# Modification and Development of Roof Top Ventilation and Power Generation

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## ABSTRACT

ABSTRACT: - Wind energy is one of renewable energies available and it is ecological. Therefore, presently, there is the technological development of applying wind energy for the electrical power generation. Wind energy will be used to replace fossil energy such as oil and coal which causes environmental pollution. This paper presents the electric power generation by using Rooftop Turbine Ventilator (RTV). Rooftop ventilation system (RTV) generally used for ventilation purpose, can be used to extract wind power by suitably designing a generator attached to it. Rooftop Ventilation system do not consume any electrical power for its working. The paper elaborates the development of a power generation system using a typical RTV (Rooftop ventilation system). The paper emphasizes on the materials and the construction methodology adopted for developing a Rooftop power producing system. The RTV (Rooftop ventilation system) power generation system is designed to charge a battery and power up the LED lighting load connected to it. Speed of 150 rpm. The modified roof ventilator that can generate electricity. The new Change in the roof ventilator system is by attaching the extra fins to help it to rotate faster and more efficient. This system is suitable to use for the low-speed wind places. The system is containing the combination of the AC generator, roof ventilator, solar charger, batteries and inverter. The operational concept of the system is the load will use the energy from the batteries that charged using roof ventilator. The observed performances of system are the voltage and current of the roof ventilator, batteries and the load. This project is about generating electricity from Rooftop Turbine Ventilator (RTV). Generally, RTV (Rooftop ventilation system) are used for ventilation purpose. A standard RVT generally mounted on rooftops of building. We are using this RTV (Rooftop ventilation system) for electricity generation. It. It can produce electricity with the help of low wind speed. Wind energy is renewable energy source. We will be using inverter to convert DC to AC and operate light load or for other applications. Wind energy is a renewable energy which can be adapted for many applications such as water pumping, domestic air ventilation and electricity generation because wind is clean form of energy that does not cause pollution to environment.

## Keywords:-

Turbo Ventilator, Gear Coupled Ventilator, System Lightening, Power Generation Ventilation; Synchronous Generator; Hot air ventilation; Generator winding design roof ventilator, wind energy.

## 1. INTRODUCTION

The demand of electricity is increasing day by day. To achieve that demand different renewable and non-renewable energy sources are used to produce electricity. In other side by using conventional energy source the pollution is increasing and this creates global warming. This type sources are destroyable energy sources. Now all countries and associations are interested in the renewable energy sources. The solar, wind, water, ocean waves can have important role in electricity production. But there are some problems created in the production of electric power generation like, high cost, difficulties in maintenance, space for plant installation and power distribution.

**FIG NO 1.1**

India begins to develop a micro power station to improve such problems. India is in the tropical zone and have high humidity and warm weather present in all over the year, especially in march and April. The day temperature may be increasing to 43ºC, so this increase in temperature is affected on the worker and this effect decreases the work efficiency of worker and also reduces the productivity of company. Because of high intensity of sunlight and high room temperature the ventilation system is used in workshops, industries or factory building. The rooftop ventilators work without using electricity. This technology is commonly used in the roof in workshops, industrial buildings, houses. The ventilator removes the hot air from building and maintain the normal temperature. Rooftop ventilator is design technically to work as a vertical spindle and it does not consume electric energy. The RTV rotates because of the wind in the surrounding or due to the internal hot air. This rotatory motion of the RTV can be utilized for producing electricity. This system is obtained by modifying a typical RTV into a Roof top ventilator generator. Thus, the RTV Generator can be used for ventilation purpose and also for small scale power generation.

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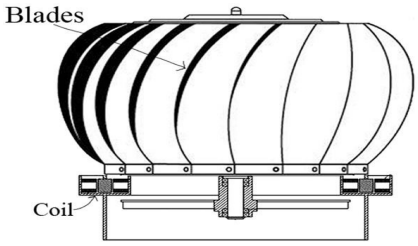


FIG..12

The wind turbine captures the wind's kinetic energy in a rotor consisting of two or more blades Which are mechanically coupled to a generator. The turbine is mounted on a tall tower to enhance the energy capture. Numerous wind turbines are installed at one site to build a wind produce more energy over the year. Two distinctly configurations are available for turbine design, the horizontal-axis wind turbine (HAWT) configuration and the vertical-axis wind turbine (VAWT) configuration. The horizontal-axis machine has been the standard in Denmark from the beginning of the wind power industry. Therefore, it is called Danish wind turbine. The vertical-axis machine has the shape of an egg beater and called the Darrius rotor after its inventor. It has been used in the past because of its specific structural advantage.

HAWT are the blades are to the side of the turbine's centre of gravity, helping stability. It also allows the angle of attack to be remotely adjusted gives greater control, so the turbine Will collect the maximum amount of wind energy. Tall tower allows access to stronger wind in sites with wind shear and placement on uneven land or in offshore locations and most of them are self-starting. At the same time, it can be cheaper because of higher production volume. The disadvantages are it has difficulties operating near the ground and with turbulent winds because the yaw and blade bearing need smoother, more laminar wind flows. The tall towers and long blades are difficult to transport and need a special installation procedure. The advantages of the VAWT are the generator, gearbox and other components may be placed on the ground, so the tower doesn't need to support it, and it is more accessible for maintenance. It also has relatively cost of production, installation and transport compared to horizontal axis turbines. The turbine doesn't need to be pointed into the wind to be effective. This is an advantage on sites where the wind direction is highly variable. The hilltops, ridgelines and passes can have higher and more powerful winds near the ground than higher up because due to the speed up effect of winds moving up a slope. In these places, vertical axis turbines are suitable. The blades spin at slower speeds than the horizontal turbines.

**FIG.1.3**

Thailand is the country in the tropical zone. There are high humidity and warm weather all of year. Especially in Summer on April and May, Day time temperature may be increasing to 45 OC or 39-41 OC for the average temperature at noon all of the year. It effects to decreasing work efficiency of worker or damage product for some business. So, air conditioner in Thailand is the best seller for residence but not for industrial because it must pay a lot of cost as such as electric charge and maintenance cost.

In viewing the energy crisis and the fast degradation of the natural environment, scientists have become increasingly interested in the renewable energy. Kinetics in nature, for example winds, water, ocean waves, can play a significant role in tomorrow's electricity production, but the constructions require adaptations to their media. However, there are some problems in the development of the clean energy power generator, such as high cost of construction, difficult maintenance, the power distribution and need to install in specific place etc. Therefore, many countries now gradually begin to develop a small power station to improve such flaws.

The latitude of Taiwan is between the subtropical and the tropical zone. There is high humidity and warm weather in summer. Long exposure to the sunlight and high room temperature make ventilation a necessity in the factory building. Therefore, the concept of natural ventilation without using electric energy has led to roof ventilators. When the air flow on the top of the roof or the heat air that lifting to under the roof, it turns the roof ventilator. The ventilator sucks the heat air in the building and throws it to the outside of the building, then the inside building temperature and humidity are not too high. This technology is popularly installed on the roofs in warehouses, workshops, industrial buildings and even residences

There are two rotating principles of the ventilator. The first principle is the hydromechanics that the air current can flow from the high temperature area to the low temperature area to motivate blades to rotate. This air con- vector can both exhaust and ventilate spontaneously, when the indoor and outdoor temperature is different. The air can flow through the gap of the turbine blades from high temperature side to low temperature side; therefore a spontaneous ventilating phenomenon is formed. In addition, when the turbine wheel revolves, the high temperature air will be discharged from the room, so the air density in the room can be reduced, then the cold air outdoor therefore enters the room to achieve the convection goal.

**FIG.1.4**

Figure Ventilators on the rooftop of the building.

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Effect of ventilation and refrigeration at the same time. The second principle is the air convector. It relies on the breeze air to rotate its blades. Its structure is similar to that of a backward-curved fan. The curving direction of the blades is opposite to the direction of the rotation. For a centrifugal fan, the air flows in from the axial direction, but after pressurization it flows out from the blade's radius direction, which forms a spiral air current from the circumference direction.

When a wind direction changes, the air convector does not have to change its structure just because of the change of the wind direction. Therefore, the wind power generation may reduce the design of complexity. In the past, some electric generators driven by a roof ventilator have been developed. For example, have reported a new modification of the roof ventilator generator system by adding the extra fins to rooftop ventilator turbine in order to help it to spin faster and more efficiently. In this design, the rubber belting was attached to the moving object of the roof ventilator. The AC generator is connected to the belting area by using a small plastic wheel. When the wind blows on the fins and generates enough drag forces, the roof ventilator will rotate. The plastic wheel of the AC generator and the moving roof ventilator will spin synchronously to generate electricity. However, the rubber belting has to rub against the wheel and will lead to friction that occurs at the belting/wheel interface causing energy loss and is hardly employed. Using a RFPM (Radial Flux Permanent Magnet) generator for voltage generating. The system comprises of stationary part and rotational part. Stationary part is composed of base and fixed shaft. Rotational part is composed of fan blades and bush that put on the fixed shaft on stationary part. When the air flow on the top of roof or the heat air that lifting to under the roof, it turns the roof ventilator. Since the generator is directly mounted on the bottom of the shaft, it can prevent thermal convection.

To overcome these issues for the rooftop ventilator generator, a small power generation system motivated by a coreless stator AFPM (Axial Flux Permanent Magnet) generator which is driven by the air ventilator has been proposed. AFPM machines are generally regarded as ideally suited whenever low speed is required, such as in direct-drive applications. Compared with other PM machine topologies, the AFPM designs have higher power densities. For a given magnet material and air-gap flux density, radial flux designs have higher rotor moment of inertia, the active weight of the AFPM machines is smaller. Furthermore, the AFPM machines have many unique features. For being permanent magnet, they are usually more efficient. As field excitation losses are eliminated, reducing rotor loses significantly. Machine efficiency is thus greatly improved, and higher power density achieved. Also, AFPM machines have thin mag- nets, so they are smaller than radial flux counterparts. AFPM machine size and shape are important features in applications where space is limited, so compatibility is crucial. The noise and vibration they produce are less than those of conventional machines. Their air gaps are planar and easily adjustable. Also, direction of main air-gap can be varied, so derivation of various discrete topologies is possible. These benefits give AFPM ma- chines advantages over conventional machines in various applications.

Rotates, the flux of the permanent magnet rotor part moves across the air gap and induces the emf. AFPM machines with coreless stators are regarded as high efficiency and simplicity of construction and very low rotor losses for distributed power generation systems. Because of the absence of core losses, a generator with this type of design can potentially be operated at a higher efficiency than conventional machines. Besides, the high compactness and disk- shaped profile make this type of machine particularly suitable for mechanical integration with ventilator.

In this paper, a small power generation system motivated by a coreless stator AFPM generator has been de- signed and fabricated. This generator has two outer disk rotors and one coreless stator in between. Neodymium- Iron-Boron (N d-Fe-B) rare-earth magnets produce the necessary excitation in the generator.

These magnets are glued onto the two inner surfaces of rotor disks. After the preliminary design, and for precision study, a two-dimension model of the machine is Analysed using finite element method software. In addition, analytical results will be validated through a series of experiments to demonstrate the usefulness of the system.

**APPLICATION: -**

This ventilation system is used in many places. Its general purpose is to ventilate a confined space and provide healthy air for breathing by both diluting the pollutants formed inside the building and removing the pollutants from it. It also provides a continuous supply of fresh outside air. This system can also maintain the temperature and humidity at comfortable levels. It can also reduce the possibility of catching fire or explosive hazards. One of the reasons it is used in kitchen rooms in restaurants is to remove cooking fumes at the source as close as possible to the cooking equipment. Remove excess heat and replace it with cool clean air helping it to maintain comfortable environment. Like every other building the industrial places such as boilers need a continuous supply of air for optimal operation. When boiler room air must be consistent, or it can cause problems. Process includes soot build-up, rough combustion, carbon monoxide, operational hazards and maintenance calls just to name a few. Similarly, ventilation systems are needed in healthcare facilities, the ventilation system would also most likely to help prevent diseases and treat patients.

The ventilation system is also used in warehouses, this means increased safety because constant airflow removes dust, particles and gas emissions are harmless. In painting room ventilation is mainly used to control indoor air quality by diluting and displacing indoor pollutants; it can also be used to control indoor temperature, humidity, and air motion to benefit thermal comfort, satisfaction with other aspects of indoor environment, or other objectives.

An important consideration in auditorium spaces is how the sound carries in the space and that the ventilation is designed so that it does not affect this. Its highly important also that the CO2 levels stay low and that the space enable and enhance learning.

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**LITRATURE & REVIEW: -**

It has a DC motor which runs as generator to produce electricity. We have developed work cycle which includes fan along with power generation. Initially a DC motor (DC dynamo 12V DC) is chosen to work as generator and a suitable V belt is chosen which can fit perfectly on front wheel rim. Suitable wooden base is bolted on to front wheel to

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align motor and front wheel rim on the same base. A pulley is chosen as per the width of the belt. Motor is kept on a wooden base provided at the front left end of the front wooden base. Motor is clamped to the wooden box using clamp to restrict the axial movement of the DC motor. Hence as the user pedals front wheel rotates which in turn runs the motor shaft at higher rpm and hence power is generated.

DC bulb is connected to indicate the power generation. We have developed a low-cost air cooler using DC fan (12V, 65amp) which is being installed at back side of the sheet metal duct. This fan is run by the DC motor. A sheet metal stand is made to give correct alignment to the user. A wet husk is provided in between the duct. Two holes being drilled at the top and the bottom centre of the pipe. Funnel is used to supply the water to the wet cloth. Seals being used to avoid the drained water to scatter. As the gym cycle user runs the cycle, motor starts generating the power. This power is used to run DC fan which in turn sucks the air axially and made it to pass through the wet cloth. Wet cloth adds the moisture content in the air and blows it over user body. This will produce breezing effect over the user.

Roof top ventilators has not only been utilized for purpose of ventilation instead scientists have incorporated in generating power using the ventilators.

A.Electricity Generation Using Rooftop Ventilator" by, Dr S. V. Rode, Ganesh Damdhar, Chinmay Gadhikar, Vipul Dhumale, Mandar Deshpande, Tejas Ratnaparkhi, Department of Electronics & Telecommunication Engineering, Amravati University, Amravati, Maharashtra, India In Auditoriums, Theatres, work places, etc. there were number of peoples gather together, due to this warm atmosphere gets form.

This warm air is lighter than cold air, so it goes upward towards roof and gets thrown out in atmosphere through roof ventilators. This warm air is a natural source provided by human being. The ventilator sucks the warm air in the building and throws it to the outside of the building, then the inside building temperature and humidity are not too high. We can convert this warm air into electrical energy using Rooftop Ventilators. By using this technique, we can glow at least 5-watt bulb. This technology is popularly installed on the roofs in warehouses, workshops, industrial buildings and even residences.

B.„Generation of Electric Power using Turbo Ventilators" by, Rushikesh Shinde, Vaibhav Lavhale, Ashwin Nair, Shubham Pawar, Ritesh Mahajan, Marathwada Mitra Mandal's Institute of Technology Lohgaon, SPPU, Pune- 47, India In this world of depleting resources, renewable energy plays an important role. Wind energy is one of the major renewable energy sources. In this paper we intend to study and review various research papers on generating electricity from wind energy using turbo ventilators. This method is economical and feasible by applying various electrical and mechanical techniques. In this paper we also intend to improve the efficiency of the system by using various materials for the fabrication of turbo ventilators. We have reviewed the papers on this topic published by various authors. We have compared their designs and concluded into an efficient model by combining all the designs into one.

**RESULT & DISCUSSION: -**

The maximum speed of ventilator is limited to 400rpm, there is mechanical vibrations at 400 rpm and above, which slightly affect the system stability. A RTV mounted on the roof, no such vibrations will occur at this low speed. A maximum voltage of 20 V DC is obtained at a ventilator speed of 400 rpm.

The booster converter was connected to 12-volt batteries and the charger with roof ventilator and record DC voltage. The result of dc voltage from booster circuit and voltage from electric charger shown below.

The system has been tested at different locations and performance of the system was measured. We observed that the results obtained was practically well enough. 1. The results of roof ventilator with stepper motor comparing to the wind speed stated that the roof ventilator will create the electric voltage at wind speed 0.4 m/s. At the maximum speed at 4 m/s, the roof ventilator can create 5.0 volt of DC voltage. The results of average of DC voltage at the wind speed.

The prototype of the small power generation system. This is a standard roof ventilator in the market with diameter size, 7 inch. The mechanical aspects of this prototype are just the simple bearing with the proper installation of the components. In this system, research process involved the study how to generate the electricity from the spinning roof ventilator. The important specification of the generator is the torque must be-low to enable it to start at the low speed. This test is operated in electrical machines laboratory and essentially to determine the characteristics of the small power generation system. The ventilator is driven by a variable speed DC motor. Experiments are of two types; no-load and on load tests. In the latter cases, 100-Ω resistive loads are used.

The output voltage as a function of wind speed in parallel configuration. RPM from roof ventilator speed [4]. To experimentally obtain the performance of the generator at different speeds, the speed is changed from zero to the nominal speed of 190 rpm, which corresponds to the wind speed 4 m/s. The maximum output voltage and current in parallel configuration can achieve 103 V and 0.17 A, respectively. In addition, the output voltage and current with 100 Ω resistive loads are 20 V and 0.13 A, respectively. The output power can achieve 17.5 W at the speed of 200 rpm. Furthermore, we also installs the prototype genera- tor with roof ventilator on the roof.

In the outdoor test, the generator is tested by charging 12 V 5 Hr battery. The minimum wind speed for enough charging to battery is below 1 m/s (almost at light air). The output voltage still can achieve 20 V, which is sufficient to charge the battery. In Taiwan, the annual average wind speed exceeds 4.5 m/s, which corresponds to 390 rpm. At this speed, the output voltage of the designed ventilator generator can achieve 152 V. The max speed of ventilator is limited to 325 rpm and beyond, which will slightly affect the systems stability property. A roof top ventilation system mounted on the roof, no such vibrations will occur at these minimum rpm. A maximum voltage of 15 V DC is obtained at the ventilator speed of 325 rpm.

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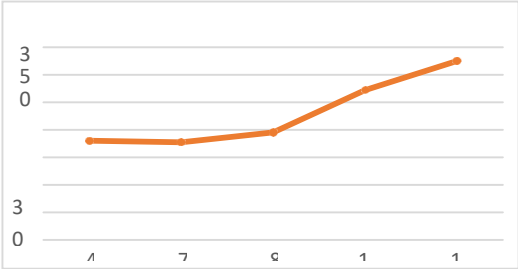


| Sr. No | Voltage(V) | Speed(rpm) |
|---|---|---|
| 1 | 4 | 180 |
| 2 | 7 | 177 |
| 3 | 8 | 195 |
| 4 | 12 | 272 |
| 5 | 15 | 325 |

**FIG.1.5**

**CONCLUSION: -**

The rooftop ventilator generates electric power from the wind energy. This system also performs the main assigned function that is to provide air ventilation in house or factories. The low speed of the ac generator is one of the main factors to make this system perform in the right condition. It can produce up to 15 V ac charge at the 325-rpm speed. This system can create to charge the 15V dc charge batteries system in the good and efficient condition. Induced voltage from generator is directly proportional to the speed of roof ventilator. In case of installation on the roof, voltage is induced lower than the measurement in lab because of wind speed changing. Free accessible energy can be created with the help of this work, which can provide to the growing demands of energy all around the globe. The net approximate monthly power of 210kW which can be supplied by the battery can be used to light many powerless homes in the long run.

Thus, an alternate means of renewable energy is provided by this project, which will not only help solve the energy problems, but will also to an extent reduce the load on major sources of energy production like thermal power plants and nuclear power plants, which generally consume much of the treasured reducing resources. Therefore, positive ramifications of this entire research are manifold and will tend to soothe the major energy crisis problem faced all over the world. Induced voltage from generator is directly proportional to the speed of roof ventilator.

In case of practical installation on the roof, voltage is induced lower than the measurement in laboratory because of wind changing. Errors of prototype generator is come from calculation and especially stator construction because of no magnetization data of laminated sheet and accuracy of tools for slot making. Present scenario of the power generation needs improvement due to the fact that there is energy crisis which needs some sort of upgrading to be done.

We can start of by utilizing the Hybrid ventilator turbine which is able to make use of two different renewable energy resource to generate power and also provide proper ventilation. These systems can bring new wave of ideas.

This system was able to provide best output at higher speed and when it is sunny from both the sources as well as provide ideal ventilation. Solar tracking mechanism provides a high efficiency in terms of power generation. The availability of Solar panel did not affect the ventilation in fact this made the system ideal for the current market trends to be utilized and also can be used as secondary source of power in time of emergency. This study is to provide the air ventilation ball to generate the electric current. It is to study the probability to use the small DC electric generator to install in the ball by adapting, adding the element for electric current with least effect of the movement of the ventilation balls. In this paper, after the introduction of AFPM machines with no iron cores, one typical generator was theoretically designed. Next, with the finite element analysis, the parameters of the generator were calculated. After the construction of the generator, the performance of the generator was experimentally evaluated.

**FUTURE SCOPE: -**

Due to the development of technology around the world, the need of energy is increasing every year. But what would be the best way to produce energy without polluting the air, or depleting fossil fuels? Renewable energy would also be the best solution for this problem. Of the available sources of renewable energy, wind power shows much promise. There are many benefits of using wind energy in comparison to using fossil fuels.

The first is that once wind turbines are built, they don't release greenhouse gasses into the atmosphere. Wind energy also doesn't pollute the air or water with other pollutants. Renewable forms of energy are becoming more and more necessary for a sustainable future. Wind energy is a form of energy that is becoming more and more popular, and it offers a way for people to harness energy from something natural to create electricity. As we can implement this technology to use "green energy" instead and help preserve Mother Nature.

**RELEVANCE: -**

One of the most important aspects of proper roof ventilation is to help prevent condensation, which ultimately leads to mold and rot. Your home produces a lot more moisture than you think. Laundry, showers and bathing, cooking and more all produce warm, damp air inside the living space of your home.

## REFERANCE

1]Y. Ting, H. Gunawan, A. Sugondo, K. L. Hsu and J. T. Teng, "Analysis and Design of Roof Turbine Ventilator for Wind Energy Harvest," Proceedings of the 2nd Inter- national Conference on Mechanical and Electronics En- gineering (ICMEE), Kyoto Japan, 1-3 August 2010, pp. 265-269.

2]. Daut, C. Shatri, M. Irwanto, A. N. Syafawati and S. S. Shema, "Power Generation Roof Ventilator," Proceed- ings of the 2011 International Conference on Environ- ment and Industrial Innovation IPCBEE, Singapore, 26- 28 February 2011, pp. 183-187.

3].S. Dangeam, "An Electric Generator Driven by a Roof Ventilator," Energy Procedia, Vol. 9, 2011, pp. 147-158.

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4].A. Mahmoudi, N. A. Rahim and W. P. Hew, "Axial-Flux Permanent-Magnet Machine Modeling, Design, Simula- tion and Analysis," Scientific Research and Essays, Vol. 6, No. 12, 2011, pp. 2525-2549.

5]. J. F. Gieras, "Permanent Magnet Motor Technology: Design and Applications," 3rd Edition, CRC Press, Boca Raton, 2009.

6]. J. F. Gieras, R. J. Wang and M. J. Kamper, "Axial Flux Permanent Magnet Brushless Machines," 2nd Edition, Springer, Berlin, 2008.

7]. N. F. Lombard and M. J. Kamper, "Analysis and Per- formance of an Ironless Stator Axial Flux pm Machine," IEEE Transactions on Energy Conversion, Vol. 14, No. 4, 1999, pp. 1051- 1056.

8].Ministry of Power, Government of India "Load Generation Balance Report 2015 - 16"

9]. M Canale, et. al. "High Altitude Wind Energy Generation Using Controlled Power Kites",IEEE Transaction on Control System Technology, Vol.18, March 2010.

10]. P Kaewtip, N Hoonchareon, "A Magnetic Levitation Rooftop Turbine Ventilator: A Case Study for Wind Micro-Generation" International Journal of Innovative Research in Science, Engineering and Technology, Vol.3, Issue 4, April 2014.

11]. www.Allianceorg.com"Alliance LLC Magnet Guide and Tutorial"

12]. 2016 IEEE Students' Conference on Electrical, Electronics and Computer Science

13].Zagade, Akshay S., et al. ''Review on Micro-generation of Electricity Using Rooftop Turbine Ventilator (RTV)." International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering 4.10 (2015).

14] Rode, Dr SV, et al. 'Electricity Generation Using Rooftop Ventilator." International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 5 (2016).

15] Miss. Autade Puja Padamnath , Mr. Londhe Ganesh Bhausaheb , Mr. Wagh Sagar Atmaram, Prof. N. B. Shaikh. " ELECTRICITY GENERATION USING ROOF TOP VENTILATION". International Journal of Advance Research and Innovative Ideas in Education(IJARIIE), Vol-3 Issue-2 2017

16].KMathew, Mobi, et al. "Development of a Small scale power generation system using Rooftop Ventilator." 2016 IEEE Students' Conference on Electrical, Electronics and Computer Science (SCEECS). IEEE, 2016.

17].Shinde, Rushikesh, et al. "Generation of electric power using turbo ventilators." International Journal of Current Engineering and Technology 6.6 (2016): 89-93.

18]Hsieh, Ming Chun, David King Jair, and Huann Ming Chou. "The Development of a New Type Rooftop Ventilator Turbine." (2013).

19] Daut, I., et al. "Power Generation Roof Ventilator." 2011 International Conference on Environment and Industrial Innovation IPCBEE. Vol. 12. 2011.

Shashank D. Daddikar, Ashitosh N. Patil , Bahubali B. Farande. "ELECTRICITY GENERATION BY USING ROOF VENTILATOR". International Journal of Advanced Research in Science and Engineering, Vol. 7, Issue 03, April 2018. Authorized

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