INFINITE MINING
for
STRUCTURAL COMPOSITES

P5, Msc Architectural Engineering & Technology
Delft University of Technology

01 / 07 / 2016

Stefanie Tseggai

Tutors:
Job Schroen
Maarten Meijs
Jan Jongert

INTRODUCTION

RESEARCH
material
system

DESIGN
site
building

REFLECTION

INTRODUCTION

Coal debris dump, Lu Guang, WorldPressPhoto, 2015

ENCI Factory, Maastricht, The Netherlands

Staatsmijn Oranje-Nassau, Heerlen, The Netherlands

"DE TOEKOMST VAN PARKSTAD IS GEOPEND"

IBA manifestatie en presentatie Open Oproep. Parkstad, 27 & 28 juni

Beste,

Parkstad werkt aan haar toekomst op een unieke manier: door het organiseren van een Internationale Bau Ausstellung. Met deze IBA wil Parkstad een impuls geven aan economie, ruimte én samenleving. Tot 2020 functioneert IBA Parkstad als laboratorium en is het een motor

How to propose an incentive for new industrial activity in the Parkstad region?

‘In nature the waste of one process is always a nutrient, a material, or a source of energy for another.

Thus the solution not only to the environmental challenges of pollution,

but to the economic challenges of scarcity

may be found in the application of models we can observe in a natural ecosystem.’

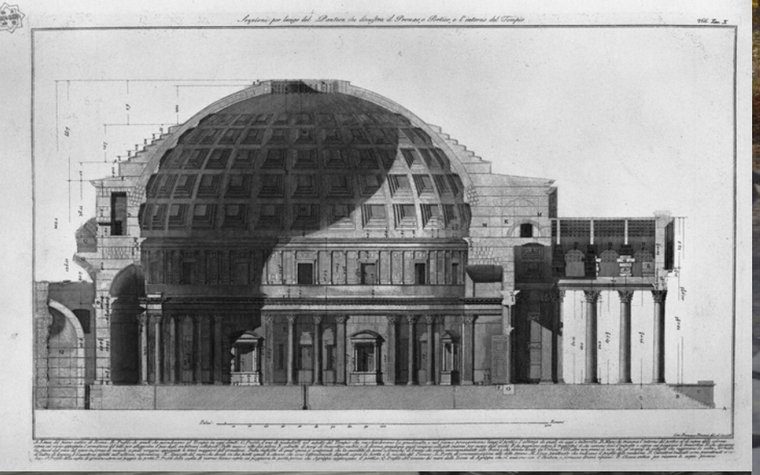
The Blue Economy, Gunter Pauli, 2010, p. 6

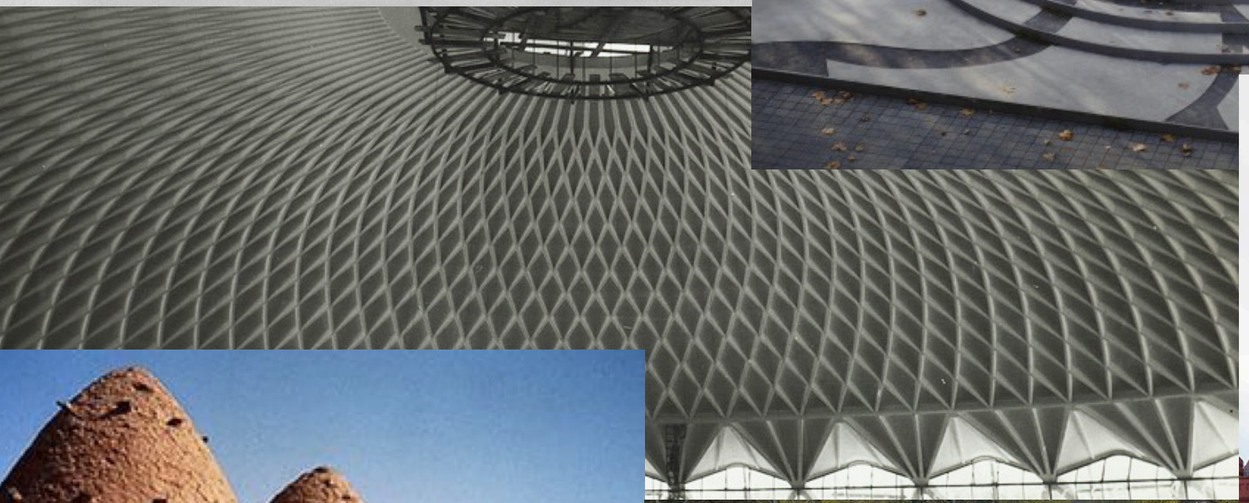
OBJECTIVES

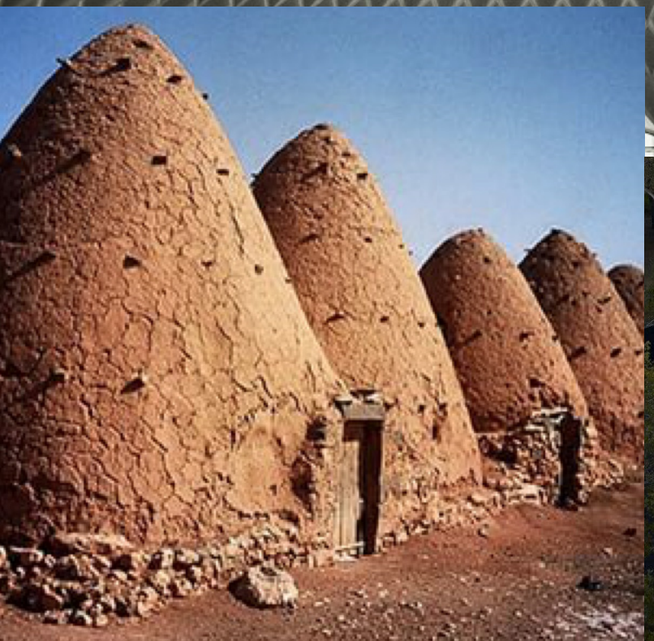
Eliminating the extraction of limited resources

Creating high-end construction material from low-valued wastes

Making a material-based design







composite */'kompezit; in sense B.5 -zait / a. & n.* In *Archit.* orig. **† -ita.** LME. [Fr., or L *compositus* pa. pple of *componere*: see COMPOUND *v.*, -ITE.] **A** *adj.* **1** *Math.* † **a** Of a number: composed of more than one digit. **b** Of a number: being the product of two or more factors greater than unity; not prime. **2** *Archit.* Designating the fifth classical order, a compound of Ionic and Corinthian. **3** *gen.* Made up of various parts or elements, compound; made of constituents that remain recognizable. **4** *Biol.* Made up of a number of seperate simple parts or individual organisms; *spec.* (*Bot.*) belonging to or designating the large plant family Compositae **B** *n.* † **1** *Math.* A number composed of more than one digit. **2** *Archit.* The composite order. **3** *gen.* A compound, a composite thing, a composite material. **4** A composite plant.

(Oxford English Dictionary; on Historical Principles, 1993)

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Modern structural composites are mixtures of two or more components: stiff long fibres and a matrix, which affixes the fibres (Chollakup, Nardin, Smitthipong, 2015, p. 1).

By layering the fibres and matrix in different directions it is possible to customize the directional strength and stiffness to the occurring loads (Ibid., p. 2).

Bio-based means derived from biomass.

Biomass consists non-fossilized and biodegradable organic material originating from plants, animals, and micro-organisms (Kabasci & Stevens, 2013, p. 2). It is considered a renewable resource as long as its exploitation rate does not exceed its replenishment by natural processes (Ibid.).

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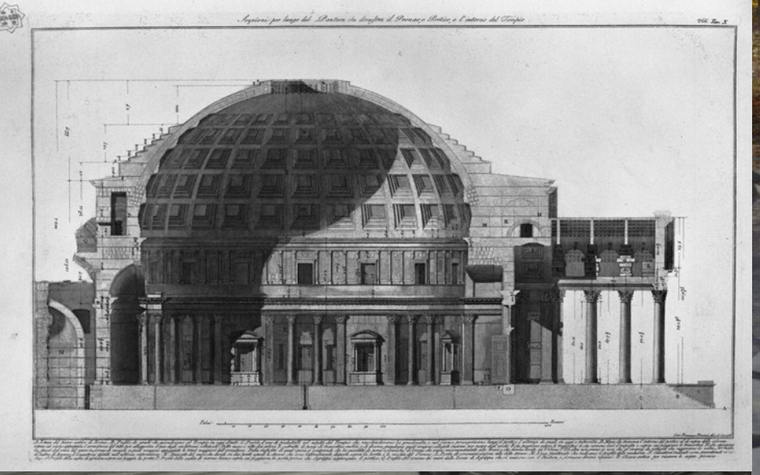

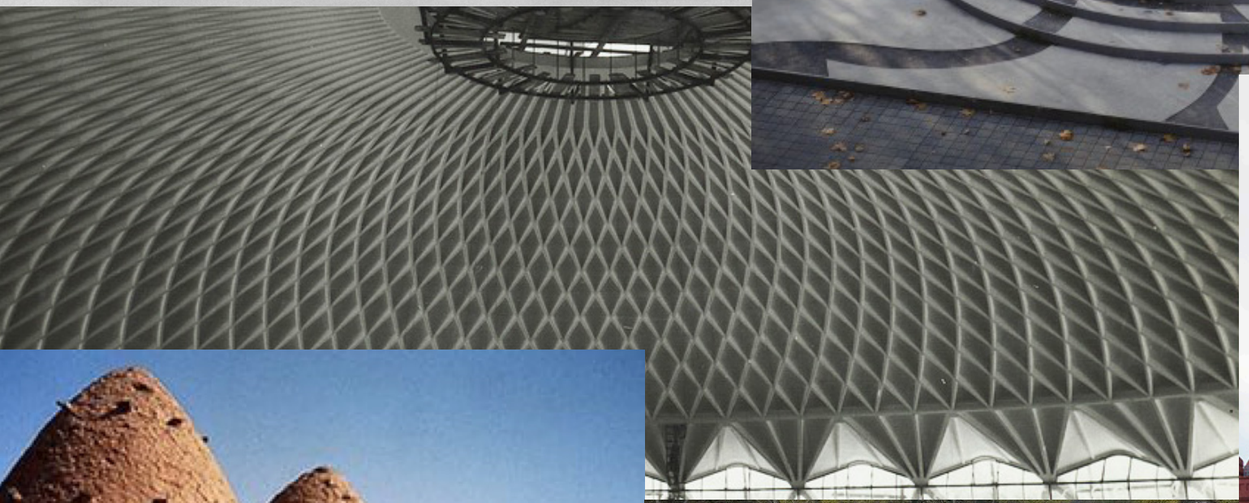

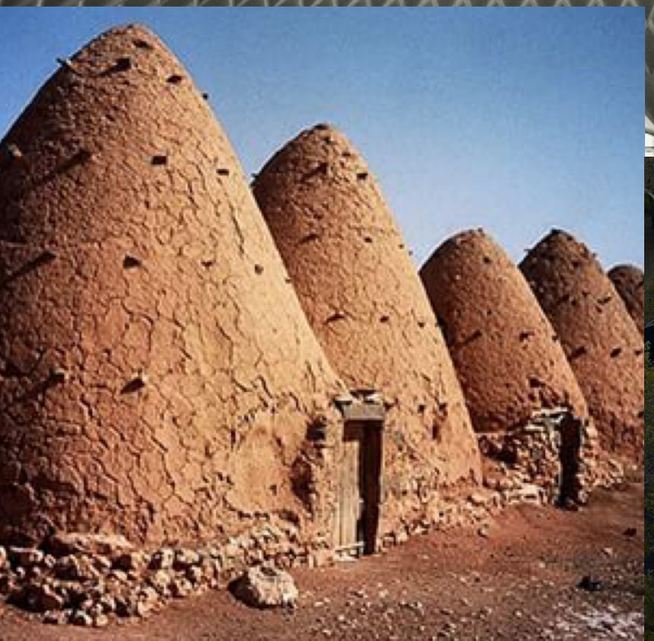

RESEARCH

DESIGN

GOAL

RESEARCH

DESIGN

GOAL

To set up
the **production system**
of
a structural bio-based composite
from waste

RESEARCH

DESIGN

GOAL

To set up
the **production system**
of
a structural bio-based composite
from waste

Circular, Multipliable, Flexible

Uniform, Consistent, Abundant

RESEARCH

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Circular, Multipliable, Flexible

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DESIGN

To design
an **‘infinite mine’**
for
the composite
in Parkstad

RESEARCH

Circular, Multipliable, Flexible

To set up
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Uniform, Consistent, Abundant

GOAL

DESIGN

Material based

To design
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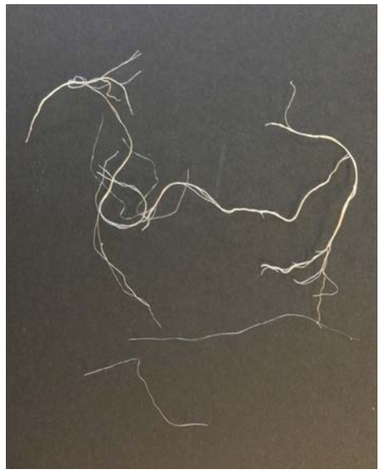
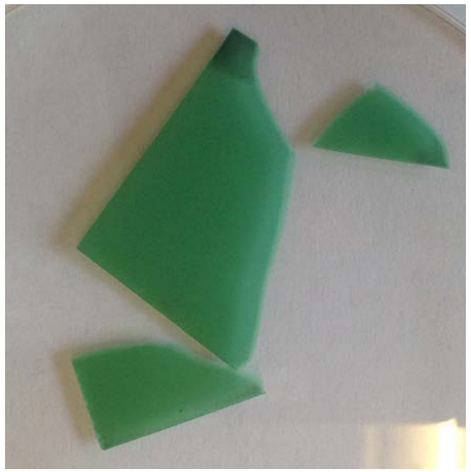
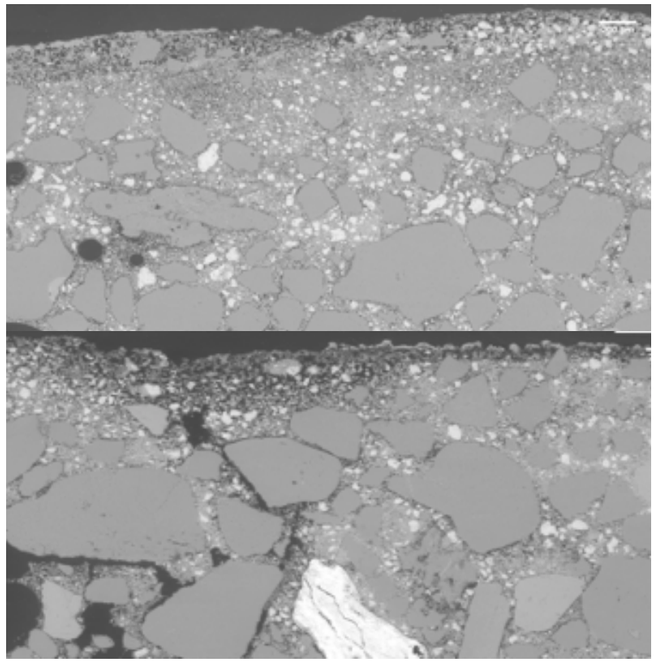
Connects Local Flows, Flexible, Example

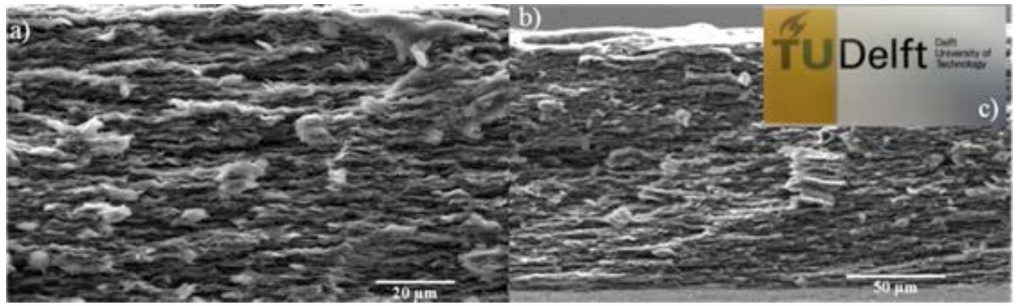
RESEARCH

Alginate Like Exopolysaccharide (ALE)
Nereda waste water treatment

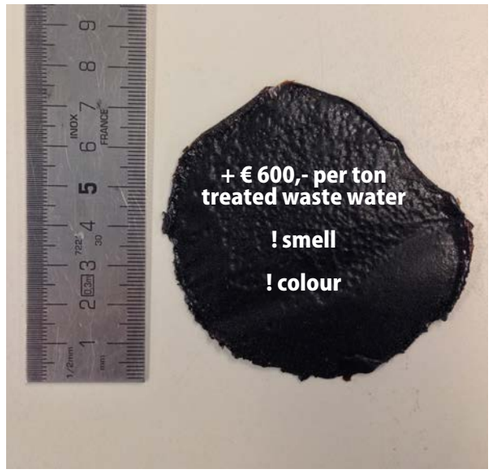


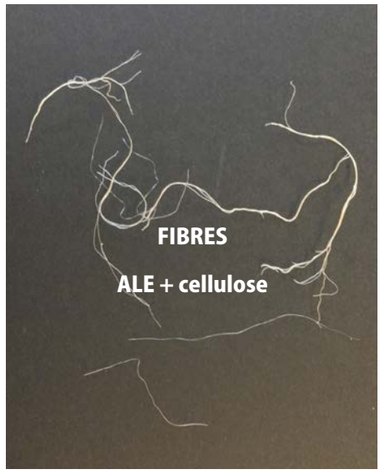


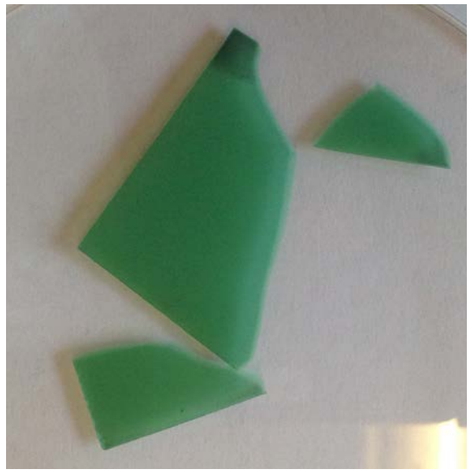


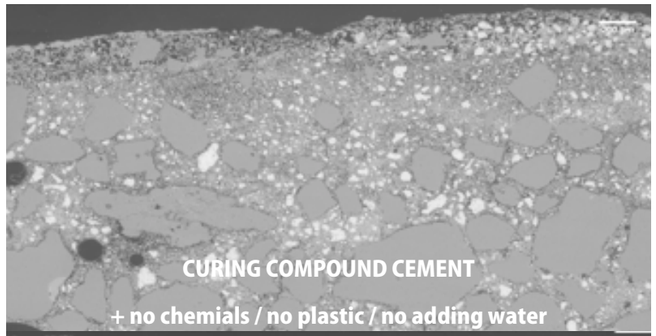


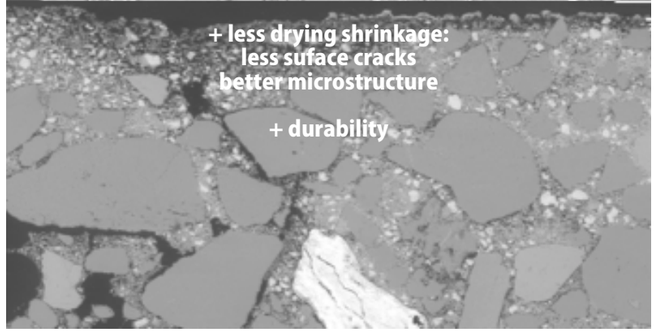
Applications of ALE

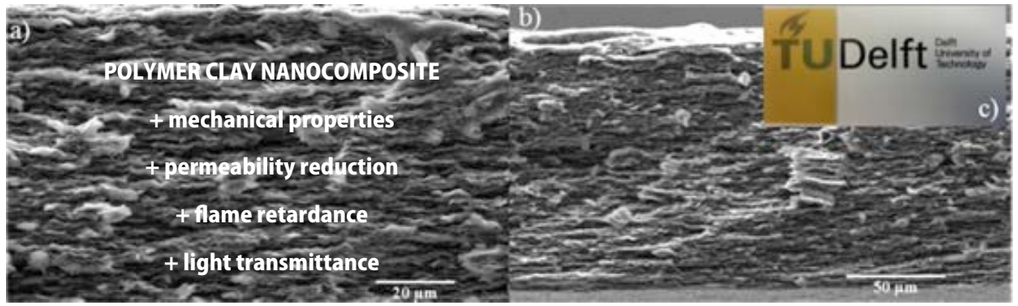


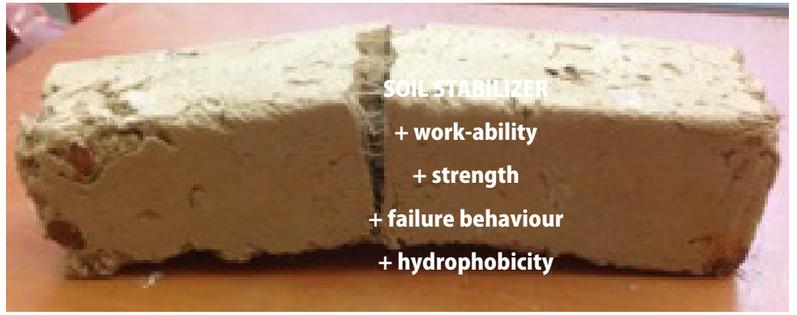












Applications of ALE

water 400 ml + abaca fibres 12 g + loam 2000 g + ALE 14 g

mix & mould & dry (2days)

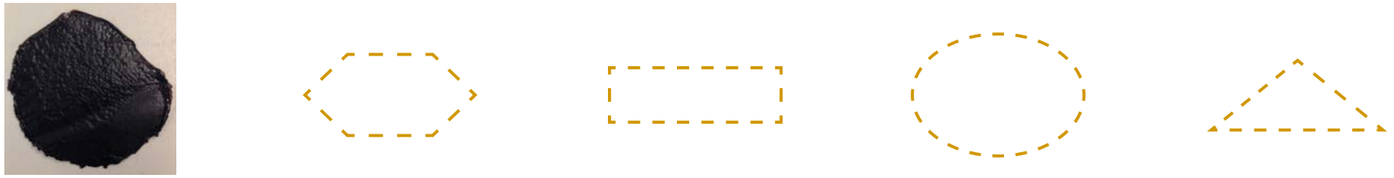
bricks

sand 35 % + silt 45 % + clay 20 %

water 400 ml + abaca fibres 12 g + loam 2000 g + ALE 14 g → mix & mould & dry (2days) → bricks

sand 35 % + silt 45 % + clay 20 %

Components of new composite



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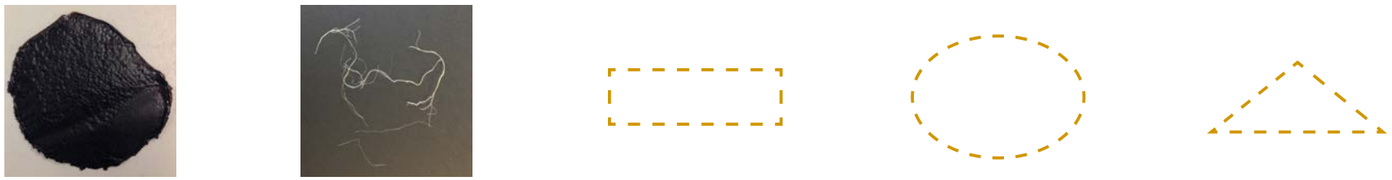


Components of new composite

ALE +  ALE-cellulose +  Bio-Cement +  aggregate +  water

Components of new composite

ALE

+

ALE-cellulose

+

Bio-Cement

+

biomass ash

+

water

Components of new composite

ALE

+

ALE-cellulose

+

Bio-Cement

+

biomass ash

+

effluent

Components of new composite

ALE

+

ALE-cellulose

+

Bio-Cement

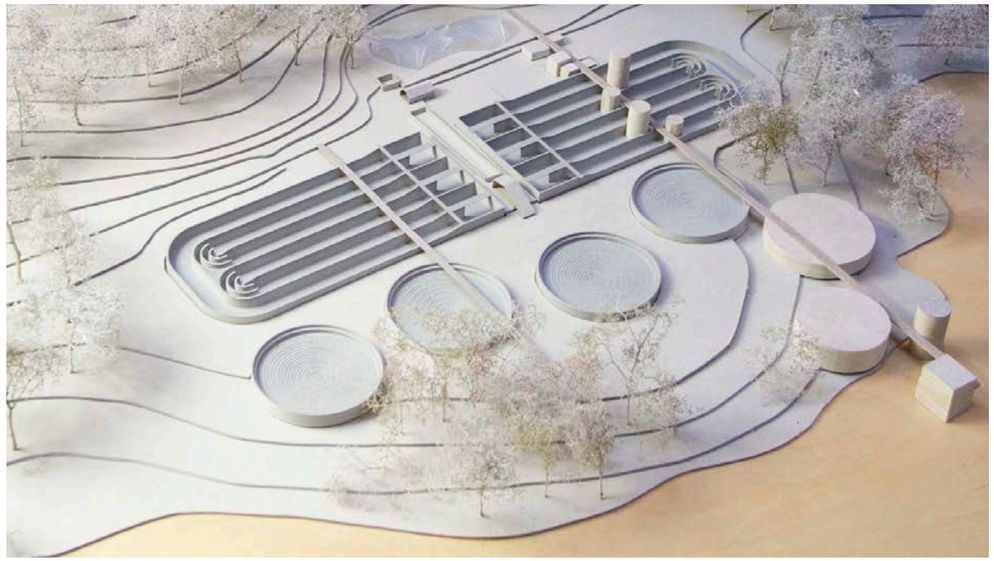
+

biomass ash

+

effluent

Components of new composite



WWTP KERKRADE = INFINITE MINE

semi-finished
product

extracted
materials

ENCI = COMPOSITE FACTORY

The Production System

DESIGN

AMBITIONS

Material-based

Connect Local Flows

Room for exploration & change

Example

DESIGN
site

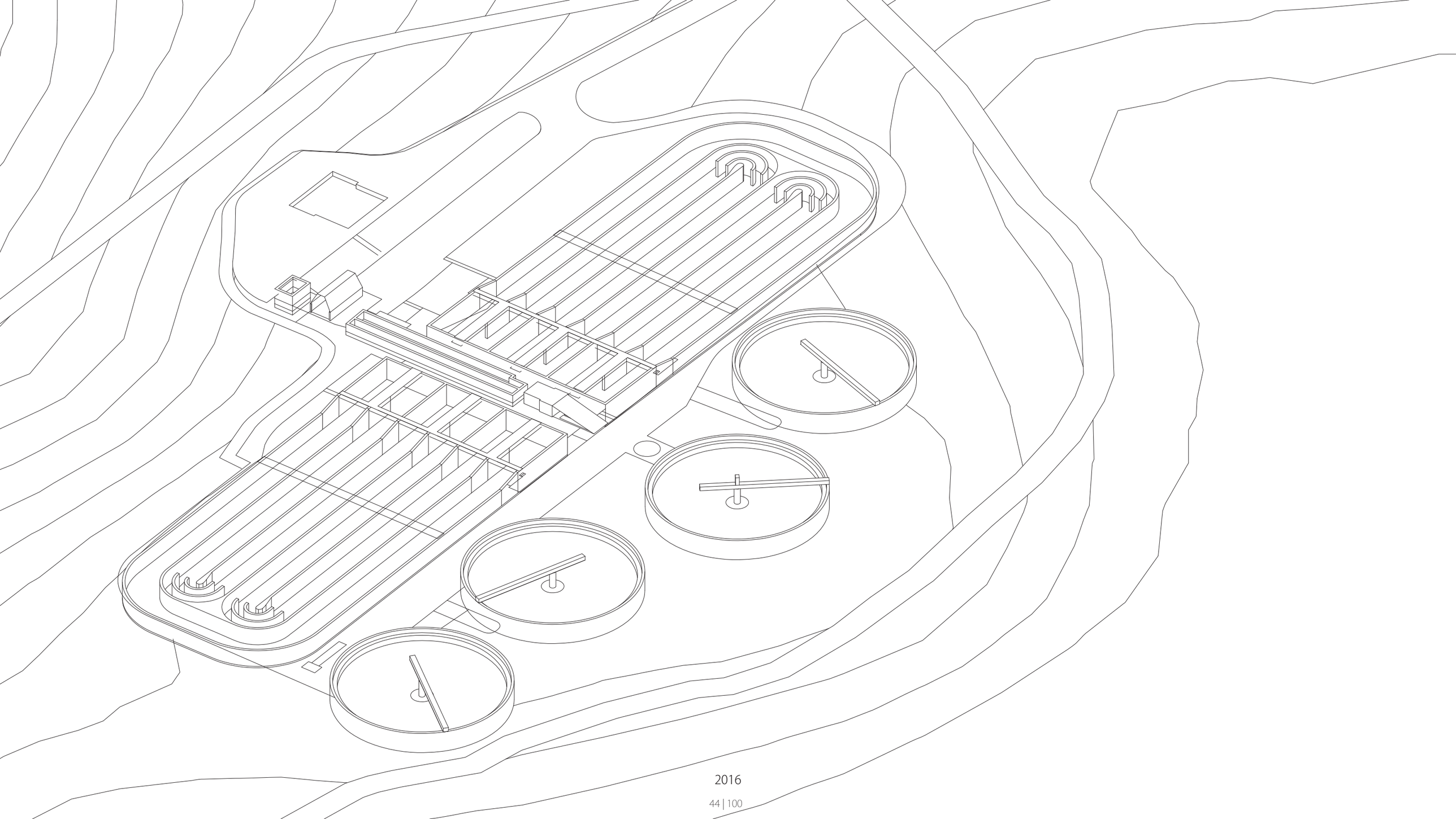

MONDE VERDE
CASTLE
MEGA LAND
(PINK POP)
CASTLE
INDUSTRIAL
PARK
FARMSTEAD
FARMSTEAD
SNOW WORLD
ESTATE
CASTLE
GAIA ZOO
Kerkrade
1000 m
Image © 2015 GeoContent
Google earth

FORM = FUNCTIONAL

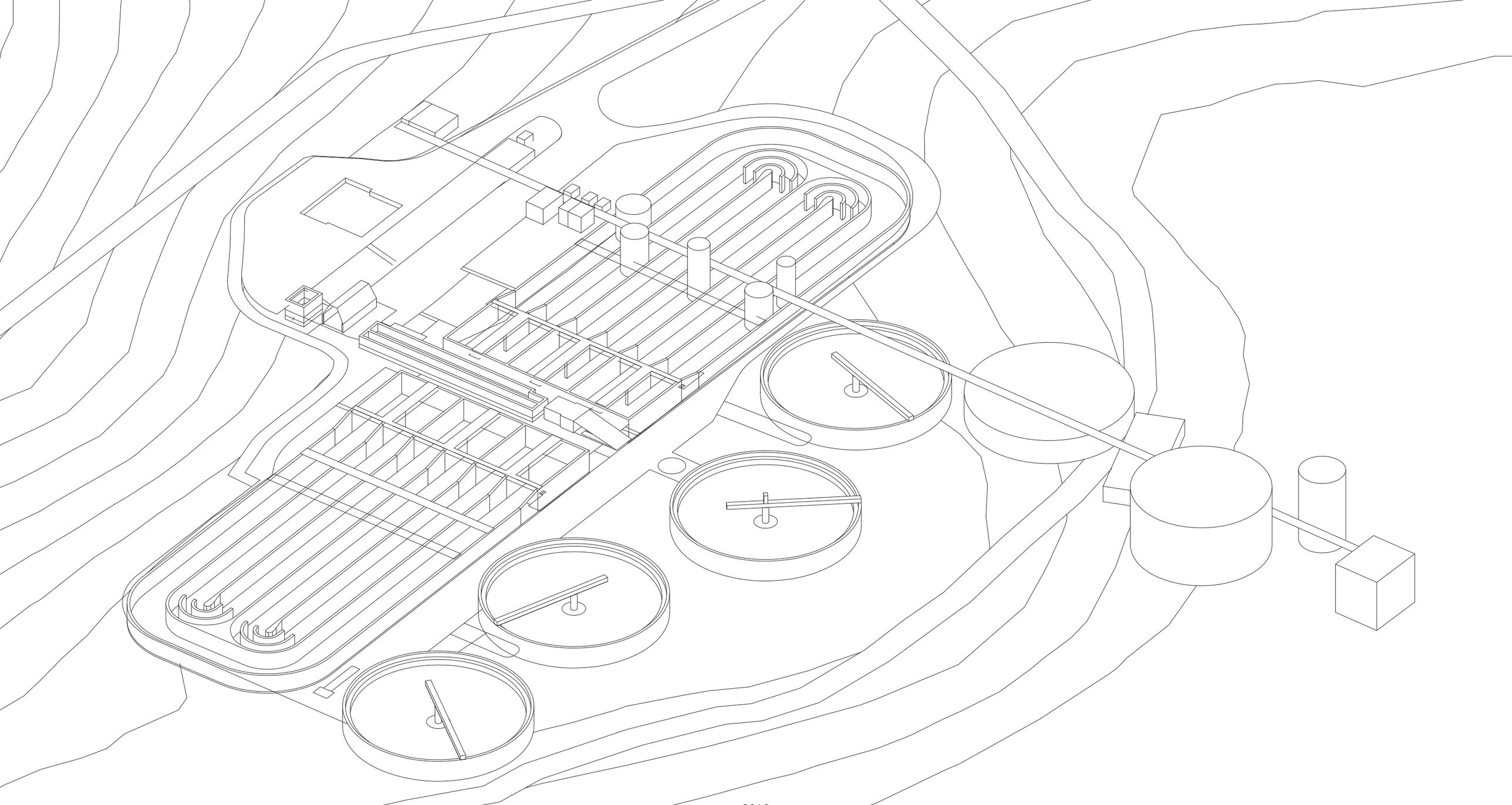
COMPOSITION = PRAGMATIC

ANTI -ARCHITECTURE

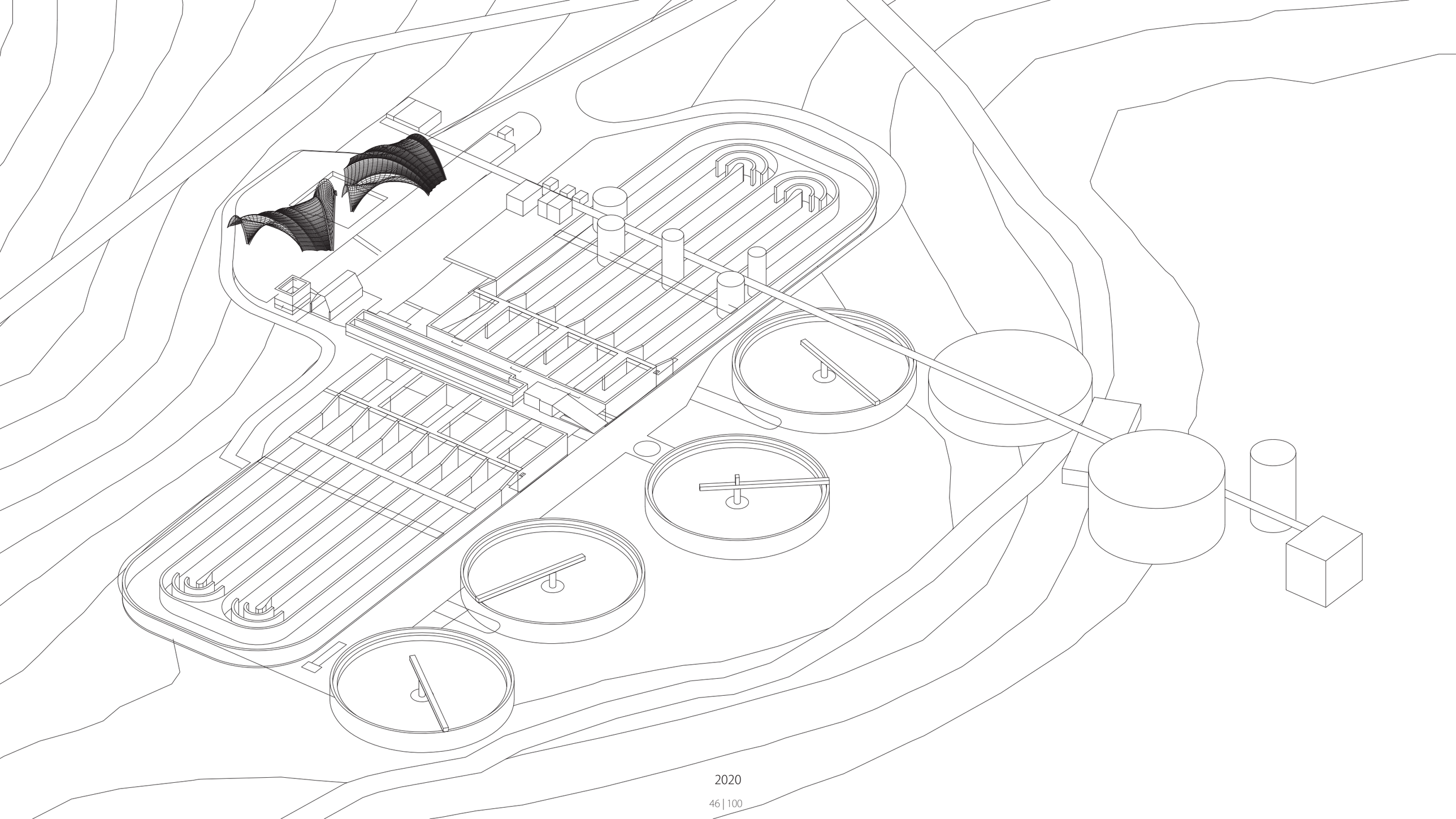

LAKE CRANENWEYER
SEDIMENTATION TANKS
AERATION TANK
FILTERS
AERATION TANK
MAIN BUILDING



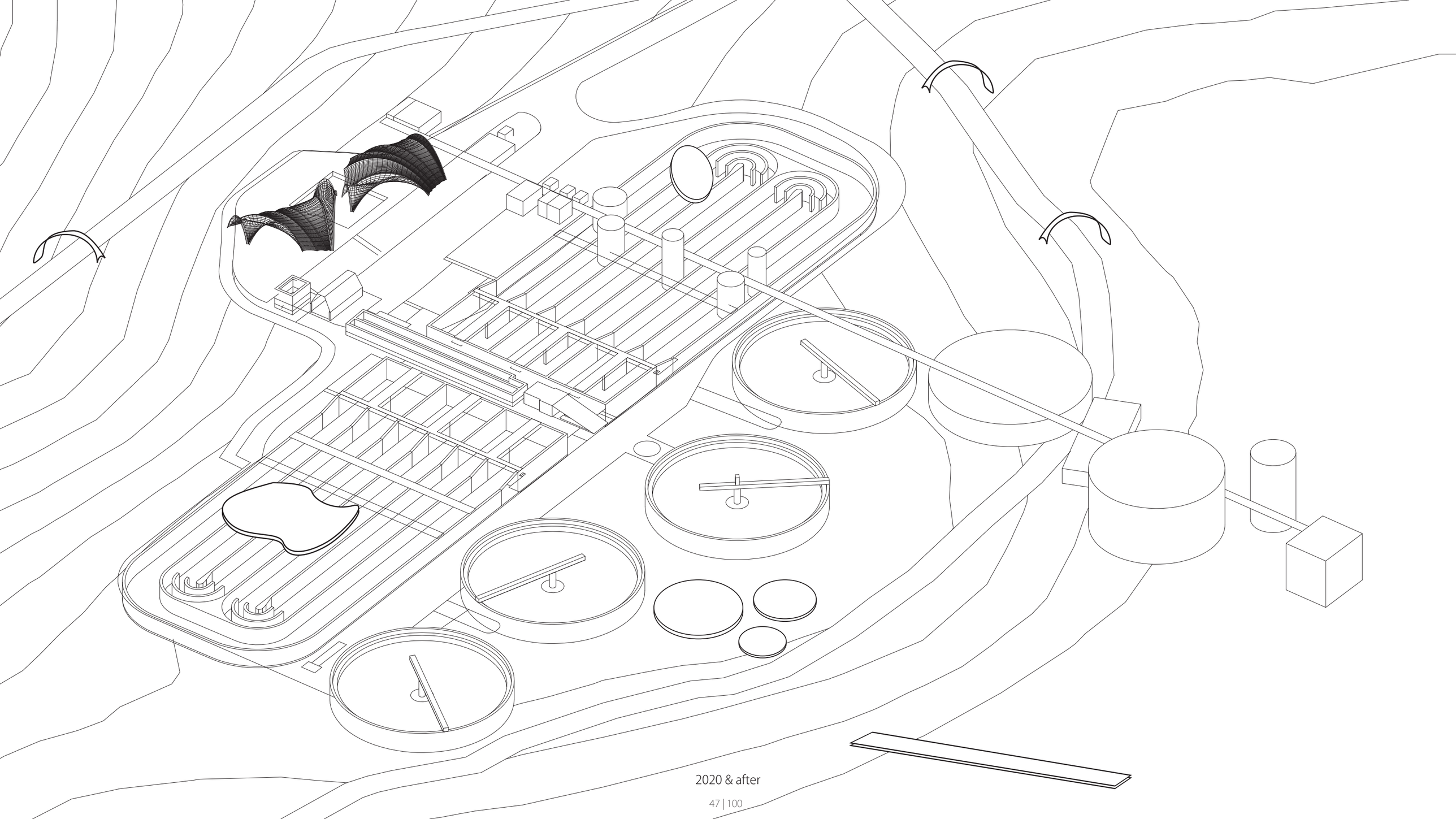
2016



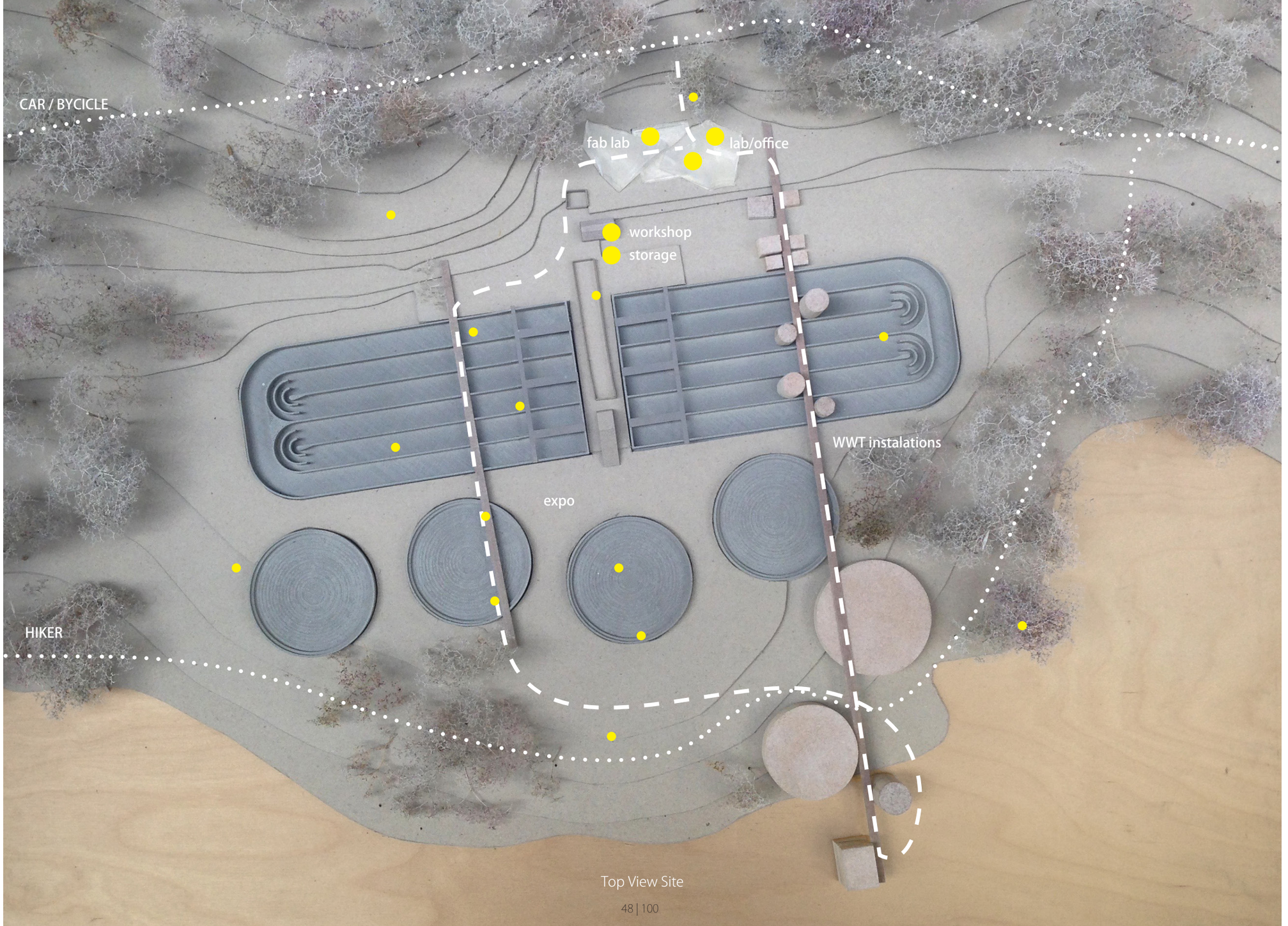
2018



2020

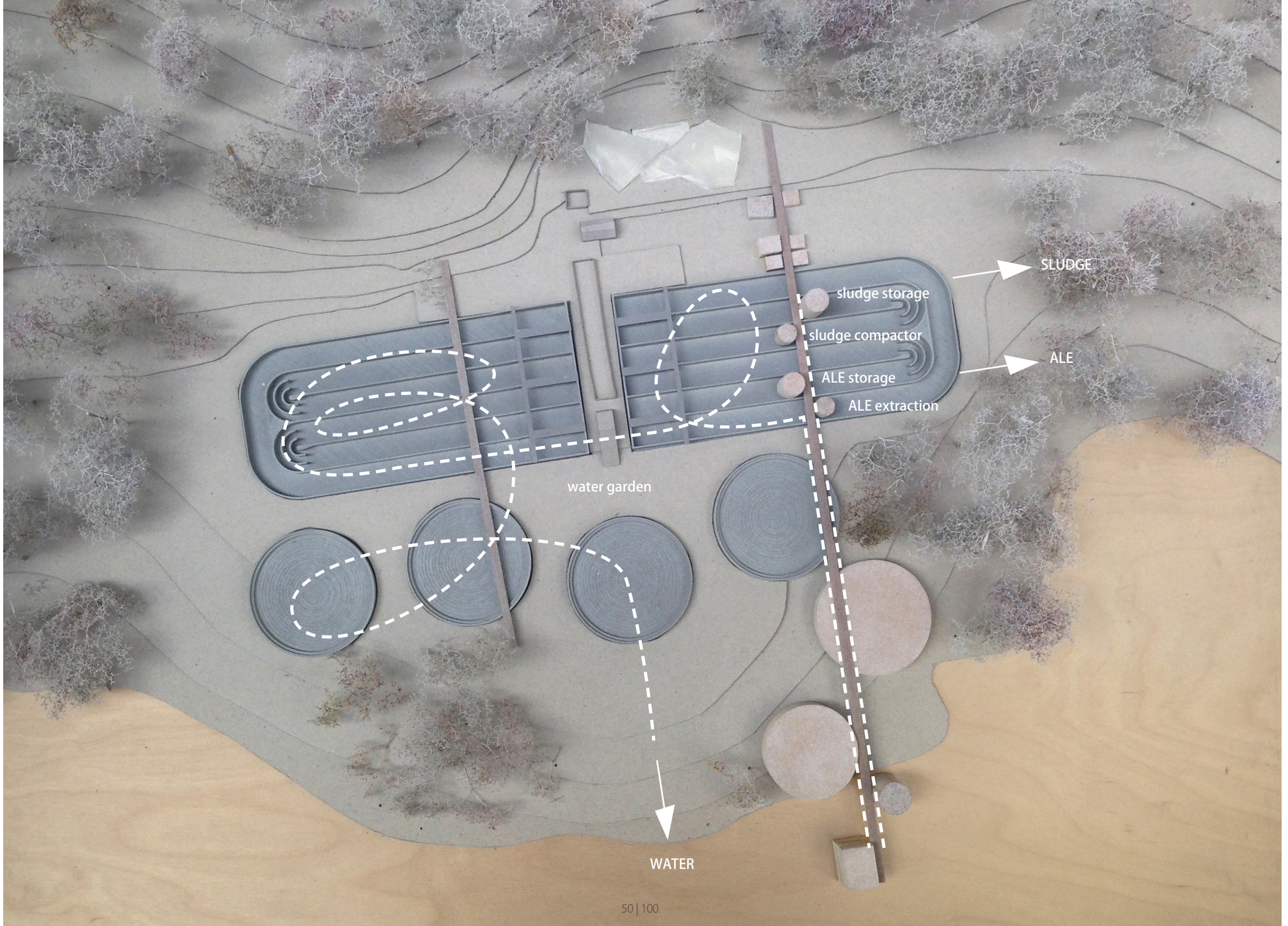


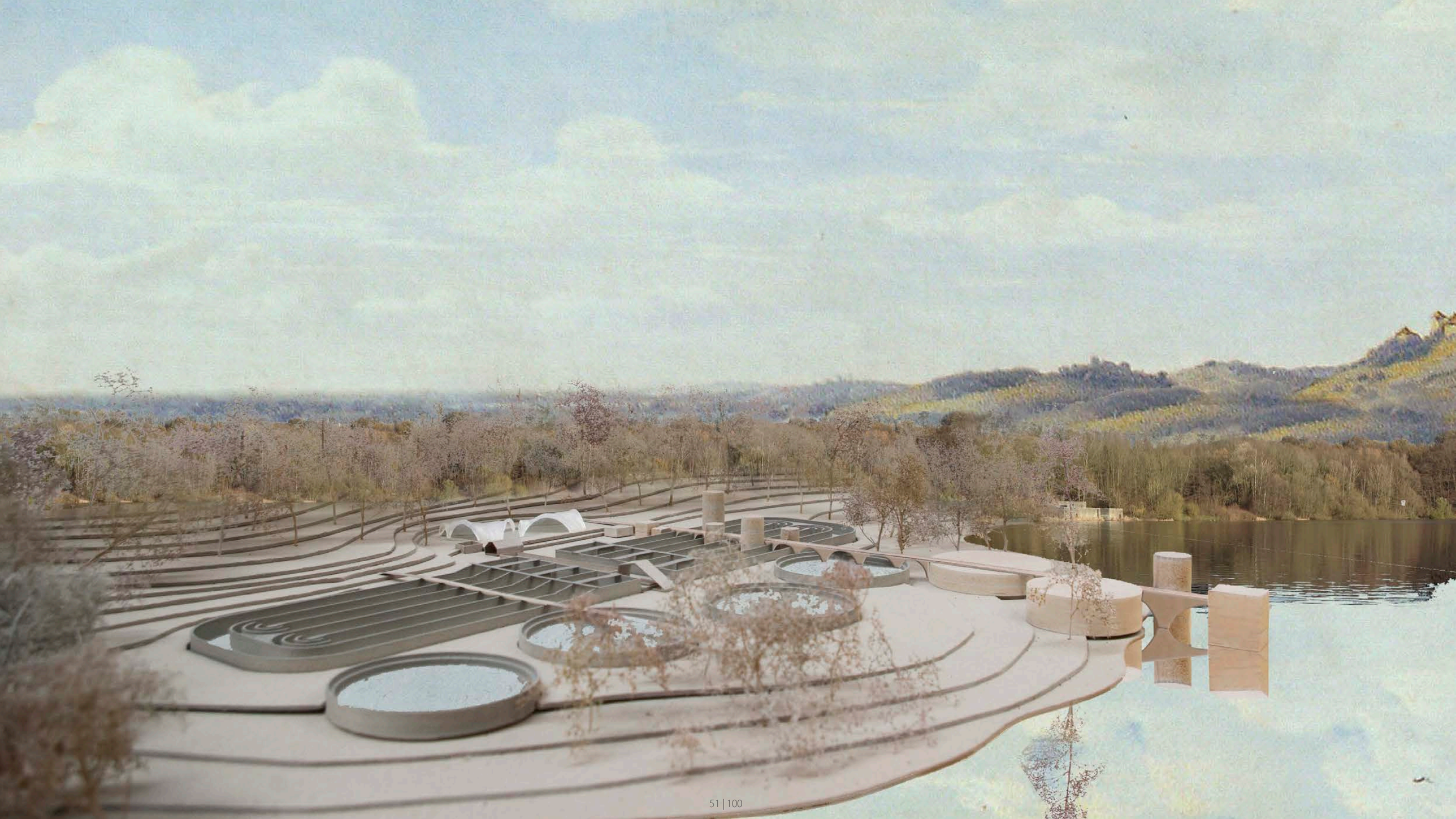
2020 & after



Top View Site

Top View Site


SLUDGE
sludge storage
sludge compactor
ALE
ALE storage
ALE extraction
water garden
WATER



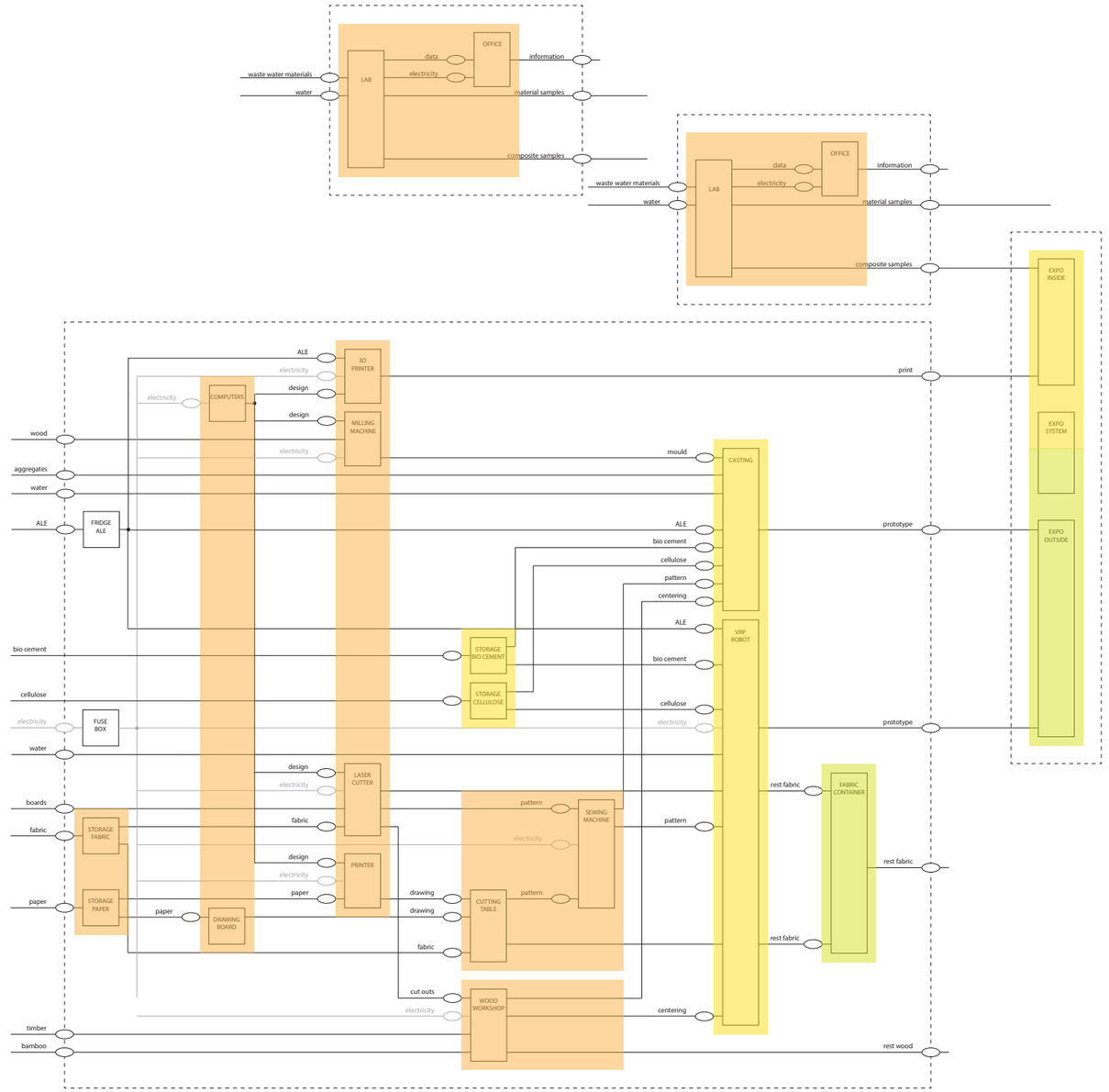
DESIGN
building

ASPECTS

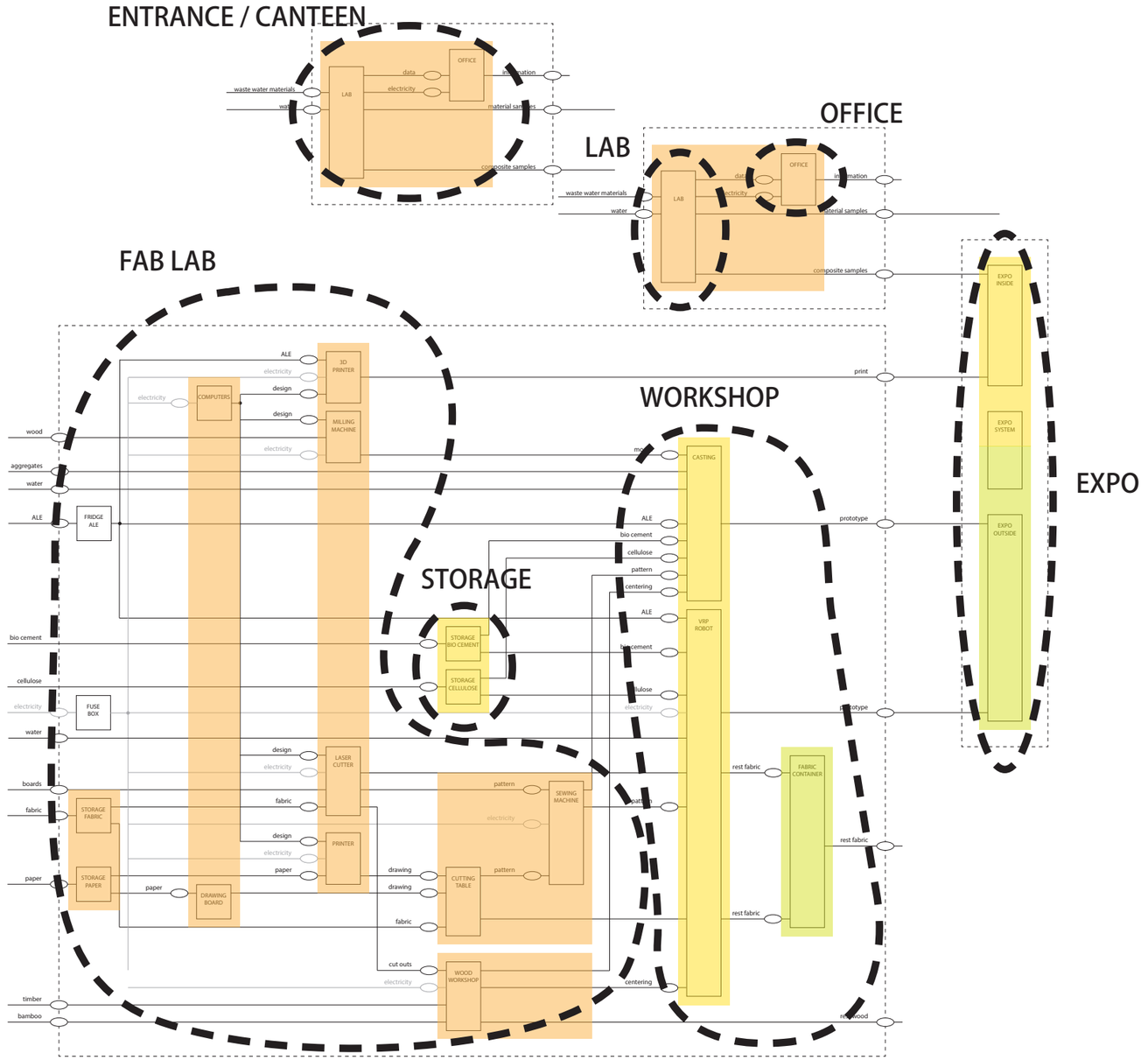
Surroundings

Material properties

Program of Requirements



Material Flow Analysis (Programm of Requirements)



Material Flow Analysis (Programm of Requirements)

Plan

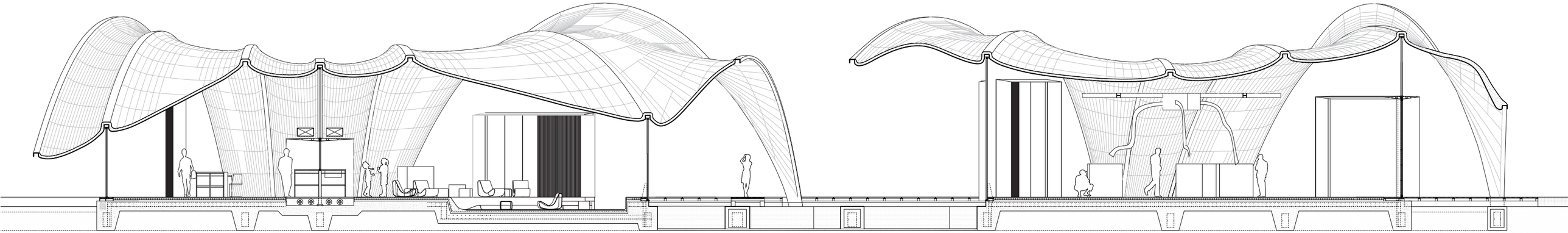
Plan 1:50

Plan

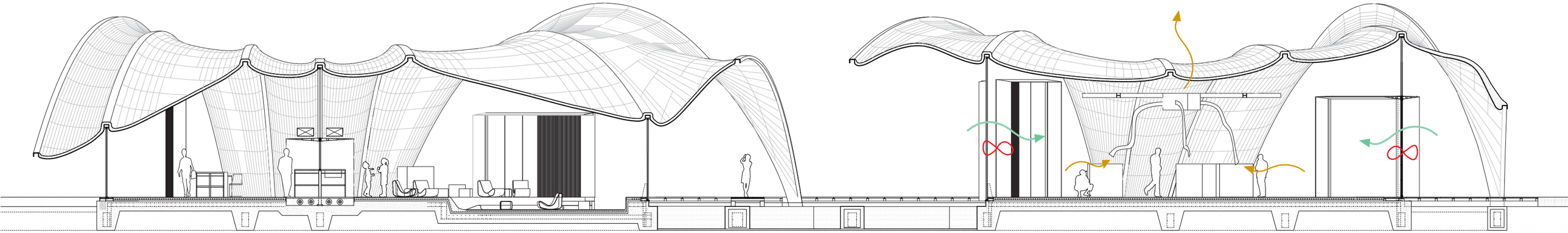
Plan

Plan 1:50

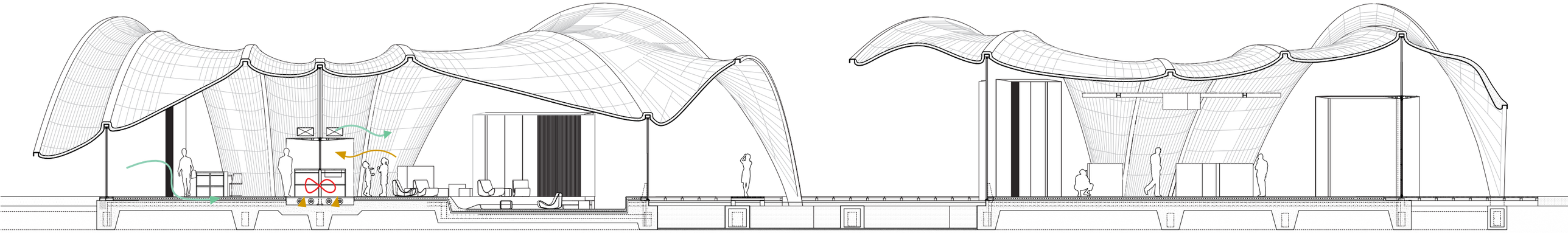
Plan



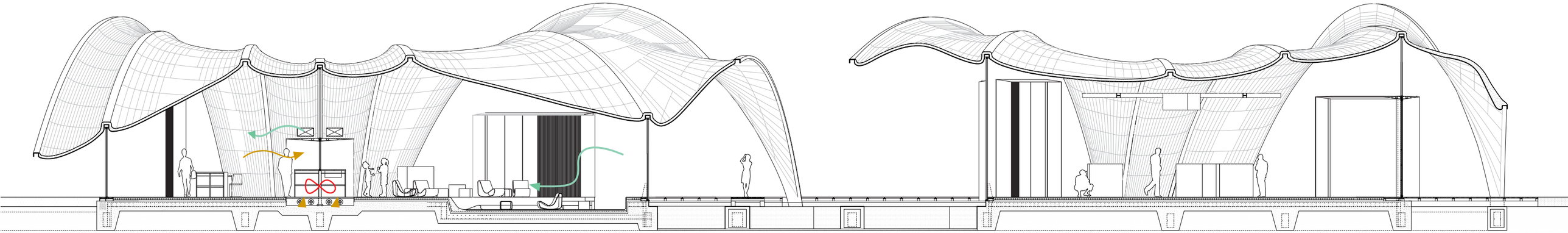
Longitudinal Section



Ventilation of Workshop



Ventilation of Entrance



Ventilation of Lab / Office

ALE

+

ALE-cellulose

+

Bio-Cement

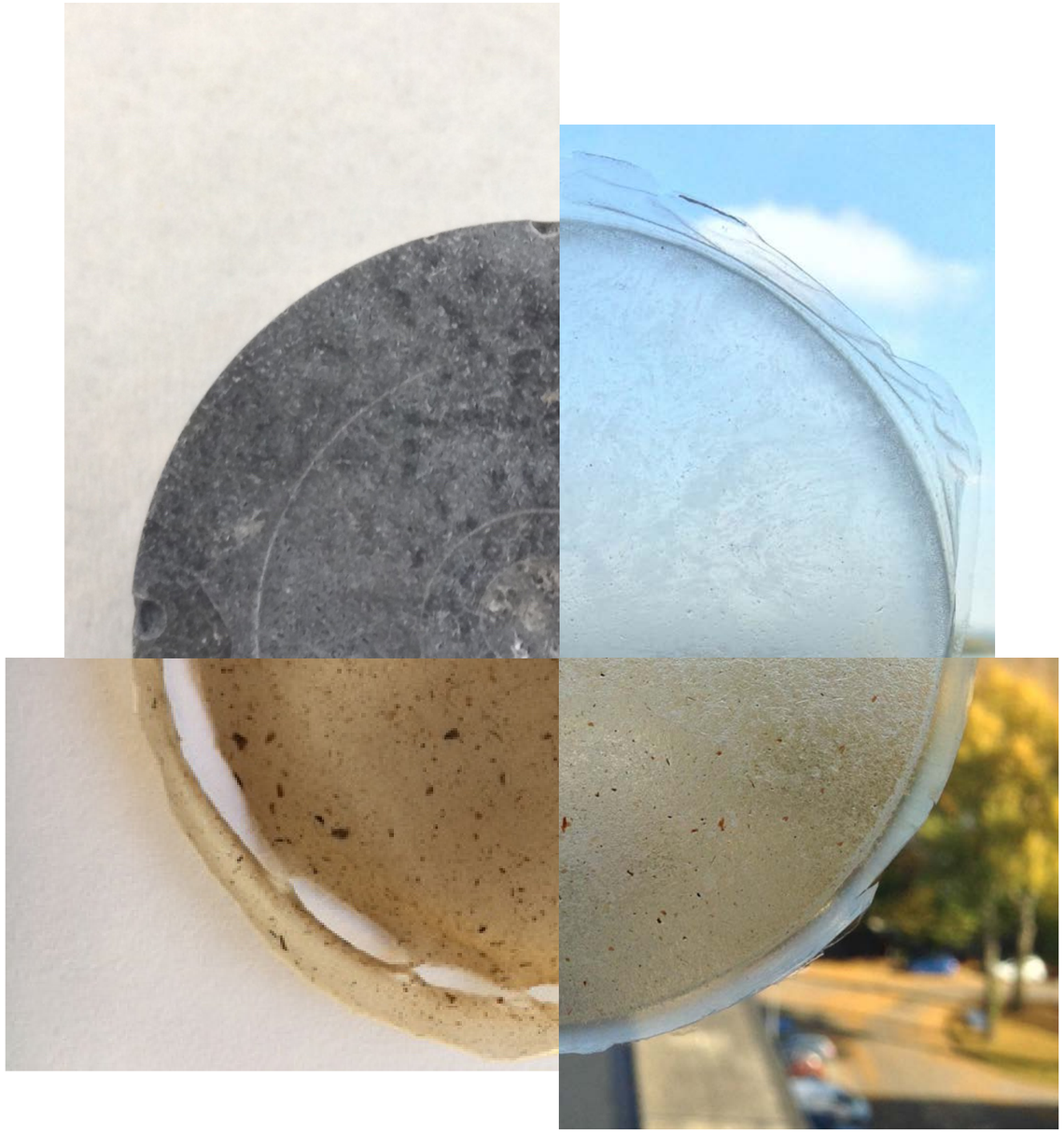
+

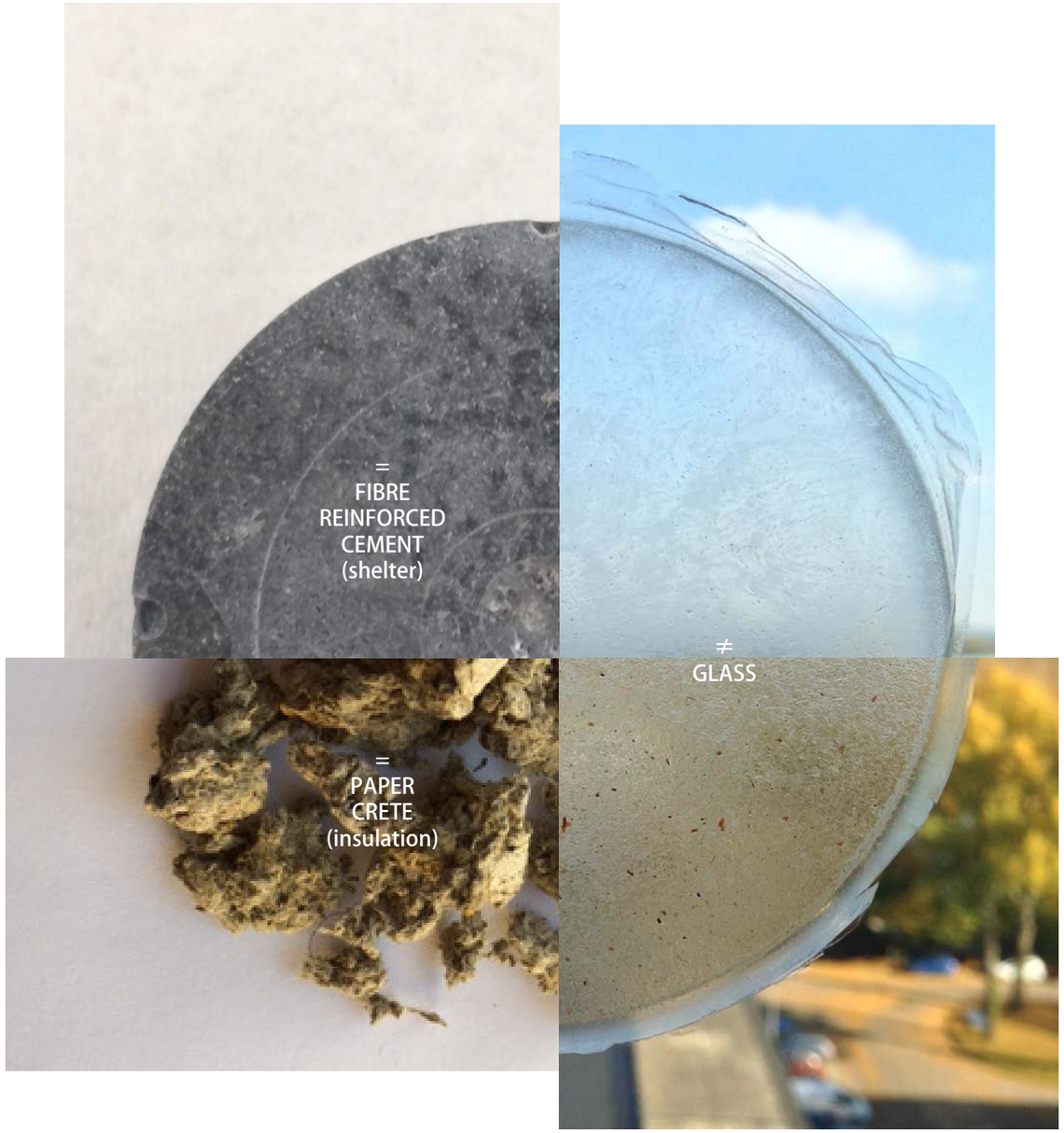
biomass ash

+

effluent

Components of new composite




=
FIBRE
REINFORCED
CEMENT
(shelter)
≠
GLASS
=
PAPER
CRETE
(insulation)

DESIGN CONSEQUENCES

1

Construction

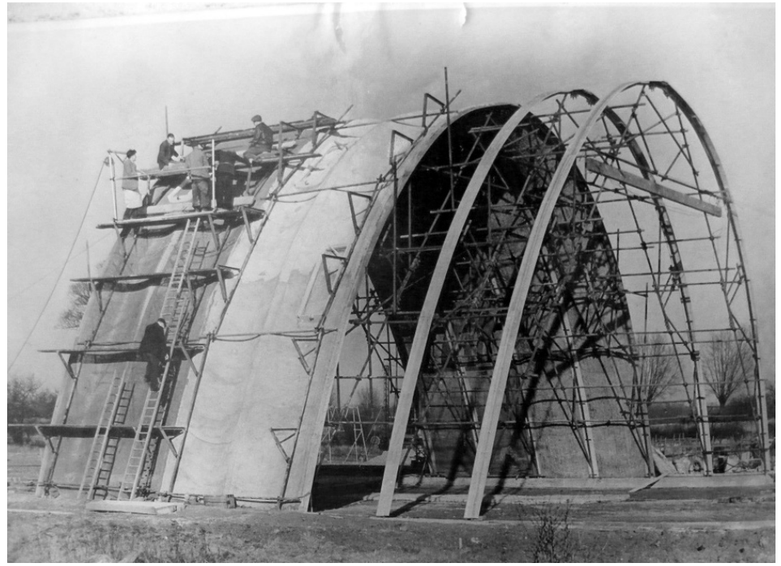
Composite material (≈ FRC / concrete) doesn't have form of its own.
|
It is in need of a **mould**.

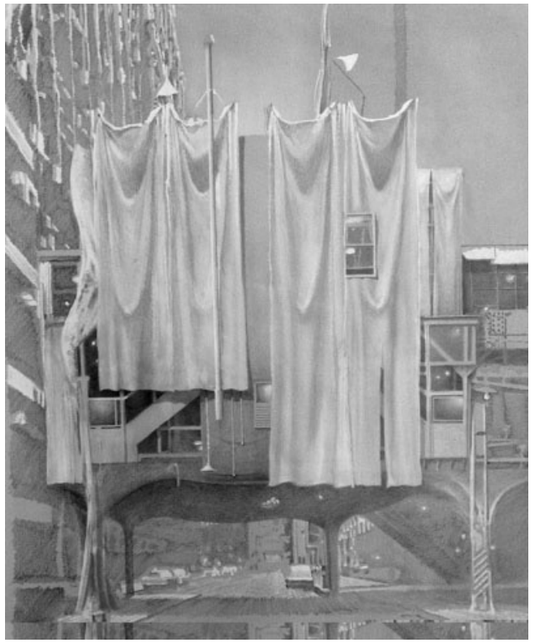
2

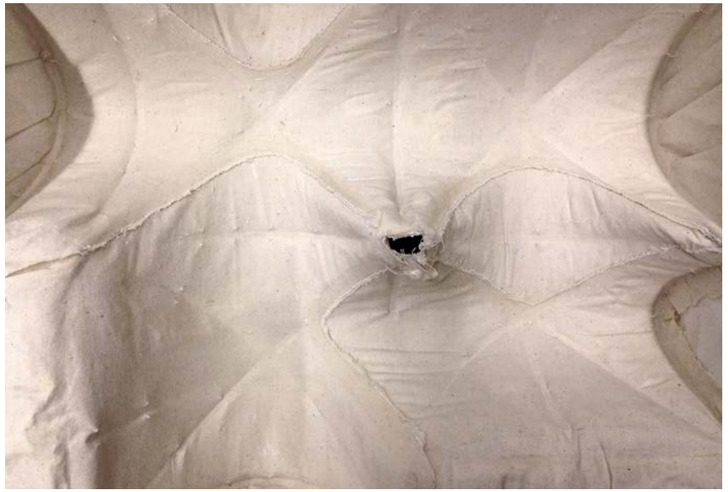
Details

Composite material (translucent ≠ insulating) can not answer to all 'building requirements'.
|
Distinction between **shell(ter)** & **services**.

construction

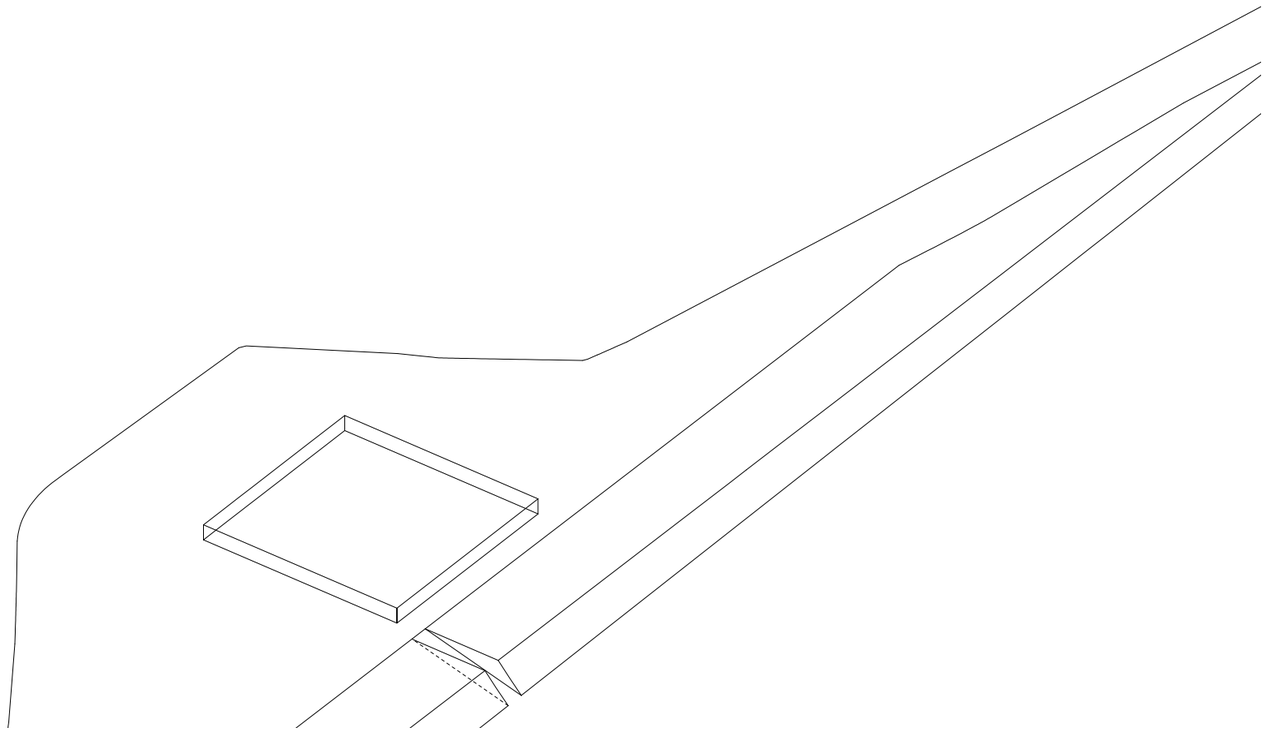






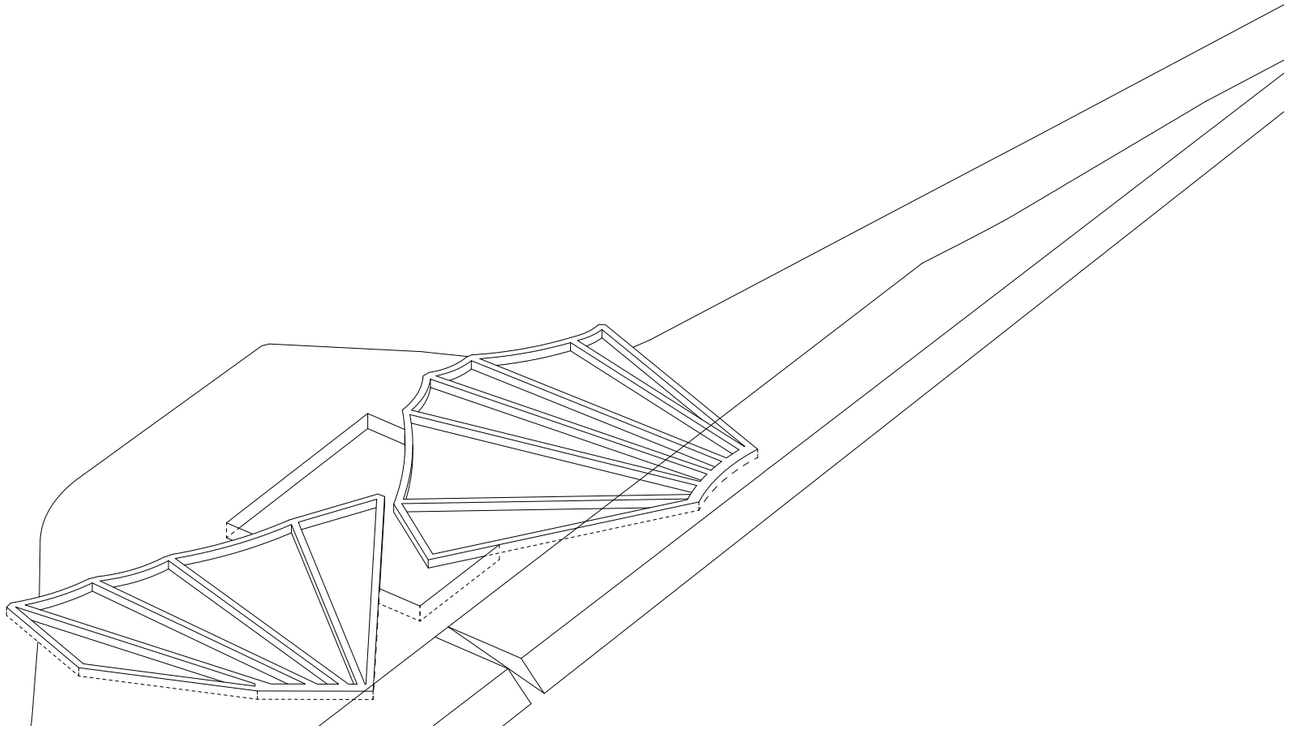
Fabric Reinforced Cement

sand mould



Construction Sequence

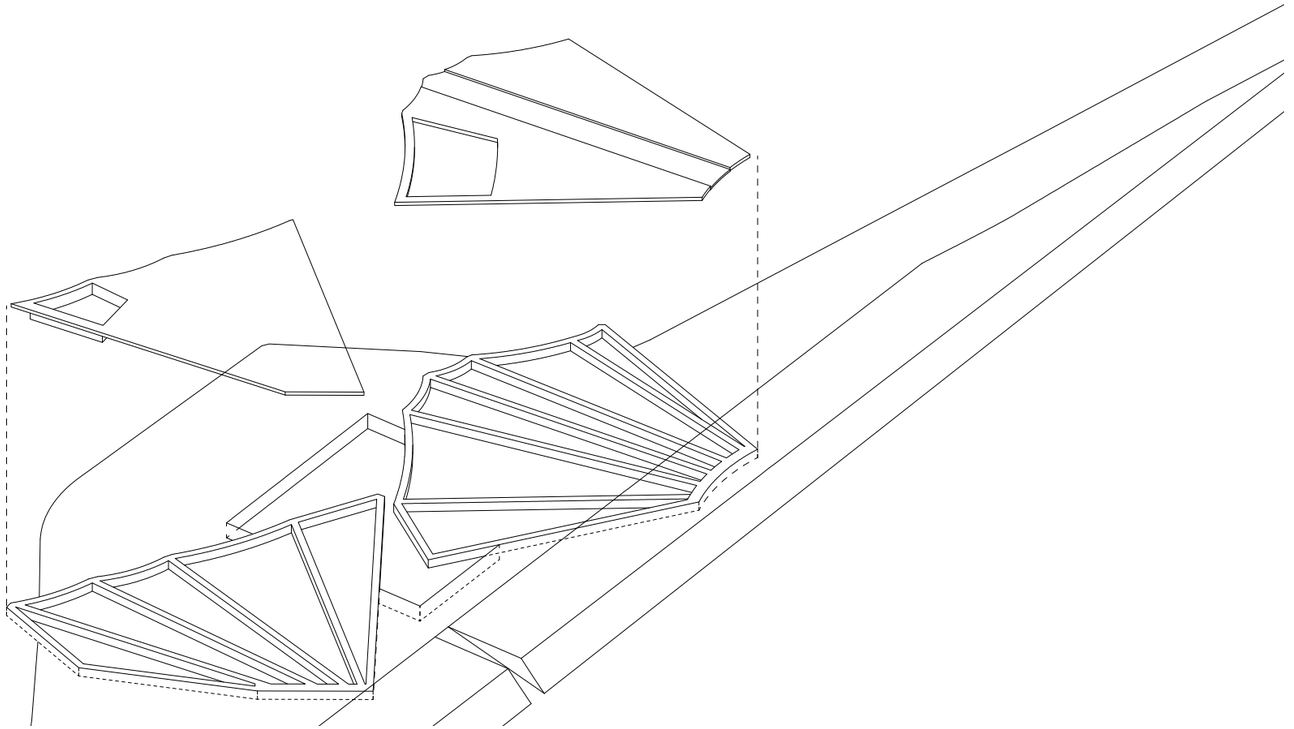
foundation



Construction Sequence

floor

foundation

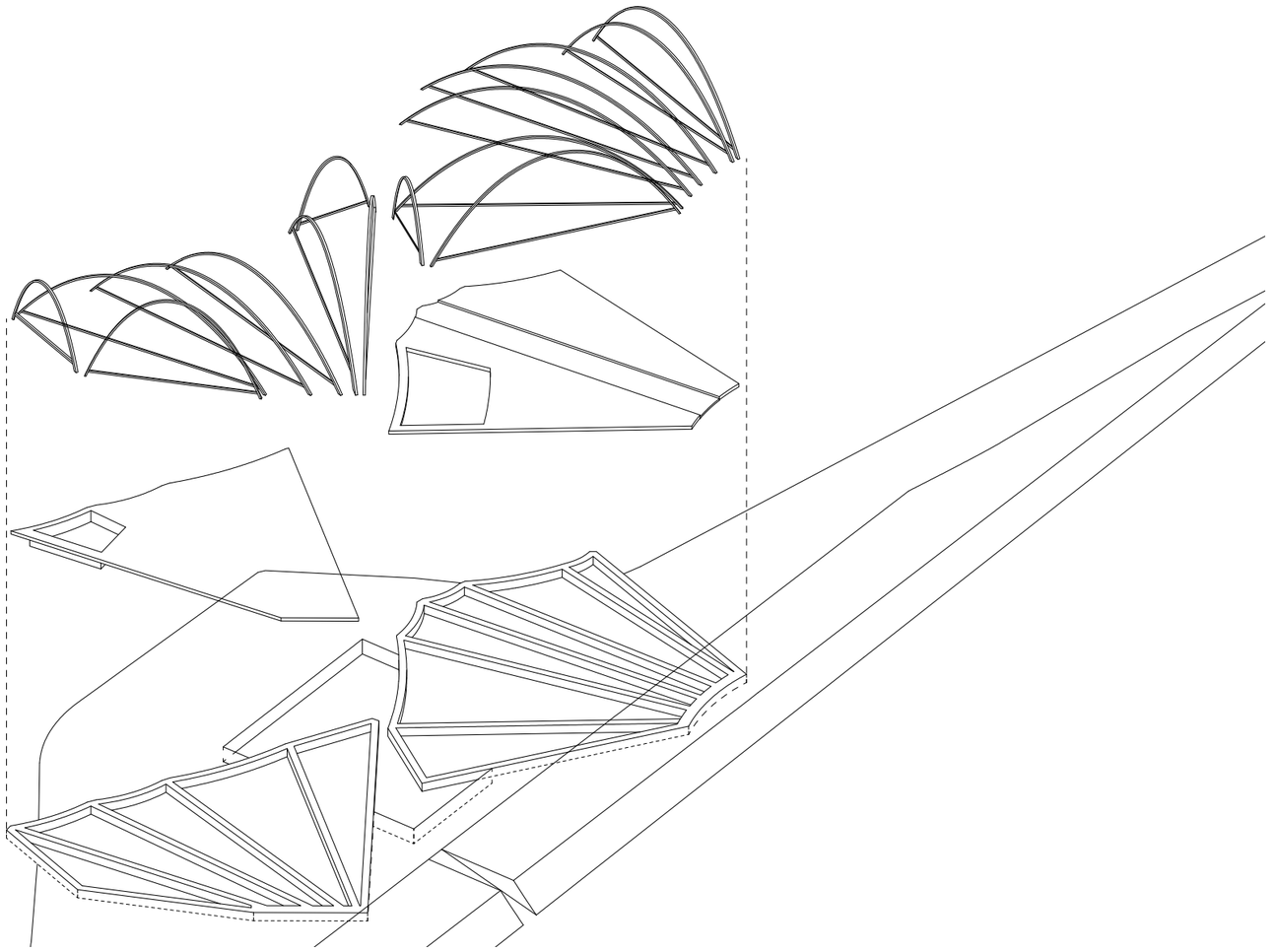


Construction Sequence

centering

floor

foundation



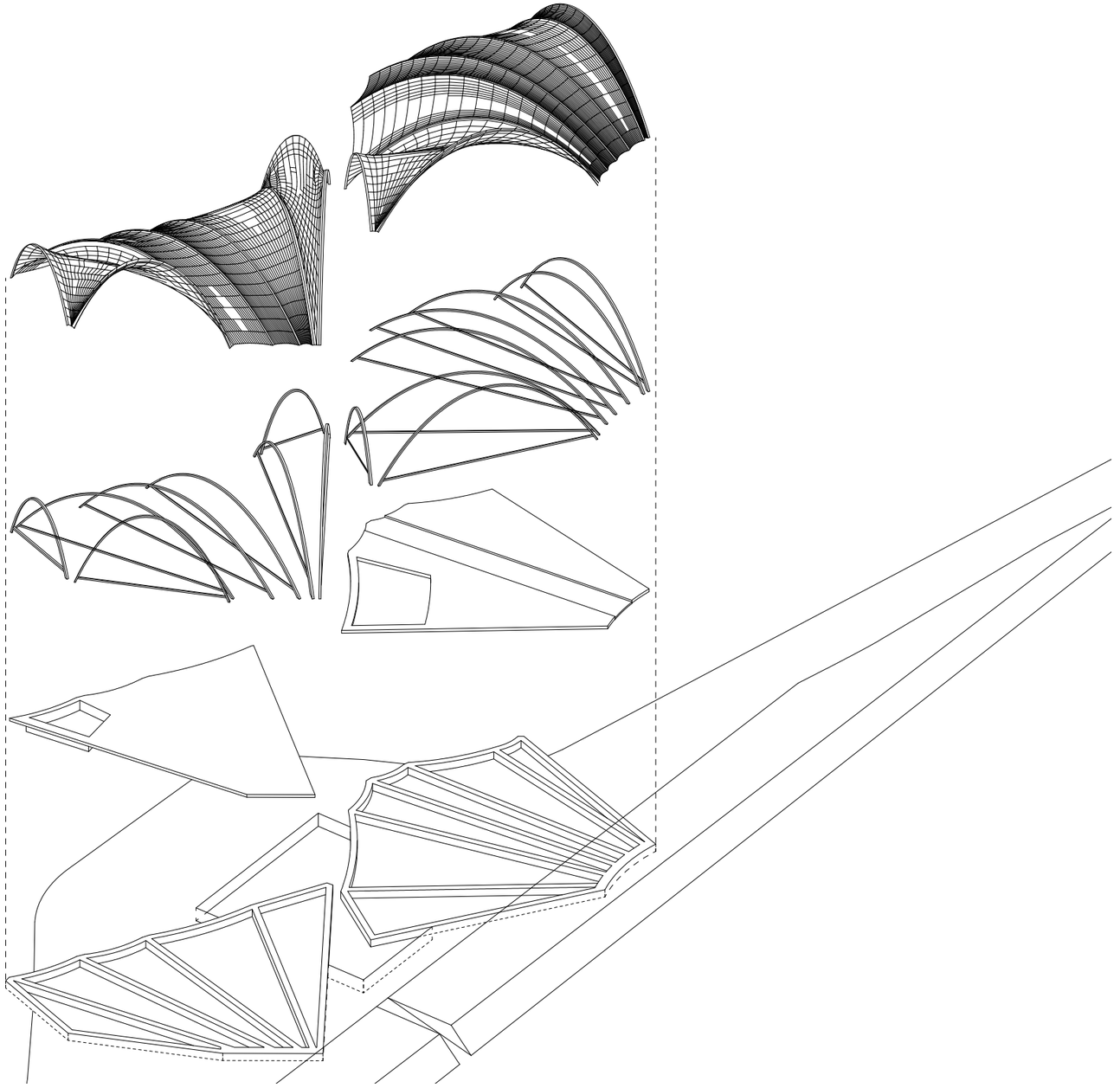
Construction Sequence

fabric

centering

floor

foundation



Construction Sequence

FINAL SHAPE

1

3-d boundary conditions

|

determined

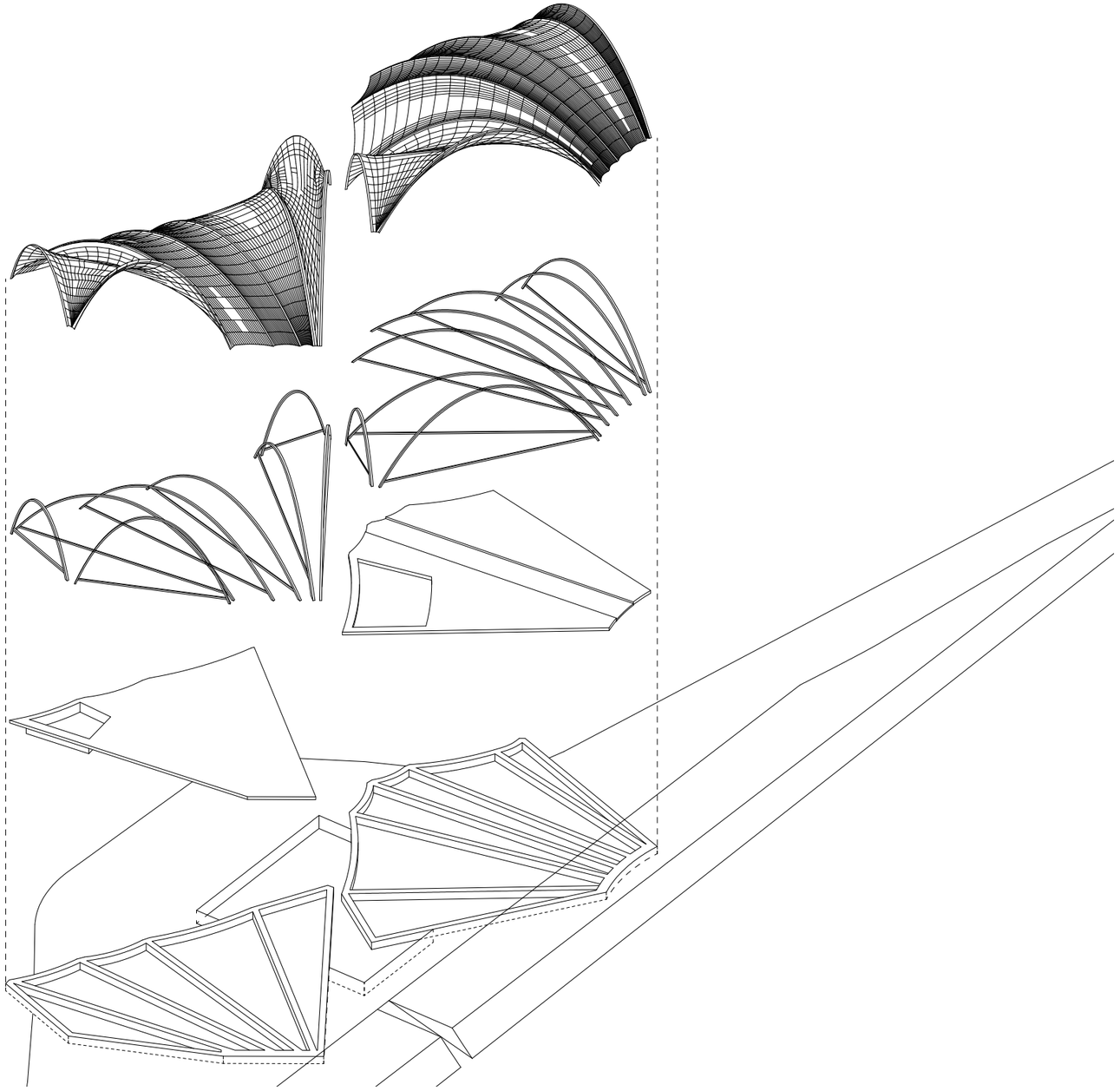
2

balance

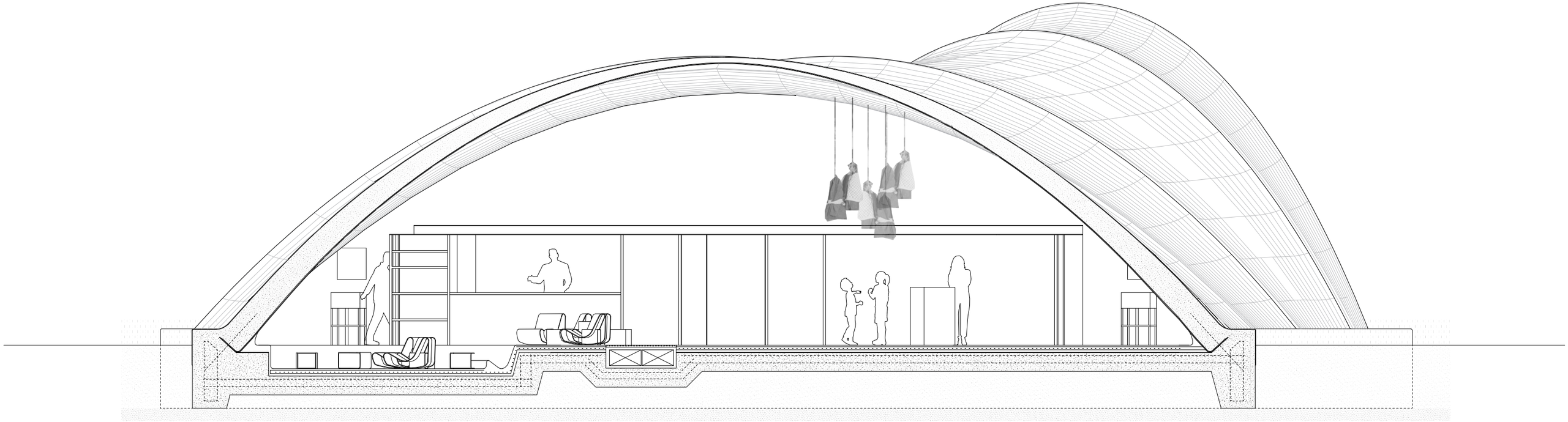
tension strength fibres
&
pressure forces own weight

|

undetermind



Construction Sequence



Cross Section

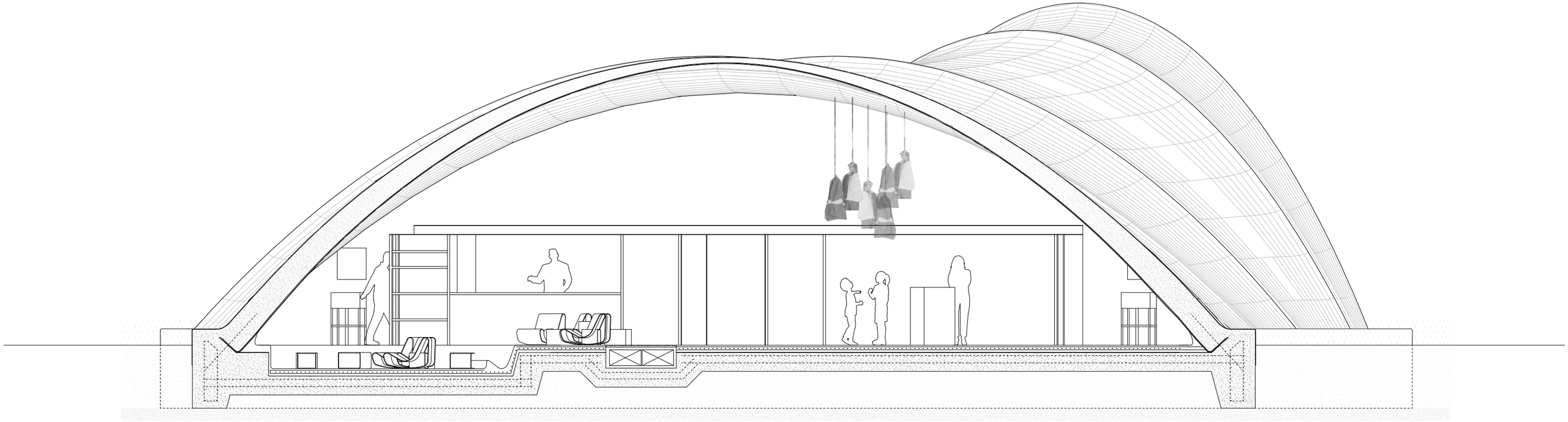
STRENGTH & STIFFNESS OF STRUCTURE

Catenary arch

Diffrerence thickness & density

Double curved surface
3d boundary conditions
relaxing of surfaces

Structural ribs



Cross Section

details

DISTINCTION

1

Composite

|

shell, floor, foundation

|

cast, continuous, heterogeneous

|

ruin

2

Steel

|

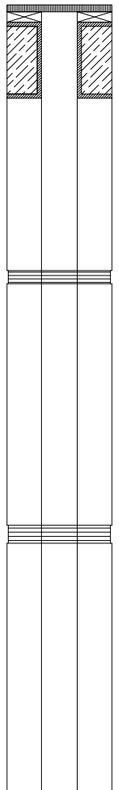
portals, furniture, machines

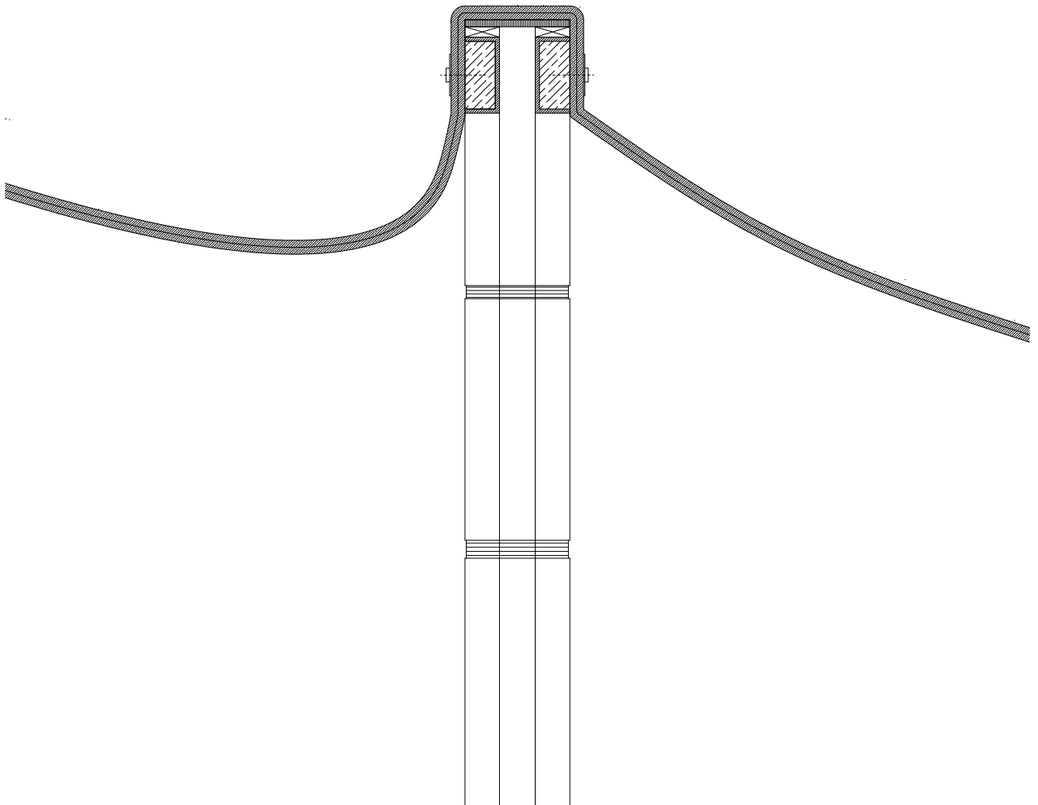
|

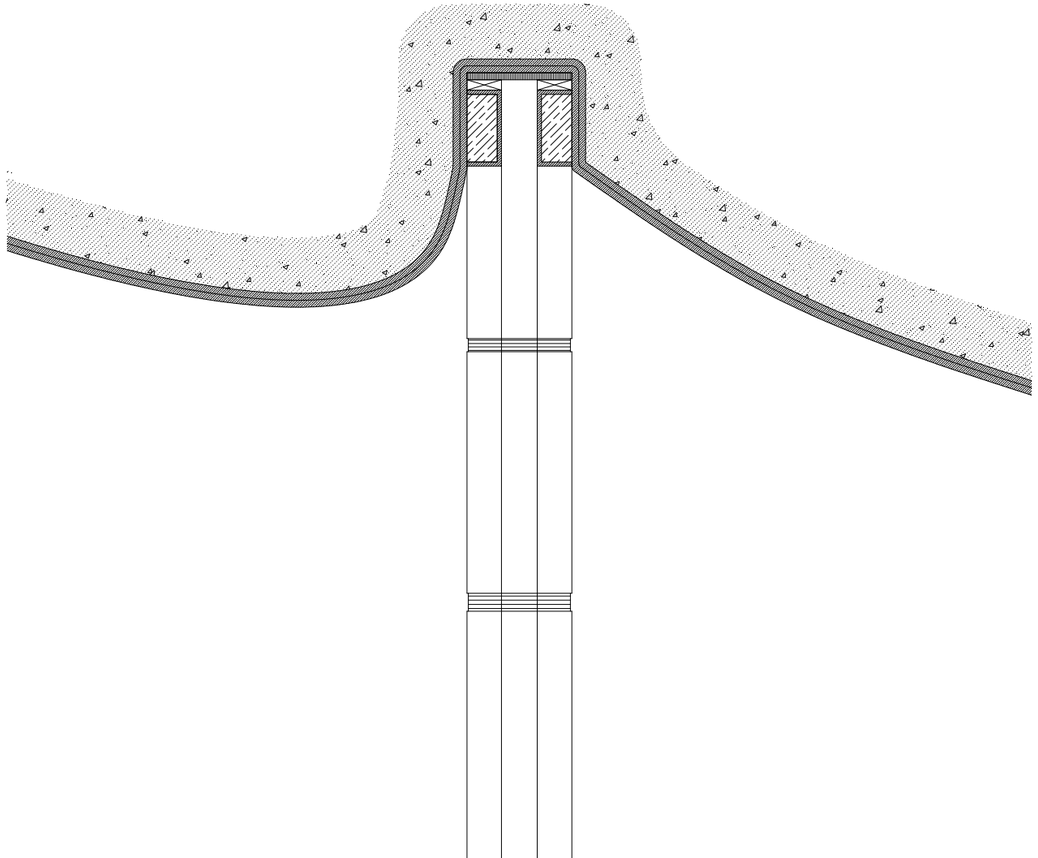
assembled, demountable, uniform

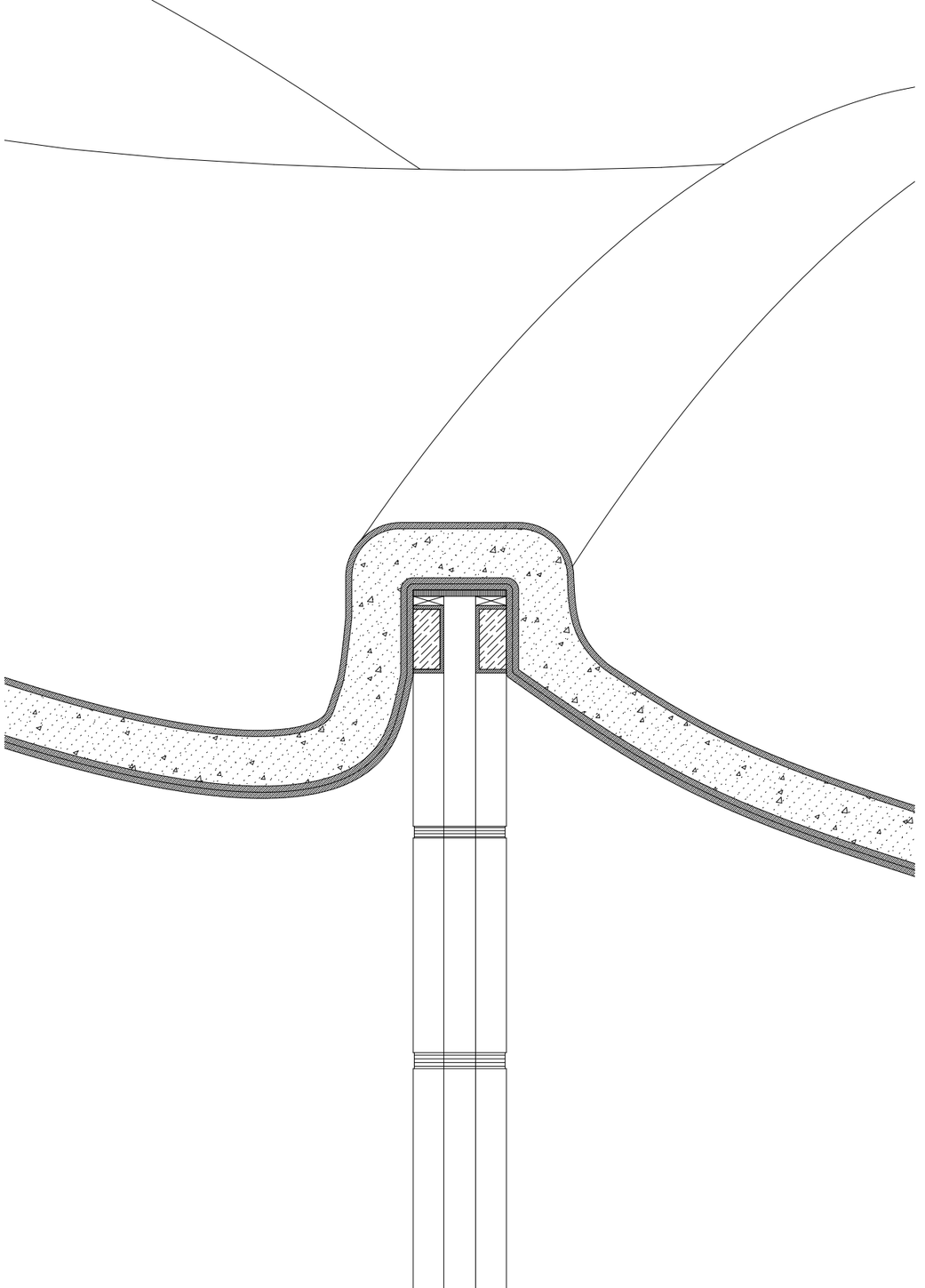
|

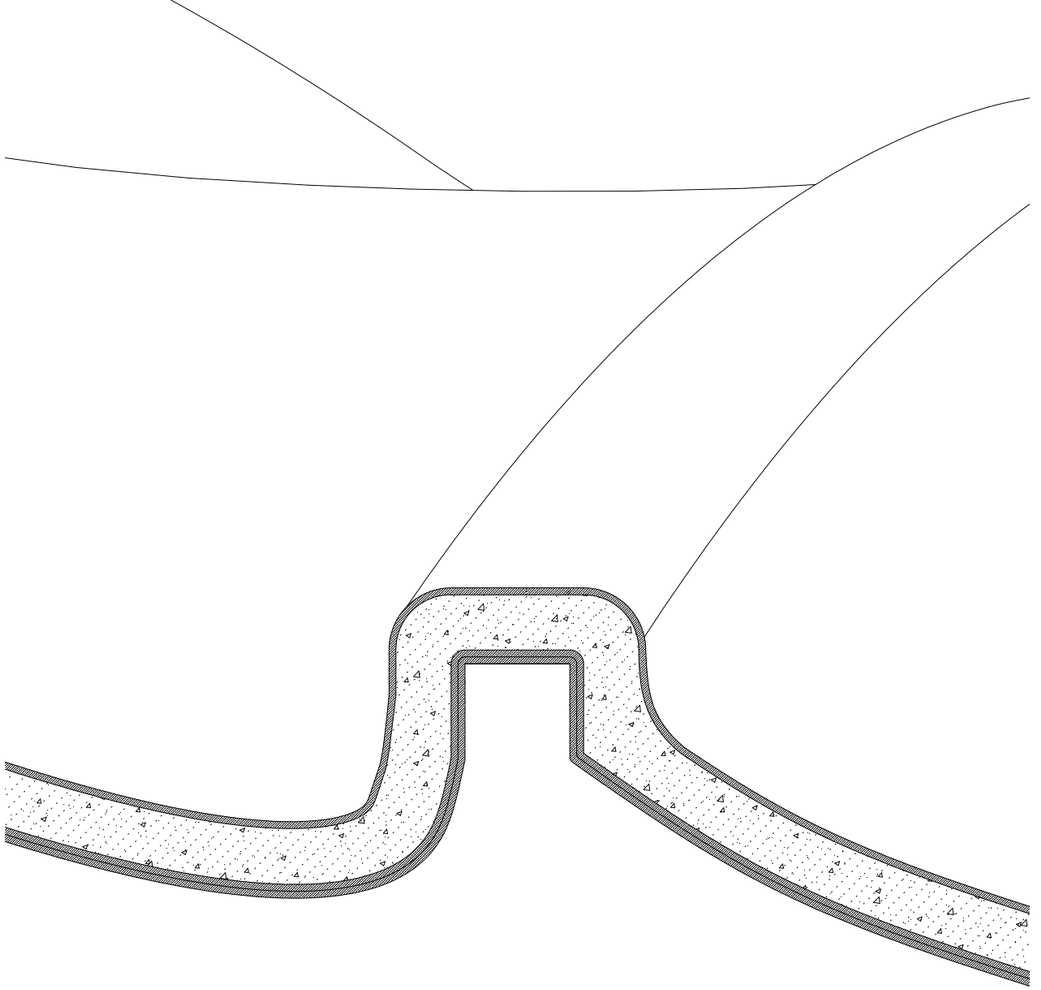
re-used

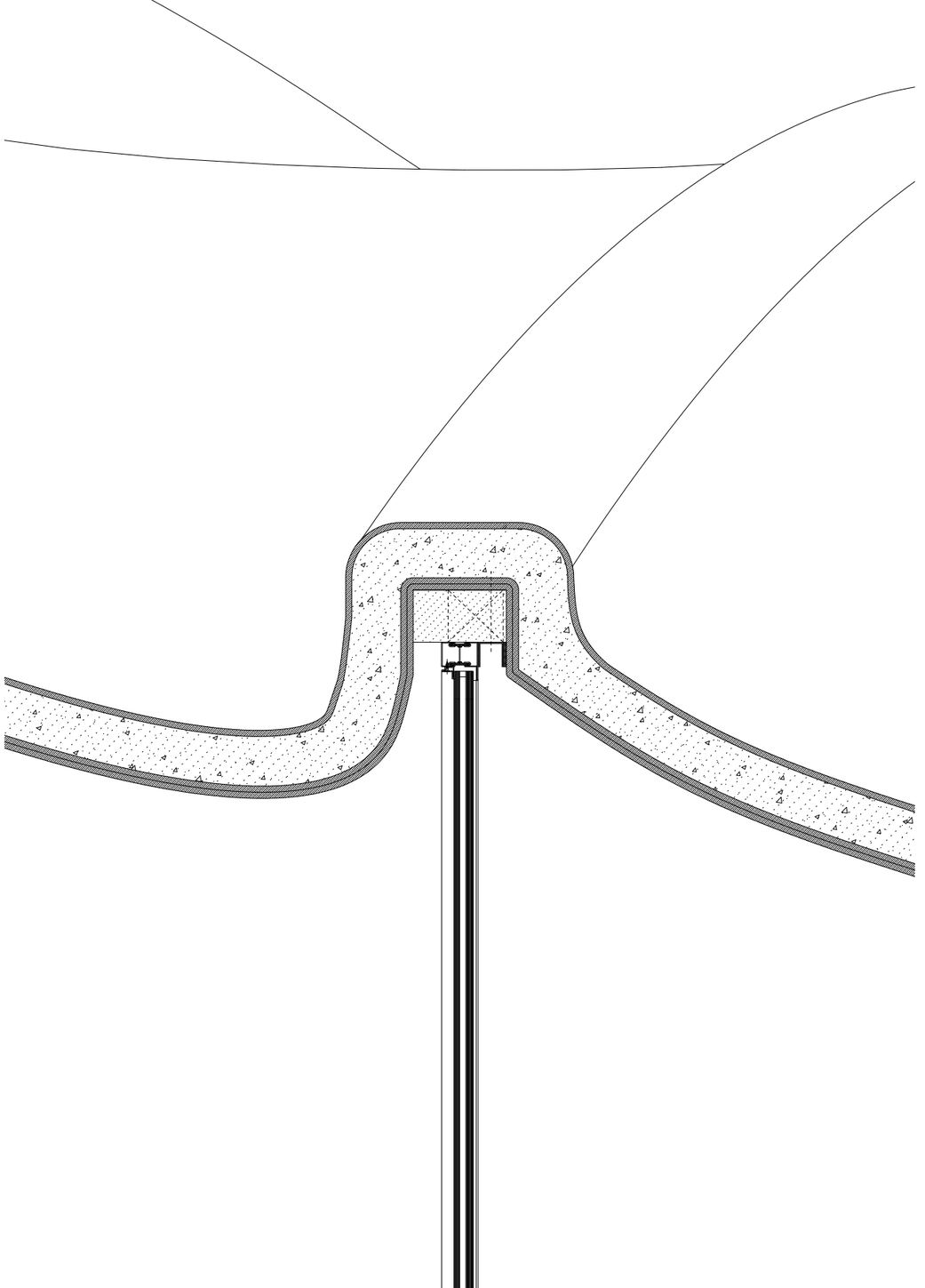




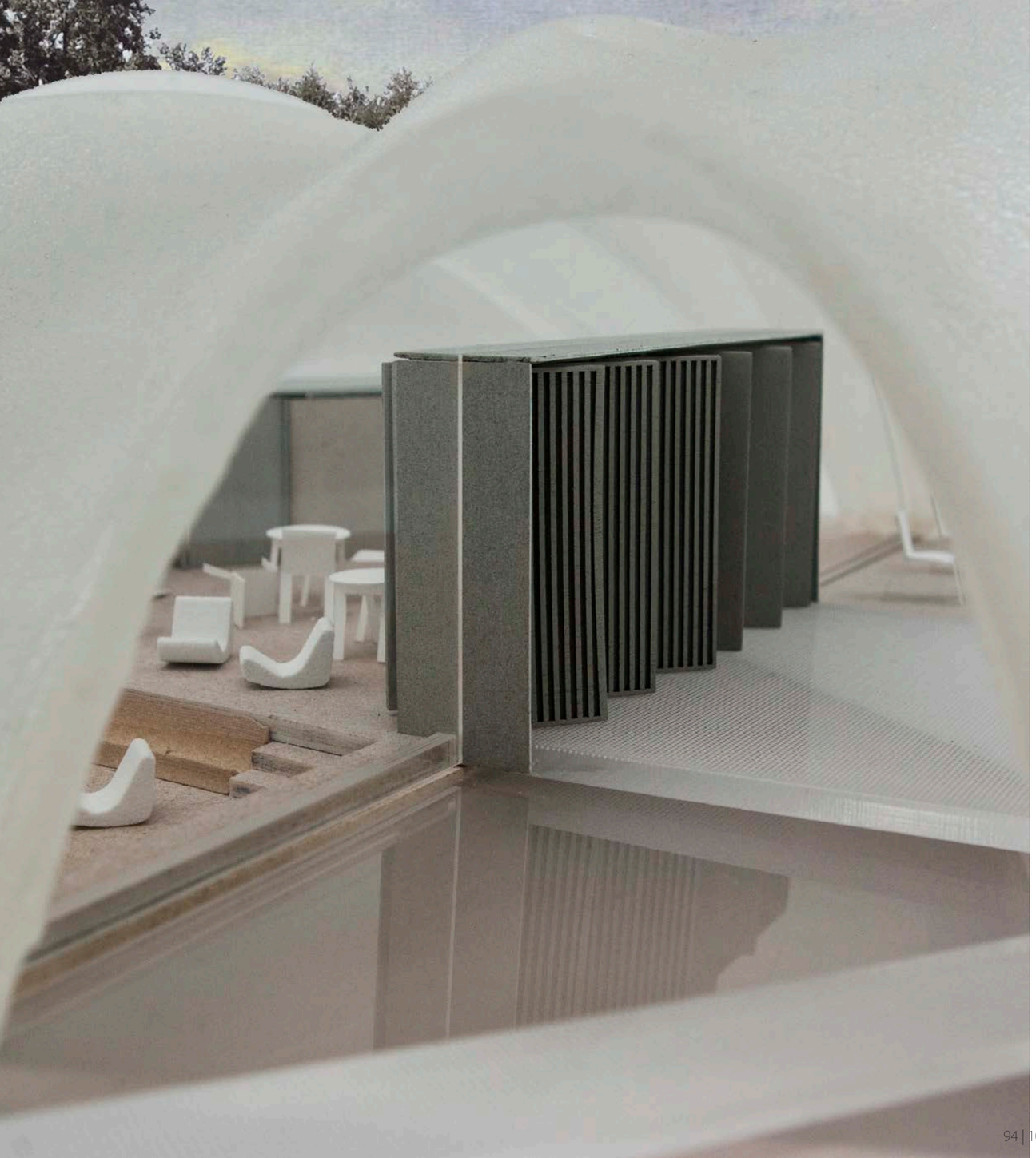








Vertical DetaiS hell - Glass



PORTALS

1

Technical

|

Installations, safety shower, wash boots, light

2

Architectonic

|

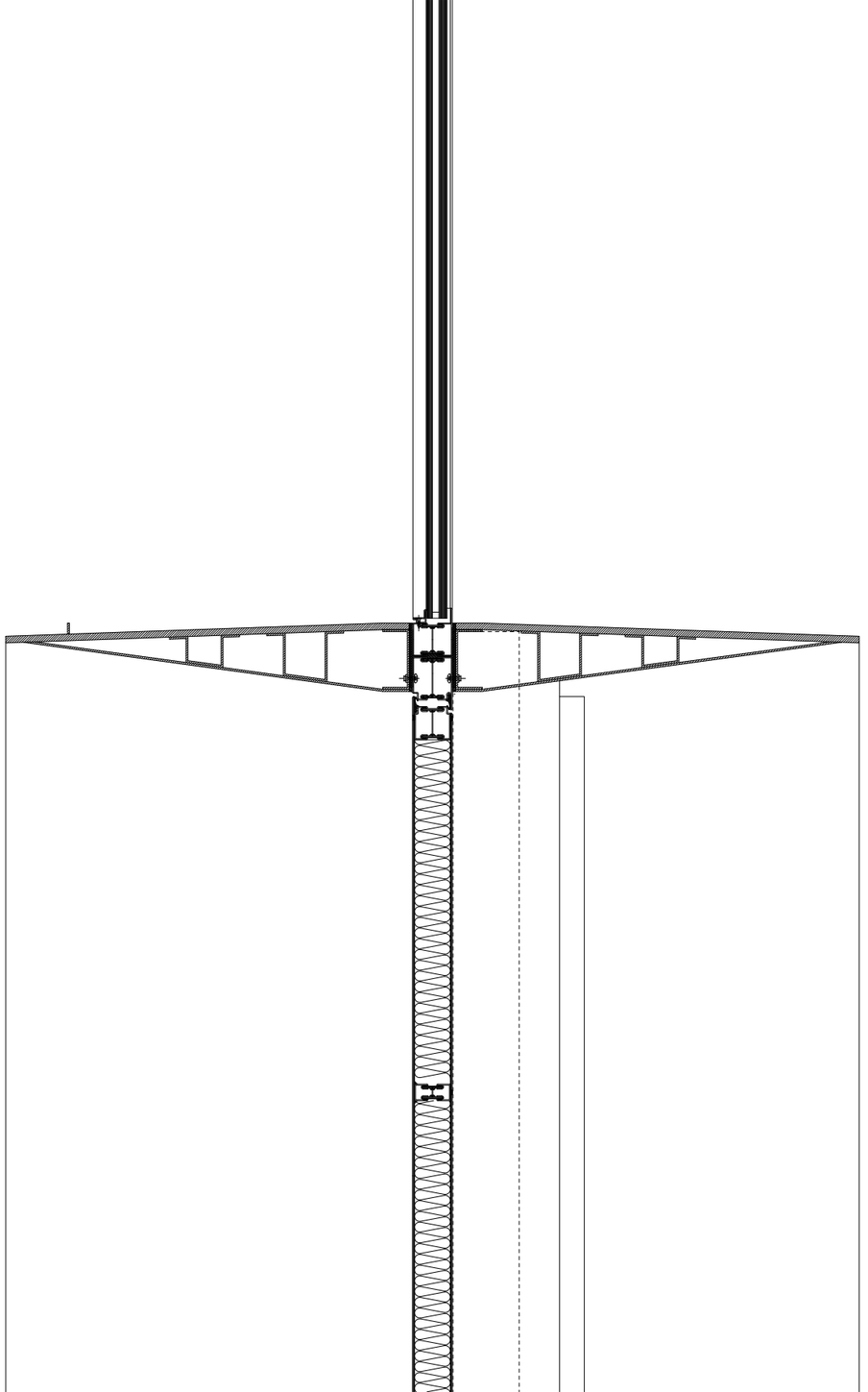
Transition / Differentiation between curved & straight

3

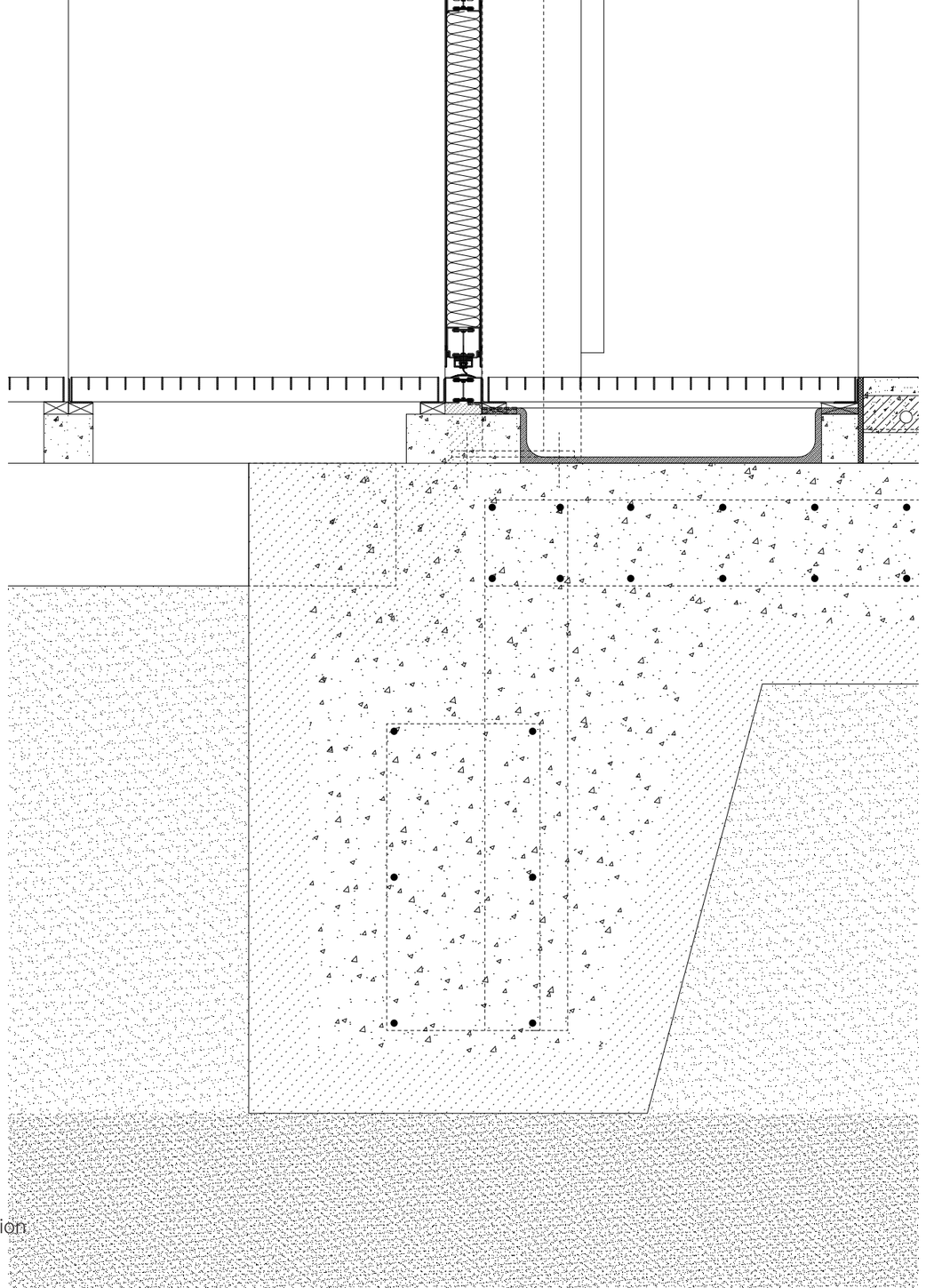
Experience

|

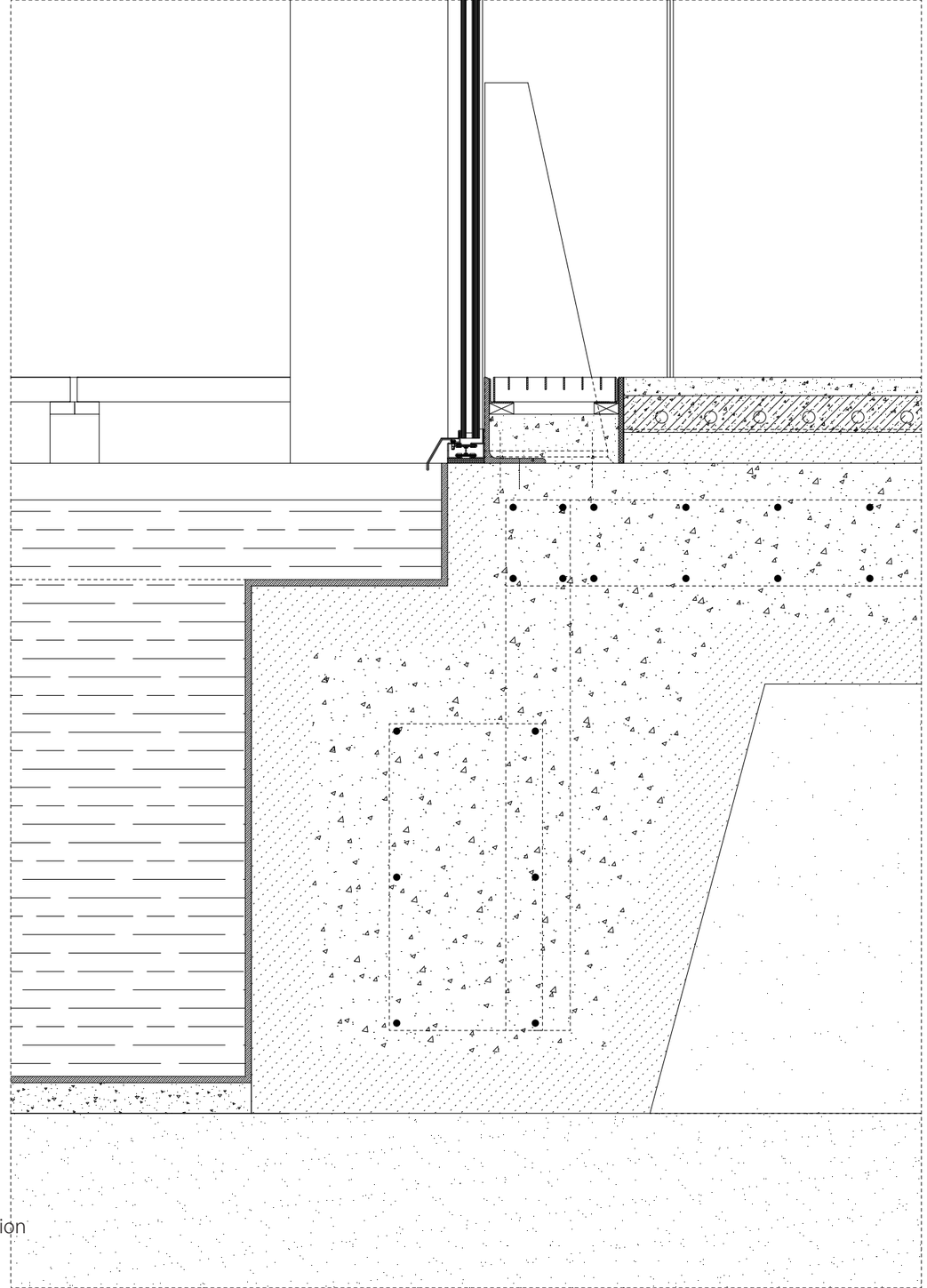
Gate (vestibule) between zones



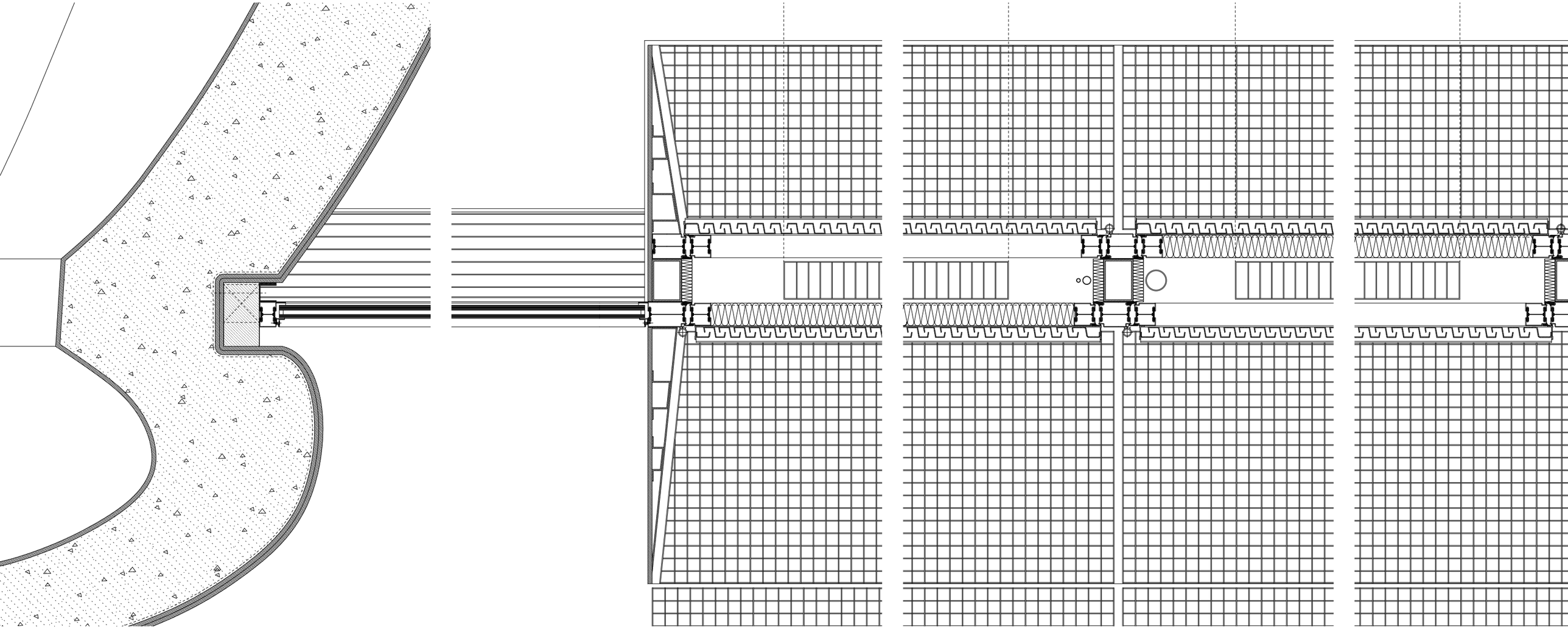
Vertical Detail Glass - Portal



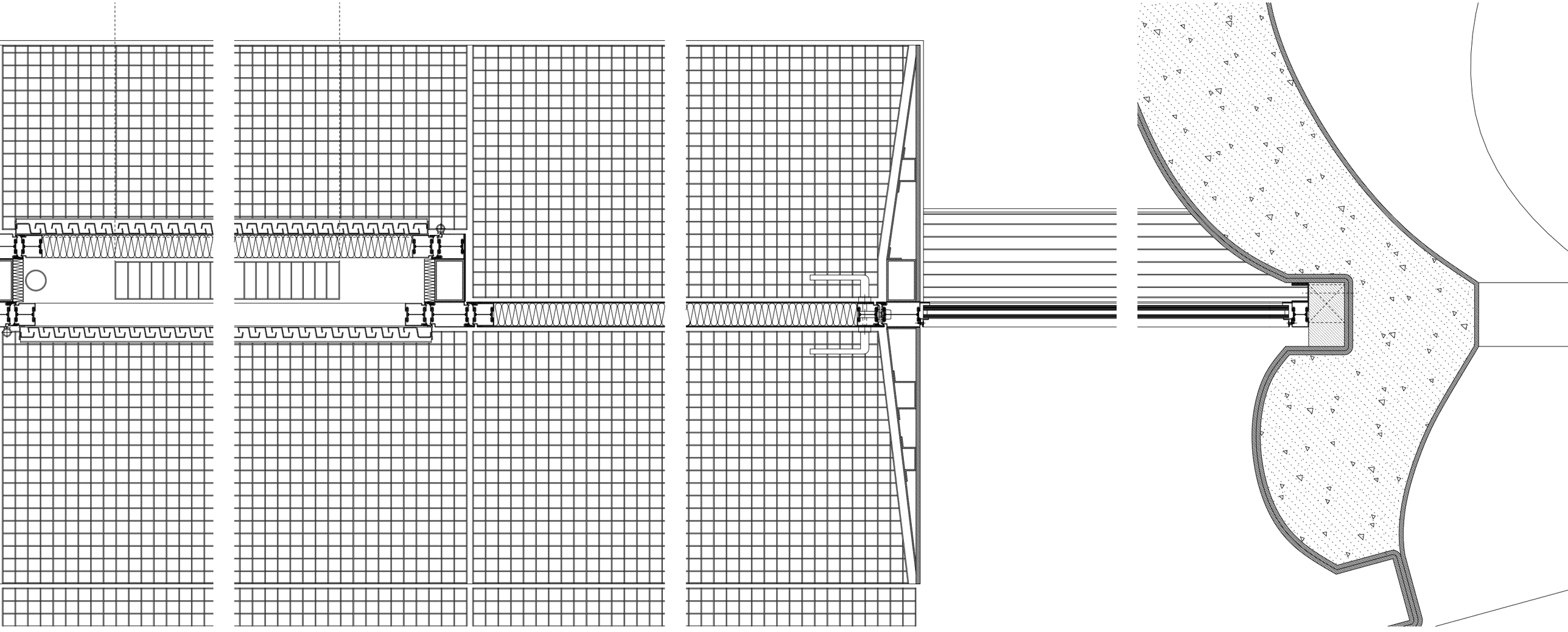
Vertical Detail Portal - Foundation



Vertical Detail Glass - Foundation



Horizontal Detail Shell - Glass - Portal



Horizontal Detail Shell - Glass - Portal

REFLECTION

OBJECTIVES

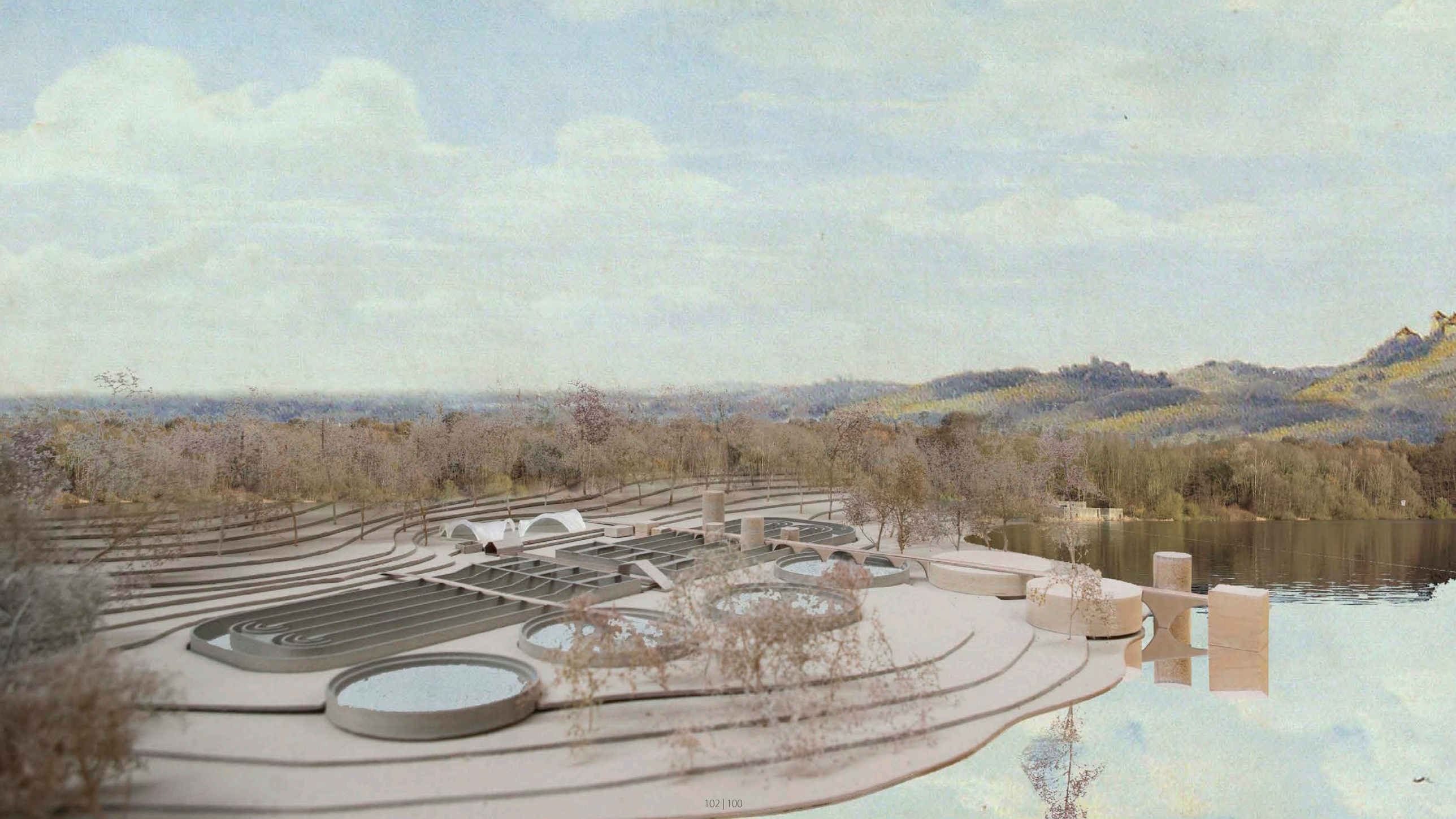
Eliminating the extraction of limited resources

Creating high-end construction material from low-valued wastes

Making a material-based design

Room for exploration & change

Example



INFINITE MINING
for
STRUCTURAL COMPOSITES

P5, Msc Architectural Engineering & Technology
Delft University of Technology

01 / 07 / 2016

Stefanie Tseggai

Tutors:
Job Schroen
Maarten Meijs
Jan Jongert