

# **Analytical and Experimental Study of the Integral Aerodynamic Characteristics of Low-Wind Turbines**

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## **Abstract**

This work presents experimental and analytical results for a horizontal axis wind turbine designed for operation at low wind speeds. This is dictated by the need to develop wind turbine farms at remote areas where average annual wind speeds are below 7 m/s. The key idea behind the proposed concept is the use of a two-element blade. The relative position of the elements is optimized for performance.

A closed-circuit, low-speed wind tunnel with open test section is used for a set of measurements on a simple wind turbine with blades made out of the CLARCK Y section without any blade twist. The experimental data is compared with results from the literature in Figure 1 [1] where the efficiency of various wind turbine types is also presented. The results suggest that good efficiencies can be obtained even at low wind speeds if the two lifting elements of the blade are positioned in an optimal way. In addition to the experimental work, an analytical method has also been developed for flapped-blades wind turbines based on the blade element momentum approach.

Experimental and analytical studies suggest that the wind turbine with flapped blades design is a sound concept, and can offer a realistic alternative to conventional horizontal-axis wind turbines because of its good power efficiency at low tip speed ratios. This also means that this wind turbine has low noise level due to its lower tip speed. The proposed configuration achieves the best performance at wind speeds of 4-7 m/s and is therefore suitable for installation at low-wind fields.

## **Acknowledgements**

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## References

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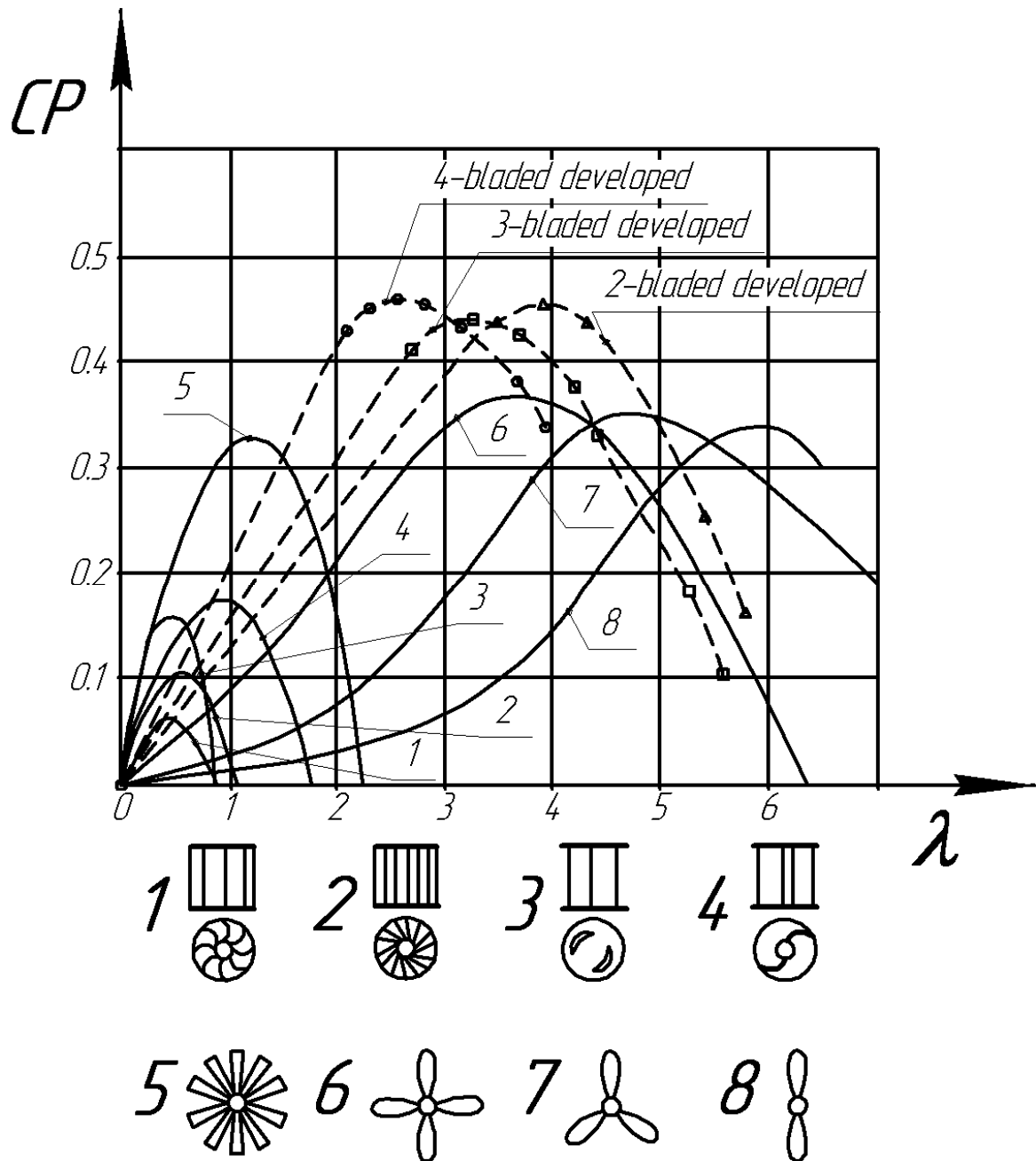


Figure 1. Comparisons of efficiency between the proposed design, and conventional configurations.  $CP$  is the power performance coefficient (efficiency), and  $\lambda$  is the tip speed ratio. Configurations 1 to 8 were studied in reference [1].