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Design And Analysis Of The Piston Using Composite Materials

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Abstract

This paper is regarding the thermal analysis of the automobile piston within the automobile piston in the IC engine. currently reduction of the engine is a promising field for research that benefitted in the reduction of fuel consumption and pollutants emission from the engine. whereas on the opposite side varied pressure boosters connected with the engine piston-cylinder to maintain the output power at the bar more than the bar. These attachments induce high stresses and displacement vectors in the piston-cylinder and also the gas forces generated throughout the combustion cause to produce thermal stresses on the face of the piston that sometimes may result in the failure of piston material. to resist these issues, the material used should be durable enough and thermal efficient. Al-Si alloys are the main material used to manufacture the piston owing to the low coefficient of thermal expansion, minimum weight high hardness and strength and adequate wear resistance properties. as such a few more materials were are tested in the paper to understand and deduce the best thermal efficient material to construct the automobile piston. the material taken into consideration are: cast iron, forged steel, cast Aluminium, hypereutectic aluminium, and forged aluminium. very careful observation is needed during the production of automobile piston to attain desired thermal and mechanical properties

Keywords: Piston Modelling, solid works and Ansys.

1. Introduction

We almost take our Internal Combustion Engines for granted, don’t we? All we do is buy our vehicles, hop in and drive around. There is, however, a history of development to know about. The compact, well-toned, powerful and surprisingly quiet engine that seems to be purr under your vehicle’s hood just wasn’t the tame beast it seems to be now. It was loud, it used to roar, and it used to be rather bulky. In fact, one of the very first engines that had been conceived wasn’t even like the engine we know so well of today. 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. The internal combustion engine was conceived and developed in the late 1800s. It has had a significant impact on society and is considered one of the most significant inventions of the last century. The internal combustion engine has been the foundation for the successful development of many commercial technologies. For example, consider how this type of engine has transformed the transportation industry, allowing the invention and improvement of automobiles, trucks, airplanes and trains.

Internal combustion engines can deliver power in the range from 0.01 kW to 20x103 kW, depending on their displacement. The complete in the marketplace with electric motors, gas turbines and steam engines. The major applications are in the vehicle (automobile and truck), railroad, marine, aircraft, home use and stationary areas. Most internal combustion engines are produced for vehicular applications, requiring a power output on the order of 102 kW. Next to that internal combustion engines have become the dominant prime mover technology in several areas. For example, in 1900 most automobiles were steam or electrically powered, but by 1900 most automobiles were powered by gasoline engines. As of year, 2000, in the United States alone there are about 200 million motor vehicles powered by internal combustion engines. In 1900, steam engines were used to power ships and railroad locomotives; today two- and four-stoke diesel engines are used. Prior to 1950, aircraft relied almost exclusively on the piston's engines. Today gas turbines are the power plant used in large planes, and piston engines continue to dominate the market in small planes. 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.

The components of a reciprocating internal combustion engine, block, piston, valves, crankshaft and connecting rod have remained basically unchanged since the late 1800s. The main differences between a modern-day engine and one built 100 years ago are the thermal efficiency and the emission level. For many years, internal combustion engine research was aimed at improving thermal efficiency and reducing noise and vibration. As a consequence, the thermal efficiency has increased from about 10% to values as high as 50%. Since 1970, with recognition of the importance of air quality, there has also been a great deal of work devoted to reducing emissions from engines. Currently, emission control requirements are one of the major factors in the design and operation of internal combustion engines.

A piston is a component of reciprocating engines, reciprocating pumps, gas compressors and pneumatic cylinders, among other similar mechanisms. It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod and/or connecting rod. In a pump, the function is reversed, and force is transferred from the crankshaft to the piston for the purpose of compressing or ejecting the fluid in the cylinder. In some engines, the piston also acts as a valve by covering and uncovering ports in the cylinder wall.

Automobile components are in great demand these days because of increased use of automobiles. The increased demand is due to improved performance and reduced cost of these components. R&D and testing engineers should develop critical components in shortest possible time to minimize launch time for new products. This necessitates understanding of new technologies and quick absorption in the development of new products. A piston is a moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine its purpose is to transfer from expanding gas in the cylinder to the crank shaft via piston rod and or connecting rod. As an important part in an engine piston endures the cyclic gas pressure and inertia forces at work and this working condition may cause the fatigue damage of the piston. The investigations indicate that greatest stress appears on the upper end of the piston and stress concentration is one of the mainly reason for fatigue failure

1.1 Modeling:

Piston Design The piston is designed according to the procedure and specification which are given in machine design and data handbooks. 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.

In designing a piston for an engine, the following points should be taken into consideration: It should have enormous strength to withstand the high pressure.

- It should have minimum weight to withstand the inertia forces.
- It should form effective oil sealing in the cylinder.
- It should provide sufficient bearing area to prevent undue wear.
- It should have high speed reciprocation without noise.
- It should be of sufficient rigid construction to withstand thermal and mechanical distortions.
- It should have sufficient support for the piston pin.

1.2 Forces:

The major forces acting on the piston are as follows:
Inertia force caused by the high frequency of reciprocating motion of piston
Friction between the cylinder walls and the piston rings
Forces due to expansion of gases
Forces acting due to the compression of gases
Friction at gudgeon pin hole

1.3 Objective:

Designing the piston for 150 cc petrol engine taking reference to the existing piston.
Design is modified to get better results
Creating of 3D model in Solid works and then by using CAE tools Simulation Xpress Study
Meshing of 3D model in Simulation Xpress Study
Material Aluminum 2024-T361 is selected for the study

2. Literature Review

The cast iron pistons were superseded by aluminum alloy piston around the year 1920 (Sarkar 1975). Cole G.S. and Sherman A.M.(1995) explained that a considerable interest had been grown in replacing cast iron and steel in automotive component like piston with lightweight aluminum alloy casting to improve the performance and efficiency. Haque M.M and Young J.M. (2001) referred the low expansion group of aluminum–silicon alloy as piston alloy, since this group of alloy provides the best overall balance of properties [6].According to Morishita (1981), in internal combustion engines particularly diesel cycle Engine, piston with aluminum based alloy is provided for the purpose of better heat radiation and lower weight [1].

A.R. Bhagat et al. 2012 [2] stated that, Piston skirt may appear deformation at work, which usually causes crack on the upper end of piston head. Due to the deformation, the greatest stress concentration is caused on the upper end of piston, the situation becomes more serious when the stiffness of the piston is not enough, and the crack generally appeared at the point A which may gradually extend and even cause splitting along the piston vertical. The stress distribution on the piston mainly depends on the deformation of piston. Therefore, in order to reduce the stress concentration, the piston crown should have enough stiffness to reduce the deformation. The optimal mathematical model which includes deformation of piston crown and quality of piston and piston skirt is used. The FEA is carried out for standard piston model used in diesel engine and the result of analysis indicate that the maximum stress has changed from 228MPa. to 89MPa. And biggest deformation has been reduced from 0.419 mm to 0.434 mm.

Hitesh Pandey et al. 2014 [3] stated that, Aluminum alloy should be used as a piston material as it has minimum thermal stress and mechanical distortion in same working condition as that of cast iron and structural steel as piston material. Aluminum alloys are lighter in weight thus provides good mechanical strength at low temperatures. Aluminum alloys have high heat conductivity thus; high rate of heat transfer is possible between the center and edge of the piston head. Use of CAE software eliminates the human effort International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072 © 2020, IRJET | Impact Factor value: 7.529 | ISO 9001:2008 Certified Journal | Page 7656 in determination of stress, distortion values and so are referred as good tool for piston mechanical as well as thermal analysis. It is concluded that the maximum thermal stress and the maximum distortion of piston in decreasing order are as follows: Structural Steel > Cast Iron > A2618 Aluminum Alloy. So, it is convenient to use aluminum alloy as piston material rather than cast iron or structural steel.

Dilip Kumar Sonar et al. 2015 [4] stated that, the stress distribution on piston of internal combustion engine by using FEA. The FEA is performed by CAD and CAE software. It describes the FEA technique to predict the higher stress and critical region on the component. With using CATIAV5 software the structural model of a piston will be developed. Using ANSYS V14.5 software, simulation and stress analysis is performed. The first main conclusion that could be drawn from this work is that although thermal stress is not the responsible for biggest slice of damaged pistons, it remains a problem on engine pistons and its solution remains a goal for piston manufacturers. From the analysis, it is evident that thermal stress was higher than mechanically induced stress hence it could be concluded that the piston would fail due to the thermal load rather than the mechanical load and hence during optimization design, this could be put into consideration to ensure that thermal load is reduced. It can also be deduced that individually, thermal and mechanical stress proportions have a direct influence on the coupled thermal-mechanical stress hence during design each load can be considered and reduced independently. It can be concluded that the piston can safely withstand the induced stresses during its operation.

Subodh Kumar Sharma et al. 2015 [5] stated that, a methodology is proposed for the estimation of the temperatures in piston and cylinder wall, piston body distortions, and radial stresses of a water-cooled four stroke single cylinder direct injection diesel engine. The purpose is to obtain a generalized method (FEM) for analyzing temperature field, piston distortion, and corresponding thermal stresses so simulated temperatures are to be verified by direct measured temperatures. In this work, seven thermocouples were used, in which four thermocouples were mounted on the piston inner surface and three were mounted on the cylinder wall. By installing thermocouple at seven points on piston and cylinder wall, variation in temperature of piston and cylinder wall at no load, half load, three-quarters load, and full load conditions was determined. As engine load increases, temperature of the piston and cylinder wall increases exponentially and has a positive relationship. The piston temperature for every engine load condition tested was estimated and good agreement was obtained with the expected results.

Ankit Kumar Pandey et al. 2016 [6] stated that, Solid Model of piston has been made using ANSYS 16.2 Geometric module. Thermo-Mechanical (Static Structural Analysis + SteadyState Thermal Analysis) analysis is done for Piston. The objective of FEA is to investigate stresses and problem area experienced by piston. Aluminum alloy is material of piston for the FEA, since this piston is also used at optimization. Thermo-mechanical analysis is used for analysis of piston. Analysis of S.I. engine piston using ANSYS The piston is divided into the areas defined by a series of grooves for sealing rings. The boundary conditions for mechanical simulation were defined as the pressure acting on the entire piston head surface. It is necessary to load certain data on material that refer to both its mechanical and thermal properties to do the coupled thermo-mechanical calculations. After Response Surface Optimization percentage of weight reduces is 26.074%, Resultant percentage of increase in factor of safety, percentage of decease in equivalent von-mises stress is 3.072%, 2.982% respectively. After optimization Equivalent von-mises stress, factor of safety and weight is 259.99 mpa, 1.0769 and 0.10065 Kg respectively. Here factor of safety is greater than 1 and Maximum Equivalent Von-mises stress is less than yield stress of aluminum alloy so designed model of piston is safe.

Amitanand B Suralikerimath et al. 2016 [7] stated that, Aluminum alloy is selected for the design and analysis of the piston head. After designing the model in CATIA V5R20 the model is converted to STP file and imported to ANSYS 14.5. Then analysis is carried out accordingly. Aluminum alloy is chosen and applied to the imported model. All the material properties of aluminum alloy are predefined by the software. In order to analyze the model by FEM meshing of the model must be done. The analysis can be further carried out for thermal analysis from which we can compute the thermal stress induced in various portions of piston head.

3. Solid Works

Solid Works is mechanical design automation software that takes advantage of the familiar Microsoft Windows graphical user interface.

It is an easy-to-learn tool which makes it possible for mechanical designers to quickly sketch ideas, experiment with features and dimensions, and produce models and detailed drawings.

A Solid Works model consists of parts, assemblies, and drawings.

- Typically, we begin with a sketch, create a base feature, and then add more features to the model. (One can also begin with an imported surface or solid geometry).
- We are free to refine our design by adding, changing, or reordering features.
- Associatively between parts, assemblies, and drawings assures that changes made to one view are automatically made to all other views.
- We can generate drawings or assemblies at any time in the design process.
- The Solid works software lets us customize functionality to suit our needs.

3.1 Introduction Solid Works

Solid works mechanical design automation software is a feature-based, parametric solid modeling design tool which advantage of the easy to learn windows ^{tm} graphical user interface. We can create fully associate 3-d solid models with or without while utilizing automatic or user defined relations to capture design intent.

Parameters refer to constraints whose values determine the shape or geometry of the model or assembly. Parameters can be either numeric parameters, such as line lengths or circle diameters, or geometric parameters, such as tangent, parallel, concentric, horizontal or vertical, etc. Numeric parameters can be associated with each other through the use of relations, which allow them to capture design intent.

Design intent is how the creator of the part wants it to respond to changes and updates. For example, you would want the hole at the top of a beverage can to stay at the top surface, regardless of the height or size of the can. Solid Works allows you to specify that the hole is a feature on the top surface and will then honor your design intent no matter what the height you later gave to the can. Several factors contribute to how we capture design intent are Automatic relations, Equations, added relations and dimensioning.

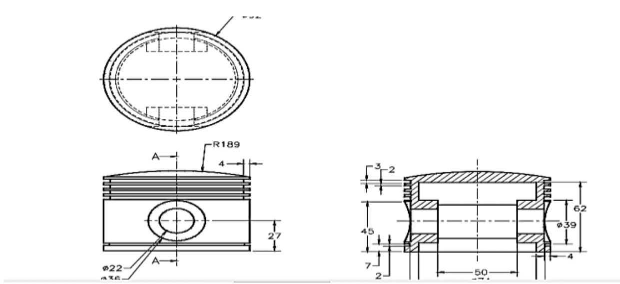
Features refer to the building blocks of the part. They are the shapes and operations that construct the part. Shape-based features typically begin with a 2D or 3D sketch of shapes such as bosses, holes, slots, etc. This shape is then extruded or cut to add or remove material from the part. Operation-based features are not sketch-based, and include features such as fillets, chamfers, shells, applying draft to the faces of a part, etc.

Building a model in Solid Works usually starts with a 2D sketch (although 3D sketches are available for **power users**). The sketch consists of geometry such as points, lines, arcs, conics (except the hyperbola), and spines. Dimensions are added to the sketch to define the size and location of the geometry. Relations are used to define attributes such as tangency, parallelism, perpendicularity, and concentricity. The parametric nature of Solid Works means that the dimensions and relations drive the geometry, not the other way around. The dimensions in the sketch can be controlled independently, or by relationships to other parameters inside or outside of the sketch.

4. Modelling of Piston

Figure 4.1 Sketch with dimensions of a piston:

Figure 4.2 Take a new file and select front plane and draw sketch as follows



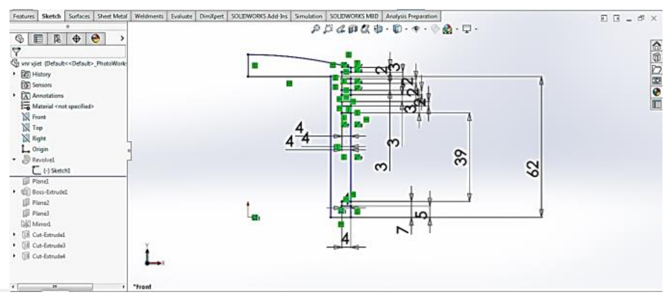


Figure 4.3 Now go to features and select revolve option

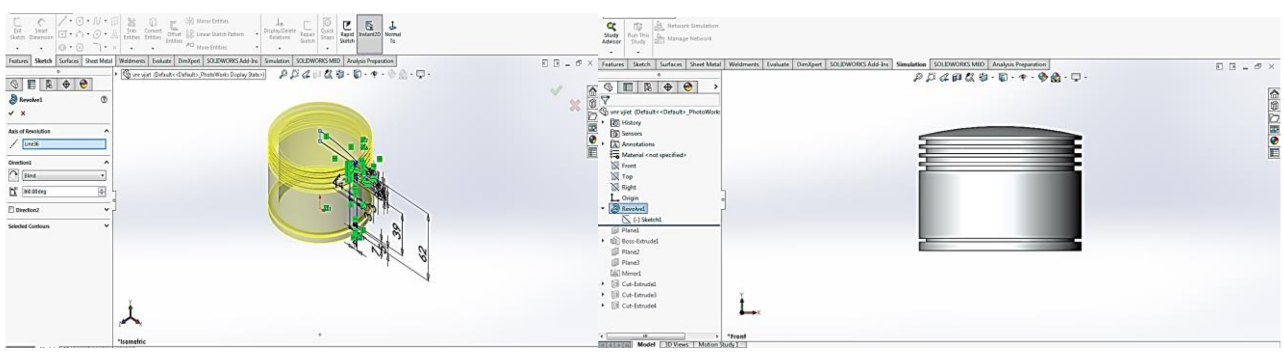


Figure 4.4 Now go to features and select reference geometry for selecting a plane which is parallel to the face (as it is not planar we cannot draw the following sketch without selecting the reference plane)

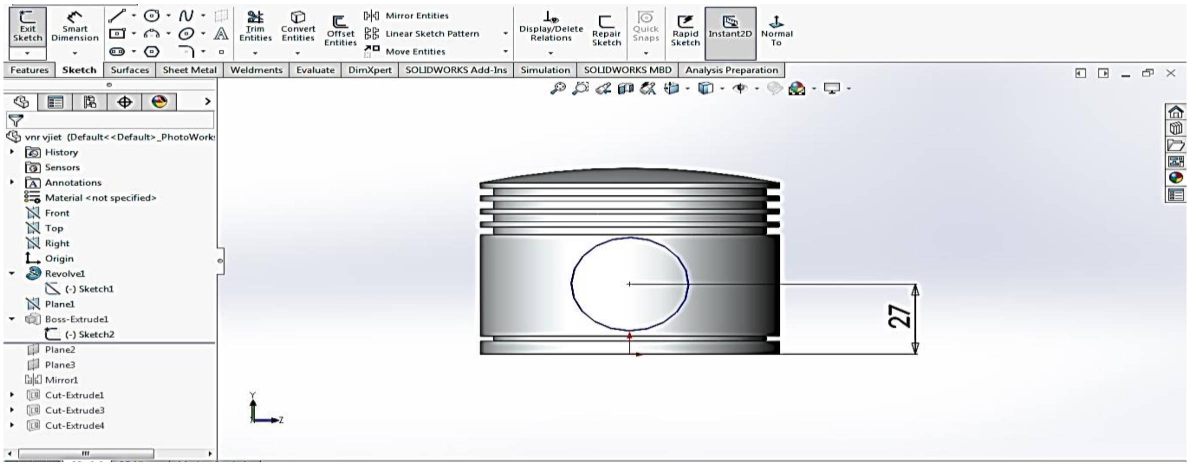
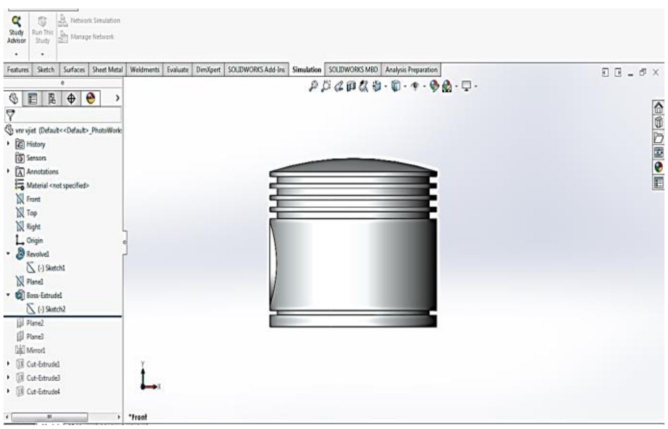


Figure 4.5 Then go to features and extrude it

Figure 4.6 By selecting the reference plane as following mirror the extrude



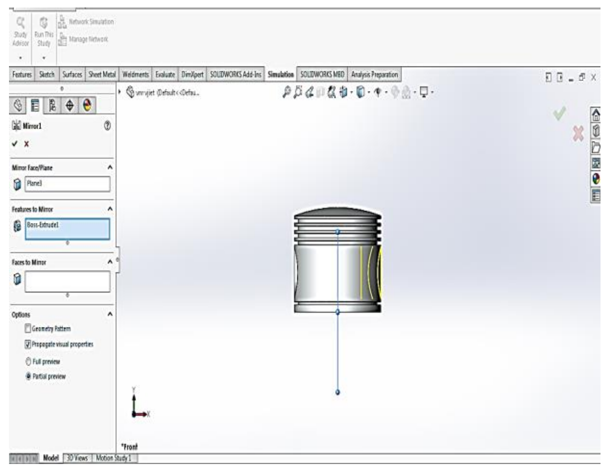
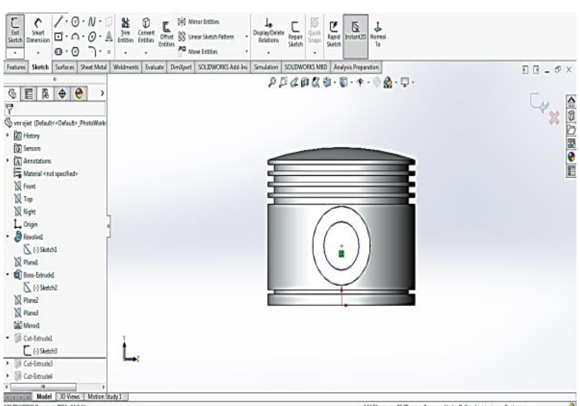


Figure 4.7 Now draw the sketch as follows



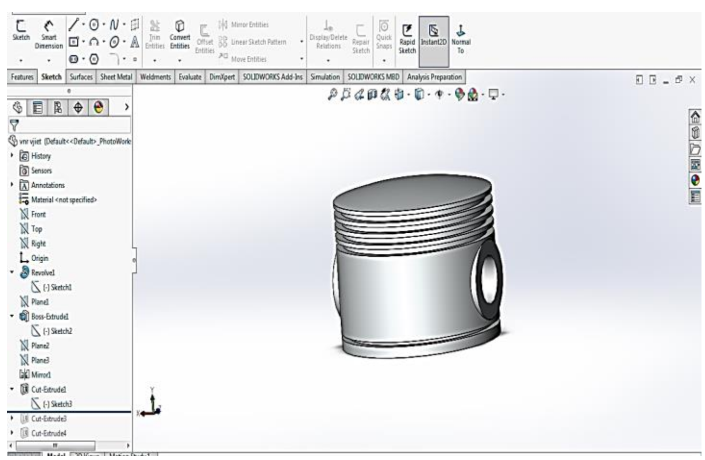


Figure 4.8 Go to features and make cut-extrude

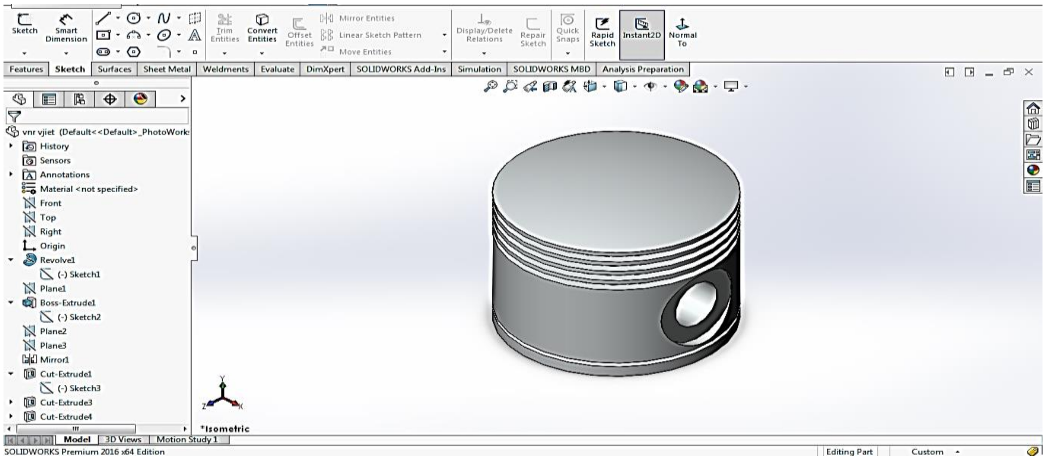
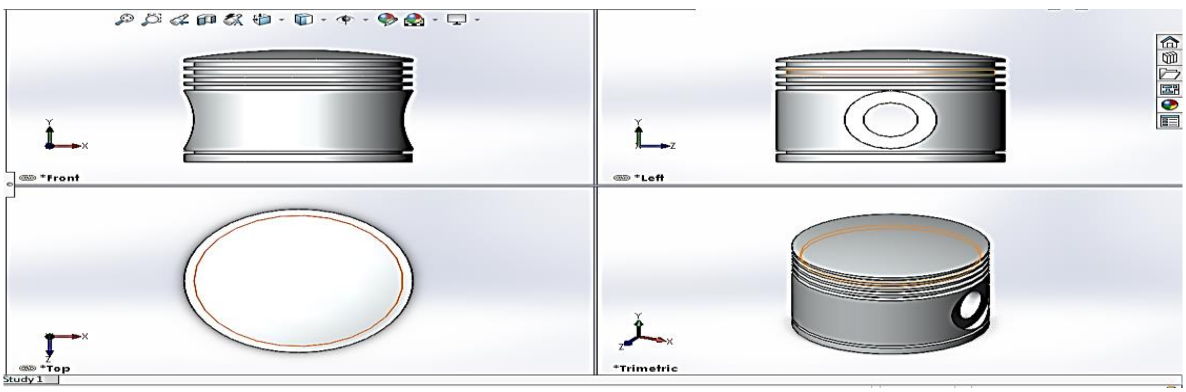


Figure 4.9 Four views of piston:



5. ANSYS

5.1 Introduction to Ansys analysis

5.2 Basic Concepts of Analysis:

The software uses the Finite Element Method (FEM). FEM is a numerical technique for analyzing engineering designs. FEM is accepted as the standard analysis method due to its generality and suitability for computer implementation. FEM divides the model into many small pieces of simple shapes called elements effectively replacing a complex problem by many simple problems that need to be solved simultaneously.

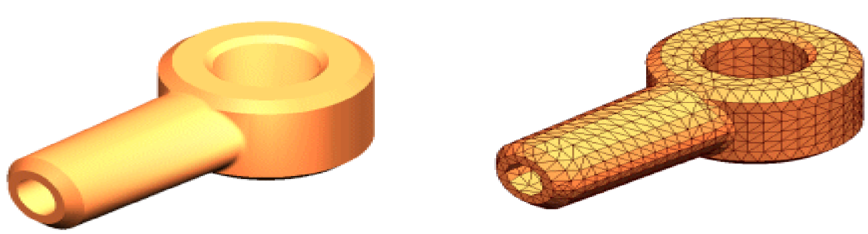
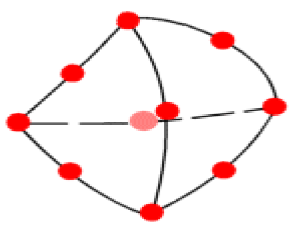


Figure 5.2 (1)CAD model of a part   Figure5.2(2) Model subdivided into small pieces (elements)

Elements share common points called nodes. The process of dividing the model into small pieces is called meshing.

The behavior of each element is well-known under all possible support and load scenarios. The finite element method uses elements with different shapes.

The response at any point in an element is interpolated from the response at the element nodes. Each node is fully described by a number of parameters depending on the analysis type and the element used. For example, the temperature of a node fully describes its response in thermal analysis. For structural analyses, the response of a node is described, in general, by three translations and three rotations. These are called degrees of freedom (DOFs). Analysis using FEM is called Finite Element Analysis (FEA).



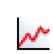
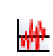
Figureure 5.3 A tetrahedral element. Red dots represent nodes. Edges of an element can be curved or straight.

The software formulates the equations governing the behavior of each element taking into consideration its connectivity to other elements. These equations relate the response to known material properties, restraints, and loads.

Next, the program organizes the equations into a large set of simultaneous algebraic equations and solves for the unknowns.

In stress analysis, for example, the solver finds the displacements at each node and then the program calculates strains and finally stresses.

Table1: The software offers the following types of studies:

Study type	Study icon	Study type	Study icon
Static		Modal Time History	
Frequency		Harmonic	
Buckling		Random Vibration	
Thermal		Response Spectrum	

Study type	Study icon	Study type	Study icon
Design Study		Drop Test	
Nonlinear Static		Fatigue	
Nonlinear Dynamic		Pressure Vessel Design	

5.3 Analysis Steps:

The steps needed to perform an analysis depend on the study type. You complete a study by performing the following steps:

- Create a study defining its analysis type and options.
- If needed, define parameters of your study. A parameter can be a model dimension, material property, force value, or any other input.
- Define material properties.
- Specify restraints and loads.
- The program automatically creates a mixed mesh when different geometries (solid, shell, structural members etc.) exist in the model.
- Define component contact and contact sets.
- Mesh the model to divide the model into many small pieces called elements. Fatigue and optimization studies use the meshes in referenced studies.
- Run the study.
- View results.

6. Ansys analysis on piston

6 .1 Static Analysis on Piston:

The static and thermal analysis for the piston was done by finite elements method using ANSYS software. For ANSYS simulation the solid works geometry is separated into elements. In this elements are interlinked to one another at a point called as Node. In present examination work we have used FEA for the Thermal and Structural analysis of piston. The solid works software is used to prepare the piston. After completing solid works modeling, the model is saved in IGES file then IGES file is imported to ANSYS software for the finite element analysis.

6.1. 1 Meshing: Mesh type is tetrahedral

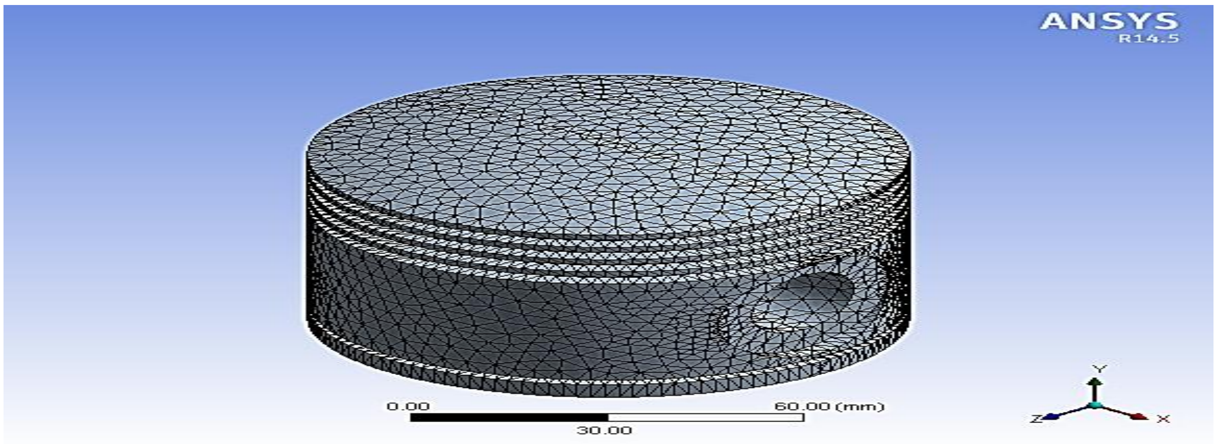
The piston is meshed by using the fine mesh and values of 53857 nodes, 30345 elements and element size 4.

the piston is meshed by using the coarse mesh and the values of 14410 nodes, 7426 elements and the element size 4.

Table 2. comparison table

Mesh type	Nodes	elements
Coarse	53857	30345
Fine	14410	7426

Figurer 6.1 Mesh type is tetrahedral



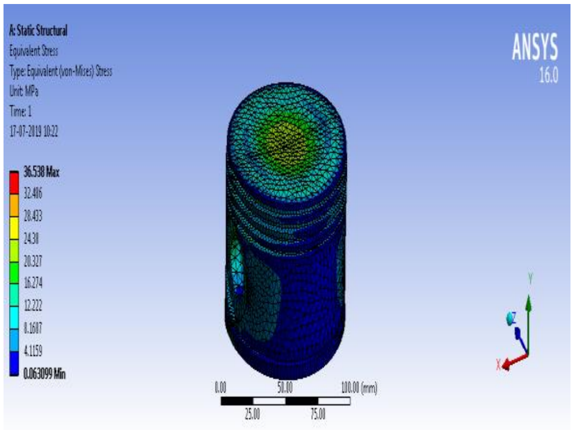
6 .1.2 cast iron For the pressure load applied is 1.5MPa

Table 3 Material Data : Cast Iron Cast Iron > Constants

Density	7.22 g/cc
Young's Modulus MPa	147Gpa
Poisson's Ratio	0.287
Thermal Conductivity	26.6 W/m-k

Figure 6.2 Maximum Stress

Figure 6.3 Total Deformation



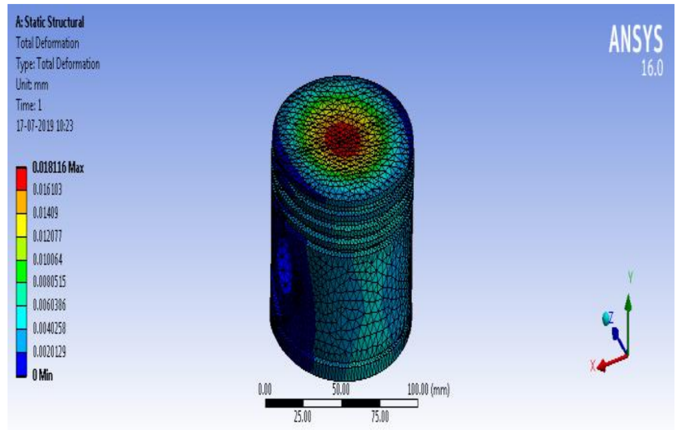
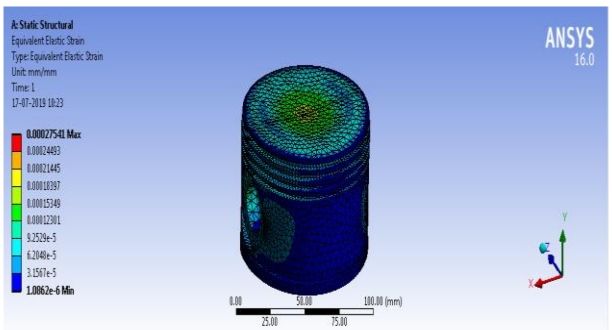


Figure 6.4 Maximum strain

Figure 6.5 Maximum shear stress:



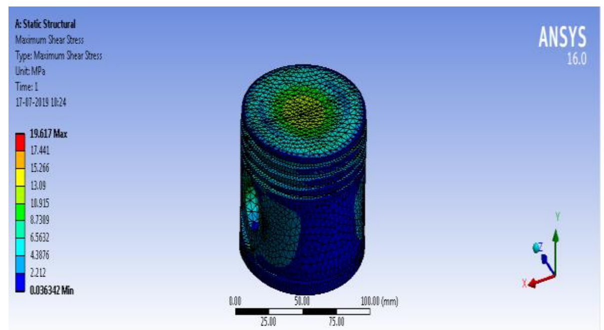
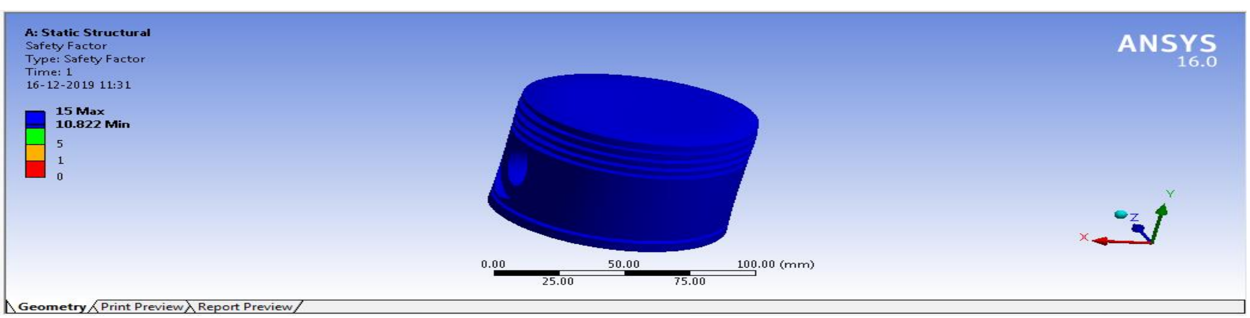


Figure 6.6 safety factor



6.1.3 Forged high carbon steel

For Forged high carbon steel at 1.5Mpa Pressure

Table 4 Material Data : Forged high carbon steel > Constants

Density	7.85 g/cc
Young's Modulus MPa	205 Gpa
Poisson's Ratio	0.292
Thermal conductivity	49.8 W/m-k

Figure 6.7 Maximum Stress

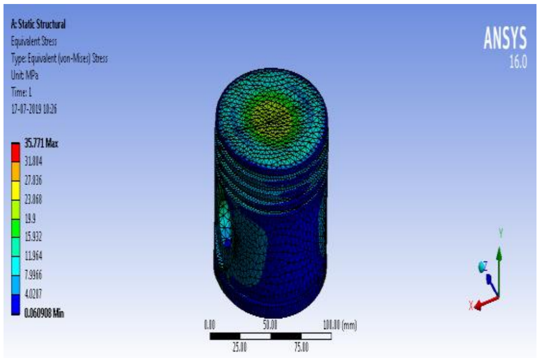


Figure 6.8 Total deformation:

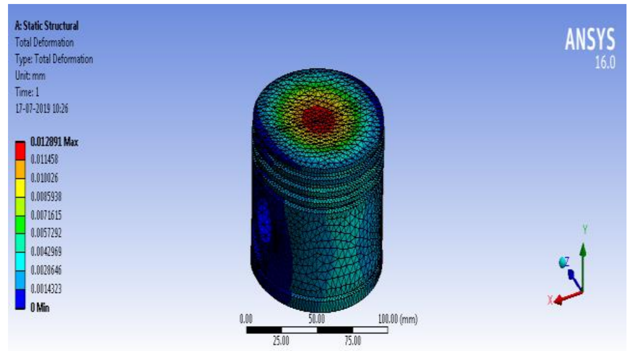


Figure 6.9 Maximum strain:

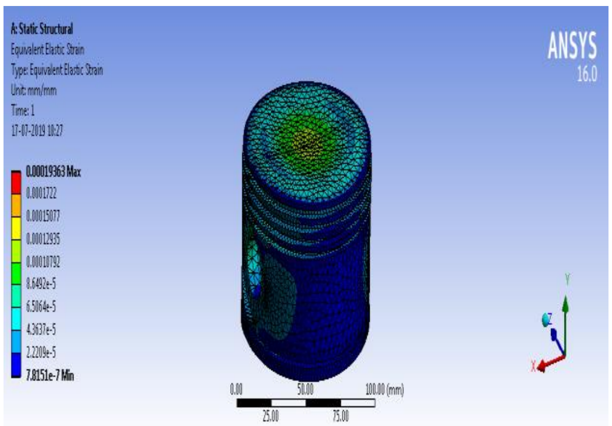
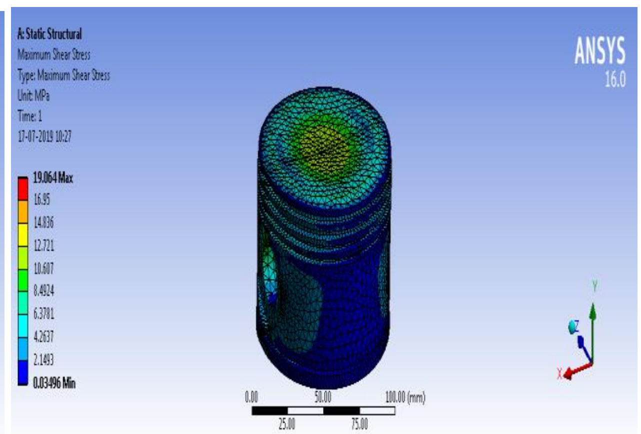
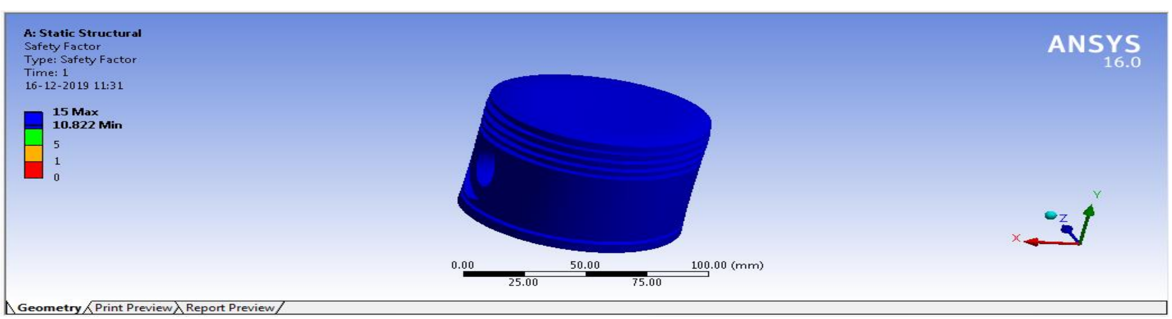


Figure6.10 Maximum shear stress



6.11 safety factor



6.1.4 Cast Aluminum

For Aluminum Silicon Carbide Graphite (Al-Sic Graphite) at 1.5 M pa pressure

Table 5 Material Data : al-sic-graphite > Constants

Density	2.80g/cc
Young's Modulus MPa	72Gpa

Poisson's Ratio	0.33
Thermal conductivity	120 W/m-k

Figure 6.12Maximum Stress

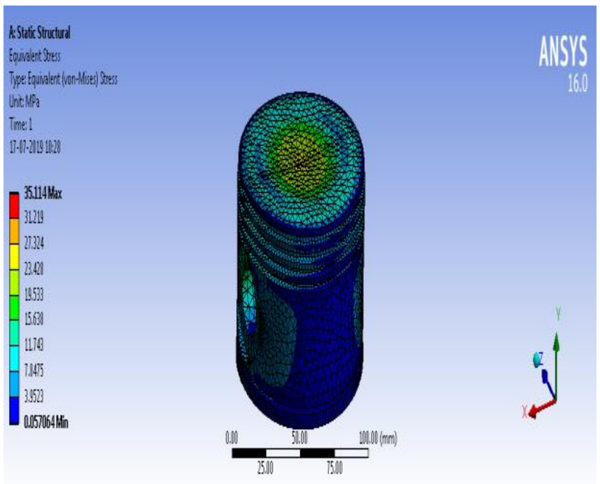


Figure6.13 Total Deformation:

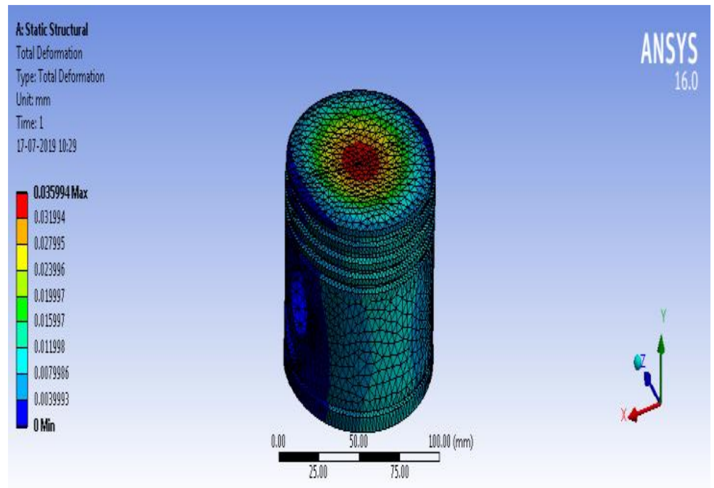


Figure 6.14Maximum Strain:

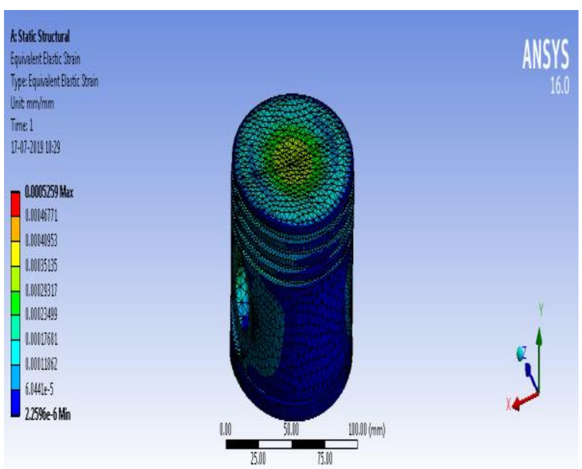
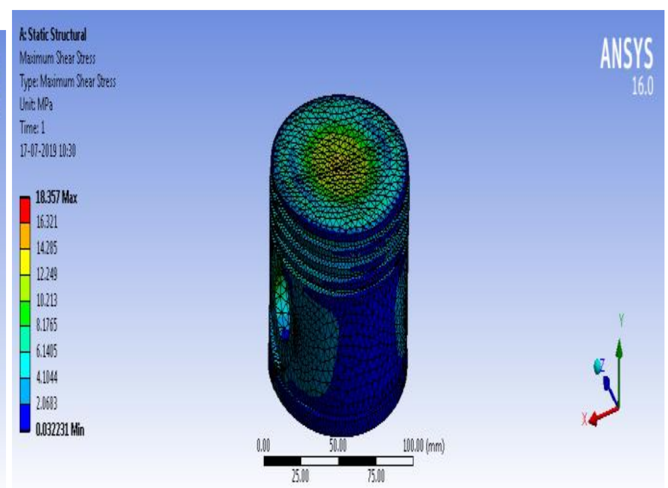
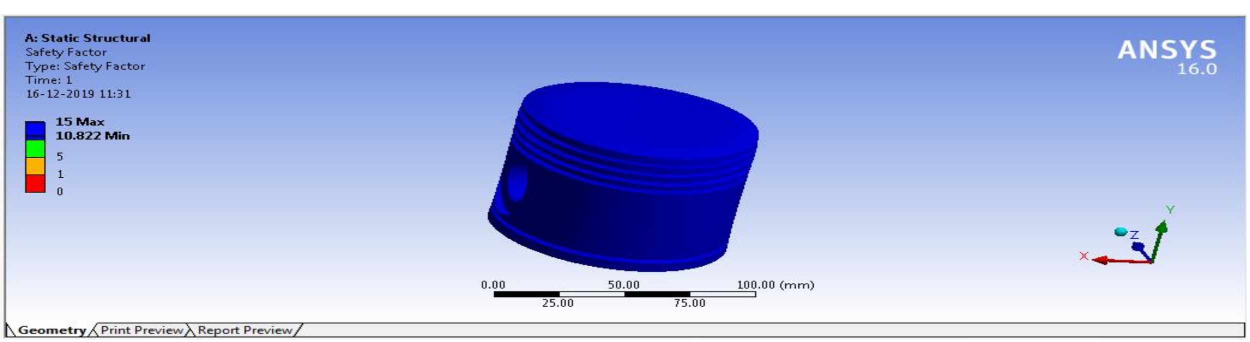


Figure 6.15 Maximum Shear Stress:



6.16 safety factor



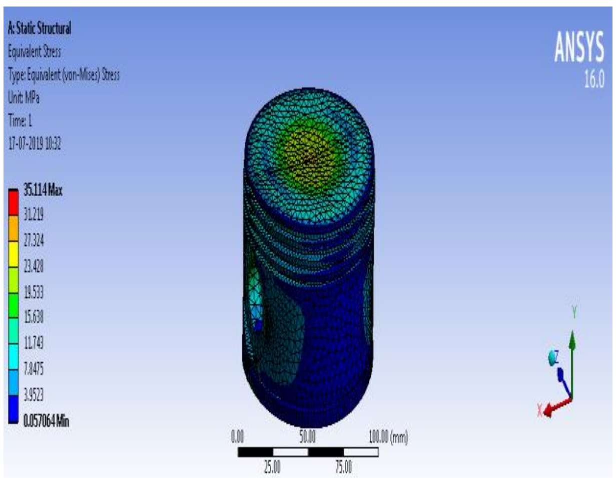
6.1.5: Eutectic forged Aluminum alloy

For Eutectic forged Aluminum alloy at 1.5 M pa pressure

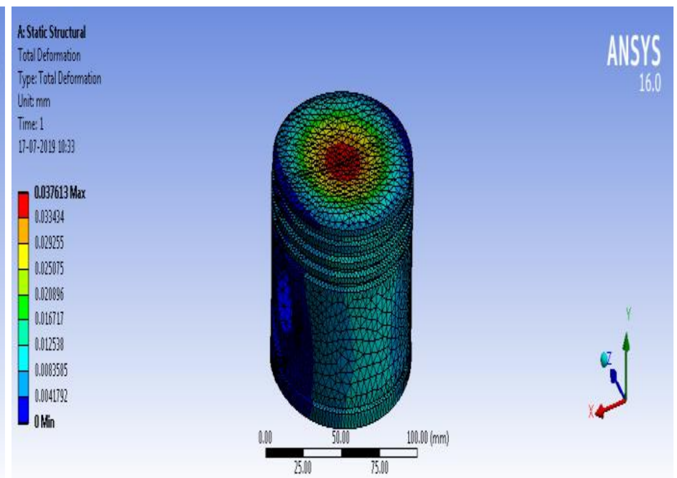
Table 6 material data :Eutectic forged Aluminum alloy > Constants

Density	2.70 g/cc
Young's Modulus MPa	68.9Gpa
Poisson's Ratio	0.33
Thermal conductivity	154 W/m-k

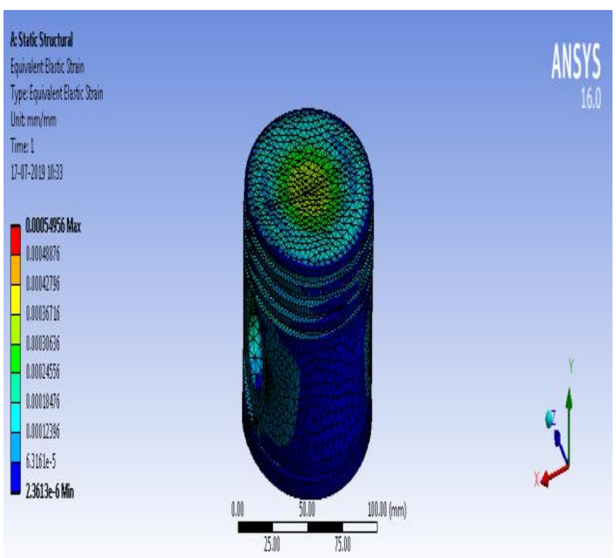
Figure 6.17 Maximum stress



6.18 Total deformation



6.19 Maximum strain



6.20 Maximum shear stress

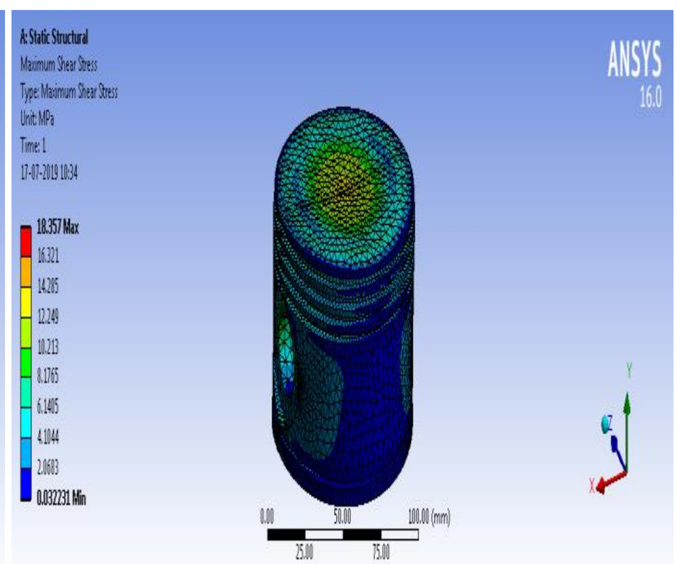
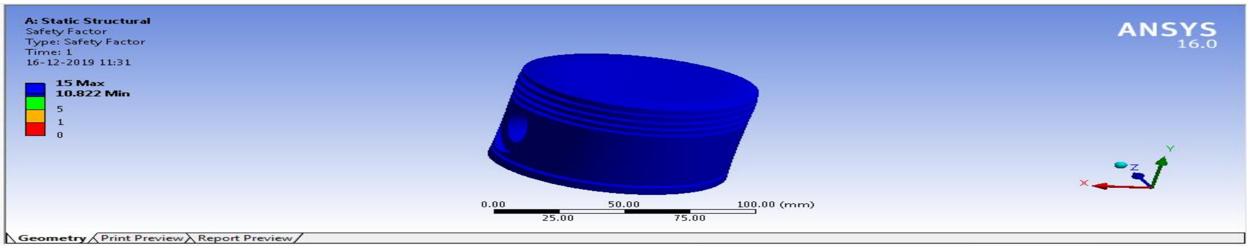


Figure 6.21safety factor



6.1.6: Hypereutectic forged Aluminum alloy

For Hypereutectic forged Aluminum alloy at 1.5 M PA pressure

Table 7 Material Data :Hypereutectic forged Aluminum alloy > Constants

Density	2.68g/cc
Young's Modulus MPa	68.3Gpa
Poisson's Ratio	0.33
Thermal conductivity	210 W/m-k

Figure 6.22 Maximum stress

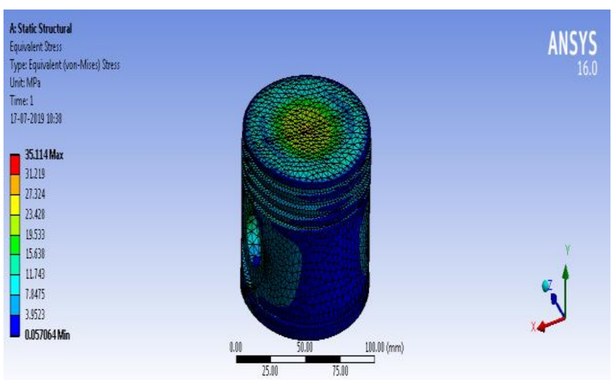


Figure6.23 Total deformation

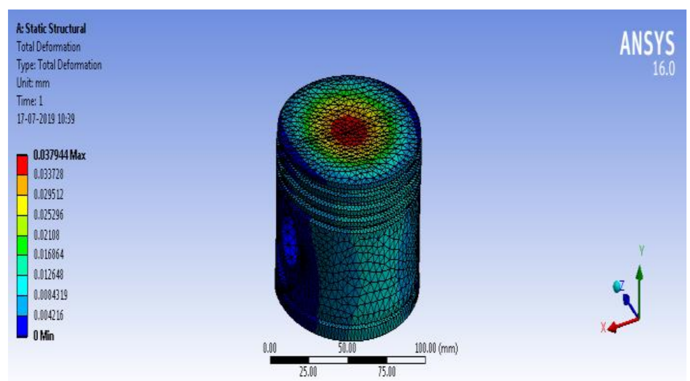


Figure 6.24Maximum strain

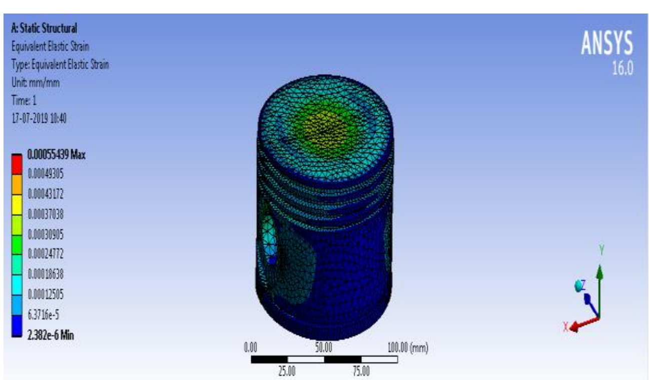


Figure6.25 Maximum shear stress

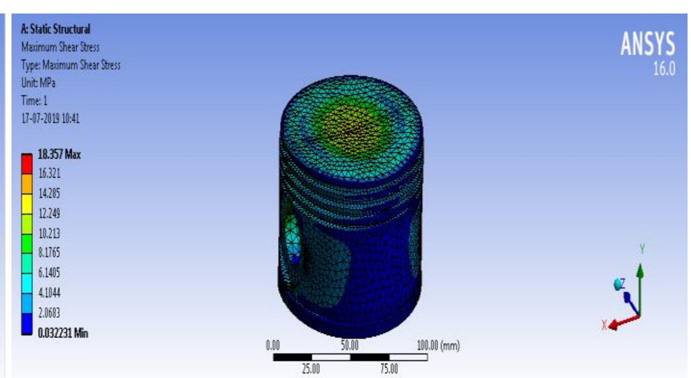


Figure 6.26 safety factor

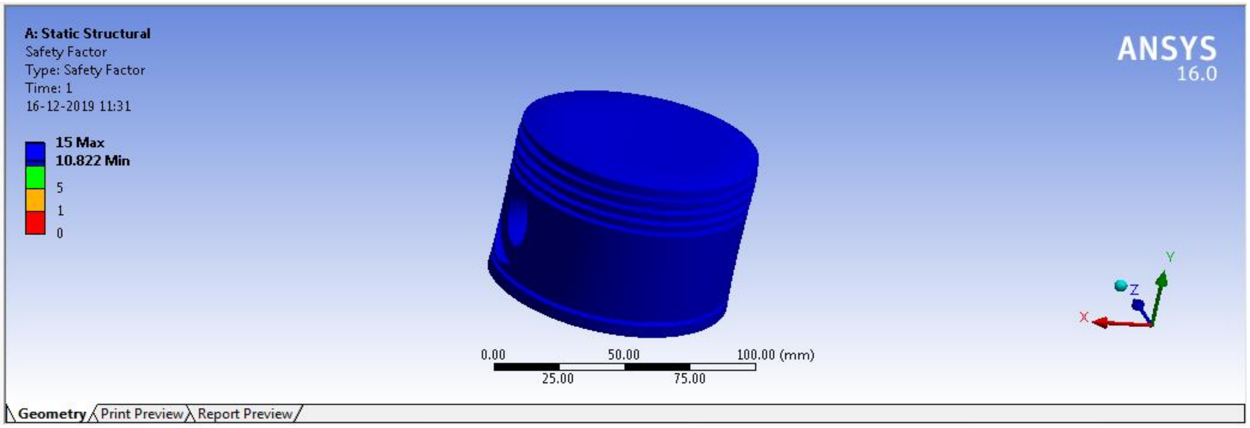
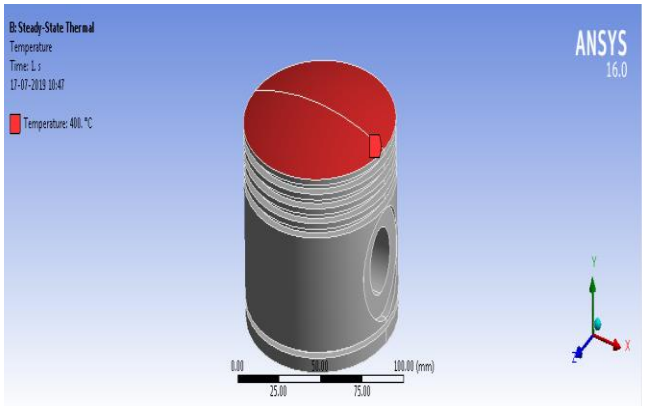


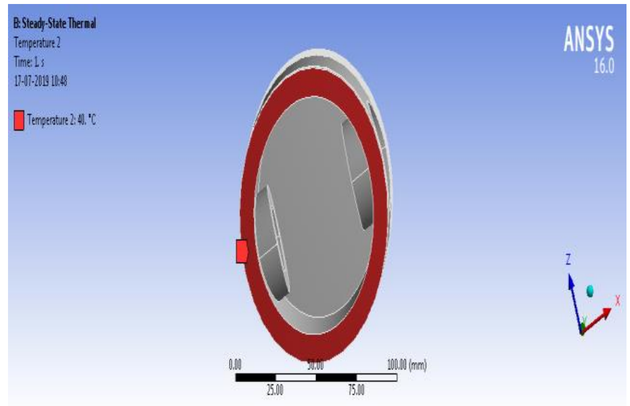
Table 8 comparison on maximum stress and maximum strain on different material

Material	Maximum stress	Total deformation	Maximum strain	Maximum shear stress
Cast iron	36.538	0.018116	0.000275	19.617
Forged high carbon steel	35.771	0.01289	0.00019	19.064
Cast Aluminum	35.114	0.03599	0.000525	18.357
Eutectic forged Aluminum alloy	35.114	0.0376	0.000549	18.357
Hypereutectic forged Aluminum alloy	35.114	0.0379	0.000554	18.357

6.2 Thermal analysis on piston:

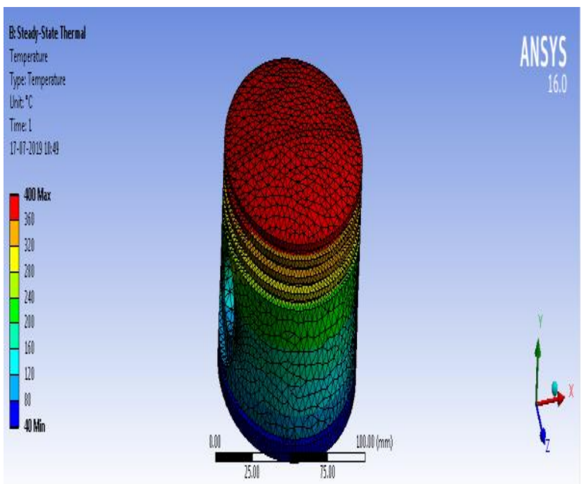
Figure 6.27 Maximum temperature given at piston crown 400deg Figure6.28 Minimum temperature given at bottom face 30deg

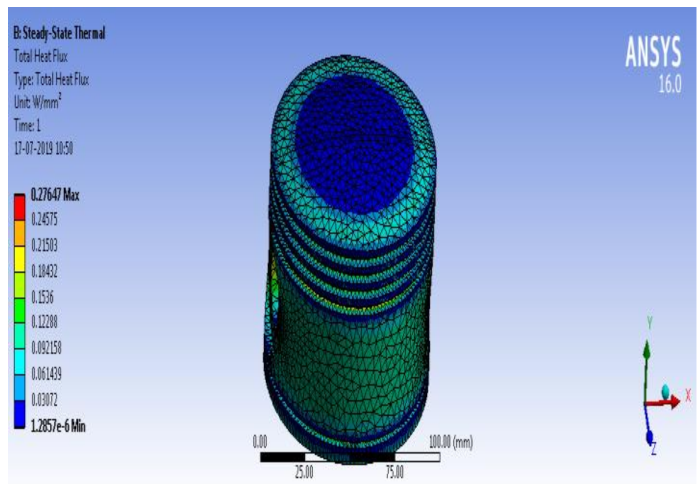




6.2.1 Cast Iron:

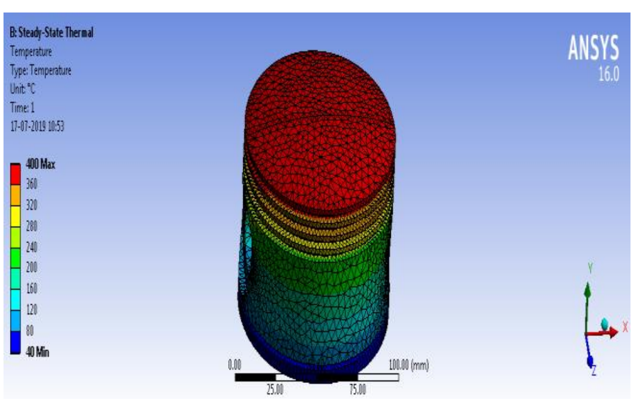
Figure 6..29Temperature distribution: Figure 6.30 Heat flux:

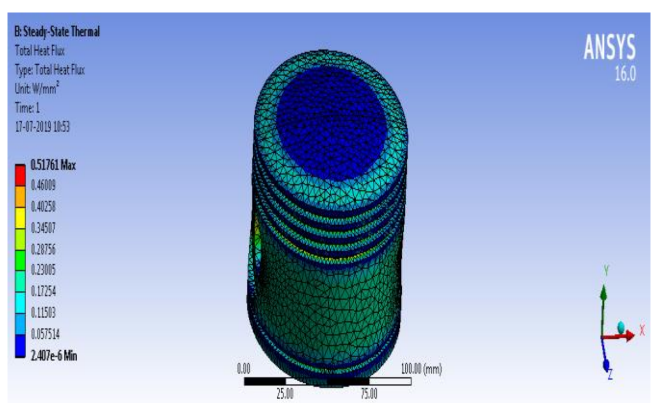




6.2.2 Forged high carbon steel

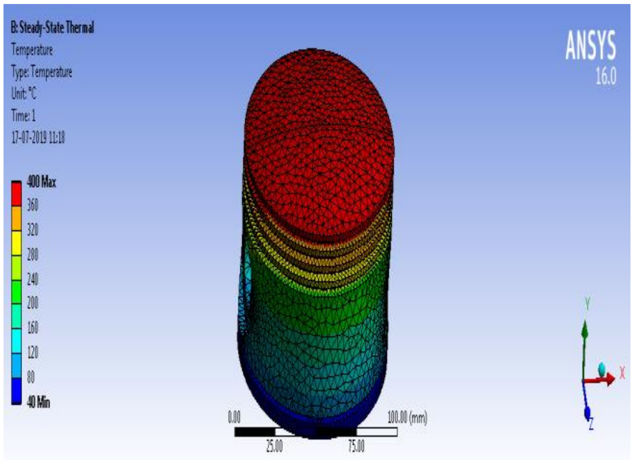
Figure6.31 Temperature distribution: Figure6.32 Heat Flux:

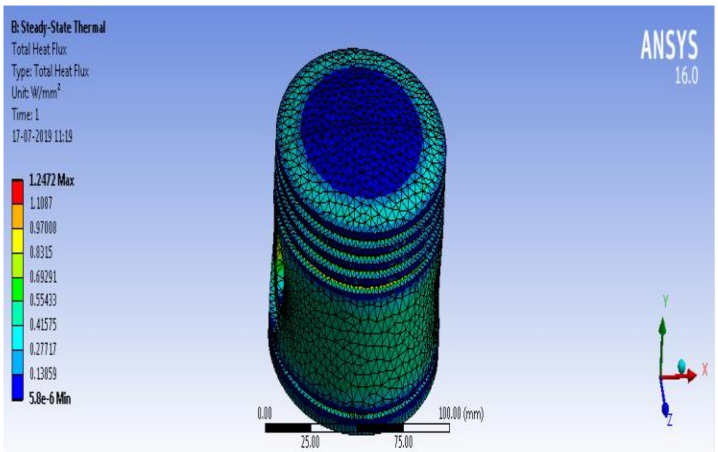




6.2.3 Cast Aluminum

Figure 6.33 Temperature distribution: Figure 6.34 Heat flux:

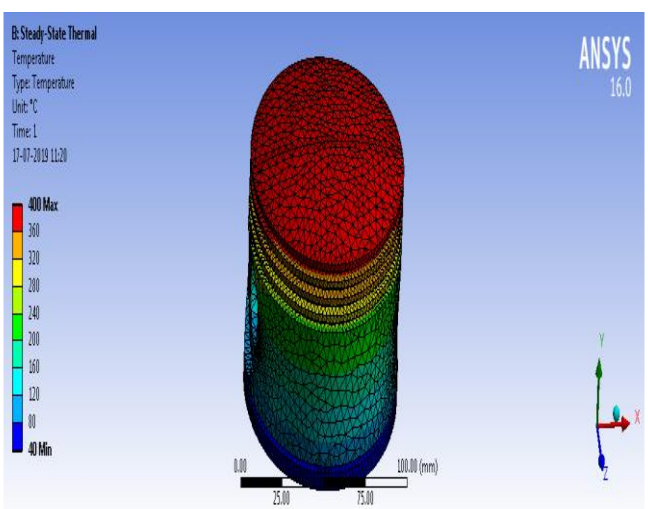


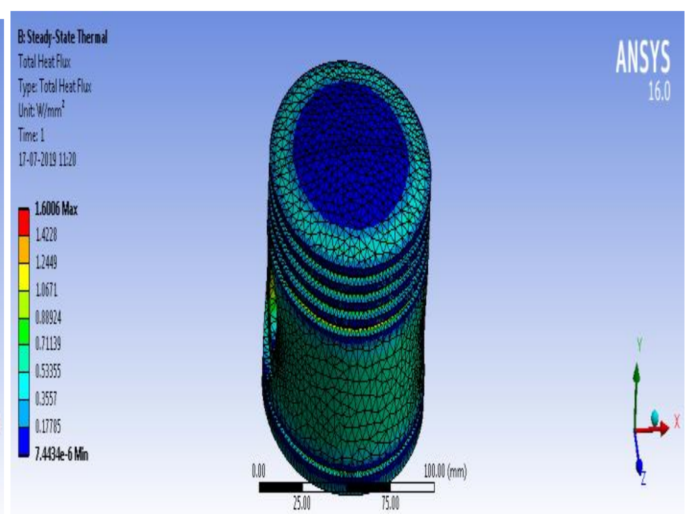


6.2.4: Eutectic forged Aluminum alloy

Figure 6.35Temperature

Figure 6.36 Total heat flux

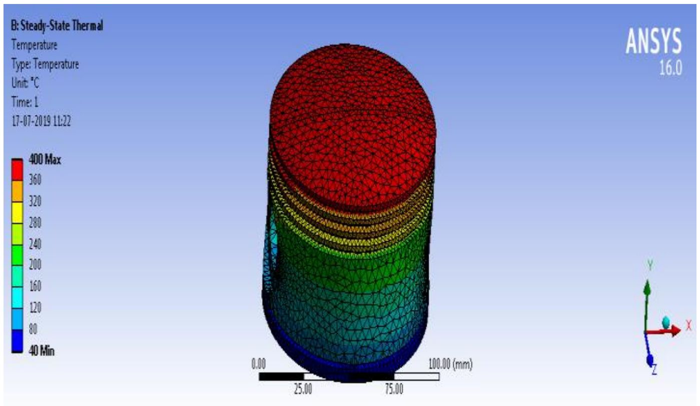


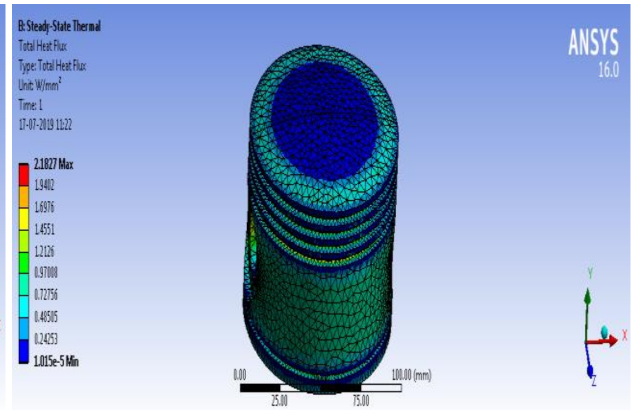


6.2.5Hypereutectic forged Aluminum alloy

Figure 6.37Temperature

Figure6.38 Total heat flux





7. Results and Conclusions

Material	Heat flux
cast iron	0.27647
Forged high carbon steel	0.51761
Cast Aluminum	1.2472
Eutectic forged Aluminum alloy	1.6006
Hypereutectic forged Aluminum alloy	2.1827

- Modeling and analysis of piston is done
- Modeling of piston is done in solid works 2016 design software by using various commands
- The solid works part file is converted into IGS file and imported to ansys workbench.
- First Static structural analysis is carried out on piston at 1.5MPa pressure with four different materials, such as cast iron, Forged high carbon steel, Cast Aluminum, Eutectic forged Aluminum Alloy, Hypereutectic forged Aluminum Alloy in ansys workbench.
- Maximum stress, deformation, maximum strain and maximum shear stress are noted and tabulated
- Then steady state thermal analysis is carried out at maximum temperature 400deg and minimum temperature 30deg for the above four various materials.
- Temperature distribution and heat flux are noted for four different materials and tabulated.
- From the tables it is concluded that the Forged high carbon steel is showing efficient results
- Hence Forged high carbon steel is preferable among the four applied materials

References

1. Haque M.M and Young J.M. (2001), “Study on wear property of aluminium-silicon piston alloy , Journals of

Material Processing technology page 69-73

2. A.R. Bhagat, 2012 “Thermal Analysis And Optimization Of I.C. Engine Piston Using Finite Element Method., Research gate, page 670–680.

3. Hitesh pandey, 2014 “Thermal Stress Analysis of a Speculative IC Engine Piston using CAE Tools” Int. Journal of Engineering Research and Applications Vol. 4, Issue 11(Version - 5), page.60- 64

4. Dilip Kumar Sonar, 2015“Theoretical Analysis of Stress and Design of Piston Head using CATIA & ANSYS” International Journal of Engineering Science Invention. Volume 4 Issue 6 June 2015 Page .52-61

5. Subodh Kumar Sharma,, 2015 “Experimental Thermal Analysis of Diesel Engine Piston and Cylinder Wall”. Journal of Engineering Volume 2015,

6. Ankit Kumar Pandey, Sandeep Jain, Lokesh Bajpai, 2016, "Design, Analysis and Optimization of Four Stroke S.I. Engine Piston using Finite Element Analysis in ANSYS software", International Journal of Advance Engineering and Research Development, 9, pp. 16-27

. 7. Amitanand B Suralikerimath 2016, "STUDY ON DESIGN AND STATIC ANALYSIS OF PISTON HEAD", International Journal of Research in Engineering g and Technology Volume: 05 Issue: 10, pp. 11-15