VIVA-Tech International Journal for Research and Innovation
ISSN(Online): 2581-7280

Volume 1, Issue 3 (2020)
Article No. 1
PP 1-8

VIVA-TECH INTERNATIONAL JOURNAL FOR RESEARCH AND INNOVATION
ANNUAL RESEARCH JOURNAL
ISSN(ONLINE): 2581-7280

Design and Implementing of Roof Ventilator in Small Scale Industry for Future Prospective

Ms. Ashwini Pawar[1], Ms. Amruta Dhuri[2], Ms. Riya Patil[3], Prof. Bhushan Save[4]
[1]*(Electrical Engineering Department, VIVA Institute of Technology, India)*
[2]*(Electrical Engineering Department, VIVA Institute of Technology, India)*
[3]*(Electrical Engineering Department, VIVA Institute of Technology, India)*
[4]*(Electrical Engineering Department, VIVA Institute of Technology, India)*

Abstract: *This paper gives an idea about a futuristic method for producing electricity with the help of Renewable energy driven by wind. The Rooftop Ventilator works on the simple principle of wind-assisted rotation and stack effect. Several electrically active material is assigned on the turbine ventilator under the wind speed in the surrounding are ultimately assesses the efficiency of wind harvest. This concept resembles with DC generator. This paper prominence on the materials and the construction methodology for developing the Rooftop power generating system. Thus, a roof ventilator reduces air- conditioning energy use and increases the occupant comfort level. It can become a grand success for any industry/factory for using an electricity saver item.*

Keywords – *Rooftop Ventilator, DC generator, Renewable Energy, Gear Mechanism.*

1. INTRODUCTION

Global warming is increasing drastically due to the use of Non- Renewable energy. It is very hazardous for the environment as well as for humans. The consumption of Non-Renewable energy is evanescing for example oil will run out in a few years. Increasing the supply of renewable energy would allow us to replace carbon-intensive energy sources and significantly reduce global warming emissions.

This project is based on power generation by using renewable energy. Mostly this roof ventilator is elevated on the tip of the roof for providing ventilation on the floor. A rooftop ventilator provides a form of natural ventilation, moving air continually and causing trapped, stale air to be replaced with cleaner, cool air from outside. The supplementary function of the rooftop Ventilator is to produce electricity without any charges. Even a small amount of wind is enough to rotate a rooftop ventilator.

2. LITERATURE REVIEW

The literature exploration was mainly targeted on topics related to Power Generation using RTV. The review of publications and probing work revealed the basic arrangement and generation by using a precise model of roof ventilator, where a positive result is expected, in favour of civilization and future demand for the saving of fossil fuel and environment pollution point of view.
The system was devised and implemented with the following goals to be completely distinctive from conventional electricity labs and to be fresh and interesting. To show a convoluted, relevant system that is closer to the "real world" than the usual simple systems covered in educational labs.

[1]* Miss. *Autade Puja Padamnath et al.:-

In this paper, they have examined electricity generation using rooftop ventilation they have told about generating electricity from RTV. Generally, RTV is used for ventilation purposes. A standard RTV is typically escalated on rooftops of industry and factory. It does not deplete electricity for its working. According to their research journal, it can produce electricity for low wind speed. The structure can produce electricity without provoking any kind of pollution. Wind energy is a renewable source of energy; it can replace conventional or non-renewable sources of energy that cause pollution to the environment. According to their research, we can use an inverter to convert DC to AC and operate light load or for other applications

[2] Sirichai Dangeam:-

In this paper, Dangeam developed a model by installing a three-phase synchronous generator into the roof ventilator. The AC voltage is developed in the three-phase stator winding is rectified into DC voltage and charged into the 12V 5A lead-acid battery. The author studies the working of this model under two different conditions such as with motor driven and with natural air driven. Further the author design and installs the generator. The maximum voltage is raised to 8V and 28mA at 49 rpm.

[3] Ponnson Kaewdip et.al:-

In this research, establishes a prototype to reduce the self-starting speed. This is accomplished by installing the magnetic levitation system to carry the weight of the turbine body followed by the adjusting of rotor and stator for power generation. The test is conducted by diverging wind speed and obtained a self-start at 0.4 m/s wind speed. The methods include Axial Flux Permanent Magnet (AFPM), Permanent Magnet Synchronous Generator (PMSG), AC-Generator and AC Synchronous Generator coupled with Rooftop ventilator for power generation.

[4] Anthony Lloyd et al.:-

In this paper, they develop an approach by experimenting with the model designed. This paper modifies the rooftop ventilator by adding extra fins to spin faster and to improve efficiency. Here AC generator is coupled so that the system charges the 12 V dc batteries. The author asserts that this concept is not practical in the business world after performing the economic and feasibility study.

[5] Ganesh K.Jadhav et al.:-

In this paper, they developed a model to enhance the ventilation by installing a fan inside the ventilator and propeller system geared to the inside drive. The power required to drive the fan is supplied using the Solar PV panel. A model for power generation from a rooftop ventilator by mounting a DC generator inside the ventilator geared to the central shaft. The maximum output obtained from this model generates a voltage of 40.32 V and current up to 220 mA glows the LED lamp. Further, the authors conduct several trails under different conditions followed by three-dimensional analyses.

3. FUNCTIONAL PATTERN

As shown below the Fig.1 the architecture consists of a rooftop ventilator, Gear mechanism, DC generator, charging circuit, Battery, Inverter, AC load. The brief description is epitomized in below.

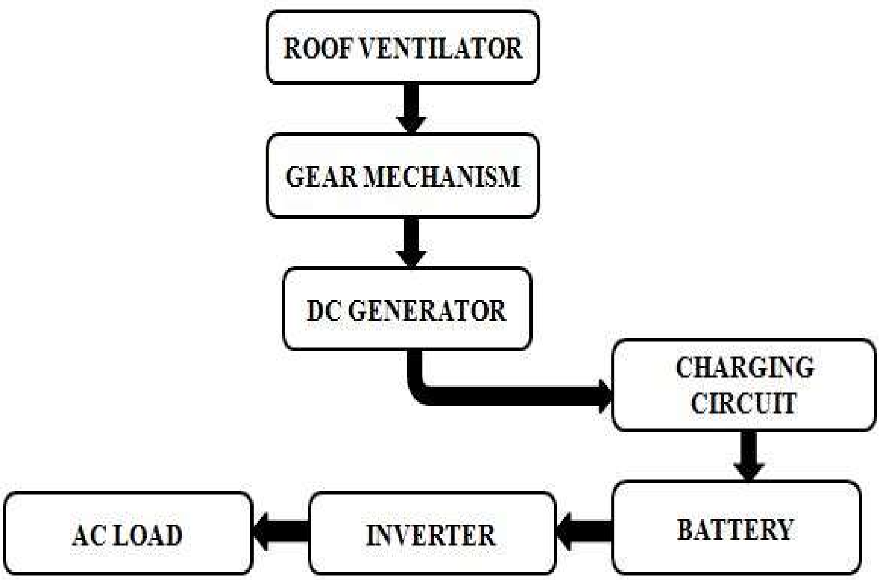

Fig 1: Block diagram of Power Generation by using Rooftop Ventilator

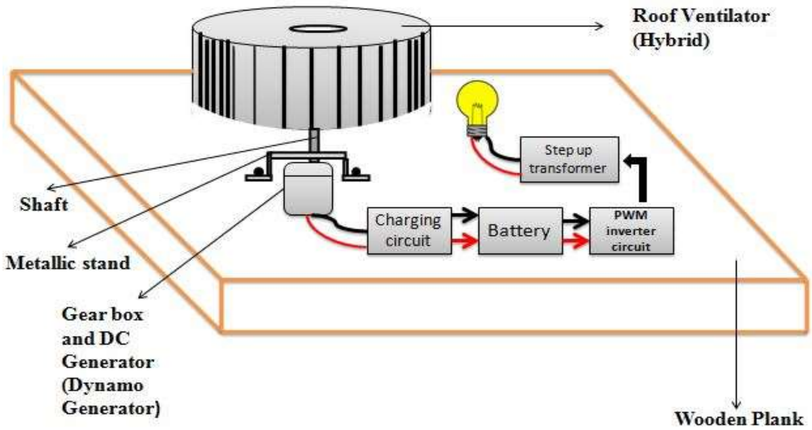

Fig 2: Working Model of Power Generation by using Rooftop Ventilator

1. Rooftop Ventilator

Fig 3: Rooftop Ventilator

Roof vents- These vents are used in roof assemblies to furnish a means of allowing outside air to enter and exit Garret and ventilation expanse. Roof vents should be located along with a roof assembly's lowest spout at or near soffits or eaves. The roof ventilator can enhance the architectural and aesthetic appearance of your building.

The continuous positive extraction provided by the roof turbine ventilator eradicates heat, dust and fume penetration - The ventilator thus helps ensure a cleaner and healthier working environment. The roof ventilator helps improve productivity by promoting a healthier and more convenient working environment.

Table 1: Specifications of roof ventilator

Sr. No.	Parameters	Rating
1.	Type of Roof Vent	Hybrid
2.	Type of Material	Carbon Fibre
3.	Height	10×4 inch
4.	Neck	Approx. 420mm
5.	Pitch Angle	15°
6.	Area to be ventilated	Roof

2. Gear Mechanism

The Roof vents are fabricated with a Gear mechanism. The elementary function of a gear mechanism is to transmit rotary motion as well as power from one shaft to another. Gears can also be used to amplify power. When two gears mesh, if one gear is bigger than the other, a mechanical influence is produced, with the rotational speeds, and the torques of the two gears differing in proportion to their diameter. The gear ratio of a system is the ratio between the rotational speed of the input shaft to the rotational speed of the output shaft.

3. DC Generator

The small gear is mounted on a shaft of a DC generator. The generator is a device that converts motive power into electrical power. In a DC generator, field coils produce an electromagnetic field and the armature conductors are rotated into the field. Thus, an electromagnetically induced emf is generated in the armature conductors. The direction of the induced current is given by Fleming's right-hand rule.

4. Charging Circuit

The output of the DC generator is fed to an electronic circuit that regulates the voltage into a constant level and is applied to the battery undercharge. The circuitry to recharge the batteries in a conveyable product is a prevalent part of any power supply design. The charging system is primarily dependent on the type of battery and recharge time.

5. Battery

The output of the charging circuit is applied to Battery for undergoing a chemical reaction. It is a storage device. Batteries convert chemical energy into electrical energy. A battery consists of a several voltaic cells. Each cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. Cations are reduced (electrons are added) at the cathode during charging, while anions are oxidized (electrons are removed) at the anode during charging. During discharge, the process is reversed.

6. Inverter

In many industries/factories, Warehouses, household applications it is vital to glow AC loads like LED panel lamps, CFL bulbs. The DC voltage is stored in Battery; we need to convert the DC voltage to an AC voltage by using an inverter. The most prominent inverter is used to supply AC power are in three ways: 1. Square wave inverter 2. Modified Sinusoidal wave inverter 3. Pure Sinusoidal wave inverter.

7. AC Load

A 230 V, AC load is a device that receives alternating-current (AC) electrical power from an Inverter. The maximum output power of this circuit about 100 watts, it is suitable for a normal lighting (all home lamps), also used for radio, LED panels, CFL blubs etc.

4. MATHEMATICAL MODELING

- **Calculation of velocity**

Considering wind speed for gentle breeze is 12 km/hr

The formula to calculate velocity of wind is expressed as,

$$\textbf{Velocity} = \frac{\textbf{Displacement}}{\textbf{Time}} \quad \text{... (Eq. 1)}$$

Where, d= Displacement = 12 km

t= time or change in time = 1 hour

$$\mathbf{V} = \frac{\mathbf{d}}{\mathbf{\Delta t}} \quad \textbf{or } \mathbf{V} = \frac{\mathbf{d}}{\mathbf{t}} \quad \text{… (Eq. 2)}$$

$$V = \frac{12 \text{ km}}{1 \text{ hour}}$$

(Multiplying and dividing by 1 km)

$$V = \frac{12 \text{ km}}{1 \text{ hour}} \times \frac{1000 \text{ m}}{1 \text{ km}} \quad \text{… (} \because \text{ 1 km = 1000 m)}$$

$$V = \frac{12000 \text{ m}}{1 \text{ hour}}$$

(Multiplying and dividing by 1 hour)

$$V = \frac{1200 \text{ m}}{1 \text{ hour}} \times \frac{1 \text{ hour}}{3600 \text{ sec}} \quad \text{… (} \because \text{ 1 hour = 3600 sec)}$$

$$\therefore \mathbf{V = 3.33\ m/sec} \quad \text{... (Eq. 3)}$$

- **Calculation of Gear:**

$R = \frac{T_2}{T_1}$ … **(Eq. 4)**

Where,

T_2 refers to the number of teeth on the gear linked to the output shaft

T_1 refers to the same on the input shaft.

Table 2: Roof Ventilator Gear

Gear	**A**	**B**
Teeth	**10**	**40**

Roof Ventilator Gear ratio :

Roof ventilator gear ratio = $R = \frac{T_B}{T_A}$ … **(Eq. 5)**

$R = \frac{T_B}{T_A}$

$R = \frac{40 \text{ teeth}}{10 \text{ teeth}}$

$R = \frac{4}{1}$

R = 4 : 1

The gear A will to revolve 4 times for each full revolution of gear B.

Table 3: DC Generator Gear

Gear	A	B
Teeth	13	26

DC Generator ratio:

DC Generator gear ratio = $R = \frac{T_B}{T_A}$ … **(Eq. 6)**

$R = \frac{T_B}{T_A}$

$R = \frac{26 \text{ teeth}}{13 \text{ teeth}}$

$R = \frac{2}{1}$

R = 2 : 1

The gear A will to revolve 2 times for each full revolution of gear B.

- **Calculation of current:**

AC load = 20 watts

System Voltage = 12V

Current =?

The general formula for power is expressed as,

Power = Voltage × Current … **(Eq. 7)**

20 = 12 × Current

∴ Current = 1.66 A ... **(Eq. 8)**

- **Inverter/Battery detail:**

Additional Further load expansion (Af) = 20%

Efficiency of Inverter (Ie) = 80%

Power factor (P.F) = 0.8

Efficiency of battery (n)= 85%

Total load = 20 watts

No. of hours = 6 hours

- **Calculate total load :**

Total load = No. × Watts ... **(Eq. 9)**

= 1 × 20

= 20 watts

∴ Total Electrical load = 20 Watts ... **(Eq. 10)**

Total Electrical load (VA) = $\frac{\textbf{No.}\times\textbf{Watts}}{\textbf{Power Factor}}$

= 20/0.8

∴ Total Electrical load (VA) = 25 VA ... **(Eq. 11)**

- **Size of Inverter :**

Size of Inverter = $\frac{\textbf{Total load}+(1+\textbf{Af})}{\textbf{Efficiency of Inverter}}$ ... **(Eq. 12)**

$= \frac{20+(1+\frac{20}{100})}{\frac{80}{100}}$

∴ Size of Inverter = 26.5 VA … **(Eq. 13)**

- **Size of Battery** :

Battery size = $\frac{\textbf{Total load} \times \textbf{No.of hours}}{\textbf{Voltage}}$ ... **(Eq. 14)**

= 20 × 6/12

∴ Battery size = 10Ah ,12 V ... **(Eq.15)**

- **Calculation of Kinetic energy :**

The general formula for kinetic energy is expressed as,

Kinetic energy = ½ (mass) × (volume)²

$= \frac{1}{2} mv^2$

where, m= mass of roof ventilator = 250 gram … **(Eq. 16)**

v= velocity of wind = 3.33 m/sec ... **(from Eq. 1)**

Kinetic energy = ½ $(0.25)(3.33)^2$

= 1.38611 kg m^2/sec^2 or J

∴ Kinetic energy = 1.38611 kg m^2/sec^2 or J … **(Eq. 17)**

5. ANALYSIS AND ADVANTAGES

The proposed system has many advantages:

1. Roof ventilator fabricated of carbon fiber, galvanized steel, aluminum etc.
2. The roof ventilator can complement the constructive and creative appearance of a building.
3. The roof ventilator is a reliable rotary that works automatically.
4. Promoting the healthier or more comfortable working environment.
5. Much lower operational noise level.
6. The system has lighter weight

6. CONCLUSION

The conclusion focuses on the relationship between the output power and the range values of the resulting current and voltage, as well as the suitable wind speed range through the superlative design of the system. The voltage and current developed are proportionate with the speed of the roof ventilator.

REFERENCES

[1] "Hybrid Ecopower Hybrid Ventilator "https://skylinegroup.co.in/ecopower.html Last Accessed on 5th March, 2020.

[2] https://en.wikipedia.org/wiki/Gear Last Accessed on 20th February, 2020.

[3] Unggul Wibawa, Akhmad Frandicahya Permadi, Rini Nur Hasanah "A Micro-Scale Cyclone-Wind Turbine for Rooftop Ventilator" Indonesian Journal of Electrical 4 Science Vol. 11, No. 2, August 2018.

[4] Pradeep Dhumal, Swapnil Patil, Prof. Anubha Panchal "Electricity Generation By Using Roof Ventilator" International Engineering Research Journal (IERJ), Volume 2 Issue 8, 2017.

[5] Maneesh Khandelwal, Partik Mundle, Darshan Pande, Tushar Bang "Use of Roof Top Ventilator for electricity Generation" International Conference on Smart Technology for Smart Nation,2017.

[6] Miss. Autade Puja Padamnath, Mr. Londhe Ganesh Bhausaheb, Mr. Wagh Sagar Atmaram, Prof. N. B. Shaikh. "Electricity generation using Roof Top Ventillation" Vol-2 Issue-2 2017.

[7] Akshay.S.Zagade,Rahul.P.Sadagar, Sonali Naiknaware, Pravin S. Phutane "ELECTRIC POWER GENERATION BY USING ROOFTOP TURBINE VENTILATOR" International Journal of Current Trends in Engineering & Research (IJCTER) e-ISSN 2455–1392 Volume 2 Issue 4, April 2016.

[8] Dr.S.V.Rode,GaneshDamdhar, Chinmay Gadhikar, Vipul Dhumale, Mandar Deshpande, Tejas Ratnaparkhi "ELECTRICITY GENERATION USING ROOFTOP VENTILATOR" International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 5, Issue 4, April 2016. http://ijarece.org/wp-content/uploads/2016/05/IJARECE-VOL-5-ISSUE-4-1009-1012.pdf last Accessed on 2nd March, 2020.

[9] Chonmapat Torasa, Nichanant Sermsri, "The Application of Roof Ventilator for Electricity Generation,Elsevier, Science Direct, Procedia-Social and Behavioural Science 197 (2015) 1690-1696.

[10] Akshay.S.Zagade,Rahul.P.Sadagar,Sonali.J.Naiknaware, Pravin.S.Phutane "Review on Micro-generation of Electricity Using Rooftop Turbine Ventilator (R.T.V)" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 10, October 2015.

[11] Ponnson Kaewtip, Naebboon Hoonshareon, "A magnetic levitation rooftop turbine ventilator: A case study for wind micro-generation", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, Vol.3, Issue 4, April 2014, http://www.ijirset.com/upload/2014/april/76_AMagnetic.pdf last accessed on 2nd March, 2020.

[12] Ming Chun Hsieh, David King Jair, Huann Ming Chou, " The Development of a New Type Rooftop Ventilator Turbine", Scientific Research, Engineering, 2013, 5, 16-20.

[13] I.Daut, C.Shatri, M.Irwanto, A.N.Syafawati , S.S.Shema "Power Generation Roof Ventilator"2011 International Conference on Environment and Industrial Innovation IPCBEE vol.12 (2011) © (2011) IACSIT Press, Singapore.

[14] Dangeam.S, "An Electric Generator Driven by a Roof Ventilator", 9th Eco-Energy and Materials Science and Engineering Symposium, Chiang Rai, Thailand 25-28 May. 2011. http://www.research.rmutt.ac.th/wp-content/uploads/2012/03/ET09r.pdf last Accessed on 2nd March, 2020.

[15] Ashvi Suresh, Basil Jacob, Lishana Fathima Sharaf, Gomathy "A Development of Micropower Generation System using Rooftop Ventilator" IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), http://iosrjournals.org/iosr-jeee/Papers/Conf.17017/Volume-3/14.%2088-91.pdf?id=7590 last Accessed on 2nd March, 2020.