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A Review on Traffic Wind Turbines

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A B S T R A C T

An energy harvesting device, such as highway wind turbines, can still be employed for purposes where less power is required in nations where wind energy is less economically viable. Vertical axis wind turbines (VAWT) can be used to gather this energy by utilizing the traffic passing in both directions on the sides of the highways. Using a three-bladed helical VAWT to generate electricity from the wind generated by moving cars on highways for lighting applications like highway lights, traffic signals, and light guide lines is the experimental investigation presented in this article.
A variety of locations along the sides of the roadway in various nations were used to measure the wind speed of moving automobiles and the wind power from the VAWT. Based on test results, it was discovered that the VAWT prototype can generate up to 48 Watts of power from driving cars on highways, which generate winds with an average speed of 4.4 m/s.
The wind turbine power curve is created from the observed data, and based on the power curve's best fit, an efficiency of 34.6 percent is found. This is encouraging for the work's future advancement on a commercial scale.

OBJECTIVE

The main objective of this paper is to harvest and recapture the maximum amount of wind energy from the auto-mobiles running on the highway. The unused and considerable amount of wind is used to derive the vertical wind turbine, which will use the kinetic energy of the wind to produce the electricity.

Keywords:Energy harvesting, highway wind turbine, traffic wind turbine, vertical axis wind turbine (VAWT)

1. INTRODUCTION

On the side of a busy main road leading into Dundee, on the east coast of Scotland, a small wind turbine spins in the wind of passing cars and trucks. As it rotates, it charges a battery that is below the ground. This is the prototype of an invention by Sanwal Muneer, a young entrepreneur from Pakistan, which has received funding from Shell and won an award from the United Nations. Muneer was inspired to create the turbine as he stood on the side of a Malaysian racetrack four years ago.

The turbine stands two-and-a-half metres tall. Made of recyclable carbon fibre, it weighs just nine kilogrammes, making it easy to transport and install. The fully-charged battery can hold a kilowatt of electricity, enough to run two lamps and a fan for around 40 hours. The idea is that this could be a source of electricity for rural communities in developing countries, or could power traffic lights or road signs in urban areas.Dundee City Council is the first local authority to allow Muneer’s company, Capture Mobility, to test the turbine beside its roads. “Reusing our energy is so important,”

The cleanest energy source with the fastest global growth is wind energy. The technology's biggest problem is the volatility in the wind's source. Due to the fast-moving traffic, there is an almost continual source of wind power on the roadways. The goal of this initiative is to realistically contribute to the worldwide trend towards renewable energy. Most wind turbines in use today have three air foil-shaped blades arranged around a horizontal axis.These wind turbines must be pivoted to face the wind and often need high air speeds to function. Another type of turbine has its blades vertically or transverse to the axis of rotation. These turbines must be oriented into the wind in order to function, and they generally need high air speeds. Another type of turbine has its blades arranged transversely or vertically to the axis.

Fig-1: Traffic wind turbine, when a car passes through the turbine

2. VERTICAL AXIS WIND TURBINE

These are distinguished for their capability to catch the maximum of wind from all the directions thus neglecting the need of yawning mechanism and rudders. There are two types of vertical axis turbines. They are: The Darrieus and The Savonius type.

But recent worries about the exhaustion of fossil fuels and greenhouse gas emissions have increased interest in wind power. The same principles govern how modern wind turbines work as they did in the past. They transform the wind's momentum into revolving blades' kinetic energy, which is subsequently directed into a rotating shaft. Horizontal axis wind turbines (HAWT) and vertical axis wind turbines are two subgroups that fall within this basic concept (VAWTs).

The primary justification for the development of vertical axis wind turbines is that they operate in any wind direction.The direction of VAWTs and the blade's direction cannot be changed once they are placed, hence they do not need a yaw mechanism. One of the reasons VAWTs are less expensive and hard to construct is because they lack a yaw mechanism.

2.1. Design and methodology

A new design of three-bladed helical VAWT model that was created expressly to be used on roadways to generate power displays the constructed VAWT prototype that was tested on highways. After a prototype is made, the turbine will be installed alongside a busy highway in Bhubaneswar, Orissa, India, which has a lot of moving vehicles. A battery will be used to store and measure the generated electricity. Since the electricity generated is direct current (DC), it will be connected to light-emitting diodes (LED) using the same direct current so that the highway can be illuminated.

Component	Quantities	Specifications	Material
Blades	Three	Darrieus (Helical)	Aluminum sheet
Hub	Two	Diameter = 46 cm	Cast iron
Bearings	Three	Diameter= 6 cm	Aluminum
Bearing holders	Three	Diameter= 6 cm	Aluminum
Axis	One	Length=175 cm Diameter=6 cm	Steel
Generator	One	Rotational speed= 600 rpm	Permanent magnet (AC)

Table-1: Prototypes of 3- blade vertical axis wind turbine

2.2. Wind power and output power calculation

As anemometer is used to measure the speed of the wind before it hits the turbine blades. The wind speed that strikes the turbine blades varies depending on the highway's vehicle speeds and should be recorded. As a result, the moving vehicles generate the anticipated wind power. To assess the wind turbine's efficiency, a separate measurement of the VAWT's output power is made. These factors affect the amount of power generated by the wind:

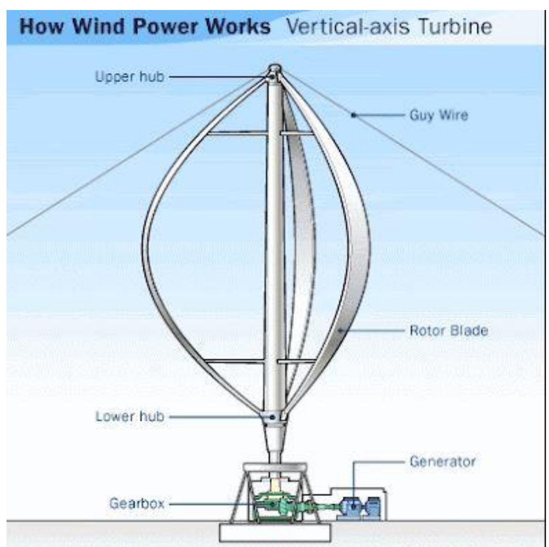
Wind power = ½ * A v³

Where, v is the velocity of the wind (m/s), is the air density kg/m³ and 'A' is the cross-sectional area (m²) that wind passes through the wind turbine. The cross-sectional area is the diameter of the rotor (D) multiplied by the height of the rotor (H). the reference density used is the standard sea level volume (1.225 Kg/m³).
The power extracted by the wind turbine is determined by using the below formula:

Power extracted = ½ * A v³* Cp

Here 'Cp' is the power coefficient, which shows efficiency of a wind turbine design and is the efficiency of mechanical drive unit. Wind turbines cannot ocnvert all of the wind energy inti work and unlike other generators, they can only produce energy in response to the wind that is immediately available. The maximum power that can be extracted from a given wind stream is defined as Betz limit. The maximum value for the power coeficient is called the Betz limit (Cp-max = 0.5926).

3. COMPONENTS OF VERTICAL AXIS WIND TURBINE



Fi g 2 Components of vertical axis wind turbine

- **Generator:**

In a turbine generator, a moving fluid water, stream, combustion gases or air—pushes a series of blades mounted on a rotor shaft. The force of the fluid on the blade spins/rotates the rotor shaft of a generator. The generator, that converts the mechanical (kinetic) energy of the rotor to electrical energy.

- **Anemometer:**

It is an instrument used to determine the spedd of the airfllow in the atmosphere and in wind flow tunnels. It can check the total velocity magintude of fluids on a horizontal plane or in a specific direction.

- **Gearbox:**

It is often used in a wind turbine to increase the rotational speed from low speed main shaft to a high speed shaft connecting with an electrical generator. Gears in wind trubine gerabox are subjected to severe cyclic loadng due to variable wind loads that are stochatic in nature.

- **Nacelle:**

The nacelle of a wind turbine is a complex electromechanical system with quite a few components that function correctly with precision. Significant turbine parts are the generator and the turbine shaft that transfers the harvested power from wind to the generator through a gearbox.

➢ **Rotor and Hub:**

The rotor is the rotating part of the turbine which consists of three blades and a central part connecting the blades, the hub. Although it is the most common, a turbine does not necessarily have three blades. But the three-blade rotor has advantages such as optimum efficiency.

➢ **Tower:**

A thumb rule for a turbine tower is that it is the same height as the circle's diameter, its blades make as they spin.

4. CONCLUSION

The main objective of this project is to construct a miniature vertical axis wind turbine. These turbines need less money to build and are simpler to manufacture. As it would ease the pressure on the use of conventional energy sources, the installation of vertical axis wind turbines on road dividers, along train tracks, and as power supplies for remote areas would be a tremendous advantage to the minister of Nonconventional energy Resources.

The width is the sole restriction;thus, they can be erected on any route. Small turbines can only capture a certain amount of wind because of their size. As a result, they might be billboards.

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