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CFD ANALYSIS OF COMPOSITE RADIATOR FAN WITH THREE, FOUR AND SIX BLADES

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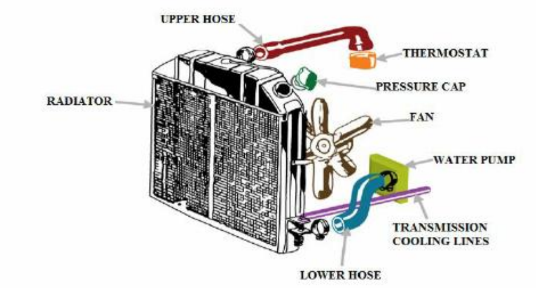
ABSTRACT

In this paper, an axial flow fan is to be designed and modeled in 3D modeling software Pro/Engineer.In this Paper CFD analysis with the number of blades are changed to 3,4 and 6 is performed. Theoretical calculations are done to determine the blade dimensions, The design is to be changed to increase the efficiency of the fan and analysis is to be done on the fan by changing the no.of blades(3,4,6), angle of blade (30^0,45^0,60^0) and speed of fan(750,1250,1750 rpm) for flow velocity and discharge. Analysis is done in finite element analysis ANSYS.

Keywords : Composite Material ,Radiator Fan, CFD Analysis.

I. INTRODUCTION

The radiator fan is a device, which sucks the atmospheric air through the radiator panels and expels it to the atmosphere to cool the engine coolant after discharge from the engine and maintains an acceptable operating temperature by transferring heat from the engine to the atmospheric air. The cooling fan is part of the cooling system and their design to keep a cooler temperature in the engine.



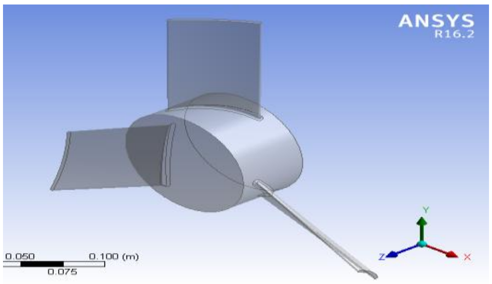
The Radiator performs the function of cooling, the coolant which has passed through the water jacket and becomes hot and is mounted in front of the vehicle. The radiator consists of an upper tank and lower tank, and a core which connects the two tanks [1]. The upper tank contains an inlet for coolant from the water jacket and a filler inlet. It also has a hose through which excess coolant can flow. The lower tank has an outlet and drain cock for the coolant. The core contains many tubes and cooling fins through which coolant flows from the upper tank to the lower tank so that coolant has been heated up as it passes through the water jacket is cooled by the air sucked through the radiator by the cooling fan.

Till the various researches done on the materials of the radiator fan. Such as material used for the fan are aluminum, FRP but due to the various problem occurred in the materials it was failed. The axial flow fans are conventionally designed with impellers made of aluminum or mild steel. The grey area today is the inconsistency in proper aerofoil selection & dimensional stability of the metallic impellers. This leads to high power consumption & high noise levels with lesser efficiency. In the present work, we use the glass fiber epoxy material for the manufacture cooling fan. The design is to be changed to increase the efficiency of the fan and analysis is to be done on the fan by changing the no.of blades(3,4,6), angle of blade (30^0,45^0,60^0) and speed of fan(750,1250,1750 rpm) for flow velocity and discharge.

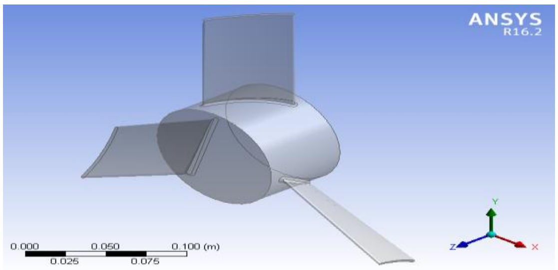
II.FINITE ELEMENT ANALYSIS- CFD

2.1 CAD Model

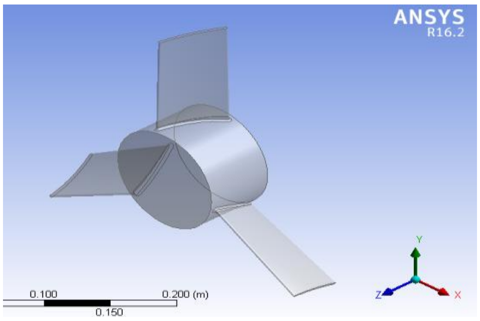
2.1.1 3 BLADE 30 DEG.



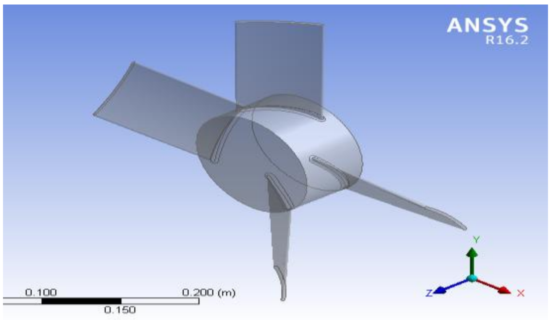
2.1.2 3 BLADE 45 DEG.



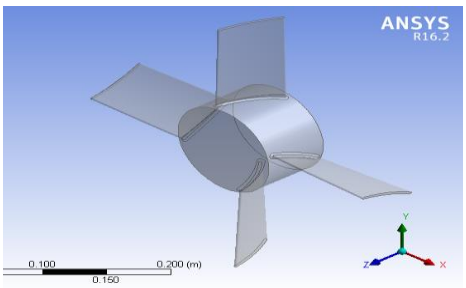
2.1.3 3 BLADE 60 DEG.



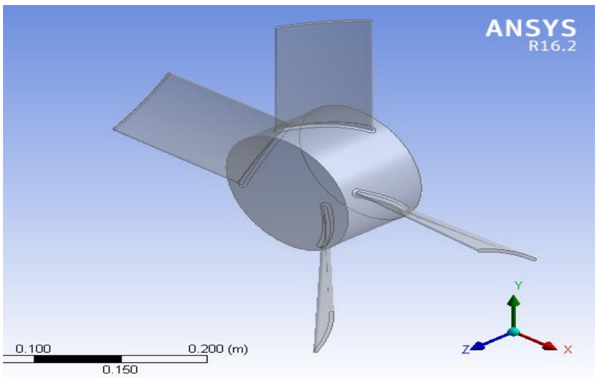
2.1.4. 4 BLADE 30 DEG.



2.1.5 4 BLADE 45 DEG.



2.1.6 4 BLADE 60 DEG.



2.1.7 6 BLADE 30 DEG.

2.1.8. 6 BLADE 45 DEG.

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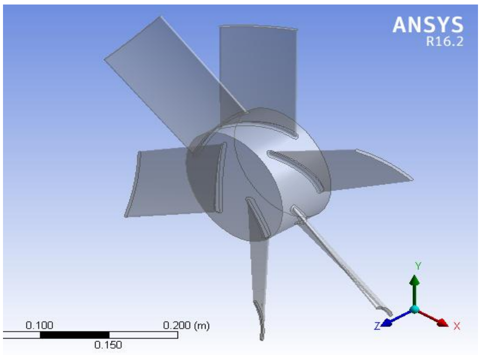
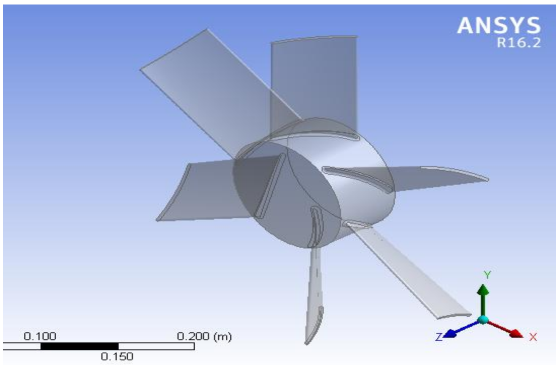
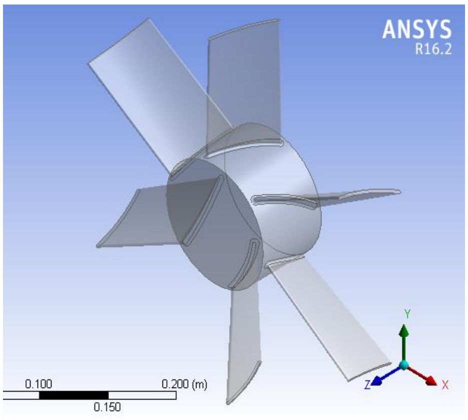
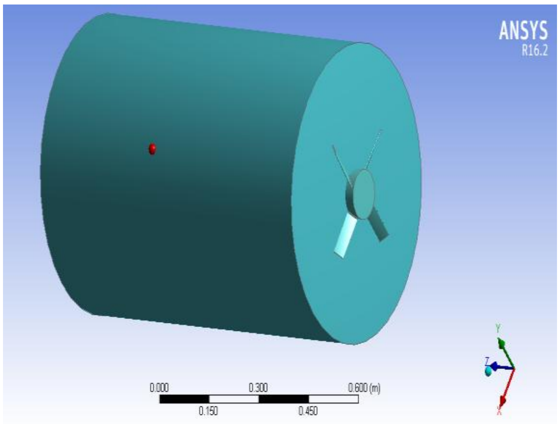


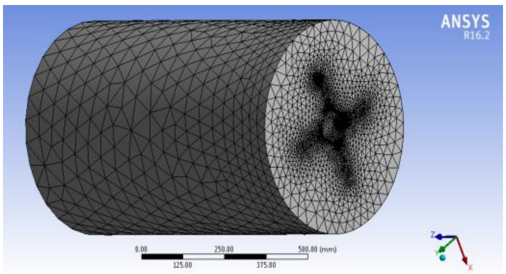


2.1 .9. 6 BLADE 60 DEG.



2.1 .10. MESH MODEL





Details of "Mesh"	
⊞ Patch Conforming Options	
⊞ Patch Independent Options	
⊞ Advanced	
⊞ Defeaturing	
⊟ Statistics	
Nodes	122980
Elements	679187
Mesh Metric	None

2.1.11. DETAILS OF MESH

Supported 3D elements (TETRA_4, PYRA_5, PENTA_6 and HEXA_8).

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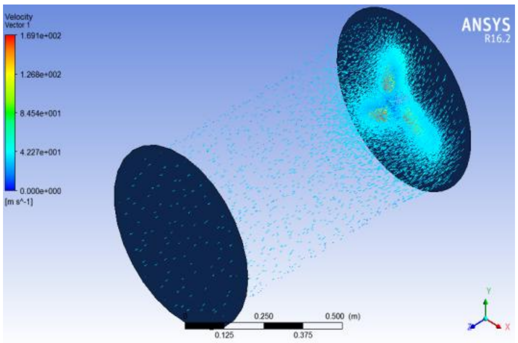
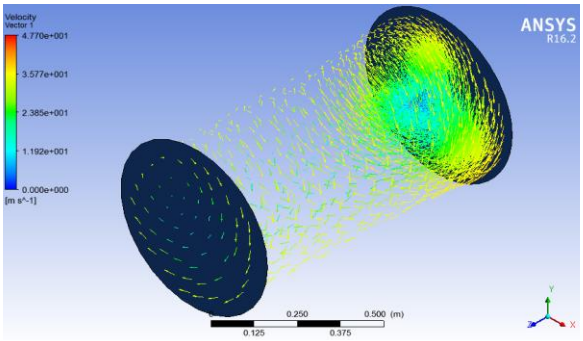
2.2 FEA-CFD Results

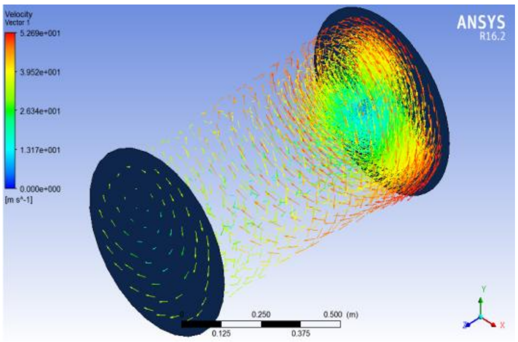
2.2.1 3 Blade 30Deg. 750RPM



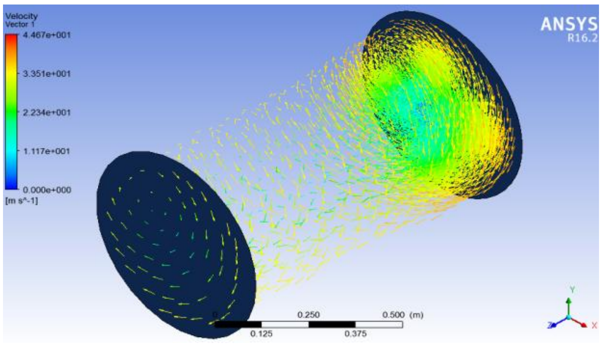
2.2.2 3 Blade 45Deg. 1250RPM



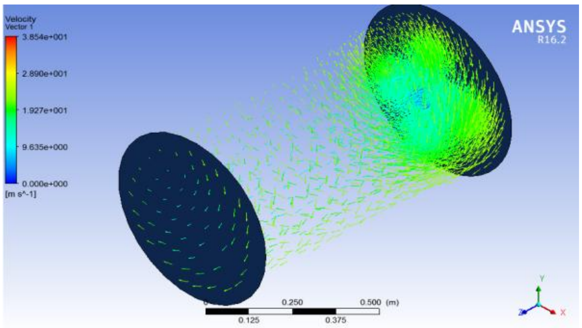
2.2.2 3 Blade 60Deg. 1750RPM



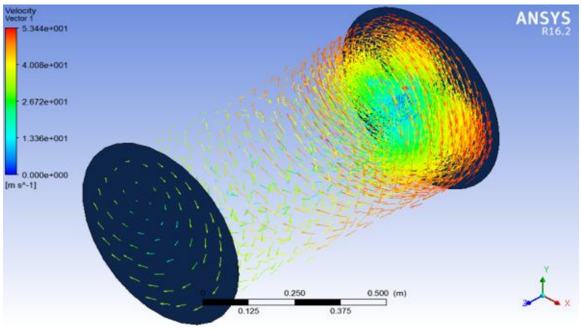
2.2.3 4 Blade 30Deg. 1250 RPM



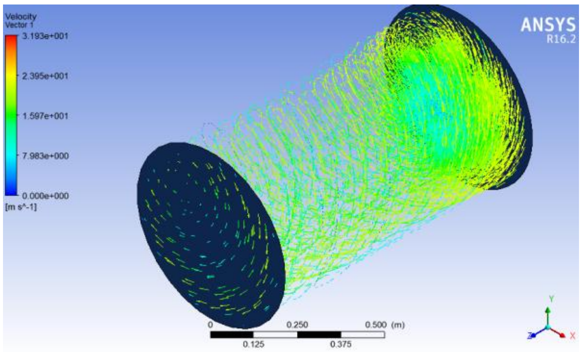
2.2.5 4 Blade 45 deg. 750 rpm



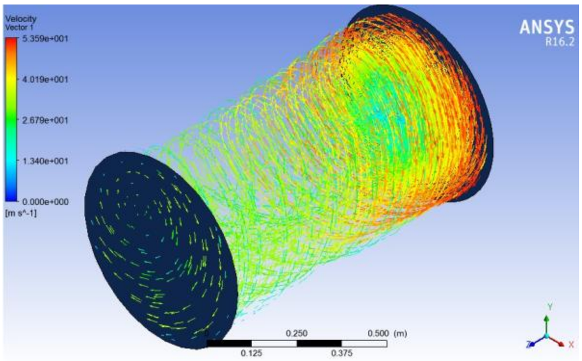
2.2.6 4Blade 60Deg. 1750 RPM



2.2.7 6 Blade 30Deg. 750 RPM



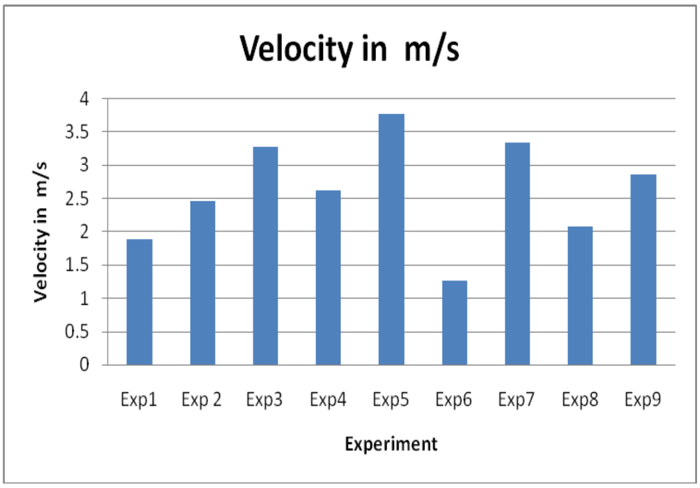
2.2.8 6 Blade 45Deg. 1250 RPM



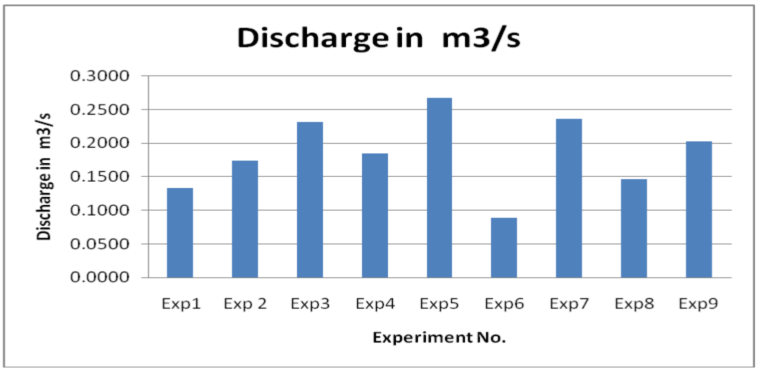
FEA Result Table

	No. Blade	Angle(^{0})	Speed (RPM)	Velocity (m/s)	Discharge Q(m3/s)
EXP 1	3	30	750	1.89	0.1335
EXP 2	3	45	1250	2.47	0.1745
EXP 3	3	60	1750	3.28	0.2317
EXP 4	4	30	1250	2.62	0.1851
EXP 5	4	45	1750	3.78	0.2671
EXP 6	4	60	750	1.26	0.0890
EXP 7	6	30	1750	3.34	0.2360
EXP 8	6	45	750	2.08	0.1470
EXP 9	6	60	1250	2.87	0.2028

Table 9.1 FEA Result Table



2.2 .10 Fig. Bar chart Velocity



2.2 .11 Fig. Bar chart Discharge

III. CONCLUSION

- The design of Composite radiator fan and its CFD numerical modeling technique proves to be very useful in initiating further and more comprehensive numerical study of the engine cooling system which is currently in progress.
- In this paper, investigations on the effect of radiator fan parameters on performance has been presented thorough experiments and CFD simulations has been presented
- CFD results were presented in the form of velocity streamlines; it provides actual flow characteristic air around the fan for different number of fan blades and fan angles.
- According to FEA results in Experiment no. 5 (Combination: No. of Blade 4, Blade Angle 45^0, Speed of Fan 1750 RPM) give the high airflow velocity of 3.40 m/s and calculated discharge of 0.24 m3/s.
- The study revealed that a fan with an optimum number of four fan blades gives maximum velocity of 3.78m/s (By FEA) Also blade tilting angle of 45^0 gives remarkable effect on flow velocity.

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