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Design and Analysing the Piston Head by using Computer Softwares

(SOLIDWORKS, CREO, ANSYS)

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Abstract:- Piston plays a main role in energy conversation. Failure of piston due to various thermal and mechanical stresses. The working condition of the piston is so worst in comparison of other parts of the internal combustion engine. The main objective of the work is to design and analyze the piston head. Design and analysis of an IC engine piston using different material that are used in these project. We are taking pulsar 220 piston dimensions different materials (grey cast iron, aluminum). Have been selected for analysis of piston and we created a piston head 13.65 Mpa and 19.649 N on this two materials. Finally we find out which one is the suitable material on piston. We applied temperature 4000c on piston crown. Ansys provide simulation solutions that enable designers to simulate design performance directly on the desktop. The software uses the Finite Element Method FEM is a numerical technique for analyzing engineering designs. Design of piston is carried out using SOLID WORKS and CREO software, thermal analysis is performed using Finite Element Analysis (FEA).

1. INTRODUCTION

An internal combustion engine is defined as an engine in which the chemical energy of the fuel is released inside the engine and used directly for mechanical work, as opposed to an external combustion engine in which a separate combustor is used to burn the fuel. Drawing software is defined as a computer program for creating art on the computer. An example of drawing software is the paint program on many computers. Drawing software are the computer assisted drawing programs used by engineers. The mechanical drawing software's like AutoCAD, Solid works, Creo, Catia, etc… The Analysis also plays main role in computer drawing to analyzing design and material. The Analysis is the process of breaking a complex topic or substance into smaller part in order to gain a better understanding of it. As of year 2000, in the United States alone there internal combustion engines. In 1900, steam engines were used to power ships and railroad locomotives; today two- and four- stoke diesel engines are used.Priorto1950, aircraft relied almost exclusively on the pistons engines. The adoption and continued use of the internal combustion engine in different application areas has resulted from its relatively low cost, favorable power to weight ratio, high efficiency, and relatively simple and robust operating characteristics of compressing or ejecting The technique has been applied in the study of mathematics and logic since before Aristotle (384-322 B.C.), though analysis as a formal concept is a relative recent development.

2. GRAY CAST IRON

Gray cast iron is a type of cast iron, that has a graphitic micro structure. It is named after the gray color of the fracture it forms, which is due to the presence of Graphite. It is the most common cast iron and the most widely used cast material based on weight. It is used for housings where the stiffness of the component is more important than its tensile strength, Such as internal combustion engine cylinder blocks.

Fig 2(a) Gray cast iron

ADVANTAGE OF GRAY CAST IRON

- Gray cast iron is a common engineering alloy, because its relatively low cost and good machinability.
- The gray cast iron has excellent damping capacity because observes the energy and convert it into heat.
- It has good galling and wear resistance.

3. SOFTWARE USED

3.1 Solid works 2014
3.2Ansys R 18.1
3.3creo Parametric 4.0

3.1 SOLID WORKS

Solid works is a solid modeling computer aided design and computer aided engineering computer program that runs on Microsoft windows. Solid works is published by Dassault System's. According to the publisher, over to million engineers and designers at more than 165,000 companies were using solid works. Piston Design The piston is designed according to the procedure and specification which are given in the dimensions are calculated in terms of SI Units. The pressure applied on piston head, temperatures of various areas of the piston, heat flow, stresses, strains, length, diameter of piston and hole, thicknesses, etc., parameters are taken into consideration Design Considerations for a Piston. Solid works is a solid modeler, and utilizes a parametric feature based approach which was initially developed by PTC (creo /pro engineer) to create models and assemblies.

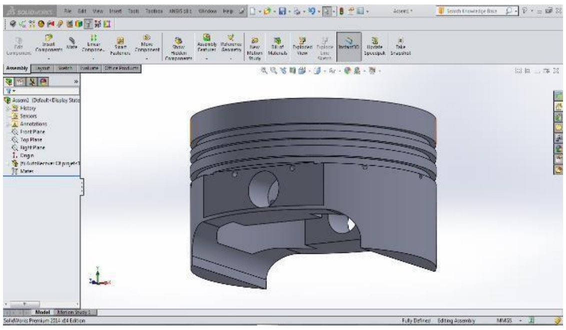


Fig 3.1(a) piston head designed in solid works

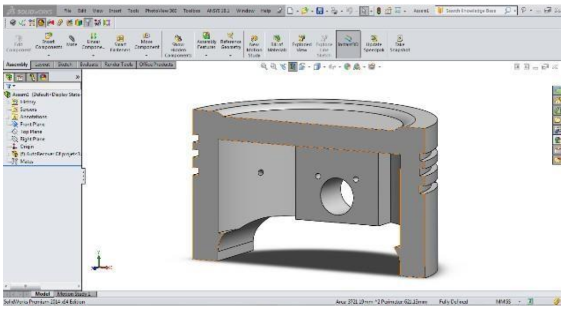


Fig 3.1(b) Cross section view

Fig 3.1(c) Material (gray cast iron) apply to piston head in solid works using rendering option

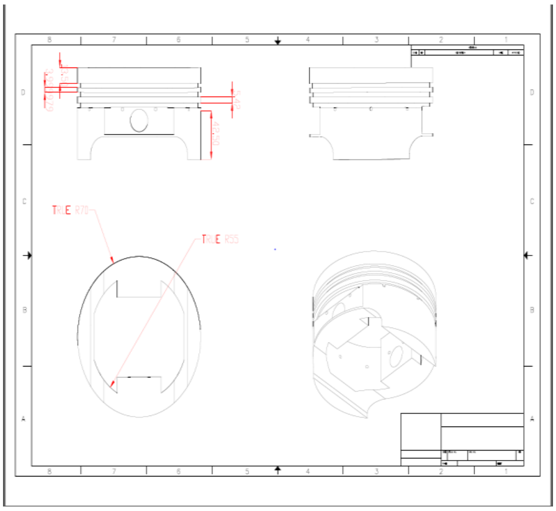


Fig 3.1(d) drawing view (gray cast iron)

3.2 ANSYSIS

Ansys is a product analysis software it is a world leading widely distributed and popular commercial cae package, it is widely used by designers/analysis in industries such as

1. Aerospace
2. Automotive
3. Manufacturing
4. Nuclear
5. Electronic
6. Bio-medical…..,etc

Ansys provide simulation solutions that enable designers to simulate design performance directly on the desktop. In this way, it provides fast efficient and cost – effective product development from design concept stage to performance validation stage of the product development cycle

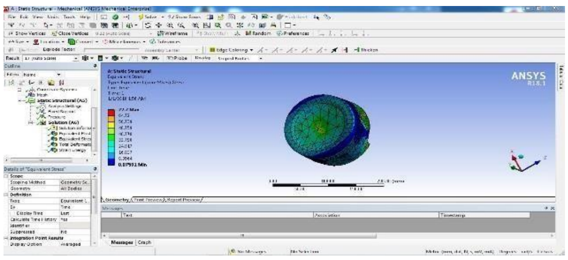


Fig 3.2(a) Stress test(gray cast iron)

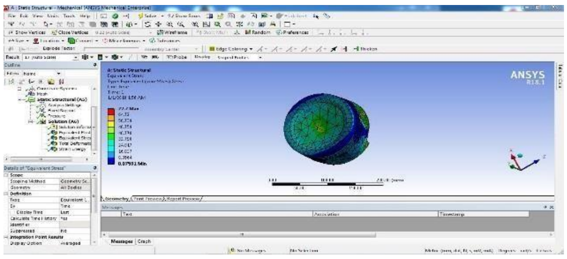


Fig 3.2(b) Total deformation (gray cast iron)

4. CALCULATIONS OF HEAT TRANSFERCOEFFICIENTS

The heat transfer from the combustion gases is assumed to be similar to the turbulent heat transfer of gases in a cylinder as follows:
Nu = C Rem Prn

$$h_g = 226.6 * P^{0.8} * T^{-0.4} * (V+1.4)^{0.8}$$

Therefore equation (2) will be the basic equation for a heat transfer coefficient calculation at piston crown surface.

So the heat transfer coefficient will be equal to
Nu=hDh/k=8.235 where, Dh , is the hr =8.235*k/Dh Dh =4A/P

$$Nu = 0.023 Re^{0.8} Pr^{0.3}$$

By substituting above equations

$$h_{oil} = 0.023 D_h^{-0.2} k_{oil} \left(\frac{\rho_{oil} U_{oil}}{\mu_{oil}} \right)^{0.8} Pr^{0.3}$$

$$Nu = \frac{h_{oil} D_h}{k_{oil}}$$

Heat flux=3.111

REFERENCE VALUE

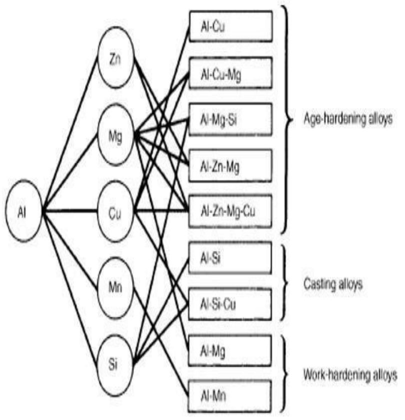
Piston ring Materials	Total deformation	Stress intensity	Temperature distribution	Heat flux
Cast iron	16.52	470.04	300	2.999
Grey cast iron	18.52	470.08	300	3.111

OBTAIN VALUE

Material	Total deformation	Sress	Strian	Heat flux
gray cast iron	**18.68**	**72.7**	**0.0066**	**3.111**

ALUMINIUM ALLOY

The history of the light metal industry, as that of many other industries in this century, is one of notable and ever accelerating expansion and development. There are few people today who are not familiar with at least some modern application of aluminium and its alloys. The part it plays in our everyday life is such that it is difficult to realise that a century ago the metal was still a comparativermity. Aluminium is a strongly electro-negative metal and possesses a strong affinity for oxygen; this is apparent romm the high heat of formation of its oxide. For this reason, although it is among the six most widely distributed metals on the surface of the earth, it was not isolated until well into the nineteenth century.



Principle of aluminium alloy

3.3 CREO

In this course, you will learn core modelling skills and quickly become proficient with Creo Parametric 4.0. Topics include sketching, part modeling, assemblies, drawings, and basic model management techniques. The course also includes a comprehensive design project that enables you to practice your new skills by creating realistic parts, assemblies, and drawings. After completing the course, you will be well prepared to work effectively on product design projects using Creo Parametric 4.0.At the end of each module, you will complete a set of review questions to reinforce critical topics from that module. At the end of the course, you will complete a course assessment in PTC University Proficiency intended to evaluate your understanding of the course as a whole.This course has been developed using CreoParametric 4.0.

PARAMETERS	VALUE
ENGINE TYPE	Four stroke, IC Engine
INDUCTION	Air coolant
NIMBER OF CYLIMDERS	Single
COMPRESSIVE RATIO	9.5+/-0.51
MAXIMUM POWER	15.120kw At 8000 Rpm
MAXIMUM TORQUE	19.12 Nm At 7000 Rpm
NUMBER OF REVOLUCTION	2

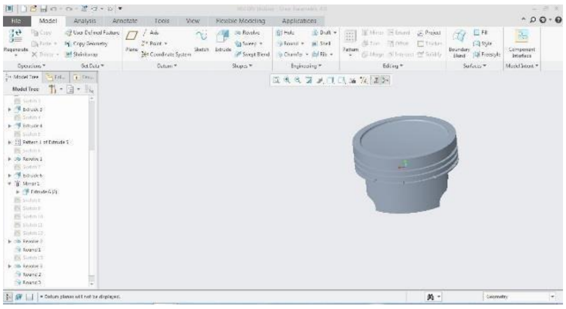


Fig 3.3(a) Designed piston head in cre0APPLICATION OF CREO

Creo is a suite of applications, and not simply a new name of Pro/Engineer.

- Pro/E WF4-> Creo Parametric
- CoCreate-> Creo Direct
- Product View-> Creo View

- PTC Creo Products (10 applications)
- PTC Creo Parametric
- PTC Creo Direct
- PTC Creo Simulate
- PTC Creo Illustrate
- PTC Creo Schematics
- PTC Creo View MCAD
- PTC Creo View ECAD
- PTC Creo Sketch
- PTC Creo Layout
- PTC Creo options Modeler

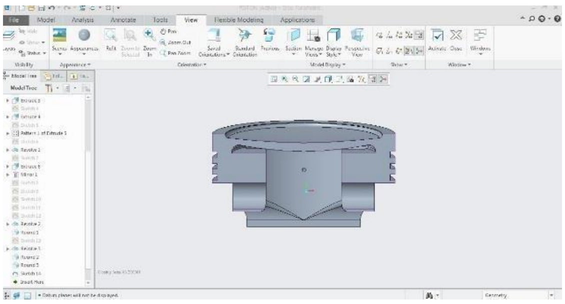


Fig 3.3(b) cross section view of piston head in creo

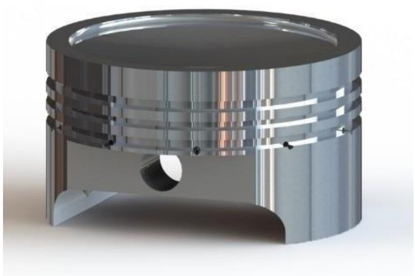


Fig 3.3(c) **Rendering view of aluminium piston head**

ANSYS RESULT FOR ALUMINIUM ALLOY PISTON HEAD

ANSYS RESULT FOR ALUMINIUM ALLOY PISTON HEAD

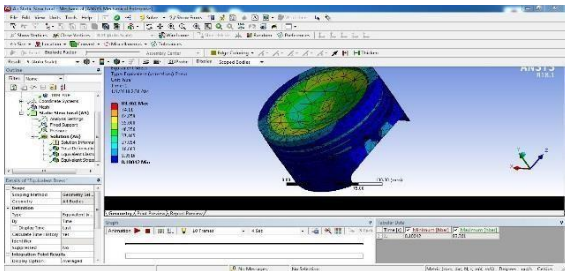


fig 3.3(d)Strain test(Aluminium alloy)

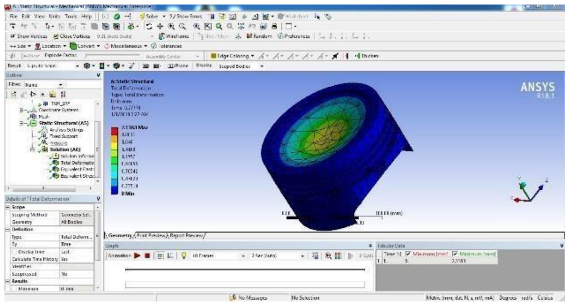


fig 3.3(e)Strain test(Aluminium alloy)

ALUMINIUM ALLOY PISTON HEAD OBTAIN VALUES

Material	Total deformatio n	Sress	Strian	Heat flux
Aluminium alloy	**21.16**	**83.36**	**0.011 7**	**5.81**

CONCLUSION

Modeling of piston is done in creo 2016 design software by using various commands

The creo part file is converted into IGS file and imported to ansys workbench.

First Static structural analysis is carried out on piston at 13.65MPa pressure with three different materials, such as grey cast iron, aluminium alloy and al- sic graphite in ansys workbench.

Maximum stress, deformation, maximum strain and maximum shear stress are noted and tabulated

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