



Performance Evaluation of a Newly Invented Vertical Axis Wind Turbine with Deflectable Blades

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The proposed mechanism is made more efficient by minimizing the friction and the force required to tilt the blades and by ensuring perfect blade orientation. A workable prototype design features rotatable blades on horizontal shafts connected to a vertical axis, with a wheel-and-track system linked to a yawing mechanism that turns the blades with wind direction. The turbine was fabricated using readily available materials such as PVC pipes, fittings, cardboard, metal sheets, etc.

The wind speed just before (V_1) and after (V_2) both sides of the turbine were measured at several wind speeds generated by a wind source. The $V_1:V_2$ (m s^{-1}) results are: 2.1:0.6, 2.4:0.8, 2.5:0.9, 2.7:1.0, 3.0:1.3, 3.2:1.5, 3.5:1.7, 3.9:1.9. Then the energy available in the blowing wind before and after passing the side of the turbine that captures the wind was calculated. The difference is the energy captured by the wind turbine. A part of this absorbed energy is consumed for the operation of the tilting mechanism. Since both sides of the tilting blades are well balanced, there is minimum or no energy consumed for lifting a blade. The only factor that consumes energy is friction. If friction is minimized, the captured energy can be assumed to approach the mechanical energy generated by the turbine.

The calculated power coefficient values for each incoming wind speed are: 0.98, 0.96, 0.96, 0.95, 0.95, 0.93, 0.92, 0.90, 0.89, 0.88. These results show that the Betz limit of 0.59—defined as the maximum efficiency that can be achieved by any Horizontal Axis Wind Turbine (HAWT)—is exceeded by this VAWT. From the results, it can be concluded that the efficiency of capturing wind energy of this new VAWT is higher than that of conventional Horizontal Axis Wind Turbines (HAWT), which are the most common in commercial use.

Keywords: Vertical axis wind turbines, Deflectable blades, Betz limit, Wind energy