RESEARCH PLAN

Architectural Engineering Graduation Studio

Personal Information

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Studio

Name of studio: Architectural Engineering

Design tutor: Mo Smit

Research tutor: Olga Ioannou

Title of Graduation Project

"From Wetlands to Woodlands: A Holistic Approach to Sustainable Construction in Berlin-Brandenburg"

Argumentation for Choice of the Studio

The Architectural Engineering studio provides a research-driven framework that allows for an interdisciplinary approach to material innovation and regenerative design. My research focuses on the integration of paludiculture-based materials and locally harvested Brandenburg timber into public buildings, combining ecological restoration with circular construction strategies and a regional valuechain. By investigating how these materials can be used in new construction, the project aligns with Berlin-Brandenburg's efforts to promote sustainable building practices, CO_2 sequestration through wetland restoration, and regional material cycles. The studio offers the ideal platform to explore this research-by-design approach, where material studies determine architectural solutions.

Keywords

Regional value chain, local harvest, regenerative design, renewable materials

Glossary

Regenerative Design:

- Regenerative design is an approach to architecture and design that aims to create systems that restore, renew, or revitalize their own sources of energy and materials. It emphasizes sustainability and the creation of resilient systems that integrate with natural processes, promoting a harmonious relationship between human activities and the environment. (Tillie, 2025)

Paludiculture:

- Paludiculture refers to the practice of cultivating peatlands for agricultural purposes. It involves growing plants that thrive in wet conditions, such as reeds, sedges, and certain types of grasses. Paludiculture is often promoted as a sustainable alternative to traditional agriculture, as it can help restore degraded wetlands, sequester carbon, and provide renewable resources for the construction industry, where it can be used as cladding and insulation. (wetlands international, 2025)

Peatland:

- Peatlands are a type of wetland characterized by the accumulation of partially decayed organic matter, known as peat. They form in areas where waterlogging slows the decomposition of plant material, leading to the buildup of thick layers of peat over time. Peatlands are crucial for carbon storage, water regulation, and biodiversity. They include ecosystems like bogs, fens, and swamps, and they play a significant role in global climate regulation due to their ability to sequester large amounts of carbon. (Craft, 2022)

Turf:

- Turf refers to the upper layer of soil that is held together by the roots of grasses or other plants. It is often used in landscaping and sports fields to create a smooth, grassy surface. In the context of wetlands, turf can also refer to the dense mat of vegetation and roots that forms in marshy areas, contributing to soil stability and water retention. (european Soildata center)

General Problem Statement

“A key distinction of regenerative design is the recognition and emphasis on the co-evolutionary, partnered relationship between human and natural systems, underscoring the importance of project location and place.” - from "Net-Positive Design and Sustainable Urban Development", Routledge & CRC Press

The current approach of the building industry often views buildings as standalone entities rather than parts of a larger system. (Buckton) However, the climate crisis and increased resource scarcity necessitate a rethinking of architecture through a more interdisciplinary lens. This involves considering where the materials we use originate and understanding their impacts on ecosystems. Instead of letting design dictate the resources we import, we should consider the ecosystems surrounding us and the resources they provide to predetermine our architectural choices. Relinking architecture to its site, and thereby to its surrounding ecosystem, is, in my opinion, a crucial point for the future of the building industry.

Berlin’s identity is deeply linked to its wetlands, with the city's name originating from the Polabian Slavic word for "swamp," refering to the wetlands that once dominated the region. (SWR, Kunze) However, centuries of urbanization and land drainage have severed this connection, leading to significant drought periods, wildfire events, biodiversity loss, soil degradation, and increased CO_2 release. (Material Cultures, 2023)

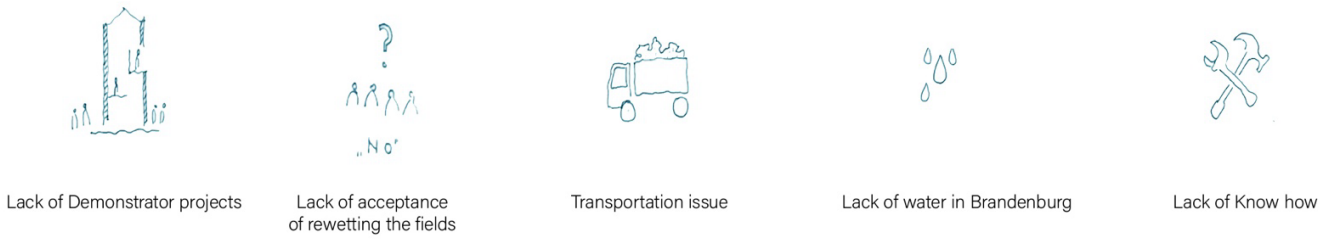
Approximately 93% of these wetlands have been drained, resulting in annual emissions of 7.2 million tons of CO_2 in Brandenburg—more than the total emissions from the region's transport sector (Greifswald Moor Centrum). Despite ambitious goals set by the Moorschutzprogramm to rewet 50,000 hectares of drained peatlands to meet climate targets, progress has been slow, with only 2,000 hectares rewetted to date. (Mooratlas, 2023)

Beyond the CO_2 impact, there is a secondary incentive for peatland regeneration. Brandenburg, known for its timber exports, particularly the regional pine (Märkische Kiefer), faces increasing threats from climate change. Recent droughts have stressed these trees, which are not adapted to extreme heat, and predictions of even drier and hotter summers underscore the urgent need to restore the region's heritage ecosystem. Although the process of Waldumbau –transforming areas from pine to more robust mixed forests with species such as beech began almost 20 years ago, the majority of forest is still monocultural pine. (NBL, TU Berlin) Rewetting landscapes can enhance drought resilience, making them more resistant to future extreme weather events.

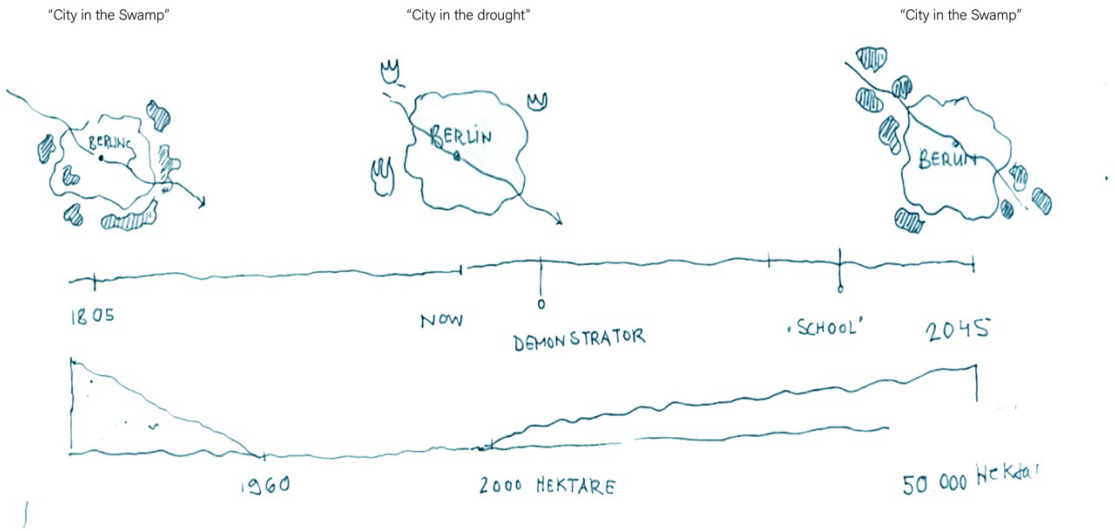
Both wetlands and forests are valuable sources of building materials and can create a symbiotic regional value chain of renewable resources for Berlin-Brandenburg's building industry. Paludiculture offers potential for insulation and cladding products; however, it currently lacks incentives and demonstrator projects to prove its feasibility and motivate farmers to rewet their fields. (Material Cultures, 2023)

In my initial literature analysis I have identified several bottlenecks in establishing paludiculture as a resource in the surrounding areas:

- **Transportation network :** Efficiently moving harvested crops to processing and construction sites.
- **Water Availability:** Ensuring sufficient water for rewetting fields.
- **Lack of acceptance and refusal of local communities, employed in agriculture**
- **Lack of Know-How and Craftsmanship:** lost craftsmanship networks and knowledge throughout the region.
- **Lack of Demonstrator Projects:** The absence of community-engaging projects that showcase the feasibility and benefits of paludiculture.



Thematic Research Objective



Sketch of potential mapping timeline

By tracing the evolution of these wetlands over the last two centuries, the impact of human activities becomes evident. The focus will be on developing a rewetting strategy along the waterways leading into Berlin, with the River Spree serving as the primary focus for research and mapping. The maps will focus on the River Spree as a case study and because it can work as

a supply artery for Berlin and the surrounding areas, as well as providing water to re-wet the fields and serve as a transport route for harvested crops to factories. This will focus the mapping process and create a more feasible workload for MSc 3.

The resulting map will serve as a strategic tool for planning, site identification, and resource management, creating a network for future building resources.

Based on the mapping and gained knowledge of the investigation through site visits of wetlands surrounding Berlin the research phase is also driven by designing a low-tech, small-scale building, to test first theories.

Key Components:

- **Foundations on Wetlands:** Focus on foundation techniques suitable for wetland environments.
- **Sacrificial Envelope Design:** Implement a design where the building envelope is periodically replaced, allowing for continuous experimentation and adaptation.
- **Integration of Wetland Regeneration:** Incorporate wetland regeneration strategies into the spatial and material logic of public building design, such as stilted construction and water-based landscape strategies.

The idea is to design in a way that the building can be constructed by the community, with a façade that is replaced annually with new materials, inspired by the "Zagata"[1] approach, based on resources harvested from the surrounding ecosystem.

Thematic Research Question(s) / thematic research hypothesis

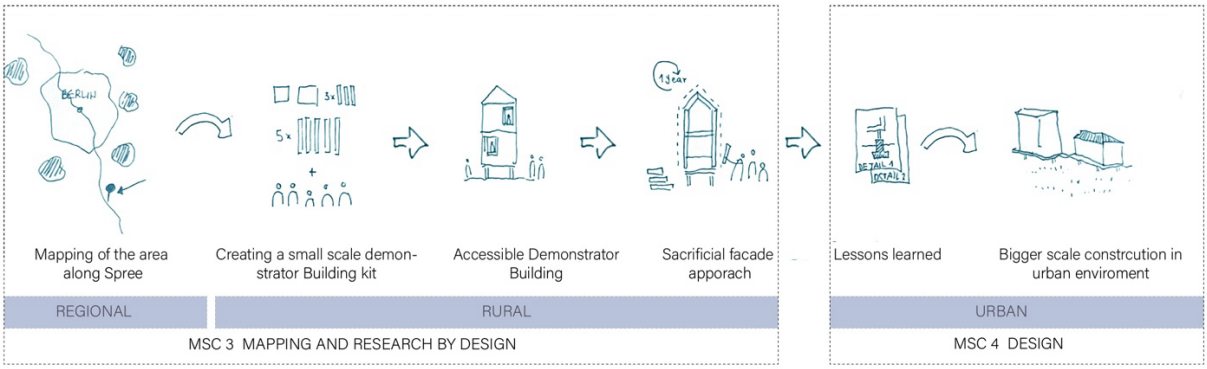
“How could we facilitate the integration of the Paludi-culture Materials and local timber into the construction industry?”

Supporting Sub-Questions:

1. **Material Research:** What are the structural, thermal, and acoustic properties of paludiculture-based materials? (How much info can I find?)
2. **Timeline development and Harvest Mapping:** Where can we find the drained Peatlands and how did they develop throughout the centuries? (Mapping)
3. **CO_2 Impact (case study impact):** How can architecture contribute to wetland restoration as a climate mitigation strategy? (Calculations)

[1] “Winterfacades”, found in Poland and northern germany: Sacrificial layers of additional insulation and protection that could be easily repaired or replaced -sometimes removed fully in Spring (Brorson,2025)

4. **Construction Typologies:** What building methods (e.g., stilted, prefabricated, modular, functional rewetting mechanism) are most effective for wetland-integrated architecture?
5. **Knowledge Transfer:** How can we use the act of making as a tool to educate about the landscape and material?



Reflection on the relevance

The act of making—engaging rural communities in the process of creating and building with these materials—can foster interest and acceptance of new agricultural techniques, while also cultivating a deeper relationship with the surrounding ecosystems. The adaptable small scale building kit, designed to be constructed with schools and local stakeholders, can serve as a tangible demonstration of these principles. This approach not only educates but also actively involves the community in the sustainable transformation of their environment, highlighting the relevance and urgency of this research in addressing contemporary ecological challenges.

Currently, the only existing case study by Material Cultures explores paludiculture in a rural setting. By researching and mapping the link between Berlin Brandenburg's heritage and its surrounding wetlands, this project aims to demonstrate the feasibility and benefits of integrating paludiculture material into the urban construction industry of Berlin.

Thematic Research Methodology

Mapping, Literature, Sitevisit, Casestudies, Research by design

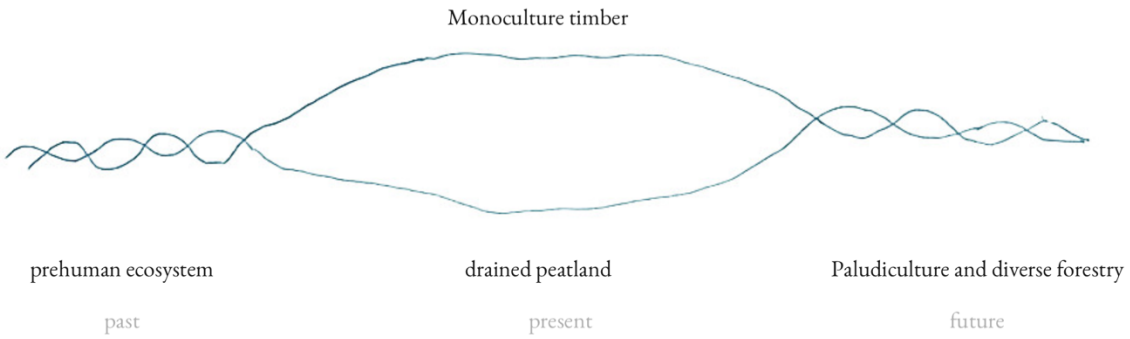
The approach for this project will blend historical and geographical analysis with material evaluation and research by design exploration. It begins with developing a timeline that illustrates the historical drainage, current state, and future prognosis of wetlands around Berlin. This involves examining archival maps, such as Schmettau's Kartenwerk, and geological maps to trace the evolution of these landscapes. Additionally, maps will be created to show the historical

changes in wetlands over time and to identify potential sites for rewetting and paludiculture, utilizing GSI data on trees, peatlands, and turf depth.

A schematic assessment of the quantity of available paludiculture materials in the region will be conducted, along with an evaluation of their CO_2 sequestration potential to understand their environmental benefits. The research-by-design phase will involve designing a small-scale demonstrator project, such as an exhibition tower, using paludiculture materials.

Existing experiments with paludiculture materials, such as the Greifswald Moor Centrum Tiny House, will be examined, and relevant sites like the swamp center will be visited to gather insights and data on material performance and construction techniques. The theoretical background of the project will draw on the principles of regenerative design, emphasizing the co-evolutionary relationship between human and natural systems. It will also utilize the concept of Open Building to create adaptable and user-centric architectural solutions and apply the shearing layer concept to design buildings with a permanent load-bearing structure and adaptable, replaceable building envelopes, ensuring longevity and sustainability.

Overall Design Objective [± 300 words]



Intertwining the two regional resources—wood and paludiculture—into construction techniques fosters a symbiosis between the construction industry, agriculture, and ecosystems.

Applying the lessons learned from the small-scale demonstrator project from the research phase to a larger-scale public building design in an urban context in Berlin at Koepernicker strasse 14., Freidrichshain, the last innercity plot with a natural shoreline of the river spree, and a former peatland. (this still needs to be proven through further research) This phase aims to prove the applicability of these materials for larger structures calculating material needs and adapting to the functionality requirements of a public building. The building is designed to be multifunctional and open, (stilted above a regenerated wetland landscape) in an urban environment. This project proposes a research-by-design approach, investigating how locally sourced paludiculture-based materials and Brandenburg timber can be applied in new low-tech construction. The design

follows the shearing layer concept, using timber as a load-bearing structure and the building envelope made from paludiculture materials.

The proposed program is an educational one—a school that will not only be built using these materials but will also serve as an educational hub. This hub will teach craftsmanship techniques for sustainable construction using timber and paludiculture materials, however, it should also cater to the surrounding quarter as a meeting point.

Overall design question / design hypothesis

"How can a Timber & Craftsmanship School in Berlin (built on a rewetted wetland) integrate locally harvested Brandenburg timber and paludi-culture materials to develop a new building approach that strengthens the connection between built structures and their surrounding ecosystems?"

Reflection on the relevance

“Innovative, publicly accessible demonstrator buildings would not only showcase the feasibility of paludiculture materials but also contribute to the development of a new architectural vernacular rooted in circular and biobased principles.”

-Material Cultures in their wetland report

Currently, there are no major projects utilizing paludiculture materials, (Material cultures, 2023) presenting an opportunity to prove their viability for future construction. Using these materials in buildings with a public and somewhat representable function makes the ecosystem a tangible element in the construction industry. The social component is equally significant; much of the wood harvested in Brandenburg is exported due to a lack of local craftsmanship culture, unlike in southern Germany.(NBL Berlin) During the GDR era, restrictions on self-employment led to the closure of many small craft workshops or their absorption into larger state-owned cooperatives, resulting in the loss of traditional craftsmanship knowledge. Consequently, this knowledge was not passed on to the next generation. (Schmidt, 2014)

By establishing a school of craftsmanship that leverages Brandenburg's most important resource—wood—in combination with paludiculture harvest, this initiative would be a necessary and valuable addition to the region. It could revive traditional skills, foster innovation, and create a sustainable model for future construction practices.

Expected results of thematic research and design implementation

Problem Statement

Lack of Demonstrator projects

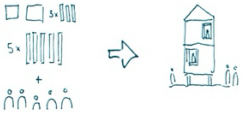
Lack of acceptance of rewetting the fields

Transportation issue

Lack of water in Brandenburg

Lack of Know how

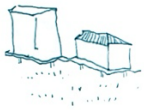
Expected result and design implementation



Creating a small scale demonstrator Building kit

Transportation via boat

Primarily rewetting fields next to river Spree



School building

For a deeper understanding during the research phase I will schematically map the evolution of wetlands over centuries (Map from 1805, 1874, 1962, 2007, 2021) offering a historical perspective on the impact of human activities on these ecosystems. This mapping will provide a conclusive overview of the ecosystems surrounding the site, allowing for a regenerative design approach that respects and integrates natural processes. By intertwining historical insights with regenerative design, the project seeks to create architectural solutions that are both contextually appropriate and environmentally responsible.

The primary outcome will be a schematic mapping of the forests and the drained peatlandssurrounding the river Spree flowing into Berlin, highlighting their potential to serve as networks for material production.

Based on the mapping results I will pick a site for the design Project in MSC 4 and for the MSC 3 research by design created instruction manual of a small-scale, low-tech demonstrator on the site of the case study. This demonstrator will serve as a testing ground for building envelopes and foundation techniques specifically adapted for structures placed on peatlands. The insights gained from this phase will be instrumental in refining designs for larger-scale applications, ensuring that the principles of regenerative design are effectively translated into practical construction methods.

A key outcome will be the development of a public building, using the paudiculture in combination with local timber. This model will demonstrate how architecture can actively contribute to wetland restoration by utilizing materials that enhance carbon sequestration and support ecological health. The design of these buildings will emphasize material circularity and regenerative principles.

In summary, the thematic research and design implementation aim to foster a symbiotic relationship between architecture and ecosystems, utilizing local resources to create sustainable, resilient, and ecologically beneficial buildings.

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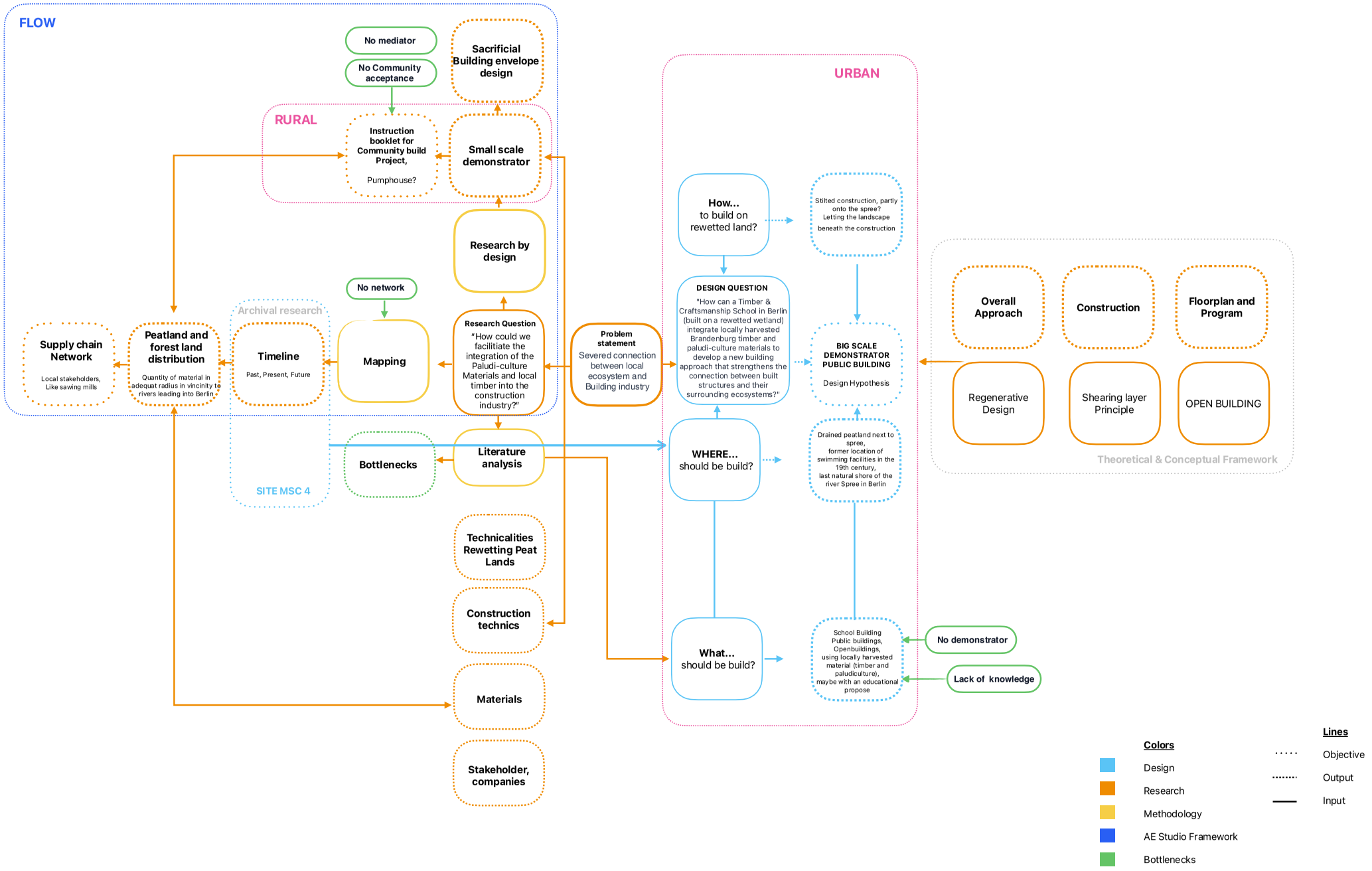
Appendix:
Research diagram and Planing


FLOW
No mediator
No Community acceptance
Sacrificial Building envelope design
RURAL
Instruction booklet for Community build Project,
Pumphouse?
Small scale demonstrator
Research by design
No network
Archival research
Supply chain Network
Local stakeholders, Like sawing mills
Peatland and forest land distribution
Quantity of material in adequat radius in vincinity to rivers leading into Berlin
Timeline
Past, Present, Future
Mapping
Research Question
"How could we facilitiate the integration of the Paludi-culture Materials and local timber into the construction industry?"
Problem statement
Severed connection between local ecosystem and Building industry
Bottlenecks
Literature analysis
SITE MSC 4
Technicalities Rewetting Peat Lands
Construction technics
Materials
Stakeholder, companies
URBAN
How... to build on rewetted land?
Stilted construction, partly onto the spree? Letting the landscape beneath the construction
DESIGN QUESTION
"How can a Timber & Craftsmanship School in Berlin (built on a rewetted wetland) integrate locally harvested Brandenburg timber and paludi-culture materials to develop a new building approach that strengthens the connection between built structures and their surrounding ecosystems?"
BIG SCALE DEMONSTRATOR PUBLIC BUILDING
Design Hypothesis
WHERE... should be build?
Drained peatland next to spree, former location of swimming facilities in the 19th century, last natural shore of the river Spree in Berlin
What... should be build?
School Building Public buildings, Openbuildings, using locally harvested material (timber and paludiculture), maybe with an educational propose
No demonstrator
Lack of knowledge
Overall Approach
Construction
Floorplan and Program
Regenerative Design
Shearing layer Principle
OPEN BUILDING
Theoretical & Conceptual Framework
Colors
Design
Research
Methodology
AE Studio Framework
Bottlenecks
Lines
Objective
Output
Input

PLANNING

Week		Important Dates	Planning
6			
7	3.1		
8	3.2.		
9	3.3.		
10	3.4.		
11	3.5.		
12	3.6.		
13	3.7.		
14	3.8.		
15	3.9.		
16	3.10	P 1	
17	4.1.	Application for P2	Site visit
18	4.2.		
19	4.3.		
20	4.4.		Casestudy visit
21	4.5.		Research Paper Draft
22	4.6.		
23	4.7.		Finalise Research Paper
24	4.8.	P 2	
25	4.9.		
26	4.10.		
27	5.1.		
		Summer Break	
36	1.1.		
37	1.2		
38	1.3		
39	1.4		
40	1.5		
41	1.6.		
42	1.7.		
43	1.8.	Application for P4	
44	1.9.	P3	
45	1.10		
46	2.1		
47	2.2		
48	2.3		
49	2.4		
50	2.5	P4	
51	2.6		
52		Christmas Break	
1			
2	2.7		
3	2.8	P5	
4	2.9		
5	2.10		
6			