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](mailto: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

<table>
<thead>
<tr>
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### Studio

<table>
<thead>
<tr>
<th>Name / Theme</th>
<th>Delta Interventions</th>
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<tbody>
<tr>
<td>Teachers / tutors</td>
<td>Kristel Aalber; Diego Andres Sepulveda Carmona</td>
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<tr>
<td>Argumentation of choice of the studio</td>
<td>Water plays a crucial role in the world and in our lives. However, it could also bring disasters. Through history, people living around water tend to adapt themselves to the environment and various circumstances, while nowadays we tend to rely on single infrastructure, and problems have emerged. Climate change further facilitates these problems and puts risks on cities. Water is a crucial element in delta region, as important resource and also risk. I would like to learn and explore how to work trans-disciplines and borders to design deltas that are safe, energetic, and provides opportunity for nature and people to communicate. I am interested in the studio because it focuses on the dynamic relation between natural processes and societal practices in urbanisation in the North Sea region.</td>
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### Graduation project

<table>
<thead>
<tr>
<th>Title of the graduation project</th>
<th>Live with Rain: Adaptive livability in Bergen</th>
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<tbody>
<tr>
<td>Goal</td>
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<tr>
<td>Location:</td>
<td>Bergen, Norway</td>
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</table>
| The posed problem, | Climate change is a global issue. Norway is considered to be influenced less from climate change compared to some other countries, however, there are still risks and threats. Some direct impacts from climate change already emerged in Norway, such as shorter snow period, increased frequency and intensity of precipitation and storms, spring flood...More importantly, the indirect impacts might cause more problems on social, economic and environmental sectors than direct impacts.

Under climate change, those impacts would threaten the quality and function of current urban system and also the future potential for development. For instance, the more frequent and intensified precipitation will put pressure on current drainage system and retention system. Once the current system could not handle the increase, there would be urban flood and thus cause damage to property and spacial quality. Sea level rise would put areas locate below the estimated rising level under risk. Therefore, these areas that have certain value should be protected and future development intentions should be reconsidered.

Climate change means more and intensified precipitation, rising sea level and temperature, and flood and landslide risk from snow melting in Bergen. These impacts would create pressure on current urban system and threat future development of the city. If no precautions were taken, the livability of Bergen in terms of drinking water safety, accessibility to good public space and outdoor activities, and experience would be damaged. |
**Main Research Question:**

How to adapt to the risks from climate change on livability of Bergen through planning and spatial design?

The main research question will be answered through six sub research question using different methods as indicated in the methodology and research framework.

**Sub Questions:**

1. **What are the impacts from climate change on Bergen?**
   The first step is to understand the actual impacts on the city. Maps and data could be combined to reveal the question. Data and information could be reached through national research institutions such as NVE and Bergen community.

2. **How to define livability of Bergen and identify factors that would be influenced by climate change?**
   The definition could be conducted through literature review and site visiting. Identification of factors that would be affected by climate change should be based on the definition of livability.

3. **What are the risks (in terms of vulnerability of each factor under specific climate change impact)?**
   Exposure, vulnerability and adaptive capacity are key factors when estimate the impact of climate change risk. Specific approach to conduct risk analysis is further explained in the next section.
4. What approaches could be applied to deal with the risks and what other opportunities could be achieved simultaneously? Adaptation approaches should be implemented with other urban developments. On the one hand, adaptation alone would not create sufficient profit for developers; on the other hand, new urban developments need to be adaptive to climate change and other risks. Successful adaptation projects could be studied and suitable adaptation approaches could be learnt for this project. Balance among economic, social and environmental benefits should be considered. Cooperation between public and private sectors should be promoted to facilitate other opportunities.

5. Where should these approaches be conducted and how can these contribute to a better system (instead of fragmented interventions)? Implementation of adaptive approaches should be considered at city level instead of separated projects. Approaches that could contribute to a better system (such as green-blue infrastructure system) should have priority.

6. How to integrate the research and design process into planning system? The final design should include a roadmap illustrating how and when each project should be negotiated and implemented, which parties would be involved, priority and interaction among different projects, and their effects on other urban systems.
design assignment in which these result.

Under climate change, the livability of Bergen will be impaired due to related impacts such as intensified and concentrated precipitation and sea level rise. The project will conduct adaptive climate change related strategies align with livability perspective for Bergen, especially central Bergen. A new vision for integrating climate change adaptation strategies with livability strategies will be designed. Use livability as guide force to define local water management for precipitation and improve urban structures by re-integrating the southern part of the city.
Process

Method description

What are the impacts from Climate Change on Bergen

What is the urban structure and functionality of Bergen

Define livability of Bergen in a set of indicators & Find out indicators that would be affected by impacts from climate change

(e.g., good public space quality - increased precipitation induces urban flood)

Site Analysis

Spatial Trend - Historic Analysis
- Evolution of urban structure & functionality, the relationship between city and water, how people live with water
- Planning Framework
- Current strategies, future vision
- Public Space System
- Structure & functionality of public space

Risk Analysis

Risk Analysis
- Specific impacts, exposure & vulnerability
- 3x3x3 Analysis
- Understand local context

Other Opportunities
- Social, economic, environmental

Support

Theoretical Framework

- Climate Change Risk Assessment
- Adaptation to Climate Change Impacts
- Adaptive Pathway
- Managing Climate Change Adaptation
- Livability
- Water-related Ideas
- Delta Utopians
- Blue-green infrastructure
- Live with water

Approaches

- Water Management
- Adaptive, integrated approach

Strategic / Design

- Assessment
- Integrated Planning System

Impacts

indicators

A

B

C

sub indicators

A1

A2

A3

impact exposure map

a

b

vulnerability map a-A1

vulnerability map a-A2

vulnerability map a-A3

risk map a-A

risk map a-A

b

vulnerability map b-A1

vulnerability map b-A2

vulnerability map b-A3

risk map b-A

risk map b-A

c

vulnerability map c-A1

vulnerability map c-A2

vulnerability map c-A3

risk map c-A

risk map c-A

A=abc
**Literature Review & Environmental Modeling:** Through literature review and environmental modeling review, general understanding of the possible risks from climate change on Norway could be achieved, as well as the impacts on different sectors and groups.

**Site Visit:** By visiting the site, much more about a place could be experienced through five senses of a person, which could not be achieved through literature. The chance to meet with local people and know about their understanding and experience of climate change in their daily life and their visions.

**Layer Analysis:** By using a 3x3x3 layer analysis of the site, how the three layers functioned and their relationships through 3 historical time and 3 scales could be understood (occupation, infrastructure and landscape). This could help to read the current context and form the base for future interventions.

**Mapping & Literature Review:** By mapping and literature review on the historical development of Norway, the pattern of settlement and the way people make themselves adaptive to natural system (notably water) could be learned.

**Modeling:** In the small scale spatial design part, modeling might be used to test the feasibility of the design.

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**Literature and general practical preference**

**Literature:**


**Projects:** Sand Engine; Room for the River; The BIG U project in Manhattan; Port regeneration in Rotterdam
**Reflection**

**Relevance**

Currently more than 40% population live along the coastline area in Norway, and it's the most expensive land. Under the risks from climate change, it's essential to start with the coastal areas to create (urban or natural) landscape that is adaptive to the risks. Moreover, the project aims not only at dealing with the direct impacts from climate change, but also, even more importantly, at achieving other opportunities through the adaptation process to mitigate the indirect impacts on society or economy of the country.

**Time planning**

P1: Concept research; Literature research; Design references; Theory Paper; Site visiting in North Sea region and Norway; Mapping of general information in Norway and North Sea; Roadmap of the whole project

P2: Theory Paper; Design references; Risk analysis of the city and the city centre; Central structure of the Bergen Metropolitan region; Urban structure analysis; Site analysis choosing two or three specific sites for further design

P3: Conclude design references, literature review, and historical settlement for design development; Set up systems and models for assessment and monitoring

P4: Reflection and adjustment

P5: Final presentation