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# Optimization and Thermal Analysis of Piston of Different Materials Using FEM

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ABSTRACT

The goal of this project is to design a motorcycle-specific piston petrol engine. Performance optimization is the focus of research on stress fluctuations on the top face of the piston. Both the piston's pressure on the surface and its thermal behaviour are examined. The operating gas pressure, temperature, and material functions of the piston were all taken into account for this investigation.An inquiry was done to determine whether the top face of the piston may have been scratched or fractured as a result of the working conditions because scratched or broken parts are so expensive to replace and frequently unavailable. Along with being straight and curved To design the piston geometry and do a FEM study to improve the piston's thermal behaviour, Solid Works 2016 was used. Gray cast iron and aluminium alloy were used in the piston's design. By exerting pressure on the piston, structural analysis analyses its stress and displacement. The study's findings can be used to determine if our piston design is secure under actual load levels.

**Keywords-** Piston Head, Crown, Finite Element Analysis (FEA), Steady State Thermal Analysis, Static Structural Analysis.

## INTRODUCTION

Otto first discovered pistons in 1866, making them one of the earliest mechanical parts. Pistons are one of the most important parts of reciprocating engines. The chemical energy released by burning fuel can be transformed into useful mechanical power by using engines, reciprocating pumps, gas compressors, and pneumatic cylinders, among other devices. The flow of gas into the piston and connecting rod, which transfer it to the crankshaft for final combustion, increases as the combustion chamber is expanded. Cylindrical stopper of the cylinder moves up and down. For a tight seal, piston rings are provided.Metal rods are used to move pistons in an oscillating motion that applies pressure to the fluids inside the chamber. Fuel and air may be kept out of the oil by a ring that separates the piston oil from the combustion chamber oil. Nearly every piston in a cylinder comes with a set of piston rings. A seal between the piston and the cylinder wall is frequently created using two spring compression rings, an oil control ring, and other components. Piston heads come in a wide range of sizes and shapes. There are accessible both cast and forgeable pistons. The piston can take on many different shapes, but its most typical shape is spherical.

## PROBLEM STATEMENT

The gasoline is transformed into kinetic energy by the vehicle. It is a moving part used to transfer the power from the cylinder to the crankshaft. It is generally acknowledged that pistons are the engine parts that transmit the greatest heat through compression. Determining the temperature distribution within the piston is crucial for controlling thermal pressure and deformation in the operating environment. If we can precisely estimate the temperature distribution on the piston surface, thermal properties may be optimized for a low-cost design. Distortion is brought on by an increase in inertia, high gas pressure, and the periodic load impact on alternating movements. Radiation from the piston layer is taken into consideration by convectional heat load as well. Heat radiation causes the piston to be harmed. The piston experiences thermal compression and fluctuation as a result of excessive gas combustion. Examining the pressure distribution, temperature distribution, heat transfer, and mechanical load is important to minimise the pressure beneath the piston of a different load.

## OBJECTIVES OF THE RESEARCH WORK

The following are the goals of the current work:

- To investigate the maximum thermal stress using stress analysis by Ansys software.
- To investigate the maximum Temperature using stress analysis by Ansys software.
- To Develop different geometries of piston by Catia Software.

## RESULT AND ANALYSIS

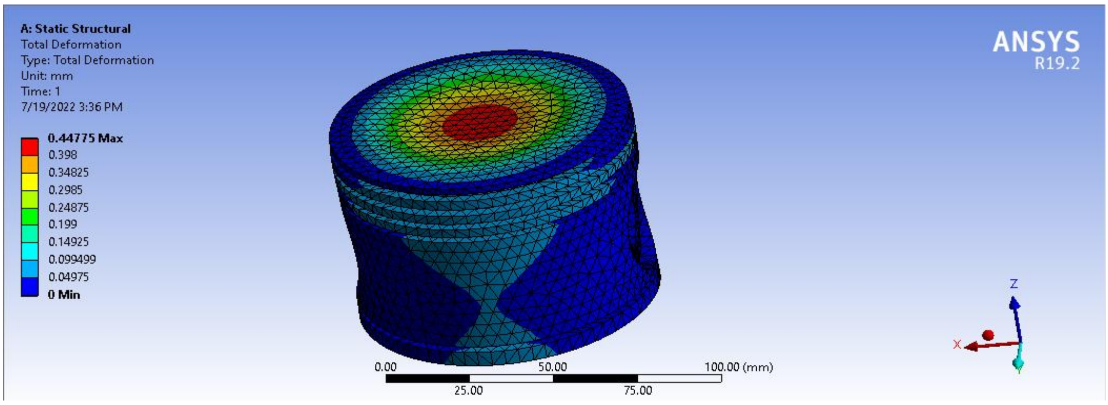


**Figure4.1:** Total Deformation

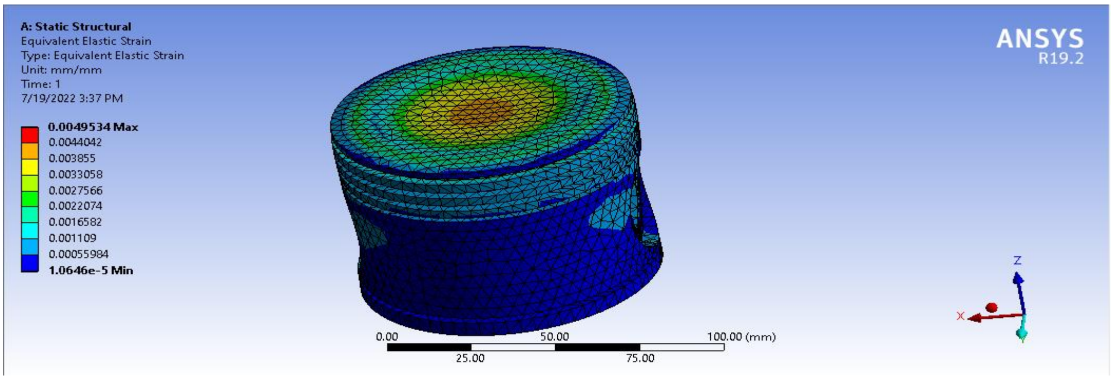


**Figure4.2:** Equivalent Elastic Strain

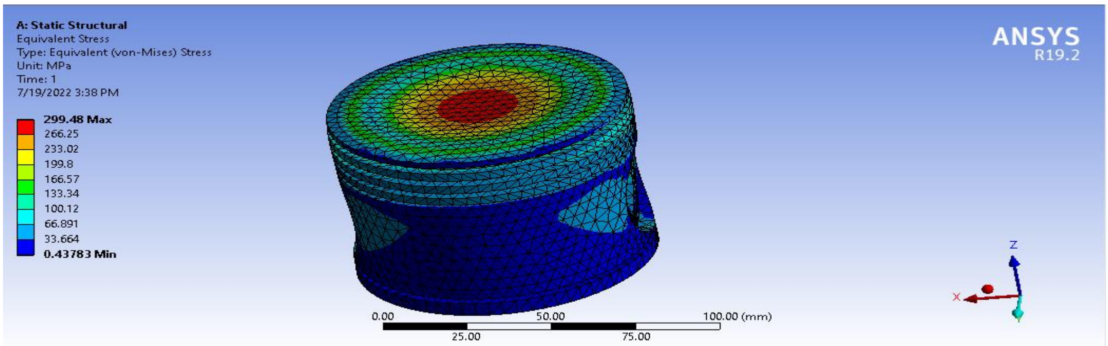


**Figure4.3:** Equivalent(Von-Misses) Stress

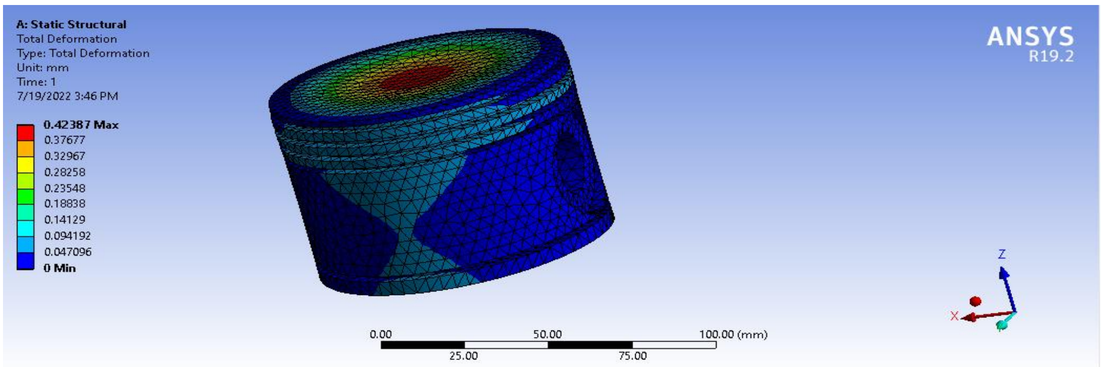


**Figure4.4:** Total Deformation

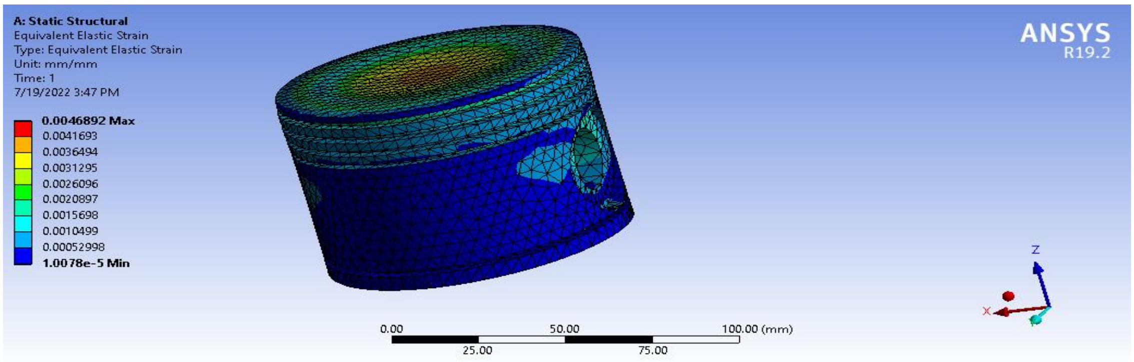


**Figure4.5:** Equivalent Elastic Strain

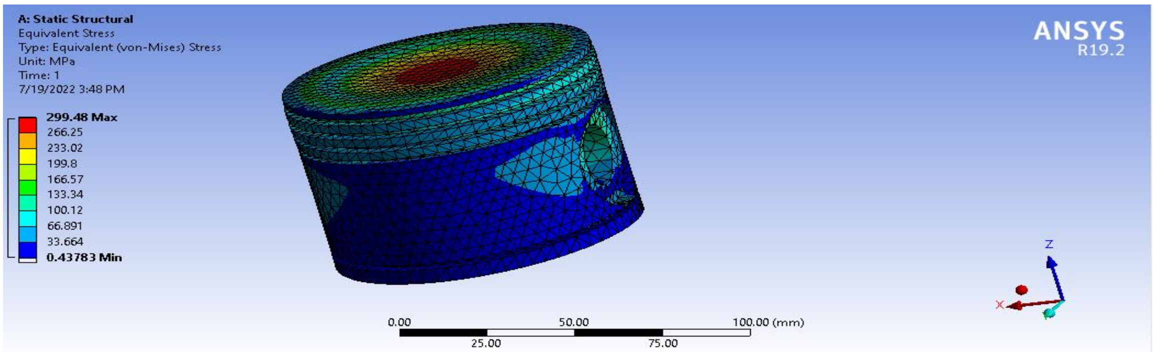


**Figure4.6:** Equivalent Stress

## CONCLUSION

The piston's strength, a crucial element in engine performance, is influenced by the material from which it is made. The bottom surface of the piston crown experiences the greatest stress, which is to be expected for all materials. Maximum displacement is absorbed on the top of the piston by an aluminium alloy and grey cast iron. Due to the materials' high thermal conductivity, the maximum value of the piston's maximum temperature is caused, and the largest heat flow is absorbed by both piston materials. Utilizing cutting-edge materials and a variety of design and analytical methodologies, further research may be conducted.Concave-shaped piston designs exhibit higher stresses and total deformations than convex-shaped piston designs.

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