WINDCYCLE
Recycling The Wind Energy Future

Design of Wind Turbine Blade

Design Procedure:

1. Set a constant Swept Area of the turbine rotor.
2. Assume a number of blades.
3. Assume a range of rotor Aspect ratios AR.
4. Calculate the Radius and Height of the Rotor based on the constant area and the assumed ARs.
5. Assume a number for the Rotor solidity.
6. Calculate the Airfoil chord length based on the assumed number of blades, Solidity, R, and calculated Radius.
7. Model these parameters in Qblade, Then simulate them to get the expected performance curve of Cp vs TSR.
8. After a bunch of trials and parametric studies, we select a total of 3 versions. Two of them are showing superior performance and one with mediocre performance.

Conclusions:

1. Even with different Solidity, the Slender VAWTs with Higher Aspect Ratios are better in performance than Wider VAWTs (lower Aspect ratios.
2. The higher the solidity, we got the maximum performance early at a lower Tip speed ratio. which allows us to get VAWTs with low RPM which means low noise levels.
3. Increasing the AR to about 10 results in superior performance. The predicted maximum Cp is near the Betz limit.
4. Increasing the number of blades has a tiny effect on the maximum Cp but it helps in getting lower TSR at Cp, max.

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Table of Selected versions:

Version No.	#1	#2	#3
Geometrical Parameters			
Swept Area [m^2]	0.5		
No. of blades	3		
Rotor Aspect Ratio, AR=H/R [-]	10	4.0	0.5
Rotor Radius, R [m]	0.158	0.25	0.707
Rotor Height, H [m]	1.58	1.0	0.3535
Rotor Solidity, σ [-]	0.75	0.75	0.3
Airfoil Chord Length, C [m]	0.0395	0.0625	0.0707
Expected Performance			
Cp,max.	0.577	0.416	0.0394
TSR, @ Cp,max.	2.51	2.61	2.81

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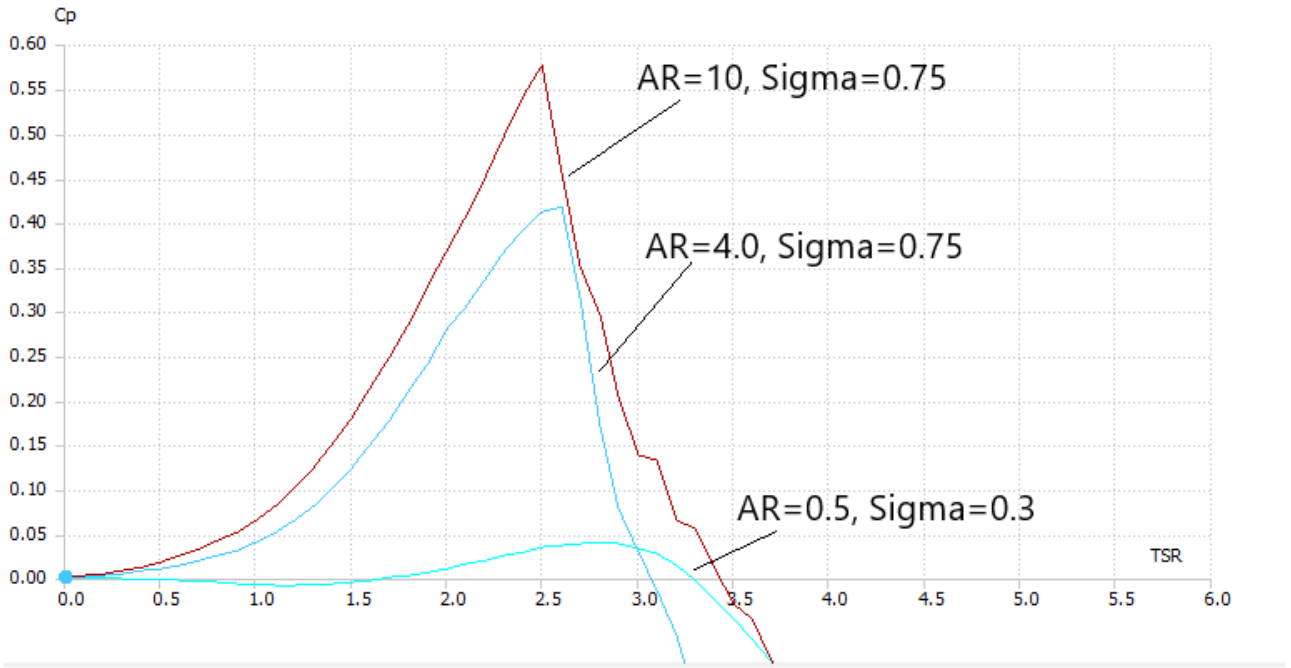
Performance Plot of The selected Versions:



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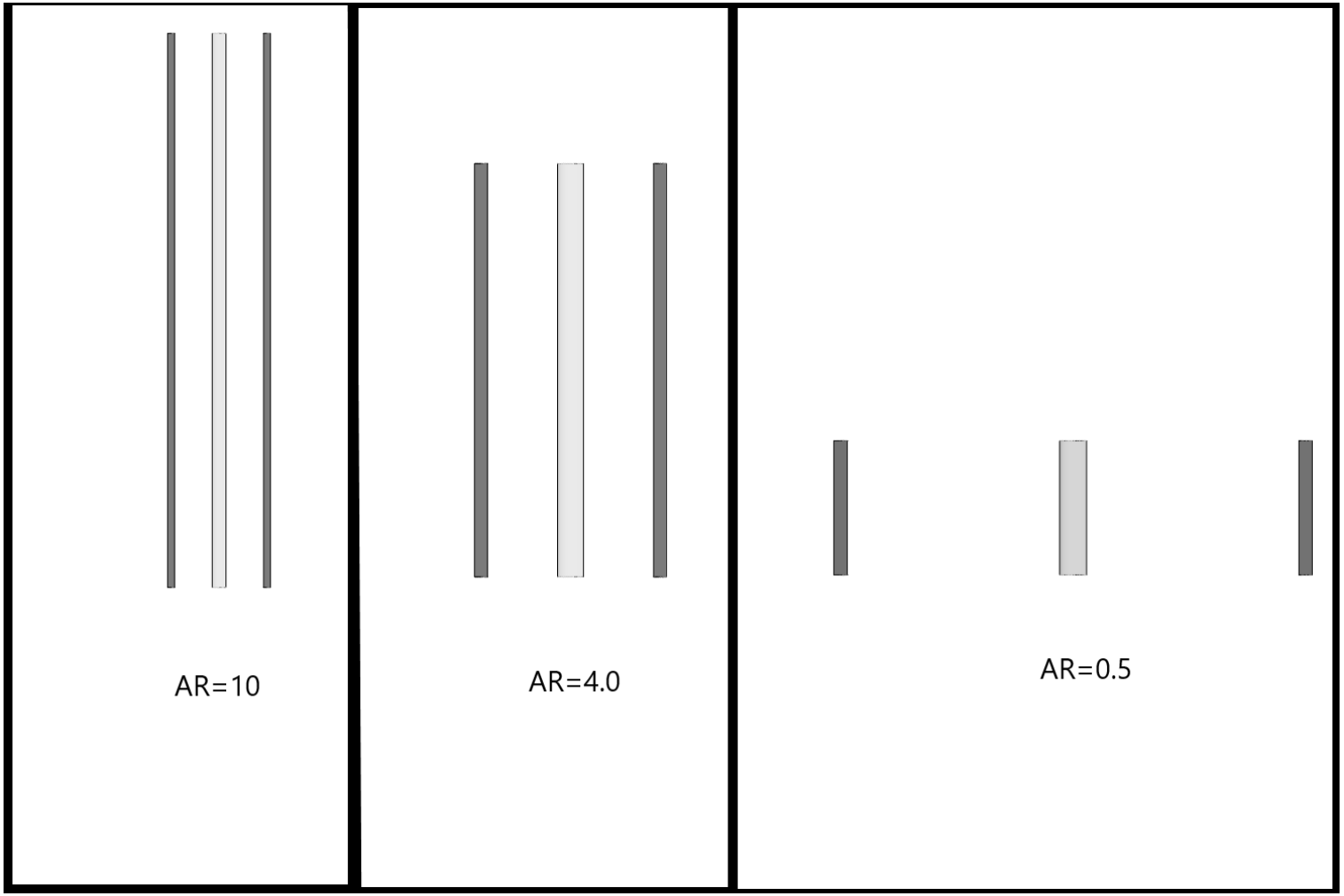
Model Comparison of the 3 Versions:



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