

# Development of a Small Scale Power Generation System using Rooftop Ventilator

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## ABSTRACT

The ever finishing call for electric electricity has caused widening of electricity call for - deliver gap, which has pressured researchers to beautify the strength production from renewable sources of electricity like solar, wind etc. attempting out every viable methods. rooftop ventilators (RTV) usually used for ventilation reason, can be used to extract wind strength by means of suitably designing a generator to couple with it. rooftop ventilators do no longer at any electric power for its running. the paper discusses the development of a energy technology gadget the use of an average RTV. the paper emphasize on the materials and the development technique followed for developing a rooftop energy producing system. as a take a look at case, the RTV energy generation system is designed to charge a battery and strength up the led lighting load linked to it. experimental results indicates that the system may want to generate a most dc voltage of 25v with the ventilator blade velocity of 150rpm. this kind of small scale strength era systems are appropriate to rate low strength hundreds. an exhaust device which does no longer devour electrical power for its operating is applied to provide electric electricity, thus improving the use of green electricity for a sustainable the next day.

**Keywords :** Rooftop Ventilator (RTV), Neodymium Magnet, RTV Power Generation System.

## I. INTRODUCTION

The demand for energy has never faced a fixed back since michael faraday has evolved the first electric generator in 1831. the widening of strength demand deliver hole has pressured researchers/engineers to beautify energy manufacturing with present technology and additionally to increase new technology to generate power. the burden era stability report 2015 - 2016 by way of the critical strength authority indicate the demand-supply shortage inside the indian strength device. as per the file, with in the yr 2014 - 2015, only 10,30,785 mu become to be had for a total strength requirement of 10,68,923 mu, indicating a scarcity of 38,138 mu. it also depicts a scarcity of 7,006 mw in height energy

with 1,48,166 mw call for and 1,41,a hundred and sixty mw furnished [1]. the environmental influences of the conventional coal based totally strength vegetation and safety issues worried with nuclear energy vegetation pressure people to suppose approximately easy and environmental pleasant resources of power like solar, wind and so forth.

Industries, ware houses etc. spend a giant amount for cooling the indoor spaces the use of hvac, aircon and so on to make sure a wholesome working surroundings to the personnel. a very good working situation may be provided with an awesome stage of ventilation. herbal ventilation with out electrical energy consumption is legitimate in this context that's executed via natural air driven rooftop ventilator.

generation of electrical energy from wind power is typically by wind turbines, employing horizontal axis wind mills (HAWT) or vertical axis wind generators (VAWt). however the strength manufacturing from such wind farms isn't dependable on the grounds that wind speed modifications as in step with the climate conditions. Different opportunity for energy manufacturing from wind is 'kitegen technology', the usage of tethered kites, extracting energy from high altitude wind. there may be appreciable wind velocity at high altitudes irrespective of the locations, that's capable of rotating the big wind turbines [2]. both technology require high investments rooftop ventilator is designed technically to work as a vertical spindle [3]. as a ventilator device, it does no longer eat electric powered electricity. the RTV rotates because of the wind velocity or due to the internal hot air. this rotatory motion of the RTV can be utilized for generating electric powered power. This has caused the modification of a regular RTV right into a rooftop ventilator generator. for this reason the RTV generator may be used for air flow of exhaust in addition to for small scale electricity technology. the modifications done to a standard RTV and the circuit to extract dc output is presented on this paper. phase ii in short explains the operation and advantages of rooftop ventilator. specs of the RTV used on this have a look at is also mentioned. in segment iii, generator production is mentioned with issue level description. the power technology device using RTV and the built generator is defined in phase iv. results of the experimental test are mentioned in segment v and the paper is concluded with the aid of phase vi.

## II. ROOFTOP VENTILATOR

Rooftop ventilators are commonly implemented on the roofs of industries, workshops, ware houses and so forth. for air flow purposes. they do not require electricity for its running. being an eco-friendly inexperienced product. it facilitates in decreasing the carbon footprint and aid in strength financial savings. they're honestly renovation loose. they do no longer create any noise all through its operation and are leak

and rain evidence. it gets rid of hot air in summer and moisture weighted down air in iciness from the interior of the homes. rooftop ventilators rotate due to two principles. first is that the air flows from high temperature region to low temperature location or from high stress region to low strain location. 2nd is due to the moderate breeze that exist within the surroundings. determine 1 suggests a typical rooftop ventilator and determine 2 offers a pictorial description of the blessings of rooftop ventilators



Fig. 1: A typical Rooftop Ventilator

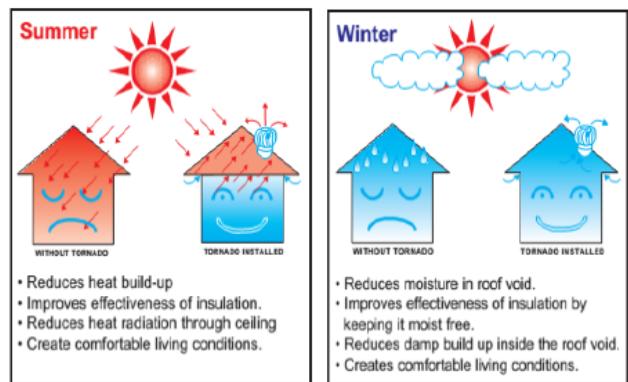


Fig. 2: Pictorial description of advantages of RTV

At some stage in summer and iciness seasons (source: technical sheet of wind twister turbine roof ventilator for domestic air flow). RTV additionally called as faster ventilators are designed to withstand a wind velocity of up to a hundred kmph.

TABLE I: Technical specifications of RTV

Technical Specifications	Considered
Outer Diameter	810 mm
Neck Diameter	610 mm
Blade Thickness	0.5 mm
Number of blades	42
Type of blades	Aluminium
Approximate Weight	6.5 kg
Center assembly	MS Galvanized

it is constructed the usage of light-weight materials like stainless steel or aluminium. the curved construction and lightweight materials useful resource it to rotate at low velocity of wind in any path. the specification of the RTV used in this examine is given in table i.

## GENERATOR CONSTRUCTIONAL DETAILS

A everlasting magnet generator is developed to harness the wind strength thru rooftop ventilator. neodymium magnets are used as the everlasting magnets, connected to the rotor body constitutes the rotor of the generator. an ordinary ceiling fan stator rewound with 0.345 mm copper winding wires make up the stator of the generator. both rotor and stator are bolted to the RTV frame. desk ii depicts the generator constructional specs. following subsections describe the principal components of the generator.

### A. CORE & WINDING

Electric fan technically known as as capacitor start single phase induction motor is a normally used gadget. it is a bidirectional gadget able to transforming electric strength into mechanical power and vice-versa as consistent with its connections. the stator of a fan motor is made as the stator of the generator developed for this examine with slight adjustments in the winding. the fan motor (center of the generator advanced) has 14 slots. the rotor winding of the fan is removed and copper enameled winding wires of swg variety 29 with a thickness of zero.345 mm is wounded like a simplex lap winding. winding is completed in this type of fashion that every slot of the core houses three hundred conductors. the newly wounded middle is proven in Figure 3.



Fig. 3: Newly wounded core of the generator

TABLE II: Generator constructional specifications

Technical Specifications	Considered
<b>Core &amp; Winding</b>	
Number of slots	14
Number of conductors per slot	300
Thickness of each conductor	0.345 mm
<b>Permanent Magnet</b>	
Number of magnets	4
Length of each magnet	4.5 cm
Breadth of each magnet	1.5 cm
Height of each magnet	1.25 cm
Strength of each magnet	2.5 Wb
<b>Bearings</b>	
Number of Roller bearings	2
Number of Bushed bearings	1

### B. PERMANENT MAGNET

The main objective of a magnet is to resource in energy con- version. in devices like turbines, sensors and many others. they help in conversion of mechanical electricity to electrical power. magnets are used in motors, actuators and so forth. to provide the magnetic field essential for the conversion of electrical energy into mechanical strength. The four main magnetic properties of any magnetic materials are: 1) residual flux density( $b_r$ ) - the quantity of magnetic flux density in tesla that remains permanently in a fabric is the residual flux density. it is also known as as residual induction. 2) coercivity ( $h_c$ ) - it's far the demagnetization pressure wished to lessen the residual flux to 0 in a magnetic cloth, after it has been magnetized to saturation restrict, measured in ampere-turns in step with meter. three) electricity product ( $bh_{max}$ ) - it is the entire saved electricity in the magnet. it's miles obtained as the fabricated from residual induction and coercivity and is particularly used to grade the uncommon earth

magnets. 4) temperature balance - any magnetic material loses its magnetic homes if its operating temperature is greater than its curie temperature ( $T_c$ ). for solid operation, the magnets for any software ought to be decided on primarily based on its curie temperature. 4 essential kinds of permanent magnet substances to be had in marketplace are neodymium or neo rare earth (NdFeB), samarium cobalt (SmCo), tough ferrites (SrFeO<sub>3</sub>) and alnico magnets. neodymium additionally known as as nib is an alloy of neodymium, iron and boron, is the strongest of all everlasting magnets with curie temperature approximately 310°C and strength product cost starting from 60 to 440 kJ/m<sup>3</sup>. the demagnetization curve for a neodymium magnet n- 45m for numerous curie temperature is proven in determine four. (source: alliance llc magnetic guide and tutorial [4]). 4 nib magnets, every of 2.5 weber power is used in the generator construction period, width and height of the magnet used are respectively 4.5cm, 1.5cm and 1.25cm. the magnets are bolted to the rotor body as proven in figure 5 ,which constitute the rotor of the generator



Fig. 4: Demagnetization curve for a Neodymium magnet for various Curie Temperature



Fig. 5: Magnet bolted to the rotor frame

#### C. BEARING

Rolling bearings are used in electric machines for you to guide and locate the rotor and to transfer the load to motor frame from the shaft. for any electric gadget for the choice of bearings, there are various elements like: the running pace, ambient temperature and the working temperature of the system, surroundings type in which it is implemented and many others. are to be taken into consideration. but in this example, such complex layout is no longer followed due to the fact that it's far a model for the feasibility have a look at. roller bearings in two numbers are used right here for the clean rotation of the rotor plate in conjunction with the rooftop ventilator as proven in figure 6. a bushed bearing is also used to repair the stator parts inside the machine. figure 7 indicates the evolved generator fitted to the body of rooftop ventilator.

#### III. CONCLUSION

This examine advanced a small scale power technology machine the usage of an ordinary rooftop ventilator and there by cementing an opportunity to harness wind power too produce strength. the maximum dc voltage generated is 30 v which may appears smaller, however there are some hundreds that paintings with this voltage. a unmarried RTV generator set, if ought to produce a voltage of 30v, a collection of RTVs mounted on a factory roof can generate a large amount of electricity. furthermore

studies on this system would supply more attractive results. the RTV energy generation device produces small scale strength using the interior warm-humid air or the breeze outside, permitting a way to shorten the power call for - deliver hole. this gadget empowers the green initiatives for sustainable improvement.

#### RTV POWER GENERATION SYSTEM

The RTV strength generation gadget consists of a rooftop ventilator coupled with the everlasting magnet generator.

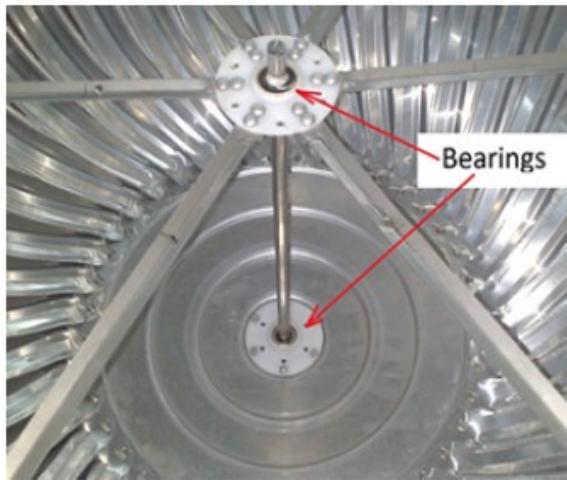


Fig. 6: Bearings connected in the RTV



Fig. 7: Generator developed fitted to RTV frame.

The RTV generator set is attached to a battery thru a bridge rectifier. the load (led array) is hooked up to the battery for its operation. Figure 8 indicates the block diagram of the RTV strength generation system.

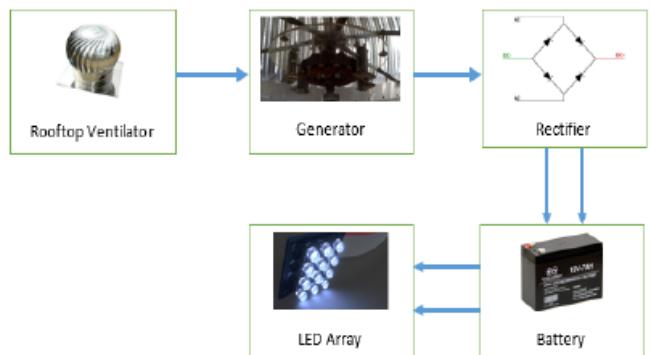


Fig. 8: Block diagram of RTV Power generation system

The winding and the rotating magnets respectively constitute the stator and rotor of the generator. whilst the rooftop ventilator rotates either due to internal hot or damp air depending at the seasons or due to the mild breeze inside the environment, the rotor rotates which produces a rotating magnetic subject. in line with faradays regulation of electromagnetic induction, a voltage is triggered within the stator winding which is surpassed to the rectifier. a bridge rectifier is hired on this observe for rectifying the generated ac voltage to dc, seeing that they have got excessive rectification ratio of 0.81 and a ripple factor of 0.48. the systematic conduction of the diode gives a rippled dc at the output which is filtered to gain clean dc voltage. the rectified output is fed to the battery for charging it. the machine is designed such that the burden attracts power from the battery charged via the RTV generator set.

The designed RTV electricity generation machine is examined by using blowing wind at special velocities. the set is welded to the pinnacle of an iron stand of 5 toes height for trying out. generated voltage is measured at an intervals of 25 rpm velocity of the ventilator starting from 50 rpm. the most pace of ventilator is confined to a hundred and fifty rpm, due to the fact that there is mechanical vibrations at 130 rpm and above, which might affect the gadget stability. for a RTV established at the roof, no such vibrations will occur at these low speeds. a most voltage of 30 v dc is obtained at a ventilator velocity of a hundred and fifty rpm. the generated voltage versus ventilator velocity graph s depicted in figure 9.

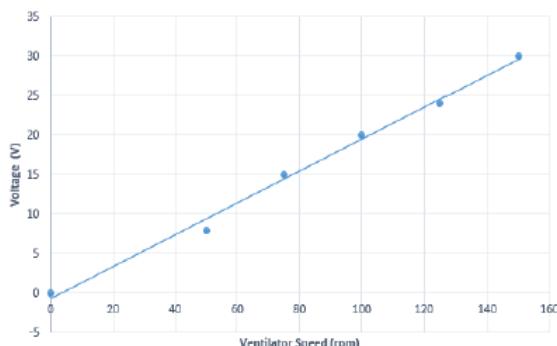


Fig. 9: Generated voltage versus ventilator speed.

#### IV. CONCLUSION

This examine advanced a small scale power technology machine the usage of an ordinary rooftop ventilator and there by cementing an opportunity to harness wind power too produce strength. the maximum dc voltage generated is 30 v which may appears smaller, however there are some hundreds that paintings with this voltage. a unmarried RTV generator set, if ought to produce a voltage of 30v, a collection of RTVs mounted on a factory roof can generate a large amount of electricity. furthermore studies on this system would supply more attractive results. the RTV energy generation device produces small scale strength using the interior warm-humid air or the breeze outside, permitting a way to shorten the power call for - deliver hole. this gadget empowers the green initiatives for sustainable improvement.

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