INNOVATIVE DESIGN OF POWER GENERATION FROM MOVING TRAINS

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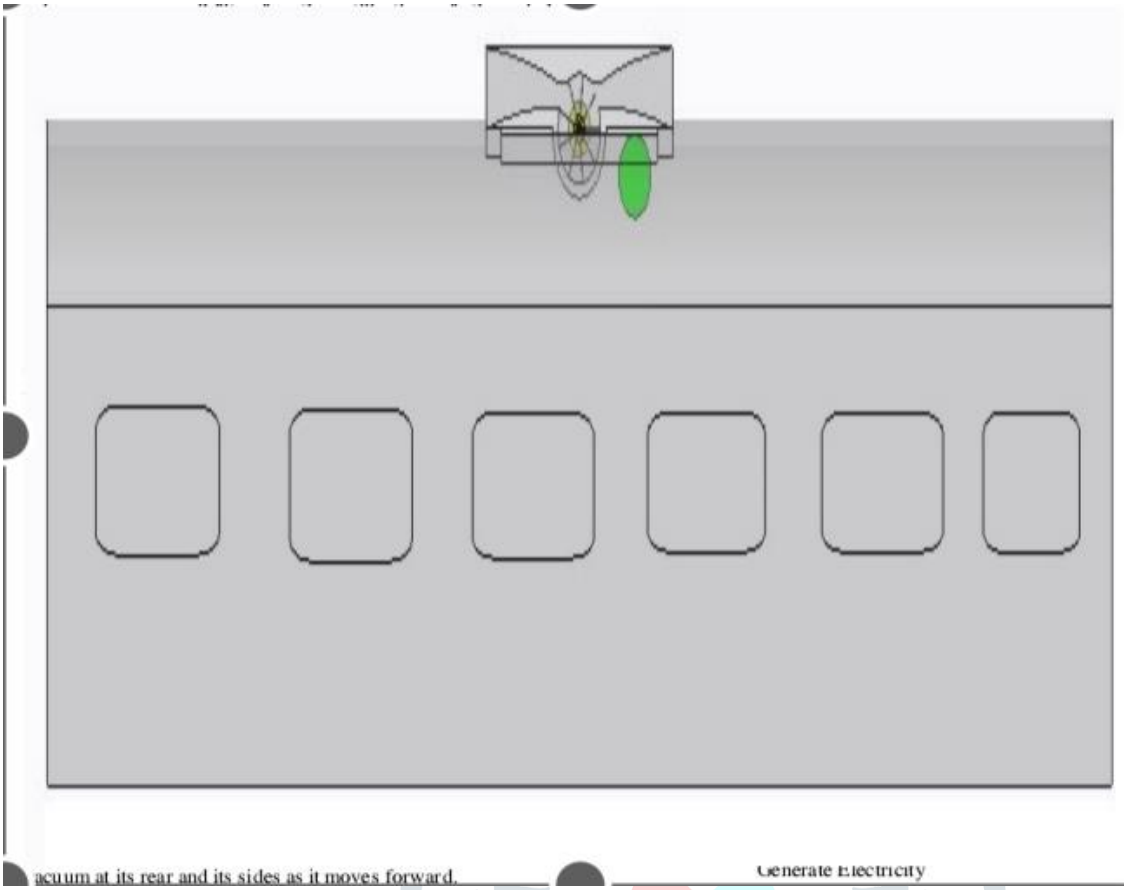
Abstract: Energy resources in our modern and fast paced technological world are getting depleted fast. Hence a renewable energy source of energy is required today. Wind energy is a renewable source of energy. today, the output power from wind turbines can be utilized in two ways, either by direct use of mechanical shaft power (through a gearing ratio) or by utilizing the generated mechanical power to run an electrical generator for saving the power which is used by the train motors during running. This paper brings a new possibility for the utilization of the wind generating power by injecting the power back to the OHE (over head electrification).
The wind turbines are mounted at the top of the coaches of the train. The set up is designed is designed is such a way that it does not affect the performance of the train.

The average velocity is estimated for the train and the suitable specification of generator is selected.

The theoretical calculations of turbine such as its axis of rotation, diameters are calculated in such a way that the overhead electrification is not affected at all. By varying the speed of the wind velocity, the speed and torque of the turbine is calculated manually.

The future advancements are discussed, and a path for experimental verification is proposed.

Keywords: Renewable wind energy, wind turbine, moving train. Rotation, Electricity.



INTRODUCTION

In this modern age more and more energy is required for daily consumption in all walk of life. Sources and quantum of fossil energy are dwindling day by day and getting exhausted at a very fast rate. Hence conservation, tapping new sources of energy and harnessing of the same from the various nonconventional sources, is an important aspect of energy production/conservation and utilization all over the world. The sky-rocketing price of crude oil has ruined the economy of many a country, hence there is a crying need for production of energy from non-conventional sources at the earliest. The present concept is one of the answers to this problem, as the said induced wind into useable electric energy which can be utilized by directly injecting the generated power to the OHE (overhead lines) by voltage and the phase angle, which is same as the power is injected during the process of regenerative braking.

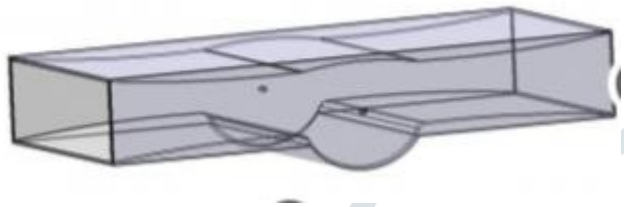
REGENERATIVE BRAKING.

The regenerative braking occurs (or done) when there is need to slow down the electric train driver by electric motor.

When brakes are applied in an electric train the traction motors stats slowing, then as the faraday's raw of electromagnetic Induction states that when an electric conductor is rotated

around a magnetic field, an induced emf is induced in the cause of its generation. In the same way when the traction motors tries to down they starts behaving like electric generator and the electrical power is generated, the generated electric power is fed back to the overhead electric lines.

In this research this concept of regenerative braking is used to injected the generated electrical power back to the overhead lines (OHE).



This research relates to a method for generating electricity using high wind pressure generated by fast moving vehicles channeling the induced wind in the direction of the wind turbine. A fast moving vehicle compresses the air in the front of it and pushes the air tromirs sides there by creating a vacuum at its rear and its sides as it moves in the forward direction.

The kinetic energy of the wind movement thus created can be used to generate electricity. The moving vehicles encounters wind may be railway train at airplanes, will sweep off it, in a faster manner making heavy winds. During this, when a wind turbine, if fit to a moving vehicle will generate adequate amount of energy. The air thaw will cause turbines to rotate and thus electricity can be produced.

The main objective of the present research is to provide a method and a system for generating electricity using easily available wind induced by moving electric trains in transit or in operation. The other object of this research is to provide a method and a system for generating electricity by using high wind pressure generated by moving vehicles, using this free renew able input namely air and independent of vagaries of seasonal winds having the variation in direction and wind speeds when they do flow and that too neither at all times or places not having the necessary force of wind to operate wind will to generate electricity as required.

Description of the Research

Wind Pressure

↓

Compressed Air

↓

Rotate Turbine

↓

Generate Electricity

↓

Injecting back to the line (OHE)

Paper Background

The energy crisis is one of the major problems of India and to overcome this, our government is aspiring in all possible ways. The paucity of electricity has left various parts of the country in darkness. It is the duty of every organization to contribute in overcoming the power crisis.

The Indian Railway is one of the most power consuming sector or out county. The data says that the Indian Railways consumes approximately 60% of the total electrical power generated in India. So, in this research it has been found that almost 20% of the power is saved by installing wind turbines generators on the roots of the train coaches.

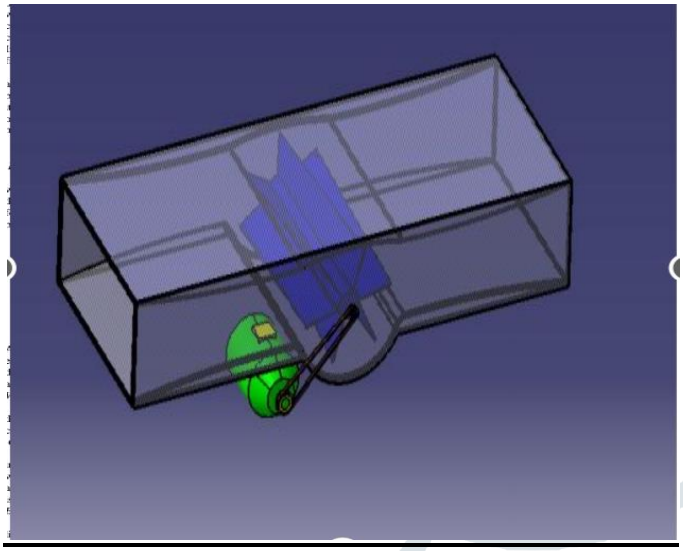
So, if we calculate the 20% of 60% of the overall generated power, it comes 12% of the total power generated which would be saved.

CONSTRUCTION

Specially designed horizontal axis wind turbines along with wind turbine generators (WTG) are fitted on the top of train coaches. In each coach 4-5 wind turbine generators one mounted and this process is done in almost all the coaches (nearly 19-20 coaches in a train). All the last coach a power house is made so as to collect all the generated power at one place and it is converted into 25KV 1- ∅ 50HZ A.C.

The total generated power is injected back to the overhead electrical lines using specially designed pantograph.

Working model.



DESIGN PARAMETER

RPM	VOLTS	AMPS
150	12	1.5
300	25	4
500	43	7
750	60	10
1000	70	11

Generator specification

Torque 7.35-1.14 N-m
Rated power-0.77 kw

Actual speed of turbine

F b=0.6
Fb= blade coefficient for variable speed appliances.
V= $\frac{\pi D\ N}{60}\ m/s.$

Duct Inlet

Considering the arag force the duct inset is designed as small as possible so that it makes maximum use of inflowing air.

The hollow space provided for wiring and piping is 20.2cm. her the inlet area be (considering drag)

L = 500mm, B=240 mm.

Inlet air velocity = vehicle velocity km/h.

Vehicle

Velocity (max) = 120km/hr (source railway)

Maximum velocity (v_1) = 120 km/h = 33.33m/s

Air inlet velocity (v_1) = 33.33m/s.

Velocity desired at throat (v_2) =44 m/s.

From continuity equation,

$A_1 V_1 = A_2 V_2$

$L_1 \times b_1 \times V_1 = L_2 \times b_2 \times V_2$

$500 \times 240 \times 33.33 = 500 \times b_2 \times 44$

$B_2 = 181.8 = 182$mm.

Duct Throat Dimensions

L_2 = 500mm.

B_2 = 182mm.

Torque

$P = \frac{2 \pi NT}{60}$

$0.77 = 2 \times \pi \times 1000 \times T/60$

T=7.352 Nm.

Load of drive 0.75 to 5kw

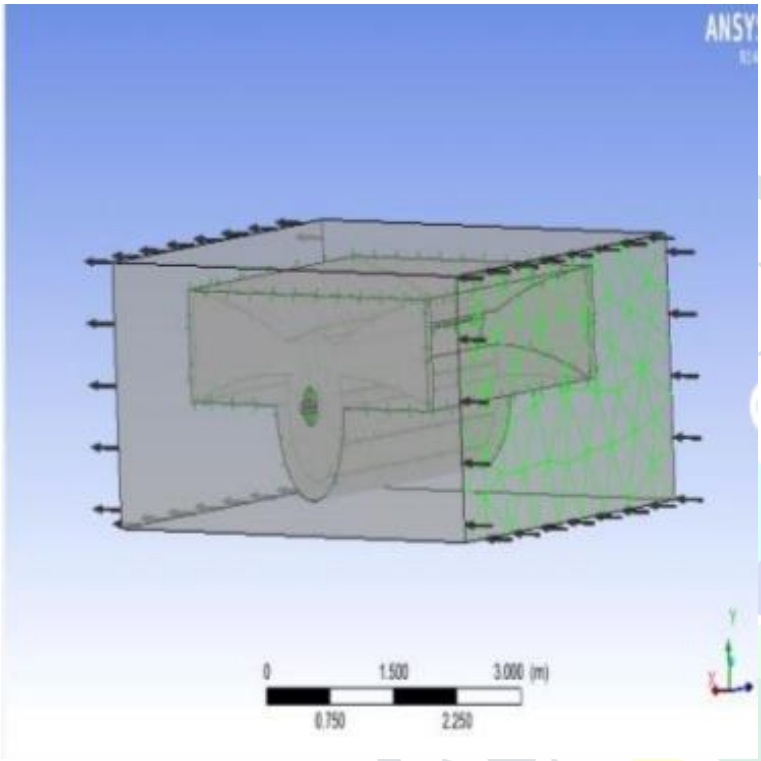
No slip : $V_1 = V_2$

D = 300 mm.

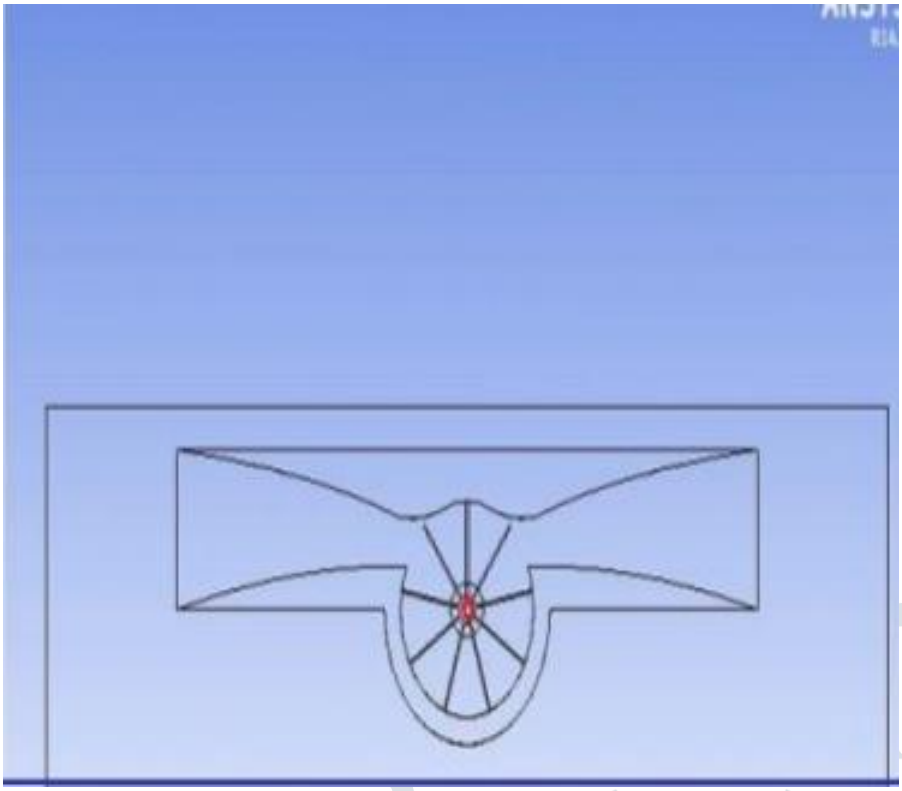
V = 43.62 m/s (Inlet velocity)

Results and discussion.

By employing ANSYS CFX, flow analysis is done for the wind turbine model and the results are tabulated for different air velocities and the corresponding speed Values of the turbine and generators are calculated.



Velocity profile of turbine in ANSYS



S.no.	Air inlet velocity v m/s	Turbine speed	Turbine torque
1	33	1555.08	0.831
2	32	1497.32	0.935
3	26	1225.49	1.793
4	25	1155.46	1.932
5	15	700.28	3.380
6	14	630.25	0.723
7	12	560.22	0.577

Computational approach

S.no.	Air inlet velocity v m/s	Turbine speed N rpm.
1	33	1666.67
2	32	1604.2
3	26	1336.9
4	25	1260.5
5	15	763.94
6	14	687.54
7	12	611.15

Theoretical Approach.

The technology is expected to contribute to the cause of the environment as it helps to reduce carbon emissions and also assists the government in saving on fuel too.

It can be concluded that an effective system can be installed in rail coach to generate power which is purely environment friendly and cost effective.

Conclusion

This system helps in effectively utilizing the wind energy and generating electrical energy at low cost with less maintenance.

With the Indian railways network of thousands of kilometers running across the length and breadth of our nation, by implementing this system of power generation, we can generate power to reduce the power consumption by the trains by injecting the generated power to the over head electric lines (as it is done while using regenerative braking)

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