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"TRANSIENT THERMAL ANALYSIS OF IC ENGINE PISTON HEAD DESIGN USING FEA METHOD BY USING ANSYS SOFTWARE"

***Harshit Karole* [1], *Dr. S.K. Nagpure* [2]**

[1]*P.G. Scholar, Dept. of Mechanical Engineering, Scope College Of Engineering, Bhopal, MP, India*

[2]*Assistant Professor, Dept. of Mechanical Engineering, Scope College Of Engineering, Bhopal, MP, India*

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 A2618, ALG-HS 1300 Aluminium Alloy and TI-6AI-4V Alloy Titanium 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 .

Keyword: *CATIA, ANSYS, Modeling, Analysis, Structure, FEM*

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.

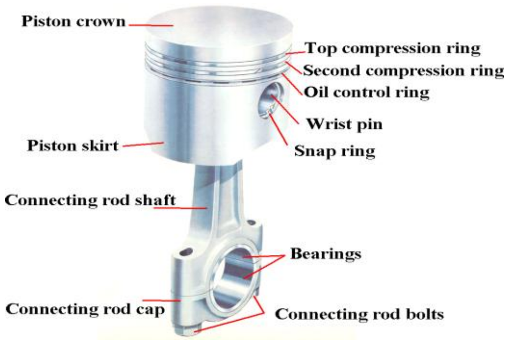

Figure-1

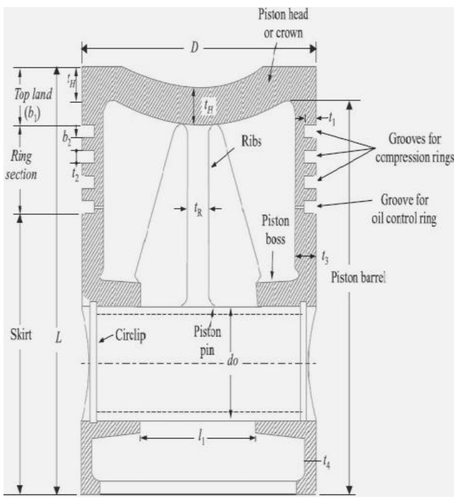

Figure-2

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II. MATERIALS

We have selected three materlas

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

III. MODELING & SIMULATION

SPECIFICATIONS (Hero CD Deluxe)

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

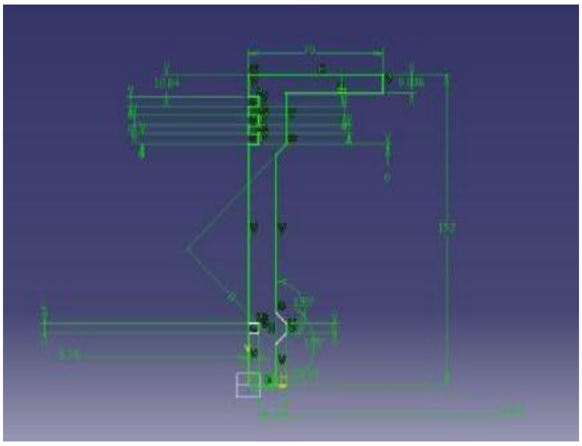

Fig.3.1 2D Drafting

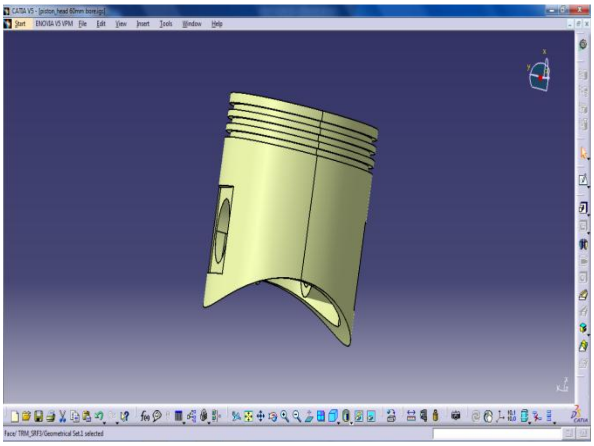

Fig.3.2 CATIA Model

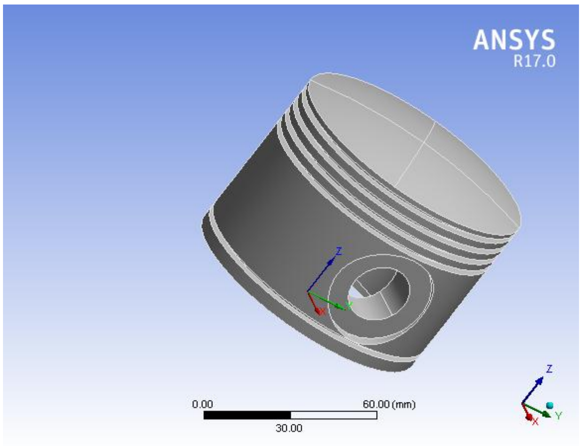

Fig.3.3 Import Geometry ANSYS

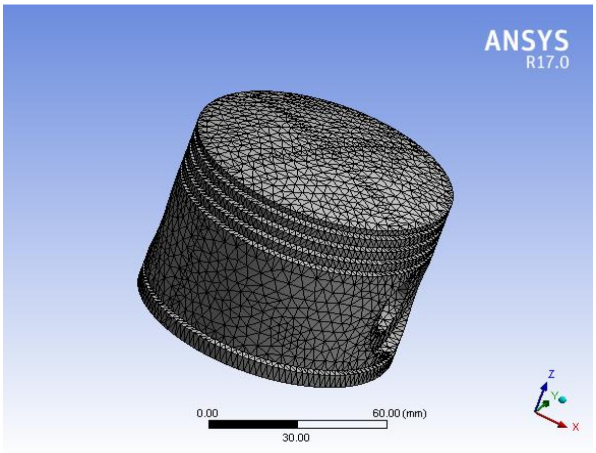

Fig.3.4 Meshing

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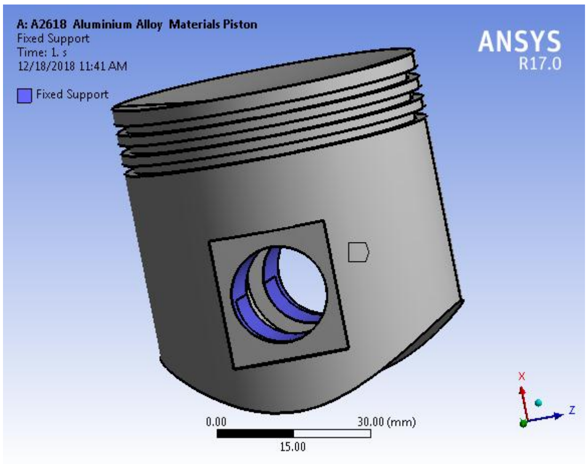

Fig.3.5 Fixed support A2618 Aluminium Alloy

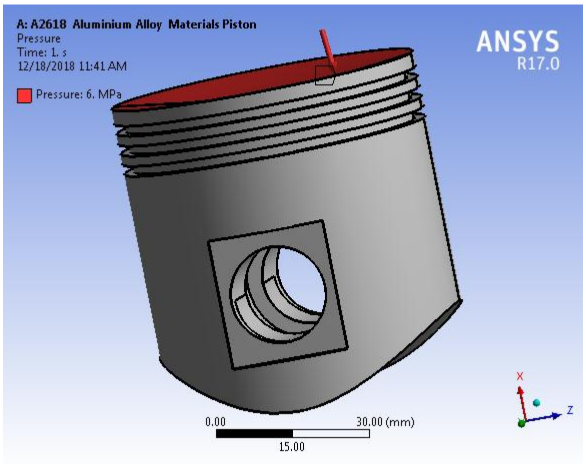

Fig. 3.6 Pressure applied A2618 Aluminium

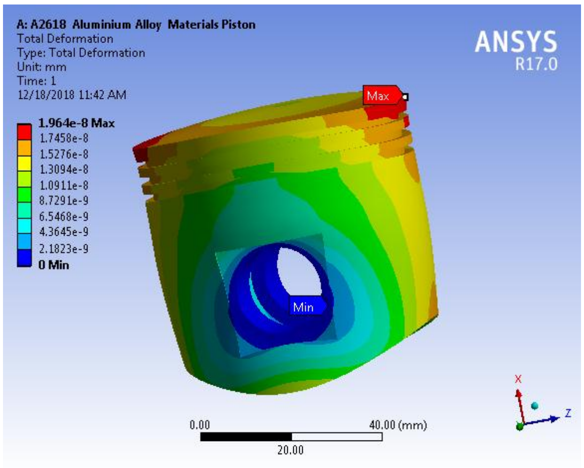

Fig. 3.7 Total Deformation A2618 Aluminium Alloy

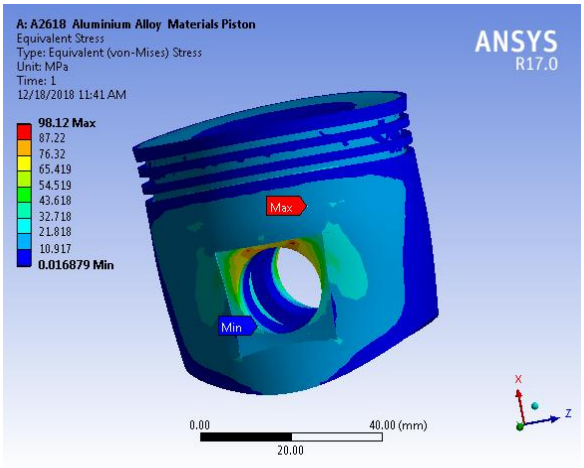

Fig.3.8 Equivalent Stress A2618 Aluminum Alloy

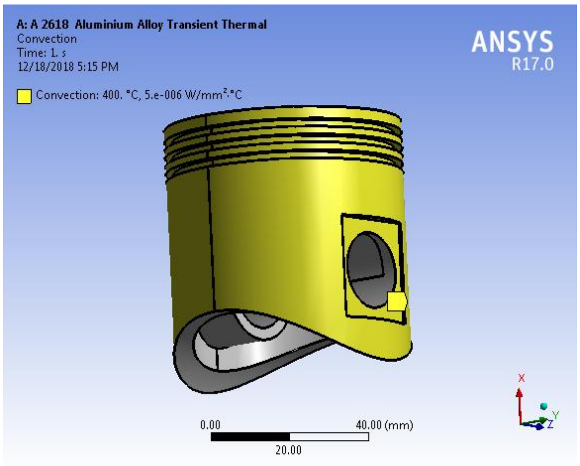

Fig.3.9 Transient Thermal Boundary

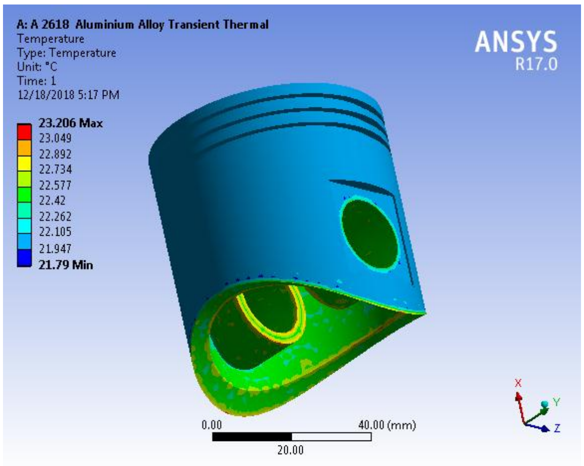

Fig.3.10 Temperature A2618 Aluminium Alloy

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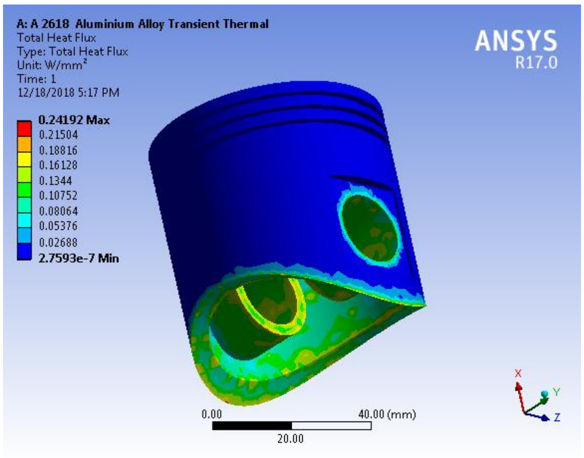

Fig.3.11 Total Heat Flux A2618 Aluminium Alloy

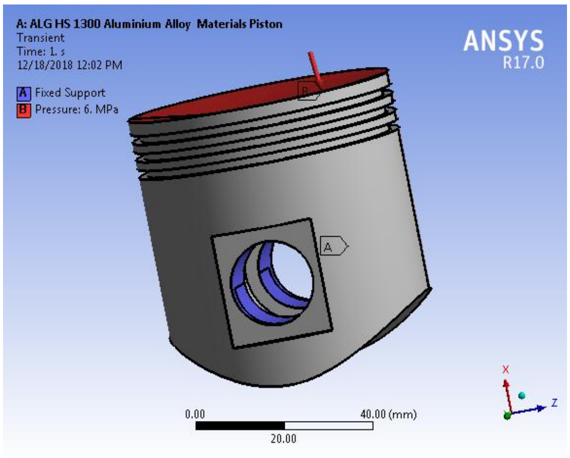

Fig.3.12 Pressure and fixed support boundary conditions ALG-HS 1300 Materials

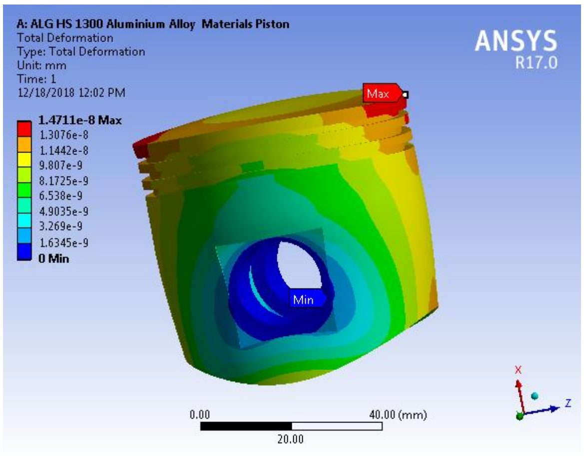

Fig.3.13 Total Deformation ALG-HS 1300 Materials

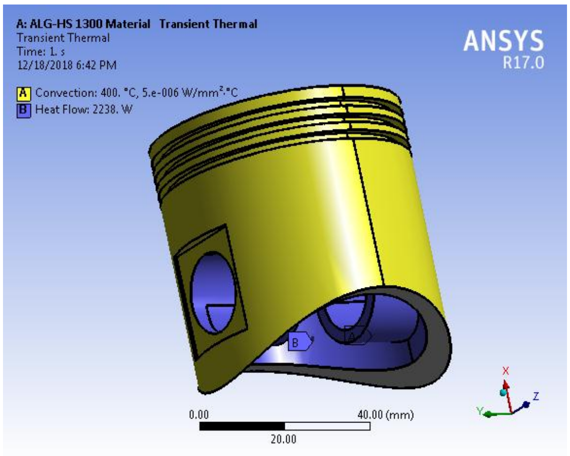

Fig.3.14 Transient Thermal heat flow ALG-HS 1300 Materials

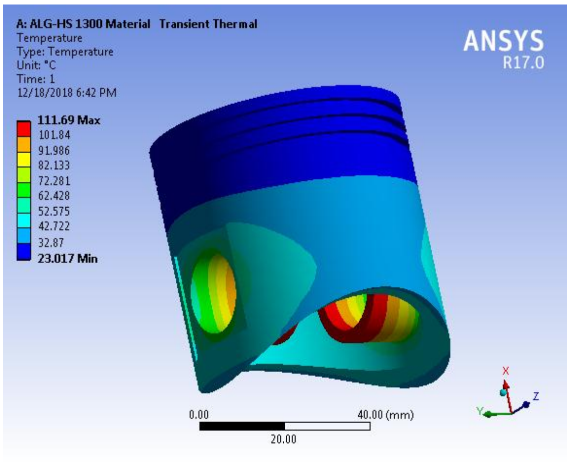

Fig.3.15 Temperature ALG-HS 1300 Materials

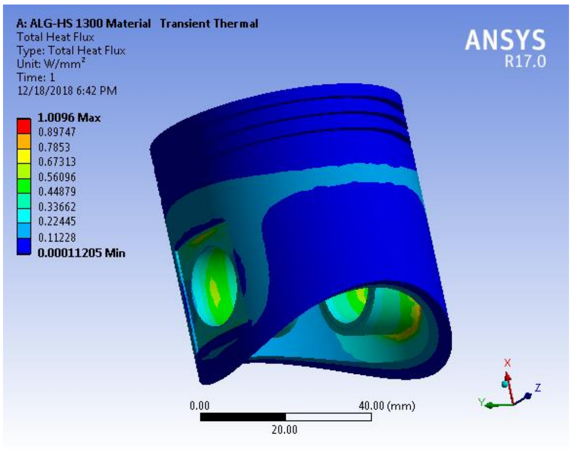

Fig.3.16 Total Heat Flux ALG-HS 1300 Materials

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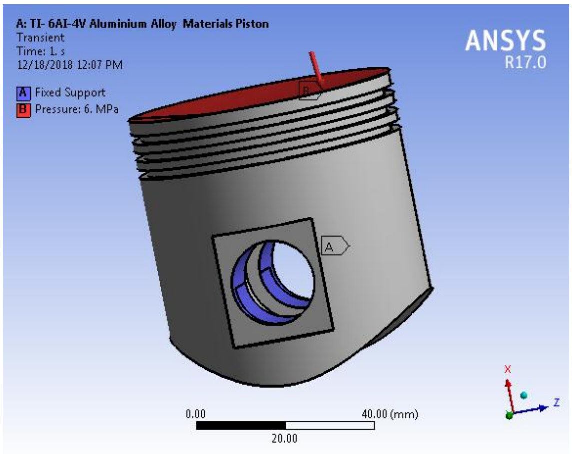


Fig.3.17 Pressure and fixed support boundary condition Titanium Alloy TI-6AI-4V Materials

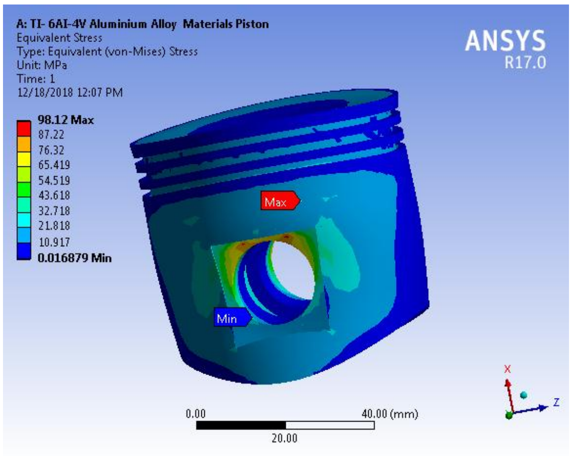


Fig.3.18 Equivalent Stress Titanium Alloy TI-6AI-4V Materials

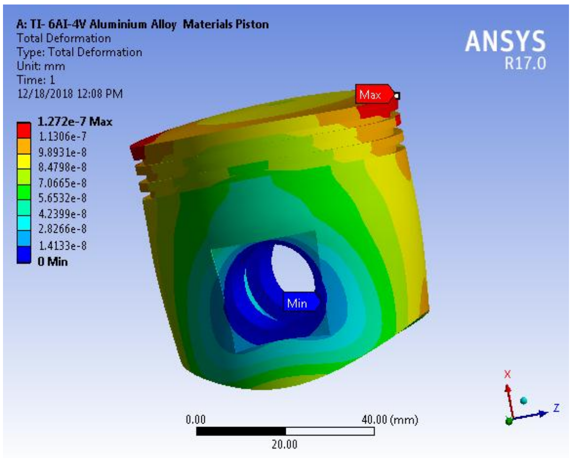


Fig.3.19 Total Deformation Titanium Alloy TI-6AI-4V Materials

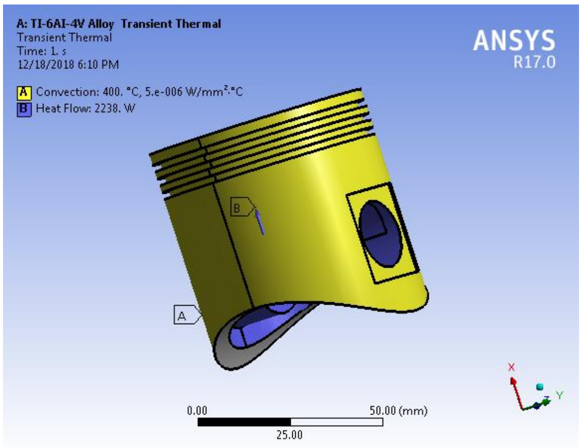
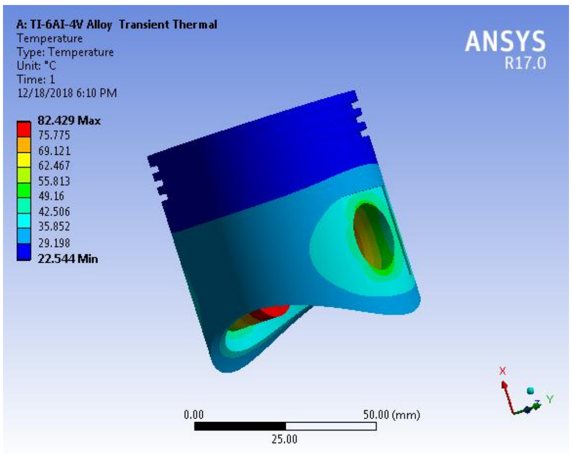


Fig.3.20 Transient Thermal Titanium Alloy TI-6AI-4V



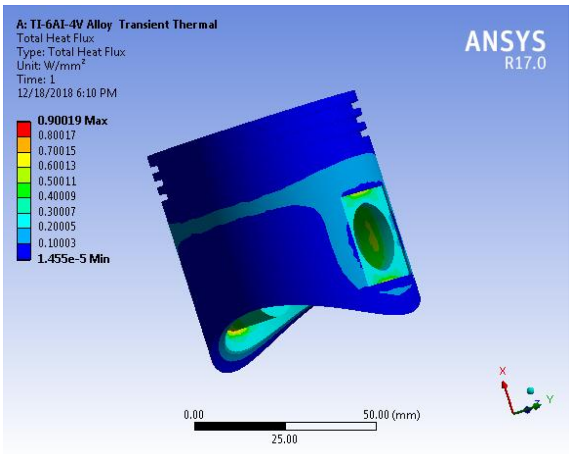


Fig3.21 Temperature Titanium Alloy TI-6AI-4V

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IV. RESULT & DISCUSSION

We take three 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 17.0 for analysis. Static structural analysis of pistons is carried out.

Meshing is done with an automatic which gives a fine mesh. For static 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 **A2618 Aluminium, ALG- HS 1300 Alloy, TI-6AI-4V Titanium Alloy** are done and results are obtained for Equivalent (Von-Mises) stress, Temperature, deformation and heat flux .

We can observe that in case of **equivalent (von-mises) stress**, piston made of A2618 is found to have maximum stress of 98.12 Mpa is observed. When piston made of **ALG-HS 1300** then stress value maximum 97.9 MPa. when piston made of TI-6AI-4V Titanium titanium alloy then Maximum stress on is found to be 98.12 Mpa .

We can observe that in case of **deformations** , piston made of A2618 is found to have maximum deformation of 1.96E-08 mm is observed. When piston made of ALG-HS 1300 then deformations value maximum 1.47E-08 mm. when piston made of TI-6AI-4V Titanium titanium alloy then Maximum deformation on is found to be 1.27E-07 mm . We can observe that in case of **Temperature** , piston made of **A2618** is found to have maximum temprature of 23.2 °C is observed. When piston made of ALG-HS 1300 then temperature value maximum 111.6 °C. when piston made of TI-6AI-4V Titanium titanium alloy then Maximum temperature on is found to be 82.4 °C

We can observe that in case of **heat flux (w/mm²)**, piston made of **A2618**is found to have maximum heat flux of **0.24 (w/mm²)**, is observed. When piston made of ALG-HS 1300 then heat flux value maximum **1 (w/mm²)**, maximum heat flux for TI-6AI-4V Titanium alloy is found to be **0.810 (w/mm²)**, and maximum heat flux for titanium alloy that of is found to be **0.9 (w/mm²)**.

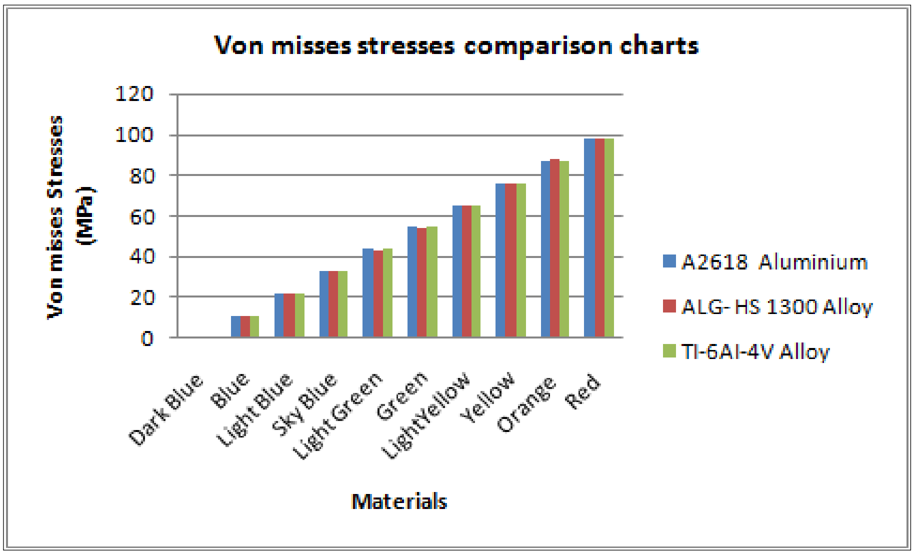

Fig.4.1 Comparison Graph for Stress with different materials

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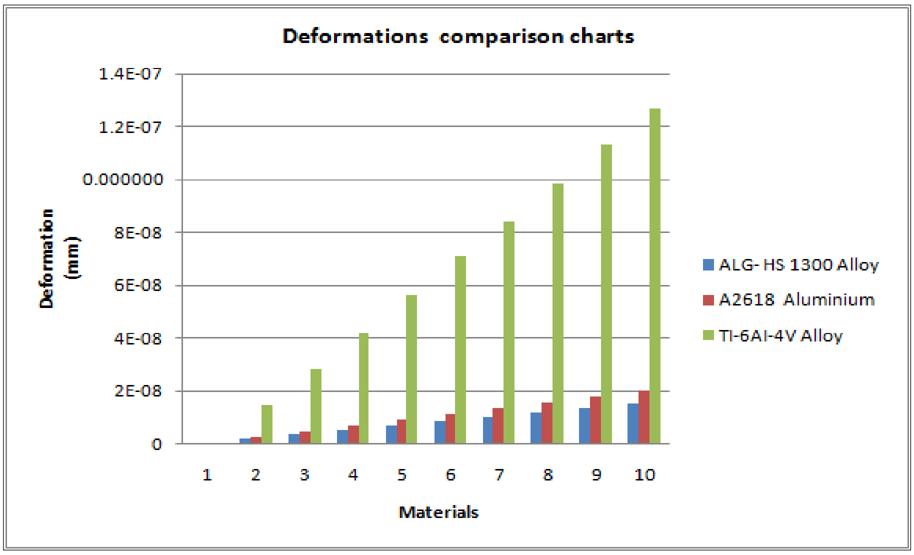

Fig.4.2Comparison Graph for Deformation with different materials

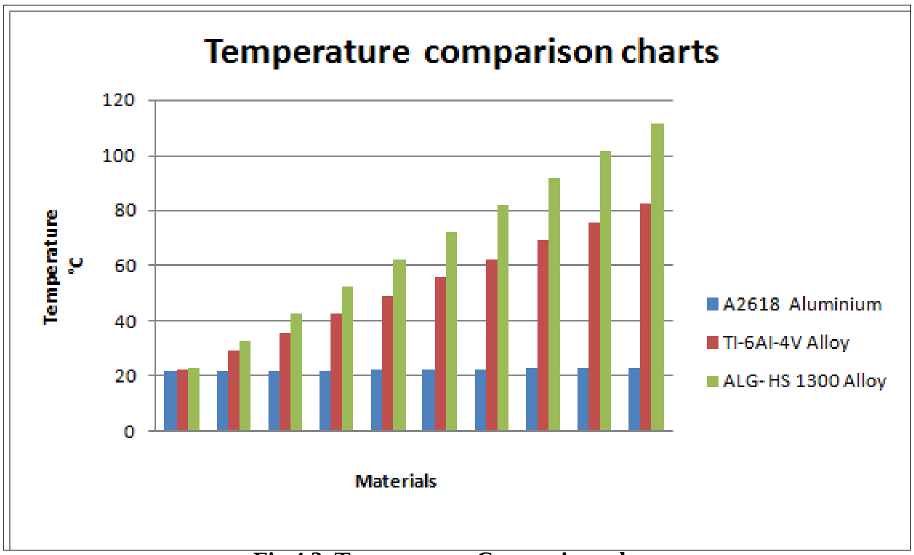

Fig.4.3 Temperature Comparison charts

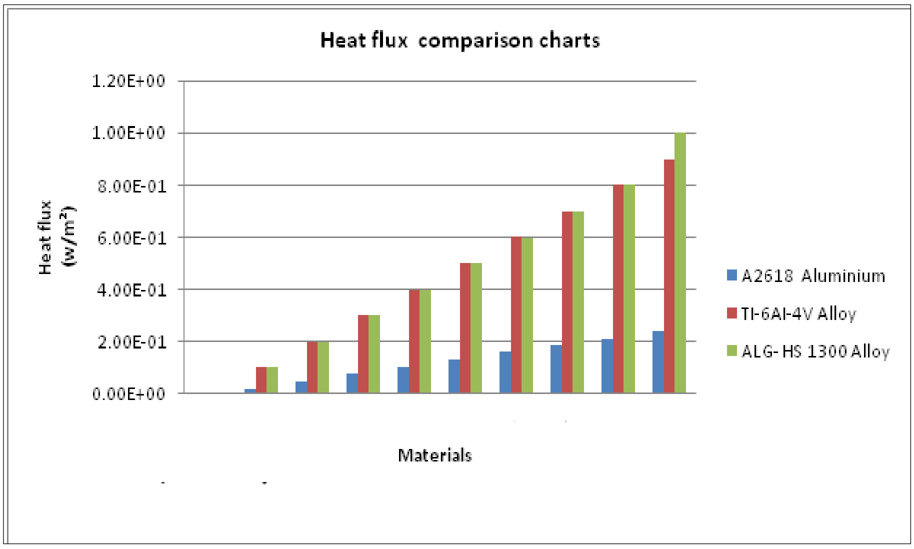

Fig.4.4 Heat Flux Comparison Charts

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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 aluminum amalgams like A2618, AL-GHS 1300, Ti-6Al-4V 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 ALG-HS 1300 this material has less deformation esteem contrast with different materials of aluminum composite. So we will be recommended this material for future work.

Fig. 5.1 Actual piston

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