Finite Element Analysis of Blower Impeller with Different Materials by ANSYS and CFD

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Abstract— In the present work, the numerical investigation of blower on single-cylinder, four stroke diesel engine has been carried out further modified by turbocharged, supercharged and combination of super-turbocharged engine.
In this regards blower is modeled and analyzed in catia and ANSYS software with different materials. Also the flow characteristics is studied and identified by CFD software.
Through the installed blower increase in brake power, volumetric efficiency increases and ultimately increases loading capacity of the vehicle. To analyzed the 3-D flow field with the CFD tool. The flow is analyzed at different angular and axial positions. The analysis results was compared with different materials such as structural steel, aluminum, glass fiber reinforced polymer.

Keywords- *Blower Impeller , structural steel, aluminum, glass fiber reinforced polymer , ANSYS , CFD*

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I. INTRODUCTION

There are two basic types of air moving devices: the centrifugal fan or blower, and the axial flow fan. The centrifugal fan creates higher pressures than that of the axial flow fan and is applied on jobs with higher resistance to their flow. Centrifugal Blower consists of impeller withsmall blades on the circumference, a shroud to direct and control the air flow into the center of the impeller and out at the periphery.

The blades move the air by centrifugal force and throwing it out, thus creating suction inside the impeller and suction duct.. The pressure rise and flow rate in centrifugal blowers depend on the peripheral speed of impeller and blade angles. The stage losses and performance also vary with the blade geometry. To reduce the variables, all variables related to turbo machines are identified and grouped into non dimensional quantities. Thus, the dimensionless parameters are varied instead of large number of variables in design and performance test.

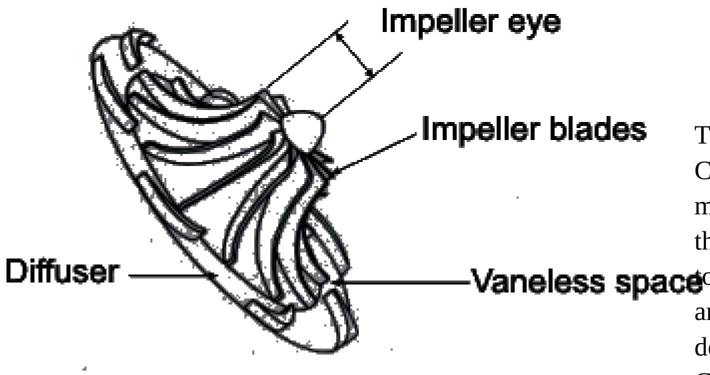


Figure1. A rotating impeller

II. MATERIAL PROPERTIES

A. Aluminimum (AL-360)
- Density-2650 kg/m^3
- Young's modulus-6.85e+010 Pa
- Poisson's ratio-0.33
- Bulk modulus-6.7157e+010 pa
- Shear modulus: 2.5752e+010 pa

B. Structural steel
- Density-7850 kg/m^3
- Young's modulus-2.e+0.11 pa
- Poisson's ratio-0.3
- Bulk modulus-1.6667e+011 pa
- Shear modulus: 7.6923e+010 pa

C. Glass fiber reinforced polymer material
- Density-2000 kg/m^3
- Young's modulus-1.5e+010 pa
- Poisson's ratio-0.21
- Bulk modulus-8.6207e+009 pa
- Shear modulus: 6.1983e+009 pa

III. MODELING

The modeling of blower impeller has been carried out by using CATIA-V5 software. Modeling is a pre-processor tool, the modeling of crankshaft is created by using the Computer aided three-dimensional interactive application (Catia) V5 software tool. Catia helps us to draw and assemble various parts. There are various platform and workbench features are available to design blower impeller. Main workbenches available in CATIA are part workbench, wire frame workbench, surface design, assembly design and drafting workbench etc. A feature is defined as the smallest building that can be modified individually/ block. The different workbenches designs are saved in CATIA are sketcher, part design, wire frame and surface design. The reason for selecting CATIA software, user tool makes it possible for mechanical designers to create quickly. Sketch required ideas.

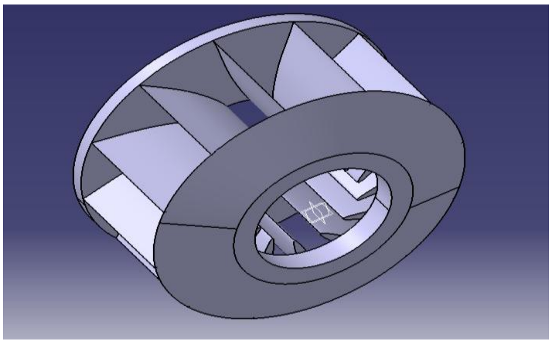


Figure2. Impeller Model

IV. STATIC STRUCTURAL ANALYSIS

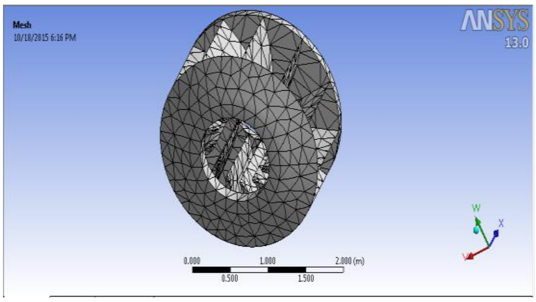


Figure 3. Meshing Creates Tetrahedral Mesh Elements

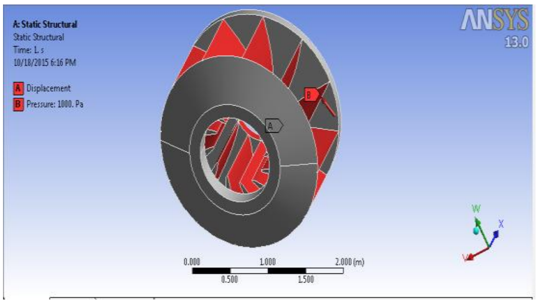
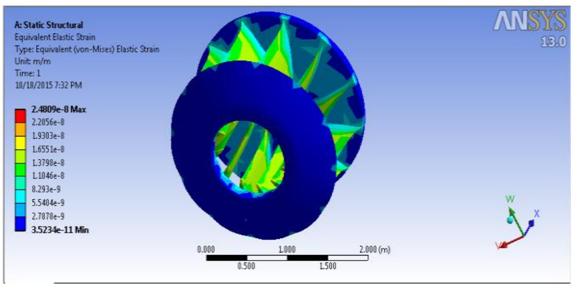
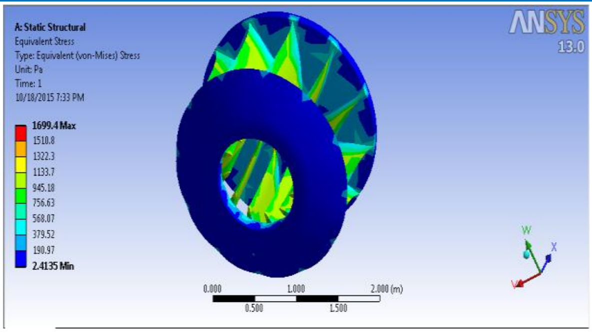


Figure 4. Boundary Conditions

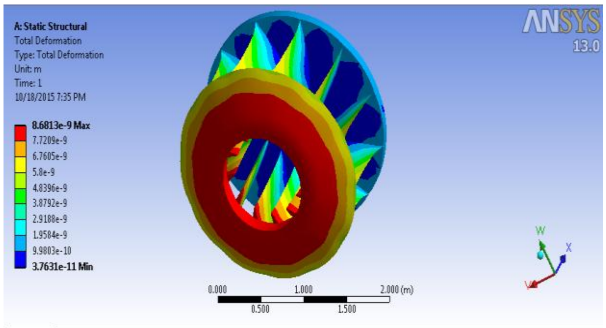
ALMINIMUM-(360)



The maximum strain occurs at the blower impeller is 2.4809e^{-8} Mpa and minimum strain occurs in 3.5234e $^{-11}$Mpa.

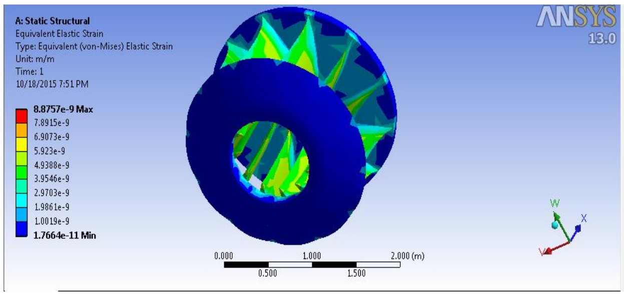


The maximum stress occurs at the blower impeller is 1699.4 Mpa and minimum stress occurs in 2.4135Mpa.

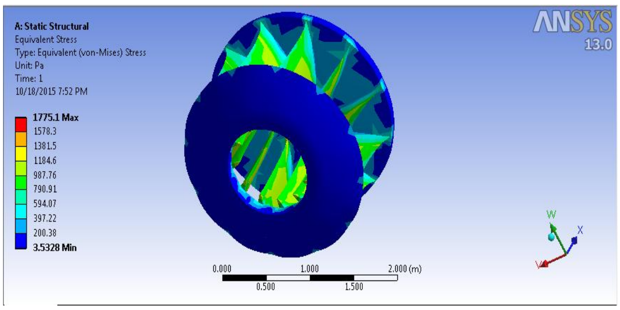


The maximum deformation occurs in the blower impeller is 8.6813e^{-9}mpa and the minimum deformation occurs in 3.7631e $^{-11}$ mpa .

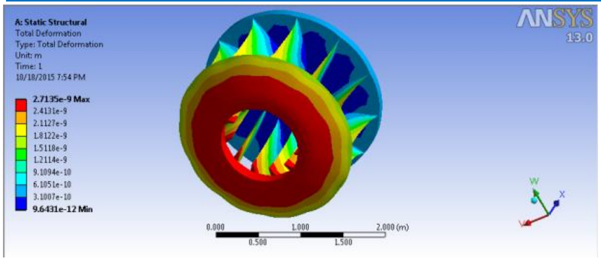
STRUCTURAL STEEL



The maximum von-mises strain induced in the blower impeller area is 8.8757e^{-9}Mpa and the minimum strain is 1.76646e $^{-11}$Mpa.

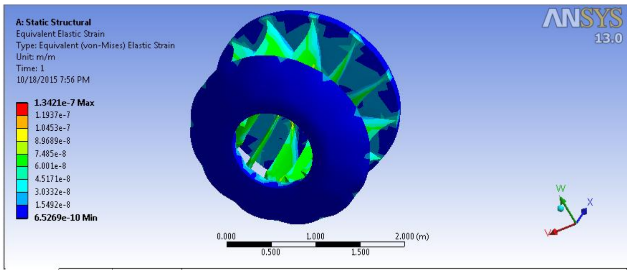


The maximum von-mises stress induced in the blower impeller area is 1775.1Mpa and the minimum stress is 3.5328Mpa.

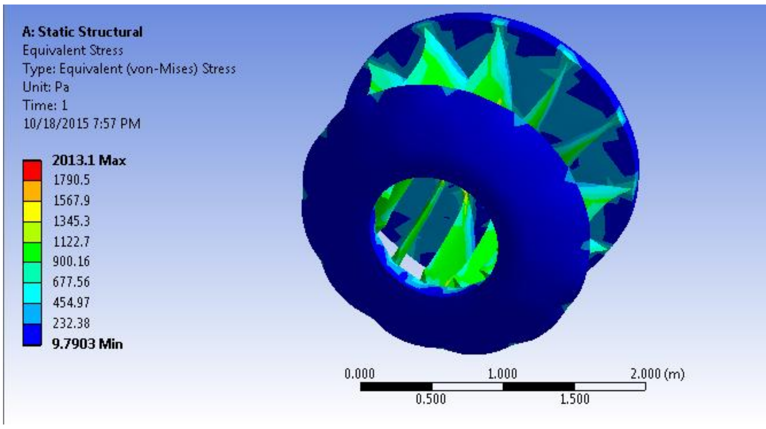


The maximum deformation occurs in the blower impeller is $2.7135e^{-9}$mpa and the minimum deformation occurs in $9.6431e^{-12}$ mpa .

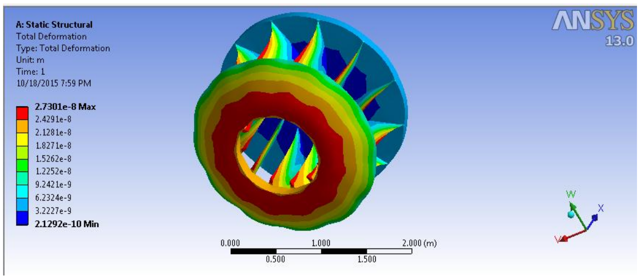
GLASS FIBER REINFORCED POYMER



The maximum von-mises strain induced in the blower impeller area is 1.3421e $^{-7}$ Mpa and the minimum strain is 6.5269e $^{-10}$ Mpa.

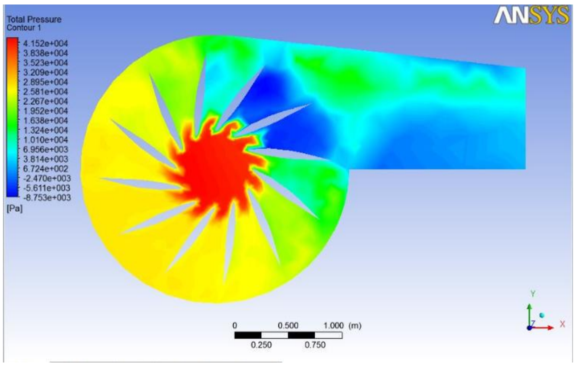


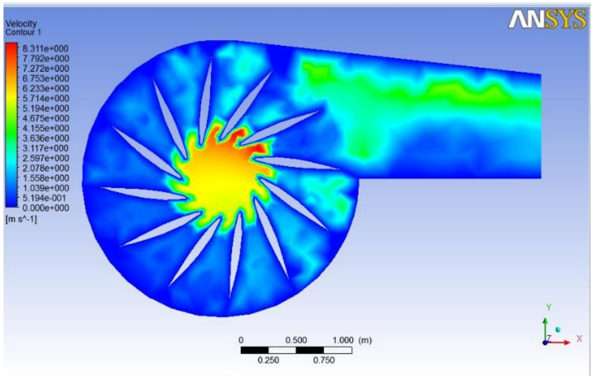
The maximum von-mises stress induced in the blower impeller area is 2013.1Mpa and the minimum stress is 9.7903Mpa**.**

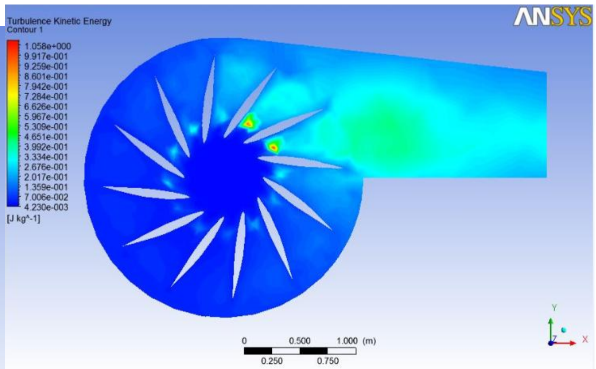


The maximum deformation occurs in the blower impeller is $2.7301e^{-10}$mpa and the minimum deformation occurs in $2.1292e^{-10}$ mpa

V. CFD RESULTS







VI. CONCLUSION

From the obtained analysis results in papers reviewed, the effects of engine blower on the engine performance can be summarized. The numerical results have proven that the performance of downsized engines can match that of their larger counterparts, with the aid of intake boosting by the engine blower. Also from the obtained numerical results it was found the suitable proposed material for engine blower is aluminium. Because of its versatile properties and costs. Also which is a optimized materials than the other conventional materilas like steel and GFRP. From the obtained numerical results it is found that the gfrp material also suitable for the application of GFRP.

The aluminiummaterial having lesser deformation when compared with gfrp.

Also the flow characterization of the engine blower was analysed with above said materials. When compare the other conventional materials like structural steel, aluminum, gfrp was to having better flow rate .In general for structural application, the glass fiber is most suitable materials. Finally it was concluded that, the suitable material for blower is glass fiber reinforced polymer

REFERENCES

[1] JSME, "Data Handbook of Heat Transfer Engineering," JSME1971
[2] Siward Cheng, I Du, Jose A. Restrepo, Pinjia Zhang and Thomas G. Habetler, "Power Electronics" IEEE Trans. On volume: PP, Issue: 99 2012, Page(S) 1-1
[3] Walter J and Konstanty, "DC Motor Cooling Considerations" (PPIC) 2011, page(s): 159 – 162
[4] Paul Buckley, H. Hawkeye King, Marta Wang and Blake Hannaford, (WHC) IEEE 2011, page(s): 143 – 148
[5] M. Aniblal Valenzuela and Guillermo Ramirez, "Industrial Application" IEEE trans. Volume: 47, Issue: 2, 2011, page(s) 719 – 729
[6] Ye Zhen-nan, Luo Wei-dong, Zhang Wen-ming and Feng Zhi-xiang, "Electric Information and Control Engineering" 2011, Page(s): 746 – 749
[7] Boglietti, A. Cavagnino, A. Staton, D.A. Popescu, "Power Applications" IET, 2011, 5 (2), 203 – 209.
[8] Guzzella, L., Wenger, U., and Martin, R., "IC-Engine Downsizing and Pressure- Wave Supercharging for Fuel Economy", SAE Technical Paper 2000-01-1019, 2000, doi: 10.4271/2000-01-1019.