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Thermal Analysis of Turbocharger by Varying Materials

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ABSTRACT:

A turbocharger is a turbine driven forced induction device used to allow more power to be produced by an engine of a given size. A turbocharged engine can be more powerful and efficient than a naturally aspirated engine because the turbine forces more air, and proportionately more fuel, into the combustion chamber than atmospheric pressure alone.

Turbo charging increases the power output from reciprocating engines by utilizing the waste energy in the exhaust gases. The exhaust gases drive a turbine, connected via a shaft to a compressor, which pressurizes the air at the engine inlet thus allowing more fuel to be burned for the same air/fuel ratio. The exhaust from the cylinders passes through the turbine blades, causing the turbine to spin. The more exhaust that goes through the blades, the faster they spin. On the other end of the shaft that the turbine is attached to, the compressor pumps air into the cylinders. The compressor is a type of centrifugal pump it draws air in at the center of its blades and flings it outward as it spins.

Turbochargers allow an engine to burn more fuel and air by packing more into the existing cylinders. The typical boost provided by a turbocharger is 41.368 kpa to 55.158kpa since normal atmospheric pressure is 101.353kpa at sea level the engine is getting about 50 percent more air. Therefore, 50 percent of more power is expected in the engine. It's not perfectly efficient, so 30- to 40 percent improvement instead is expected.

In this project, a turbo charger used in a car is designed and modeled in 3D modeling software Catia V5. CFD analysis is to be done on the turbo charger with turbine and compressor in a assembly. Heat transfer analysis is to be done on the turbo charger by changing the materials of the turbine blade by assuming car is running at higher speeds. Analysis is to be carried in Ansys.

I. INTRODUCTION

A turbocharger or turbo is a turbine-driven forced induction device that increases an internal combustion engine's efficiency and power output by forcing extra air into the combustion chamber. This improvement over a naturally aspirated engine's output results because the turbine can force more air, and proportionately more fuel, into the combustion chamber than atmospheric pressure alone.

Turbochargers were originally known as turbo superchargers when all forced induction devices were classified as superchargers. Nowadays the term "supercharger" is usually applied only to mechanically driven forced induction devices. The key difference between a turbocharger and a conventional supercharger is that a supercharger is mechanically driven by the engine, often through a belt connected to the crankshaft, whereas a turbocharger is powered by a turbine driven by the engine's exhaust gas. Compared to a mechanically driven supercharger, turbochargers tend to be more efficient, but less responsive. Twin charger refers to an engine with both a supercharger and a turbocharger.

Turbochargers are commonly used on truck, car, train, aircraft, and construction equipment engines. They are most often used with Otto cycle and Diesel cycle internal combustion engines. They have also been found useful in automotive fuel cells.

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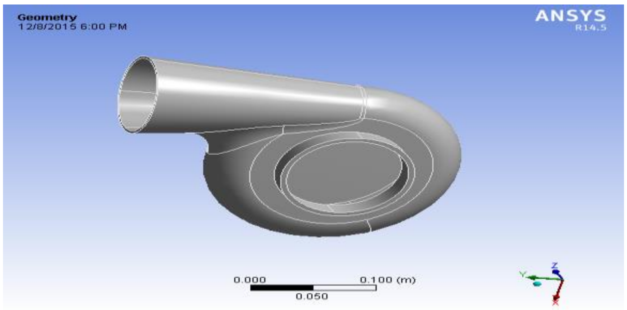
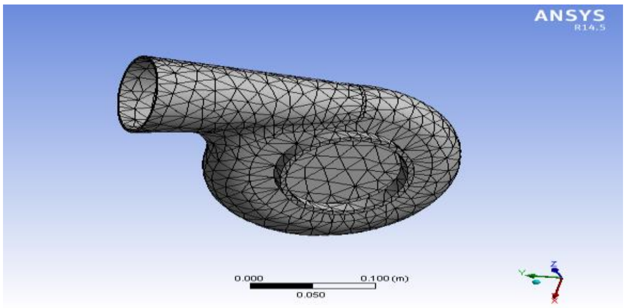
STEADY STATE THERMAL ANALYSIS OF TURBO CHARGER MADE UP OF ALUMINIUM IMPORTED GEOMETRY



MESHED GEOMETRY



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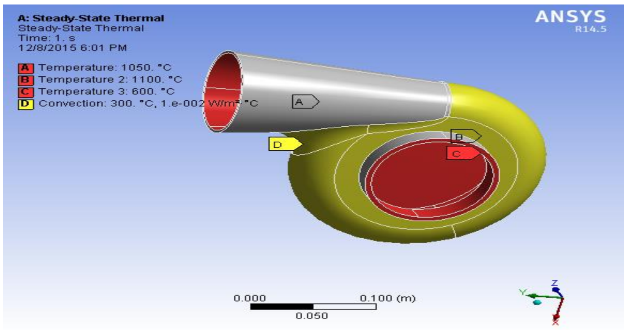
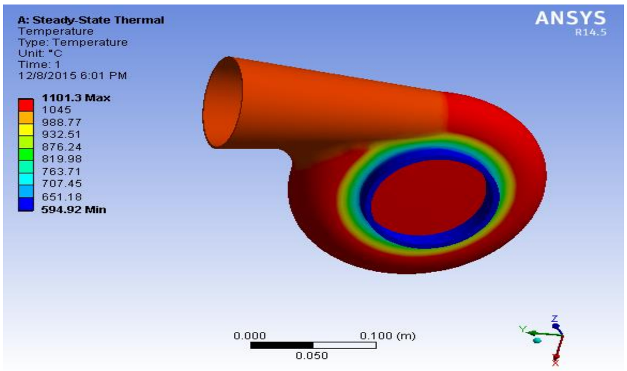
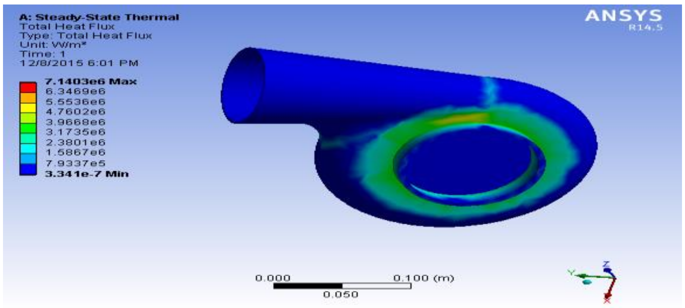


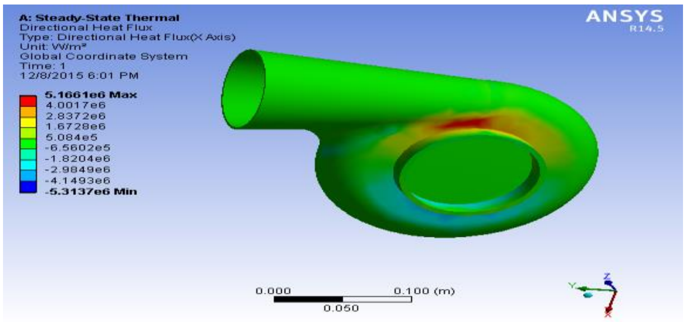
TEMPERATURE VARIATIONS



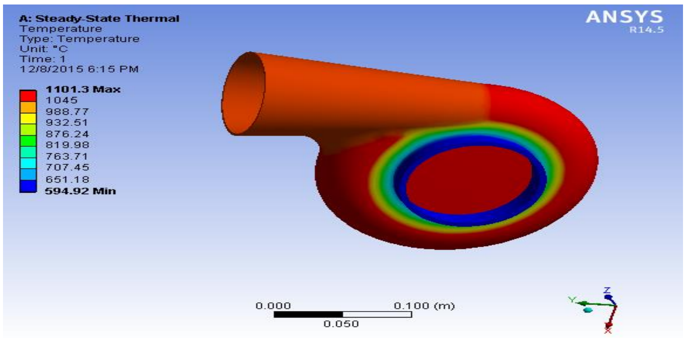
TOTAL HEAT FLUX



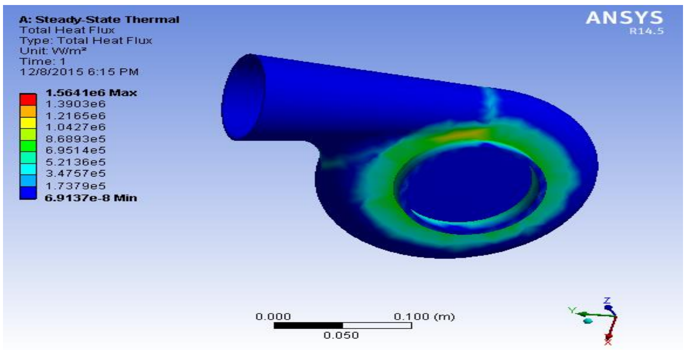
DIRECTIONAL HEAT FLUX



STEADY STATE THERMAL ANALYSIS OF TURBO CHARGER MADE UP OF CAST IRON TEMPERATURE VARIATIONS



THERMAL FLUXES



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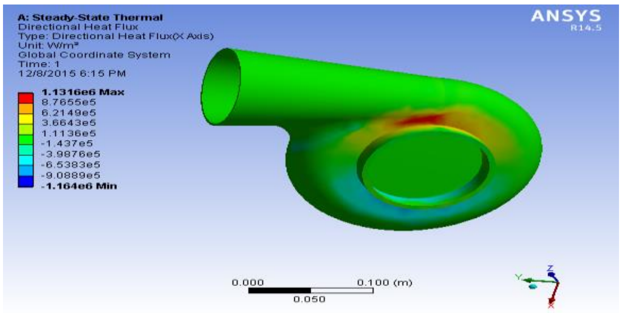
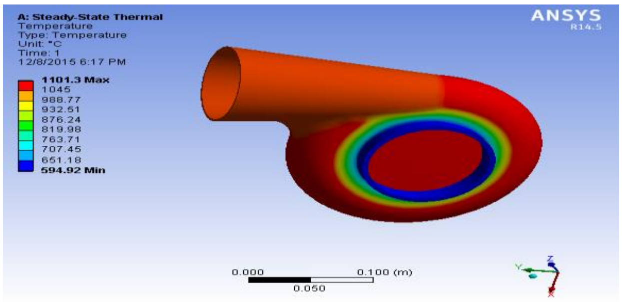
DIRECTIONAL HEAT FLUX



STEADY STATE THERMAL ANALYSIS OF TURBO CHARGER MADE UP OF NICKEL

TEMPERATURE VARIATIONS



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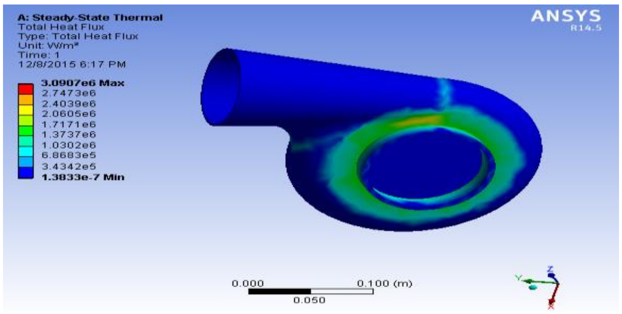
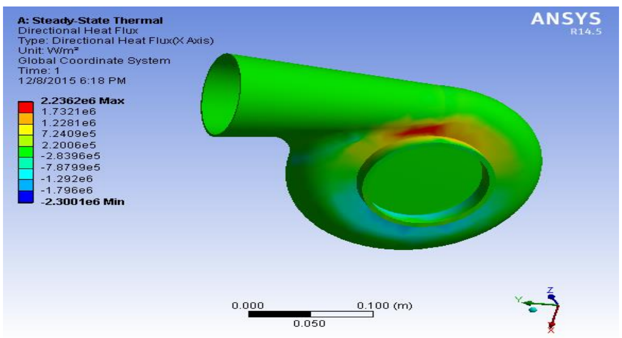
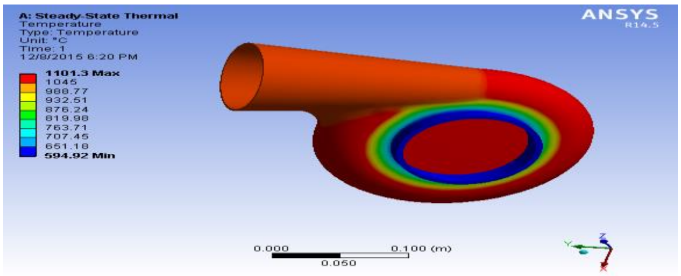


DIRECTIONAL HEAT FLUX



STEADY STATE THERMAL ANALYSIS OF TURBO CHARGER MADE UP OF TITANIUM ALLOY

TEMPERATURE VARIATIONS



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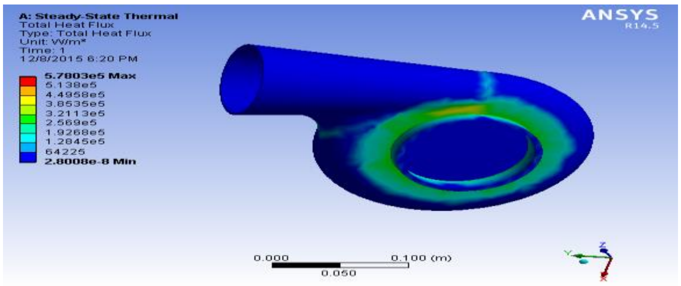
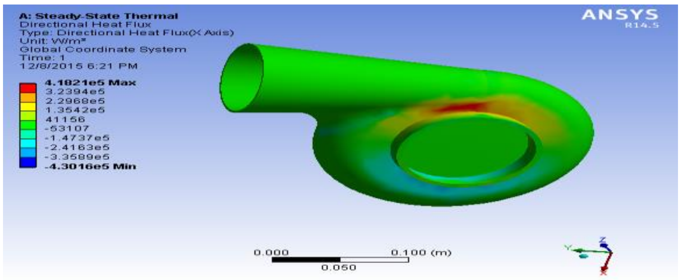
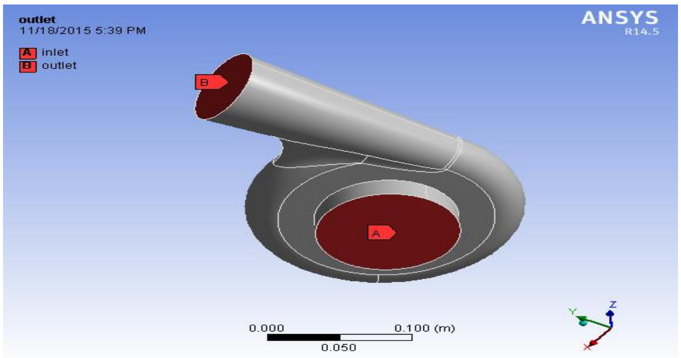


DIRECTIONAL HEAT FLUX

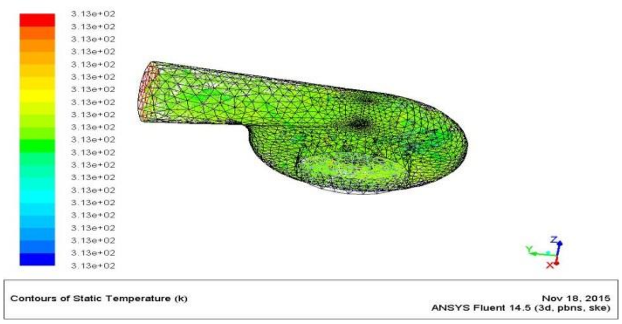


CFD ANALYSIS OF TURBO CHARGER

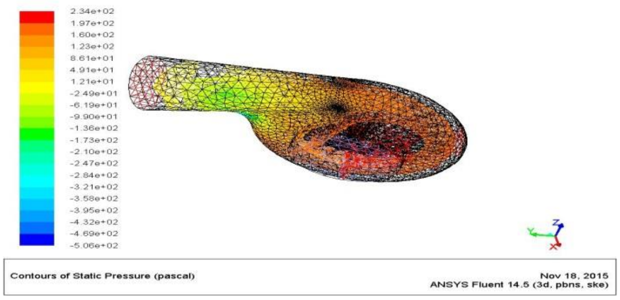
INPUT DATA



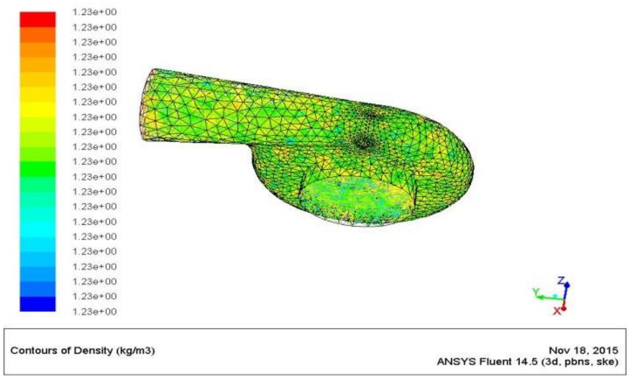
TEMPERATURE



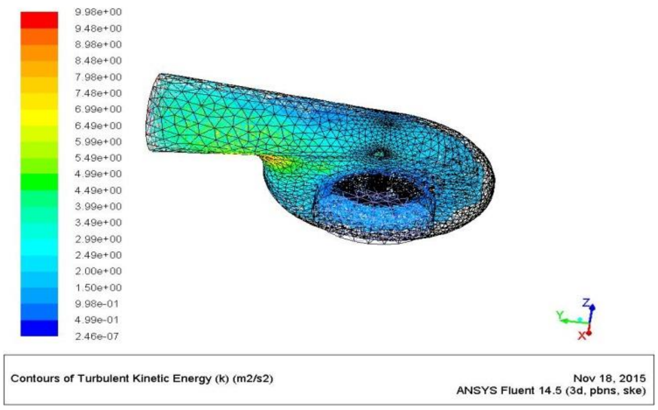
PRESSURE



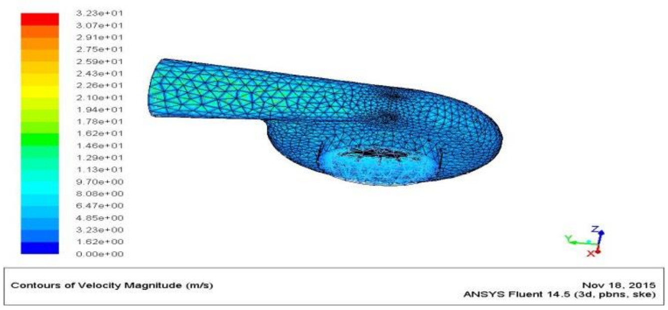
DENSITY



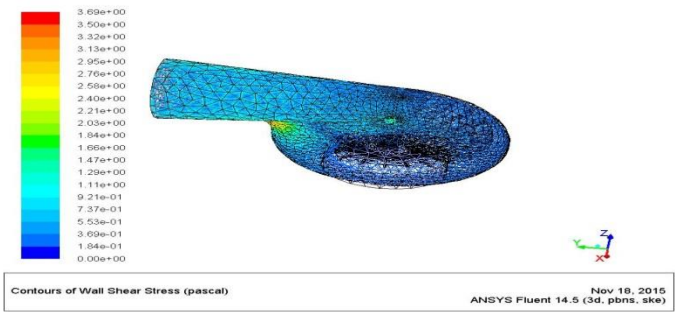
TURBULENCE



VELOCITY



WALL FLUX



RESULTS TABLE

Thermal analysis table

	TEMPERATURE		TOTAL HEAT FLUX		DIRECTIONAL HEAT FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
ALUMINIUM	594.92	1101.3	3.34E-07	7.14E+06	-5.31E+06	5.17E+06
CAST IRON	594.92	1101.3	6.91E-08	1.56E+06	-1.16E+06	1.13E+06
NICKEL	594.92	1101.3	1.38E-07	3.09E+06	-2.30E+06	2.24E+06
TITANIUM	594.92	1101.3	2.8008E-08	5.7803E+05	-4.3016E+05	4.1821E+05

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CFD analysis table

	MIN	MAX
PRESSURE	-5.06E+02	2.34E+02
DENSITY	1.23E+00	
TEMPERATURE	3.13E+02	2.45E-07
KINETIC ENERGY	2.45E-07	9.98E+00
VELOCITY MAGNITUDE	0.00E+00	3.23E+01
SHEAR STRESS	0.00E+00	3.69E+00

CONCLUSION

In this project, a turbo charger used in a car is designed and modeled in 3D modeling software Catia V5. CFD analysis is to be done on the turbo charger with turbine and compressor in an assembly. Heat transfer analysis is to be done on the turbo charger by changing the materials of the turbine blade by assuming car is running at higher speeds. Analysis is to be carried in Ansys.

Here we have considered the materials Aluminum, Cast Iron, Nickel, and Titanium alloy for the thermal analysis. And after that a CFD is to the best material output.

As per the results obtained in the tabular form and graphical representation we have considered the temperature, total heat flux and directional heat flux and then they are compared. As we observe the results the aluminum is the best material for the turbo charger as it is having the less heat flux, and as if we see in the CFD analysis even here the density and the temperature and the pressure is very low and thus we can consider the aluminum is the best material and give the better life output.

REFERENCES

1. Turbocharger design & analysis solutions by bill Holmes
2. Computational fluid dynamics analysis of a turbocharger system
3. Design of an axial flow turbocharger using finite element analysis arunankam
4. Future turbocharging challenges with Cfd, fea
5. Design and thermal analysis of radial turbo charger using finite element method paulson joseph a
6. Here dimensional Cfd simulation of a turbocharger turbine for motorsport applications

AUTHOR DETAILS

1. **STUDENT**

Shaik Mohammed Shafi received the BTech degree in mechanical engineering from Samuel George Institute of Engineering & Technology, JNTK, Kakinada, Andhra Pradesh, India, in 2013 year, and perusing MTech in Thermal Engineering from Kakinada Institute of Technology & Science, Divili, Andhra Pradesh, India.

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3. **GUIDE 2**

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