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	Marinde Reijman
Student number	4664132

Studio		
Name / Theme	Form Studies: Technologies and Aesthetics	
Main mentor	Peter Koorstra	Research mentor
Second mentor	Geert Coumans	Architecture mentor
Argumentation of choice of the studio	First of all, the design assignment caught my interest. Also, I previously engaged in a studio from formstudies, which I absolutely enjoyed, giving me a positive experience. Further, I have a keen interest in incorporating model making as a main element in the design process, acknowledging its importance in this studio.	

Graduation project	
Title of the graduation project	Harboring Home
Goal	
Location:	Groningen, the Reitdiep area
The posed problem,	**Architectural innovations for a changing landscape** The contemporary Dutch context is increasingly defined by environmental challenges, with the presence of climate change and sea level rise as urgent concerns. We are confronted with the ever-pressing consequences of climate change, such as the risk of flooding, hotter summers and colder winters, a shortage of drinking water, and more extremes making nature more vulnerable (KNMI, n.d.). As academic architecture students, we are directed toward creating resilient and sustainable architectural solutions. The graduation studio Form Studies: Technology & Aesthetics offers a unique opportunity to engage with the design of a building within the province of Groningen, The Netherlands, that must endure for a

	century, bearing in mind both sustainability and the aesthetics of the architectural language. **Land of waters** In the Dutch context, water management plays a critical role, as the country is confronted with its unique low-lying topography and proximity to water bodies (Bosch and van der Ham, 2015). The historical necessity of protection against floods and managing water resources has led to the development of an intricate system of dikes, canals, and polders. This system not only safeguards the population from floods but also enables efficient land use for agriculture (Bosch and van der Ham, 2015). The outcome is a water defense system that is both highly sophisticated and extensively branched, yet comparatively closed in nature (Brugge et al., 2005). Illustrated in Figure 1 is the historical evolution of water and land distribution in the Netherlands over the decades, revealing notable expansions of land. However, a less optimistic outcome emerges when considering the future (KNMI, n.d.). The Dutch expertise in water management, founded upon centuries, can offer valuable insights for addressing global challenges related to climate change and sea level rise. Perhaps interesting to mention that these have mostly been mitigation measures against floods and that we now need to look more for adaptive solutions to create more resilience. In this research, we embark on an exploration of the conceptual and practical dimensions of this academic initiative, which not only seeks to pass on the knowledge and skills necessary to confront these challenges but also strives to contribute to a more sustainable and resilient future in the field of architecture and the built environment. Specifically, investigating floating architecture as a potential solution to Groningen's vulnerability to sea level rise, emphasizing the potential implementation of floating communities or neighborhoods.
research questions and	**Main research question:** How can floating communities contribute to resilient

	living solutions in areas vulnerable to sea level rise, such as Groningen, The Netherlands? **Sub-questions:** a. What historical factors led the Dutch to inhabit water? b. In what ways do the living conditions on floating homes differ from those on traditional land-based dwellings? c. What lessons can be learned from existing floating communities within the Netherlands? d. What sustainable materials and construction methods are suitable for floating structures in a sea-level rise context? e. What factors contribute to Groningen's vulnerability to sea-level rise and make it an evident candidate for developing future resilience against rising sea levels?
design assignment in which these result.	Designing a floating building that brings the community together.

Facing the inevitable

The Netherlands, renowned for its innovative water management systems and large-scale network of dikes and polders (Bosch and van der Ham, 2015) is facing a challenge in the form of sea level rise due to climate change. The rise in sea levels is definite, the only uncertainty lies in the speed at which it is occurring (Haasnoot, 2018). The Netherlands stands out as particularly vulnerable to this imminent threat cause of its low-lying landscape (KNMI, n.d.). According to The Royal Dutch Meteorological Institute (KNMI), the sea levels can rise from 0.35 to 1 meter by the year 2100 (KNMI, n.d.). Recent insights and signals regarding potential additional accelerated sea level rise due to the accelerated breaking and melting of Antarctica are not included in this, highlighting the uncertainty and difficulty in predicting the extent of these changes (Haasnoot, 2020). This prediction calls for an urgent demand for strategies that align closely with the changing environment. Resilient design closely coordinates with changing environments. It focuses on creating structures and spaces that can withstand and adapt to various challenges such as climate change, natural disasters, and evolving societal needs.

Beyond dikes

The rich history of water management and architectural innovation in the Netherlands is due to previous floodings (Bosch and van der Ham, 2015). However, the traditional approach of building higher dikes and reinforcing existing structures, while effective to a certain extent, will not be enough to safeguard Groningen's future (Roggema, 2009, Kleinhans et al., 2018). Raising dikes to keep the seawater at bay as a result also deepens polders, making them more vulnerable and more expensive to maintain. The higher dikes are also problematic since they prevent natural silting, which means the delta is unable to grow along with the advancing sea (Schuttenhelm, 2019).

From land to water

The rising sea levels in combination with conventional architectural structures, are what make Groningen stand out as notably vulnerable. Throughout human history, people have

built structures on land to meet their needs for shelter, work, and social interaction. This long history where skills and knowledge have been passed down skills and knowledge have been passed down through generations has established land-based architecture as the standard (Bazelmans et al., 2012). However, the current structures are evidently not made to handle high water and flooding. The division between traditional building practices and buildings that can withstand the sea level rise emphasizes the pressing need for alternative solutions. The perception of the safest place to reside from floodings caused by sea level rise is arguably on the water according to Koen Olthuis, an architect specialized in floating structures (Olthuis, 2010). Floating architecture allows for adaptive responses to rising water levels, reducing vulnerability and highlighting resilience.

Process

Method description

This research investigates the integration of floating communities as a sustainable solution in regions vulnerable to sea level rise. The research uses qualitative and quantitative data analysis techniques, including interviews, content analysis, and case studies to compare and draw meaningful insights and conclusions from the collected information. Figure 02 presents the research in a diagrammatic way.

Firstly, this research will try to understand the history of floating architecture in the Netherlands through literature. The current understanding of houseboats goes beyond the scope of existing academic literature. The complexity arises from the fact that water-based living is a relatively recent phenomenon that continues to expand and evolve. The books *Twee Eeuwen Rijkswaterstaat*, *Float!*, *Mooring Site Amsterdam* and *Making Waves* are not scientific, nevertheless give great insights into the evolution of floating architecture in the Netherlands.

To provide a qualitative perspective on the social aspects of floating communities, in-depth interviews with five individuals living on houseboats will be conducted to understand their experiences, challenges, and preferences in terms of daily life, community dynamics, and adaptation to living on water. Potential limitations should be acknowledged, such as the subjective nature of interviews, regional variations in legislation, and evolving sustainability technologies, while interpreting and generalizing the research findings.

Furthermore, this research incorporates an analysis of existing floating communities in the Netherlands through case studies. Analyzing their infrastructure, construction methods, sustainability features, and integration into the current urban context, with a focus on lessons learned and best practices. The case studies will encompass three floating communities located in Amsterdam; the IJsbaanpad neighborhoud, Water residences on Steigereiland and Schoonschip, a sustainable floating housing project created by the community. These case studies were chosen due to comparable conditions to Groningen in terms of weather/climate and building practices. In order to design a floating building and develop resilient living solutions the current existing situations must be explored.

An interviews with an expert in floating architecture and engineering will be conducted to gather insights into sustainable materials and construction methods suitable for floating buildings, addressing both ecological impact and structural resilience.

Chapter 3 delves into the examination of Groningen's location, drawing insights from literature on its historical evolution and future prospects, encompassing the present landscape where historical imprints remain visible. Various reports detailing potential future scenarios are also taken into account.

In the end, the findings from the scientific research, houseboat residents interviews, case study analysis, the expert interview and location research have to be combined to develop architectural guidelines for floating communities in regions vulnerable to sea level rise.

Literature and general practical references

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Reflection

1. What is the relation between your graduation (project) topic, the studio topic, your master track (Architecture), and your master programme (MSc AUBS)?
   My research aligns with the studio topic as we are asked to design a building in Groningen meant to endure for a century, emphasizing innovation and aesthetics. I specifically focus on the pressing issue of rising sea levels. The significant demand for adaptive solutions provides an opportunity for me to develop a practical and realistic response to this overarching problem. I aim to create a building that not only addresses this concern but also raises awareness amongst people.
2. What is the relevance of your graduation work in the larger social, professional and scientific framework.
   If, for whatever circumstances, the sea does not end up rising, or rises much less than expected, building on water can still offer multiple advantages. For example, in terms of design flexibility, there are endless configuration possibilities (Lin et al., 2019). This approach also offers the potential for changing surroundings for inhabitants, instead of moving to a new house, take the house with you. Additionally, building on water leads to reduced land use, which is particularly valuable in densely populated areas (Ingels, 2019; Reinmann, 2023). Moreover, it is worth noting that floating architecture may present solutions to a range of challenges and issues beyond those specifically addressed in this study. Other research should explore the legislation, environmental and resource efficiency aspects of floating communities.

   The relevance of floating architecture in Groningen is underscored by the region's sensitivity to seismic activity. Given Groningen's history of earthquakes resulting from gas extraction activities, conventional building structures face challenges in ensuring structural integrity and safety (Mulder et al., 2018). Floating architecture presents an alternative and resilient solution, as it is adaptable to ground movements. By embracing floating construction principles, buildings can mitigate the impact of seismic events, providing a safer and more sustainable option for urban development in Groningen. This innovative approach not only addresses immediate safety concerns but also contributes to the long-term resilience and adaptability of the built environment in the face of ongoing seismic risks.

   As our world faces the complex challenges of urbanization, climate change, and sea-level rise, innovative solutions are urgently required to create sustainable, resilient, and adaptable built environments. Building on water, in its various forms such as floating architecture or amphibious structures, not only addresses the issues of urban density and land scarcity but also presents opportunities to develop eco-friendly and climate-resilient designs (Landman, 2023). This research offers a path toward mitigating the impact of rising sea levels and fostering sustainable urban growth, making it an appropriate field of study in the realm of modern architecture and urban development, especially within the Dutch context.