International Journal of Research

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 07 Issue 10
October 2020

Experimental And Analytical Investigation On The Vertical Axis Wind Mill Using Different Velocities And Blade Angles

AUTHOR 1
Rayudu Durgaprasad received the B.Tech degree in mechanical engineering from, Srinivasa Institute of Engineering and Technology, JNTU, Kakinada, Andhra Pradesh, India, in 2017 year, and perusing M.Tech in Thermal Engineering from BonamVenkataChalamayya Engineering College (AUTONOMOUS), Odalarevu, Andhra Pradesh, India.
AUTHOR 2
Mr.B.Srikanth,**M.Tech. Asst.Prof.Department of Mechanical Engineering**, at BonamVenkataChalamayyaEngineering college (AUTONOMOUS), Odalarevu, Andhra Pradesh, India.

ABSTRACT

A wind turbine is a rotary device that extracts energy from the wind. Any wind turbine comprises of three main components namely: rotor, generator and structural support. Based on the alignment of their shafts of rotation, two types of turbines are designed - Horizontal Axis Wind Turbines (HAWT) and Vertical Axis Wind Turbines.

Ever since the Seventh Century people have been utilizing the wind to make their lives easier. The whole concept of windmills originated in Persia. The Persians originally used the wind to irrigate farm land, crush grain and milling. This is probably where the term windmill came from.

In this paper we are going to do develop an existing wind will and then change the tail angles of the wind turbine blade and CFD analysis is done a different velocities to check whether it withstands or not. So here for the design CATIA Is used and for analysis ANSYS is used and later for the better output the experimental analysis is done using different velocities taken in the ansys. And then the results are compared to get the better output.

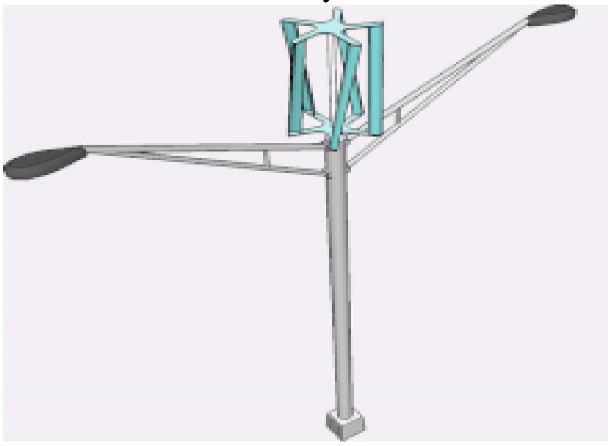
Even here the current voltage rating is also calculated for the model using different velocities used.

INTRODUCTION

A **vertical-axis wind turbine (VAWT)** is a type of wind turbine where the chief rotor shaft is set crosswise to the wind (but not unavoidably vertically) while the main mechanisms are situated at the dishonorable of the turbine. This preparation lets the producer and gearbox to be situated close to the ground, easing service and overhaul. VAWTs do not essential to be pointed into the wind, which removes the essential for wind-sensing and location mechanisms. Major disadvantages for the early projects (Savonius, Darrieus and giromill) comprised the significant torque difference or "ripple" throughout each rebellion, and the large bending moments on the knife-edges. Advanced projects addressed the torque ripple subject by far-reaching the blades helically (Gorlov type).

A vertical axis wind turbine has its axis vertical to the wind rationalizes and vertical to the ground. A more overall term that comprises this choice is "transverse axis wind turbine" or "cross-flow wind turbine." For instance, the original Darrieus patent, US Patent 1835018, includes both options.

Drag-type VAWTs such as the Savories rotor typically function at lower tip haste ratios than lift-based VAWTs such as Darrieus rotors and cyclo turbines.



Light pole wind turbine

LITERATURE REVIEW

1. Niranjana.S.J investigated the power generation by vertical axis wind turbine. In this paper the power is generated by fixing the wind mill on the road high ways .when the vehicle is passed through the road at high speed the turbine of the wind mill rotates and generates the power sources. This analysis indicates that the vertical axis wind turbine can be able to attain the air from all the direction and produces the power of 1 kilowatt for a movement of 25 m/s. The efficiency of vertical axis wind turbine can be increases by modifying the size and shape of the blade.
2. ParthRathod et al. analyzed a review on combined vertical axis wind turbine. In this paper, the increased efficiency is achieved based on the characteristics such as aspect ratio, tip speed ratio, velocity and other geometry parameter. The experiment is conducted to increase the power production and efficiency of a wind turbine. The development of design is optimized by combining the blade structure and the flow performance. The result indicates that the efficiency of turbine is always based on the wind speed and climatic conditions. The lowest aspect ratio improves the power coefficient of the turbine. The power generation of combined rotor is high compare to the single savonius and darrieus rotor.
3. Abmjit N Roy et al. analyzed the design and fabrication of vertical axis economical wind mill. This paper indicates that vertical axis wind mill is one of the most important types of wind mill. In this main rotor shaft is connected to the wind turbine vertically with the generator and gear box which can be placed near the ground. Performance characteristics such as power output versus wind speed or versus angular velocity must be optimized in order to compete with other energy sources which make the process economically and eco-friendly. The experimental result shows that wind turbine is placed on the top of the building in an ideal position to produces electricity. The power generation becomes easy and it is used for various applications such as street light, domestic purpose, agriculture etc.
4. KunduruAkhil Reddy et al. investigated a brief research, study, design and analysis on wind turbine. This paper evaluates the aerodynamic performance of variable speed fixed pitch horizontal axis wind turbine blade using two and three dimensional computational fluid dynamics. The primary objective of the paper is to increases the aero dynamic efficiency of a wind turbine. The blades are designed using different type of airfoils which are associated with angle of attack. The blade design is

responsible for the efficiency of the wind turbine. The design of the blade is done using Q- blade software. The result indicates that the power output is determined using blade elemental theory. The power output of designed blade design is higher when compare to existing design of the blade.

5. Mohammed Hadi Ali Lecturer University of Mustansiriya presented research paper on "Experimental Study for savonius Wind Turbine of Two and Three Blades at Low Wind Speed". The experiment's procedure was carried out and tested in the wind tunnel and the required measurement were obtained to study the performance of the two blades and three blades savonius wind turbine and makes the comparison between them to see which one is better in performance than the other. The performance [the dimensionless parameters torque coefficient ( ) and power coefficient ( )] was evaluated as function of the dimensionless parameter the tip speed ratio (λ) at low wind speeds in terms of starting acceleration and maximum no-load speed.
6. Prof. VaibhavBankar and AshwinDhote presented research paper on "Design, Analysis and Fabrication of Savonius Vertical Axis Wind Turbine". Following are the same conclusions drawn from this Research: [1] At least 10% power of the consumption can be fulfilling by this set up. [2] Multi stage generator is the double generation concept with the same size rotor. [3] Gear arrangement can increase the number of rpm in case of low wind speed. [4] This turbine is generally suitable for 8 to 10m of height above ground level. Because at ground level velocity of air is very less. [5] Combination of alternator with gear arrangement can be used to increase output but unnecessarily it will increase the cost of machine. [6] Considering the all-weather point of view the material use should be non-corrosive. [7] The alternate option for turbine blade material is reinforced glass fibre because of its more elastic nature but it is costlier than aluminium alloy
7. MagediMoh. M. Saad, a, NorzelawatiAsmuin presented research paper on "Comparison of horizontal axis wind turbines and vertical axis wind turbine". This paper gives a comparison between the horizontal axis wind turbines, or HAWTS, and the vertical axis wind turbines, or VAWTS. The two types of wind turbines are used for different purpose. Both types of turbines, whether VAWTs or HAWTs, are used for generating electrical power from the wind. This work has compared both types, and also presented the advantages and disadvantages of both types. Each type has its applications. It depends on the wind speed and place to be fixed on. Any way the horizontal axis with propeller blades is the most common one, since its efficiency is about 60%.

<u>MODEL 1</u>

<u>CFD ANANLYSIS FOR WIND TURBINE BLADE WITH VELOCITY - 5m/s</u>

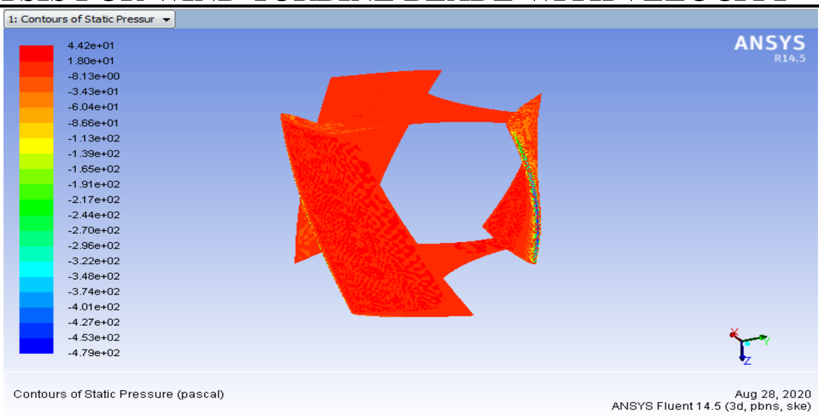


Fig: STATIC PRESSURE

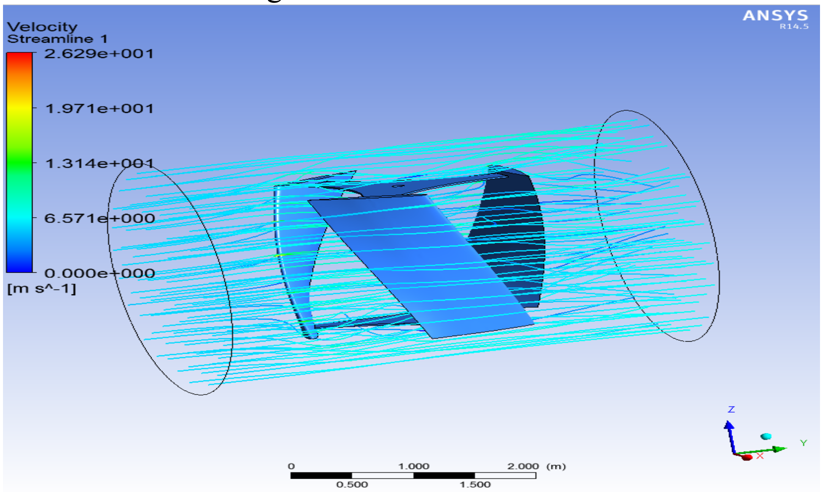


Fig: VELOCITY

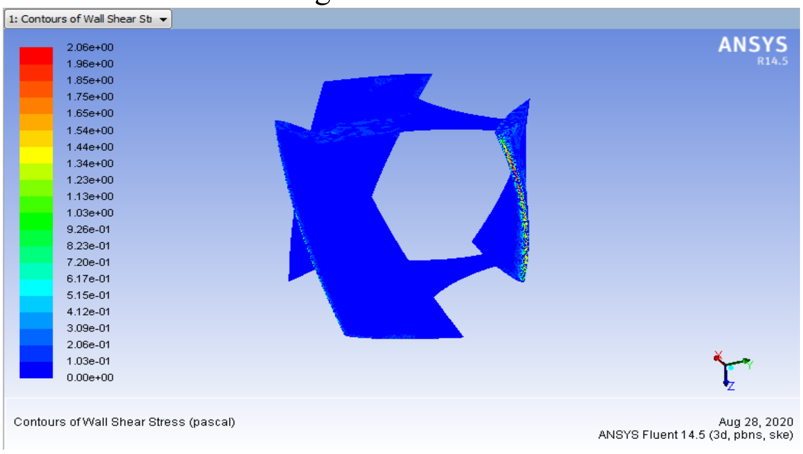


Fig: SHEAR STRESS

<u>WITH VELOCITY – 7.5m/s</u>

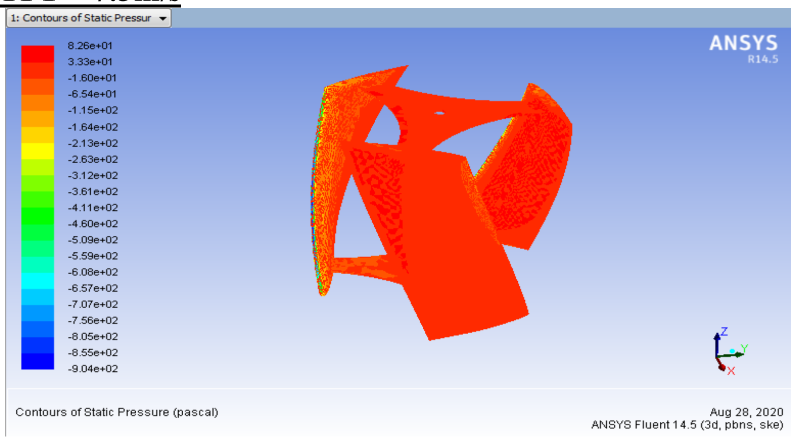


Fig: STATIC PRESSURE

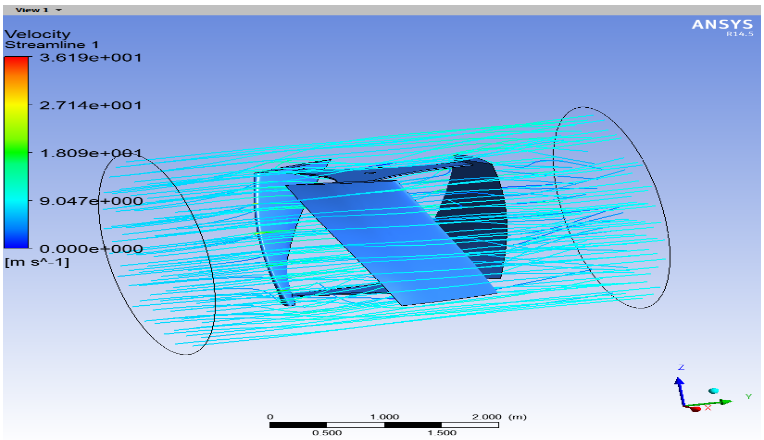


Fig: VELOCITY

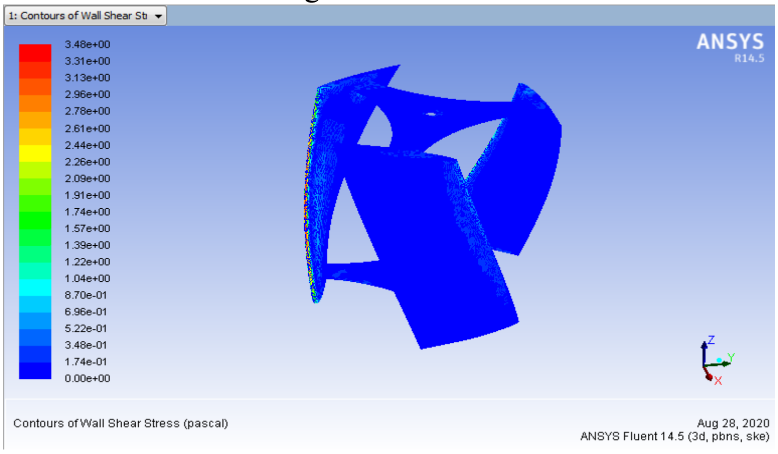


Fig: SHEAR STRESS

MODEL 2

CFD ANALYSIS FOR WIND TURBINE BLADE WITH VELOCITY – 5m/s

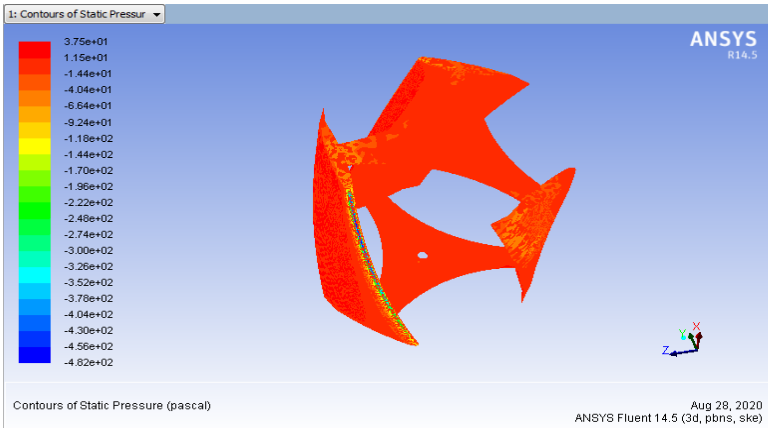


Fig: STATIC PRESSURE

International Journal of Research
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 07 Issue 10
October 2020

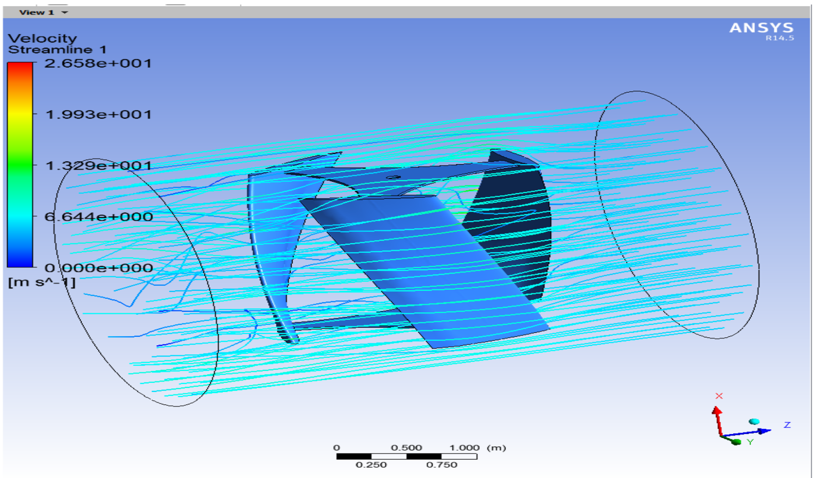


Fig: VELOCITY

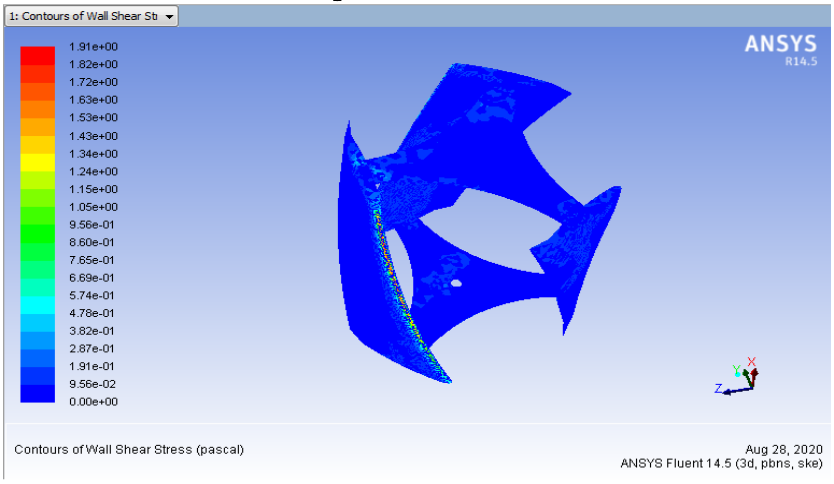


Fig: SHEAR STRESS

<u>WITH VELOCITY – 7.5m/s</u>

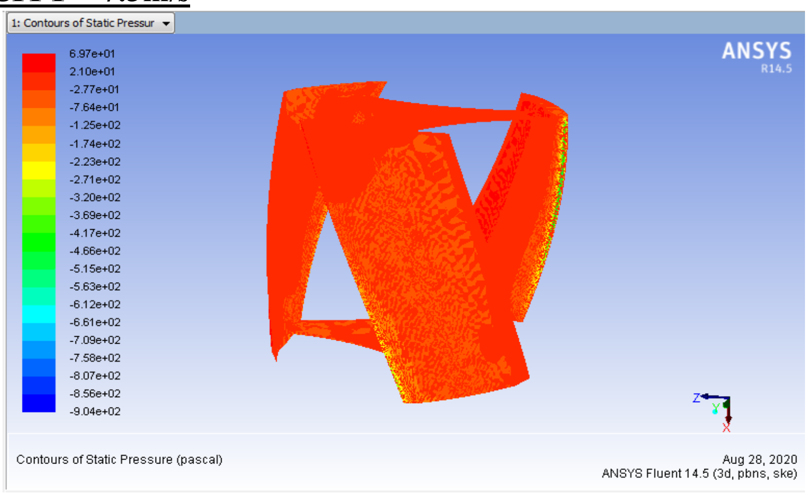


Fig: STATIC PRESSURE

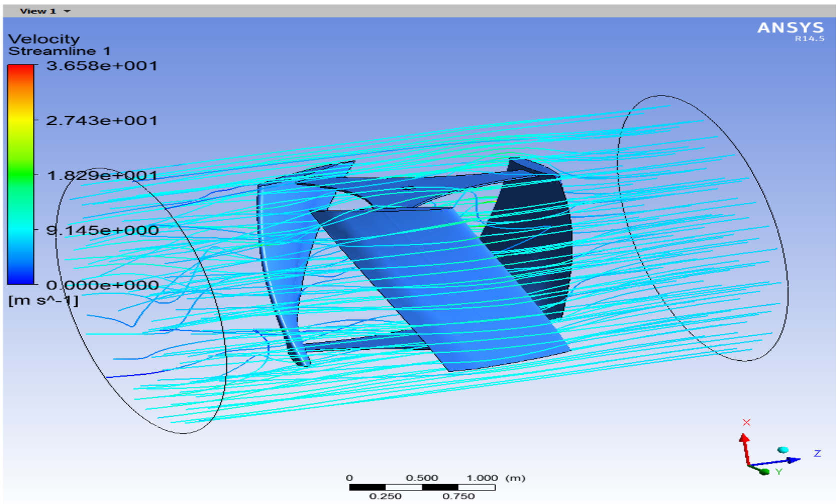


Fig: VELOCITY

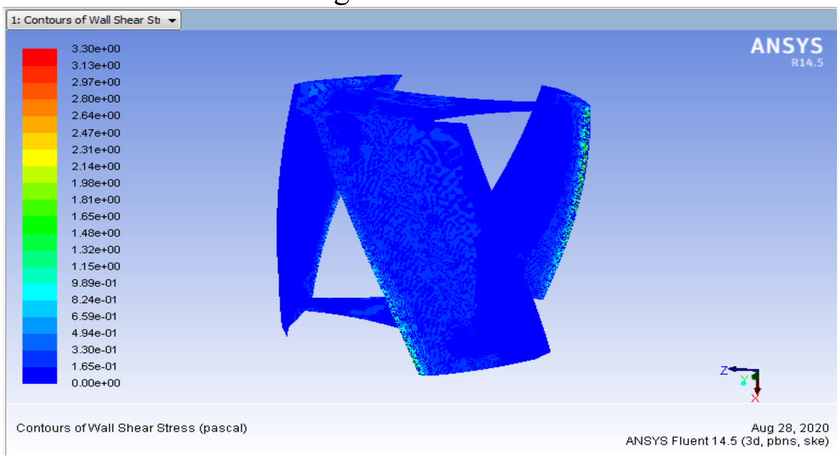


Fig: SHEAR STRESS

TABLES

MODEL 1

DIFFERENT VELOCITIES	PRESSURE (Pa)	VELOCITY(m/s)	TURBULENT KINETIC ENERGY(m^2/s^2)	SHEAR STRESS(Pa)	STRAIN RATE(1/s)	MASS FLOW RATE(kg/s)
5	4.42E+01	2.629E+001	1.07E+01	2.06E+00	4.40E+03	0.027935028
7.5	8.26E+01	3.619E+001	1.99E+01	3.48E+00	5.82E+03	0.037734985
10	1.47E+02	4.849E+001	3.50E+01	5.66E+00	7.52E+03	0.061164856

MODEL 2

DIFFERENT VELOCITIES	PRESSURE (Pa)	VELOCITY(m/s)	TURBULENT KINETIC ENERGY(m^2/s^2)	SHEAR STRESS(Pa)	STRAIN RATE(1/s)	MASS FLOW RATE(kg/s)
5	3.75E+01	2.658E+001	1.21E+01	1.91E+00	5.05E+03	0.0014610291

International Journal of Research
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 07 Issue 10
October 2020

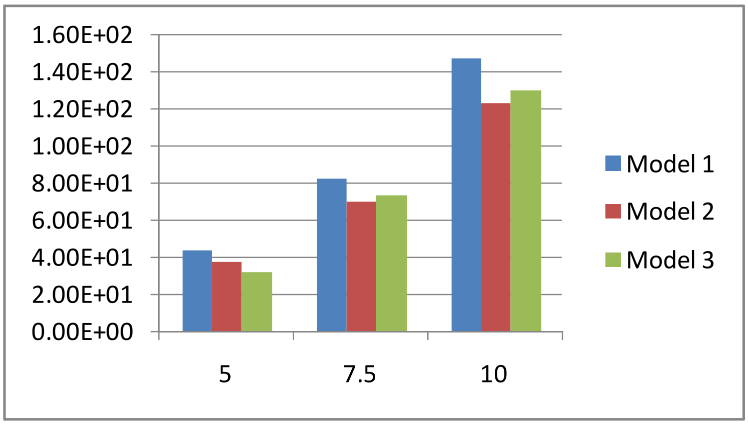
7.5	6.97E+01	3.658E+00 1	2.26E+01	3.30E+0 0	6.65E+03	0.014373 779
10	1.23E+02	4.908E+00 1	4.03E+01	5.44E+0 0	8.54E+03	0.023780 823

MODEL 3

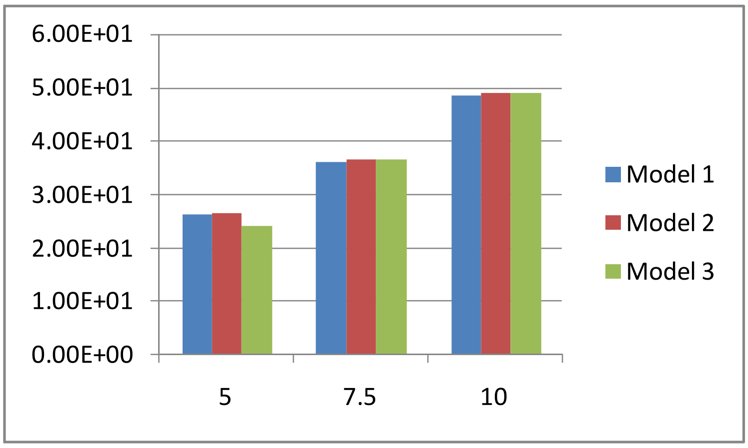
DIFFERENT VELOCITIES	PRESSURE (Pa)	VELOCITY(m/s)	TURBULENT KINETIC ENERGY(m^2/s^2)	SHEAR STRESS(Pa)	STRAIN RATE(1/s)	MASS FLOW RATE(kg/s)
5	3.26E+01	2.421E+001	9.53E+00	1.76E+0 0	5.28E+03	- 0.0007133 4839
7.5	7.34E+01	3.657E+001	2.18E+01	3.54E+0 0	8.12E+03	0.0046920 776
10	1.30E+02	4.911E+001	3.90E+01	5.83E+0 0	1.16E+04	0.0085601 807

GRAPHS

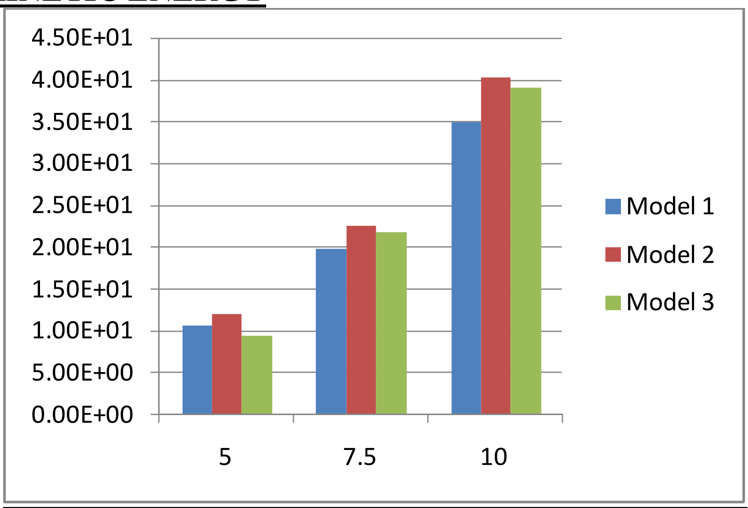
PRESSURE



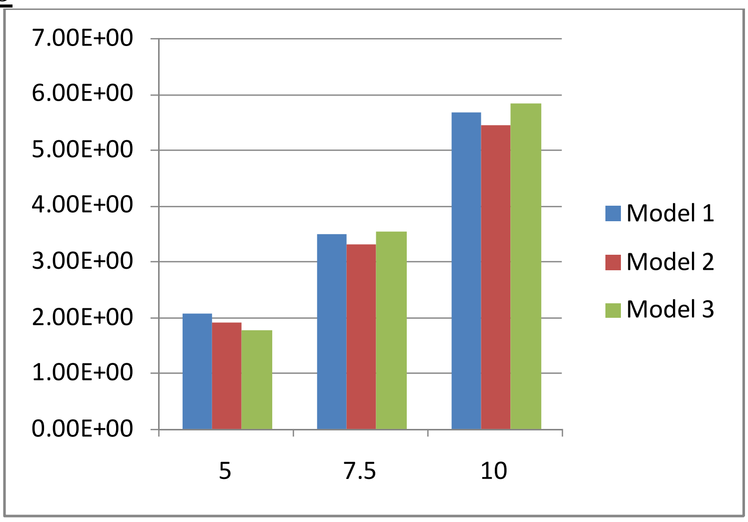
VELOCITY



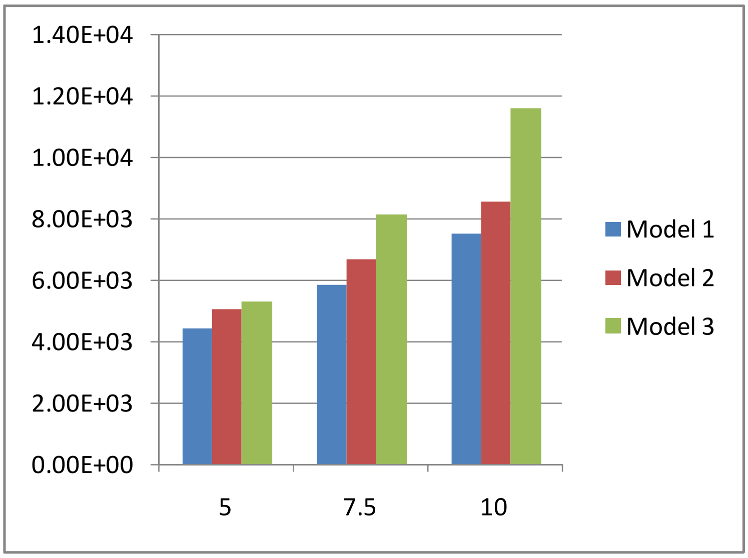
TURBULENT KINETIC ENERGY



SHEAR STRESS

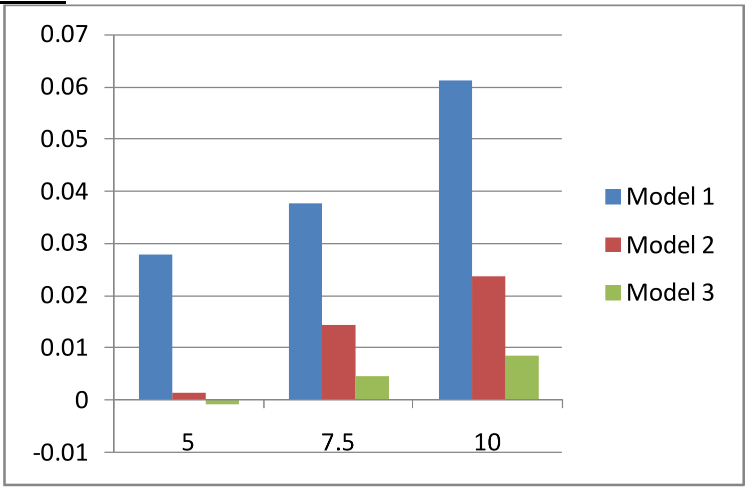


STRAIN RATE



International Journal of Research
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 07 Issue 10
October 2020

MASS FLOW RATE



CONCLUSION

In this paper we are going to do develop an existing wind will and then change the tail angles of the wind turbine blade and CFD analysis is done a different velocities to check whether it withstands or not. So here for the design CATIA Is used and for analysis ANSYS is used and later for the better output the experimental analysis is done using different velocities taken in the Ansys. And then the results are compared to get the better output.

As if we verify the results obtained here the energy and the flow velocity of the air is being increased when the velocity of air is being increased. Even the pressure of the air is being increased when we have changed the model. By these results we can observe that the energy is being developed as if we increase the velocity of the air on the wind mill, and even the better output is being given by the model as the output results.

REFERENCES

1. http://www.energybeta.com/windpower/windmill/helical-wind-turbine/
2. http://www.turby.nl/99-downloads/Turby-EN-Application-V3.0.pdf
3. http://en.wikipedia.org/wiki/Vertical_axis_wind_turbine
4. Kinloch Kirke Brian, *Evaluation of Self-Starting Vertical Axis Wind Turbines for Stand-Alone Applications,* PhD Thesis, School of Engineering, Griffith University, 1998.
5. http://www.worldofkrauss.com
6. R. Gupta and AgnimitraBiswas ,*Computational Fluid Dynamics Analysis Of Twisted Three-bladed H-Darrieus Rotor* , Journal Of Renewable And Sustainable Energy_2, 043111(2010).
7. Fluent 6.3, Users guide, September 2006.
8. Marco D' Ambrosio, Marco Medaglia, *Vertical Axis Wind Turbines: History Technology and Applications,* Master of Science Thesis in May 2010, University of Halmstad.
9. http://en.wikipedia.org/wiki/Darrieus_wind_turbine
10. http://www.worldchanging.com/archives/002383.html
11. http://www.quietrevolution.com/qr5-turbine.htm
12. M C Claessens, *The Design And Testing Of Airfoils For Application In Small Vertical Axis Wind Turbines,* Master of Science Thesis, Delft University of Technology 2006.
13. Scheurich Frank, Fletcher M. Timothy, Brown E. Richard, *Influence of Blade Curvature and Helical Blade Twist on the Performance of a Vertical Axis Wind*

Turbine, Department of Aerospace Engineering, University of Glasgow, Presented at the 48th AIAA Aerospace Sciences Meeting, January 2010.
14. http://www.gisdevelopment.net
15. http://www.awea.org/