DE WADLOPER



Graduation Report | Simone Hermans | July 2024

Graduation Report P5

MSc Technologies & Aesthetics

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CONTENTS

01 PROLOGUE
- 1.1 Preface
- 1.2 Introduction

02 RESEARCH
- 2.1 Group research
- 2.2 Location
- 2.3 Layer analysis
- 2.4 Masterplan

03 DESIGN
- 3.1 Concept
- 3.2 Visitor centre
- 3.3 Pavilion
- 3.4 Details
- 3.5 Impressions

04 BUILDING TECHNOLOGY
- 4.1 Loadbearing structure
- 4.2 Exploded details & facade
- 4.3 Moving a module
- 4.4 Climate
- 4.5 Calculations

05 EPILOGUE
- 5.1 Conclusion
- 5.2 Reflection

06 BILBIOGRAPHY
- 6.1 Literature
- 6.2 Documentation



01
PROLOGUE

1.1 Preface
1.2 Introduction

Preface

In front of you is the research report 'The Wadloper'. This report is the result of a year's study in the graduation studio Technologies & Aeshetics, part of the Form Studies chair. It is the concluding report of the MSc Architecture, Urbanism and Building Sciences, track Architecture, at Delft University of Technology. I have been researching and designing my graduation project from early September 2023 to July 2024.

During my Bachelor of Architecture at TU Delft, my love for Form Studies and design through models and maquettes already lightly emerged during the assignments of Transfer and Form. For me, aesthetics have always played an essential, if not fundamental, role in my designs.

The master confirmed for me where my passion lay: designing innovative and aesthetic, but also technical structures by using intensive modelling during the design process, often using the landscape as a starting point. During MSc2 the Delta Shelter, it became clear to me that the Form Studies chair's way of thinking, working and designing fit well with my preferences. I am therefore very happy that I was allowed to graduate in this studio. I learned a lot in the past year, and surprised myself with my graduation design. I am very proud of the result that is now in front of you.

I would like to thank my research tutor, Peter Koorstra, for his guidance and enthusiasm throughout the year. Your involvement and freedom allowed me to research what interested me, and apply it in a new way. Thank you for setting up a studio that suited me so well.

I would also like to thank my design tutor, Geert Coumans, for his excellent guidance and support during the project. I am very happy and grateful that you were my tutor this year, and I really enjoyed the fact that we could have the same substantive conversations with each other about not only my design, but about architecture in general.

Furthermore, I would like to thank my structural engineering tutor Claudia van Leest, for clearly imparting her knowledge, as well as for her positive attitude and listening ear. It was nice that you were always available for an extra appointment when I needed extra help.

Finally, I would like to thank my family and friends for being there for me during my research and design process. Pim and Gertrix, thank you for your support and trust. Mare and Kim, thank you for your conviviality, your daily presence and fun working atmosphere at the studio made my graduation year unforgettable. Margot, Juliette, Jesse, and especially Jules, thank you for your help in the modelling hall, without you my maquette would never have become as beautiful as it is now.

I wish you much reading pleasure.

Simone Hermans
Delft, 1 July 2024

Introuction

Climate change is an increasingly urgent and growing problem. Not only is the climate changing, but the landscape is changing with it. Think of sea level rise, heat stress and water shortages. This makes the demand for future-proof landscapes, in which new, climate-proof buildings can be realised, increasingly necessary.

One of the areas that will be subject to change in the future is the Hunze Valley in northern Groningen, a location that is developing as a nature reserve connected to the Wadden Sea: the Hunze river valley between the city of Groningen and Lauwersmeer. However, today's architecture is not sufficient for the challenges that await us in this area. This developing landscape can serve as inspiration for the design being both a technical and aesthetic challenge to build in. Therefore, the graduation studio Technologies & Aesthetics poses the following question: what will the architecture look like in this beautiful wetland area a hundred years from now?

In order to determine what kind of architecture is appropriate in this area, it must first be determined what the area will look like a hundred years from now. To outline this scenario, landscape research was carried out on the area around the Reitdiep, the former Hunze. This research is explained in chapter 2. The Reitdiep is a river that flows from the city of Groningen to the Lauwersmeer. This area is now protected by sea dykes and is completely reclaimed, but due to its low position it is very vulnerable to seawater rises. The area in northern Groningen has a long history of living with, but also against water. The signs of this can be seen in the landscape; mounds, dikes and pumping stations are everywhere. Of the various themes suggested by the studio, I therefore decided to focus on the theme of water.

After the land survey, from which several scenarios emerged, I designed a master plan for the Hunze river valley for a hundred years from now. In this master plan, space is created for people, but above all space is given back to nature by returning the Lauwersmeer to the Wadden Sea. This natural buffer, the Lauwerszee, thus becomes a nature reserve again, while also offering protection to the landscape behind it. This new tidal area offers opportunities for innovative architecture that takes into account the changing water levels, rising sea levels and the technology of the future.

The new landscape offers an opportunity for a new research and visitor centre of the returned Lauwerszee; The Wadloper. This design is explained in chapter 3. The centre reflects the landscape, both in function and concept: the duality of the relationship with the water is used in the duality of the centre. The first building, the visitor centre, is positioned against the embankment, becoming, as a static structure, part of the infrastructure, as it were. The second building, the visitor pavilion, stands in the Wadden Sea, and, like its dynamic surroundings, moves with the landscape.

Chapter 4 presents the technical rationale for the design of the Wadloper. Both the supporting structure, building structure and climate design are calculated, through calculations and tools. A unique aspect of the pavilion is also explained; the building's ability to walk on the mudflats, just like its visitors.

After the research, design and technical justification, the conclusion and reflection follow in Chapter 5. This looks back at the past year, and what I can conclude from the research and design. In chapter 6, you can find the literary justification, and the documentation of the design research, in the form of models.



02
RESEARCH

2.1 Group research
2.2 Location
2.3 Layer analysis
2.4 Masterplan

REITDIEP

[reit - diep] • Dutch

Reit is derived from the ancient Dutch word rith (flood) and middle Dutch word rijt (flowing water). The Middle Dutch word deep literally means ‘water with a certain depth’.

LAUWERSMEER

[lau - wers - meer] • Dutch

Lauwers is derived from Lawiki (Laviki, Lauuichi or Laueke). This means ‘the lovely’ and is related to the Gothic word galaufs ‘pleasant’.



Start of the cycle route



Ezinge





The church of Ezinge



The dike at Englum



The Waterwolf

Cycling route

The landscape research started with an excursion to the province of Groningen, the northernmost province of the Netherlands. As a research method Mare Schut, Sarah Hermsen and I, went cycling through the area, along the waters of the Reitdiep. We started in the village of Ezinge, and cycled 40 kilometres through the countryside, up to Zoutkamp. While cycling, we were able to observe and experience well the versatility of the Groningen landscape. Our cycling route, and more importantly, cycling experience, is thus the basis of our group research.

Upon returning to Delft, we decided to analyse our findings together. We made a plaster model of the area around Reitdiep to map our cycling route, and understand the landscape. We mainly focused on the height differences in the landscape, as we noticed these while cycling. This model prompted me to delve further into the landscape in the intermediate dike area around the Reitdiep. Indeed, the maquette revealed the big difference between the natural landscape between the dykes around the river, in which the history of the landscape is clearly readable; an area that culminates in the national park Lauwersmeer. This natural area is in great contrast to the cultivated landscape behind the dykes, where many small villages are built on mounds, with an orthogonal water network between arable crops.

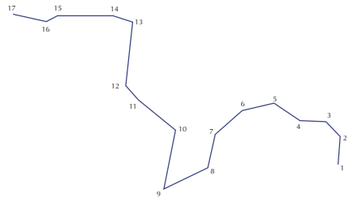


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Photo documentation cycling route (own work, 2023)

Infrastructural exploration

During the bike ride, the subtle height differences along the road were noticeable. We also cycled on many different roads, all of which we captured on camera. This map depicts the cycle route, with an impression of the road in eight different places in the direction of the cycle route. This ‘measuring points method’ comes from photographer Peter de Kan, and is also called a photo essay (Sponsland, 2021). During our bike ride we could distinguish 8 different types of roads. We have indicated these types on the map. The Zuiderweg (1), the road we started on, was a narrow motorway without a marked cycle path. This road only led to some farms, and contained local traffic.

As soon as we entered the Van Swinderenweg (2) towards Ezinge we immediately noticed a difference. Because the area is lightly built up, there are few major roads and this is one of them. The road is quite busy, and despite the indicated cycle path, you are not very safe as a cyclist because of the many cars.

On the Englumerweg (3) towards Oldehove we arrived at a somewhat quieter road again, as this was not a main road. Here we could cycle quietly next to each other. In addition, there was a ditch with a dike next to it on our right, the first noticeable height difference. The Niehoofsterweg (4) towards Niehove was the quietest road until then. It was a beautiful avenue, with trees on both sides of the road.

After Niehove we took the cycle path, exclusively for cyclists, the Anne Pilat path (5). This narrow path was enclosed on two sides by ditches. It was no wider than a meter, making it impossible to cycle side by side. The path led through open fields.

After this we arrived at the beginning of Electraweg (6), before the Waterwolf. After the Waterwolf the character of the Electraweg (7) changed. We cycled along a dike on which wild flowers had been planted to improve the biodiversity in the region. This small intervention had a major influence on our experience, as we could no longer see over the dike, and it was also the first flowers we saw in an almost completely grassy landscape.

Finally we arrived at the Zoutkamperweg (8). In contrast to the previous roads, which were all quite orthogonal (with the exception of road 4). This path followed organically through the landscape. There were trees along the road again, but due to the heavy truck traffic we did not feel sheltered but rather vulnerable. We felt we had arrived more in the more built up, busy part of the area.



Structural analysis cycling route (Hermans, Hermsen & Schut, 2023)

Research question

The site covers an area in the northernmost province of the Netherlands: Groningen. This area, bordering the Wadden Sea, has a close relationship with water, both the seawater of the North Sea, and freshwater flows through the province. The province is home to the municipality of Het Hogeland, an area created partly by nature, but also almost entirely man-made, by raising the area (hence the name). In this municipality is the Marne located, a former municipality of Groningen. In the Marne flows the Reitdiep, a meander river in the landscape that flows into the Lauwersmeer, a park and protected nature reserve.

The design area for the graduation studio is located in the Hunzedal between the city of Groningen and Lauwersoog. The Hunze is the former river that flowed through this area, now known as the Reitdiep. The Hunzedal is an area that is subject to change. In the 20th century the valley slowly changed into an agricultural landscape.

However, the area will remain subject to a lot of change; Due to climate change, the landscape will have to be designed in a different way. For example, rising sea levels will affect the dikes that protect this country, but the water discharge from the rivers will also have an influence. In addition, the housing shortage is only increasing, especially in Groningen (Van Kampen, 2021). Perhaps the area will transform into a water-rich and dynamic landscape that changes with rising sea levels. This developing landscape can serve as inspiration for the design, which is both a technical and aesthetic challenge to build in.

This location will be analysed and the findings will be used for a new masterplan for this are. To do so, the research is using the following research question:

"How can an in-depth study of existing landscapes contribute valuable knowledge for designing sustainable and resilient landscapes in the future?"

To answer this research question, first the location and its history will be analysed. After this, the landscape will be investigated using the layer approach. In the end, future scenario's will be presented, which will lead to a masterplan for the Hunze Valley river. To do so, the method of cartography is being used to document the findings.



Province: Groningen



Municipality: the Hogeland

Landscape: the Marne

Formation of the delta

The sea began advancing at the end of the last ice age, around 12,000 years ago, as an ice sheet north of the Netherlands melted. Meltwater flowed into channels carved by previous ice ages, including the Hunze Valley. About 8,000 years ago, rising sea levels covered sandy landscapes with clay and created beach walls that moved toward the coast, forming the unique intertidal Wadden Sea.

When sea levels stabilized 5,000 years ago, the land began to grow. A tidal basin of mudflats and salt marshes formed where the Hunze met the sea. Over thousands of years, these areas filled with sediment, forming salt marsh walls and levees visible along the Reitdiep. These features trapped water, allowing clay, called knipklei, to settle, suitable only for grassland.

By the beginning of our era, the sea became more active, causing increased flooding and reducing the salt marsh landscape, partly due to agricultural peat extraction in the fourth and fifth centuries, leading to soil subsidence.

The Hunze river flowed south to north until the Middle Ages. Gradually, it silted up, while the Lauwers river widened, creating the Lauwerszee. Around 800, a flood connected the Lauwerszee with the Hunze, forming a new outlet and redirecting the Hunze westward. This new waterway was called the Reitdiep, from ancient Dutch and Middle Dutch words for "flood" and "flowing water."

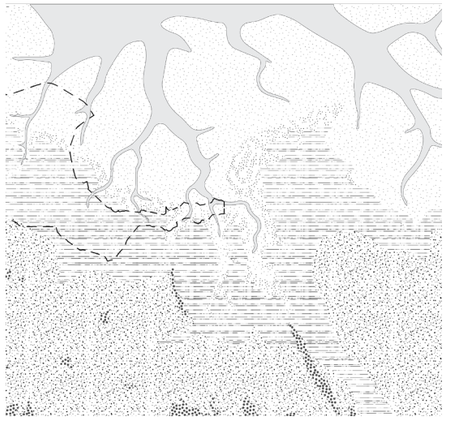
The origin of the Reitdiep, whether natural or artificial, is debated. It may be a combination of both, as there are manually created waterways in Groningen. Residents might have intervened to improve drainage from the silted Hunze basin. Until dikes were built in the 12th century, the Reitdiep flowed freely in the Hunze Valley (Westerhuis et al, 2023).

Legend

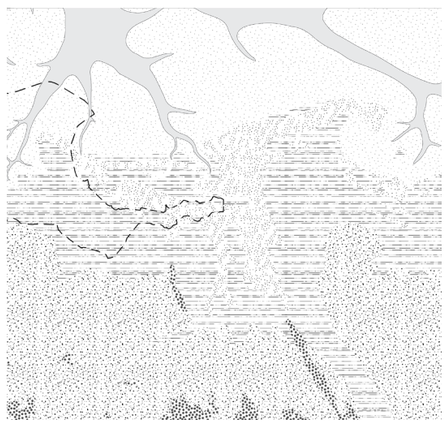
- Pleistocene
- Peat area
- Salt marsh (kwelder)
- Salt marsh wall
- Tidal area
- Rifts and watercourses



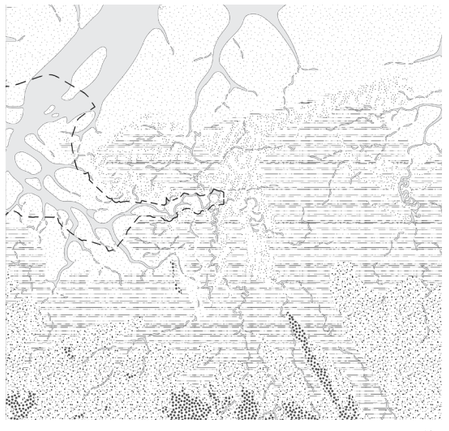
1. 1000 BC



2. 600 BC



3. Around the era



4. 800 AC

History of the Hunze Valley (own work, 2023)

The origin of the Lauwersmeer

The Reitdiep area was shaped by both natural events and human intervention. The Lauwersmeer, formerly the Lauwerszee, has experienced significant human influence since its formation. The Lauwerszee's contours were already visible around 600 BC, and it connected inland to the Hunze, now the Reitdiep. Early inhabitants built mounds to live on and engaged in farming, fishing, and trade. Despite frequent sea level rises making the area uninhabitable, people continually returned and began building dikes around 1000 AD to reclaim the land.

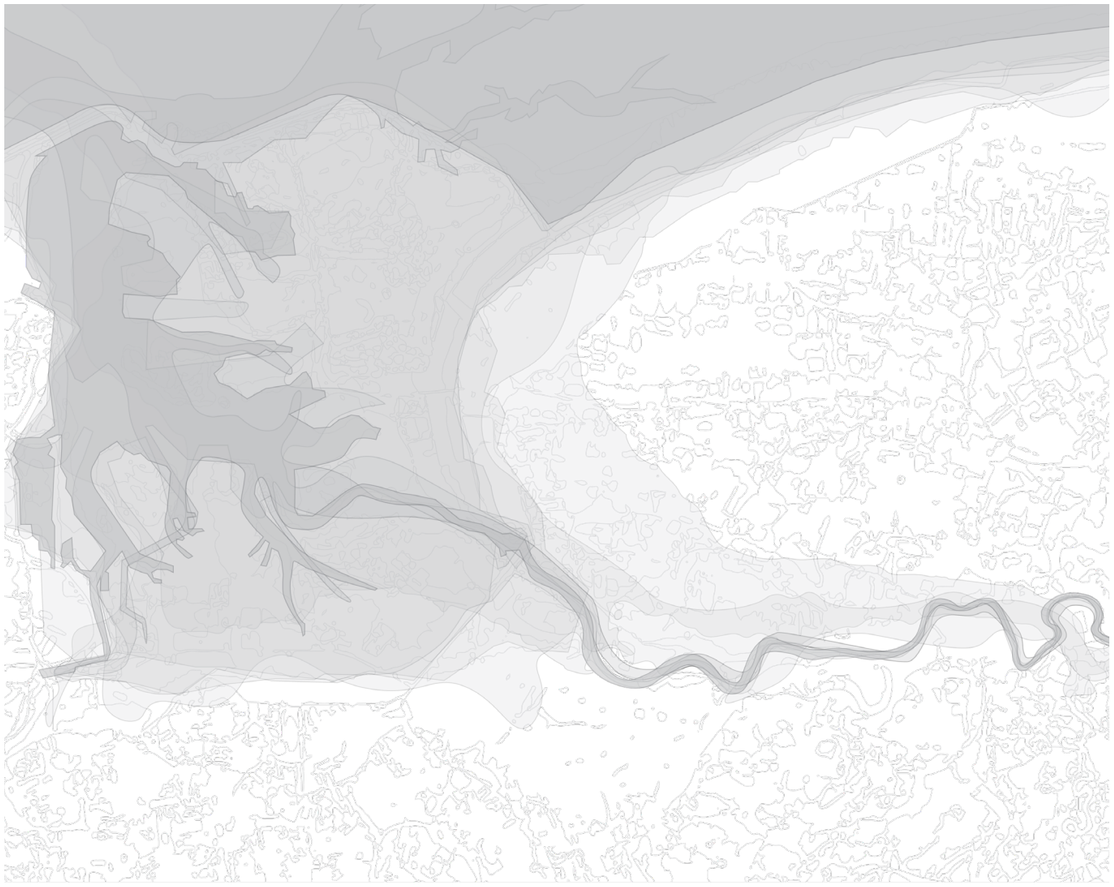
By 1400, approximately 2,500 salt marsh areas had been diked, complicating drainage and causing more frequent floods. Proposals to close the shipping route to Groningen were rejected due to its importance, but in 1877, the Reitdiep's mouth was finally closed to protect the city from flooding. The Lauwerszee was significantly reduced in size by human activity, and by 1875, it had nearly its current shape.

Plans to close off the Lauwerszee focused on improving drainage rather than preventing floods, with initial proposals dating back to 1849. Despite various plans, financial and political challenges delayed implementation. However, continued flooding and pressure from northern residents led to government action. In 1961, Rijkswaterstaat began preparations, and on May 23, 1969, the Lauwerszee was closed off, converting it into the inland Lauwersmeer with a stable water level.

This transformation ended the Lauwerszee's role as a part of the Wadden Sea, reducing the Wadden area by 9,000 hectares, draining 7,000 hectares of water, and leaving 2,000 hectares of freshwater. Over the past 55 years, the Lauwersmeer has served as an inland lake, supporting both recreation and agriculture. The clay areas became farmland, while the sandy areas were preserved for nature due to their unsuitability for agriculture (Rijksdienst voor de IJsselmeerpolders & Ministerie van Verkeer en Waterstaat, 1989).

Legend

- 1815
- 1830
- 1868
- 1891
- 1930
- 1969
- Current situation



The history of the Lauwerslake and the Reitdiep (own work, 2023)

Flora and fauna

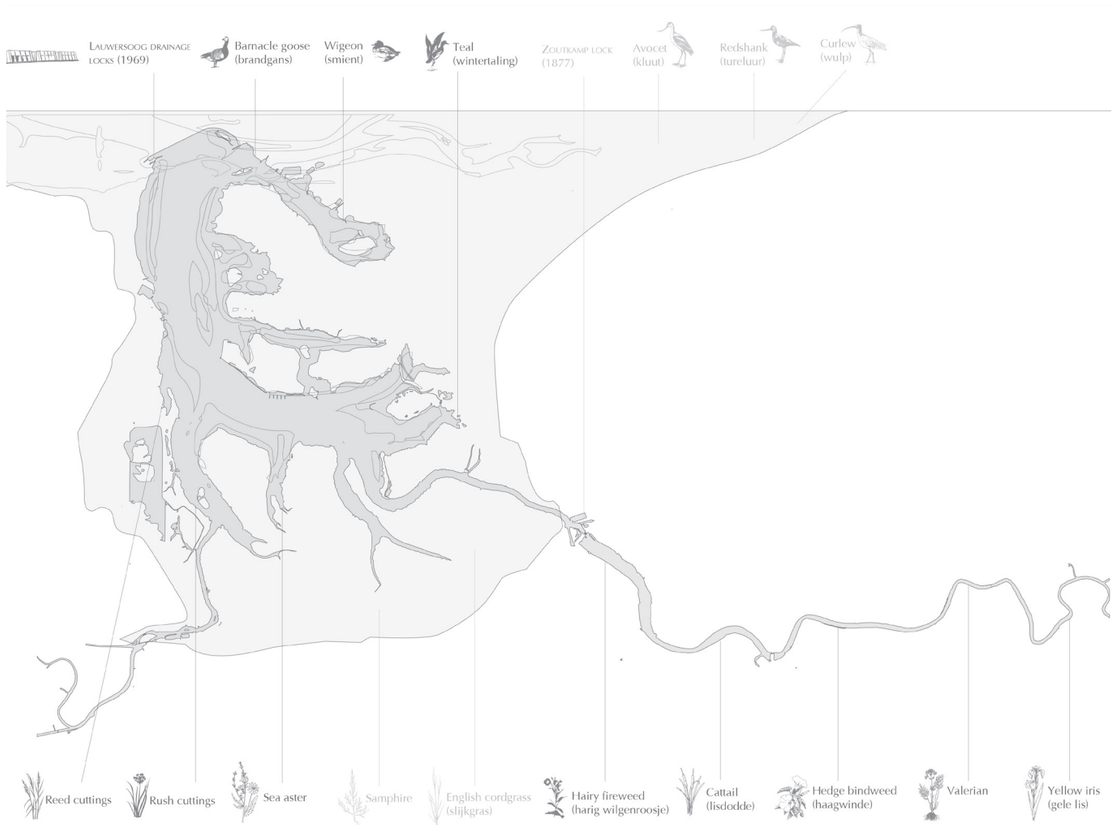
Following the area's drainage, significant changes occurred in both the landscape and its flora and fauna. Saltwater-dependent species were unable to thrive, leading to declines or migrations, including seals.

Previously, the Lauwerszee's tidal flats were a haven for tens of thousands of birds, such as dunlins (20,000) and oystercatchers (12,000). Species like avocets (2,700), redshanks (7,000), and curlews (8,000) were particularly abundant compared to other parts of the Wadden Sea. However, after the closure, the area lost its role as a feeding ground, and detailed bird counts do not confirm their relocation within the Wadden area.

The newly formed Lauwersmeer now attracts different bird species, with large populations of barnacle geese, smews, and wintering teal thriving there. Barnacle geese numbers tripled to nearly 100,000, feeding on sea crusts formed on the exposed flats. Smews increased to over 50,000, while approximately 65,000 wintering teal are now observed.

Post-closure, reeds and rushes were planted to stabilize the shores. Initially barren, grassy vegetation soon took hold in higher areas, eventually supporting seagulls, shrimp grasses, and other species (Rijksdienst voor de IJsselmeerpolders & Ministerie van Verkeer en Waterstaat, 1989).

Vegetation in the Reitdiep area varies, with diverse species near the Lammerburen lock including reeds, valerian, and yellow loosestrife. Closer to Groningen, the landscape features more uniform vegetation interspersed with occasional grids along the shores (Franken & van Haskera, 2019).



The flora and fauna of the Lauwerslake (own work, 2023)

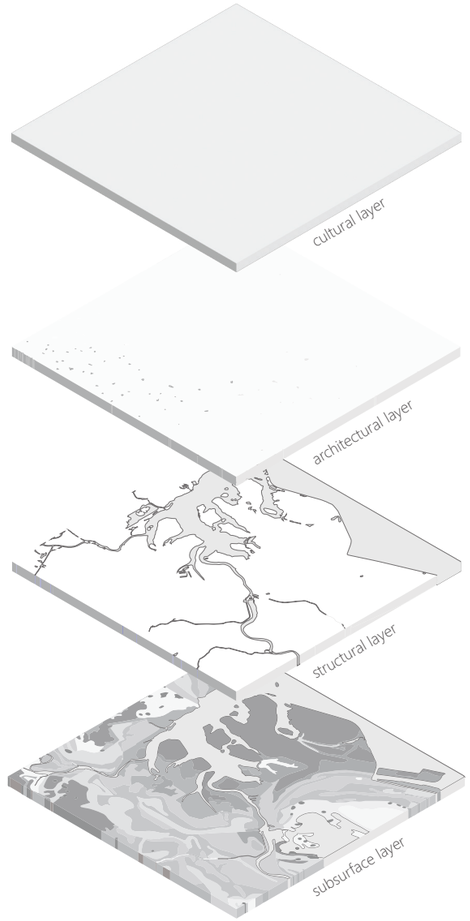
Layer approach

This research uses the layer approach, a common method in landscape architecture and spatial planning, notably at Wageningen University & Research. The layer approach simplifies the complex landscape by depicting it in three layers: subsurface, networks, and occupation. Each layer has a different temporal aspect: 100-500 years for the subsurface, 50-100 years for networks, and 25-50 years for occupation. These interconnected layers help understand the landscape as a single entity.

Thinking in layers, especially the interaction between humans and landscape, is a typically Dutch method. The layer approach helps recognize and manage the complex spatial tasks of the Dutch landscape by prioritizing between layers (Hagens, 2006).

The subsurface layer, comprising the abiotic, biotic, and water systems, is very static and changes over centuries. **The structural layer** includes green, traffic, and water networks, essential for urban and economic dynamics. **The occupation layer**, consisting of landscape use and architecture, changes within a generation.

Additionally, I propose a fourth, intangible layer: **the cultural layer.** This layer is intertwined with the other layers and is present in the consciousness of the landscape's inhabitants and visitors. The cultural layer of Groningen is explored through literature, art, and memories. This addition aims to map Groningen completely for its preservation. Though there is some research on culture mapping (e.g., Underwood and So, 2021), no clear method exists yet. This research will also explore documenting culture.

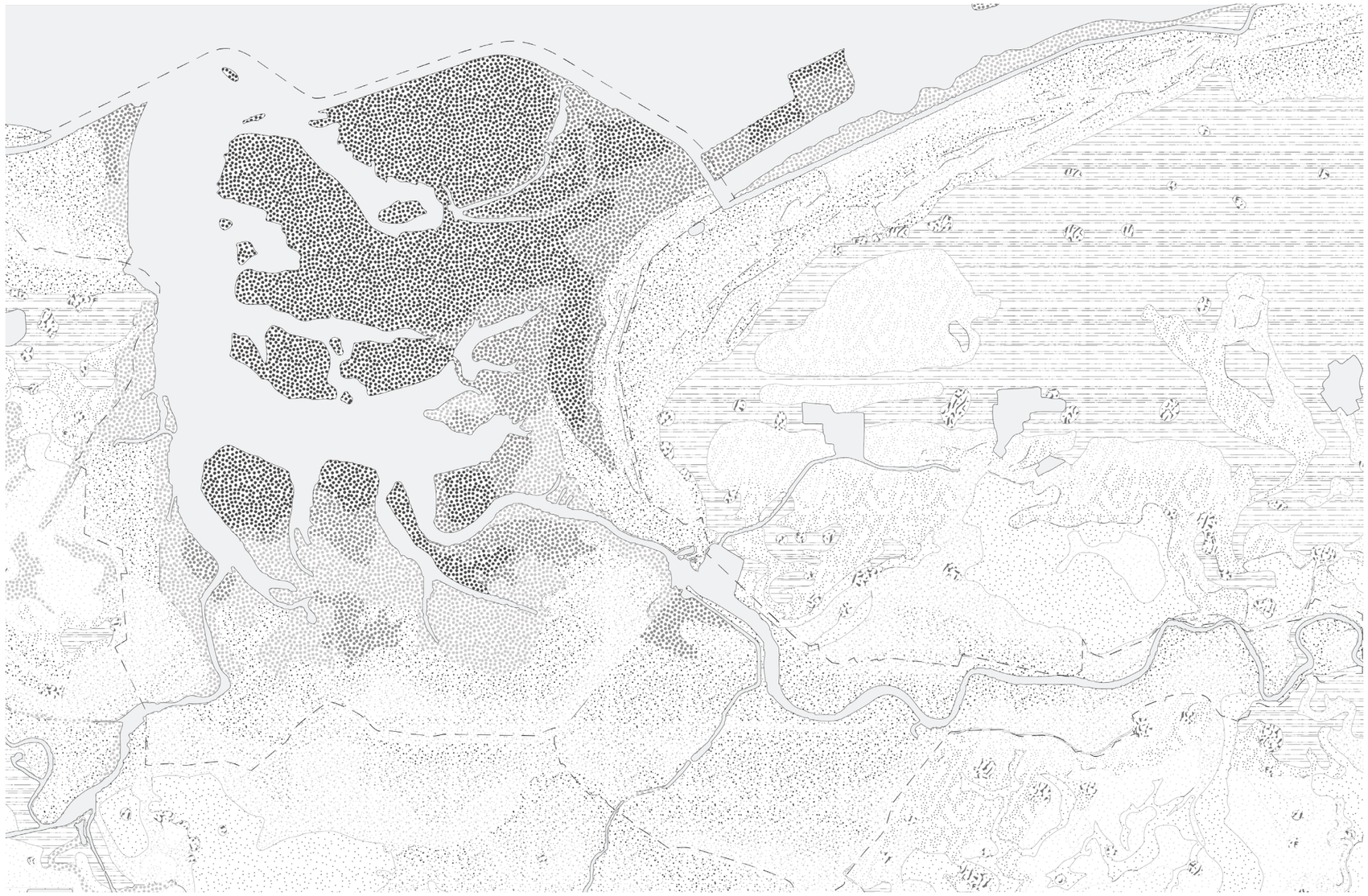


Subsurface layer: soil

The first subsoil layer mapped is the soil. The area around Reitdiep mainly consists of many different types of sea clay, due to the genesis of the Delta. This map distinguishes between the different types of clay. The map shows a clear distinction between the clay that lies along the river and sea, and the clay in the land in between.

Legend

- Calcareous shallow soils
  very fine sand
- Calcareous shallow soils
  extremely fine sand
- Calcareous nesphage soils
  light sabulous clay (zavel)
- Calcareous polder swamp soils
  heavy sabulous clay (zavel)
- Calcareous polder swamp soils
  light sabulous clay (zavel)
- Calcareous polder swamp soils
  clay
- Knippoldervaaggronden
  heavy sabulous clay (zavel)
- Knippoldervaaggronden
  clay
- Knippoldervaaggronden
  sand and light clay
- Low-lime polder swamp soils
  light sabulous clay (zavel)
- Low-lime polder swamp soils
  light clay
- Mound
  old settlement sites



Soil map of the research area (own work, 2023)

Subsurface layer: height

This map highlights the next layer of the subsurface layer: the height differences in the area. What is striking about the landscape is that it is not sloping towards the sea, as you might think. Instead, the landscape gets higher and higher the closer you get to the sea. Even next to the Reitdiep, the banks are clearly visible because of the difference in height. Especially the inner area outside the dykes is low-lying, in which the parcellation is also clearly visible in the difference in height. Park Lauwersmeer is also very low. Therefore, if the sea dyke collapses, the park will be the first to flood. The highest structures in the area are the mounds, the dykes and the road to Zoutkamp. All these high interventions are man-made, to protect from the rising waters, while the sea-river banks are a consequence of the formation of the delta (Westerhuis et al, 2023).mounds are also found in the study area.

Legend

- Lower than -1 meter
- - 1 to 0 meter
- 0 to 1 meters
- 1 to 2 meters
- Higher than 2 meters



Height map of the research area (own work, 2023)

Structural layer: water

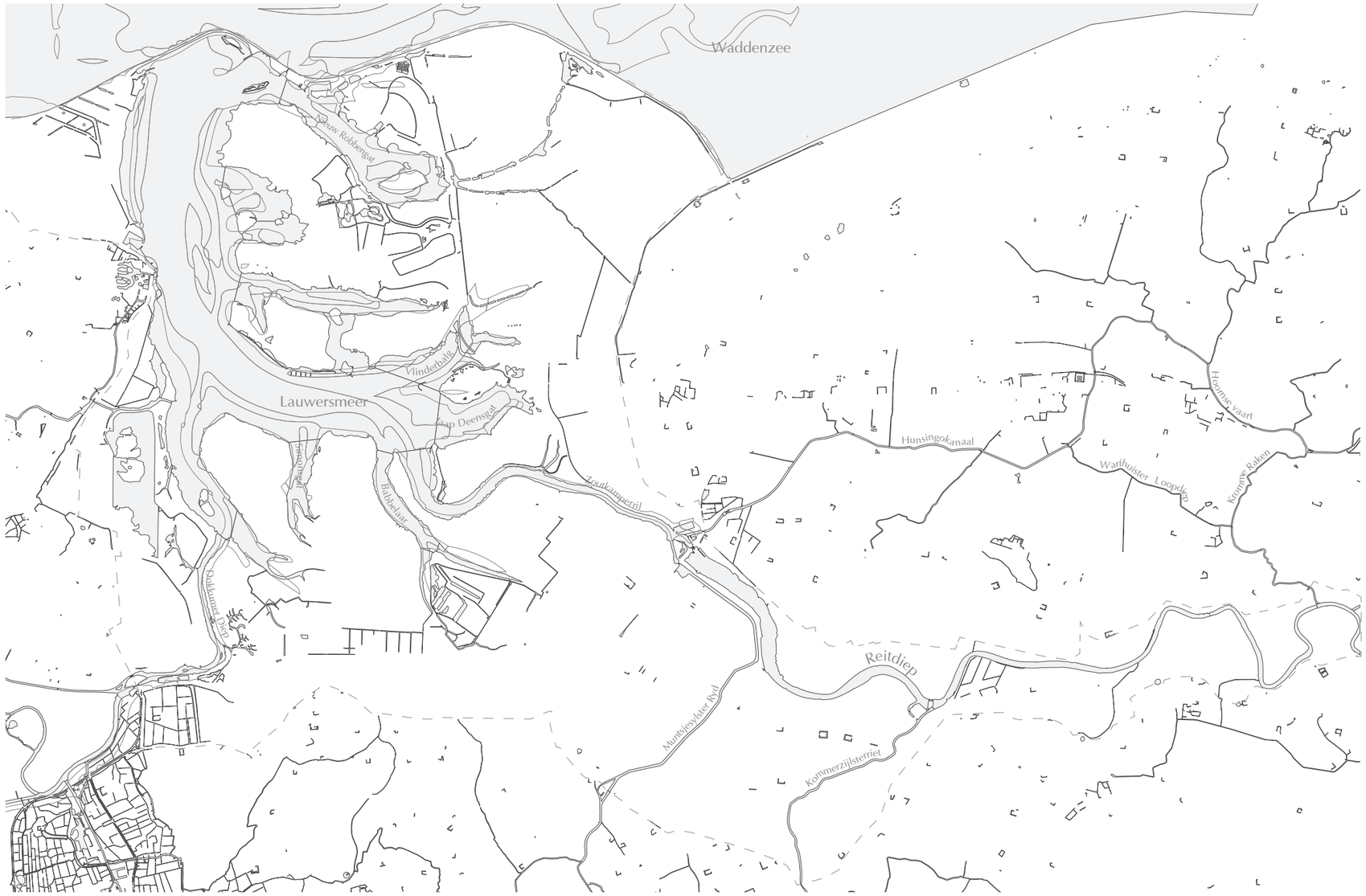
The next layer is water, which falls under both the subsurface and structural layers, encompassing groundwater and water networks. This study views water as a structure due to its historical role in transport via sailboats, ships, trawlers, and steamboats (Steenhuis, 2002).

The Lauwersmeer, once open to the sea, connects to the Dokkumer Diep to the south and the Zoutkamperril to the east. From the Zoutkamperril, three water structures emerge: the Hunsingo Canal to the north, the Reitdiep to the east, and the Muntsjesylster Ryd to the south. The Reitdiep also branches into the Kommerzijlsterriet to the south and the Kromme Raken to the north, forming a fine water network.

The map shows a contrast between the organic forms of the Lauwersmeer and Reitdiep and the orthogonal ditches between meadows and villages.

Legend

- Water
- Water network
- Land



Water map of the research area (own work, 2023)

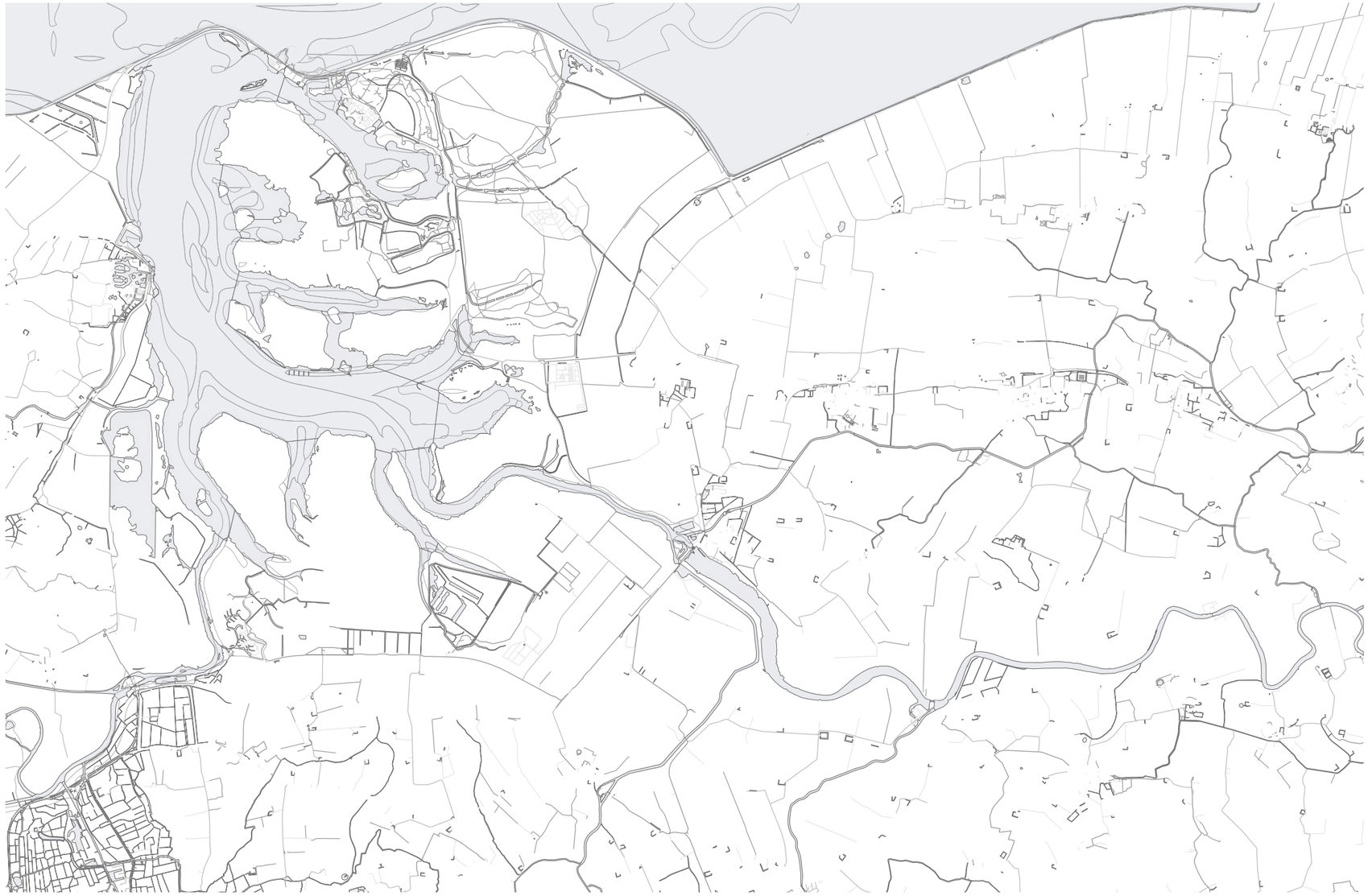
Structural layer: road network

The next structural layer is the road network. Historically, roads were secondary to water routes for transport, and there are few paved roads in the area. Site visits revealed frequent detours due to limited road access. Notably, there are no motorways along the Wadden Sea coast, except near Lauwersoog, making it inaccessible by car. Few roads cross the Reitdiep, indicating the area is designed for local rather than heavy car traffic.

In contrast, there are many cycling routes due to the area's popularity as a recreational destination, with paths like the Anna Pilat path between Niehove and Electra. Additionally, numerous unpaved, often dead-end roads lead to individual farms, each with its own access road. In the northern part, the subdivision is evident in the street pattern.

Legend

- Water
- Paved road
- Bike path
- Unpaved road
- Land



Road map of the research area (own work, 2023)

Structural layer: dikes

The last structural layer is the dikes. The Netherlands' landscape is shaped by decisions over time, embodied by the dikes which "freeze" the landscape at specific moments (Metz, 2014).

Sea dikes, found along the coast, are at least 8 meters high and protect the land from the sea. River dikes, about 3 meters high, are found along rivers and were built later.

North of the Reitdiep, various historical dikes are visible. These dikes follow the pattern of waker-sleeper-dreamer: the "guard" is the primary dike, the "sleeper" is the secondary inland dike, and sometimes there's a "dreamer" behind that (Kranenburg, 2015).

Legend

- Water
- Dikes
- Land



Dike map of the research area (own work, 2023)

Architectural Layer: Land Use

The final layer in the layer approach is the occupational or architectural layer, which includes patterns of human use of the subsurface and networks. This study focuses on the spatial layout and land use of the area.

Groningen has a long history of agriculture, with fertile sea clay and sand, especially around the Reitdiep and the coast, making it ideal for arable farming. The fertile soil, called sulphur, is well-suited for crops due to its moisture and permeability. South of the Reitdiep, heavy clay soils dominate, which are unsuitable for arable farming, leading to more livestock farming (Westerhuis et al, 2023). The Lauwersmeer National Park, with its natural, organic shape, contrasts sharply with the cultivated, orthogonal landscape around the Reitdiep.

Legend

- Water
- Grass landscape
- Agriculture
- Landscaped greenery
- Swamp landscape
- Nature reserve



Land use of the research area (own work, 2023)

Architectural layer: buildings

The final layer under study is the built-up area. The Reitdiep region features sparse population density and open landscapes with small villages compared to other parts of the Netherlands, reflecting its ancient origins.

Settlement began around 600 BC in this fertile area, where early inhabitants raised house mounds using waste and manure to protect against floods. These evolved into clusters of elevated mounds known as wierden villages, with the oldest dating back to the 4th or 3rd century BC. Typically, these villages had circular layouts with farms surrounding a central church, as seen in Niehove. Village names often indicate their medieval roots, ending in -um (from Old Dutch "heem" or "heim" meaning dwelling place) or -werd (derived from "wierd"), such as Garnwerd or Ezinge (Westerhuis et al, 2023). These historic villages are still visible on modern maps of the Reitdiep area. The elevation map vividly displays their history, including vanished villages.

Legend

- Water
- Buildings
- Land



Buildings in the research area (own work, 2023)

Cultural layer: art

Having completed the analysis of the physical environment, attention now turns to understanding the cultural identity of the Reitdiep area. This exploration seeks to uncover its Genius Loci, or spirit of place, using various methods, starting with its artistic expressions.

The Blauwbörgje farm, situated in the Reitdiepdal near Groningen, played a pivotal role for the Groningen-based expressionist art group, de Ploeg. F.H. Bach, a teacher at the Minerva art academy, discovered this location and led his students to paint its surroundings. Prior to this, Bach had already developed an appreciation for the scenic beauty of Groningen through his paintings of Drenthe landscapes.

De Ploeg artists, influenced by Jan Wiegers and German Expressionism, employed vivid colors to depict the simplicity of Groningen's countryside—the dikes, farms, churches, and waterways. They increasingly frequented the Reitdiepdal, drawn to its picturesque cultural landscape and historical connection between Groningen and the sea. This area held significant cultural value for Groningen residents, evident in the art produced during that period (Steenhuis, 2002).

Not only have I selected the painted art of Groningen, I also selected a couple of poems from Groninger artists.

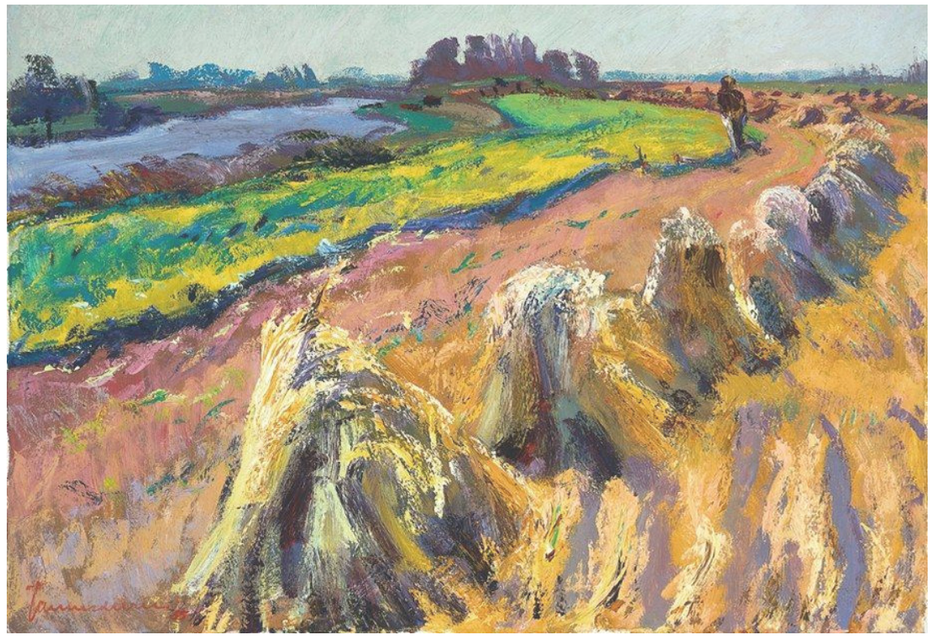


Het Reitdiepdal - Johan Dijkstra (1896 - 1978)

Reitdiep

Langzaam glijdt de rivier
door de kom van het dal
en kronkelt zich weg
in haar dromen,
om tot slot bij
het zilte en zompige wad
oeverloos in de ruimte te stromen.

Josephine Banens (2005)



Landschap met korenschoven bij het Reitdiep - Jannes de Vries (1901 - 1986)



Reitdiep bij Zuurdijk - Jan Altink (1885-1971)

Hail achter in toen,
doar kwamen wie bie mekoar,
doar was n hail mooi plekje,
n lindeboom ston doar.

Uit ‘Stemmen van Groninger Dijken’ (2001)

Cultural layer: painted art map

This cultural map overlays De Ploeg paintings on an underlay of the Reitdiep. Efforts were made to place the paintings where they were originally created. Water areas are represented by fragments of these paintings, and the horizon is depicted for the Wadden Sea, as it was rarely painted. The focus was on inland scenes and the everyday lives of Groningers, not the sea, so the map stops at the Wadden Sea, showing the horizon.

South of the Reitdiep features the characteristic wierden landscape with churches and grasslands with cattle. Paintings of churches and vast grasslands are depicted here, along with the Blauwborgje in the direction of Groningen. North of the river shows the distinctive parcel landscape, captured by de Ploeg painters, including fields, working farmers, and distant farms. The horizon is visible, focusing on the Reitdiep rather than the coastline.

This collage provides a unique view of the Groningen landscape through the eyes of De Ploeg painters, revealing insights into their perspective and the landscape they depicted.

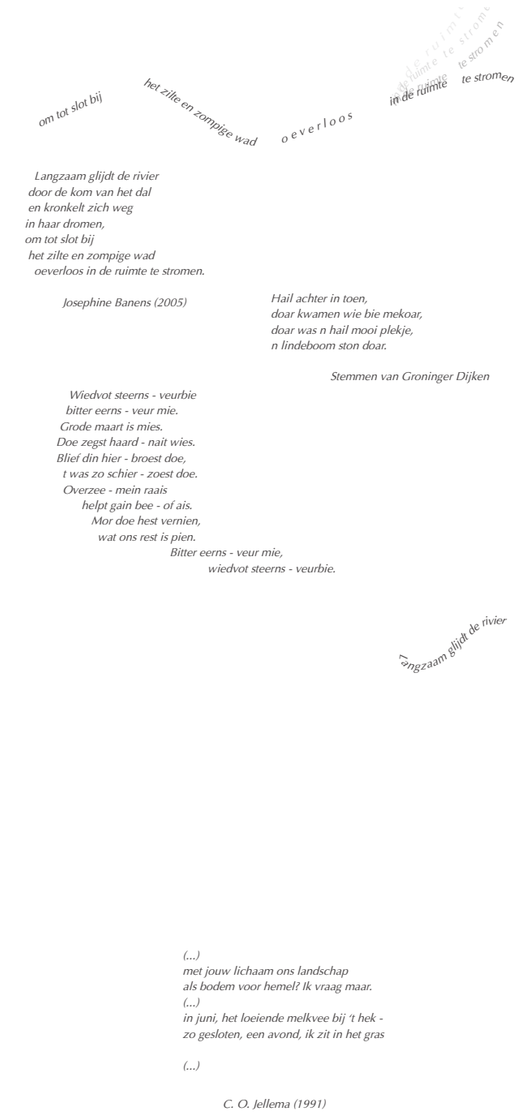


Culture map made out of artwork of the Ploeg (own work, 2023)

Cultural layer: poetry map

Just like with the culture map regarding painting, I have now also tried to map the poems about the Reitdiep. Some poems are better suited to this than others. For example, the poem by Banens (2005) is quite literal, and can therefore be placed well in context; in the river and at the mouth of the Lauwersmeer at the Wadden Sea. The poem 'Aan het Reitdiep' by Jellema (1991) can also be placed well in this context, and is therefore placed around the Reitdiep. Fragments have been taken from his poem 'Kerkje van Fransum' that fit in with the surroundings.

The poems from the book 'Voices of Groninger Dijken' were written across the entire area, and therefore do not have one location. One poem is about a lime tree, and is therefore placed in the Lauwerspark. The other poem is about the transience of the people in the area, but the eternity of the landscape. That is why it has been placed several times around the dikes, which are also being raised and dilapidated, just like the disappearing text.



Poetry map made out of artwork of the Ploeg (own work, 2023)

Conclusion of the layer analysis

One of my most important conclusions is the different way in which water is handled in the Reitdiep area. In the past, residents of Groningen built mounds, or Wierden as they call them, on which they built their farms. In this way they ensured that their house was dry, while the animals they kept could graze in the area. When the area flooded, they took their animals onto dry land, and when the water subsided they released the animals again. When the area flooded too often, they moved to another place and started over. For years, this dynamic way of living was how people in Groningen dealt with the water. In Groningen, traces of this way of life are still part of the landscape, such as the mound under the church of Ezinge.

On the other hand, around the Reitdiep you will also encounter many signs of a different way of dealing with water, such as dikes and water pumps. Instead of living with the water, people fought against the water. The dikes were supposed to keep the threat out, and the water is pumped away from the land. Instead of moving with the water, the dikes become higher and preserve what is there.

This duality in the identity of the landscape was subsequently also reflected in the art. During my research into the cultural layer of the landscape, I made two maps of the culture: a map of local art over the Reitdiep area, and a map of local poets over the Reitdiep.

The landscape often comes to the fore in the art map, farmers are depicted in several ways, and the churches are all depicted on a mound. The richness of the landscape and its vicissitudes are expressively depicted with lots of color. The water is not painted as a threat, but as part of the landscape.

On the other hand you have the poems of Groningen poets, in which I have also selected a few in Groningen accent. The down-to-earthness of the people of Groningen comes to the fore in this. The poems also show signs of the solidarity of the people of Groningen. For example, there are sentences about 'generations come and generations go, but our world always remains', and 'cows behind fences, locked up'. Bygone times are looked at with nostalgia, the past plays an important role. Little is looked into the future in the poems. This way of thinking is also more in line with the way the landscape is handled today.



Mound of Ezinge



The Waterwolf

Future scenario

Human health and life are currently and increasingly threatened by climate change (Whitmarsh, 2008). Groningen is particularly vulnerable, being one of Europe's most impacted areas (Smink, 2014). As the northernmost province in the Netherlands, adjacent to the Waddensea, Groningen faces several threats: rising sea levels, increased precipitation leading to winter floods, dry summers causing water shortages, and higher temperatures endangering wildlife (Roggema, 2009). It's anticipated that every resident in Groningen will experience at least one flood in their lifetime (Smink, 2014).

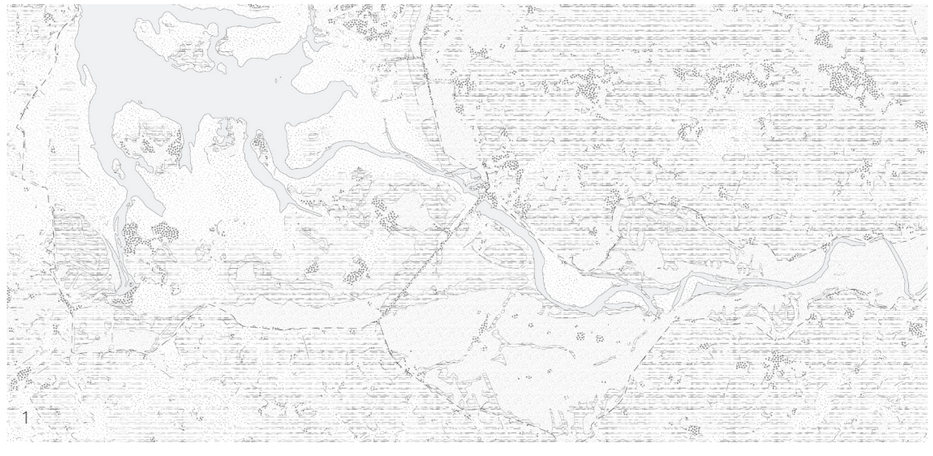
Flood risks from rising river waters due to glacier melt and severe weather are also increasing. Recent examples include the Valkenburg floods of 2019 and 2021, where the town was submerged under 1.25 meters of water from the Geul river. Such events could become three times more frequent by 2050 and six times more by 2085 (Van Heeringen et al., 2022).

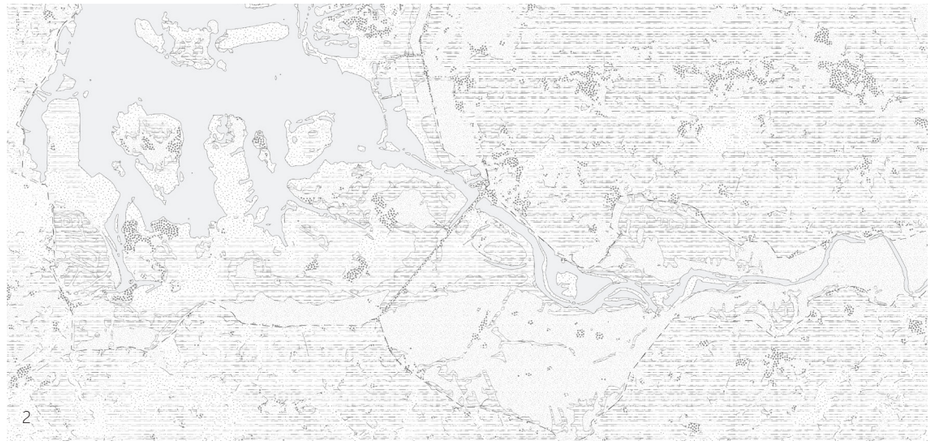
Flooding has become more frequent, as seen in December 2023 around the Maas and Aa rivers, and the Rijn's high water levels (Werkgebied Aa and Meuse, 2023). Reitdiep's floodplains are also increasingly susceptible, necessitating redesign for more water and nature space to protect the residents of Groningen.

These maps show potential flooding in the Reitdiep area with a 3-meter rise, similar to the Geul's 1.25-meter rise in Valkenburg. The northern dyke of Reitdiep is 3.45 meters high, and the southern dyke is 2.55 meters, allowing water to rise about 3 meters (2 meters above NAP) without flooding. Map 1 depicts the current situation, while Map 6 shows which floodplain areas remain above water.

Legend

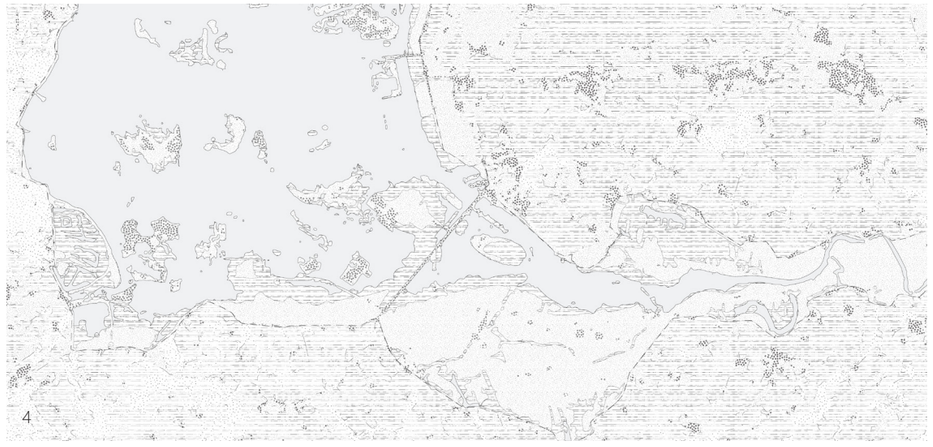
- Rising water
- Lower than 1 meter
- - 1 to 0 meter
- 0 to 0.5 meters
- 0.5 to 1 meters
- 1 to 2 meters
- Higher than 2 meters





Future predictions of the floods around the Reitdiep (own work, 2023)





Future predictions of the floods around the Reitdiep (own work, 2023)





Future predictions of the floods around the Reitdiep (own work, 2023)

Current situation

Using the layers approach, the current situation was examined and analysed. This map shows the current planning situation. From this, it becomes clear how the landscape is currently arranged. With the maps on the previous page, it is clear how the current area would look in case of flooding of the inner dike area. Only the mounds remain, clearly recognisable, above the rising water.

Legend

- Water
- Grass landscape
- Agriculture
- Swamp landscape
- Nature reserve
- Dikes
- Road network
- Buildings



Current situation of the research area (own work, 2023)

Masterplan

For the Reitdiep area, I have formulated a Master Plan for the design of the designated research area. This master plan serves as a projection for the next century. Employing a layered approach has brought to light various tangible and intangible layers, crucial in conceptualizing a new utilization of this region. Given the imminent rise in water levels, a portion of Groningen is at risk of being lost, necessitating preservation methods to retain its historical significance.

Multiple scenarios have been developed for the Reitdiep and Lauwersmeer regions, revealing two distinct strategies: opening the land to the water or storing water on the land. In the first scenario, the dikes are removed to let the Lauwers Lake works an energy supplier and under the influence of tides. The Lauwers Lake becomes the Lauers Sea again. A tidal plant at the old dike site and an upstream osmosis plant generate energy. This revitalization enhances biodiversity, turning the area into a climate buffer and enabling unique housing, leading to a profound transformation of the entire coastal area (Roggema et al, 2008).

In the second scenario, the dikes remain and uses the Lauwers Lake as a fresh water reservoir, increasing storage capacity for winter precipitation. The area between the dikes is submerged and selectively released to the Waddenzee. This stored water is utilized in drier summers, benefiting the wildlife in the upstream Reitdiep area. Seasonal variations lead to the emergence of wet grasslands and water bodies (Meliefste et al, 2009).

I propose a third scenario where the dike at Zoutkamp plays a pivotal role. Dikes surrounding the Lauwersmeer are breached, returning it to the Waddenzee and restoring its former Lauwerszee state. The area around the Reitdiep is designated as a nature reserve, potentially serving as a freshwater buffer but primarily allowing space for nature. The rising river levels create a marsh landscape around the Reitdiep, mirroring the current Lauwersmeer landscape. With the Lauwerzee reverting to a tidal area connected to the Waddenzee, lost and displaced flora and fauna, such as wading birds like the avocet, redshank, and curlew, are expected to return. Additionally, samphire and English cordgrass may gradually reclaim the area.

However, a unique natural habitat, the Lauwerspark, emerges due to rising water levels around the Reitdiep, making room for a freshwater climate with marsh areas. This provides a new habitat for species like the barnacle goose, pintail, and teal. Sufficient space is allocated for plant life, considering the designated nature reserve status.

This redesign allows the preservation of the hinterland, the ancient mound landscape with mound villages and agriculture. Existing dikes merely require elevation, providing space for nature, animals, and humans. The current research facility, Lauwersnest, will become unusable in this plan, leading to its relocation to the southern side of the dike at Zoutkamp. In this new location, the research center can monitor and study both saltwater and freshwater climates. Currently, there are observation points in the Lauwers Park for bird watching. These will be repositioned around the new Lauwersnest following the structure of the mounds. This ensures that the observation points remain, even during high water levels, while also remembering housing in Groningen.

Masterplan

In this map, I propose the masterplan for a nature inclusive and future resiliant landscape for the Lauwerslake and the Reitdiep area in Groningen.

The Lauwerslake will be Lauwerssea again, and it will be an area to attract the wadenbirds and plants which where present in the past. The area will provide space for nature and recreation, and will at the same time, protect the area's behind the dikes, working as a natural bufferzone.

Legend

- Water
- Grass landscape
- Agriculture
- Swamp landscape
- Nature reserve
- Dikes
- Road network
- Buildings



Masterplan (own work, 2023)

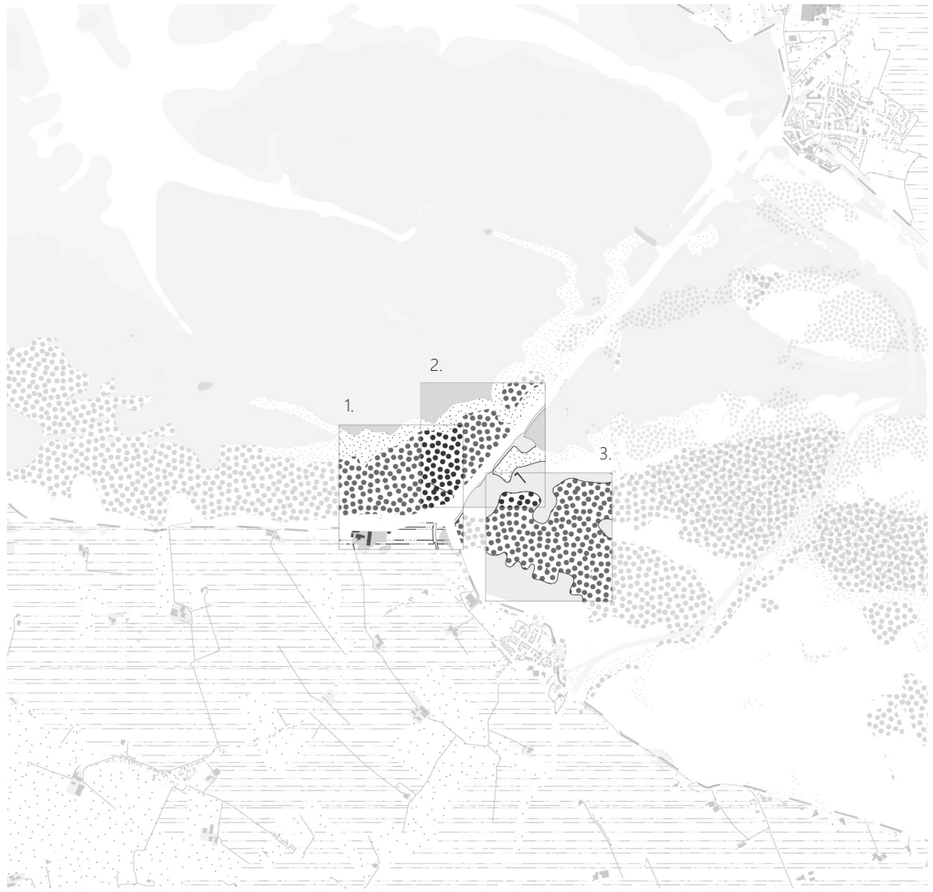
Building site

South of the Zoutkamperdijk, a new visitor and research center will be established, replacing the Lauwersnest visitor center, which will be submerged in the new scenario. This new center will include exhibition space(s), a café with a terrace, an information point, and a research section with two overnight accommodations. Since the building is in a crucial location for the new flora and fauna in the nature reserves, the facades of the building must be designed to harmonize with nature. Therefore, the Program of Requirements (PVE) also incorporates the preferences of both wading birds and marsh birds. The final choice of the location is decisive in this regard.

As several nature reserves will emerge around the new Zoutkamperdijk over the next 100 years, there are roughly three possible locations for the research center. The first potential location (1) is west of the dike, in the new tidal area of the revamped Lauwers Sea. Because the building serves not only visitors but also researchers, it is essential that the building itself is situated within the research area. Since this area is regularly flooded and somewhat unpredictable due to tides, it is necessary to construct the building on stilts. In this scenario, the focus is primarily on the Lauwers Sea and the possibilities of this restored natural area.

In the second potential location (2), the center is placed on the border of the two new nature reserves, between the renewed Lauwers Sea and the new Park Reitdiep. The combination of these two different nature reserves offers very interesting possibilities: on one side, the tidal area extending from the Wadden Sea, and on the other side, the river landscape that will gradually evolve into a marsh landscape like the Lauwersmeer was. The building can adapt to these two different environments and play a crucial role in providing housing for new animals and plants. Additionally, the building can serve as a base for visitors to both nature reserves. Het building could be situated next to or along the Zoutkamperdijk, or even within the dike itself. This presents an intriguing opportunity, both aesthetically and technically, which poses numerous challenges for the practical construction within a dike.

The last possible location (3) places the center east of the dike, in the new Park Reitdiep. This building mainly showcases the former Lauwersmeer and the new Park Reitdiep. The migration of birds to the new natural area can be researched and monitored. New walking and cycling routes can be planned, and the network of mounds can be reused for new observation posts.



Possible locations for the research centre (own work, 2024)



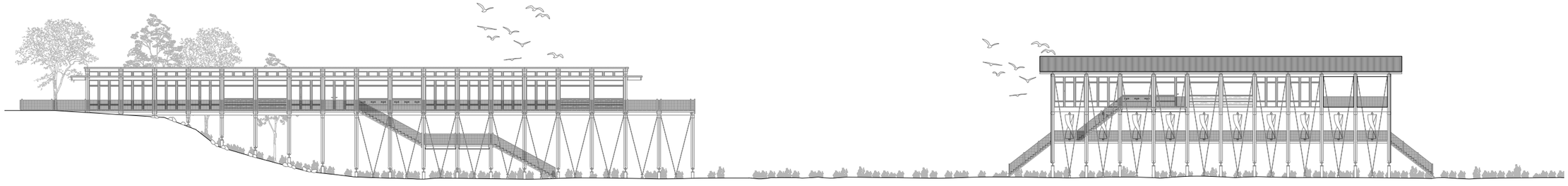
03
DESIGN

3.1 Concept
3.2 Visitor centre
3.3 Pavilion
3.4 Details
3.5 Impressions

Concept ‘De Wadloper’

The concept of my design is in line with the principle behind the master plan, the duality of the landscape in the way water is handled. One half of the building will be placed against the Zoutkamperdijk, thus connecting, as it were, to the existing dike structure. It thus becomes part of the infrastructure and remains in place. The pavilion is located in the middle of the Wadden Sea and moves dynamically through the landscape. When the tide is low, visitors can walk to the building. When the tides rise, it can remain standing, because it is placed on piles, and visitors can retreat to the building, as if it were a kind of mound. However, when sea levels rise, the building, consisting of demountable modules, can move through the landscape and ‘walk’ on the mudflats, just like the visitors.

When the water level has risen too high, the building, which is completely demountable, can be taken apart and placed in another similar tidal area, or reused in another way. It can even be used to expand the static visitor center, as these buildings will have the same building structure. If the sea water rises too high, the visitor center can also be taken apart, and the area will no longer be accessible to humans, and will be completely returned to nature.



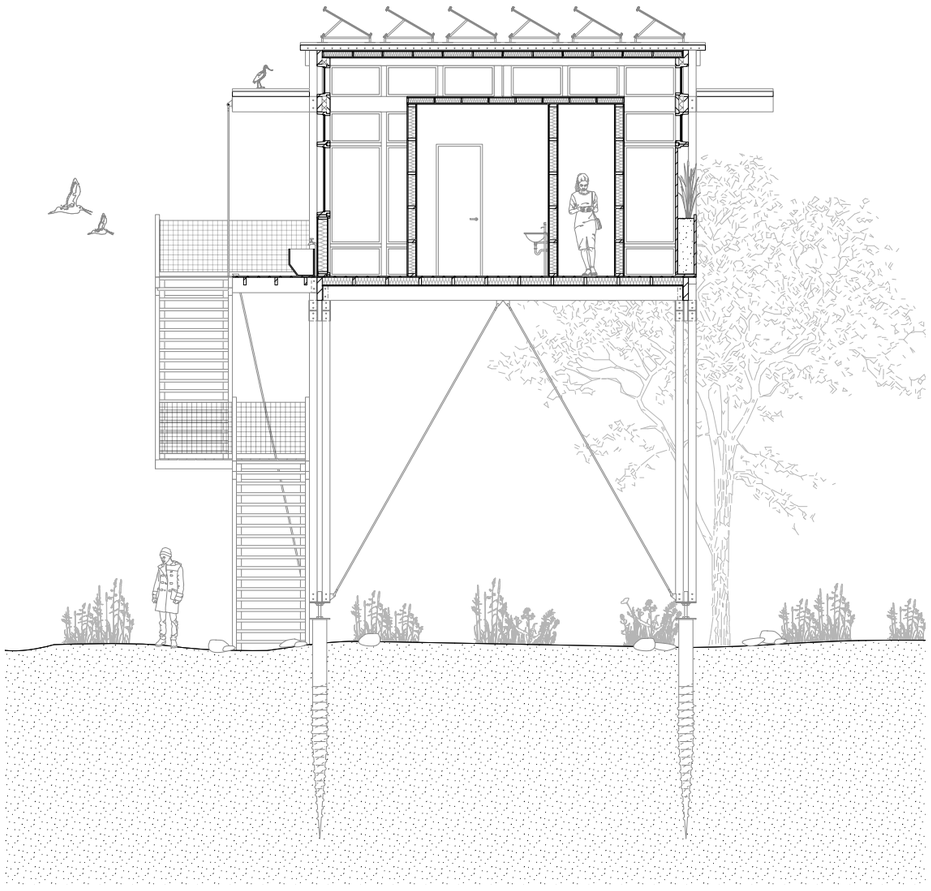
De Wadloper| elevation | scale 1:200

Visitor centre ‘De Wadloper’

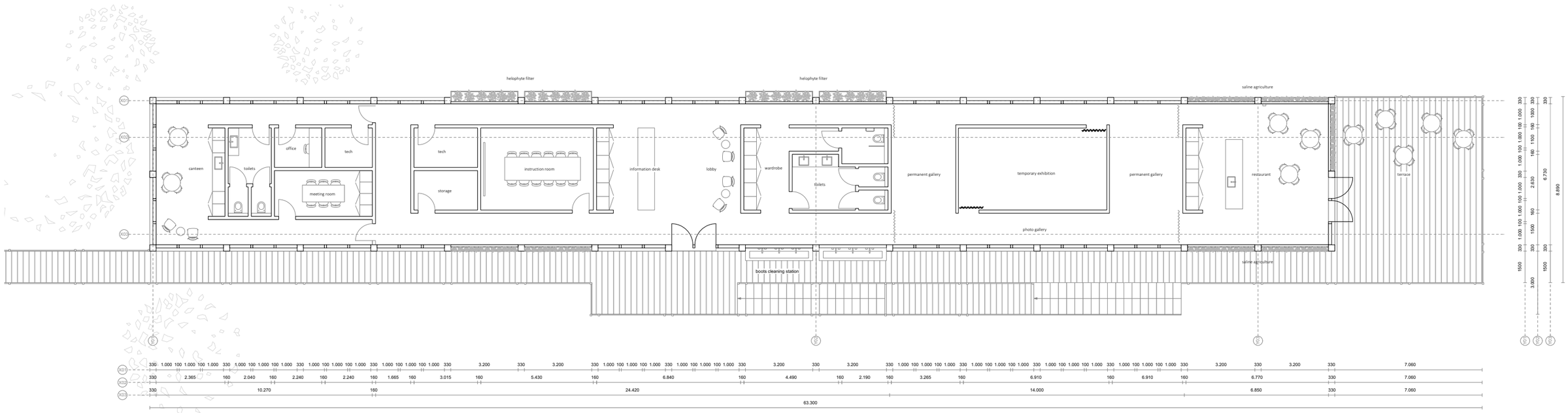
The visitors center is a meeting place for people from the area and outside the area. Visitors who want to go mudflat hiking are welcomed here by local guides before they enter the area. There is also an exhibition about the history of the Lauwerszee, and the importance of climate-proofing the landscape is explained. There is a small café with a terrace, where visitors can have a cup of coffee with a view of the new Wadden Sea. Furthermore, the building is also a workplace for researchers into the area, who can also guide visitors. The building is constructed from Accoya wood. Accoya starts out as a fast-growing conifer (pinus radiata) that grows in production forests. This tree is harvested after approximately 30 years and then undergoes a modification process as a plank or beam, the so-called acetylation with acetic acid. This process ensures very dimensionally stable and rot-resistant wood.

If we look at the floor plan, the function of the building becomes even clearer. The entrance to the building is via a footbridge that connects to the dike. The building is only accessible to pedestrians, but wheelchair approved as the building itself is on the ground floor. Both visitors and researchers enter the lobby. Visitors can register at the counter, ask for information about the area or mudflat walking, or buy a ticket for the exhibition. The left side of the building faces the researchers and guides. There is an instruction room for groups of mudflat hikers where guides can inform them about the tour or where lectures can be given. Behind it is a technical room and storage for tools, such as research tools and extra wellies. To the left is the researchers’ private area with a meeting room, office, toilet group and canteen. On the right side of the lobby is the cloakroom for visitors with the toilet group. Behind it is the exhibition space, with a permanent and temporary exhibition. At the end of the building is the café, which can also be reached via the platform from outside. Visitors can therefore only sit here for a snack and a drink. A wooden walkway runs along the outside of the entire building. This provides access to the viewing platform, but is also the entrance to the Wadden area.

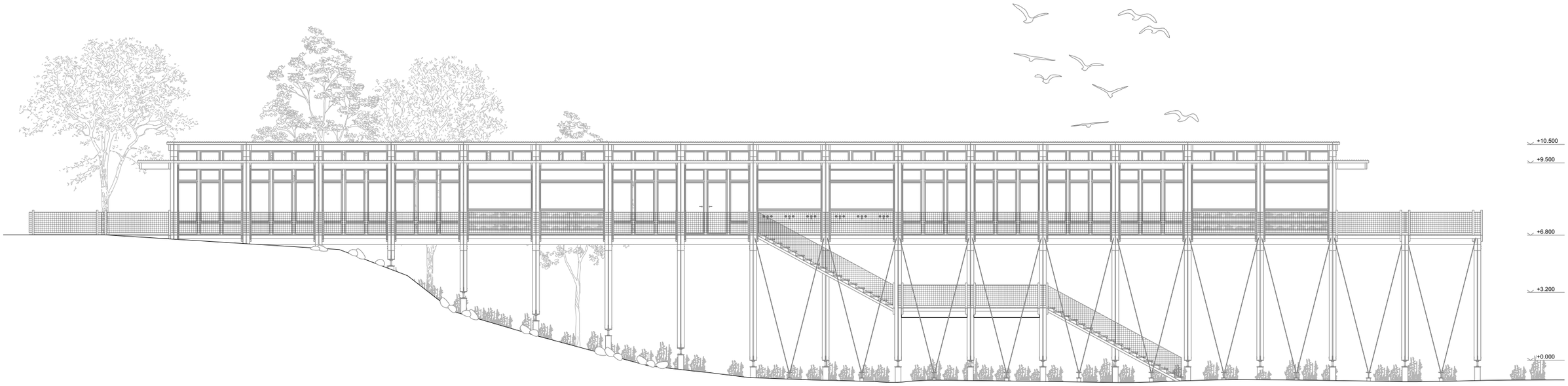
Visitors can enter the area via the stairs and start their walk. There are several outdoor taps installed in the facade, where visitors can rinse their shoes after their walk. This is essential, experience has shown.



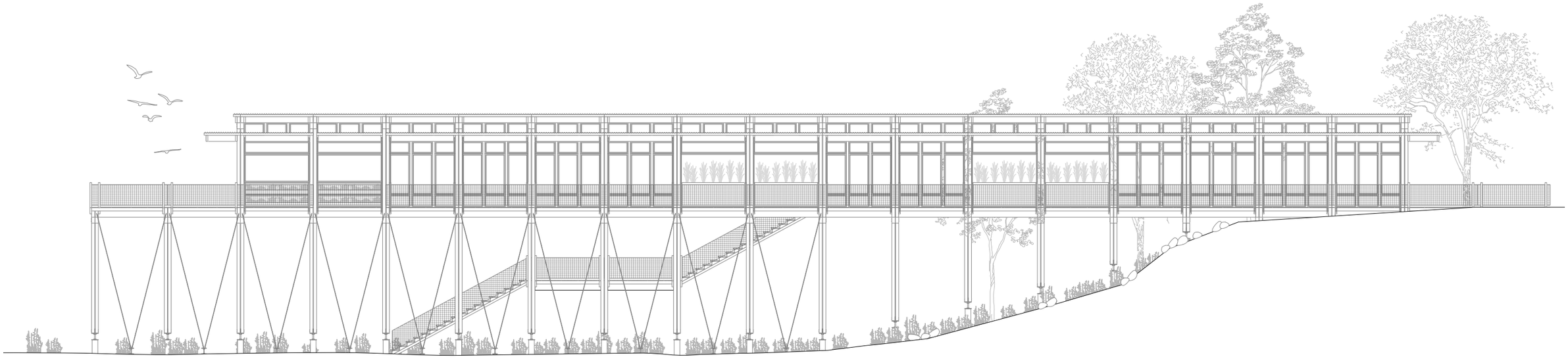
Visitor centre | section | scale 1:50



Visitor centre | floorplan | scale 1:100



Visitor centre | elevation north facade | scale 1:100



Visitor centre | elevation south facade | scale 1:100

Pavilion'De Wadloper'

After a walk through the Wadden area, visitors or researchers arrive at the pavilion called 'De Wadloper'. This sustainable and demountable building is composed of roughly three layers: a layer that leaves space for nature, a connecting layer that serves the building, and the layer for the users: these can be visitors, birds or insects.

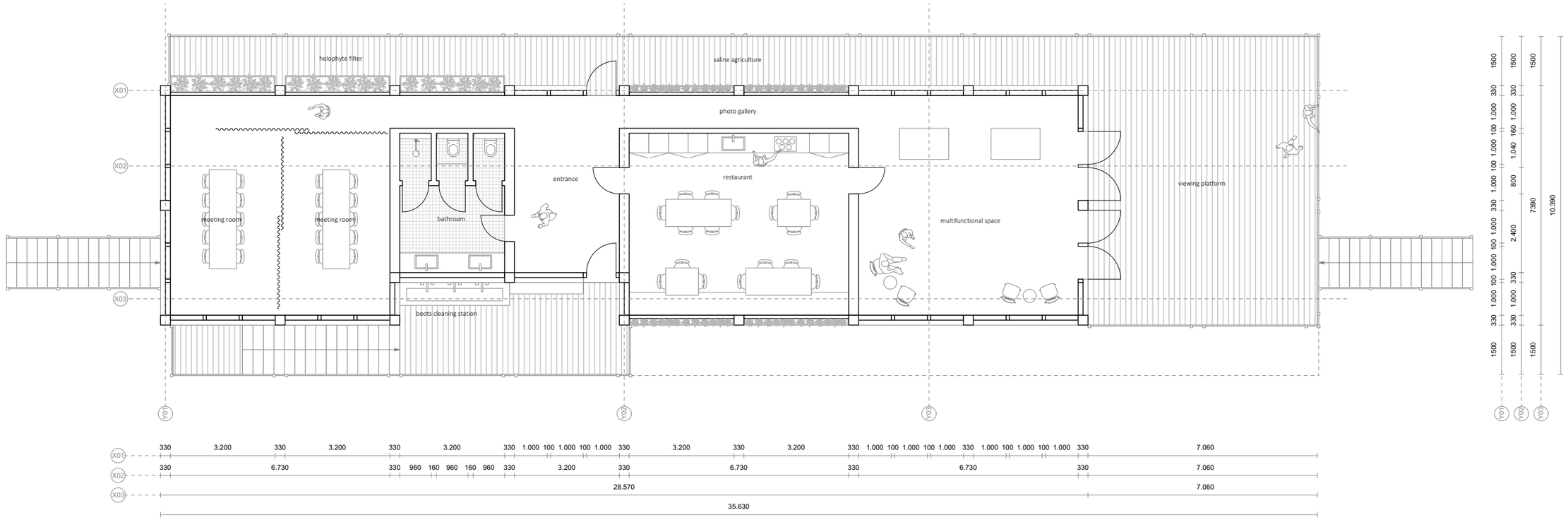
By placing the building on legs, the footprint of the building is minimized. This gives primary plants that can be found in tidal areas the space to grow. The posts are mounted on screw piles that serve as a foundation. This has several advantages. Screw foundations eliminate the need for concrete, reducing CO2 emissions and the impact on natural resources. Installing screw foundations does not require heavy machinery, resulting in less fuel consumption and air pollution. Much less heavy means of transport are also required for transport to the construction site. When using screw foundations, no excavation work is required, which prevents disruption of the soil and biodiversity. Screw foundations can be reused, extending the lifespan of the materials and reducing waste. This is ideal when the building needs to be moved.

A staircase leads up from the ground to the walkway under the building. The walkway hangs 3.2 meters above the ground and provides access to the pavilion. By hanging everything on the pavilion, the impact on the ground is kept as small as possible. On the other side of the building, self-designed wind turbines made of fabric are mounted. These fabric sculptures catch the wind blowing under the building, thus fulfilling two functions: it generates energy for the pavilion, but also keeps the walkway out of the wind. To ensure that the wind turbine works optimally, the building is placed perpendicular to the most common wind direction. In addition, the pipes and installations run underneath the building.

There is room for people and animals in the top layer. The module structure is clearly visible from the facade. Not only the interior space has a function, the facade also offers space. The facade is constructed from wooden frames that consist of the same set of dimensions, so that they can be exchanged. These can be replaced or changed in the future. The design has tried to use sustainable and reused, local materials as much as possible. For example, the roof is covered with corrugated sheets from nearby farms that must be removed due to the master plan. The fencing is cordoned off with fishing nets. When the wooden frames are closed, they are filled in with residual wood and insulated with the local cattail plant. Furthermore, space is made in the facade for saline agriculture and herbs. These attract insects. Unfortunately, due to its location on the wind, an insect hotel cannot be placed in the facade. A helophyte facade has been placed at the back of the building, which purifies the rainwater so that it can be used for taps and toilets. this will be explained in more detail later in the climate diagram.

Visitors arrive via the stairs and can rinse their boots clean before entering. There is a drying rack for really dirty shoes. The entrance provides access to the toilet and the restaurant. The functions in the building are all linked via a long south-facing corridor, which also functions as a climate facade. Along this corridor are the meeting rooms, which can be divided if necessary, and the photo gallery. At the end is a multifunctional room that can be used by the researchers during excursions. The restaurant can be used to cook with local vegetables or herbs that grow in the area or on the facade, to showcase the possibilities of the Wadden area. It can also be used as a café for mudflat hikers who need a break. The surroundings can be enjoyed via the viewing platform.

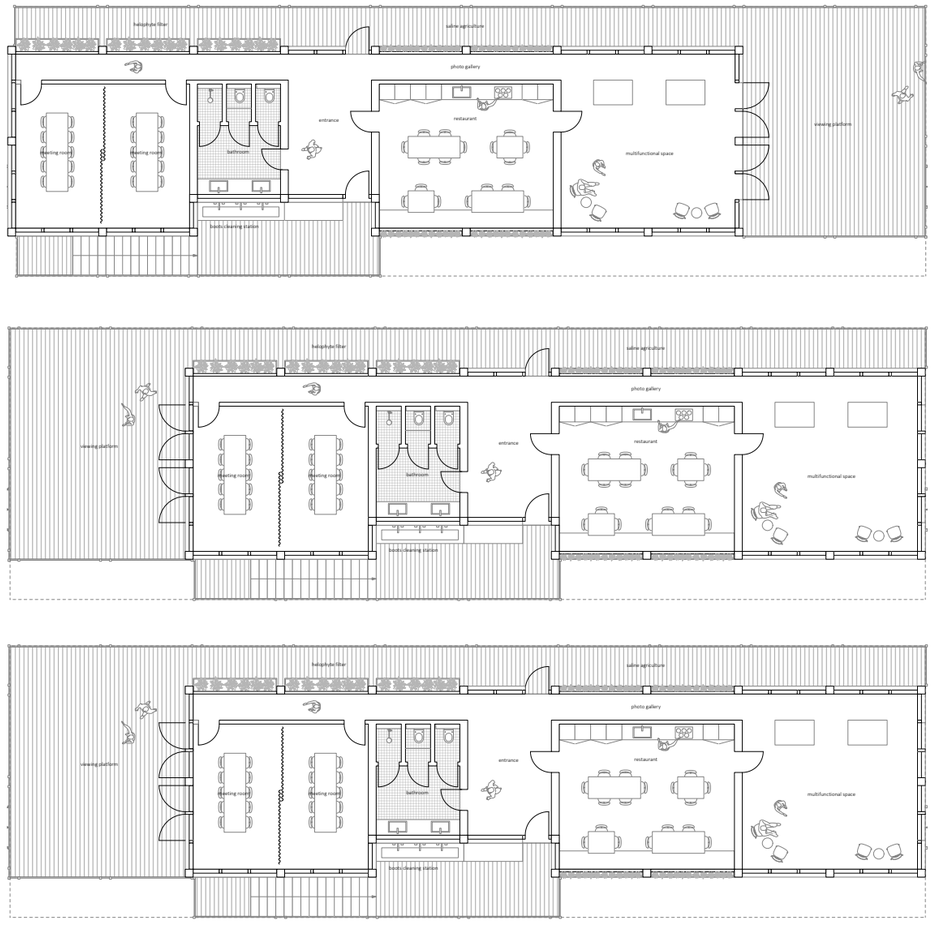
Since the building is a pavilion, it is not fully air-conditioned. Only the interior spaces are fully insulated. This is clearly visible in these cross-sections. You can see that the roof of the multifunctional space is openly connected to the outside air. Using recycled tarpaulins, the space can be closed off for birds, but can also be opened up in nice weather. However, the toilets and the restaurant are closed and insulated. Because the facades and floors are insulated with Kerto Ripa roof elements.



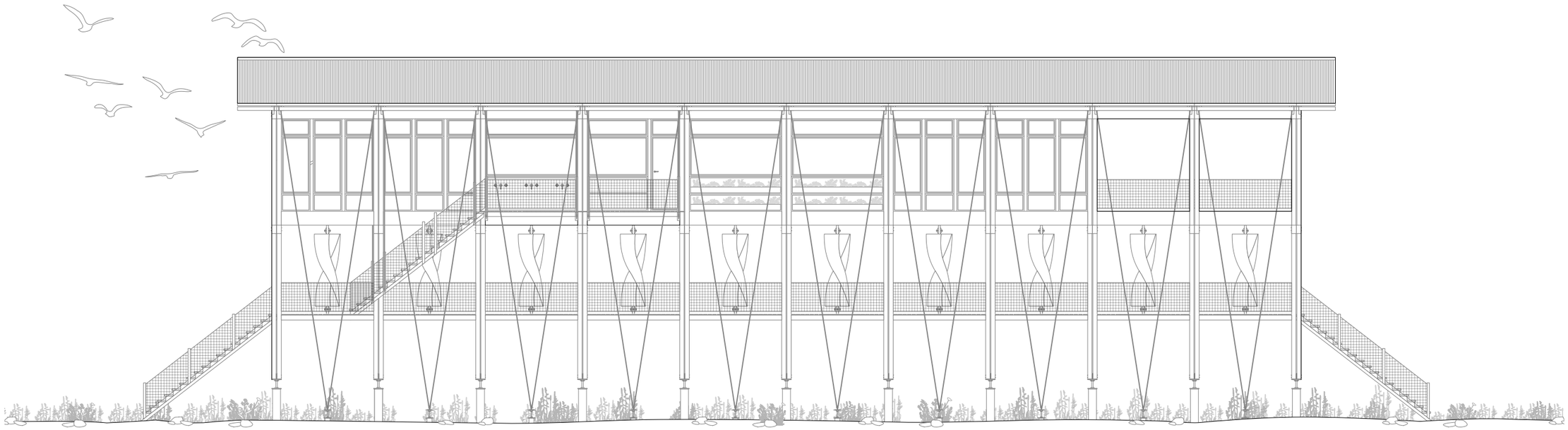
Pavilion | floorplan | scale 1:100

Different configurations

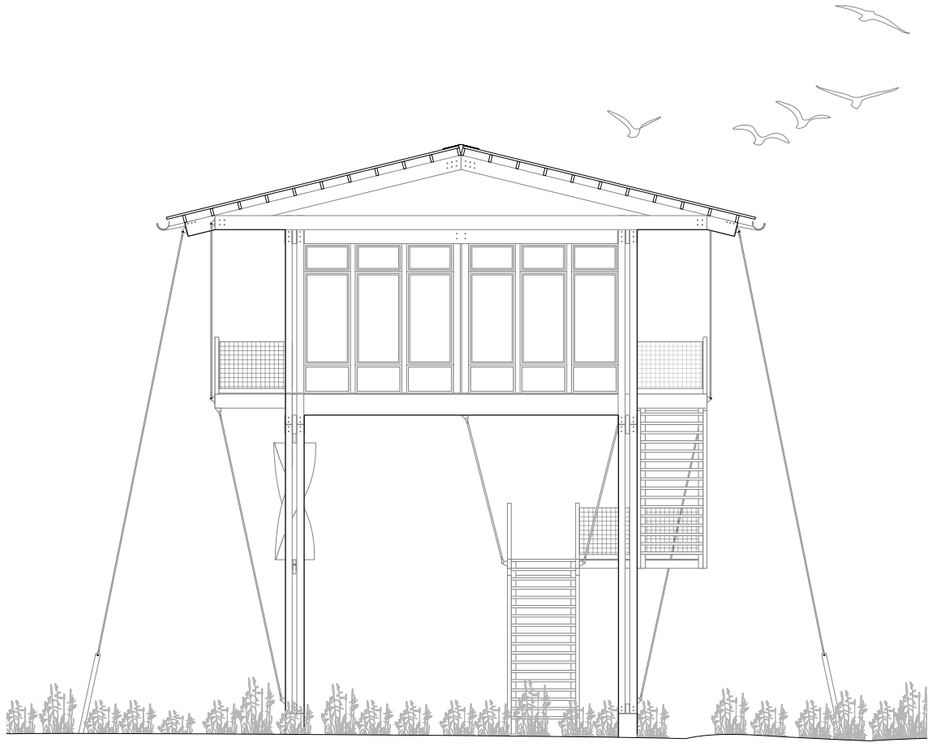
Because the building can 'walk' through the environment, it is important that the floor plan works in different configurations. Here you see different appearances of the building when the modules are moved from the front to the back. By placing a long walkway and long corridor on the south side of the building, all areas remain accessible. The only two modules that need to be moved together are the meeting rooms and the entrance and toilets, as they are linked together by the placement of the stairs and helophyte filters.



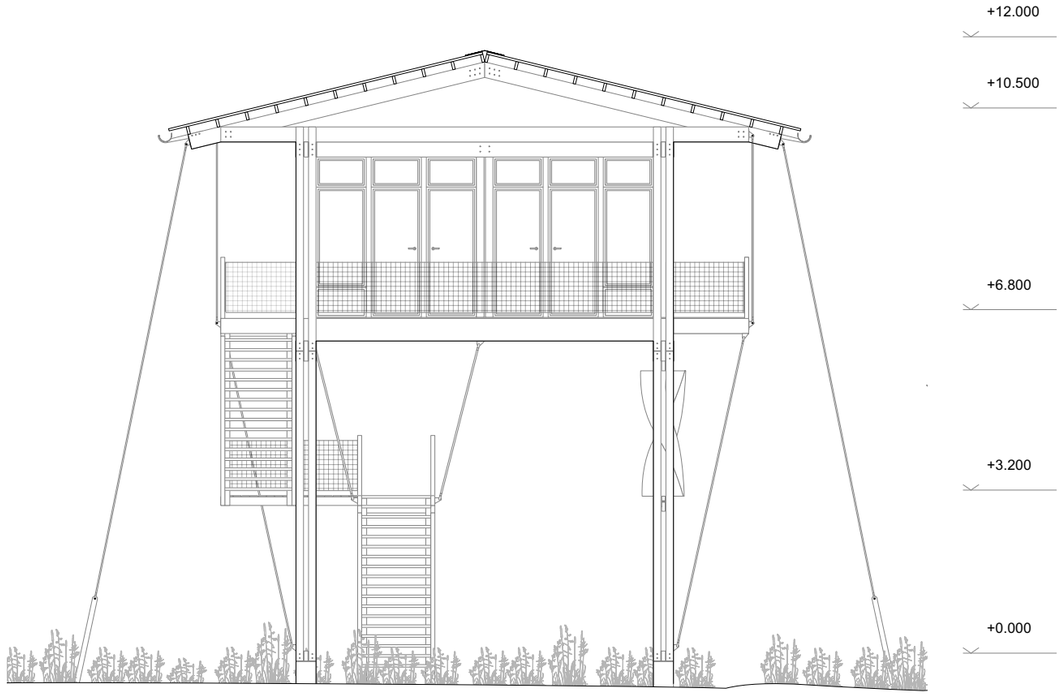
Pavilion | different configurations | scale 1:200



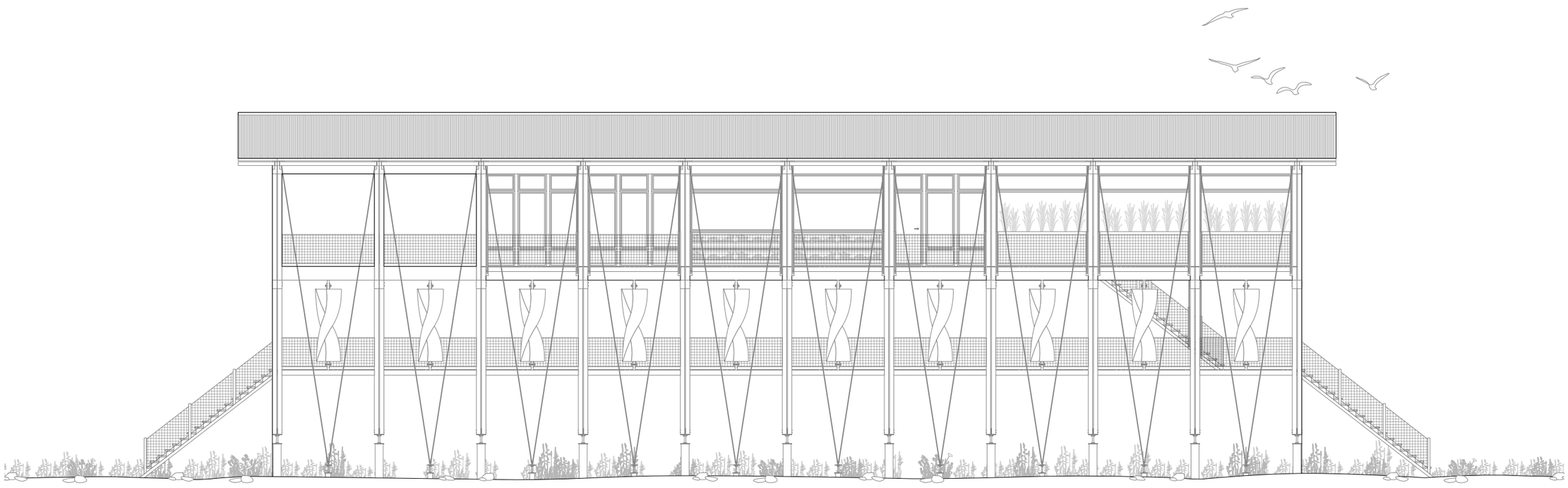
Pavilion | north elevation | scale 1:100



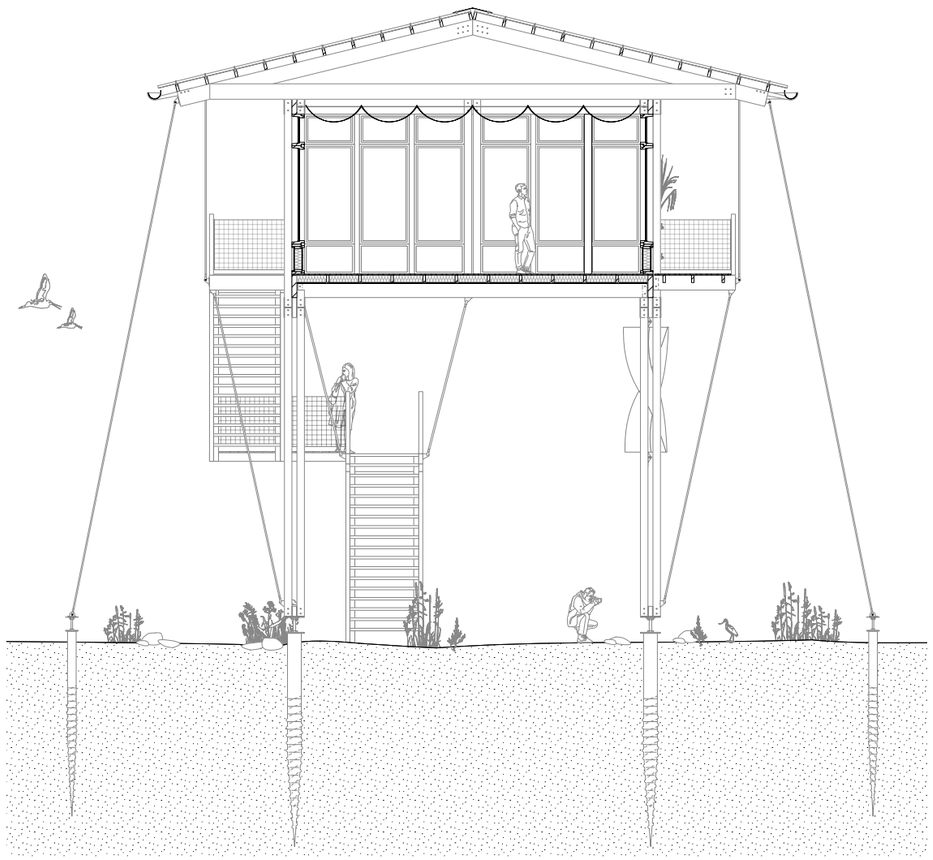
Pavilion | east elevation | scale 1:100



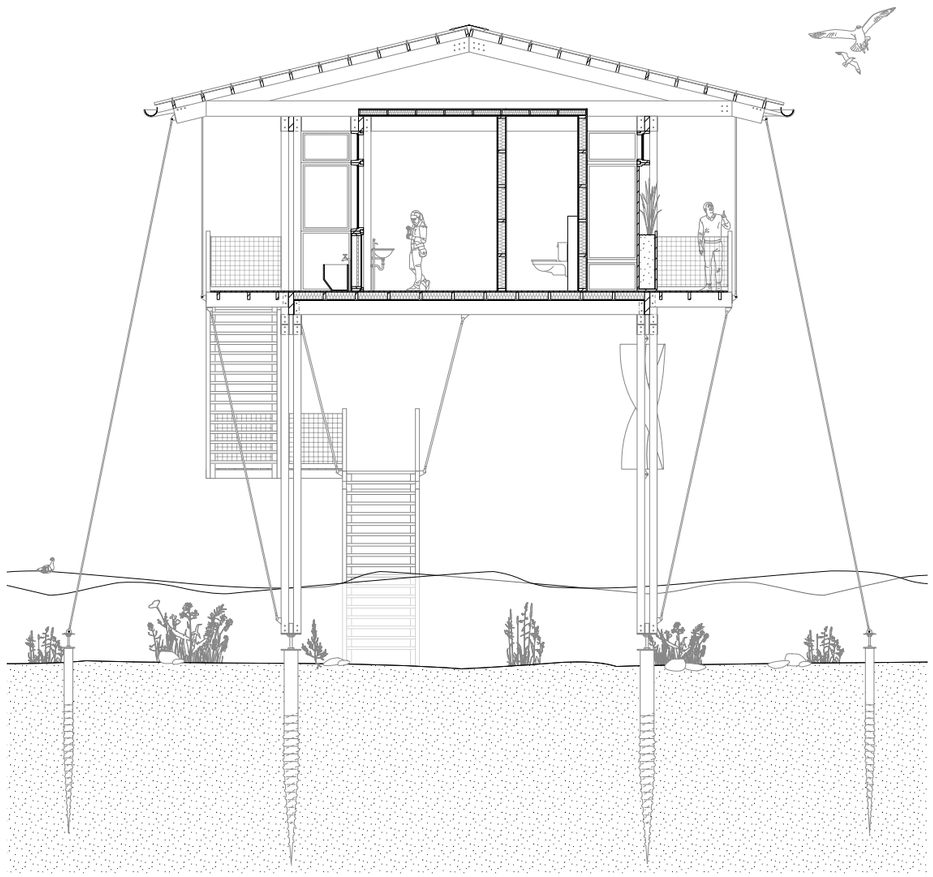
Pavilion | west elevation | scale 1:100



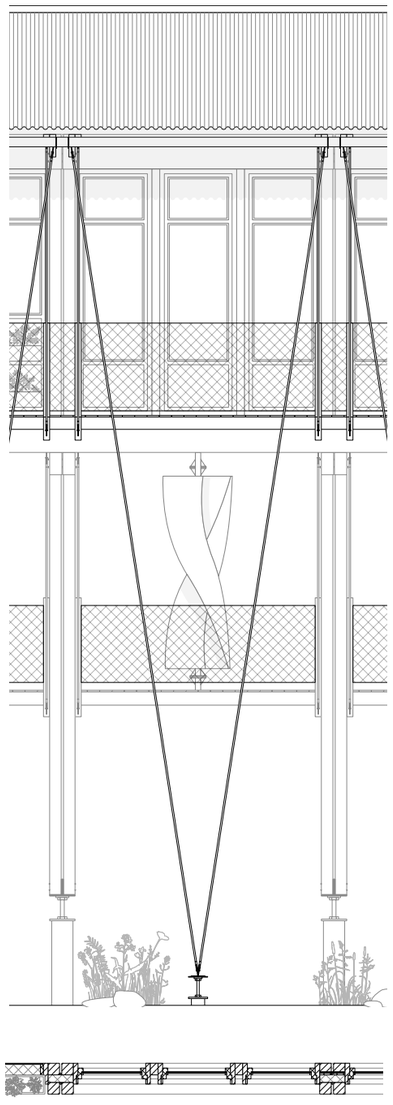
Pavilion | east elevation | scale 1:100

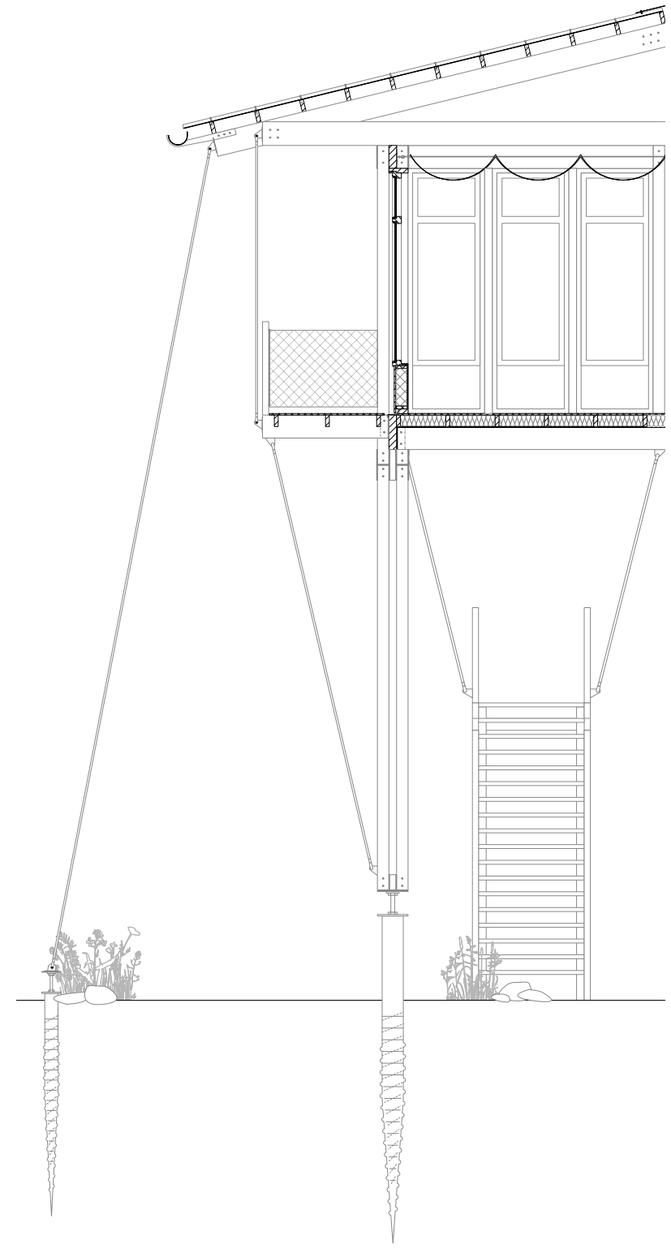


Pavilion | section | scale 1:50

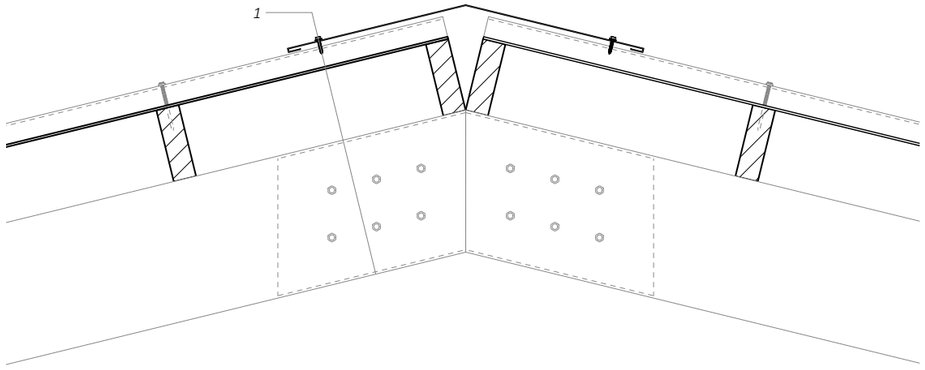


Pavilion | section | scale 1:50



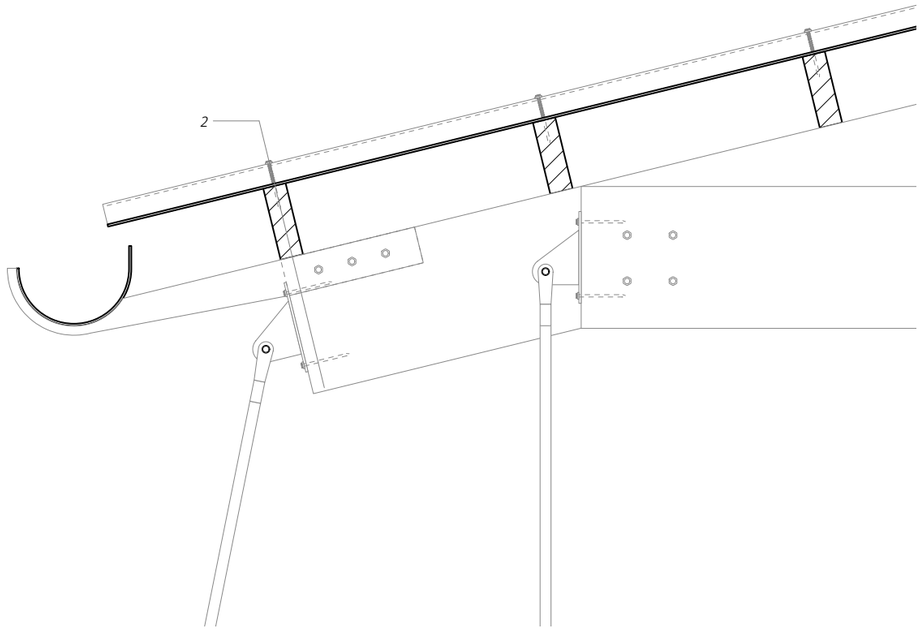


Pavilion | facade fragment | scale 1:20



1. Ridge Capping 150° angle (3mm)
   1/4" Panel Lap Self-Drill Screw
   Outside foam closure (set in sealant)
   7/8" corrugated panel
   Wooden beam (Accoya Caïro) (160 x 50 mm)
   Wooden roof beam (300 x 100 mm)
   Invisible steel beam support in ridge

Pavilion | detail roof ridge | scale 1:5



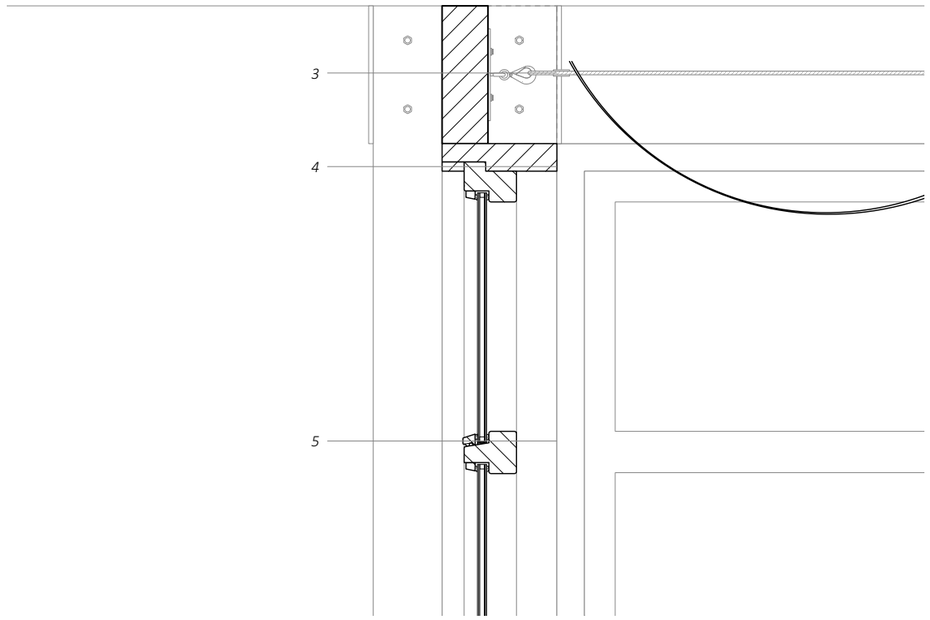
2. Wood screw hex head (100 mm)
7/8" corrugated panel
Wooden beam (160 x 50 mm)
Aluminium gutter bracket
Wooden roof beam (300 x 100 mm)

Pavilion | detail gutter | scale 1:5

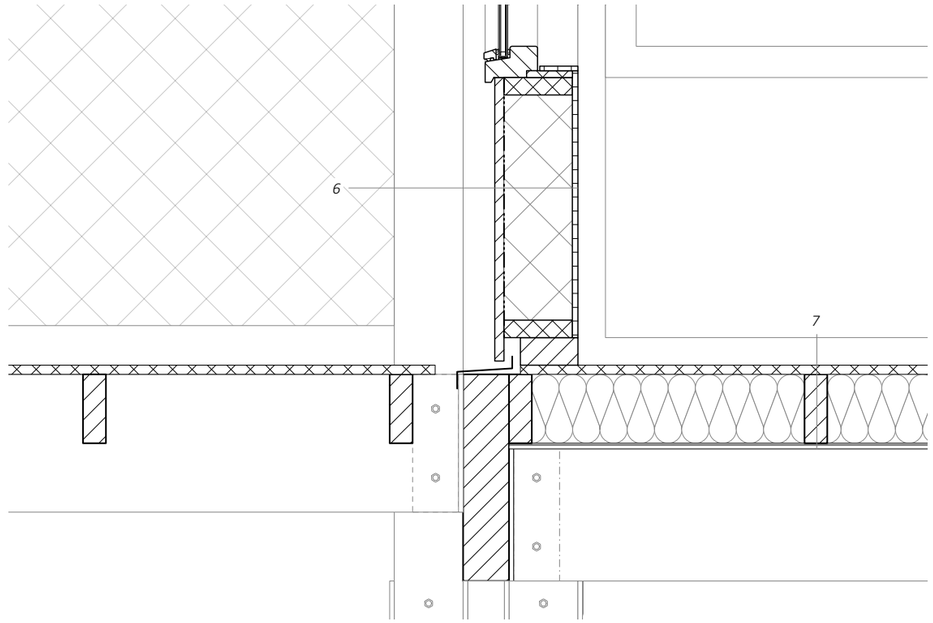
3. Steel connection for demountable construction
Wooden column (150 x 150 mm)
Wooden beam (300 x 100 mm)
Steel cable for hanging canvases

4. Wooden demountable frame (Accoya Caïro)
Wooden windowframe (67 x 114 mm)
Structure in which wooden frame is placed

5. Glazing bead
Top seal (wet)
Support and adjustment blocks
HR++ glass
Wooden window frame (90 x 114 mm)



Pavilion | detail window | scale 1:5



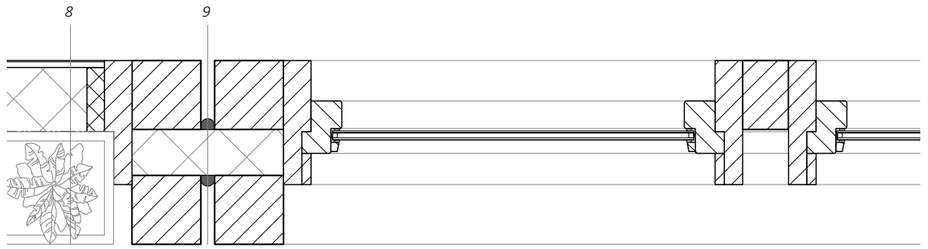
6. Wooden demountable frame (Accoya Caïro)
Wooden panel (filled with residual wood)
Natural insulation from cattail (150 mm)
Multiplex panel (12.5 mm)

7. Wooden decking board (Lourd Preto) (21 x 165 mm)
Natural insulation (cattail) placed in HSB element
Residual wood as finishing (12.5 mm)

Pavilion | detail facade | scale 1:5

8. Planter with saline agriculture
Wooden finish from residual wood (12.5 mm)
High-quality insulation
Multiplex (12.5 mm)

9. Wooden column (150 x 150 mm)
Rubber profile for airtightness
High-quality insulation block
Rubber profile for airtightness
Wooden column (150 x 150 mm)



Pavilion | horizontal detail | scale 1:5



South facade of the Wadloper



Entrance of the Wadloper





Interior of the Wadloper



04
BUILDING TECHNOLOGY

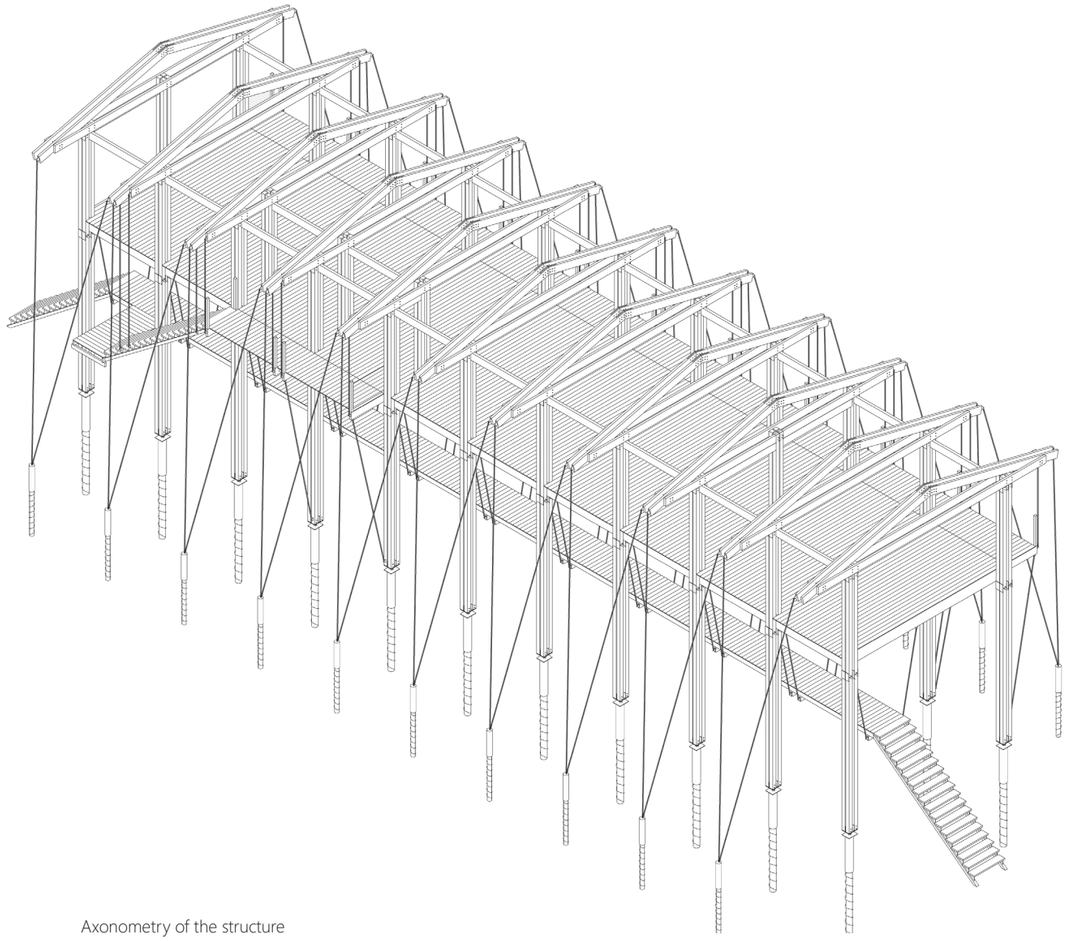
4.1 Loadbearing structure
4.2 Exploded details & facade
4.3 Moving a module
4.4 Climate
4.5 Calculations

Loadbearing structure

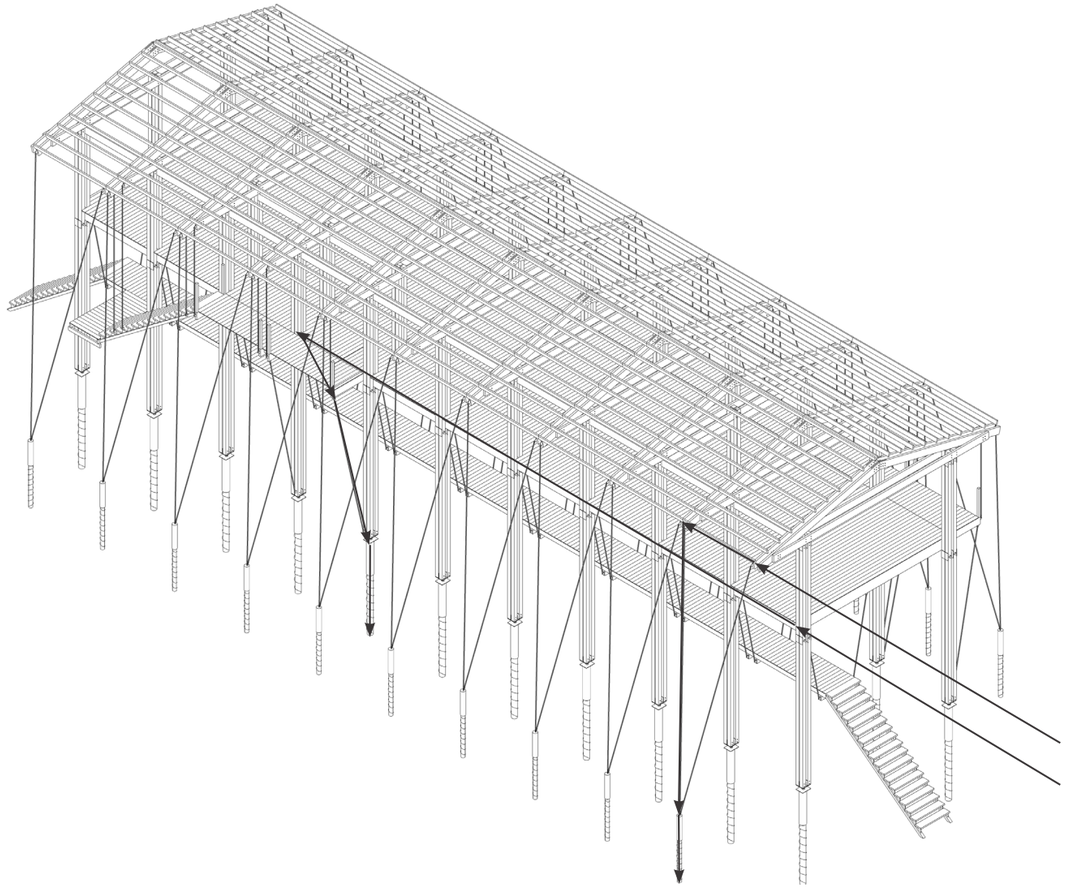
Looking at the structure we see that the building is supported by wooden poles, and that everything else is hung and mounted on these poles. The steel cables also play an important role, both in the aesthetic design of the pavilion and in its stability. Aesthetically, the steel cables provide a reference to tent guy ropes, and give the entire structure a temporary appearance. The guy ropes also ensure the stability of the structure.

The structure is made of Accoya wood. Accoya wood is resistant to salt and can be used near salt water (for example along the coast). Accoya wood is guaranteed for 50 years above ground and 25 years in contact with the ground and immersion in water. To protect the columns from being flooded twice a day during the tides, the poles are lifted one meter and a half above the ground on screw piles. These screw piles are made of steel. Steel can withstand fatigue much better and is stronger. Steel can be subjected to heavier loads and will deform before breaking. In general, galvanized steel is very suitable for use at sea.

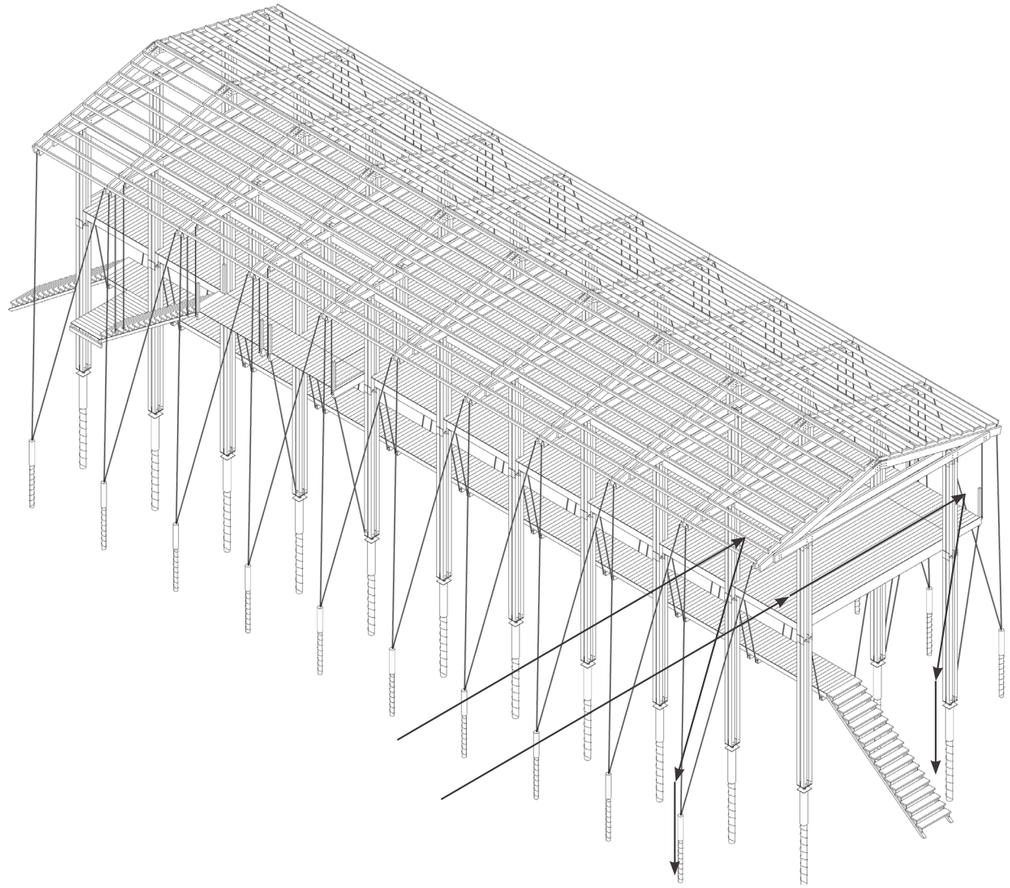
In the following axonometries, the wind load transfer in both directions becomes clear. Because the guy lines are placed in one point, they work in both the x and y directions of the building. The screw piles act as a kind of pegs and transfer the force into the ground.



Axonometry of the structure



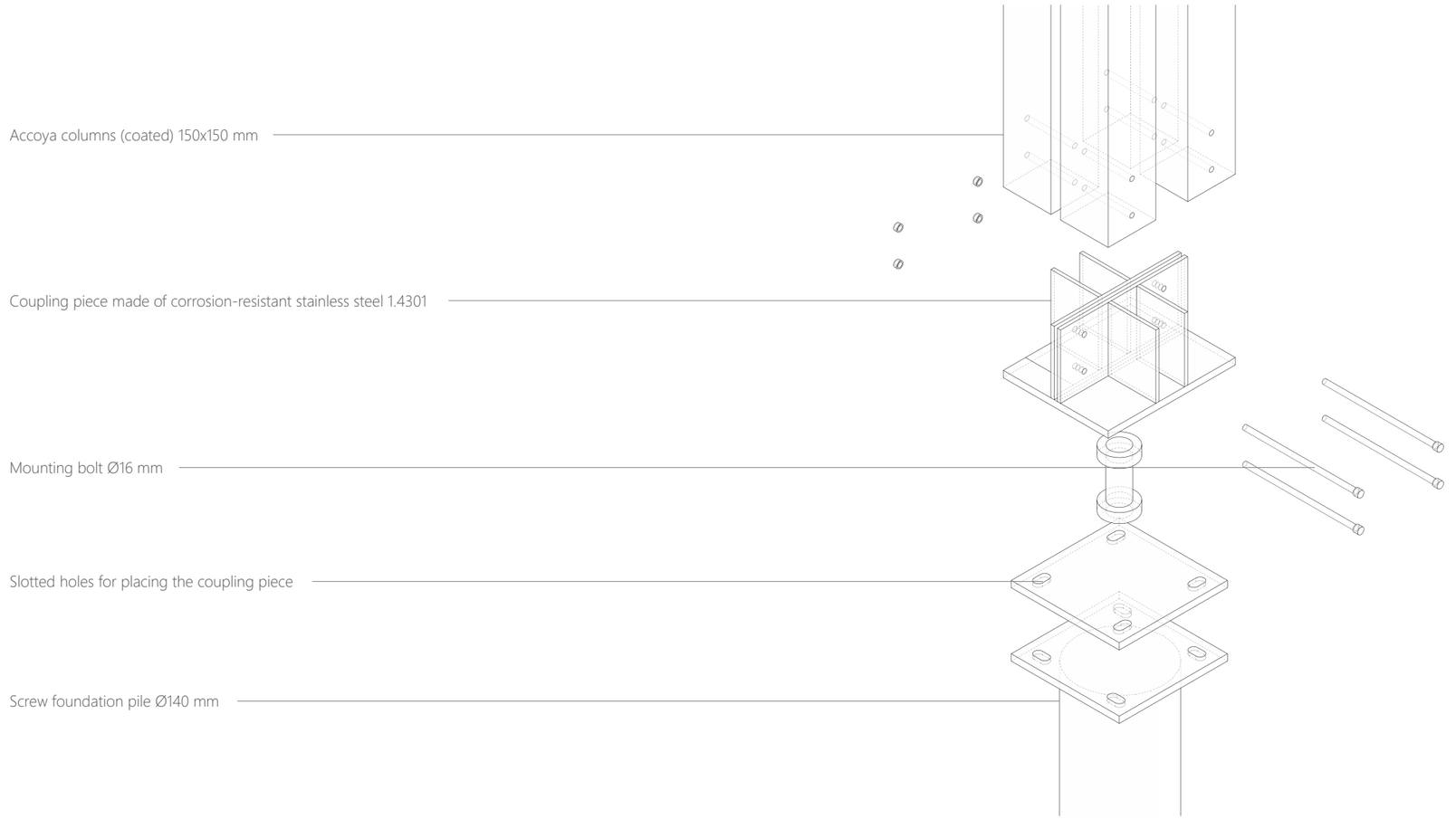
Wind load transfer in x-direction



Wind load transfer in y-direction

Foundation

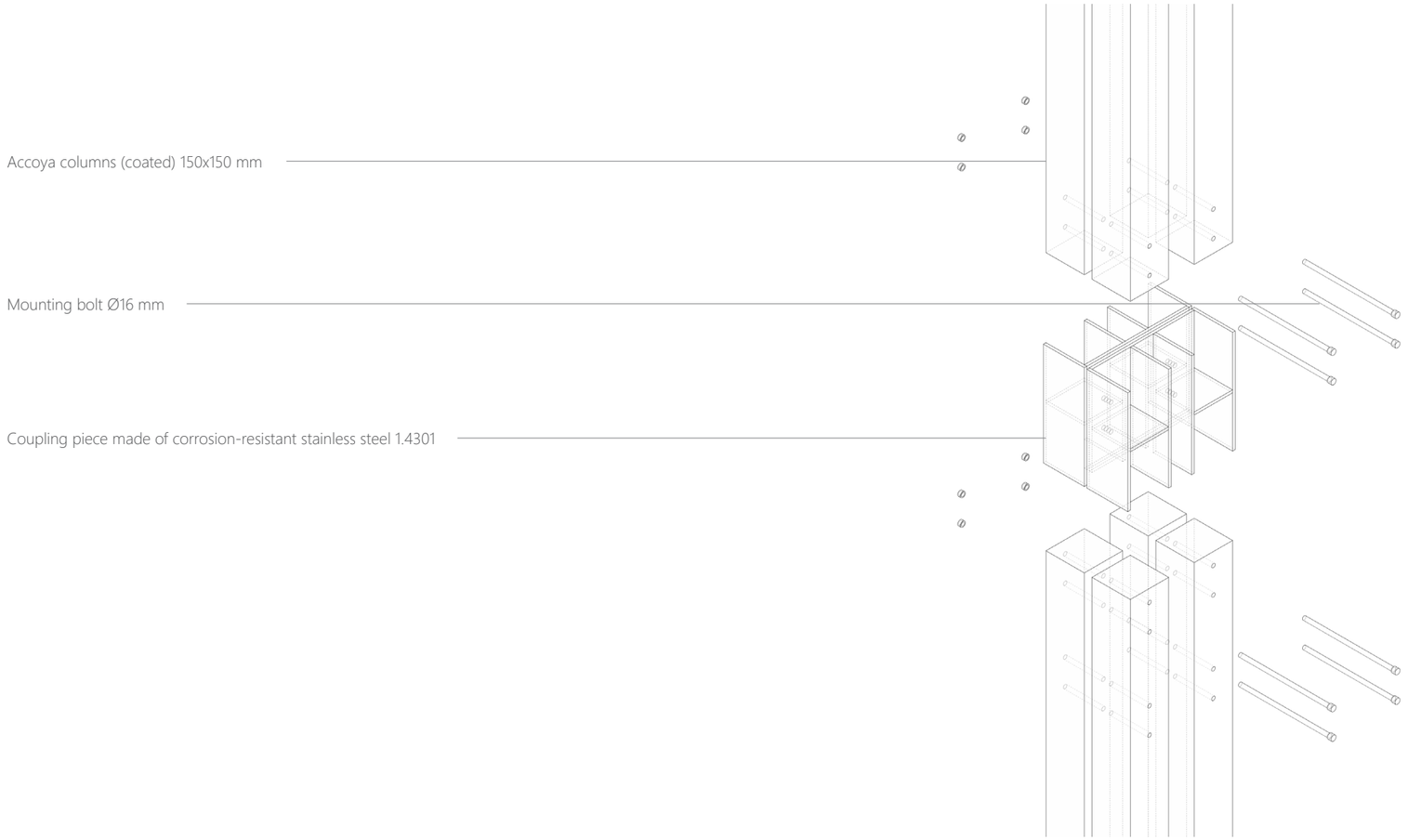
First, the screw foundation pile is screwed into the ground. This can simply be turned into the ground by hand. The slotted holes above the post can resolve any irregularities that occur during installation. This shows the steel profile around which the four Accoya beams can be placed. Galvanized metals are not corrosion resistant in combination with Accoya wood. That is why the profiles are made of corrosion-resistant stainless steel. The columns have been quadrupled, so that part of the structure can be demolished and the rest left standing. This doubling is also visible throughout the construction.



Exploded detail of the foundation

Column

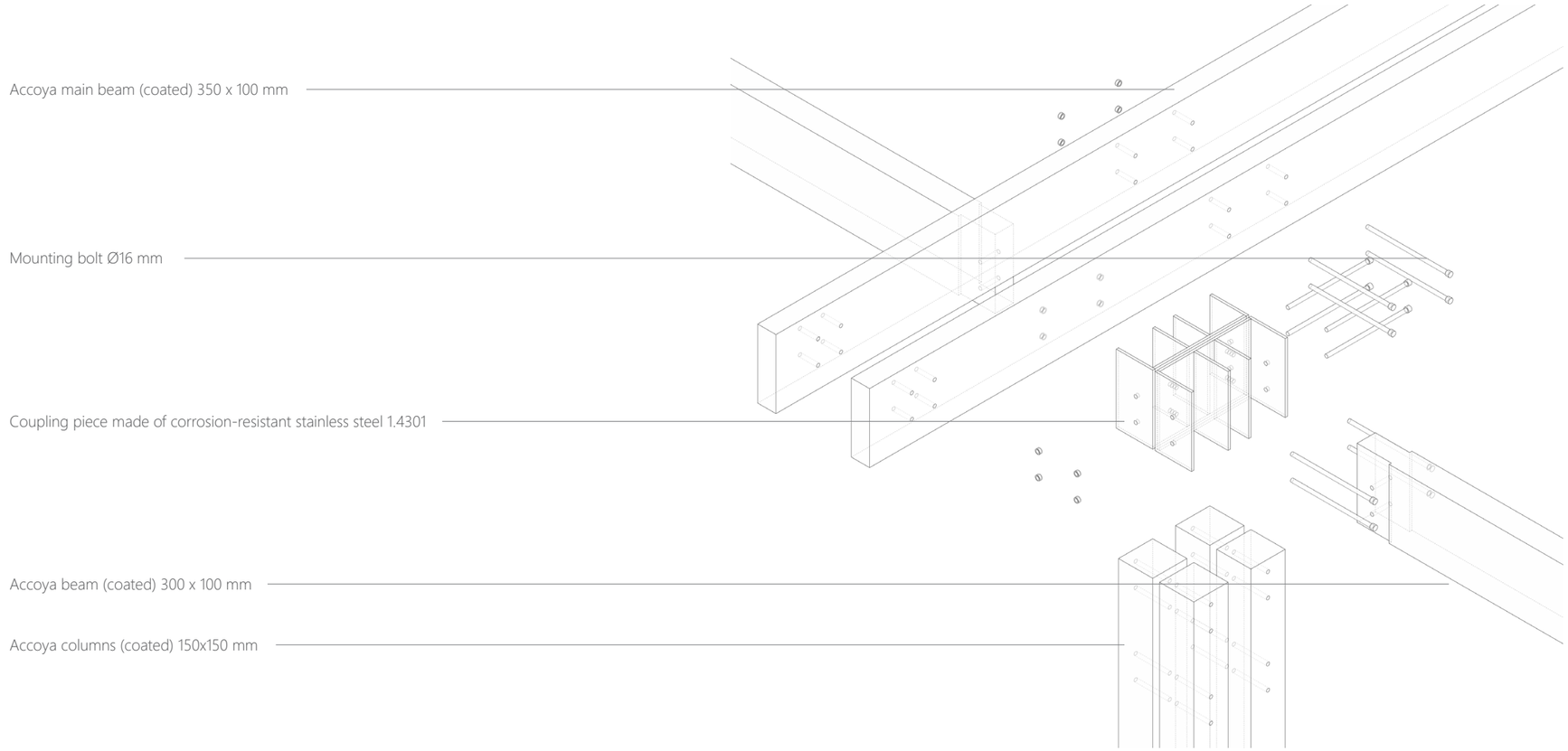
The Accoya columns are interrupted halfway by a new stainless steel element. This ensures that the risk of buckling of the columns is resolved, and a possible height difference in the subsurface can be resolved if the screw piles do not provide sufficient play. The dimensioning and buckling calculation of the beam can be found in the design report.



Exploded detail of the column

Column on beam

The top of the column is closed again with a steel profile. A wooden beam is placed on both sides of the columns, the calculations of which are also included in the design report. Here too we see the doubling.



Exploded detail of the column on beam

Roof beam

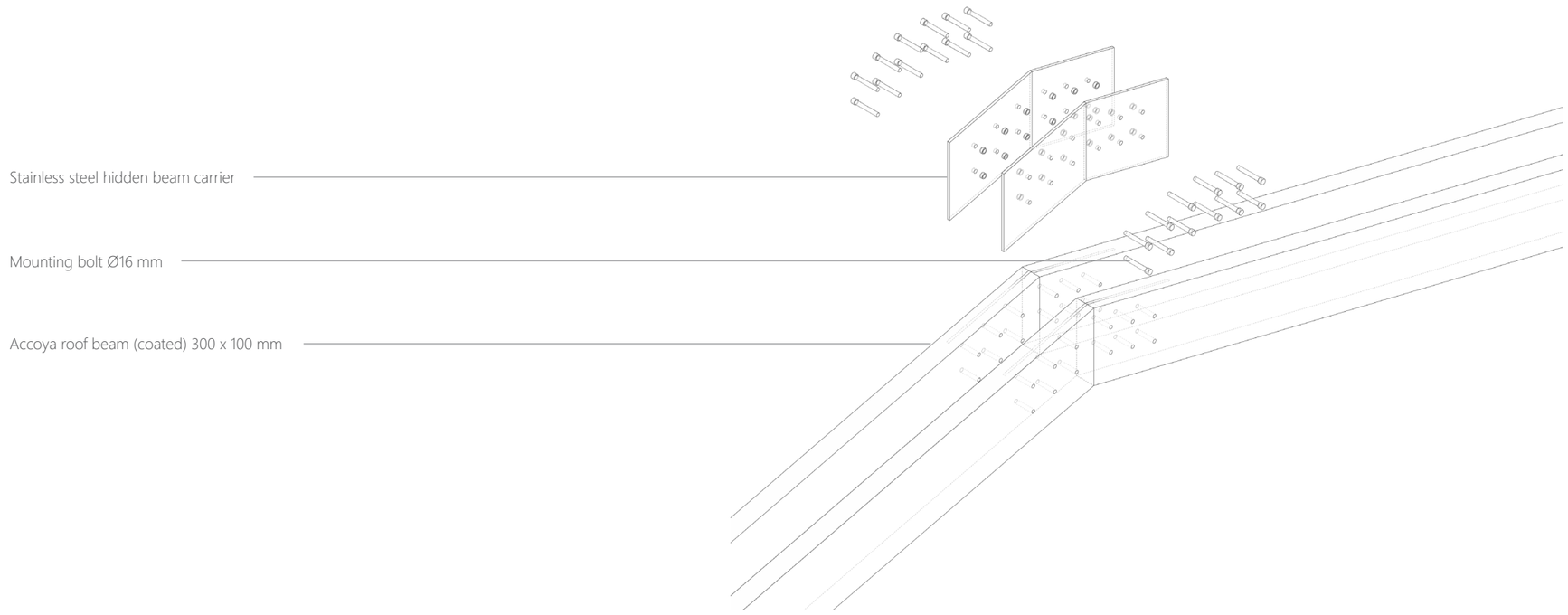
The roof beams are attached to the horizontal beams. This contains the steel cables that provide stability and the rainwater drainage for collecting water from the roof. Everything is done in duplicate, so that half of the construction can remain standing when one module is moved. In addition, the pure shape of the beam was chosen, where no extra corners are cut off. This has to do with the fact that the beams can be reused more easily.



Exploded detail of the roof beam and gutter

Roof ridge

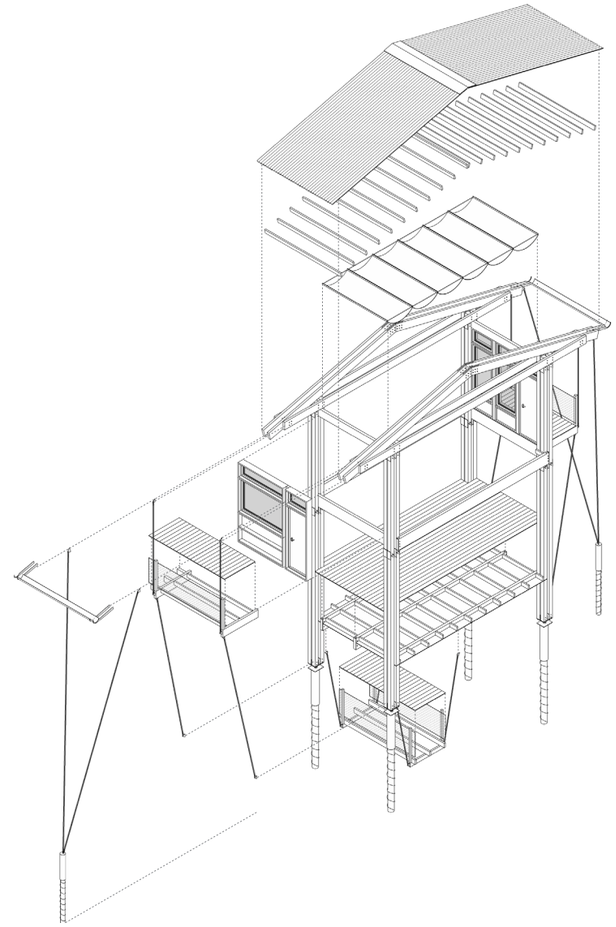
Finally, we arrive at the connections between the wooden roof girders. These are not connected to each other, so they can stand alone. In addition, blind roof supports were chosen, so that the focus in the design is on the steel nodes in the columns, as this is where the two modules are connected to each other.



Exploded detail of the roof ridge

Exploded module

This exploded axonometry gives us insight into which parts a module of the Wadloper consists of. The roof consists of the recycled tarpaulins, the rules, and the recycled corrugated iron roof. The facade consists of the facade parts of wooden frames, the suspended balcony with fencing, the guy lines and the rain gutter. The floor consists of the main construction, sub-construction with insulation in between, and then the wooden plank floor. This together forms the construction kit of the Wadloper.

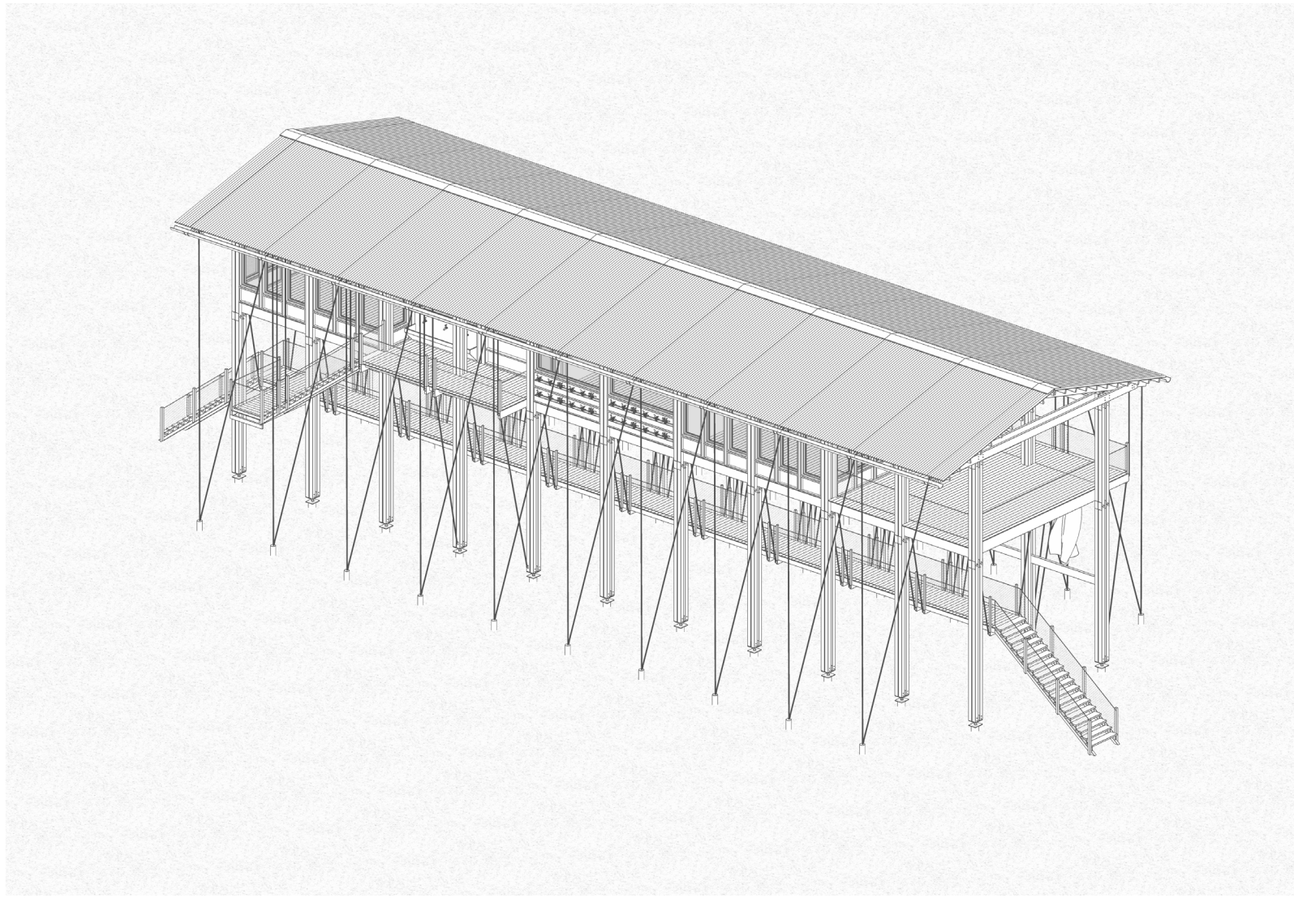


Exploded module

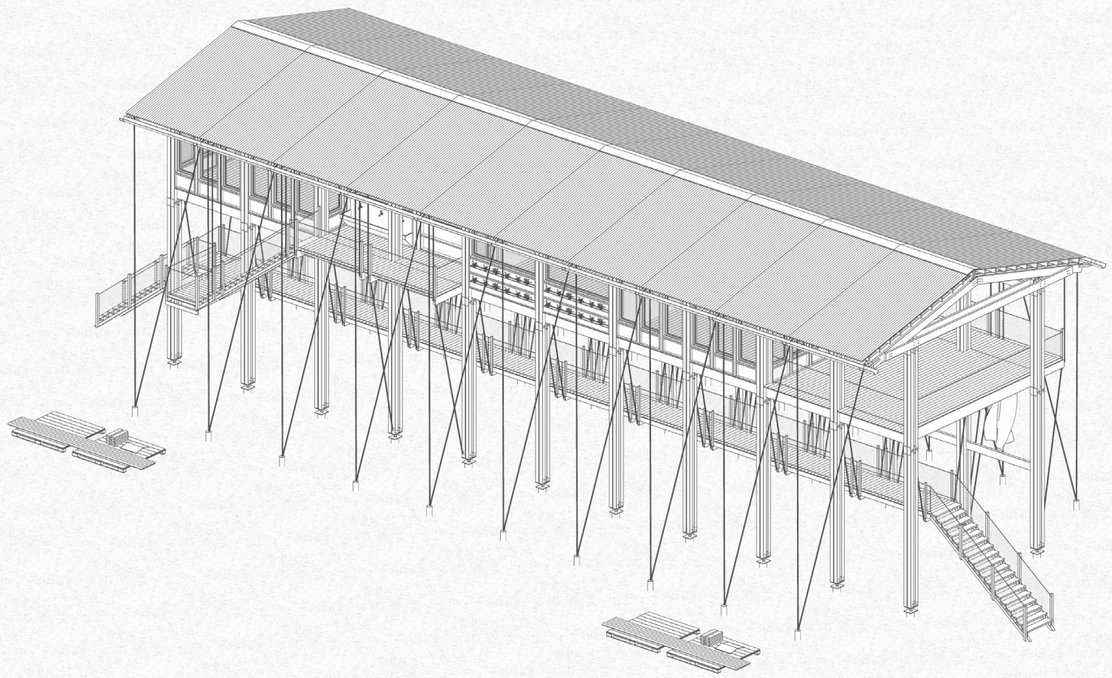
Moving the Wadloper per module

To provide more insight into how the building can actually run through the area, I will take you through the construction process of moving one module. Because the area is only dry at low tide, one module must be moved within 6 hours. If the building needs to be moved further, this will take several days.

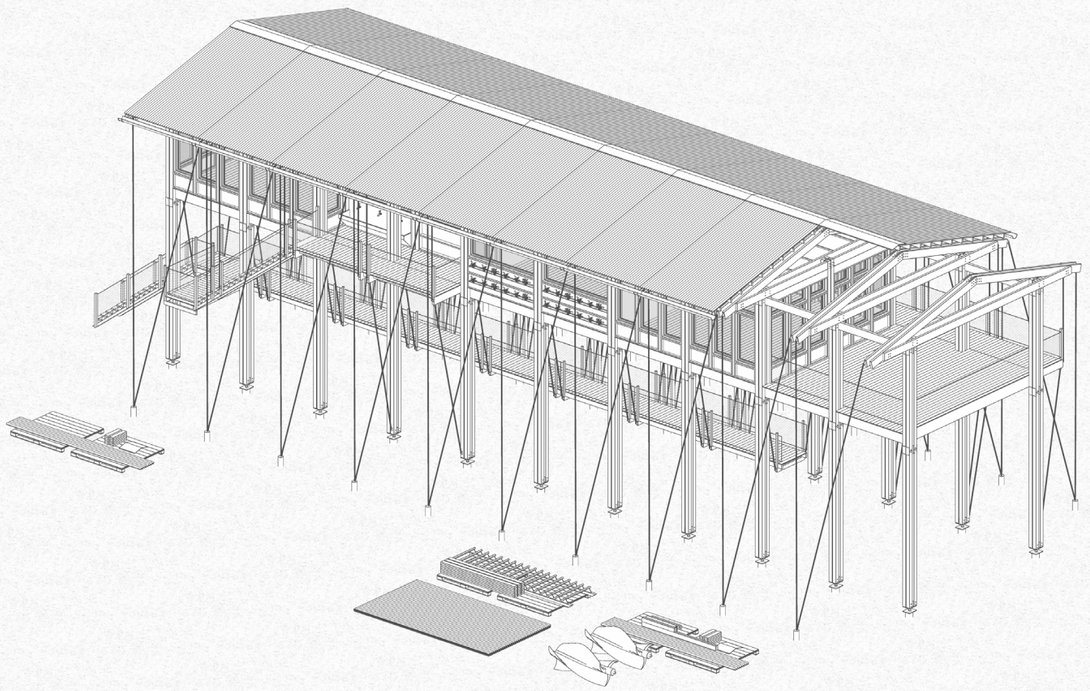
Because everything is placed in duplicate or quadruple, the rest of the building can always remain stable when various parts are installed and removed. All wooden beams are attached with bolts, making the pavilion actually one large construction kit.



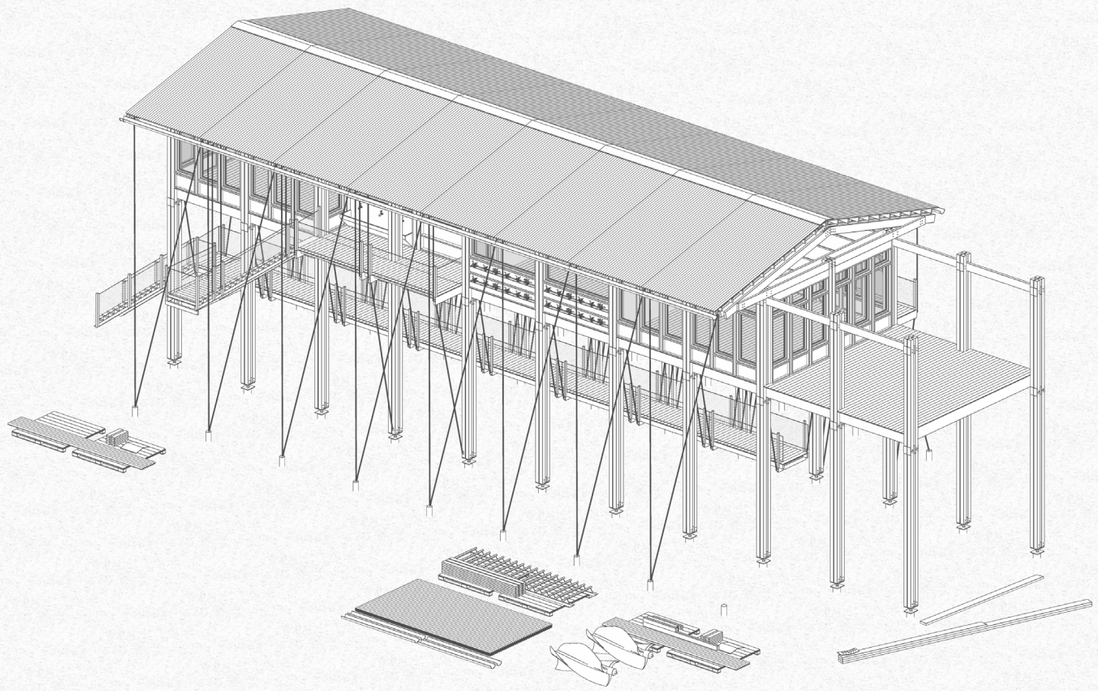
Starting configuration of the Wadloper



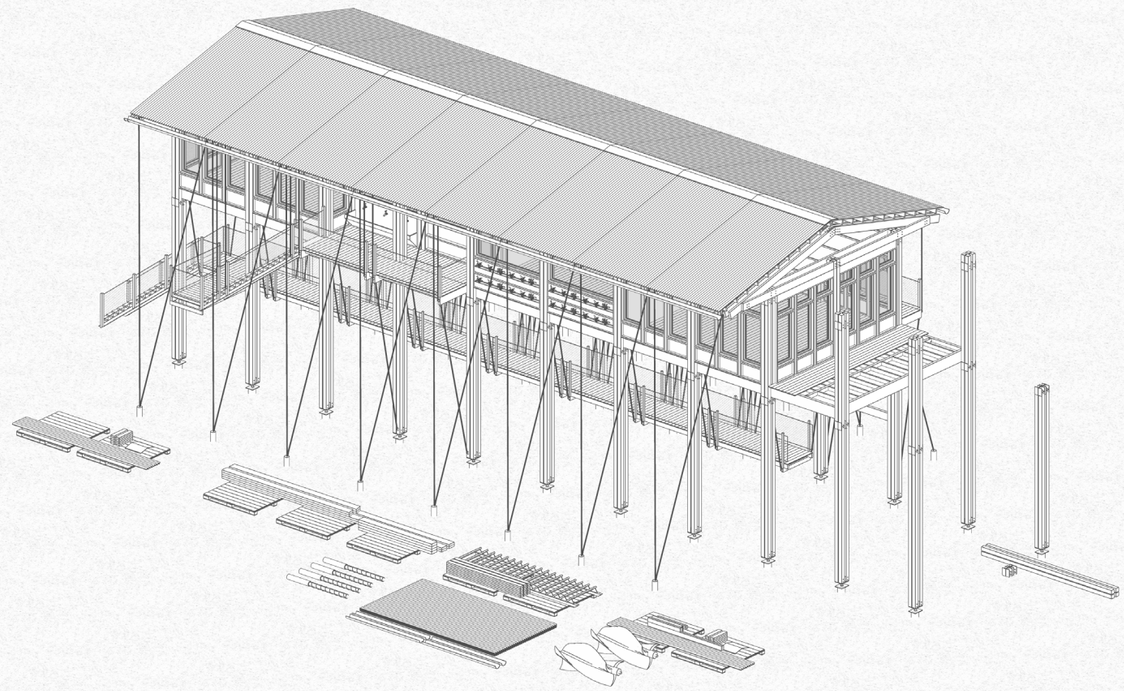
The deviation ends of the building are being removed. Then the stairs are dismantled and the walkway is detached from the building.



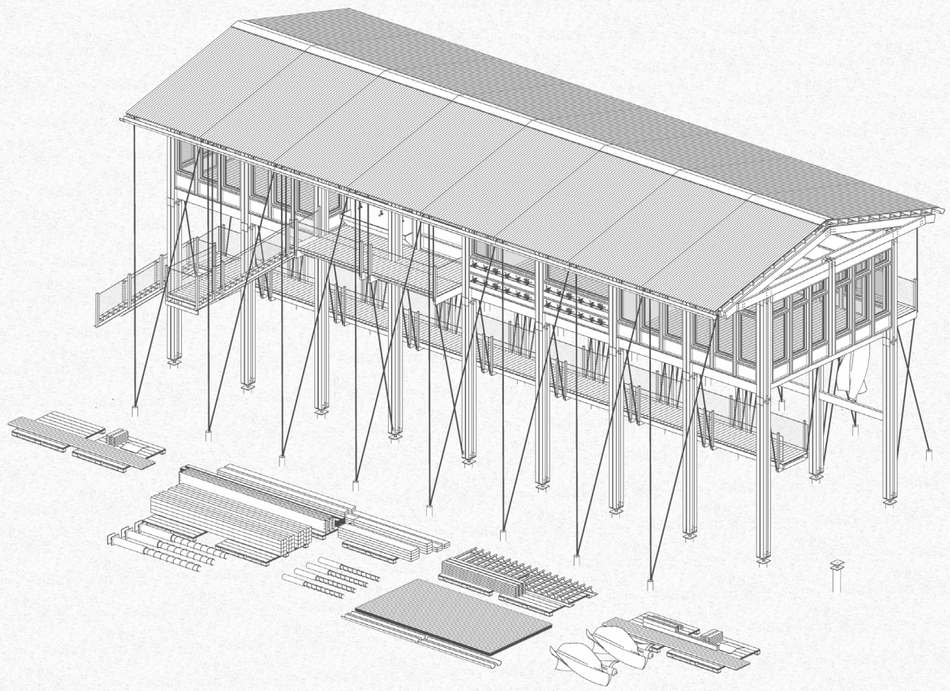
The corrugated sheets and beams are removed from the roof, and the wind turbines are detached.



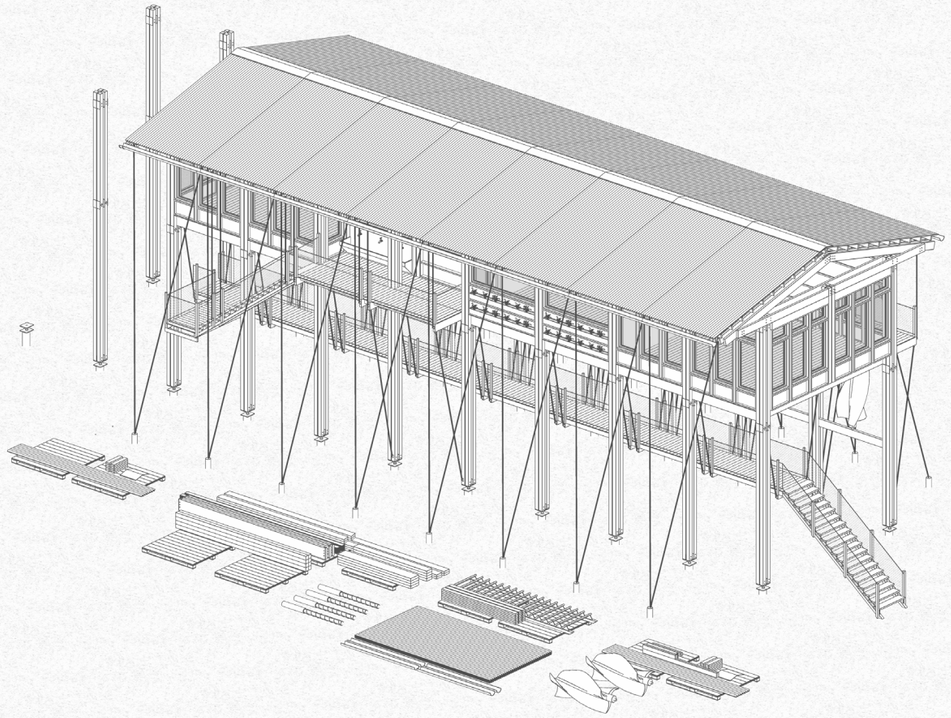
The guy ropes are loosened and the roof structure is unscrewed. The screw piles of the ropes are screwed out of the ground.



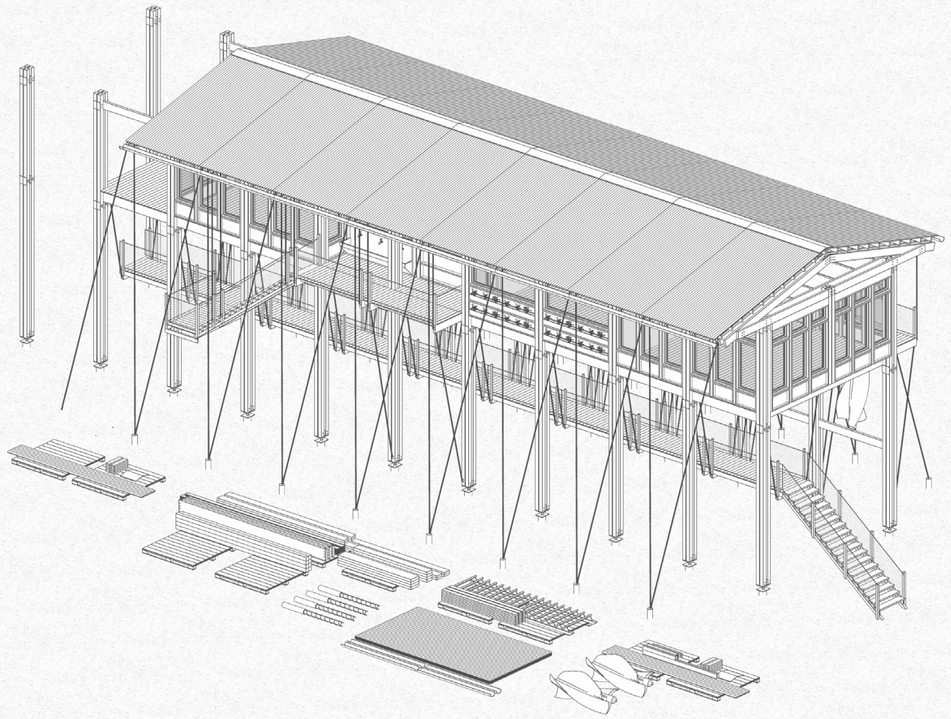
The floor planks and beams are removed, and the columns are taken apart.



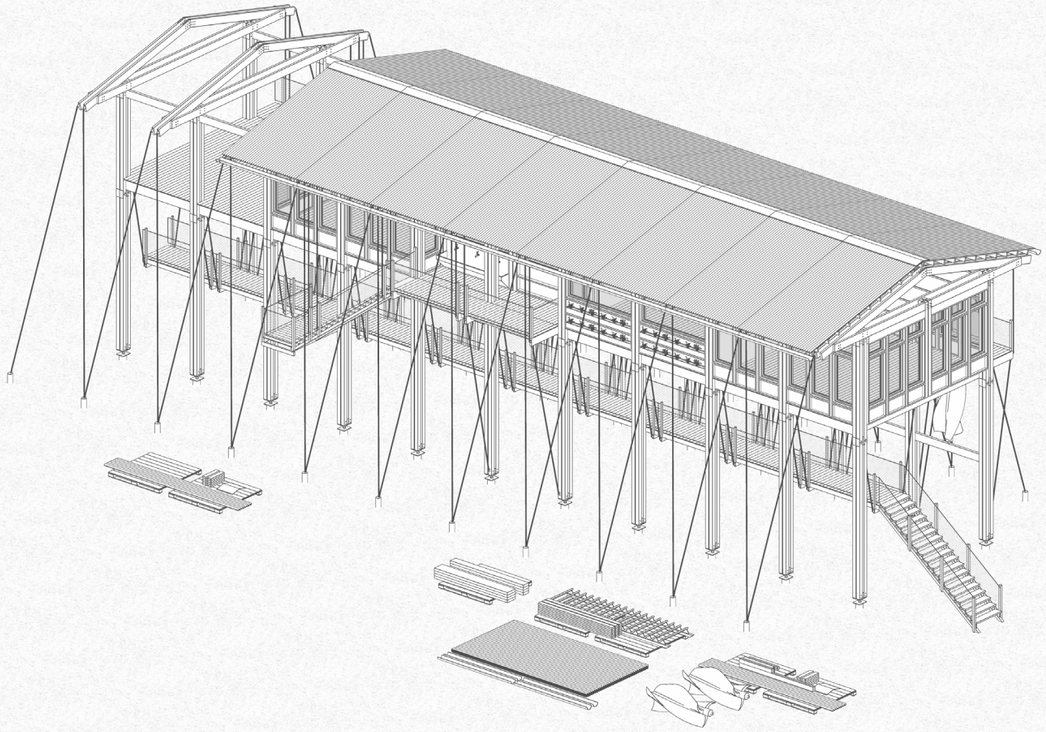
The screw piles of the foundation are screwed out of the ground and the module is removed from the building. Now the construction begins on the other side. The stairs of the walkway are moved to the other side.



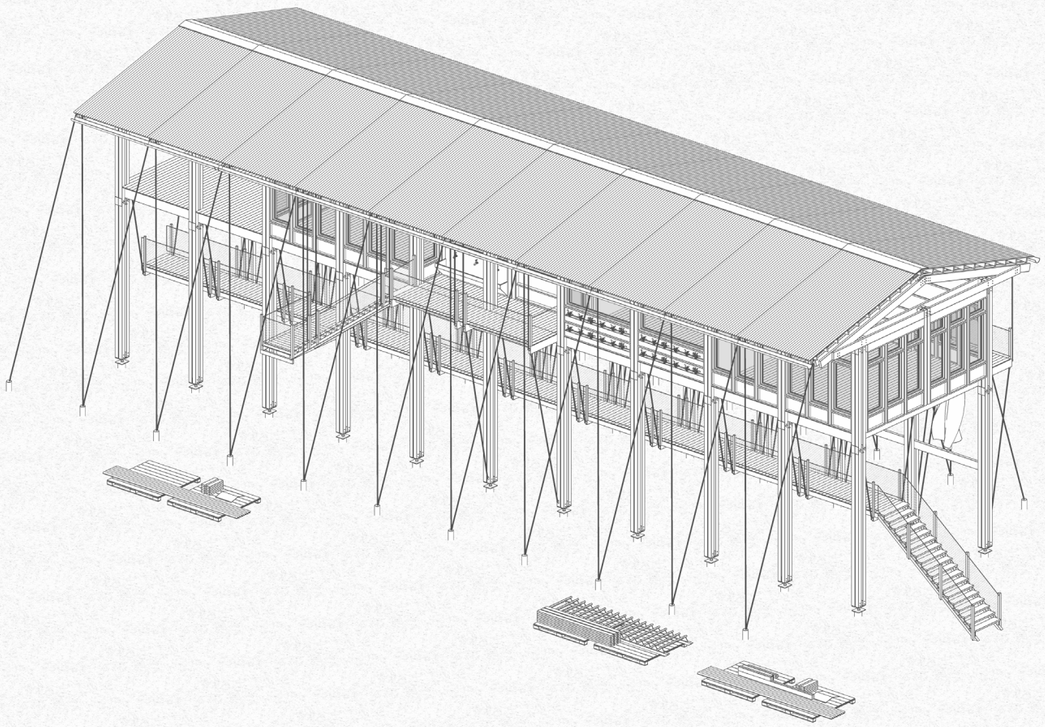
The screw piles are driven into the ground again and the columns are mounted on them.



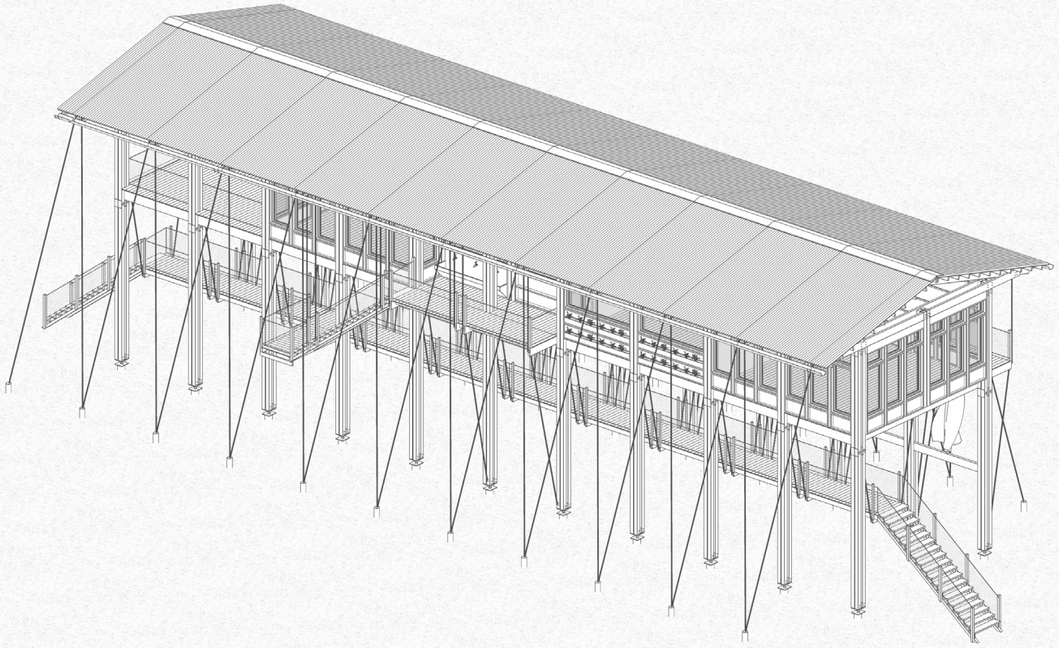
The floor beams are mounted and the decking planks are laid.



The roof construction is attached to the columns and the module becomes stable again by means of the guy lines. The walkway is hung under the floor again.



The beams are attached to the container with the corrugated sheets on top.



Finally, the stairs are reassembled and the ends are reattached to the building. The building has run one module.

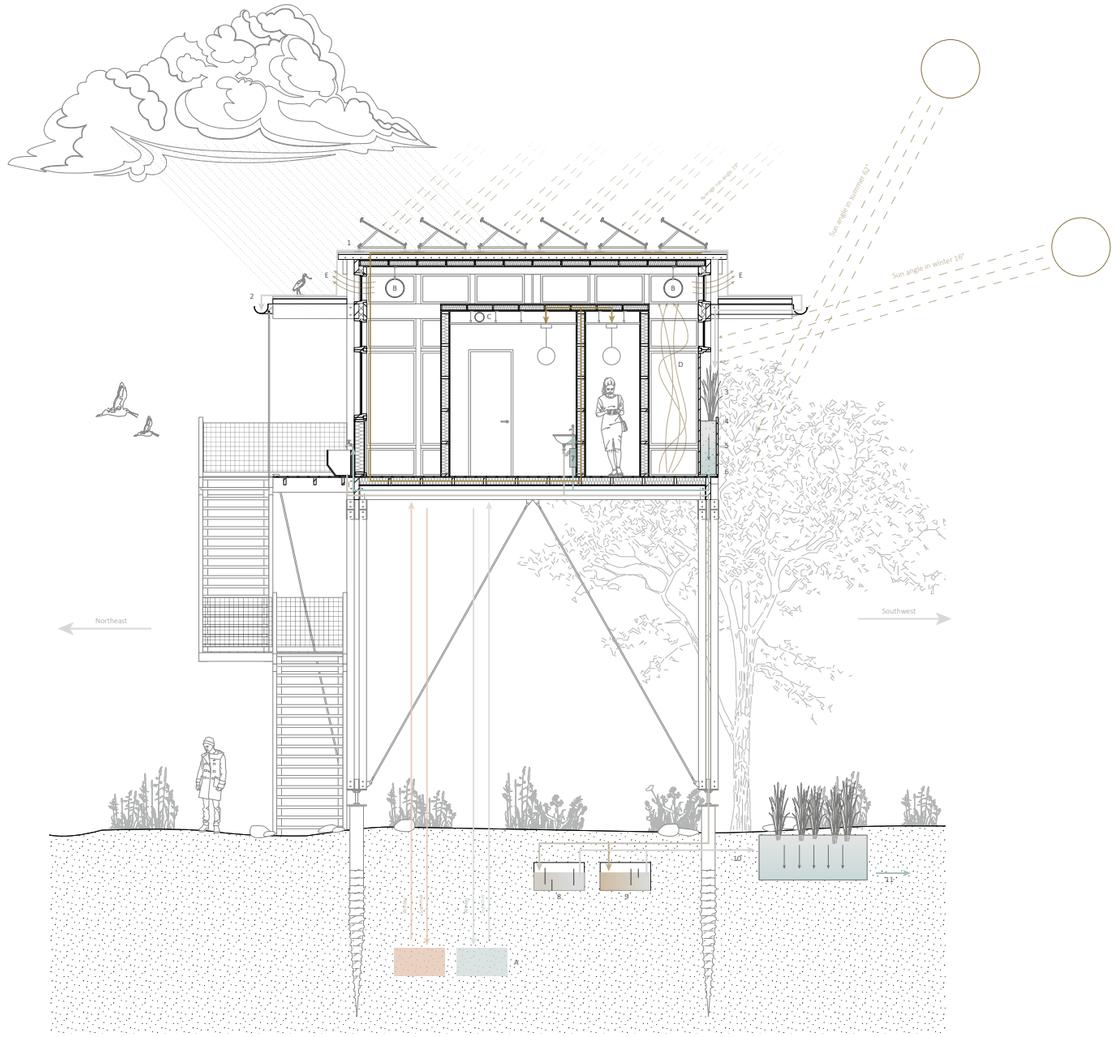
Climate concept visitor centre

Watercycle

1. Rainwater collection on the roof
   850 mm x surface roof (m2) x downstream factor (1/2) = average yield per month850 mm x 224 m2 x 1/2 = 95200 L per month
2. Rainwater is used for irrigation of the saline agriculture in the facade, surplus rainwater poured into the Wadden Sea
3. Marsh plants in helophyte filter (bulrush, rush, sedge and arrowweed)
4. Pressure pipe in gravel bed
5. Roots of swamp plants in a foil container
6. Drainage pipe with venting, after which the water is used for the toilets and outdoor taps (not drinking water)
7. Filtered water is purified with membrane filtration using osmosis, making the water drinkable
8. Drain tap and shower water into grease separator
9. Drain toilets in septic tank
10. Gray water again through helophyte filter installed with local plants in the Wadden Sea
11. Pilotage of clean water in the area

Ventilation and climate control

1. Heat supply via a heat-cold storage (WKO), connected to a ground source heat pump. In summer, excess heat is stored in the ground so that it can be used in winter.
2. The building is ventilated with ventilation type D, and is heated and cooled via ventilation through an air handling unit (LBK). The air supply takes place in the circulation areas.
3. The used air is removed in the toilets. The supply is visible, the discharge is behind a suspended ceiling.
4. On the south side of the building, the corridor is heated in winter because this side functions as a climate facade. This extra heat is used to heat the building.
5. The upper windows can be opened to remove excess heat in summer.



Visitor centre | climate section | 1:50

Climate concept pavilion

Watercycle

1. Rainwater collection on the roof
   850 mm x surface roof (m2) x downstream factor (1/2) = average yield per month850 mm x 224 m2 x 1/2 = 95200 L per month
2. Rainwater is used for irrigation of the saline agriculture in the facade, surplus rainwater poured into the Wadden Sea
3. Marsh plants in helophyte filter (bulrush, rush, sedge and arrowweed)
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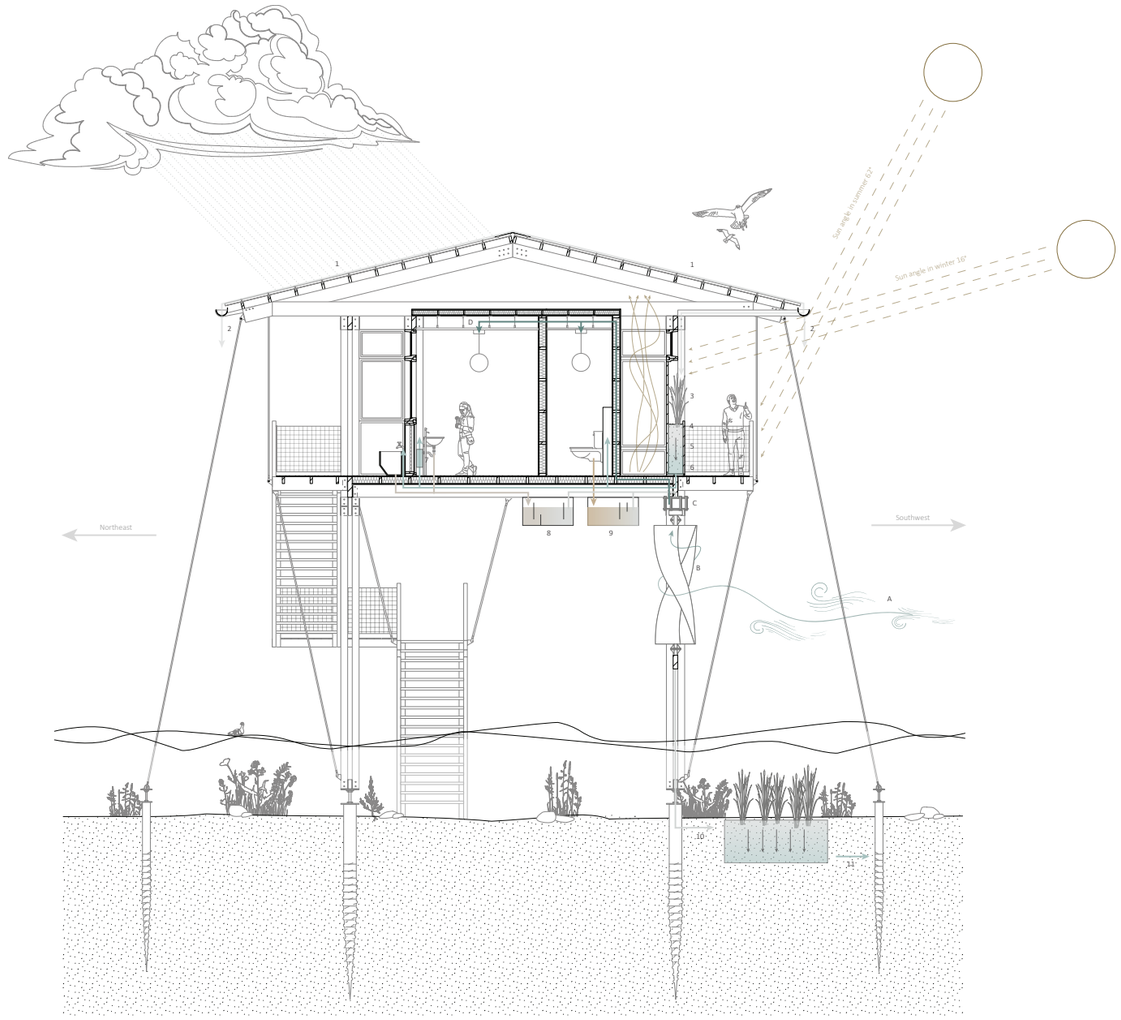
7. Filtered water is purified with membrane filtration using osmosis, making the water drinkable
8. Drain tap and shower water into grease separator
9. Drain toilets in septic tank
10. Gray water again through helophyte filter installed with local plants in the Wadden Sea
11. Pilotage of clean water in the area

Windenergy

1. Wind mainly comes from a south-westerly direction, so the building is oriented in the east-west direction for maximum wind yield. The average wind speed is 8.0 m/s, or 8.0 x 3,6 = 28.8 km/h.
2. Lightweight wind turbines made of cloth. The turbines are 3 meters high, and provide a constance output of 10 Watts per turbine at an average speed of 18 KM/h. Since the wind blows harder on average in this area (28.8 km/h), the output is 16 Watts. The turbines deliver 16 W x 10 wind turbines = 160 W (based on Nils Ferber's design).
3. A generator that generates energy from the wind and then stores it in the battery.
4. The energy generated is used to illuminate the building with LED lamps and for electric cooking.



Pavilion | climate section | 1:50

Calculations wind turbines

To get more insight on the vibrations and noise from the wind turbines, I conducted an interview with Tjeu Gehlen from MuTech, a start-up from TU Delft that is working on making wind turbines quieter.

In the interview Gehlen (2024)states the following: "I wouldn't actually worry too much about the noise and vibrations when I look at them like that. They don't look that big, which might be a good thing to say. The placement of the turbines should be considered. I think it now only works well with 1 wind direction, so in the southwest. So I can't imagine that this noise will cause any problems. If it makes a sound at all, it will sound like a flapping tent canvas."

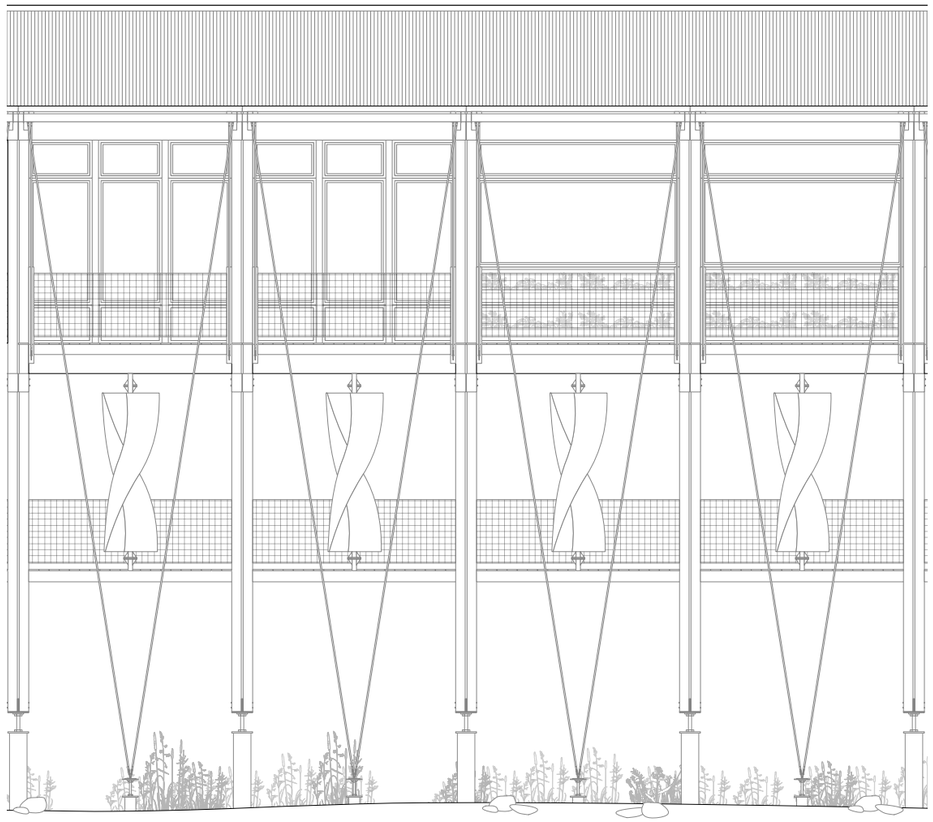
The tone that the wind turbines will make when spinning is called the Vortex Shedding frequency. The Vortex Shedding frequency can be calculated with the following formula.

St = (f x D)/V

St = 0.22 (cash Strouhal number)
f = vortex shedding frequency (s-1)
D = diameter of the wind turbine (m) = 0.82 m
V = speed of the wind (m/s) = avarage of 8 m/s

0.22 = (f x 0.82) / 8
f x 0.82 = 0.22 x 8 = 1.76
f = 1.76/0.82 = 2.15 Hz

This frequency can be related to what is audible to humans, which is between 20 Hz and 20 kHz. So the wind turbines are not audible by humans. The wind turbines are also not disruptive to birds. Frequencies lower than 125 Hz and higher than 15,000 Hz are inaudible to birds.



Wind turbines are places below the building

Calculations beams

Floor structure

The pavilion and museum consist of a modular timber structure that follow the same dimensions. To dimension these, rules of thumb were first used to determine the overall dimensions. The grid dimension between the columns is 3500 mm centre-to-centre. The span of the beams everywhere is twice the frame size, or 3500 x 2 = 7000 mm.

For the floor, the rule of thumb for beam height is h = 1/15 x l or h = 1/20 x l, with for beam width b = 1/3 x l or b = 1/4 x l. The maximum span for the floor beam is 7000 mm.

h = 1/20 x 7000 = 350 mm
b = 1/4 x 350 = 87.5 mm

The floor beam is slightly oversized, so becomes 350 x 100 mm.

Roof construction

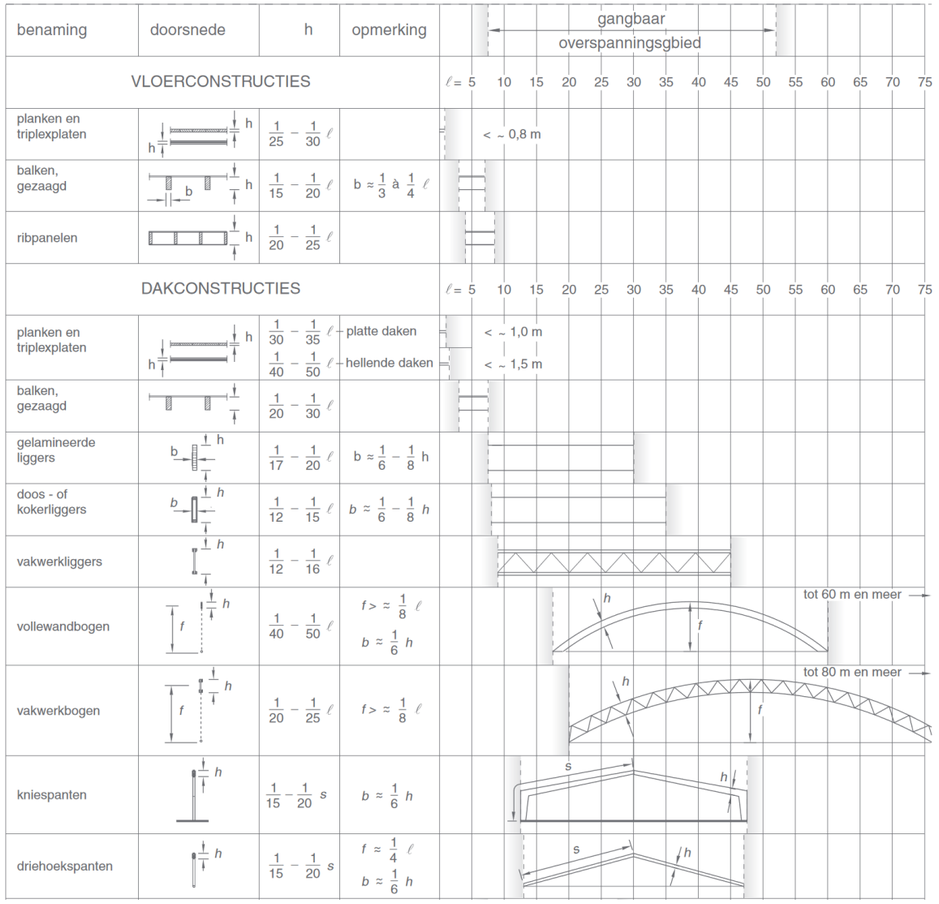
The roof construction differs slightly from the floor construction. Laminated beams are used. The rule of thumb for the height of the laminated roof beam is h = 1/17 x l or h = 1/20 x l, and for the width for the beam b = 1/6 x l or b = 1/8 x l.

The pavilion has a pitched roof, so the length of the beams is somewhat longer. The rules of thumb for sawn beam beams are h = 1/20 x l or h = 1/30 x l for beam height, and b = 1/6 x l or b = 1/8 x l for width.

The museum has a two-storey flat roof, but the beams have the same span as those in the floor. As they have to carry less weight, they are dimensioned 300 x 100 mm.
These are therefore sized the same as the floor beams. For the pavilion, the roof beams are placed in a triangular truss. The rules of thumb for this are h = 1/15 x s or 1/20 x s for the height and b = 1/6 x h for the width of the beam. Including overhang, the length of the roof beam becomes 6400 mm.

h = 1/20 x 6400 = 320 mm
b = 1/6 x 320 = 53.3 mm

The roof beam is slightly oversized, so becomes 350 x 80 mm.



Calculations columns

Column

The rule of thumb for column dimensions is l / 20, with l being the length of the column in mm, and the result being two sides of the column. In total, the columns under the pavilion are almost 10 metres long.

Using the rule of thumb, these would become (10,000/20) 500 x 500 mm. These columns are far too large. The columns are divided per floor, reducing their length. The longest column is now 6 metres high. This gives the following dimension for the column:(6000/20) 300 x 300 mm.

Check calculation buckling

The calculations have shown that the dimensions for the column determined by the rule of thumb (300 x 300 mm) comply with the Unity Check (0.20 < 1). To check that the column has no buckling hazard, a check calculation is performed.

N = Fcr / Fc;d > 5

Fcr = pi2 x E x Iz/ Lk2

E = 10.000 N/mm2

Iz = 6.75 x 108 mm4

Lk = 3500 mm

Fcr = (pi2 x 10 x 103 x 6.75 x 108) / 35002 = 5.438 x 103

This is correct, as it corresponds to the table

Fc;d = 219.8 x 103

n = (5.438 x 103) / (219 x 103) = 24 > 5

So there is no buckling hazard.

Bepaling dimensies houten ligger volgens globale belasting van blad1.

Accoya	ℓ_{hoh} =	1.75	[m]	b =	150	[mm]
	$q_{tot\ rekenw}$ =	10	[kN/m^2]	h =	450	[mm]
	q_{UGT} =	17.5	[kN/m]	W =	5062500	[mm^3]
	$q_{Q;kar.w}$ =	5	[kN/m^2]	I =	1139062500	[mm^4]
	$q_{BGT\ vb}$ =	8.75	[kN/m]	f_{cd} =	32	[N/mm^2]
	ℓ_{oversp} =	7	[m]	E =	14200	[N/mm^2]
sterkte						
veld mom =	107187500	[Nmm]		σ_m =	21.2	[N/mm^2]
	UC =	0.66		$W_{benodigd}$ =	3349609	[mm^3]
stijfheid						
	$q_{BGT\ kruip}$ =	7	[kN/m]	$U_{bij\ norm\ vloer}$ =	21.00	[mm]
	U_{bij} =	30.44	[mm]	$U_{bij\ norm\ vl\text{-}wand}$ =	14.00	[mm]
	UC $_{vloer}$ =	1.45		$I_{benodigd}$ =	1651215889	[mm^4]

Determining dimensions of wooden beams (BrightSpace, 2021)

Bepaling dimensies houten dakligger volgens globale belasting van blad1.

gelamineerd	ℓ_{hoh} =	1.75	[m]	b =	100	[mm]
	$q_{tot\ rekenw}$ =	2	[kN/m^2]	h =	350	[mm]
	q_{UGT} =	3.5	[kN/m]	W =	2041666.667	[mm^3]
	$q_{Q;kar.w}$ =	1	[kN/m^2]	I =	357291667	[mm^4]
	$q_{BGT\ vb}$ =	1.75	[kN/m]	f_{cd} =	22	[N/mm^2]
	ℓ_{oversp} =	7	[m]	E =	10000	[N/mm^2]
sterkte						
veld mom =	21437500	[Nmm]		σ_m =	10.5	[N/mm^2]
	UC =	0.48		$W_{benodigd}$ =	974432	[mm^3]
stijfheid						
	$q_{BGT\ kruip}$ =	1	[kN/m]	$U_{bij\ norm\ dak}$ =	28.00	[mm]
	U_{bij} =	27.56	[mm]			
	UC $_{dak}$ =	0.98		$I_{benodigd}$ =	351708984	[mm^4]

Determining dimensions of wooden roof beam (BrightSpace, 2021)

Bepaling dimensies houten of betonnen kolom volgens globale belasting van blad1.

	lengte			breedte			rekenwaarde			
opp.vl dak =	6.4	[m]	x	3.5	[m]	x	2	[kN/m^2]	=	44.8 [kN]
opp.vl verd.1	5	[m]	x	3.5	[m]	x	10	[kN/m^2]	=	175 [kN]
									$F_{c;d}$ =	219.8 [kN]

A = $F_{c;d}/f_{c;d}$ =	9990.90909	[mm^2]	-->	d =	99.954535	[mm]	-->	b =	300 mm
$f_{c;d}$ =	22	[N/mm^2]						h =	300 mm
ℓ_{cr} =	3.5	[m]		$E_{d\ (UGT)}$ =	10000	[N/mm^2]		I_z =	6.75E+08 [mm^4]
F_{cr} =	5.44E+06	[N]							
UC =	0.20			$I_{z\ ben}$ =	1.36E+08	[mm^4]	-->	350 x 350	

Determining dimensions of wooden roof beam (BrightSpace, 2021)

BENG calculation

Calculation of floor area and building volume

Facade module is 3200 mm, supporting structure is 300 mm. Each module is therefore 3500 mm, or 3.5 m. The Wadden Museum consists of 16 modules. The length of the building is 16 x 3.5 = 56 m. The depth of the building consists of 2 modules. That is 2 x 3.5 = 7 m. In total, the Wadden Museum has a surface area of 56 x 7 = 392 m2.

This is equal to the roof area and the floor since the building has only one floor. A facade module is 4100 mm high, or 4.1 m. The volume of the building is 4.1 m x 392 m2 = 1,607.2 m3.

Calculation of facade surface

A facade module is 4100 mm high, or 4.1 m. The surface area of one module is 4.1 x 3.5 = 14.35 m. The museum is oriented to the southwest. The facades on the NE and SW are the same, just like the facades on the NW and SE.

Facade NE/SW is 16 x 14.35 = 229.6 m2.

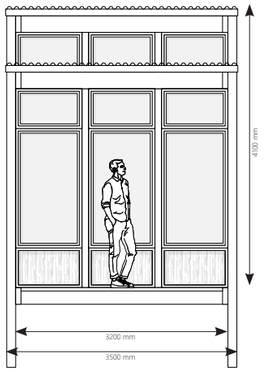
NW/SE facade is 2 x 14.35 = 28.7 m2.

Type of heating and cooling

A heat pump is used as a heat source in the Wadden Museum. A WKO is used to store the heat. Heating and cooling of the building is done by means of an AHU via the air, which provides automatic mechanical ventilation with ventilation type D; mechanical supply and discharge. This is a completely different system than the pavilion, which is ventilated with ventilation type A, natural supply and exhaust.

PV panels

The building is oriented to the southwest, with a sloping roof in that direction. This entire roof can be used to generate energy with solar panels. The energy in the pavilion is generated by the use of wind turbines.



Resultaat: 124 -207 328
Eis: Beng1: < 135.5 Beng2: < 60 Beng3: > 30%

TU Delft BK Bouwkunde

Indicatieve BENG-berekening alleen voor onderwijsdoeleinden — **Versie 3.06 20210416**

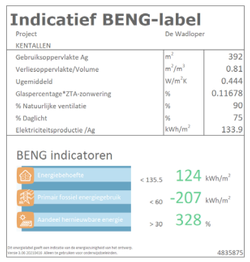
Vul de onderstaande gegevens in. Zie voor verdere toelichting de instructievideo op Brightspace.

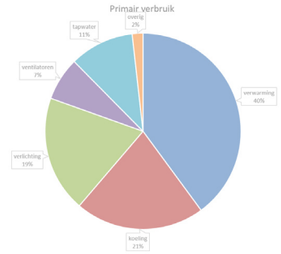
Projectnaam	De Wadloper		zelfgekozen projectnaam
Studentnummer	4835875		studentnummer
Totale gebruiksoppervlakte	392	m^2	gebruiksoppervlakte van alle gebruiksfuncties samen
Bouwvolume V	1607.2	m^3	totaal gebouwvolume

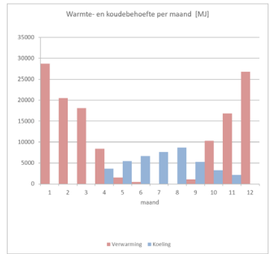
	1	2	3		
Gebruiksfunctie	Bijeenkomstfunctie - over	Onderwijsfunctie	Sportfunctie		het gebouw kan tot 3 gebruiksfuncties hebben gebruiksfuncties (pulldown menu)
Percentage van totale oppervlakte	100	0	0	%	aandeel gebruiksfuncties (let op samen 100%)
Aantal woningen	0				totaal aantal woningen

	Gevels (zonder kelderwanden)							Dak	Vloer en kelderwanden			
	Noord	NO	Oost	ZO	Zuid	ZW	West	NW	Aan grond	Boven lucht		
Oppervlakte		229.6		28.7		229.6		28.7	392	392	m^2	totale oppervlakte uitwendige scheidingsconstructie
Raampercentage		58		33		58		90	0		%	raampercentage (glas+kozijn) t.o.v. geveloppervlakte
Gemiddelde Rc-waarde dichte delen		4.5		4.5		4.5		4.5	6	3.5	m^2K/W	gemiddelde Rc-waarde dichte delen
Gemiddelde U-waarde ramen		1.2		1.2		1.2		1.2			$W/(m^2K)$	gemiddelde U-waarde van de ramen, incl kozijn
g-waarde glas		0.6		0.6		0.6		0.6			-	bij zonwering op
g-waarde glas+zonwering		0.2		0.2		0.2		0.2			-	bij zonwering neer

Type verwarming	Bodemwarmtepomp		type verwarming dat wordt toegepast in de meeste verblijfsruimten
Type warmtapwater	Elektrische boiler(s)		type tapwaterbereider dat wordt toegepast in de meeste verblijfsruimten
Tapwater centraal / decentraal	Centraal		centrale tapwaterbereiding voor meerdere tappunten of decentraal per tappunt
Percentage douchewater WTW	90	%	gemiddeld percentage warmteterugwinning bij de douches
Zonneboiler	0	kWh/jaar	opgewekte warmte door een zonneboiler ***LET OP:*** *ook meetellen bij totale energieopwekking, zoals onderstaand gevraagd!*
Type koeling	Bodemwarmtepomp		type koeling dat wordt toegepast in de meeste verblijfsruimten
Percentage natuurlijke ventilatie	90	%	vloeroppervlakte met koeling door natuurlijke ventilatie in tussenseizoenen en zomer (voorwaarde voldoende te openen ramen)
Type ventilatie (luchtverversing)	D		type ventilatie dat wordt toegepast in de meeste verblijfsruimten
Percentage warmteterugwinning	80	%	gemiddeld percentage warmteterugwinning van de ventilatie (alleen bij C en D)
Percentage daglicht	75	%	vloeroppervlakte met 70% van de gebruikstijd voldoende daglicht (daglichtsector)
Vermogen verlichting	8	W/m^2	gemiddeld geïnstalleerd vermogen aan verlichting
Thermische massa Dm	110	$kJ/(m^2K)$	default waarde 110 of bepaal Dm volgens tabblad Thermische massa
Energieopwekking	52500	kwh/jaar	opgewekte elektriciteit (bijvoorbeeld PV-panelen) en warmte (bijvoorbeeld zonneboiler)







BENG-calculaions for visitor centre (BrightSpace, 2021)



05
EPILOGUE

5.1 Conclusion
5.2 Reflection

Conclusion

After doing the research and designing the building, conclusions can be drawn. First, it answers the research question posed as the reason for the study:

"How can an in-depth study of existing landscapes contribute valuable knowledge for designing sustainable and resilient landscapes in the future?"

The study analysed the landscape in three different ways: by looking at the history of the landscape, by examining the current landscape by dividing it into layers, and by sketching future scenarios. This information led to the design of a future-proof master plan. This approach, which examines multiple sides of the landscape, ensures an integrated landscape design that addresses the future dangers of the area. By looking at how the landscape was created, the design takes into account the history and information is under the landscape. As a result, the design follows naturally from the reseltata, and the designer becomes almost more of a documentation of what already exists, rather than a designer of something new. As a result, the design fits well with the landscape, and the Groningen mentality. Exploring the cultural layer has gained extra depth by also being able to include this duality in mentality in the landscape design.

From this design, the architectural brief naturally followed. This design fits well with the new landscape, as the deed is placed in the landscape. The duality in the landscape design is also reflected in the architectural design. Thus, these start to work together and reinforce each other, so to speak. The architectural design cannot exist without the landscape, and vice versa. By designing a centre for mudflat walkers, which itself can also mudflat, Groningen's tradition is celebrated not only in function but also in architecture. Due to the dynamic nature of the landscape and the design, the pavilion fits perfectly into its surroundings and feels grounded, despite its 'walking' aspect. This way of designing creates a landscape and architectural whole that uses new techniques in an aesthetic way.

It is our responsibility as architects to be concerned with the future because, as designers, we determine what it will look like. This new way of building that I present in my project is therefore not only interesting, but even urgent in the light of climate change. Changing conditions require us to change with them, and move away from current building standards. The Wadloper shows how we can shape the future as future-proof and climate-proof architects.

Another interesting aspect about The Wadloper is the convergence between technology and aesthetics. By consciously dealing with (new) technologies from the outset, they are integrated into the design. And De Wadloper shows even more than that, it goes a step further. In standard construction, technology is used to make architecture possible. By including technology in the design, it is not only better implemented but also celebrated. The aesthetics of engineering itself is used to characterise the design. This way of working brings a new aesthetic, and itself a new language of form. No 'updated' technology, such as implemented solar panels and heat pumps, needs to be used to create an innovative building. By purely applying and visualising the technical solutions, the architecture speaks for itself.
This was reinforced by the creation of the final model. The makeability in the process shows how makeable the building could actually be. Technology as a starting point does not create complicated and unnecessary solutions, but rather makeable and pure architecture. This is an insight that has made a big impression on me, and which I will take with me into my future career. In this way, I think the Wadloper is a fitting answer the subject of the Technologies & Aesthetics studio.

Reflection

In this reflection, I look back at the research and design process of my graduation project. The project concerns a complex called 'the Wadloper', consisting of two buildings: a visitor centre and a pavilion. Both buildings are located in the north of Groningen, in the former Lauwersmeer.

What is the relation between your graduation project topic, your master track, and your master programme?

My graduation project 'The Wadloper' falls under the Technologies & Aesthetics track, a studio of the Chair Form Studies. This falls under the graduate programme Architecture. The studio focuses on innovative ways of architecture with a focus on three different themes from which students can choose: water, materials and energy. The design brief amounts to a medium-sized building, of about 1,000 square metres, in the north of Groningen. The building will be built over 100 years, so the design is innovative, sustainable and future-proof. The function of the building is up to the students.

I spent the first weeks working on the energy theme, focusing on wind energy. Then I focused on the landscape, and in particular how the landscape can be designed in a water-inclusive way. In the design, both the role of wind energy and building on water play an essential role. In addition, the aesthetics of the building were not lost sight of during the design process. Through modelling, the aesthetic values of the building were preserved while applying practical and innovative interventions.

How did your research influence your design and/or recommendations and how did the design/recommendations influence your research?

After P1, we went on an excursion with the studio to the site in Groningen. I did a bike ride through the landscape there to get as many impressions as possible. After this bike ride, we made a model of our cycling route for an exhibition. From this, my interest in the landscape followed, because the duality in the model emerged: the whimsical landscape of the delta around the Reitdiep, and the orthogonal system of ditches and cultivated landscape between the meadows. This contrast intrigued me, and this made me decide to research the landscape.

In the research phase of the project, I researched specifically the identity of the Groningen landscape, and carried out several analyses. For instance, I did a site survey on the history of the area and looked at the flora and fauna around Lauwersmeer. Then I did a layer analysis into the layers of the landscape: the subsurface layer, the structural layer and the architectural layer. To this I added the cultural layer myself to include the identity of the Groningers themselves in the analysis. I also conducted additional research on landscapes that are water inclusive, and future-oriented in design. From this research, I formulated a master plan to return the Lauwersmeer to the Wadden Sea in the future, restoring the Lauwerszee. With this intervention, I want to return the landscape to its original state: a nature area with space for Wadden birds and plants, in which the tidal action takes place again. Another advantage is that it protects the landscape behind it from rising sea levels: the natural sedimentation effect of this restored Wadden area creates a natural dike. This area is where my new building will be located.

I took inspiration for the building from the master plan, but also from the cultural layer that emerged during the layer analysis. The duality of the identity of the Groningers was an important inspiration in the design of the building: on the one hand, you have the down-to-earth, rigid Groningers who have a conservative attitude towards water: preserving what is already there, and keeping out the sea. On the other side there is the dynamic side of the Groningers, the artistic side. History has shown that the first inhabitants did not live against the water, but with the water. They built mounds, using the land when it was given to them, and when it flooded they retreated and started again. This contradiction is also reflected in the building. The research centre connects to the raised dike structure, forming the static part of the complex. It is built against the embankment, overlooking the landscape.

The other part of the complex, the pavilion, stands in the middle of the mudflats. It is for visitors who go mudflat hiking, and need a break. It can also be used by researchers, as well as lectures or workshops. This building can only be visited when it is low tide. If visitors want to spend longer in the building, they will have to surrender to the tidal action, as the building will be flooded. The building is poorly accessible through the tidal flats by pedestrians. Since the building is in a dynamic environment, a dynamic attitude is also expected of the building itself. The building itself can 'walk' across the tidal flats, as it were. It consists of modules, which can be taken apart from each other, and then linked together in different sequences. As the sea level rises, the building can adapt to its surroundings, 'walking' across the mudflats to higher ground.

Later in the studio, I joined the MSc2 studio's excursion the Delta Shelter, to the Land of Saeftinghe and to the Field Station. This excursion contributed both to my research on tidal landscapes, as it gave me a good insight into what

my own master plan might look like in about 100 years. In addition, the Field Station gave me inspiration to make my own building even more nature-inclusive.

How do you assess the value of your way of working?

During the research, I used cartography. I made a lot of maps to visualise my findings. This forced me to work a lot on the computer. However, this did not benefit my creativity. I find that on the computer, I spend a lot of time on the appearance of the drawings, rather than on the research or design itself. So after my P2, I switched to making models. I noticed during Delta Shelter, when I took this course myself last year, that making models gives me a lot of insight while designing. From concept models, I get a better idea of the shape of my building. Combining a sense of aesthetics and usability while designing, it takes into account the building's function, both in programme and mobility through the landscape. After working in models, the programme was considered through drawings. This interaction between making and drawing and gave me more insight into the spatiality of the design. When making the models, I focused mainly on the building's external appearance: the façade and shape were given top priority. The spatiality of the interior spaces lagged slightly behind in this, this was only addressed when 3D modelling was done on the computer. Hence, many design choices were still made at the end of the design process.

This made the process vary in intensity. Throughout MSc4, I have been busy with design. After P2, I started making and designing hard. By P3, I therefore already had a fairly complete design. However, I got stuck then, as little new input had been added. A year to design is also a long period during which many developments can take place in your design. After many facade studies, I had little inspiration. After the inspiration to the Land of Saeftinghe, I got through both the landscape and the Field Station. As a result, I made many changes to the design in the final weeks of the design phase. Although that was still a lot of work, it made the design more complete and better.

How do you assess the academic and societal value, scope and implication of your graduation project, including ethical aspects?

The academic and societal value of the project lie in the sustainability question that is emerging everywhere. Climate change is an increasingly pervasive problem that we, as architects of the future, simply cannot ignore. My graduation project is fundamentally a project that focuses on the future, through the studio's brief. By combining scientific research with cultural research, new insights are gained into designing from and with the landscape. The landscape as a source of inspiration is a sustainable and innovative way of designing. However, this makes the subject of my project more in line with the design brief and design method of the Delta Shelter. This way of designing could be a solution of future resistant design with the landscape, instead of against it.

How do you assess the value of the transferability of your project results?

The dynamic approach of both landscape and architectural design can form a new direction within architecture to look at our existing environment with renewed eyes. For the future of the Netherlands, where sea levels are rising and the earth is sinking, it is important to look ahead enough, and design ahead, rather than having to act on unpleasant situations. The threat of sea level does not only play out in Groningen or the Netherlands, but has an impact on delta areas around the world. The project can contribute to the sustainability of architecture in the future.

How could the research process before the P2 be optimised?

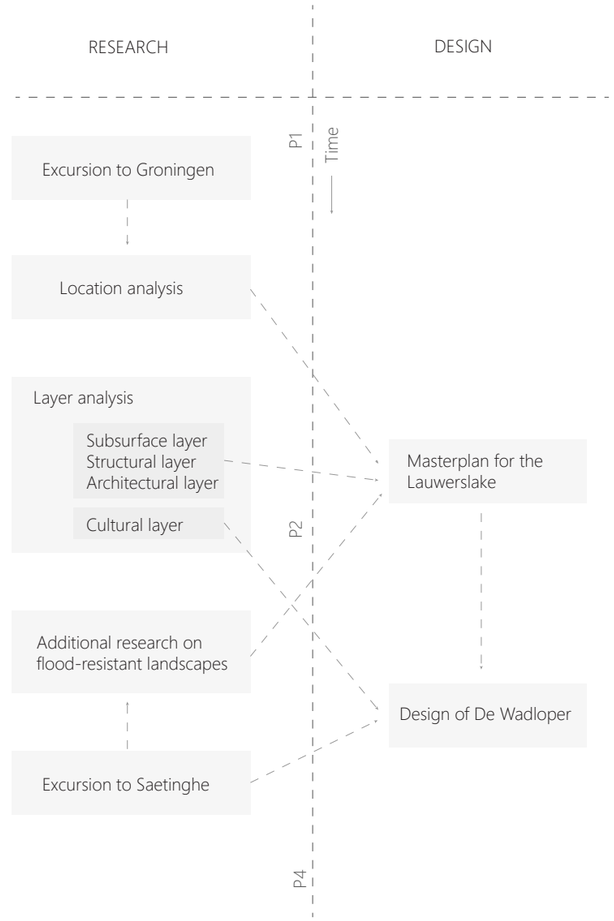
As I mentioned earlier, especially the designing part of my final project was better than the research. In the first period, P1, I felt I did not make the best use of my time. Because I did not yet know quite what I wanted to research and then design with it, nor did I know how to go about it, I lost a lot of time. In the undergraduate, I gained little or no experience in setting up my own research. During the first period of the year, I found it difficult to decide on a definitive direction. Now that I look back on the period, I am very happy with the result of the design, and how it connects to the research, but during the research I did not always feel that I was going in the right direction. While designing, however, I did come across some things I would have liked to have investigated earlier: reference projects of landscapes designed in an innovative way, references of projects in such areas, and practically more research on demountable wood joints. Ultimately, the research on wind also influenced my design, so the period was not in vain after all, even if you can't always assess that at the time.

What are my goals for the P5 presentation, and what do I want to learn?

Looking at the last period, I feel very much like making a final maquette of my entire design. In the final phase, I made many drawings and computer models, but for me, nothing works as well as a physical maquette. It makes the materials, dimensions, impressions and atmosphere tangible. I think

it would be nice if the model could reflect the qualities of the building: its mobility, the positive influence on the environment, the innovative way of generating energy, the inquisitive attitude towards nature, and the dynamic construction that reflects both the Groningers and the tides, thus responding to the unpredictability of the sea. By paying attention to these aspects, without losing sight of aesthetics, I hope to have created a complete and innovative design that can be an inspiration for myself, but also for others, to look at architecture with new eyes.

This reflection was written before the P4 presentation.





06
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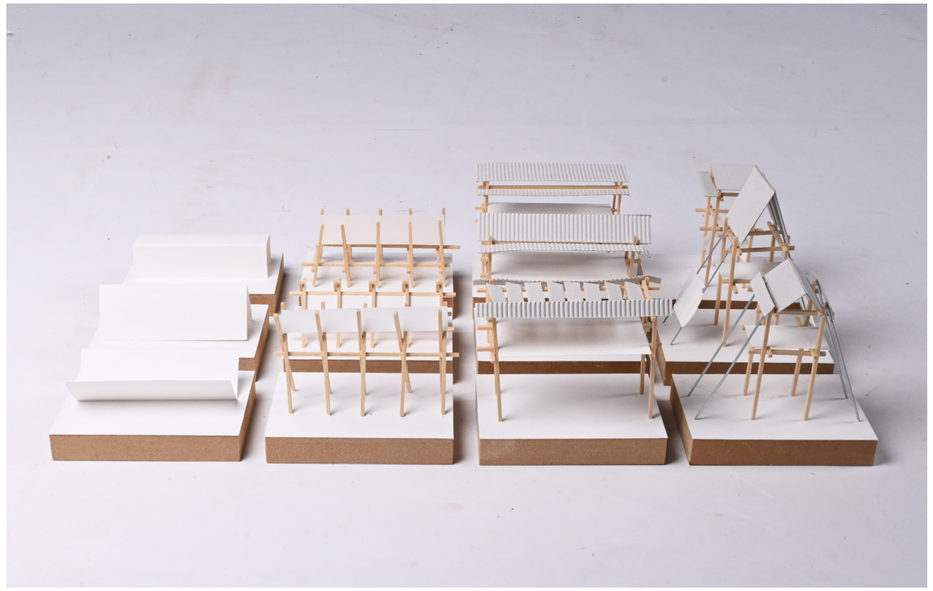


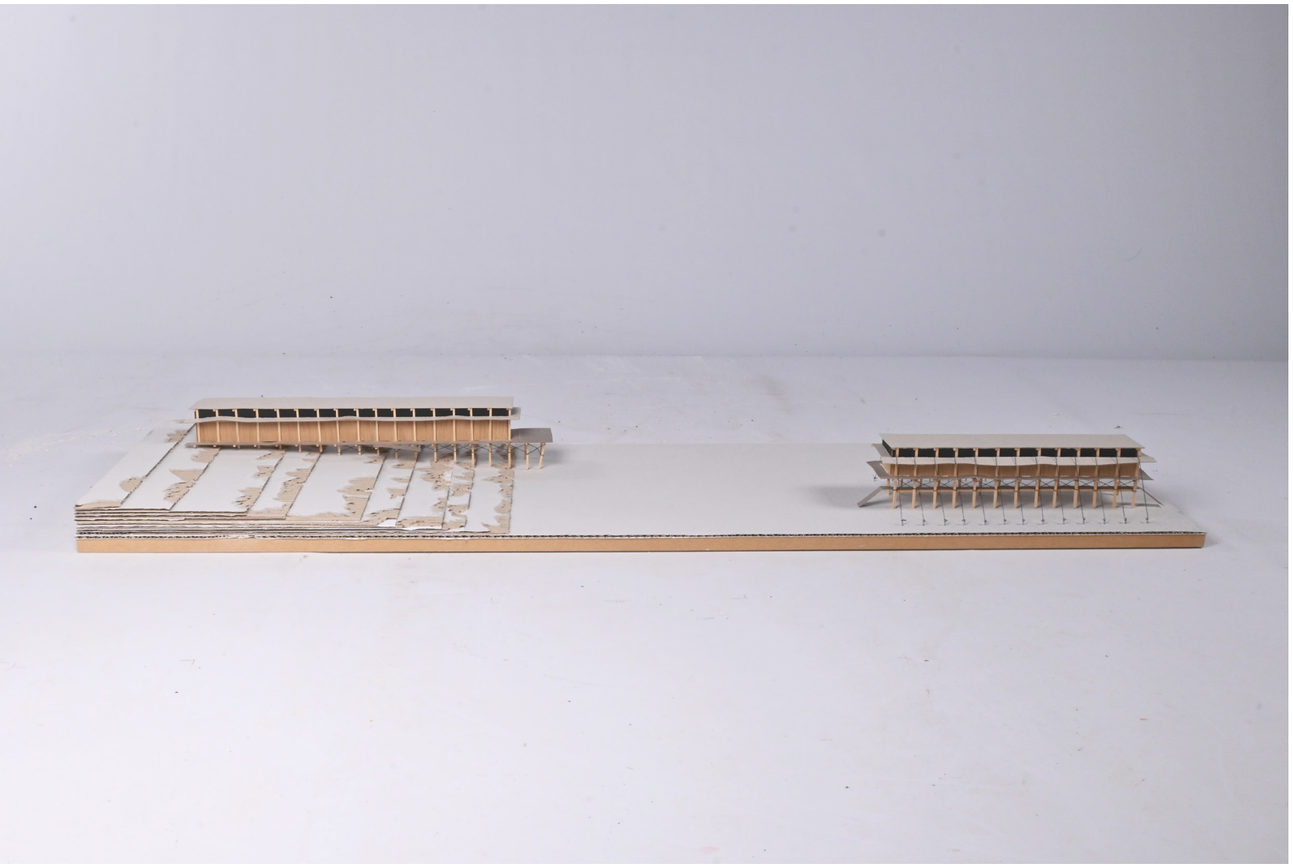
Concept studies



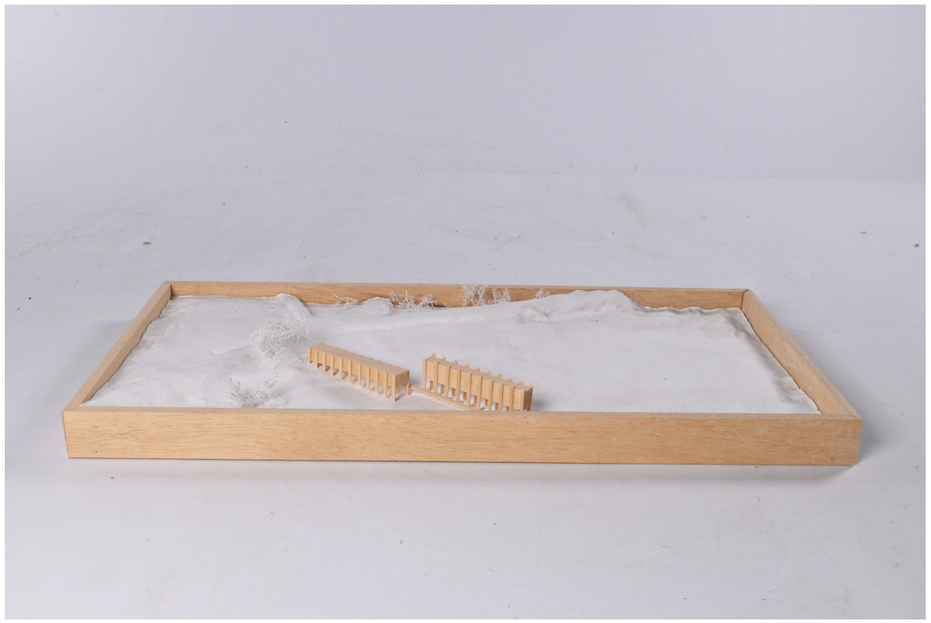
Facade studies



Facade fragment 1:20



Building complex 1:200



Situation 1:500



North facade Wadloper 1:50



East facade Wadloper 1:50



South facade Wadloper 1:50



West facade Wadloper 1:50

