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Analysis on Turbo Charger Outer Casing of Diesel Engine Using of Different Materials

Gujju Hymavathi
M.Tech (Thermal Engineering)
Department of Mechanical Engineering
VITS College of Engineering,
Sontyam, Visakhapatnam.

Jasti Kasi Babu, M.E, M.I.E
Associate Professor (Project Guide)
Department of Mechanical Engineering
VITS College of Engineering,
Sontyam, Visakhapatnam.

Abstract

A turbocharger or turbo is a gas compressor that uses the turbine driven forced induction device that increases an engine's efficiency and power by forcing extra air into the combustion chamber. A turbocharger has the compressor powered by a turbine. The turbine is driven by the exhaust gas from the engine. It does not use a direct mechanical drive. This helps improve the performance of the turbocharger. The main problems with the turbo charger are oil leakage, damage of blades, whistling, sluggish, and outer case compression problem to overcome this problem many of the peoples work on the problem and they came out with new solutions to it. The objective of this project is to be design the outer case of a turbocharger for a diesel engine to increase its power and efficiency, and showing the advantage of designing of a turbocharger. The project tends to usage of new materials is required. In the present work impeller was designed with three different materials. The investigation can be done by using Creo-2 and ANSYS software. The Creo-2 is used for modeling the impeller and analysis is done in ANSYS .ANSYS is dedicated finite element package used for determining the variation of stresses, strains and deformation across profile of the impeller.

INTRODUCTION

Internal Combustion Engine

The internal combustion engine is the powerhouse of a variety of machines and equipment ranging from small lawn equipment to large aircraft or boats. Given the focus of this paper, the most important machine powered by an internal combustion engine is the automobile. The engine literally provides the driving force of the car while also directly or indirectly powering just about every other mechanical and electrical system in the modern automobile. While there are several types of internal combustion engines that cover the aforementioned large range of applications, they all basically do the same thing.

They all convert the chemical energy stored in a fuel of some kind into mechanical energy, which can then be converted into electrical energy. The three most common types of internal combustion are the 4-stroke gasoline engine, the 2-stroke gasoline engine, and the diesel engine. A brief description of each the common types of internal combustion engine are provided below.

Turbocharger as a System

These components will be discussed briefly here and then at length in subsequent sections of the paper. The intake system consists of everything from the air filter to the intake ports on the engine. This includes the compressor, intercooler (see next paragraph), manifold and throttle bodies. The job of the intake system is to connect all of these components with hoses or pipes. The design of the manifold, which consists of the plenum and runners, and the throttle bodies are also considered part of the intake system. The intake system in general and specifically for this project will be discussed at length in section 6 – Intake System. The intercooler is a heat exchanger that is included to remove the unwanted heat added to the intake air by the compressor. It is impossible to prevent the compressor from adding heat to the air as it compresses it, though the amount of heat added can be limited by choosing a properly sized compressor. It is undesirable to just allow the hot intake air to go straight to the engine as it can reduce power gains and lead to engine knocking. An intercooler is thus included in the system to remove the heat added by the compressor. The heat is removed via cross flow of a cooling fluid, either air or water. The air is then free to flow to the engine with a lower temperature but still higher than atmospheric pressure.

The concept of boost was introduced in the previous section as was the relationship between boost and the system. That is to say that while higher boost generally leads to higher power it also leads to increasingly complicated and expensive system requirements. Since a turbocharged system is rarely designed with unlimited budget and design freedom, there will always be a maximum boost that the system is designed to accommodate. This maximum boost is usually chosen based on performance goals, and the system is then designed specifically for that boost pressure. If this maximum boost pressure is exceeded, the system could very likely fail, resulting in damage to the turbocharger or engine. If left unchecked though, the turbocharger will continue to create boost well past the maximum boost pressure. A boost control system is thus added to limit the boost created by the turbocharger. A waste gate works by bleeding exhaust gas away from the turbine once the maximum boost pressure is reached. As less exhaust reaches the turbine, the turbocharger slows down and creates less boost pressure.

The exhaust system consists of everything from the engine exhaust ports to the tailpipe. This includes the manifold, turbine, waste gate and the muffler. The job of the exhaust system is to connect and support all of these components with pipes. The design of the exhaust manifold, including the primaries and merge collectors, is considered part of the exhaust system. The final major system component is the lubrication system for the turbocharger bearings. In the drawing, this system consists of an oil feed line and an oil drain line between the turbocharger bearings and the engine. The oil feed line is connected to the engine at a location with positive oil pressure, and the oil drain line is connected to the engine's oil pan. More complicated systems including dedicated pumps and oil reserves are not uncommon. The coolant lines between the turbocharger bearings and the engine's radiator circuit are not included in the figure as water jackets are not available on all turbochargers and thus are not considered to be standard. In addition to these components, any high boost turbocharged system is going to require modifications to various engine parts. Electrical and ignition systems may need to be upgraded to ensure proper ignition. The fuel injection systems may need to be upgraded to maintain the correct AFR. The throttle bodies and valve train may need to be changed to provide for proper flow conditions

Input Data of Turbo Casing:

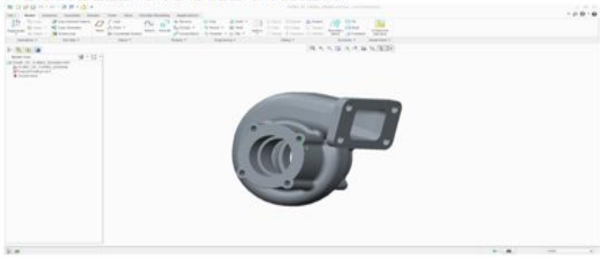
Engine capacity (L) Up to 7
Output range (hp) 100 to 310
Airflow (max) 0.46 kg/s
Length (mm) 250
Width (mm) 240
Height (mm) 220
Mass (kg) 16 to 17

Turbo outer Casing stress analysis

Turbo outer Casing stress analysis

Stain less steel	CF8C plus cast stain less steel	HK30Nb stainless alloy
Density	7.96	7.81
Ductility	0.32	0.34
Elastic limit	209MPA	207MPA
Thermal conductivity	14.54w/mk	15.23w/mk
Heat input	350°c	350°c

3-D MODELING OF TURBO CASING



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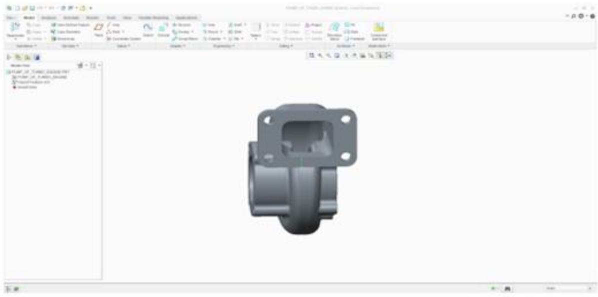
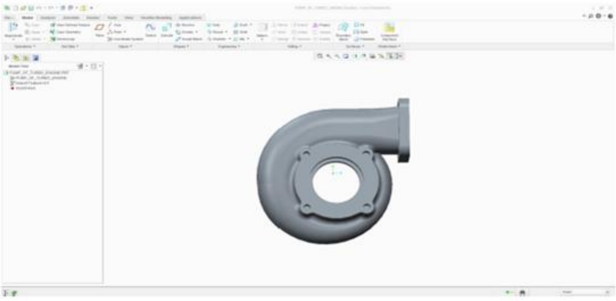
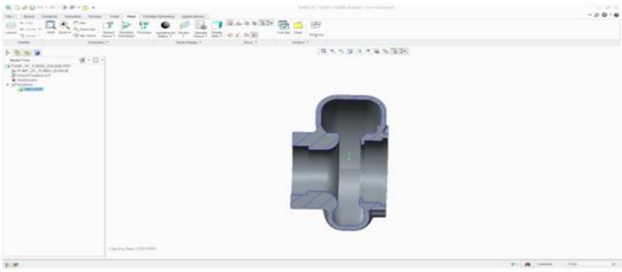






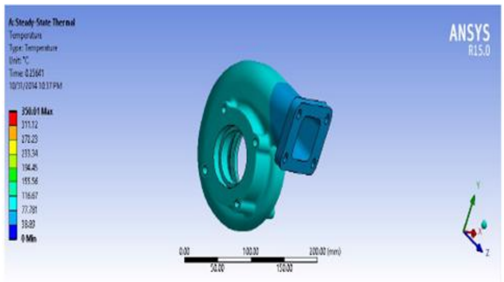
MODAL ANALYSIS

A modal analysis is typically used to determine the vibration characteristics (natural frequencies and mode shapes) of a structure or a machine component while it is being designed. It can also serve as a starting point for another, more detailed, dynamic analysis, such as a harmonic response or full transient dynamic analysis. Modal analyses, while being one of the most basic dynamic analysis types available in ANSYS, can also be more computationally time consuming than a typical static analysis. A reduced solver, utilizing automatically or manually selected master degrees of freedom is used to drastically reduce the problem size and solution time.

HARMONIC ANALYSIS

Used extensively by companies who produce rotating machinery, ANSYS Harmonic analysis is used to predict the sustained dynamic behavior of structures to consistent cyclic loading. A harmonic analysis can be used to verify whether or not a machine design will successfully overcome resonance, fatigue, and other harmful effects of forced vibrations

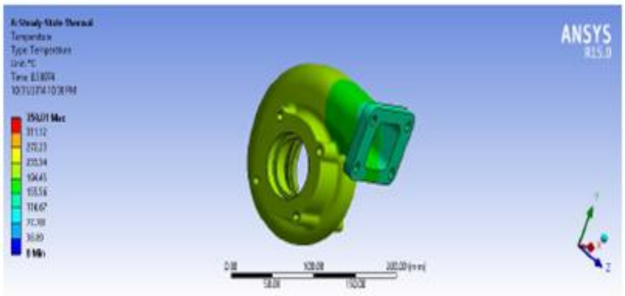
THERMAL ANALYSIS OF TUBO CASING

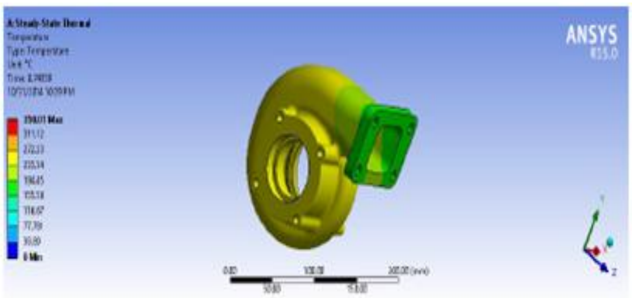


Material Properties:

Stain less steel	HK30Nb stainless alloy
Density	7.81
Ductility	0.34

Elastic limit	207MPA
Thermal conductivity	15.23w/mk
Heat input	350°c





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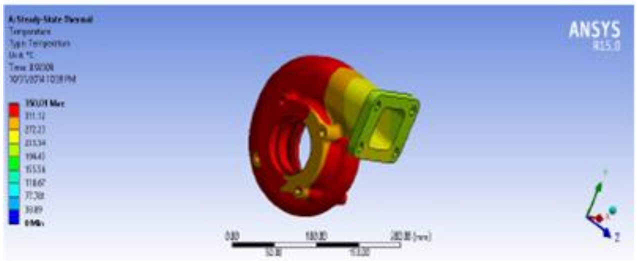
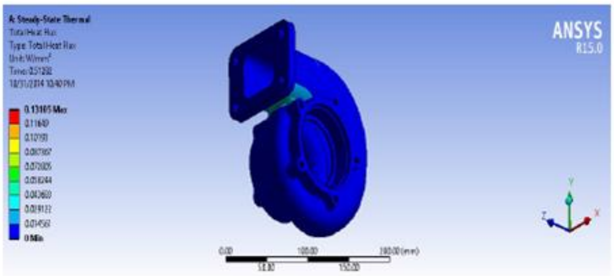
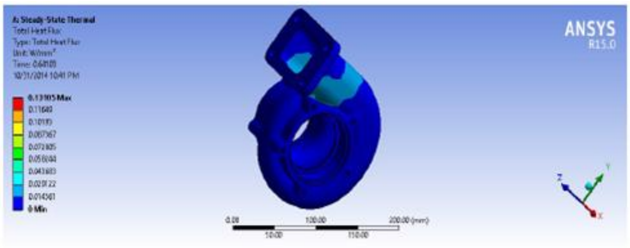
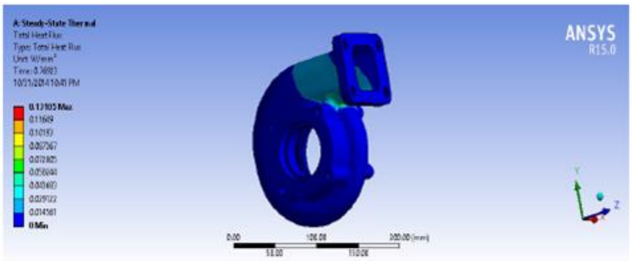


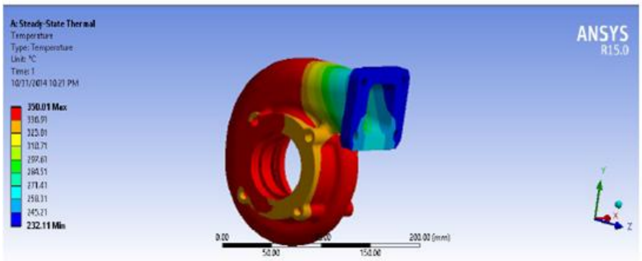
TABLE 10: Model (A4) > Steady-State Thermal (A5) > Convection

Temperature [°C]	Convection Coefficient [W/mm²·°C]
1.	9.5e-007
10.	2.05e-006
100.	4.41e-006
200.	5.56e-006
300.	6.36e-006
500.	7.54e-006
700.	8.43e-006
1000.	9.5e-006





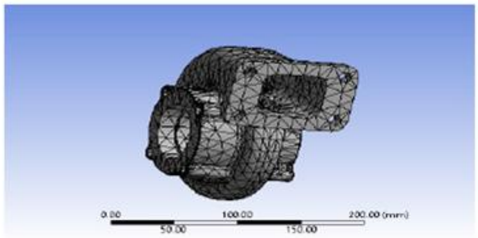


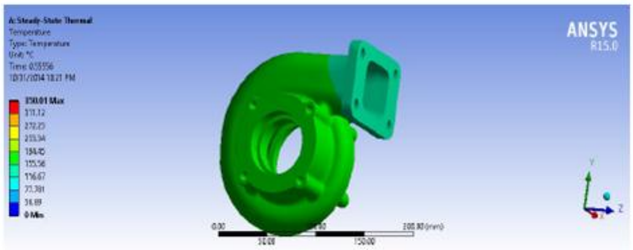


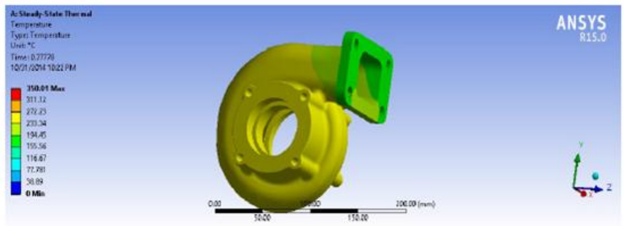
Material Properties

Stain less steel	CF8C plus cast stain less steel
Density	7.96
Ductility	0.32
Elastic limit	209MPA
Thermal conductivity	14.54w/mk
Heat input	350°c

Coordinate Systems:







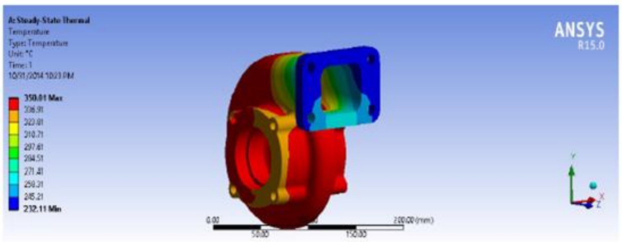


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TABLE 19: Model (A4) > Steady-State Thermal (A5) > Convection

Temperature [°C]	Convection Coefficient [W/mm²·°C]
1.	9.5e-007
10.	2.05e-006
100.	4.41e-006
200.	5.56e-006
300.	6.36e-006
500.	7.54e-006
700.	8.43e-006
1000.	9.5e-006

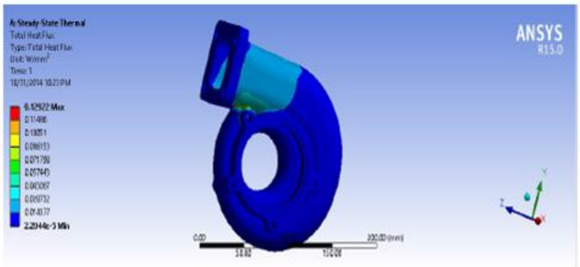
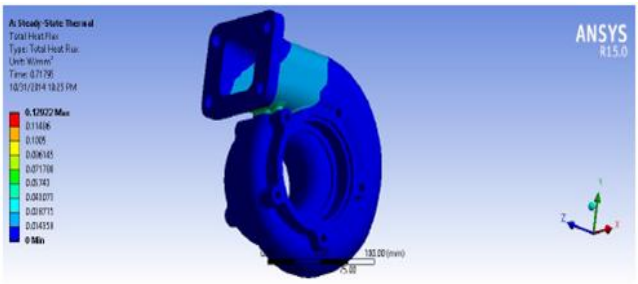
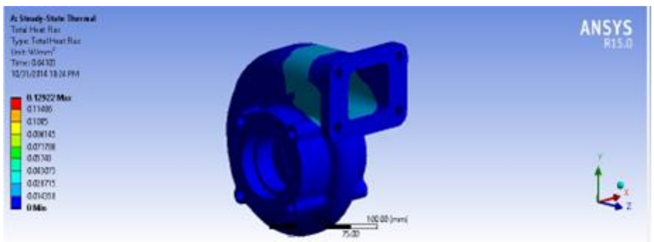


TABLE 20: Model (A4) > Steady-State Thermal (A5) > Solution (A6) > Results

Object Name	*Temperature*	*Total Heat Flux*
State	Solved	
Scope		
Scoping Method	Geometry Selection	





Material Data

Material 2

TABLE 21: material 1 > Constants

Thermal Conductivity	1.454e-002 W mm^-1 C^-1

Material 1: HK30Nb stainless alloy

Results		
Minimum	235.63 °C	2.2085e-005 W/mm²
Maximum	350.01 °C	0.13105 W/mm²
Minimum Value Over Time		
Minimum	235.63 °C	2.2085e-005 W/mm²
Maximum	235.63 °C	2.2085e-005 W/mm²
Maximum Value Over Time		
Minimum	350.01 °C	0.13105 W/mm²
Maximum	350.01 °C	0.13105 W/mm²

Material 2: CF8C plus cast stain less steel

Results		
Minimum	232.11 °C	2.2044e-005 W/mm²
Maximum	350.01 °C	0.12922 W/mm²
Minimum Value Over Time		
Minimum	232.11 °C	2.2044e-005 W/mm²
Maximum	232.11 °C	2.2044e-005 W/mm²
Maximum Value Over Time		
Minimum	350.01 °C	0.12922 W/mm²
Maximum	350.01 °C	0.12922 W/mm²

CONCLUSION

In this project we designed the outer case of a turbocharger for a diesel engine to increase its power and efficiency, and showing the advantage of designing of a turbocharger. In this project tends to usage of new materials is required. In the present work impeller was designed with three different materials. The investigation can be done by using Creo-2 and ANSYS software. The Creo-2 is used for modeling the impeller and analysis is done in ANSYS .ANSYS is dedicated finite element package used for determining the variation of stresses, strains and deformation across profile of the impeller. So, by this HK30Nb stainless alloy is best material for the turbo casing design It have the bypass to control the air flow in the system which it will through the intercooler or release direct to the ambient.

REFERENCES

[1] C. Berrou, A. Glavieux, and P. Thitimajshima, “Near Shannon limit error-correcting coding and decoding: Turbo-codes,” in ICC Proc., May 1993, pp. 1064–1070.

[2] S. Benedetto and G. Montorsi, “Unveiling turbo codes: Some results on parallel concatenated coding

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schemes," IEEE Trans. Inform. Theory, vol. 42, pp. 409–429, Mar. 1996.

[3] S. Benedetto, D. Divsalar, G. Montorsi, and F. Pollara, "Serial concatenation of interleaved codes: Performance analysis, design, and iterative decoding," IEEE Trans. Inform. Theory, vol. 44, pp. 909–926, May 1998.

[4] L. C. Perez, J. Seghers, and D. J. Costello, Jr., "A distance spectrum interpretation of turbo codes," IEEE Trans. Inform. Theory, vol. 42, pp. 1698–1709, Nov. 1996.

[5] O. Y. Takeshita and D. J. Costello, Jr., "New classes of algebraic interleavers for turbo-codes," in Proc. 1998 IEEE Int. Symp. on InformationTheory, Cambridge, MA, Aug. 16–21, p. 419.

[6] D. Divsalar and R. J. McEliece, "Effective free distance of turbo codes," Electron. Lett., vol. 32, no. 5, pp. 445–446, Feb. 1996.

[7] O. Y. Takeshita, O. M. Collins, P. C. Massey, and D. J. Costello, Jr., "On the frame error rate of turbo-codes," in Proc. ITW 1998, Killarney, Ireland, June 22–26, 1998, pp. 118–119.

[8] S. Benedetto, D. Divsalar, G. Montorsi, and F. Pollara, "Analysis, design, and iterative decoding of double serially concatenated codes with interleaves," IEEE J. Select. Areas Common., vol. 16, pp. 231–244, Feb. 1998.