Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Zhaolei Li
Student number	5593603

Studio		
Name / Theme	Water crisis and hope	
Main mentor	Dr. L. (Laura) Cipriani	Architecture and the Built Environment
Second mentor	Dr. Ir. B.C. (Bram) van Prooijen	Hydraulic Engineering
Argumentation of choice of the studio	The Wadden Sea is the largest intertidal area in the world, where the power and charm of nature can be felt, while the history of the local people who have lived here and fought with the sea for the past thousand years has left a precious cultural memory. I was fascinated by both. However, the Wadden Sea is in crisis, both naturally and culturally, and I want to explore how this crisis can be transformed into a possibility by means of the landscape.	

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Graduation project	
Title of the graduation project	Soft Estuary: Mud as Adaptation and Mitigation
Goal	
Location:	Ems-Dollard estuary, Netherlands, Germany
The posed problem	• Ecology: The Ems estuaries constitute the part of the Wadden Sea with the worst ecological condition. Compared to the other two estuaries of the Wadden sea, where the tidal flats mainly consist of fine sand, in the Ems-Dollard estuary, the mud content is relatively high(typical mud content is >70%). The river Ems is presently negatively indicated as the "yellow river" of Europe. Industrial development along estuaries, including the deepening of waterways and bunding of river banks, has resulted in major changes in morphology, hydrology, flora, and fauna, for example, the loss of brackish and freshwater marshes. What's more, there is a conflict between the creation of a good ecological environment and the further deepening of

	the waterway. • Natural disasters and climatic extremes: sea level rise, flooding, land subsidence behind dykes, and salinization continue to threaten the area, as the requirement for higher dykes, and the transformation of agricultural cultivation, all at a very high economic and labor cost. • Culture & Memory: The natural heritage status makes people overlook the cultural value of the area. Also, the economic situation here is not as good and recreation is not as attractive as on other islands.
research questions	How can the area use mud to become more resilient, functional, ecological, dynamic, and rich in cultural memory? **1. Understanding questions**: 1.1. What are the main crises facing the Wadden Sea region? 1.2. What are the mud landscapes and practices in the context of the Wadden sea? **2. Application questions** 2.1 Ecology: 1) What role does mud play in the ecology of the estuary?What function does it serve? 2) What is the ecological potential of mud and according to what principles can it be used to promote ecology? 2.2. Climate extremes 1) What can be the coping potential of mud in extreme climatic conditions? Is it possible that the mud suspended in the river could be compensation for land subsidence? Is it possible to collect mud as a material for strengthening dykes? 2.3.Identity & Culture 1) How have people lived with and used mud in the history of the region? 2) What is the cultural potential of the mud? Is it possible to use this material to enhance the sense of place? 3) How to translate ancient cultures, legends, and literature into a tangible, material landscape that can fit well into a new reality of global tourism as well as the need in modern humans for a vague, mythical past? **3. Reflection questions:** 3.1. What are the limitations of the mud and what further research and practice are required for the Wadden sea? 3.2. What other landscape elements need to be drawn upon to help shape the mudscape of the Wadden Sea? 3.3. How does the mud landscape system work, how much manual maintenance is required and how long can it be effective

	for?
design assignment in which these results.	1. Context analysis: to learn about relevant geography and ecology, understand the mechanisms by which landscape systems operate; understand the main crisis of the Wadden sea, and explore my fascination. 2. Territorial strategy planning: Propose design principles, presenting an integrated strategy on a large scale, shown through the master plans and diagrams. 3. Regional design: Select areas around the Ems estuary for the design, shown through the master plans, diagrams, sections, and drawings related to the time process. 4. Local scale detailed design: Further selection of one or two specific sites, with specific spatial shaping, and use of materials (mud), shown through master plans, sections, perspective drawings, detailed drawings, and 3D models.

1. Mud as climate adaptation

Mud as subsidence compensation.

Mud as material to create double dike (for aquaculture).

Multi-layers of salt marsh as flood defense & buffer.

2. Mud as ecology enhancement

Mud aggregation to reduce river turbidity (only helpful, but not decisive).

Mud aggregation (create shallows) as mussel bed, bird mound, salt marsh.

Reconnection of old rivers.

Exiting salt marsh protection (by grazing and …).

3. Mud as a socio-economy booster

Mud processing to improve agricultural soils (by mud factory or mud park).

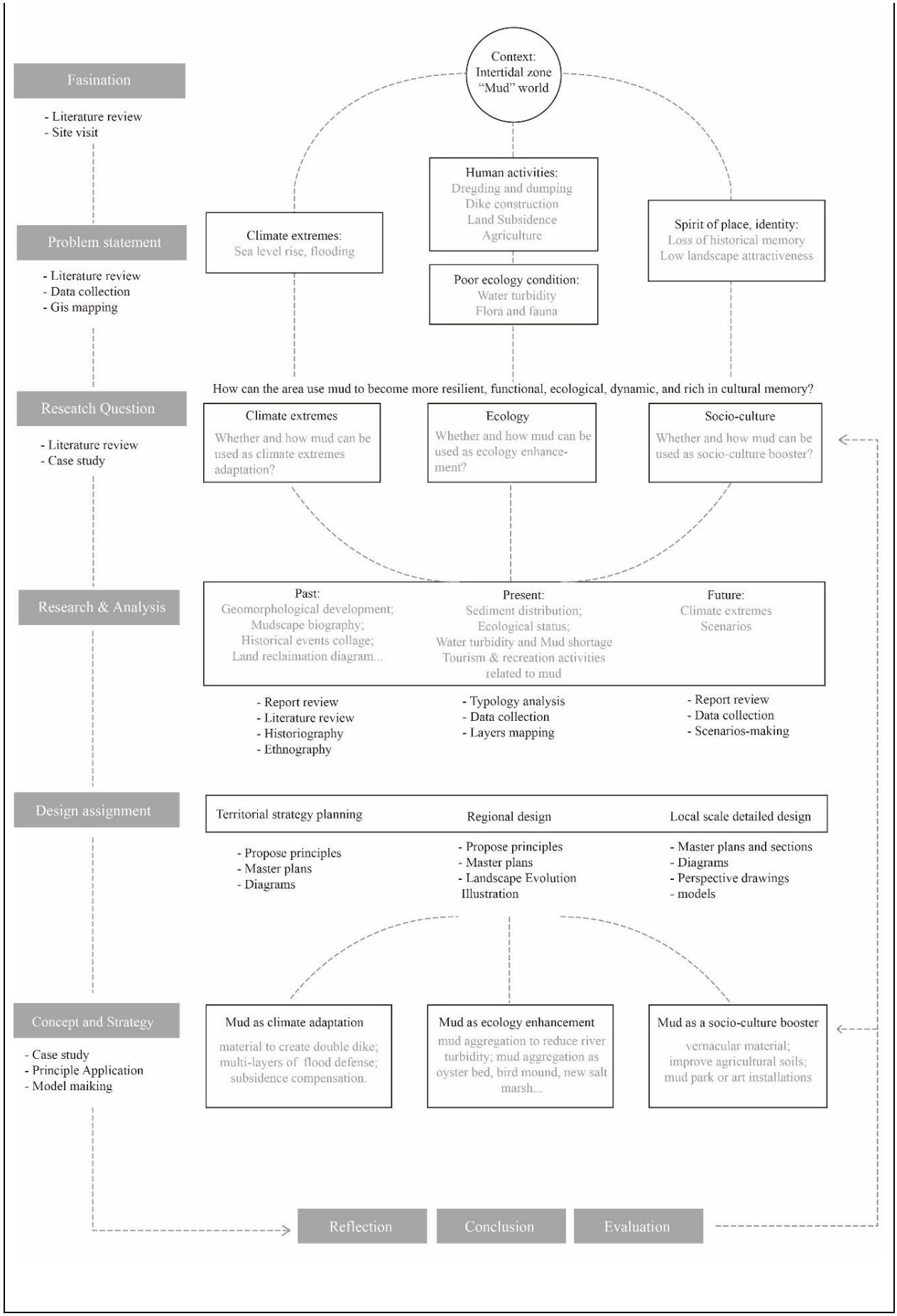
Mud as material for ceramic handicrafts.

Recreation value enhancement (recreation node design).

Experiential landscapes (rework with old dikes and mud, artworks, or special space design).

Process

Method description


Fasination
- Literature review
- Site visit
Problem statement
- Literature review
- Data collection
- Gis mapping
Reseatch Question
- Literature review
- Case study
Research & Analysis
Design assignment
Concept and Strategy
- Case study
- Principle Application
- Model maiking
Context:
Intertidal zone
"Mud" world
Human activities:
Dregding and dumping
Dike construction
Land Subsidence
Agriculture
Climate extremes:
Sea level rise, flooding
Poor ecology condition:
Water turbidity
Flora and fauna
Spirit of place, identity:
Loss of historical memory
Low landscape attractiveness
How can the area use mud to become more resilient, functional, ecological, dynamic, and rich in cultural memory?
Climate extremes
Whether and how mud can be used as climate extremes adaptation?
Ecology
Whether and how mud can be used as ecology enhance-ment?
Socio-culture
Whether and how mud can be used as socio-culture booster?
Past:
Geomorphological development;
Mudscape biography;
Historical events collage;
Land reclaimation diagram...
Present:
Sediment distribution;
Ecological status;
Water turbidity and Mud shortage
Tourism & recreation activities related to mud
Future:
Climate extremes
Scenarios
- Report review
- Literature review
- Historiography
- Ethnography
- Typology analysis
- Data collection
- Layers mapping
- Report review
- Data collection
- Scenarios-making
Territorial strategy planning
Regional design
Local scale detailed design
- Propose principles
- Master plans
- Diagrams
- Propose principles
- Master plans
- Landscape Evolution Illustration
- Master plans and sections
- Diagrams
- Perspective drawings
- models
Mud as climate adaptation
material to create double dike; multi-layers of flood defense; subsidence compensation.
Mud as ecology enhancement
mud aggregation to reduce river turbidity; mud aggregation as oyster bed, bird mound, new salt marsh...
Mud as a socio-culture booster
vernacular material; improve agricultural soils; mud park or art installations
Reflection
Conclusion
Evaluation

1. Research for Design

1.1. Description of the main crisis: (to answer question 1: what are the main crises of the Wadden sea region?)

- Secondary description and interpretation:Creating "Mud Biography" through the study of historical maps and texts, exploring the relationship between humans and mud, humans and nature, and their evolution. Through a series of geomorphological evolution maps, a collage of timelines and historical events, and ethnography.
- Observation: Sensing landscape qualities and identifying spatial issues through the site visit,
- Evaluation and diagnosis: through current data collection, literature review, GIS analysis and mapping, etc.
- Site visit:
- Integrating the main crisis through the above process.

2. Research about Design

- Case study: Figure out specific solutions and landscape potentials to the current crisis; to answer the question: how to use mud as climate and ecology mitigation & adaptation, social and economy booster. By diagram drawing.
- Literature review: Figure out specific solutions and landscape potentials to the current crisis; learn about the landscape potential of mud and how it can be used through literature and reports. By diagram drawing, and listing principles.

3. Design as Research

- Explore how to use the principles explored above and how to combine them with real spaces.
- Design Projection: Forming a new design, to create new spaces with possibilities for resilience, ecology, sustainable development, and genius loci. Through sketching, 3D modeling, mapping in different layers, etc.
- Interpretation: through perspective drawing, master plan, sections, diagrams, etc.

Literature and general practical reference

Main Literature (theories or research data) :

1. Mudscape:

Oost, A., Alonso, A. Colina, Esselink, P., Wang, Z., van Kessel, T., & van Maren, B. (2021). where mud matters: Towards a Mud Balance for the Trilateral Wadden Sea Area: Mud supply, transport and deposition. In https://www.waddenacademie.nl/en/organisation/publications-list/eng/where-mud-matters (No. 978-94-90289-57–7). Wadden Academy.

Mud in the past, present, and future. (2020). In https://rijkewaddenzee.nl/wp-content/uploads/2020/12/1-Concept-Mud-Past-Present-and-Future-1.pdf. Programma naar een Rijke Waddenzee.

Firet, M., Oterdoom, T., Pot, P., Braaksma, J., Harden, D., Subic, M., & Desoy, F. (2020). Exploratory design study binnendijks toepassen Havenslib Harlingen. Programma naar een Rijke Waddenzee. https://rijkewaddenzee.nl/nieuws/havenslib-harlingen-inspiratie/

Wang, Z. B., Elias, E. P., van der Spek, A. J., & Lodder, Q. J. (2018). Sediment budget and morphological development of the Dutch Wadden Sea: impact of accelerated sea-level rise and

subsidence until 2100. Netherlands Journal of Geosciences, 97(3), 183–214. https://doi.org/10.1017/njg.2018.8

2. Climate extremes

Pauw, P., de Louw, P., & Essink, G. O. (2012). Groundwater salinisation in the Wadden Sea area of the Netherlands: quantifying the effects of climate change, sea-level rise and anthropogenic interferences. Netherlands Journal of Geosciences - Geologie En Mijnbouw, 91(3), 373–383. https://doi.org/10.1017/s0016774600000500

Oost P., Hofstede J., Weisse R., Baart F., Janssen G. & Zijlstra R. (2017) Climate change. In: Wadden Sea Quality Status Report 2017. Eds.: Kloepper S. et al., Common Wadden Sea Secretariat, Wilhelmshaven, Germany. Last updated 21.12.2017. Downloaded 20.09.2022. qsr.waddensea-worldheritage.org/reports/climate-change

3. Ecology

Bos, Daan & Büttger, Heike & Esselink, Peter & Jager, Z. & Jonge, Victor N. & Kruckenberg, Helmut & Maren, D.s & Schuchardt, Bastian. (2012). The ecological state of the Ems estuary and options for restoration.

Unger B., Baltzer J., Brackmann J., Brasseur S., Brügmann M., Diederichs B., Galatius A., Geelhoed S.C.V , Huus Petersen H., IJsseldijk L.L., Jensen T. K., Jess A., Nachtsheim D., Philipp C., Scheidat M., Schop J., Siebert U., Teilmann J., Thøstesen C.B., van Neer A. (2022) Marine mammals. In: Wadden Sea Quality Status Report. Eds.: Kloepper S. et al., Common Wadden Sea Secretariat, Wilhelmshaven, Germany. Last updated: 06.09.2022. Downloaded 29.11.2022. qsr.waddensea-worldheritage.org/reports/marine-mammals

Giebels, D., van Buuren, A., & Edelenbos, J. (2013). Ecosystem-based management in the Wadden Sea: Principles for the governance of knowledge. Journal of Sea Research, 82, 176–187. https://doi.org/10.1016/j.seares.2012.11.002

Prop, J., Ubels, R., Oudman, L., Gerdes, L., Wolters, E., & De Boer, H. (2012). Wadvogels in de Dollard : Herstel van aantallen of aantasting van een natuurlijk systeem? Limosa, 85(1).

4. Culture & Memory:

Egberts, Linde & Schroor, Meindert (eds.), Waddenland Outstanding: The History, Landscape and Cultural Heritage of the Wadden Sea Region. Amsterdam: Amsterdam University Press, 2018 doi: 10.5117/9789462986602/ch22

Schaapman, J., Jukema, N. Rixt, & Wagenaar, T. (2022). Dagen har øjne, natten har ører: Om den kulturhistoriske værdi af mørket. Programma naar een Rijke Waddenzee. https://rijkewaddenzee.nl/wp-content/uploads/2022/08/Dagen-har-ojne-natten-har-orer-Danish.pdf

5. Ems-Dollard Estuary:

Hein Sas. (2019). Answers to knowledge questions for the Eems- Dollard 2050 programme. In https://rijkewaddenzee.nl/wp-content/uploads/2019/06/Rapport-2895_Antwoorden-op-kennisvragen.pdf. Programma naar een Rijke Waddenzee.

Talke, S. A, & de Swart, H. E. (2006). Hydrodynamics and morphology in the Ems/Dollard estuary: review of models, measurements, scientific literature and the effects of changing conditions. UU PHYS IMAU Marine and Atmospheric Research. https://dspace.library.uu.nl/handle/1874/42826

Vos, P., & Knol, E. (2015). Holocene landscape reconstruction of the Wadden Sea area between Marsdiep and Weser. Netherlands Journal of Geosciences - Geologie En Mijnbouw, 94(2), 157–183. https://doi.org/10.1017/njg.2015.4

General practical experience/precedent:

1. Goes soft: Dredge Locked,2012. To learn the treatment of dredged material and the process of remediation.

2. Dredge Landscape Park, 2017. To learn how the Landscape infrastructure works for cleaning polluted dredges.

3. Design with Dredge: Resilient Landscape Infrastructure in the Chesapeake Bay,2018. Learn to recast and restore urban sediment as an essential component of resilient urban infrastructures.

4. Indoor dike application harbor sludge Harlingen, 2020. How to use sludge as an engine for regional and local developments, and how applying sludge can enhance regional identity.

Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

My graduation project is a sub-project of the studio, which is about the crisis and hope of the Wadden Sea, and my graduation project is about ＂Mud as a crisis response strategy for estuarine landscapes＂.

After exploring the general crisis of the Wadden Sea, I found the Ems estuary and the mud as an initial point of entry and then studied the great potential of the mud, the ecology of the estuary, and so on. Therefore I want to use the theme of mud as a means of responding to the various aspects of the crisis, such as the extreme climate crisis, the ecological crisis caused by human activity, and the shaping of a sense of place and historical memory.

The climate extremes are a crisis for the entire Wadden Sea region, the estuary ecology is an important part of the Wadden Sea ecosystem, and the sense of place and historical memory is a cultural commonality of the Wadden land, all three of which are closely related to the theme of the studio.

My graduation project is also a response to my master's program, I will apply the four perspectives that I have learned throughout the master's program.

- Landscape scale continuum: from territory scale to regional scale to location scale, the continuum has helped me to better understand the workings and major crises of landscape systems and to switch between scales and reflect on design.
- Landscape Palimpsest & Perceiving Space: through learning about the history, building a landscape biography and experiencing the site first hand, I have become more aware of the cultural landscape of the Wadden Sea region and have been inspired by the local atmosphere, while 'mud as the shaping of the spirit of place and the preservation of historical memory' echoes this theme.
- Landscape Process: The resilience and variability of the landscape echoes the landscape process, where ecological processes and maintenance will continue to

take place and where people and nature are constantly interacting, therefore the need for a resilient landscape in the face of crisis and an open landscape process is important.

2. What is the relevance of your graduation work in the larger social, professional, and scientific framework?

On a larger social level, this graduation project aims to enhance the landscape character of the entire Wadden area, thereby deepening the emotional attachment of residents and visitors to the place and promoting economic development wherever possible. The mud has not only a historical and cultural value but also a potential economic value, for example, people used to make bricks and handicrafts from it and then trade them; nowadays people hike on the mud flats ..... It's important to balance the protection of the natural heritage with the neglect of the cultural heritage and to diversify tourism. Preserving the cultural memory and identity of the inhabitants such as Frisians.

For the discipline of landscape, this graduation project aims to explore the landscape potential of mud. Mud is an important element of the landscape, just like trees and water. While it is common enough to use water or plants to shape space and to design systematically, mud has received less attention and 'Mudscape' is an interesting topic. And since the natural accumulation and formation of mud is a long process, the dredging of mud in rivers requires human and material resources and continuous maintenance, and it is a challenge to design this landscape system in a way that makes it more efficient.

On a scientific level, this graduation project aims to provide a crisis response. Many regions are faced with rising sea levels, flood crises, the development of shipping industries, deepening waterways and turbid water bodies, where ecological conservation and economic development are in conflict. This project, on the other hand, is a reconciler of ecology and economy, extracting the key role of mud and investigating how it can be turned from a pollutant unearthed in the process of economic development into a new ecological enabler, for example by being reused for agricultural farming or flood control infrastructure, how to collect suspended mud and how to create oyster beds and salt marshes from mud are important techniques, etc.