

Power generation by using vortex bladeless windmill

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Abstract

This paper presents a summary of the work done by the authors regarding the non-renewable energy sources are gone to depth of the earth, so we obviously need to produce energy by using renewable energy sources. The traditional blade wind turbines are used to produce energy but its cost is very high and it have many disadvantages like as capital cost, maintenance cost, running cost, friction loss and it is also dangerous to birds and is noisy as well. Hence, there is a need to find low-priced and safe replacement to conventional windmills. The concept of bladeless windmill works on the theory of vortex shedding effect. Vortex bladeless windmills are a wind powered generator that generates electricity with minimum moving parts. It generates the electric current using the oscillation or vibrations produced due to the wind. It's working principle of vortex-induced vibrations (VIV). Hence, the electricity is generated by using linear alternator or piezoelectric material. Generally, structures are designed to minimize vortex-induced vibrations (VIV) in order to minimize mechanical failures. But in this project work, we try to increase the vortex-induced vibrations (VIV) with maximum deflection of bladeless windmills ,which is used to produce electricity with experimental and geometrical approach.

Keyword - (Vortex wind turbine generation , vortex shedding effect, wind power generation without blade).

INTRODUCTION –

A windmill is a device which converts the kinetic energy of wind into electrical energy. There are two ways of producing the energy from windmill which is through rotational windmills and oscillation windmills. The Rotational windmills are nothing but the conventional windmill. In this type, the rotating turbine blades are mounted to shaft of gearbox at the center. This gearbox is used to convert the rotational energy of blades into mechanical energy and this mechanical energy is used to run the generator. The generator is used to convert mechanical energy into electrical energy in suitable form. Rotational windmills are effectively used in commercial applications because of its Effectiveness and efficiency at a larger scale. Oscillation type windmills are used produce less amount of electrical energy that's why it is not used in commercial applications. Its main advantage is that it has less moving parts, less space is required for installation, light in weight and cost is also less because it is bladeless and gearbox is also absent. To understand the reason behind it, we have to understand the working of oscillation type windmills.

The efficiency of renewable energies has grown significantly in recent years and wind energy has been one of the most important responsible .generator similar to those used to harness wave energy. The cylinder oscillates on a wind range, which then generates electricity through an alternator Bladeless wind turbine use radically new approach to capturing wind energy. When wind passes one of the cylindrical , it shears off the downwind side shows in fig no 1.



Fig no. 1 vortex windmill (vortex free standing structure)

BLOCK DIAGRAM OF BLADELESS WINDMILL

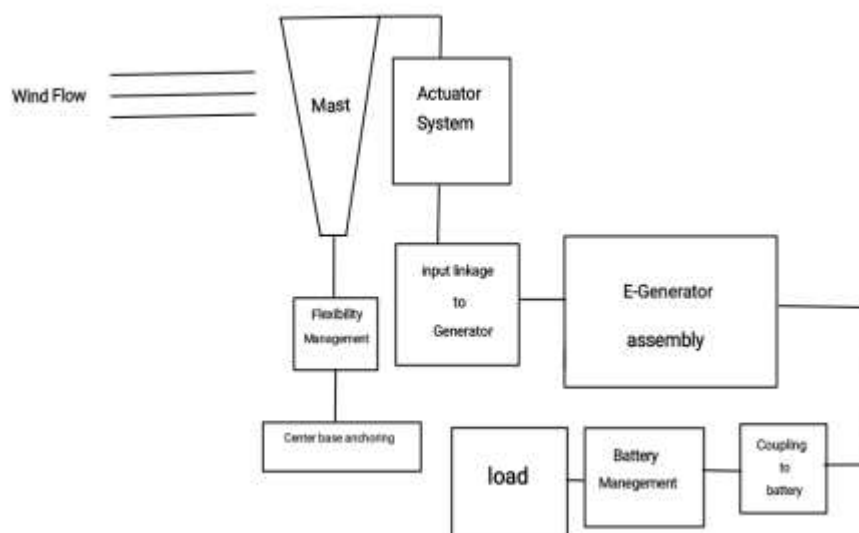


Fig no .2 Block Diagram Of Vortex windmill

Construction Diagram

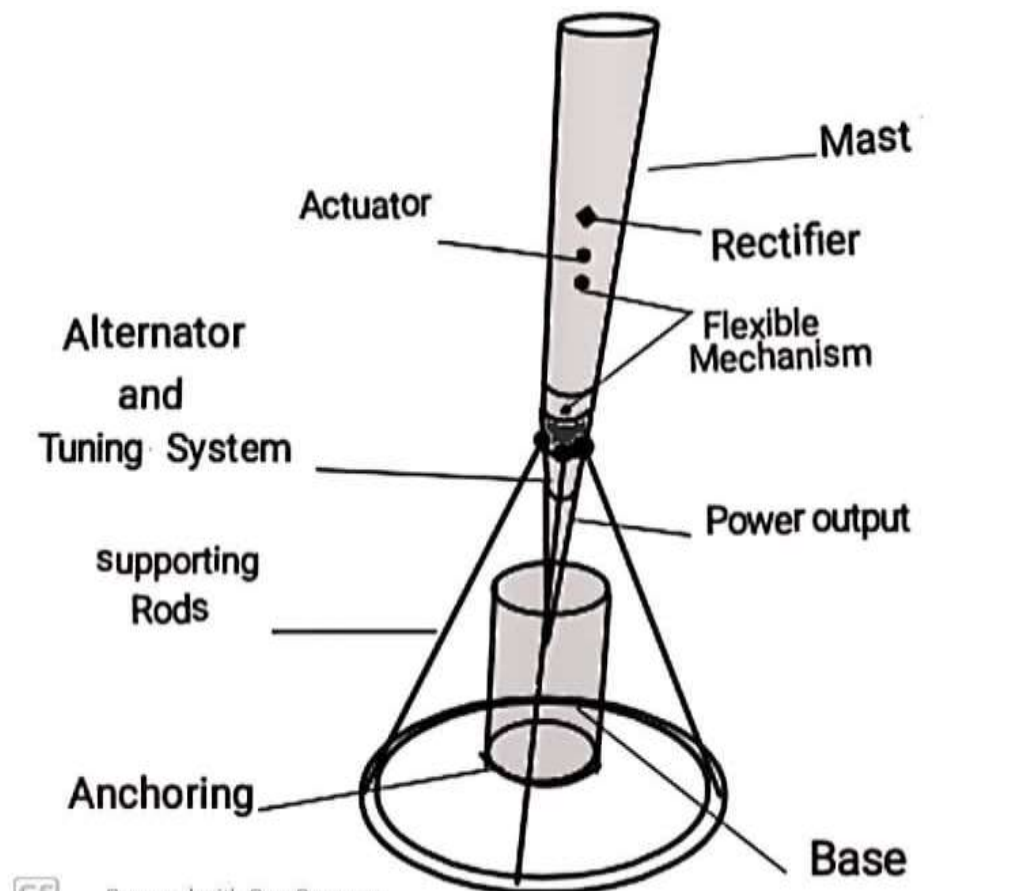


Fig no. 3 Construction Diagram Of Vortex Turbine windmill

Components of vortex windmill

Rod- The rod gives a strength and flexibility to the moment while minimizing energy dissipation.

Generation System- The kinetic energy from the wind is converted into the electricity by using alternator.

Mast- It's a light circular section structure made up of fibre glass and carbon fibre. It acts as a wind breaker that generates the oscillatory motion .

Foundation- Reduced significantly because of vortex lightness.

Finite Element -Static Structural analysis and CFD analysis of vortex bladeless windmill is carried out by ANSYS 16.0 software to determine deflection values of the windmill. The finite element analysis includes CAD modelling, pre-processing, solution and post processing.

Actuator- An actuator is a device which is liable for moving and controlling the mechanism or system, it's like opening a valve. In simple terms, it's a "mover". An actuator requires a control to signal and source of energy to produced by wind.

Wind performance-vortex generates, attached to the basis section of a turbine blade, can help improve performance by energizing flow round the surface. This helps reduce flow separation and increases the performance of the whole turbine, in terms of power, loads, and repair life.

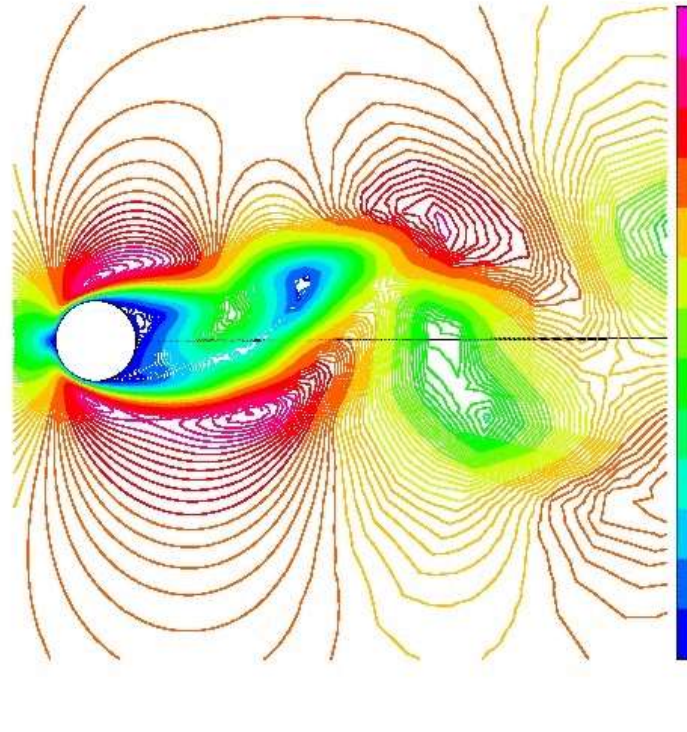


Fig no. 4 wind performance On vortex Turbine (global wind analysis)

Methods Of Electricity generation By Linear Generator - When a magnet moves in reference to an electromagnetic coil, this changes the magnetic flux passing through the coil, and thus induces the flow of an electrical current, which may be went to work . A linear alternator is most ordinarily wont to convert back-and-forth motion directly into electricity . This short-cut eliminates the necessity for a crank or linkage that might rather be required to convert a reciprocating motion to a rotation so as to be compatible with a rotary generator.

It fails in our project because our project may be a small prototype so, it's unable to get that quantity of pressure required for electricity generation from piezoelectric materials. But it's

possible with real project with large dimensions. during this we've studied the planning of the mast during which we designed and analysed it for the utmost output frequency for the lock in frequency. For the calculations of the planning the subsequent procedure is administered .

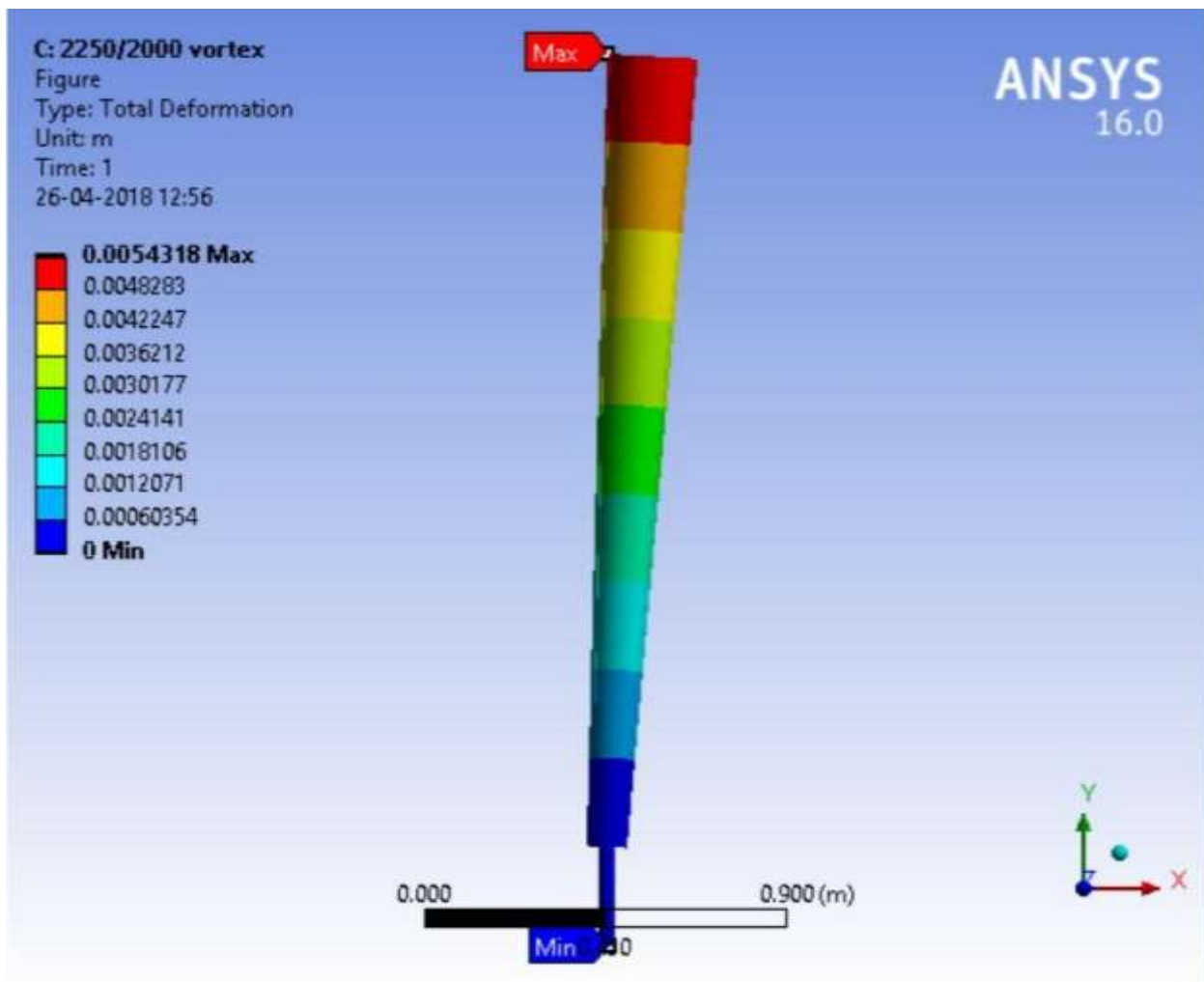


Fig no. 5 Total Deformation Of Prototype (vortex shedding effect report)

Arrangements of the Generator and tuning system It consists of a gyroscopic rotor that's held in an inner ring (sub-frame), the latter being liberal to pivot in an outer ring (main-frame). The mainframe is liberal to rotate in transmission housing. The sub-frame is connected to the input mechanism by linkage (off-set pin), which pivot the sub-frame within the mainframe. The mainframe, the sub-frame and therefore the linkage rotate together under the influence of gyroscopic reaction. The mainframe is connected to output (rotating shaft) and therefore the transmission housing via one-way clutch. Ability to decouple and control the transmission with minimal effort for maintenance purposes and variable operation. Ability to work two or more gyro Torque units in parallel kill if required to realize high transmission capacity. After rectification and filtering it's transformed. It consists linkage system within the inner portion and to the outer portion of the gyroscope so it can move freely by their speed. this technique provide help to the gyro-rotor to take care of the speed which require to get the facility .

The tuning is maintain the terminal voltage and stability operational for a synchronous generator utilized in power generation is that the basic need of safe and economic power grid operation. Fluctuation voltage are often reduced by the excitation system of the synchronous generator also balancing of inactive power distribution, anti-interference expansion and sturdiness operation is improved by excitation system of the synchronous generator. PID controller is that the commonest controller for the control purpose of the excitation system of the synchronous generator

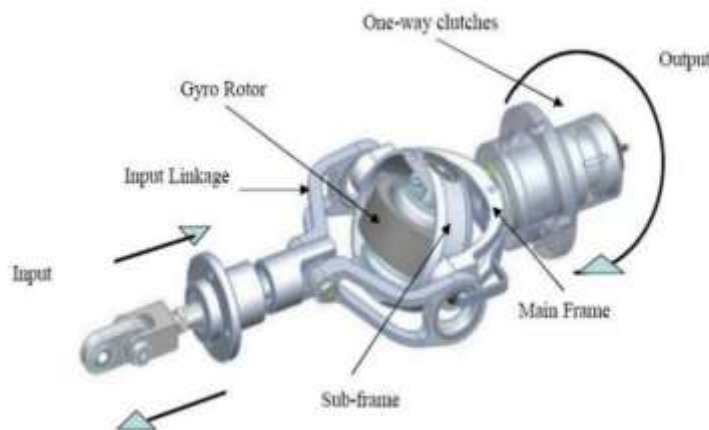


Fig no .6 Part's Of Gyro Generator (vortex mainstream energy production)

Operational principle

The energy conversion happens within the mast, during which the wind strikes the column mast to vibrate. This vibration is converted into energy then to electricity. This is often a windmill without blades. We are getting to generate electricity by using the bladeless windmill. This wind mill will generate electricity by using oscillation because of wind. It works on principle of electromagnetic induction or vibration. Electricity are often generated by using linear alternator. The K.E. is converted into electricity by an alternator to enhance the efficiency of the energy being gather performing on a turbine that operates on the principle of vortices which will be used as electricity. When the body isn't formed symmetrically around to its mid-plane then because of this reason different lift forces were developed on all sides of the body, hence it tends to converts motion transverse to the flow.

This motion changes the character of the vortex formation in such how on cause limited motion amplitude. The cylinder is best Because of produce the vortex shedding property of fluid flow and it produces oscillation due to its simple and aerodynamic shape. The cylindrical mast also easy to manufacturing with any material and straightforward to style also. to satisfy its energy requirement, coal can't be the first source of energy. this is often because coal is depleting in no time. it's estimated that within few decades coal will get exhausted. subsequent clean choice of energy is solar energy, but thanks to its lower concentration per unit area, it's very costly. India has fifth largest installed wind generation capacity within the world. because the regions with wind speed are limited, the installation of conventional windmill is restricted. Windmills that might provide safe, quite, simple, affordable and work on lesser wind speeds are need of the hour. The Bladeless Windmill is such an idea which works on the phenomenon of vortex shedding to capture the energy produced. Generally, structures are designed to attenuate vortex induced vibrations so as to attenuate mechanical failures. But here, we attempt to increase the vibrations so as to convert vortex induced vibrations into electricity. The paper studies the scope and feasibility of the bladeless windmill.

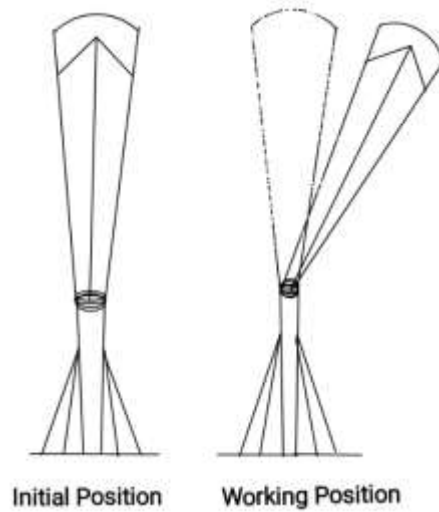


Fig no.7 Position's Of Windmill while performing..

Natural Frequency

We know that Theory of torsion of shaft

we have

$$\text{So } \omega_n = \sqrt{(T / I)}$$

T-torque of rotating member

I- Moment of inertia

now from CAD drawing software and selecting material as pp polypropylene and

Determining Their mass Properties considering wall thickness as 2mm we calculated

mass=1.8kg

and also found the position of centre of gravity. Z= 859.188mm from top mast

now natural frequency frequency= $\frac{1}{2\pi} \sqrt{\{(KL^2 - 2mgL)/4I\}}$

putting the values in the formula

$$I = \frac{1}{3} m * L^2$$

$$I = 2.4 \text{ kg-m}^2$$

now as we know strouhal frequency should be close to natural frequency

so we know St=0.22

putting the value in strouhal formula

$$St = f_s * D / U$$

$$f_s = 3.1 \text{ Hz}$$

This should be equal to natural frequency

so by putting frequency=3.1

We get K=834.22 N/m

value of spring stiffness . This much force is provided to sustain the Air thrust.

Merits

1. This is clean energy source and The Bladeless Turbine aims to be a "greener " wind alternative ,Claimed to be much less noisy than conventional wind turbine
- 2.No gears and bearing Hence it reduces Maintenance
- 3.No lubricant needed because of less frictional mechanism.
- 4.It reduce the foundation at the bottom by 50%.
- 5.Cost of energy production is 40% than Other conventional turbine.
- 6.It bladeless hence it is not harmful for birds that's why it called as environmental friendly.
- 7.The wind can cause twisting and displacement of the structure, primarily in the elastic rod, especially in the lower section that has to withstand greater forces. However, studies carried out by the company confirm that, the stress on the rod is far from working limits of materials, i.e. carbon fiber. Computational modeling estimates operational lifetime of the installation to be between 32 and 96 years .It currently takes up as much as 30% of the area of a conventional generator, with maximum amplitude around a diameter at the top.
- 8.The impact on the 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.

Demerits

- 1.Their is requirement of control systems for controlling the oscillation to meet the natural frequency of the mast and control of the frequency at higher velocity winds.
- 2.The efficiency of the energy absorbed from the wind is comparatively less than that of the conventional wind turbine.

Applications

- 1.We Can use this system over Remote place and control easily. Vortex mainly a solution for distributed energy generation it is Perfect to be placed over the roof or near to the house.
- 2.It can be as a part of hybrid solar installation plus wind generation.
We can also use this turbine As saphon turbine So it will become more efficient.
- 3.On the other hand we can install on the ground with near distance Cause it take less space . bladeless hence it is not harmful for Birds that's why it called as environmental friendly.
- 4.Off-Grid Power for Rail Signalling: Large parts of the rail network lack convenient mains electricity. Bladeless wind power generators can be installed near railway signals to supply power to the signalling systems.
- 5.Bladeless wind energy can be used in a variety of industries and applications, including marine off-grid systems, industrial applications, remote telemetry and mobile base stations and for houses, schools and farms.
- 6.Bladeless wind energy for Off-grid Lighting: Small scale bladeless wind turbine generators are ideal for providing efficient and reliable lighting in off-grid locations.
- 7.The bladeless energy generates free renewable energy which is stored in a battery ready for when it gets dark to power public street lights, car parks and playgrounds. We can combine the bladeless energy with solar panels from our advanced solar range to ensure a continuous supply of renewable energy for a sustainable off-grid lighting solution.
- 8.This bladeless turbine will be focused to small scale production. This system it has been designed to bring energy to an off grid locations and matching it with solar panels. This is a cost-effective solution for houses where are existing solar installations and where having a non-expensive wind device will help to storage the energy produced while the solar is not producing. Also it will work for those villages where having energy could be a matter of life. It can be used for Residential Battery Charging and Grid Connection.

Conclusion

From above information it is clear that the bladeless turbine wind generator is the best option for electricity generation using wind power due to its various advantage. The bladeless wind system is powerful and consistent the usage of convention wind turbine for utilizing the wind energy in lesser area . Hence bladeless wind energy help us to achieve these criteria. It will help to increase percentage of renewable energy for electricity power generation and provide electrically as well as economically efficient power to the consumer. Hence we have to spread this concept because only renewable energy can survive the world in coming future and in that wind energy is efficient option. Vortex bladeless .windmill is mostly used in small application where less amount of electricity is required. It is most preferable solution as compare to conventional windmill due to it have simple in construction, easy to design, easy to manufacture and less space required. The main advantage is that it requires low maintenance cost because of less moving parts. For future use of this project work, we can use this type of windmill for home appliances or where less amount of electricity is required.

Future Scope

relative newcomer to the wind industry as compared to Denmark or the US, domestic policy support for wind generation has enabled India to become the fourth largest within the world with an installed capacity of over 34 GW. The vortex turbine capable of harvesting from the wind in an efficient and safe manner wind generators will help to increase percentage of renewable energy for electrical power generation and provide electrically as well as economically efficient power to the consumer and also contribute to the "Green Energy". The country like India which having more rural population and condition suitable for wind generation through bladeless wind turbine is the best option.

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