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Interactive comment on “Performance analysis of a Darrieus-type wind turbine for a series of 4-digit NACA airfoils” *by* Krzysztof Rogowski et al.

Anonymous Referee #1

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Interesting work. Focused on the description of the impact of changes in thickness and camber of the H-turbine blade profile on its aerodynamic properties. Changes to these characteristics are discussed without analyzing changes in the flow structure. Perhaps a separate work is being devoted by the Authors to the analysis of changes in flow structures.

General thoughts. The paper presents a rational test of the influence of the mesh size based on the number of nodes on the edge of the profile, and not on the total number of nodes.

The authors ignore the influence of the Reynolds number, but at constant wind speed, two TSR values mean two Re values at the same time. In the analyzed range of TSR values, this means a three-fold increase in Re between TSR = 2 and 6.

To explain the reasons for the change in turbine performance characteristics, it may be necessary to pay attention to the following effects. For TSR = 2, the angle of attack change is + - 30 degrees, which means fow separation. For TSR = 5, the max angle of attack change is + - 11.6 degrees, which means work without flow separation. For TSR = 2, with the blade rotation angle of 46 degrees, the profile approach angle of attack 15 degrees corresponding to the flow separation. For TSR = 3, at a blade rotation angle of 66 degrees, the angle of attack of the profile exceeds 15 degrees corresponding to the flow separation. For TSR = 4 and larger TSRs, the profile angle of attack never exceeds the critical angle of attack. The influence of flow inertia effects is not strong. Increasing TSR means only slightly increasing the rate of the angle of attack changes.

It is seen lack of basic characteristics for different profile thicknesses, although the authors provide some information. "In addition, in the case of the NACA 0012 airfoil, the decrease in lift above the critical angle is much more rapid, indicating a leading edge stall, than in the case of NACA 0015 and NACA 0018 airfoils, for which the decrease in lift is much milder and where the separation starts at the trailing edge and 300 gradually increasing with the angle of attack. "

The description is focused on the analysis of force variation. And yet the course of the curves is the result of changes in the flow structure. The changes in the flow structure cause certain effects. The symptoms are described, not the causes.

There are a number of questions that are not answered.

The dramatic change in the performance characteristics for TSR = 2 is surprising. When the camber changes, the transfer of received energy from the windward side of the cycle to the leeward one for TSR = 5 (Fig. 12) can be noticed. It seems that visualizations of flow structures for thin and thick profiles would help explain this phenomenon.

Fig. 12 clearly indicates a shift in the generation of mechanical energy from the windward half cycle to the leeward half cycle. Why? What is the reason for this behavior?

Is the sum correct?

Declines in tangential forces are observed in some phases of movement (windward side) and increases in others (leeward side). What are the effects within a single cycle? Are the turbine powers falling or rising? Or are they the same? What are the reasons for this? Why does a strongly cambered profile generate small tangential forces in the windward phase and large ones with the leeward?

The conclusions are correct, but drawn from other materials than those shown in the work. "âĂć Although the NACA 0012 airfoil has the largest maximum lift coefficient of all symmetrical airfoils tested, it gives the worst results of the tangential blade load in the low tip speed ratio range. This is due to the worse airfoil characteristics in the detachment area compared is thicker airfoils. "

"âĂć The analysis showed that symmetrical airfoils are much worse at low tip speed ratios. This is because of the worse characteristics of these airfoils in the stall regime. The introduction of one percent maximum camber greatly improves the aerodynamic performance of the rotor over the entire tip speed ratio range. " Will the cambering of a thin profile work similarly?

"âĂć The effect of the relative airfoil thickness on the characteristics of aerodynamic blade load components is larger at low tip speed ratios, whereas, the maximum camber affects more these characteristics at higher tip speed ratios." Which chart has this conclusion been drawn from?

"âĂć The study examined the impact of tip speed ratio on the velocity distribution in the aerodynamic wake of a rotor equipped with NACA0018 airfoils. Numerical analysis showed that as the tip speed ratio increases, there is a linear decrease in the average velocity Vx (velocity component parallel to the wind direction) of these profiles. " This is a wake area, so isn't it obvious that receiving energy from the flow, as indicated by the increase in power factor in Fig. 11, must be reflected on the longitudinal velocity component in the wake.

Specific comments.

Fig. 4. No angle definition around the perimeter. It is in fig. 3.

Surrounding the 220 line unclear description. Line 220 - general information about Dx is given

It seems that Dx is incorrectly defined because it depends on TSR. Should it depend more on the speed? It is rather important how far the disturbance moves away at the flow speed to not affect the flow around the profile.

No 0.3. but 0.03

2.6.1 Unclear description

The definition of Re appears to be incorrect, no inflow speed.

240 - unclear sentence.

2.6.2 Unclear assumptions.

3.1. 3 blades?

Different chart scales (Fig. 10) do not allow checking the information given in the text. No zero axis.

What is the angle of attack corresponding to a 52 degree circumference angle?

The explanation for line 300 is good, but no hard arguments.

Mistake in description of Fig.12, is Normal should be Tangential

Fig. 11 and Fig. 13 - the form of the charts should be supplemented with charts containing lines for thickness and bending parameters. Existing charts are clear, but numerical values are difficult to read.

There is no graphic background - comparison of flow structures.

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Discussion paper

Perhaps the authors' assumption was to limit the information provided in the work to the description of changes in forces. They use software that can provide much more information about the flow and enable them to obtain answers to a number of questions that arose while reading the current version of the work.

The manuscript can be published in the form currently presented after removing minor errors.

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Discussion paper