Best airfoil for wind turbine

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Airfoils, the cross-sectional shape of wind turbine blades, are the foundation of turbine blade designs. Generating lift and drag when they move through the air, airfoils play a key role in improving the aerodynamic performance and structural durability of a turbine"s blades.

The aerodynamic design of an airfoil significantly impacts blade airflow. The wind turbine blade is a 3D airfoil model that captures wind energy. Blade length and design affect how much electricity a wind turbine can generate. Blade curvature, twist, and pitch all affect performance and the profile of the airfoil has a direct effect.

In the present study, three new airfoils (EYO-Series) for small wind turbine applications were designed and tested in XFOIL for aerodynamic performance at Re = 300,000. The airfoils were subsequently used to develop and test 3-bladed 6 m diameter wind turbine rotors for power generation.

New airfoils developed at NREL substantially increase the aerodynamic efficiency of wind turbine blades. The airfoil designs won a prestigious R& D 100 Award in 1991, and the Federal Laboratory Consortium Excellence in Technology Transfer Award in 1990. Nine families of airfoils have been developed.

To advance the design of a multimegawatt vertical-axis wind turbine (VAWT), application-specific airfoils need to be developed. In this research, airfoils are tailored for a VAWT with variable pitch. A genetic algorithm is used to optimise the airfoil shape considering a balance between the aerodynamic and structural performance of airfoils.

Schematic representation of laminar flow separation. a Subcritical flow regime. b Supercritical flow regime

Velocity streamlines for different flow regimes. a Short separation bubble (supercritical regime). b Long separation bubble (supercritical regime). c Unattached shear layer (subcritical regime)

The RG15 airfoil. a Theoretical profile. b Actual profile [14]

The theoretical profile of the RG15 airfoil was generated by means of the Eppler airfoil code, according to the following criteria:

Higher maximum lift than E180 airfoil.

Critical Reynolds number well below 100,000.

Higher absolute value of pitching moment than E180 airfoil.

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