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Design and Fabrication of Vortex Bladeless Windmill

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Abstract: This Study discusses about the windmill which will provide simple, eco-friendly and efficient alternative to the conventional windmill and named it as Vortex Bladeless Wind mill. This is also known as Green turbine with almost no harmful effect on environment. Vortex created vibration is utilized to develop a gadget that can gather wind and change it into electrical vitality by using vortex shedding and piezoelectric material. Also, the components are of low cost which creates a way for low cost renewable source of energy. The main aim of this paper is to bring a new model of turbine with improved performance that will be economic as well as reliable. This paper will also focus on working principle, design and fabrication of a small prototype. The gadget is made out of a solitary basic part. For the most part, structures are intended to maintain a strategic distance from vortex initiated vibrations so as to limit the mechanical failures. Be that as it may, here, we attempt to build the vibrations to expand the age of power.

Keywords: Vortex Bladeless Windmill, Green turbine

Introduction: Vortex Bladeless Windmill is a new approach which harness wind energy from the phenomenon of vortices that is known as Vortex Shedding. In Vortex windmill, the mass of the 'mast' and the flexibility of the 'spring' makes it a vibrating framework. This windmill controls the energy vorticity, for example, the turning movement of air or different liquids. At the point when the wind strikes the cone like pole, the progression of the breeze gets isolated in light of the impediment and along these lines causing swirls flows to shape. This swirl current at that point applies power on the mast, making it vibrate. The active energy of the swaying can be changed over to electrical vitality. The development of the bladeless windmill is very

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straightforward. The cone shaped mast is rotated vertically with the assistance of a round and hollow bar held inside so that it can vibrate in just a single course. The segment underneath the purpose of the rotate is secured with the assistance of a metal sheet so the fundamental minute is produced by wind power striking the anticipated surface region over the turn.

The bladeless windmills are 40% more productive than regular ones and it additionally requires less space, ok ridiculous. An innovative jump forward and an insurgency in wind control age. A more practical and earth well-disposed approach to deliver vitality from wind. Vortex Technology gathers vitality from a liquid when it goes through the surface, making an air flexible swaying development on device. Vortex lessens fabricating, activity cost definitely. A sustainable asset is a characteristic asset which will recharge to supplant the bit drained by utilization and utilization, either through normal multiplication or other repeating forms in a limited measure of time in a human time scale. Inexhaustible assets are a piece of Earth's regular habitat and the biggest parts of its ecosphere. A positive life cycle appraisal is a key pointer of an asset's supportability. Sustainable power source alludes to the arrangement of energy by means of inexhaustible assets which are normally recharged quickly enough as being utilized. For example daylight, wind, biomass, rain, tides, waves and geothermal warmth. Sustainable power source may supplant or upgrade fossil vitality supply different particular zones: power age, boiling water/space warming, engine powers, and rustic (off-grid) vitality administrations.

The various phenomenon and concepts that are used in the wind power harvesting are discussed. Also the various problems which are related with the conventional wind power harvesting are discussed. The possible solution of using a piezoelectric material in the oscillation wind power harvesting type model is also discussed [1]. The study of the bladeless wind power generation in which various aspects of bladeless wind power generation. In this paper various applications of bladeless windmill and its future is discussed [2]. Study was conducted in which a series of tests were conducted and the influence of the various taper ratios was studied. For linearly tapered cylinders wider range of lock-in ranges were observed as compared to uniform cylinders. The tests are carried out on small ratios [3]. Kumar et.al investigated the material used for the mast was Polypropylene. Materials used for generating electricity are piezoelectric material, linear generator, and Rack and pinion mechanism [4]. Agarwal et.al investigated material used by them for the mast is Glass fiber. Materials used for generating electricity are piezoelectric material,

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fluid dynamics. Vortex bladeless can be seen as future alternative energy generator. It have huge potential for generating power with the help of wind. In general, vertical & horizontal wind turbines are used for harvesting energy from the wind [5].

Gohate et.al studied the principle of Vortex induced vibrations. They considered the influence of length of the mast, mechanical output is obtained. In this VIV is used and this has potential to integrate with other renewable sources such as solar, wind and tidal [6].

The relation between traditional windmill and bladeless vortex windmill is shown in Table 1.

Problem definition and solution: The problems that are associated with the conventional windmills are very much solved in the oscillation type wind power harvesting. Bladeless windmill is less costly and require less maintenance than the conventional windmill. The bladeless windmill has less moving parts than the conventional windmill. It requires less area and wind speed for its area. The bladeless windmill works on a principle of vortex shedding effect. The vortex shedding is the effect which set the object in oscillations when a fluid flow is passed over an object. Instead of capturing energy through rotational moment the energy is generated through oscillations through a piezoelectric material. There are some researchers who are further working on the implementation of solar panel in this model and generating more power through this windmill in more effective way. Implementation of solar panel have few drawbacks as due to continuous oscillation of the bladeless windmill the life span of the solar panel will decrease as well as it will require proper maintenance at some interval of time. The amount of electricity that will be generated will not be sufficient as the solar panels are fixed in particular direction for particular place at certain defined angles. Figure 1 shows the proposed model of mast component.

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Table 1**shows the comparison of conventional windmill and vortex bladeless wind mill.**

Parameters	Conventional Windmill	Bladeless Windmill
Mode of generation	It captures wind energy using Rotational motion of the blades.	It captures wind energy using "Vorticity"
Acoustics	It's operation is noisy, as it produces noise above 20 Hz.	It is silent in operation as it oscillate at a frequency that doesn't produce audible noise (below 20Hz).
Structure	The design is sturdy & there is high wear & tear.	The design is sturdy & there is minimal wear.
Safety	It is not safer for birds,that often suffer from collision with blades.	It is also safer for birds,that often suffer from collision with blades.
Maintenance	It is not feasible to maintain, as it has higher maintenance cost.	It is easy to maintain due to 80% reduction in maintenance cost.
Construction	It requires more no. of moving parts.	It requires less moving part & less material to produce same amount of electricity.
Economics	The manufacturing cost is higher.	The manufacturing saving is at around 53% of usual production cost.
Efficiency	It has higher efficiency (About 60%).	It has lower efficiency of energy conversion (About 30%).
Space Consideration	The area required for installation is more.	We can put more vortex in the same area to produce electricity

Figure 1 Proposed model of Mast

Materials: The material form which the cylindrical airfoil is directly correlates to device performance. The most importance attributes to this project are material density, rigidity, surface

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finish, availability cost .By sorting out from glass fiber, carbon fiber, moldable plastic it was conclude to select polyvinyl chloride (pvc) as material for the mast and mild steel for the base and spring. Piezoelectric material used for electricity generation, amplifier for amplifying the current to provide enough power to the led. Table 2 represents the mechanical properties of polyvinyl chloride material.

Table 2 Mechanical properties of PVC material

Properties	Value
Tensile strength	4.14e7 - 5.27e7 pa
Compressive strength	1.22e8 - 1.55e8 pa
Density	1.3e3 - 1.49e3 kg/m^3
Thermal expansion	50 - 100 µstrain/°F

Block Diagram of Vortex bladeless windmill

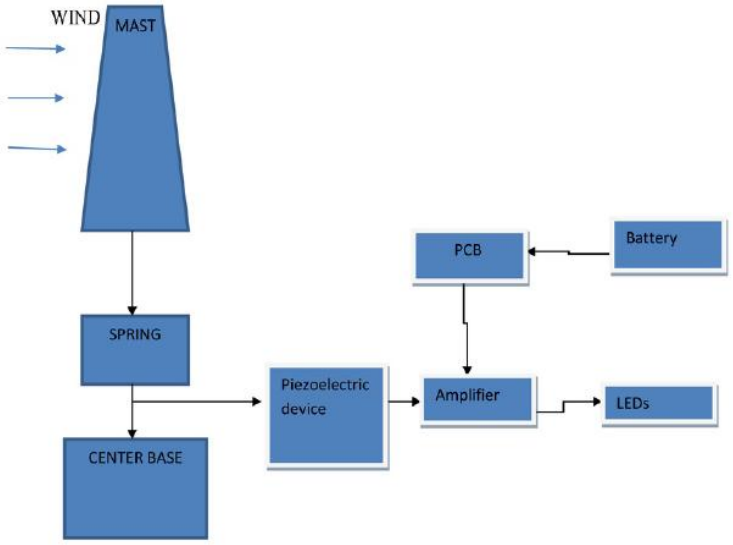

Figure 2 Schematic of Vortex bladeless windmill

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Result and Discussion

The component was modeled and simulated in Ansys workbench 16.2 version software as show in Figure 3.

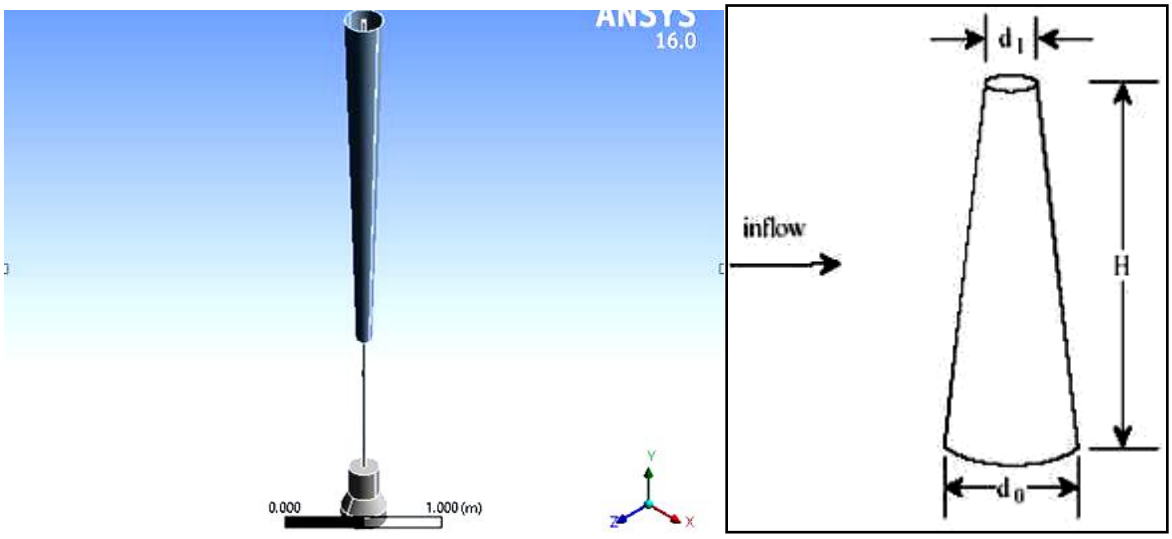

Figure 3 Modeling of Vortex bladeless windmill

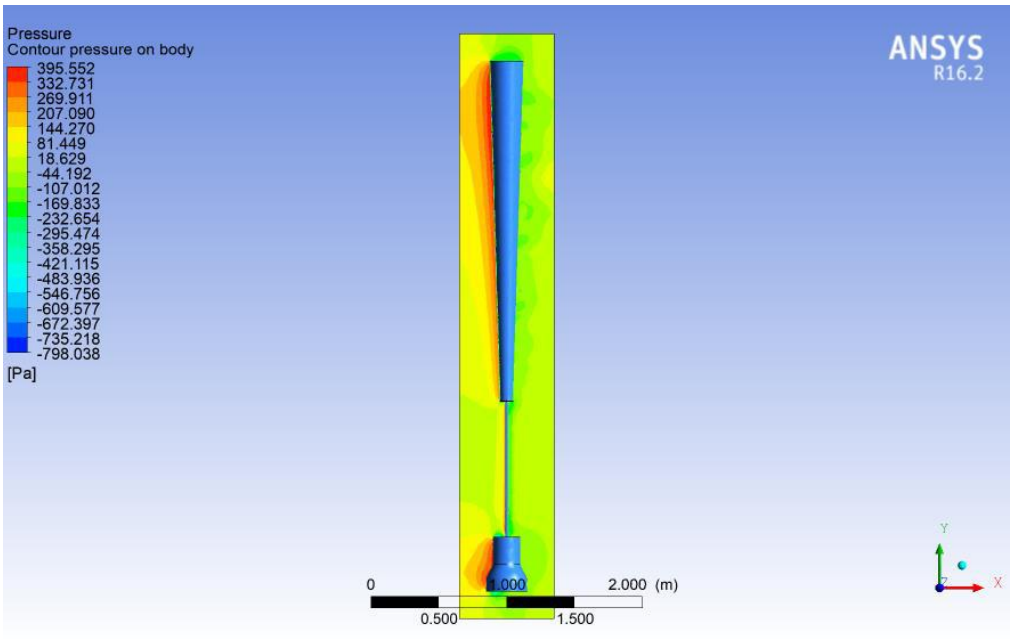

Figure 4 Pressure Contour on body

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Results shows that extreme contour pressure generated on the body was 395.5 Pa with maximum velocity streamline obtained was 38.73 m/sec which is more at the striking side of the mast.

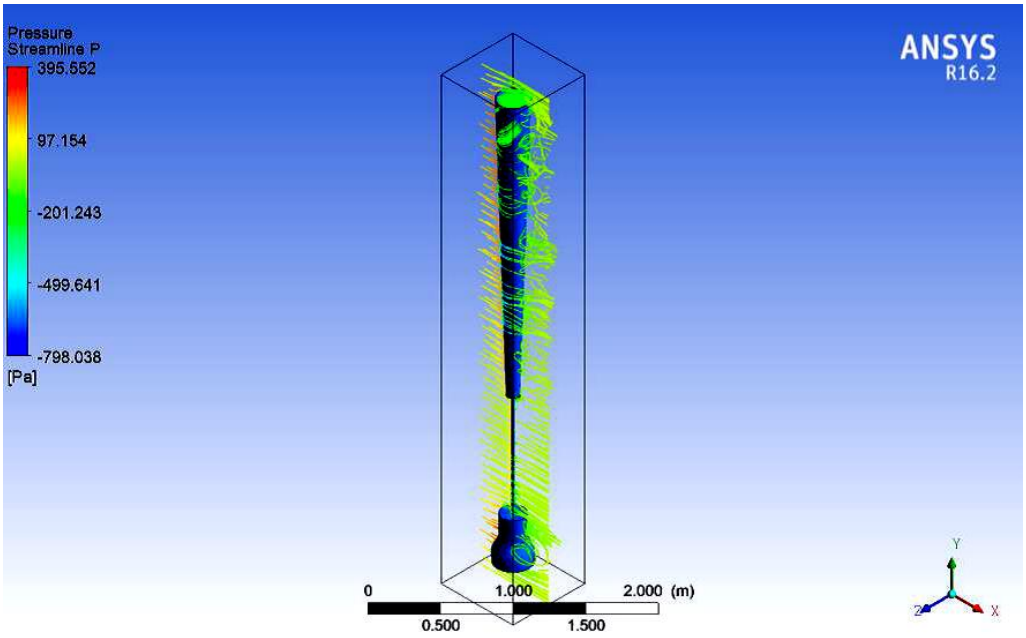

Figure 5 Pressure Streamline

It shows that the vibrating of mast gives you generation of electricity using piezoelectric material as shown in Figure 4 and 5. Velocity contour shows that maximum velocity striking on the mast is 37.422 m/sec. which is very nominal velocity.

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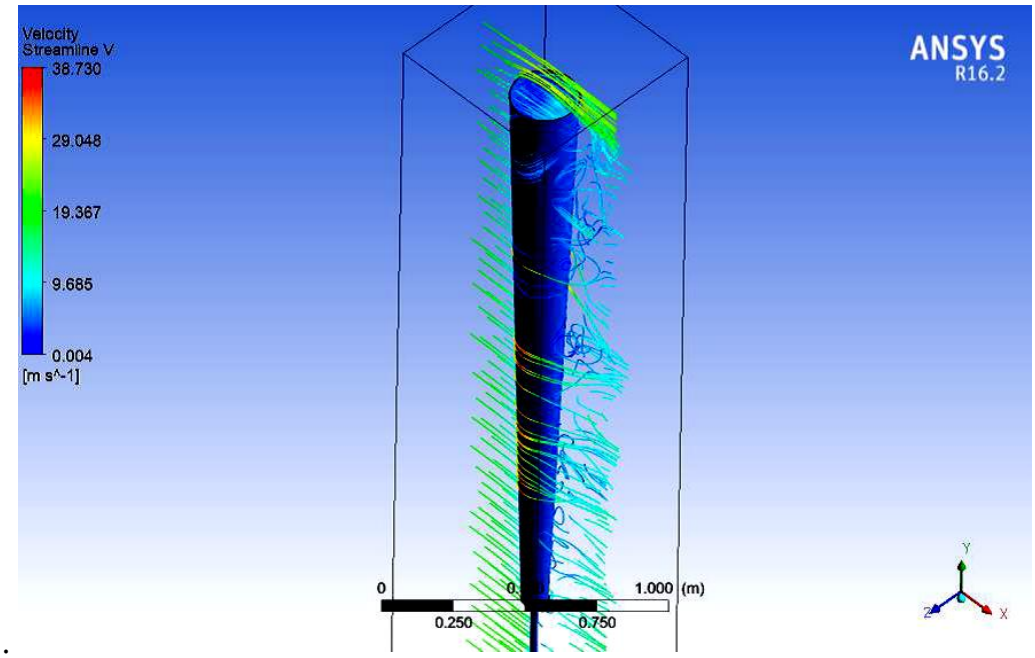

Figure 6 Velocity streamline results

To achieve high velocity for more efficient model. System need to be mounted on the terrace of the building or in a wide open space where there is no interference of tall building etc. Figure 6 and 7 represents the result obtained during analysis.

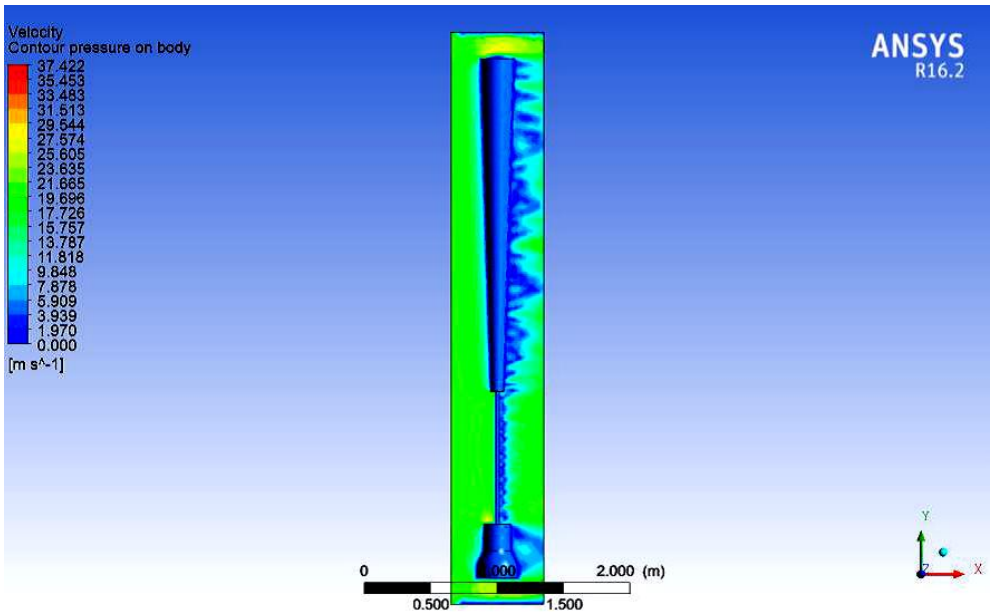

Figure 7 Velocity contour pressure on body result

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Conclusion: Bladeless wind powered harvesting is convenient, requires less investment and also less area than the convenient wind powered harvesting. The highly efficient energy is generated through the bladeless windmill. As the wind speed required is very low the future of the wind power harvesting is very much depend upon bladeless windmill concept. The device produces renewable clean energy which will provide alternate option for exhausting non-renewable energy sources in future.

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