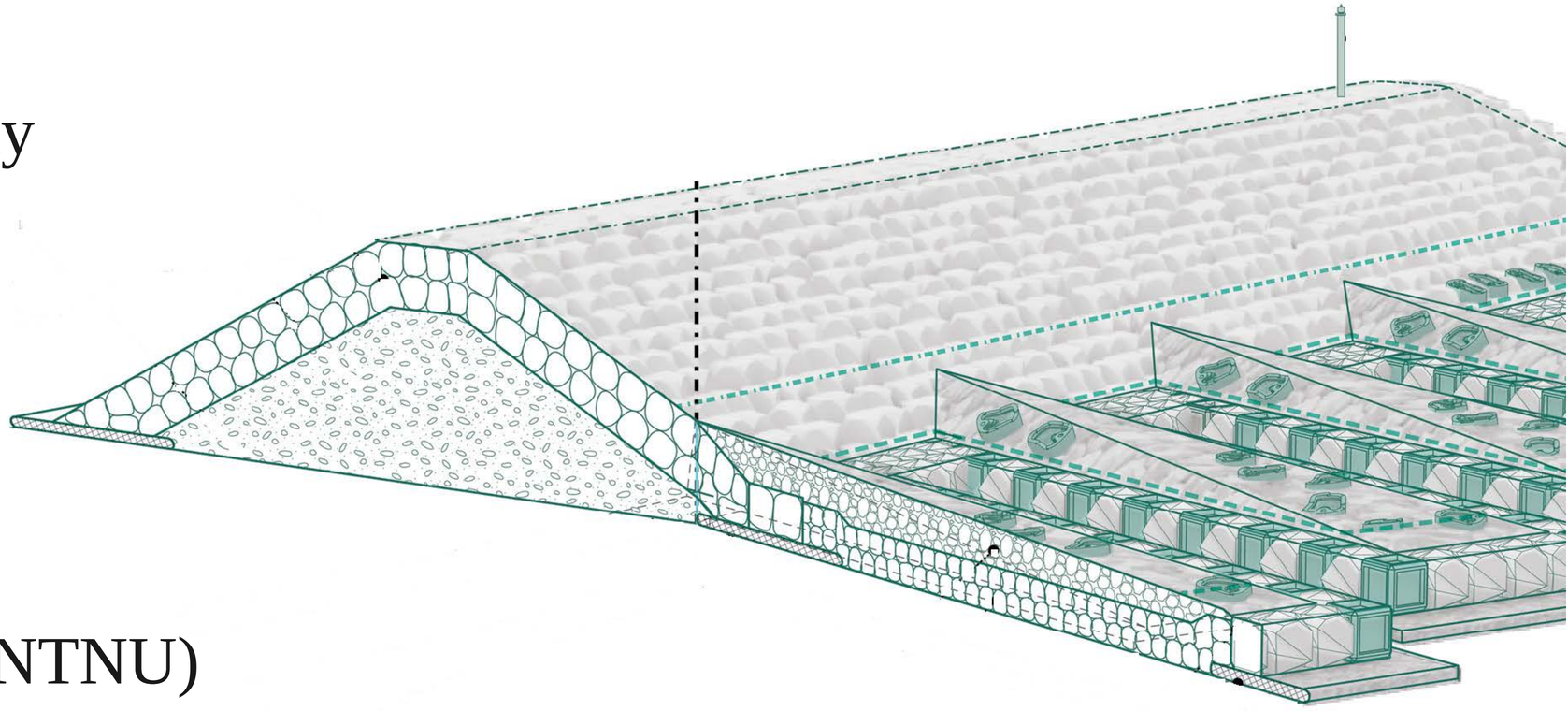
Physical Model Study of Living Breakwaters

Nauman Raza

Coastal Engineering Day
April 29, 2019



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NTNU Norconsult

Outline

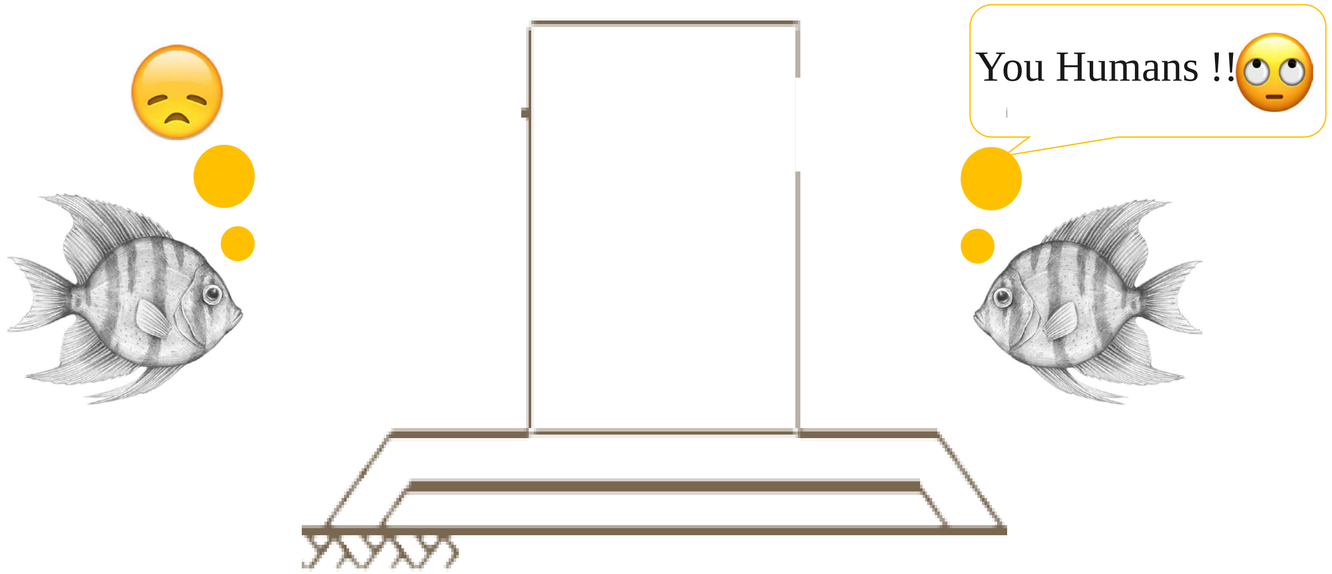
- Background
- Relevance to Norway
- Concept of the study
- Experimental Setup
- Testing Methodology
- Progress

Background

- Building with Nature
- Ecological Damage
- Ecosystem Based Defense System
- Restriction in Application
- Living Breakwater

Before Development

After Development

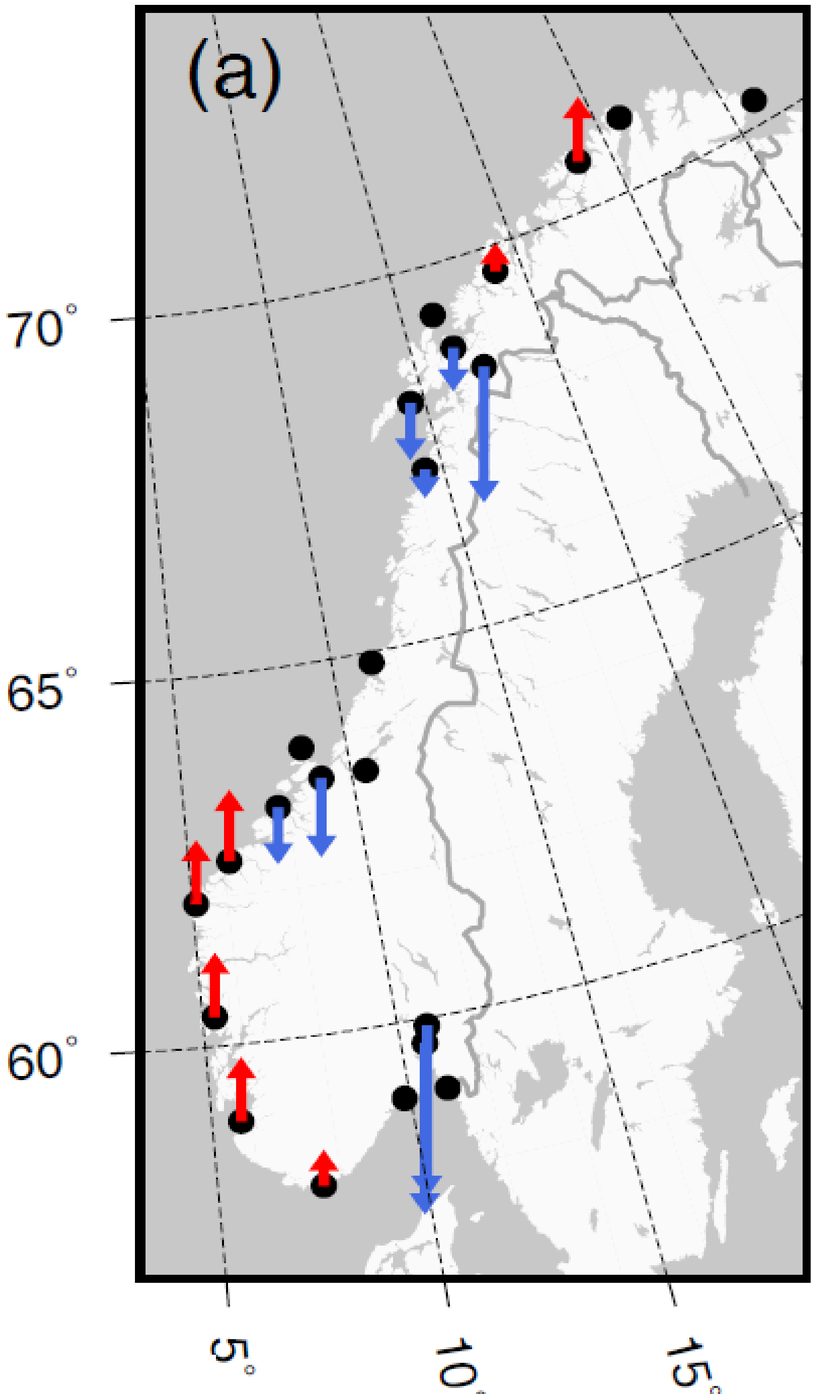


Relevance to Norway

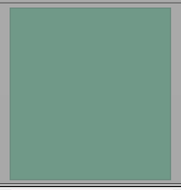
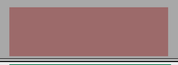
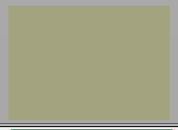
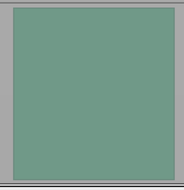
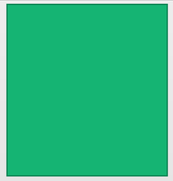
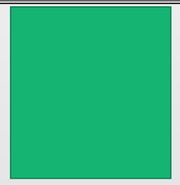
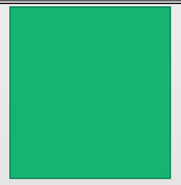
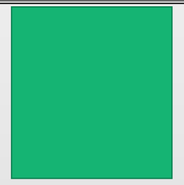
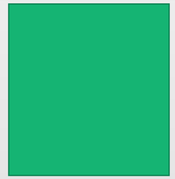
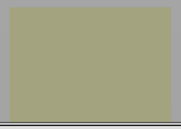
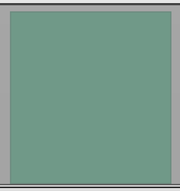
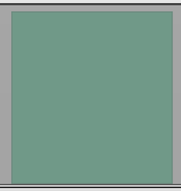
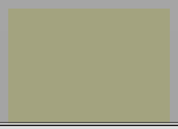
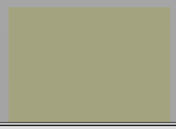
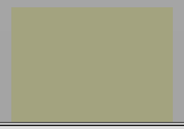
- Building with nature and climate change
- Sea Level Rise in Norway (1.9mm/yr)
- 10mm/yr by the end of 21st century
- Increased frequency of extreme events (2-6%)
- How to make existing coastal structures climate change adaptive ?

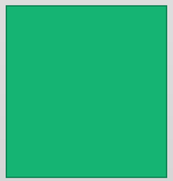
"The likelihood of exceeding present-day return heights can be dramatically increased with sea level rise."

Sea Level Change for Norway, NCCS Report 01/2015



Coastal Technologies for Climate Change Adoption

Technology	Effectiveness	Relative Cost	Co-Benefits	Co-Costs	Barriers	Feasibility of Implementation
Structural Barriers						
Geosynthetics		No data				
Constructed Wetlands and Artificial Reefs						
Beach Nourishment & dune Construction						

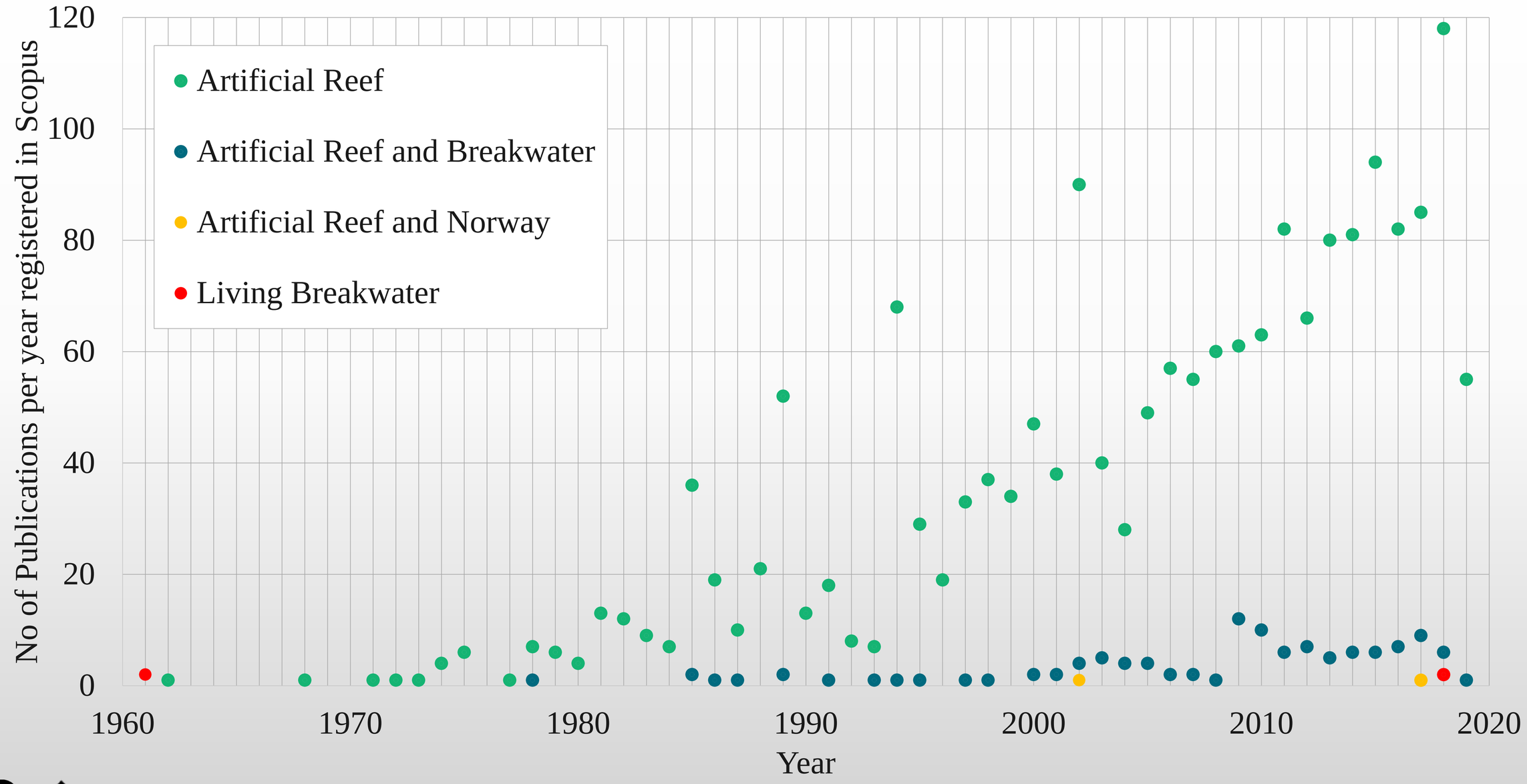


More Desirable

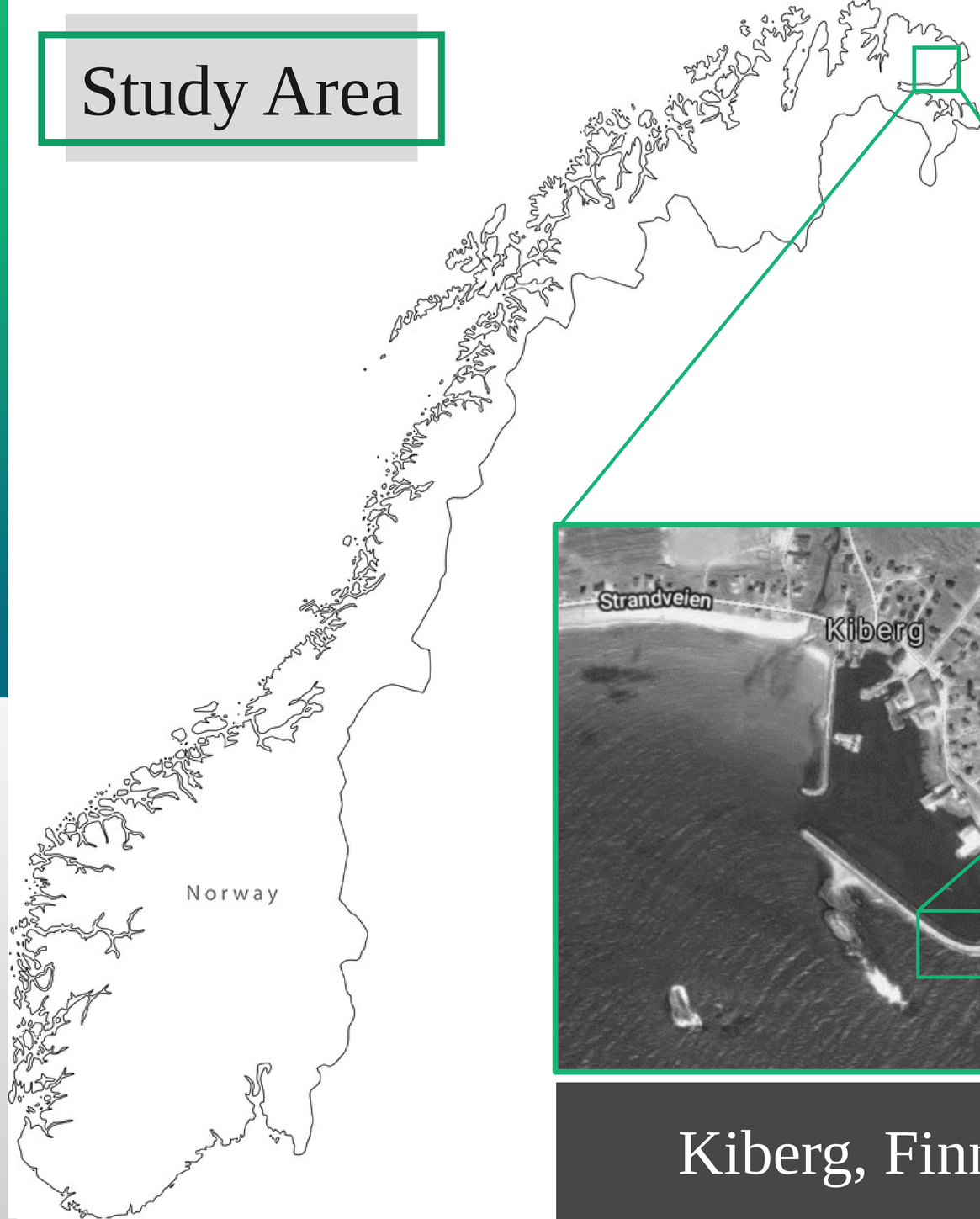
Intermediate

Less Desirable

Artificial Reefs in Norway



Study Area

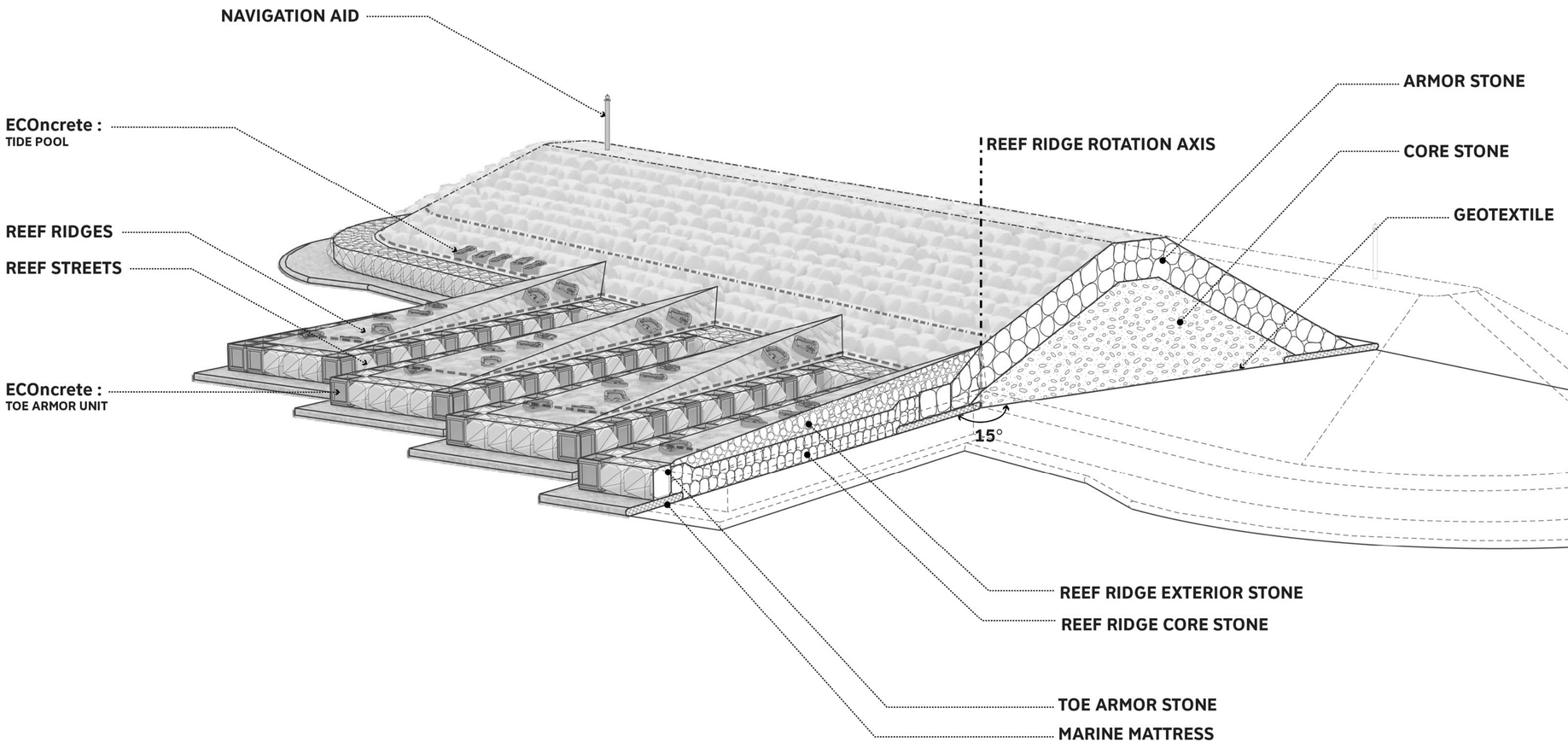


Kiberg, Finnmark

- Ruaset molo built in 1960’s
- Damaged due to wave concentration
- Temporary Repair
- Further damage expected
- Alternatives of further repair
- Presence of Lophelia pertusa

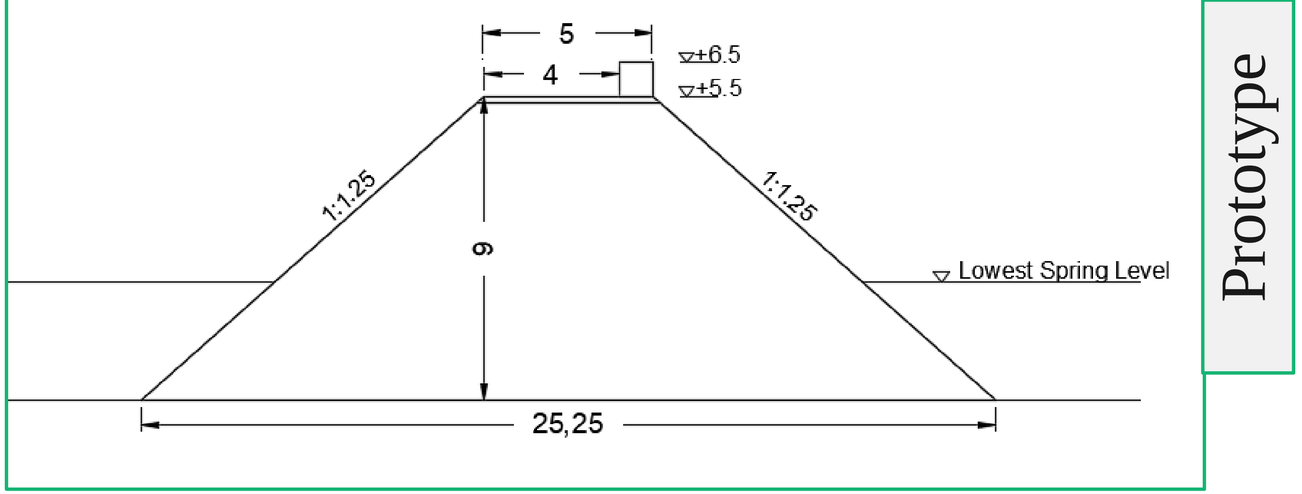
Concept of the Study

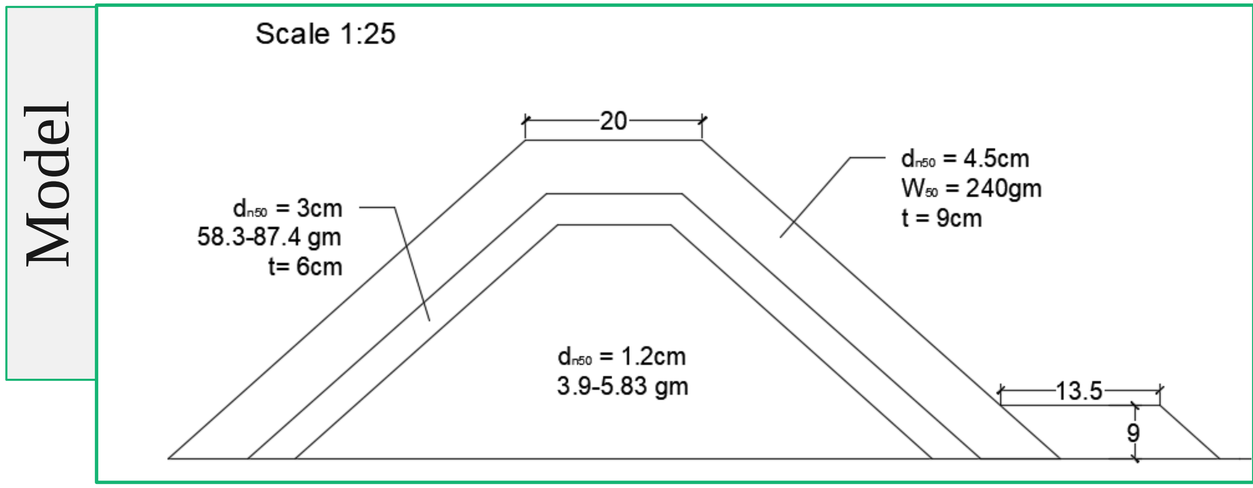
- Building with Nature
- Extended Toe Concept
- Wave Impact Study
- Effect of Artificial Reefs
- Optimization of Reefs
- Comparison with traditional
- Potential Locations

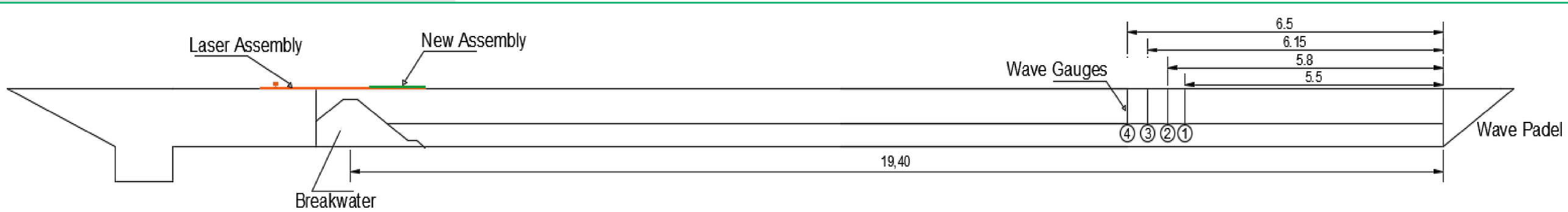


Experimental Setup

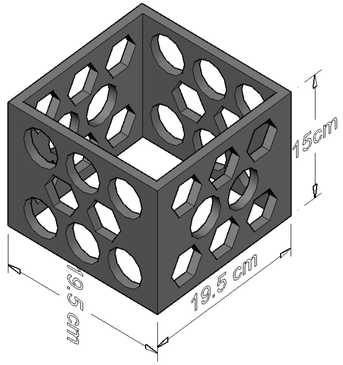
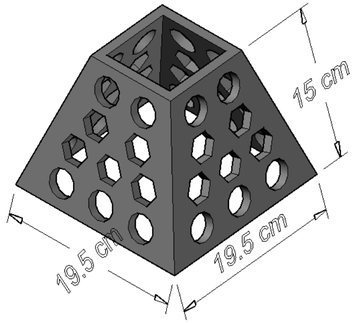
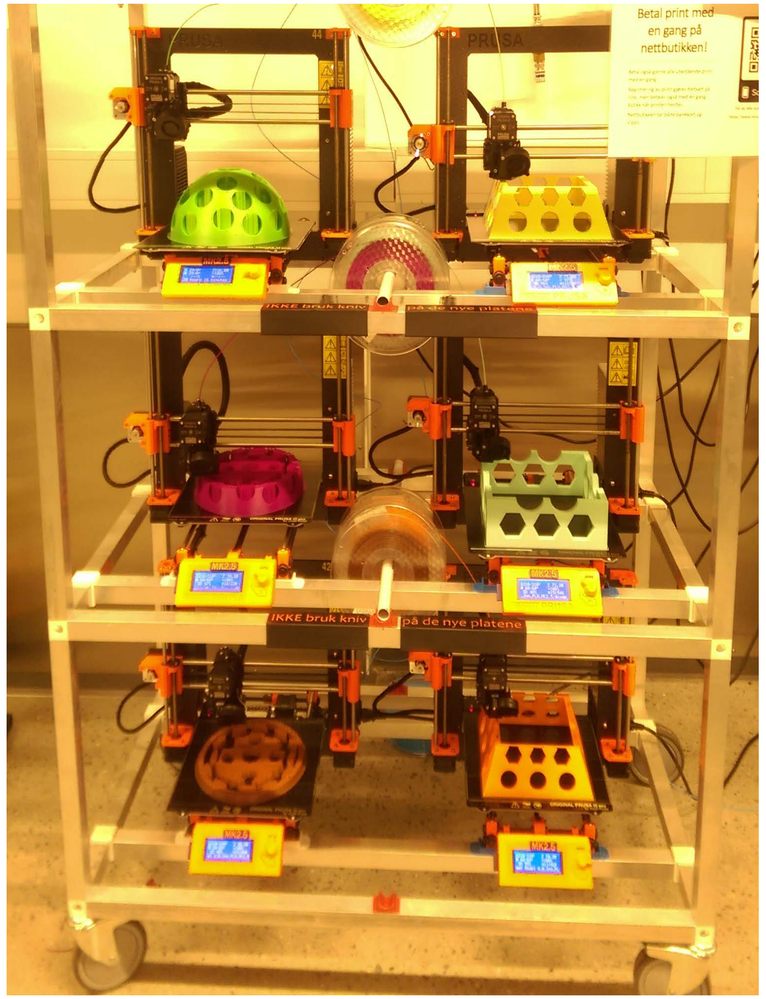
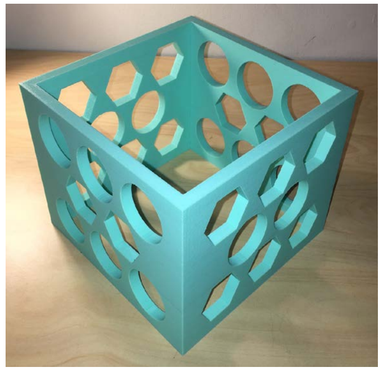
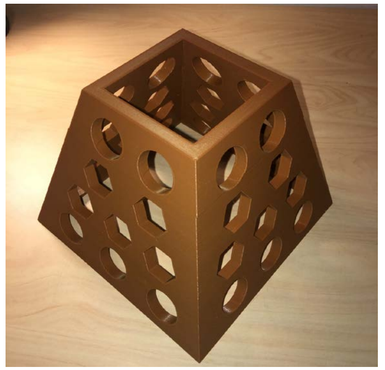
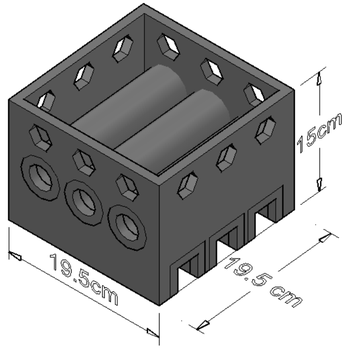
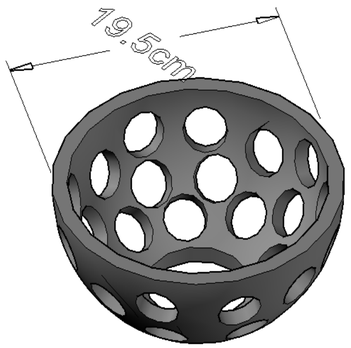
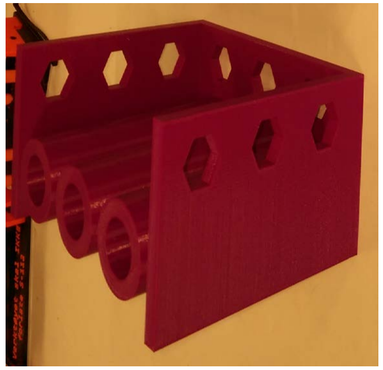
- Wave Flume 0.6m x 0.85m x20m
- Kiberg Inspired Breakwater
- First trial, made by available material in lab
- Rubble mound breakwater with one under-layer





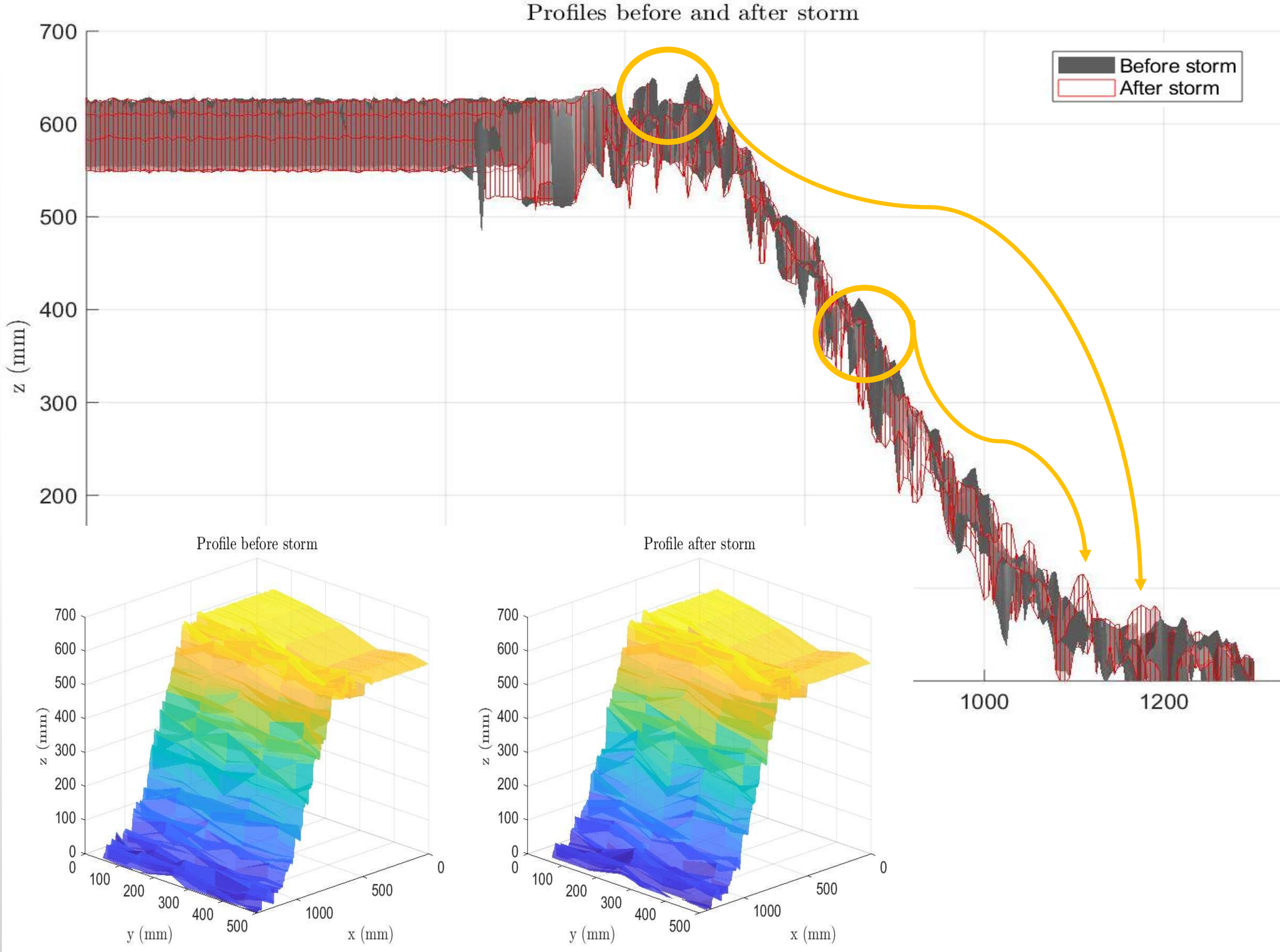


Artificial Reefs

Conceptual Design	3D Printing	Final Product
 Type-1  Type-2		 Type-1  Type-2
 Type-3  Type-4		 Type-3  Type-4

Testing Methodology

- Run test to check the damage of the breakwater
- Runs with and without artificial reefs
- Different toe dimensions
- Measure wave height and velocities in artificial reefs
- Ecological suitability



Progress

Literature Review, Norwegian Perspective

Artificial Reef Design and 3D Printing

Experimental Work (Building Models, Run Tests)

Post processing of data, Wave Impact Study, Ecological Benefits

Thesis Writing

Project Kick off

Milestone 1

Milestone 2

Milestone 3

Submission

February	March	April	May	June	July

Thank you for your attention.

Questions ?

NTNU Norconsult

References

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