PO.ID 078

EXPERIMENTS ON A SCALE MODEL OF A MONOLITHIC CONCRETE SPAR FOR FLOATING WIND TURBINES

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Abstract

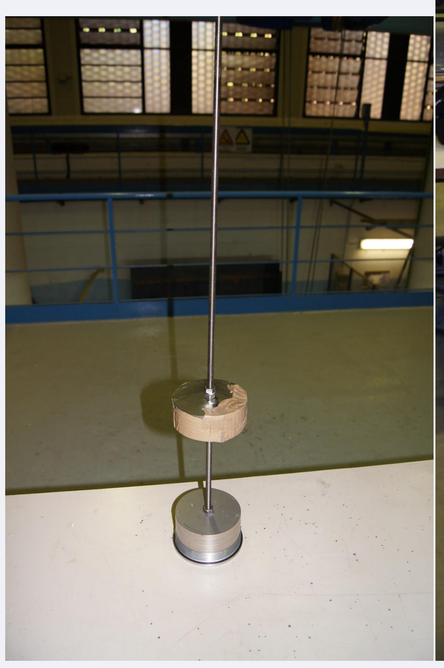
Preliminary studies of a concept consisting of a monolithic concrete SPAR platform were presented in 2014. The studies were performed in the framework of the AFOSP KIC-InnoEnergy project (Alternative Floating Platform Designs for Offshore Wind Towers using Low Cost Materials) showing significant CAPEX and OPEX reductions. The experimental phase of the project was developed during 2014.

The experiments comprised a set of hydrodynamic tests performed in the CIEM wave flume facility at the Universitat Politècnica de Catalunya (UPC), with a 1:100 scale model. The complete experimental campaign included free decay tests, a set of 22 regular wave trains of different periods to determine the RAO's and another set of 21 regular and irregular wave trains in conjunction with a mechanical wind device, simulating the mean thrust force exerted by the wind turbine.

The Scale Model

The scale model was manufactured using aluminum as base material. All the external dimensions were properly scaled from the prototype, in 1:100 scale assuming Froude similitude, including the tower to allow the scale model to be suitable for other type of tests.

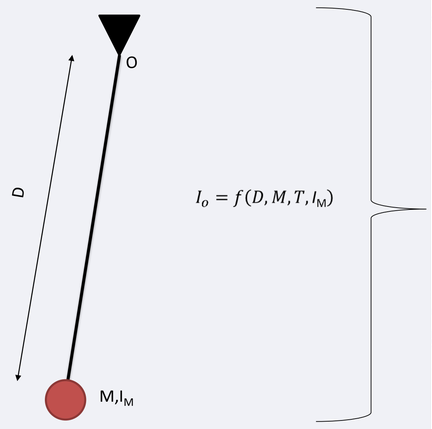
An adjustable ballasting system was used to fit both the total weight, the center of mass and the overall inertia.



Mooring system

The mooring system was designed as a scaled truncated mooring system using catenary lines and dead weight anchors as main components that fits the prototype mooring system. The system was tested to check the real stiffness of the moorings.

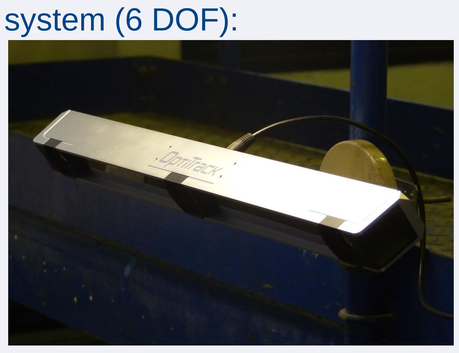
Physical Properties Determination



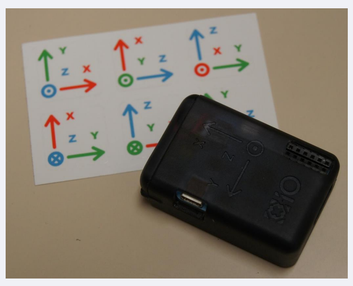
Mass, draft and center of mass were checked by conventional procedures. The overall inertia was checked by measuring the period of the scaled model pendulum motion.

Monitoring

- IR Optical Tracking system (6 DOF):



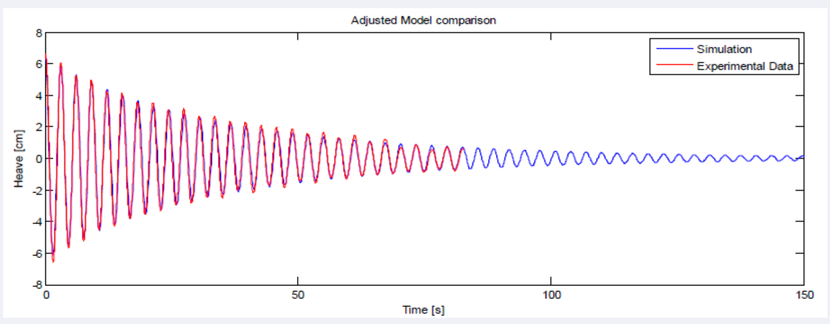
- Inertial sensor (3 DOF):



Facilities

The wave flume where the tests are carried out (CIEM) is placed in the Lab of Marine Engineering at the UPC. The CIEM wave flume is 100m long, 3m wide and up to 7m deep.

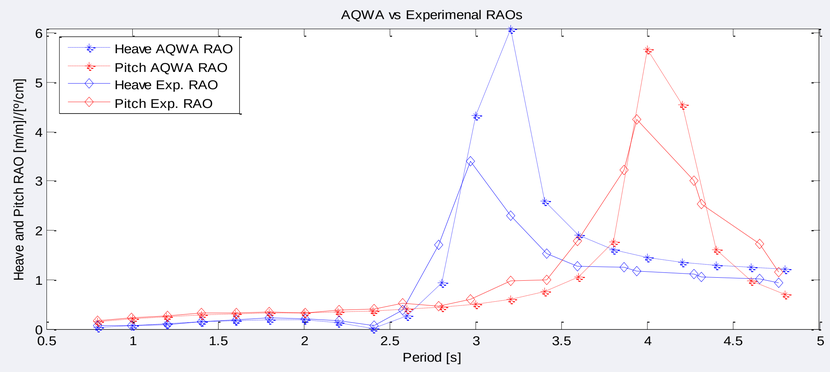
Hydrodynamics Characteristics Determination Free Decay Test



Heave, Pitch and Yaw tests were performed with and without mooring system.

RAO's

The RAO's test were performed in the wave flume where the platform was exposed to several regular wave trains with a constant 6 cm wave height, and periods from 1.0 s to 4.8 s.



Conclusions

A description of the methodology for the experimental campaign is presented, including the adjustment and checking of the final properties of the manufactured scale model, the mechanical wind device system design and configuration as well as the monitoring used during the tests.

References

1. Molins,C.;Campos,A.;Sandner,F.;and Matha,D., "Monolithic concrete off-shore floating structure for wind turbines," in *EWEA 2014 Barcelona*, 2014, pp. 107–111.
2. Chakrabarti,S., *Handbook of offshore engineering Vol 1 & 2.* Elsevier, 2005.
3. Molins,C.;Matha,D.;Sandner,F.;Campos,A.;Trubat,P.; and Roca,P., "AFOSP WP2: Prototype Conceptual Design. D2.2 Prototype pre-design," 2013