Situation
Plan
1:500

Activity Rooms 77m²
Restroom 14m²
Foyer 34m²
Storage 14m²
Participatory Kitchen 60m²
Dining Hall 75m²
Bikes

Floor Plan
Acitivites Pavilion
1:100

Workshop 84m²
Reed Study 52m²
Breakroom 25m²
Restroom 14m²
Café 78m²

Floor Plan
Nature Pavilion
1:100

Need for Reed

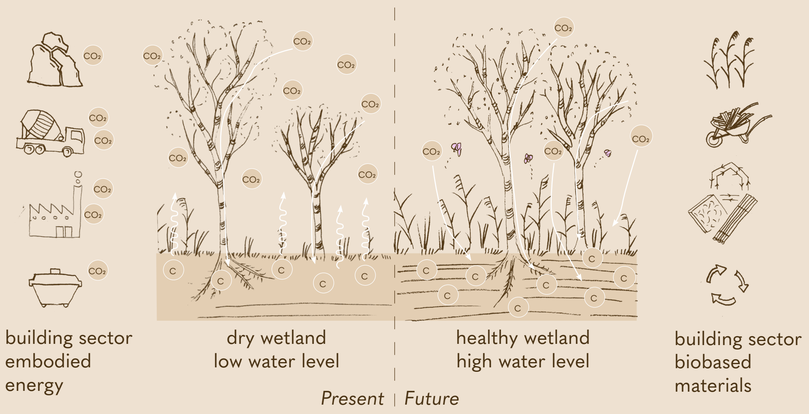
The use of reed as a building material and the benefits of local reed production

Graduation Project East Elevation

The Present and the Future of Reed

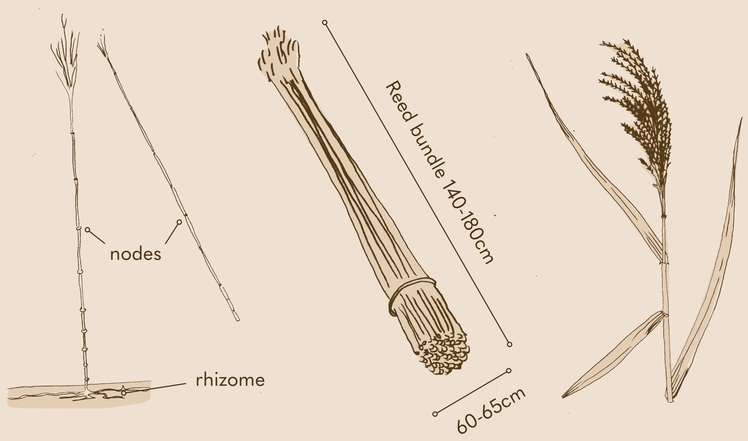
The Netherlands has an extensive history of draining wetlands to create new land for agriculture and settlements. What at that time was considered a harmless creation of new ground led to the disappearance of valuable wetlands. The soggy peat soil can store carbon underground which makes wetlands one of the biggest carbon sinks on earth and an important contributor to the mitigation of climate change. They are also crucial for biodiversity, as habitat for various species and to regulate excessive water. Thanks to the rewetting of the polders in the Netherlands for the creation of healthy wetlands, the potential to grow more wetland crops re-establishes itself, like reed. Currently, the Netherlands imports around 80% of its used reed from abroad. The emissions for such a production chain are enormous and the tradition of local reed harvest gets lost. Locally grown reed can lead to smaller loops, that can be entirely closed or regrown in just one season. This research explores the circularity of the biobased building material reed with the following research question:

How is locally harvested reed applicable to a design considering the whole lifecycle of reed as a plant and as a building material?



Common Reed (Phragmites Australis)

Common reed is a grass-like plan with a height up to 5 m. It grows along river shores, in marshes, and on wetlands all over the world. It can be recognised by its broad leaves and a smooth and hollow stem. The stem is divided with nodes that give it its strength with minium fibre mass. It is waterproof thanks to the woody epidermis as outer layer. As the plant usually grows with its feet in the water, there is no quick mould growth. The roots of the rhizome spread underground so reed can expand several meters per year.



Growth

To understand how reed grows is essential for its further fabrication and application in the built environment. An architect should only consider reed if it grows in the region and value the people that take care of the reedbeds and harvesting. When the layout of a reedbed is provided in a mosaic way with pools and a diverse structure of density for shelter and openness for light birds, fishes, insects, and other species can find a healthy living environment there.

Harvest

In the Netherlands and other European countries, the harvesting season takes place from December to April, while the actual harvesting only happens a couple days per year due to the dry weather conditions needed. Traditionally, reed is cut manually by sickle or scythe, but nowadays modern reed harvesters are in use. The cutting tractors collect all of it and the selection and cleaning process takes place by hand later. This makes reed cutting still a procedure deeply connected to manual labour. It increases the value of the craftsmanship which is a crucial factor of the application of reed.

Manufacture

After the reed has been cut, it gets assembled into bundles. In a storage facility the reed can stay useable for years provided the building has good air circulation. Afterwards the reed can either be used as entire bundle for reed thatches, put together for panels or be cut down. To apply the material in its most efficient way the cascading principle is ideal. From the whole stem as reed thatch to the smallest fibres in biobased insulation boards, reed can be used. This research focuses on the raw material.

Application

Reed as a multifunctional building material has a broad variety of application possibilities. The building elements analysed in this research (with a selection presented on this poster) are reed as load-bearing structure, as partition wall, as roof thatching, as foundation, as insulation, interior finish, or bioenergy. The criteria chosen are the functionality, durability, and circularity of reed for each building element. The decision wether the application of reed is feasible and desirable is closely connected to the previously mentioned criteria. In conclusion, the application is possible in many building layers and stores CO_2 wherever it is put but in some cases other biobased materials are more profitable.

As Load-Bearing Structure

Functionality Flexible and stable, leight weight, build-up easy but connected to manual labour
Durability With protective layer or intererior climate it can last centuries
Circularity Difficult to replace due to its function but possible to take apart if assembled with strips or rope
Discussion Hardly any built examples, to proof capacity more testing and prototyping is necessary. The picture below is from Econstrucció (ES) with Spanish reed.

As Partition Wall

Functionality In combination with a timber frame good and flexible in shape
Durability If not exposed to changing humidity it can last centuries. Protective layer of plaster beneficial
Circularity Easily removable
Discussion Beneficial light weight dividing wall. Examples already found from Hiss Reet (DE).

As Interior Finish

Functionality Pleasant climate, good acoustic qualities, normal flammable
Durability At walls not resistant to damage and dirt, on ceiling better
Circularity Loose material that is biodegradable and can be replaced
Discussion Reed is a good natural sound absorber due to its hollow stems that need to be placed orthogonally to the incoming sound. An example was found at the Floriade Expo 2023 in Almere (NL).

As Insulation

Functionality Reed thatch 350 mm (λ = 0.084 W/mK, R = 4.167 m^2K/W), Reed panel insulation 250mm (λ = 0.065 W/mK, R = 4.0 m^2K/W)
Durability If not exposed to changing humidity it can last centuries. Protective layer of plaster beneficial
Circularity Easily disassembled due to dry connections and ropes/ties/plugs
Discussion Thick wall to achieve good insulation factor. Reed thatch can be combined with a thin additional insulation. The picture shows the insulation panels of Leo Bodner (IT).

Disposal

If the disposal of reed is necessary it can lead to a circular process in nature. Traditionally, left-over reed got spread out in the forest. It would decay and serve as manure for the soil for plants to grow. However, the overregulated process nowadays prevents this. Reed that is not harvested for construction and left behind gets picked up by a heavy vehicle bringing the reed to the nearest compost facility. To use reed as a natural manure for a closed loop of this biobased material, the processes of the harvesting and the natural circularity of the plant need to find their way back into the regulations of reed cutting.

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Title image
East Elevation of Poelpolder Design intervention in Haarlem, NL, drawn by author, May 2023
All graphics drawn by author, May 2023
Images of Application from left to right
'Aula d'Agricologia, Benidoleig' (2016), 12 March. Available at: https://econstruccio.wordpress.com/portfolio/aula-dagricologia-benidoleig/ (Accessed: 12 May 2023).
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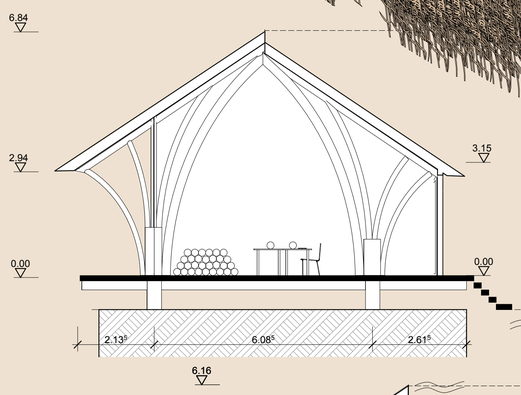
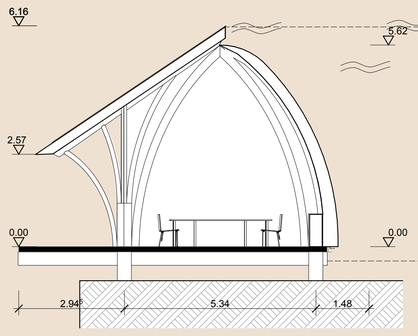
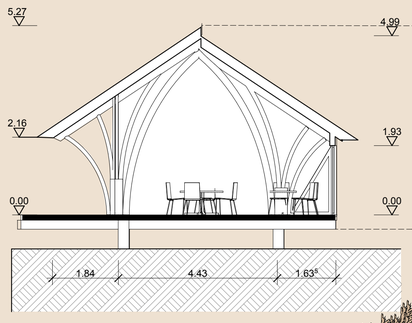
Reed wall in natural pavilion Floriade 2022 Almere, photographed by author, 13 october 2022
Bodner, L. (2023) 'SCHILFROHRPLATTEN', Leobodner. Available at: https://www.leobodner.it/de/produkte/schilfrohrplatten/ (Accessed: 5 January 2023).

Cross Sections
Nature Pavilion
1:100







Long Section Back
Activities Pavilion

Long Section Front
Activities Pavilion

Cross
Section
1:50
(blown up)