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STUDY OF FLOW STRUCTURE THROUGH CENTRIFUGAL FAN AND ITS IMPACT ON MACHINES PERFORMANCE

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The widespread use of centrifugal fans in engineering practice has resulted in many geometric variations of designs in order to meet application requirements. Such applications range from large scale industrial dryers and air conditioning units, to smaller scale blowers for the purpose of augmenting heat transfer intensity in portable electronics. The requirement of fans in the industry and other applications has substantially driven the demand for high performance characteristics, low noise, and low cost units.

The paper presents some results of experimental studies of the air flow through radial fan operating in different configurations. A main tool used for detailed flow investigations was three-axial hot-wire anemometer (CTA), enabling measurement of the absolute velocity and turbulence of air flow in the Cartesian coordinate reference system. The precise positioning of the CTA probe and developed Matlab procedures for processing and analysis of the measurement data set provided an important information about distribution of the flow parameters. These results are valuable for assessing a high machinery quality and are a good base for practical verification of numerical CFD models.

Authors focused the attention to an analysis of the fan geometry, its influence on the performance and flow structure. In such rotating machines, the losses affecting its characteristics and performance are determined mainly by rotor geometry and housing shape. The improper flow path generates a number of losses, among other things; changes in flow direction, separation, acceleration/deceleration flow, mixing, friction, etc.

A significant influence of a flow structure inside the tested components has been confirmed at various configurations during machine operation. Measurements of the local velocity components gave an information about the rotor and fan performance parameters.

The spatial distribution of velocities in the inlet chamber to the rotor, as well as in the rotor exit section has been determined for two principal configurations: in the open space, and covered by external housing for two angles of spiral diffuser, see Figs.1a-1c. Complete results consist distribution of velocity components and profiles at the rotor exit and different housing position. Averaged velocity profiles at several sub-surfaces in the flow have been collected on the common diagram.

Additionally the turbulence level and intensity in the flow was analyzed. The work consist results both for an isolated rotor and constrained in the housing. In both cases, exist a zone of energy dissipation associated with high turbulence levels. Finally, an influence of turbulence level in the flow on centrifugal fan efficiency has been investigated. Fig.2. depicts a linear correlation between fan efficiency and turbulence level for two operating modes of the rotor (in free space and in the spiral housing).

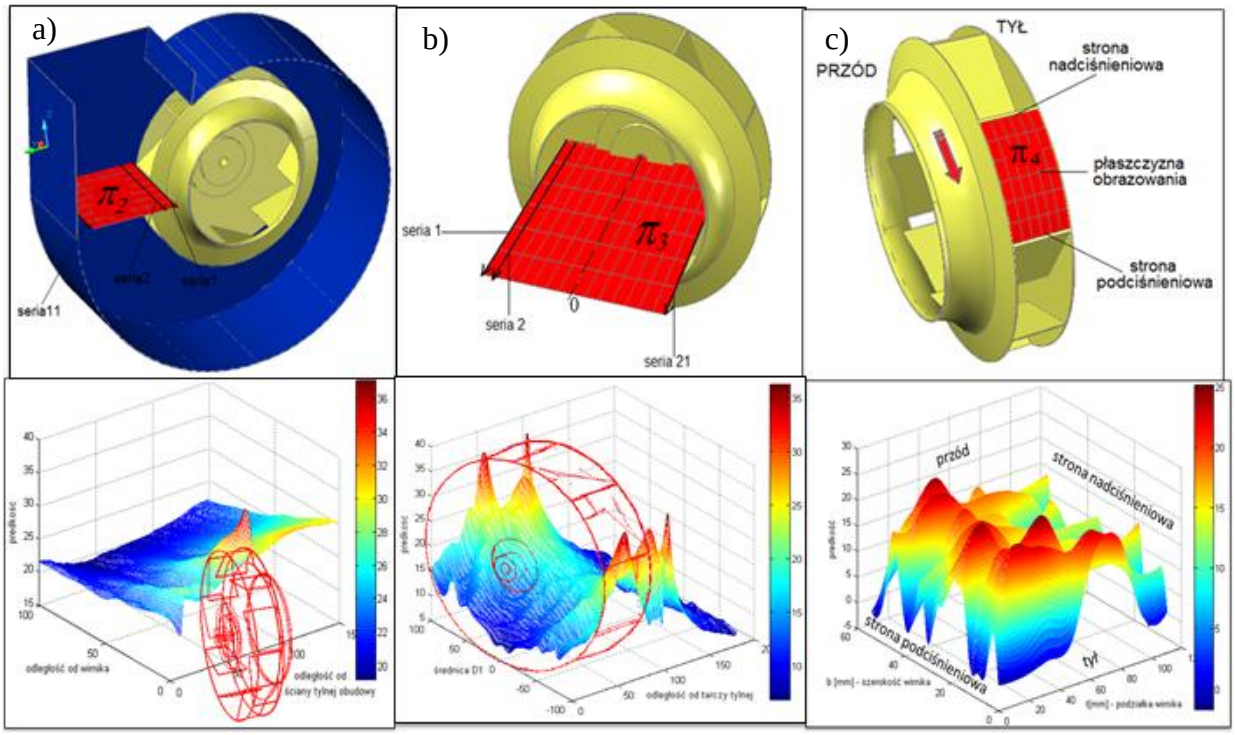

Fig.1. *Absolute velocity distributions in the selected measurement planes: a) behind the rotor (with housing), b) at the rotor inlet chamber, c) radial components in the exit blade passage*

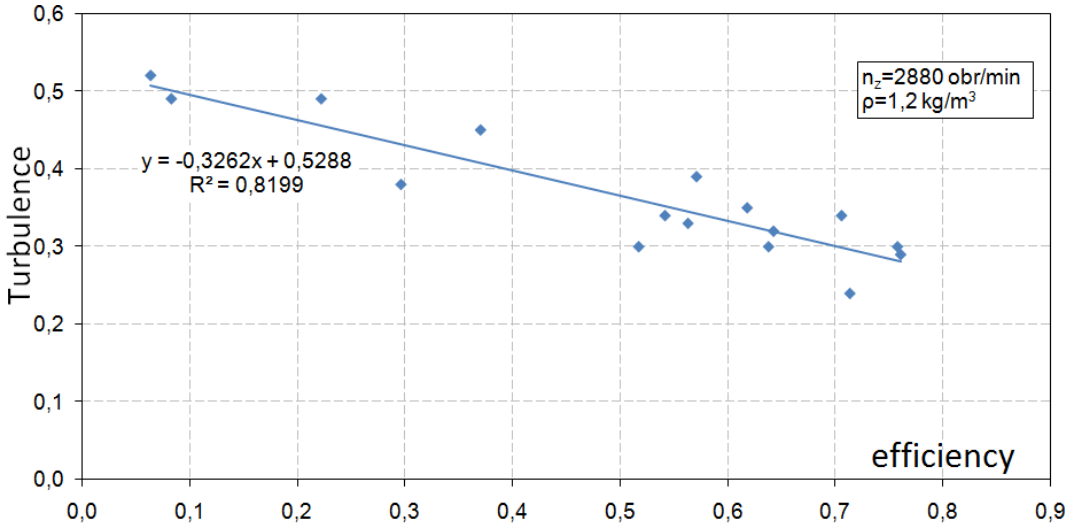

Fig.2. *Correlation between fan efficiency and turbulence*

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