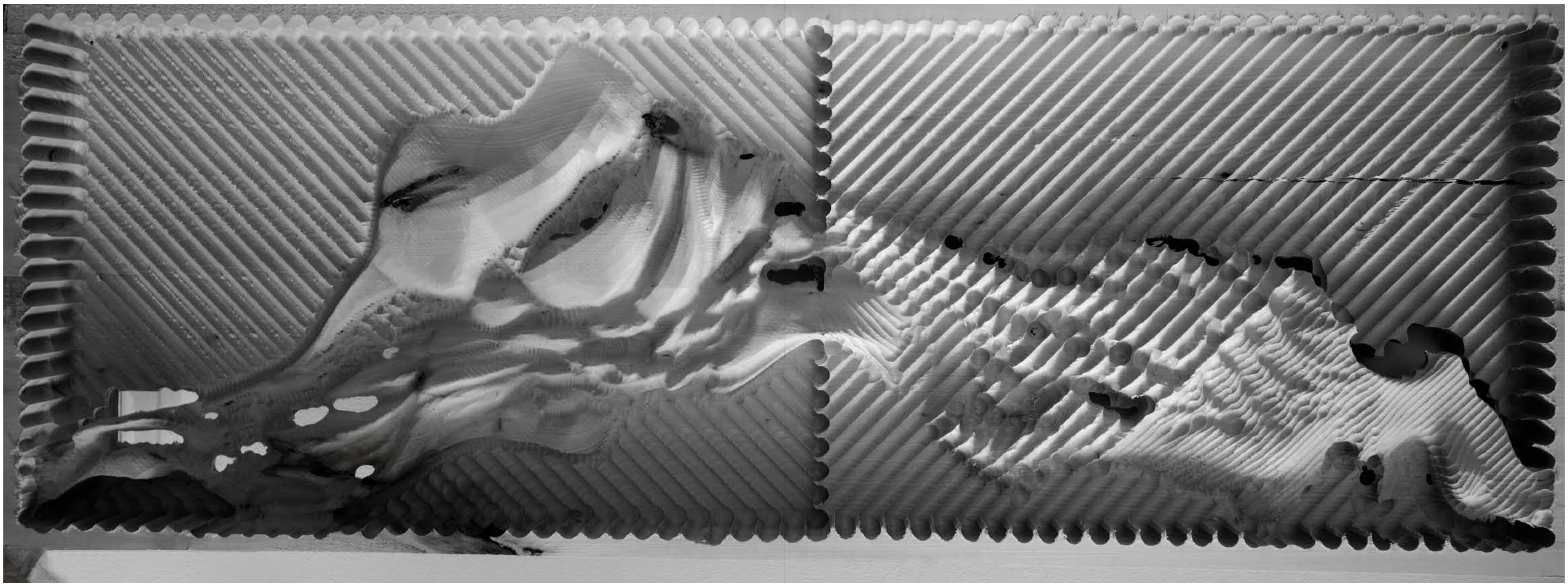
ANALYSIS - POTENTIAL ELEMENTS FOR DESIGN APPLICATION

1) blurred & dissolving edge
2) soften corners
3) loose & porous coverage of the initial geometry
4) smooth & thick coverage of the initial geometry
5) offsets

A, B, D - samples at day 13.

C - Triangular 'cut out' of mycelium grown earlier on the petri dish was introduced into the new petri dish with 2% malt agar medium. Mycelium was growing in a offset manner - keeping explicit triangular shape.

# VII : FINAL MODEL & EXHIBITION



**E L E V A T I O N 1 : 1 0 0** C N C C U T ( M A P L E )

drill 10mm, offset: 4mm(left part)11mm (right part),tool rotation(opposite on each side) 45°

left (Haiti): smooth, curated, synthetic, to be overgrown
right(Dominican Republic): rough, uncontrolled, overgrown, merging with the background

O P E N   S E M I N A R

Exhibition overview.



O P E N   S E M I N A R

Models.

# VIII: REFLECTION

THE BORDER

Working with the bridge design, which holds a function of the national border control opened up an extremely interesting, but also a very intricate conversation, that added different levels to the project complexity.
To start with, the nation is a synthetic concept in itself. Furthermore, the border control disintegrate over time through the process of biological decay and only the paths connecting the countries function. In the extreme scenario the whole border might be overgrown by the nature. In such way, the project questions the future of borders from the political point of view. Will the borders be still valid?

THE LIVING

The designed Threshold is a living object - it is constantly changing. It has an extreme form derived from the overscaled and overlayed textures. What would be the experience of walking through such a bridge? How would it smell? How would it affect the everyday life of the local people? Would it activate the society to meet there?

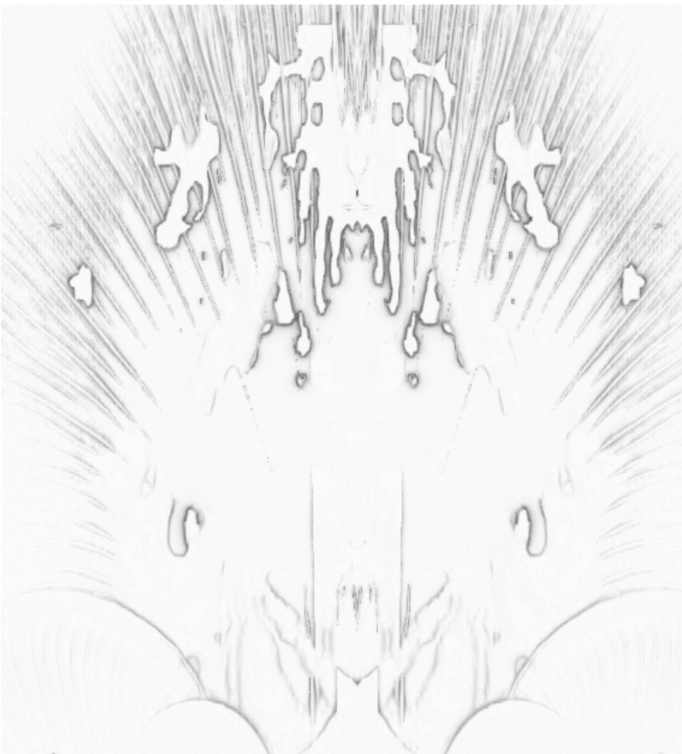
The project attempted to take a position in some of these aspects, but there is way more to address.

THIRD NATURE

The new form of the Threshold building and a new form of the landscape architecture is being introduced. It links to the concept of the 'third nature', which stands for a novel built condition and materiality that response to the contemporary societal challenges.

DEEP TEXTURE

The initial driving force for the project was the interest in relations between the man-made (synthetic) and the natural. The key aspects for its development were the texture exploration through different media and experimentation with the living organism - mycelium.
The outcome was a creation of the deep texture, that links together the digital texture studies, the mycelium experimentation and fabrication methods.

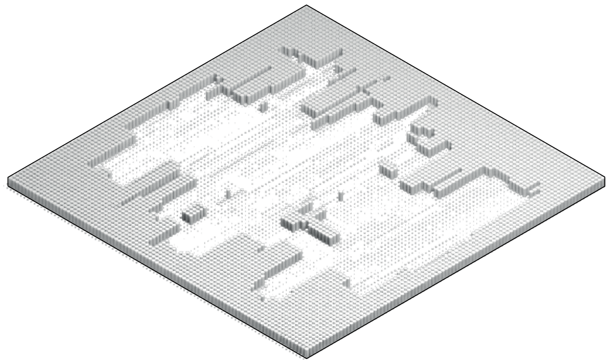


Texture composite study: Linearity & Soft Edge.

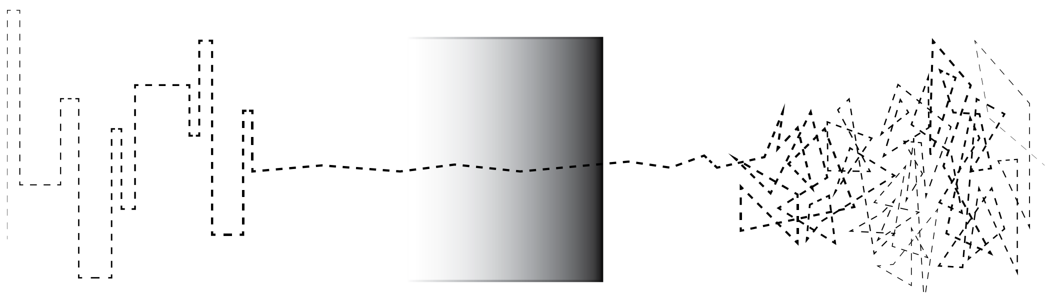


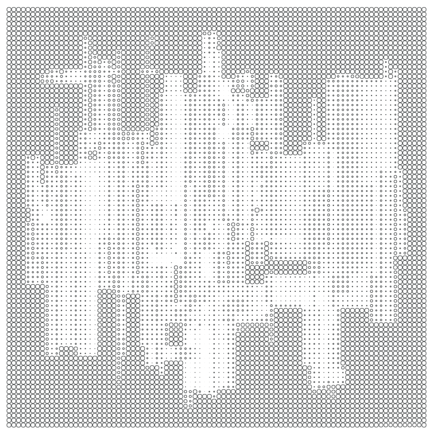
# IX: DESIGN RESEARCH

## Texture Spatial & Performative Qualities



Site sketches. Axonometric view.
Representation of synthetic.



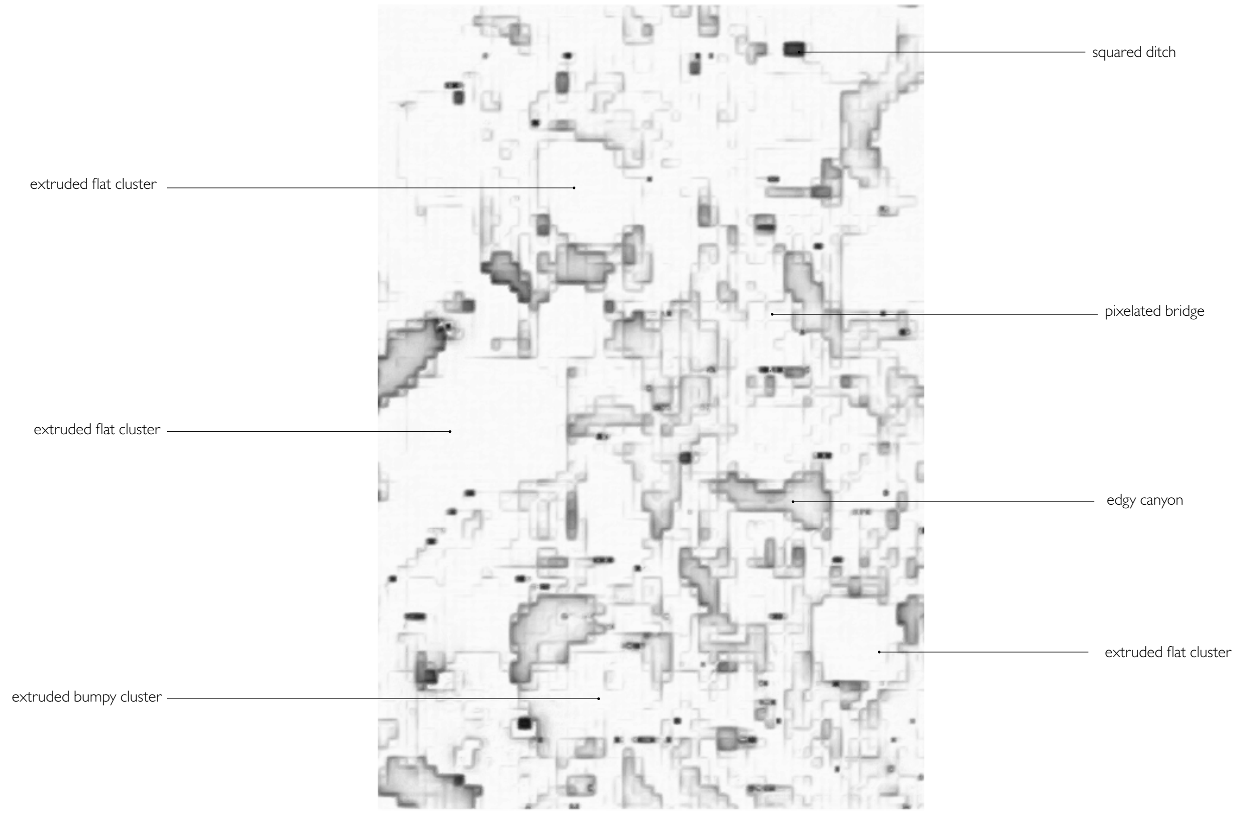



Site sketches. Top view.
Representation of synthetic.

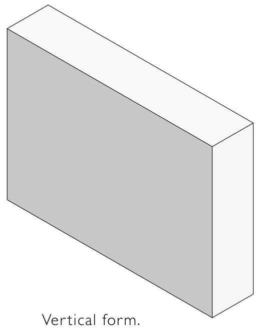


# THRESHOLDS & TRANSITIONS

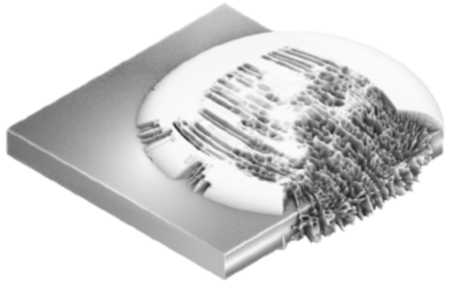
## INITIAL CONCEPTS



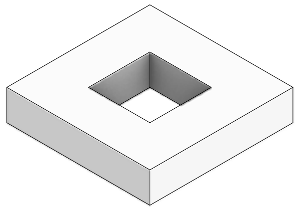

Initial texture spatial analysis.



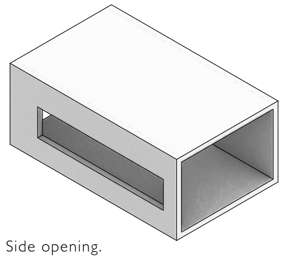
Vertical form.



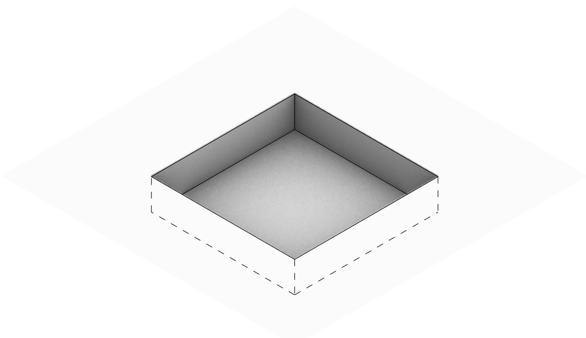
Simple & complex form merge.



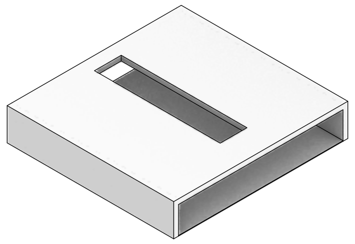
Horizontal form, central opening, courtyard.



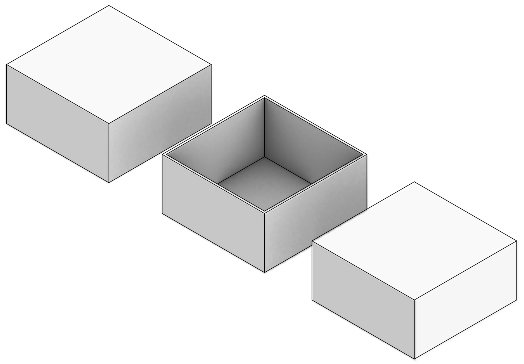
Side opening.



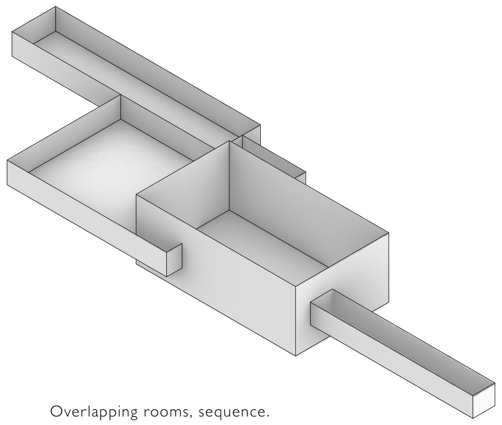
Horizontal form, underground.



Horizontal form, top opening.



3 forms with different qualities (gradient).

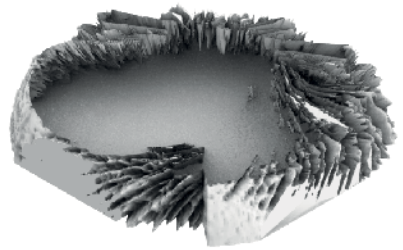


Overlapping rooms, sequence.

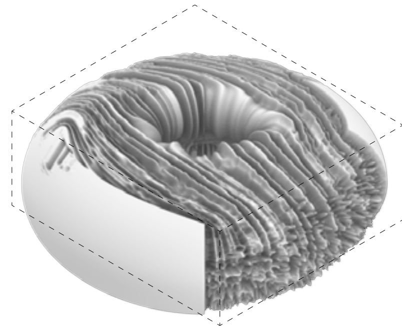


# THRESHOLDS & TRANSITIONS

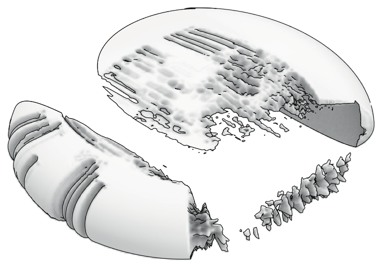
## INITIAL FORM STUDIES



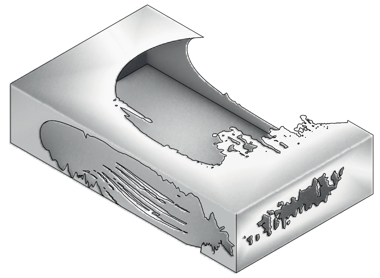
Decaying multi-layered wall.



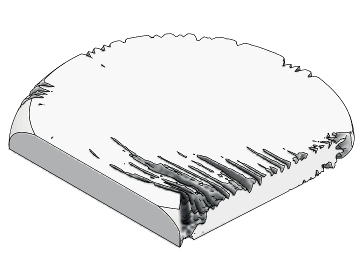
Displaced form, organic & overgrown.



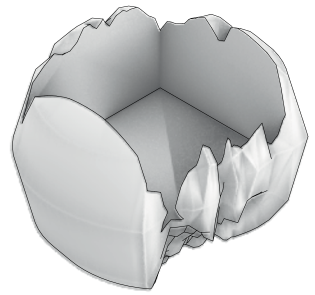
Decaying multi-layered wall.



Distorted, organically erased form.



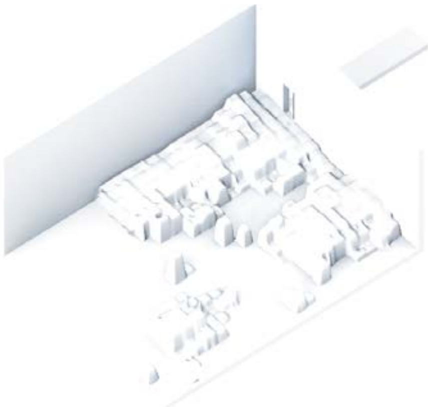
Slight distortion / impression of being overgrown.



Simple (inside) and complex (outside) form : boolean difference operation.

Axo: Texture as semi-landscape / furniture.

Top view.



Axo: Texture as semi-landscape / stair / furniture.

Top view.

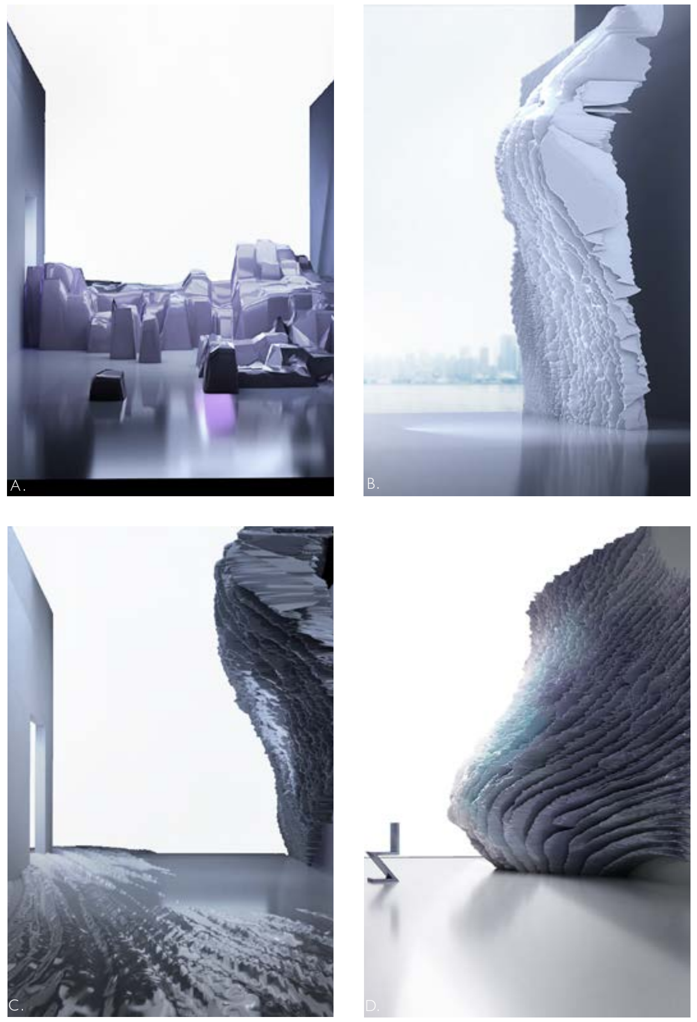
Axo: Texture as a wall / partition.

Top view.

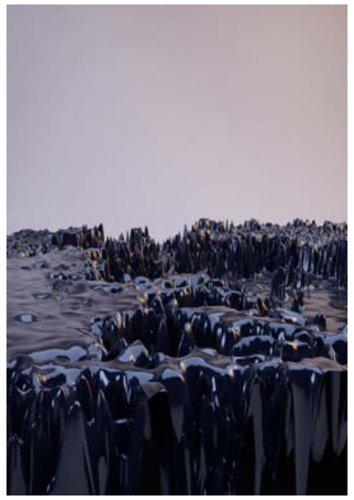


# THRESHOLDS & TRANSITIONS

## INITIAL INTERIOR STUDIES




A: Texture as semi-landscape/ stair / furniture.
B: Texture as a wall / partition.
C: Texture as a direction indicator.
D: Texturized wall extension.



Texture study: organic apertures.

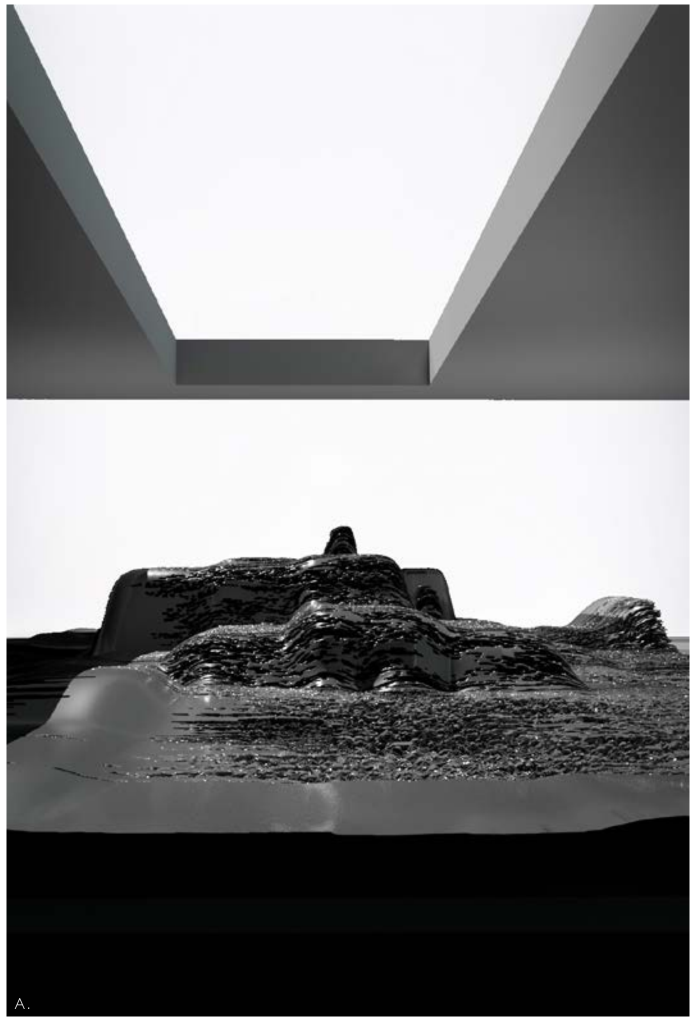
Texture study: sitting area.
Contrast between minimal frame and intense textured infill.



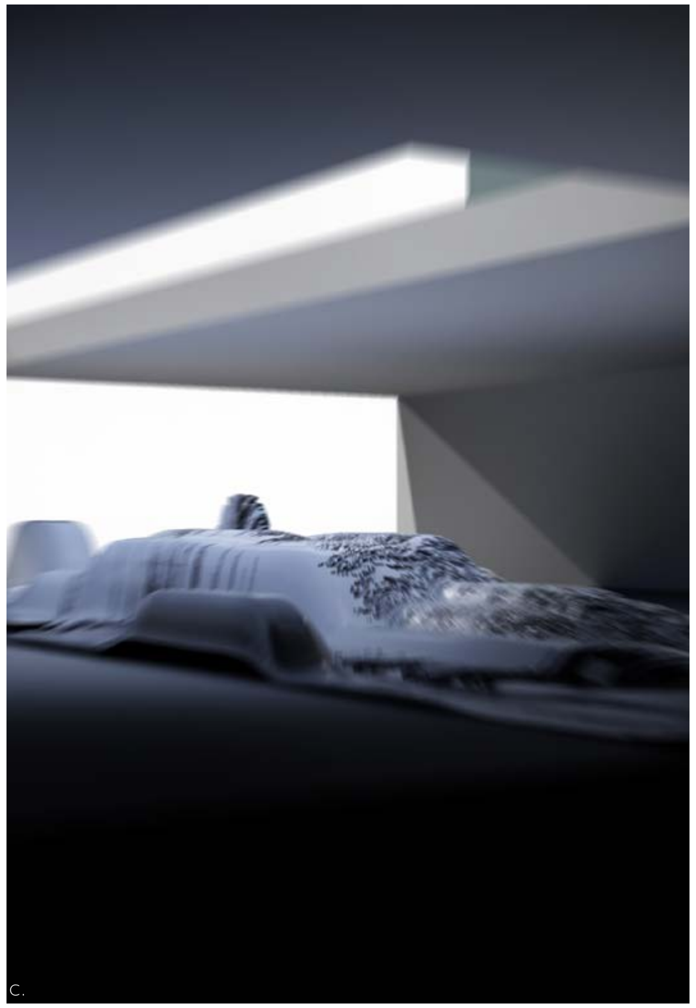
# THRESHOLDS & TRANSITIONS

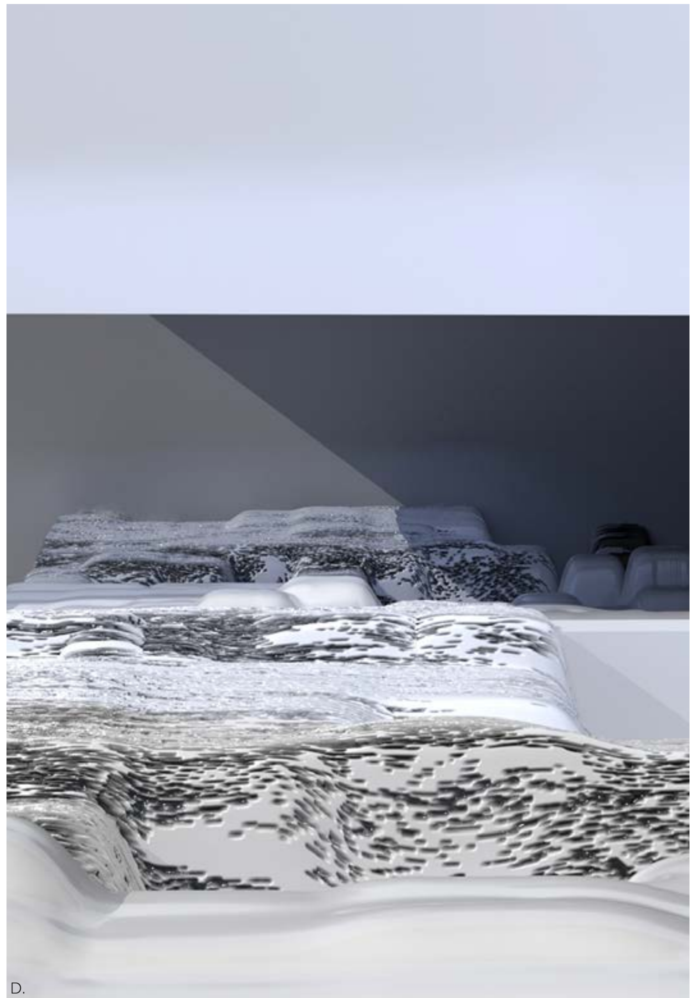
## INITIAL INTERIOR STUDIES

Texture as semi-landscape / stair / furniture.


A.


B.


C.

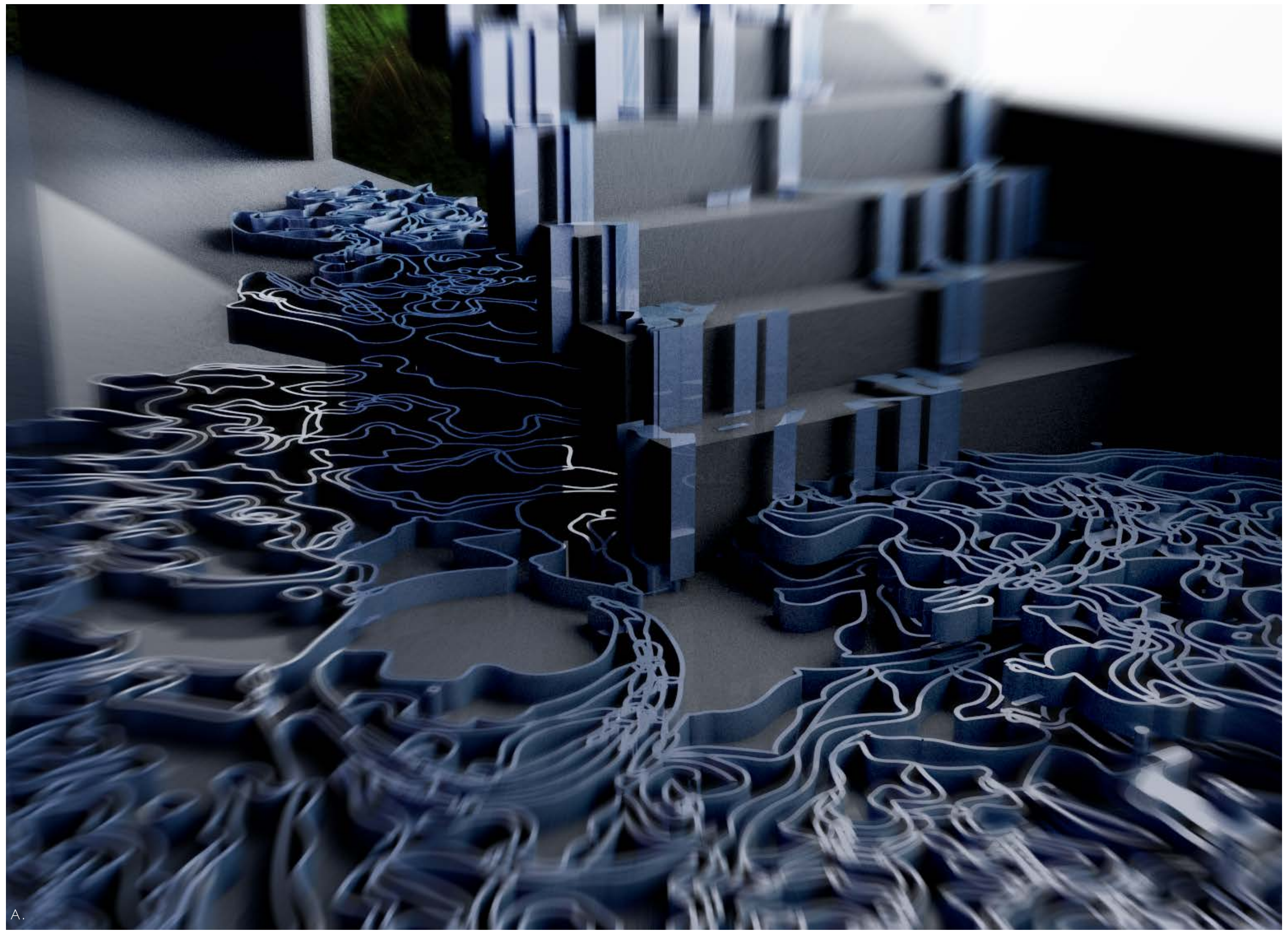

D.

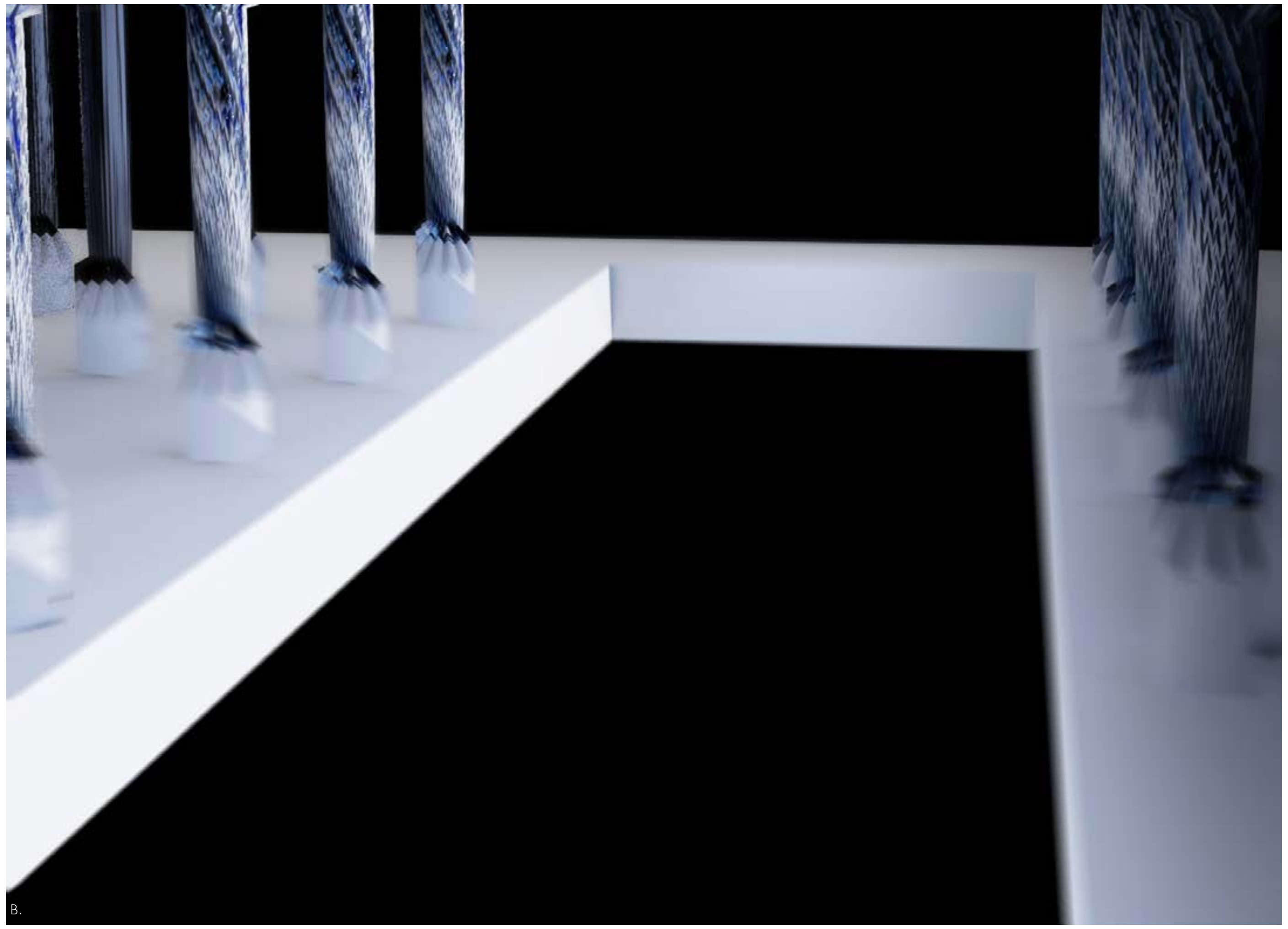
# THRESHOLDS & TRANSITIONS

## INTERIOR STUDIES BASED ON DISPLACEMENT MAPS


Linear distortion of the surface.

A: Clear space hierarchy, dark communication space on the side.
B: Displaced texture create impression of being overgrown. One texture connects exterior and interior.
C: Texture becomes a kind of furniture, lighten up by direct light from the opening in the ceiling.
D: Texture connects exterior and interior, with no clear belonging to one or another.



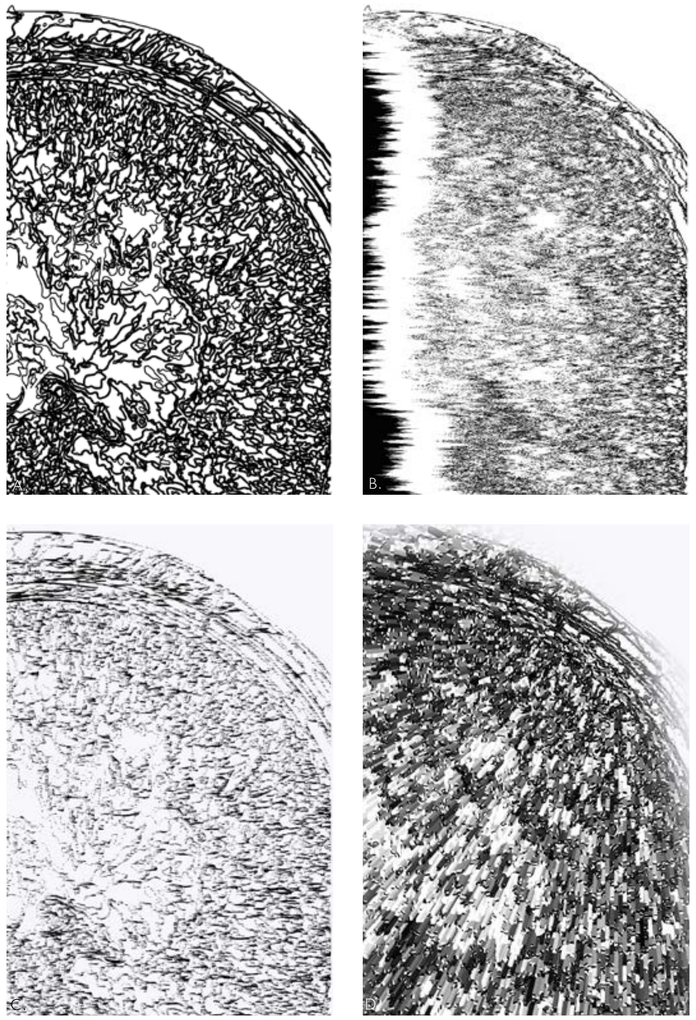




# THRESHOLDS & TRANSITIONS

## INTERIOR STUDIES BASED ON DISPLACEMENT MAPS

Narrow passage / Synthetic imitation of an overgrown wall.

A: Vectorized and extruded pattern of mycelium growth / Synthetic overgrown stairs.
B: Distorted columns.

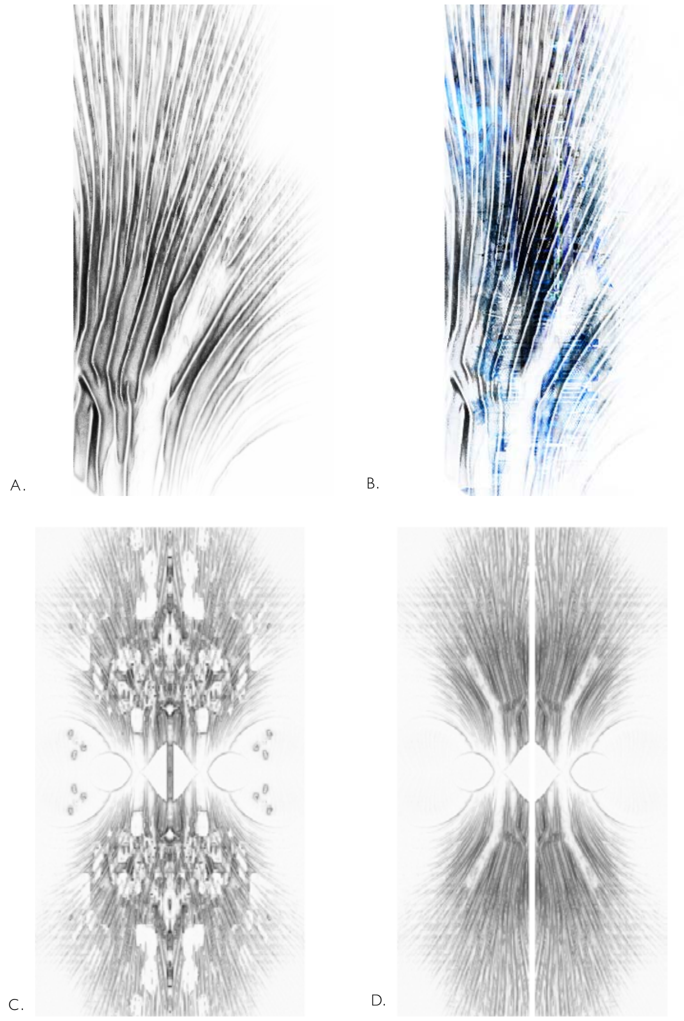


A: MYCELIUM: vectorized image, Illustrator
B,C,D: image modification, Photoshop



# DISPLACEMENT MAPS

## IMAGE MODIFICATION



A, B: Radiality / Linearity
C, D: Texture compositions

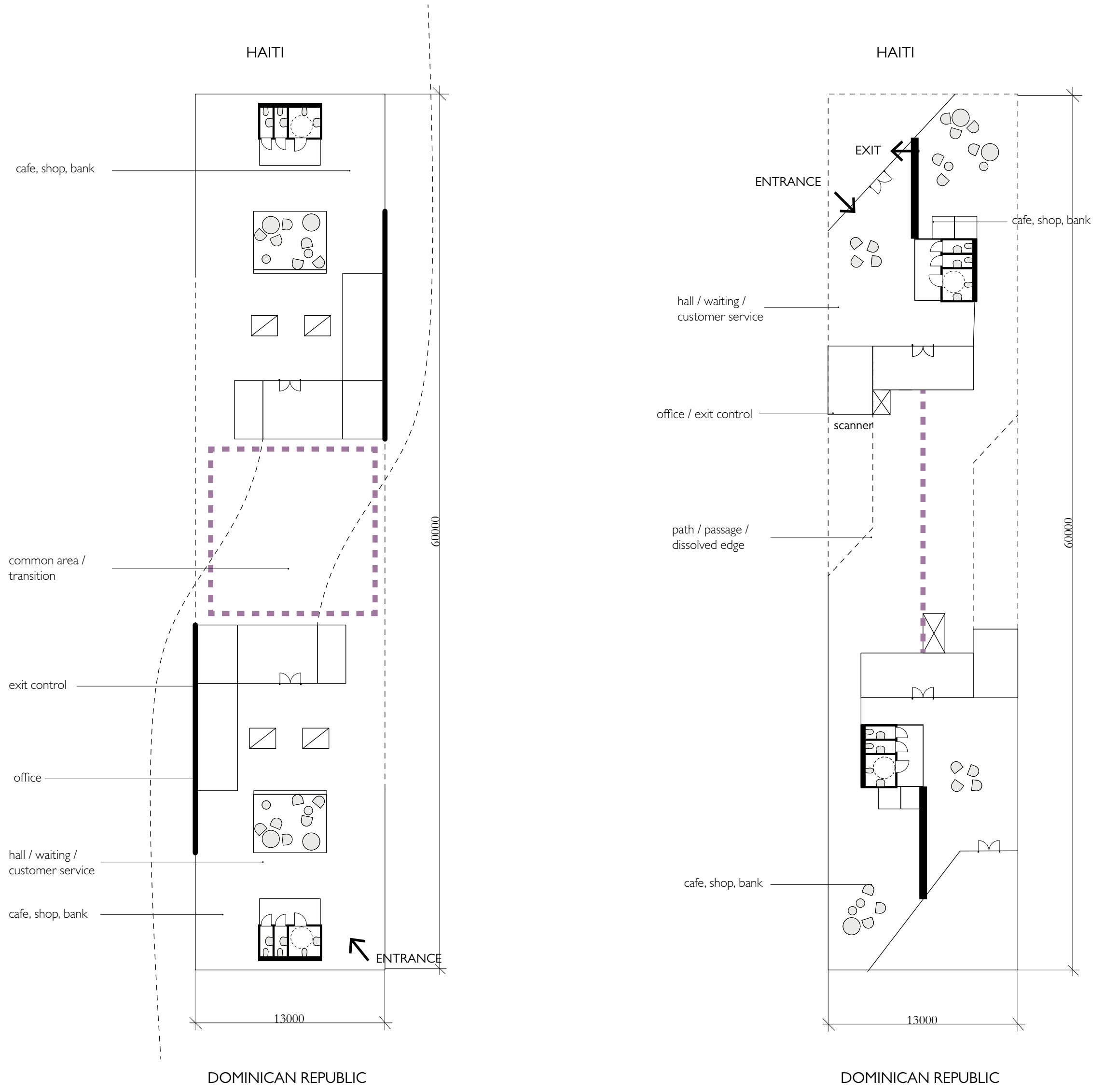



DIAGRAM: Plan - initial program sketches; common courtyard vs separate passage.



# PROGRAM & TRANSITIONS

## INITIAL STUDIES

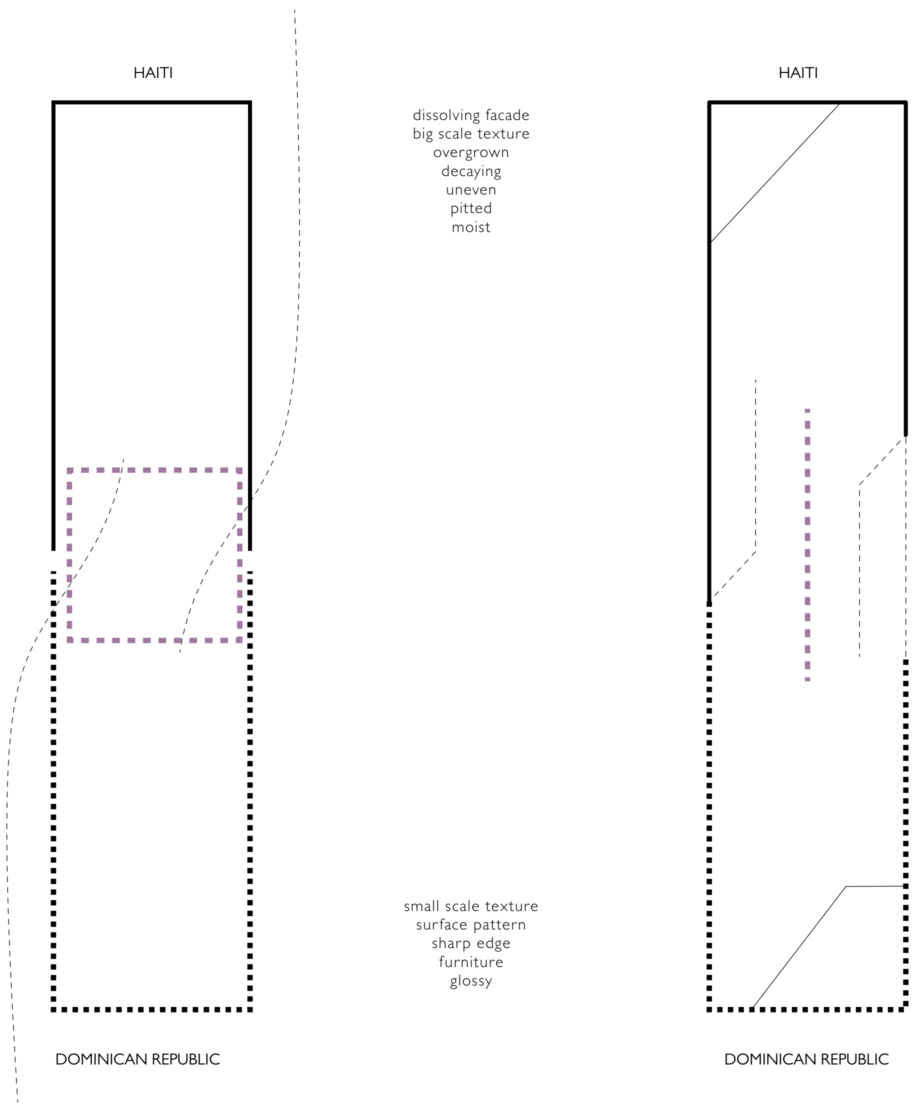
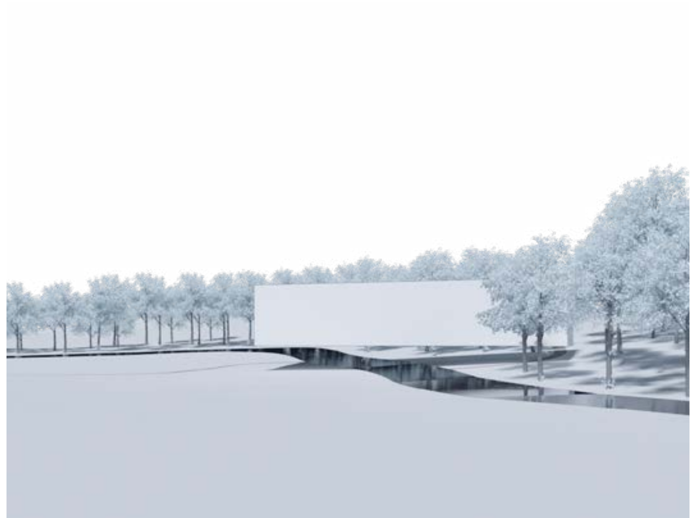
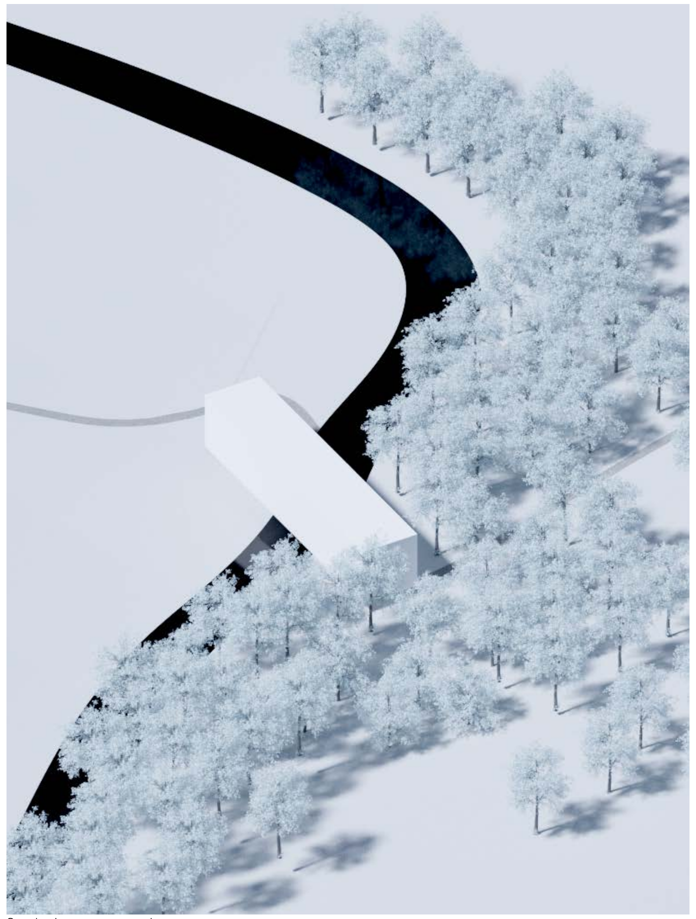
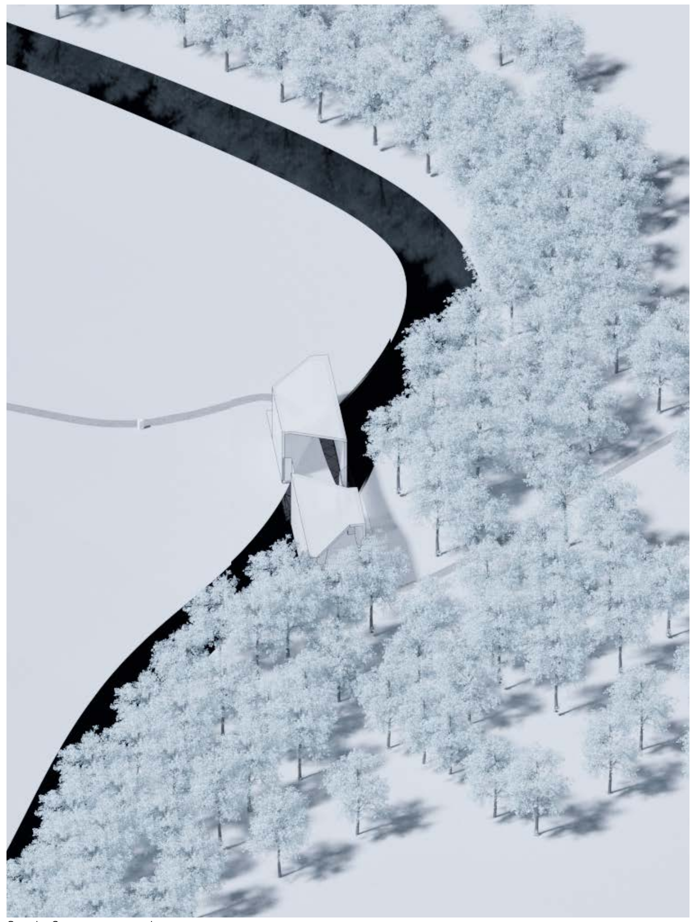



DIAGRAM: Design features - differences between two sides of the Threshold.


Study 1: perspective / a solid block.


Study 2: perspective / single block with a break.

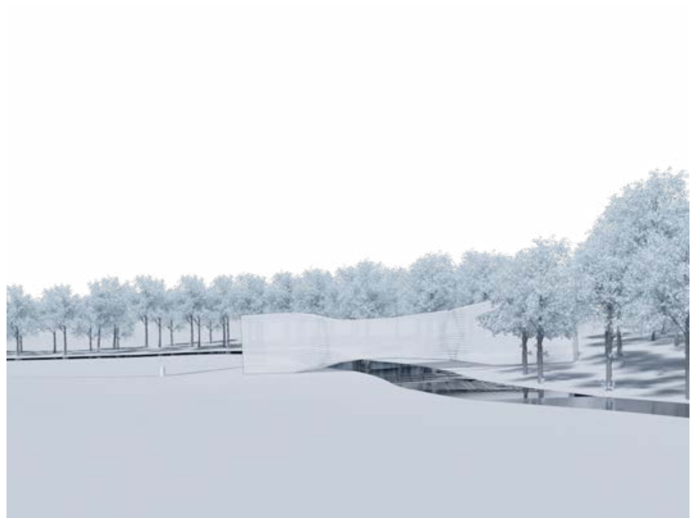

Study 1: axonometric.

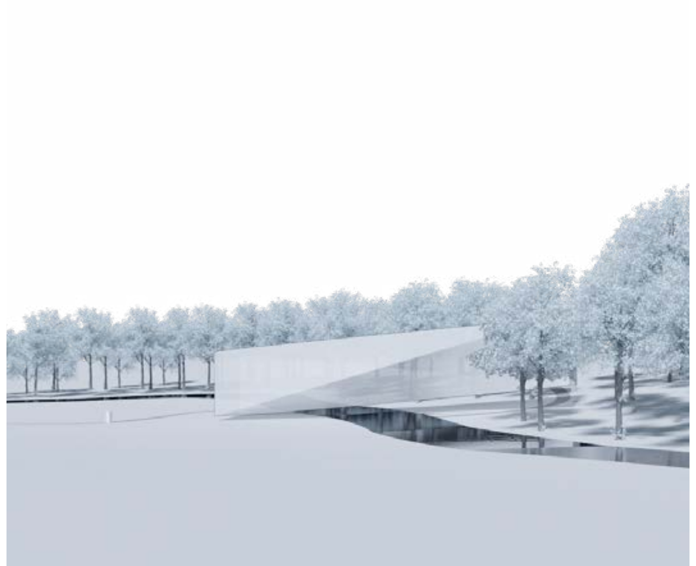

Study 2: axonometric.

# THE BRIDGE

## INITIAL SITE RELATED FORM STUDIES

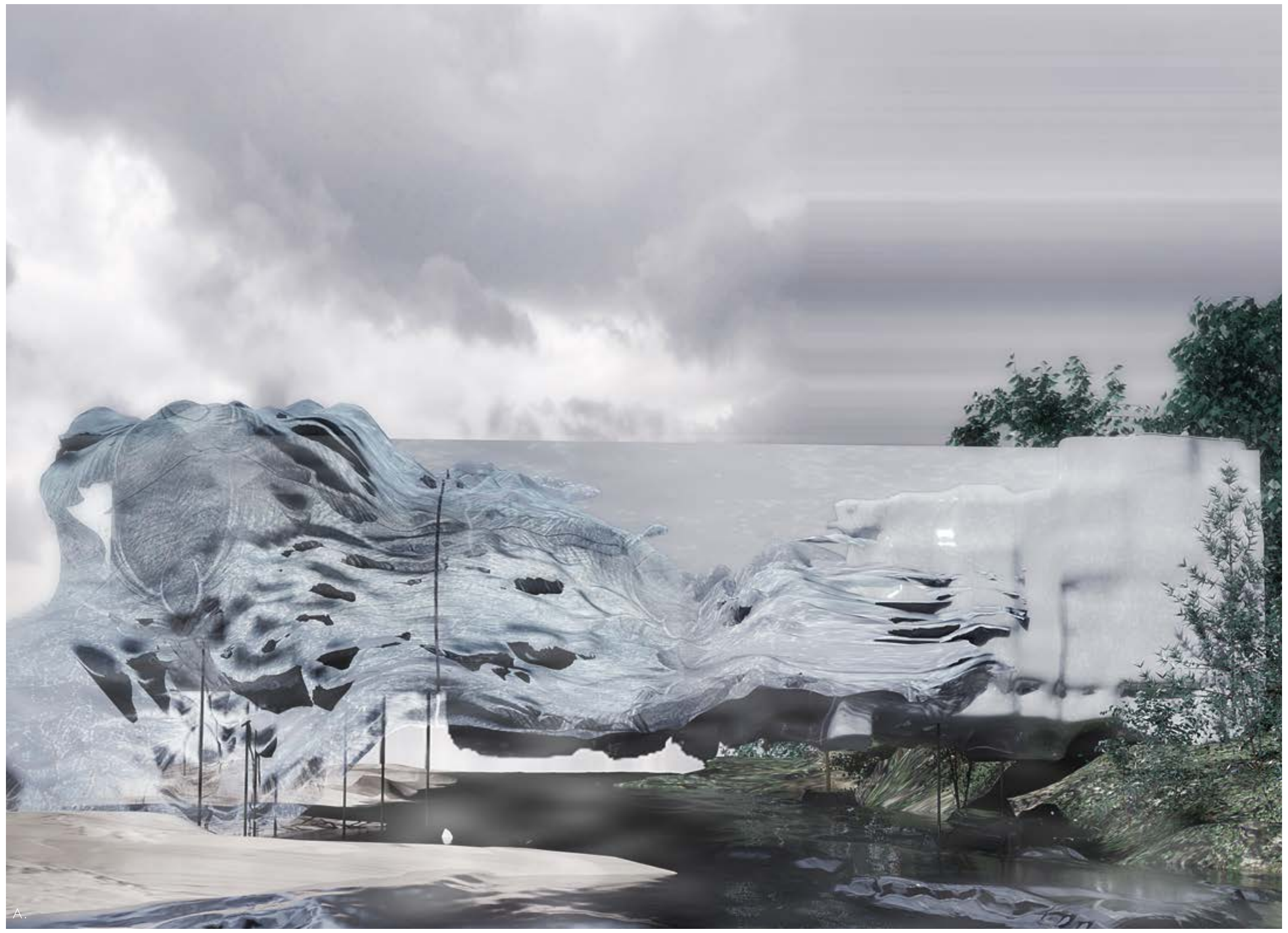
Investigations of positioning building on the site, its relations with the context and the Libon River, terrain level differences etc.


Study 3: perspective / 2 separate blocks, slim center.

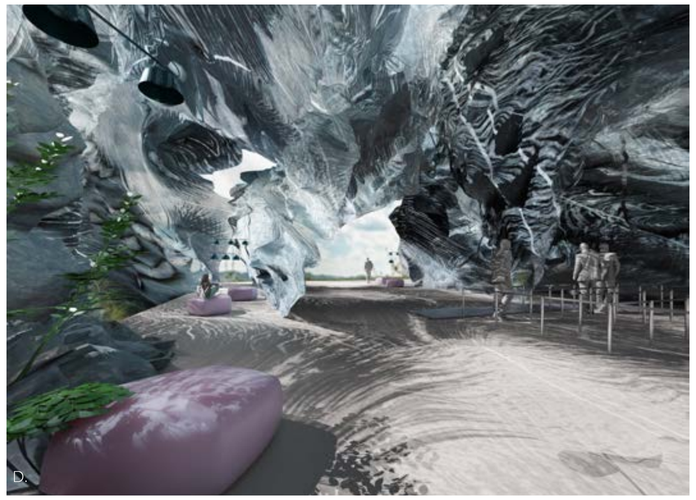

Study 4: perspective / solid block with a twirl.


Study 3: axonometric.


Study 4: axonometric.







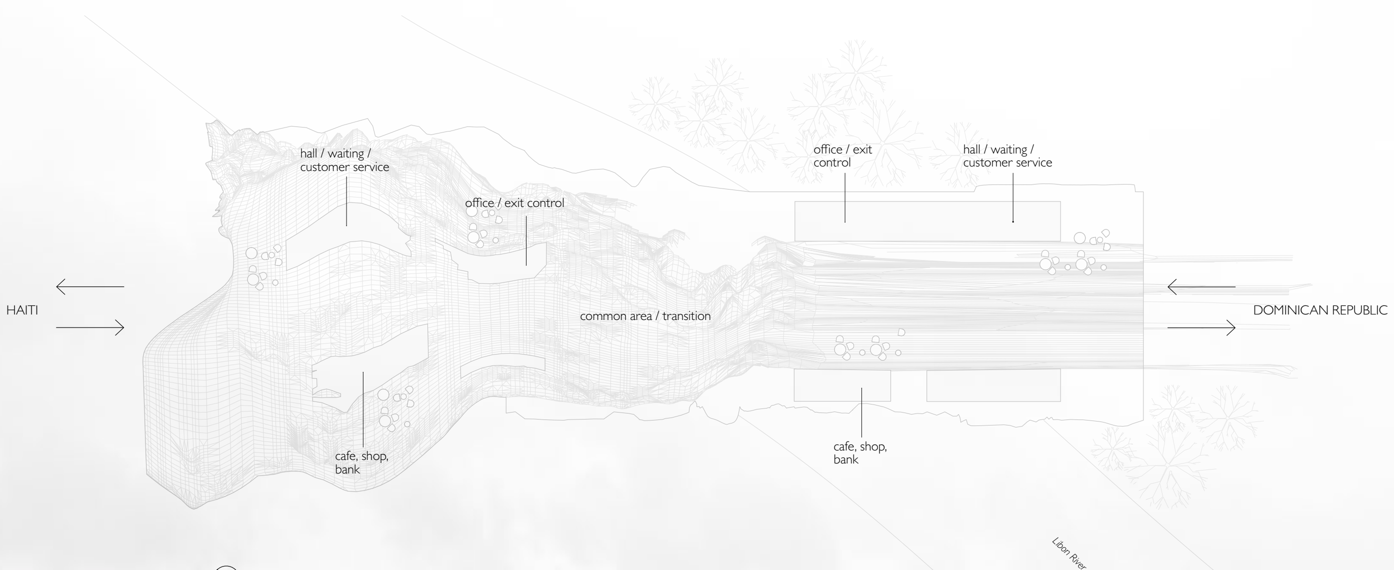
# THE BRIDGE

## CONCEPT DEVELOPMENT

Initial concept was based on the division of the structure into synthetic and natural part. Synthetic was represented with smooth, simple textures; natural - with uneven, rough, irregular ones. The conclusion was that both textures were synthetic. Natural 'side' was trying to mimic natural surfaces - still in a purely artificial way.

A: 'Natural' vs 'Synthetic'.
B-E: Interior studies with focus on the texture.


DIAGRAMMATIC LANDSCAPE SECTIONS / RELATION TO THE GROUND /
Left : nature-like part situated on Haiti side; Right : synthetic part towards Dominican Republic.



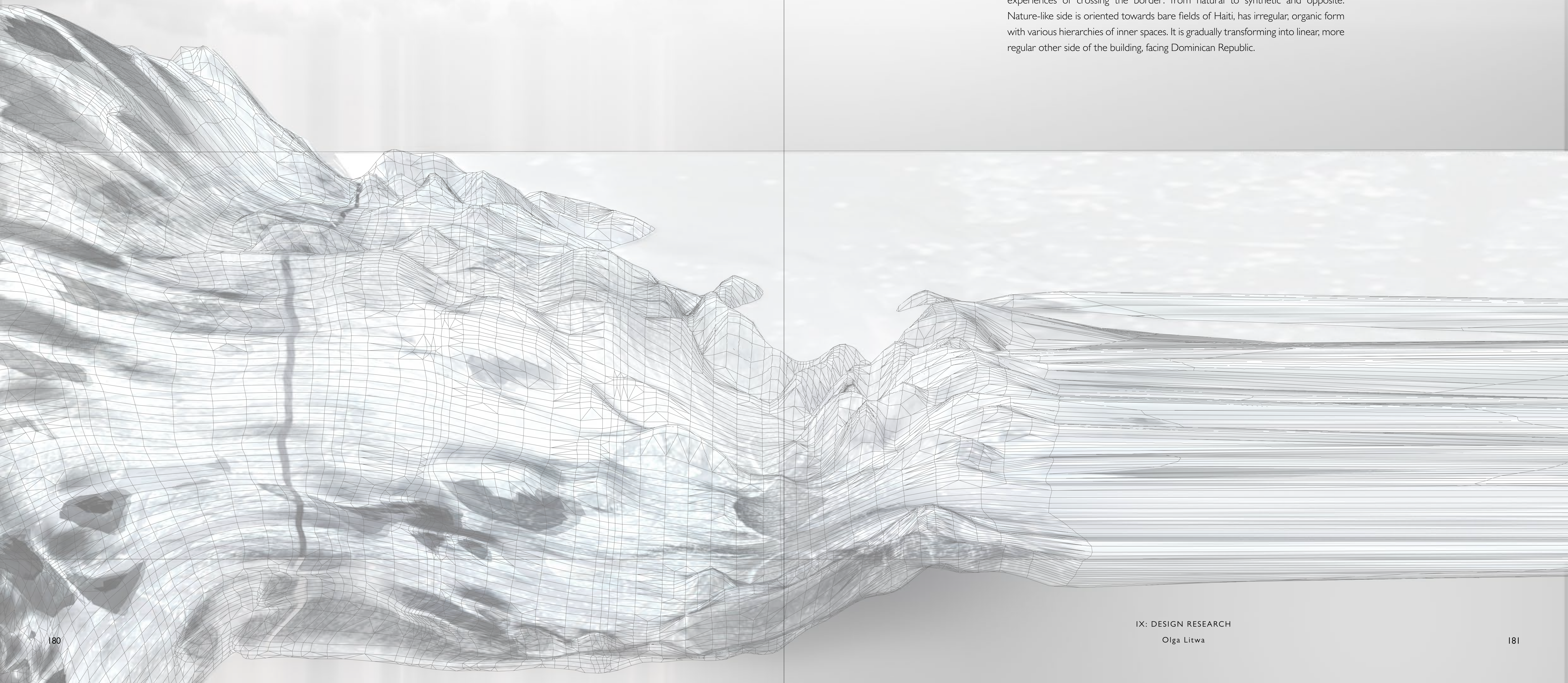

TRANSITION. Conceptual plan drawing.

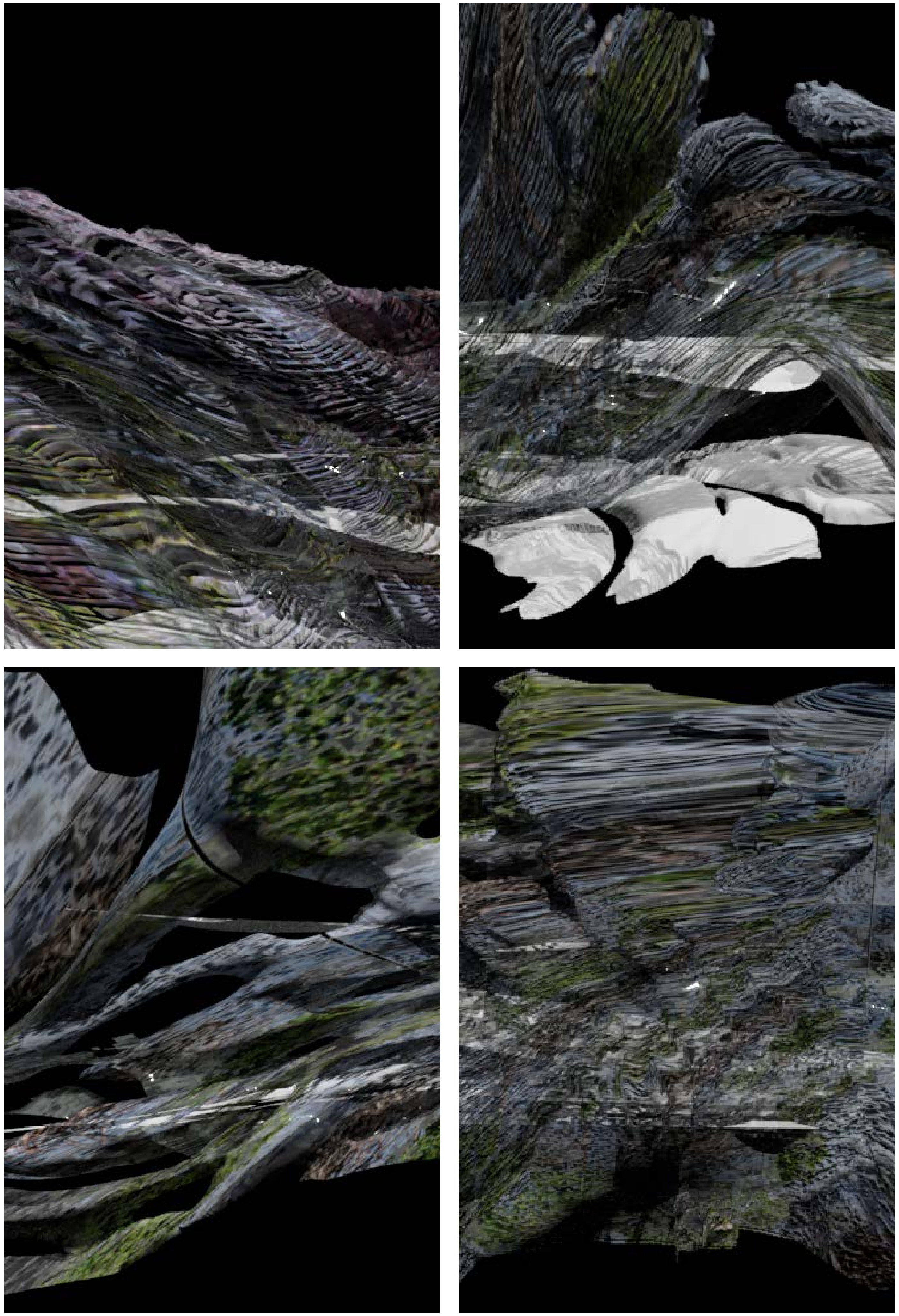
# THE BRIDGE

## CONCEPT DEVELOPMENT

TRANSITION : Mesh render created in Maya, representing the process of moving from one condition to another.

At that stage the main design aim was to create and enhance two different experiences of crossing the border: from natural to synthetic and opposite. Nature-like side is oriented towards bare fields of Haiti, has irregular, organic form with various hierarchies of inner spaces. It is gradually transforming into linear, more regular other side of the building, facing Dominican Republic.

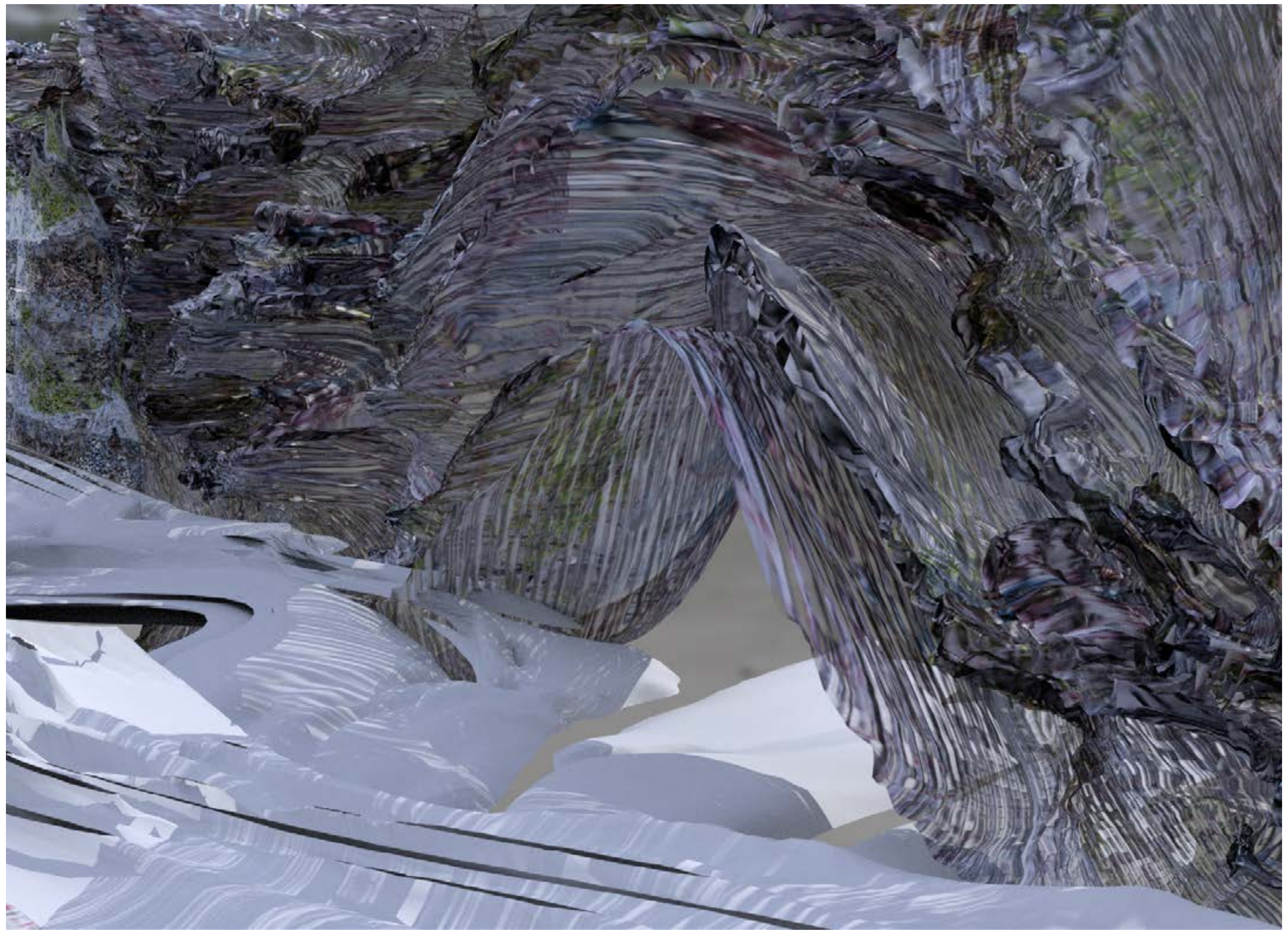
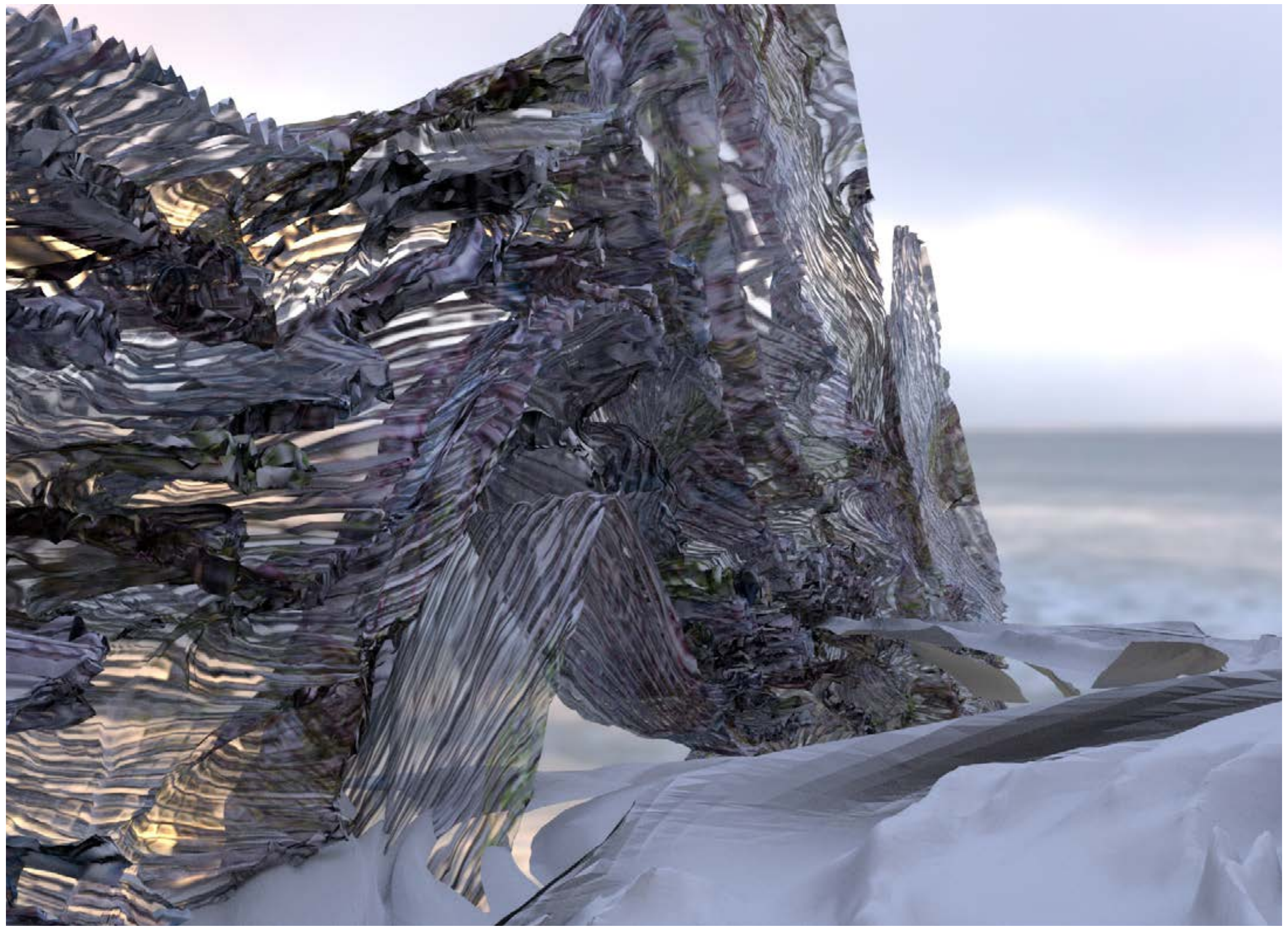
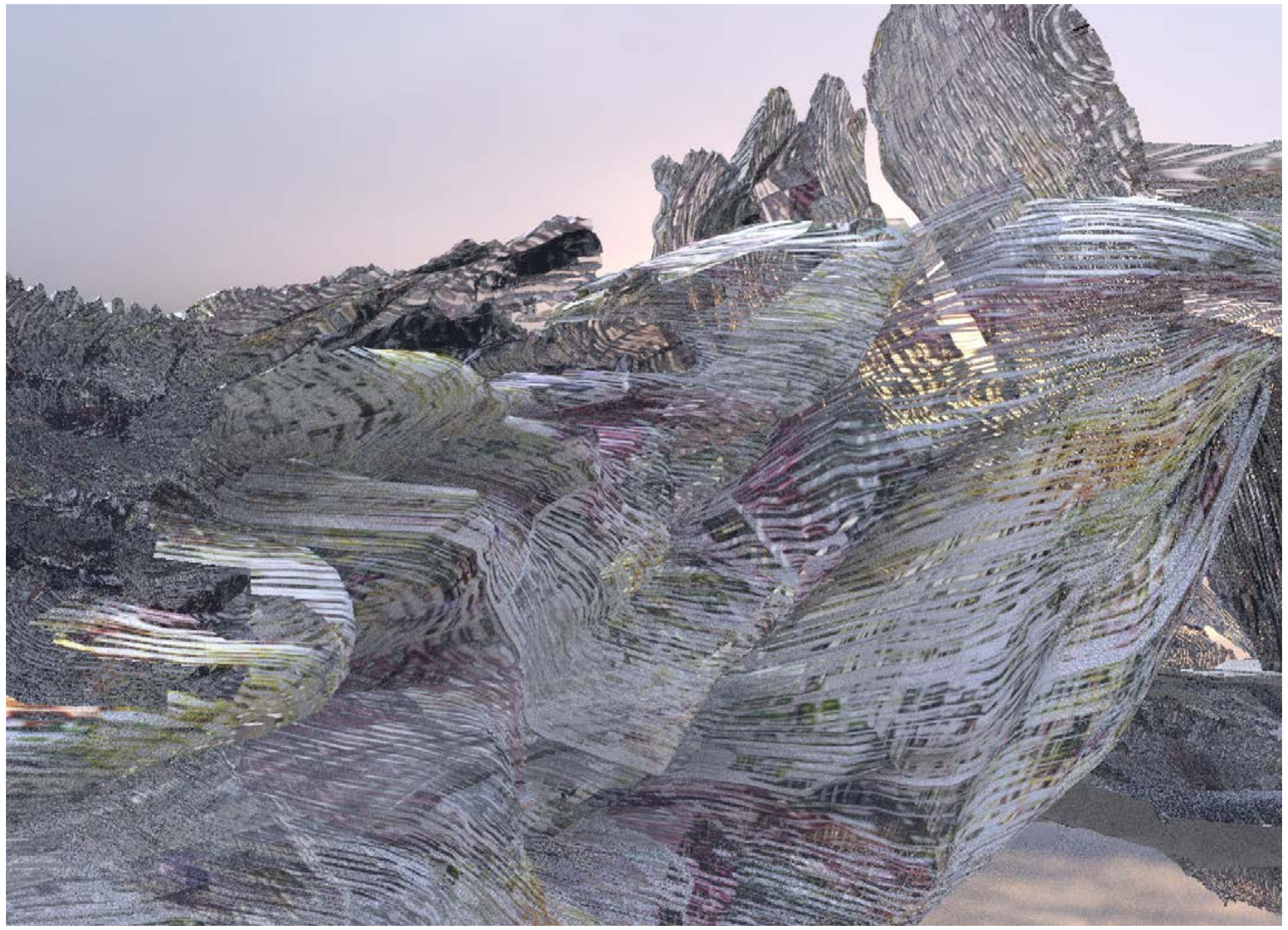


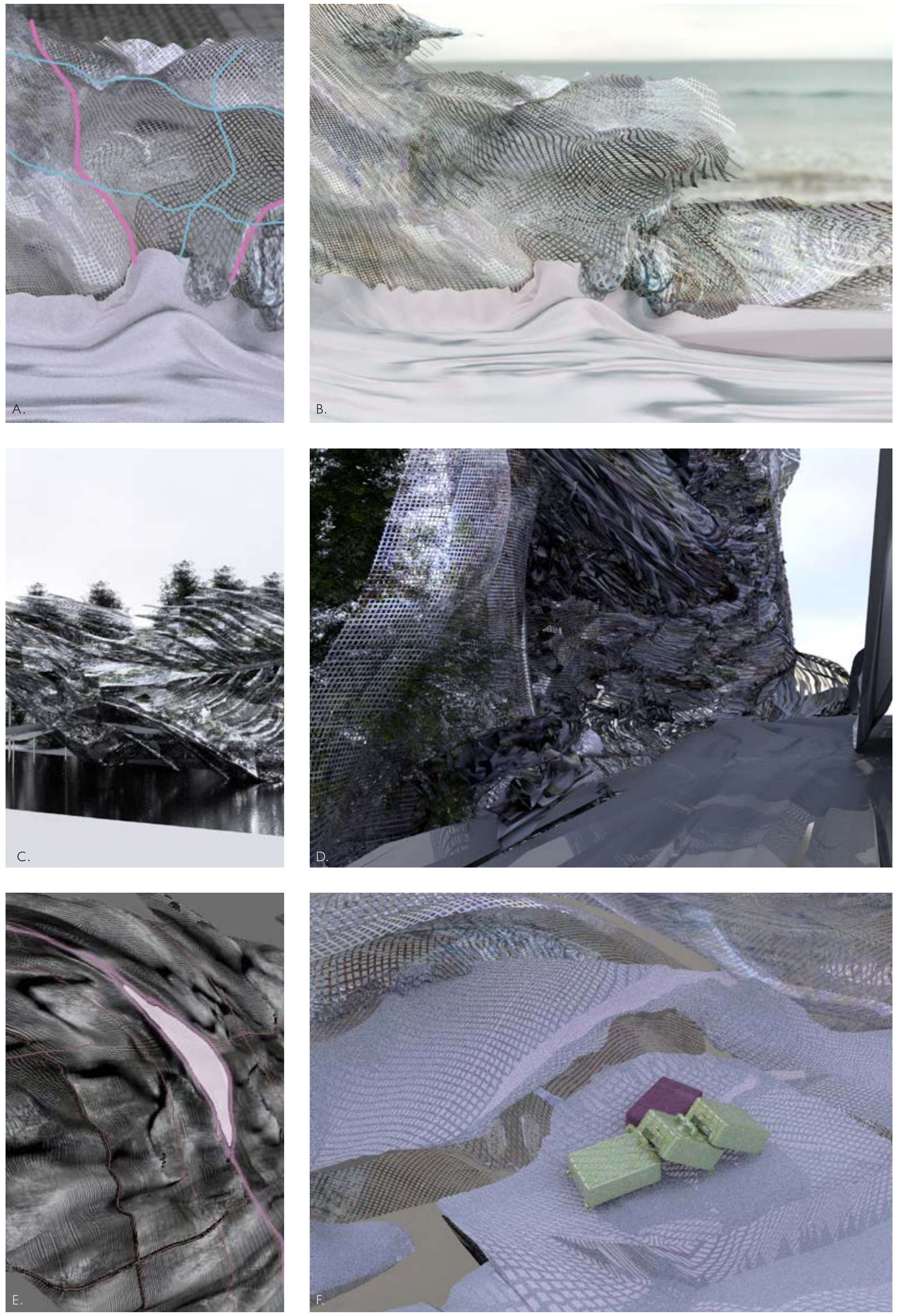


# THE BRIDGE

## FURTHER CONCEPT DEVELOPMENT

Deep texture: playing with displacement and opacity masks.




DESIGN SKETCHES
A-B: Alcove; pipe wall structure. C,E: Investigating the aperture.
D: Defining the walking experience.F: Luggage drop-off; path texture.



# THE BRIDGE

## FURTHER CONCEPT DEVELOPMENT

View from Haiti.

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SYNTEXTURE

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