Design and Fabrication Vertical Axis Wind Turbine

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**Abstract**: *This project's goal is to use wind energy as efficiently as possible to produce the highest amount of electricity possible, thus we chose a highway as the location for our installation since we can benefit from the flowing traffic on both sides of the road. The blades utilised in the current work are semi-circular in form and attached to the disc that is connected to the shaft. The turbine is designed and constructed in accordance with the requirements. With the aid of a bearing, the shaft is next linked to the pulley, which is subsequently connected to the alternator, which produces the power. The electricity generated is stored in a battery and may later be utilised for a signal, toll, or street light. For testing purposes, a tiny model has been developed for this project. In order for the government to consider this project and install this sort of vertical axis wind turbine on roads at a reasonable cost, this project also strives for maximum output with minimal cost indulges.*

**Keywords:** Vertical axis wind turbine, design, fabrication.

# INTRODUCTION

One of the key goals of the nation is to produce energy since it is essential for the growth of the nation. Approximately 68% of the world's electricity is produced in thermal power plants, which rely on scarce fossil fuels like coal and diesel to generate electricity. These fuels also contribute to pollution, the greenhouse effect, and global warming. Therefore, the amount of electricity produced from unconventional resources like wind is growing daily, and this kind of power production is particularly clean and secure. There are essentially two kinds of wind turbines. Wind turbines with a horizontal axis (HAWT). 2) A wind turbine with a vertical axis. In effectively generating power from the wind, HAWT has advanced. However, owing to VAWT's extra benefit over HAWT, such as the fact that it can create electricity regardless of wind direction, development on it has also just begun. VAWT can be generated for less than HAWT would cost, and its maintenance costs are similarly reasonable.

# OBJECTIVES

Utilising the most wind energy possible from the moving cars on the roadways is the major goal. The vertical axis wind turbine is propelled by a sizeable quantity of wind that is otherwise wasted and will be converted into electricity using the motionless energy of the wind. More turbulence causes the wind to change direction and speed more often. Vertical axis wind turbines (VAWT) successfully capture the turbulent winds that are characteristic of urban environments, in contrast to classic horizontal axis wind turbines (HAWT). A vertically directed wind mill with a greater production capacity is being created. Our goal is to create the wind turbine utilising readily accessible, affordable raw materials, such as cycle wheels with built-in ball bearings and half-cut PVC pipes, among others. By positioning it in the ideal location and taking into account the system's cost and safety, this wind turbine is designed to gather the most wind energy possible from any direction. This technique may provide an enormous quantity of usable electrical energy when employed in large quantities.

# USED MATERIALS

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Components** | **Material** |
| **1** | **Blades** | **MS CRC** |
| **2** | **Shaft** | **MS Bright** |
| **3** | **Bearings** | **UCM 204** |
| **4** | **Frame** | **MS Angle** |
| **5** | **Blade Support** | **MS Flat** |

* 1. **COMPONENTS**

Numerous factors must be considered in this task, such as the wind speed influencing the turbine blades as it starts to rotate. A rooftop or other open surface with a high mounting area must be accessible for the turbine. The support's body is designed in such a manner that it can absorb the most vibration caused by the turbine.

# Bearing Design

A bearing is a component of a machine that limits relative motion to just that motion that is intended and reduces friction between moving elements. The bearing's design may, for instance, provide free rotation around a fixed axis or free linear movement of the moving component. It may also serve to prohibit motion by managing the vectors of normal forces acting on the moving parts. Numerous bearings also help the intended motion as much as they can, for example, by reducing friction. According to the kind of operation, the movements permitted, or the directions of the loads (forces) applied to the components, bearings may be generically categorized.



# B.Blade

A wind turbine is an apparatus that transforms the kinetic energy of the wind into electrical energy. The blade is shaped semi-circularly to allow for first-blade succession as one blade passes. To make the most of the wind from moving vehicles and the air, 8 blades are employed. The is made of (AL) material. The substance is "22grades" thick.

# Frame Design

The frame's primary function in a turbine is to support the turbine. We utilised materials like mild steel since we wanted to create an affordable model. They are further utilised to create street light poles. Additionally, this material is superior than others in absorbing vibration. We dyed the material to lengthen its lifespan.

# Gearbox

In a wind turbine, a gearbox is primarily used to increase the rotational speed of a low-speed shaft that connects to a high-speed shaft. Because of stochastic, irregular wind loads, the gears in the powertrain of a wind turbine are exposed to intense cyclic stress.

# Shaft

A shaft is a spinning machine component that transmits power from one part with another or from a machine that creates power to a machine that absorbs power. Shafts are typically circular in cross section.It is mounted with a variety of members, including pulleys and gears.

A drive shaft, also known as a driveshaft, driving shaft, or propeller shaft (prop shaft), is a mechanical part used to transmit torque and rotation. It is typically used to connect other drive train components that cannot be connected directly due to proximity or the need to allow for relative movement between them.

# VARIOUS OPERATIONS INVOLVED IN FABRICATION PROCESS

* Welding
* Cutting
* Rolling
* Drilling
* Turning
* Mig-Welding

# CAD MODEL

**Side View of Assembly**

# Full Assembly

1. **CALCULATIONS**

The wind mill works on principle of converting kinetic energy of the wind in to mechanical energy. The k.E. of any particle is equal to the one half of its mass times the square of its velocity, or ½ mv2.

K.E. =½ mv2. (1)

K.E = kinetic energy m = mass

v = velocity,

M is equal to Volume multiplied by its density ρ of air, Mass = ρ AV (2)

Substituting eqn (2) in eqn (1) We had got,

K E = ½ ρ AV3 watts

ρ = density of air (1.225 kg/m3) A = l\*b (Sq.m)

D = diameter of the blade A = l\*b

A = 0.3 Sq.

Available wind power Pa = (½ ρ π D2 V3)/4 P = 1/8 ρ π D2 V3

# TRAIL 1

FOR VELOCITY 4.5m/s

Pa = (½ ρ π D2 V3)/4

Pa = (½\*1.225\*π\*0.4\*0.4 \*4.53)/4 Pa = 7.1watt

# TRAIL 2

FOR VELOCITY 5.5m/s

Pa = (½ ρ π D2 V3)/4

Pa = (½\*1.225\*π\*0.4\*0.4 \*5.53)/4 Pa = 15.1watt

# TRAIL 3

FOR VELOCITY 7.5m/s

Pa = (½ ρ π D2 V3)/4

Pa = (½\*1.225\*π\*0.4\*0.4 \*7.53)/4 Pa = 33 watt

# TRAIL 4

FOR VELOCITY 10m/s

Pa = (½ ρ π D2 V3)/4

Pa = (½\*1.225\*π\*0.4\*0.4 \*103)/4 Pa = 77watt

# TESTING AND RESULT

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr no.** | **Wind Speed in m/s** | **Speed of Shaft** | **Voltage** |
| **1** | **2 to 3** | **109 to 121** | **3.9** |
| **2** | **3 to 4** | **189 to 201** | **4.8** |
| **3** | **4 to 5** | **271 to 320** | **6.2** |
| **4** | **5 to 6** | **382 to 353** | **8.8** |
| **5** | **6 to 7** | **390 to 396** | **9.2** |
| **6** | **7 to 8** | **400 to 409** | **12** |

1. **CONCLUSION**

The VAWT is constructed and designed to be able to capture wind from all directions. The project's power output is 28W at 6.1 m/s, and the efficiency of the device can be increased by altering the size and shape of the blade. However, the theoretical and experimental results differ because, while in the theoretical calculations, we assume that the wind is hitting all eight turbine blades, this is not actually the case. Our research and the findings show that, even in low-ideal sitting circumstances, vertical axis wind energy conversion is feasible and has the potential to significantly contribute to the generation of clean, renewable power from the wind. The concept on the roadway will activate the street lights. Highways in most cities are quicker routes for everyday commuting, and because they need steady light, this is a particularly effective technique to generate natural energy.

# FUTURE SCOPE

With 1.25 billion inhabitants, or 17.5% of the world's population, India is the second most populous nation in the world. India's GDP is expanding at the second-fastest rate in the world. India's long-term, significant economic expansion has increased demand for its energy resources tremendously.

In particular, in urban settings where there are presently untapped winds, the VAWT technology is advancing towards the application of modest generating facilities. Studies on the omnidirectional-guide-vane show that under these conditions, power, speed, and torque all significantly increase.

Employing Wind VAWT in power generation system can be the solution at many locations since the cost of this system is considered to be lower than the use of both individual technologies.

The helical arrangement of the blades appears to increase the power coefficient in comparison to the straight arrangement of the blades, increasing from 33% to 42% under the same operating conditions, as has been verified by simulation using numerical methods.

Numerous studies have been devoted to trying to improve the performance and efficiency of VAWT through computer programmes and various calculation methodologies. This will continue until observable results are achieved and someone is found who can take credit for them. This is due to the high cost and risk involved in the physical realisation of a model to be filed to the testing necessary to meet the different criteria for operation as well as how changes in the environment and the shape evidence bearing on this.

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