

# Vortex Blade Less Wind Turbine

Sachin Mardolkar<sup>1</sup>, Jatin Panchal<sup>2</sup>, Parag Sase<sup>3</sup>, Prof. Mukeshkumar Mishra<sup>4</sup>

<sup>1, 2, 3, 4</sup> Dept of Electrical Engineering

<sup>1, 2, 3, 4</sup> VIVA Institute of Technology, Virar.

**Abstract-** *Vortex-Bladeless is a Spanish SME whose objective is to develop a new concept of wind turbine without blades called Vortex or vorticity wind turbine. This design represents a new paradigm in wind energy and aims to eliminate or reduce many of the existing problems in conventional generators. As you flip across the pages for this project, you will find that it is structured in a systematic manner so as to provide a sequential flow of the spectator. The intent is to present a precise picture without getting lost in finer points. Beginning with a general introduction to the subject we have tried to fathom the depth of it in quite a brief manner and with a simplistic approach.*

**Keywords-** Vortex Windturbine, Wind Power, Tuning, Piezoelectric Device, Neo Magnet.

The bladeless turbine currently takes up as much as 30% of the area of a conventional generator, with maximum amplitude around a diameter at the top. It can capture about 40% of the wind power contained in the air, which is a more than reasonable capacity, and at same height as many modern wind turbines. The system does loose some electrical conversion capacity (reaching 70% yield of a conventional alternator), because the design is so focused on avoiding and wear and tear .It aims to focused on avoiding and wear and tear .It aims to bird population is expected to be much smaller, because it doesn't require the same type or magnitude of movement as the traditional wind turbine, allowing for higher visibility. With the oscillation frequency of the equipment very low the impact sound level is non-existent, opening the possibility to make the future wind farms completely silent.

## I. INTRODUCTION

Bladeless turbines will generate electricity for 40 percent lesser in cost compared with conventional wind turbines. In conventional wind power generation transportation is increasingly challenging because of the size of the components: individual blades and tower sections often require specialized trucks and straight, wide roads. Today's wind turbines are also incredibly top heavy. Generators and gearboxes sitting on support towers 100 meters off the ground can weigh more than 100 tons. As the weight and height of turbines increase, the materials costs of wider, stronger support towers, as well as the cost of maintaining components housed so far from the ground, are cutting into the efficiency benefits of larger turbines.

The alternative energy industry has repeatedly tried to solve these issues to no avail. But this latest entry promises a radically different type of wind turbine: a bladeless cylinder that oscillates or vibrates.

The Bladeless Turbine harness vorticity, the spinning motion of air or other fluids. When wind passes one of the cylindrical turbines, it shears off the downwind side of the cylinder in a spinning whirlpool or vortex. That vortex then exerts force on the cylinder, causing it to vibrate. The kinetic energy of the oscillating cylinder is converted to electricity through a linear generator similar to those used to harness wave energy.

## II. AIM

There is a need to find cheap and safe alternatives to conventional windmills. The concept of bladeless windmill is far less costly and also has less maintenance cost. The bladeless wind mill has lesser moving parts as compared to the conventional windmill. Also it will require lesser wind speed. It requires less space and also is safe for birds. An aerodynamic effect that occurs when wind breaks against a solid structure. The structure starts to oscillate, and captures the energy that is produced. This technology works by placing cylindrical bodies in normal to wind flow. Flow over this cylinder will generate an irregular vortex pattern which creates alternating high lift forces on the body and pushing it up and down perpendicular to fluid flow. The alternating movement of this body will produce fluctuating kinetic motion which can be converted into electricity.

## III. HISTORY OF BLADELESS POWER GENERATION

The Vortex Street effect was first described and mathematically formalized by Theodore von Karman, the genius of aeronautics, in 1911. This effect is produced by lateral forces of the wind on any fixed object immersed in a laminar flow. The wind flow bypasses the object, generating a cyclical pattern of vortices, which can become an engineering challenge for any vertical cylindrical structures, such as towers, masts and chimneys. The issue is that they may start

vibrating, enter into resonance with the lateral forces of the wind, and ultimately, collapse. One of such examples is the collapse of three cooling towers of the power station Ferry Bridge in 1965.

However, it is possible that the same forces can be captured to produce energy - the idea behind Vortex. When a semi-rigid structure enters into a horizontal laminar air flow, it begins to vibrate under the influence of the lateral forces generated by the vortex street. When the frequency of vortex occurrence in the atmosphere matches the natural frequency of the structure, it enters into resonance, maximizing the amplitude of vibration and coincidentally, the power generation capability we are interested in. The natural frequency of any object is limited and would only enter resonance and vibrate at certain wind speeds.

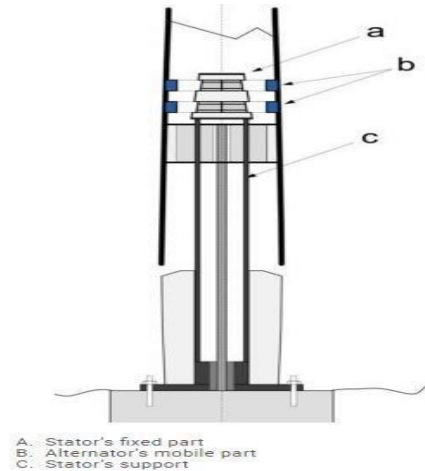
#### IV. STRUCTURE & GEOMETRY

The outer cylinder is designed to be largely rigid and has the ability to vibrate, remaining anchored to the bottom rod. The top of the cylinder is unconstrained and has the maximum amplitude of the oscillation. The structure is built using resins reinforced with carbon and/or glass fiber, materials used in conventional wind turbine blades.

The rod's top supports the mast and its bottom is firmly anchored to the ground. It is built of carbon fiber reinforced polymer, which provides a great fatigue resistance and it has a minimal energy leak when oscillating.

Naturally, the design of such wind turbine is quite different from a traditional turbine. Instead of the usual tower, nacelle and blades, our device has only a mast made of lightweight materials over a base. This reduces the usage of raw materials and the need for a deeper foundation.

#### V. VORTEX'S ALTERNATOR



Currently, Vortex generates electricity through an alternator system, made by coils and magnets, adapted to the vortex dynamics, without gears, shafts or any rotating parts. Our Vortex generator is currently considered a “small wind turbine”. Alternators are a well known technology, although the way Vortex is using it is innovative and patented. This design allows to reduce maintenance and eliminates the need for greasing.

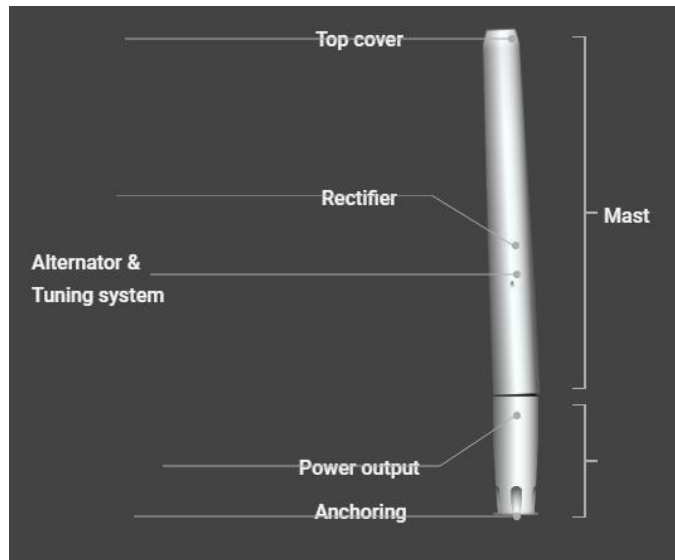
#### ENERGY CONVERSION

Our bladeless wind turbine captures the energy from the wind by a resonance phenomenon produced by an aerodynamic effect called vortex shedding. In fluid mechanics, as the wind passes through a blunt body, the flow is modified and generates a cyclical pattern of vortices. Once the frequency of these forces is close enough to body's structural frequency, the body starts to oscillate and enters into resonance with the wind. This is also known as Vortex Induced Vibration (VIV).

#### VI. MAIN FEATURES

##### A. Materials & Life Span

Current wind turbine technology need to support very different load levels under variable wind speeds, which puts high mechanical demands on transmitting components such as gears, bearings, bushings or brakes. The multiple moving parts are constantly under wear, which leads to high maintenance costs.



Bladeless wind turbines completely eliminates mechanical elements that can suffer wear by friction. The main materials used for manufacturing Vortex turbines are carbon fiber polymers, plastics, steel, neodymium, and copper. The working limits of these materials are far away from Vortex's operational standards.

### B. Cost-Effectiveness

One of the main advantages of Vortex turbines are the low costs associated. We have estimated that Vortex turbines' levelized cost of energy (LCOE) will be lower, which will allow a faster return on investment. Anyway, further research has to be done on this topic to say with certainty.

This makes this tech highly competitive not only against generations of alternative or renewable energy, but even compared to conventional technologies. You can read an study about cost-effectiveness for bladeless turbines here.

These cost reductions come from a clever design and usage of raw materials. There is no need for a nacelle, support mechanisms, and blades, that are usually costly components in the conventional wind generators.

Thanks to be very lightweight and to have the gravity center close to the ground, anchoring or foundation requirements have been reduced significantly compared to regular turbines, easing installation.

### C. Generation Capacity

In wind energy conversion, power generation is proportional to the swept area of the wind turbine. Vortex

currently sweeps up as much as 30 % of the working area of a conventional 3-blades-based wind turbine of identical height.

As a result, generally speaking we can say Vortex wind power is less power efficient than regular horizontal-axis wind turbines. On the other hand, a smaller swept area allows more bladeless turbines to be installed in the same surface area, compensating the power efficiency with space efficiency in a cheaper way.

The Vortex Tacoma (2,75m) estimated rated power output is 100w once industrialised. Eco-friendly. Vortex turbines aim to be a "greener" wind alternative. Although a more rigorous carbon footprint analysis is needed, bladeless wind power seem to bring some extra advantages from the environmental point of view. Vortex bladeless is mainly a solution for distributed energy generation. It is perfect to be placed near a house or over the roof. It can work on grid and off grid, and as a part of a hybrid solar installation plus wind generation.

### D. Environmental impact

Its simple design and light weight allow a very efficient use of raw materials. No complex manufacturing process is required to build a bladeless wind turbine, although current methods has to be slightly different to industrialise the production. The absence of lubricants makes unnecessary to manage this waste.

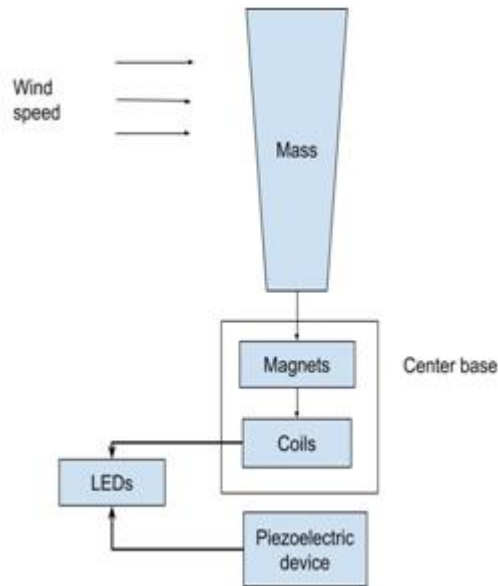
The total weight of a Vortex Tacoma is estimated to be less than 15 Kg once industrialised. Unlike regular rotating-based wind power, with the proper calibration and anchoring we expect Vortex technology to be completely noiseless. As an extra, Vortex Bladeless design's interferences on radio signals are negligible.

### E. Wildlife's impact

Although small wind turbines usually do not represent an important issue for local wildlife, bladeless wind power's impact on birds population is expected to be much smaller. Vortex's design allows an oscillatory movement on bladeless turbines to be tiny and less aggressive than traditional wind turbines, so it won't disturb wildlife and allow birds and bats to avoid them easily while flying.

The NGO Birdlife is collaborating with us to measure this impact. Wind energy and birds can share the same wind!

## VII. BLOCK DIAGRAM



### Working:-

#### Centre Base:-

Base is made up of the rigid pipe angular structure. The base provides equidistant point for the position of the mast. It is capable of tolerating the mechanical stress acting on it. This provides the strong foundation to the mast and spring.

#### Spring:-

Spring is mounted at the centre of the mast which provides the oscillation of the mast in any of the direction. This spring is capable to withstand the weight of the mast.

#### Mast:-

The mast is a conical shaped, rigid structure which oscillates when subjected to wind. The Mast is lighter in structure in order to increase the oscillations also decrease the mechanical stress on the suspension spring as well as the base.

#### Magnets-

The polarity of the induced emf is such that it produces a current whose magnetic field opposes the change which produces it. The induced magnetic field inside any loop of wire always acts to keep the magnetic flux in the loop constant.

#### LED

In electronics, an LED circuit or LED driver is an electrical circuit used to power a light-emitting diode (LED)

#### Load:-

When the generated voltage is less than 5V, the power has to be dumped. Therefore a dummy load is connected. The load consists of LED bulbs.

#### Using Piezoelectric Material:-

When wind flows at some specific speed oscillations surrounding the pole of windmill. Due to this the rod will oscillate. These oscillations will be applied to the steady part of the windmill which is placed at the bottom. In the steady part we have placed either piezoelectric material. Due to oscillation produced by the rod, vibrations will create in piezoelectric material. Due to vibrations there will be production of voltage which is dc in nature. We have to convert it into the ac voltage and step it up and then will give to the load. There will be production of voltage which is ac in nature. This bladeless windmill has very high efficiency as there are minimum losses and this windmill will start energy production at very low speed of wind. This windmill will start to produce energy at speed of 1.3 meters/sec. i.e. 4.6 km/hour. At this much low speed of wind the bladeless windmill starts to produce the energy. So the efficiency of this windmill is around 50% higher than the normal windmill.

#### Using neo magnets:-

The new Vortex is designed to vibrate as much as possible. At the base of the cone are two rings of repelling magnets, which act as a sort of nonelectrical motor. When the cone oscillates one way, the repelling magnets pull it in the other direction, like a slight nudge to boost the mast's movement regardless of wind speed. This kinetic energy is then converted into electricity via an alternator that multiplies the frequency of the mast's oscillation to improve the energy-gathering efficiency. The energy generation is ac in nature.

#### WORKING PRINCIPLE –

It's based on Faraday's first law. Faraday's First Law of Electromagnetic Induction states that whenever a conductor is placed in a varying magnetic field, emf is induced, which is called induced emf, if the conductor circuit is closed, current is also induced, which is called induced current.

#### Voltage Doubler Circuit Working

A voltage doubler is an electronic circuit which charges capacitors from the input voltage and switches these charges in such a way that, in the ideal case, exactly twice the voltage is produced at the output as at its input.

### VIII. FUTURE SCOPE

Tapping newer ways of wind turbine for renewable energy is gaining Momentum in the recent years. The purpose of this project is to provide some fundamental Results on the analysis of bladeless wind turbine structure and serve as stepping stones for the Future development of bladeless wind generating system. The output can be increased by the Following techniques,

1. The output of this project can be improved by increasing the height of the mast.
2. By using lighter material for the construction of the mast (fibreglass or carbon fibre) the weight of the mast can be reduced to increase the oscillation. This project can be connected with a feedback control system with magnets in order tune the mast to the natural frequency.
3. The threads can be increased with cable wires in order to withstand the wind forces.
4. The base can be made simple and compact by installing a compact pulley mechanism.
5. By installing efficient generators, output can be increased.
6. By installing efficient transmission system, the output can be improved.
7. The efficiency of the transmission system via the thread mechanism can be improved by using threads with higher tensile strength
8. A control mechanism can be implemented at the base for the protection of the mast from turbulent wind.

### IX. CONCLUSION

The bladeless wind generation system configuration has been considered and the obtained results appear to be very encouraging, even though they are based on simulations and model taken from the literature, which certainly can give only approximate description of involved dynamics. Tapping the wind for renewable energy using new approaches is gaining momentum in the recent years. The purpose of this project is to provide some fundamental results on the bladeless wind system and serve as stepping stones for the future development of bladeless wind power generating system. The forces that is beneficial or useful to generate power in bladeless are different from those in conventional horizontal axial wind turbines. Our device captures the energy of

vorticity, and aerodynamic effect that has plagued structural engineers and architects for ages (vortex shedding effect). As the wind bypasses a fixed structure, its flow changes and generates a cyclical pattern of vortices. Overall the project has been a success with all of the project requirements achieved. As the wind energy is powerful and consistent, the usage of conventional wind turbine for utilizing the wind energy in lesser area and cost is not possible. Hence bladeless wind energy helps us to achieve these criteria.

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