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Helical Axis Wind Turbine

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ABSTRACT

Wind power is the use of air flow through wind turbine to mechanically power generators for electric power. Wind power, as an alternative to burning fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emission during operation, consumes no water, and uses little land. The net effects on the environment are far less problematic than those of non-renewable power sources. Wind farms consist of many individual wind turbines which are connected to the electric power transmission network .The main idea of the project is to increase the power output of the turbine. Vertical axis wind turbine was chosen because of its various advantages. It is easy to manufacture and installation and operation cost is low. The power produced is less when compared to horizontal axis wind turbine but it is comparatively cheap and is effective for household purposes. Fibre reinforced plastics [FRP] was used for the manufacture of the main nozzle setup whereas mild steel was used for turbine and the stand. Thus the structure was made as robust and right weight as possible. The main objective of the design is to increase the velocity of incoming air with the help of nozzles and there By increasing the power output and efficiency, The mechanisms used are made based on different calculation, keeping various aspects and parameters in mind and is the first of its kind.

Keywords:- FRP, Wind Turbine

I. INTRODUCTION

Energy is the one of the most fundamental parts of our universe. Energy is defined as "the ability to do work". Energy is used to do work like lights our cities, powers our vehicles, trains, planes and rockets. Energy powers machinery in factories and tractors on farm. There are two main sources of energy.

1) Non-renewable energy.
2) Renewable energy.

II. NON-RENEWABLE ENERGY

A non-renewable resource is a resource that does not renew itself at a sufficient rate for sustainable economic extraction. An example is carbon based organically-derived fuel. The original organic material, with the aid of heat and pressure, becomes a fuel such as oil or gas. Earth minerals and metal ores, fossil fuels (coal, petroleum, natural gas) and ground water in certain aquifers are all considered non-renewable resources, through individual elements are almost always conserved.

III. RENEWABLE ENERGY

Renewable energy is free source of energy or natural source of energy. Renewable energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves and geothermal heat.

Renewable energy resources exist over wide geographical areas, in contrast to other energy sources,which are concentrated in a limited number of countries.

Rapid deployment of renewable energy and energy efficiency is resulting in significant energysecurity,climate change mitigation, and economic benefits. The results of a recent review of the literature concluded that as greenhousegas emitters begin to be held liable for damages resulting from greenhouse gas emissions resulting in climate change, a high value for liability mitigation would provide powerful incentives for deployment of renewable energy technologies. In international public opinion surveys there is strong support for promoting renewable sources such as solar power and wind power.

IV. LITERATURE REVIEW

Niranjana.S.J investigated the power generation by vertical axis wind turbine. In this paper the power is generated by fixing the wind mill on the road high ways. When the vehicle is passed through the road at high speed the turbine of the wind mill rotates and generates the power sources. This analysis indicates that the vertical axis wind turbine can be able to attain the air from all the direction and produces the power of 1 kilowatt for a movement of 25 m/s. The efficiency of vertical axis wind turbine can be increases by modifying the size and shape of the blade.
Abmjit N Roy et al. analysed the design and fabrication of vertical axis economical wind mill. This paper indicates that vertical axis wind mill is one of the most important types of wind mill. In this main rotor shaft is connected to the wind turbine vertically with the generator and gear box which can be placed near the ground. Performance characteristics such as power output versus wind speed or versus angular velocity must be optimized in order to compete with other energy sources which make the process economically and eco-friendly. The experimental result shows that wind turbine is placed on the top of the building in an ideal position to produces electricity. The power generation becomes easy and it is used for various applications such as street light, domestic purpose, agriculture etc.
AltabHossain et al. investigated the design and development of A 1/3 scale vertical axis wind turbine for electrical power generation. In this paper the electricity is produce from the wind mill by wind power and belt power transmission system. The blade and drag devices are designed in the ratio of 1:3 to the wind turbine. The experiment is conducted by different wind speed and the power produced by the windmill is calculated. The experimental result indicates that 567 W powers produced at the speed of 20 m/s while 709 W powers produced at the speed of 25 m/s. From this, the power production wills increases when the velocity is high.

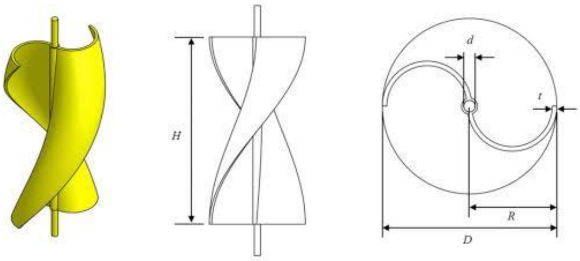
V. COMPONENTS USED

Components used in this project are:

1. Main shaft.
2. Support strips.
3. Blades.
4. Bearing.
5. Iron base.

WORKING PRINCIPLE OF HELICAL AXIS WIND TURBINE

A wind turbine works on a simple principle. This figure shows how energy in the wind turns two or three propeller-like blades around a rotor. The dynamo is connected to the main shaft, which spins a generator to create electricity. Wind turbines are mounted on a tower to capture the most energy. At 100 feet (30 meters) or more above ground, they can take advantage of faster and less turbulent wind. Wind turbines can be used to produce electricity for a single home or building, or they can be connected to an electricity grid for more widespread electricity distribution.



(a) 3D representation (b) Side view (c) Top view

Schematic representation of blades of HAWT

Fig : Working model

SELECTION OF ASPECT RATIO, BLADEHEIGHT AND DIAMETER

For vertical axis helical blade wind turbine,

Selected aspect ratio = 1.2

Selected blade diameter (d) = 800 mm

Aspect ratio = h/d=1.2

= h/800 = 1.2

Blade height = 1000 mm

CALCULATION OF SWEPT AREA

Swept area of wind turbine = h*d

Height of blade (h) = 1000 mm

Diameter of blade (d) = 800 mm

Swept area = 1000*800 = 800000 mm^2

REYNOLDS NUMBER

We can generate more power when the air flow is turbulent.
The Reynolds number for turbulent flow Re= $5^5\times10$

Re = ρ×V×d/υ ----- (1)

Where,

ρ= Density of air = 1.201kg^3/m
V= Velocity of wind blower =10m/s
d= Diameter of Rotor=800mm

υ= kinematic Velocity =1.8×10^{-5}
Substituting the above values in equation 1
Re = (1.201×10×0.8) / (1.8×10^{-5})
Re=5.3377*10^5

CALCULATION OF POWER OUTPUT

Power output (w) = 1/2*ρ*A*V^3*ηT*ηg
Where,
ρ=air density(kg/m^3)
A=sweep area (m^2)
V=wind velocity (m^2/sec)
ηT=wind turbine efficiency
ηg=generator efficiency

APPLICATIONS OF FRP MATERIAL USED IN HVAWT

Fibre Reinforced Polymer (FRP) composites are used in a wide variety of applications.
FRP are best suited for any design program
FRP can also applied for strengthen the beams, columns and slabs of buildings and bridges.

ADVANTAGES:

They can produce electricity in any wind direction except top and bottom.
Strong supporting tower is not needed because dynamo and other components are placed on the ground.
Low production cost as compared to horizontal axis wind turbine.
The helical orientation of the blades often results in these devices being quieter than standard turbines.
Easy installation as compared to other wind turbine.
Calculation of power and efficiency generated by helical axis wind turbine

Table : At Normal Weather Conditions

S.NO	Time	Wind Speed N (rpm)	Wind velocity V (m/s)	Wind Power IP (wt)	Current Generated I (amp)	Power Produced OP (wt)	Overall Efficiency (%)
1.	9:00 AM	58	2.43	7.03	0.81	1.040	14.8
2.	4:00 PM	60	2.52	7.81	0.94	1.179	15.1
3.	8:00 PM	62	2.60	8.61	0.102	1.31	15.3

S.NO	Time	Wind Speed N (rpm)	Wind velocity V (m/s)	Wind Power IP (wt)	Current Generated I (amp)	Power Produced OP (wt)	Overall Efficiency (%)
1.	9:00 AM	220	9.21	382.8	7.41	94.93	24.8
2.	4:00 PM	243	10.17	516.63	7.56	96.84	25.3
3.	8:00 PM	262	10.97	647.87	7.66	97.93	25.6

Table-: At Hilly Areas with Blower

$$\text{Average efficiency} = \frac{24.8+25.3+25.6}{3}$$

$$=25.23\%$$

VI. CONCLUSION

These turbines are comparatively easy to build and the investment is also high when compared to the HAWTs. Since the turbines are smaller in size, they can be only used for low power applications such as for powering streetlights or the toll plazas. Moreover, they may also be used to power the advertisement hoardings. An advantage is that they can catch wind from all directions except top and bottom. In addition, they can be built lower so they are less visible and can withstand much harsher environments and do not need to be shut down at greater wind speeds.In this project we have fabricated one such vertical axis wind turbine with helical blades which can be used.

REFERENCE

[1] Muhammad MahmoodAslamBhutta, Nassir Hayat, Ahmed UzairFarooq, Zain Ali, "Vertical Axis Wind Turbine Review of Various Configurations and Design Techniques", Renewable and Sustainable Energy Reviews 16 (2012) 1912-1939.

[2] Bhaumik, T.; Gupta, R.: Performance measurement of a two-bladed helical savonius rotor, IIT Madras, Chennai, 2010, India.

[3] Hau, E.: Wind Turbines, Fundamentals, Technologies, Application, Economics2nd edition, 2006, Springer-Verlag, Berlin.

[4] Manwell, J.-F.; McGowan, J.-G.; Rogers, A.-L.: Wind Energyexplained,theory, design and application, Wiley, 2002.

[5] Saha, U.-K.: Twisted bamboo bladed rotor for Savonius wind turbines,International Journal of Solar Energy Society of India, 14(2), 1994, 1–10.