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New Onshore Wind Turbine Foundation System for Poor Soil

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The main aims

1) To investigate the geotechnical behavior of the new foundation solution (raft with a water tank).
2) To compare the new solution with the most common foundation system (piled raft).
3) To investigate the dynamic behavior of the new foundation solution.

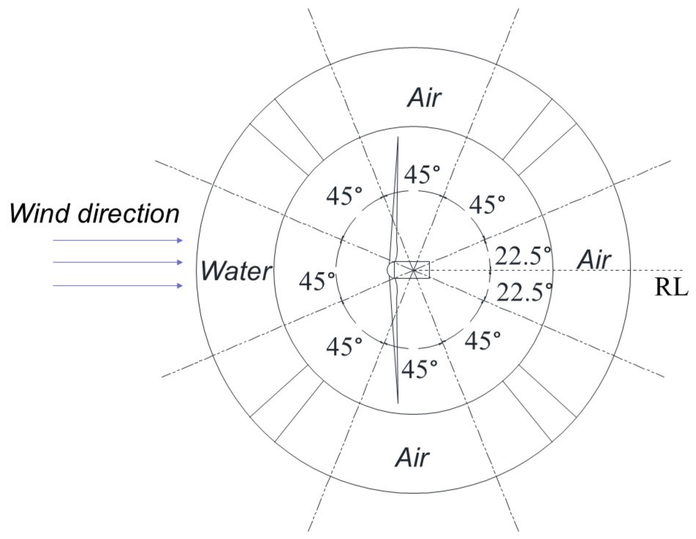
Conclusions

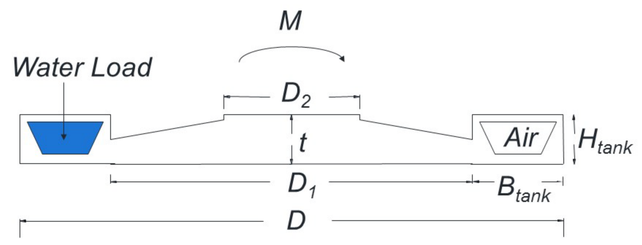
1) A piled raft with a pile length equal to 24 m and a pile diameter equal to 0.5 m is used to get tilting less than the allowable value.
2) Using a raft with a water tank decrease the foundation cost by almost **28%** compared to using a piled raft.
3) Using a raft with a water tank increases the settlement by **37%** and decreases the tilting by **16%** compared to a piled raft.
4) Using the new foundation system successfully avoids resonance through the rotor excitations.

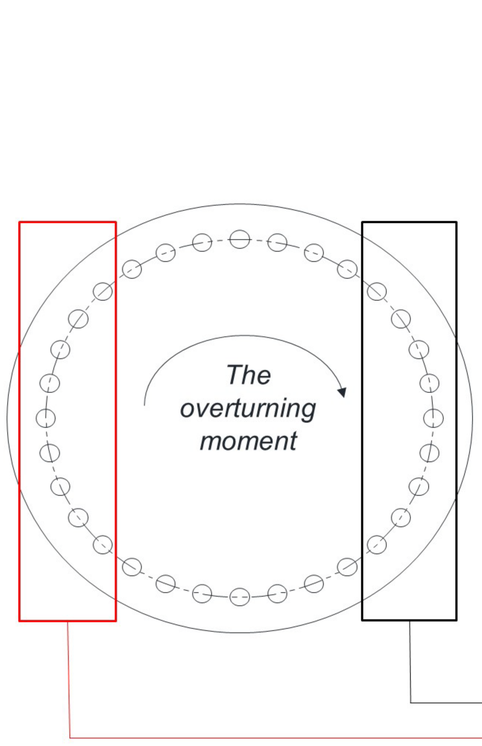
Foundation Description

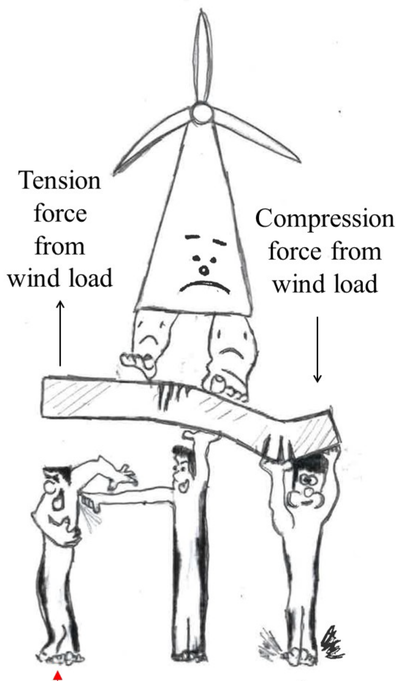
The idea of using a raft surrounded by a water tank involves:

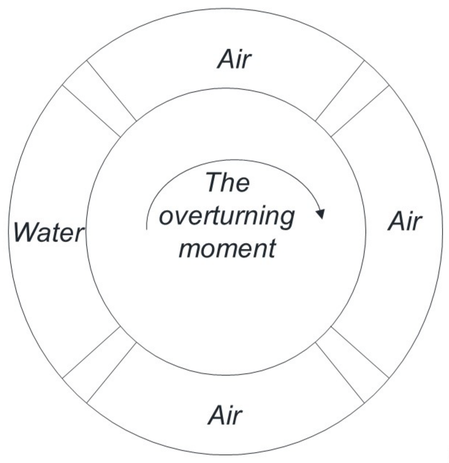
1) Make a stabilizing moment using water to resist the overturning moment.
2) The moving of water with the wind turbine movement.
3) A water tank divided into four compartments being connected.
4) A system to move water between the compartments.

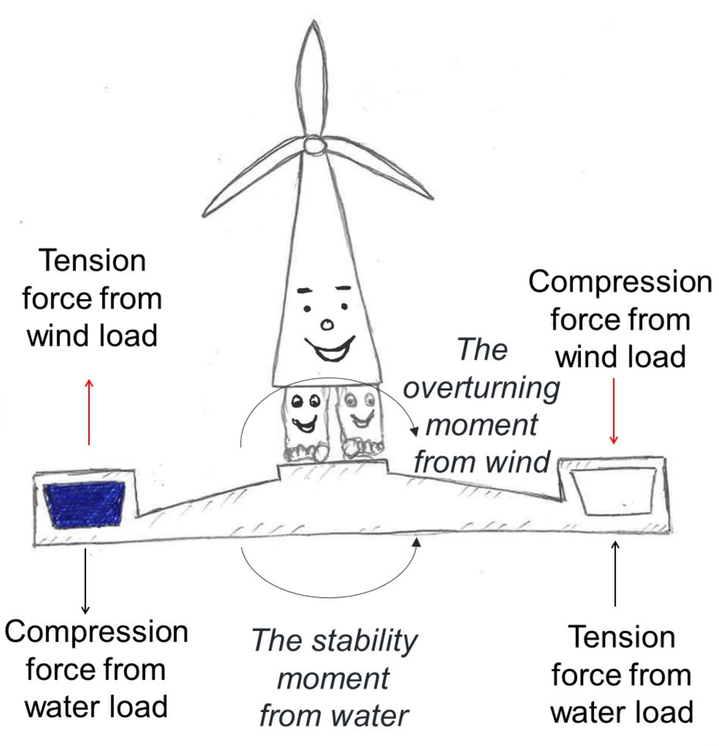






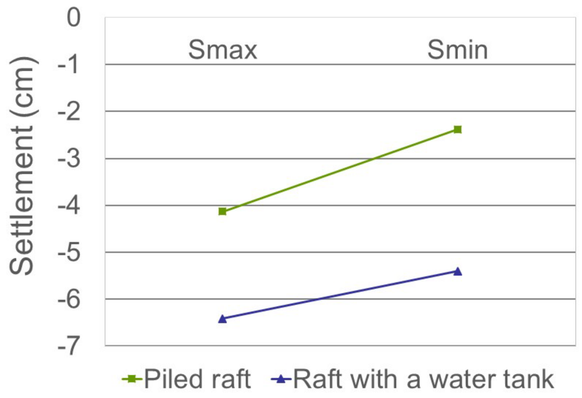






Results

Settlement and tilting

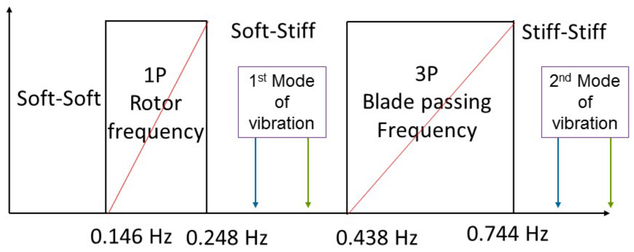


The maximum and the minimum settlements for a raft with a water tank 4m by 2.5 m and a piled raft with a pile legth equal to 24 m.

Cost Comparison according to the Egyptian construction costs

	Piled raft	Circular raft with a water tank	Cost in Egypt (USD)
Volume of Reinforcement concrete (m^3)	771	739	180/m^3
Steel weight (tons)	60	56	1325/ton
Pile (drilling + material) (m)	600	0	380/m
Excavation (m^3)	1131	1131	12.5/m^2
Water system	0	24 Motors + 32 Pipes + 128 valves	110400
Total Cost (USD)	460000	332000	

Dynamic response



Forcing frequencies plotted against power spectral density for Vestas V90-2.0 MW wind turbine

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