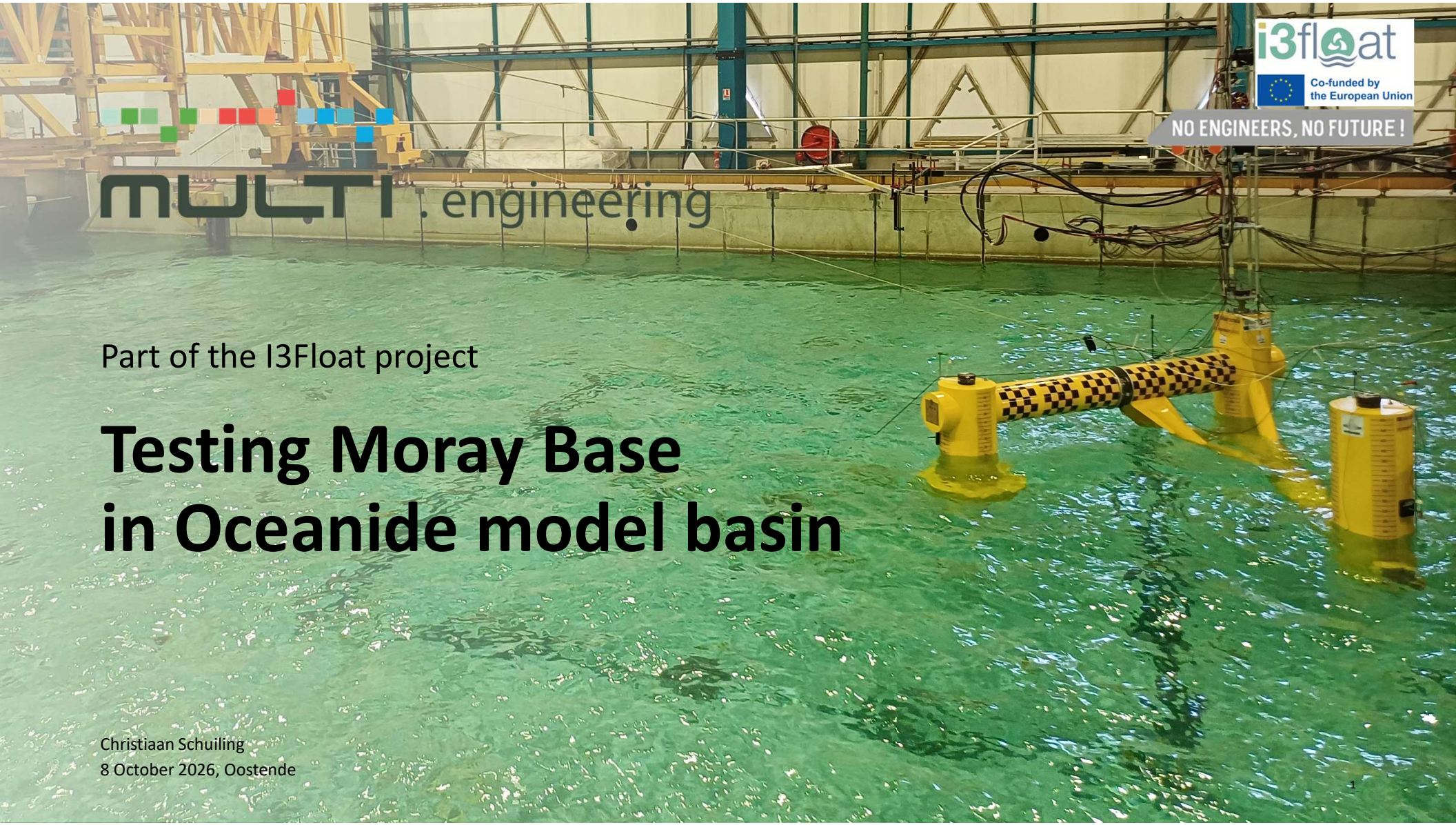


Part of the I3Float project

Testing Moray Base in Oceanide model basin

Christiaan Schuiling

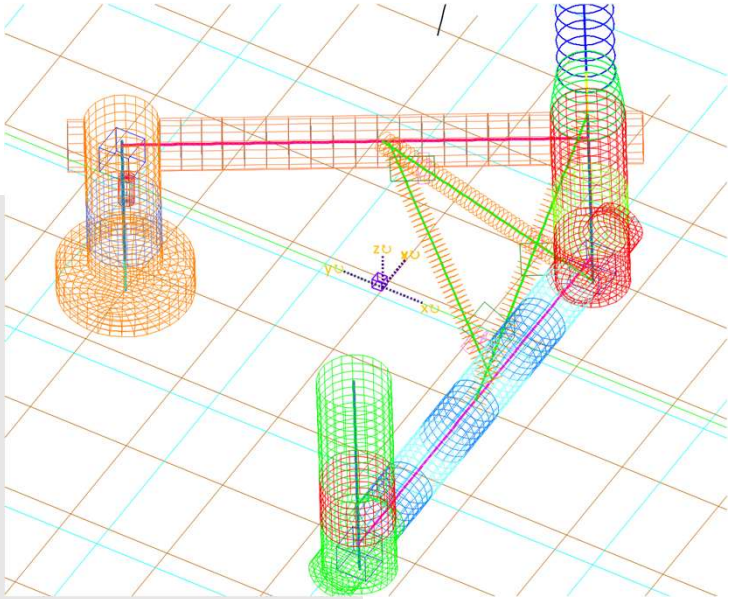
8 October 2026, Oostende

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1. Test program
2. Basin model
3. Growing complexity of the basin model
4. Typhoon testing
5. Results
6. Conclusion





Test program

- As part of I3Float project model tests on Moray Base have been executed at the basin of Oceanide
- Purpuse of tests:
  - Validation of digital modelling:
    - Hydrodynamic drag
    - Aerodynamic load and damping
    - Hydromechanic mass
  - Reality check for typhoon design conditions
- Focus on digitally closely reproducible tests:
  - Decay testing
  - Current load testing
  - Regular wave testing in constant wind

  → Simple tests



Basin model

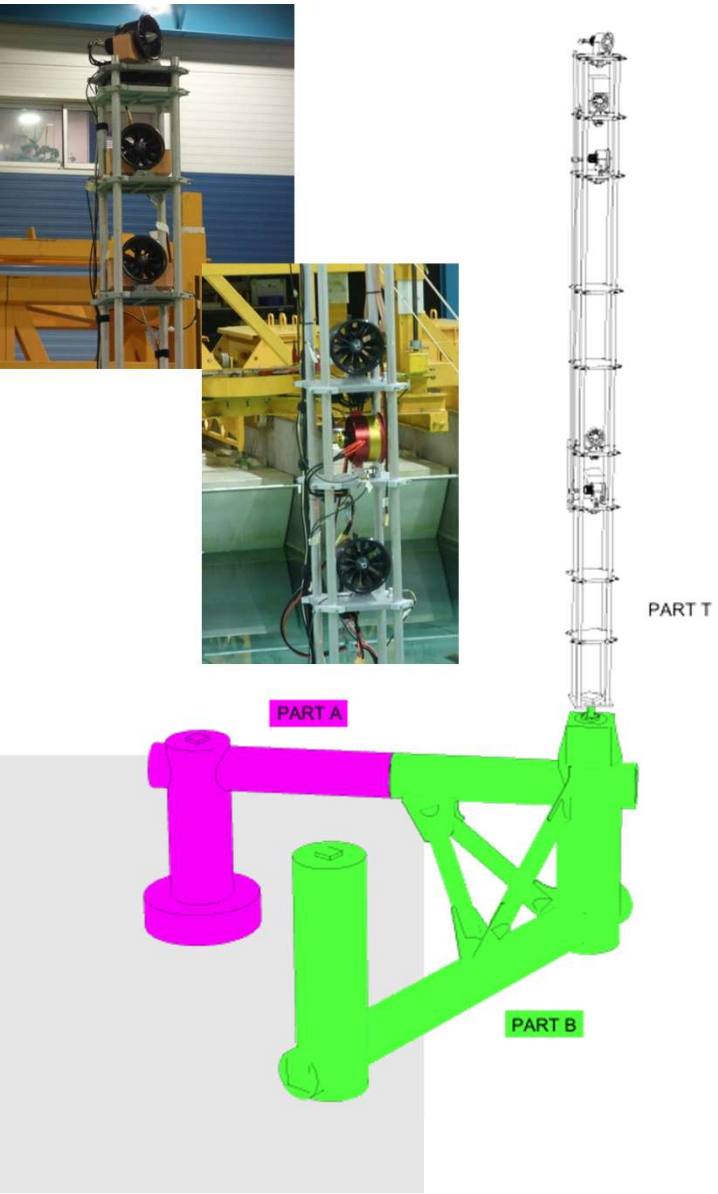
- Largest scale possible while still allowing longest waves
- 1 : 35

Quantity	Full scale	Basin model
Mass	19561 ton	456 kg
Centre spacing columns	84 m	2.40 m
Column diameter	13.5 m	0.39 m
Draught	24 m	0.68 m
Depth	42 m	1.20 m
Tower length	137 m	3.91 m



Complexity of basin model kept growing (1)

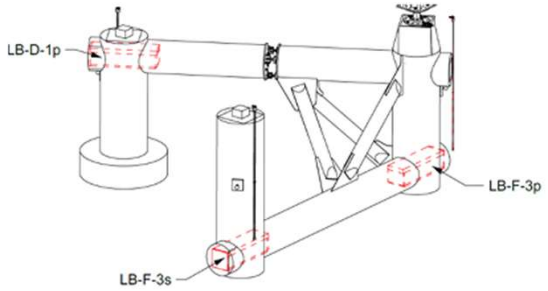
- Validation of numerical models:
- 5 Headings, 2 regular waves, 2 typhoon seas
  1. Measuring of internal forces:
     - Tower base (2 directions)
       → Common load cell + Large scale → Soft suspension of tower
     - Centre of decktube (6 directions)
       - →Available space for 6D sensors
       - → Model needed supporting during fabrication/hoisting
       - → Reset point of force sensors
  2. Applying wind loads, aerodynamic damping
  3. Applying mooring system

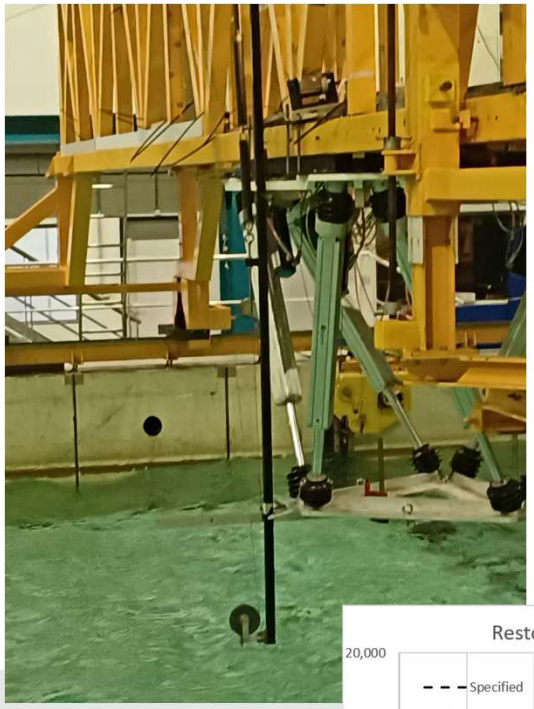


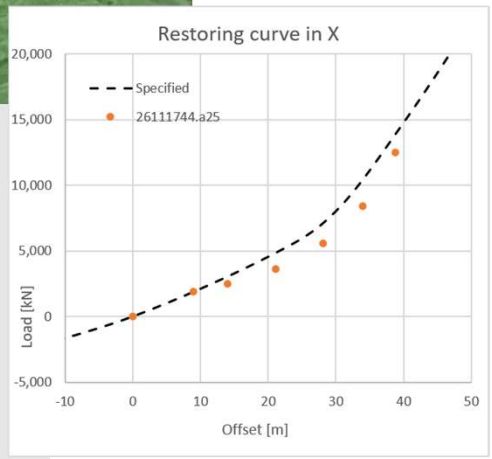
Complexity of basin model kept growing (2)

- Validation of numerical models:
- 5 Headings, 2 regular waves, 2 typhoon seas
  1. Measuring of internal forces
  2. Applying wind loads, aerodynamic damping
     - Windload during typhoon → tower drag → fans in middle of mast → truss mast
     - Truss mast + Large scale → Structurally soft
     - Operational windload → Ballast
       - 5 headings → 5 ballast configurations
       - Ballasting below waterline
     - Assymmetric location of turbine
       - Unit yaws 15deg → Aerodynamic load must rotate
         - Fans in multiple directions
     - Aerodynamic damping of motions → software in loop
     - Large number of drive wires → heavy umbilical
  3. Applying mooring system



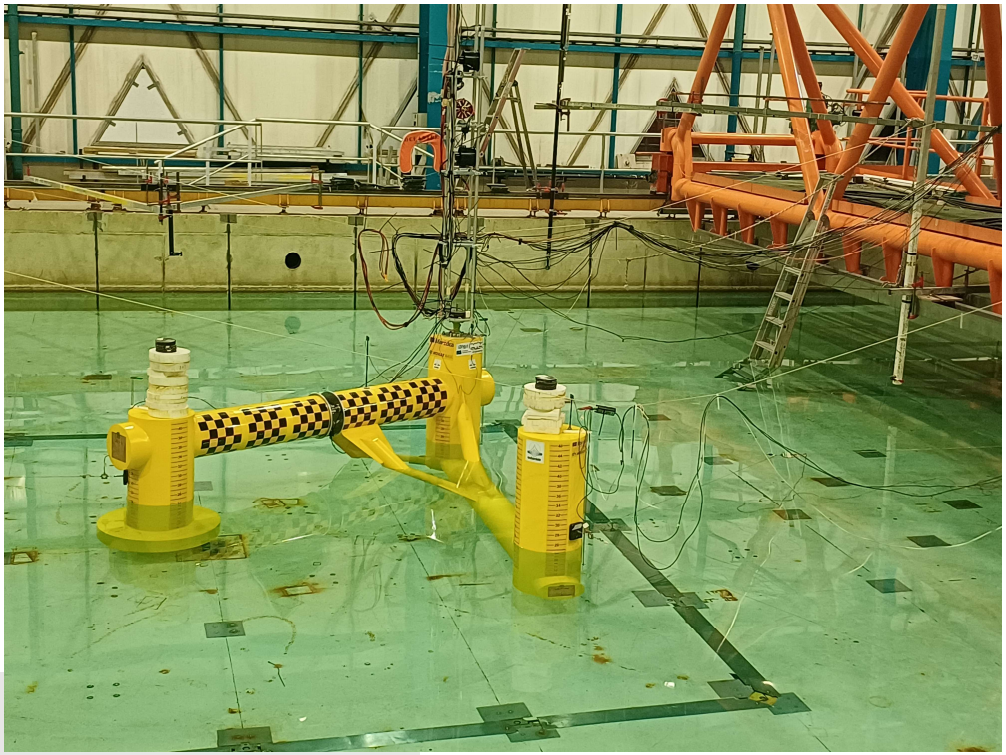


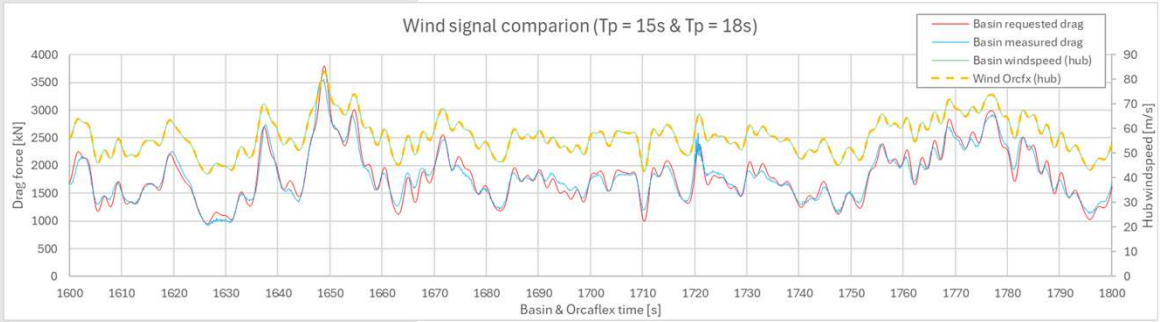




Complexity of basin model kept growing (3)

- Validation of numerical models:
- 5 Headings, 2 regular waves, 2 typhoon seas
  1. Measuring of internal forces
  2. Applying wind loads, aerodynamic damping
  3. Applying non linear mooring system
     - Large scale demands truncated system
       - Non linearity → Set of serial springs
       - Long set → intermediate sheave → gravity acts partly opposite
     - Multiple headings demand 5x retuning of system





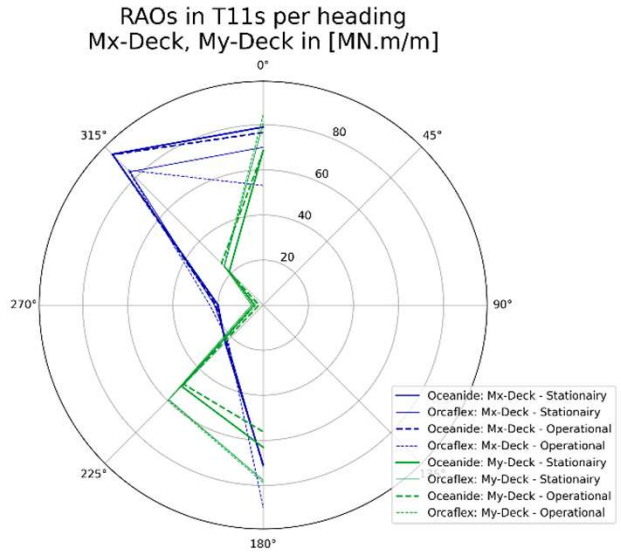
Complexity

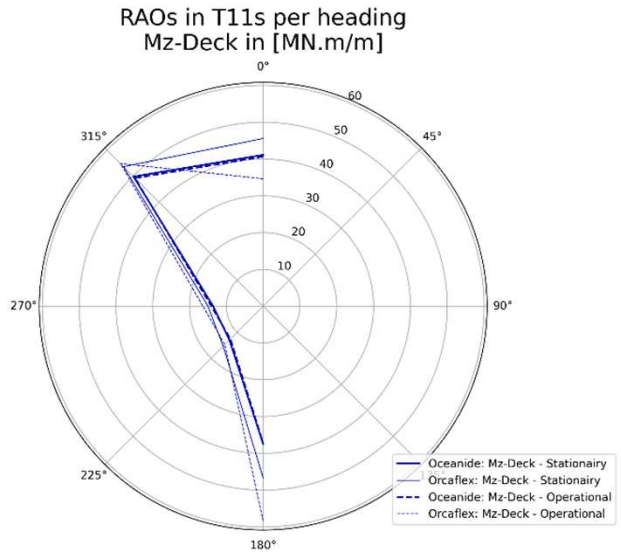
- A lot instrumentation:
  - 7 wave probes
  - 1 current probes
  - 1 Krypton camera (motion measurements)
  - 8 internal loads
  - 3 mooring loads
  - 2 mooring excursion loads
  - 6 speed controlled fans
  - 9 tower accelerometers
  - 3 wave run-up probes
  - 2 high-speed, high resolution cameras
  - (1 drone)
- All proofed solvable, but:
  - 4 weeks delay
  - 90 tests took 5 weeks
  - Multiple corrections necesary months after the tests
- Software-in-loop worked immediately
  - Requested wind drag/thrust matched closely to measured values

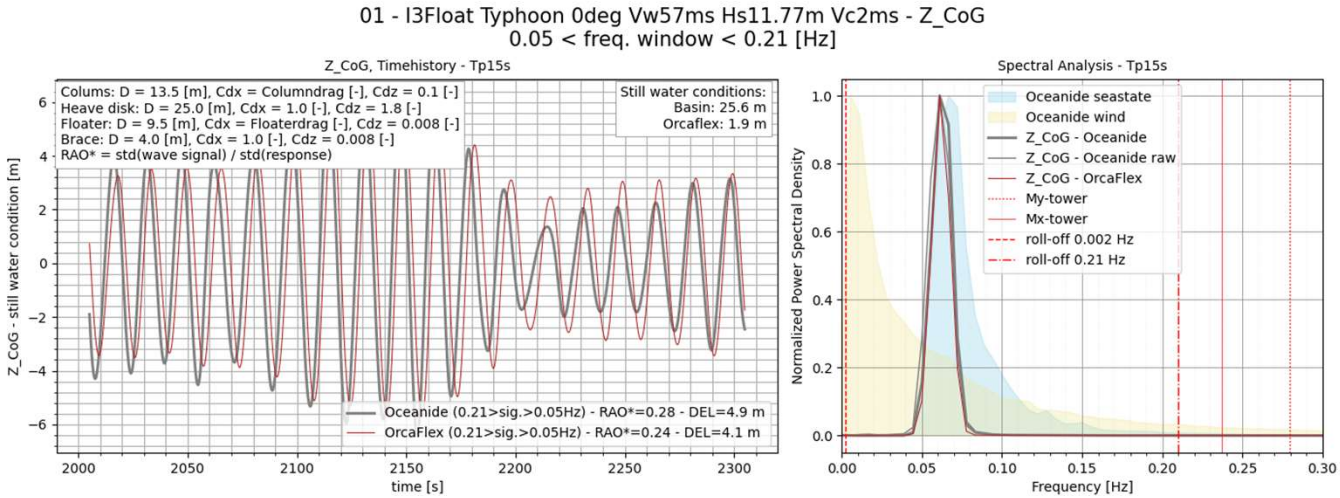


Typhoon test

- Second order effects not seen in Orcaflex get visible:
  - Wave run-up on column
  - Slamming on Decktube → No substantial impact measured on internal loads
- Tower started shaking
  - Solvable with filters
- … a mooring line broke







Most important test results

- Motions predicted by OrcaFlex correlate well
- Internal forces correlate reasonably
- In basin: Current drag less than surge decay drag (Tn = 80s)
  - Reynolds dependency?
  - Strouhal dependency?

  → Appears solvable with Reynolds dependency

Conclusion

- ✓ The numerical model was properly validated and found to be representative
- ✓ Numerical design loads (typhoon) have proved representative
- Complexity:
  - Coupled basin tests with floating wind turbines are **not simple:**
    - Hydro-Aero mechanic coupling
    - Ballast systems
    - Measuring of structural loads (mostly driven by inertia)
  - But was our focus on simplicity sufficient?

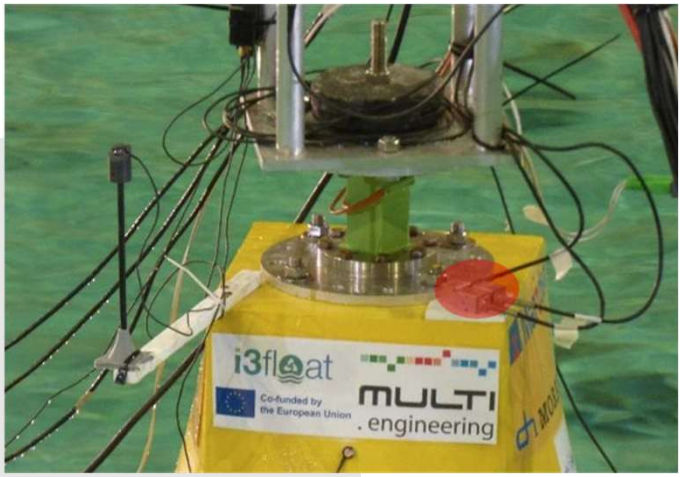
→Tests are used to reproduce numerical simulations, but shouldn't it have been the other way around?

→ Allow for yaw misalingment wave/wind and adapt OrcaFlex → simplified tower

→ 2 lineair moorings, rather than demanding a non linear stiffness curve

→ Etc.

→Stiffness checks could have been done upfront



MULTI . engineering

Thank you!

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