

Review paper on vibrowind system (aerofoil)

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Abstract— Our motive is developing of alternative fuels to reduce the consumption of fossil fuels. So here we are concentrating on the renewable energy resources, Here vibro wind system is a new developing technology in renewable systems. In this Vibro wind system mechanical energy (vibration source) can converted into electrical energy. This is a new developing technology now a days

I. INTRODUCTION

In today's world, there is a high requirement for electricity. In order to reduce fossil fuel consumption and minimize greenhouse gases emission to atmosphere nowadays lot of attention is paid to renewable resource like wind energy. It's right time to switch over to the renewable resources and stop depending on the existing ones. Among there many renewable resources available on the earth, the most abundant ones are water, sun light and wind. Already, solar energy has taken over the world by being implemented widely. In the case of wind energy, the conventional method of producing electricity through wind is by using wind turbines. These wind turbines are huge in structure and hence consume a lot of man work, material and space. An alternative for this would be the "VIBRO wind energy harvester" or in short "VIBRO wind".

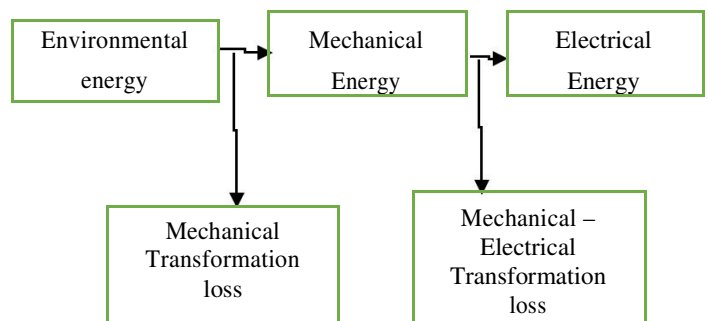
The focus of this proposal was to investigate the principles and feasibility of VIBRO wind power i.e. harvesting energy from wind. The available kinetic energy in the environment needs a transduction mechanism to electrical energy. The three important mechanisms to convert the available mechanical vibration into electricity are electromagnetic, electrostatic and piezoelectric transduction. In this project piezoelectric transduction is used for energy conversion.. This new technique will use piezoelectric materials to harvest wind energy. The necessity of Electricity is increasing day by day, so vibro wind helps in increasing the productivity of power generation. This could create a great impact in forth coming days.

In order to utilize the wind energy in an optimistic manner for producing electricity, some particular design requirements are required in this system. This system can be best used when the cantilever beam is made using acrylic material along with particular dimensions combined with a blunt shaped foam body. Coming to the dimensions of the cantilever beam, it is

essential that the length of the beam should be high and the thickness being thick. The thickness of the cantilever beam should be taken care of because when there is high wind current, there are chances of breakage of the cantilever beam. In order to avoid that, the thickness should be thick. Preferring, long cantilever beams would lead to high power output. When the beam length is short, the movement or vibration of the beam is tough or almost nil. Hence, when the length increases, the movement of the beam increases which in turn increases the overall power output. Another main important factor to be considered is opting of blunt body shape. The blunt body shape enables to produce high number of vibrations. Thus, when the number of vibrations increases the output power is increased.

II. ENERGY HARVESTING

Energy harvesting refers to the generation of the energy from sources such as ambient temperature, vibration or airflow, solar energy and wind energy. As shown Figure. There are various types of sources and different types of losses available during energy conversion. The system of converting the available energy from the environment allows a self-sufficient energy supply for electronic devices. Energy harvesting requires a transduction mechanism to generate electrical energy from motion. The design character of mechanical system should maximize the coupling effect between the energy source and the transduction mechanism and which will depend completely upon the characteristics of the environmental motion.



The Electricity will be generated by the transduction mechanism itself, by exploiting the mechanical strains or relative displacement occurring within the system. The strain effect may develop the deformation within the mechanical system which typically services piezoelectric materials whereas in case of relative displacement, moreover the velocity or position can be coupled to the transduction mechanism. Velocity is mainly associated with the electromagnetic transduction while relative position is associated with the electrostatic transduction.

III. METHODOLOGY

I. Vibro wind system - Introduction

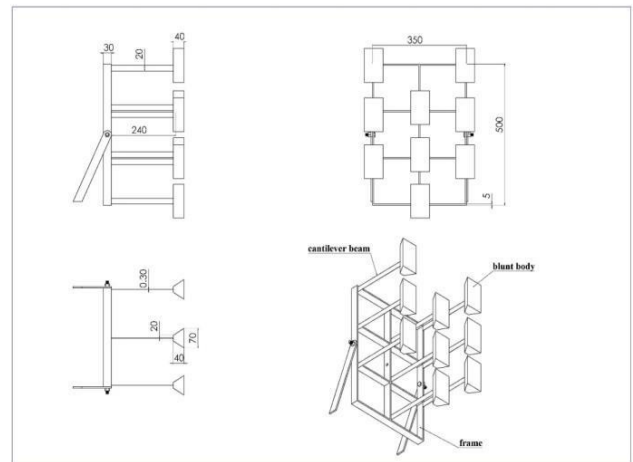
Vibro wind is the bladeless technology which uses piezoelectric material to produce electrical energy. Vibro wind models harness energy through the oscillation of foam body. Vibro wind denotes harvesting of energy from the wind as it flows around vibrating structure and is an emerging alternative to conventional rotary wind turbines.

The basic science involves wind induced vibration due to the non-linear fluid flow and vortices around flexible bodies and the technology. Vibro wind motion is an example of transverse aerodynamic galloping. The composite structure of a VIBROWIND system consisting of a cantilever beam attached with the PIEZO electric material, Here one end of the cantilever beam is attached with the frame setup and another end of the cantilever beam is attached with the foam blunt body.

II. Construction of System

Vibro wind design consists of cantilever beams attached with piezoelectric cell that will generate electricity when the cantilever beams flutter in the wind with the help of the foam blunt body. Individual cantilever beams of vibro wind's generate a small amount of energy, but when it is arranged in an array they can provide significant amount of usable energy. Material of the cantilever beam is stainlesssteel which is attached to the frame with the help of metal bonding agent and blunt body (foam) is attached with the cantilever beam at its free end with the help of bonding agent. The bonding agent used is epoxy resin because of its effective properties. The panel grid of vibro wind system is kept at an inclined angle of 25° for making the effective utilisation of wind energy. Piezoelectric transducer is used for converting the vibrating energy created by the cantilever beam into the electrical energy. Piezoelectric transducer is attached to the cantilever beam near to the fixed end where the frequency of vibration is high.

Similarly from the construction the blunt body design is changed to the required AEROFOIL design for the better vibration.

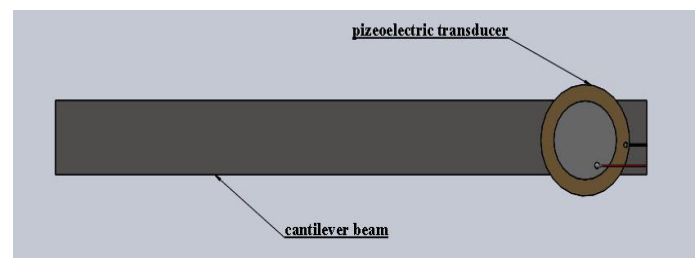


IV. WORKING PRINCIPLE

The working of vibro wind is simple when compared with other wind energy harvesting devices such as wind turbines and the components used are very less. The vibro wind system works on the mechanism of piezoelectric transduction in which the available kinetic energy (vibration) is converted into the electrical energy. When the wind makes an impact on the blunt body it starts to oscillates, because of the oscillations the cantilever beams are also vibrates along with the blunt body. Thus the vibration energy is produced in the beam, and then these vibrations are absorbed by the piezo electric transducer and convert into useful electrical energy.

I. Cad modeling of a cantilever beam with piezoelectric material

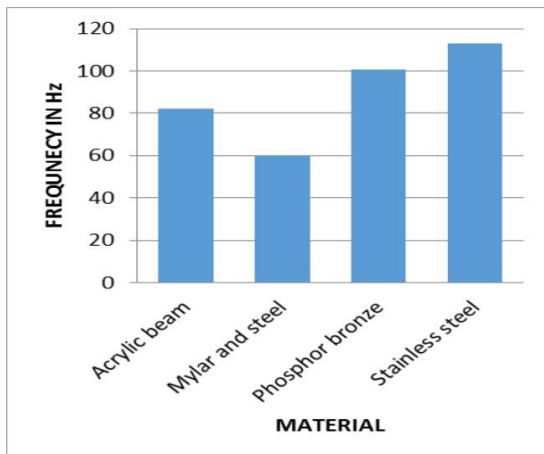
For this cad modelling we used solid works 2016. This CAD modelling shows the cantilever beam and the piezo electric attached to the to it.



V. FABRICATION OF VIBRO WIND

I. cantilever beam

The cantilever beam is a structure which has one end fixed and another is supported with the areofoil blunt body(foam).The cantilever system is an estimated technique used for calculating the moments and shear forces developed in the beams and columns of a frame or structure due to lateral loads. The applied lateral loads typically include wind loads and earthquake loads. The cantilever beam dimension is designed effectively for the construction of the vibro wind.



II. frame

Frame is the structural element which support the other components used in the construction of the vibro wind. It is rectangular in shape to which the cantilever beam is attached and has divided into small cross section . It is made of mild steel because it can weld easily and cheap in cost.



III. blunt body model

Blunt body is used for making the effective utilization of the wind energy and it is attached to the cantilever beam by using the epoxy resin. Blunt body size and cross section shape affect its performance in a Vibro-wind energy harvesting system. The designing of blunt body play the effective role in the construction of the vibro wind. The material used for the blunt body is polystyrene. Trapezoid shape is selected for the blunt body design which is more effective than the rectangle and conical shape.

VI. RESULTS

BY USING TRAPEZOIDAL BLUNT BODIES,
 For trapezoidal section Single beam with blunt body

Wind speed=6.2 m/s Output voltage=0.59V

For trapezoidal section 9 beams with blunt body

Wind speed = 1-2 m/s output voltage = 1.3 V

BY USING CONICAL BLUNT BODIES,

For Conical Section,

For Conical Section,

Single beam with blunt body

9 beams with blunt bodies

Wind Speed=7.2 m/s

Wind Speed=1.5 to 2 m/s

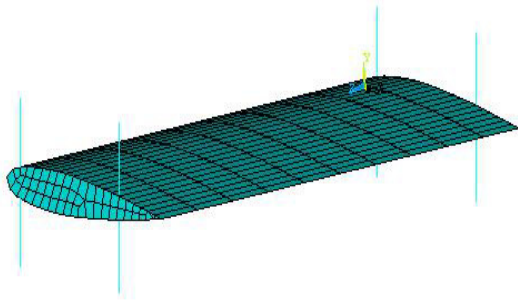
Output voltage=0.11V

Output voltage=0.27V

VII. AEROFOIL BLUNT BODY

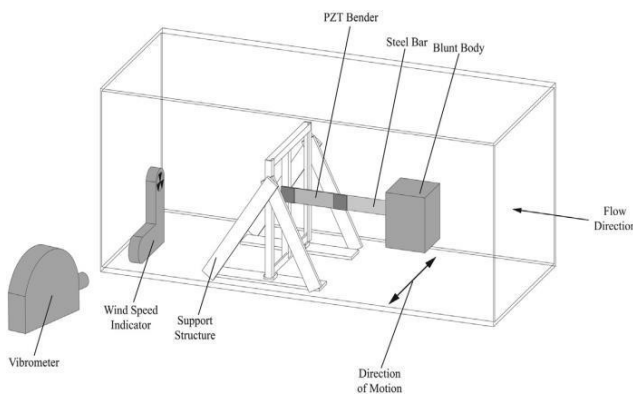
Here instead of the rectangular or a conical shape of the blunt body aerofoil shape blunt bodies are preferred. Based on the

drag and lift forces it can give more oscillation than the other 2 shapes of blunt body



These aerofoil shapes are derived by National Advisory Committee for Aeronautics. Here a design shows the aerofoil 0015. Our idea is based on the drag and lift force on the aerofoil shapes. Due to the reactions of drag and lift, there is a disturbance on the blunt body, due to this a blunt body can increase the oscillation of the cantilever beam.

I. Testing setup of the system



Here a setup box has cross-section of 1200mm*30mm*30mm. A support stand setup is made up of aluminium 6063. This setup is experimented at 2 to 3 m/s wind speed. A non-touching vibrometer used to measure the produced vibration. In this setup instead of rectangular blunt body aerofoil section blunt body can be used.

VIII. CONCLUSION AND FUTURE WORK

The main purpose of this paper is to select the suitable material for the cantilever beam and to determine the frequencies generated by them. We have compared many materials and have to select which is suitable. Since each and every material shows different properties they have to be tested. Another factor is the piezoelectric transducers which can bring some changes in the output and they should also be selected properly. The major output is depended upon the

beam structure. Higher the frequency greater will be the output.

Thus, Vibro wind system is essential in today's world as we may run out of the resources (fuel) used for producing electricity anytime in the near future. Thus, with further improvisations in design for better optimization of the energy, this system will create a huge impact just as in the case of how solar is ruling in the world of producing electricity. This alternative may create a major impact in upcoming generations.

- Harvesting of energy from wind as it flows around commercial and residential buildings through the mechanism of vibrating structures is now possible.
- Since it consumes only less space, Can be placed on any surface in an outdoor environment making it possible to use even in urban areas.
- Bladeless mode of producing electricity is now possible. Hence, the materials required, money and man work needed is hugely reduced compared to the work involved in case of a conventional wind turbine.
- Since it can use wind speed as low as 2m/s, it can be fitted on roof tops, buildings. Further developments can be made by introducing the concept – hybridization i.e, by combining wind along with solar energy.
- Harmless to the environment and is almost noiseless unlike wind turbines which produces a lot of noise.
- Since wind speed is high during the night times than day and less electric power is consumed less in the night hours, storage of electricity can be made.
- If this system is used effectively, it can almost light up the entire city.

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