

# GRADUATION PLAN

Master of Science Architecture, Urbanism & Building Sciences

Aphitchaya Wongnitchakul (Min)  
Student number : 5245265

Design tutor: Thomas Offermans  
Building technology tutor: Pierre Jennen  
Research tutor: Luca Iuorio  
The Delegate examiner: Hugo Legoux

## THE LIVING BARRIER

The architectural adaptation of existing flood barriers on Zeeland's biodiversity synergy.

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AR3AE100 | aE Graduation Studio | 2022-2023

## Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (**Examcommissie-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** Aphitchaya Wongnitchakul (Min)  
**Student number** 5245265

### Studio

**Name / Theme** Architectural engineering / Second life  
**Main mentor** Thomas Offermans Architecture  
**Second mentor** Pierre Jennen Building technology  
**Third mentor** Luca Luorio Research (Urbanism)  
**The Delegate examiner** Hugo Legoux Geomatics Engineering

#### Argumentation of choice of the studio

The architectural engineering graduation studio is one of the most practical studios and simultaneously provides freedom of imagination, allowing the master's student to develop their fascination, techniques, and methodology. With all these opportunities and my passion for the impact of megastructures and biodiversity, the architectural engineering studio would be the best answer. Moreover, the related studio themes, such as "Harvest and Second Life," allow the research investigation to include not only architecture but also landscape and specific construction methods.

### Graduation project

**Title of the graduation project** The Living Barrier  
The architectural adaptation of existing flood barriers on Zeeland's biodiversity synergy.

### Goal

**Location** Zeeland, The Netherlands  
**The posed problem,** Sea level rise, Future adaptation of The Delta works, Biodiversity impact After the construction.

In the era of rapid environmental transformation and the impact of Sea level rise, it is undeniable that designs and construction on both new and current projects demand greater adaptability and flexibility. Especially the flood defense systems' design in Zeeland coastal areas still requires more adaptability concerning the increasing seawater. According to the IPCC announcement in August 2021, the acceleration of the sea level rise will be faster than the Delta Scenarios (Climate Change 2022: Impacts, Adaptation, and Vulnerability, n.d.) Another meaning is that when the water level rises year after year, the lifespan of the flood barriers diminishes. For instance, the height of the static barriers could not withstand the dynamic of the water level. Also, storm surge barriers that once



## Goal

facilitated water passage must permanently close the estuaries. This action causes multiple environmental issues, such as obstructing the fish migratory path and decreasing the transition water zone where the seagrass meadow flourishes—resulting in the irreversible loss of one of the Netherlands' most diversified ecological locations. The massive construction of the Delta works came after a significant adjustment with positive and negative consequences, predominantly on local people, nature, and the environment. The positive example aspects are the successful flood protection for the whole country over seven centuries and the reservoir of fresh water for agriculture. Conversely, it came with much adjustment for the local people. The mono-function of tourism replaced Zeeland's historical culture of fisheries communities, aquaculture, and agriculture. All these cultures are beginning to vanish, along with the water rising. The domestic economy was left behind, and less population growth in the area because of future uncertainties.

This new challenge necessitates developing new approaches, planning, and strategies for the Delta works in the long term. As an opportunity from the negative outcome of climate change and the most extensive maintenance period of the Delta works. This design research initiates by considering the further innovative stage of the flood defense system in Zeeland. Either direction of strengthening the hydraulic systems, removing the flood barriers for environmental respect, or adapting both directions with the surrounding concern. To identify the best approach to extend the life expectancy of these existing flood barriers. Nonetheless, not only are the Delta works and sea-level rise of significance but so are local people and ecology in Zeeland.

## Research questions and

The study's main research question is:

'What flood barriers typology offers the greatest biodiversity potential for future spatial adaptation?'

To further explore the topic, the sub-questions are:

01. What are the principles and lifecycle of the Delta work's flood barriers?
02. What are the major spatial alterations on land and water after the completion of the Delta works?
03. What architectural techniques can increase the multifunctional capacity of the existing flood barriers?

## Design assignment in which these result.

Overall design question

What if the integration of architecture, embodied knowledge of the place, and ecosystems can collaborate with the existing flood-barriers to cope with rising sea levels?

The overall objective of the graduation project is to envision **the possible adaptability process of existing flood barriers** to prepare and cope with the inevitable circumstances, particularly sea level rise, through architectural design. Simultaneously, the research aims for a better design solution between human intervention and natural ecology on how we can live harmoniously. Both accomplish a win-win situation from the impact of climate change. The objective of the research part preference mainly focuses on understanding the principle and lifespan of the Zeeland flood barriers and the impact after construction on biodiversity. To determine the best method to extend the lifetime of the flood barriers.

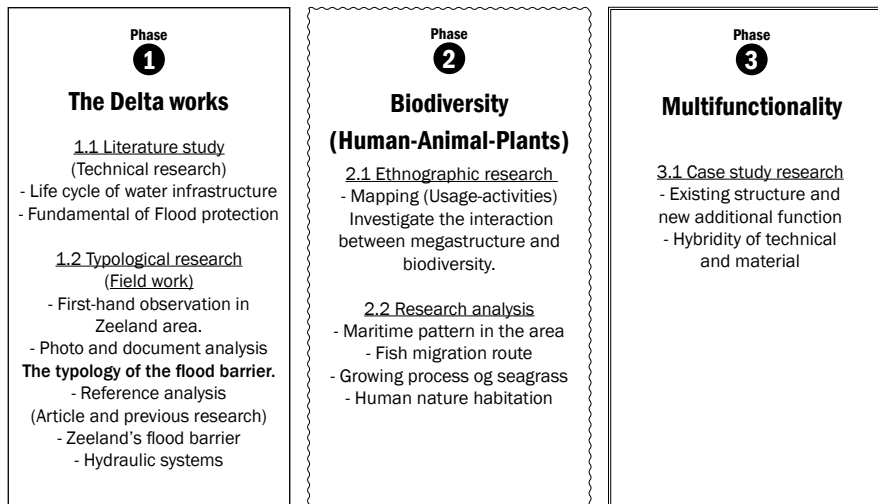


## Process

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### Method Description

The research methodology approach uses mixed types of research techniques because the megastructure topic impacts multiple scales, mainly through Literature research, typological research, and Ethnographic research. In the specific location of Zeeland, the research investigates the process of three crucial investigations.



#### Phase 1: The existing flood barriers (The Delta works) - Research part

One of the crucial aspects before taking the further innovation step is understanding the principles of the past. Thus, the first investigation is mainly about the life cycle of the thirteen Zeeland flood barriers by accumulating and translating information about the Design, construction, and typology. This research process overviews the history and principles of the flood-barriers, which could project the possible extend the life cycle. In order to prove why the adapting decision would be the solution for these barriers in the future.

#### Phase 2: The user behavior (Biodiversity: Humans, Animals, Plants) - Research part

The extended period from three to twenty years of construction of the Delta works from 1954 to 1997 significantly impacted the local people, animals, and flora in one way or another. These could result in positive and negative consequences. On a global and national scale, this initiative has resulted in flood protection for over 70 years. Nonetheless, the initiative may have an unanticipated influence on a minority number of residents. This issue resulted in the investigation of phase 2. The second part of the study is mainly about the relationship between the flood barriers and the local Zeeland community through ethnographic research, research analysis, and historical mapping.

#### Phase 3: The potential solutions. (Multifunctionality/Hybridity) - Design part

The third stage of the study is the transition between research and design, in which the research finding intentionally overlaps both parts. Following the conclusion of the principle of the Delta works in phase one and the relationship to the surrounding in phase two, the last step investigates the possibilities of integrating the current structure with the new multifunctionality. This phase's data is derived from the two preceding phases and experimental design with the existing structure.



## Literature and general practical preference

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- Steenhuis, M. (2016). *De Deltawerken*. NAI010.
- *The Storm Surge Barrier in the Eastern Scheldt: For Safety and Environment*. (n.d.). Oosterschelde Stormvloedkering.
- Rijkswaterstaat, D. (1994). *Design Plan Oosterschelde Storm-Surge*. CRC Press.
- Toussaint, B. (2018). Modern wereldwonder. *De Deltawerken, toen en nu*. Boom Lemma.
- Ministerie van Infrastructuur en Waterstaat. (2021, December 2). *Delta Works*. Rijkswaterstaat. Retrieved November 22, 2022, from <https://www.rijkswaterstaat.nl/en/water/water-safety/delta-works>
- Watersnoodmuseum (n.d.). *The Delta Plan*. Retrieved November 4, 2022, from <https://watersnoodmuseum.nl/en/knowledgecentre/delta-works/>
- Zeeuws Archief (n.d.). *Archives and Collections*. Retrieved December 12, 2022, from <https://www.zeeuwsarchief.nl/onderzoek-het-zelf/archief/>
- Fairway Information Services. (n.d.-a). *Waterways*. Retrieved December 15, 2022, from <https://vaarweginformatie.nl/frp/main/>
- Archieven (2001). *Zelandia Illustrata, Part I (Maps and plans), 16th-20th century*. Retrieved December 20, 2022, from <https://www.archieven.nl/>
- Nedbase - www.nedbase.nl. (n.d.). *Bruinvisracker - Home - Ontdek de Oosterschelde*. <https://www.ontdekdeoosterschelde.nl/bruinvisracker.htm>
- Dolch T., Folmer E.O., Frederiksen M.S., Herlyn M., van Katwijk M.M., Kolbe K., Krause-Jensen D., Schmedes P. & Westerbeek E.P. (2017) *Seagrass*. In: Wadden Sea Quality Status Report. Eds.: Kloepper S. et al., Common Wadden Sea Secretariat, Wilhelmshaven, Germany. Last updated 21.12.2017. [qsr.waddensea-worldheritage.org/reports/seagrass](https://www.waddensea-worldheritage.org/reports/seagrass)
- Reeze, B., Kroes, M., Emmerik, W. van, & Quak, J. (n.d.). *Fish Migration Calendar*. Retrieved December 19, 2022, from <https://edepot.wur.nl/417050>
- Massin, C., & Sheridan, R. (2005). *Fauna and Flora of Zeeland: Underwater Guide* (1st ed.). Nelos.
- The Expertise Network for Flood Protection (ENW) (2017). *Fundamentals of flood protection*. the Ministry of Infrastructure and the Environment. <https://www.enwinfo.nl/publicaties/>
- Zhang, Zhou, & Mao. (2019). Does the Difference in Urban Public Facility Allocation Cause Spatial Inequality in Housing Prices? Evidence from Chongqing, China. *Sustainability*, 11(21), 6096. <https://doi.org/10.3390/su11216096>
- Haasnoot, M, F. Diermanse (ed.) (2022) *Analysis of building blocks and adaptation pathways for adapting to sea level rise in the Netherlands*. Deltares 11208062-005-BGS-0001. Retrieved November 4, 2022, from <https://www.deltares.nl/en/news/we-need-to-prepare-now-for-the-sea-level-rise-of-the-future/>
- Janssen, M. (2016). *On the border of SWEET & SALT* [Master thesis]. Delft University of Technology.
- Leeuwddrent, W. J. (2012). *Decision alternatives for the safety of the Eastern Scheldt* [Msc Thesis]. Delft University of Technology.
- *Five future strategies for the Dutch delta in 2120*. (2022). TU Delft. Retrieved November 4, 2022, from <https://www.tudelft.nl/en/2022/tu-delft/five-future-strategies-for-the-dutch-delta-in-2120>



## Reflection

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### 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)?

Architectural engineering and the Second life theme are related to the selected graduation topic. The project is mainly about refurbishing and adding capacity to the existing infrastructure, which is required to understand the existing structure and find a new structure that can apply in a particular area and joinery. In general, if we design architecture, it is usually a complete building or redesign of the existing building. However, this project allows the design in architecture to be more challenged in a particular context, such as dam or flood barriers. To think how architecture can push the outdated flood barriers to a more innovative stage, coping with the sea level rise.

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

The most important aspects of the graduation project are the architectural designs for dealing with the future unpredictability of rising water levels and the adaptation of the existing structure. The project about climate change is not only to find the solution but also to raise awareness in society. We have lived with the term climate change for more than a century; it has been normalized, and people may begin to believe that nothing has happened or that there is nothing we can do about it. It is time that we have to turn adverse outcomes into opportunities. In the professional area, climate change matters come after money. This project also encourages people to reconsider what we should do for our planet.

