DESIGN OF SERIES AND PARALLEL VERTICAL AXIS HIGHWAY WINDMILL

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Abstract:

To design parallel and series Vertical Wind Mill that will utilize the wind force developed during passing of vehicles and will adjust to different traffic levels for optimum Power output using mat lab. The benefit of the VERTICLE AXIS HIGHWAY WIND MILL (VAHW) design is that it reduces the glare from opposite direction vehicle beam lights and also lowers the turbine's center of gravity.

Key words: *DC generator, coupling pipes, blades, pipes, Battery, Matlab.*

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1. Introduction:

More usage of fossil fuel increases the global warming. The excessive energy use over the years gives impact on air pollution, global warming and climate change. Almost all countries in the world today are competing to conduct research on wind energy that is used as one of the policy option in the future energy development. Besides, it is an environmentally friendly, green, unlimited and renewable energy sources, the wind energy is less cost competitive. In day today life, without energy, we can't do anything. So we should to travel via eco- friendly energy creation.

One of the best ways of resource producing is Vertical axis highway windmill. It powered by wind coming from all 360 degrees. The main problem faced by researchers in the world today is the nature of the wind always changes and the Vehicle speed cannot be regulated. Consequently, the sustainability of wind energy resources is still not able to compensate for conventional energy generation .Lot of reasons we want to decrease or increase the voltages and current, so we move to parallel or series vertical axis highway windmill.

In this paper, the simulation of Mat lab showed a parallel and series vertical axis wind mill connected to a DC generator with characteristics of wind speed (V-wind), blade speed ratio (λ), mechanical power output, the current output, and power generator output.

2. Plants Model:

Vertical axis highway windmill is a small turbine that is used to convert kinetic energy of wind into electrical energy. Theoretically, the stronger the wind blows, the greater the mechanical energy was generated. When the mechanical energy is connected to a DC generator, the rotation of wind turbine rotor will move from machine and will produce an output voltage in the stator known as electrical energy.

Vertical axis highway windmill is windmill that is used to generate electrical energy. Due to the limited energy resources such as oils and coal, Vertical axis highway windmills are developed to

accommodate the electrical energy needs of the community. Water, wind and sunlight are renewable energy sources and the sources are not limited.

3. Principles of Wind Energy Conversion:

There are two types of wind turbines. (1) Propeller wind turbine with horizontal axis. These wind turbines should be directed in accordance with the highest wind direction speed, and (2) Darrieus wind turbine is a type of vertical axis wind turbine discovered by GJM Darrieus in 1920. The advantage of this type of wind turbine is around the turbine does not require mechanisms on wind direction.

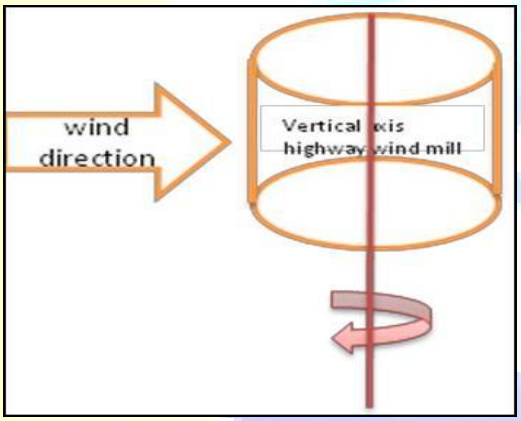

Fig1: *Vertical Axis Highway Wind Mill Direction*

4. Elementry Momentum Theory:

The kinetic energy of an air mass m moving velocity and the relative wind velocity, give velocity v can be expressed as Equation 1 [1].

$$E = \left(\frac{1}{2}\right) mv^2 Nm$$

Equation 1

$$\lambda = \frac{\Omega r}{V_w}$$

λ = Tip speed ratio Ω = Rotational velocity (rad/s)

r = Radius V_w = Windspeed

Considering a certain cross-sectional area although which the air passes at velocity V, the volume v' flow through during a certain time unit, the so called volume flow is

$$V' = VA(\frac{m^3}{s})$$

5. Designing Methodology:

This design methodology is to increase the efficiency of the windmill at first the designing steps starts with the design of windmill blades. Because this blades will mainly affects the overall efficiency of the windmill. For a particular application the wind mill blade should be in required size. Before this getting knowledge about the aerodynamic style of windmill blade in order to get the full efficiency is very much important.The various considerations are.

5.1 Wind speed:

The speed of the wind is very much important for the production of electricity in the windmill. Because in windmill we are using the wind as a raw material for the power production .this bakes the axis rotate and this axis is coupled with a dc generator and makes its also rotate and produce electricity.

5.2 Tower height and design:

The height of the tower is very much important for a windmill. In VAHW the tower is kept little sort to obtain whole air density passing from the vehicle. We also should concentrate in the design of the tower because it should able to withstand for its own weight and also in the speed of the wind.

5.3 shape of the blade:

As discussed earlier the shape of the wind mill blades is the important one if one could place an

efficient design of a blade then the efficiency of the windmill will be increased.

The various windmill shapes are as follows;

a) Flat, unmodified blade surface.

b) Wing shape with one leading edge

c) Both edges tapered to a thin line.

d) Both edges leading blade.

5.4 Tip speed ratio:

There is one major common variable between the two types of turbines, the tip speed ratio. The tip speed ratio is defined as the relationship between the rotor blade The tip speed ratio is the fundamental design parameter, around which all other optimum rotor dimensions are calculated. As the tip speed ratio increases, the efficiency of the turbine also increases.

6. Aerodynamics Blade Concept:

Vertical axis highway windmill blades are shaped to generate the maximum power from the wind at the minimum cost. Primarily the design is driven by the aerodynamics requirements but economic mean that the blade shape is compromise to keep the cost of construction reasonable. In particular the blade tends to be thicker than the aerodynamic optimum close to the root, where the stresses due to bending are greatest.

The blade design process starts with a "best guess compromise between aerodynamic and structural efficiency. The choice of materials are manufacturing process will also have an influence on how thin (hence aerodynamically ideal) the blade can be built. For instance, pre carbon fiber is stiffer and stronger than infused glass fiber. The chosen aerodynamic shape gives

rise to loads, which are fed into the structural design. Problems identified at this stage can then be used to modify the shape necessary and recalculated the aerodynamic performance.

This aerodynamic concept shows the forces and velocities cutting in a turbine.

The resultant velocity vector, W' S given by

$$W' = U' + (-w' * r')$$

Where,

U'-undistributed upstream air velocity (-w'*r') - Velocity vector of advancing blade.

Thus the oncoming velocity varies, maximum is found for $\theta = 0^{\circ}$ and the minimum is found for, $\theta = 180^{\circ}$ where θ is the azimuthal or orbital blade position. The angle of attack α is the angle between the oncoming air speed.

$$\alpha = \tan^{-1}\left(\frac{\sin\theta}{\cos\theta + \gamma}\right)$$

Here,

$$\gamma = \frac{\omega R}{U}$$

W, and the blade cords, the resultant airspeed flow and the angle of attack are calculated as follows:

$$W=U\sqrt{(1+2\gamma cos\theta+\gamma^{1})}$$

The blade turbine must place according to aerodynamic concept. All the variables related to this model definitely vary according to the environment in which it is going to be installed.

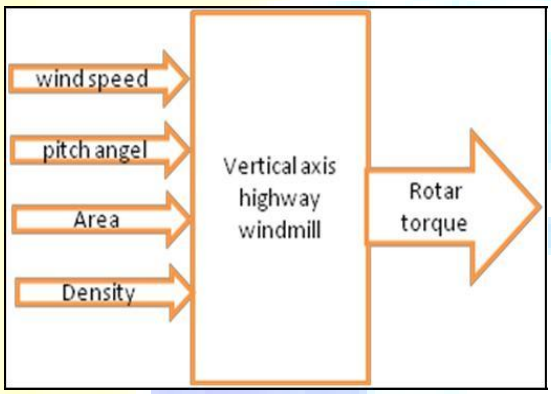

Fig2: *design parameters*

7. Design of Blades:

For the design of blades the selection material is very much important .because the material that we are selecting should be more weight less and it should able to withstand at high air pressure. For that a special grade of aluminum metal can be used it has light weight and it can able to withstand at high air pressure .the next important thing is to choose a blade shape.

The c-type blade is suitable for vertical axis highway windmill(VAHW).Because it shape can able to collect maximum air pressure and it can able to give maximum energy transformation from forced wind energy to rotational mechanical energy.

In vertical axis highway wind mill normally have four c-type blades that are placed in vertical direction. These four blades have normally separated by 90-degree angle with each other. So that in highways when vehicle passes the VAHW will rotate in clockwise direction. The wind turbine blade design has been decided and now the blades must be fixed to built the turbine.

8. DC Generator in VAHW:

The alternators or generators are the heart of the windmill and it must be properly sized to match your swept area and to produce right type of power to match your application. The unit needs to make higher voltages at lower rpms,otherwise it is not suited for wind power use, even motors can also be used a generators. In this vertical axis highway windmill we are using two dc generators coupled with the wind blade turbine.

Wind generators come in various voltages such as 12volts, 24volts and 48volts DC and in a range of currents up to 80amps at 12volts. The wind generator is a square torque machine and the output increases exponentially with increasing wind speed. Most quality wind generators come with a blade stall facility that

"stalls" the blades at high wind speed. Available also is an electrical blade lock that locks the generator on the throw of a switch. This prevents the generator turning when servicing is in progress.

Wind generator technology is very mature technology and has been used by yachtsmen for at least the last 20 years. The technology is reliable and reasonable priced. Maintenance of a wind generator is simple, just grease the front and rear bearings and check all bolts and connections on a basis.

Wind generators are capable of producing large amounts of current, up to 80amps at 12volts and should always be fitted with a charge controller containing a power dump system. Wind Generators are a cost efficient way of producing power using a sustainable energy force the wind. They indicate easily into an Hybrid Power System and work well with solar arrays. The

solar array controller can also be used by the wind generator to control and dump any excess power produced by the hybrid system. If the sun does not shine hopefully the wind will be blowing yearly

7.1 Start up Speed:

This wind speed at which the rotors starts turning, It should spin smoothly and easily when you turn it by hand, and keep spinning for few seconds. Designs that

'cog' from magnetic force or that use gears or pulley to increase shaft speed will be poor at start up. A good design can start spinning in 5 mph winds cut in at 7 mph.

7.2 Inefficiency:

Every generator has a certain speed at which it runs most efficiently. but since the wind is not constant, we must try to design to happy medium. As the wind speed rises, the raw power coming into the generator from the wind becomes more than the generator can effectively Use, and it gets more and more inefficient. This power is wasted as heat in the stator coils.

8. Operation Explanation:

This verticle axis highway windmill is placed in the highway dividers. When the air is forced by passing the vehicle from both sides the speed of a wind at the center place is higher than the pedestrain walking lane.

This wind make the VAHW to rotate at high speed and it is coupled to generator to produce electicity and the power can be stored in the battery and it is utilised iat the night time.

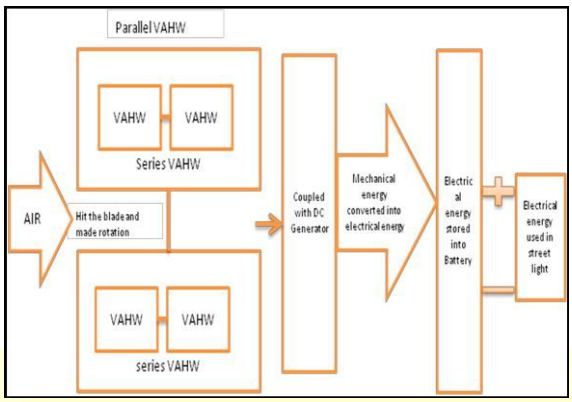

Fig3: block biagram of series or parallel vahw

This energy convertion process is explained by several following steps:

Step-1:

In the first step the forced wind and middle part of the highway will hit wind turbine blades and make a rotation in it The wind turbine blade will rotate at clockwise direction even when the vehicle move in any of the side of the highway.because thw arrangement of the wind turbine blades are in that manner.

Step-2:

The verticle axis highway windmill the wind blade turbine is couled with the two generatos .one is in the top and the other one is at the bottom of the wind turbine blades.when the turbine blade rotate the coupled generators will produce electricity in both direction.

Step-3:

Thus the mechanical energy is converted into electrical energy by using dc generator and this produced power is stored in the battery and is utilised by application wise.

9. **Simulation of Matlab:**

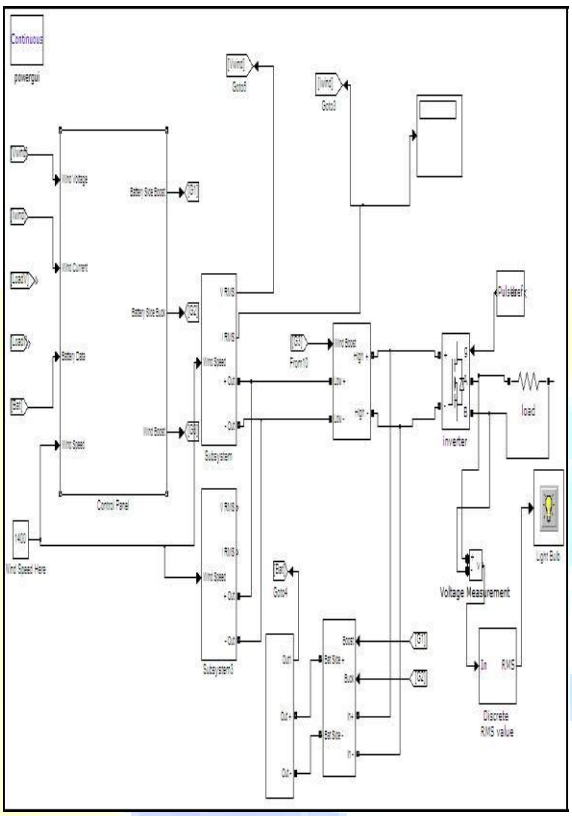

Fig4: *Block diagram of parallel or series vahw using matlab*

10. Conclusion:

This verticle axis highway windmill gives an idea about the new way of power generation and also about the new windmill technology. The power generation using VAHW is an ecofriendly methodand power produced here is almost an continuous one .By using this technology all the highways can be lightened without use of non- renewable energy resourses. And if this method is implimented in all national highways we can able to produce large amount of power.and it can also provide job for many educated fellowship.

11. Futurescope Development:

By fixing solar pannel in this vahw will increase the effeciency.

12. Acknowledgment:

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