Invelox Windmill

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Abstract- A windmill is a mill that converts the energy Wind energy conversion systems have existed for more than 3000 years. Initially, wind energy was used to induce a function, such as moving boats using sail, cooling houses by circulating outside air, running machinery in farms, and even small production facilities. A recently developed technology, Invelox (increased velocity), has shown promise. Invelox is simply a wind capturing and delivery system that allows more engineering control than ever before. While conventional wind turbines use massive turbine-generator systems mounted on top of a tower, Invelox by contrast, funnels wind energy to ground generators. Instead of snatching bits of energy from the wind as it passes through the blades of a rotor, the Invelox technology captures wind with a funnel and directs it through at a pering passageway that passively and naturally accelerates its flow. This stream of wind energy then drives a generator that is installed safely and economically at ground or sub-ground levels. The performance of the system was validated by recent measured field data. Turbines inside Invelox, or any ducted turbine, have a higher power coefficient than those installed in an open-flow environment. Standard horizontal or vertical turbines can be installed inside Invelox and generate significantly more energy compared with open-flow systems.

Keywords: conventional, Invelox, Delivery system, passageway, Turbines, generator.

1.INTRODUCTION

The project is designed based on the principle of windmill mill that converts the energy of wind into rotational energy by means of vanes called sails or blades. Centuries ago, windmills usually were used to mill grain, pump water (wind pumps), or both. The majority of modern windmills take the form of wind turbines used to generate electricity, or wind pumps used to pump water, either for land drainage or to extract groundwater. Its first innovative feature is the elimination of tower-mounted turbines. The second innovative feature of Invelox is that it captures wind flow through an omnidirectional intake and thereby there is no need for a passive or active yaw control. Third, it accelerates the flow within a shrouded Venturi section which is subsequently expanded and released into the ambient environment through a diffuser. In addition, Invelox provides solutions to all the major problems that have so far undermined the wind industry, such as low turbine reliability, intermittency issues and adverse environmental and radar impact. The objectives of the present work are to model and understand the flow field inside the Invelox where the actual wind turbine is located as well the external flow field which not only provides the intake flow but also has to match the exhaust flow of the system. The present computations involved cases with different incoming wind directions and changes in the intake geometry.

2.LITERATURE REVIEW

Prof. Duryoush Allaei, Yiannis Andrepolous (2013) Paper on “Invelox ; Description of a new concept in wind power and its performance pollution.” In this paper states that the present computations involved cases with different incoming wind directions and change in the intake geometry. This paper result shows that it is possible to capture accelerate concentrate in the wind Increased wind velocities result in significant improvement in the power output and gives computational fluid dynamics models, comparision models, system specification research. Research of this paper is the turbine generator sub system has been proven to scalable that’s why invelox system is scalable and focoused on five key part intake, pipe carrying air accelerating wind, venturi wind energy conversion system diffuser. [1]

Prof.Patel Snehal Narendrabhai , Dr. T.S. Deshmukh (2017) Paper on “Numerical simulation of flow through invelox wind turbine system.” This paper gives details of comparison between invelox system and traditional wind turbine. They results indicate that invelox system can be generate 6 to 8 times more energy than the traditional wind turbine with the same size of turbine and gives analysis of invelox. The paper states comparison which based on the velocity distribution and speed ratio in the absence of turbine. But main aim of invelox wind mill to enhance the performance of traditional turbine. The similarities between invelox and traditional and duct turbine listed in this paper having field demos and measured data. The invelox system tested with foue different turbine with venture inside it. The result presented in this Paper are from three blade turbine with power rating 600W at 20.5M/S [2]

Mr. Prashant S. Mali, Prof.Manoj R. Hans. (2015) Focoused on “Venturi Effect in Wind Mill and Maximum Power Point Tracking in Hybrid Micro-Grid in Indian Scanerio.” In this paper venturi in wind system is proposed to get smoother power. The available wind velocity placed important role in Indian power sector, venture is one of the element for increase the power. This paper presents the technology and economic analysis of wind system using different sizing method. The optimization of wind turbine and venturi assembly is focused of this work and concentrate and interface between wind and venture assembly. This paper also focused on acceleration of flow of air velocity, reduction in blade tip vertices, reduction of span wise flow of venture design. In wind mill venture effect is used which gives constant velocity as input to the blade. In india only 3% of areas are suitable for large scale turbine , 10% for turbines lower than 100KW, and more than 40% for turbine lower than 10KW. So there s laege market potential for small turbine to be installed on the yard , farms and ruler areas. In this paper venturi in wind system is proposed to get smoother power. The relation between shape and air flow was envisaged and the area in which advantages to efficiency were to be sought. According to paper power available in wind can be calculaed from the kinetic energy. The air flow that intertact with turbine is offered upto front face of rotor, this is referred to be turbine swept area. Turbine swept area and thickness equivalent to wind velocity. There is linear relationship between density and power.[3]

Miguel Martienez Lozano,Luies G.Diaz Pulgar (2012) Title on “Field Measurement of the Grounding Impedance of a Wind Farm in Venezuela.” In this paper focused on wind farm and gives idea about wind farm. Mainly traditional wind mill requires farm for foundation purpose a size and shape of traditional wind turbines large requirement of land so by this paper become to know less amount of land with less cost but high output can be produced by Invelox wind turbine system. The ground model is an essential part for correct simulation of the transient event in the wind park. The evaluation perform in this work allows the designer to have better information and complete and real model of the component. Both the information in time domain and frequency domain are important and complementary. And the foundation is more applicable for simulation, measurement etc. But for invelox no necessity to correct the simulation of transient event in wind park.[4]

3. DESIGN

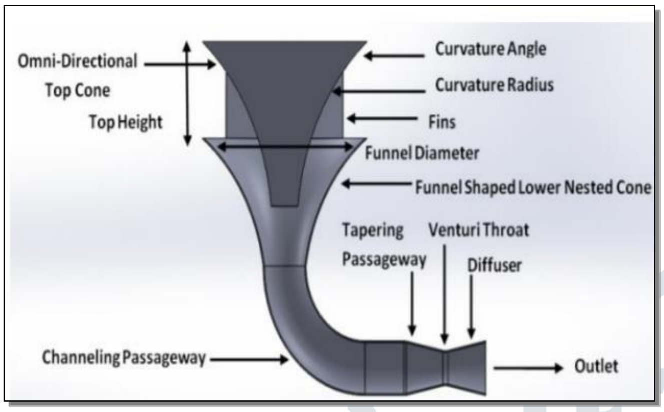

Fig.3.1 Invelox System

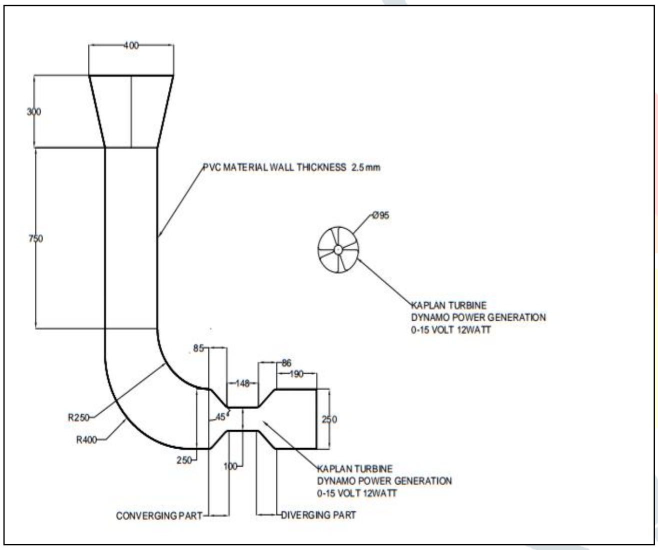

Fig. 3.2 Invelox Sketch

3.1Wind

The wind energy is one of the important renewable energy sources. The wind is the movement of air caused due to the uneven distribution of pressure. Earlier times, the wind energy is utilised for the sailing of ships, driving windmills etc.Most of the present application includes the conversion of wind energy into mechanical energy and then to electrical energy. The conversion of wind energy by wind mills uses the component of forces in the direction of wind, known as drag and the forces perpendicular to the direction of wind called lift. Modern designs use both the forces to convert the wind energy into mechanical energy.
The site selected for wind farm development need to have many positive attributes including :

Superior wind speed
Good road access to sites
Suitable terrain and geology for onsite access
Low population density and close to suitable electrical grid
Privately owned free hold land

3.2Funnel

The duct work is designed to capture wind from any direction, increase its speed and concentrate the moving air flow before passing it through a relatively small turbine at ground level.
Principle: The fact that the funnel's output wind speed depends upon on the principle of mass flow rate and swept area, it is crucial to design the funnel with the given dimensions so that the speed ratio of 2 or more can be achieved. The highest input speed to out speed ratio that can be achieved from the variation of the design parameters is which is obtained by increasing the diameter of the funnel.
Shape & size of Venturi meter: Extended-form or the traditional Venturi meter. Condensed-form where the outlet cone is shortened to save space. An eccentric form, where the bottom walls of each of said sections are in alignment and present a smooth straight surface to the liquid, hence reducing chances of deposition. The Rectangular form used in air ventilation ducts. Advantages of Venturi meter: -A higher Coefficient of discharge obtainable. Operational response can be designed with perfection. Installation direction possibilities: Vertical / Horizontal / Inclined.

3.3Kaplan turbine generation system

A Kaplan turbine is basically a propeller with adjustable blades inside a tube. It is an axial-flow turbine, which means that the flow direction does not change as it crosses the rotor. The inlet guide-vanes can be opened and closed to regulate the amount of flow that can pass through the turbine.The figure shown below of dyanamo 12 volt dc motor generator having attachment of blades as same to Kaplan turbine to generate power. We selected Kaplan turbine blades because they are flexible with minimum air velocity can gives maximum RPM. The blade angle gives high flow low head power production. Kaplan turbine blades individually design for each side to operate at the high possible efficiency, typically over 90%.
Dynamo working principle :
Dyanamo and generator convert mechanical energy into electrical power. Dynamo a device that makes direct current electric power using electromagnetism. It is also known as however the term generator normally refers to an alternator. Its based on faraday's law.

3.4 Power Generation

Wind possesses energy by virtue of its motion. Any device capable of slow in down the mass of moving air, like a sail or propeller , can extract part of the energy and converts is into useful work. Three factors determine the output from a wind energy converter:

- The wind speed ;
- The cross section of wind swept by rotor ;
- The overall conversion efficiency of the rotor, transmission system and generator.

A 100% efficient aerogenerator would there for only be able to convert up to a maximum of around 60% of the available energy in wind into mechanical energy. The power in the wind can be computed by using the concept of kinetics. The windmill work on the principle of converting kinetic energy of the wind into mechanical energy. We know that power is equal to energy per unit time. The energy available is the kinetic energy of the wind . The kinetic energy of any particle is equal to one half its mass times the square of its velocity, or 1/2mV^2.The amount of air passing in unit time, through an area A, with velocity V, is A*V, and its mass m is equal to its volume multiplied by its density ρ of air, or m=ρAV
Substituting this value of the mass in the expression for the

kinetic energy, we obtain, kinetic energy= ½ ρAV^3 watts

This equation tells us that the maximum wind available the actual amount will be some what less because all the available energy is not extractable is proportional to the cube of wind speed. Available wind power Pa= ½ ρ π/4 D^2V^3 watts.

E = 1/2mv2 = 1/2 (Avtρ) v2 = 1/2 Atρv3 (1)

P = 1/2ρv2 (2)

P = 1/2 Aρv3 (3)

m = ρAv (kg/s)

E is Energy (Joules); J

A is Cross Sectional Area (m2)

t is Time (seconds)

ρ is Density (kg/m3)

v is velocity (m/s)

m is Mass (kg)

P is Pressure (Pa)

P power in watt

The inefficiency of the current horizontal axis wind turbine (HAWT) is that it is large, have mechanically complex turbines, is also expensive, unwieldy, inefficient, and hazardous to people and wildlife. The funnel based wind turbine eliminates the need to have large towers mounted at sea, increases turbine reliability, and reduces intermittency as well as environmental issues. The maximum power output is affected by the design parameters which is the funnel height, top curvature radius and angle as well as the funnel intake diameter. The objective is to optimize the power output by analyzing the effect of the changes to the funnel design on the output wind velocity.

4. THEROTICAL RESULT

Power output calculation:

Venturimeter

When fluid passes through its convergent pipe its velocity increases and pressure reduces.

$$P1 + \rho gh1 + \frac{1}{2} \times \rho v^2 = P2 + \rho gh2 + \frac{1}{2} \times \rho v^2$$

Calculating Discharge

$$Q = \frac{a1a2}{\sqrt{a1^2 - a2^2}} \times \sqrt{2gh}$$

$$h = \frac{P1 - P2}{\rho g} = \frac{1.03 - 0.7}{1.1839 \times 9.81} = 0.0185m$$

$$Q = 7.4770 \frac{m^3}{s}$$

$$Pa = \frac{1}{2} \times \rho \times \frac{\pi}{4} \times D^2 \times V^3 watts$$

ρ= 1.1839 kg/m^3 at 25deg

D=0.095m^3

V=11m/s

Power at output=5.58470watt

Force on blade

T=P/w

T=p/3.14*0.095

T=5.58470/3.14*0.095*20

T=0.9356 N/m

Axial Force of Thrust by a Equation

F=1/2g*(Aρv2)

F=0.1035067 N

Table no. 4.1Calculation

Actual wind speed	Vilocity in Invelox	Power in Invelox
m/s	m/s	watt
1	1.724	2.796
2	3.495	24.777
3	5.272	85.043
4	7.074	205.517
5	8.885	301.11

Invelox wind turbine system can generate about 6 to 8 times more power than the traditional wind turbine system. As results shows that at any free stream wind speed, Invelox gives best performance for power generation. From the literature review, we come to know that, Omni directional wind turbine can capture a wind from the 360 degree (from all direction) and due to density of the air it forced to flow through the duct and further assembly. When wind capture at the nominal wind speed around– 6.71 m/sec it convert into a high velocity wind with passing it into a venturi portion which is measured around 50 to 60 m/sec and subsequently increased a power output. After reviewing all research papers, I found that the– extracted wind power P can increase by increasing the mass flow rate or total energy drop across the turbine. As a conclusion, the factors that determine the output of a wind turbine was investigated and factor that affects the output of a wind turbine was limited to geometry design factor in this report. The duct shape or the funnel was designed to overcome some of the set backs of the wind tunnel. Betz law states that maximum energy that could be extracted from the wind regardless of the type of device used is 59.3 percent. This number is known as the Betz' limit. The funnel basically does break the Betz law but merely provides more air velocity per area compared to amount of air that can be obtained without the duct and with this increases the amount of the power that can be extracted without violating the law. As mentioned, increased amount of power can be achieved at the output by increasing the total air intake flow to the wind turbine with the aid of a channeling passageway via the funnel omni directional intake and by utilizing the venturi effect. This increases the wind speed twofold and therefore doubling the air flow at the air outlet. Among the 4 variations done in this report (Funnel curvature radius, funnel curvature angle, funnel height, funnel diameter), the most suitable option to optimize the output of the wind tunnel is by increasing the diameter of the funnel. This finding is supported by the mass flow rate equation which states; A1V1= A2V2. When there is a reduction in swept area at A2 near the venturi, there is an increase in V2(velocity) due to equivalence on the left side of equation and conservation of mass. There are some assumptions made to ease the simulation and to get approximated geometric design parameters. Since this report only concerns about the geometry design parameters, turbine was not part of the analysis. Steady state flow is assumed and blockage as well as backflow in funnel was not taken in to consideration.

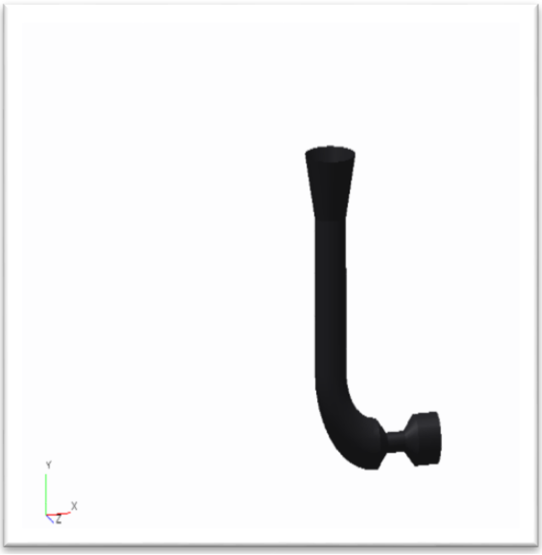

Fig. 4.1Creo Model

The funnel has a 360 capability to capture the wind which blows in any direction. The venturi is given a diameter of 100mm and the top omni directional cone and bottom cone is given a diameter of 400mm. The height of the funnel from the ground till the top is approximately 1000mm. Due to the fact that the funnel's output wind speed depends on the principle of mass flow rate and swept area, it is crucial to design the funnel with the given dimensions so that speed ratio of 2 or more can be achieved. This is a very important design feature. The top cone acts a guide for wind to be channeled into the lower cone, into the channeling passageway and finally into the venturi before diffused at the outlet as seen in figure. The Omni directional intake is also able to take more air as the four fins of the top it is orientated at 45 to the flow and have a bigger area to collect wind. According to the global wind market statistics released today by the Global Wind Energy Council (GWEC) Globally, 51,477 MW of new wind generating capacity was added in 2014 according to the Wind power capacity has expanded rapidly to 336 GW in June 2014, and wind energy production was around 4% of total worldwide electricity usage, and growing rapidly The record-setting figure represents a 44% increase in the annual market. Total cumulative installations stand at 369,553 MW at the end of 2014. Wind power market penetration is expected to reach 3.35% by 2013 and 8% by 2018 .

Table no.4.2 Previous Research History

Actual Wind Speed	Avg. V		Power P	
	Invelox	TWT	Invelox	TWT
m/s	m/s		Watt	
1.00	1.724	0.915	2.976	0.444
2.00	3.495	1.819	24.775	3.496
3.00	5.272	2.731	85.043	11.821
4.00	7.074	3.638	205.517	27.939
5.00	8.885	4.544	407.138	54.448
6.00	10.712	5.451	713.545	94.007
6.70	11.991	6.087	1000.710	130.889
7.00	12.545	6.359	1146.089	149.240
8.00	14.376	7.266	1724.465	222.641
9.00	16.213	8.172	2473.725	316.839
10.00	18.053	9.080	3415.451	434.585
11.00	19.896	9.987	4571.753	578.222
12.00	21.744	10.895	5967.491	750.639
13.00	23.592	11.803	7621.898	954.447
14.00	25.444	12.710	9561.843	1191.823

[2]

5. SCOPE

In future Invelox windmill is unique innovation in wind industry with multiple turbine can be simultaneously use to give large output in small space. Metro rails going to be plan in many cities so lighter invelox wind turbine can be installed at the sites of metro tracks.

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