Design and Analysis of Spiral Wind Turbine with Various Wind Speed

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Abstract -*The paper targeted on Spiral wind turbine adopted for manage domestic electricity generation. the design and analysis of Spiral turbine (SWT) are going to be described below. The turbine may be a device that converts the Hydraulic energy into mechanical energy then ultimately convert it into electricity. Wind turbines classified into 2 types i.e. Horizontal axis turbine (HAWT) and Vertical axis turbine (VAWT). Spiral Wind Turbine (SWT) may be a new sort of Horizontal axis turbine comprising 2 whorled blades that as wrapped on tear drop formed shell. This special style ensures that a lot of air is drawn into the rotary engine. SWT is Associate in nursing increased sort of wind turbines introducing teardrop formed spiral bladed body. the final word objective of this paper is that the analysis of Spiral turbine in varied wind rate. the design of a Spiral {wind rotary engine turbine} blade has done by AutoCAD Fusion 360 code and also the computational fluid dynamics (CFD) analysis was accustomed analyze rate and Pressure contour of the turbine. From the CFD analysis, it's finished that the SWT is appropriate for urban areas at light-weight and moderate wind speeds.*

Key Words: ***Spiral wind Turbine, Tear drop shape turbine, SWT, Analysis of Spiral turbine, Design of Turbine***

1. INTRODUCTION

This Wind energy is associate ample resource as compared with different renewable resources. Moreover, not like the alternative energy, the use couldn't be full of the climate and weather. It's a supply of renewable power that comes from weather flowing across the surface. Wind turbines act as a converter that extracts mechanical energy from wind and converts it into usable power which might offer electricity for the house, farm, factories or business applications on little (residential), medium (community), or massive scales. A turbine consists of main components, i.e. the rotor, generator, system so on. The rotor is driven by the wind and rotates at a predefined speed in terms of the wind speed in order to generate electricity as output. A rotary engine with a shaft mounted horizontally parallel to the bottom is understood as a horizontal axis turbine. A vertical axis turbine has its shaft traditional to the bottom. Power of a turbine depends on wind speed and blade style, To extract the utmost mechanical energy from wind, researchers place several efforts into the planning of effective blade pure mathematics. The orientation of the shaft and move axis determines the primary classification of the turbine. In India, a median wind speeds square measure 3 ms-1 at 20 m height; thus, Spiral turbine is ideal for low and medium wind speeds. Attention is currently being created on the Spiral turbine could be a new sort of turbine, consisting of 2 spiraling blades. This square measure wrapped on teardrop formed shell, as coils and so expanded, making a teardrop formed rotary engine. Not like old HAWT, that use the carry force to require power from wind energy, the Spiral turbine uses each the carry and drag force. Since 2000, patron saint socialist, chief executive officer of Star Power star, a renewable energy company, has been obtaining calls from customers living close to the shore of island, NY, fascinated by putting in wind turbines on their homes. Once a close search they found there was nothing offered on the market that would be directly put in a customer's roof. They recognized a chance and came up with a style impressed by biomimicry.

In this study, style of Spiral turbine shell of actual size of 400 mm diameter and 850 mm linear unit length has done by AutoCAD Fusion 360 and commercially offered code Ansys Fluent is utilized to predict the mechanics performance like force, power, carry & drag force, speed and pressure distribution, per wind condition k-epsilon with realizable model and scalable wall perform.

2. DESIGN OF SPIRAL WIND TURBINE

Figure 1 shows a schematic diagram of the Spiral wind turbine having two blades are connected to shaft with an angle of 180° between two blades and symmetric arrangement around the shaft. The blades are wrapped around the tear drop shell. The outer diameter of the Spiral wind turbine is 400 mm, the thickness of blade is 2 mm and the length is 850 mm.

Figure 1 Design of Spiral Wind Turbine

3. DESIGN OF SWT BLADE

An important design function of aerodynamic characteristics is blades. the form of the mechanics profile is determined for blade performance. Even minor changes in the shape of the profile can significantly affect the power curve and noise level. In order to extract the maximum kinetic energy from wind, have to put more effort into the design of effective blade geometry. A rotor blade may have different blade length in different sections in order to increases the efficiency. that the trendy blades are additional complicated and economical scrutiny to early turbine blades. The choice is based on comparing lift and drag ratios over different aero foils. The design of the blade has done by using AutoCAD Fusion 360. Modelling of Spiral wind turbine blade is very complex since the size of blades varies with spiral length. The final design of the Spiral wind turbine Blades without tear drop shell has shown in fig 2

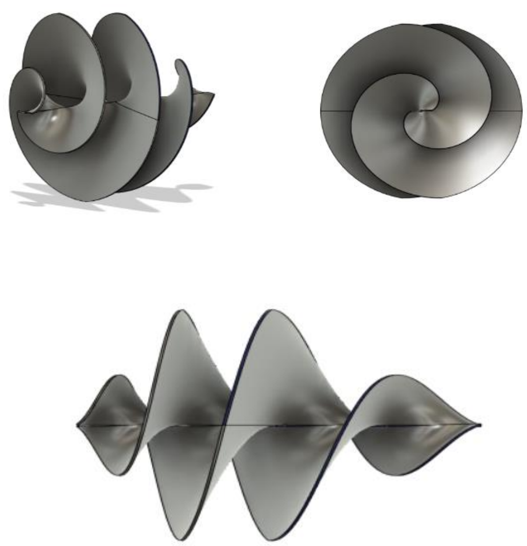

Figure 2 views of SWT

4. METHODOLOGY

The mechanics performance of turbine blades is often examined by process fluid dynamics (CFD) that is one in every of the divisions in hydraulics. Computational fluid dynamics (CFD) could be a division of hydraulics that uses numerical approaches and algorithms to unravel and analyze issues that involve fluid flows. Computers are want to execute the calculations needed to simulate the interaction of liquids and gases with surfaces outlined by the condition. CFD allows individual and engineers to realize numerical experiments, i.e. laptop simulations during a virtual flow laboratory. CFD is faster and positively cheap. A substantial reduction of your time and expenses for determination the issues as compared to ancient approaches.

4.1 COMPUTATIONAL METHOD

CFD FLUENT consists of so various turbulence model in which k-epsilon with Realizable and Scalable wall function model has been used to forecast the separation of flow which is two equation-based model. K-epsilon turbulence model uses the good thing about model wherever k is turbulence mechanical energy, ε is the rate of dissipation of the turbulent mechanical energy.

4.2 MESH GENERATION

In order to make the machine domain and generate the mesh, the commercially accessible code ANSYS Meshing tool is employed to make a structure model and generate an amorphous mesh round the blade within the machine domain. As shown in the figure, a 3D SWT blade is placed inside of an imaginary wind tunnel with inlet and outlet conditions. Number of nodes on tunnel and rotor (SWT) after meshing are 36,736 and 105,592 and total nodes are 142,328 fine mesh and hex-dominant method

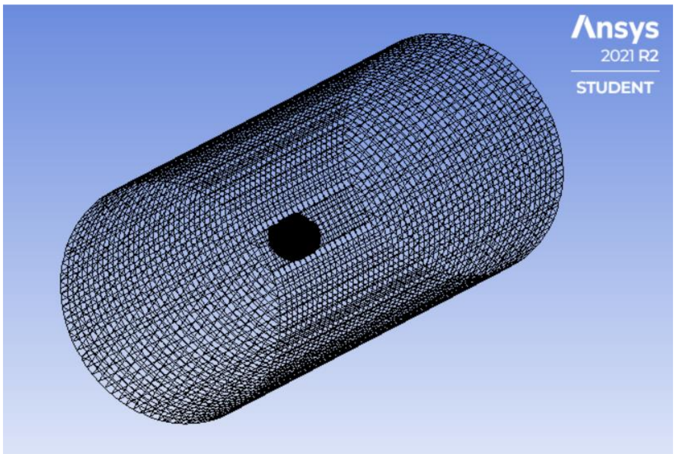

Figure 3 Mesh of SWT

4.3 BOUNDARY SETUP

In this analysis, the boundary conditions are

Inlet wind speed – 1, 5, 9, 15 in ms-1

Rotor angular speed – 100 in rpm

Outlet condition – Atmospheric pressure

Wall – No slip condition

Fig 4 shows Inlet (A) where fluid flow enters toward wind turbine blade, Outlet (B) where the flows leave, Propeller (C), walls (D) acts as boundary which restricts flow

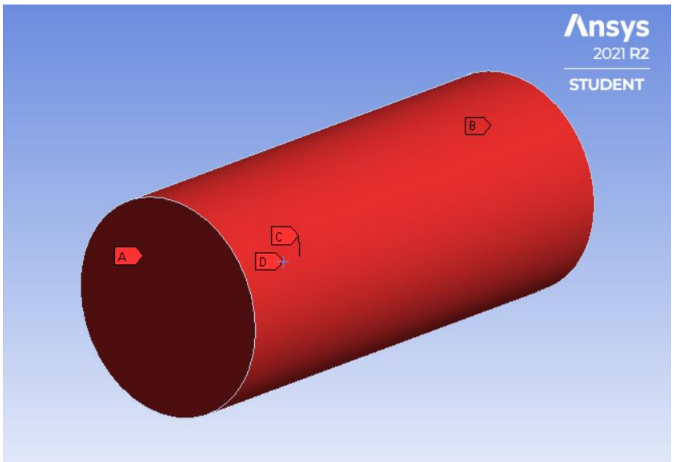

Figure 4 Boundary Conditions

5. RESULT

Initially, an 3D CFD analysis is administrated at wind speed of 1, 5, 9, 15 ms-1 associated rotor speed is 100 rpm an interval severally. The wind speed is assumed to be uniform. Flow direction is from left to right, as a result of the spiral and Teardrop form, the rate exaggerated from the forefront at the inner face of the blade meaning the flow of a fluid accelerates of the blade and highest velocities have detected at the top tip of the blade as shown in a fig 5.

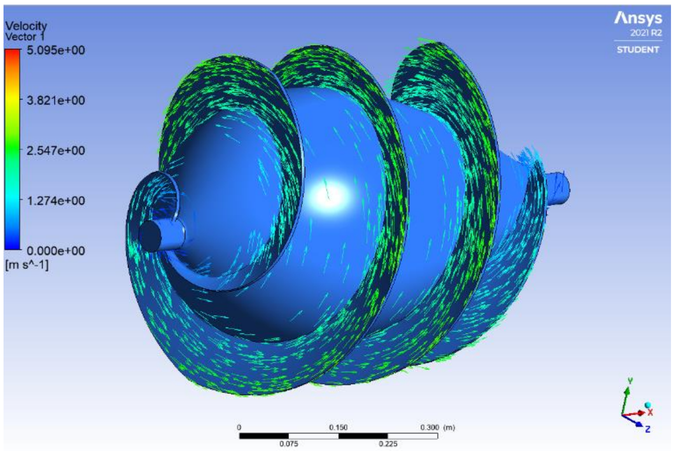

Figure 5 Velocity Vector

To find out mechanics characteristics of the Spiral turbine, speed contours in fig 5 shows that the rate field at the central portion of the blade exaggerated. On top of fig 5 additionally shows that the direction of flow on blade represents the anticlockwise direction of the rotor. The utmost pressure has found round the blade and lowest was at the rear edge. The pressure distribution of the SWT has shown in fig ten. Once the blade is rotating, a pressure distinction is additional within between the pressure facet and suction facet than the pressure distinction in SWT therefore results in generate additional force. Once the wind speed rises the pressure distinction becomes will increase suggests that additional energy may be extracted. From all the cases pressure is negative at the tip of the blade causes thrust force may be generated by a turbine blade.

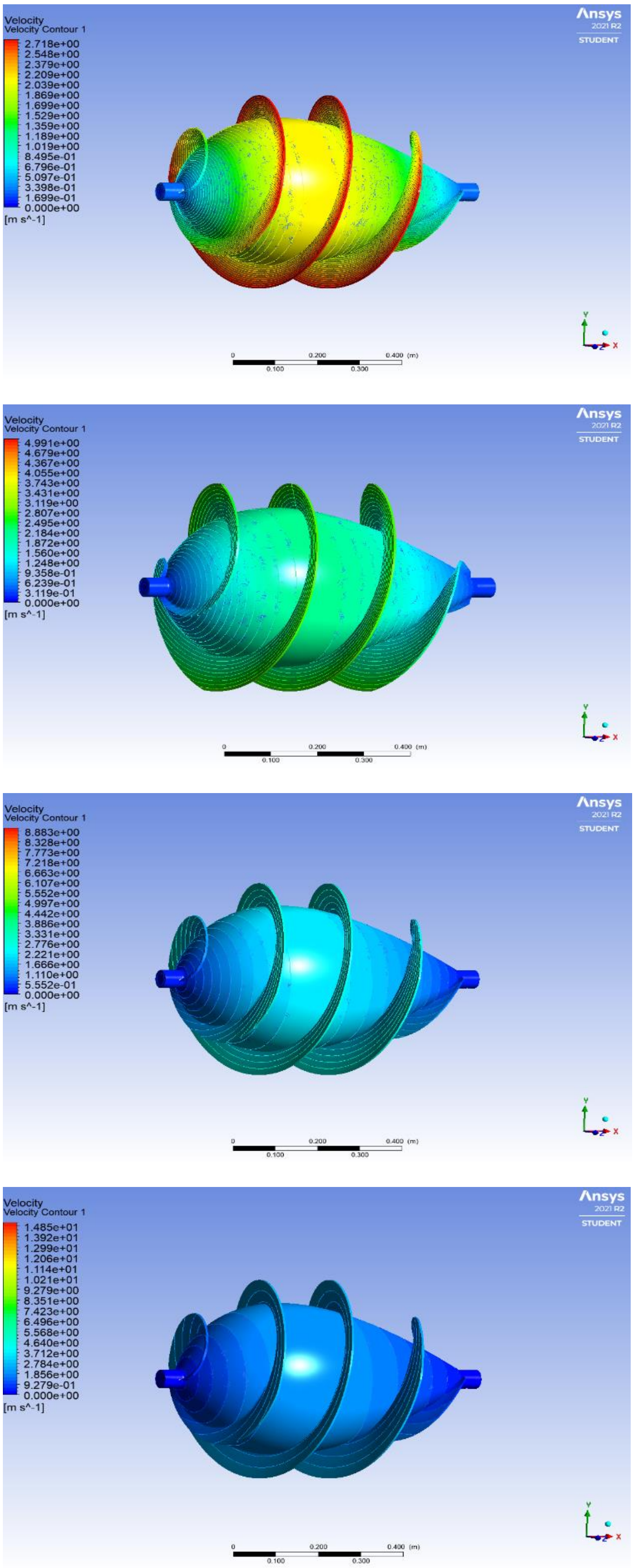

Figure 6 Velocity Contour at 1, 5, 9 and 15 ms-1

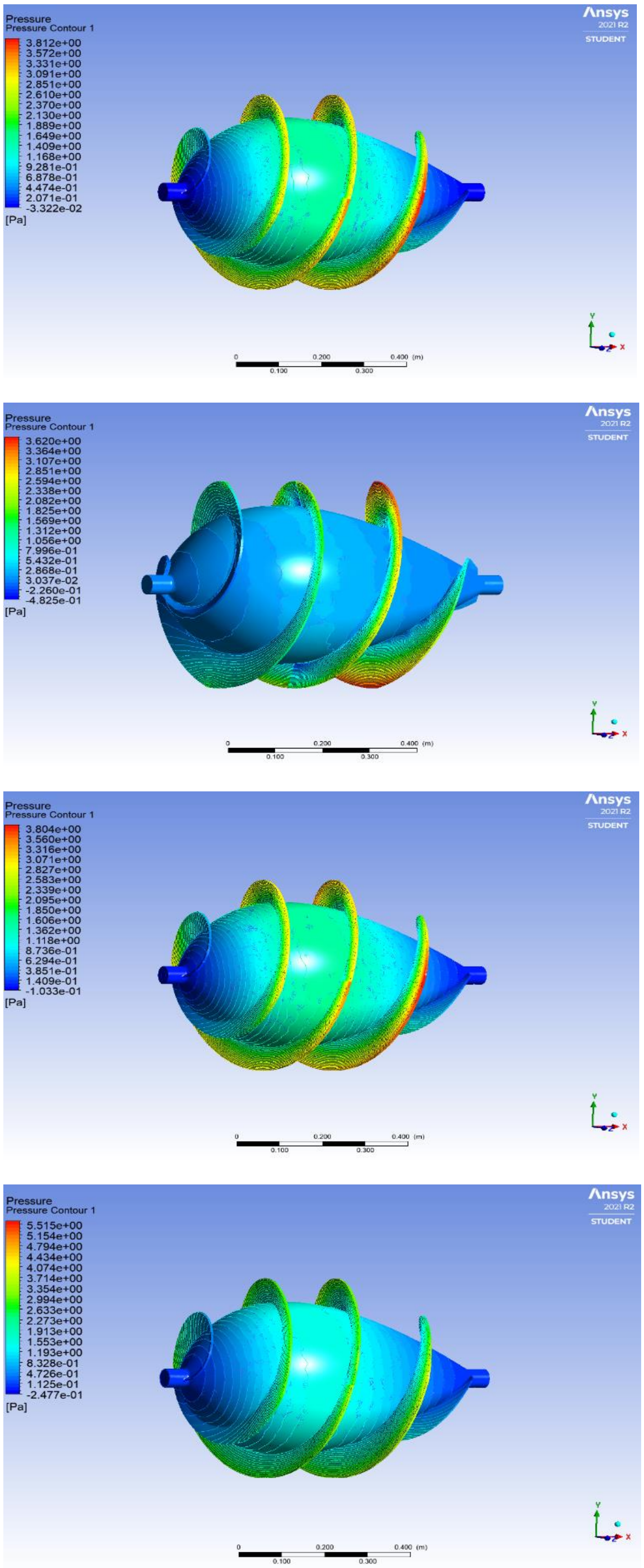

Figure 7 Pressure Contour at 1, 5, 9 and 15 Pa

6. CONCLUSIONS

To investigate the behavior wind turbine, CFD has been done on the Spiral Wind Turbine and at different wind and rotor speeds summarized as

1. Spiral wind turbine fairly increases the torque at a lower speed nearly 15 % than AWT which suggests it is more suitable for low and moderate wind speeds

2. It shows that power is that to perform of wind speed and style parameters of turbine blade

3. The Spiral wind turbine was able to extract more power than other wind turbines at lower and moderate speed

4. There is no need for electronic yawing equipment because use both lift and drag force which reduces the cost

5. According to the CFD results, Archimedes aero foil wind turbine looks getting more promising power than another wind turbine including Archimedes spiral wind turbine.

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