"THERMAL ANALYSIS OF PISTON DESIGN FOR I.C. ENGINE USING BY FEA METHOD"

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ABSTRACT

Piston is one amongst the most essential parts in a reciprocating Engine, reciprocating pumps, gas blowers and pneumatic barrels, among other comparable mechanisms' in which it changes over the substance vitality acquired by the burning of fuel into helpful (work) mechanical power. The present thesis deals with the properties of piston material related to heat. Primary issue anticipated that would be found in the outline of the expansive piston is the deformation, because of weight and temperature. The warmth originating from the fumes gases will be the primary reason of deformation.The most critical part is that less time is required to outline the piston and just a couple of essential detail of the engine. Pistons made of various materials like AL SI 12 Cu Mg , AL 6061 Aluminium Alloy and S-460 steel materials and Cast iron alloy were outlined and investigated effectively. In static-auxiliary investigation, the pistons were examined to discover the proportional (von-mises) stress, comparable flexible strain and deformation. It tends to be seen that greatest stress force is on the base surface of the piston crown in every one of the materials. Here we discovered Aluminim alloy this material has more values of heat flux with different materials .

Key Words: *Piston, Structural Analysis, Stress, CAD,FEA, ANSYS.*

I. INTRODUCTION

Piston is considered to be one of the most important parts in a reciprocating Engine, reciprocating Pumps, among other similar mechanisms in which it helps to convert the chemical energy obtained by the combustion of fuel into useful (work) mechanical power.

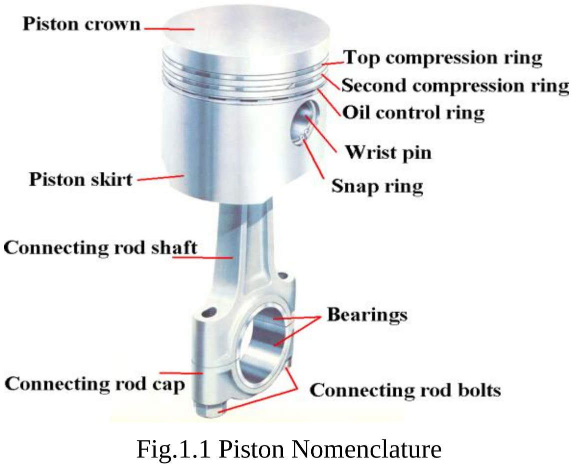


Fig.1.1 Piston Nomenclature

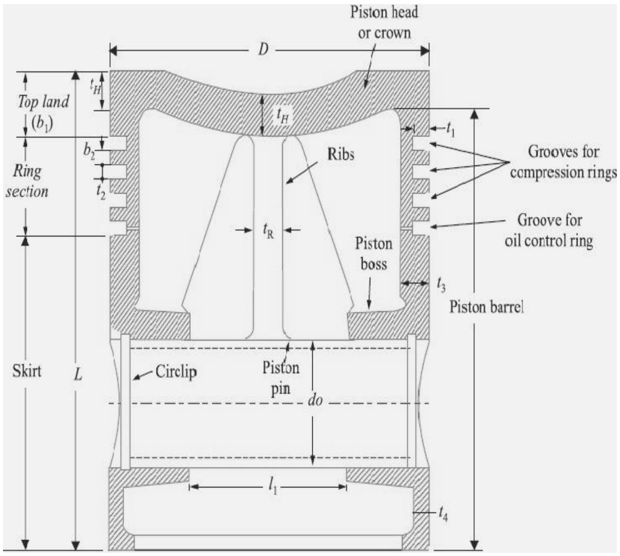


Fig.2 Cross Section

II. MATERIALS

We have selected three materlas

- Aluminium Alloy
- Structural Steel (S-460)
- Titanium Alloy

III. MODELING & SIMULATION

SPECIFICATIONS (Hero CD Delux)

Engine Type	Air-cooled, 4-stroke single cylinder OHC
Displacement	97.2 cc
Max. Power	5.66 KW ,@ 5000 rpm
Max. Torque	7.130 N-m @ 2500 rpm
Compression Ratio	9.9 : 1
Starting	Kick Start / Self Start
Ignition	DC - Digital CDI
Bore	50 mm
Stroke	49 mm

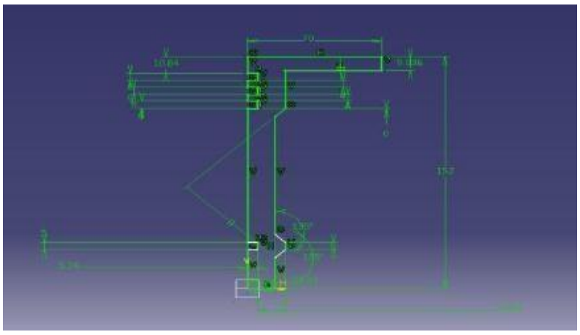
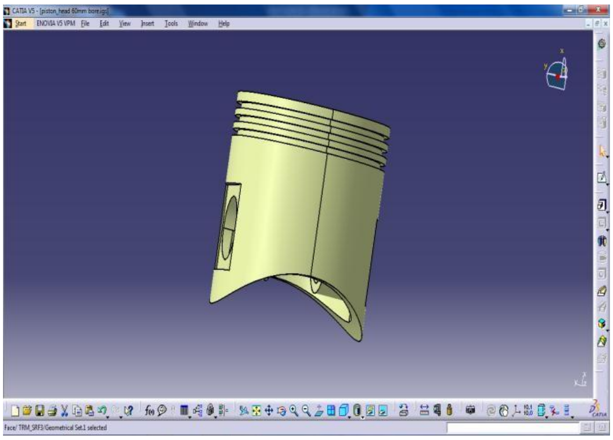


Fig.3.1 2D Drafting



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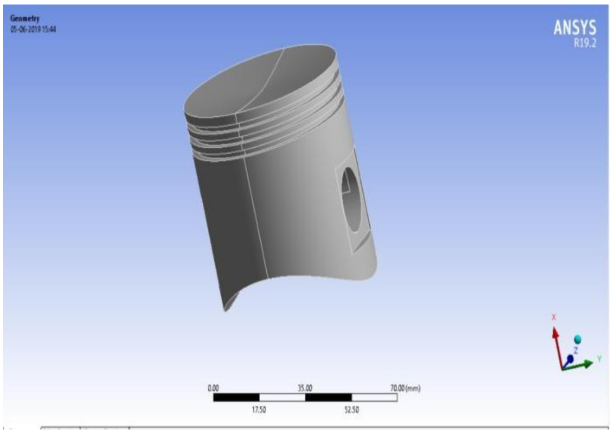


Fig.3.3 Import Geometry ANSYS

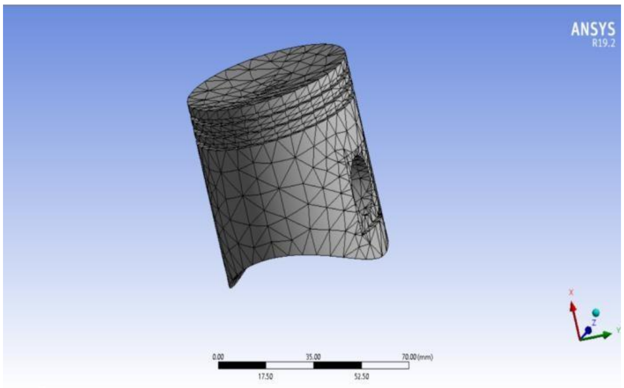


Fig.3.4 Meshing

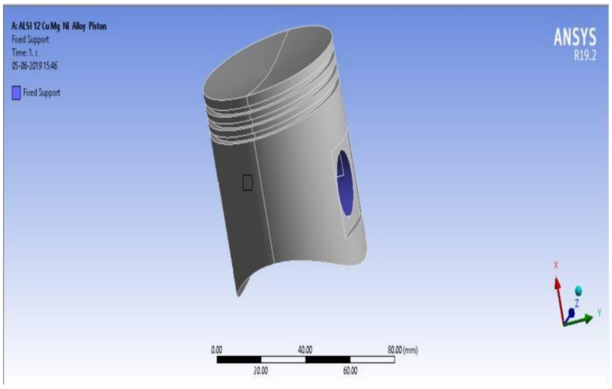
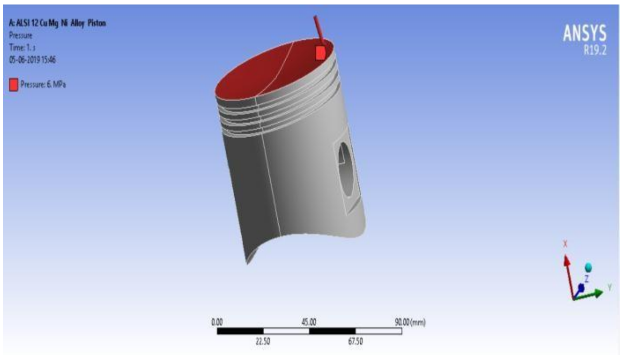


Fig.3.5 Fixed support AL SI 12 Cu Mg Alloy Materials



. Fig. 3.6 Pressure applied AL SI 12 Cu Mg Alloy Materials

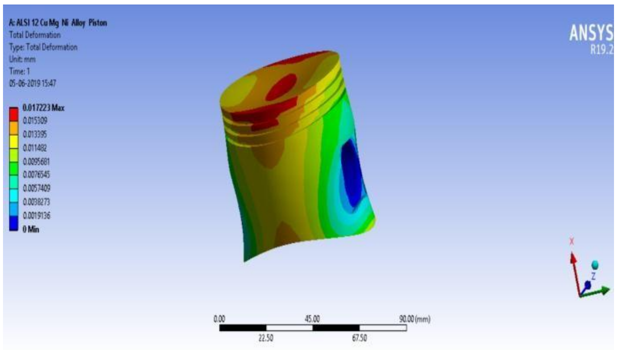


Fig. 3.7 Total Deformation AL SI 12 Cu Mg Alloy Materials

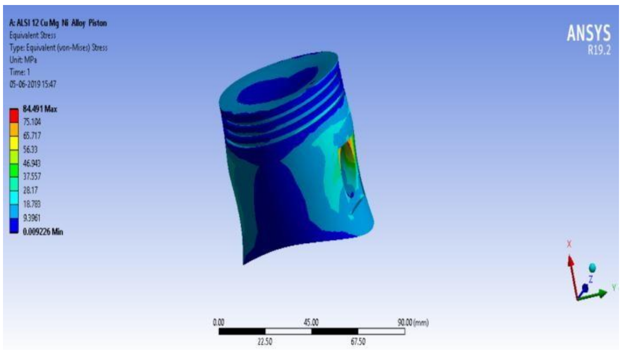


Fig.3.8 Equivalent Stress AL SI 12 Cu Mg Alloy Materials

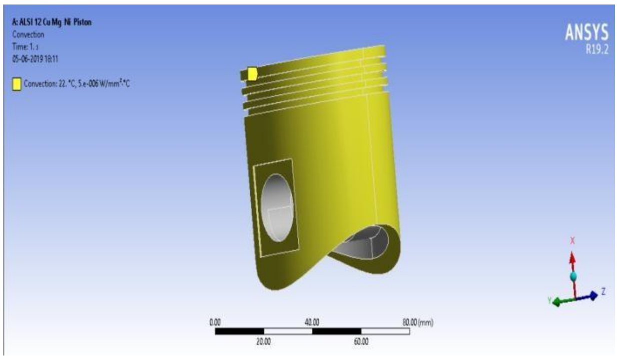


Fig.3.9 Transient Thermal Boundary conditions AL SI 12 Cu Mg Alloy Materials

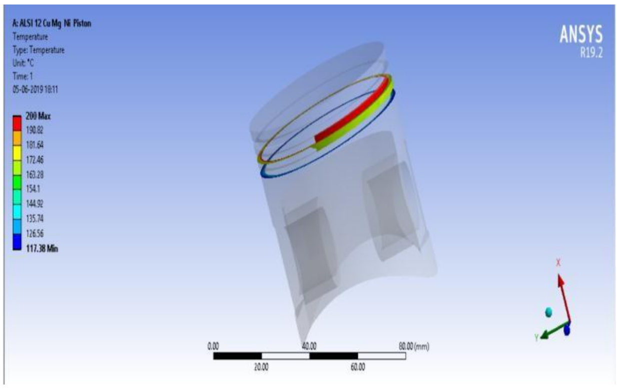


Fig.3.10 Temperature AL SI 12 Cu Mg Alloy Materials

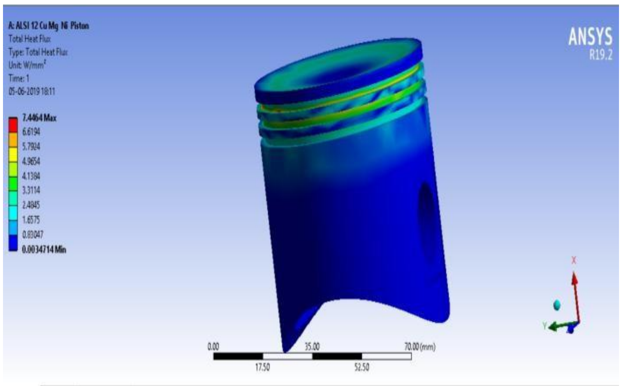


Fig.3.11 Total Heat Flux AL SI 12 Cu Mg Alloy materials

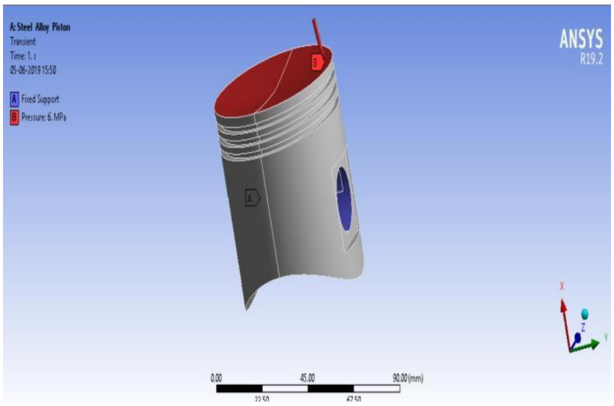


Fig.3.12 Pressure and fixed support boundary conditions S-460 steel Materials

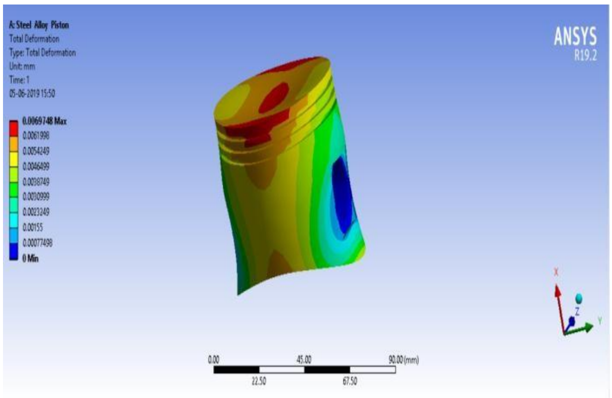


Fig.3.13 Total Deformation S-460 steel Materials Materials

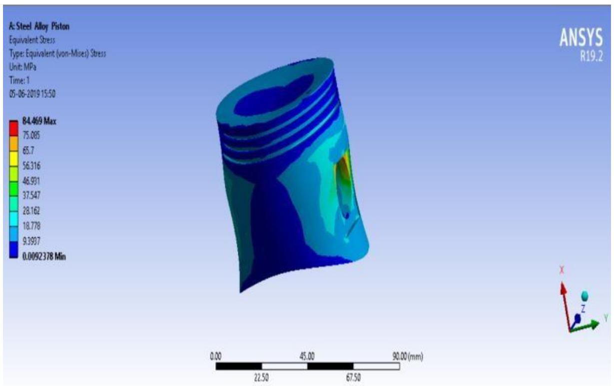


Fig.3.14 Total Deformation S-460 steel Materials Materials

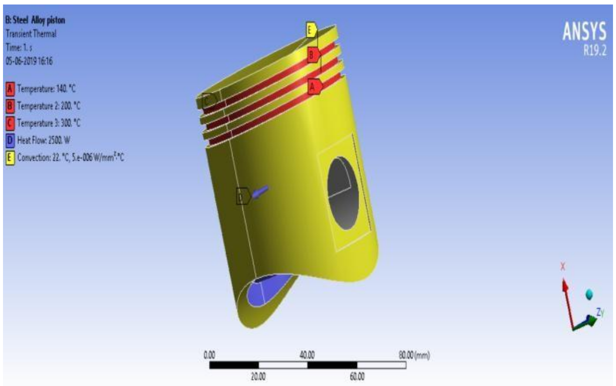


Fig.3.15 Transient Thermal heat flow S-460 steel Materials

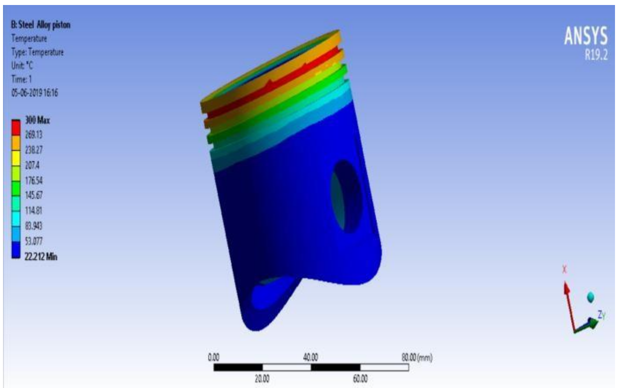


Fig.3.16 Temperature S-460 steel Materials

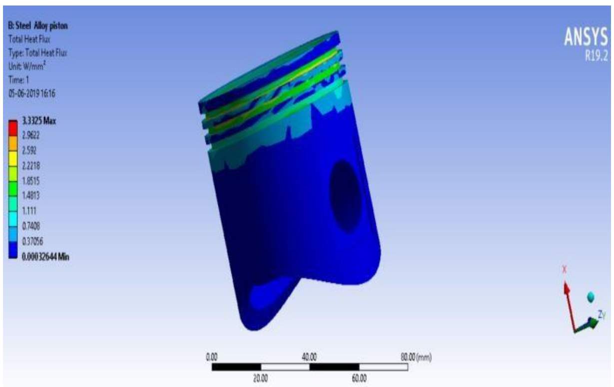


Fig.3.17 Total Heat Flux S-460 Steel Materials

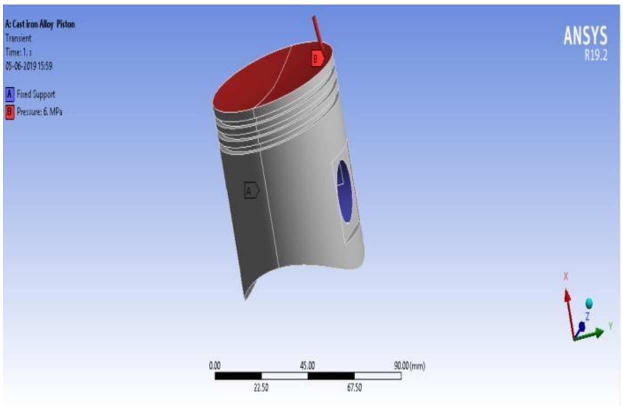


Fig.3.18 Pressure and fixed support boundary condition Cast iron Materials

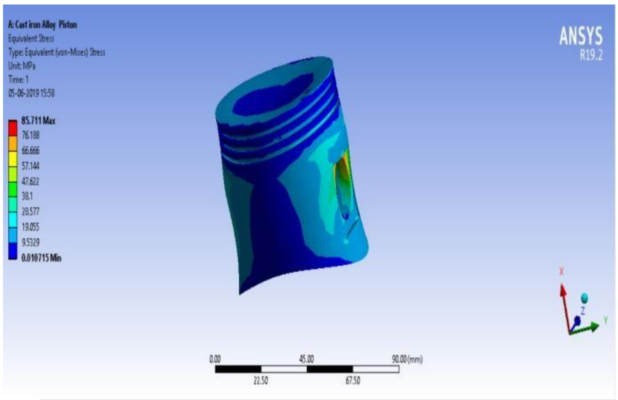


Fig.3.19 Equivalent Stress Cast iron Materials

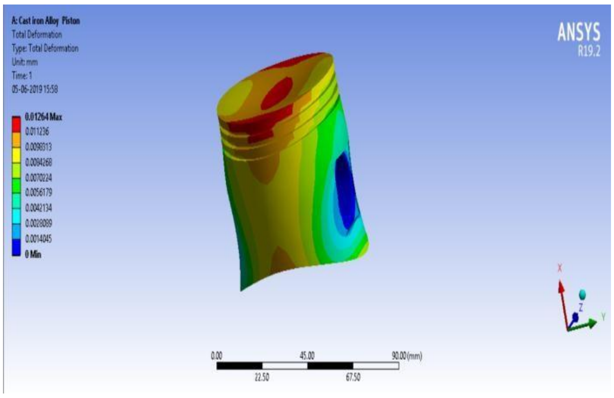


Fig.3.20 Total Deformation Cast iron materials

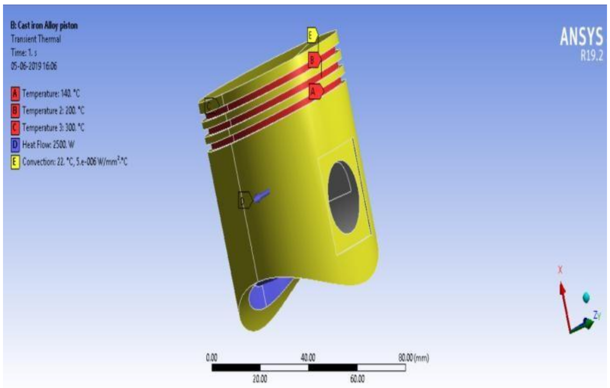


Fig.3.21 Transient Thermal Cast iron materials

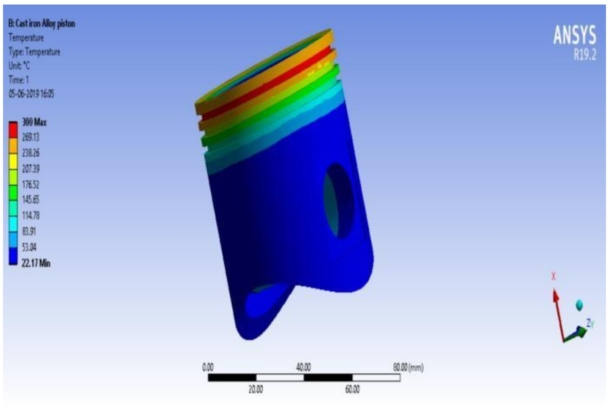


Fig3.22 Temperature Cast iron materials

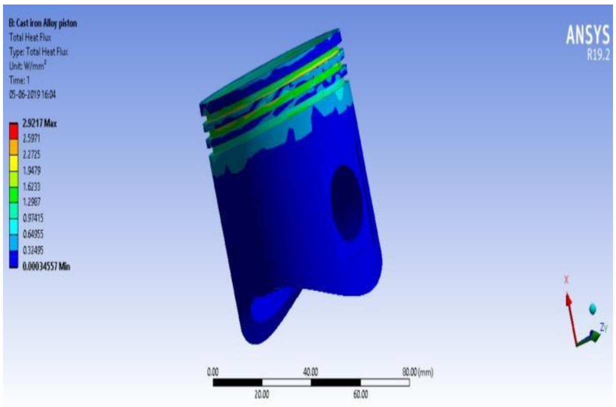


Fig. 3.23 Total Heat Flux Cast iron

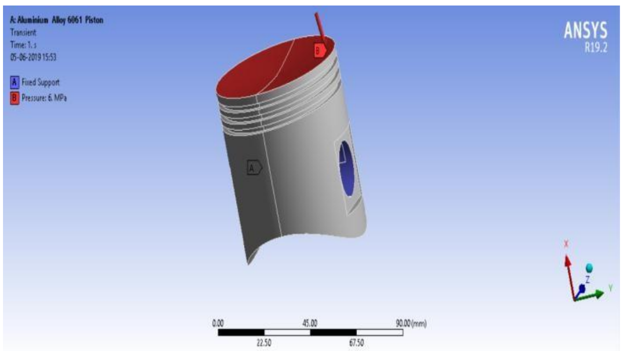


Fig.3.24 Transient Aluminium 6061 Alloy materials

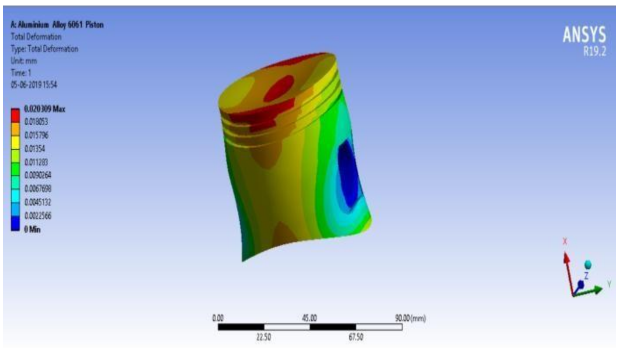


Fig. 3.25Total Deformation Aluminium 6061 Alloy materials

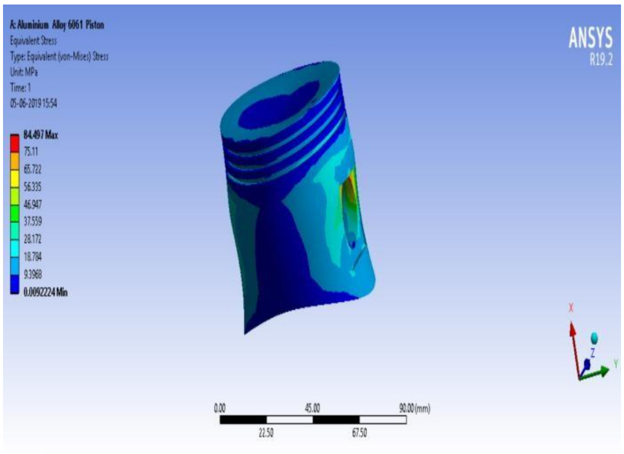


Fig.3.26 Equivalent Stress Aluminium 6061 Alloy materials

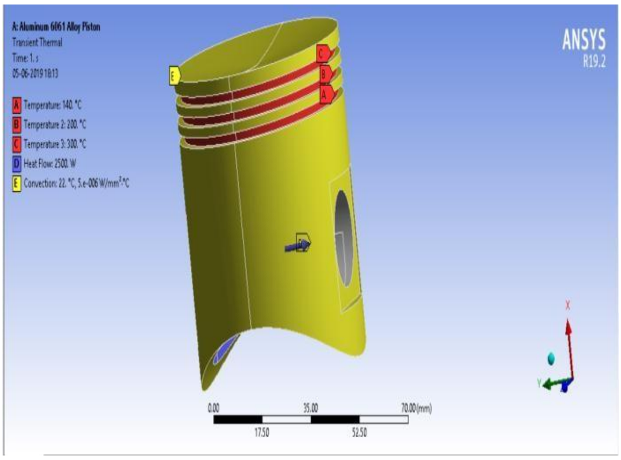


Fig. 3.27 Transient Thermal Aluminium 6061 Alloy materials

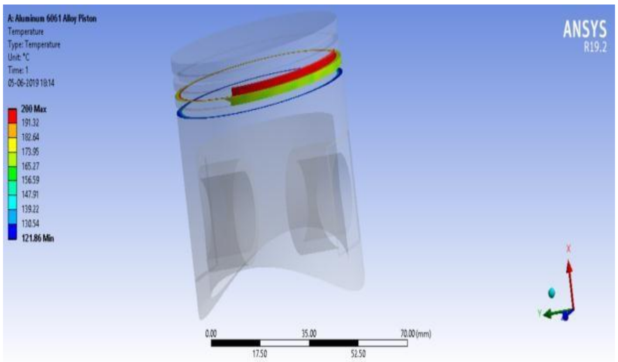


Fig 3.28 Temperature Aluminium 6061 Alloy materials

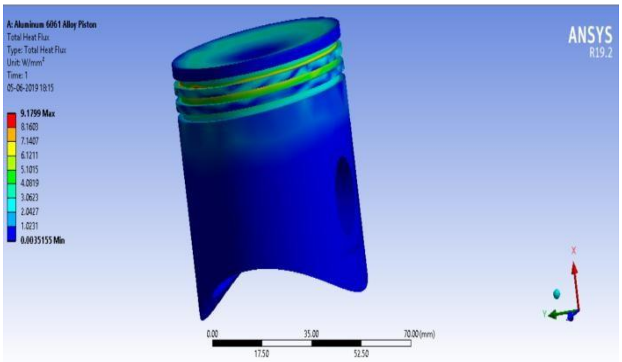


Fig. 3.29 Total Heat Flux Aluminium 6061 Alloy

IV. RESULT & DISCUSSION

We take four different materials 3D models of piston are created based on the dimensions obtained. CATIA V5R20 is used for creating the 3D model. These models are then imported into ANSYS WORKBENCH 19.2 for analysis. Static structural analysis of pistons is carried out.

Meshing is done with an automatic which gives a fine mesh. For statictransient structural analysis, gas pressure is applied on the top of the piston and frictionless support is applied across the surface of piston and also on the piston pin holes. Then results are obtained for von-misses stress and maximum elastic strain. A comparison is made between these results and the best suited aluminium alloy is selected based on the parameters.

- The static structural analysis of **S-460, Cast Iron, Aluminium Alloy 6061and AL SI 120Cu Mg Ni** are done and results are obtained for Thermal stress, Temperature, deformation and heat flux .

- Wecan observe that in case of equivalent (von-mises) stress, piston made of **S-460** is found to have maximum stress of 84.469 Mpa is observed. When piston made of **Cast Iron** then stress value maximum 85.71 MPa. Maximum stress on **Aluminum 6061 Alloy** is found to be84.49 Mpa and **AL SI 120Cu Mg Ni** that of was found to be84.91 Mpa.

- We can observe that in case of deformations (mm), piston made of **S-460** is found to have maximum deformation of 0.0069 mm is observed. When piston made of **Cast Iron** then deformation maximum value**0.012 mm**, when piston made**Aluminum 6061 Alloy**then deformation is found to be**0.023 mm** and deformation for **AL SI 120Cu Mg Ni**that of is found to be**0.017 mm**.
- We can observe that in case of **Temperature (ºC)**, piston made of **S-460** is found to have maximum

temperature of 269.13°**C** is observed. When piston made of **Cast Iron** then maximum temperature 269.13°**C**, maximum temperature for **Aluminum 6061 Alloy**is found to be**191.32°C**and maximum temperature for **AL SI 120Cu Mg Ni**that of is found to be**190.82 °C**.

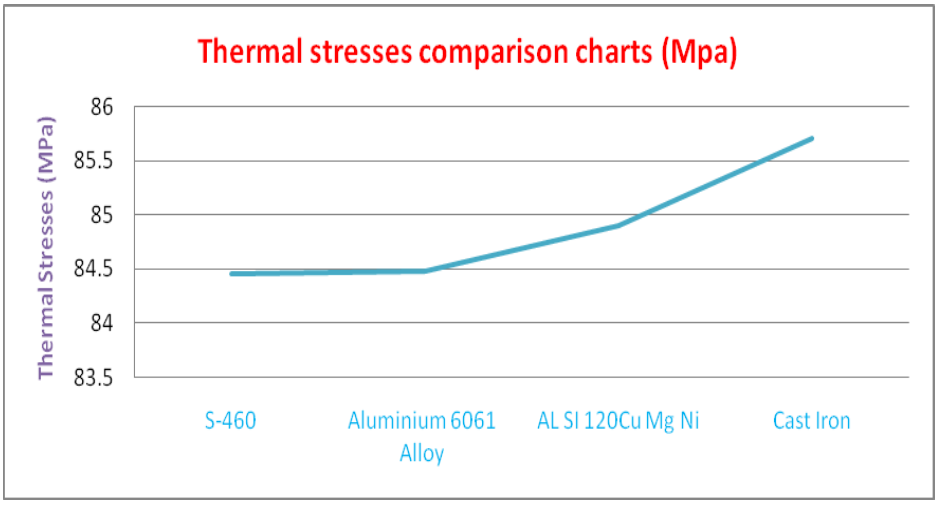


Fig.4.1 Comparison Graph for Stress with different materials

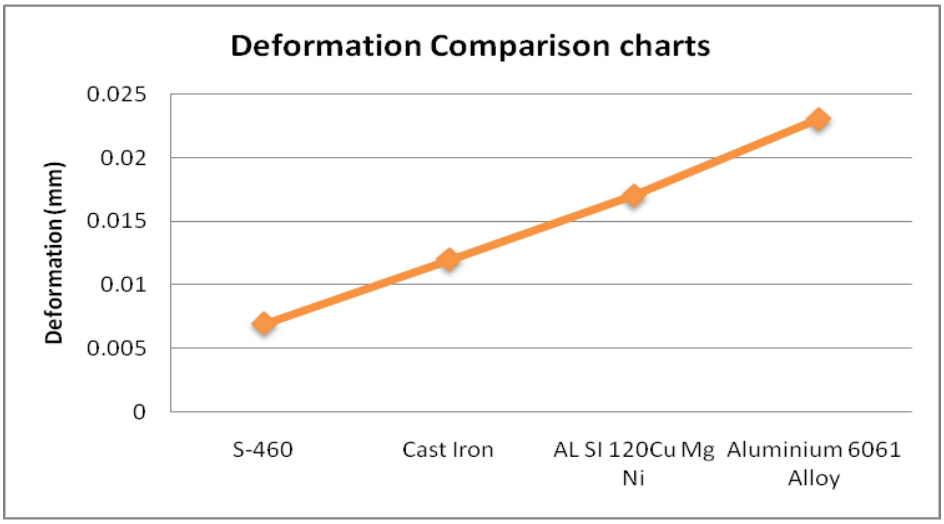


Fig.4.2Comparison Graph for Deformation with different materials

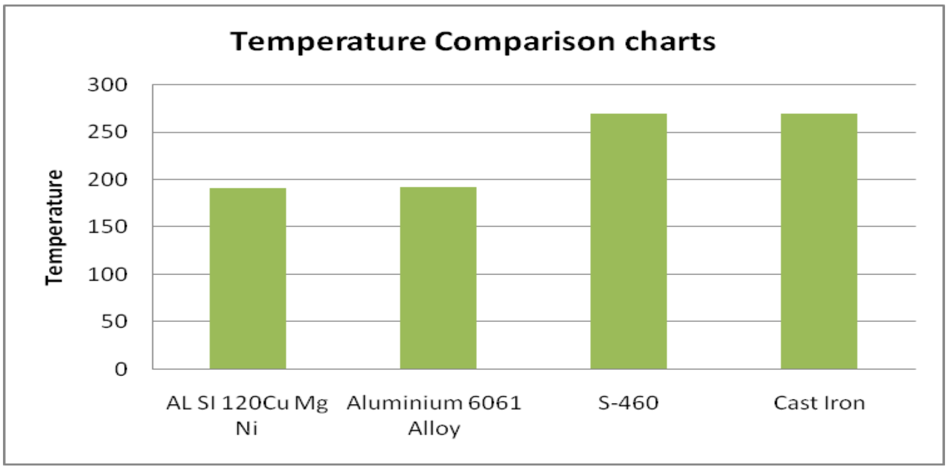


Fig.4.3 Temperature Comparison Charts

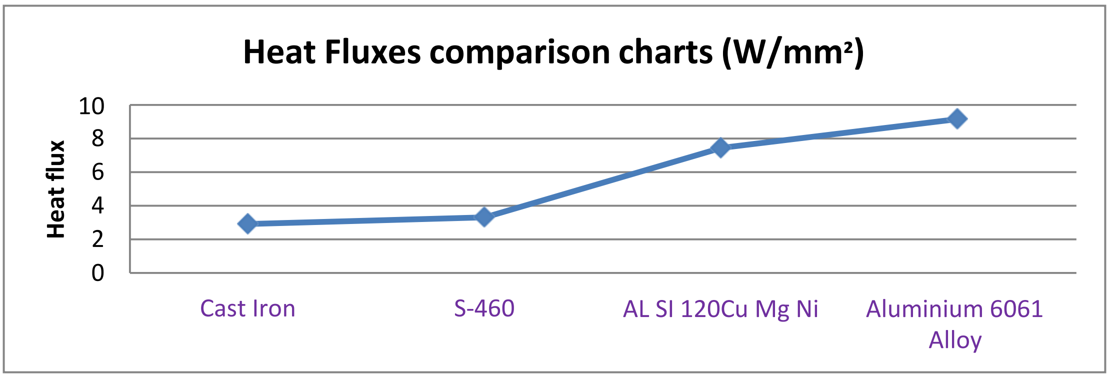


Fig.4.4 Heat Flux Comparison Charts

V. CONCLUSION

The basic ideas and outline techniques worried about single barrels petroleum engine have been considered in this paper the outcomes found by the utilization of this systematic strategy are almost equivalent to the genuine measurements utilized now a days. Henceforth it gives a quick strategy to outline a piston which can be additionally enhanced by the utilization of different programming and strategies. The most critical part is that less time is required to outline the piston and just a couple of essential detail of the engine.

Pistons made of various materilas like Aluminium 6061 Alloy, S-460, Cast Iron and **AL SI 120Cu Mg Ni** were outlined and investigated effectively.

- In static-auxiliary investigation, the pistons were examined to discover the proportional (von-mises) stress, comparable flexible strain and deformation.
- It tends to be seen that greatest stress force is on the base surface of the piston crown in every one of the materials.

Here we selected Aluminium6061Alloy this material has more heat flux value with different materials. So we will be recommended this material for future work.

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