

The Influence of Rotor Weight on the Coefficient of Performance of VAWT

Study Approaches

- Study the Weight effect by a Transient CFD analysis using dynamic meshing and 6 DOF solver. The rotor weight changed by applying different masses and moments of inertias calculated by the CAD model.
 - The calculated rotor masses based on rotor configurations optimization are as follows (1.1 kg, 4.8 kg, 22 kg)
 - A constant wind speed of 10 m/s is considered in the CFD study.
 - The results plotted in Figure 1
- Study the weight effect by changing the number of blades using the Multiple Streamtubes Model, MSTM. embedded in Qblade.
 - The selected Number of blades are (2, 3, 4, 5, 6, 7, 10).
 - A constant wind speed of 10 m/s and a constant chord of 0.06 m are considered.
 - The results are presented in Figure 2 and Figure 3.

Conclusions:

1. The lighter rotors are much better than heavier ones. specifically, at low wind speeds where lower starting torque is needed to overcome the moment of inertia MOI.
2. There is an optimum number of blades that perform well without increasing the rotor weight too much.

Cp plots for Different Rotor Weight:

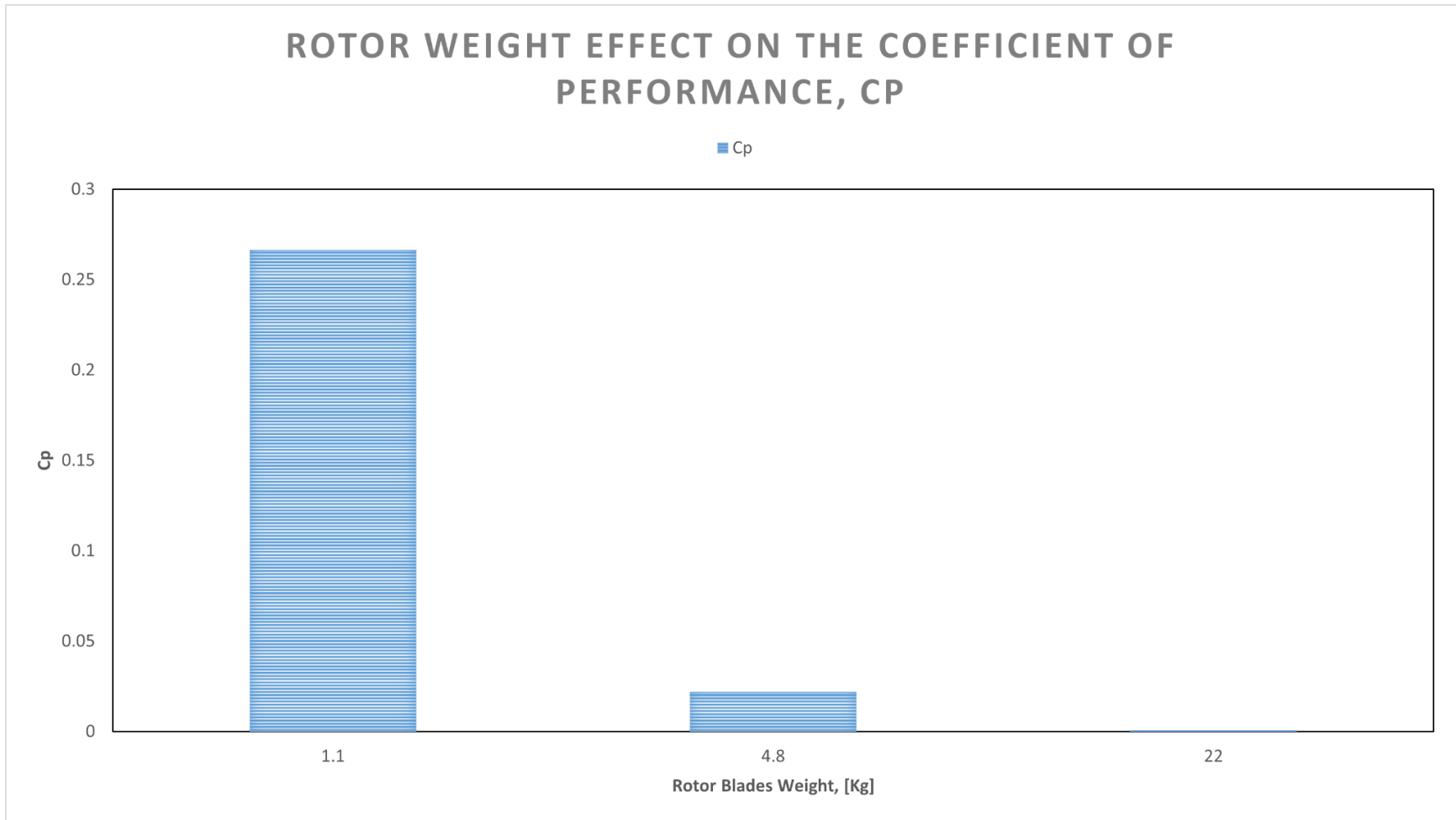
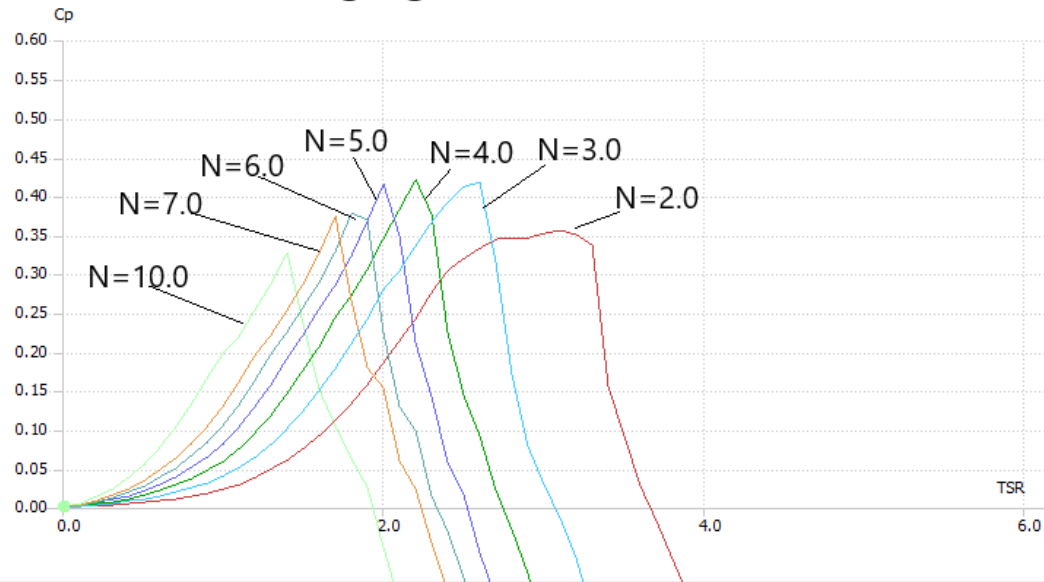


Figure 1

Performance Curves at different blade numbers:

Rotor Weight effect on Coefficient of Performance [Cp] by Changing the Number of Blades [N]



- New Blade sigma 0.75 Re5e6 AR=4.0
New Blade sigma 0.75 Re5e6 AR=4.0 Simulation
- New Blade sigma 0.75 Re5e6 AR=4.0 N=10.0
New Blade sigma 0.75 Re5e6 AR=4.0 N=10.0 Simulation
- New Blade sigma 0.75 Re5e6 AR=4.0 N=2.0
New Blade sigma 0.75 Re5e6 AR=4.0 N=2.0 Simulation
- New Blade sigma 0.75 Re5e6 AR=4.0 N=4.0
New Blade sigma 0.75 Re5e6 AR=4.0 N=4.0 Simulation
- New Blade sigma 0.75 Re5e6 AR=4.0 N=5.0
New Blade sigma 0.75 Re5e6 AR=4.0 N=5.0 Simulation
- New Blade sigma 0.75 Re5e6 AR=4.0 N=6.0
New Blade sigma 0.75 Re5e6 AR=4.0 N=6.0 Simulation
- New Blade sigma 0.75 Re5e6 AR=4.0 N=7.0
New Blade sigma 0.75 Re5e6 AR=4.0 N=7.0 Simulation

Figure 2

WEIGHT EFFECT ON CP BY CHANGING NUMBER OF BLADES

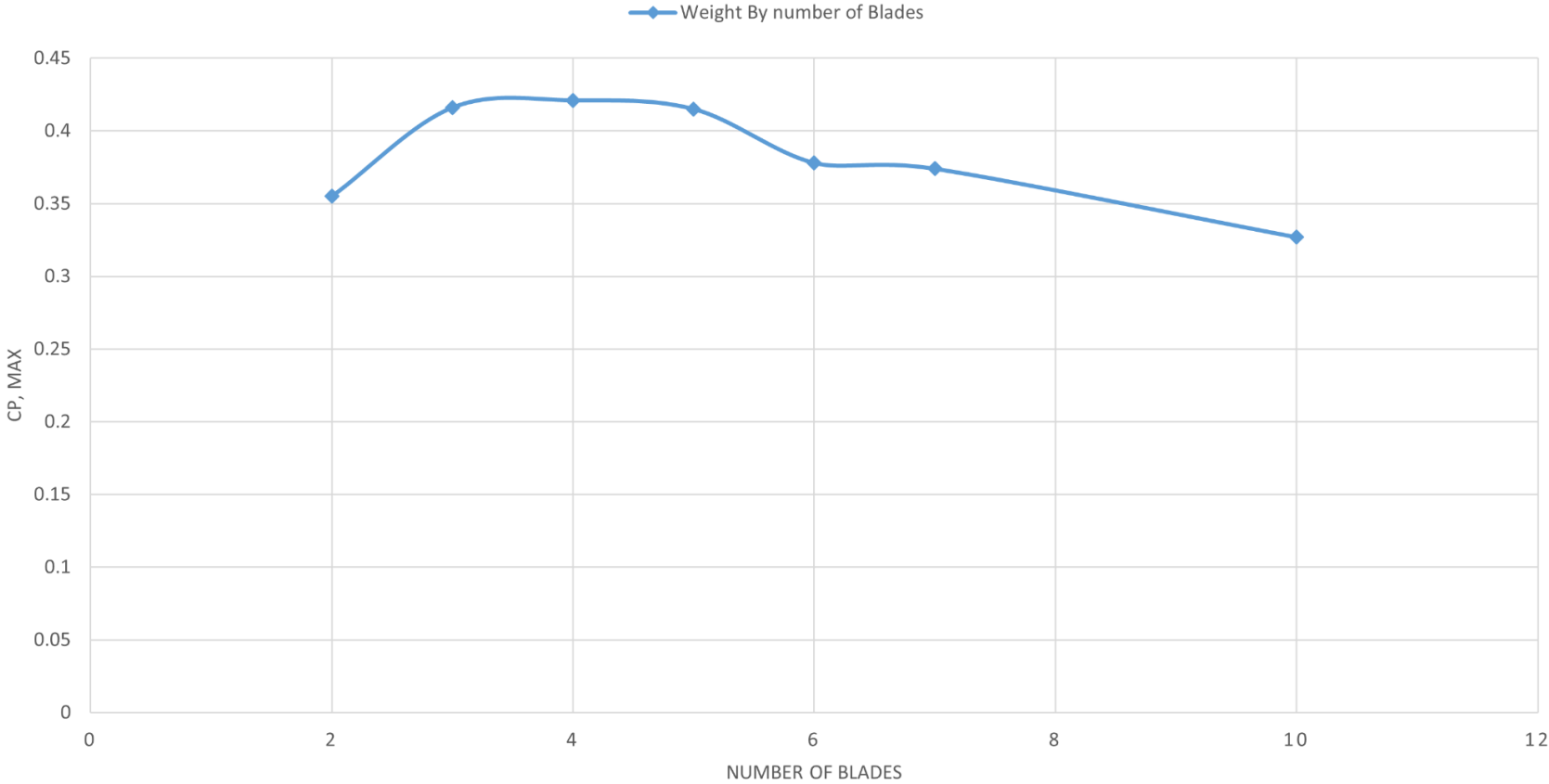


Figure 3