PC – 04

Development of Model to improve the Performance of Horizontal Axis Wind Turbine

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Presently, Sri Lankan government has paid more attention to generate electricity from the renewable energy sources. As a result of that wind energy has been identified as one of the promising candidates to generate electricity in future. Therefore, performance improvement of the wind turbines under the wind condition in Sri Lanka can be important. This paper presents an attempt to develop a horizontal axis wind turbine physical model. Also through running the developed physical model, possibilities of improving the turbine performance for water pumping system was explored while identifying practical difficulties.

According to the previous studies, this kind of systems stands with a working efficiency around 25% and turbine having 65% mechanical efficiency. Wind blade profile was developed using Solidworks software and it was further analyzed using flow simulation package. Then a new wind blade profile was designed which was easier to fabricate and install. Thereafter the physical model was developed to identify the other variables and possible defects that could occur in real applications. The water pumping system, yawing system and full structure were also designed. Designed structure was analyzed using STAAT Pro structural package to identify the stress distribution.

The model was tested in Galle where it was exposed to wind to measure related parameters. Mainly focused was given to find mechanical efficiency and power co-efficient (C_p) of the rotor. This was done using parameter of the torque with respect to the wind speed. Thereby the plots power against wind speed and C_p against tip speed ratio were produced.

According to results his wind water pumping system can satisfy 22000 l/day, if it has average wind speed around 3.5m/s. Also it would be obviously at the frontier to save the electrical energy consumption. This design can be successfully used in many applications. Such as beach hotels in the Coastal area to fulfill their water pumping requirement.

Keywords: wind energy, blade profile, mechanical efficiency