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"DESIGN AND ANALYSIS OF A PETROL ENGINE PISTON WITH DIFFERENT MATERIAL"

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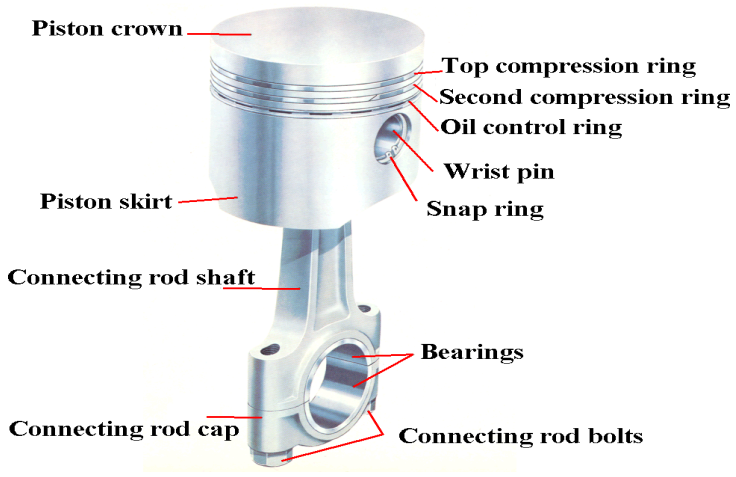
ABSTRACT

Cylinder is one among the most basic parts in a reciprocating engine, gas blowers and pneumatic barrels, among other comparable mechanisms in which it changes over the substance imperativeness acquired by the consuming of fuel into supportive (work) mechanical control. The present proposition manages the properties of cylinder material identified with heat.Primary issue anticipated that would be found in the framework of the broad cylinder is the distortion, because of weight and temperature. The glow starting from the exhaust gases will be the essential reason of deformation.The most critical part is that less time is required to outline the cylinder and only a couple of essential detail of the engine. Cylinders made of different materials like Aluminum Alloy, Structure steel (S-460), Cast Iron Alloy and Titanium Alloy were outlined and investigated effectively. In static- investigation, the cylinders were examined to discover the relative (von-mises) stress, comparable flexible strain and deformation. It tends to be seen that greatest stress force is on the base surface of the cylinder crown in every one of the materials. Here we discovered Ti-Al-4V alloy.

***Keyword**: Solidwork , 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.



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II. MATERIAL SELECTION

We have selected three materlas

- Aluminium Alloy
- Structural Steel (S-460)
- ALSI Alloy
- Cast iron

III. MODELING & SIMULATION

SPECIFICATIONS (Splendor-Pro)

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

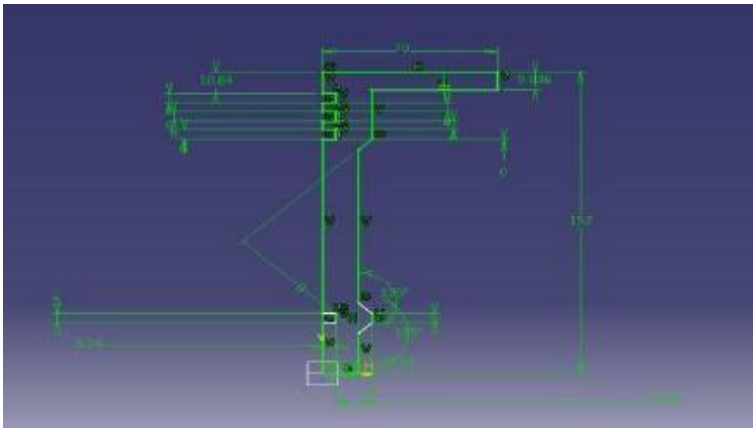

Fig.3.1 2D Drafting

Alumium Alloy piston

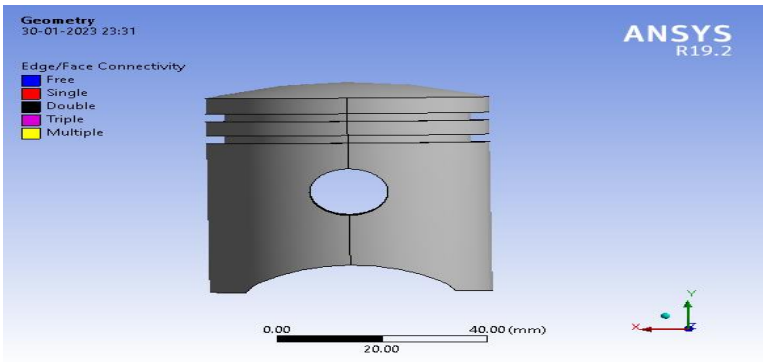

Fig.3.2 Piston model import in ANSYS

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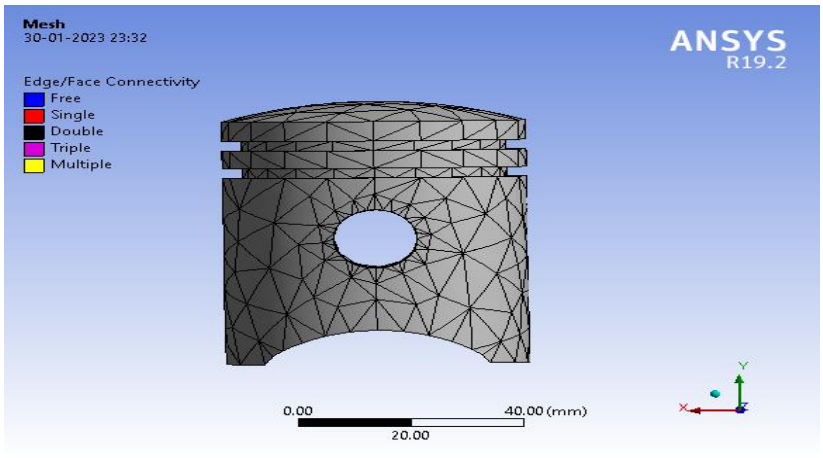

Fig.3.3 Piston meshing model

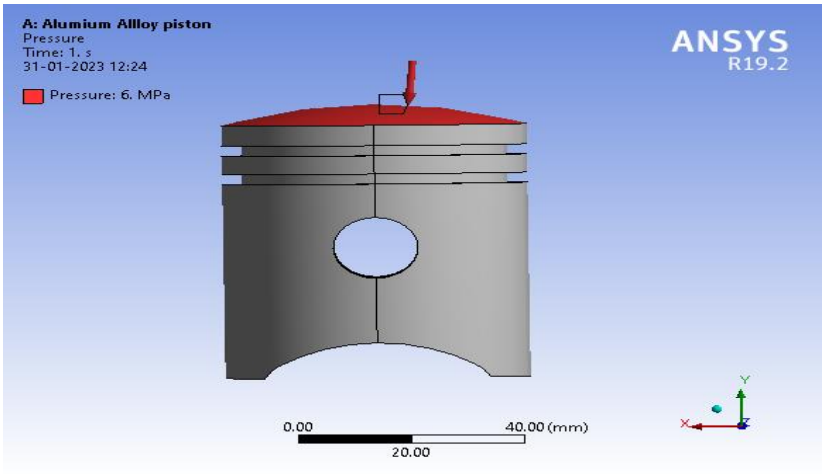

Fig. 3.4 Aluminum alloy piston 6 MPa pressure applied on crown

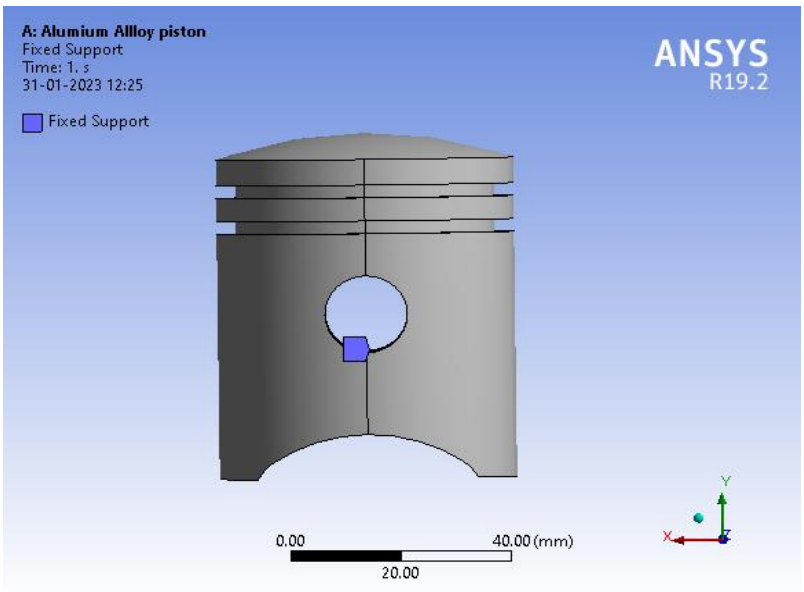

Fig. 3.5 Aluminum alloy piston fixed support boundary condition applied

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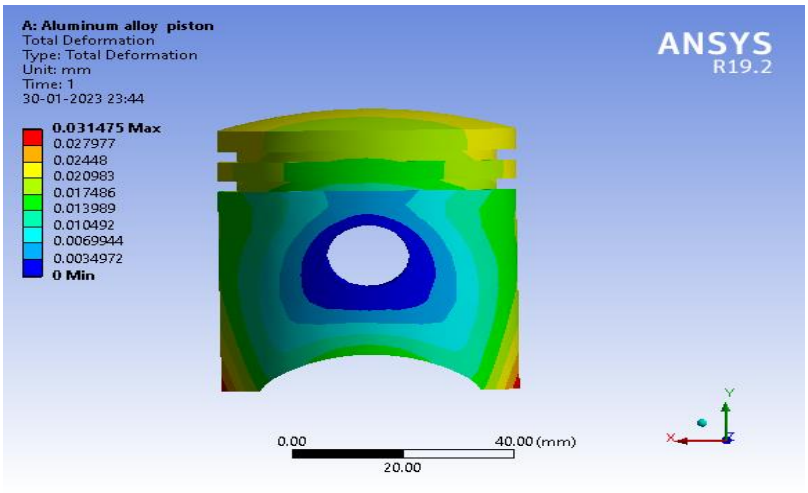

Fig.3.6 Aluminum alloy piston deformation results

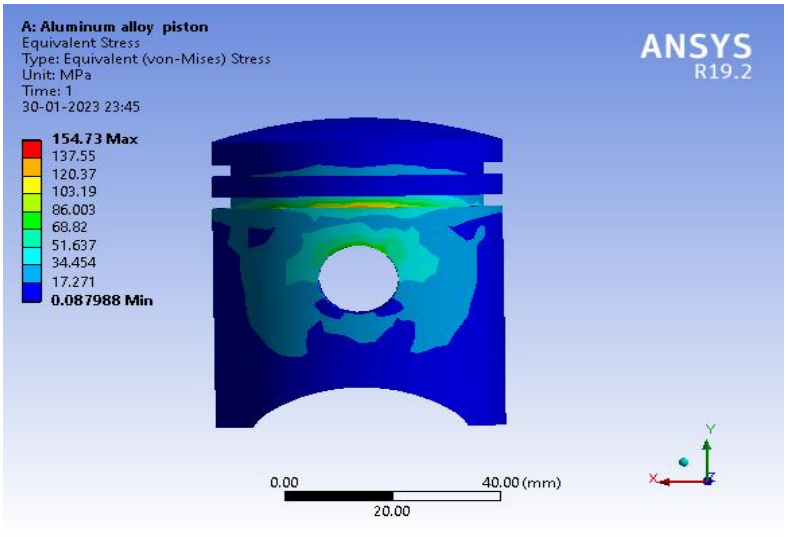

Fig. 3.7 Aluminum alloy piston stresses results

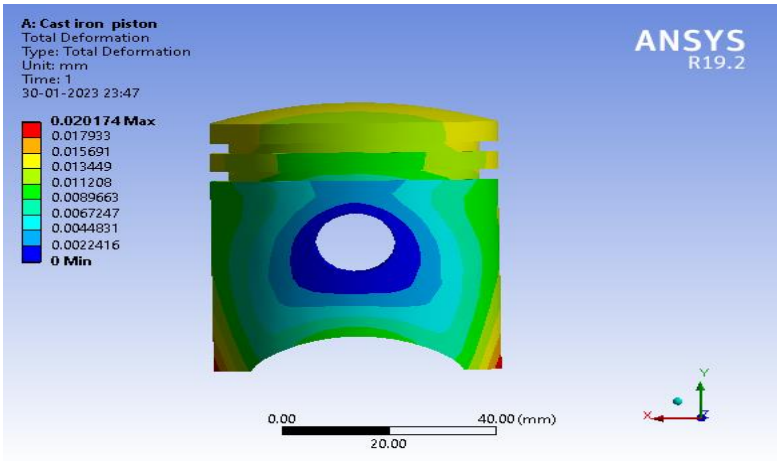

Fig. 3.8 Cast iron alloy piston deformation results

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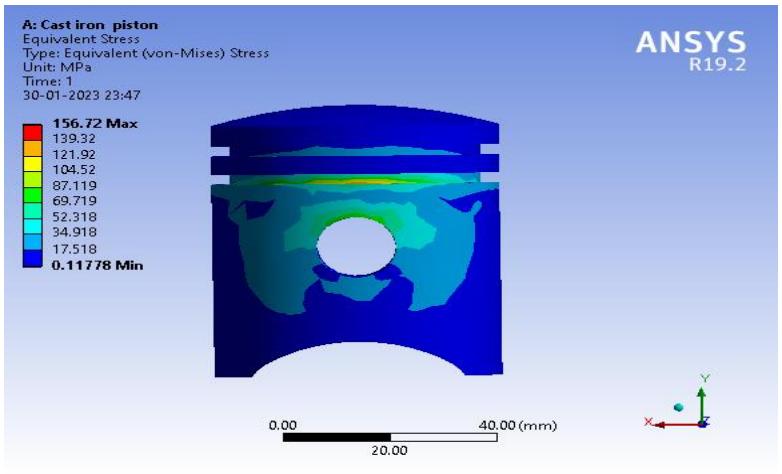

Fig.3.9 Cast iron alloy piston stresses results

TI-6A- 4V

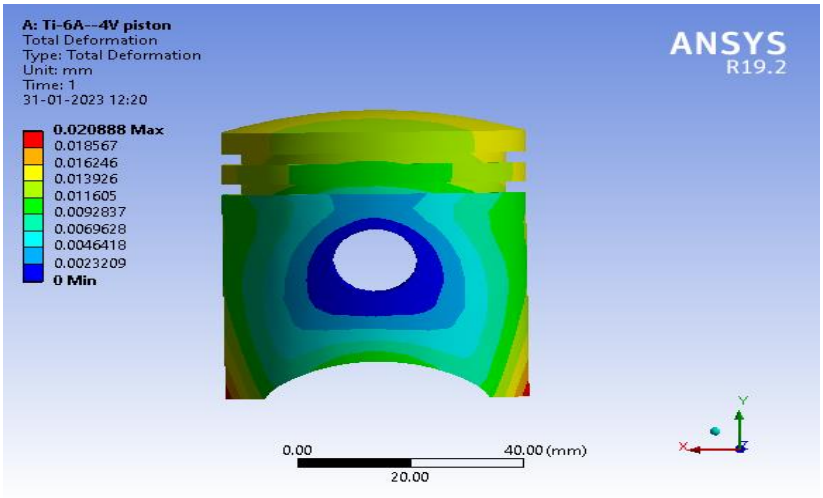

Fig.3.10 TI-6A- 4V alloy piston deformation results

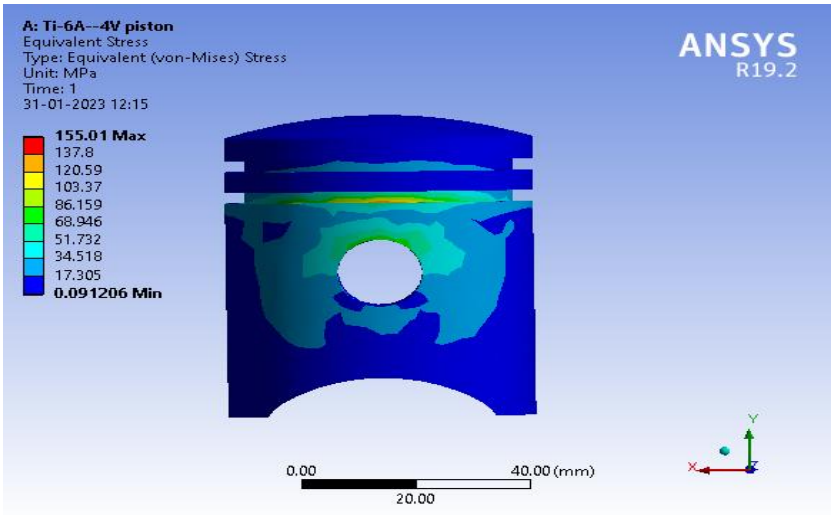

Fig.3.12 TI-6A- 4V alloy piston stresses results

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IV. CONCLUSION

Based on the measured dimensions, three-dimensional piston models were created using SOLIDWORKV5R20, a three-dimensional model. Then, for evaluation, these models were imported into ANSYS WORKBNCH 19.2. A check of the static structure of the pistons is carried out. An automatic meshing process is used to produce high quality mesh. Fuel pressure is applied to the piston pin and a frictionless guide is applied to the entire piston surface as well as the piston pin holes to evaluate the static transient structure. Then the results of von Misses strain and maximum elastic strain are obtained. These results are compared and the most suitable aluminum alloy is selected according to the parameters. Static structural assessments of cast iron, 6061 aluminum alloy and Ti-Al-4V were performed and results were obtained for thermal stress, temperature, strain and heat flow. We can confirm that a cast iron piston produces a maximum pressure of 155 MPa under equivalent pressure (von-mis). The maximum stress for 6061 aluminum alloy is calculated as 156.72 MPa, while Ti-Al-4V is calculated as 155 MPa.

- 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 Aluminium 6061Alloy this material has more heat flux value with different materials. So we will be recommended this material for future work.

REFERENCES

1. Skopp a,, N. Kelling a,, M. Woydta,, L.-M. Berger b,, Thermally sprayed titanium sub oxide coatings for piston ring/cylinder liners under mixed lubrication and dry-running conditions, Wear 262 (2007) 1061–1070

2. A. V. Sreenath And N. Raman, Running-In Wear Of A Compression Ignition Engine: Factors Influencing The Conformance Between Cylinder Liner And Piston Rings, Wear, 38 (1976) 271 – 289

3. B. Zhang, X. Peng , Z. He, Z. Xing, P. Shu, Development of a double acting free piston expander for power recovery in trans critical CO2 cycle, Applied Thermal Engineering 27 (2007) 1629–1636

4. C. Friedrich a,, G. Berg a, E. Broszeit a, F. Rick b, J. Holland b, PVD CrxN coatings for tribological application on piston rings, Surface and Coatings Technology 97 (1997) 661–668

5. C.W. Huanga,, C.H. Hsuehb,c, Piston-on-three-ball versus piston-on-ring in evaluating the biaxial strength of dental ceramics, Dental materials 2 7 (2 0 1 1) e117–e123

6. D. J. Picken; H. A. Hassaan, A Method for Estimating Overhaul Life of Internal Combustion Engines including Engines Operating, J. agric. Engng Res,28. (1983), 139-147

7. Dacheng Li a,, Haiqi Wub, Jinji Gao b, Experimental study on stepless capacity regulation for reciprocating compressor based on novel rotary control valve, International journal of refrigeration 36 (2013) 1701 e1715

8. Dhananjay Kumar Srivastava a, Avinash Kumar Agarwal a,, Jitendra Kumar b, Effect of liner surface properties on wear and friction in a non-firing engine simulator, Materials and Design 28 (2007) 1632–1640

9. E.P. Becker a,, K.C Ludema b, A qualitative empirical model of cylinder bore wear, Wear, 225-229 (1999) 387-404

ISSN : 2455-9679
SJIF Impact Factor : 6.008

10. F.S. Silva , Fatigue on engine pistons – A compendium of case studies, Engineering Failure Analysis 13 (2006) 480– 492

11. G. Floweday a, S. Petrov b, R.B. Tait b,, J. Press c, Thermo-mechanical fatigue damage and failure of modern high performance diesel pistons, Engineering Failure Analysis 18 (2011) 1664–1674

12. H. Sunden and R. Schaub , Piston rings for slow and speed diesel engines, Tribology International February 1979

13. J. E. Willn, Characterisation Of Cylinder Bore Surface Finish A Review Of Profile Analysis, Wear - Elsevier Sequoia S.A., Lausanne - Printed in the Netherlands

14. J. Galligan a, A.A. Torrance a,), G. Liraut b , A scuffing test for piston ring bore combinations: Pt. II. Formulated motor lubrication, Wear 236 (1999) 210–220

15. Jarosław Milewski, Łukasz Szabłowski, Jerzy Kuta, Control strategy for an Internal Combustion engine fuelled by Natural Gas operating in Distributed Generation, Energy Procedia 14 (2011) 1478 – 1483

16. L. Ceschini, A.Marconi, C.Martini n, A.Morri, Tribological behavior of components for radial piston hydraulic motors: Bench tests, failure analysis and laboratory dry sliding tests, Wear 305 (2013) 238 –247