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	Jae Won Choi
Student number	5927986

Studio		
Name / Theme	Architectural Engineering	
Main mentor	Stephan Verkuijlen	Design Tutor
Second mentor	Jos de Krieger	Research Tutor
Argumentation of choice of the studio	To explore a personal fascination of floating architecture and its energy supply and water management.	

Graduation project	
Title of the graduation project	Designing Large-Scale Floating Structure
Goal	
Location:	Hoek van Holland, Netherlands
The posed problem,	As sea levels rise and urban areas face increasing land scarcity, there is an urgent need for adaptable, sustainable infrastructure solutions. Large-scale floating structures offer potential to address these challenges, but their implementation faces complex engineering, environmental, and regulatory hurdles. Current floating architecture projects are limited in scale, and there is a lack of proven examples for large infrastructure like airport terminals. Key issues include maintaining stability in dynamic marine environments, achieving energy and water self-sufficiency, minimizing environmental impact, and ensuring long-term economic viability. This research aims to develop a comprehensive design framework for modular, large-scale floating structures that can serve as infrastructure while maintaining resilience against environmental changes.
research questions and	How can large-scale modular floating structures be designed for feasibility and sustainability? Sub questions:

	- How can large-scale floating structures be designed to achieve optimal buoyancy and stability in various water conditions, ensuring their functionality and safety? - What design principles and materials can be employed to enhance the buoyancy and resilience of modular floating structures against environmental factors? - What renewable energy technologies (such as solar, wind, or tidal) are most suitable for integration into large-scale floating structures to achieve energy self-sufficiency? - What systems can be implemented for the collection and treatment of rainwater and wastewater to ensure a sustainable water supply for floating structures?
design assignment in which these result.	The proposed design focuses on a modular hexagonal floating structure with a 25 m diameter and 6 m height. Key features include: · Structural stability: Metacentric height of 0.8 m demonstrates stability · Energy production: 96,500.99 kWh annually per module using solar panels · Water management: Rainwater collection of 325 m^3 per year per module · Adaptability: Modular design allows for expansion, reconfiguration, or disassembly · Materials: Concrete incorporating silica fume for improved durability in marine environments · Connections: Flexible connectors to reduce hydro-elastic response The design aims to balance technical feasibility, energy self-sufficiency, and sustainable water management while ensuring adaptability for future needs.

Process

Method description

The research will employ a mixed-method approach combining qualitative and quantitative techniques:

1. Literature Review: Comprehensive analysis of academic papers, technical reports, and design guidelines on floating structures, renewable energy systems, and water management.
2. Case Study Analysis: Detailed examination of existing floating architecture projects to gain practical insights into design strategies and operational challenges.
3. Quantitative Modeling and Simulation:
    - Structural stability calculations using engineering principles

    - Energy production and consumption simulations
    - Water management system simulations
4. Prototype Development: Design and testing of a scaled prototype to validate structural concepts and system integration.
5. Comparative Analysis: Evaluation of the proposed floating structure against land-based alternatives.
6. Expert Consultations: Interviews with professionals in marine engineering, to validate design concepts and address potential challenges.

Literature and general practical references

1. Wang, X., Xu, S. Y., Leung, M. Y., & Liang, Q. (2022). A VALUE-BASED MULTI-CRITERIA DECISION-MAKING APPROACH TOWARDS FLOATING HOUSE DEVELOPMENT: A CASE STUDY IN HONG KONG. Journal of Civil Engineering and Management, 29(3), 223–237. https://doi.org/10.3846/jcem.2023.17571
2. El-Shihy, A. A., & Ezquiaga, J. M. (2019). Architectural design concept and guidelines for floating structures for tackling sea level rise impacts on Abu-Qir. Alexandria Engineering Journal, 58(2), 507–518. https://doi.org/10.1016/j.aej.2019.05.003
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5. Banet Catherine. (2020). Regulating the Reuse and Repurposing of Oil and Gas Installations in the Context of Decommissioning: Creating Incentives and Enabling Energy System Integration. In Pereira Eduardo G., Wawryk Alexandra, Trischmann Heike, Banet Catherine, & Hall Keith B (Eds.), The Regulation of Decommissioning, Abandonment and Reuse Initiatives in the Oil and Gas Industry: From Obligation to Opportunities (pp. 205–227). Wolters Kluwer.
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11. EL-Shihy, A. A. (2024). A new approach for configuring modular floating cities: assessing modular floating platforms by means of analytic hierarchy process. City, Territory and Architecture, 11(1). https://doi.org/10.1186/s40410-024-00228-6
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Reflection

Relation to studio topic, master track, and programme:
It addresses critical challenges in urban development and sustainability, exploring innovative solutions for future cities facing environmental pressures. The project focus on large-scale floating infrastructure and its integration with urban systems reflects the interdisciplinary nature of the programme, combining architectural design principles with urban planning considerations and environmental sustainability. This approach emphasizes innovative urban solutions and commitment to developing sustainable approaches to the built environment in the face of climate change and urban growth challenges.

Relevance in larger frameworks:
Socially, this research addresses pressing issues of climate change adaptation and urban expansion, offering potential solutions for coastal cities facing land scarcity and rising sea levels. It contributes to discussions on sustainable urban development and resilience.