

Re-Reed Architecture

**A Circular Community Centre for
Nature and Neighbourhood**

Research Plan

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Argumentation of Choice of Studio

The studio was chosen to follow the fascination of a nature-inclusive design strategy to rethink the connection between humans and nature. At the Floriade Expo 2022, the Dutch and the Almere-Amsterdam pavilion both showed the possibilities of local biobased materials in buildings and the value of integrating nature into the built environment. I got inspired by the boldness and simplicity of the application of such materials but also saw challenges and opportunities to develop the circularity of buildings even further. In the sub-studio Harvest of Architectural Engineering I can thrive with a graduation project that inspires to use biobased construction materials that grow locally, are applied to buildings and can be disposed of on the same site.

Keywords

Biobased materials, reed, circularity, local building materials, ecosystem services, wetlands

Introduction

„A new mythology of technology in the era of the Anthropocene can replace the pending threat that Nature will destroy us with the optimism that a collaboration with Nature can save us.“¹ - Julia Watson

The environmental problems we are facing in the Anthropocene can only be solved in symbiosis with nature. Humans need to become aware of the interdependencies between all species. Specifically, the building sector needs to contribute its equal share to a sustainable future. The graduation project addresses several topics on different scales leading to a threefold introduction to the topic (Figure 1.). The broad scale of the environment elaborates on the urgency to restore wetlands as a major carbon storage. Zoomed in, the site of the graduation project and its characteristics are the focus of the contextual scale. Finally, the materiality, which is the subject of the research paper, mentions the angle chosen to investigate a biobased construction with reed.

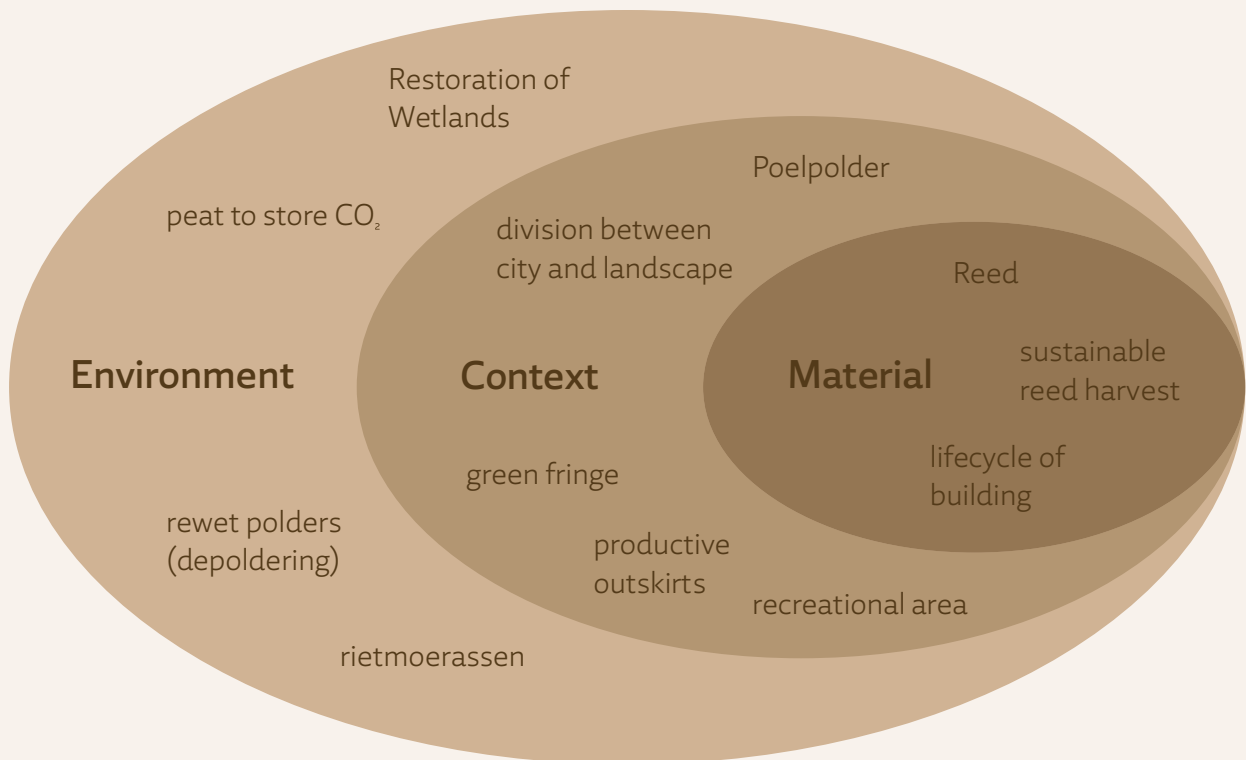


Figure 1.
Visualisation of Investigation Scales,
drawn by author

ENVIRONMENTAL SCALE - RESTORATION OF WETLANDS

The landscape of the Netherlands has been modified over centuries to exploit the nutritious soil, make space for pasture lands, agriculture, and meet the housing needs of a growing population. The polder landscape is the result of comprehensive drainage (*droogmakerij*) of peatlands in the river delta to gain land for these human needs. However, the drainage came with a cost. The loss of valuable wetlands leads to a sinking groundwater level that harms the plants and species existing on the polders. The soggy peat of wetlands that is supposed to store carbon underground is unable to fulfil its natural duty and thus releases CO₂ into the atmosphere.²

On a global scale, peatlands are one of the biggest natural carbon sinks and store more than any other vegetation type in the world. The nearly natural peatlands cover over 3 million km² and contain around 44% of all soil carbon thanks to the slow anaerobic (without oxygen) decomposition. However, when drained and damaged they can release CO₂ into the atmosphere and, thus, drained peatlands present one of the largest sources of greenhouse gas emissions today. They are responsible for almost 5% of the global anthropogenic CO₂ emissions even though they only cover 0.3% of landmass globally. Thus, the restoration and preservation of peatlands are crucial for mitigating the effects of climate change.³

¹ Julia Watson, *Lo-TEK: Design by Radical Indigenism* (Cologne: Taschen, 2020). p 398

² 'Visie klimaatbestendige veengebieden', Staatsbosbeheer, accessed 24 October 2022, <https://www.staatsbosbeheer.nl/over-staatsbos-beheer/blijf-op-de-hoogte/nieuws/2022/06/visie-klimaatbestendige-veengebieden>.

³ 'Peatlands and Climate Change', Resource, IUCN, December 2021, <https://www.iucn.org/resources/issues-brief/peatlands-and-climate-change>.

In the Netherlands, Staatsbosbeheer has recently published a vision on the sustainable future for wetlands showing the relevance of the topic nowadays. The reasons are the unsustainable agriculture and polders covered by buildings that are no longer helping to store carbon. The map of the wetlands (Figure 2.) shows how the lower wetlands (*laagveen*) are the habitat of diverse species and serve the ecosystem. It also demonstrates how much land was drained for agriculture and settlements in only Noord Holland.

How will the restoration of peatlands in the Netherlands be able to store all the carbon that the building sector right now is responsible for? This graduation project uses the environmental ideas of IUCN and Staatsbosbeheer about the urgency of peatland restoration to develop a new way of building with what the wetlands provide us with in terms of materials, water management and purification, and energy.

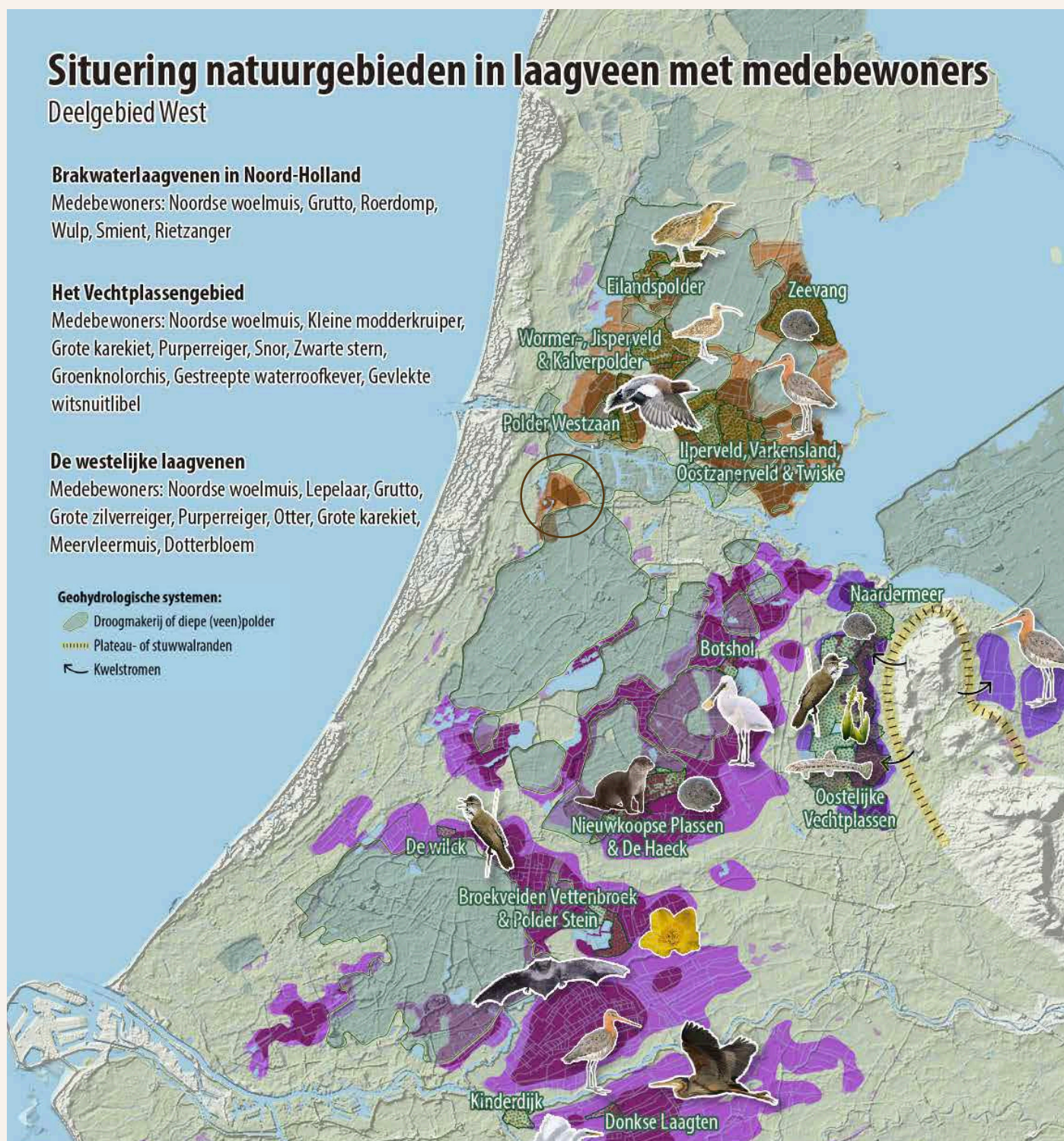


Figure 2.
 Wetlands in Noord Holland, Staatsbosbeheer, visie
 klimaatbestendige veenlandschappen juni 2022

CONTEXTUAL SCALE - DIVISION BETWEEN CITY AND GREEN FRINGE

The chosen site of the Poelpolder in the southeast of Haarlem is part of the neighbourhood Boerhaavewijk (for a map see Figure 6. on p. 8/9). It was chosen because the issues stated above about wetlands are visible in that polder. The surface of the Poelpolder is peat (*koopveengronden* or *veenmosveen*) and the area is also highlighted in the map of Staatsbosbeheer above (Figure 2.) as a valuable nature area showing its relevance for biodiversity and carbon-storing capacity.⁴

The Poelpolder is a typical example of a polder at the edge of the city. It shows a clean cut between the city and landscape and forms a threshold between rural and urban (Figure 3.). This threshold is meant to be used as a recreational green fringe of the city. The area is at first glance charming and harmonic but when one looks a bit closer it becomes clear that the polder is suffering from the aforementioned drainage. The water is at a very low level, the plants are dry, the canals need a lot of maintenance to dig out the dry peat that fell in, and the asphaltic bike lanes draw sharp borders through the meadow and flood when it rains. These concerns did not go unnoticed leading to initiatives to raise the water level and increase the water quality.⁵ However, this graduation project aims to go a step further and propose not only short-term solutions to the survival of the polder but revive the area and design for it a prospective future.

On a social scale, the so-called recreational zone for the adjacent neighbourhood only offers bike lanes, space to walk one's dog, or running trails. Thus, the Poelpolder is not only on a natural level but also on a social level a site with a lot of potentials to change for the better. The neighbourhood of Boerhaavewijk is a residential zone with a lack of community and meeting spaces. Neither do the residents feel responsible or drawn to the landscape around the built area. Architecture for the neighbourhood with a nature-inclusive design approach can add a multifunctional layer to the restored wetland without suppressing the landscape. It creates not only a community between people but also a symbiosis with the landscape surrounding them.



Figure 3.
Separation of City and Landscape,
photographed by author

4 'Basisregistratie: Ondergrond (BRO), (WKO), Bodem- En Ruimtegebruik En SOR - Themalagen', accessed 31 October 2022, <https://kaart.haarlem.nl/app/map/20>.

5 Hoogheemraadschap van Rijnland, 'Watergebiedsplan Vijfhuizer- en Poelpolder te Haarlem', webpagina, accessed 19 October 2022, <https://www.rijnland.net/wat-doet-rijnland/in-uw-buurt/vijfhuizer-en-poelpolder-te-haarlem/>.

MATERIAL SCALE – POTENTIAL OF REED AS LOCAL BUILDING MATERIAL

Architecture with a nature-driven design approach takes the necessary steps towards a reciprocal living environment with landscape and people. What could make a difference is the presence of local building materials. But the lack of their availability slows down the development of this field. The building sector is still responsible for almost 50% of the CO₂ emissions and if a drastic reduction does not occur soon, the climate goals set by the EU cannot be met. In this 50%, 20% are assigned to the building materials and construction, referred to as embodied carbon.⁶ Due to the reason that these emissions can be traced back to mainly the use of concrete, steel, and aluminium there is a desperate need for alternatives to reduce the carbon emissions in the building sector.

Along with the restoration of the peatlands in the Netherlands a big potential for growing crops on the nutritious soil arises. These crops would not only be valuable for the enhancement of biodiversity, but they could also prove themselves worthy as renewable building materials. Reed, a tall grass-like plant, grows on wetlands in the Netherlands and is the focus of the thematic research. For the famous roof thatching in the Netherlands, the reed is mostly imported from abroad (e.g. Ukraine or China).⁷ This leads to carbon emissions for transportation all over the world (Figure 4). However, reed cannot only be used for roofing. The recent research of reed as a building material, for example at the Floriade Expo 2022 in Almere, made it obvious that this multifunctional material can be used for other construction layers just as well. To successfully incorporate biobased materials the lifecycle of these materials needs to be considered in the design process as it is not as long-lasting as concrete, for example. The challenge is to design the building elements in a way to disassemble them to replace the reed when it does not meet its requirements anymore.



Figure 4.
Trucks for Reed Export, <https://trotsopmagazine.nl/wp-content/uploads/2018/12/van-Rees9-klein.jpg>

6 'Why The Building Sector? – Architecture 2030', accessed 24 October 2022, <https://architecture2030.org/why-the-building-sector/>.

7 'Riethandel - Vakfederatie Rietdekkers', accessed 24 October 2022, https://www.riet.com/riet/de_rietbranche/riethandelaren.html.

Problem Statement

Embodied carbon from building materials is released into the atmosphere contributing to the carbon emissions of the building sector (see the comparison with renewable materials in Figure 5.). Circular building with biobased materials is desirable to make active use of the interdependencies between all species. There is still a lack of expertise in this field to successfully apply biobased materials in building elements. This approach aims to store carbon not only in the peat of the restored wetland but also in the building layers on top of it thanks to the innovative use of reed.

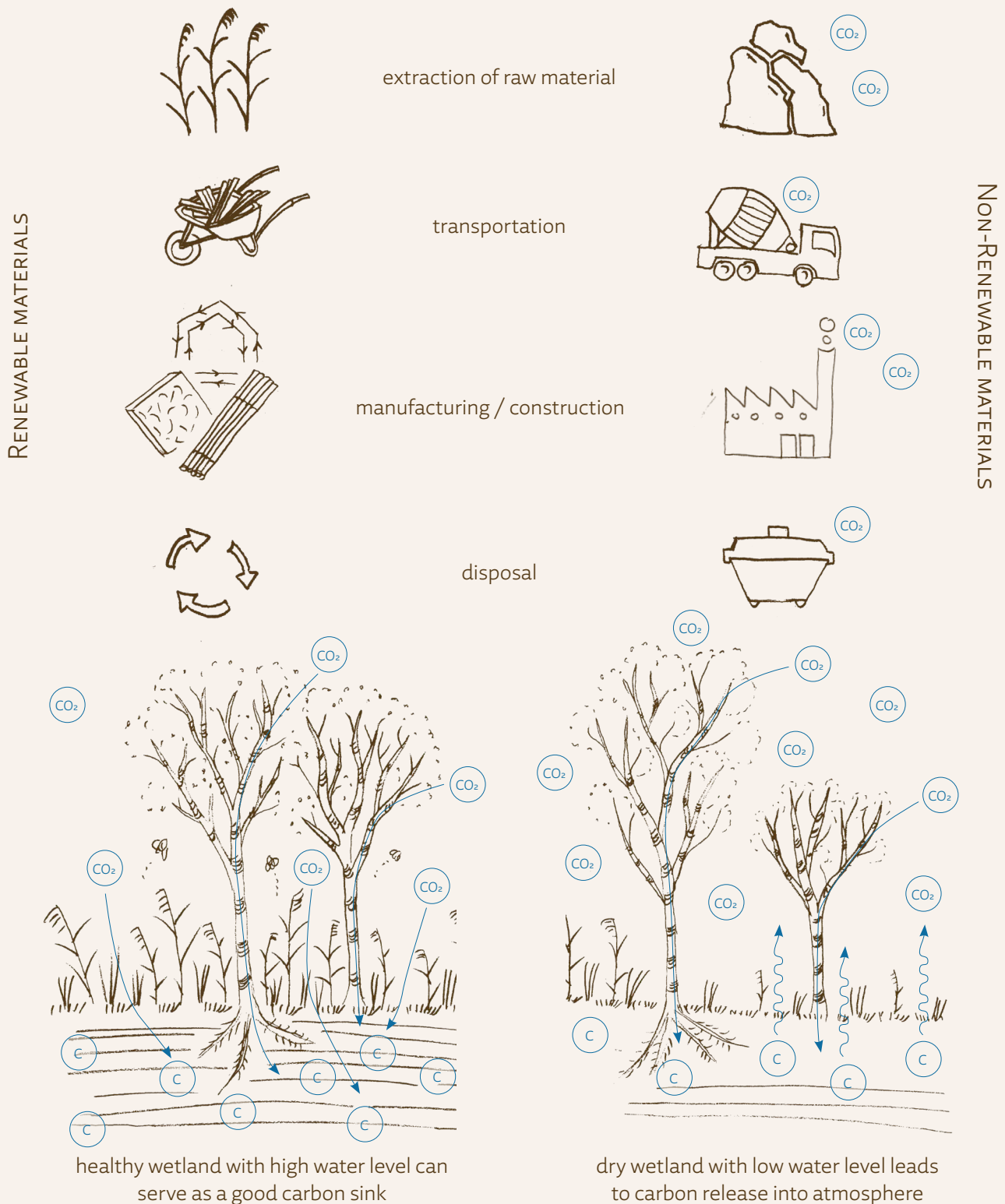


Figure 5.
Comparison renewable and non-renewable
material in relation to carbon sink,
drawn by author

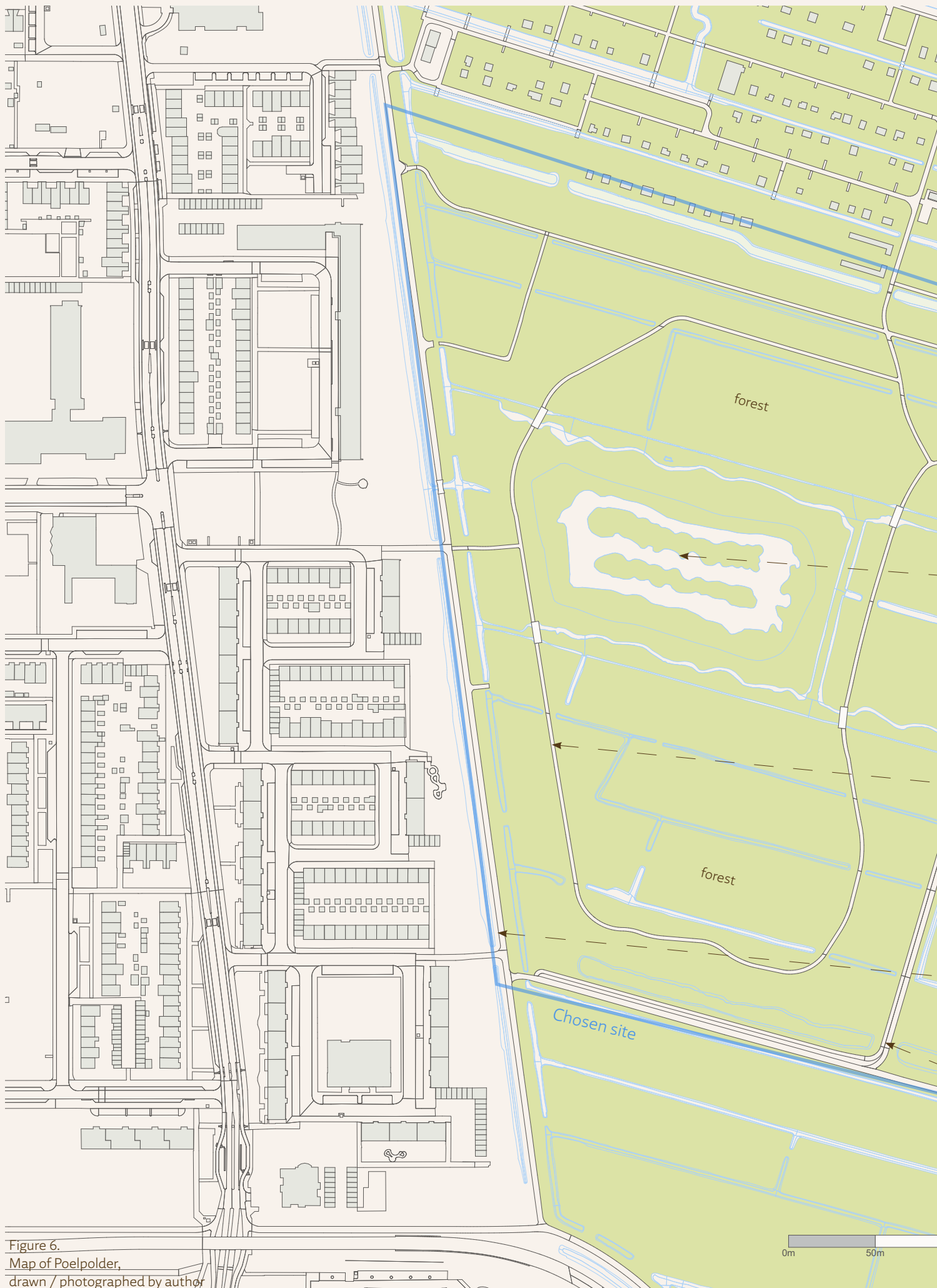


Figure 6.
Map of Poelpolder,
drawn / photographed by author



Limited access to
allotment gardens



View on Boerhaavewijk



Pond as wettest
area in Polder



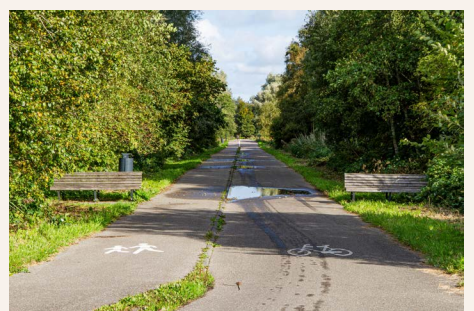
Walkway
asphalt



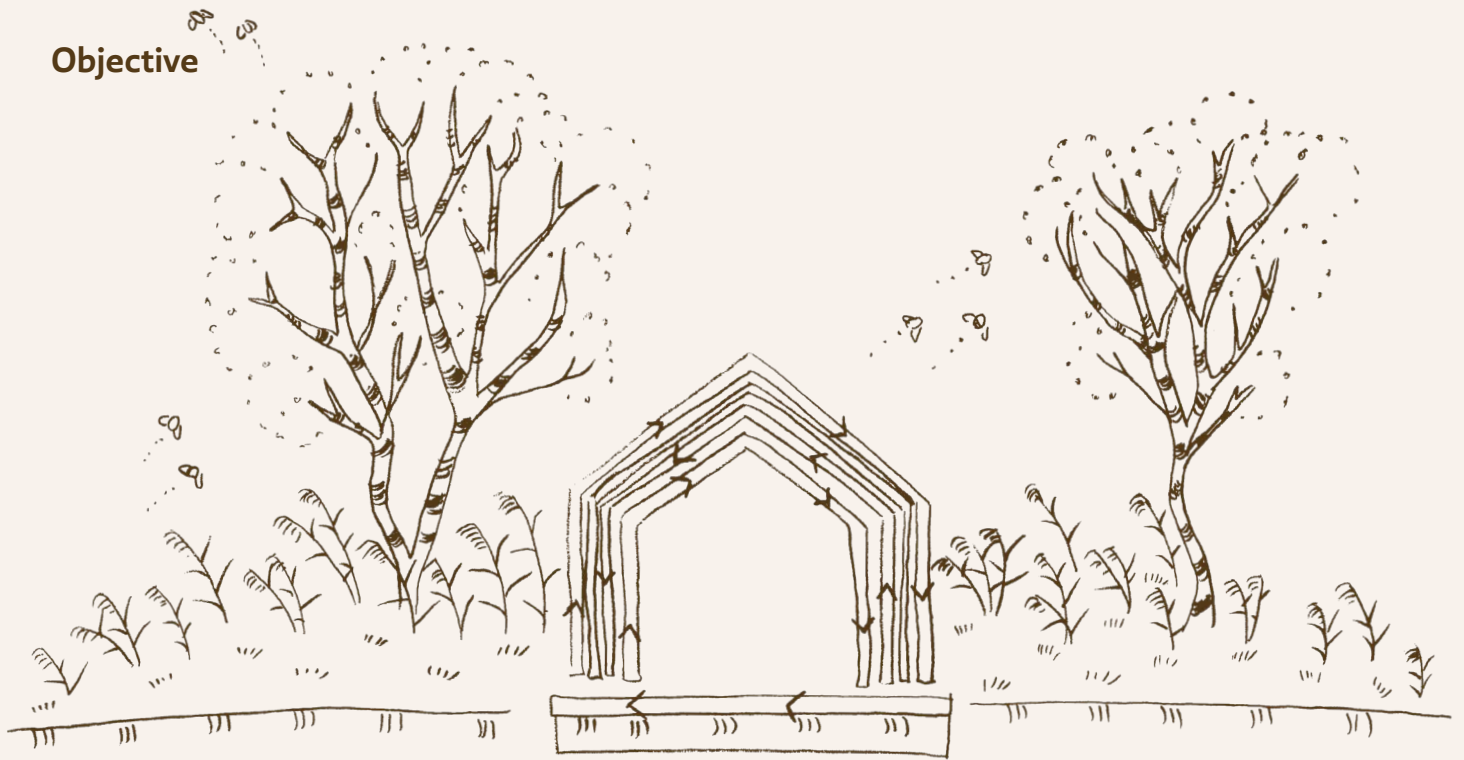
Fast lane for
bikes around
city



Bike route
through Polder



Objective



In the Boerhaave neighbourhood from the 60s, the programme is almost the same for every building. It is a residential neighbourhood that contains almost exclusively social housing. The building blocks and concrete landscape give the people living there hardly any access to nature. The built access routes to the Poelpolder are little “stitches” that seem like they would want to hide the green at the outskirts of the city. It is mirrored in the scarcely used Poelpolder as a recreational area. The result of that is the neglect of the care of the Polder. Even though the area officially belongs to the neighbourhood Boerhaavewijk, people feel no responsibility towards it and do not identify themselves with the landscape starting behind the building blocks.

This graduation project aims to develop a circular community centre that receives its construction material from the restored wetland surrounding it. It reconnects nature and people through a nature-inclusive architecture built with locally harvested material with the focus on reed. To grow this multifunctional crop on the Poelpolder on the outskirts of the city of Haarlem the rewetting of the polder is necessary. Thus, with the aid of the community centre, the polder will be transformed into a productive green fringe and will add a multipurpose to the recreational zone. It can be integrated into the residents’ daily life by providing communal functions on the fringe. The circularity of the building needs special attention from the users and will function as a main objective for communal activity as the reed needs replacement and care. Next to workshops and a market, the community hub invites the residents of the neighbourhood Boerhaavewijk out of the city and into the landscape. The new vernacular architecture explores a sustainable approach to landscape and the built environment to lower greenhouse gas emissions in the construction process and maintenance thanks to the careful use of circular building materials.

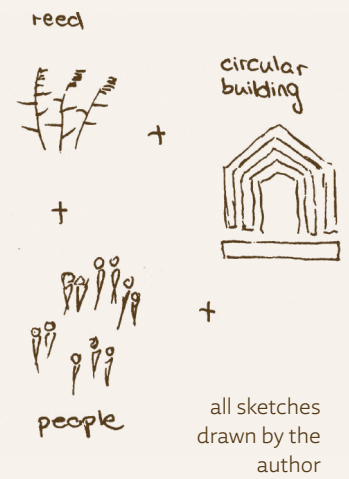
Overall Design Question

In Boerhaavewijk, there is potential for more community that would give a sense of communal identity and responsibility towards a space. Thus, to transform the Poelpolder into a lively space, a communal function needs to be added to it. It leads to the question:

How does a community centre in the green fringe of Haarlem enhance the interaction between the residents and nature using reed as a local biobased building material?

A community hub on the outskirts of the city of Haarlem gives the residents a chance to escape the city in their daily routine. It strengthens their collective identity and sense of belonging to nature. The construction of the community hub in biobased local materials involves the participation of the neighbourhood. Reed as one of the main construction materials has a shorter life span than unrenewable materials such as concrete. However, the design aims to be adaptable for the replacement of such biobased materials. It creates a lifecycle that can be regenerated locally because with the rewetted Poelpolder plenty of reed will grow locally. The productivity of the landscape adds another layer to the liveliness of the green fringe. This is the enhancement of the biodiversity that comes back to the area with the restoration of the

peatland. Not only reed will grow on the rewetted peat, but there is also a possibility for growing food with a paludiculture approach. These locally grown crops can be sold in the community centre and provide the neighbourhood with local food and a meeting point. Thus, the community centre connects wetlands and the city, people in the neighbourhood, and adds a vibrant function to the Poelpolder to promote its restoration and locally grown crops. It results in a circular architecture to allow the city to extend into the landscape as an equal player in our ecosystem.



Thematic Research Question

Common reed (*Phragmites australis*) is a large grass-like plant that grows on the margins of lakes, marshes, and most importantly, wetlands. As already mentioned above, the reed that is used for the traditional roof thatching of Dutch houses is mostly imported. However, in order to meet the climate goals of the UN and reduce carbon emissions it is highly relevant to investigate the construction materials that can be locally harvested. The Netherlands as a river delta still has a lot of nutritious peat that is in danger of drying out and sinking. In the process of rewetting the polders, reed would be one of the first crops to grow plentiful on the restored wetland. The stems of this fast-growing grass-like plant can be harvested and used in construction when they are dry. However, the qualities of reed as a building material can not only be used for the already explored roof thatching. It is desirable to explore the potential of reed in all building layers. Thus, it results in the following research question:

How is locally harvested reed applicable to a nature-inclusive design considering the whole lifecycle of reed as a building material?

The prospect of reed growing on the local wetland and being applied to the building on the same site (Figure 7.) leads to several sub-questions that need answering.

What valuable features does reed have as a biobased construction material?

How long can reed last in which building element until it needs replacement?

How can the building element be disassembled so that reed can be replaced when necessary?

How much reed for construction can be harvested locally in the Poelpolder?

What can be learnt from vernacular reed constructions from the past and abroad?



Figure 7.
Lifecycle of Reed as a Building Material,
drawn by author

Methods

The methods on how to answer the research question and its sub-questions will be elaborated in the following table.

Subresearchquestion	What data do I need?	How can this data be collected?	How will this data be analysed?	What will be the expected results?
What valuable features does reed have as a biobased construction material?	- Qualitative data on features of reed. Chemical, biological composition beneficial for construction.	- Literature study - Material analysis	The data will be categorised to evaluate what features are profitable to use reed for the construction.	Thermal, acoustic, pressure, tension and other features of reed as a catalogue.
How long can reed last in which building element until it needs replacement?	- Degradation process of reed depending on exposure and treatment	- Literature study - Prototype	Durability of material dependent on application	Insight on how long reed can last in which layer and when it needs replacement
How can the building element be disassembled so that reed can be replaced when necessary?	- Details of how material can be replaced from the building layers. Options for disassembly of construction.	- Prototype - Research by Design	By Design	Insight of how the building elements can be constructed in reed with possible replacement
How much reed for construction can be locally harvested in the Poelpolder?	- Squaremeters of reed growth, soil requirements	- Literature study - Site analysis	By measurements and calculations	Insight of how much reed is required for different building layers in relation to how much can be harvested
What can be learnt from vernacular reed constructions from other countries?	- Qualitative data on building projects from abroad	- Reference analysis - Desktop research - Case study analysis	Focus is on construction methods that can be applied in NL	Insight of how people used to build with reed and how it can be applied in contemporary design

Figure 8.
Table of Methods,
by author

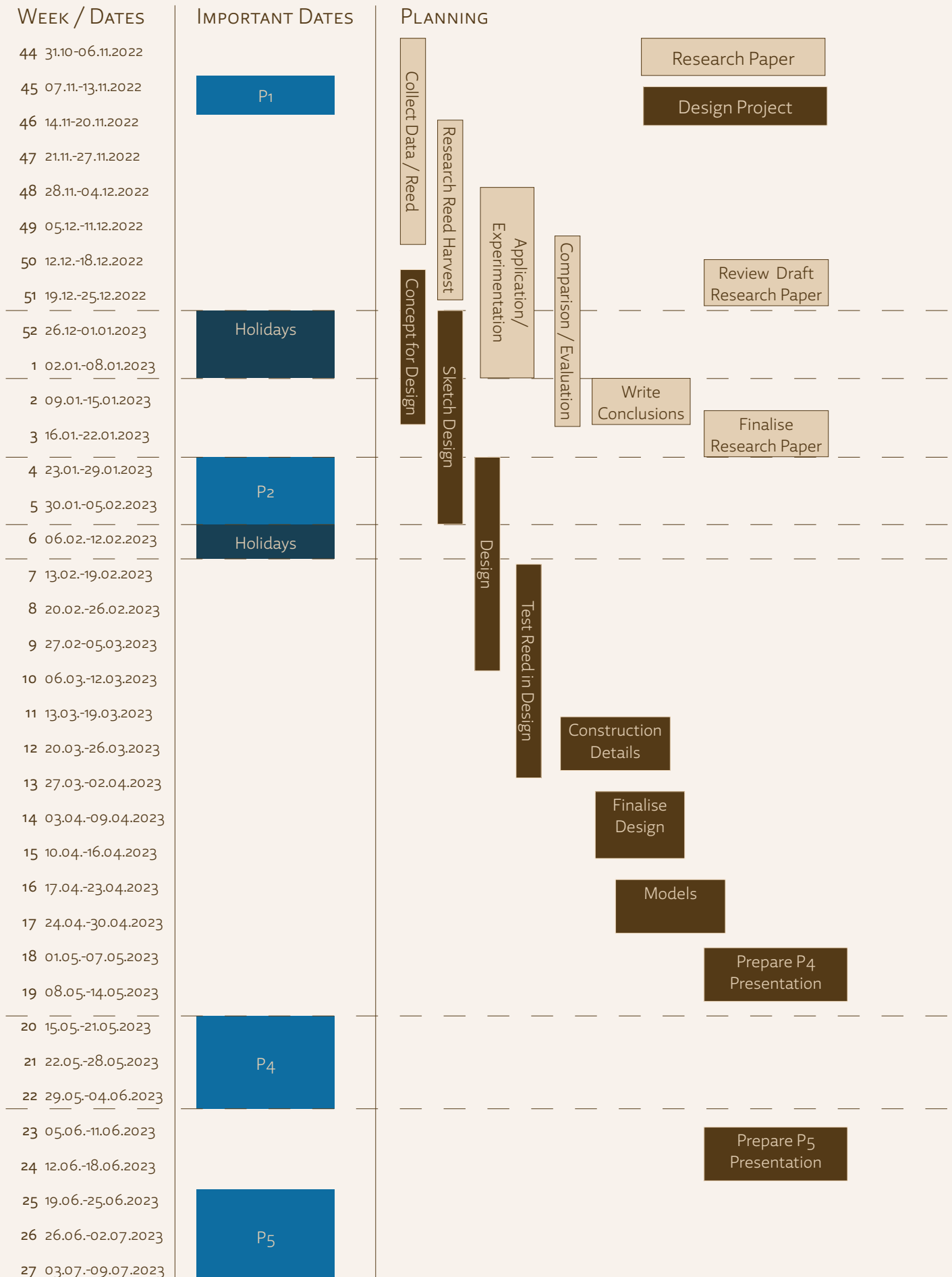
Hypothesis

The combination of an in-depth literature study on several sub-questions and the hands-on prototyping with reed will lead to expertise on reed that can be applied to the design. Traditional reed constructions will add for inspirational input on contemporary design with reed and adds to a thorough research on the history of reed construction. The research aims to implement reed in several building layers of the circular building with regard to the lifecycle of the material. The comparison with other non-renewable construction materials will be of value to argue for the construction with biobased reed. The benchmark is the CO₂ storage in the building and in which layer reed is the most beneficial regarding the circularity of the building.

Relevance

A circular economy is aspired to limit our impact on the environment. As this graduation project focuses on the use of reed that is locally produced and disposed it shows how small the cycle of a building material can be. It is a highly relevant study in the search for alternative building methods. There is a need for new design approaches with a more inclusive design towards nature and the consideration of the whole lifecycle of a building and its materials. Using reed as one of the main construction materials shows what is possible and tests the limits to biobased materials. Not only does the project focus on the material aspect of the design but also the reconnection between people and nature. The exploration of how a community hub in the restored wetland can actively integrate the users in the circularity of the building demonstrates the social benefits of such a circular design approach.

Planning



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The background of the entire page is a photograph of a field of tall, thin grasses, possibly reeds or sedges, in shades of green and yellow. In the center-right, there is a small, upright plant with green, serrated leaves and a cluster of small, light-colored flowers or seed heads at the top.

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