

# Vortex Bladeless Energy Conversion System and Calculation of Natural Frequency of Cantilever Beam

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**ABSTRACT:** The wind energy is one of the mostly used type of renewable energy resource. Since it is one of the existing technologies to generate electricity, we think of ways which can eliminate the disadvantages of the conventional wind power generation system and we came to a new technology that can generate electricity with wind power without the usage of any moving parts in the open atmosphere. This device works on the principle of vorticity or von karman effect therefore it is named as vortex wind turbine. It can generate electricity by the help of vortex formation which is formed by the resonance phenomenon. The aim was to simulate the working of the vortex wind energy system and also to find the natural frequency of mast which is the main part of the vortex wind generation system.

**KEYWORDS:** HAWT- Horizontal Axis Wind Turbine, VAT- Vertical Axis Wind Turbine, VIV- Vortex Induced Vibrations,

## I. INTRODUCTION

India is a country with largest costal lines. These coastal lines are the source for the wind energy but industries have their eye on burning of coal to produce electricity. Burning of coal emits carbon dioxide which would affect the environment causing acid rain, global warming. Development of wind power in India began in 1990s. Our Vortex Bladeless Wind Turbine is an alternative for conventional wind generation process and a replacement for coal as an energy source. Though there have been many substantial technical developments on large-scale wind generation, there are still no technologies with the same positive impact on the economic equation at the micro-generation level, either because of the long pay-back periods that small wind turbines involve or due to the susceptibility of these to the turbulence. So, it is unusual to find this type of installations either in urban or rural environments, as small-scale wind infrastructures are still less convenient than micro-generation installations of solar power. The present research describes and analyses numerically the generation of electric energy by transforming the kinetic energy of an oscillating structure, induced by the vortex shedding as it is immersed in a fluid flow, commonly known as VIV (Vortex Induced Vibrations). When wind passes one of turbines, it shears off the downwind side of the cylinder in a spinning vortex. The KE of the oscillating cylinder is converted to electricity through a generator similar to those used to harness energy. It consists of a conical cylinder vertically with an elastic rod. The cylinder oscillates in the wind, then generates electricity through a system of coils and magnets.

## II. RELATED WORK

The concept of vortex induced vibrations got from A.C.Fernandes Fundamental concepts of vortex induced vibrations [1]. The design of vortex generation around cylinder got from V.S. Marta 2008 Vortex-induced vibrations of a circular cylinder in laminar and turbulent flows [3].



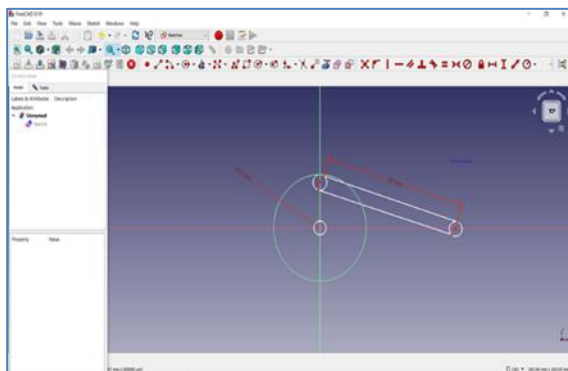
### III. METHODOLOGY

The objective of this study is to develop in the mechanical simulation of the mast we use the external motor to provide power for the mast to vibrate. This process is done to simulate the working of the mast under wind power. The motor is attached with a crank and a metallic rod is welded at the periphery of the disc. A link is attached to the end of the rod. This link is attached to top of the mast. This crank shaft arrangement converts the rotary motion of the motor into linear motion. The Disc is of 40 mm diameter, the metal rod at its perimeter is of 1cm diameter and 5cm in height. The link is of 60cm length and it varies with design of the mast. The design of the disc is in such a way that we get a maximum displacement of 40 cm at the top of the mast. The speed of the motor is controlled with an ac speed regulator so that we can simulate various wind speeds and also find out the optimum wind speed for the generation of maximum electricity. In this design the crank will be attached to the rotor shaft, the crank is of radius 20cm. The link is assumed to be 60 cm or will be increased or decreased accordingly during the construction of the model. The link will be fixed to the crank on the rod welded at the perimeter of the crank. They will be fastened using bearings

The motor has stator and rotor. The stator is made of laminated steel. There are poles on the stator. Usually two poles are there. Field coils are wound on each pole. The rotor, also called armature is also made of laminated steel, has slots and is tightly fitted with the shaft. Rotor windings are placed on rotor slots. Ends of rotor windings are permanently connected to commutator segments. Commutator segments are around the shaft of one side. There are two brushes that make contact with two commutator segments at a particular instant. As shaft rotates, the commutator segments that comes in contact also change. Field windings in the stator and rotor windings are connected in series through the rotor commutator. Universal motor can run on both AC and DC. They have high starting torque and speed. Here we uses a 750 watts motor that can be operated by 220V 50Hz AC supply

An AC Controller (Sometimes referred to as a Driver) is known as the device that controls the speed of the AC Motor. An AC Controller can also be referred to as a variable frequency drive, adjustable speed drive, frequency converter, etc. The AC Motor receives power, which is ultimately converted by the AC Controller into an adjustable frequency. This adjustable output allows the motor speed to be precisely controlled. Typically, an AC Controller consists of three basic parts: the rectifier, inverter, and the DC link to connect the two. The rectifier converts AC input into DC (direct current), while the inverter switches the DC voltage to an adjustable frequency AC output voltage. The inverter can also be used to control output current flow if needed. Both the rectifier and inverter are directed by a set of controls to generate a specific amount of AC voltage and frequency to match the AC motor system at a given point in time.

Cantilever beam natural frequency calculator to calculate natural frequency of a uniform beam with length L and uniform load w per unit length including beam weight. Beam is fixed from one end and the other end is free (cantilevered beam).T



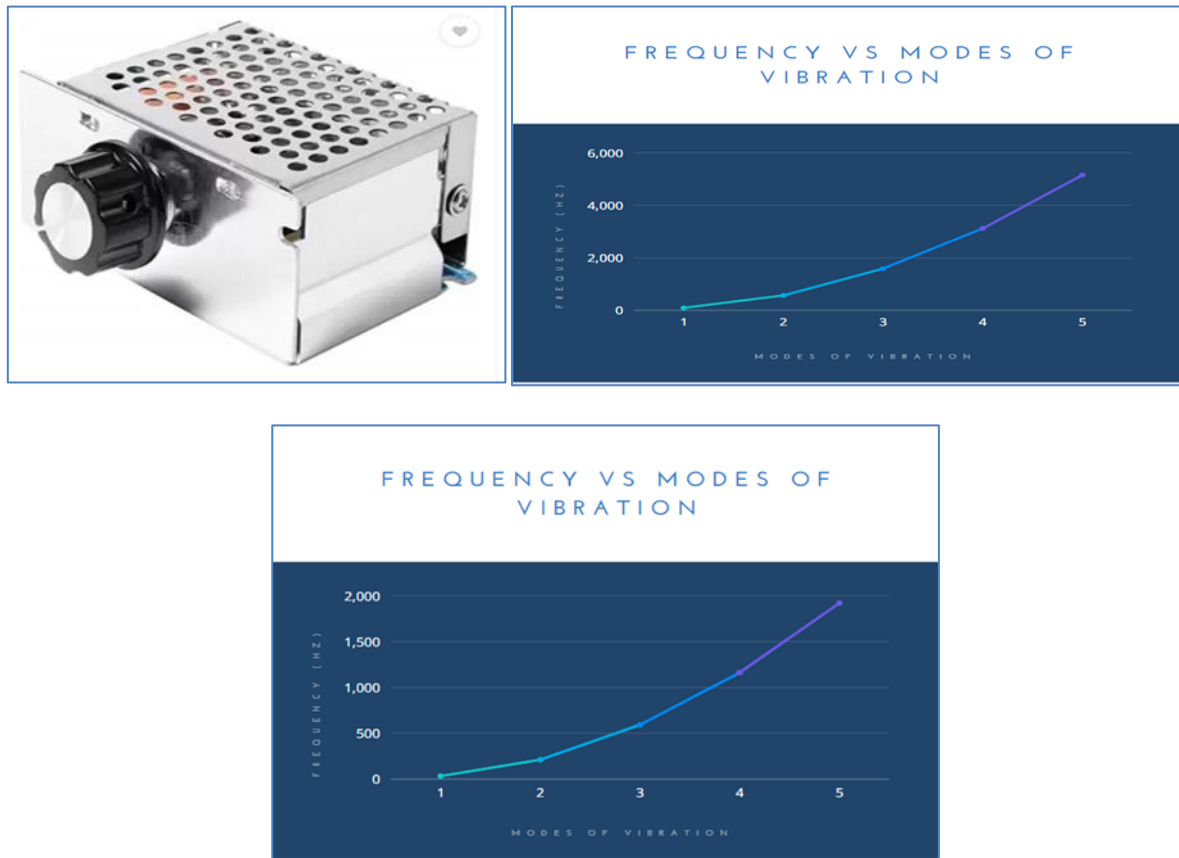


Fig.1. & Fig.2 Cad drawing and Motor, Fig.3 Regulator , Fig.4 Result of Carbon steel& Fig.5. result of Pvc

#### IV. EXPERIMENTAL RESULT

On comparing the results of both the materials for the first mode of vibration we get the value for carbon steel as 90.686 Hz and for PVC it is 33.79 Hz. For the second mode of vibration the value for carbon steel is 566.789 Hz and for PVC it is 211.233 Hz. For third carbon steel has 1589 Hz and PVC has 592.383 Hz. For fourth one carbon steel got 3117.333 Hz and PVC got 1161.724 Hz and finally for fifth mode of vibration carbon steel got 5152.617 Hz and PVC got 1920.206 Hz. On comparing the results the lighter material has low natural frequencies than carbon steel for the same modes of vibration.

#### V. CONCLUSION

As we all know that the demand for energy is increasing day by day. Convectional power systems are not adequate to meet this growing demand since they are non- renewable sources of energy. Thus the vortex bladeless wind turbine comes into relevance. The wind is a renewable energy source. Vortex wind turbine can generate electricity without the drawbacks of the large HAWT wind turbines.

The motor mechanism thus developed to transmit power to the mast so that the mast can vibrate will be a successful design for the simulation of wind energy for the model of the mast to generate electricity. As a further study on the mast we focused on finding the natural frequency of the mast. Mast is like a cantilever beam. So we numerically found out the set of natural frequencies of the mast in which the mast can vibrate. We found out the frequency of beams made of two different materials, they are carbon steel and PVC. On studying their results side by side we found that the natural frequencies of PVC were much smaller compared to that of carbon steel. Thus we found that materials like PVC and similar products are most suitable for making mast.



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