Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan

Personal information	
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Studio	
Name / Theme	Delta Interventions
Teachers / tutors	Ir. Kristel M. Aalbers – first mentor Ir. Jan van de Voort – second mentor Drs. Dirk Dubbeling – delegate of the Board of Examiners
Argumentation of choice of the studio	Interest in water-related and water-sensitive design, climate adaptation of buildings and cities

Graduation Project

Title

100 ways of water. An adaptable pumping station as a witness of the changing hydroscape.

Goal

Location

Pumping station Westland, Hoek van Holland, Rijnmond Delta.

The posed problem

1. Existing water management asset is not geared for future water challenges

2. Little public awareness of natural water-related cycles and dynamic changes in the Delta

In a changing society, there is a need to increase awareness about the ongoing natural cycles in the hydroscape of the South-West Delta, and what water challenges the future can bring.

3. Little public awareness of the role of water management infrastructures and their resulting composition in landscape or urban tissue.

Research questions

How to design a multifaceted, adaptable pumping station in a delta vulnerable to climate change? How can an architectural design address and embrace the conditions of a dynamic delta hydroscape and the uncertainties it entails?

How to increase awareness about natural water-related cycles in the delta with the means of architecture?

How to increase awareness about the infrastructures protecting human settlements from water threats and reconsider their spatial composition?

Design assignment in which these result

Inlet and main outlet water pumping station equipped with retention facilities and an observatory of water-bound changes in the surrounding landscape. The pumping station Westland is directly connected with an inlet station Winsemius in Brielse Meer, which is an external part of the design assignment.

Process

Method description

- Internship at AIR Foundation and Gemeente Rotterdam for the preparation of the Stadmakerscongres 2015. Research into water-related and systemic challenges of Rotterdam. Professional consultations at the Gemeente, IABR, De Urbanisten, and TU Delft Faculty of Architecture.
- Criteria for the design process and methods are shaped, establishing how the guiding theme can be translated into architectural process and its products. Reference architectural approaches are collected.
- A general study of the South-West Delta is undertaken by literature research, field trips and synthetic analysis. Layers of landscape, infrastructure, and occupancy trends are investigated. This allows determining a vulnerable location where the project would bring positive changes. A thorough site analysis allows responding to the physical, environmental, and societal context. On-site surveys are performed.
- Following, a thorough study of the typology of pumping stations, its specific requirements and conditions, both historically and given the changing climate and societal conditions. An inventory of pumping facilities in the area is undertaken. This part of the research feeds program specifications for the design assignment, some aspects of layout and technicalities of the design. It allows the design to evolve. Consecutively, aspects of the public function are explored - how the relationship with the building's form and its expression, reaction to time and decay, is formed. In terms of working method, physical models are resorted to in this phase.
- Study of other prominent water-related typologies, i.e. treatment plants, lighthouses, marinas, to determine overlapping elements.
- Study of current and projected cycles of the hydroscape, e.g. water levels and possible overflow/deficiencies, how those are influenced by other natural and human factors. Are there trends to bear in mind while designing a resilient pumping station and its publicly accessed parts? Are there environmental indicators of changes about to happen which could be featured in the design?
- Criteria for the design process and the end product are established, in terms of architecture, technical, structural and environmental demands. Specific reference projects and approaches are identified.
- The abovementioned steps aid shaping the program of requirement and aspects of massing and form.
- Experimentation with form versus all criteria is performed through drawing and physical modeling.
- The following phase focuses on detailing and fine-tuning the design. Detailing is critical for this project as a way to embrace different conditions in the local

hydroscape, as well as ways of experiencing them. The focus is on established and innovative ways of handling and framing water, as well as the outdoor and indoor climate and ambiance it implies. Physical and computer 3d modeling and simulations for respective aspect of design will be employed in this phase.

- Thirdly, flexibility of design and its applicability to other locations will be examined, potentially with different auxiliary functions. The test site is Gemaal Winsemius in Brielse Meer, which is part of the fresh water inlet system for Westland. The goal of this study is to determine whether the concerned design for pumping station and water management infrastructures can serve as a flexible basis for sustainable future drainage systems.

Literature and general practical reference

Literature

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Consultations
Hoogheemraadschap van Delfland
Waterschap Hollandse Delta
Municipality of Rotterdam, Departments of City Planning, Landscape Design, Traffic, Water and Sewerage Management
Faculty of Civil Engineering, Hydraulic Design, TU Delft
Rotterdam Climate Initiative
De Urbanisten
Fabric, Urban Metabolism IABR Team

Other
Work experience at Center for Coastal Resilience and Urban Excellence, Stevens Institute of Technology & related projects and conferences (completed 2014-2015)

Reflection

Relevance

In the Netherlands, water management is the crucial basis for all human development; without the complex system of dikes, polders, retention and discharge reservoirs, and pumping stations, vast areas of the country would not exist. Cities developed in the Rijnmond Delta, most importantly Rotterdam and Dordrecht, could grow thanks to the perseverance in keeping the water out, by pumping it to the channels via a system of connected vessels. They were not as affluent as Amsterdam, where ground level was elevated with layers of sand and sludge, because such process was simply too costly. Therefore, the only way forward was to pump the water out. One could say that pumping lies in the nature of this area, and pumping facilities are its vernacular typology. The typology of a pumping station is extremely important in the context of the studio and in the larger scientific discourse.

To say the least, if a pumping station fails, there is a high probability that the polder or boezem system it controls fills up with water and further damage follows. In case of urban areas, the challenge is even greater, e.g. if the Schilthuis pumping station in Oostplein stops working, the entire inner city of Rotterdam is endangered. Gemaal Westland, which is the subject of this project, performs a double function in the water management system. It is the main drainage outlet station for the agriculture-intensive Westland region, and at the same time also the main fresh water inlet, pumping it from Brielse Meer via a duct below the Nieuwe Waterweg and Europoort. It is situated near the Maeslant storm surge barrier, and exposed to varied levels of salinity which influence both water quality and ground condition, notably the structure of the dike. Those factors render a dynamic hydroscape that this project aims to address.

The Rijnmond Delta faces new water challenges as the future and climate change unfold. Exposed both to the influence of the sea and increasing riverine discharge, the urban areas are at risk. The Royal Netherlands Meteorological Institute (KNMI, 2006) highlighted four climate scenarios for the future, which suggest that a wide range of conditions may render, from a gradual increase of water levels due to sea

and rivers, to periods of prolonged warm weather and draught. Both of those polarities imply a changed weather intensity and involve a greater possibility of extreme weather events. Ways of safeguarding and flood-proofing are intensely researched.

The aspect of water quality is important considering the uncertain quantities. This project explores possibilities of sustainable drainage and retention systems which would involve water purification. Taking an environmental perspective, elements of pumping station design pose a threat to the ecosystem. Studies show that they influence mortality of riverine fish, e.g. European eel. It is also the goal of this project to look for better ways of handling water quantities while causing less damage to related flora and fauna.

Even though intricate water management lies in the nature of the region, one could claim that societal awareness of the infrastructures and their impact on urban lifestyles and built environment is rather low. Similarly, the climate change questions are not commonly associated with daily operation of those systems, sustainable, long-term planning involving multiple stakeholders and actors, but more likely with extreme weather events, storms, floods, hot summers and glacial melt. This project is a way to test if a pumping station design can make these principles clearer to a wider public with the means of architectural design, and how the notions of *change in the hydroscape*, of the water management *system*, and the varied flows and *ways of water* can be embraced.

Time planning

Before P1
Internship at AIR Foundation and Gemeente Rotterdam, August – November 2015.
Identification of research and design directions and possible sites of intervention.
Preliminary analysis of the South-West Delta with particular attention to Rijnmond Delta
Identifying the guiding theme for architectural research and design
Field trips to South-West Delta with particular attention to Rijnmond Delta, Waterschap Hollandse Delta, and Hoogheemraadschap Delfland.
Pumping station typology inventory
Determining criteria for design and design process
Preparation of the P1 presentation

Auxiliary courses:
*Aspects of Water-related Design course [completed]
*Real Estate Valuation course [completed, 2nd exam date 26.01.2016 – 1st exam date overlapped with P1 presentation].

P1 – 5.11.2015

Shaping of the guiding theme and concepts
Boezem pumping station typology inventory and field survey

Regional scale analysis
Mouth of the Nieuwe Waterweg analysis
Site choice for the intervention, site surveys
Site analysis
Catchment area analysis
Analysis of the local hydroscape, its flows and dynamics.
Identification of possible future scenarios for the hydroscape due to climate change.
Program of requirement and scope of the project.
Fine-tuning criteria for design choices
Research into sustainable water management techniques
Preliminary design at scale 1:1000 and 1:200
Physical model experimentation
Preliminary materialization
Preparation of the P2 presentation

Auxiliary courses:
*Research Methods Position Paper submission [completed]
*Theory of Urbanism Literature Review Paper submission [completed]

P2 – 21.01.2016

Further development of the architectural design at all scales
Physical and 3d model experimentation
Further identification of technical, structural, and environmental strategies, detailing
Master Thesis Report preparation
Preparation of the P3 progress presentation and draft written reflection

P3

Fine-tuning of the design at all scales, materialization
Building technology detailing
Testing design principles on another location (Gemaal Winsemius in Brielse Meer)
Master Thesis Report preparation
Preparation of the P4 presentation and written reflection

P4
Incorporation of final feedback into design
Design and research completed across scales
Preparation of final presentation materials: final Master Thesis Report, digital presentation, poster presentation, physical models, and final written reflection

P5

Appendix

Theory of Urbanism Review Paper