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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Performance Analysis of Turbocharger used in Petrol Engine

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ABSTRACT:

An integrated supercharger/turbocharger is an integral tool benefits high charging, turbocharging, and timely turbocharging to eliminate some of their individual problems. High boost, turbocharging and improved controls are key strategies for meeting future fuel savings requirements. Higher upgrades increase engine power while more losses remain always, to generate total efficiency profits. Turbocharging boosts engine efficiency by capturing multiple exhaust turbine power at high speed and torque. Supercharging increases the operating speed of high torque. The main programs used in this study are FEM, known as finite element analysis, ProEngineer forcomplete design and modelling, and ANSYS forstress and CFD analysisperformed on both turbine rotors and compressor impellers bottom. The results section reports the most important parametersfound on the turbocharger, including all stage parameters on both the turbine side and the compressor side. Thisproject proved to be a great challenge and learning experience. This gave us a deeper understanding of the conceptual, theoretical, and practical aspects of turbomachinery design.

Keywords:CFD, ANSYS, VTG, Turbocharger, Finite Element Analysis

INTRODUCTION

Ordinary I C engines take the air by themselves which is to be required for the burning of fuel. This is accomplished by utilizing the low-pressure zone within the cylinder formed by the piston's downward movement during the suction stroke of the four-stroke cycle. The power provided by these engines has a maximum capacity. By any method, allowing more air into the cylinder allows for more fuel to be burned efficiently and hence more power to be generated. Turbo Charger is the device that will take over this role. The turbocharger works by harnessing the power of the exhaust gases. It improves the engine's efficiency by utilizing the wasted power of the exhaust gases for its operation. In simple terms, a turbocharger is a small engine with a high output. A turbocharger is essentially a small centrifugal compressor connected to a turbine. When exhaust gases travel through the turbine, it causes it to spin at extremely high speeds (between 80,000 and 10,000 rpm). The compressor is attached to the turbine, and the compressor rotates with the turbine, taking in and compressing atmospheric air. The engine receives this compressed air for combustion. After flowing through the turbine, the exhaust gases are discharged through the exhaust pipe.

PROBLEM STATEMENT

Turbo software for design and analysis predicts the interaction of the active fluid with a geometric and working environment. Accurate prediction of this interaction is highly dependent on understanding the models of power loss embedded within the design code. These loss models determine how much performance decreases due to natural or sometimes negative geometric constraints and performance. Such power losses include skin friction, excessive gain, airfoil events, re-flow flow, and blade tip leaks to name a few.

Turbocharging can increase engine power and reduce fuel consumption. However, in order to test the power, large problems must be reduced during engine advancement. At low engine rpm as compared to conventional engines, turbocharged engines have less torque and at high speed has high torque. At very high rpm, the maximum power obtained from engine is limited by the inlet temperature of the turbine.

OBJECTIVE OF WORK

The main objective for this project is to design and Analysis a complete turbocharger based on a few parameters by using of software's. Specifically, the objectives include the following items:

1. Design using Pro-Engineer to the compressor impeller and housing,
2. Design using Pro-Engineer to the axial turbine impeller and housing,
3.Design using Pro-Engineer a complete turbocharger to include casing, bearings, labyrinth seals, rotor, and volutes.

TURBINE CAD DESIGN

The design of the turbine proved just as complex as design of the compressor. Similar to the design of compressor, the turbine-design mainly depended on the geometry found from the analysis. Inaddition, just as $\alpha_3$was arbitrarily chosen for the compressor design, α_2 was arbitrarily chosento be 20 degrees for the turbine design. Furthermore, a 50% degree of reaction was utilized asa design stage parameter for simplicity in calculation and design.

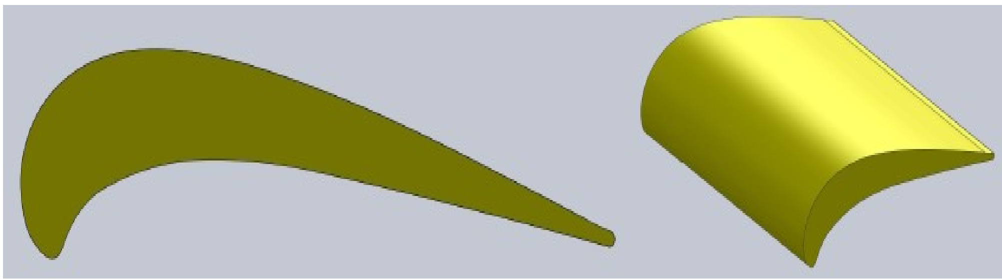

Figure 1: Turbine and stator blade designed with Pro-Engineer

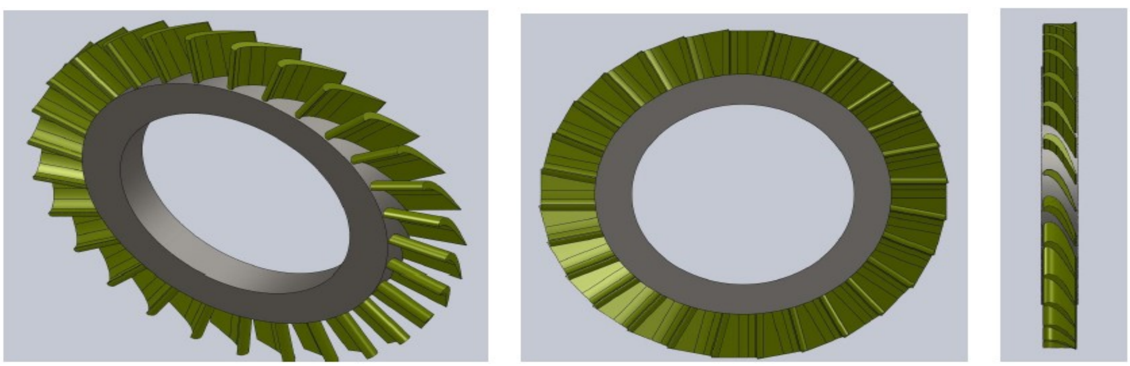

Figure 2: Turbine rotor designed with Pro-Engineer

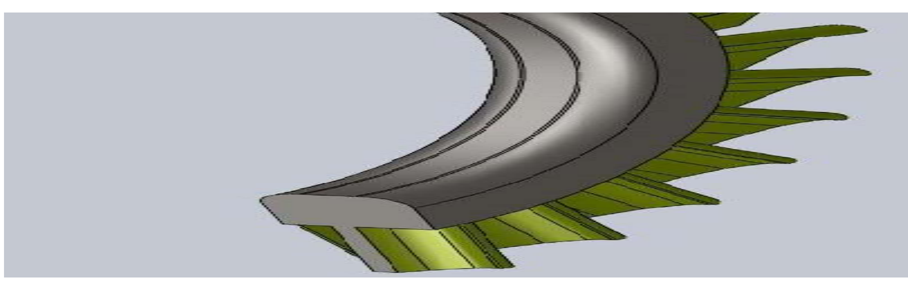

Figure 3: Section cut shows added radius to internal hub diameter

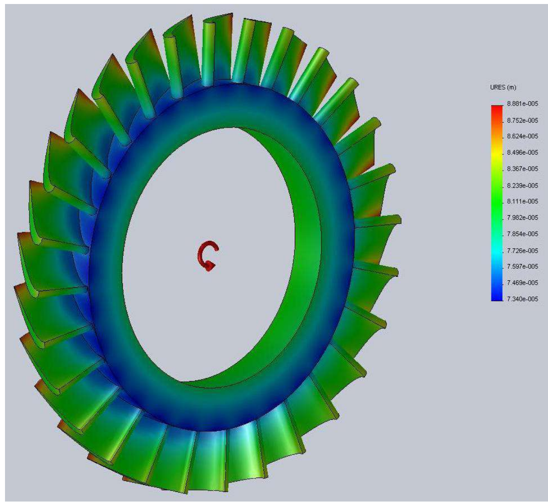

Figure 4: Final stress analysis shows rotor hub deformation

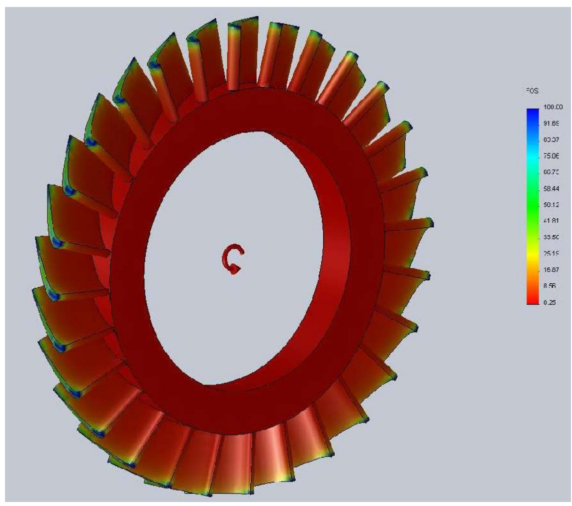

Figure 5 : Final stress analysis shows rotor hub safety factor

CONCLUSION:

Power output can be increased considerably in two-wheelers with the use of turbochargers. An engine equipped with a good turbocharger can develop 20% + more power compared to the normal one, with an increase in specific fuel consumption. As exhaust coming from the engine is utilized for useful work which would have been wasted to increase the thermal efficiency of engines over natural engine or supercharged engines.

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