

PILOT FACTORY

FOR GEOPOLYMER CEMENT PRODUCTION

DIPLOMA 22

Oslo School of Architecture

//

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RESEARCH QUESTION

How do we facilitate industrial production methods in the context of today's demands for sustainability and flexibility?

In my diploma I am investigating this through the development of a factory for geopolymer cement production.

ABSTRACT

ISSUE

Environmental awareness has never played a greater role than it does today, and we can all agree on the fact that we need new ways of thinking what we build with, and what we build for.

As much as 24 percent of the greenhouse gas emission in Norway comes from industry, and the building industry is a negative contributor to this. It is therefore important to look at alternatives in the way we operate industry.¹

Luckily, there are many contributors within this innovative field. Among these is the Norwegian developer named Saferock. Saferock is developing a new method for cement production. The product is a so-called geopolimer.

Geopolymer cement is based on using bi-products after mining as the main "ingredient" in the product. The waste-mass is mixed with an environmentally friendly activator that makes the mixture harden just like ordinary cement. By doing so, you avoid, among other things, the combustion process, which is one of the worst when it comes to CO2 emissions.²

The waste-mass used in the geopolimer product is to be found at a quarry in Tellnes, South West in Norway. This mass is a remaining substance after extraction of a mineral called Ilmenite. Ilmenite is a mineral that for many years has been used industrially to make a pigment called Titanwhite, used in products like paints, fabrics and food.³

Extraction of this "white wonder" has its disadvantages. The waste from the mineral extraction is stored in huge deposits. Landfills at Tellnes are today stored with 50 million tons of mining waste, and within 2030 these deposits are estimated to be filled up. This way of storing waste has in recent years been discussed, and has proven to be a factor that contributes to damaging nature and environment.⁴

By using knowledge of both the challenges and the opportunities regarding this, we should be able to develop solutions, and put these into practice.

PROPOSAL/ PROGRAM

The aim of my project is to develop a pilot factory for production of geopolimer cement which, with its properties, should be able to ensure:

- Efficient production of Saferock's geopolimer cement.
- An environment that is arranged for good climatic conditions. This means that a focus on air purification, removal of suspended dust and other air pollution is important.
- Be a place where the employees are able to work in good spatialities, by focusing on light conditions and an architecture that facilitates social conditions. Similar current solutions within the design of industrial facilities seem to have a smaller scope of architectural focus arranged for human scale.

My proposal involves three key elements, creating a frame for my work. These being: **sustainability, low cost and flexibility.**

Sustainability: How can this project both contribute to the development of a more environmentally friendly production method, and also be built in the spirit of this attitude?

Low cost: As Saferock is a startup with limited funds I need to make sensible choices when it comes to costs.

Flexibility: Industrial facilities often have a tendency to develop and shift location over time. In this project, the factory will be present for 18 months after it has been built. After this period, it should be possible to move the structure to another place. It is therefore important that the structure is designed to be flexible.

1. Miljødirektoratet. 14.11.22, "Klimagass fra industrien i Norge".

2. Valide. 2019, "Saferock kan endre betonghistorien".

3. Antonsen, R. 2022, Store norske leksikon, "Titania AS".

4. Hight north news. 2018, "Sjødeponi er tryggere enn landdeponi".



LOCATIONS

SITE OF PILOT FACTORY



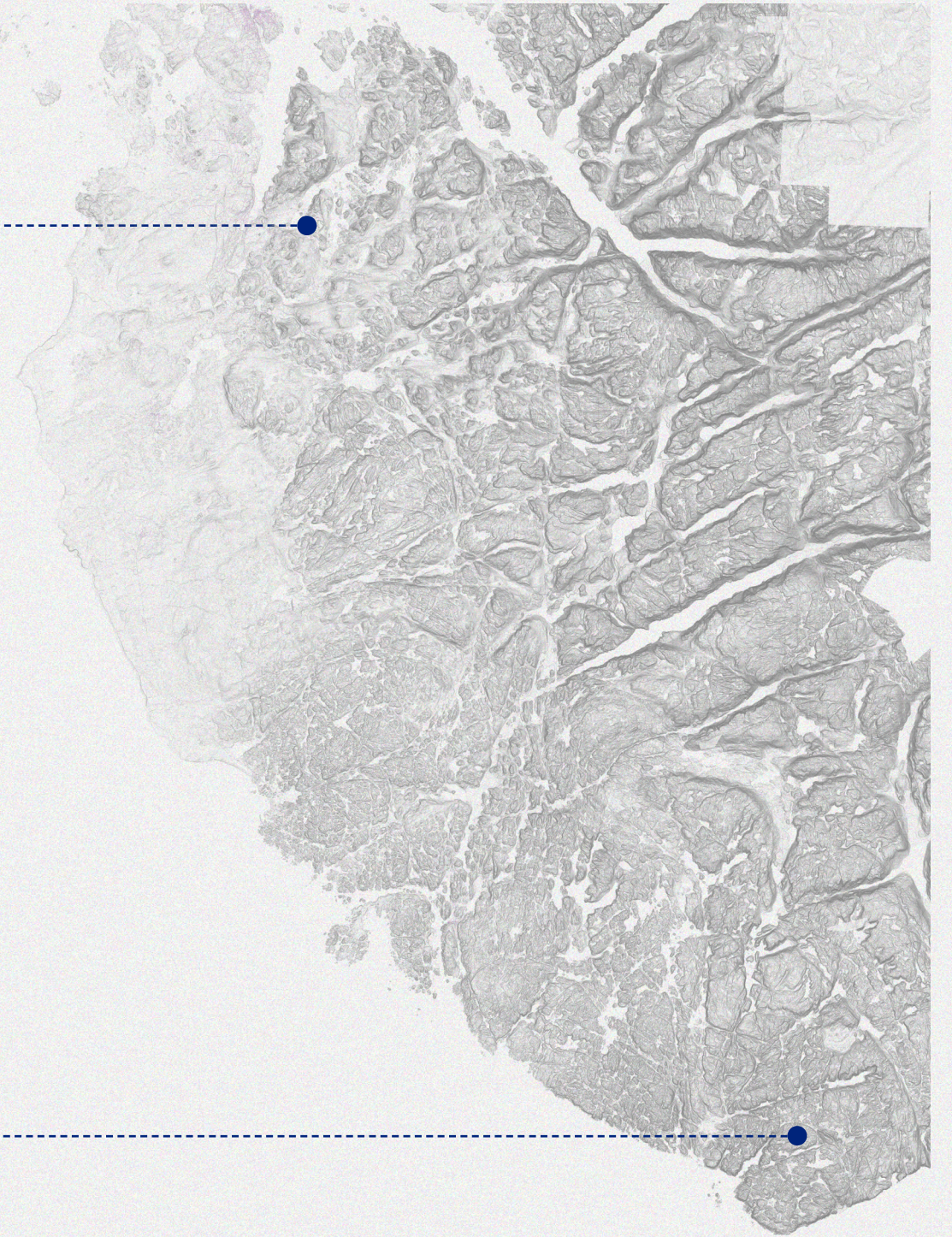
Velde

90 km



Tellnes

COLLECTION OF WASTE-MASS FOR PRODUCTION

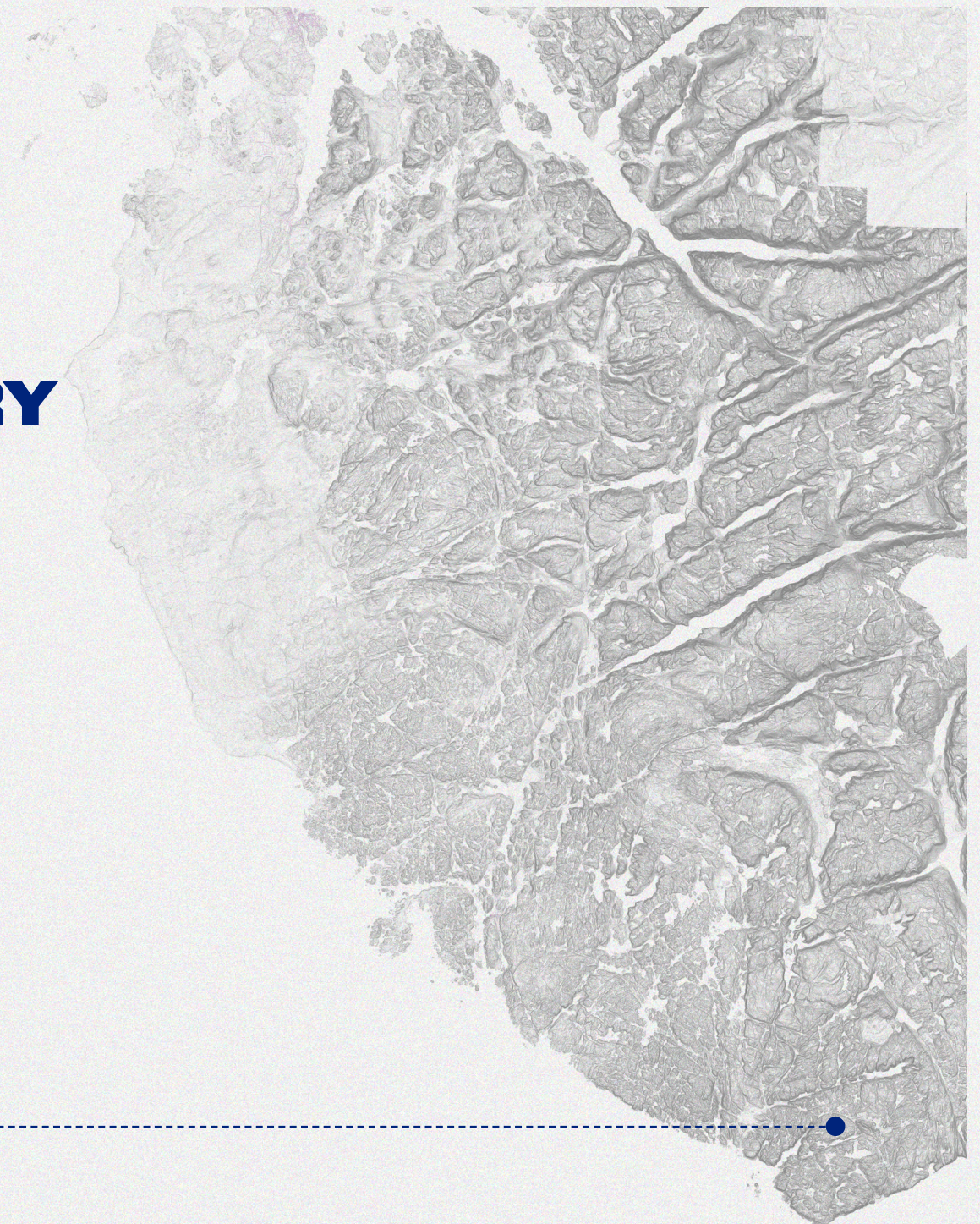




TELLNES QUARRY

Rogaland, Norway

Through research, Saferock has found that the mineral waste from this specific location, i.e. Tellnes will work well for the production of geopolymer cement. Therefore, this area has been identified as a resource site that will supplement with valuable mineral waste to the factory at Velde.



Tellnes -----●



Velde -----

VELDE QUARRY

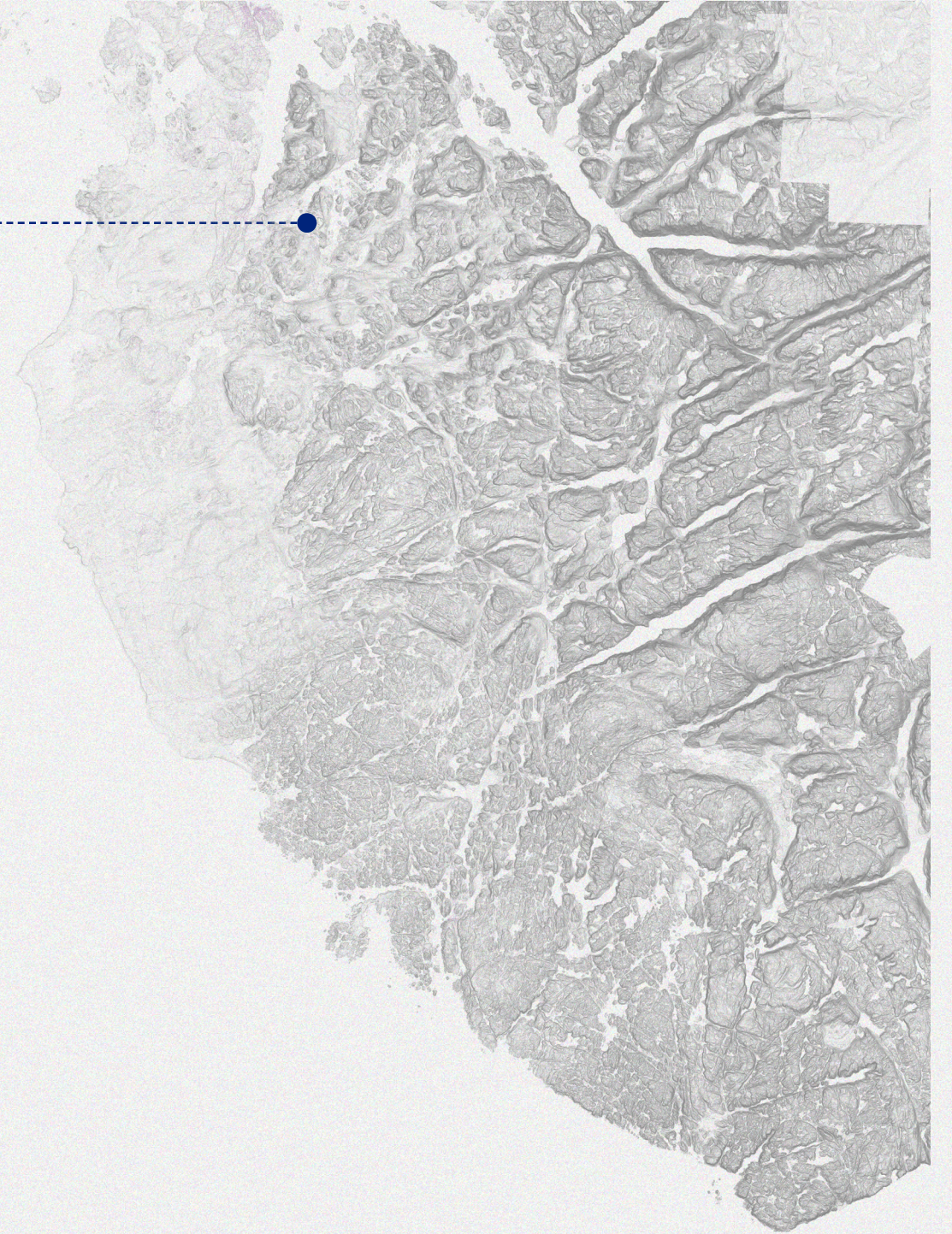
Sandnes, Norway

The pilot factory is located at Velde in Sandnes, Norway. Velde is a well established quarry that operates with a large selection of rock materials, landfill, asphalt production and paving, ready-mix concrete and concrete blocks. They also have an expertise in reuse of concrete.

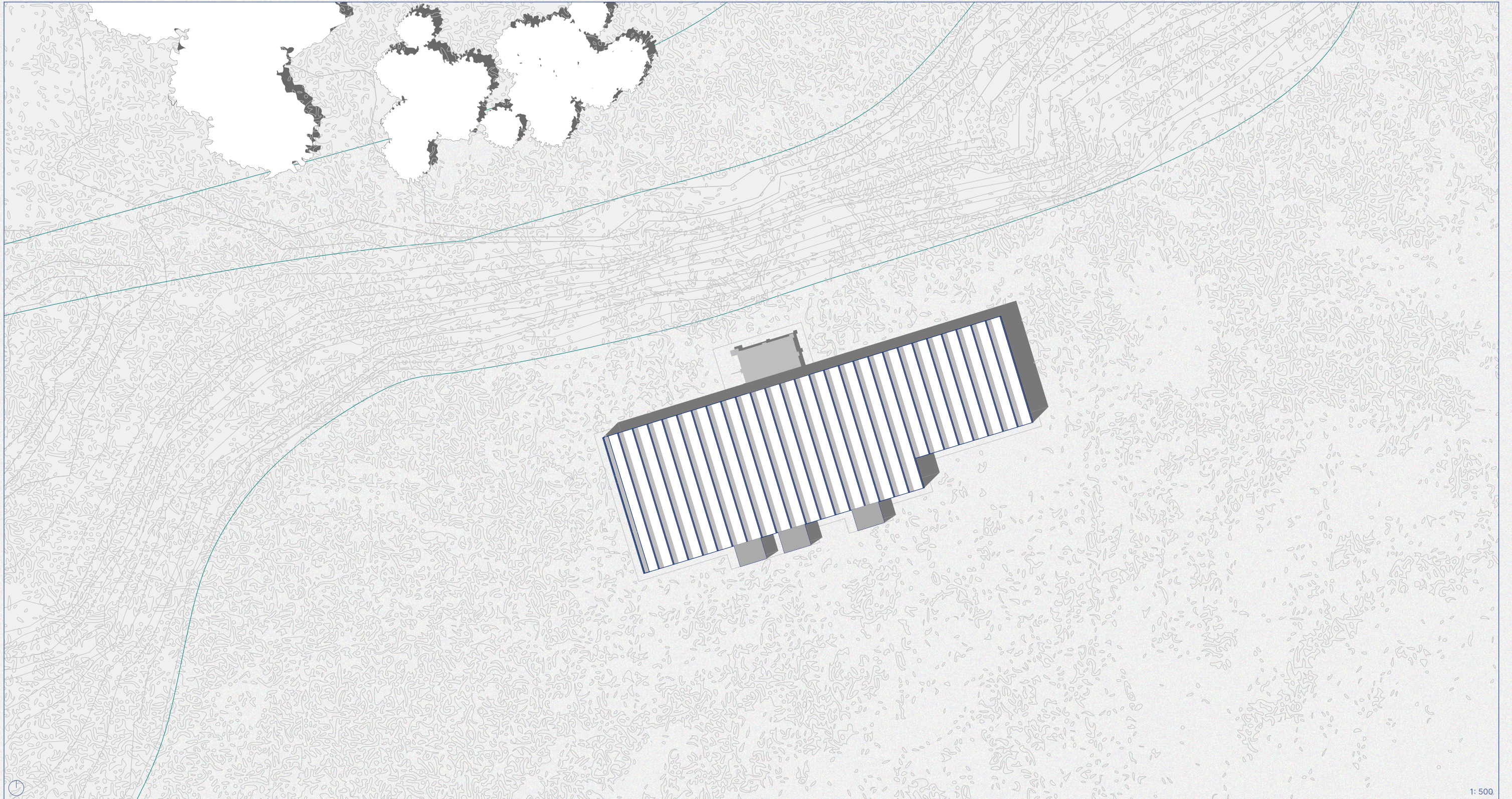
Velde is characterized by heavy transport, noise and a dusty environment. In the messy environment there is a well-functioning system and orderly logistics.

The site for the pilot factory is located 90 km north/west of Tellnes.

The ideal situation would have been to have a factory at Tellnes, but in this phase of piloting it was more efficient to locate the factory in an already existing area that has expertise in a similar industry. Looking ahead in time, a vision would be to locate a factory closer to the resource area.



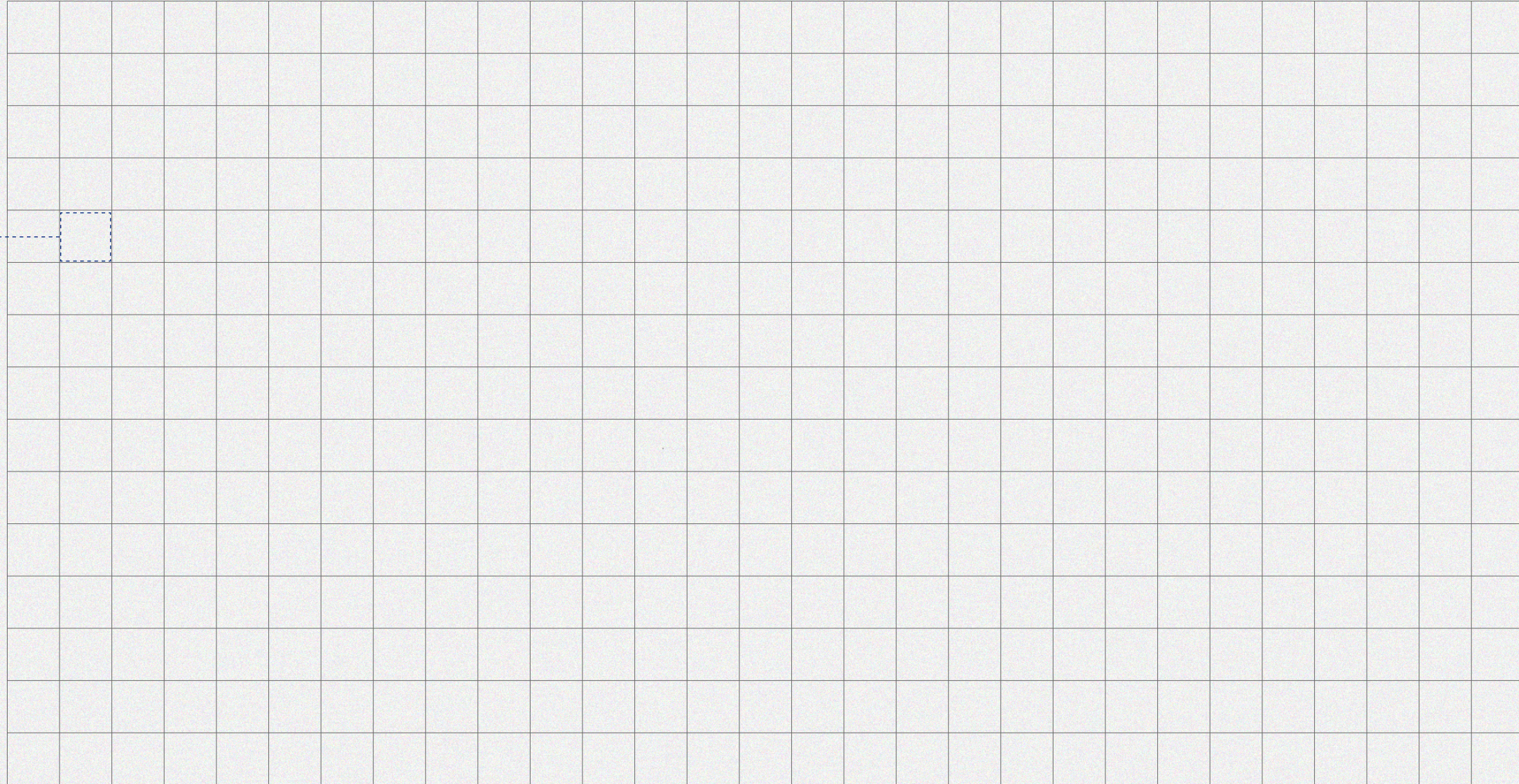
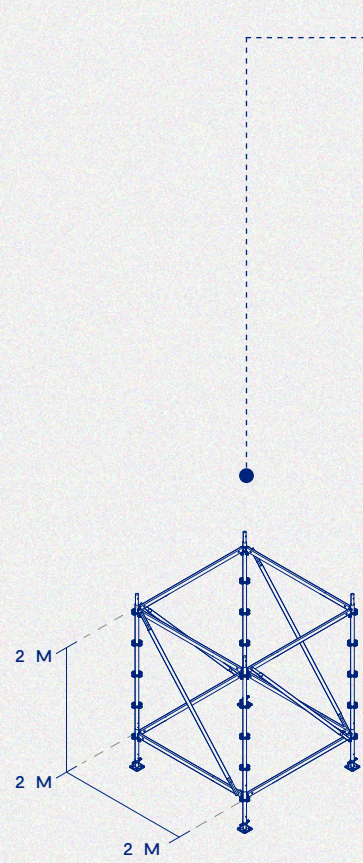


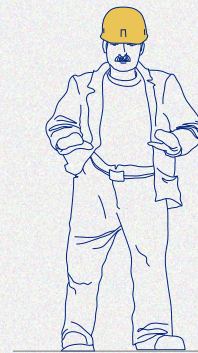
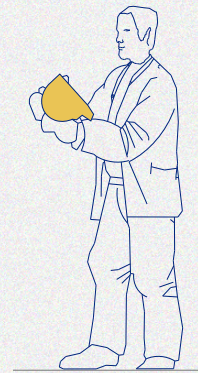
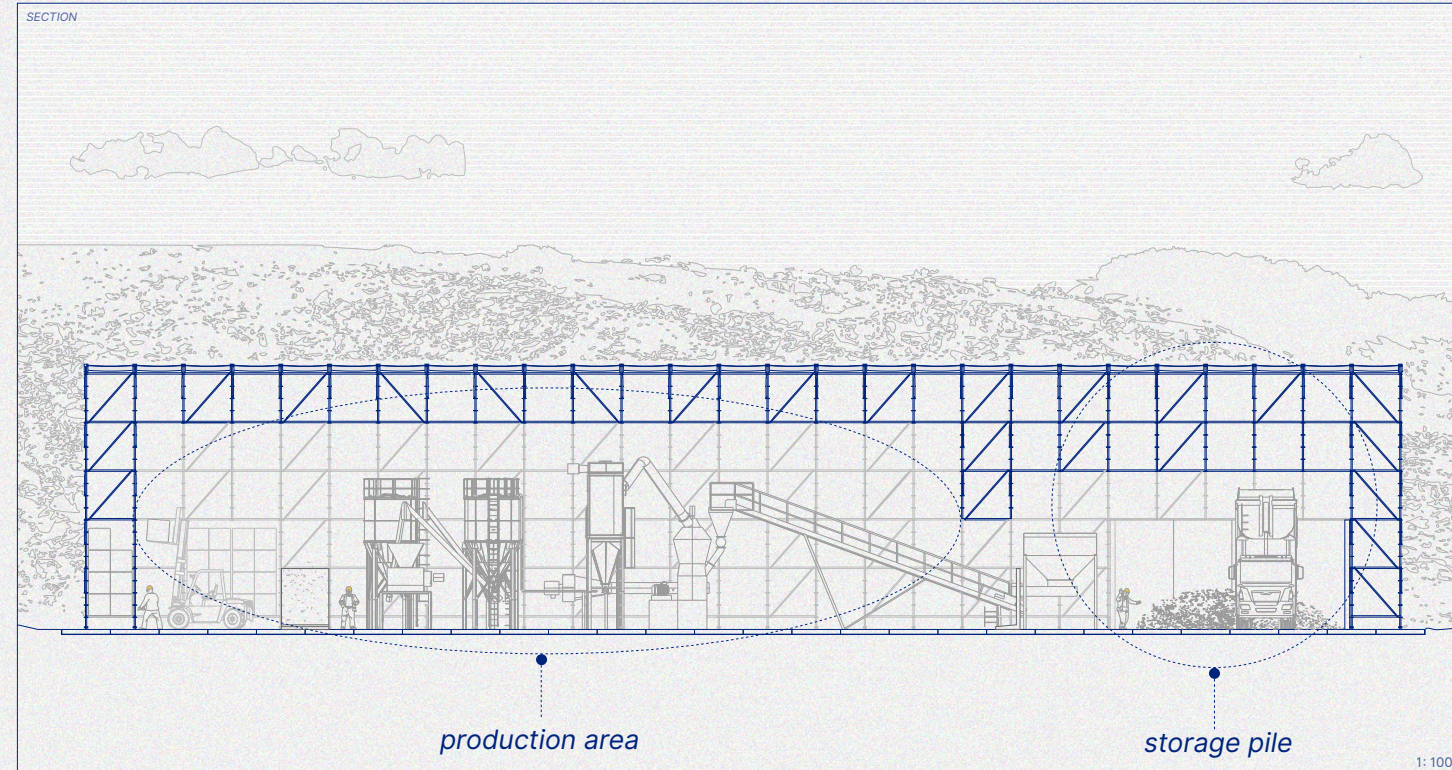
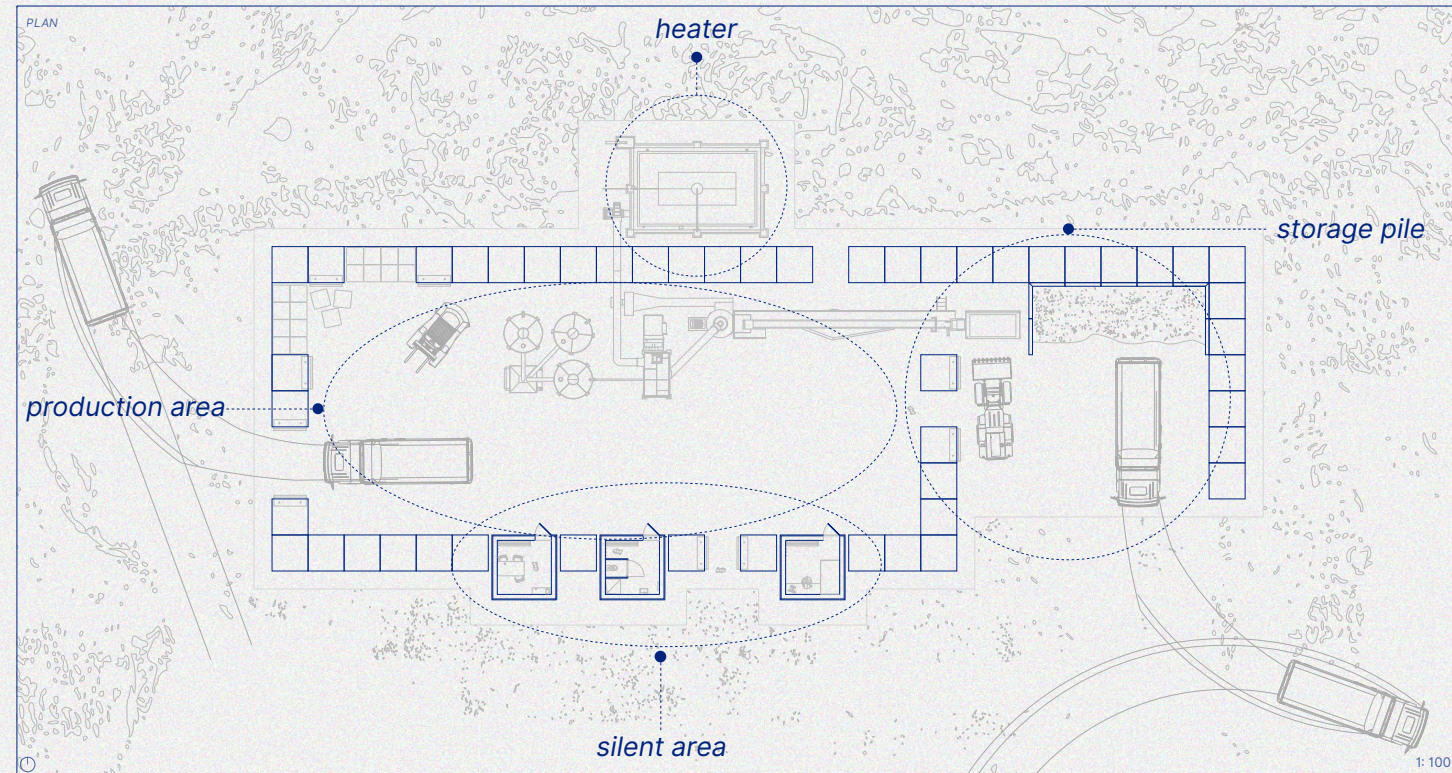


CONSTRUCTION SYSTEM

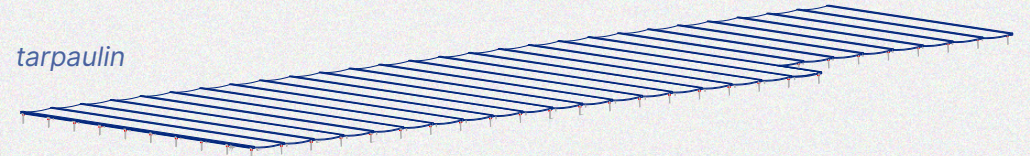
The plan is based on a 2 by 2 meter grid which is determined by a standard scaffoldingsystem.

The scaffolding system allows for a flexible structure, where changes can be made frequently.

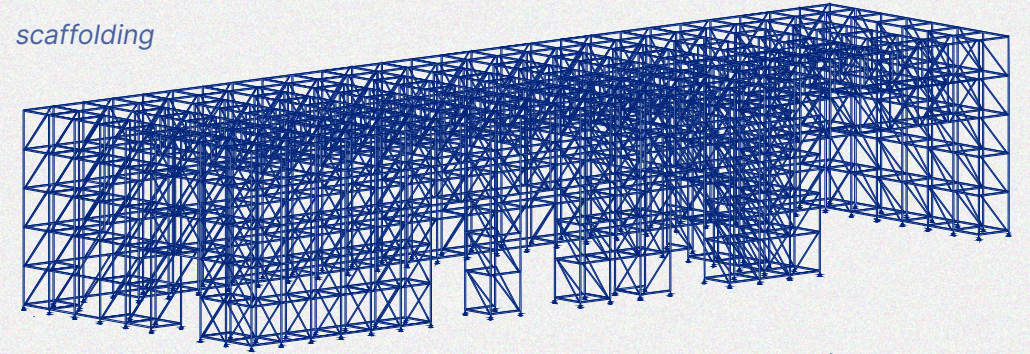




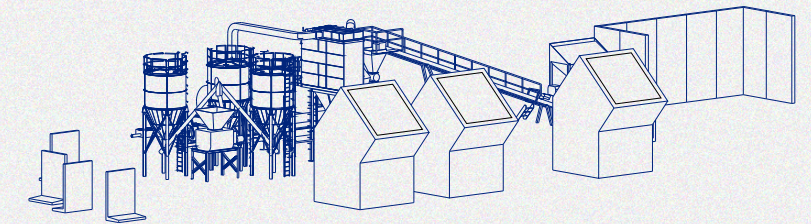
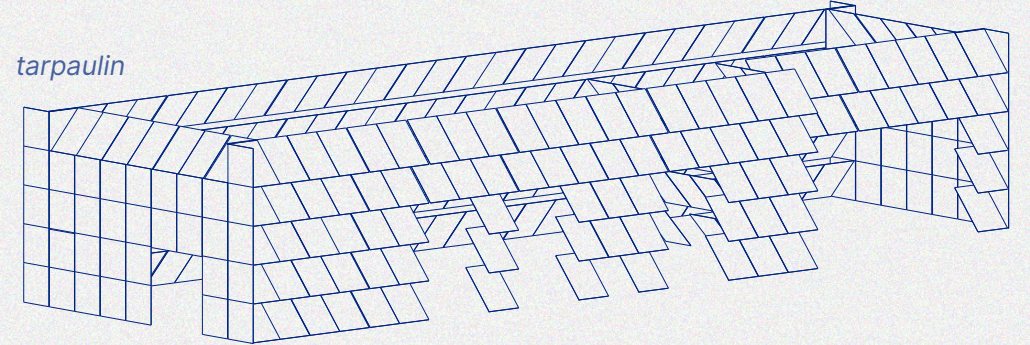
tarpaulin



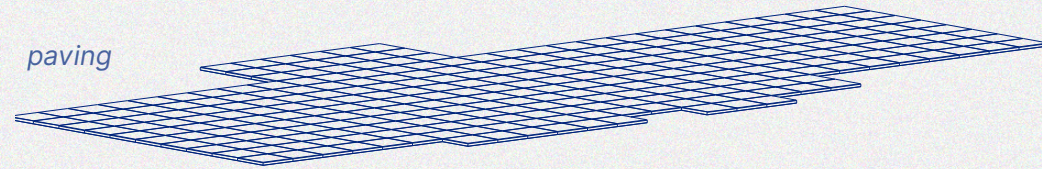
scaffolding



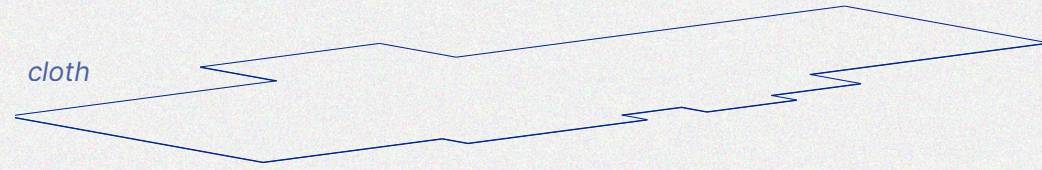
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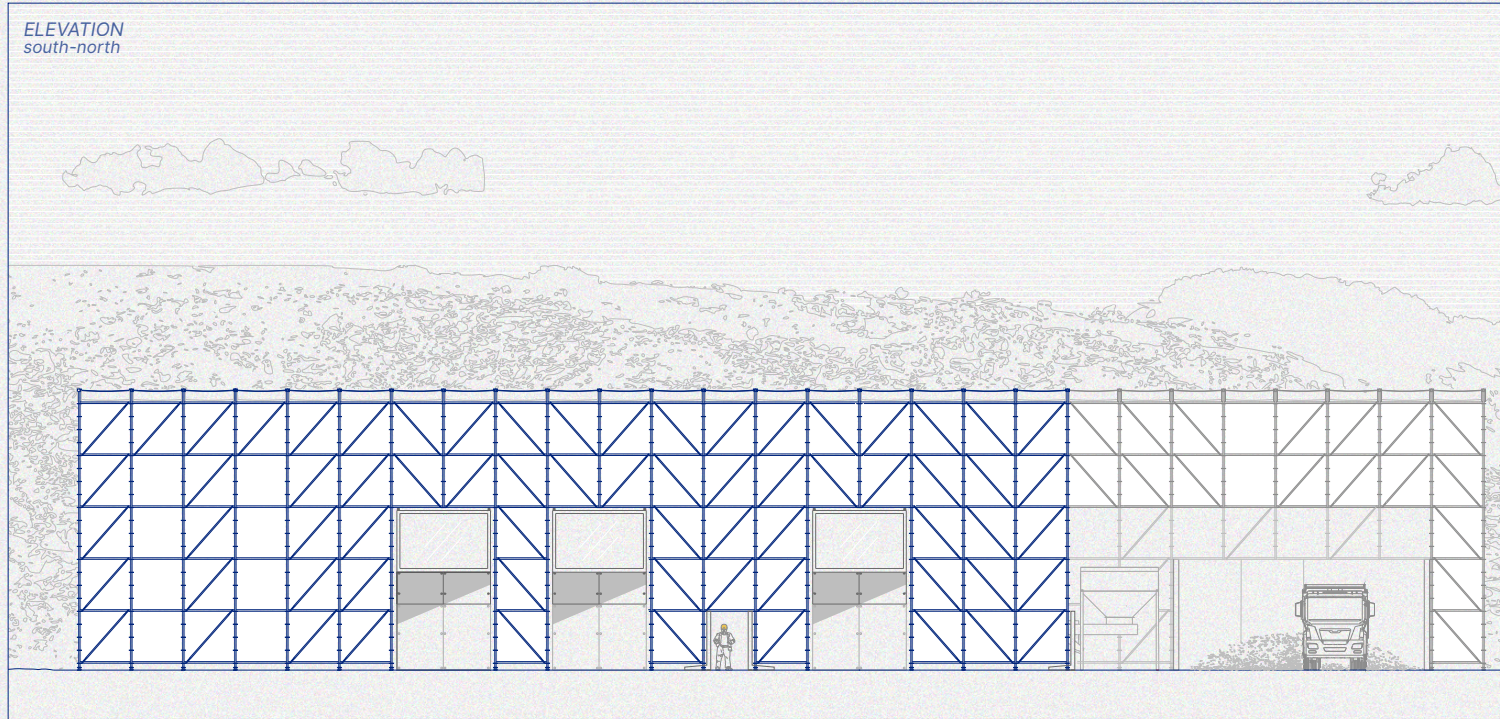
paving



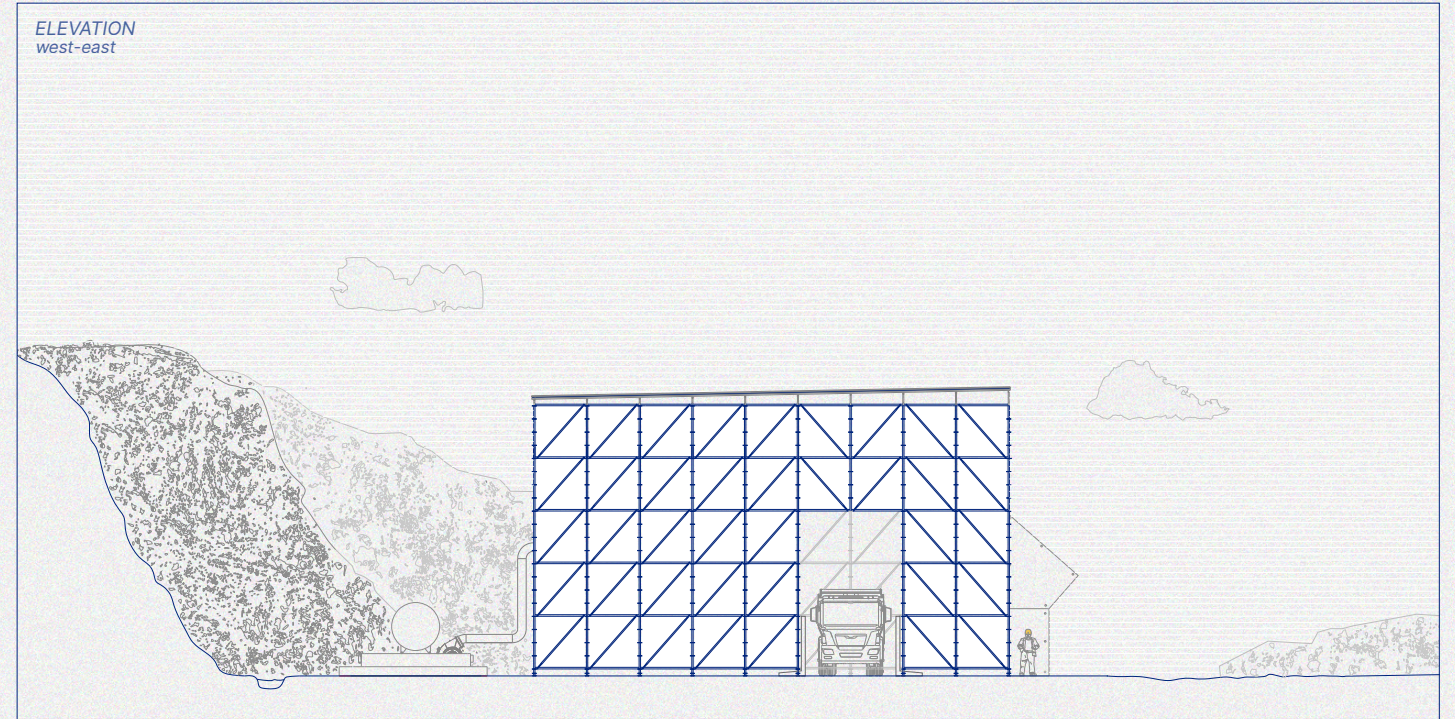
cloth



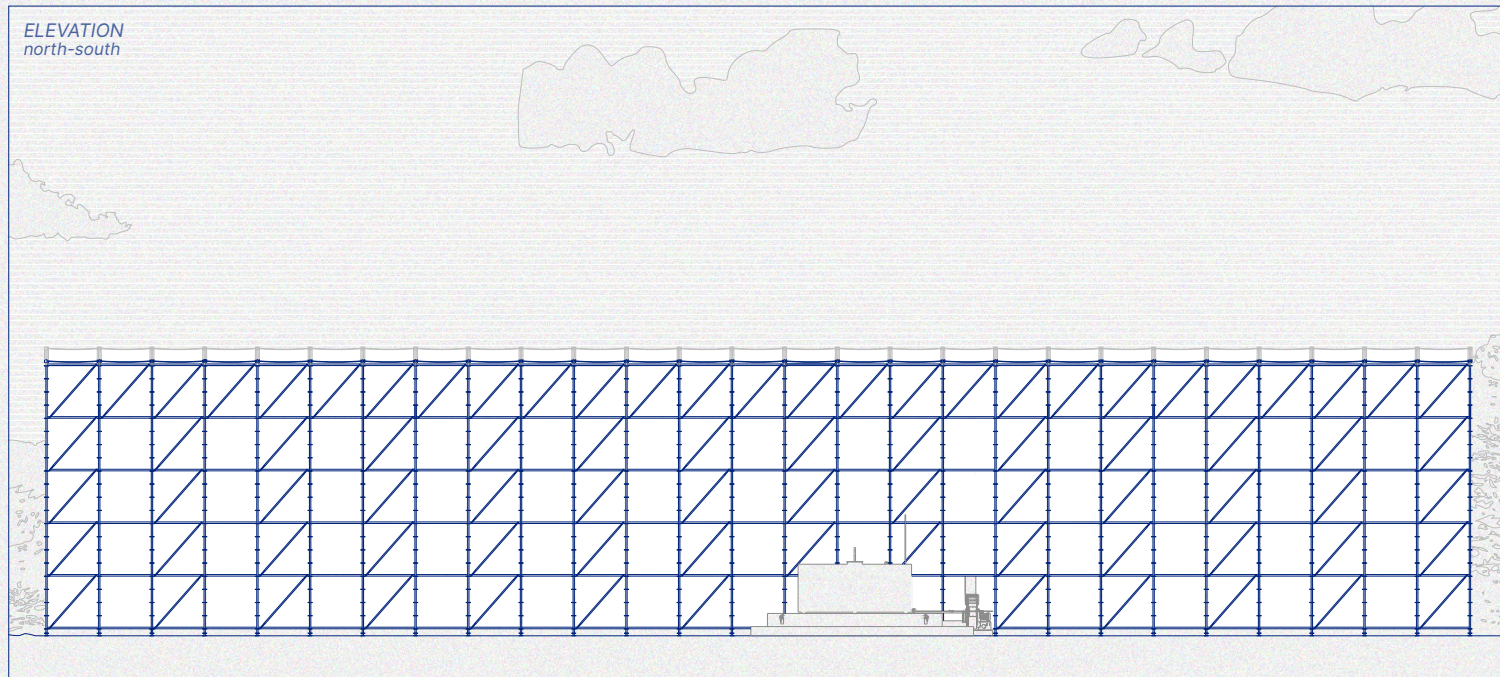
ELEVATION
south-north



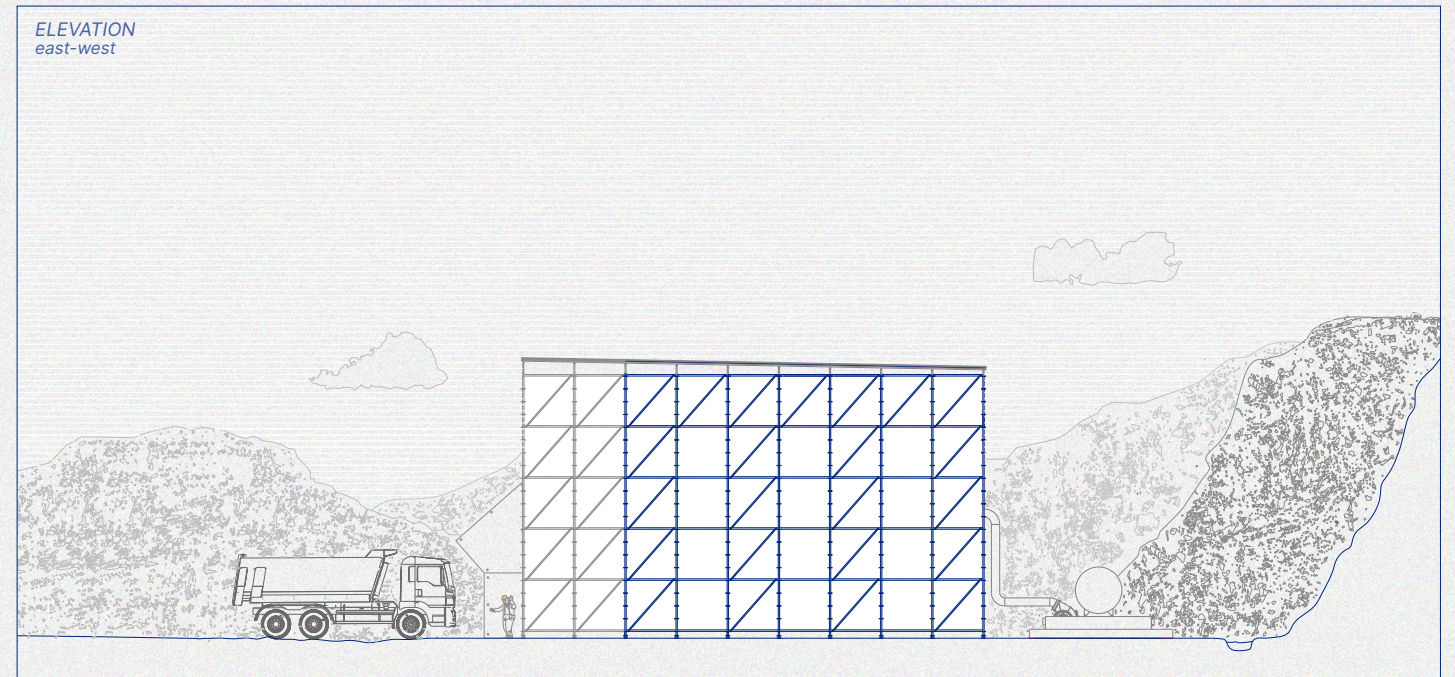
ELEVATION
west-east



ELEVATION
north-south



ELEVATION
east-west



UNIT

During site visit, I experienced the scale of the machines and the facility. This experience gave an overwhelming impression.

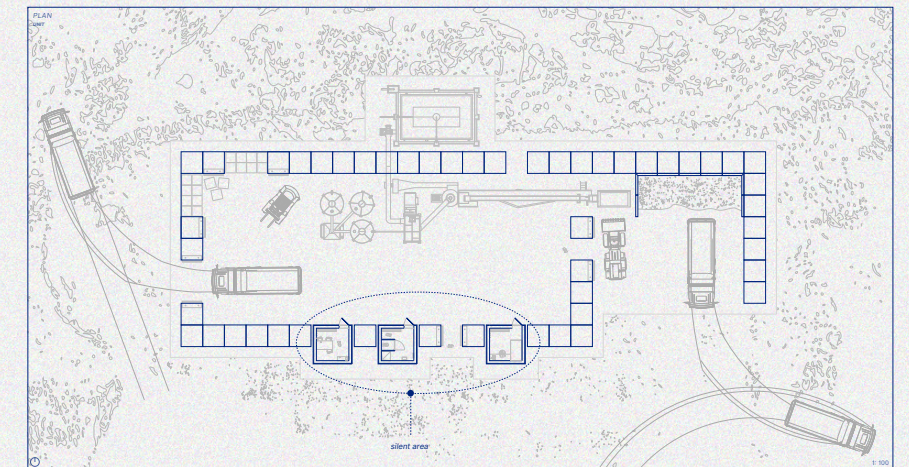
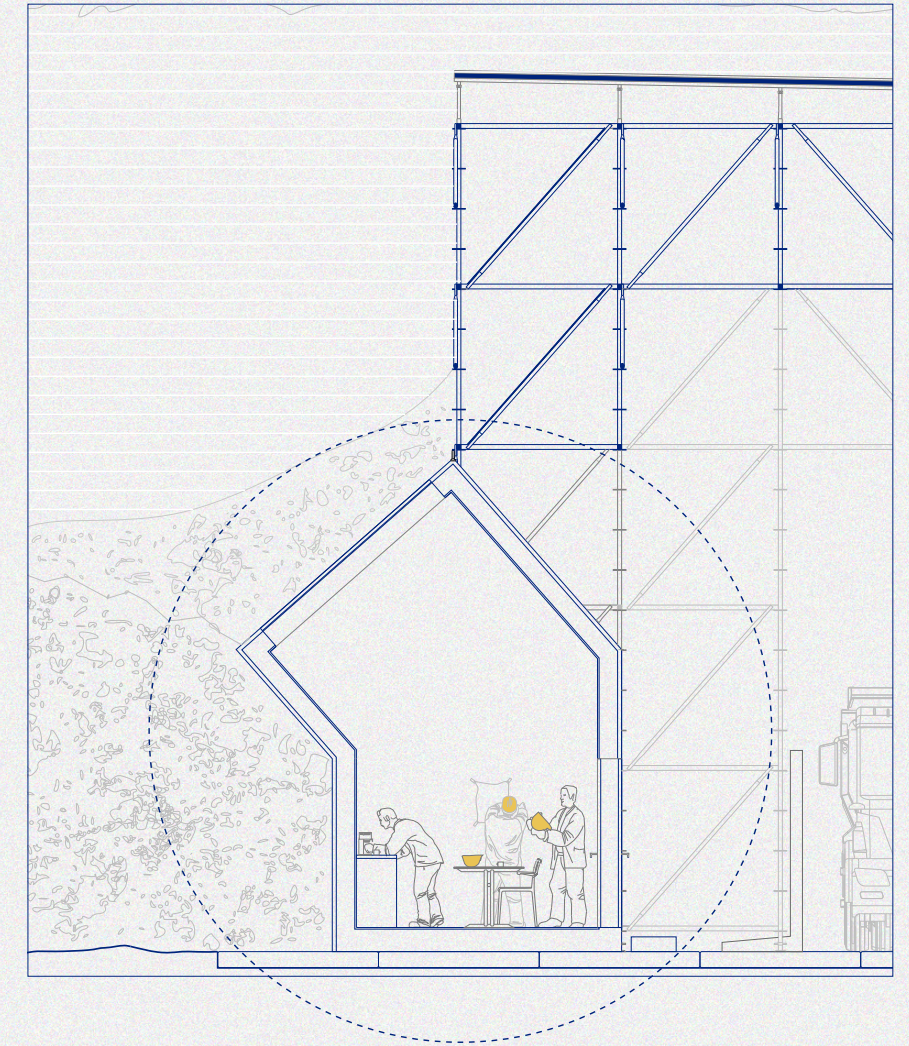
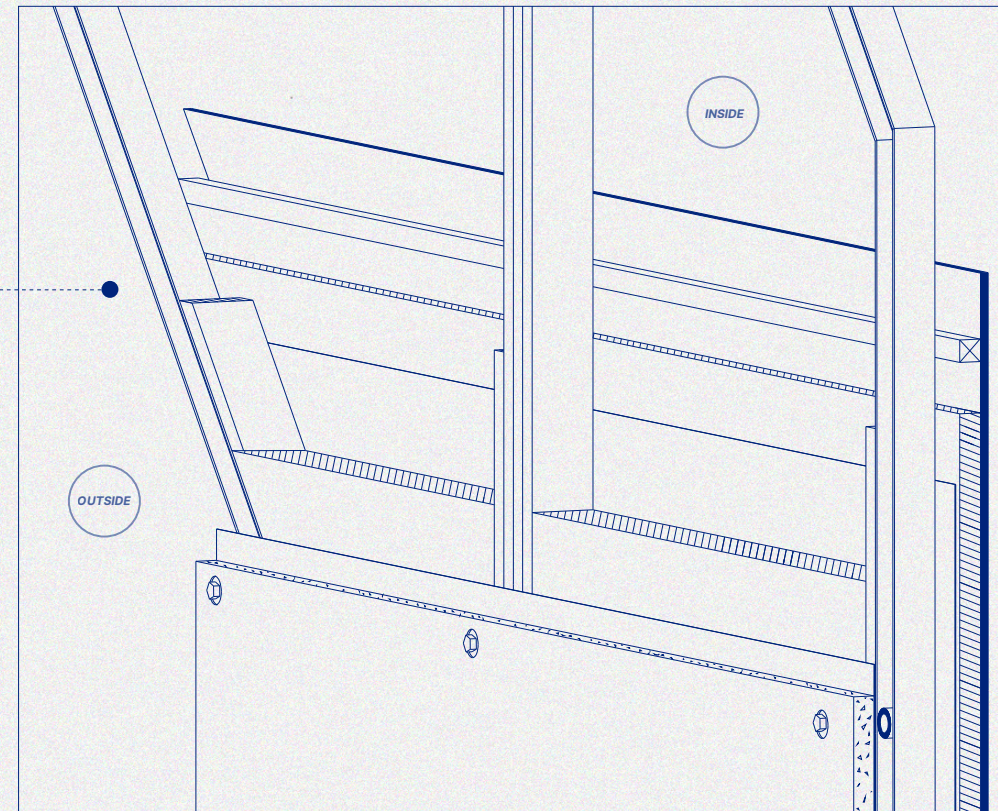
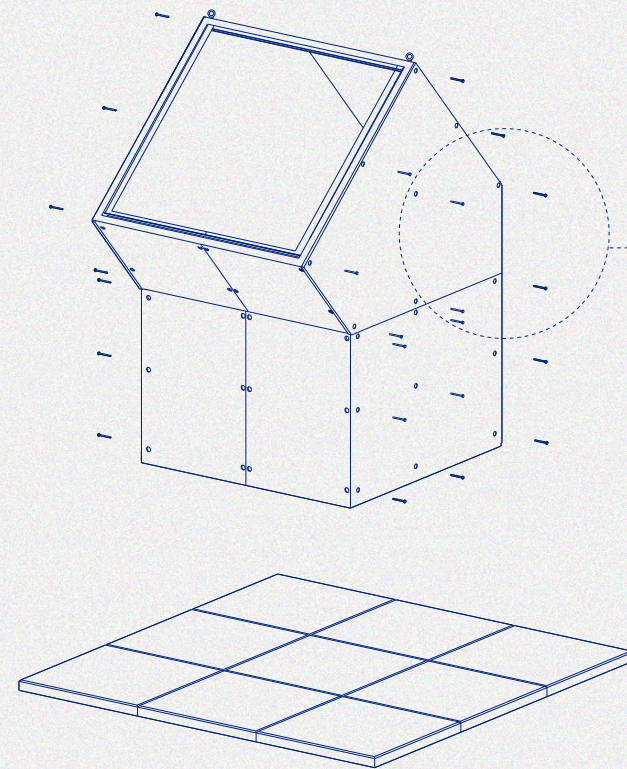
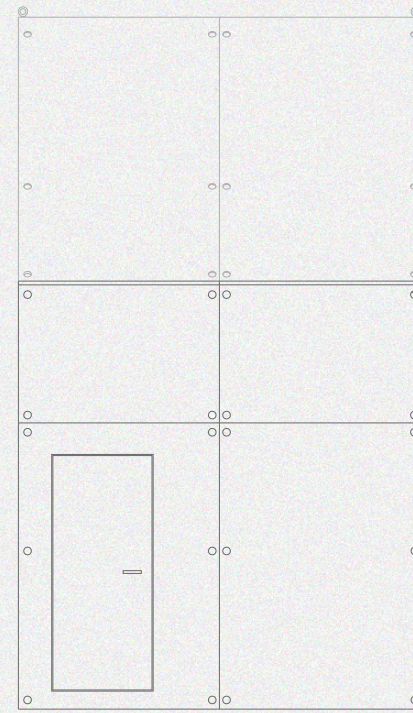
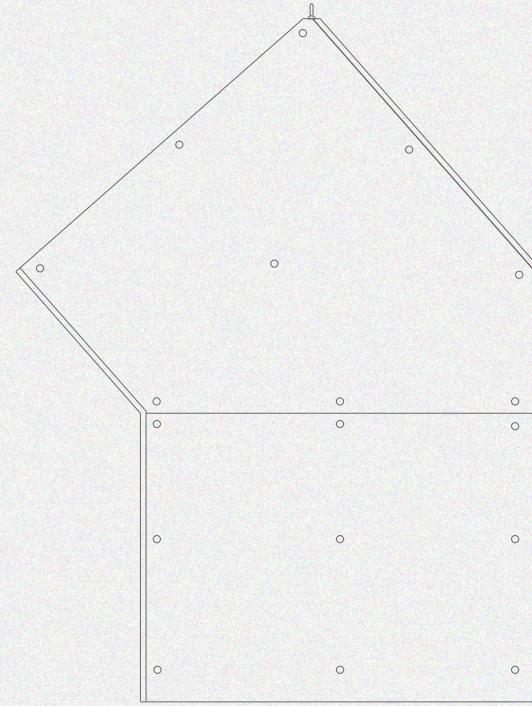
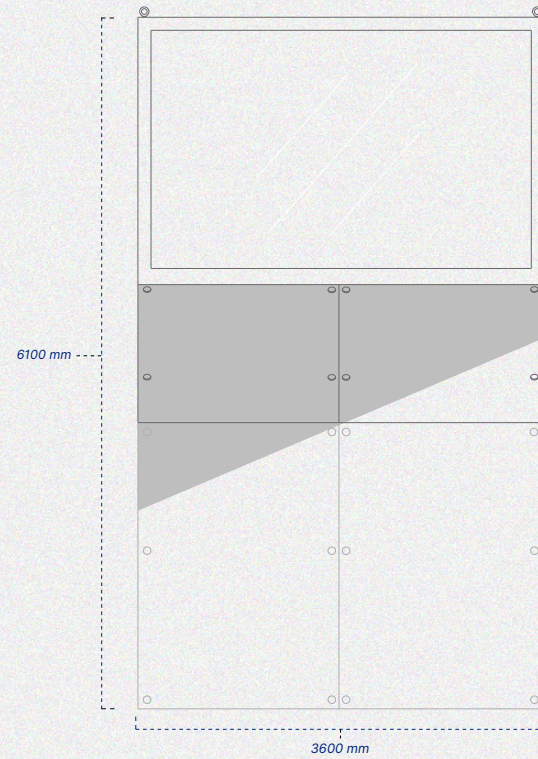
In these surroundings, I can imagine that one will seek a place to find peace, in an otherwise demanding and noisy work day.

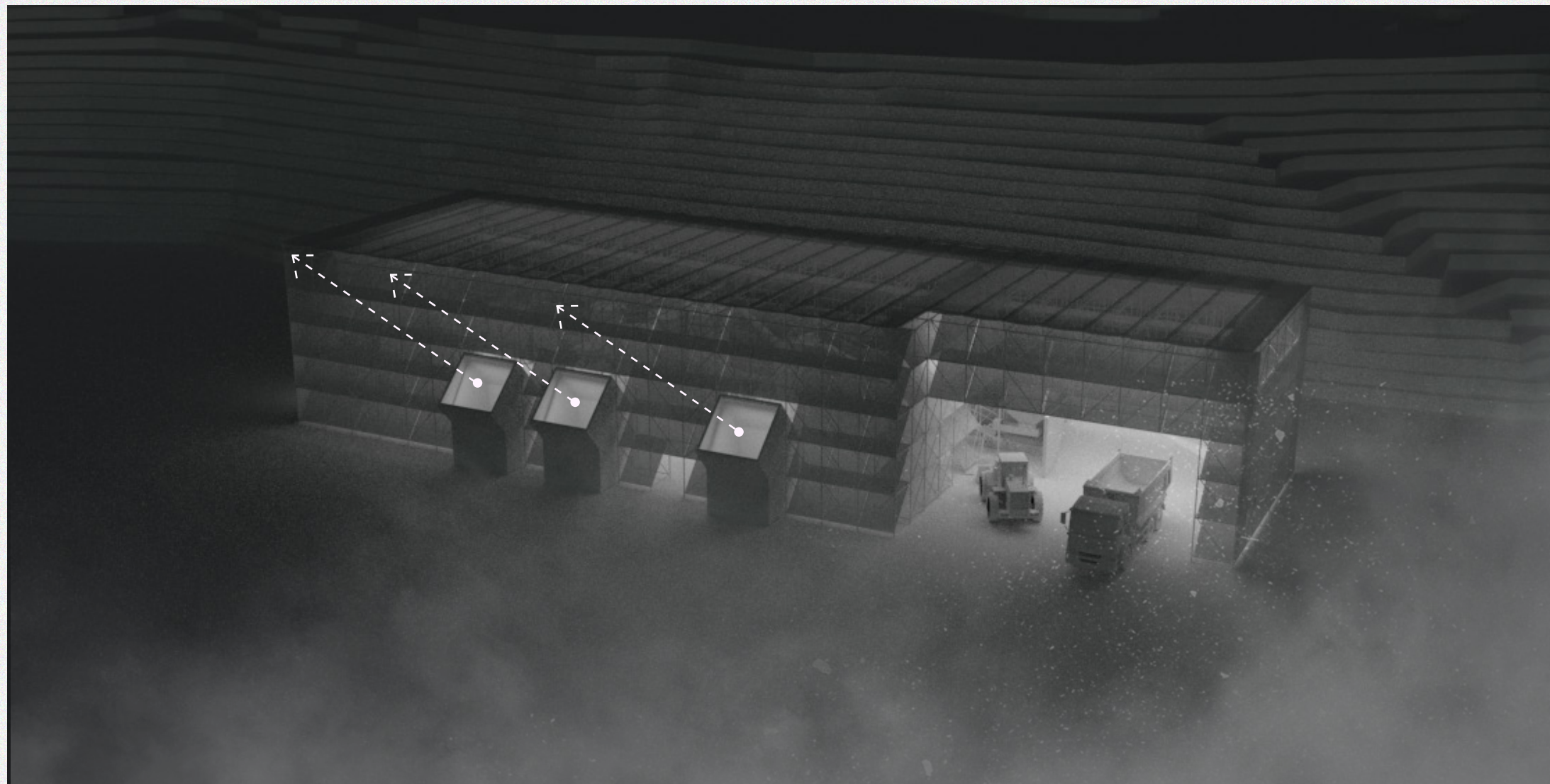
The design of the unit gives the employees an opportunity to experience a space that gives focus in a completely different place than where they otherwise spend most of the day. **Up, to the sky.**

There is one main door into each of these units, and this door provides a clear contrast- from the overwhelming outside, to the warm and safe inside.

A concrete surface meets the outside, while a warm plywood cladding provides warmth to the room inside.

The unit is modular and manufactured, before being transported in its entirety to the site. This makes it easy to add or subtract units if needed.





SECTION MODEL
MODEL 1:25



SITUATION MODEL
MODEL 1:150



