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Design and Analysis of Vertical Axis Wind Mill

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ABSTRACT

This project studied the potential for installing roof-mounted vertical wind turbine (VWAT) several types of VAWM, blades with the goal of maximizing the efficiency of a shrouded turbine. Vertical axis wind mill power generation equipment can be located at ground level, which makes for easy maintenance. Also, VAWM are Omni-dimensional, meaning they do not need to be pointed in the direction of wind to produce power. The main objective of our work is to design and analyse a self-starting vertical axis wind turbine by using CATIA & ANSYS. It was concluded that a profile with large lift at low speed used along with passive pitching could achieve self-starting status. As a result, three blade profile were tested and compared over the testing in the wind tunnel and the blade profile that offers the best performance for self-starting.
Keywords : VAWM, CATIA, ANSYS.

I. INTRODUCTION

The recent surge in fossils fuels prices, demands for cleaner energy sources, and government funding incentives, wind turbines are becoming a more available technology for electrical power generation. Fortunately there is an abundance amount of wind energy to be harnessed currently horizontal axis wind turbines dominate commercially over vertical axis wind turbines. However, (VAWT) do have some advantages over HAWT. The main objective of our work is to improve the output of wind power generation produce electric power using vertical axis wind turbine. Currently, horizontal axis wind turbine HAWT, dominate the wind energy market due to their large size and high power generation characteristics. However vertical axis wind mill is capable of producing a lot of power. The mechanical power generation equipment can be located at ground level, which makes for easy maintenance Alex Emanuel, et al (March 2007) says the implementation of an alternate configuration of wind turbine for a power generation purpose.

Figure 1. Vertical Axis Wind Mill

II. LITERATURE REVIEW

Madhura Yeligeti et.al.(April-2016): On performing stress analysis, both rotors shows considerably safe results. This analysis can be succeeded by fatigue and vibration analysis in future [1]. B. Bittumon et.al.(April-2014): The rotors were designed harnessed enough air to rotate the stator at low and high wind speeds while, keeping the centre of mass closer to the base yielding stability. In this system it originate that it functioned properly but there is a limited power output [2].

III. DESIGN OF VERTICAL AXIS WIND MILL

3.I. Introduction to CATIA

CATIA (COMPUTER AIDED THREE-DIMENSIONAL INTERACTIVE APPLICATION) is a multiple form CAD/CAM/CAE commercial software suite developed by French company **Dassault systems**. The software was created in late 1970s to develop Dassault's Mirage fighter jet, but was subsequently adapted in aerospace, automotive ship building, and other industries.

3.II. MODELLNG OF WIND TURBINE IN CATIA

Tools used in modelling of wind turbine

a) Sketch
b) Line
c) Constrain toolbar
d) Sweep
e) Split
f) Join
g) Trim

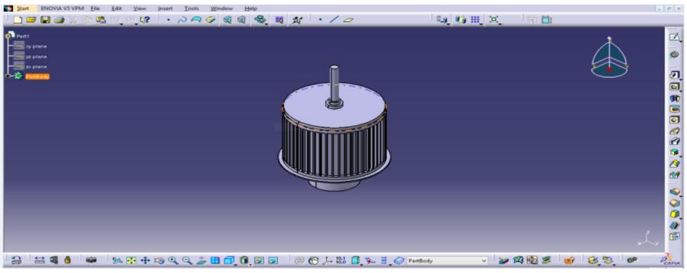

Fig.2: Fixed support (or) Base of VAWM

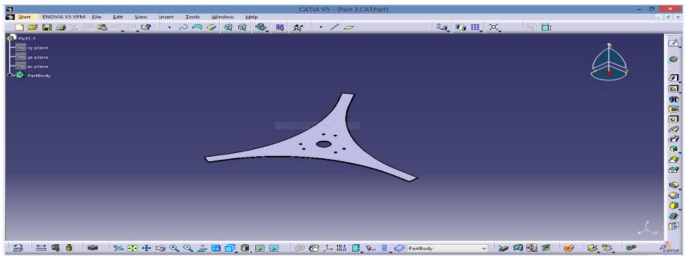

Fig.3 Support Plate

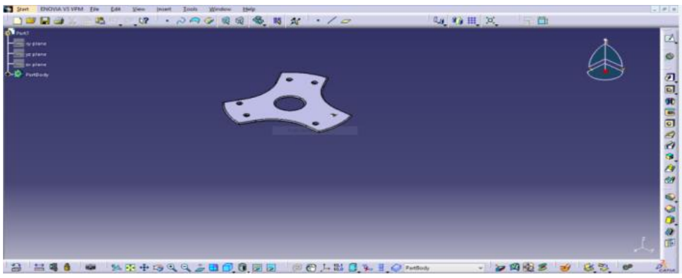

Fig.4 Spoke

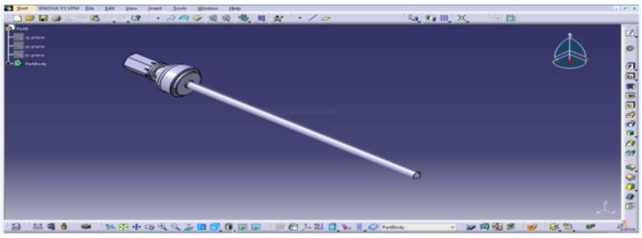

Fig.5 Main Shaft

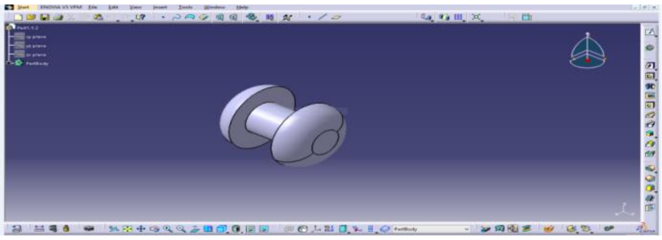

Fig.6 Stud

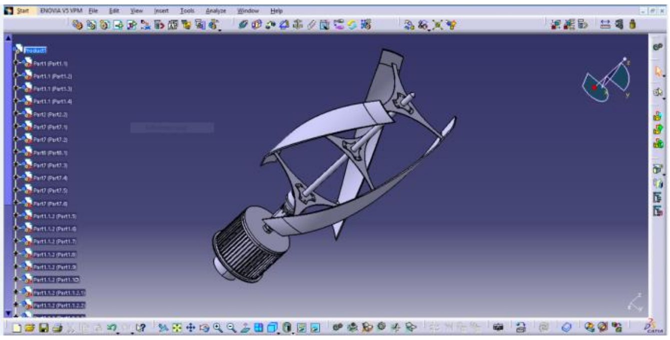

Fig.7 Final Assembly

3.3 CATIA Drafting Files:

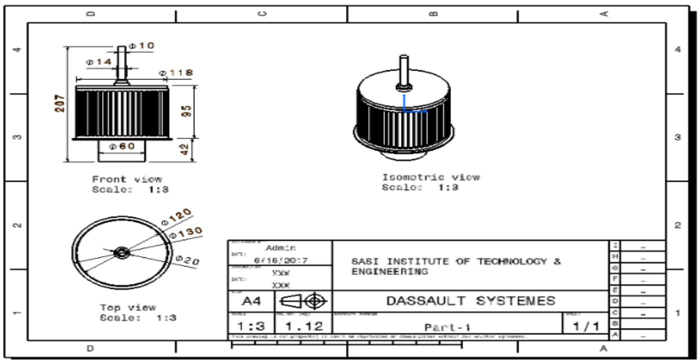

Fig.8 Part 1 detailed drafting

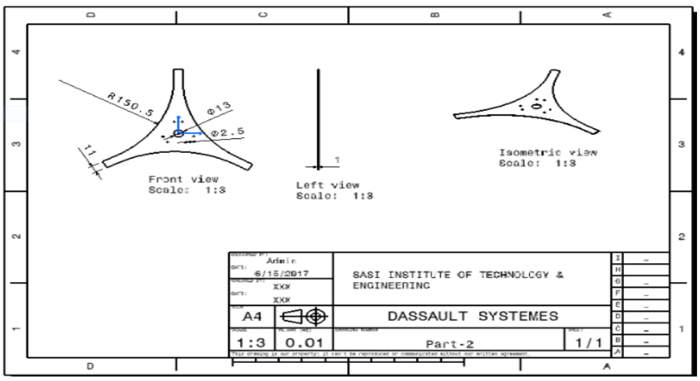

Fig.9 Part 2 details

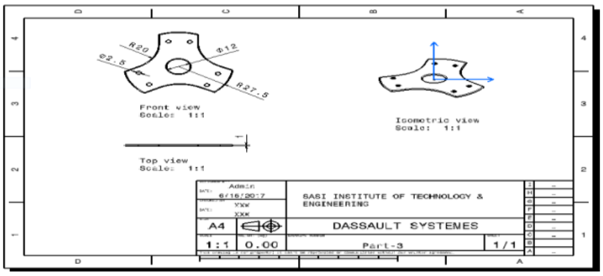

Fig.10 Part 3 details

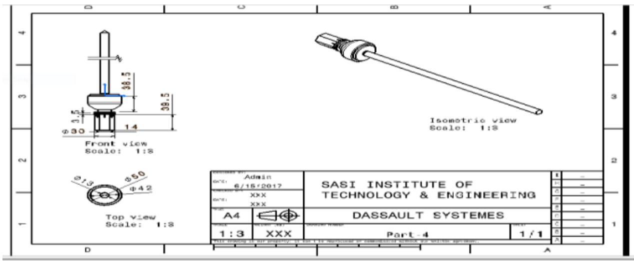

Fig.11 Part 4 details

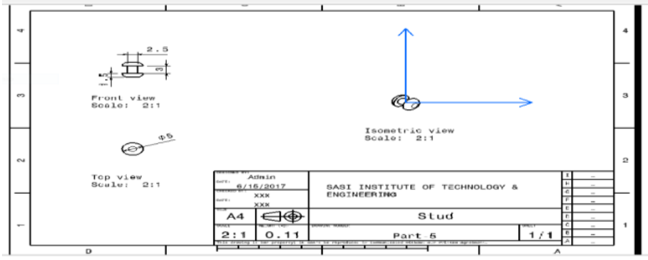

Fig.12 Part 5 details

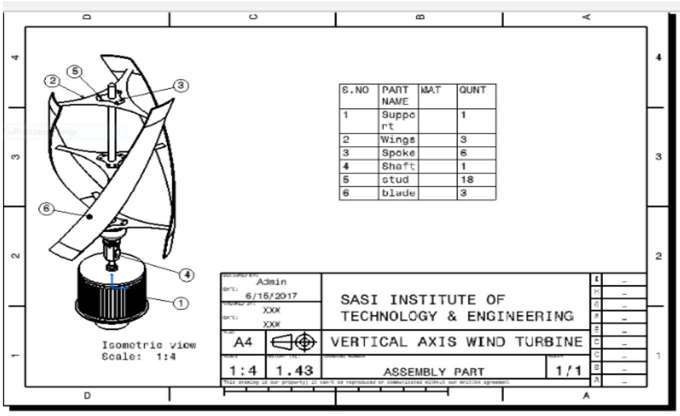

Fig.13 Assembly Drawing details

IV. ANALYSIS OF VAWM

Ansys is general purpose finite element analysis (FEA) software package. Finite element numerical method of a deconstructing a complex system into very small pieces (user designated size) called element. The software implements equations that governs the behaviour of these elements and solver them all; creating a comprehensive explanation of how the system acts as a whole. These results than can be presented in tabulate or graphical forms. This type of analysis is typically used for the designed and optimization of system for too complex to analyse by hand. Systems that make fir into this category are too complex due to their geometry, or governing equations.

- ✓ **STRUCTURAL AND STATIC ANALYSIS OF SUPPORT PLATE**

Engineering data:

For Structural Steel

Young's Modulus –2E11 Pa

Density - 7850 kg/m^3

Poisons ratio - 0.3

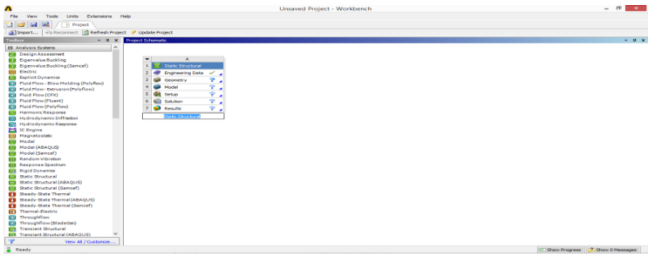

Fig.13 ANSYS workbench Introduction

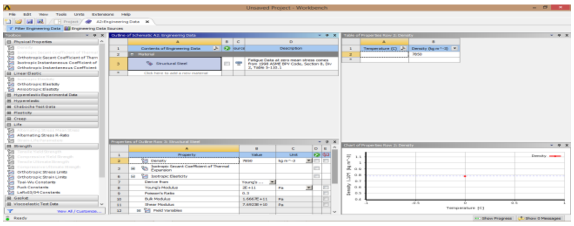

Fig.14 ANSYS Settings

- ✓ **IMPORT THE GEOMETRY FROM CATIA:**

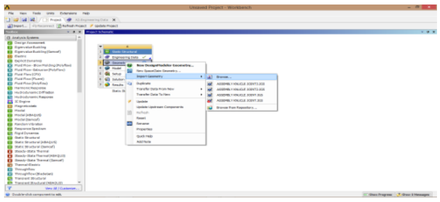

Fig.15 Importing Geometry

V. RESULTS

The following results are obtained by structural analysis,

1. Mesh
2. Total deformation
3. Von- misses equivalent stress
4. Maximum principal stress
5. Minimum principal stress
6. Safety factor
7. Damage
8. Life

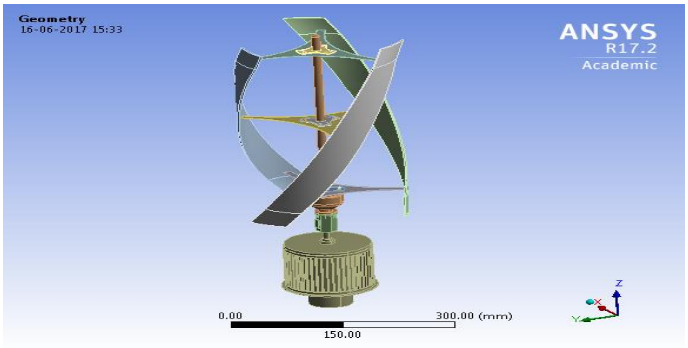

Fig.16 Meshing

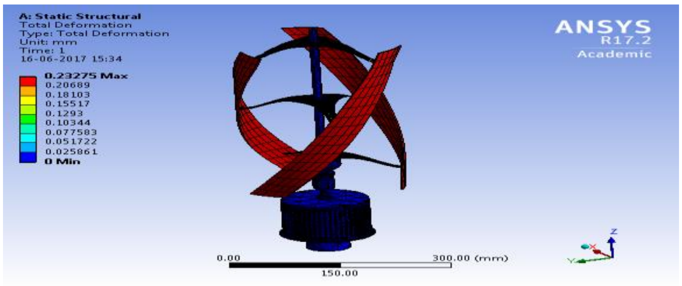

Fig.17 Total Deformation

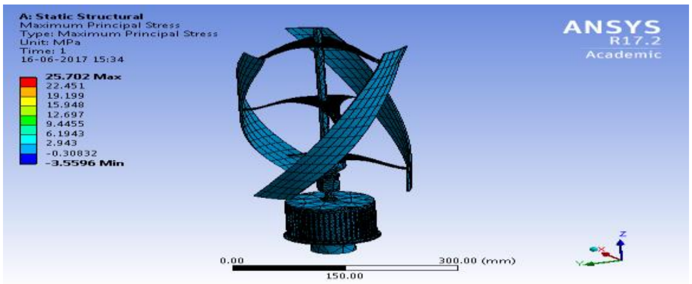

Fig.18 Maximum Principle Stress

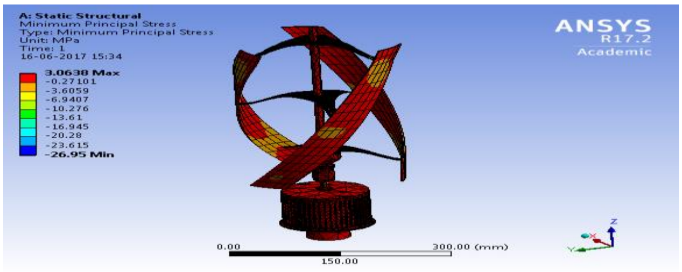

Fig.19 Minimum Principal Stress

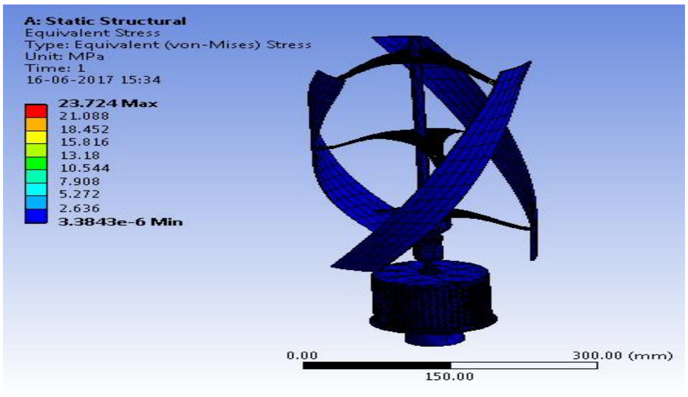

Fig. 20 Equivalent Stress

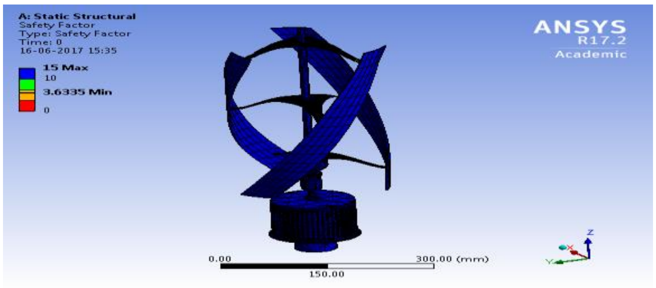

Fig.21 Safety Factor

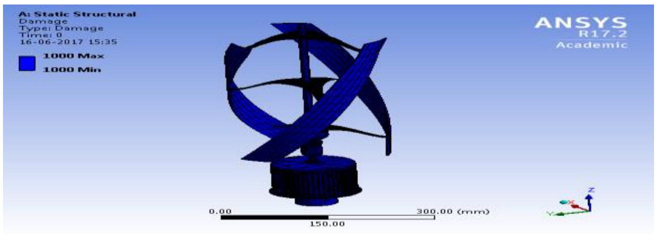

Fig.22 Damage

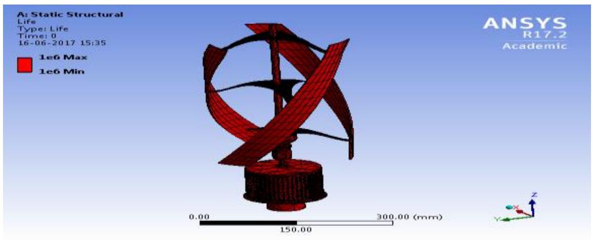

Fig.23 Life

VI. CONCLUSION:

Familiarized with designing tool CATIA (sketcher, part assembly, drafting), analysis method ANSYS (Mechanical APDL, ANSYS workbench). Successfully completed designing components of WIND MILL and assembling them by CATIA, performed structural analysis on SUPPORT BASE using ANSYS.

VII. REFERENCES

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[2]. Madhura Yeligeti, Ganesh Shete, Prateek Tade , Prof. Sachin Vankar, "Design and Analysis of Vertical Axis Wind Turbine Blades for Street Lighting ", "International Journal of Emerging Trends in Engineering Research ", Volume 4, No.4 April 2016.