

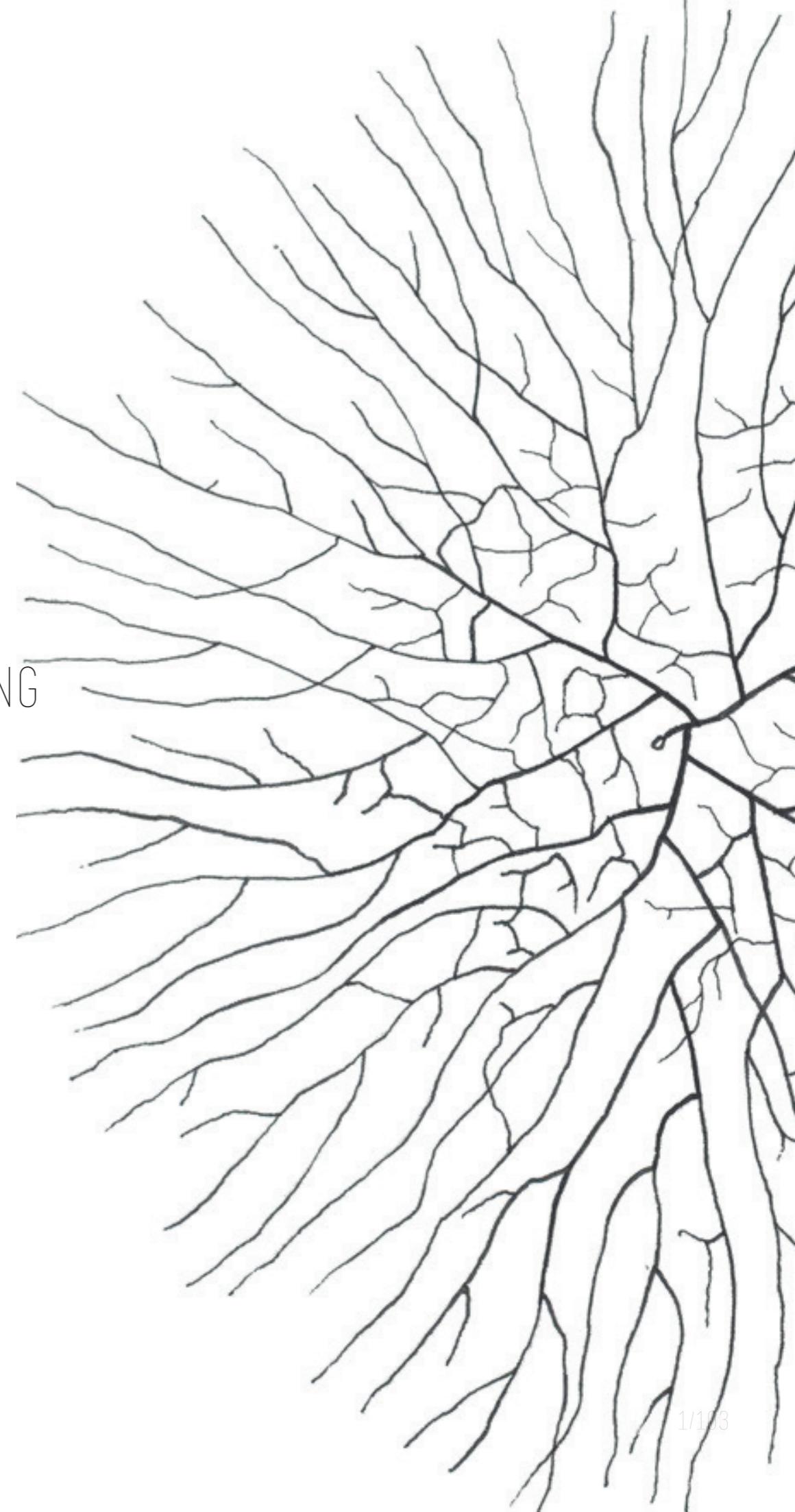


THE FUNGI FACTORY
MYCELIUM AS A NEW BUILDING
BLOCK FOR PARKSTAD

ARCHITECTURAL ENGINEERING
HARVEST BK

Sarah de Bruin
4197569

P5 GRADUATION PRESENTATION
05-07-2019



CONTENT

INTRODUCTION

*Problemstatement
Parkstad
Objective
Thematic research question*

RESEARCH

*Mycelium
Waste streams
Production process
Design question*

DESIGN

*Guiding theme
Location
Fungi Factory
Reflection*

PROBLEM STATEMENT



An touching example of what our waste does to our planet and its habitants.

Source: The Guardian

<https://www.theguardian.com/environment/2018/mar/12/albatross-film-dead-chicks-plastic-saving-birds>

PROBLEM STATEMENT

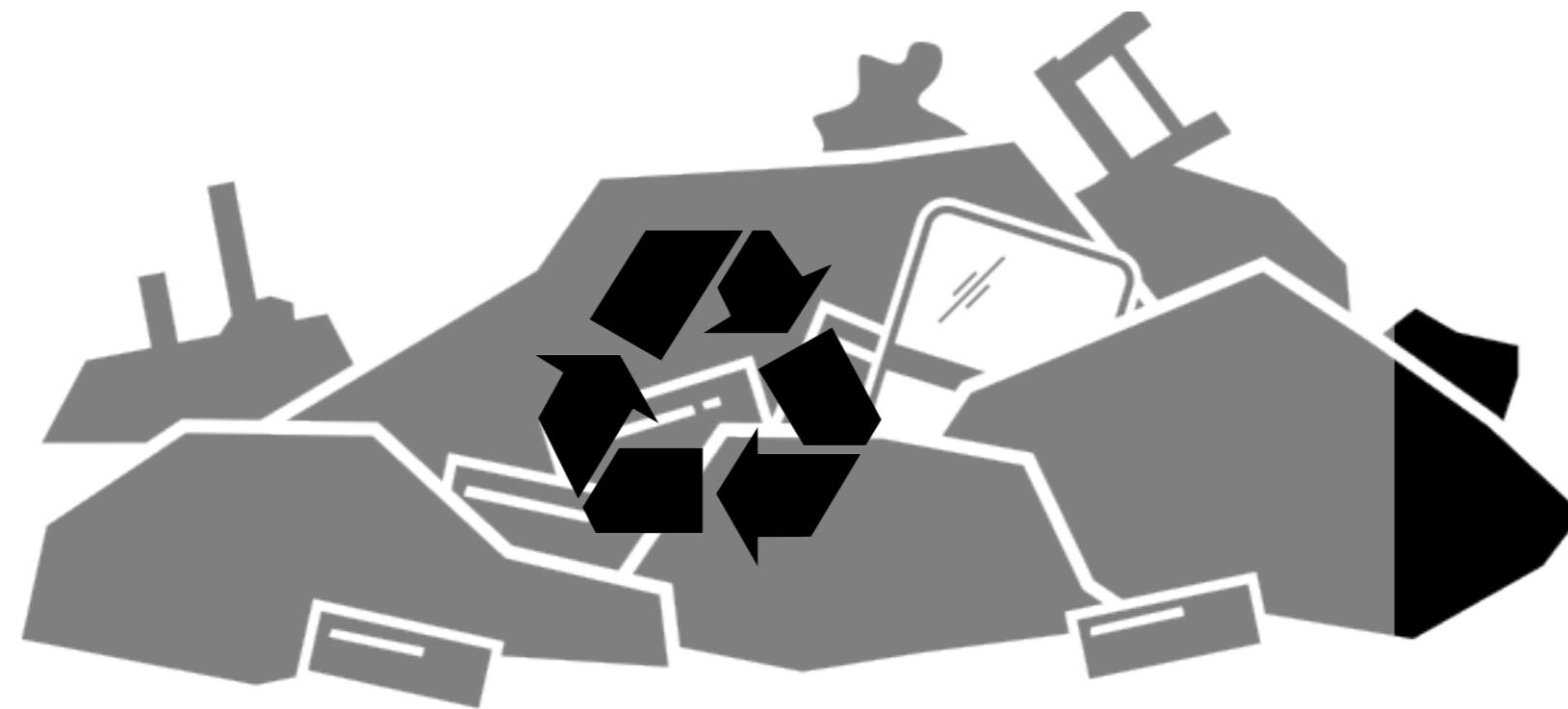


*Nowadays, the Netherlands alone are producing about
60.000 kilotonnes of waste each year.*

Source: Afvalmonitor Databank

https://afvalmonitor.databank.nl/Jive/Jive?cat_open=landelijk%20niveau/Samenstelling%20van%20huishoudelijk%20restafval

PROBLEM STATEMENT

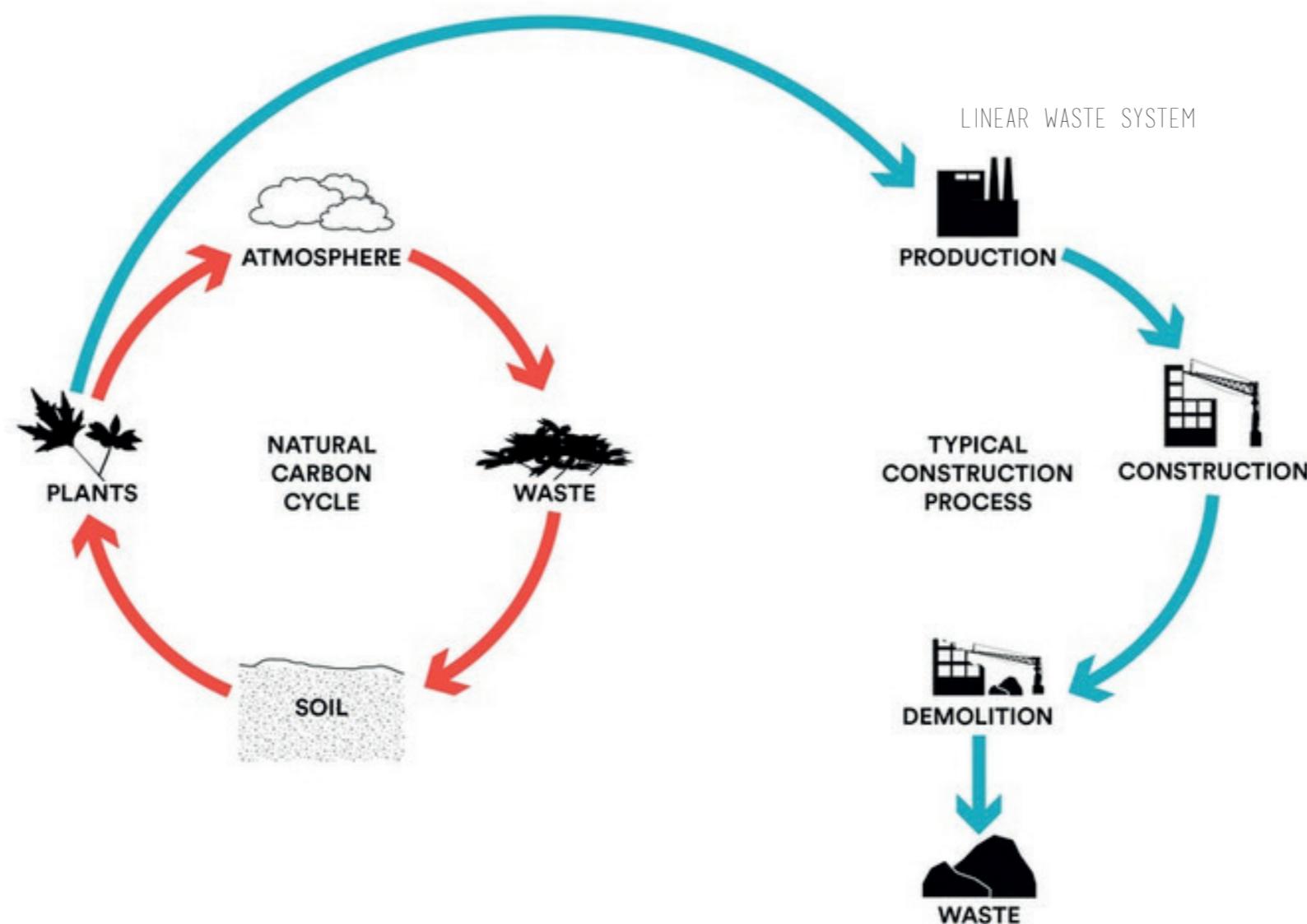


*Of which we recycle **78%**
and **10%** we use for other applications.*

Source: Afvalmonitor Databank

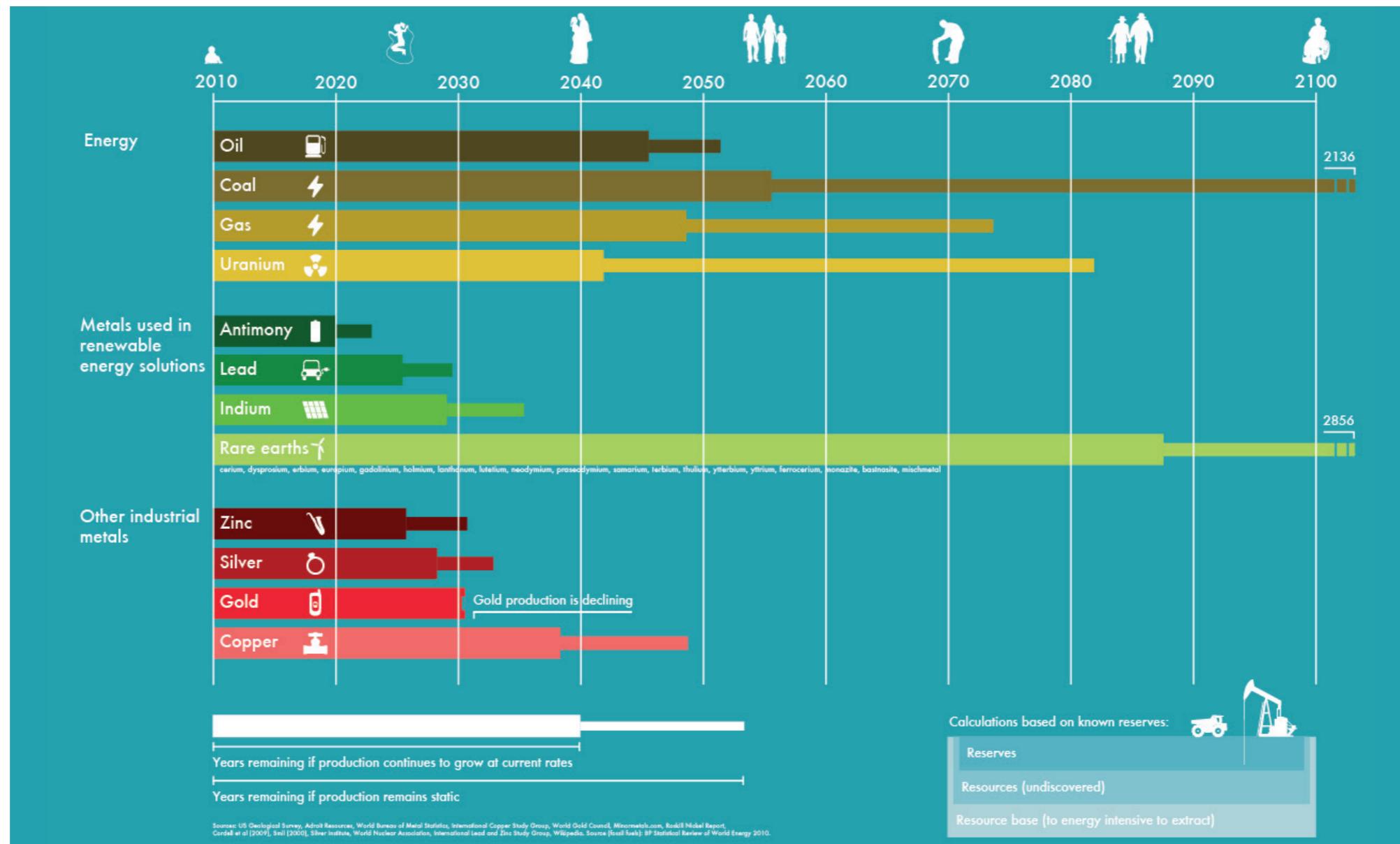
https://afvalmonitor.databank.nl/Jive/Jive?cat_open=landelijk%20niveau/Samenstelling%20van%20huishoudelijk%20restafval

PROBLEM STATEMENT



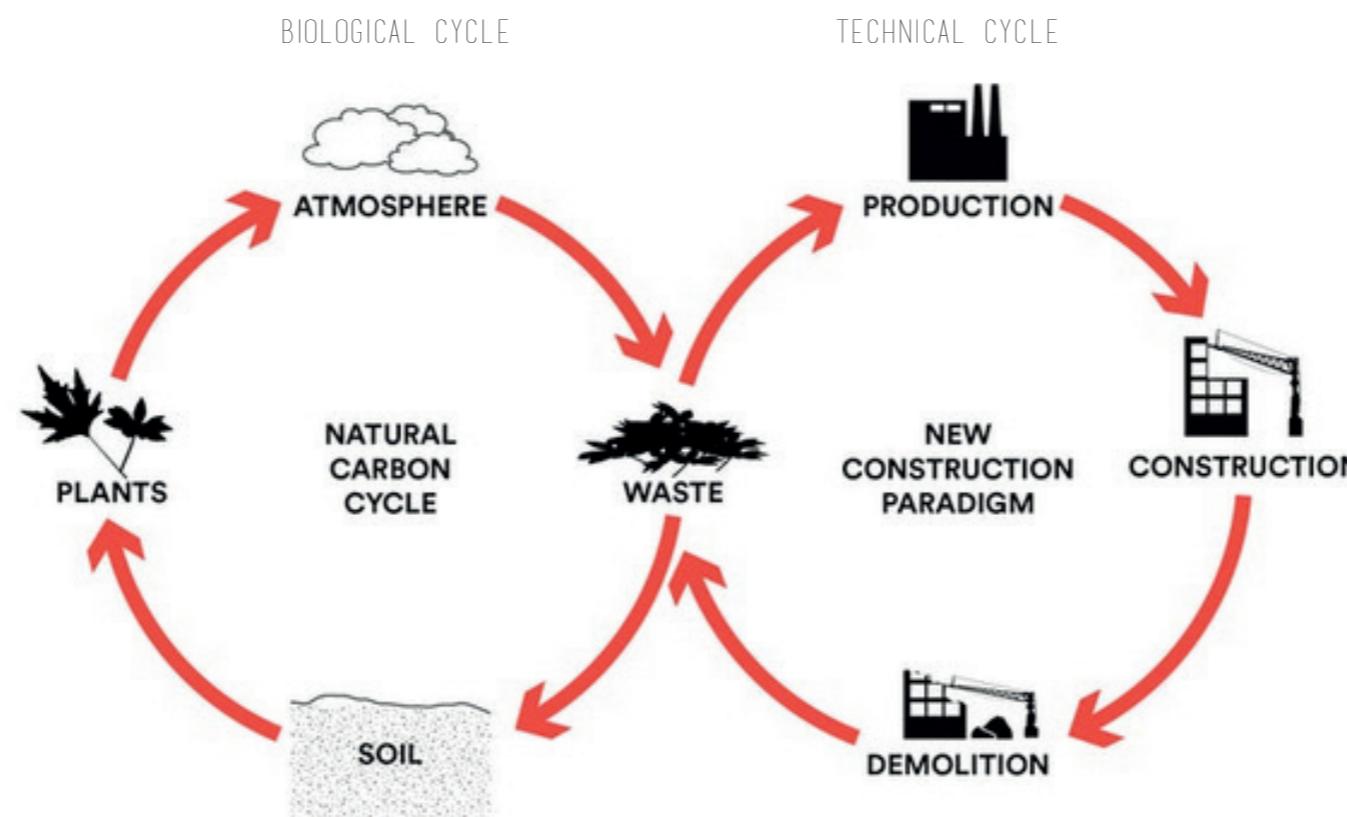
*The remaining 12% waste is the result of our unsustainable linear economy.
Which means that the Netherlands is still polluting the environment with
7.200 kilotonnes of waste every year.*

PROBLEM STATEMENT



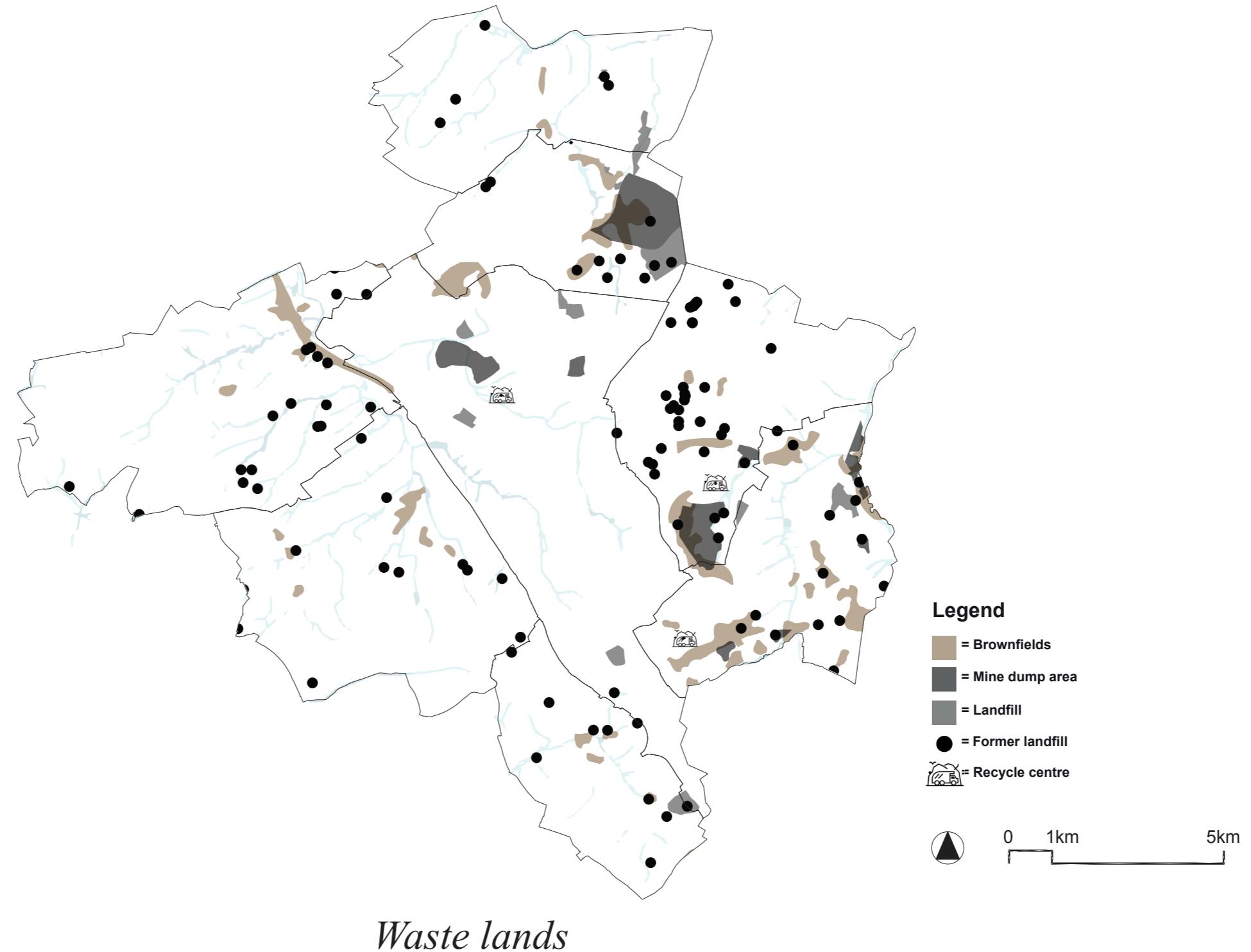
*Material resources are scarce for the coming generations.
If the consumption continue to grow at current rate there will be no metals left in 2040.*

RELEVANCE

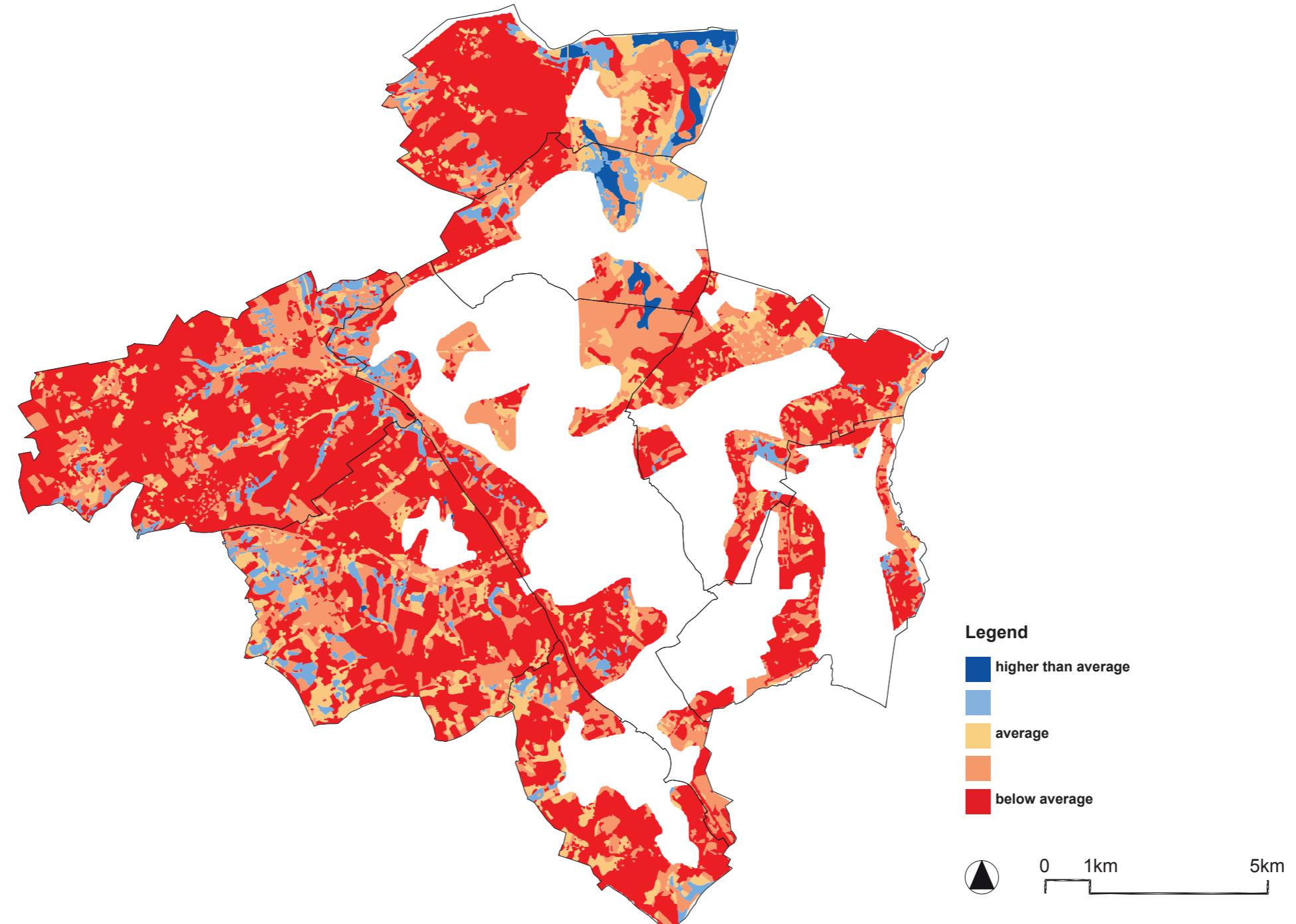


*So we need to change the way we produce and consume into a sustainable circular economy.
Where waste don't exist but seen as a valuable building material.*

PROBLEM STATEMENT WITHIN PARKSTAD

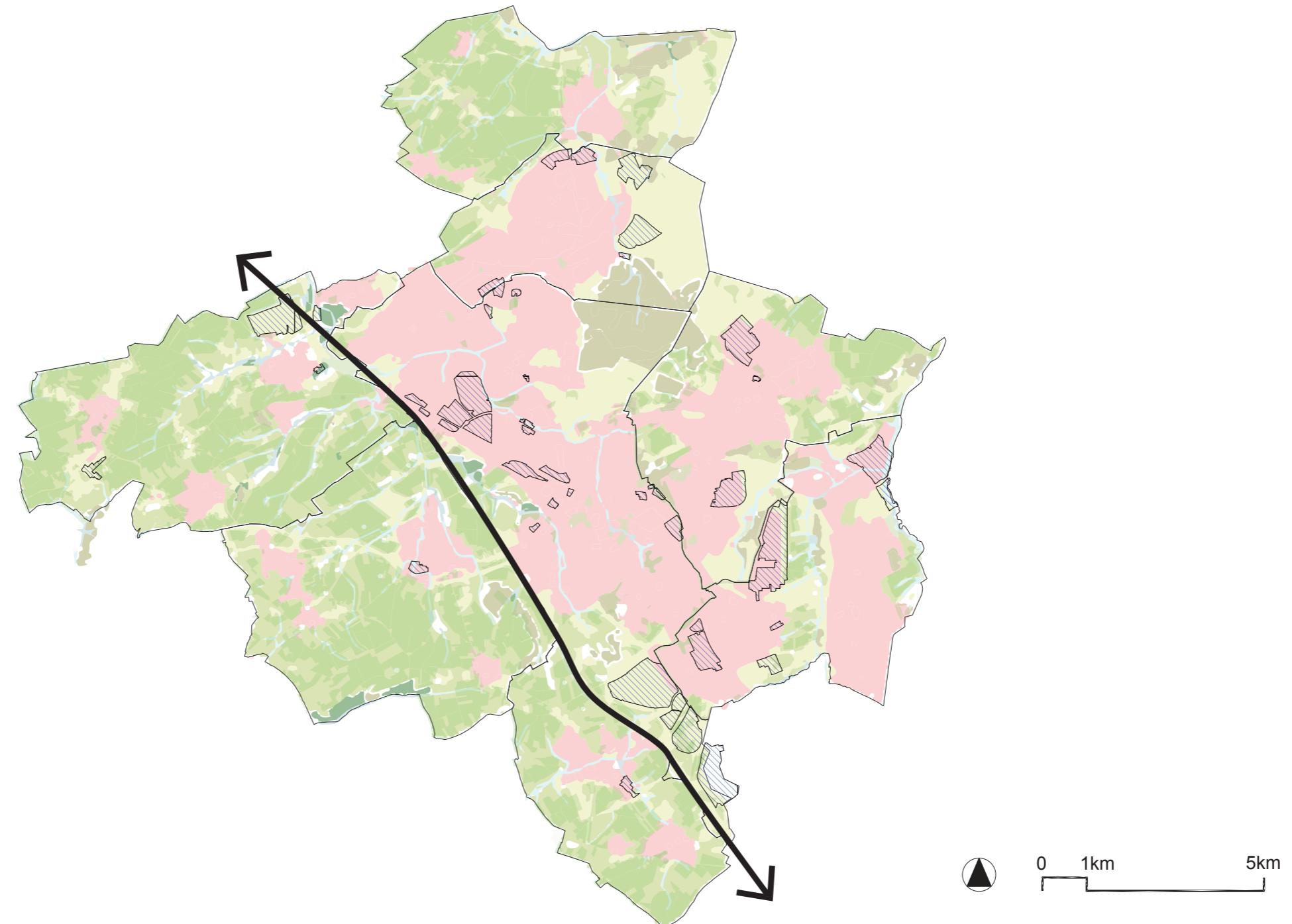


PROBLEM STATEMENT WITHIN PARKSTAD



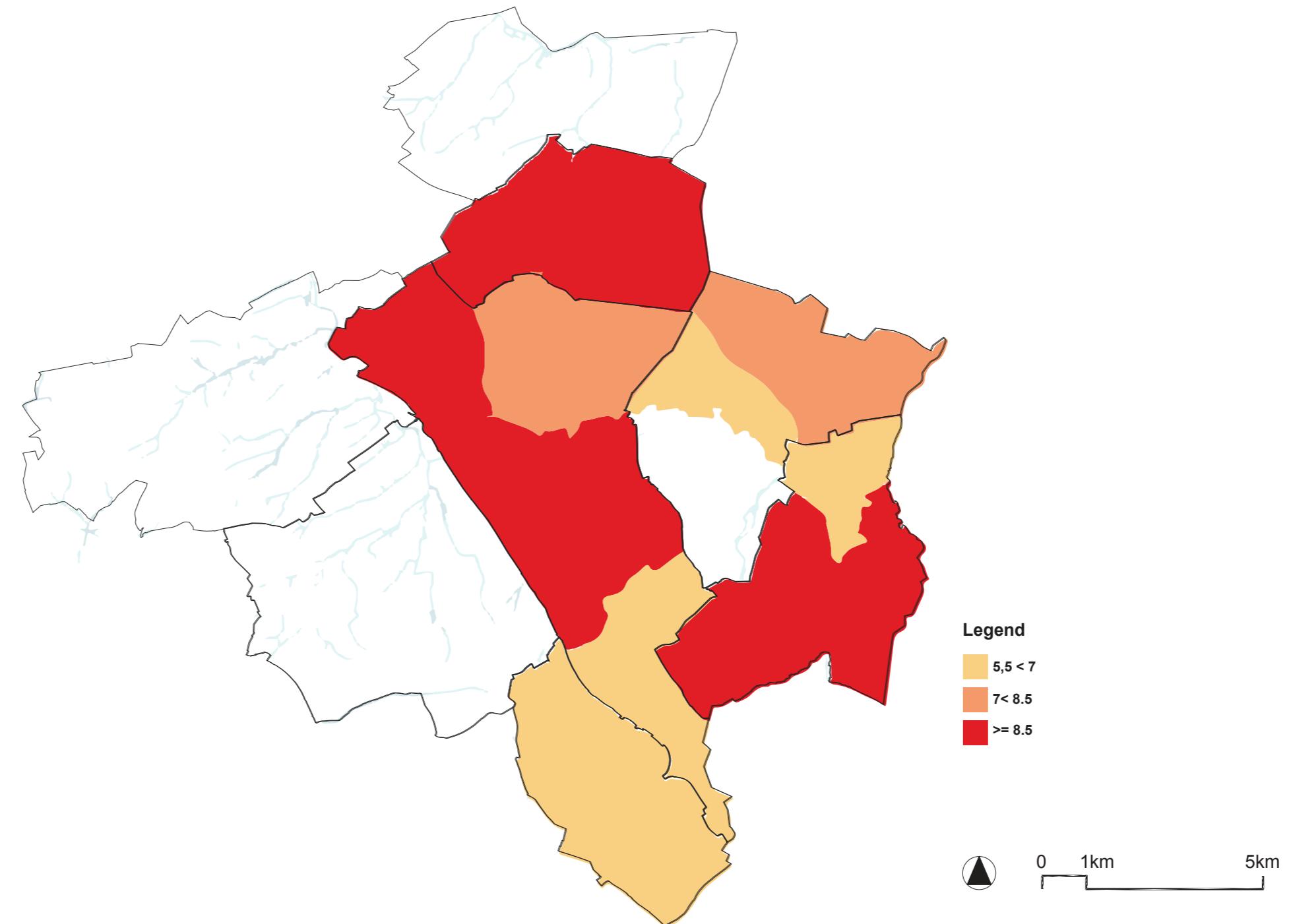
The low nutrient content in the soil has a major influence on the poor quality of the soil.

PROBLEM STATEMENT WITHIN PARKSTAD



*Strict contrast between urban (poor) and rural area (prosperous).
The buildings are oriented inwards and turn their backs to the landscape quality,
there is a need for a better connection between the urban area and rural area.*

PROBLEM STATEMENT WITHIN PARKSTAD



*There is a high vacancy rate of 4% in Parkstad.
Many people experience inconvenience from this vacancy.*

Source:

https://parkstad-limburg.buurtmonitor.nl/jive?cat_open_code=c662

PROBLEM STATEMENT WITHIN PARKSTAD



The closing of the coal mining industry resulted to a lack of identity, unemployment, vacancy, demographic shrinkage and aging population.

Image sources: 1. <http://www.rijckheydt.nl/in-de-kijker/de-val-van-de-lange-jan>
2. <https://www.archined.nl/2017/05/heerlen-al-bouwend-sloopte-de-stad-zichzelf>
3. <https://unsplash.com/search/photos/elderly>

PROBLEM STATEMENT

WILLEM - SOPHIA MINE IN KERKRADE BEFORE 1970.



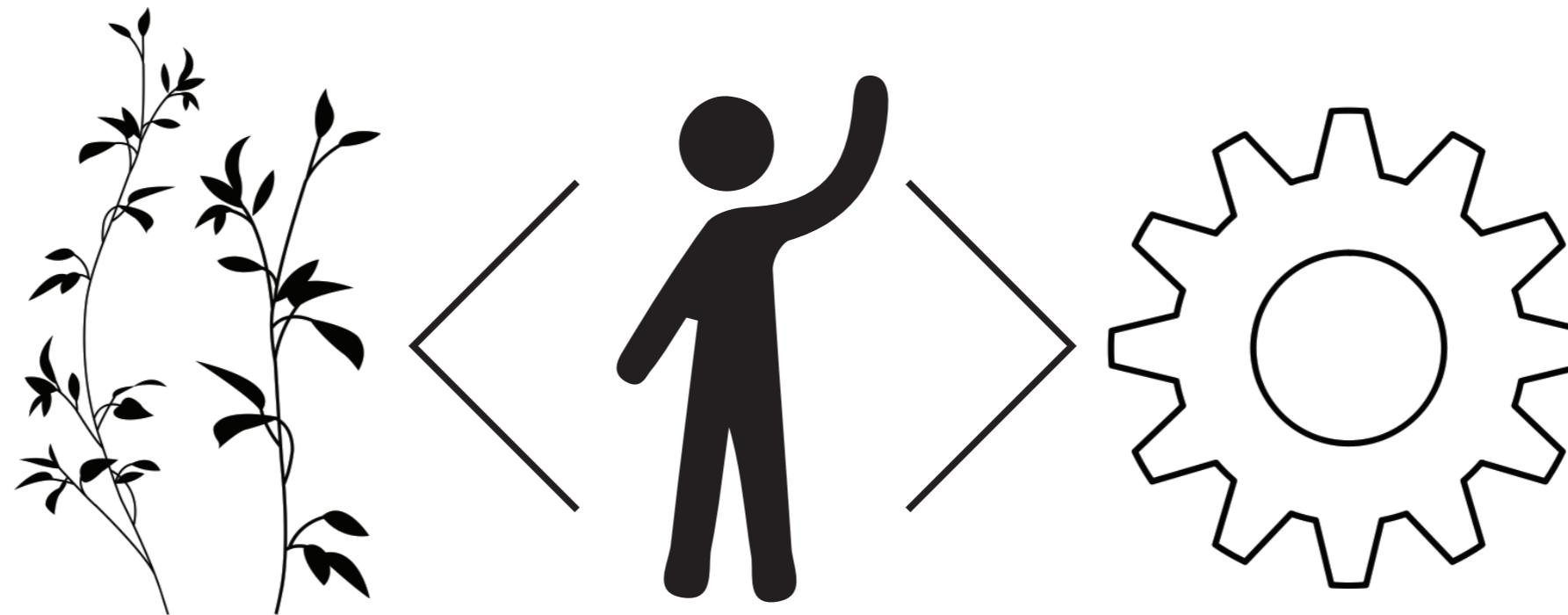
*Since the industrial revolution we entered the “Anthropocene”.
The mine industry in Parkstad is an perfect example of this “age of humans”
refers to the dramatically effects of human activates on the planet.*

Source: Haraway, D.J. (2016). Staying with the Trouble: Making Kin in the Chthulucene. Chapter 2 Tentacular Thinking. Duke University Press.

Image: Willem-Sophia Mine in Kerkrade, 1970

<https://www.demijnen.nl/mijnen/mijn/willem-sophia>

PROBLEM STATEMENT



*With the arrival of fossil energy supplies and new technologies, humanity became independent on nature which resulted disconnection between nature, people and technology.
We are not aware of the nature and its benefits around us and technology is getting more complex.*

OBJECTIVE



Philosopher and biologist Donna Haraway pursues a different epoch: Within the “Cthulucene” the entanglement between all species comes to the fore. We should take the “Response-ability” to incorporate the practice of justice and sustainable belonging to survive on this planet.

OBJECTIVE



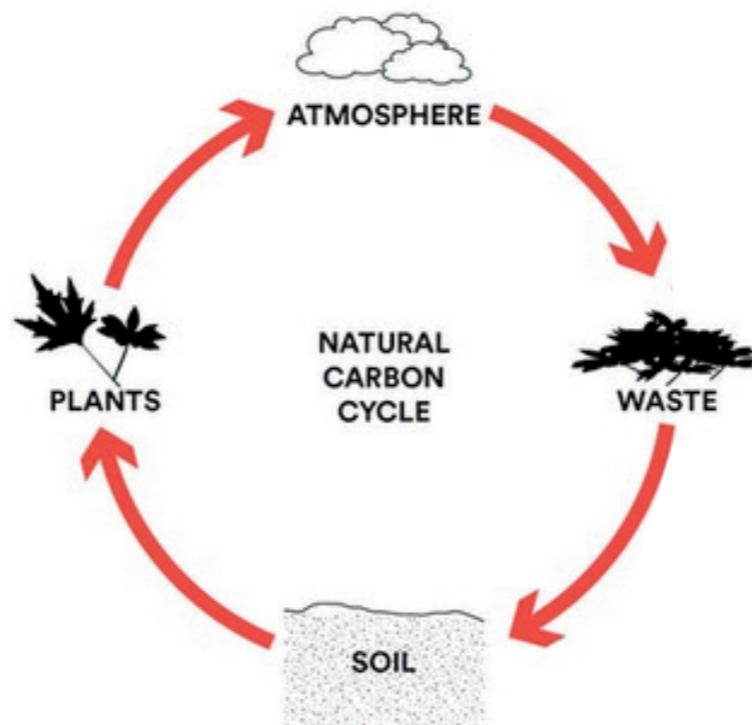
Climate activists during the UN Climate Change Conference in 2015 poetically responds: “We are not fighting for nature. We are nature defending itself”.

Source:

<https://theecologist.org/2015/nov/28/cop21-actions-go-ahead-we-are-not-defending-nature-we-are-nature-defending-itself>

FASCINATION

BIOLOGICAL CYCLE



In nature, waste don't exist.

FASCINATION

Mycelium is the vegetative part of a fungal consisting of branched chain hyphae which forming fungal network in the soil and many other substrates.



If the conditions are right, the Basidiomycetes will sprout mushrooms.

The Basidiomycetes is most appropriate fungi specie for mycelium-based materials because they are able to create much longer and more complex “roots” structures than other fungi.

FASCINATION

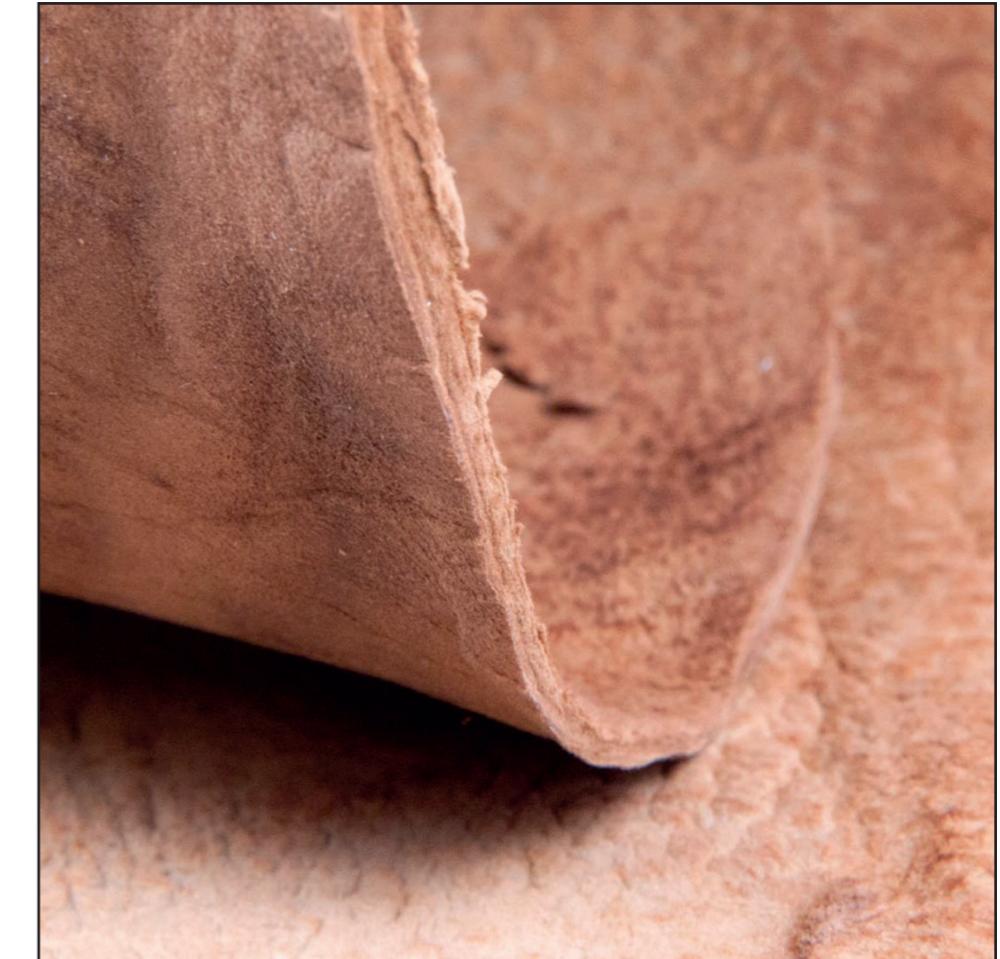
Mycelium is the largest found living organism in the world.



Fungi are more related to humans and animals than to plants.

Within the ecosystem mycelium play an important role by decomposing organic material into nutrients for the soil as a source of chemical elements for other organisms.

RESEARCH QUESTION



What are the opportunities of mycelium and how to apply mycelium-based materials from local waste streams within a vacant building in Parkstad?

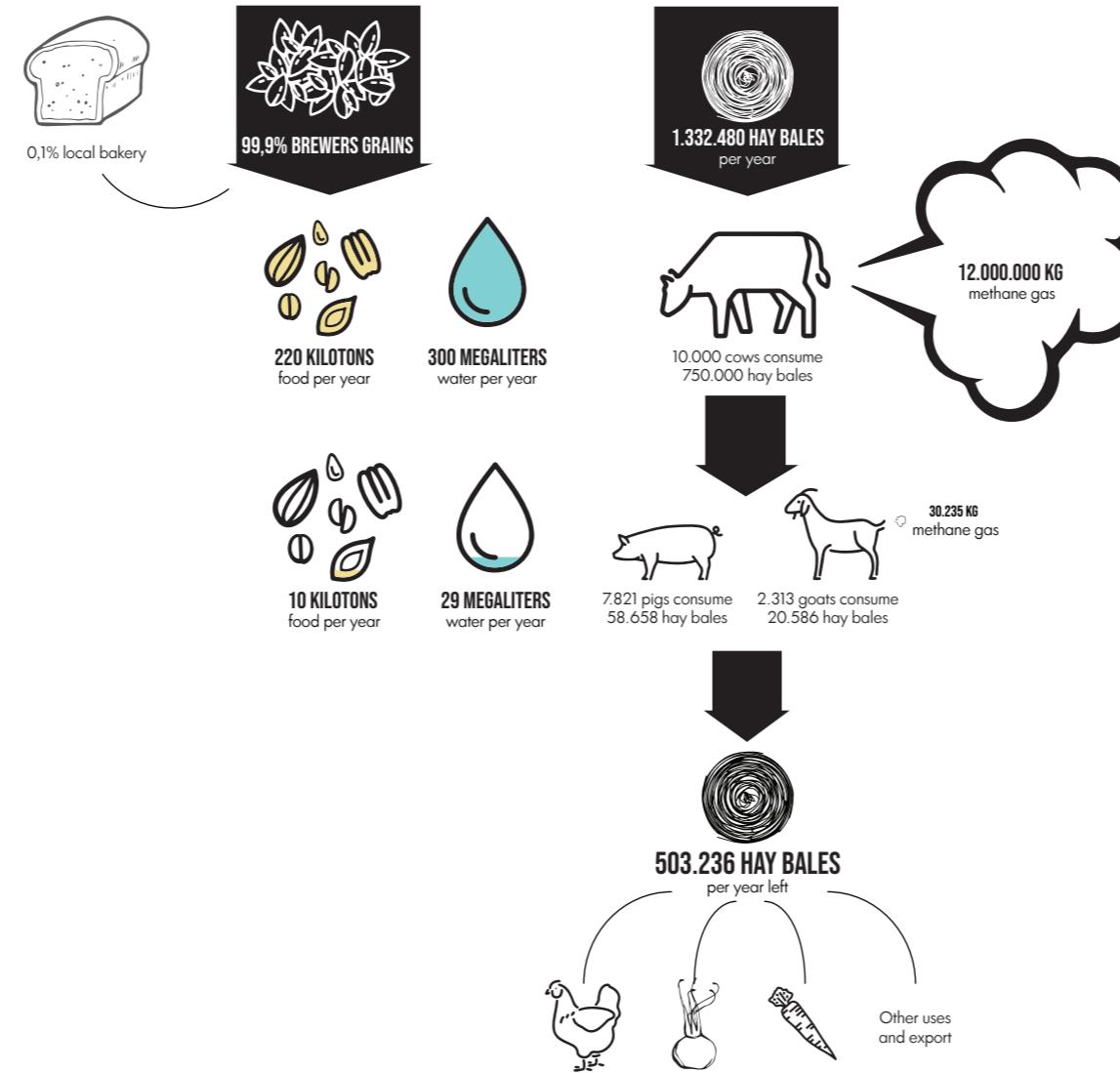
FINDINGS

Region scale



FINDINGS

Region scale



Currently, 62% the straw and 99,9% of the brewersgrains is used for the cattle industry. But the cattle industry is strongly polluting the environment with methane gas and cost a lot of food and water.

FINDINGS

Micro & material scale

OYSTER MUSHROOM
(*Pleurotus Ostreatus*)



REISHI MUSHROOM
(*Ganoderma Lucidum*)



TURKEY TAIL
(*Trametes Versicolor*)



These species are suitable for growing mycelium based materials because they have the characteristics to create dense mycelium networks, grow fast and aren't easily infected by competing organisms.

FINDINGS

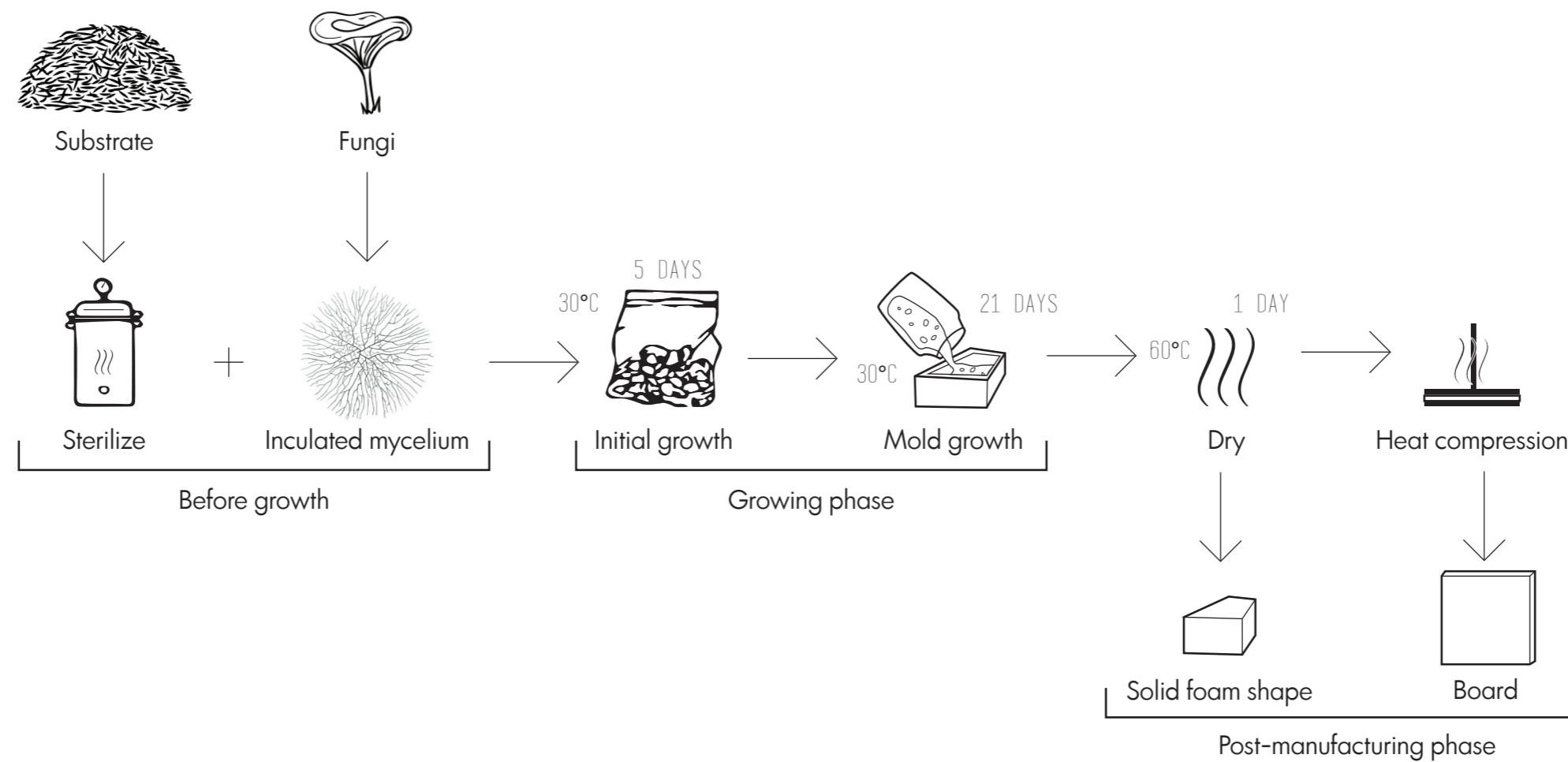
Region scale



Located in Schimmert the mushroom farmer Zwamburg is growing mushrooms on wasted coffee ground of local restaurants. Zwamburg is an interesting stakeholder to contact for local mushroom spawn suppliers, accompany for knowledge and other collaborations to strengthen each other's identity.

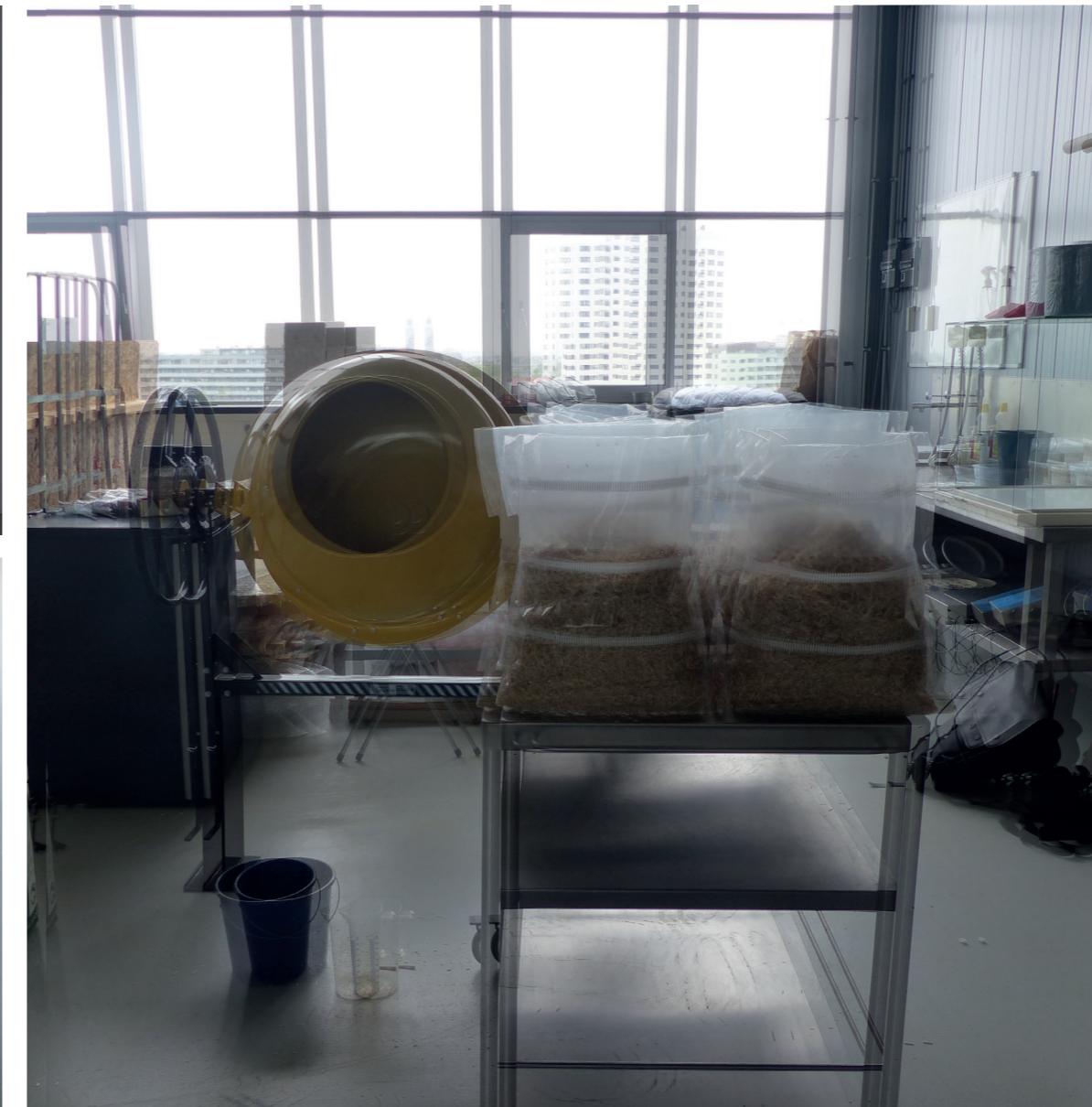
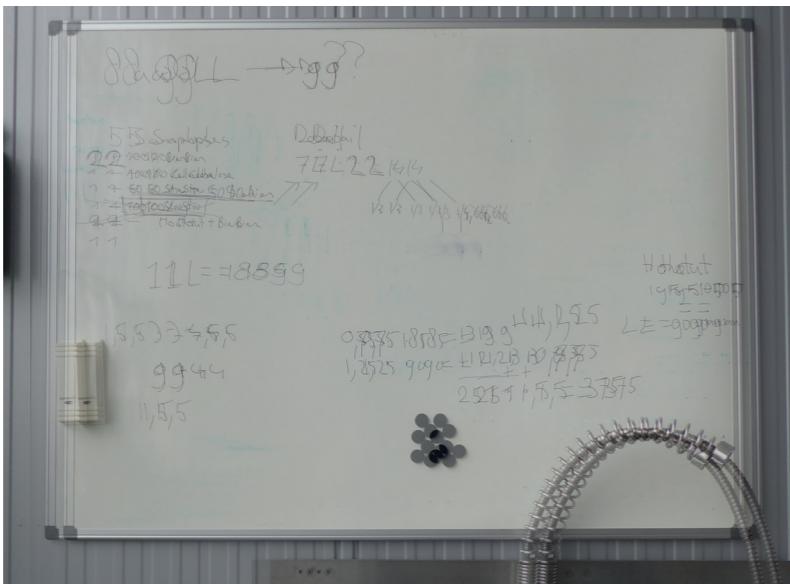
FINDINGS

Micro & material scale



Schematic diagram of the production process of mycelium-based composite

PRODUCTION PROCESS



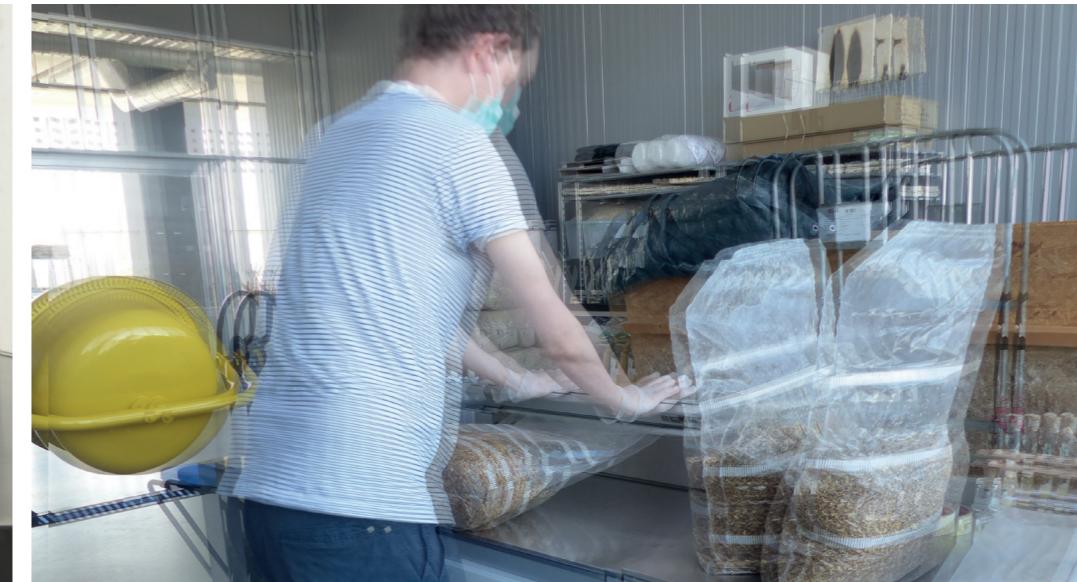
*Preparation:
mix the substrate (60% humidity)*

PRODUCTION PROCESS



Pasteurize the substrate

PRODUCTION PROCESS



Inculation

PRODUCTION PROCESS



Initial growth for about a week

PRODUCTION PROCESS



Mold growth for about a week

PRODUCTION PROCESS



Drying

FINDINGS

Material & component scale

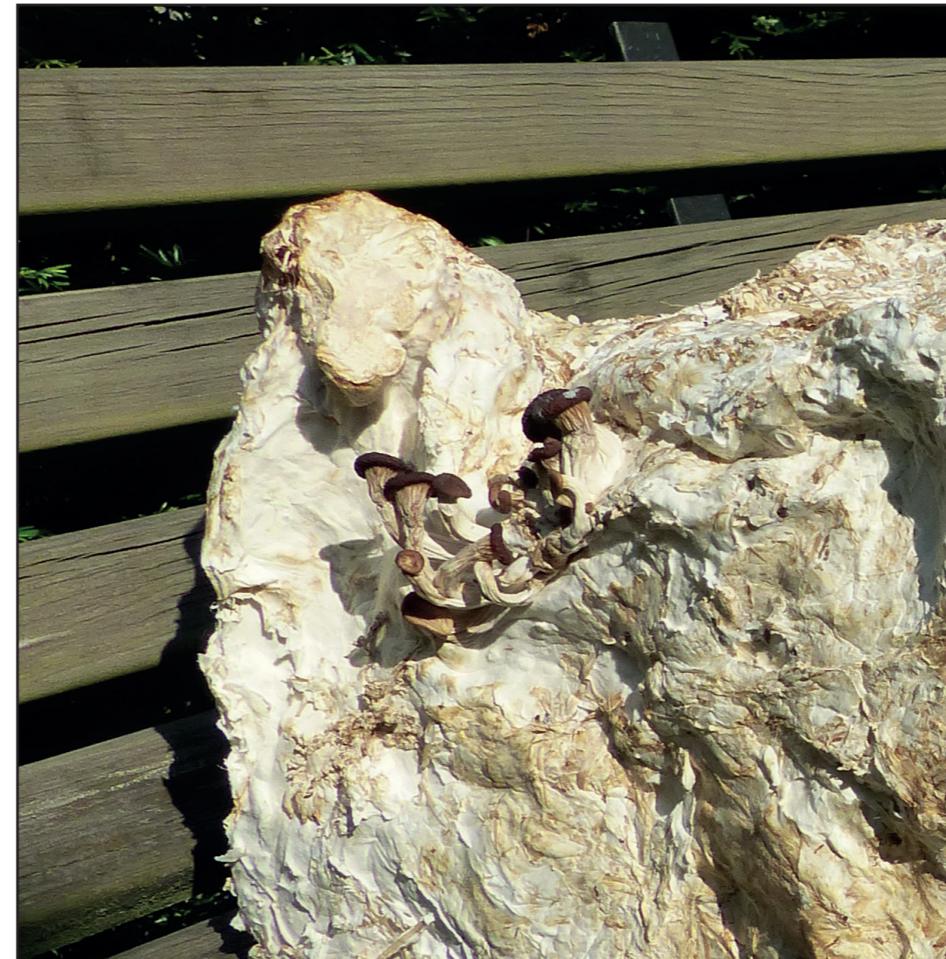


The material qualities and properties of mycelium-based materials are strongly related to material characteristics of the fungi and substrate, the environmental conditions during the growing phase and post-manufacturing process.

FINDINGS

Material & component scale

Dried above 60 °C:
growth is stopped permanently



Dried below 60 °C:
in “hibernated” mode

*Heating above 60 °C will kill the mycelium and growth will stop permanently.
When the mycelium is dried, it will restart to grow again when the moisture conditions are conductive.*

FINDINGS

Material & component scale



Biodegradability

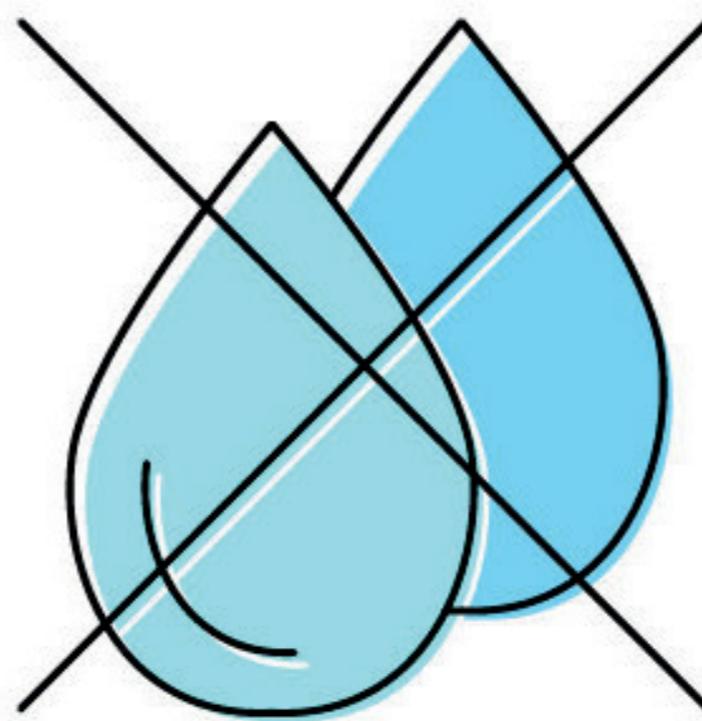
When mycelium-based materials are exposed outside on the ground it will be composted in about six weeks and returns to the ecosystem as a useful nutrient for plants.

Image source:

<https://architizer.com/blog/inspiration/industry/how-do-you-compost-a-building/>

FINDINGS

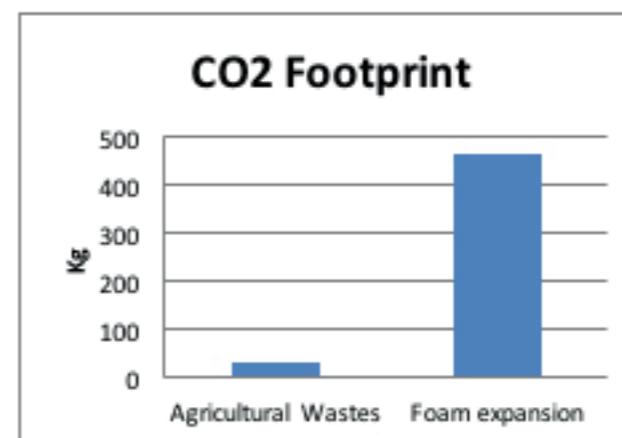
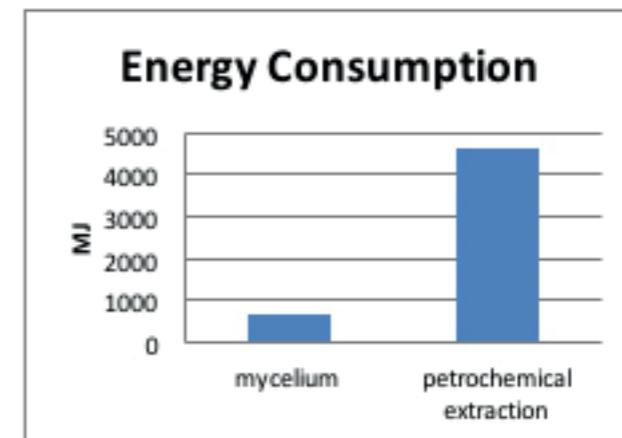
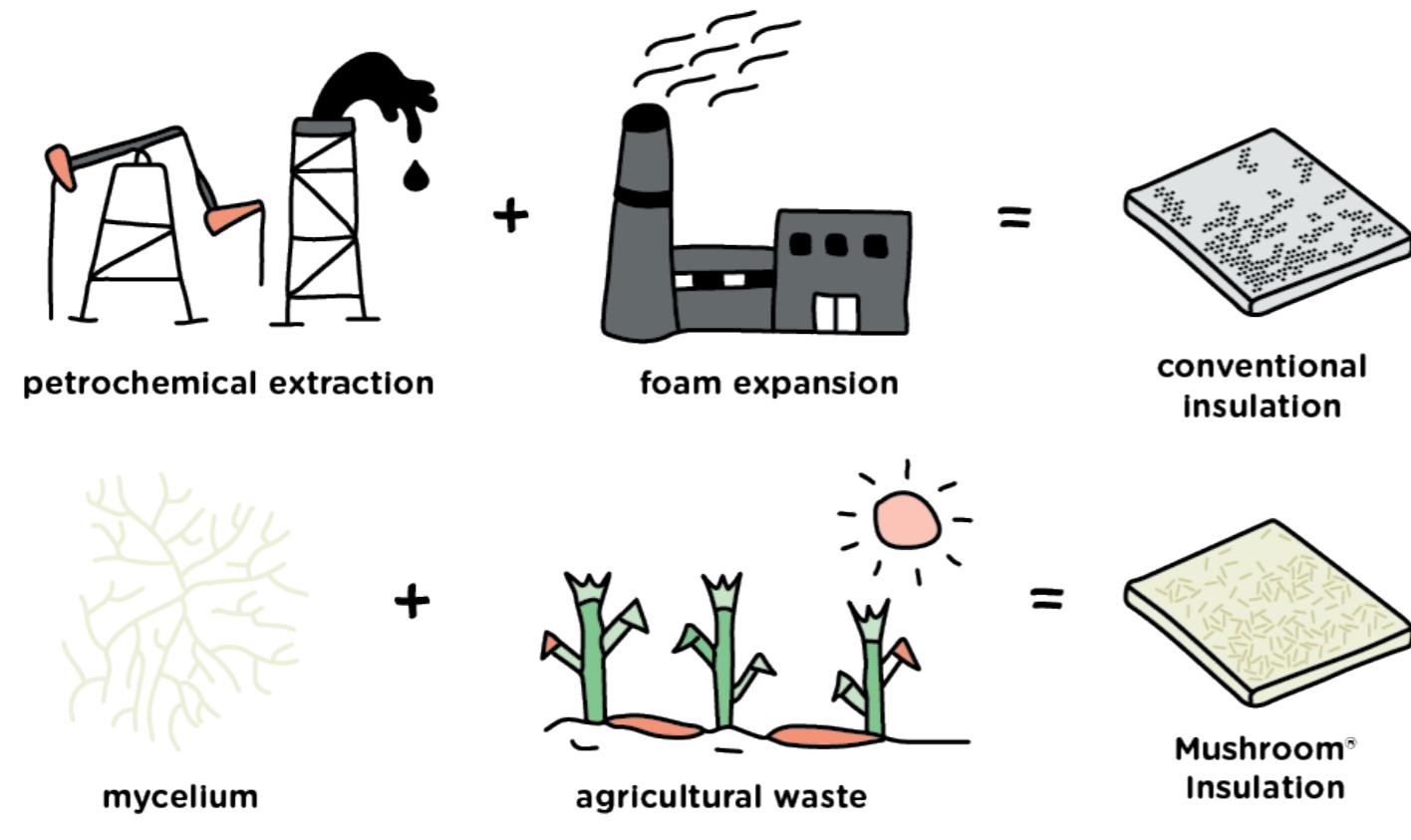
Material & component scale



The water resistance of mycelium decreases overtime which makes it vulnerable to mold and humidity. But if the material is maintained under stable and favorable conditions, it has a lifespan of approximately 20 years.

FINDINGS

Material & component scale



Low embodied emission

Image source:

1. Ecovative Design

2 &3. <https://femaleandfungi.com/2016/03/10/replacing-petroleum-based-products-with-breakthrough-biomaterials/>

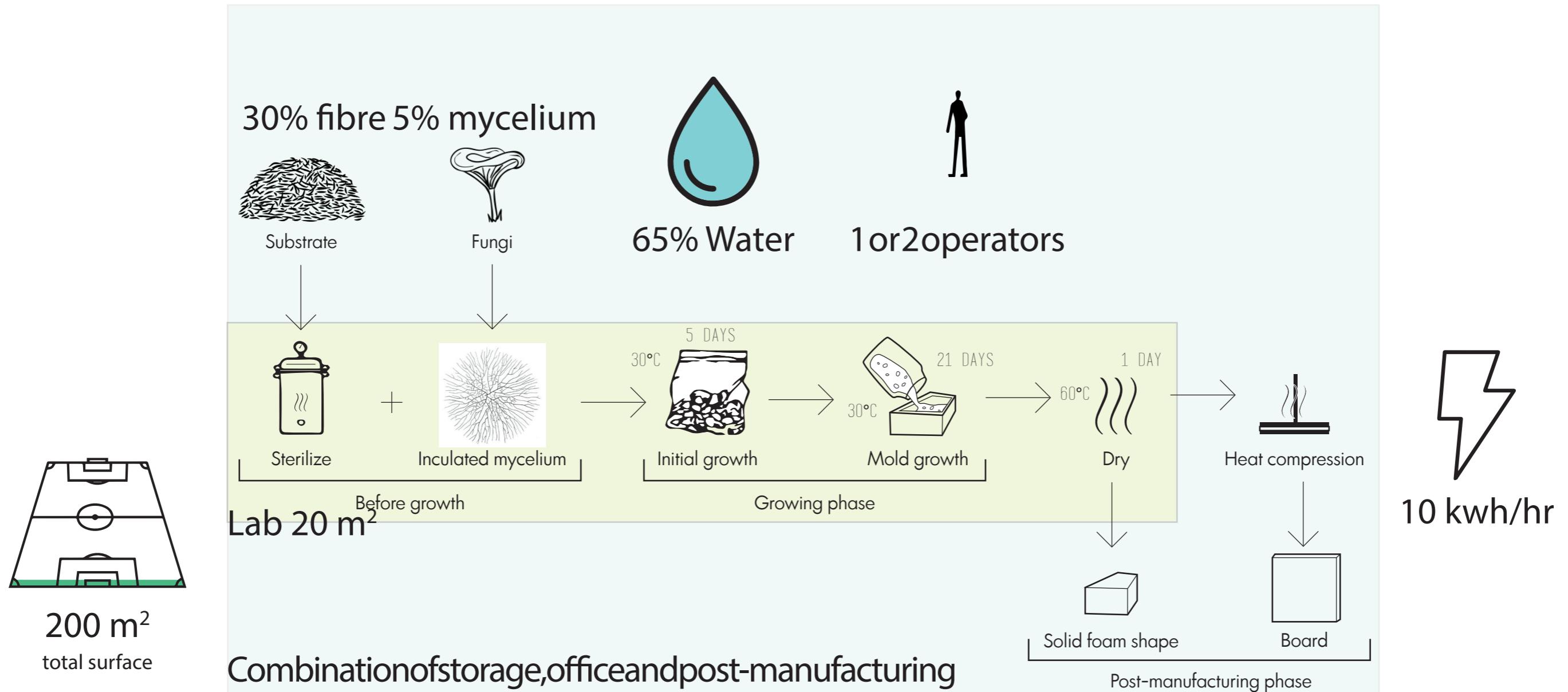
FINDINGS
Building scale



Small scale production labs in Rosmalen (left) and Den Hague (right).

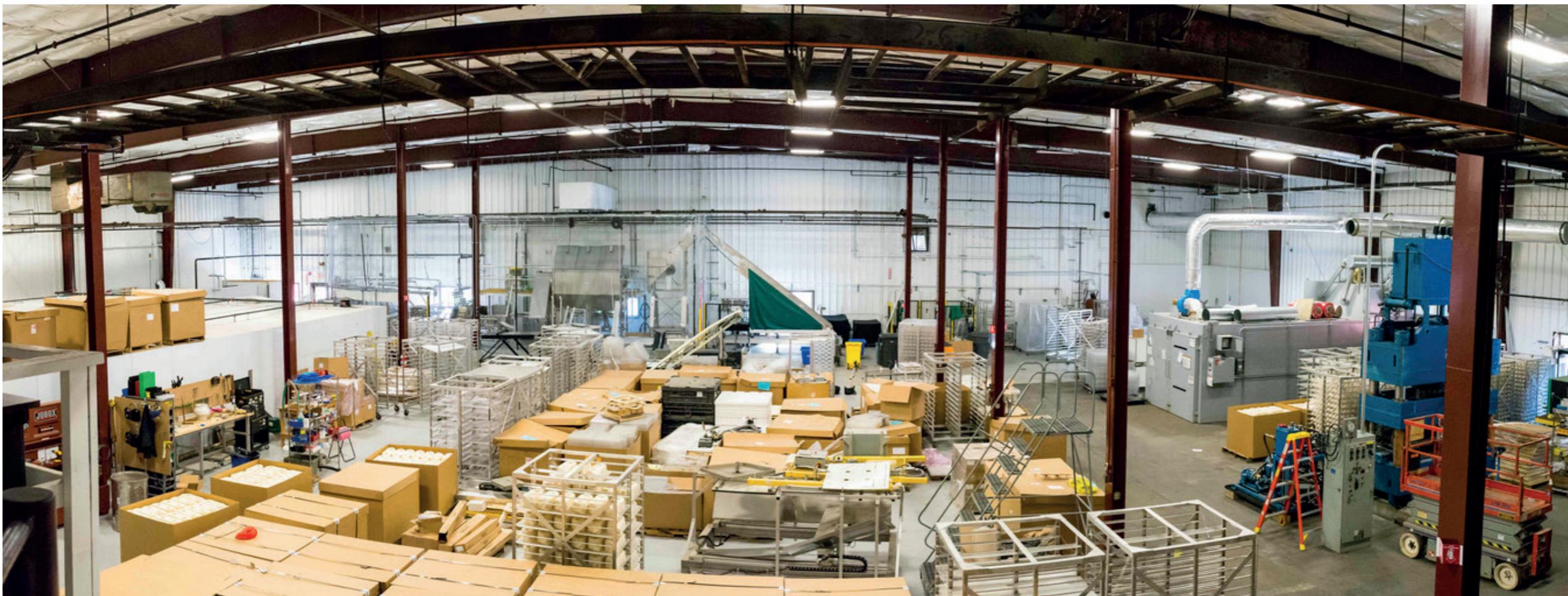
FINDINGS

Building scale



Production is divided in the three phases of mixing and molding the substrate with the mycelium and water; the growing phase and the post-manufacturing.

FINDINGS
Building scale

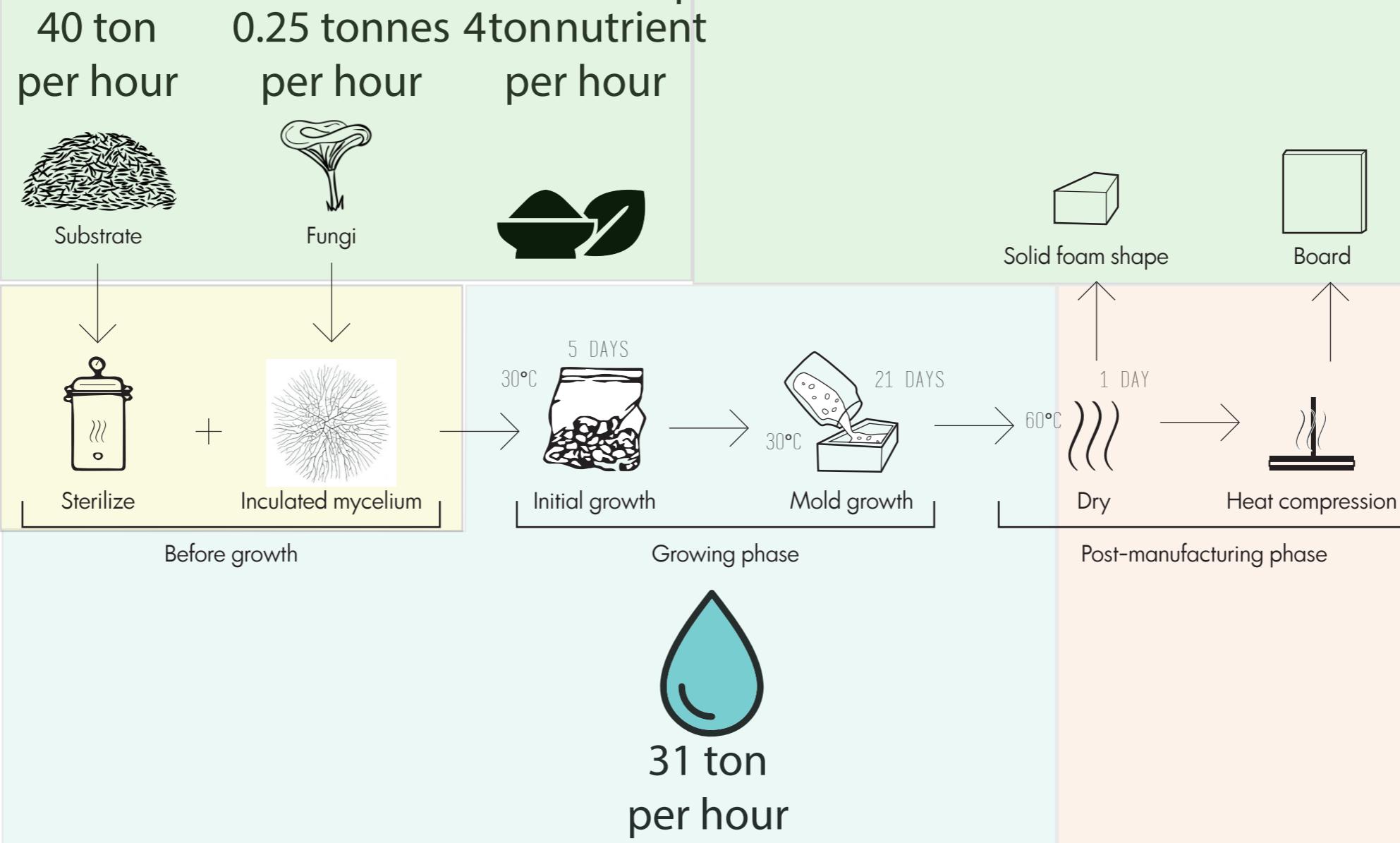


Big scale production factory of Ecovative in New York.

Image source:
Ecovative Design (2016). Inside Our Troy Facility. <https://ecovativedesign.com/blog/146> retrieved November 2018.

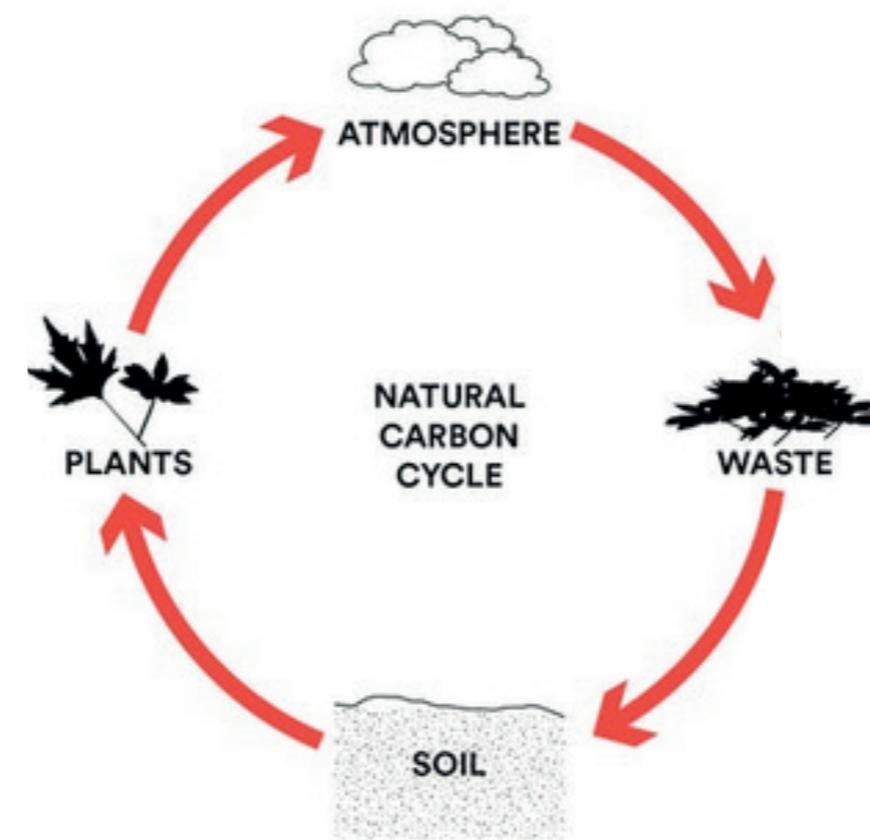
FINDINGS

Building scale



Production is divided in the three phases of mixing and molding the substrate with the mycelium and water; the growing phase and the post-manufacturing.

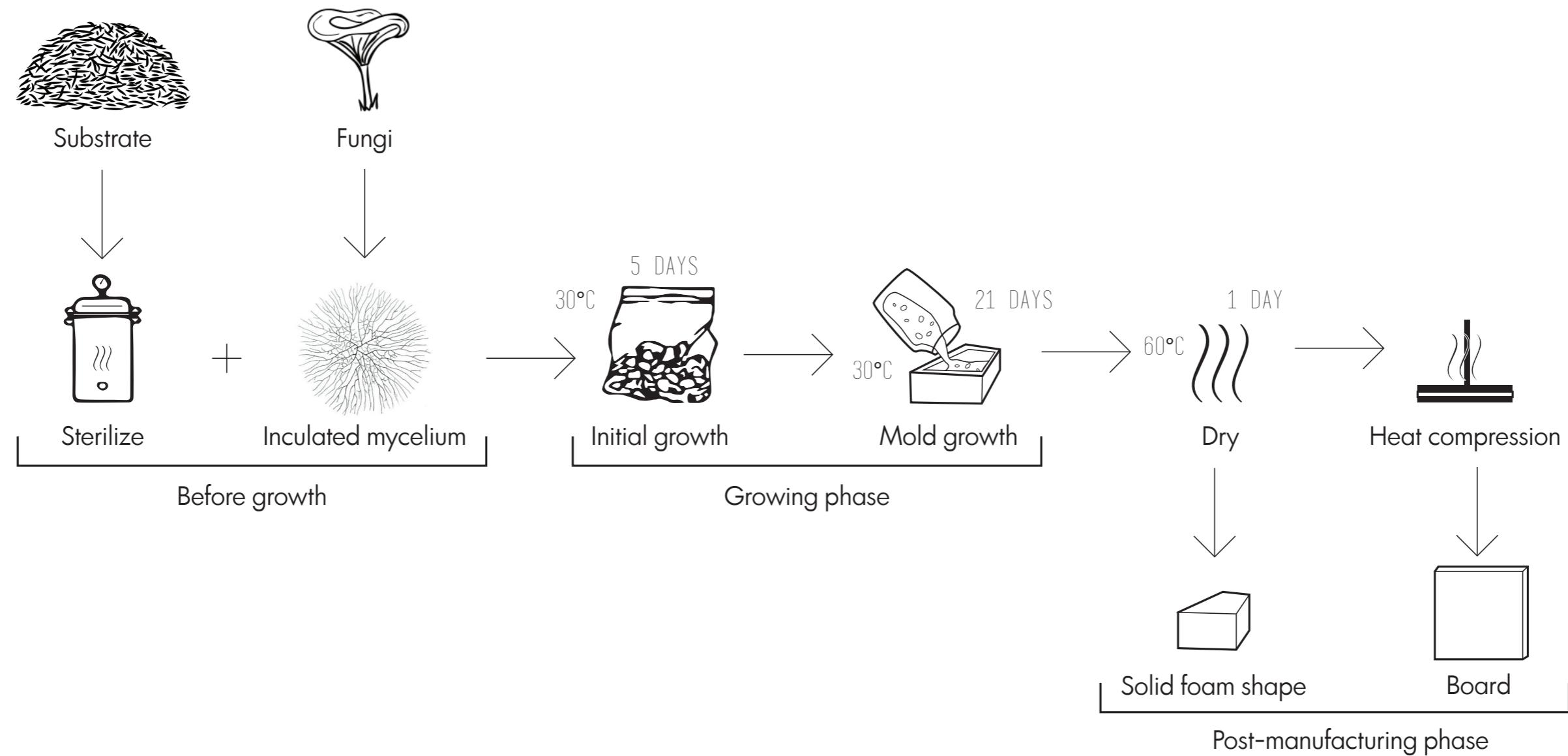
GUIDING THEME



Material based design:

*An architectural design that is built to grow, decay and eventually will disappear.
That is entangled with nature.*

GUIDING THEME



Material based design:

Experience of the three production phases of mixing and molding the substrate with the mycelium, the growing phase and the post-manufacturing.

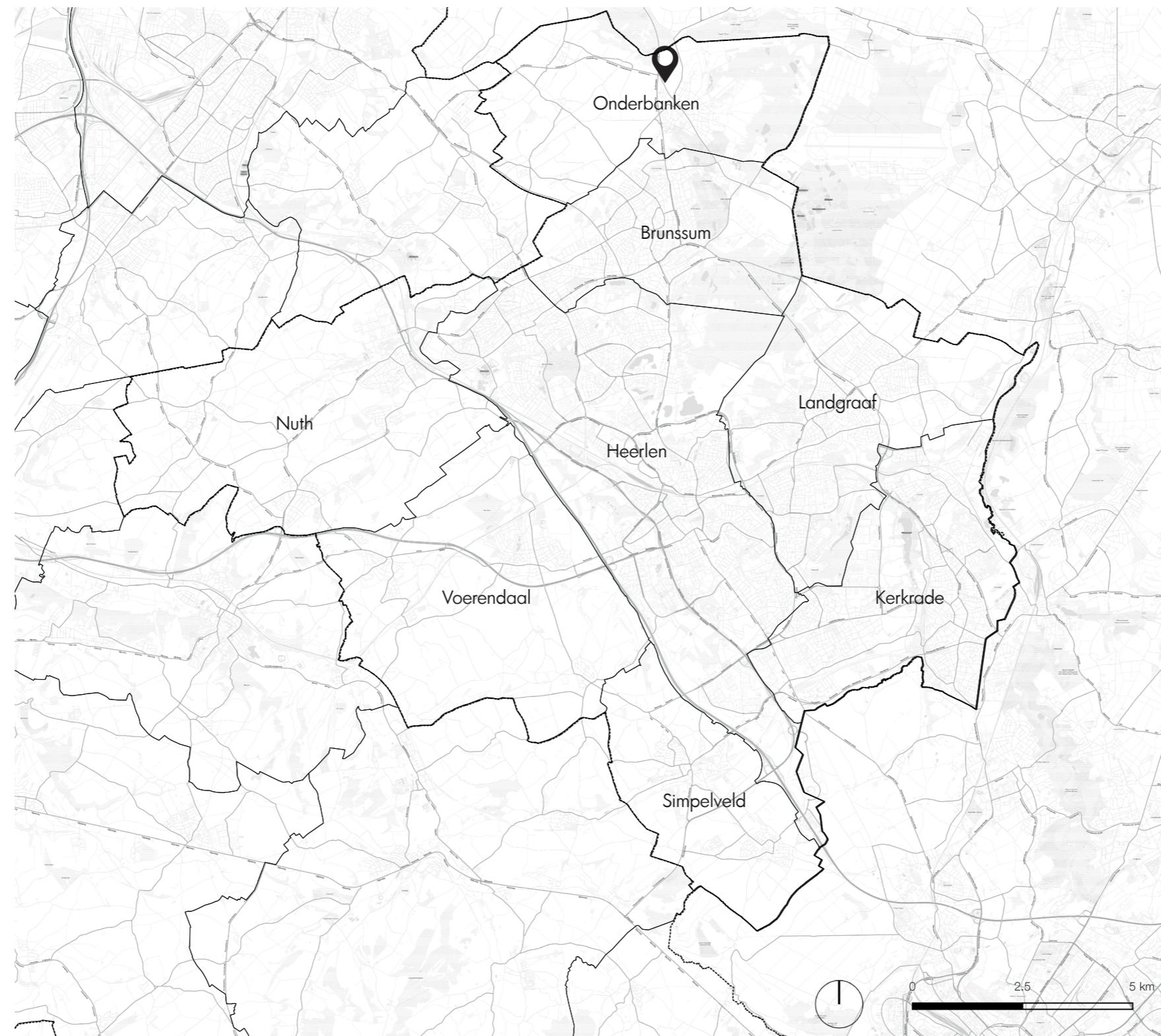
GUIDING THEME



Material based design:

Introduce the material and its various range of possibilities for wider public that exposes the unique technical and experiential qualities.

LOCATION



LOCATION



Schinveld, Brunssum.

Image source:

<https://www.google.com/maps/place/Jabeekerstraat+20,+6451+CH+Schinveld>

LOCATION



De Staalconstructie Schinveld circa 1956

Image source:
IBA Parkstad: *Folder Staalconstructie Schinveld; zu verkaufen.* p. 4.

LOCATION

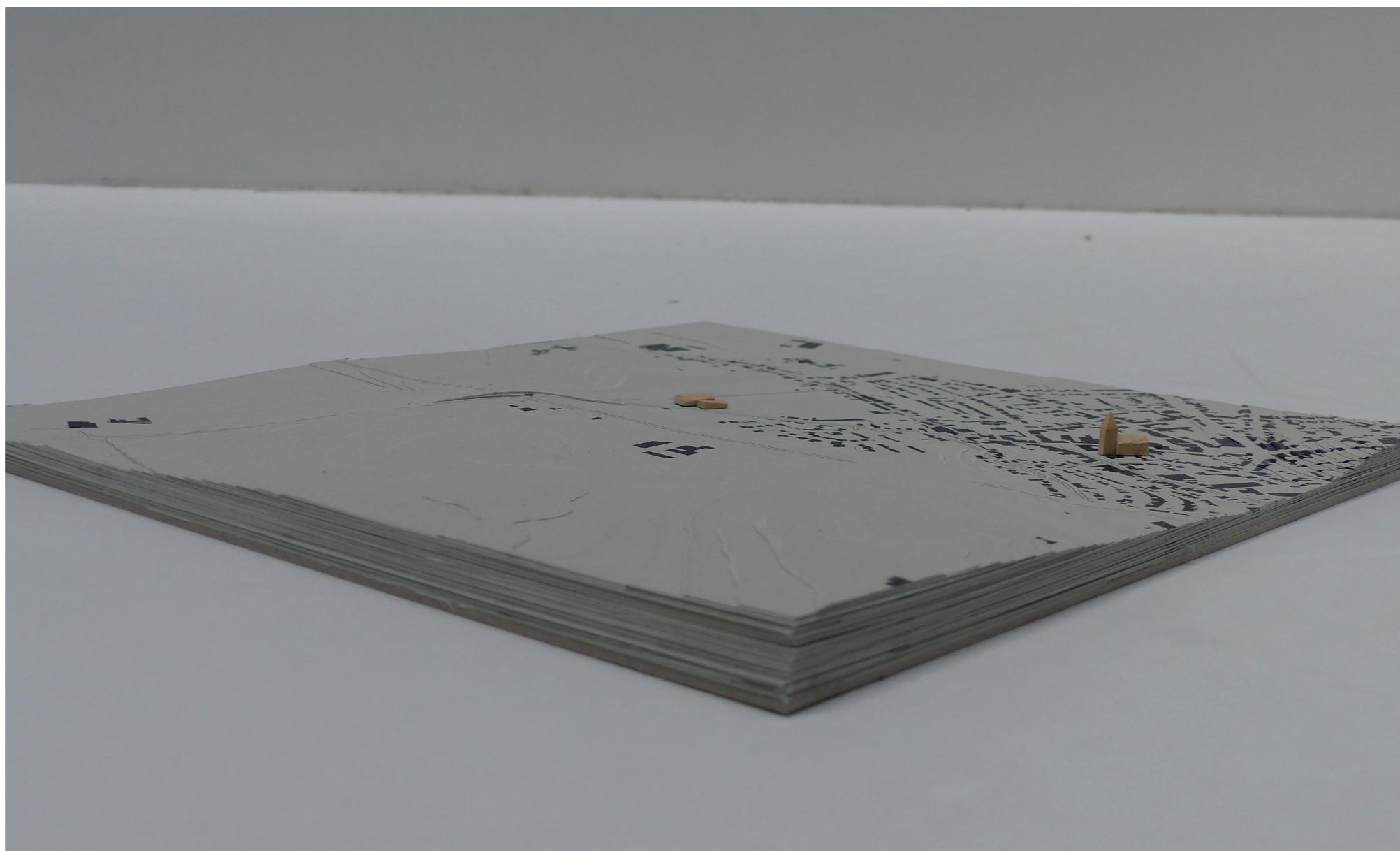


De Staalconstructie Schinveld
(on the second of May, 2019).

LOCATION



LOCATION



Situation

LOCATION



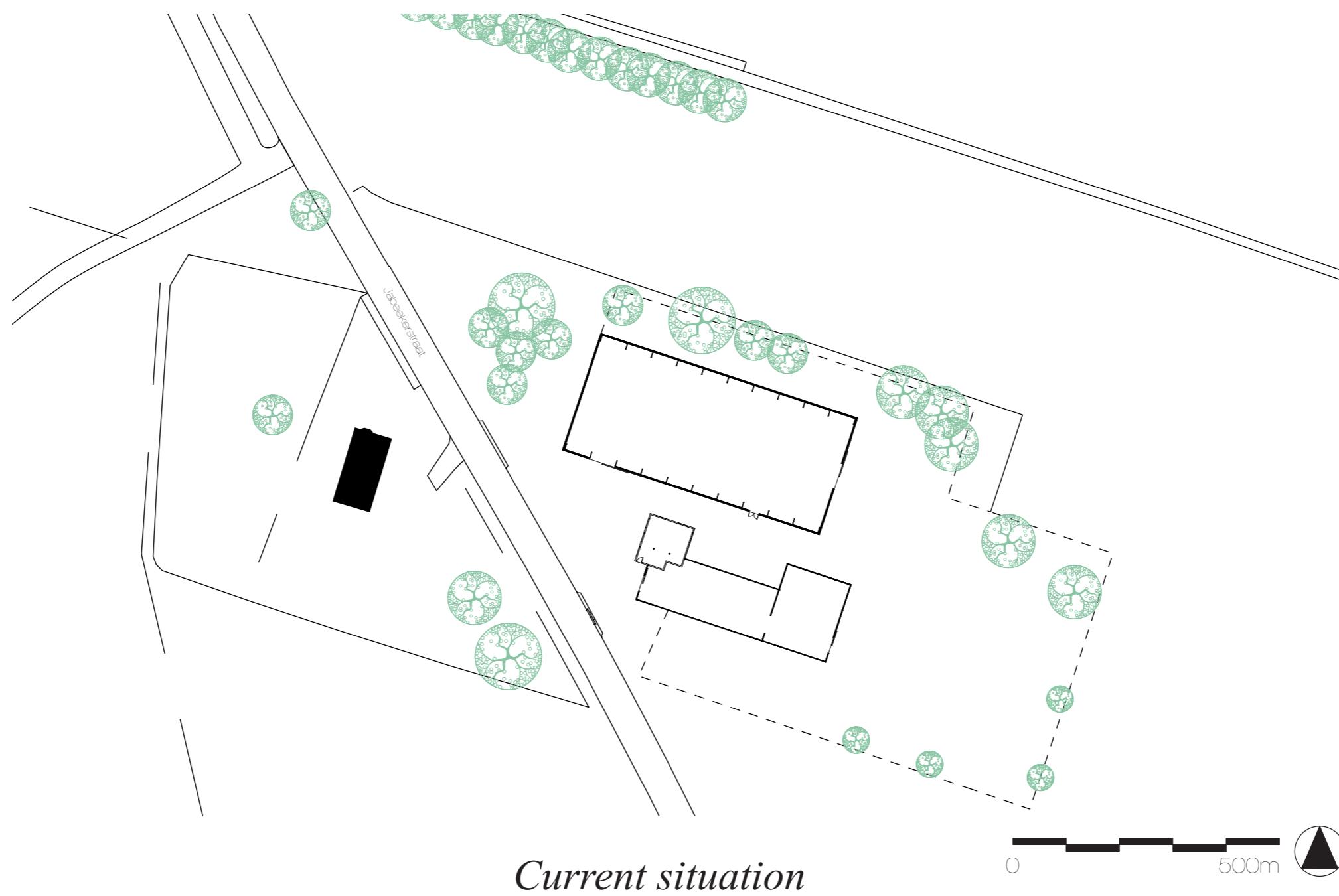
“The lotusbloem” & Sint-Eligiuskerk

LOCATION



De Staalconstructie

LOCATION



LOCATION



Current situation

LOCATION



Current situation hall 1

LOCATION



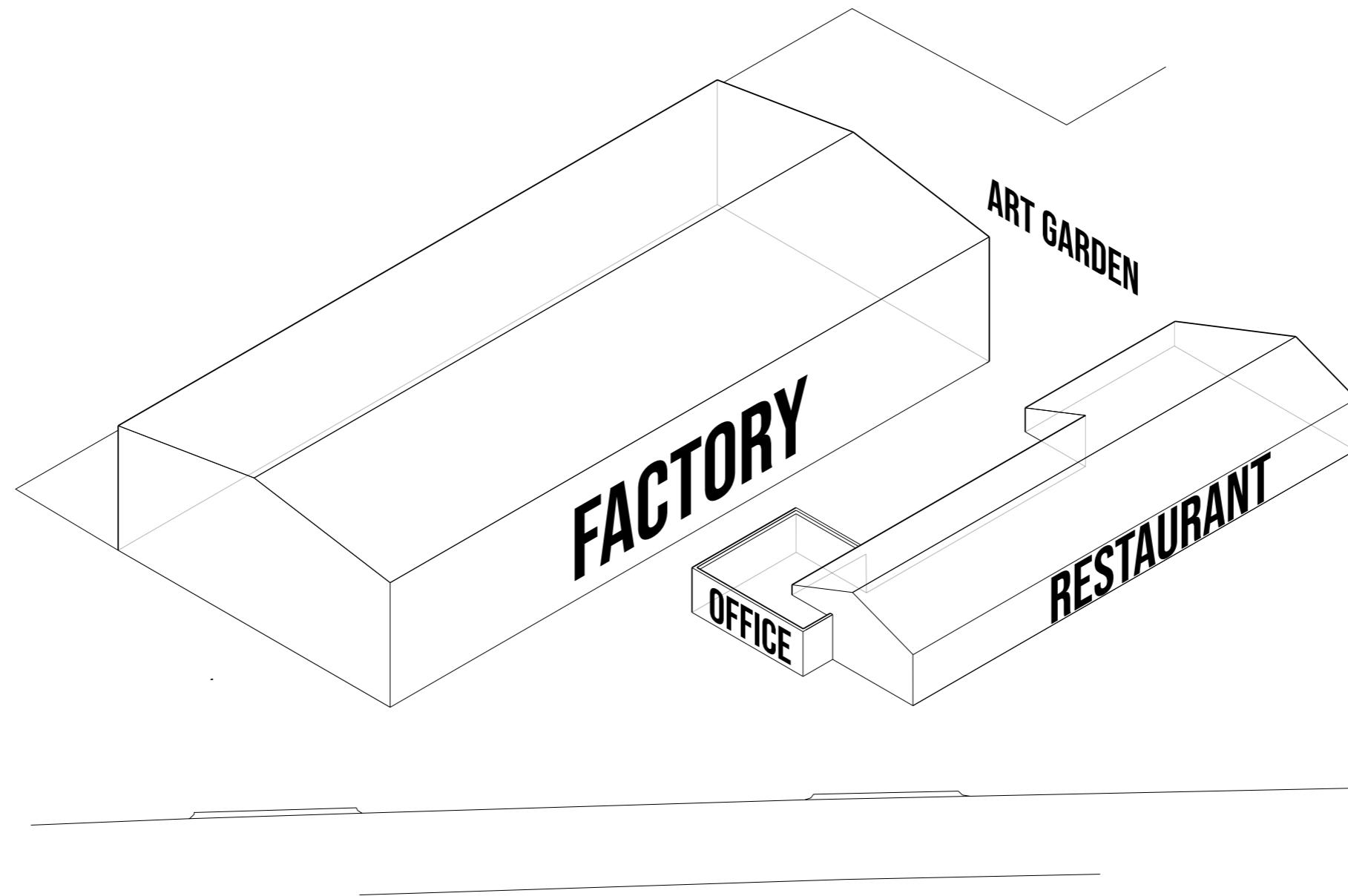
Current situation hall 1

LOCATION



Current situation hall 2

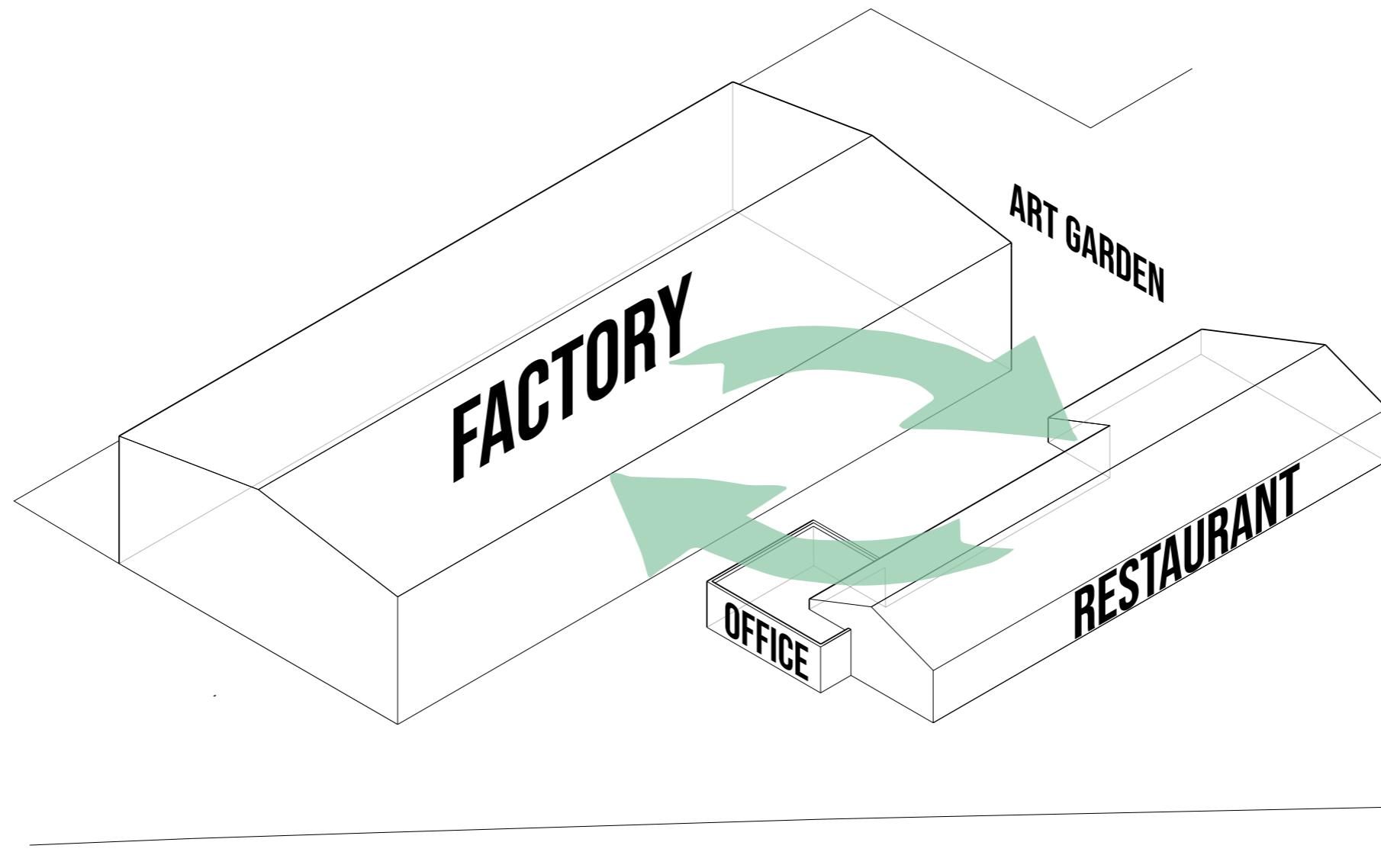
DESIGN



Program

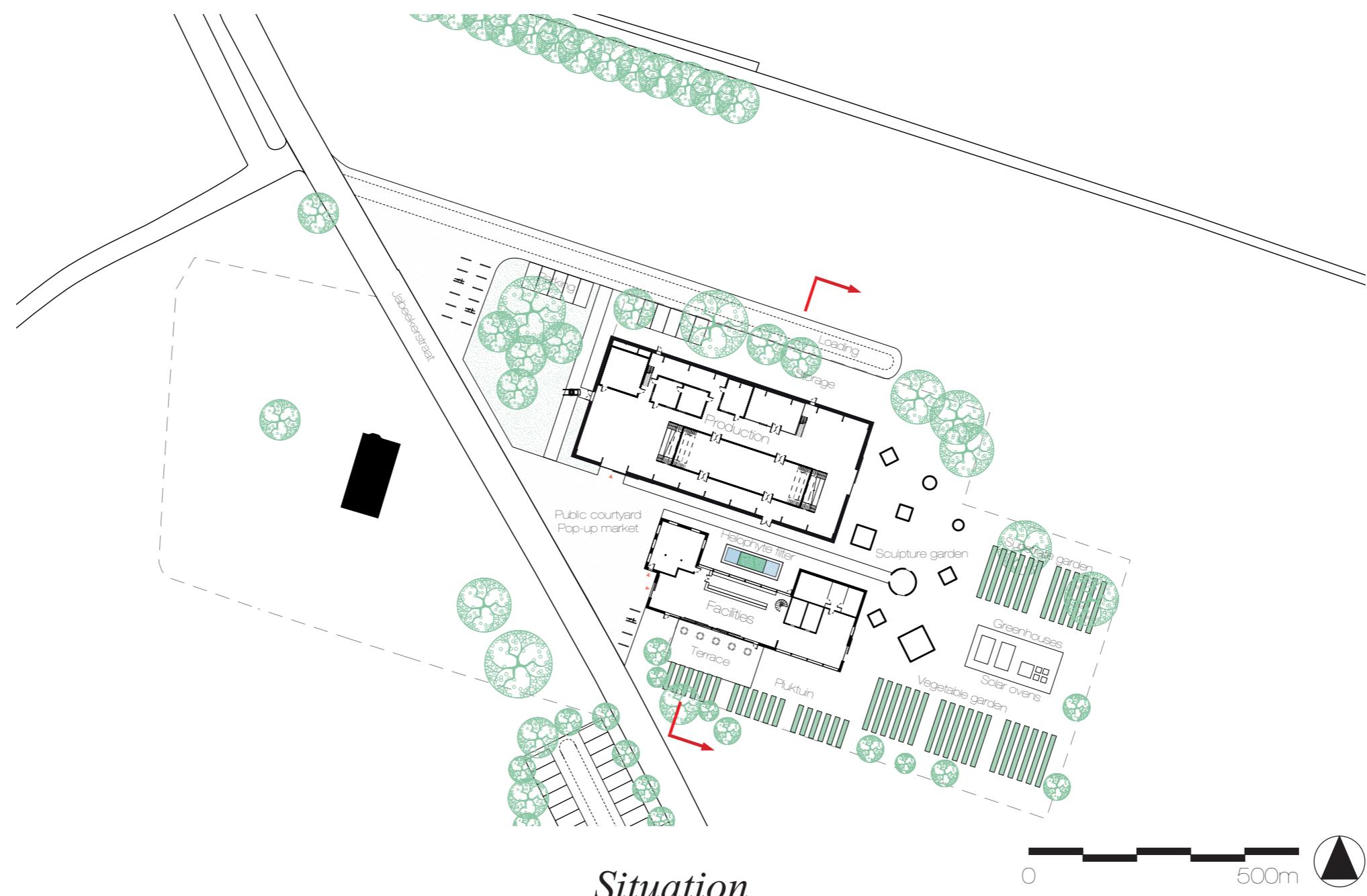
Implementing mycelium factory within vacant building

DESIGN

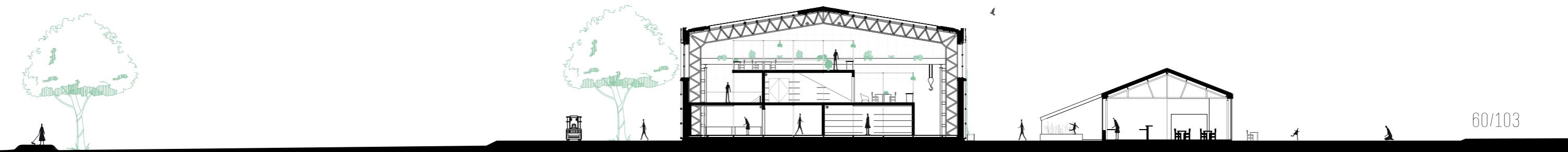


Circular system

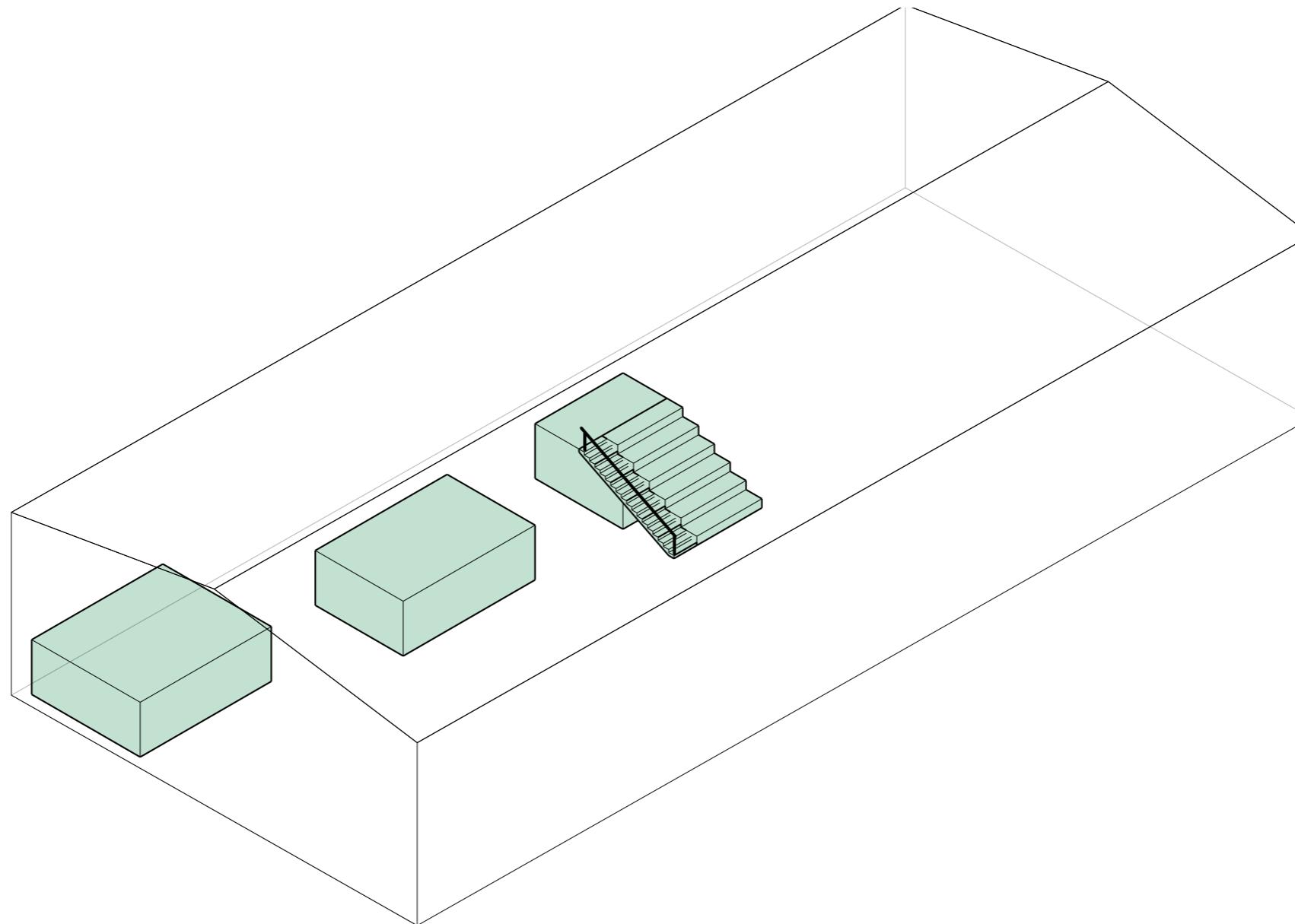
DESIGN



Situation

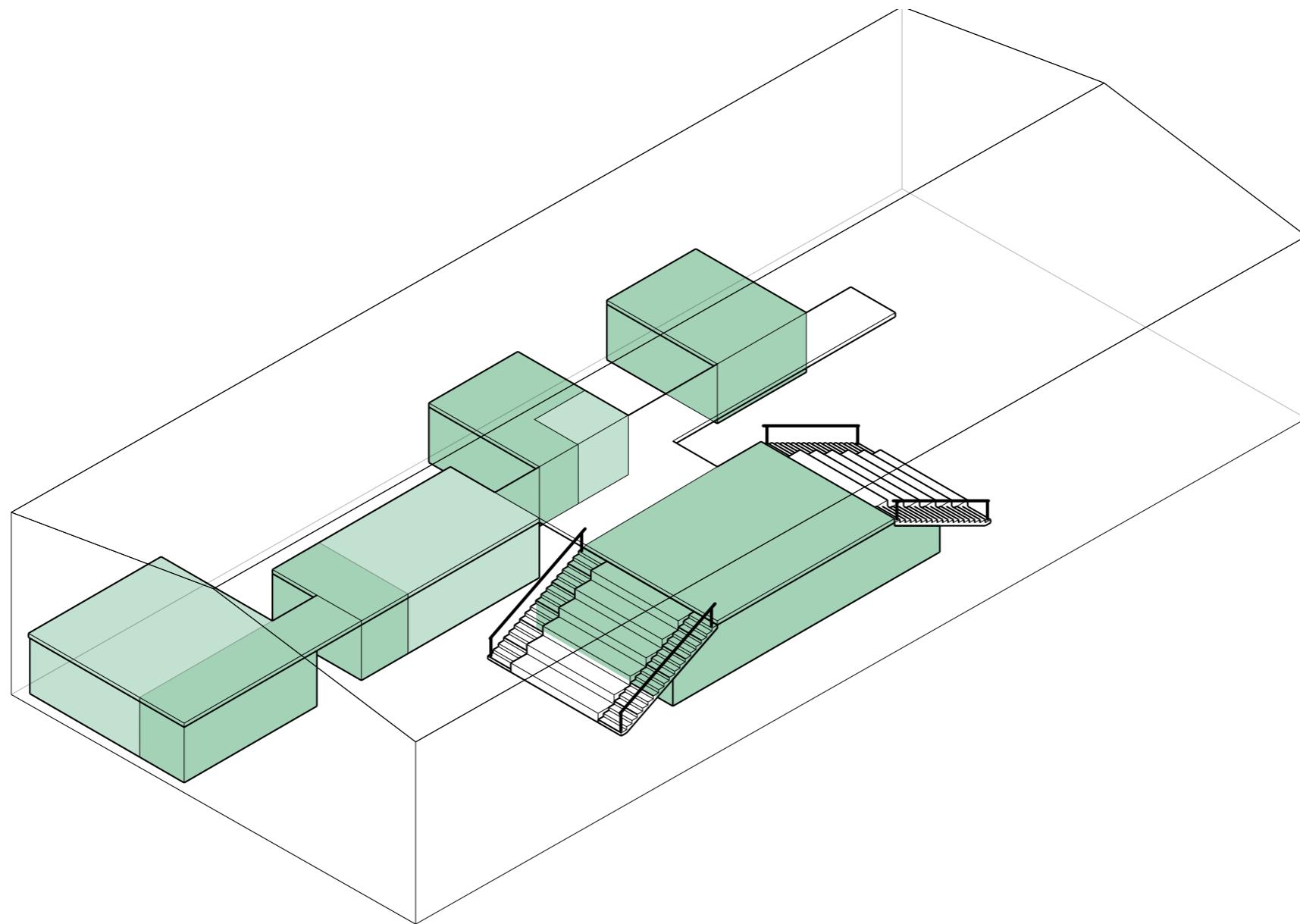


DESIGN



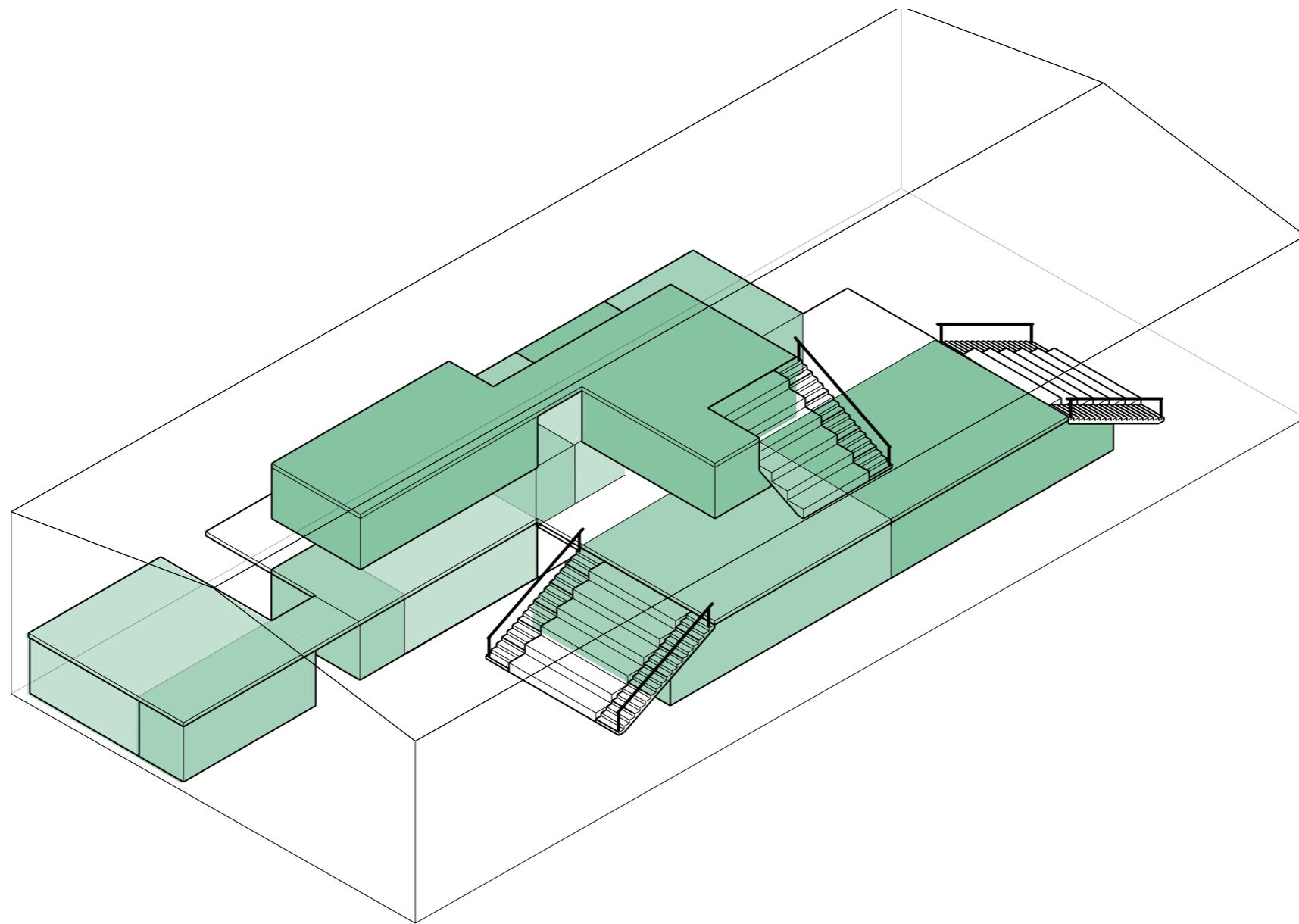
*Strategy:
Architecture that grows with its needs
Phase 1*

DESIGN



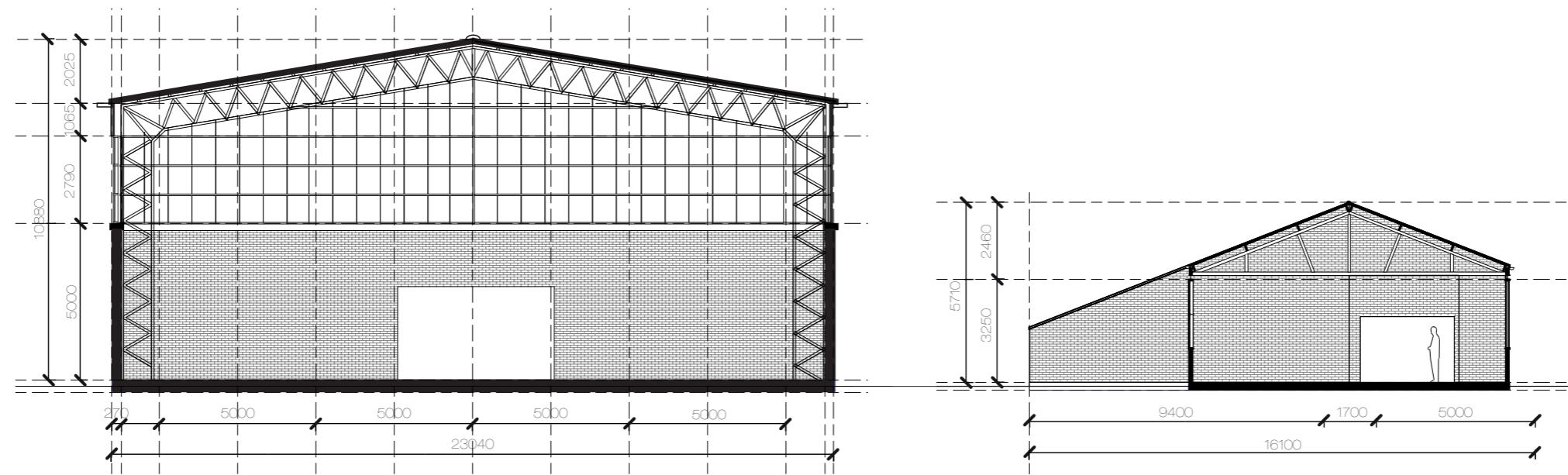
*Strategy:
Architecture that grows with its needs
Phase 2*

DESIGN



*Strategy:
Architecture that grows with its needs
Phase 3*

LOCATION

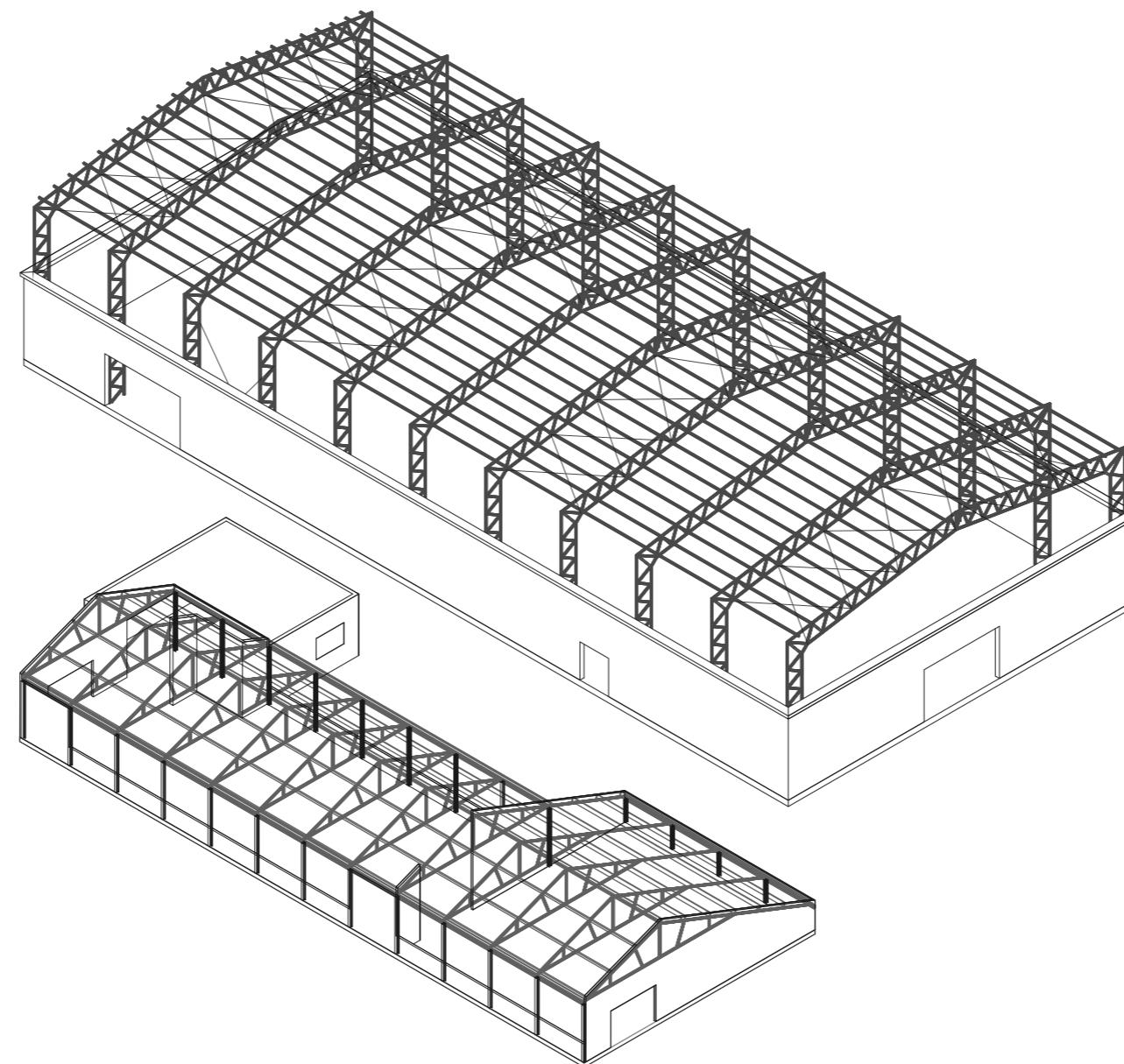


Hall 1
Section AA
Scale 1:200

Hall 2
Section AA
Scale 1:200

Current situation

BUILDING



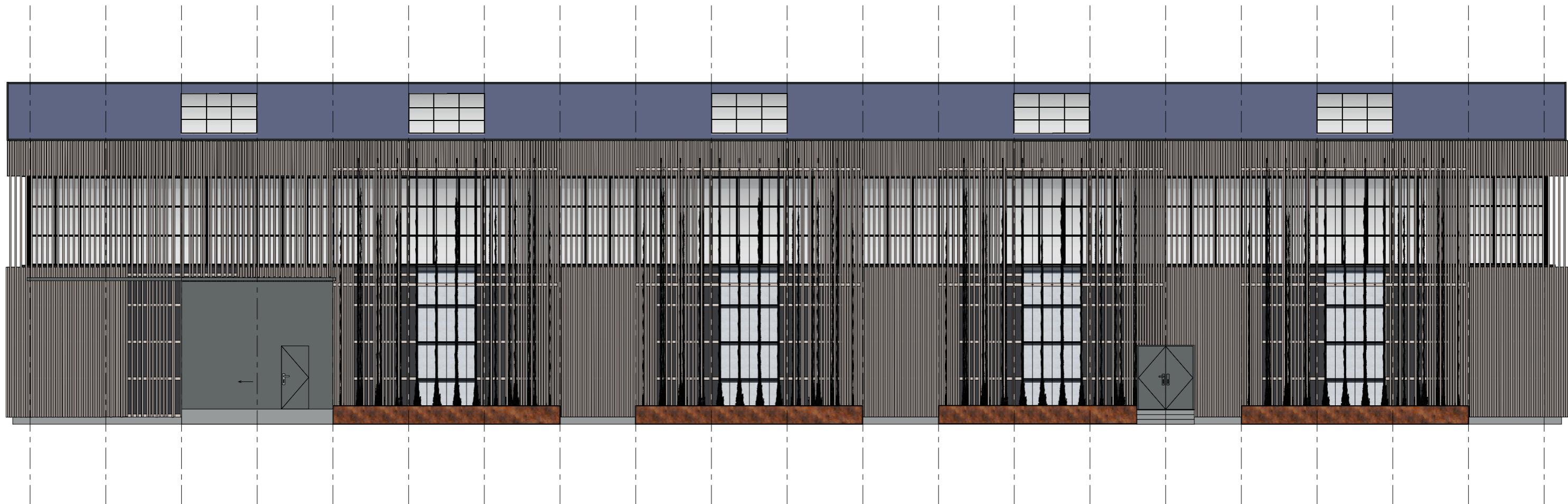
*Jón Kristinsson:
“Sustainability is everything that future generations want to inherit, use and maintain”*

LOCATION



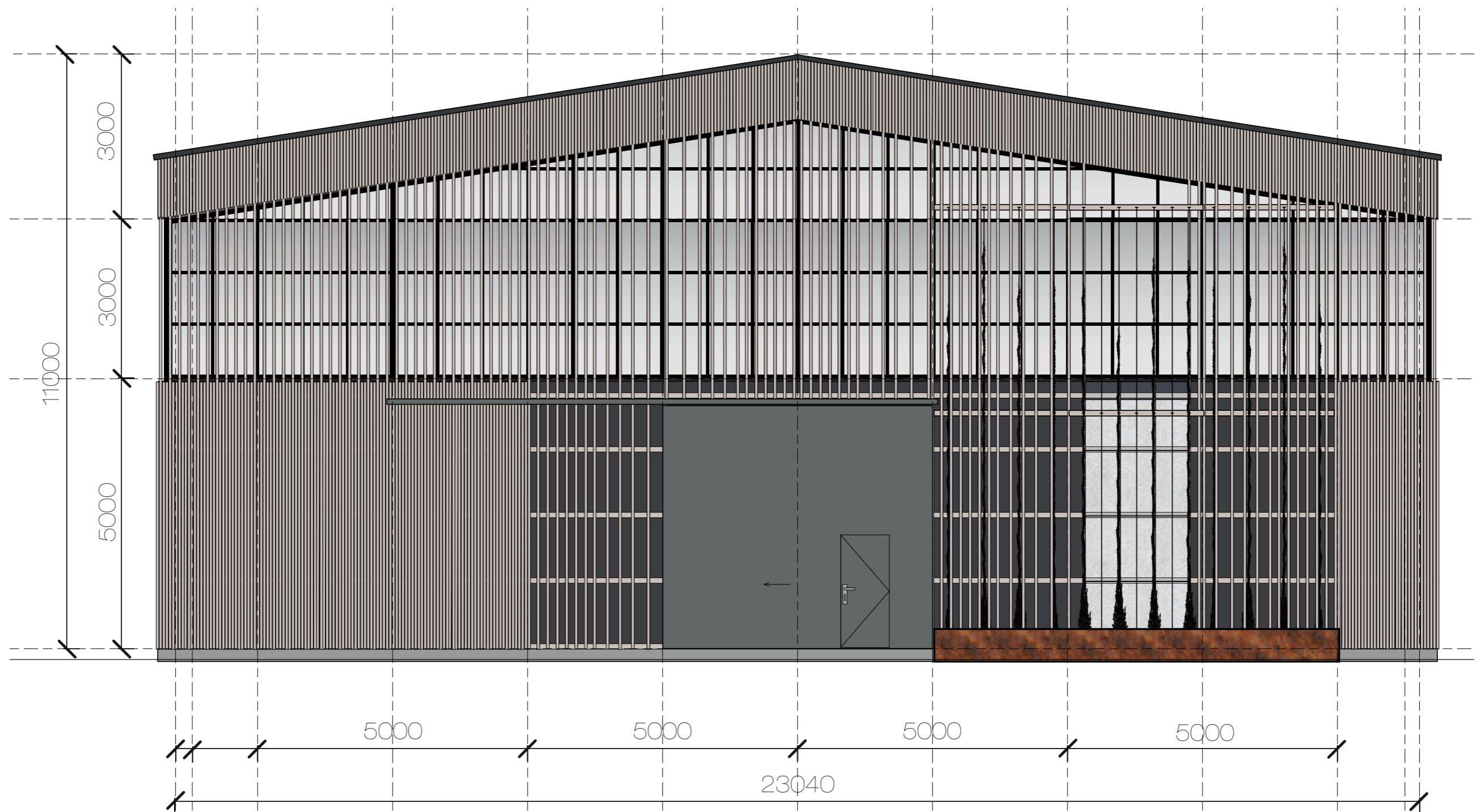
Current facade

DESIGN



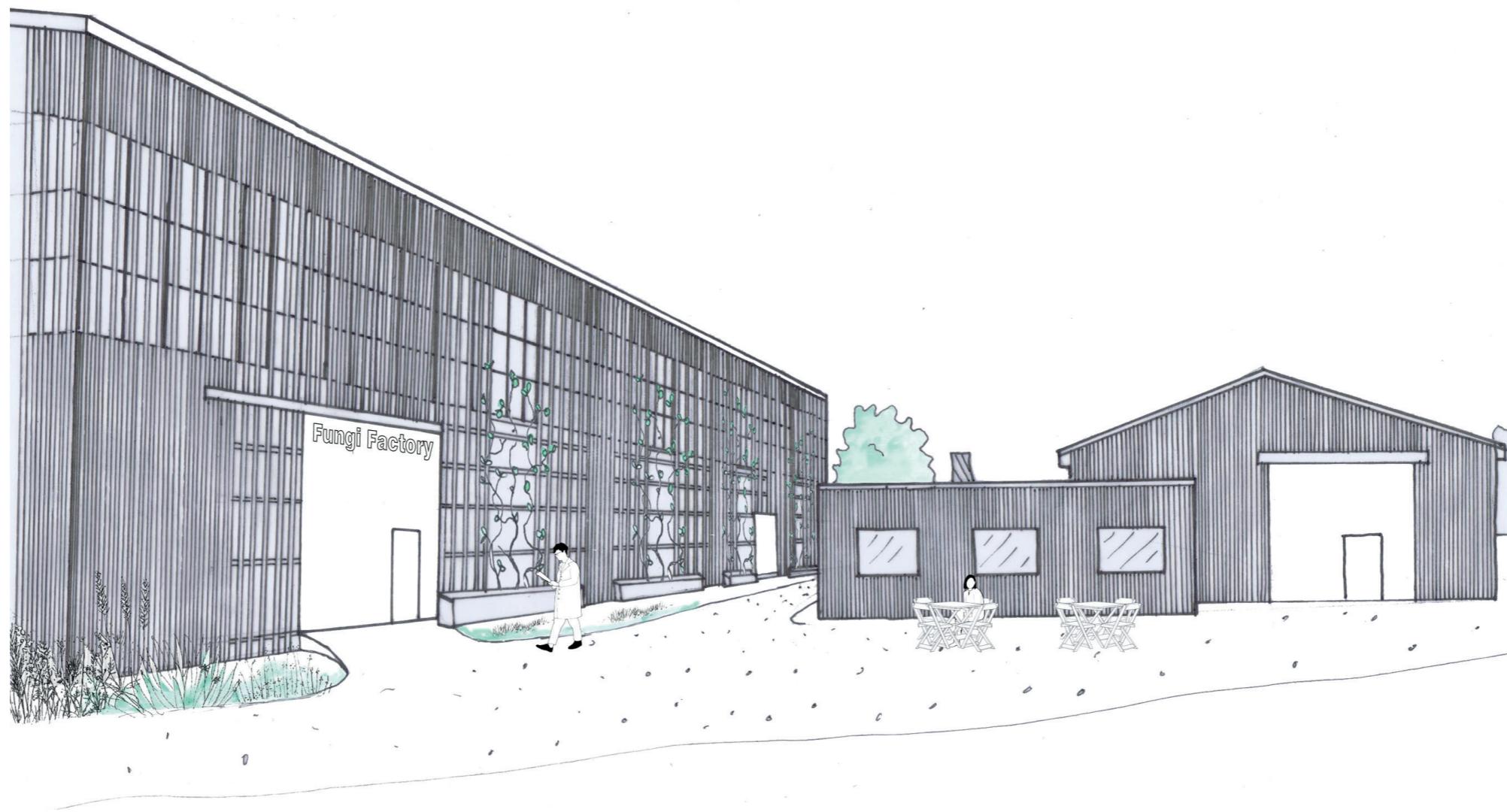
*Production hall
South elevation*

DESIGN



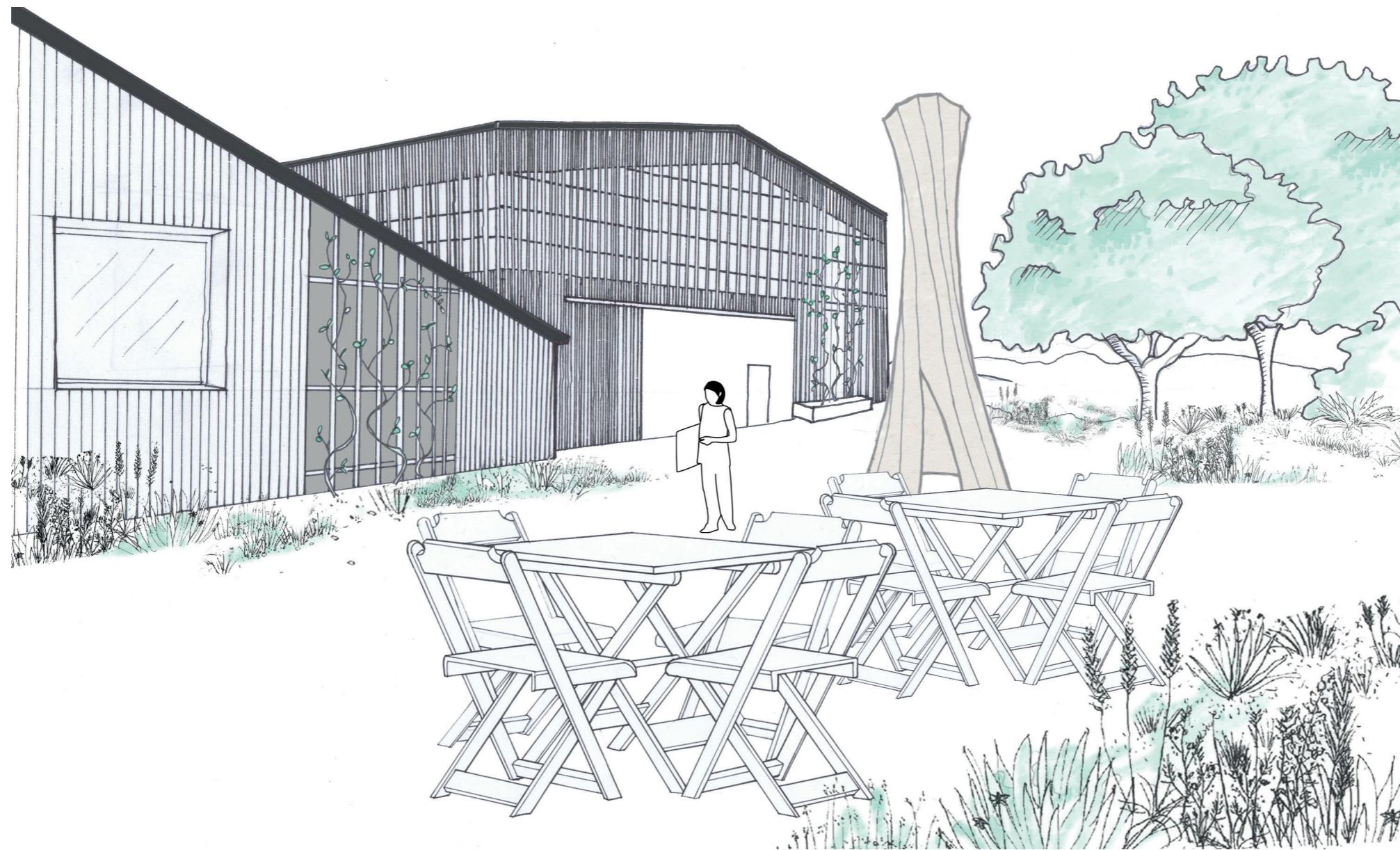
*Production hall
East elevation*

DESIGN



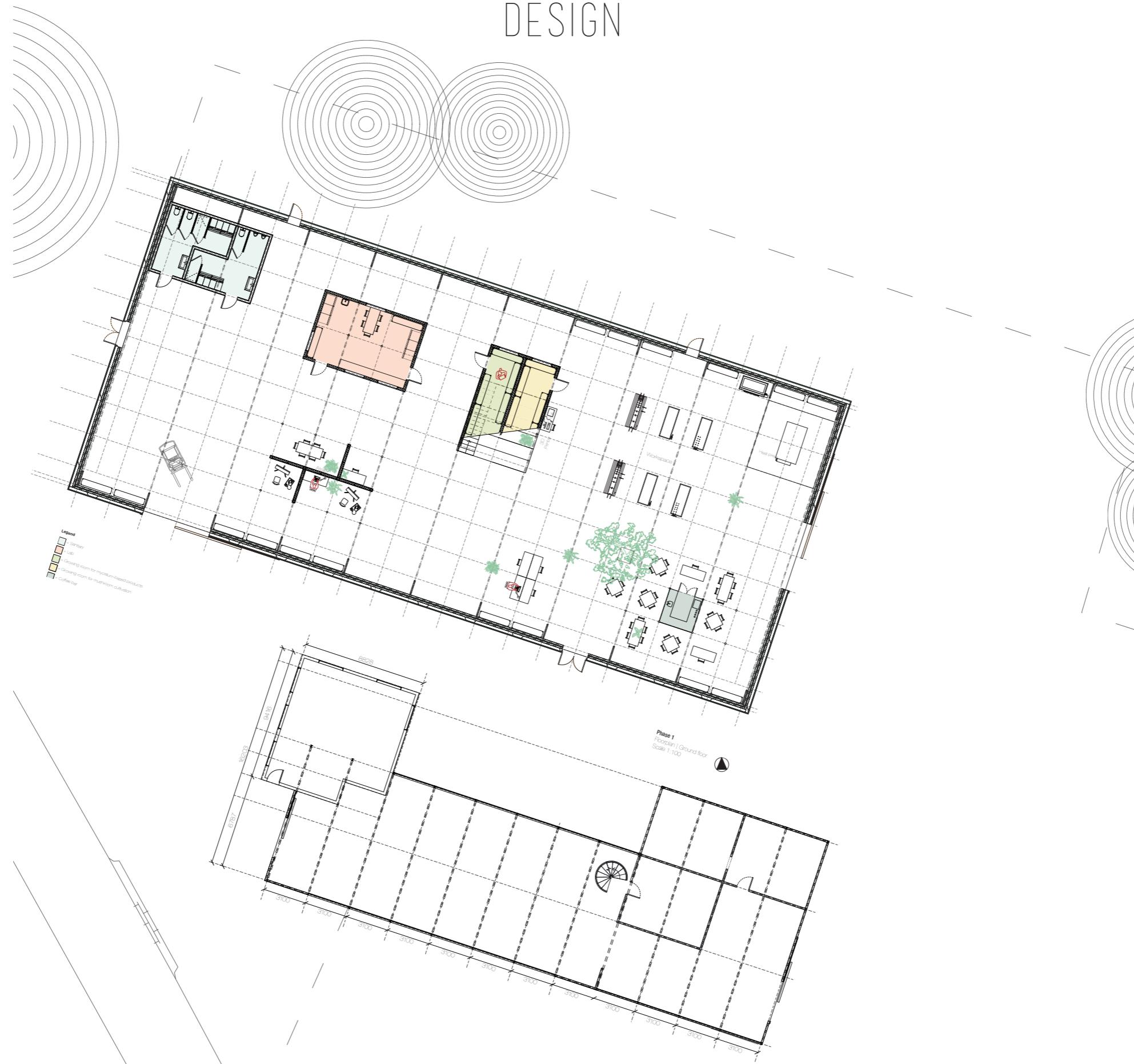
Entrance

DESIGN



Sculpture garden

DESIGN



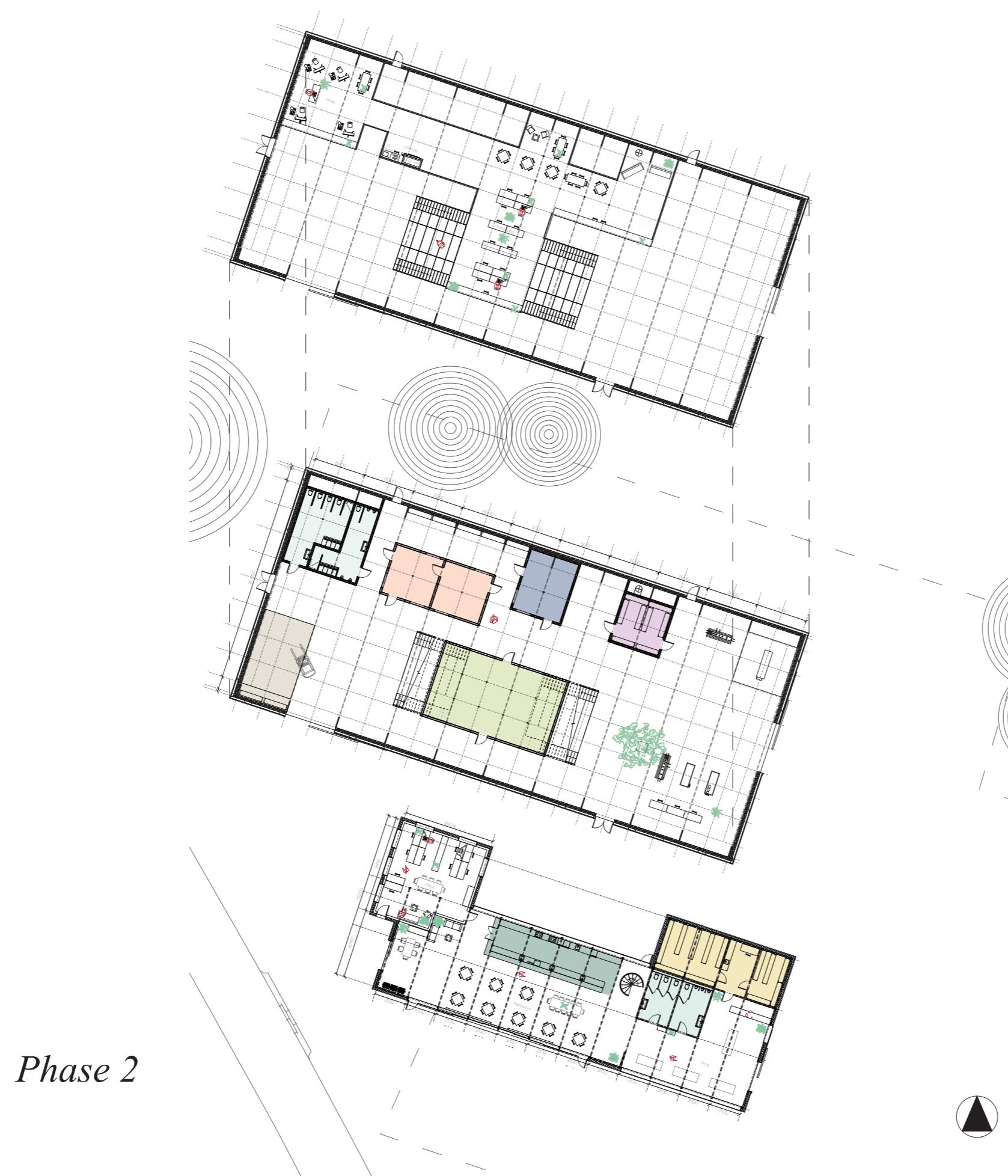
Phase 1

DESIGN

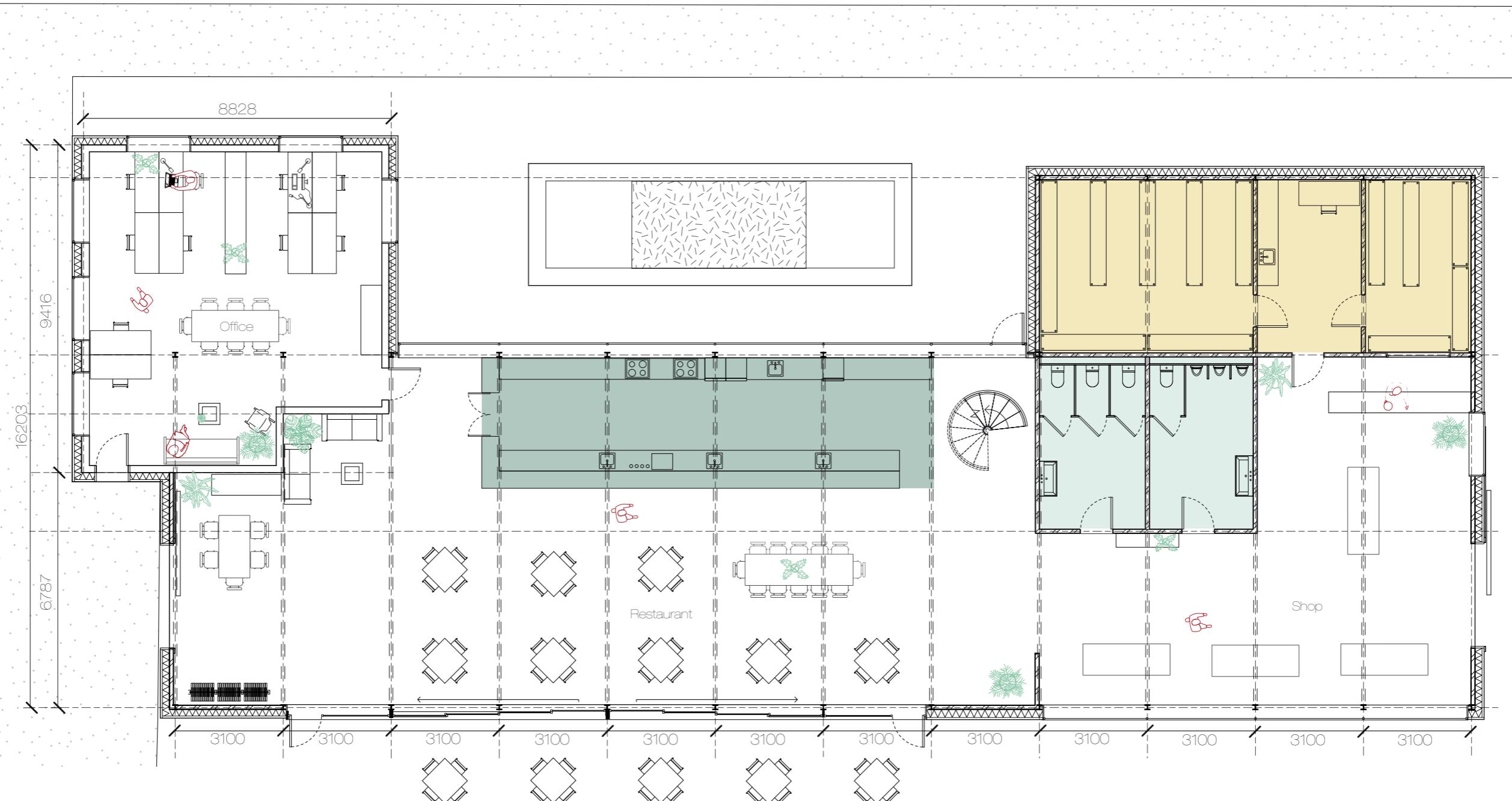


*Production hall phase 1
Floorplan*

DESIGN

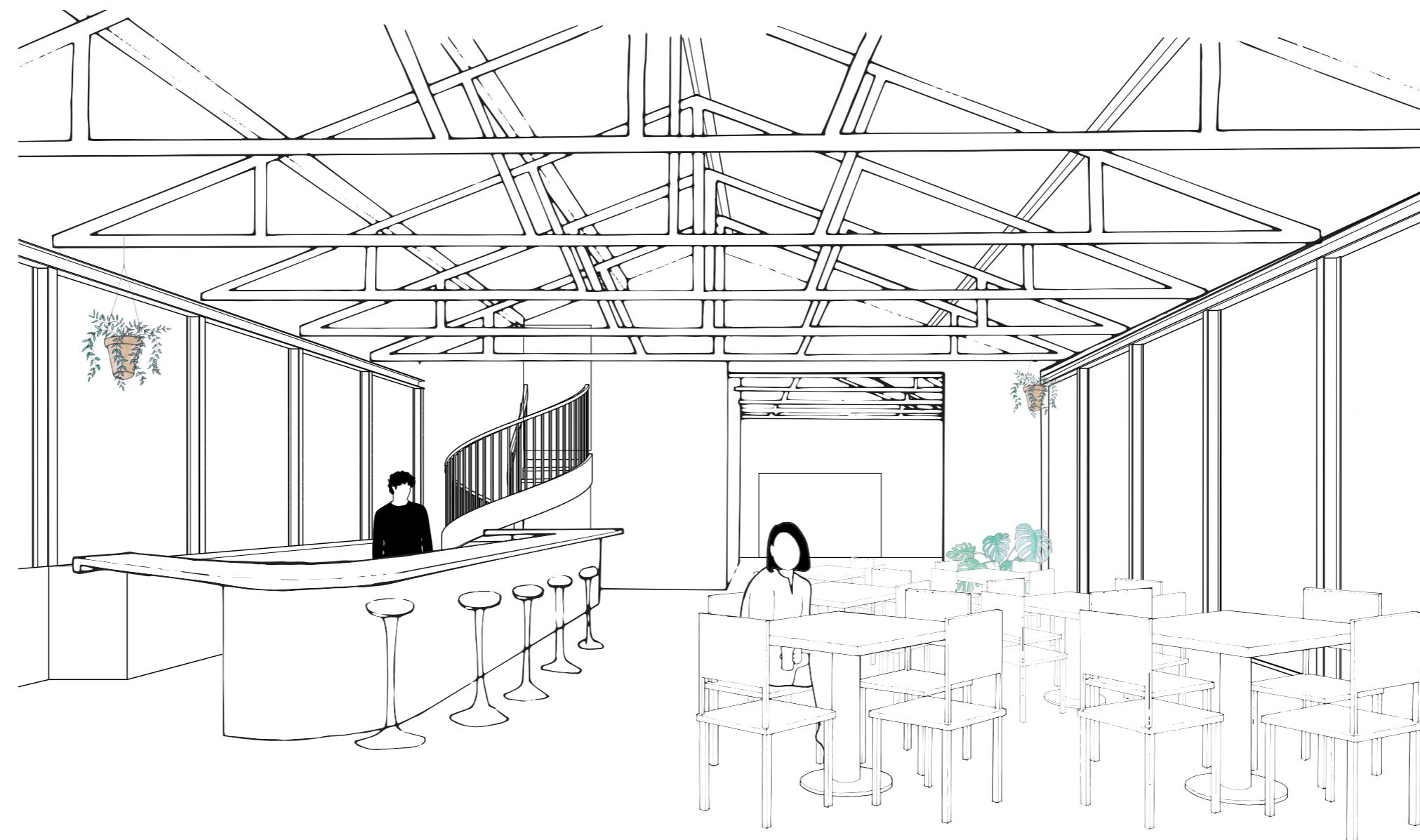


DESIGN



*Facility hall phase 2
Ground level*

DESIGN



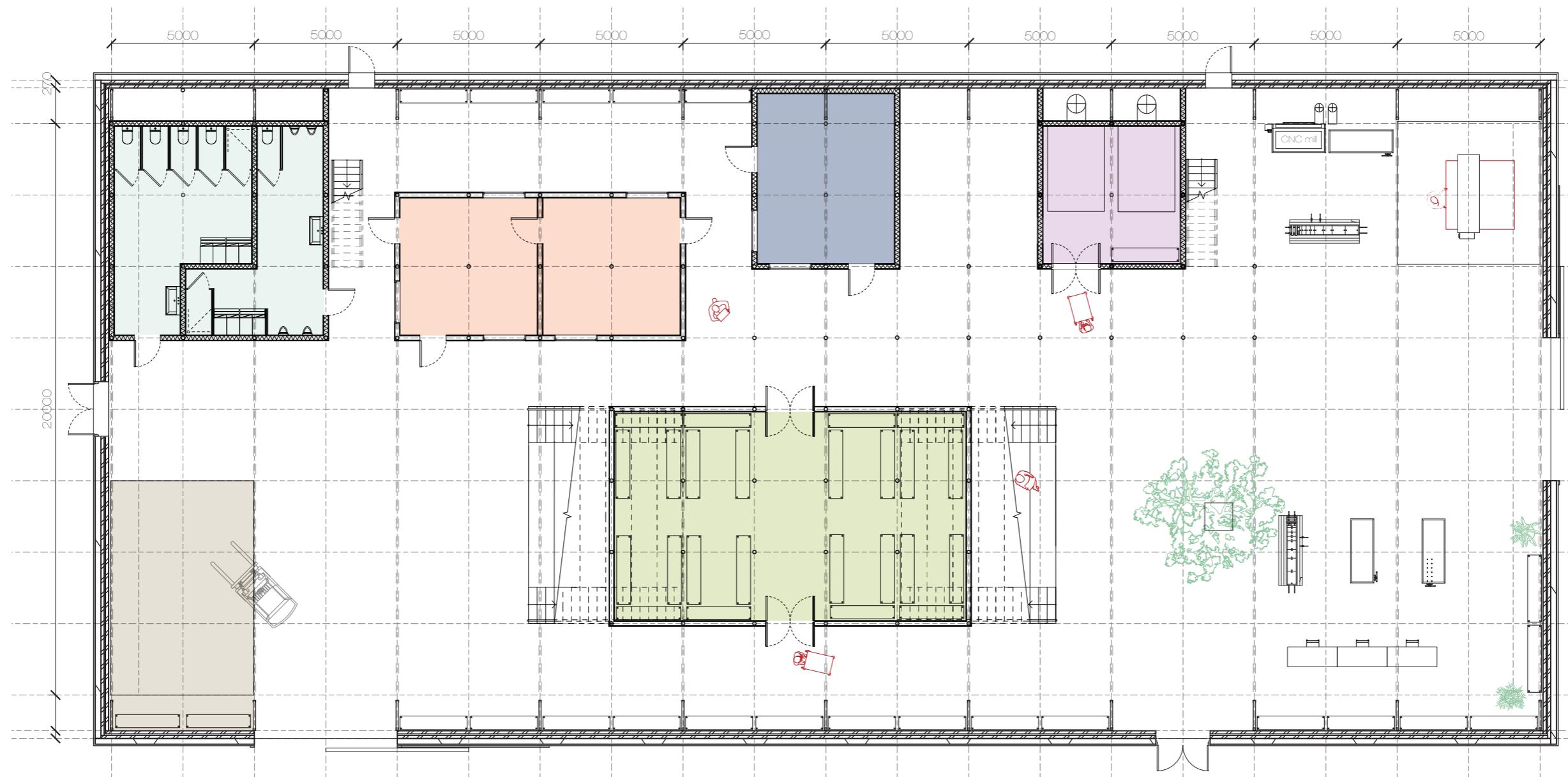
Restaurant

DESIGN



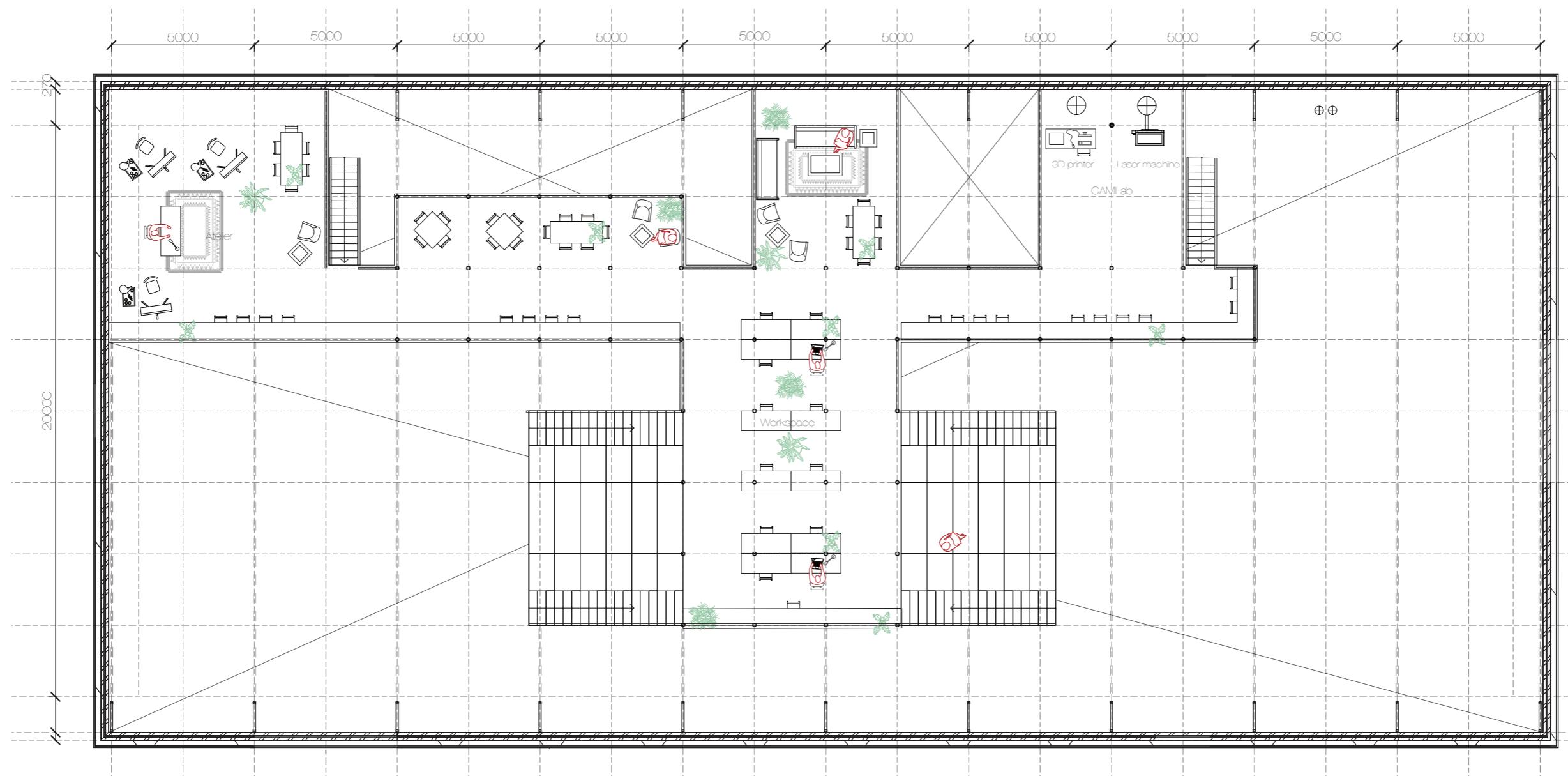
Helophyte filter

DESIGN



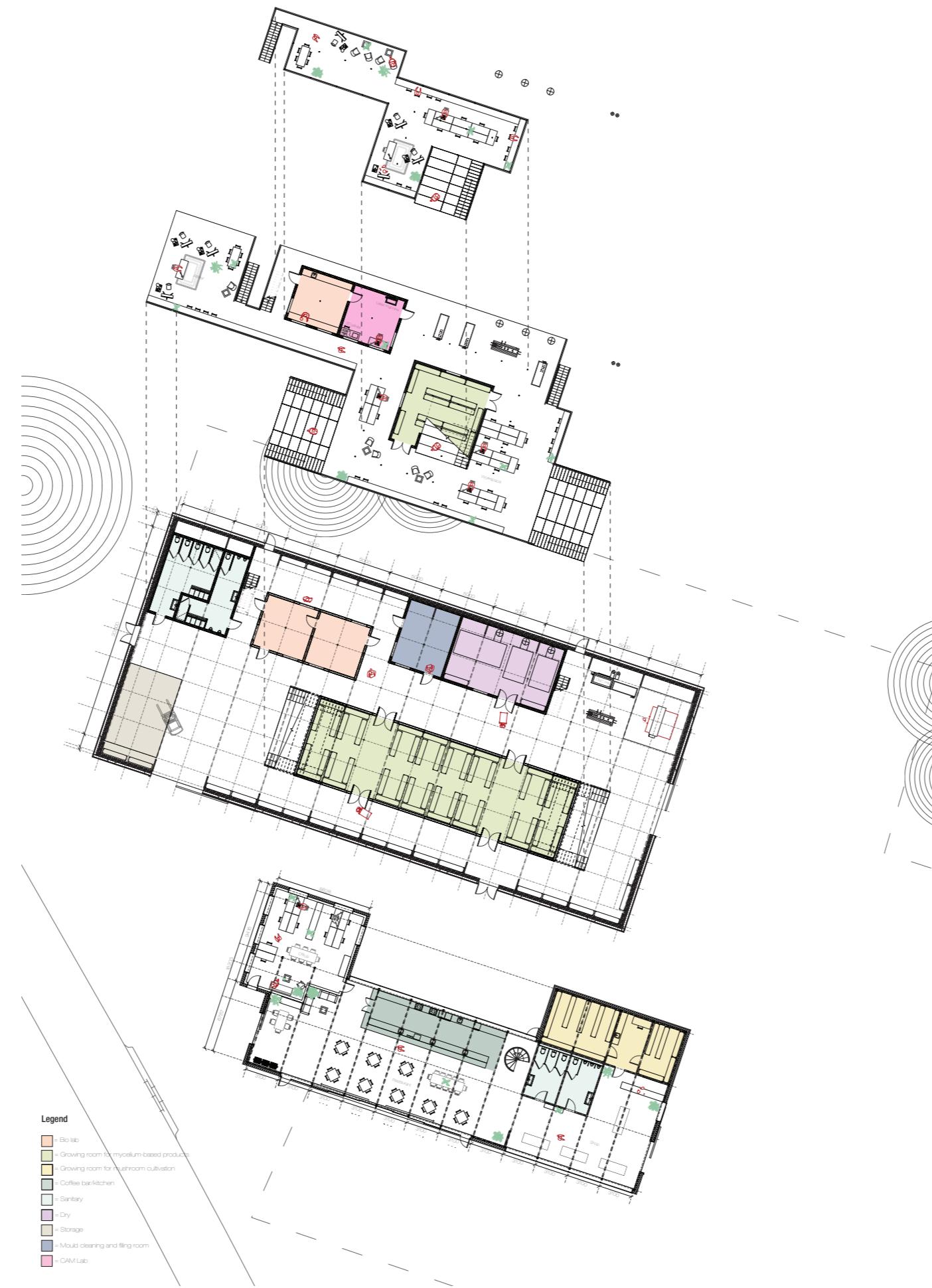
Floorplan phase 2 Ground level

DESIGN



*Floorplan phase 2
First floor*

DESIGN



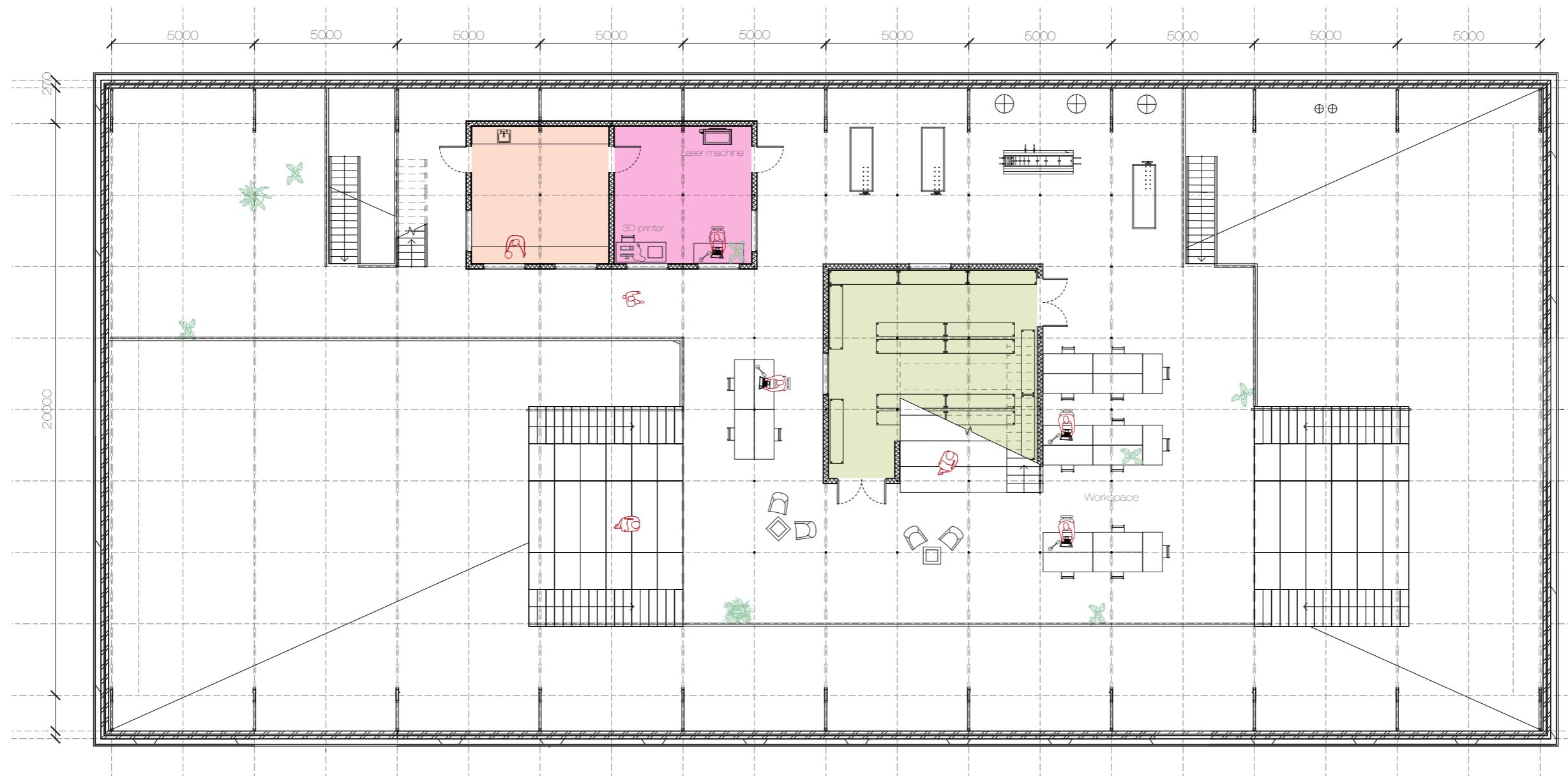
Phase 3

DESIGN



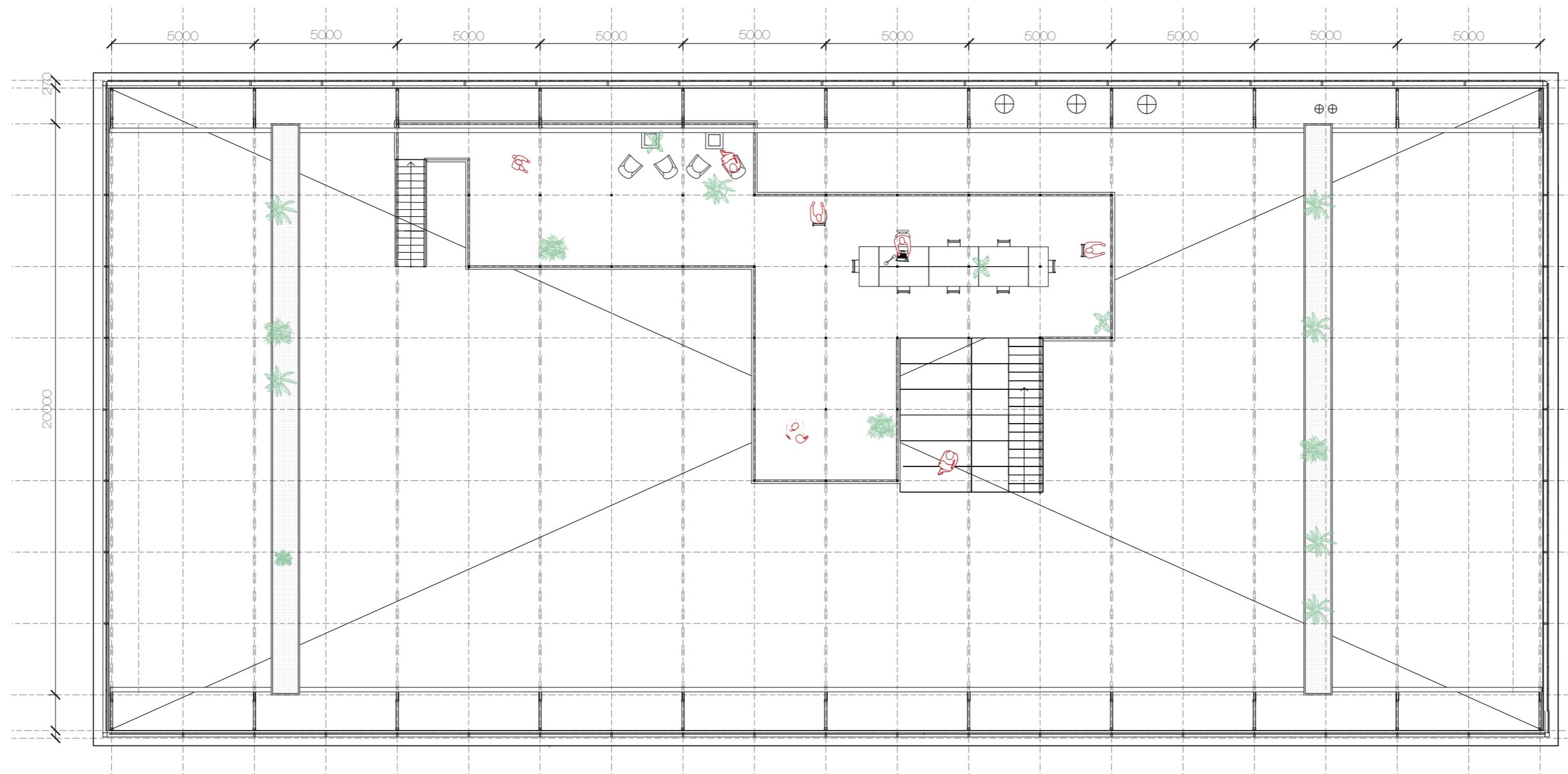
*Floorplan phase 3
Ground level*

DESIGN



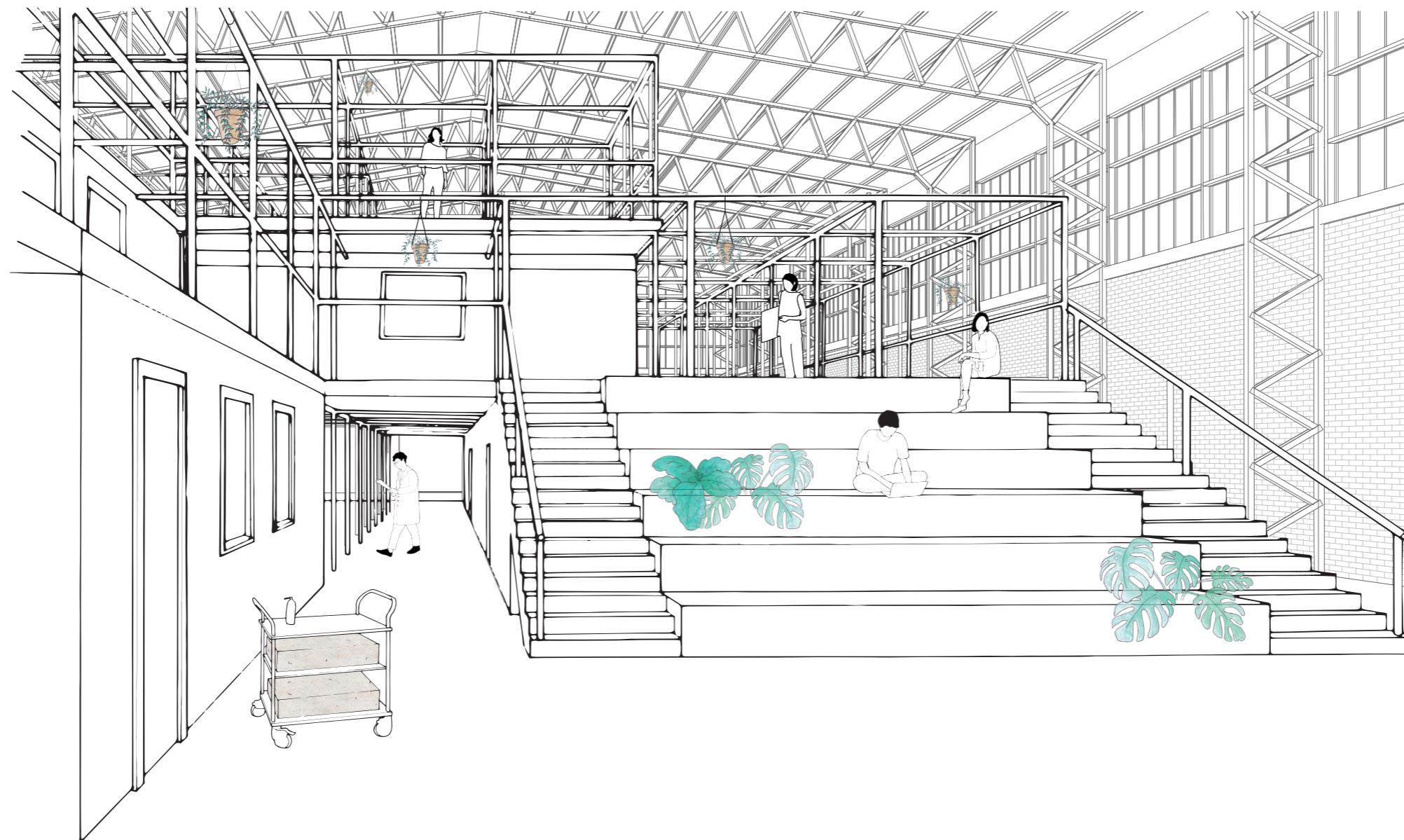
*Floorplan phase 3
First floor*

DESIGN



*Floorplan phase 3
Second floor*

DESIGN



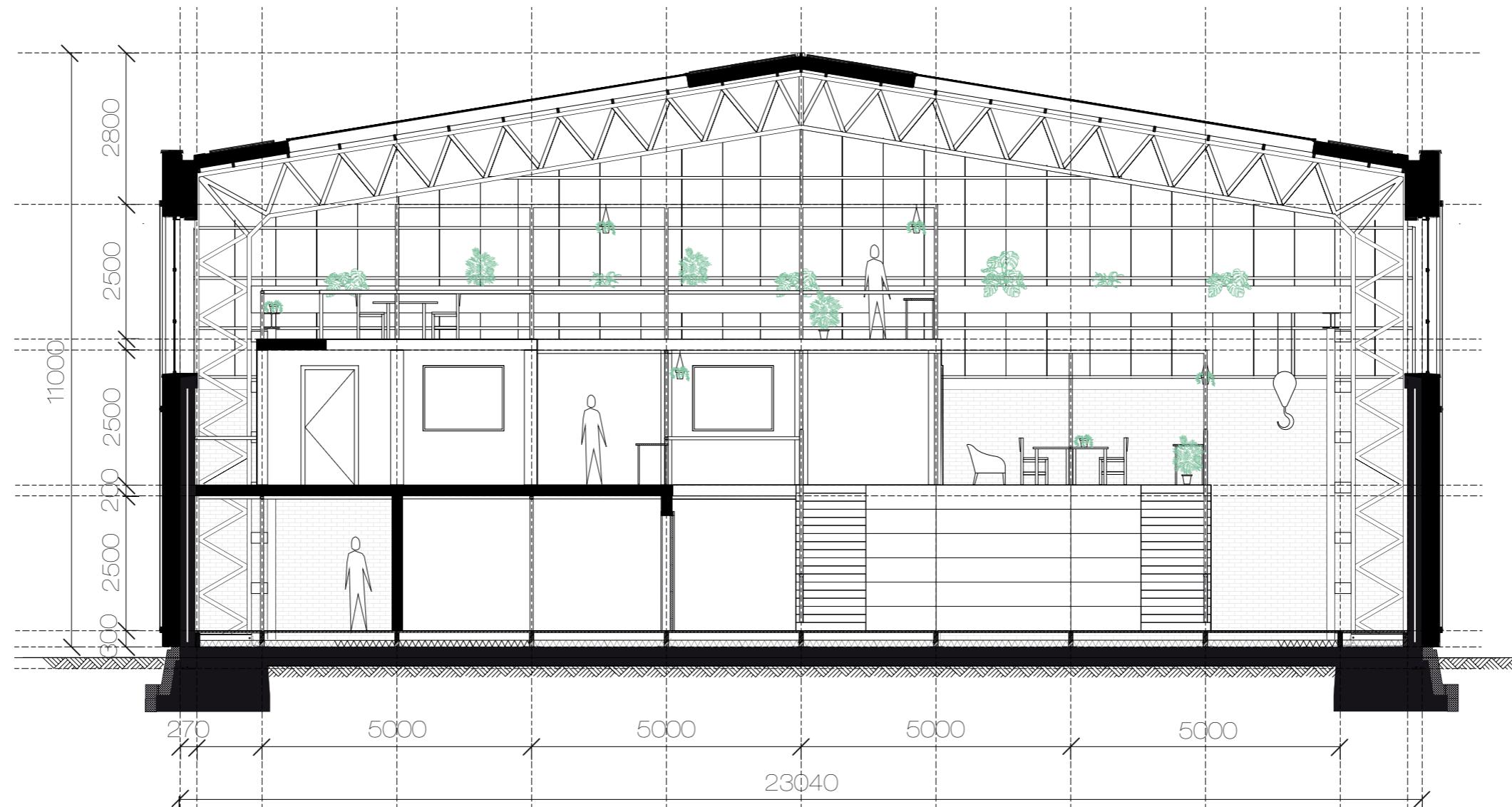
Production hall

DESIGN

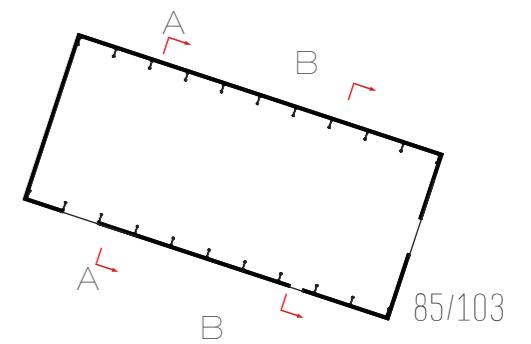


Production hall

DESIGN



Production hall
Section AA



DESIGN



Production hall

LOCATION



View to the north side

LOCATION



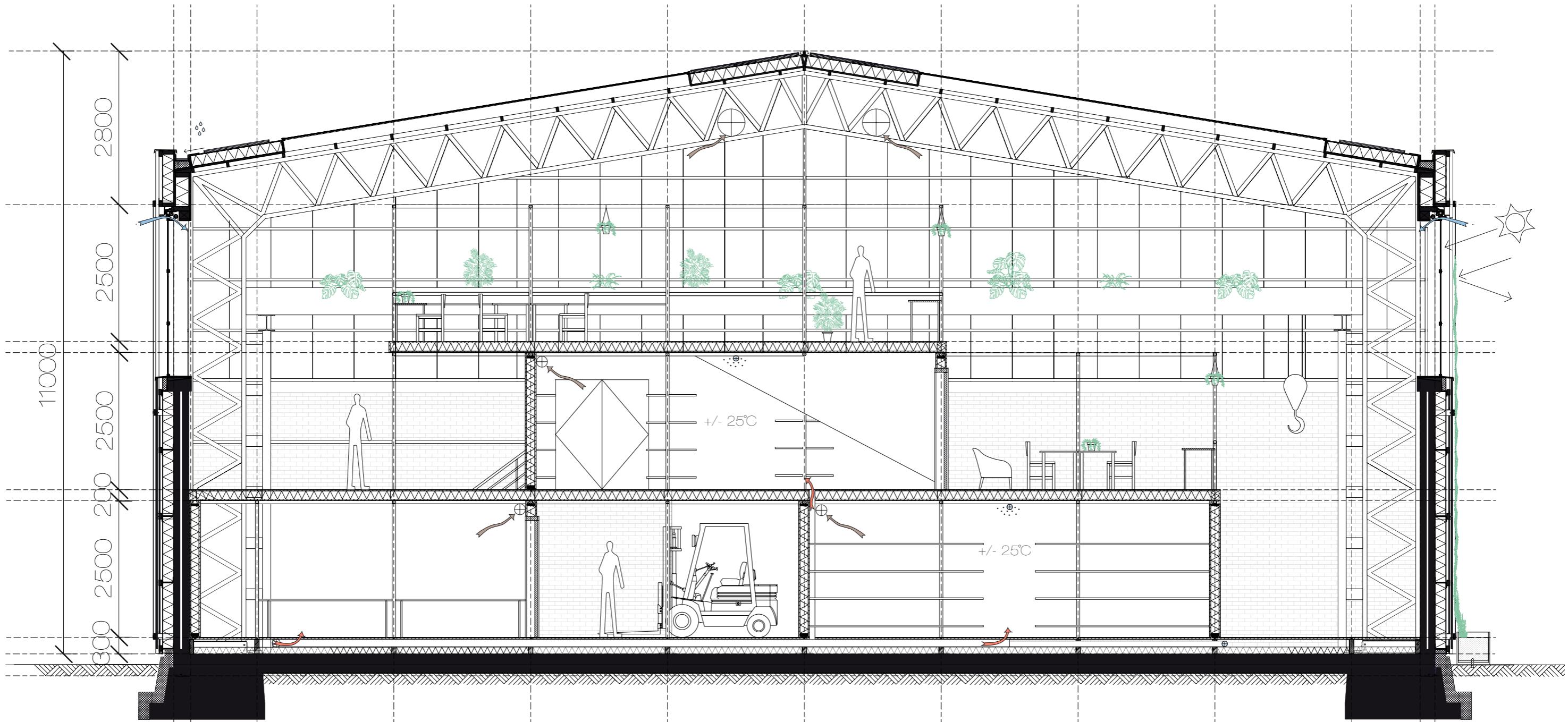
View to the east side

DESIGN

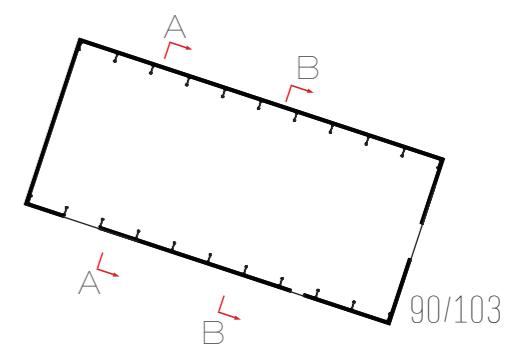


Production hall

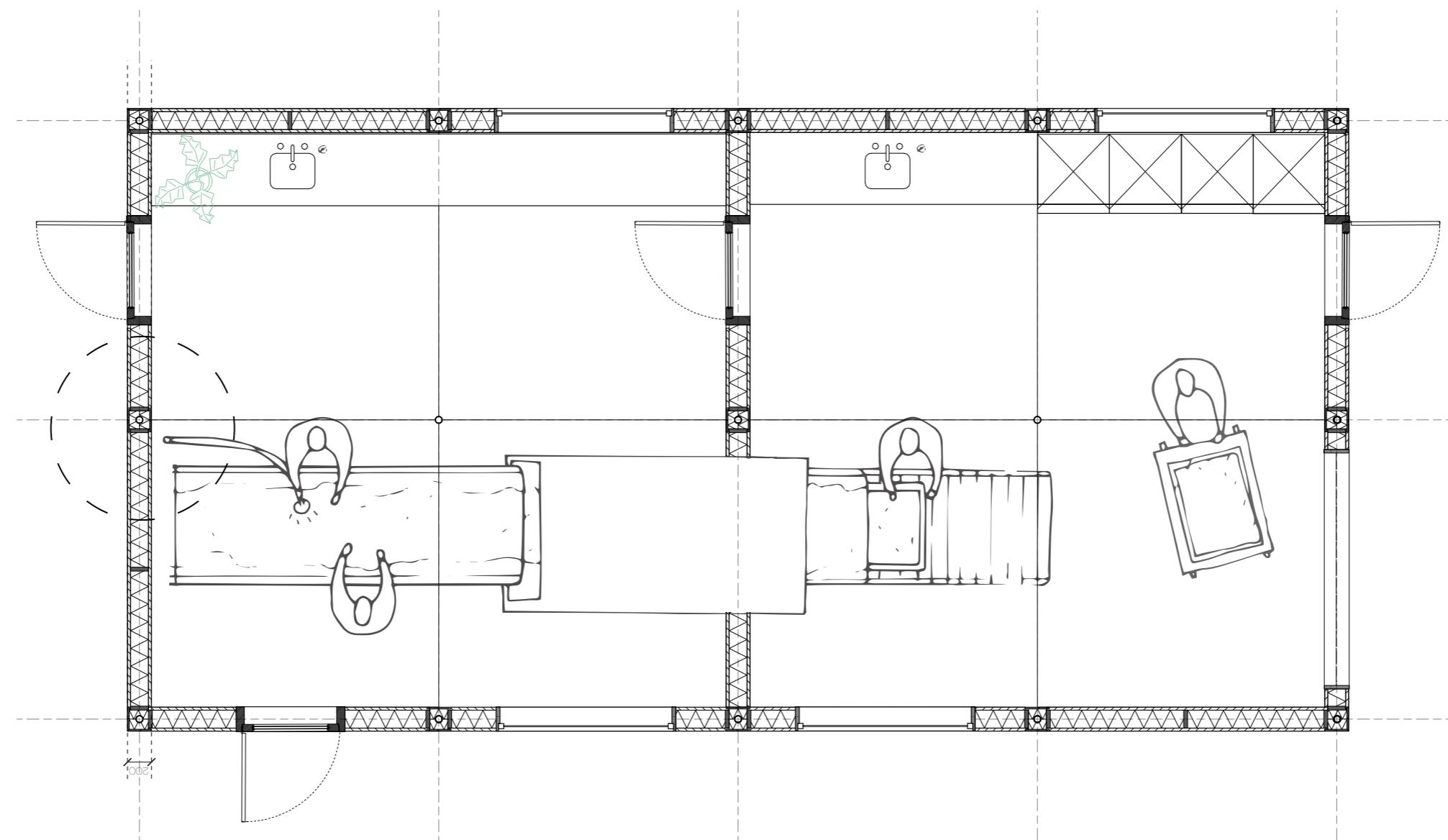
DESIGN



*Climate plan of Production hall
Section BB*

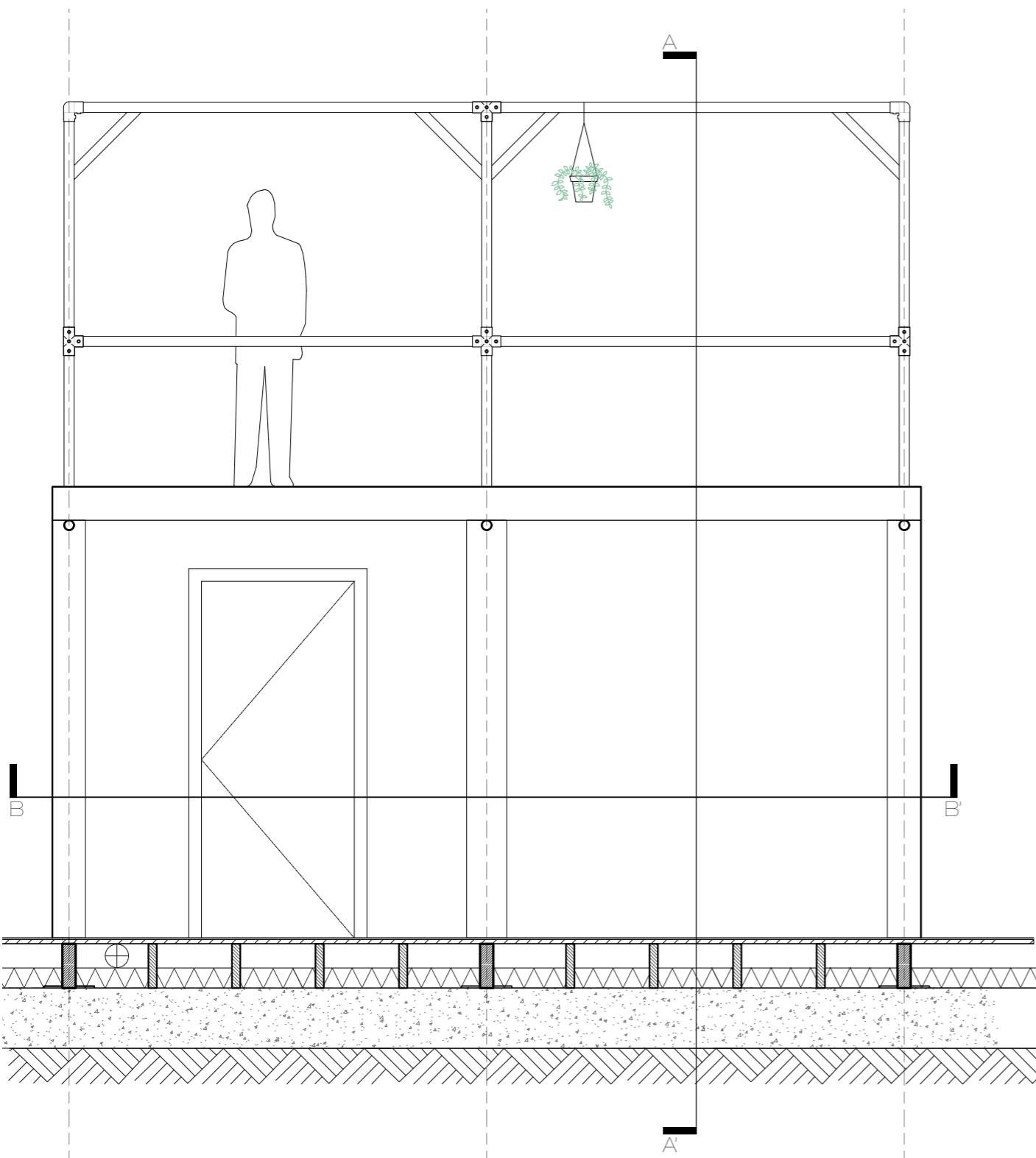


DESIGN

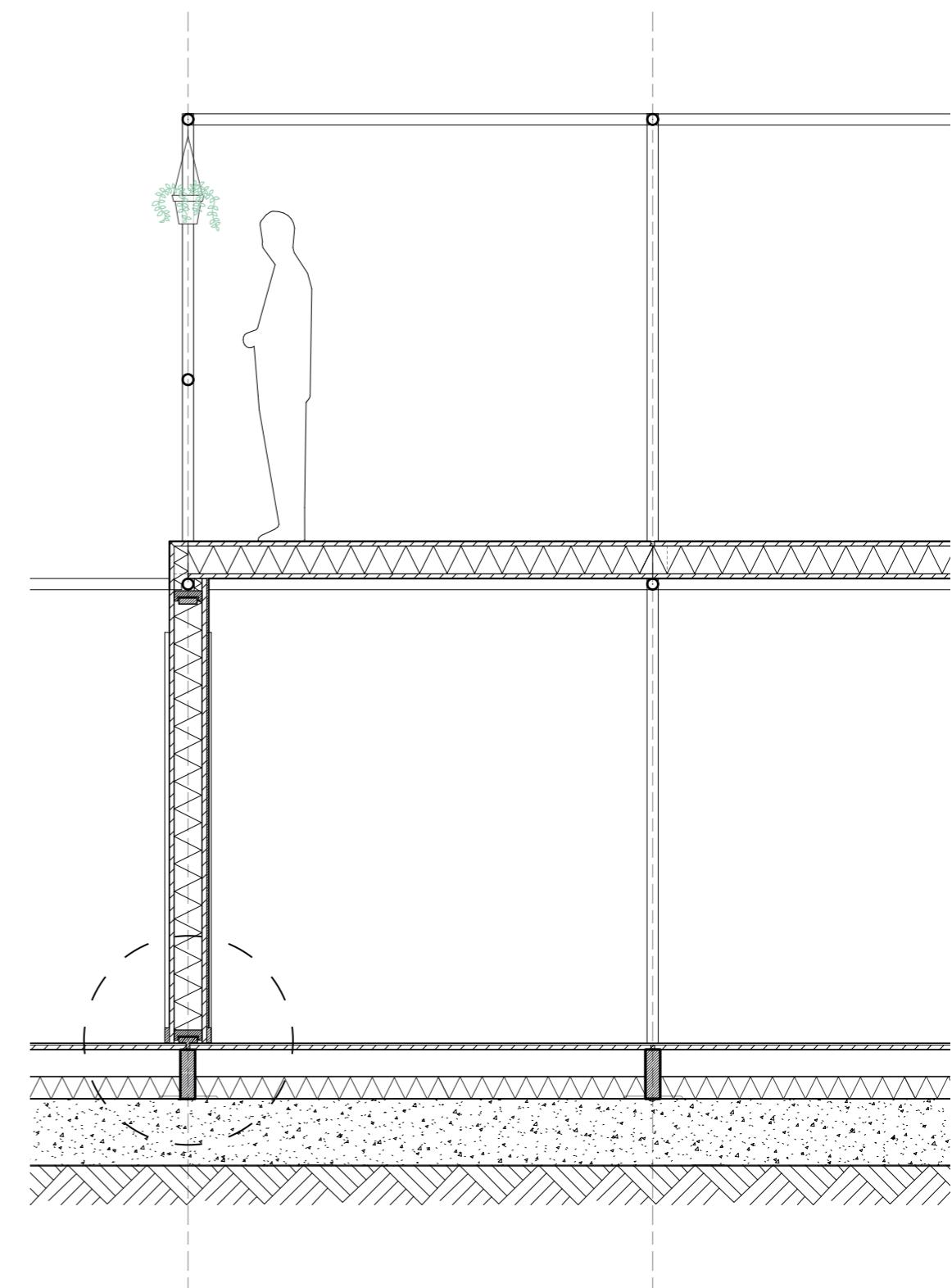


Inculcation lab

DESIGN

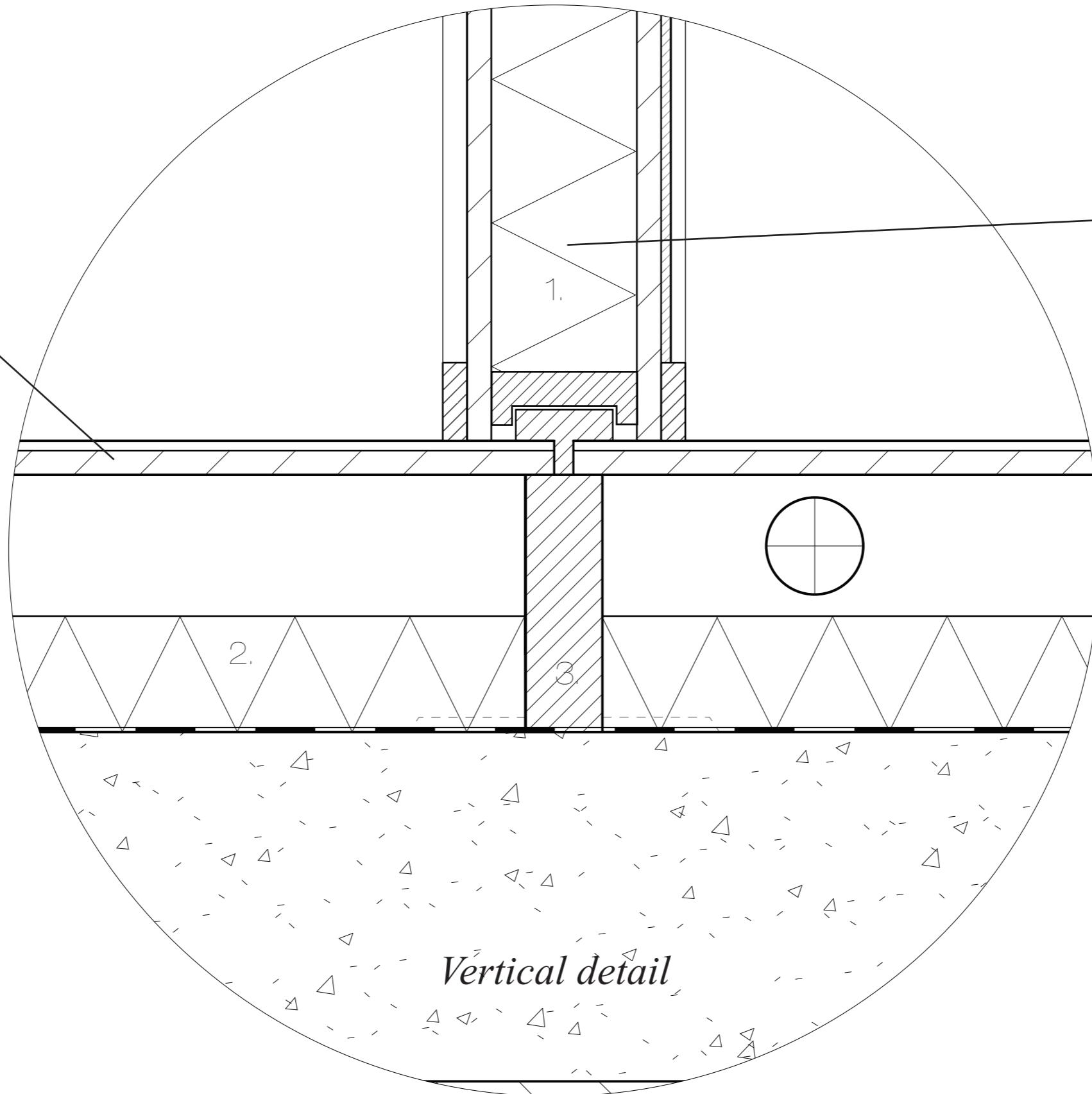


Facade fragment
Scale 1:20



Vertical section AA
1:20

DESIGN



DESIGN

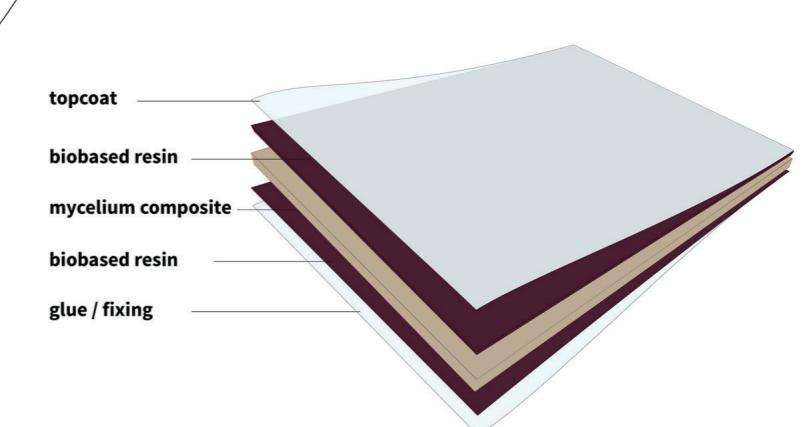
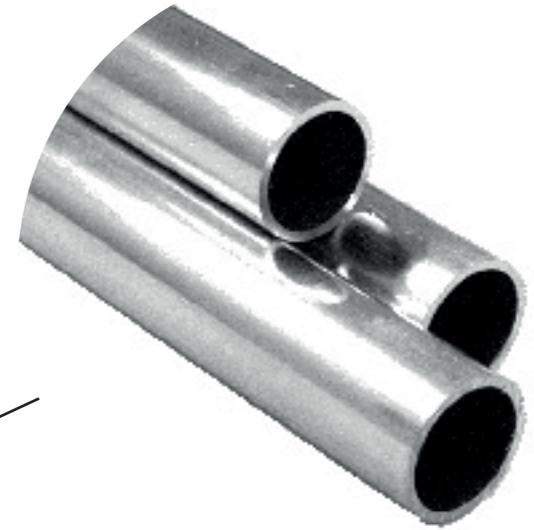
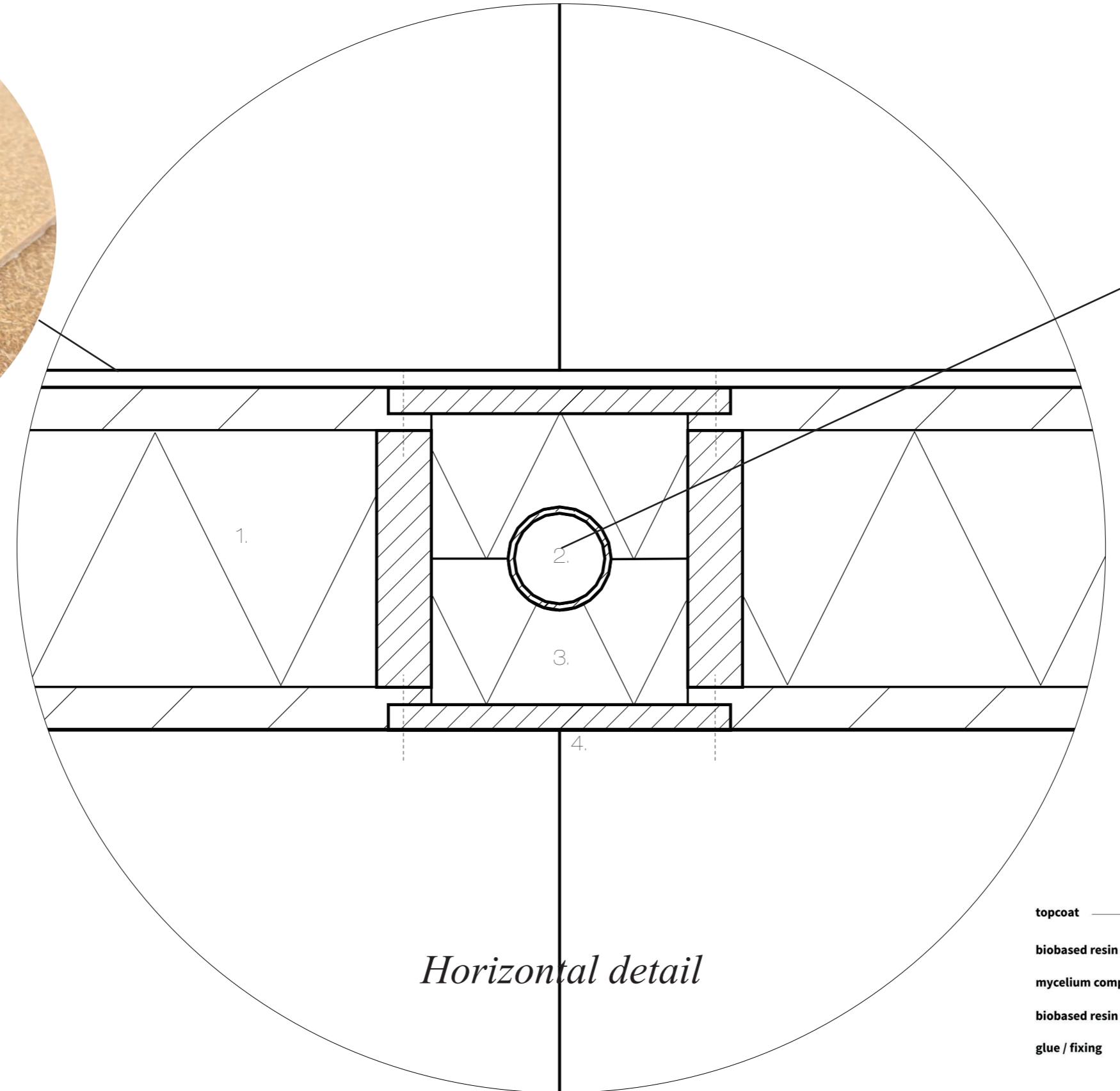
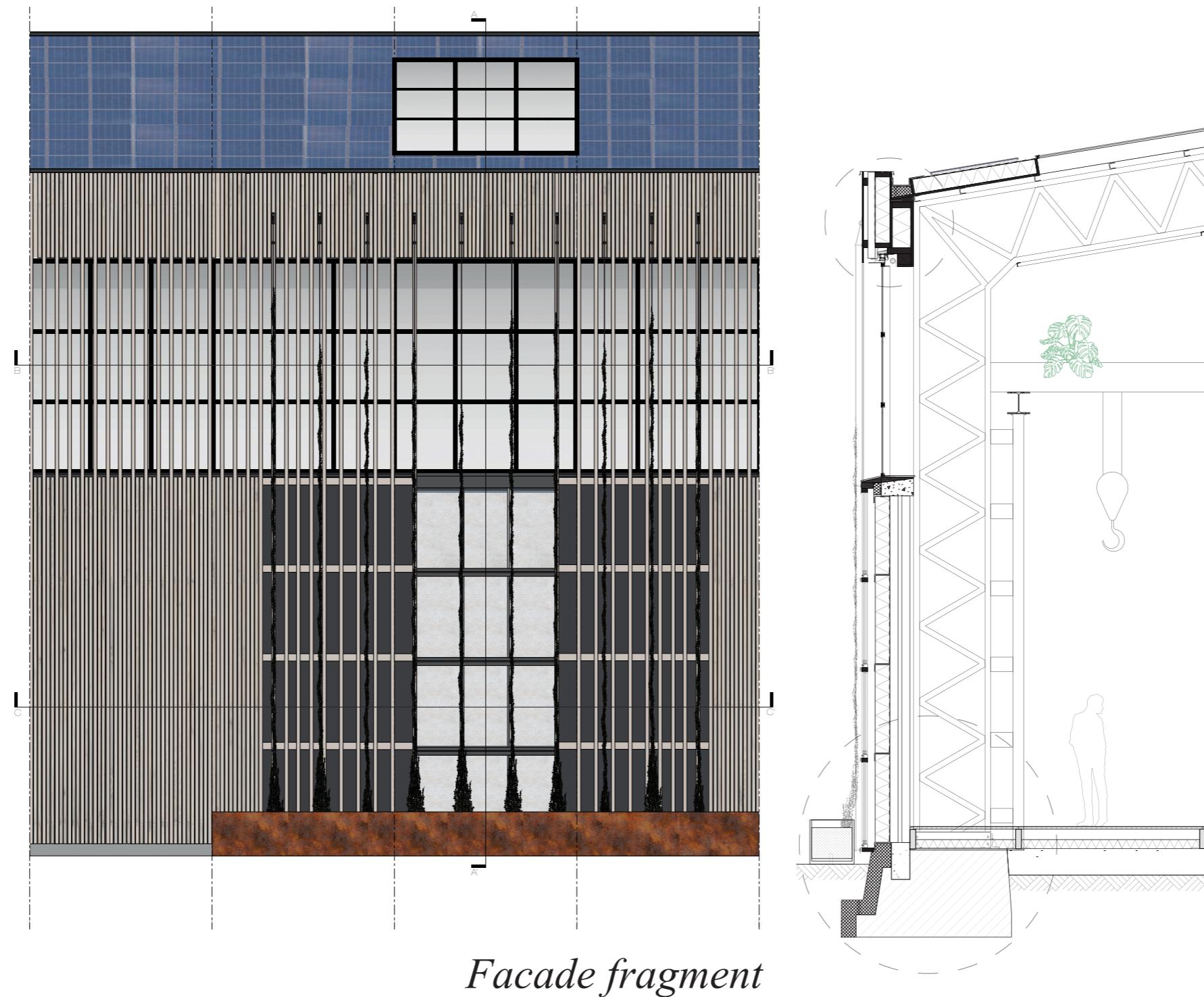


Image source:
<https://www.mogu.bio/project/mogu-floor/>

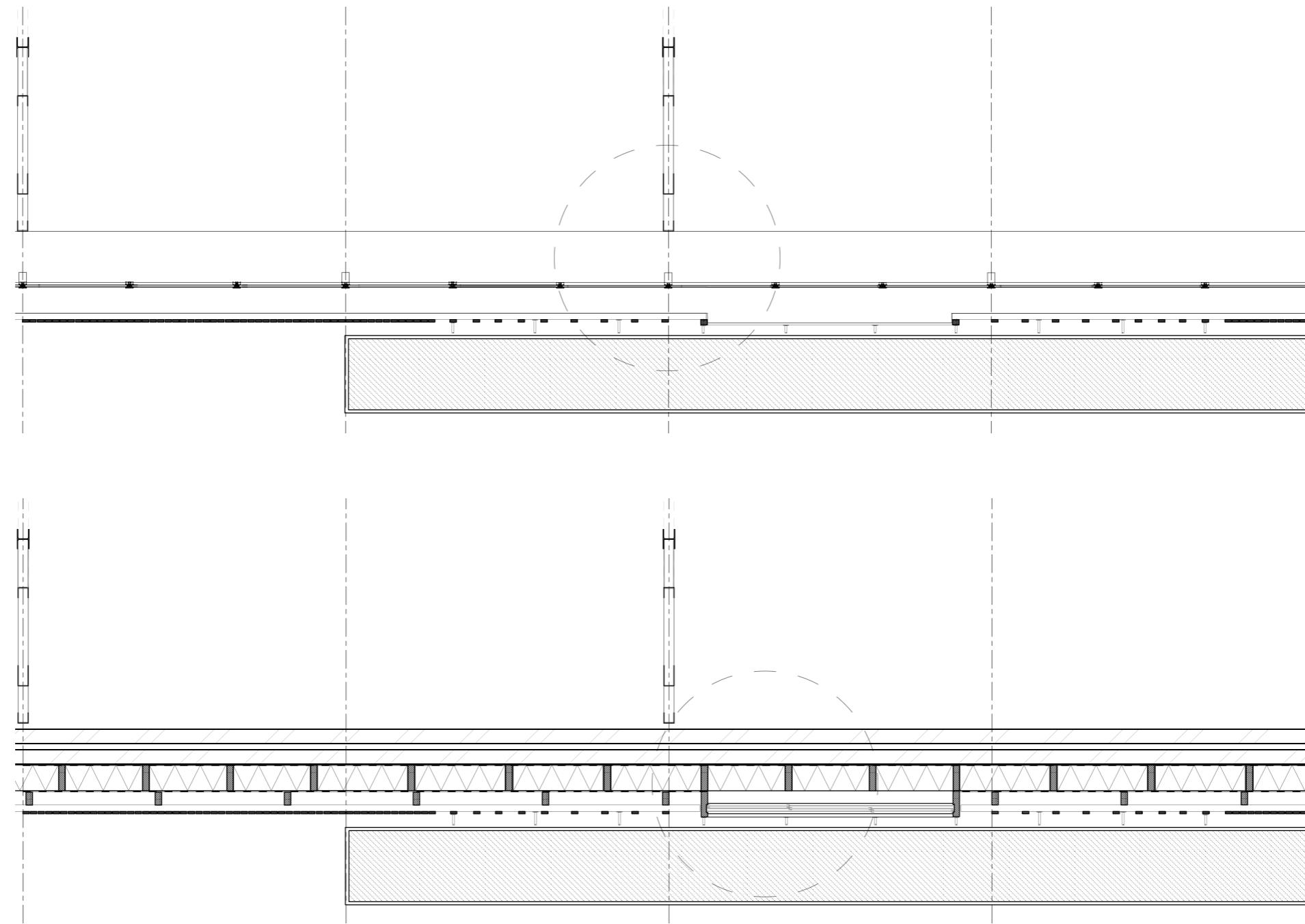
DESIGN



DESIGN

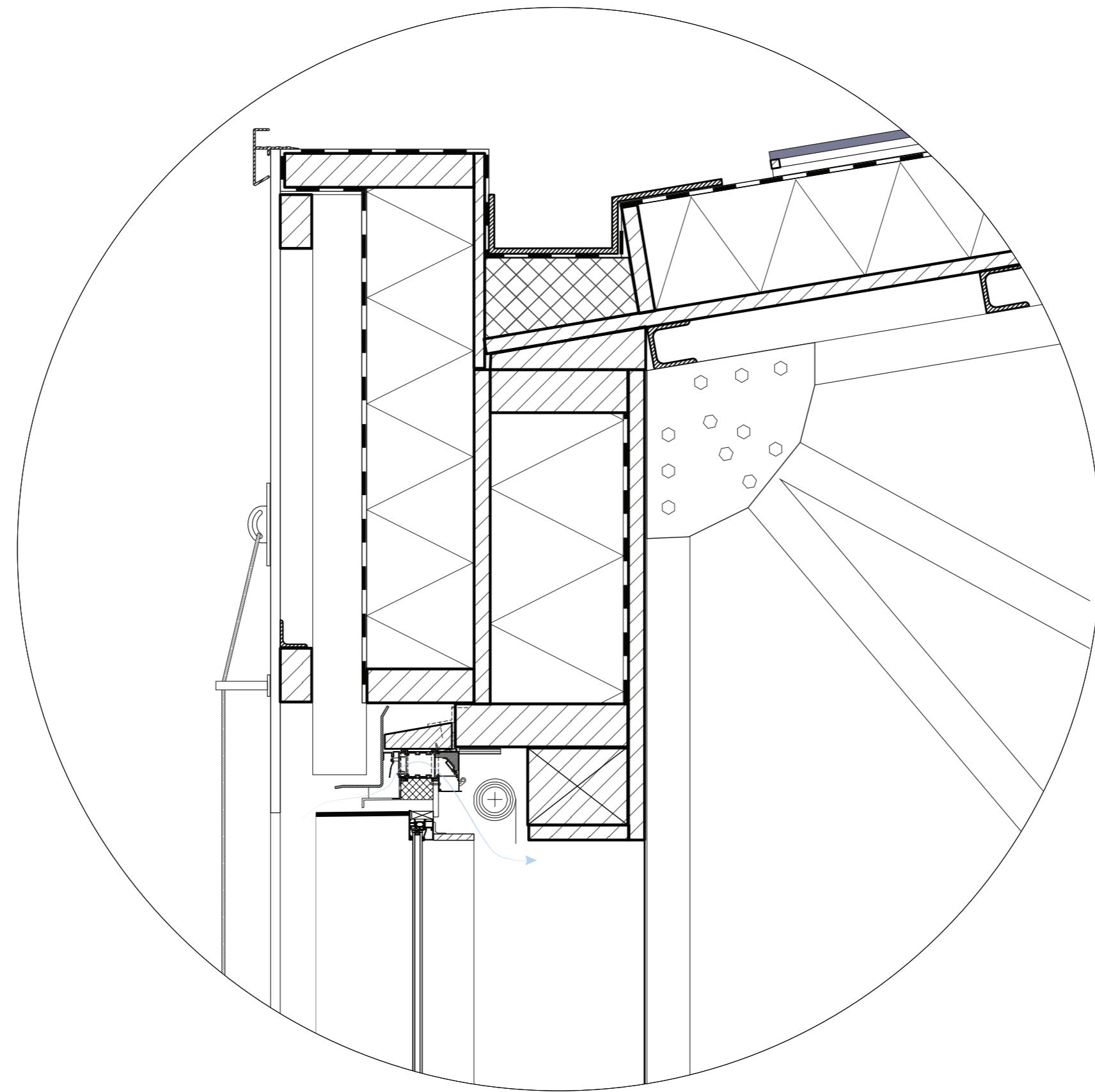


DESIGN



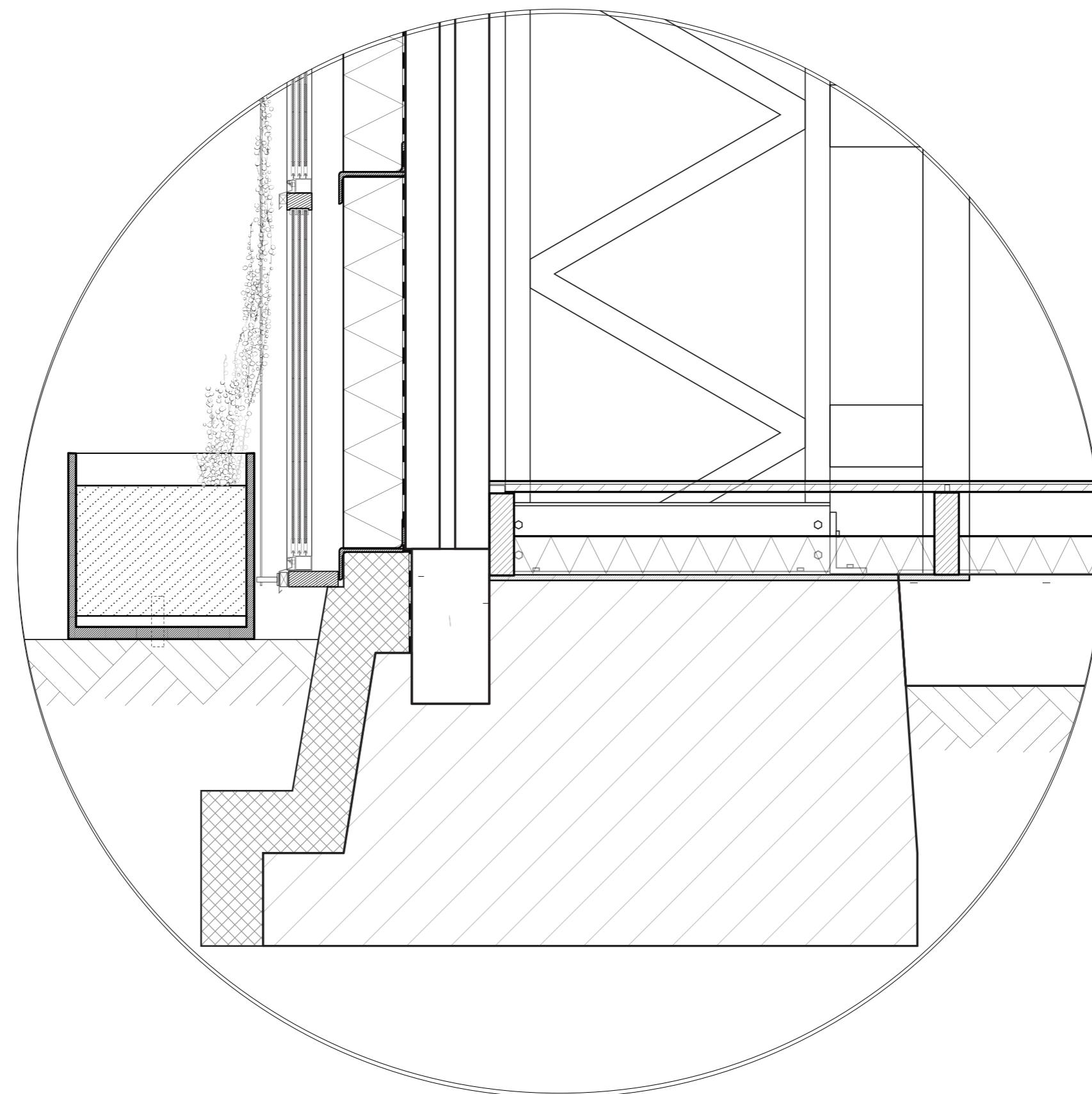
Horizontal sections

DESIGN



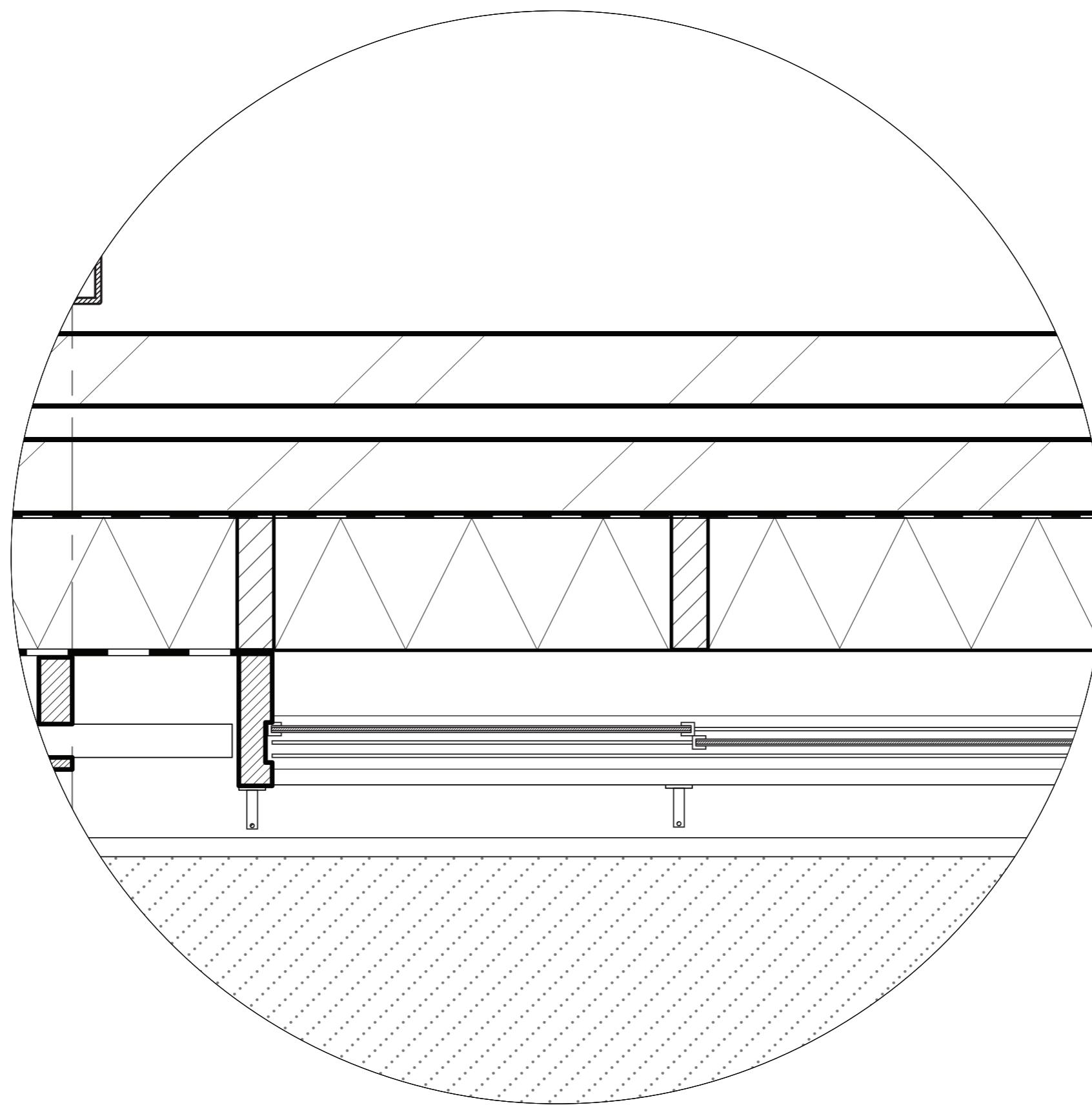
Detail 1

DESIGN



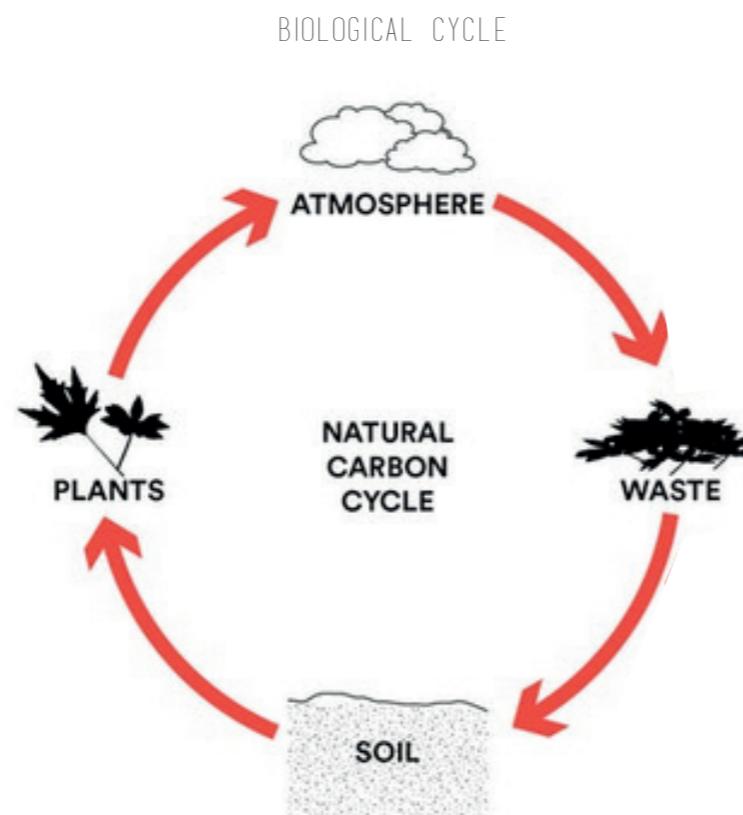
Detail 2

DESIGN



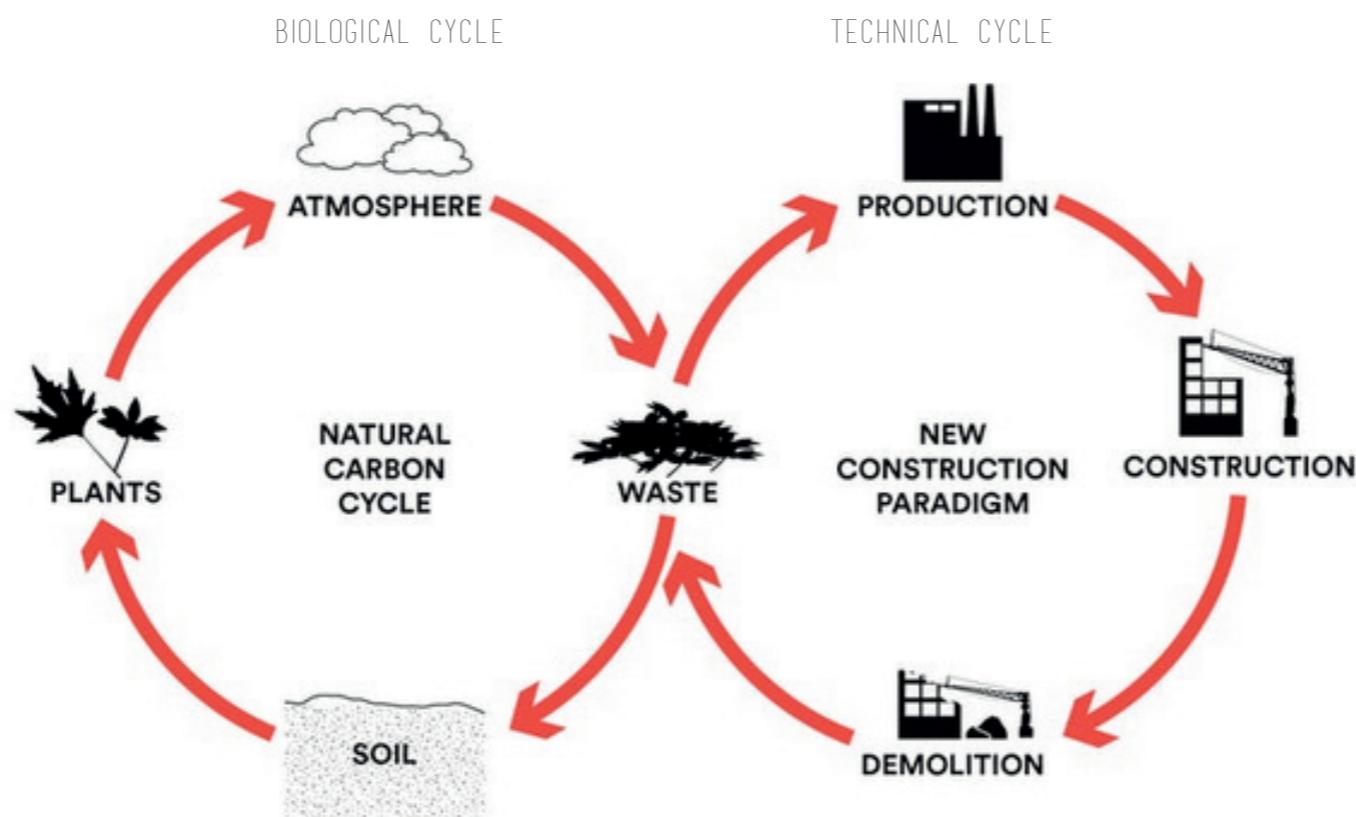
Detail 3

REFELECTION



*Is the project really circular?
And how does the Fungi Factory at value for people, profit and planet?*

REFELECTION



THANK YOU!

QUESTIONS?

