

Design and Analysis of Rotor and Airfoil Configurations for Vertical Axis Wind Turbine to Harvest Wind Generated at Highways

MM Kothalawala[#], RDMHM Ariyaratne¹, HGS Hikkaduwa¹, NVL De Silva¹,
KREMSB Ekanayaka¹, MCH Chandrasiri¹, and PS Gauder²

¹Faculty of Engineering, General Sir John Kotelawala Defence University, Sri Lanka

²Faculty of Defence and Strategic Studies, General Sir John Kotelawala Defence University,
Sri Lanka

[#]kothalawala-mm@kdu.ac.lk

Wind is generated at highways due to the fast movements of automobiles. This study focused on developing a Vertical Axis Wind Turbine (VAWT) to generate electricity for highway lightning and providing an alternative method of power generation in the country by using the wind generated at the highways. The study was divided into two phases and this paper focuses only on the design and optimization of the turbine rotor to enhance its efficiency and improve self-starting capability by selecting the most suitable airfoil profile with enhanced performance. On achievement of the full design, it can be utilized as an energy-efficient vertical axis wind turbine with an automatic speed-controlling mechanism for bad weather conditions like windstorms. Characteristics of the airfoil profile are mainly affected by the performance of the wind turbine. Hence a range of National Advisory Committee for Aeronautics (NACA) airfoil profiles was analyzed using ANSYS fluent software including symmetric, cambered, thin, and thick airfoil profiles to identify the best airfoil profile. Graphs of lift and drag forces vs angle of attack from the ANSYS fluent software had shown that NACA 4415 airfoil profile has less lift force fluctuations, a high lift-to-drag ratio, and a clear stall angle. The insights of this study can be used to understand and develop the energy-efficient Vertical Axis Wind Turbine.

Keywords: *Vertical Axis Wind Turbine (VAWT), self-starting capability, airfoil profile, National Advisory Committee for Aeronautics (NACA), symmetric, lift to drag ratio*