NTNU
Norwegian University of Science and Technology

Norwegian Centre for Coastal Technology NCCoast

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19 April , 2018, Trondheim

Outline

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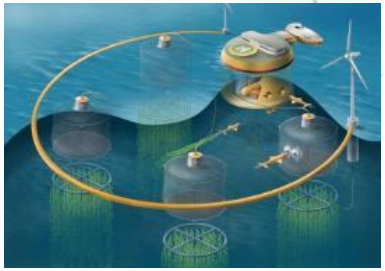
- Possible partners
- Summary

Norwegian Centre for Coastal Technology NCCoast

- A national **competence centre** to ensure and further develop education and research within coastal and limited water depth technologies
- Focus will be on:
  - **Waves** (primary) in interaction with **wind** (secondary) and **current** (secondary) as such within coastal and open waters limited by shallow to intermediate water depths
  - **Weather exposed and/or dynamic structures** within coastal and open waters limited by shallow to intermediate water depths
  - **Environmental design** and **architecture** of coastal structures, infrastructure and domestic buildings
  - **Fairway navigation** and **vessel operations** in confined and depth limited waters
- **Operated by NTNU** in cooperation with national and international **research institutes**, all relevant **coastal related industries** and **Norwegian authorities**



Why NCCoast?

- Coastal based industries and coastal infrastructures – a larger part of the **Norwegian global value chain** with reduce oil&gas income
- Norway increasingly dependent on **coastal knowledge and technology**
- A need for **new technologies** and new **sustainable design methods**
- **Fast growing industries** in the coastal zone in focus, aquaculture, renewable energies, navigation and operations of electrified or autonomous ships
- **Climate changes** – need for updated design codes and implement new knowledge

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Why NCCOAST?

- Future need for **education** of master students and PhD's on **international level** within coastal technologies in Norway
- **Attracting and recruiting** new students
- Significant upgraded of **laboratory facilities** – refer Ocean Space Centre
- Need for **environmental based design and a architectural adaption** to the Norwegian coast line
- A centre will improve **internal communication** within **NTNU** and research partners and **external communication** with the **industry**

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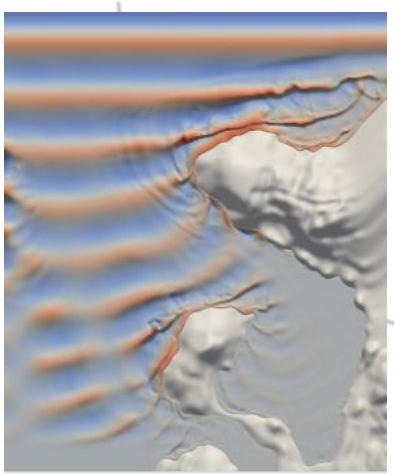
WP 1- Metocean

New requirements due to dynamic - coastal structures



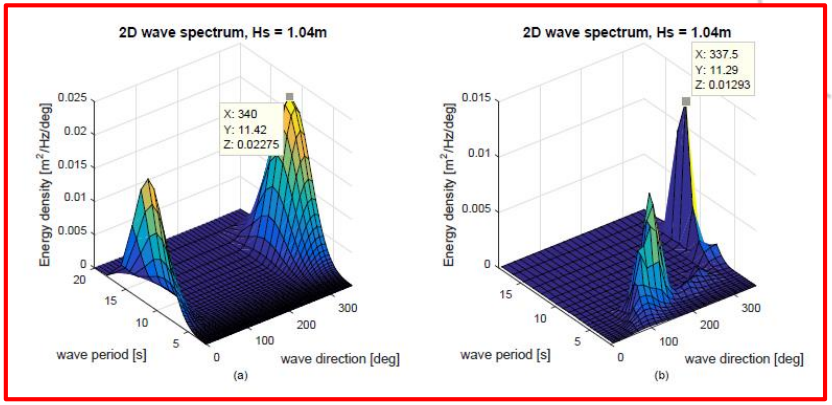


Table A.1 – Wave classes at the site decided by dimensioning, significant wave height and wave period (in accordance with the 1st Edition of NS 9415)

Wave classes	H_s m	T_p S	Designation
A	0,0 – 0,5	0,0 – 2,0	Little exposure
B	0,5 – 1,0	1,6 – 3,2	Moderate exposure
C	1,0 – 2,0	2,5 – 5,1	Substantial exposure
D	2,0 – 3,0	4,0 – 6,7	High exposure
E	> 3,0	5,3 – 18,0	Extreme exposure

1. **Low exposure assumed**
2. **Swell not identified**

   critical for a fish farm system with high natural periods - 10 – 18 sec

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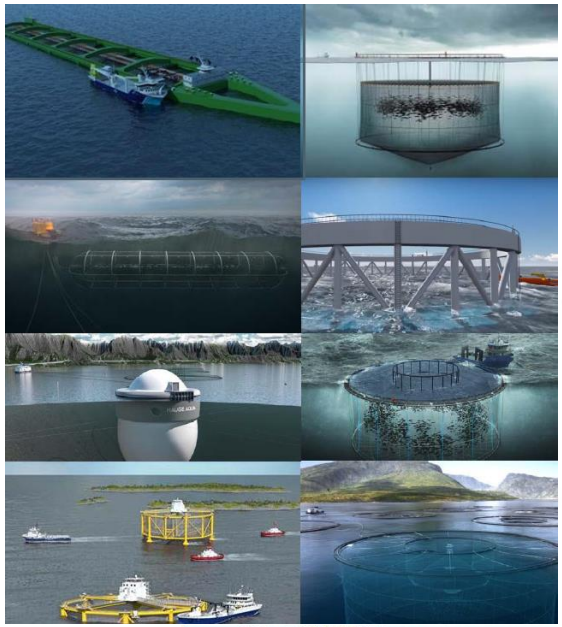
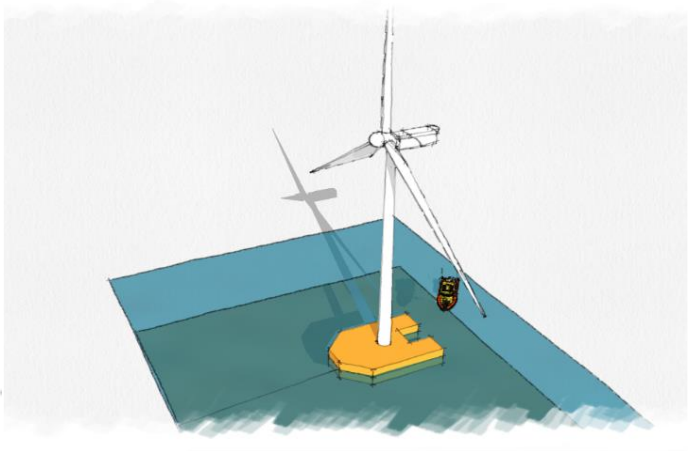
WP 2- Structures

Traditional and novel structures in the coastal zone

- Dynamic sensitive structures:
  - **Closed** and **semi closed** aquaculture cages
  - **Floating bridges** with large span
  - **New floating wind concepts** in intermediate waters
  - New **residential constructions** – (submerged restaurant)
  - **Very large** floating structures
  - **Multi-functional devices** – bridge with aquaculture, offshore wind and aquaculture





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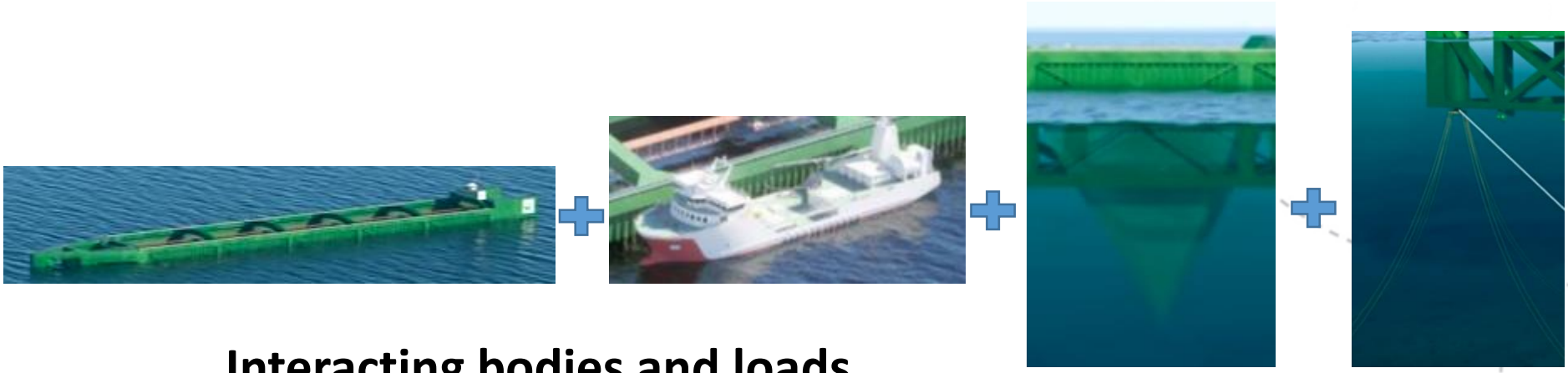
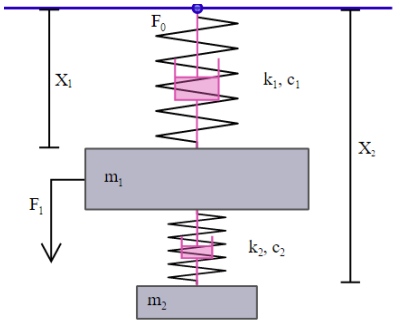
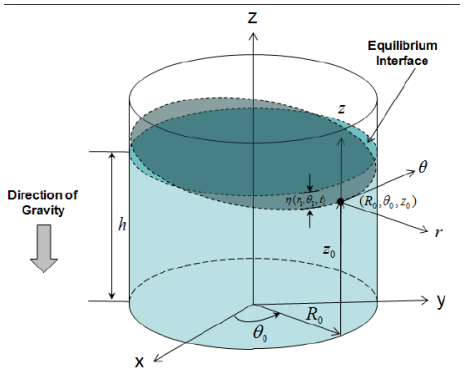
WP 2 – Structures (Integrated design)



Interacting bodies and loads





Structural Eigenmodes Frequencies

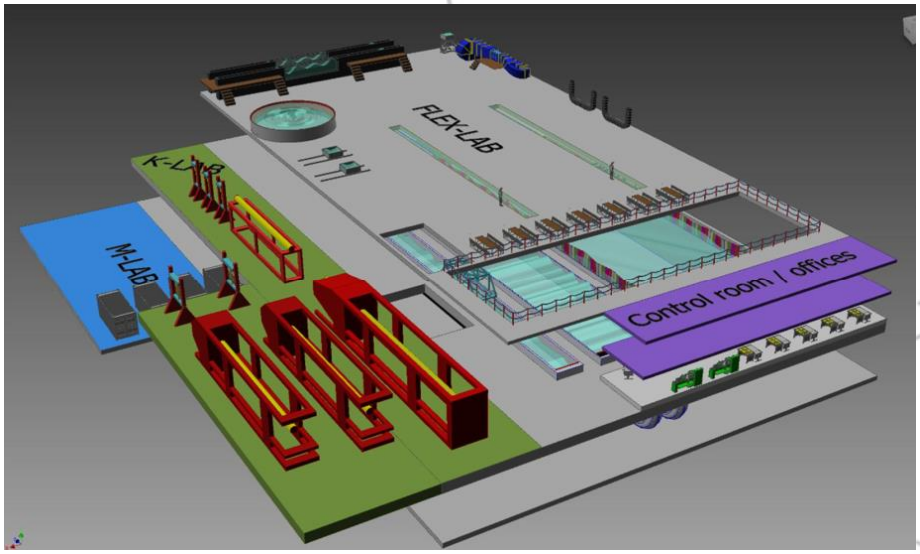
Sloshing Eigenmodes Frequencies

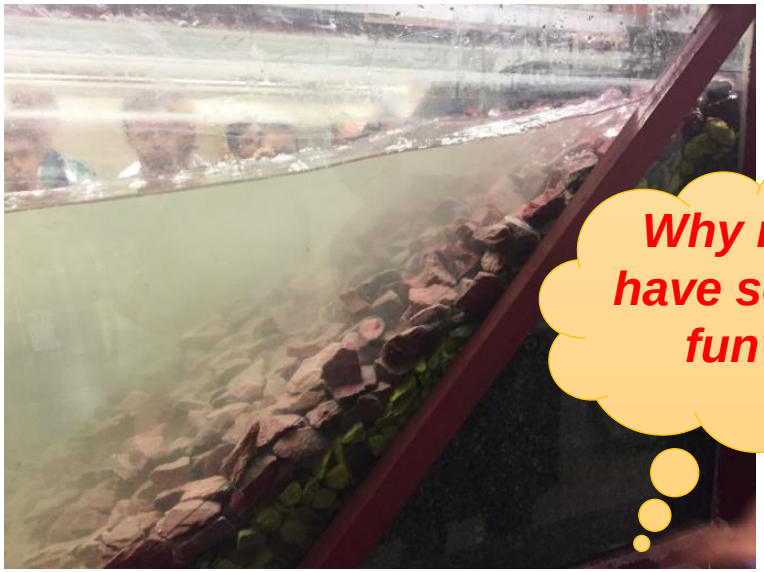
WP 3- Experimental and full scale validation

New and significantly upgraded experimental infrastructure

- Ocean Space Centre – NTNU prioritized labs – **Flexlab**
- **Finalizing date** not known
- Valgrinda – Existing labs – might be **upgraded**
- **Full scale** – Fjord Labs OSC
- In possible combination with **digital twins**

- **Challenge – go for both alternatives – temporary infrastructures at Valgrinda**





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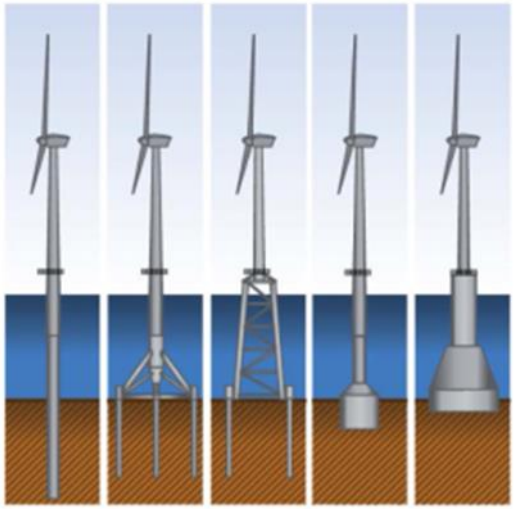
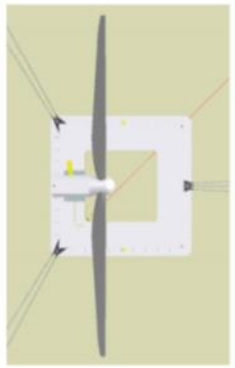
WP 4- Renewable energy

Fixed foundations, floating foundations in intermediate waters and combined bridge/aquaculture - wave energy – wind energy devices

- **Bottom fixed** offshore wind

  turbines in **complex metocean conditions**
- **Floating** wind turbines in **intermediate waters** (strategic R&D goal for Statoil - Doggerbank)
- **Combined functionality** – bridges and tidal turbines - aquaculture and wind power





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WP 5- Coastal architecture and environmental based design

Traditional and novel structures in the coastal zone

"To work with the nature – within the nature"

- Simple measures for a good working environment
- Simple measures for a sustainable working environment

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Historical coastal culture in Norway

- Buildings in **human scale**
- **Location customi**zed buildings
- Architecture is dependent on **functional needs**
- Clean and aesthetic selection and use of **materials**

WP 5- Coastal architecture and environmental based design

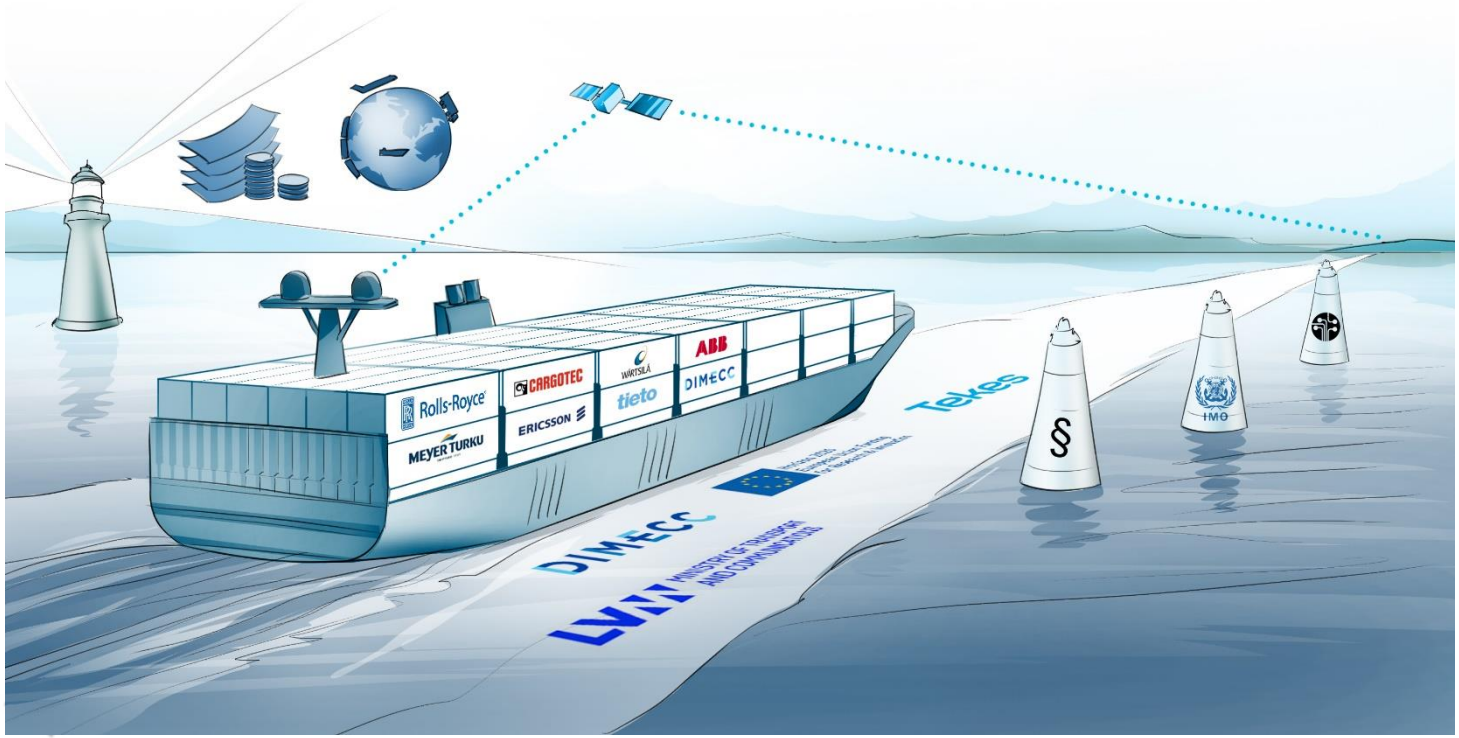
- Big and ugly
- Industrial scenery but lack of structure
- Area efficiency missing
- Not sustainable

… refreshing with some colors

…????

WP 6- Navigational and operational reliability in fairleads

- From **Road to Rail** and **Sea** (National priority) - Increased sea transport
- Autonomous ships – gives new **challenges**
- Satellite remote sensing – new **possibilities**



Operational reliability of access systems

From steel fish farm – Frøya/Hitra – 2004

Acceptance criteria –
maximum Hs <= 1.0 m ???

UPTIME – active motion compensated

Acceptance criteria –
maximum Hs = 2.5 m ???

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Preliminary activity plan

New positions		2019		2020		2021		2022	
PhD-student # 1	Civil								
PhD-student # 2	Civil								
PhD-student # 3	Marine								
PhD-student # 4	Marine								
Forsker # 1	Civil								
Forsker # 2	Marine								
PhD-student # 7	Architect								
PhD-student # 8	Architect								
PhD-student # 9	IKT								
PhD-student # 10	IKT								
Professor I	Civil/Marine								
Professor II	Civil/Marine								
Industry PhD-student # 1	?								
Industry PhD-student # 2	?								

Financing and relevant industry

- Indicated **financing**:
  - Norwegian Research Council(SFI/SFF), EU – Horizon 2020, Industry and public entities as The Public Road Administration, Norwegian Coastal Authority, Ministries and harbour owners

- **Relevant industry** might be an oil company (especially with regard to Arctic Coastal Engineering), entrepreneurs and consultants, industry that works with autonomous and electric ships (such as Rolls Royce and Siemens). Could it be possible to motivate shipping companies?

- **Statoil**, aquaculture operators, Fred Olsen, Nexans, Sjømat Norge and others

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Thank you !