CHAPTER-1

INTRODUCTION

1.1 COMPOSITE MATERIAL:

Composite materials (also called composition materials or shortened to composites) are materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons common examples include materials which are stronger, lighter or less expensive when compared to traditional materials.

Typical engineered composite materials include:

- Composite building materials such as cements, concrete
- Reinforced plastics such as fiber-reinforced polymer
- Metal Composites
- Ceramic Composites

1.1.1 COMPOSITION:

MMCs are made by dispersing a reinforcing material into a metal matrix. The reinforcement surface can be coated to prevent a chemical reaction with the matrix.

1.1.2 METAL MATRIX COMPOSITE:

A metal matrix composite (MMC) is composite material with at least two constituent parts, one being a metal necessarily, the other material may be a different metal or another material, such as a ceramic or organic compound.

1.1.3 MATRIX:

The matrix is the monolithic material into which the reinforcement is embedded, and is completely continuous. This means that there is a path through the matrix to any point in the material, unlike two materials sandwiched together. In structural applications, the matrix is usually a lighter metal such as aluminum, magnesium, or titanium, and provides a compliant support for the reinforcement. In high-temperature applications, cobalt and cobalt–nickel alloy matrices are common.

1.1.4 REINFORCEMENT:

The reinforcement material is embedded into a matrix. The reinforcement does not always serve a purely structural task (reinforcing the compound), but is also used to change physical properties such as wear resistance, friction coefficient or thermal conductivity. The reinforcement can be either continuous, or discontinuous. Discontinuous MMCs can be isotropic, and can be worked with standard metalworking techniques, such as extrusion, forging, or rolling. In addition, they may be machined using conventional techniques, but commonly would need the use of polycrystalline diamond tooling (PCD).

Continuous reinforcement uses monofilament wires or fibers such as carbon fiber or silicon carbide. Because the fibers are embedded into the matrix in a certain direction, the result is an anisotropic structure in which the alignment of the material affects its strength. One of the first MMCs used boron filament as reinforcement. Discontinuous reinforcement uses "whiskers", short fibers, or particles. The most common reinforcing materials in this category are alumina and silicon carbide.

Metal matrix composites (MMCs) generally consist of lightweight metal alloys of aluminum, magnesium, or titanium, reinforced with ceramic particulate whiskers, or fibers. The reinforcement is very important because it determines the mechanical properties, cost, and performance of a given composite.

Metal matrix composites (MMCs) usually consist of a low-density metal, such as aluminum or magnesium, reinforced with particulate or fibers of a ceramic material, such as silicon carbide or graphite. Compared with unreinforced metals, MMCs offer higher specific strength and stiffness, higher operating temperature, and greater wear resistance, as well as the opportunity to tailor these properties for a particular application.

However, MMCs also have some disadvantages compared with metals. Chief among these are the higher cost of fabrication for high-performance MMCs, and lower ductility and toughness. Presently, MMCs tend to cluster around two extreme types. One consists of very high performance composites reinforced with expensive continuous fibers and requiring expensive processing methods. The other consists of relatively low-cost and low-performance composites reinforced with relatively inexpensive particulate or fibers. The cost of the first type is too high for any but military or space applications, whereas the cost/benefit advantages of the second type over unreinforced metal alloys remain in doubt.

Cast composites designed as based on a magnesium matrix and reinforced with silicon carbide particles constitute a new group of materials that feature the desired set of properties. The use of magnesium for the matrix of composites allows a low weight of the final element to be obtained, while assuring the proper level of properties; the introduction of SiC particles, on the other hand, enables the tribological properties, Young's modulus, tensile strength and hardness of the composite to be enhanced. It should be noted that the Mg-SiC system is characterized by

- A very good wettability of SiC by molten Mg,
- A very high stability of SiC in liquid Mg.

Investigations carried out so far have determined the possibility of obtaining adhesive bonding between components and high volumetric fractions of SiC particles with their uniform distribution within the matrix.

1.2 MAGNESIUM:

Magnesium is the ninth most abundant element in the universe. It is synthesized in large, ageing stars from the sequential addition of three helium nuclei to a carbon nucleus. When such a star explodes as a supernova, much of its magnesium is expelled into the interstellar medium, where it can be recycled into new star systems. Consequently, magnesium is the eighth most abundant element in the Earth's crust and the fourth most common element in the Earth (below iron, oxygen and silicon), making up 13% of the planet's mass and a large fraction of the planet's mantle. It is the third most abundant element dissolved in seawater, after sodium and chlorine.

TABLE:1.2 General properties of magnesium

Name, symbol	magnesium, Mg
Appearance	shiny grey solid
Atomic number	12
Standard atomic weight	24.305 (24.304–24.307)
Physical properties	
Phase	solid
Melting point	923 K (650 °C, 1202 °F)
Boiling point	1363 K (1091 °C, 1994 °F)
Density near r.t.	1.738 $g \cdot cm^{-3}$
when liquid, at m.p.	1.584 $g \cdot cm^{-3}$
Heat of fusion	8.48 $kJ \cdot mol^{-1}$
Miscellanea	
Crystal structure	hexagonal close-packed (hcp)
Speed of sound thin rod	4940 $m \cdot s^{-1}$ (annealed)
Thermal expansion	24.8 $\mu m \cdot m^{-1} \cdot K^{-1}$ (at 25 °C)
Thermal conductivity	156 $W \cdot m^{-1} \cdot K^{-1}$
Magnetic ordering	paramagnetic
Young's modulus	45 GPa
Shear modulus	17 GPa
Bulk modulus	45 GPa
Poisson ratio	0.290
Mohs hardness	1–2.5
Brinell hardness	44–260 MPa

1.3 SILICONCARBIDE:

TABLE:1.3 General Properties of Silicon carbide

Molecular formula	SiC
Molar mass	40.10 $g \cdot mol^{-1}$
Appearance	Colorless crystals
Density	3.21 $g \cdot cm^{-3}$ (all polytypes)
Melting point	2,730 °C (4,950 °F; 3,000 K) (decomposes)
Electron mobility	~900 $cm^2/V \cdot s$ (all polytypes)
Refractive index (n_D)	2.55 (infrared; all polytypes)

Silicon carbide (SiC), also known as carborundum is a compound of silicon and carbon with chemical formula SiC. It occurs in nature as the extremely rare mineral moissanite. Silicon carbide powder has been mass-produced since 1893 for use as an abrasive. Grains of silicon carbide can be bonded together by sintering to form very hard ceramics that are widely used in applications requiring high endurance, such as car brakes, car clutches and ceramic plates in bulletproof vests.

1.4 PISTON:

A piston is a component of reciprocating IC-engines. 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. Piston endures the cyclic gas pressure and the inertial forces at work, and this working condition may cause the fatigue damage of piston, such as piston side wear, piston head cracks and so on.

Piston in an IC engine must possess the following characteristics:

- Strength to resist gas pressure.
- Must have minimum weight.
- Must be able to reciprocate with minimum noise.
- Must have sufficient bearing area to prevent wear.
- Must seal the gas from top and oil from the bottom.
- Must disperse the heat generated during combustion.
- Must have good resistance to distortion under heavy forces and heavy temperature.

1.4.1 FUNCTIONS OF THE PISTONS:

- To receive the impulse from the expanding gas & transmit the energy to the crank shaft through the connecting rod.
- It transmits the force of combustion gases to the crank shaft.
- It controls the opening & closing of the parts in a 2-stroke engine.
- It acts as a seal to escape of high pressure gases in to the crank case.

1.4.2 CHARACTERSTICS OF PISTON:

- Hammering effect of a combustion gas
- pressure.
- High temperature of the gases.
- Light in weight silent in a operation &Mechanically strong

An Internal Combustion Engine is that kind of prime mover that converts chemical energy to mechanical energy. The fuel on burning changes into gas which impinges on the piston and pushes it to cause reciprocating motion. The reciprocating motion of the piston is then converted into rotary motion of the crankshaft with the help of connecting rod. IC engines are used in marine locomotives, aircrafts, automobiles and other industrial applications.

1.4.3 CROSSHEAD PISTONS:

Large slow-speed Diesel engines may require additional support for the side forces on the piston. These engines typically use crosshead pistons. The main piston has a large piston rod extending downwards from the piston to what is effectively a second smaller-diameter piston. The main piston is responsible for gas sealing and carries the piston rings. The smaller piston is purely a mechanical guide. It runs within a small cylinder as a trunk guide and also carries the gudgeon pin.Because of the additional weight of these pistons, they are not used for high-speed engines.

In engine, transfer of heat takes place due to difference in temperature and from higher temperature to lower temperature. Thus, there is heat transfer to the gases during intakes stroke and the first part of the compression stroke, but the during combustion and expansion processes the heat transfer take place from the gases to the walls. So the piston crown, piston ring and the piston skirt should have enough stiffness which can endure the pressure and the friction between contacting surfaces. In addition, as an important part in engine, the working condition of piston is directly related to the reliability and durability of engine.

1.5 DESIGN PROCEDURE:

Computer aided design or CAD has very broad meaning and can be defined as the use of computers in creation, modification, analysis and optimization of a design. CAE (Computer Aided Engineering) is referred to computers in engineering analysis like stress/strain, heat transfer, and flow analysis CAD/CAE is said to have more potential to radically increase productivity than any development since electricity. CAD/CAE builds quality form concept to final product. Instead of bringing in quality control during the final inspection it helps to develop a process in which quality is there through the life cycle of the product. CAD/CAE can eliminate the need for prototypes. But it required prototypes can be used to confirm rather predict performance and other characteristics. CAD/CAE is employed in numerous industries like manufacturing, automotive, aerospace, casting, mold making, plastic electronics and other general-purpose industries. CAD/CAE systems can be broadly divided into low end, mid end and high-end systems.

Low-end systems are those systems which do only 2D modelling and with only little 3D modelling capabilities. According to industry static's 70-80% of all mechanical designers still uses 2D CAD applications. This may be mainly due to the high cost of high-end systems and a lack of expertise. Mid-end systems are actually similar high-end systems with all their design capabilities with the difference that they are offered at much lower prices. 3D sold modelling on the PC is burgeoning because of many reasons like affordable and powerful hardware, strong sound software that offers windows case of use shortened design and production cycles and smooth integration with downstream application. More and more designers and engineers are shifting to mid end system.

1.5.1 MODELING:

Model is a Representation of an object, a system, or an idea in some form other than that of the entity itself. Modeling is the process of producing a model a model is a representation of the construction and working of some system of interest. A model is similar to but simpler than the system it represents. One purpose of a model is to enable the analyst to predict the effect of changes to the system. On the one hand, a model should be a close approximation to the real system and incorporate most of its salient features. On the other hand, it should not be so complex that it is impossible to understand and experiment with it. A good model is a judicious tradeoff between realism and simplicity. Simulation practitioners recommend increasing the complexity of a model iteratively. An important issue in modeling is model validity. Model validation techniques include simulating the model under known input conditions and comparing model output with system output. Generally, a model intended for a simulation study is a mathematical model developed with the help of simulation software.

Software for modeling:

- Solid works
- Creo

- CATIA
- Unigraphics, etc

1.5.2 SOLIDWORKS:

SolidWorks is a 3D mechanical CAD (computer-aided design) program that runs on Microsoft Windows and is being developed by Dassault Systèmes SolidWorks Corp., a subsidiary of Dassault Systèmes, S. A. (Vélizy, France). SolidWorks is currently used by over 1.3 million engineers and designers at more than 130,000 companies worldwide. FY2009 revenue for Solid Works High-end CAD/CAE software's are for the complete modelling, analysis and manufacturing of products. High-end systems can be visualized as the brain of concurrent engineering. The design and development of products, which took years in the past to complete, is now made in days with the help of high-end CAD/CAE systems and concurrent engineering.

1.6 ANSYS:

ANSYS is the usually preferred analysis software package because of its functionality. In this interface, you can apply forces, pressures, torques, etc on the models and see how the stresses develop.

The ANSYS Workbench platform is the framework upon which the industry's broadest and deepest suite of advanced engineering simulation technology is built. An innovative project schematic view ties together the entire simulation process, guiding the user through even complex multiphysics analyses with drag-and-drop simplicity. With bi-directional CAD connectivity, an automated project level update mechanism, pervasive parameter management and integrated optimization tools, the ANSYS Workbench Platform delivers unprecedented productivity, enabling simulation driven product development.

But whatever it is always remember: anyone can learn ANSYS workbench and use it to analyse structures it not at all a big deal always remember to study the FEA theory very well before you start to use ansys. the reason is that in many real case scenarios, the ansys always gives some result or the other never 100% accurate and its generally impossible to find out how correct/incorrect the results are.... but FEA engineers know how to mesh their models and how to configure the solver in order to get accurate results most of the time hence always understand the FEM before blindly doing the analysis on ansys, better interpret the results..

1.6.1 FINITE ELEMENT METHOD:

The Finite Element Method (FEM) is a reliable numerical technique for analyzing engineering designs. FEM replaces a complex problem with many simple problems. It divides the model into many small pieces of simple shapes called elements.

Elements share common points called nodes. The behavior of these elements is well-known under all possible support and load scenarios. The motion of each node is fully described by translations in the X, Y, and Z directions. These are called degrees of freedom (DOFs). Analysis using FEM is called Finite Element Analysis (FEA).

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

Next, the program organizes the equations into a large set of simultaneous algebraic equations. The solver finds the displacements in the X, Y, and Z directions at each node. Using the displacements, the program calculates the strains in various directions. Finally, the program uses mathematical expressions to calculate stresses.

Finite element proceeds at present very widely used in the engineering analysis. The procedures are employed extensively in the analysis of solids structure has transferred and finite element methods are useful in virtually every field at engineering analysis.

The finite element method is a numerical analysis technique for obtaining approximately solution to varieties of engineering in the finite element analysis actual continuum or body of the matter like solid, liquid or gas is represented as an assemblage of sub division called finite element. These finite elements of field variable inside the finite element can approximately by the single function.

The approximately functions are defined in terms of the values of the field variable of the nodes by solving the solid variables the total values of the field variable of the nodes by solving the solid variables the total values of the nodes by soling the solid variables the total values of the field variable can be found out.

1.6.2 STEPS IN FEA:

- Definitions of the problem and its domain.
- Discretisation of the domain the continuum.
- Identification of state variable.
- Formulation of the problem.
- Establishing coordinate system.
- Constructing approximate functions for the elements.
- Obtaining element matrix and equation.
- Coordinate transformation.
- Assembly of element equations.
- Introduction of the final set of simultaneous equation.
- Interpretations of the results.

1.6.3 BASIC COMPONENTS OF FEA:

- Pre-processor
- Solution
- Post processor
- General post processor

1.6.4 ADVANTAGES OF FEA:

- Applicable to any field problem such as heal transfer stress analysis, magnetic field etc.
- There is no matrix restriction.
- Approximately it is easily improved by grading the mesh so that more elements appear where field gradients are high and more resolution is required.
- Compounds that have different behavior and different mathematical description can be solved.
- FEA structure closely resembles closely the actual body or region to be analyzed.

1.6.5 USES OF FEA:

- Structural analysis
- Heat transfer analysis
- Fluid flow analysis
- Mass transport

CHAPTER:2

LITERATURE REVIEW

1) R.A. Saravanan, M.K. Surappa ‘Fabrication and characterisation of pure magnesium-30 vol.% SiC particle composite’The magnesium 30 vol.% SiC composite was processed by melt stir technique. The matrix material was99% pure magnesium and SiC particles with 40 mm average size. Steps involved and the procedure employed for the fabrication of the melting was carried out using a resistance heating furnace of 5 KW. Fracture behavior of pure magnesium reveals elongated dimples at room temperature and circular dimples at high temperatures.Sliding wear rate of the Mg-30 vol.% SiC composite is two order of magnitude less compared to unreinforced magnesium.

2) Jonathan A. Lee NASA-Marshall Space Flight Center ‘Cast aluminum alloy for high temperature applications’The developed as piston material to meet automotive legislation requiring low exhaust emission, the novel NASA alloys also offer dramatic increase in strength, enabling components to utilize less material, which can lead to reducing part weight and cost as well as improving gas mileage and performance for auto engines. In hypereutectic form, the alloys also have greater wear resistant, surface hardness and dimensional stability compared to conventional cast aluminum alloys.

3) Hai Zhi Ye, Xing Yang Liu- ‘Review of recent studies in magnesium matrix composites’ Magnesium alloys have been increasingly used in the automotive industry in recent years due to their lightweight. The density of magnesium is approximately two thirds of that of aluminum, one quarter of zinc, and one fifth of steel. As a result, magnesium alloys offer a very high specific strength among conventional engineering alloys. In addition, magnesium alloys possess good damping capacity, excellent castability, and superior machinability. Accordingly, magnesium casting production has experienced an annual growth of between 10 and 20% over the past decades and is expected to continue at this rate.

4) Malarvannan, P. Vignesh ‘ Experimental Investigation and Analysis of Piston by using Composite Materials’ The increased hardness of the material ensures the less deformation due to impact loads and keeps the material strong enough to with stand loads. The Youngs modulus of the material is higher compared to the smaller composition and the tensile strength of the material is also increased to the virgin material. This shows that the AlSic is better in all the aspects when compared to the Aluminium. Models for the simulation were prepared using Pro Engineer. This software enables to create 3-dimentional model of the piston and to define physical properties of the materials used. Analysis of thermal loads and piston deformations was done by finite elements method using ANSYS software.

5) Isam Jasim Jaber and Ajeet Kumar Rai ‘Design and analysis of I.C engine piston and pistonringusing catia and ansys software’ An analysis of both thermal fatigue and mechanical fatigue damages is presented and analyzed in this work. A linear static stress analysis, using ‘‘cosmos works’’, is used to

determine the stress distribution during the combustion. Stresses at the piston crown and pin holes, as well as stresses at the grooves and skirt as a function of land clearances are also presented Finite element code is used to carry out the modeling process to determine the coupling stress .

6) Praful r. sakharkar ‘Thermal analysis of ic engine piston using FEA’The finite element analysis is performed using CAD software to investigate and analyze thermal stress distribution at the real engine condition during combustion process. Piston skirt may appear deformation usually causes crack on the upper end of the piston head. Due to deformation, stress concentration is caused on the upper end of the piston and the stress distribution on the piston mainly depends on the deformation of piston. Therefore piston crown should have enough stiffness to reduce the deformation.

7) S. Bhattacharya1, A. Basu, S. Chowdhury, Y.S. Upadhyaya ‘ Analysis of piston of two stroke engine’The piston made up of Aluminium 4032 alloy is designed by conventional approach and then both thermal and transient structural analysis have been carried out. The piston has been modeled in CATIA and analysed using ANSYS Workbench. In order to improve the design of piston, two alternative designs have been considered by providing openings at the skirt region of the piston. The analysis showed that this modification improved the thermal performance of the piston.

8) Ekrem Buyukkaya ⁎, Muhammet Cerit ‘Thermal analysis of a ceramic coating diesel engine piston using 3-Dfinite element method’The maximum surface temperature of the coated piston with material which has low thermal conductivity is improved approximately 48% for the AlSi alloy and 35% for

the steel inour studies. These results show that the reduction in the cooling load of system is also obtainable. The maximum surface temperature of the base metal of the coating piston is 261 °C for AlSi and 326 °C for steel. Structural behaviors of the conventional metal materials are varied negative with temperature. By means of ceramic coating, strength and deformation of the materials are improved.

9) Tsuguyasu Wada’Composite materials having a matrix of magnesium or magnesium alloy reinforced with discontinuous silicon carbide particles’ Reinforced composite magnesium-matrix articles, containing silicon carbide fibers or by a casting process where in a small amount of lithium,less than about 0.7% by weight, is included in a melt of magnesium matrix alloy to facilitate wetting of the reinforcing material and ready dispersal thereof in the magnesium matrix alloy.

10) C.H. Li, ‘Piston thermal deformation and friction considerations’The thermal analysis of piston isimportant from different point of views most of the internal combustion (IC) engine pistons are made of aluminum alloy which has a thermal expansion coefficient 80% higher than the cylinder bore material made of cast iron. This leads to some differences between running and the design clearances. Therefore, analysis of the piston thermal behavior is extremely crucial in designing more efficient engines.. First, the highest temperature of any point on piston should not exceed 66% of the melting point temperature of the alloy.

11) Narsaiyolla Naresh, ‘ Structural Analysis of a Ceramic Coated Diesel Engine Piston Using Finite Element Method’ The piston skirt is the main area

of the piston at which the deformation may appear while at work, which usually causes crack on the upper end of piston head. Due to this 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

12) Mustafa Kemal Kulekci ‘Magnesium and its alloys applications in automotive industry’The objective of this study is to review and evaluate the applications of magnesium in the automotive industry that can significantly contribute to greater fuel economy and environmental conservation. In the study, the current advantages, limitations, technological barriers and future prospects of Mg alloys in the automotive industry are given. Recent developments in coating and alloying of Mg improved the creep and corrosion resistance properties of magnesium alloys for elevated temperature and corrosive environments.

13) Vinoth M. A ‘Development and Assessment of Piston by using Al-Si Hybrid Metal Matrix Composites Reinforced with SiC and Cenosphere Particulates’ During the working condition piston exposed to the high gas pressure because of combustion. So the methodology for analyze the piston is to consider the gas pressure as applied uniformly over the piston crown. The pressure force generated by the burning of fuel is calculated using gas equation

and it is assumed that side thrust force and inertia force is negligible but in reality this may have some influence on stress and deformation of piston.

14) K. N. Braszczyska, Malik ‘Reactions in magnesium composites reinforced with SiC particles’ The influence between the matrix and a reinforcement is a very important structural factor influencing the properties of the metal matrix composites. The achievement of the desired composite structure and a bond between the components requires controlling of the phenomena and reactions taking place in these materials. As indicated above, the influence of individual alloying elements on the nature of the magnesium -silicon carbide interfaces is one of the main factors affecting the microstructure of these composites.

CHAPTER:3

PROBLEM DEFINITION

The function of the piston is to absorb the energy released after the combustion and to produce useful mechanical energy. When the combustion of fuel takes place in heavy diesel engine cylinder, high temperature and pressure develops. Because of high speed and at high loads, the piston is subjected to high thermal and structural stresses. The investigations indicate that the greatest stress appears on the upper end of the piston and stress concentration is one of the main reason for fatigue failure. Due to stress concentration and high thermal load the upper end of the piston, crack generally appears. This crack may even split the piston.

The main objectives are

i) To investigate the maximum stress using stress analysis

ii) To investigate the maximum temperature using thermal analysis

iii) To investigate Stiffness of the piston crown to reduce the deformation

iv) To every 10% weight reduction of the vehicle, an improvement in fuel consumption of 6–8% is expected an additional 20–40% reduction in overall weight, without sacrificing safety seems to be possible

The pistons will produce stress and deformation because of the periodic load effect, which are from high gas pressure, high speed reciprocating motion from the inertia force, lateral pressure, friction and so on. Burning of the high pressure gas products high temperature, which makes piston expands in order that its interior produces thermal stress and thermal deformation.The thermal deformation and mechanical deformation will cause piston cracks, tortuosity, etc.

The piston skirt is the main area of the piston at which the deformation may appear while at work, which usually causes crack on the upper end of piston head. Due to this 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 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.

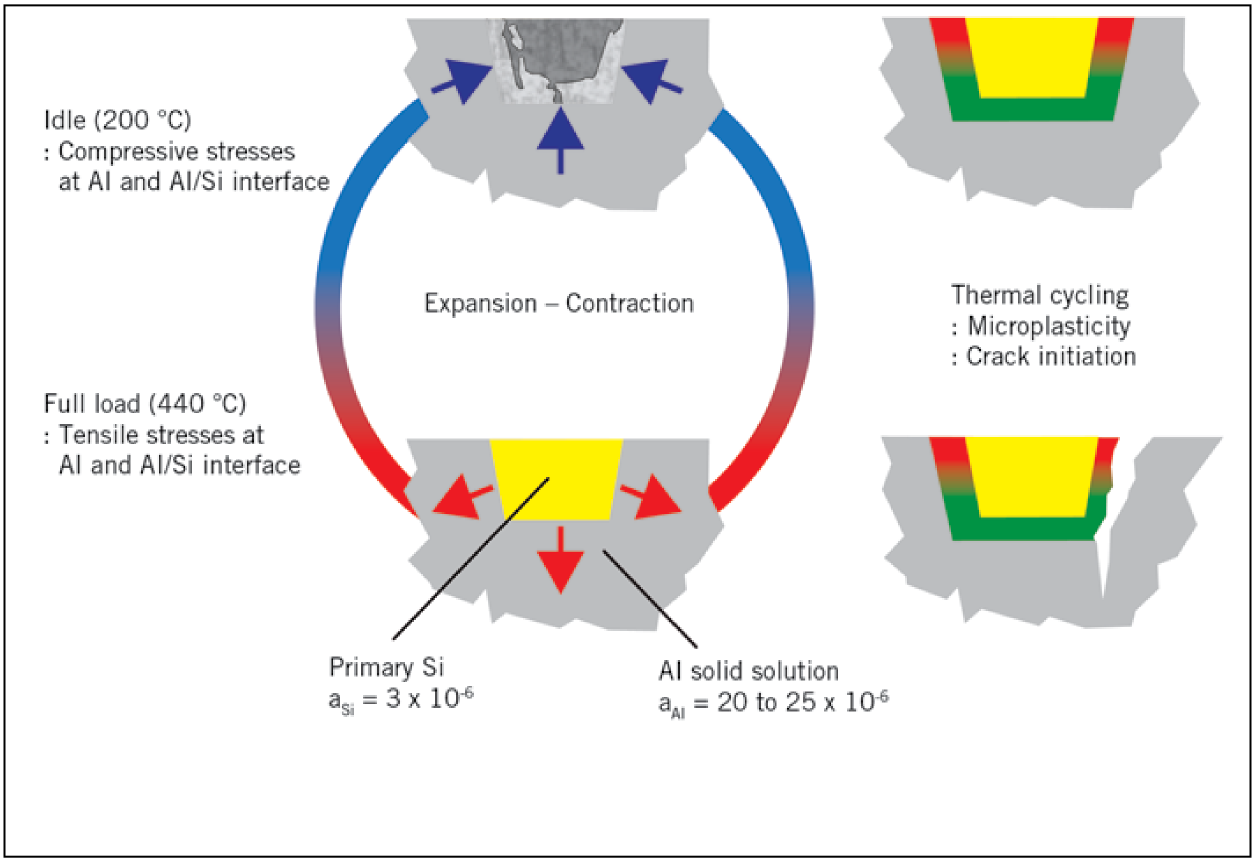

Figure 3.1 Thermo-mechanical fatigue induced by micro-plasticity after thermal cycling

To take conventional aluminium (Al) piston designs to the limit of material strength. The highest temperature of any point in piston must not exceed more than 66% of the melting point temperature of the aluminium alloy. Therefore the limit temperature for the current alloy is of 640K above this level the bowl rim is exposed to so much heat that cracks can begin to form. So they are not suitable for high temperature applications.

CHAPTER:4

FABRICATION AND MODELLING OF COMPOSITE PISTON

AZ91Magnesium-siliconcarbide composite was prepared by mechanical mixing of silicon carbide powder (220 mesh) in solidifying solid-liquid slurry of hypoeutectic, eutectic and hypereutectic compositions of AZ91 Magnesium-silicon alloy. Requisite amount of silicon carbide powder was charged into agitating metallic melt of AZ91Magnesium-silicon matrix alloy and mixing continued while dropping the temperature of the system. The mixing period was 3-4 min during which temperature of the system dropped to 15±5°C below the liquids.

Various Mg-SiC composites were prepared by melting the constituent metals and master alloy in a furnace and incorporating the silicon carbide in the solidifying metallic slurry of AZ91Magnesium-siliconcarbide matrix alloy. Aluminium of respective pure quality was selected and silicon carbide powder was dispersed. A weighed amount (400 g) of charge consisting of commercially AZ91 Magnesium and Silicon Carbide powder of a weighed amount (360g & 40g) was added respectively.

4.1.1 PREPARATION OF MAGNESIUM METAL MOLT

The pure ingots of Magnesium (AZ91) were taken and they are melted in furnace. The furnace is of oil type and the ingots got melted in the burning of the furnace. The ingots gets into a liquid state at the temperature of 650-750* C.

4.1.2 CLEANING OF THE METAL MOLT

The molten molt has some impurities present in it, so it must be removed. The molten molt is treated with the powder of “Kavaral & Degasser” in the furnace and the heating is continued for few minutes .The impurities present in it will float at the top of the molt. These impurities will form as ash and gets separated from the molt.

4.1.3 SILICON CARBIDE ADDING:

The purified molt is now ready for treating with the silicon carbide. The silicon carbide powder of 224 meshes is now added to the molt in furnace. The temperature is not reduced, so the silicon carbide would mix with the molt easily.

4.1.4 AGITATING THE MOLT

During the agitation process the materials will mix properly .The molt is mechanically stirred to mix the silicon carbide with the metal. The mixing is done for about 1-2 minutes. The mechanically made stirrer is used to stir the molt.

4.1.5 CASTING POURING

The die is prepared for pouring the molt. There preliminary works must be done before pouring the casting. The die is made up of sand by placing a pattern. Since the molt is about 700*C the molt starts burst, this produces blow holes and other improper casting. The die must be filled with a lubricating material to avoid sticking of the casting to the die. The vent for gas release is kept to avoid blow hole formation inside the casting.

4.1.6 COOLING THE CASTING

The casting from the die is removed. The casting will be too hot as its super heated, so the casting must be cooled in order to avoid the oxidation process. The casting is cooled by the quenching process. This process includes the rapid cooling of the casting by treating with the water. The casting is immersed in a bath containing water to remove the heat and to get a solid form of the casting.

4.2 MACHINING PROCESS

The Machining process is done in order to remove the excess and unwanted material. The machining process includes all the lathe works. The casting is machined to the desired shape. This process includes surface finish, surface grinding, facing, turning operations.

Weight of Mg alloy

Weight of SiC fiber

Stir casting apparatus

Heating furnace

FIG:4.1 Fabrication process OF Mg-SiC piston

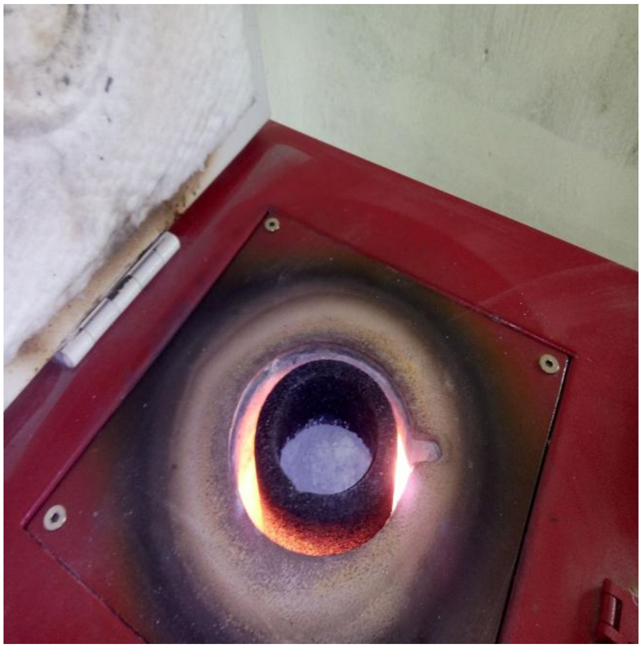

FIG:4.2 FABRICATE PART OF MG-SIC PISTON

Finishing Metal for Rod

Piston model

4.3 MODELLING OF PISTON BY USING SOLIDWORKS:

4.3.1COMPUTER AIDED DESIGNING:

Solid works is a 3D design app for parametric modeling parametric featured based solid modeling. To build a company that developed 3D CAD software that was easy-to-use, affordable and available on the desktop, with its headquarters at Concord, Massachusetts, and released its first product, SolidWorks 95, in 1995

The design of the piston starts with the definition of the piston geometry using 3D CAD software. This 3D CAD geometric model is then imported to FEA software and analysed under the predicted service conditions before anything is made. That speeds up the design and testing process, reduces the lead time to create new pistons designs, and produces a better product

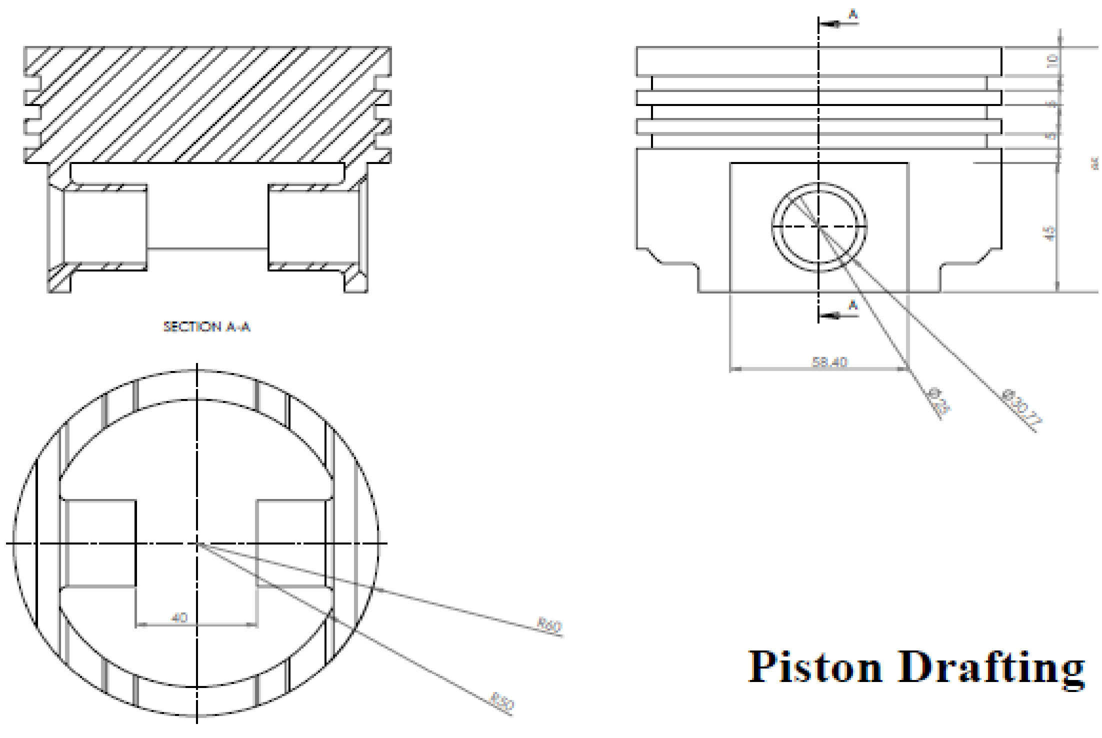

Figure:4.4 Two dimensional drawing of piston

4.4 GENERATE THREE DIMENSIONAL MODELLING:

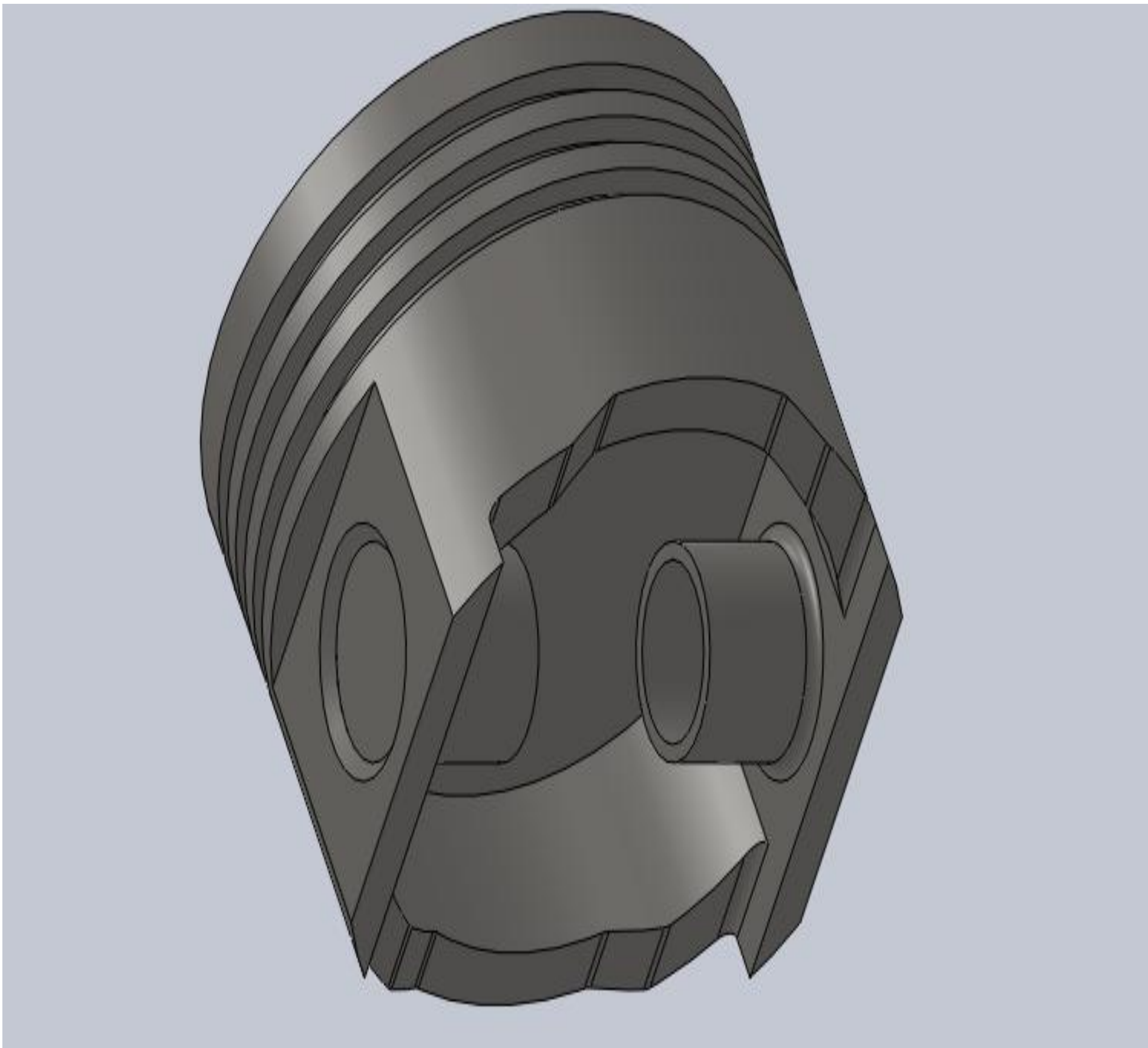

Figure: 4.5 Three dimensional model for Piston by using solidworks

The piston was successfully modelled as per specification by using software solidworks.

4.5 DESIGN CALCULATION:

4.5.1 RULE OF THE MIXTURE

Rule of mixtures is a method of approach to approximate estimation of composite material properties, based on an assumption that a composite property is the volume weighted average of the phases (matrix and dispersed phase) properties.

4.5.2 DENSITY:

$$d_c = (d_m * V_m) + (d_r * V_r)$$

Dc, dm, dr - densities of the composite, matrix and dispersed phase

V_m, V_r – volume fraction of the matrix and dispersed phase respectively.

4.5.3 YOUNGMODULUS:

$$E_c = E_m*V_m + E_f*V_f$$

Ec, Em, Ef -young modulus of the composite, matrix and dispersed phase

V_m, V_f – volume fraction of the matrix and dispersed phase respectively.

4.5.4 POISSON RATIO:

$$M_c = M_m*V_m + M_f*V_f$$

Mc, Mm, Mf - poisson ratio of the composite, matrix and dispersed phase

V_m, V_f – volume fraction of the matrix and dispersed phase respectively.

4.5.5 THERMALCONDUCTIVITY:

$$K_c = K_m*V_m + K_f*V_f$$

Kc, Km, Kf - thermal conductivity of the composite, matrix and dispersed

TABLE: 4.7 Properties of composite materials

property	AL-SiC (90%-10%)	Mg-SiC (90%-10%)
Young's modulus, Gpa	104	81.5
Poisson ratio	0.329	0.275
Density, kg/m^3	2751	1885.2
Thermal conductivity W/mk	225.3	152.4

TABLE: 4.8 Specification of piston engine

Parameters	**Significances**
Engine Type	Four stroke petrol engine
Induction	Air cooled type
Number of cylinders	Single cylinder
Bore	67mm
Stroke	75mm
Displacement	135 cc
Maximum Power	13.8 bhp at 8500 rpm
Maximum Torque	13.4 N-m at 6000 rpm
Compression ratio	9.35

The piston are designed according to procedures and specifications given in machine design and design data book. Dimensions are calculated and these are used for modeling the piston and piston ring in Solidworks.

CHAPTER-5

RESULTS AND DISCUSSION-I

5.0 ANALYSIS OF Al-SiC PISTON

To analysis of Al-SiC piston de-formations resulting from thermal load was done using calculated temperature distribution in the cross-sections of the piston. The piston is modelled and analysed for structural and thermal behaviours for the original material to the composite material.

5.1 THERMAL ANALYSIS

Thermal analysis is a group of techniques in which the variation of a physical property of a substance is measured as a function of temperature. The most commonly used techniques are those which measure changes of mass or changes in energy of a sample of a substance.

5.1.1 THERMOGRAVIMETRY

Thermogravimetry is a technique in which the mass of a sample of a substance is recorded as a function of temperature according to a controlled temperature programme.

5.1.2 APPARATUS:

The essential components of a thermo balance are a device for heating or cooling the substance according to a given temperature program, a sample holder in a controlled atmosphere, an electro balance and a recorder.

In some cases the instrument may be coupled to a device permitting the analysis of volatile products.

TABLE:5.1 Properities ofalminium- silicon carbide

Young's Modulus	1.04e+005 Mpa
Poisson's Ratio	0.329
Density	2.751e-006 kg mm^-3
Thermal Expansion	9.5e-006 1/°C
Thermal Conductivity	197. W/m·°C
Specific Heat	894. J/kg·°C
Bulk Modulus	1.0136e+005 MPa

TABLE:5.1.3 ANSYS SIMULATION

Model (A4) > Geometry > Parts Object Name	**piston**
State	Meshed
Definition	
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Material	
Assignment	al-sic
Nonlinear Effects	Yes
Thermal Strain Effects	Yes

Volume	5.4314e+005 mm^3
Mass	1.4942 kg
Centroid X	2.1118e-002 mm
Centroid Y	54.506 mm
Centroid Z	-5.2018e-011 mm
Moment of Inertia Ip1	2045.7 $kg \cdot mm^2$
Moment of Inertia Ip2	2874.7 $kg \cdot mm^2$
Moment of Inertia Ip3	2007.3 $kg \cdot mm^2$
Statistics	
Nodes	598994
Elements	391081

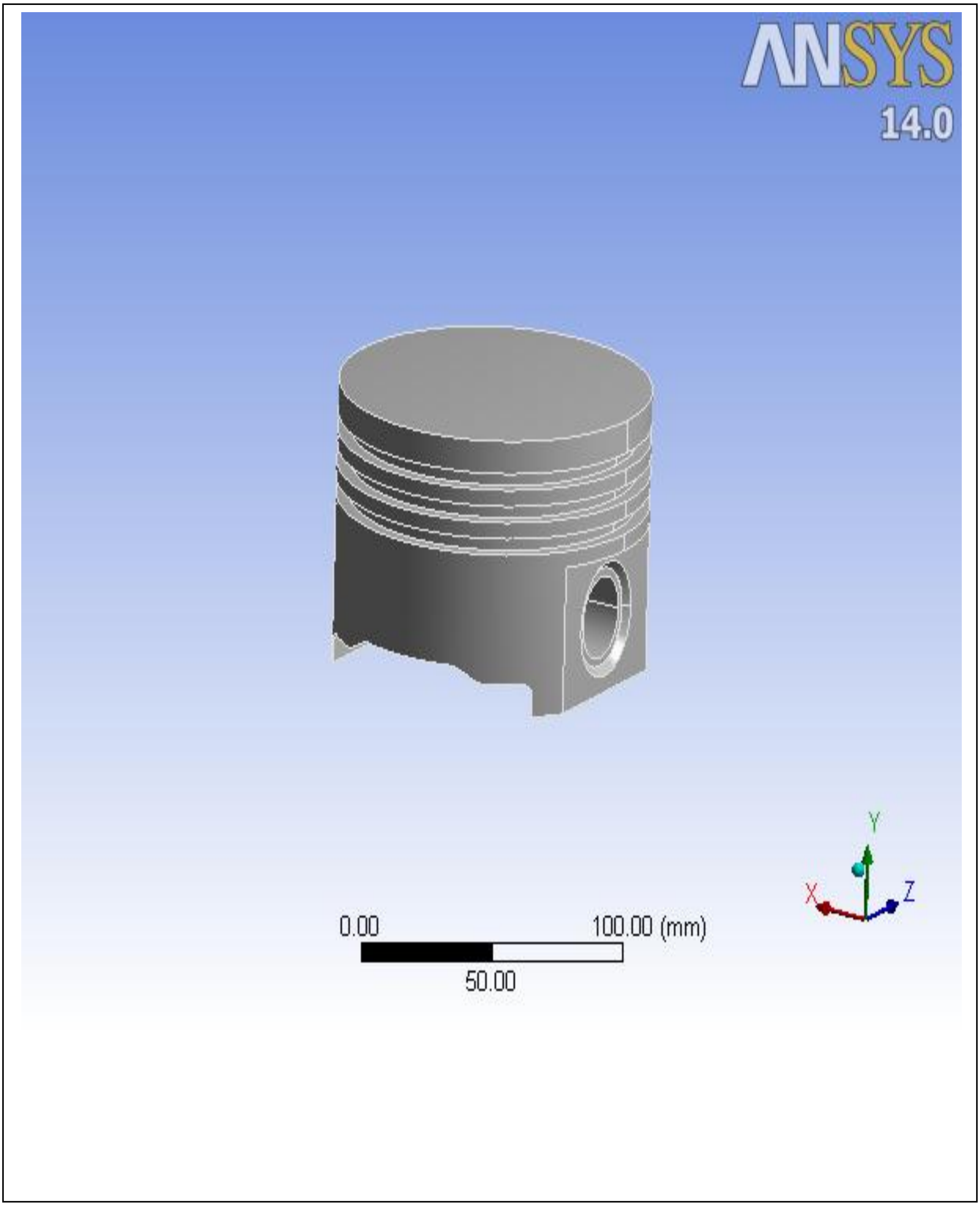

Fig 5.1.3 Geometry view of piston in ansys workbench

5.1.4 MESHING USING ANSYS

In preparing the model for analysis, Ansys subdivides the model into many small tetrahedral pieces called elements that share common points called nodes.

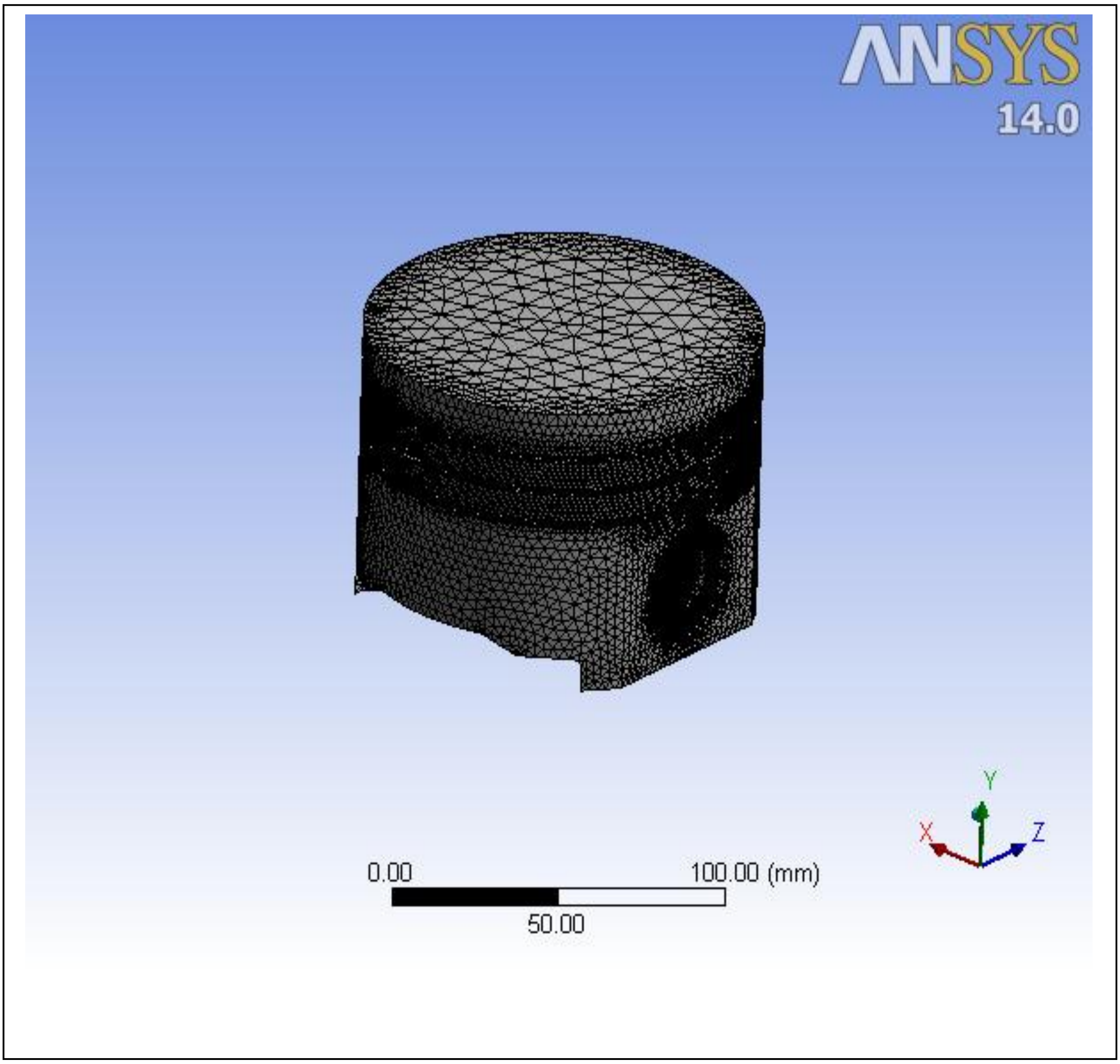

Figure 5.2 Shows the Mesh Model of Piston

- Red dots represent the element's nodes.
- Elements can have straight or curved edges.
- Each node has three unknowns, namely, the translations in the three global directions.
- The process of subdividing the part into small pieces (elements) is called meshing. In general, smaller elements give more accurate results but require more computer resources and time.
- Ansys suggests a global element size and tolerance for meshing. The size is only an average value, actual element sizes may vary from one location to another depending on geometry.
- It is recommended to use the default settings of meshing for the initial run. For a more accurate solution, use a smaller element size.

After meshing the model the boundary conditions are applied properly then the final results are obtained. The following figure shows the final results of thermal analysis for AlSiC.

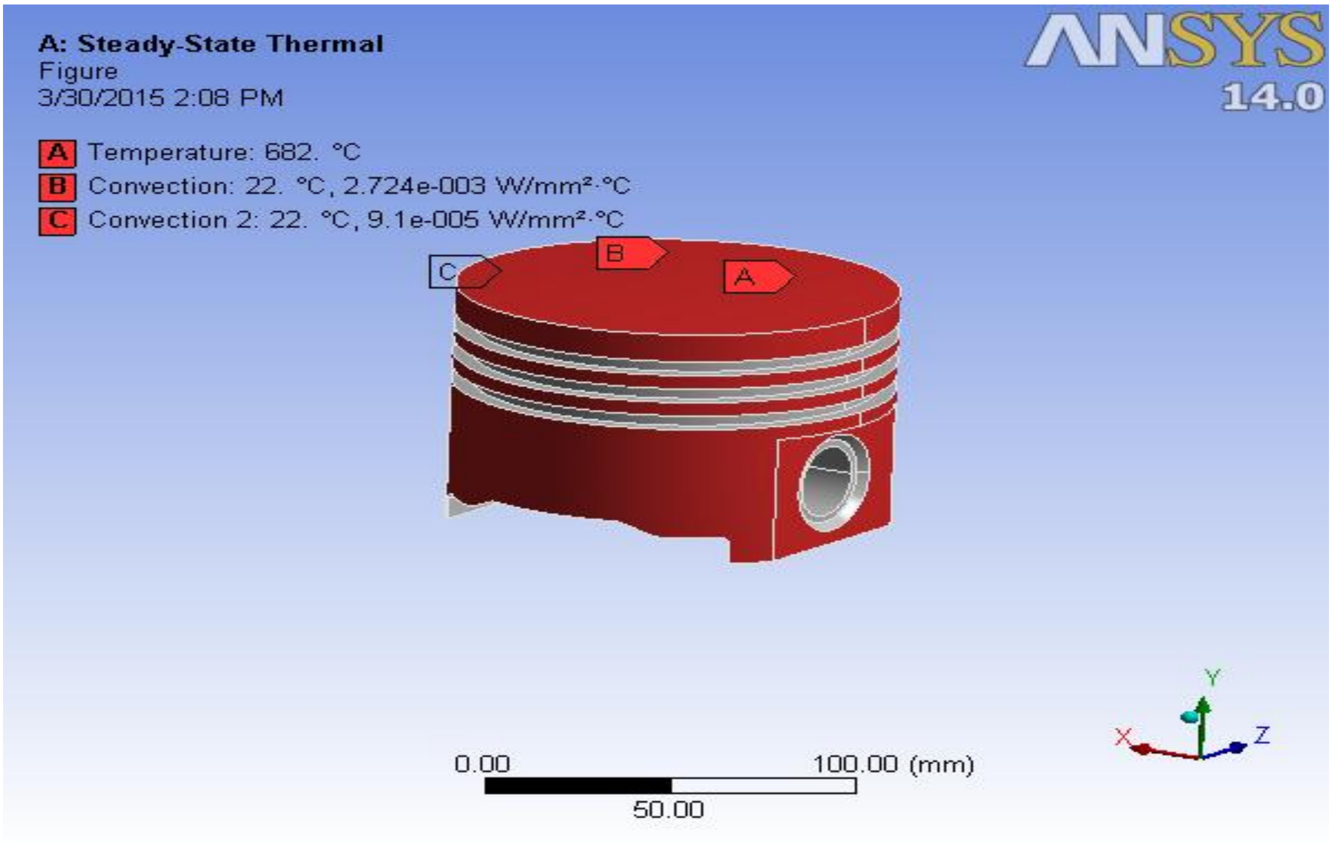

Fig: 5.3 Temperature Distribution of convection Al-SiC Carbide

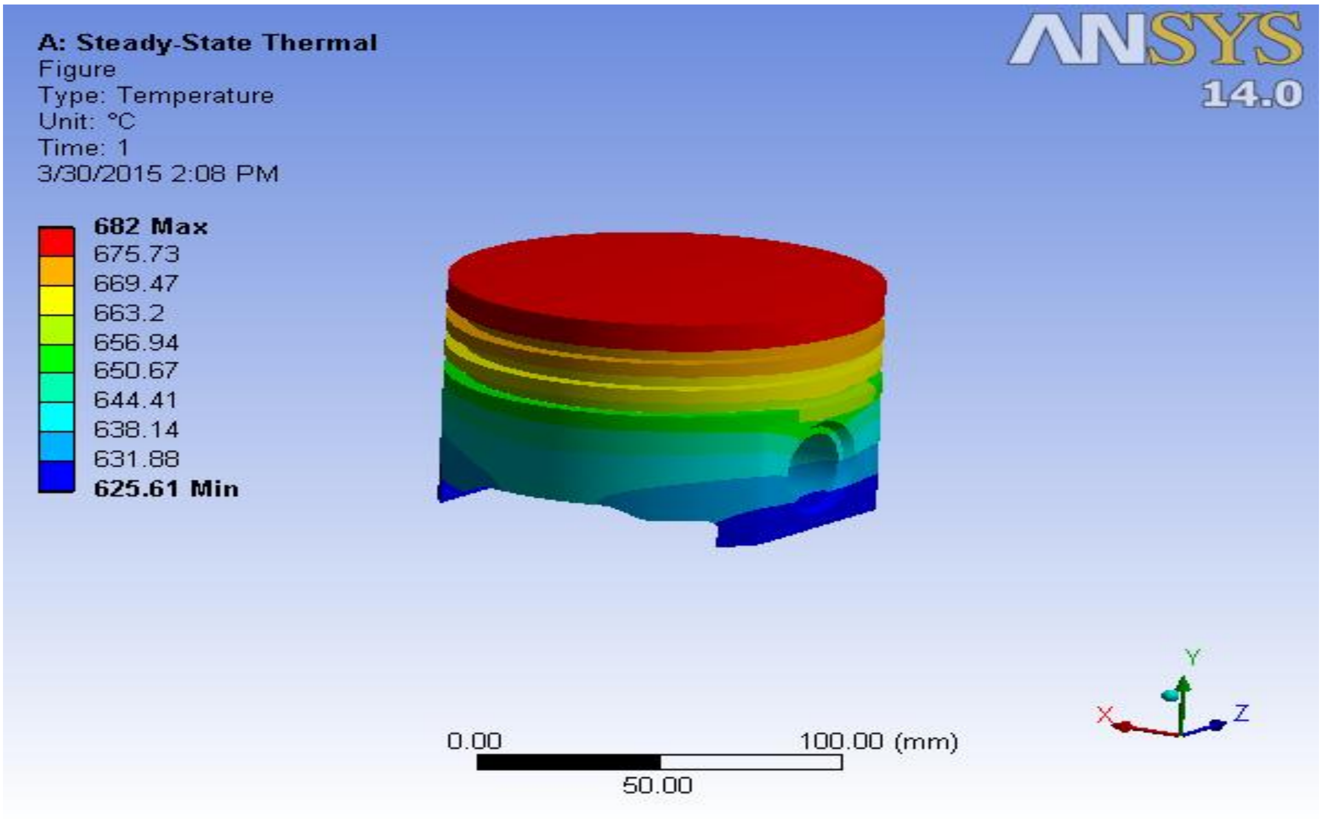

Figure:5.4 Temperature Distribution Al-SiC Piston

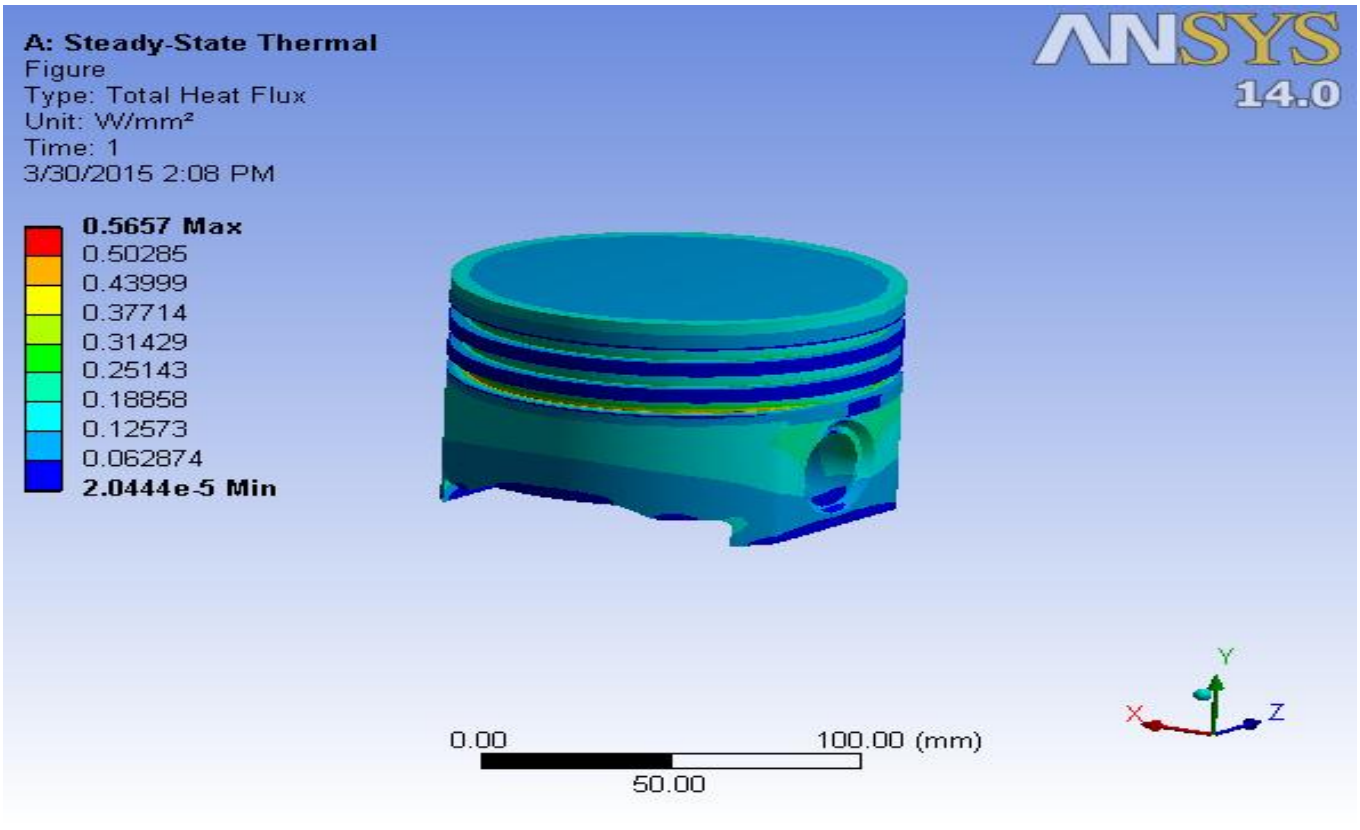

Figure:5.5 Total Heat flux in Al-SiC Piston

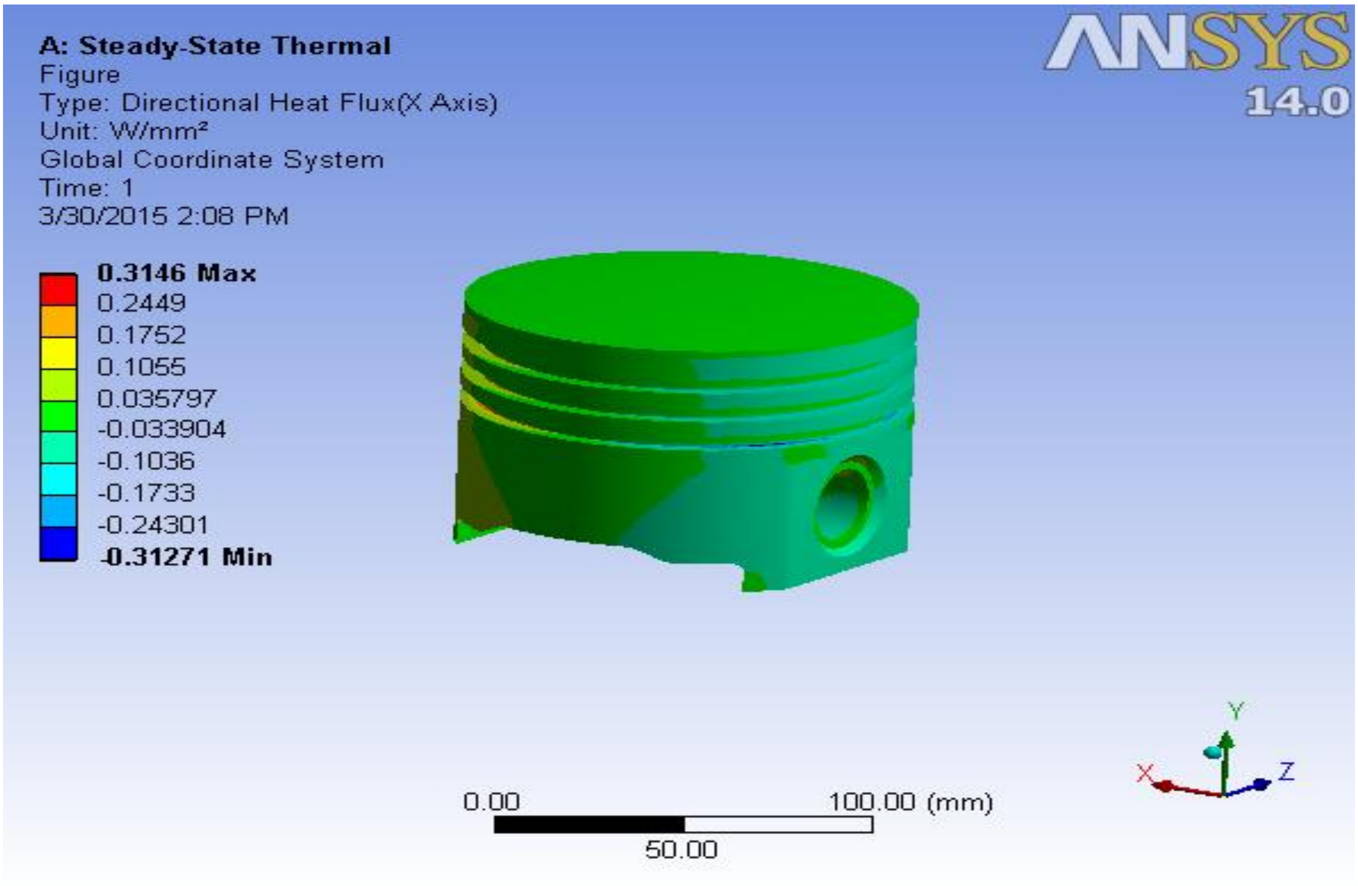

Figure:5.6 Directional Heat flux (X-axis) in Al-SiC Piston

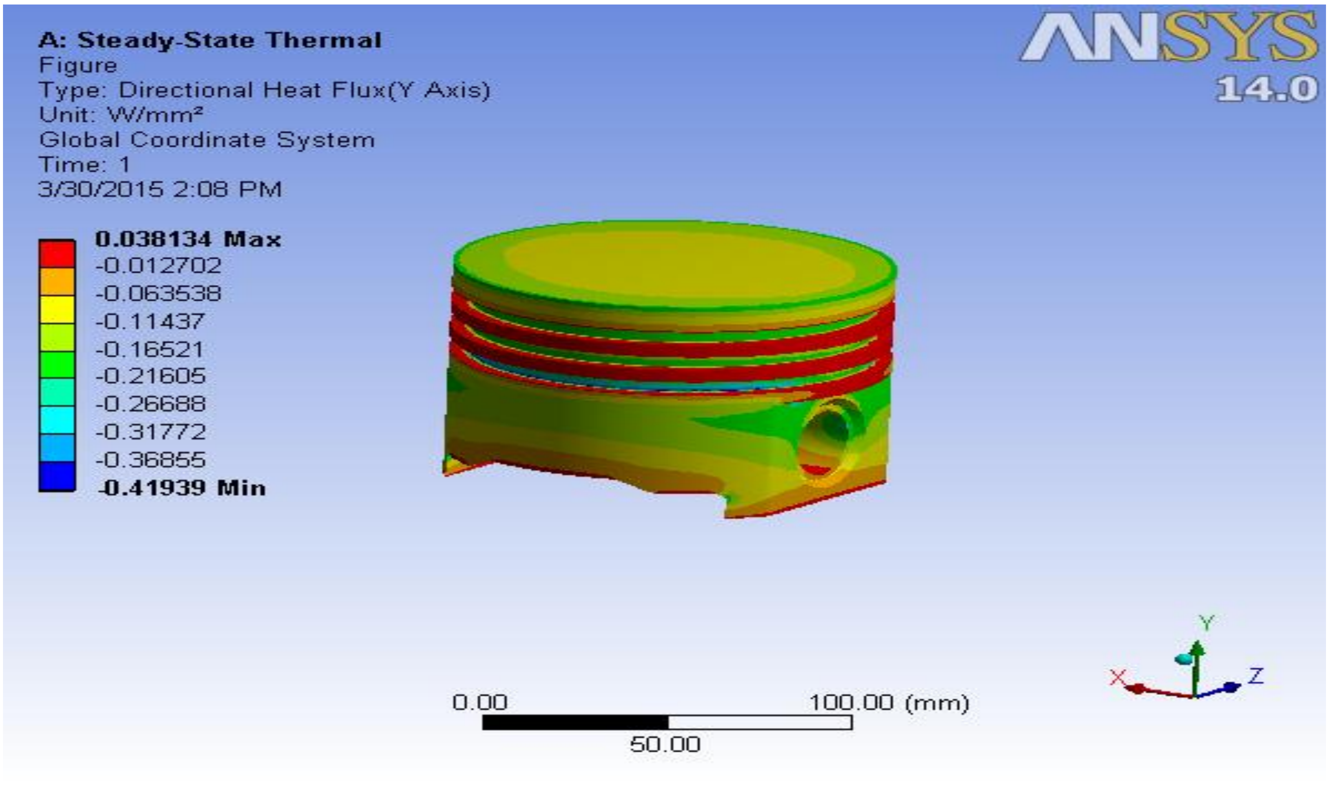

Figure:5.7 Directional Heat flux (Y-axis) in Al-SiC Piston

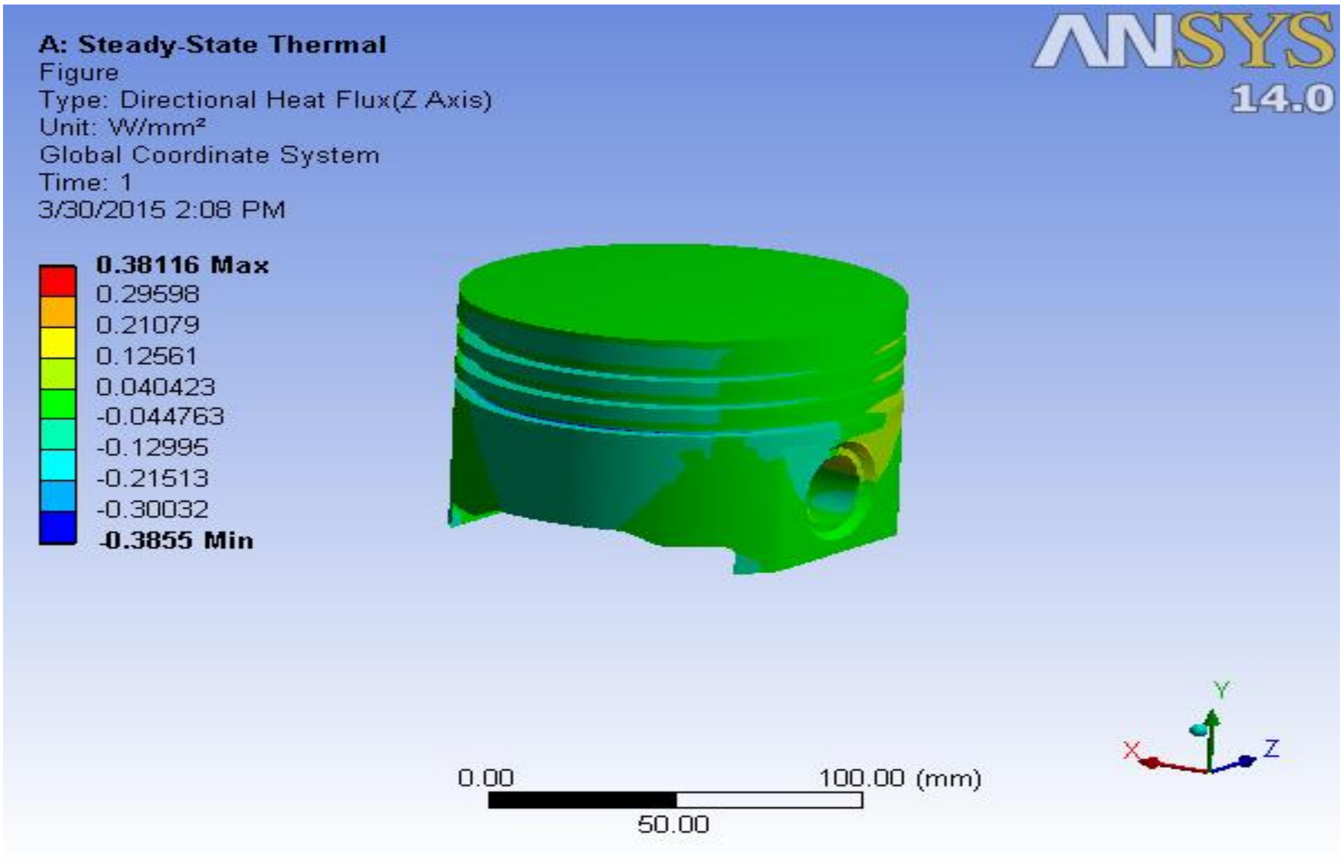

Figure:5.8 Directional Heat flux (Zaxis) in Al-SiC Piston

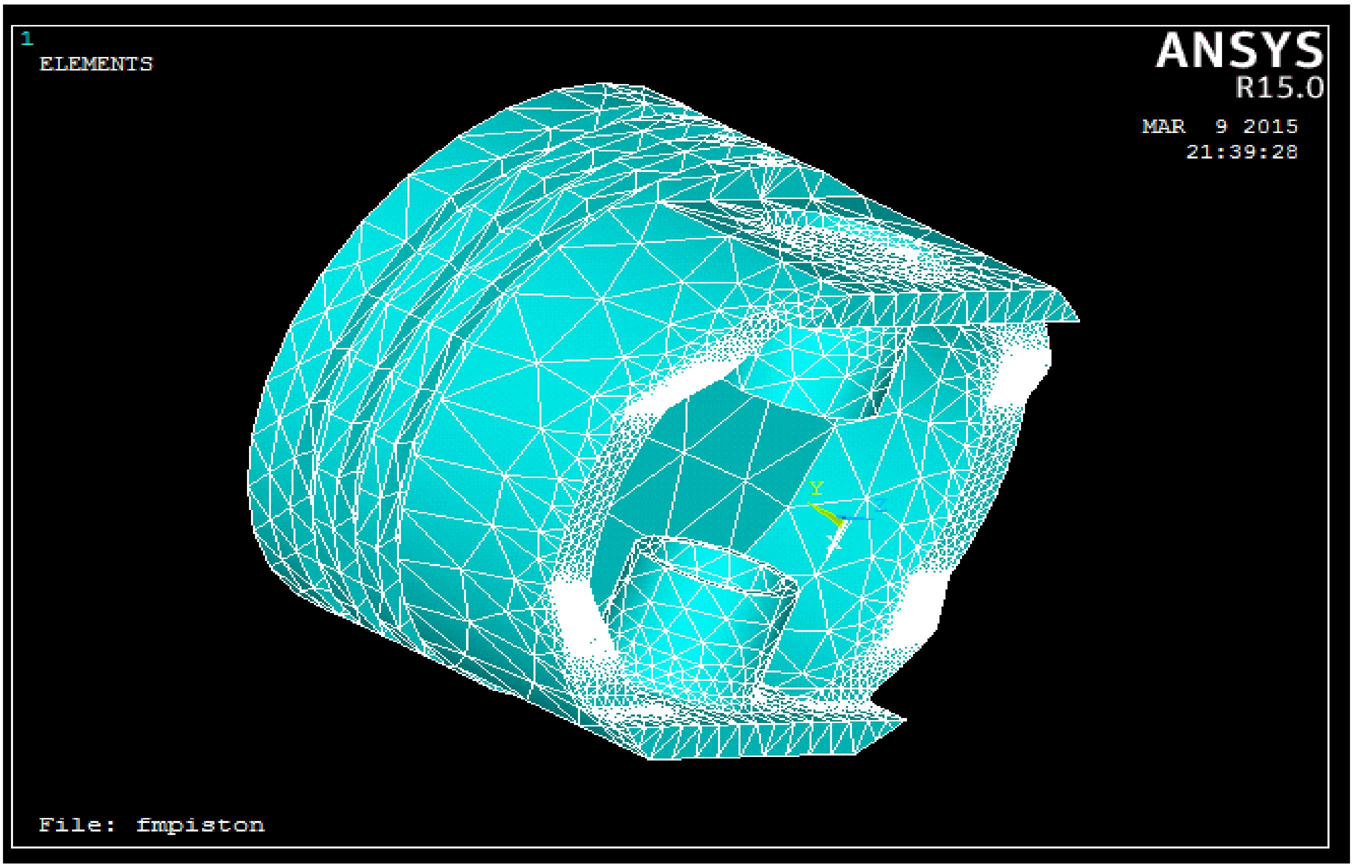

Figure 5.9 APDL Mesh model on Al-SiC Piston

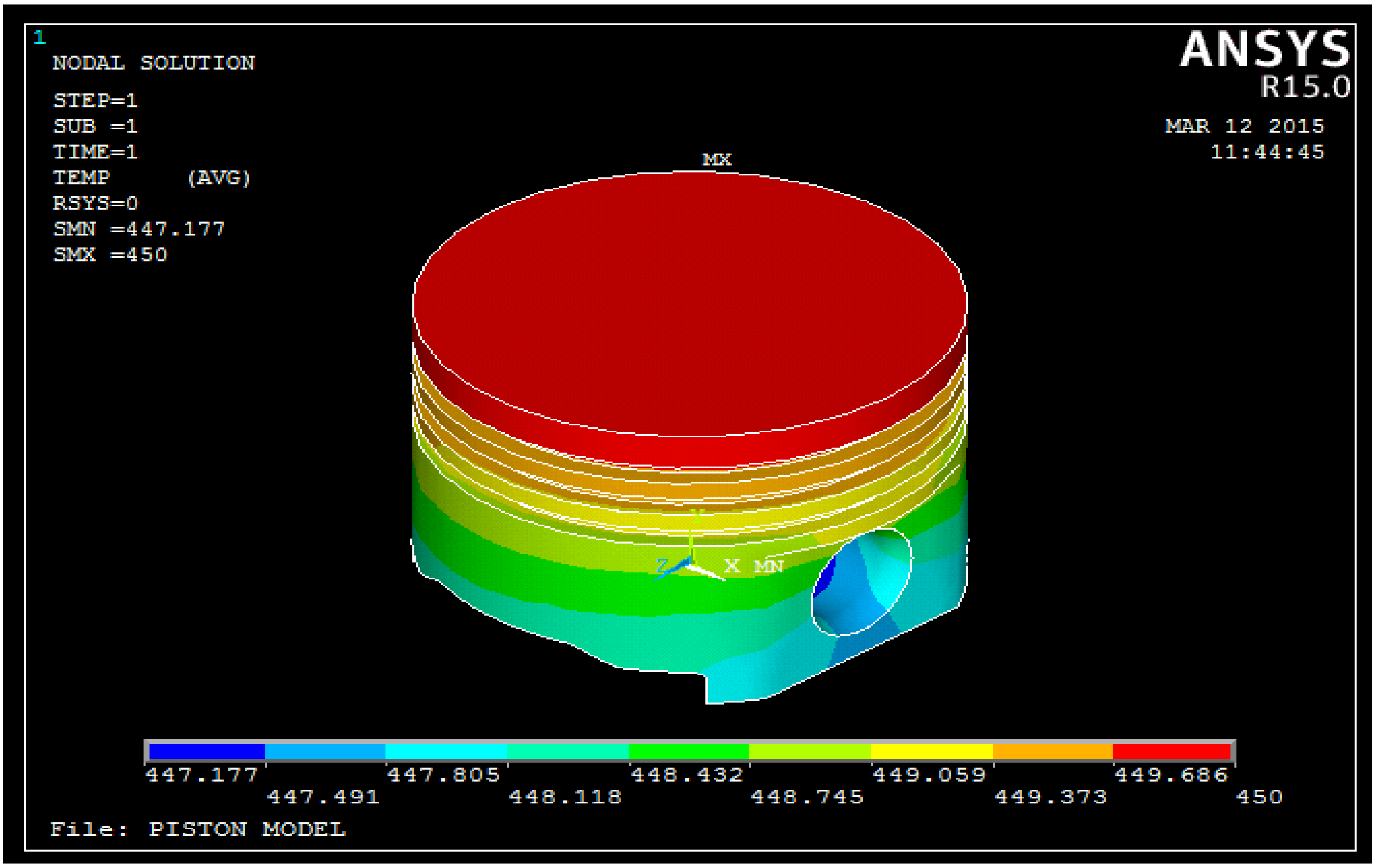

Figure :5.10 Total deformation on Al-SiCPiston

TABLE:5.10 THERMAL LOADS INPUT		
Type	Temperature	Convection
Magnitude	682. °C (ramped)	
Suppressed	No	
Film Coefficient	2.724e-003 W/mm²·°C (ramped)	9.1e-005 W/mm²·°C (ramped)
Ambient Temperature	22. °C (ramped)	

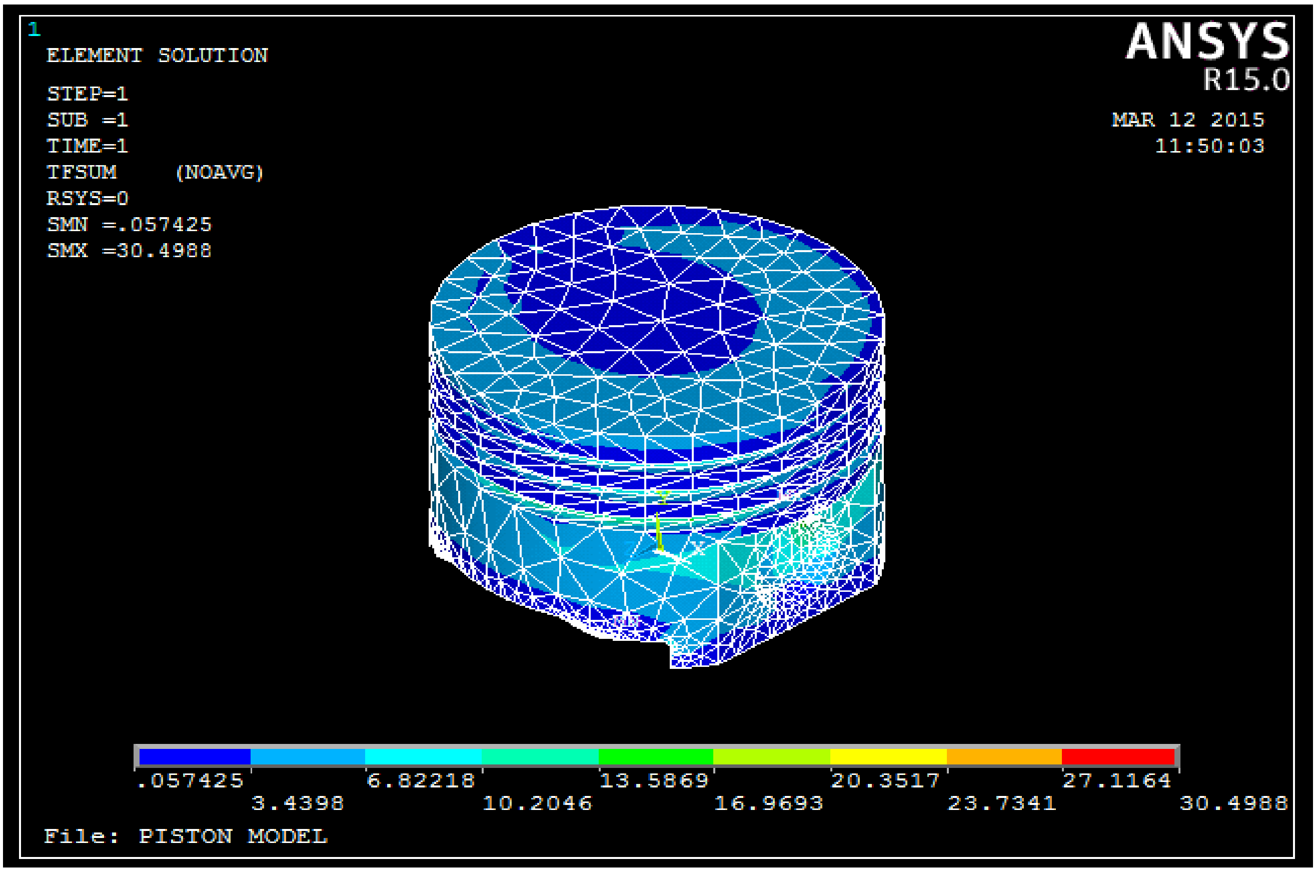

Figure:5.11 Total heat flux on Al-SiC Piston APDL

5.1.5 RESULTS OF THERMAL ANALYSIS:

TABLE:5.2 Result of thermal analysis of Al-SiC Piston

Object Name	Temperature	Total Heat Flux (W/mm²)	Directional Heat Flux X (W/mm²)	Directional Heat Flux Y W/mm²	Directional Heat Flux Z W/mm²
Minimum	625.61 °C	2.0444e-005	-0.31271	-0.41939	-0.3855
Maximum	682. °C	0.5657	0.3146	3.8134e-002	0.38116

The heat inside the cylinder block and the piston crown is reduced and this helps to achieve good wear resistance. Total heat transfer is increases and temperature distribution is uniform. Thermal deformation is very less. When compare the conventional aluminium piston it has maximum temperature 955K with stand.The result was thoroughly analysed by using Ansys workbench14.0 and mechanical Apdl 15.0

5.2 STRUCTURAL ANAYSIS OF ALUMINIUM-SILICONCARBIDE:

5.2.1 Specify Element Type & Material Properties:

Next, the material properties are defined. In an elastic analysis of an isotropic solid these consist of the Young's modulus and the Poisson's ratio of the material. The SOLID 187 tetra hedralelement is used for meshing of piston. SOLID187 element is ahigher order 3-D, 10-node element. The element is defined by10 nodes having three degrees of freedom at each nodetranslations in the nodal x, y, and z directions.

5.2.2Mesh the Object:

Then, the structure is broken (or meshed) into small elements. This involves defining the types of elements into which the structure will be broken, as well as specifying how the structure will be subdivided into elements (how it will be meshed). This subdivision into elements can either be input by the user or, with some finite element programs (or add-ons) can be chosen automatically by the computer based on the geometry of the structure (this is called auto meshing).

5.2.3 Apply Boundary Conditions & External Loads:

Next, the boundary conditions (e.g. location of supports) and the external loads are specified.

5.2.4 Generate Solution:

Then the solution is generated based on the previously input parameters.

5.2.5 Post -Processing:

Based on the initial conditions and applied loads, data is returned after a solution is processed. This data can be viewed in a variety of graphs and displays.

5.2.6 Refine the Mesh:

Finite element methods are approximate methods and, in general, the accuracy of the approximation increases with the number of elements used.

 The number of elements needed for an accurate model depends on the problem and the specific results to be extracted from it.Thus, in order to judge the accuracy of results from a single finite element run, you need to increase the number of elements in the object and see if or how the results change.

5.2.7 Interpreting Result:

This step is perhaps the most critical step in the entire analysis because it requires that the modeller use his or her fundamental 1knowledge of mechanics to interpret and understand the output of the model.

 This is critical for applying correct results to solve real engineering problems and in identifying when modelling mistakes have been made (which can easily occur).

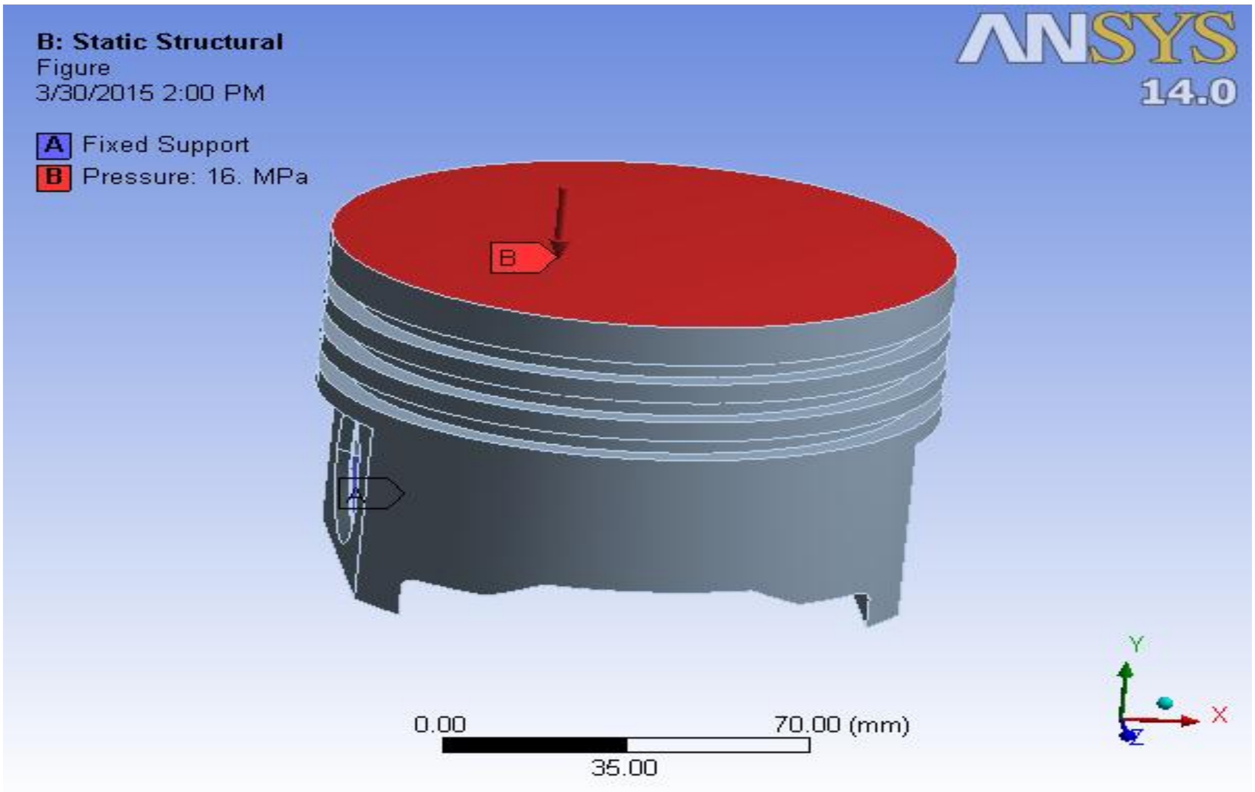

Fig:5.12 Pressure acting on Al-SiC Piston

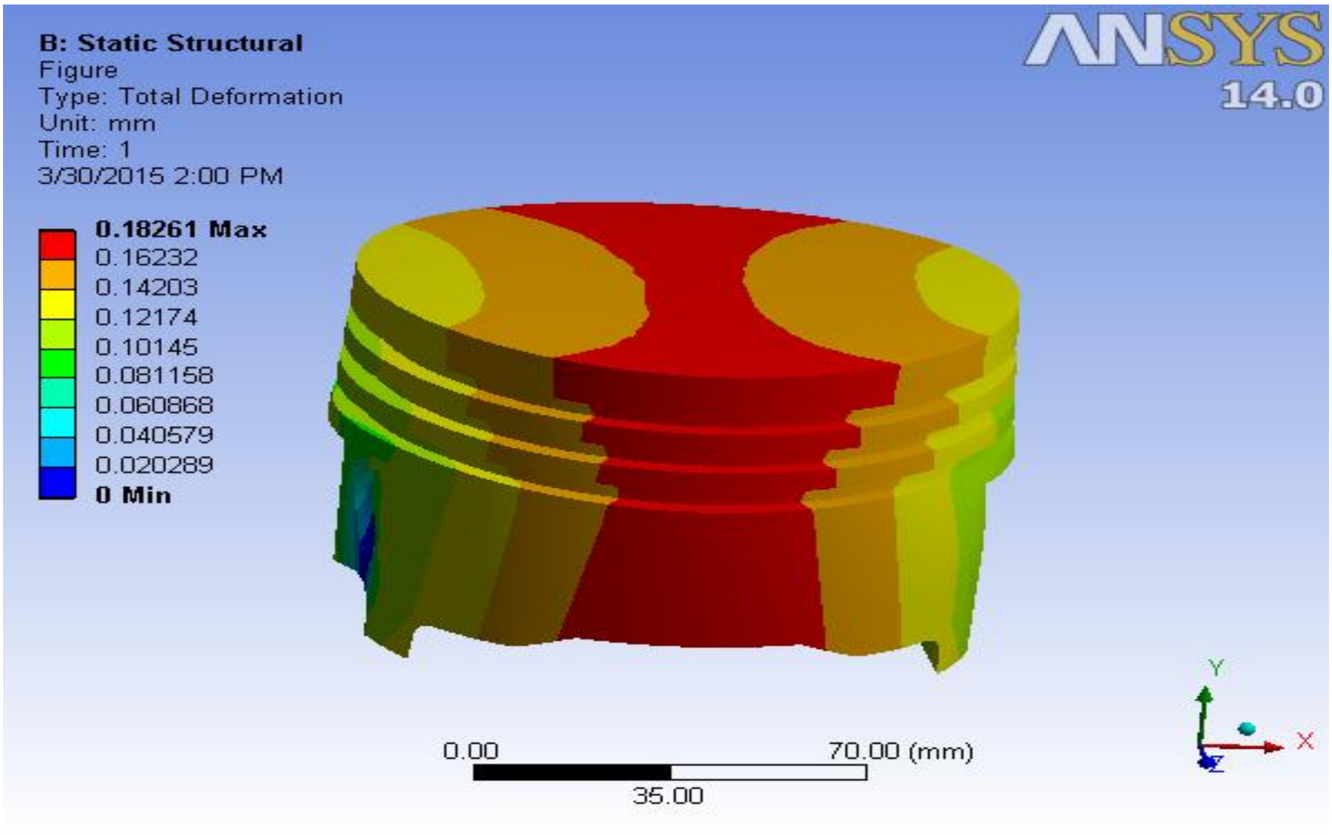

Figure :5.13 Total deformation on Al-SiC piston

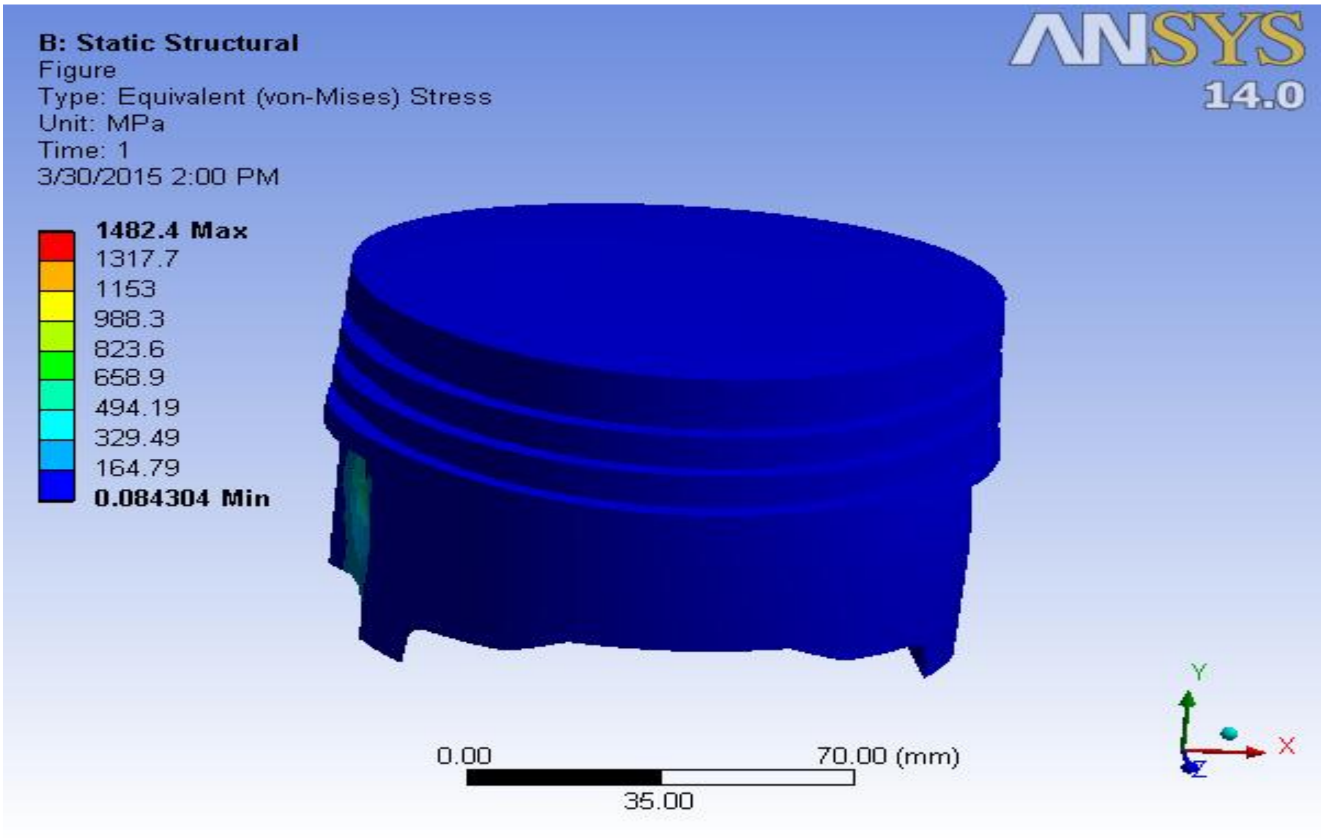

Fig:5.14 Equivalent stress of Al-SiC piston

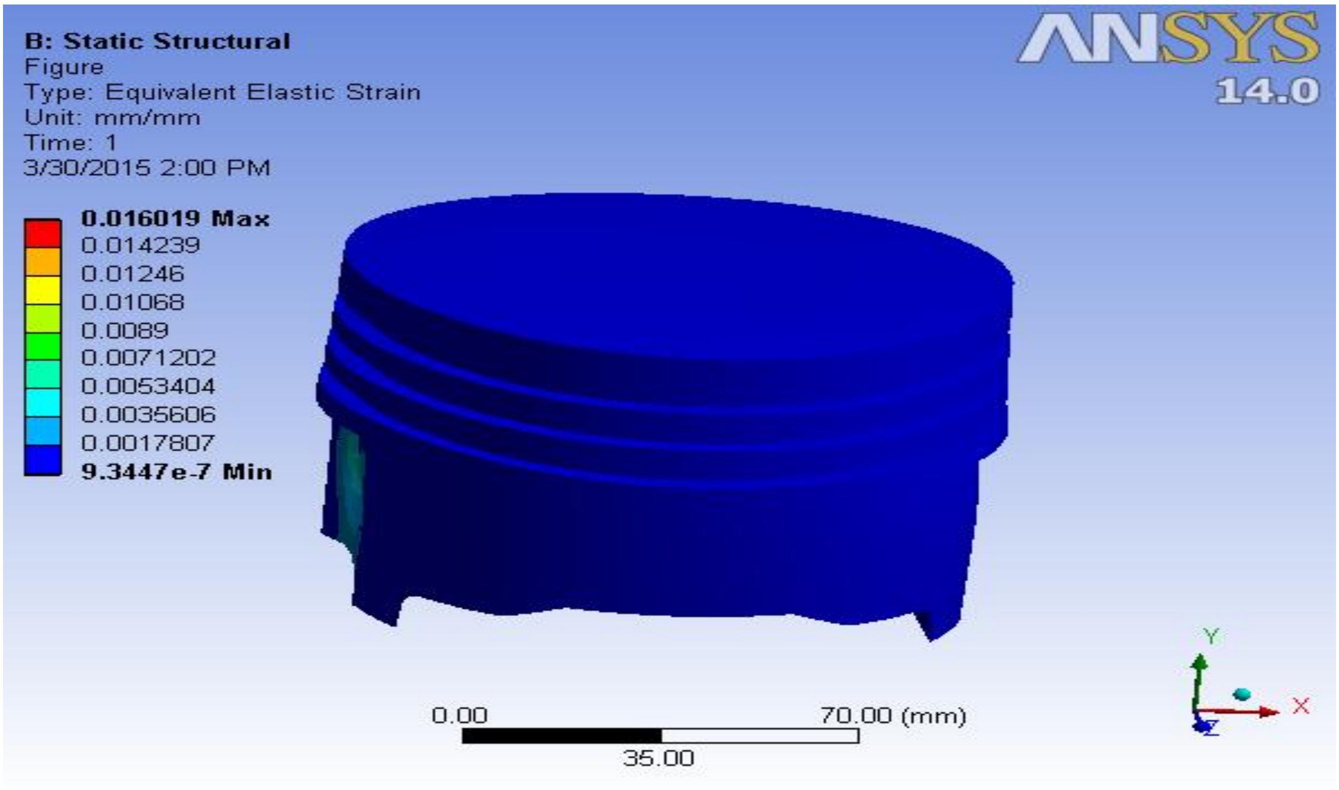

Fig: 5.15 Equivalent Elastic Strain of Al-SiC Piston

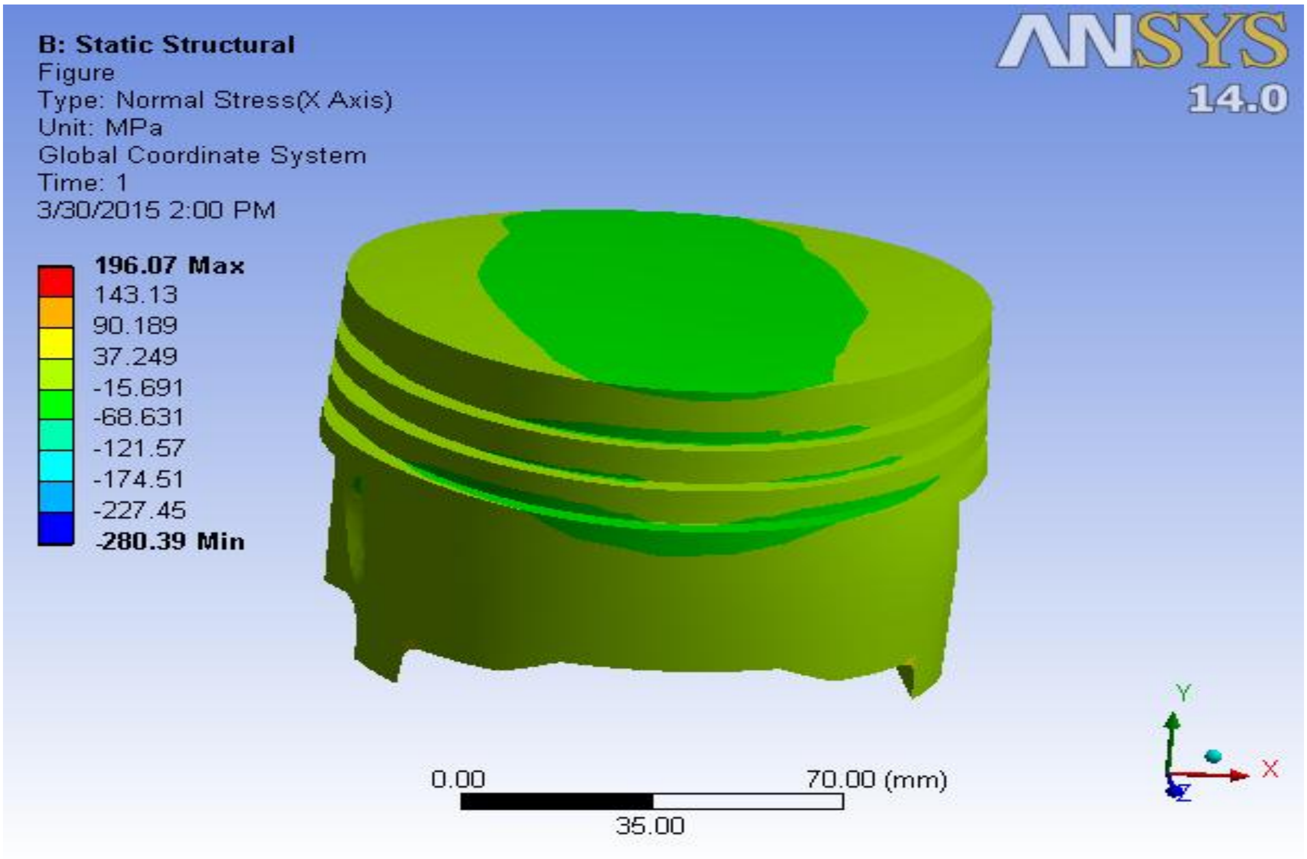

Fig:5.16 Normal stress acting along X-axis on Al-SiC Piston

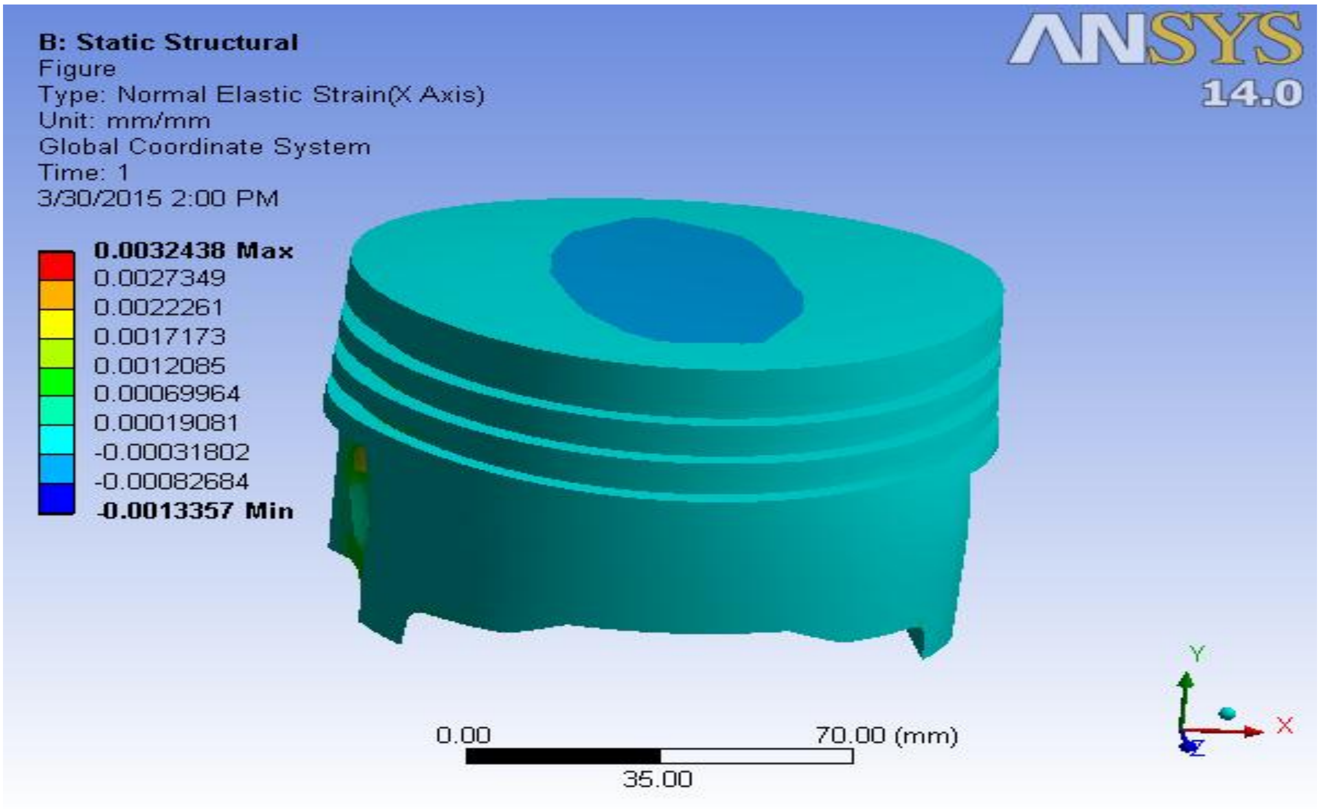

Fig: 5.17 Normal elastic strain acting along X-axis on Al-SiC Piston

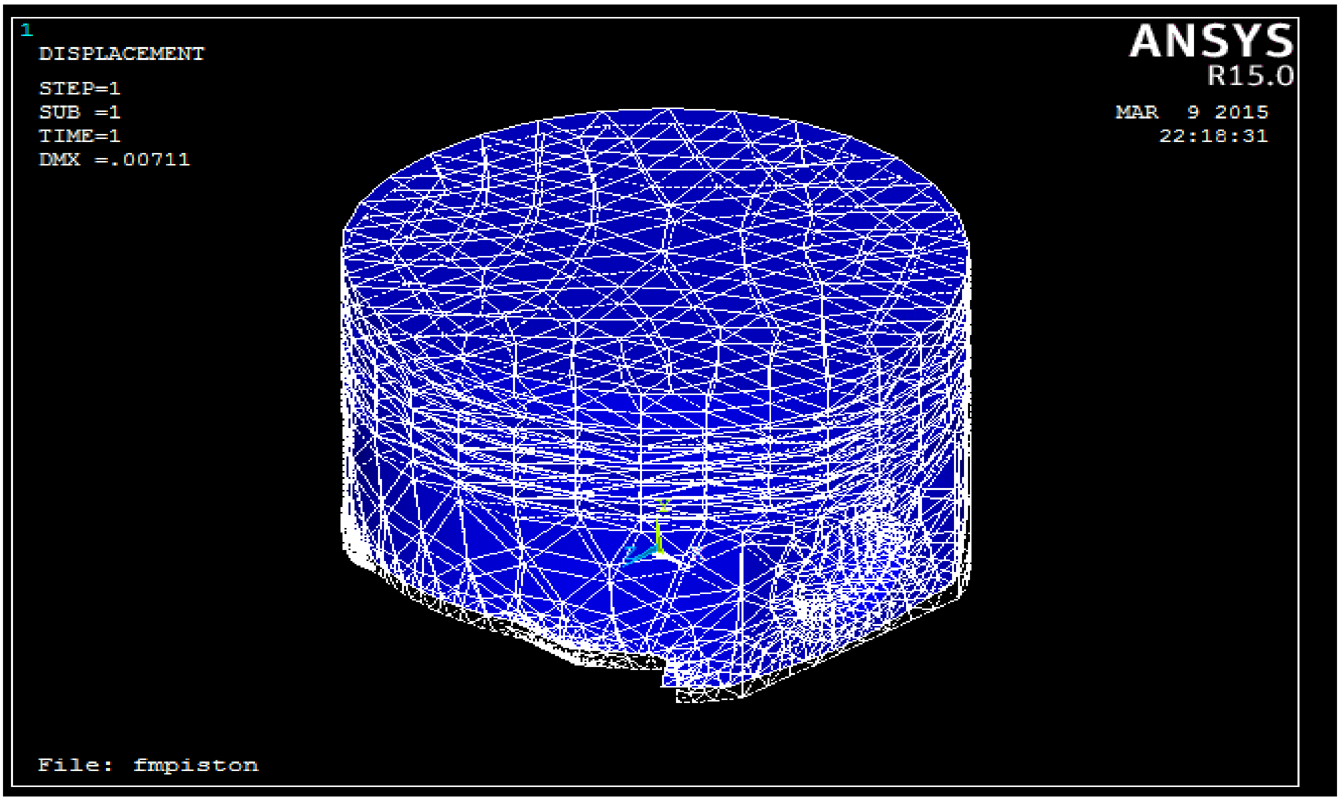

Figure 5.18 Total displacement on Al-Sic piston

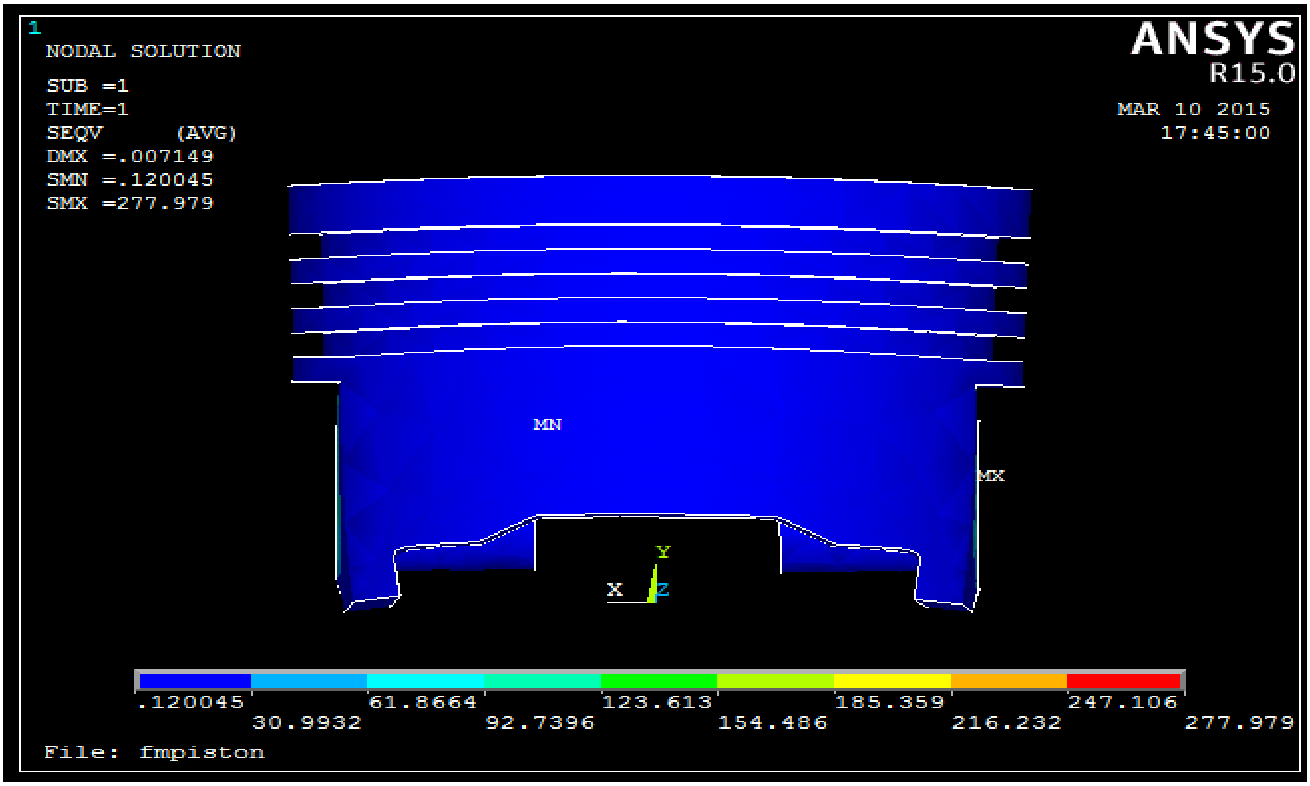

Figure 5.19: Von mises stress plot on Al-Sic piston

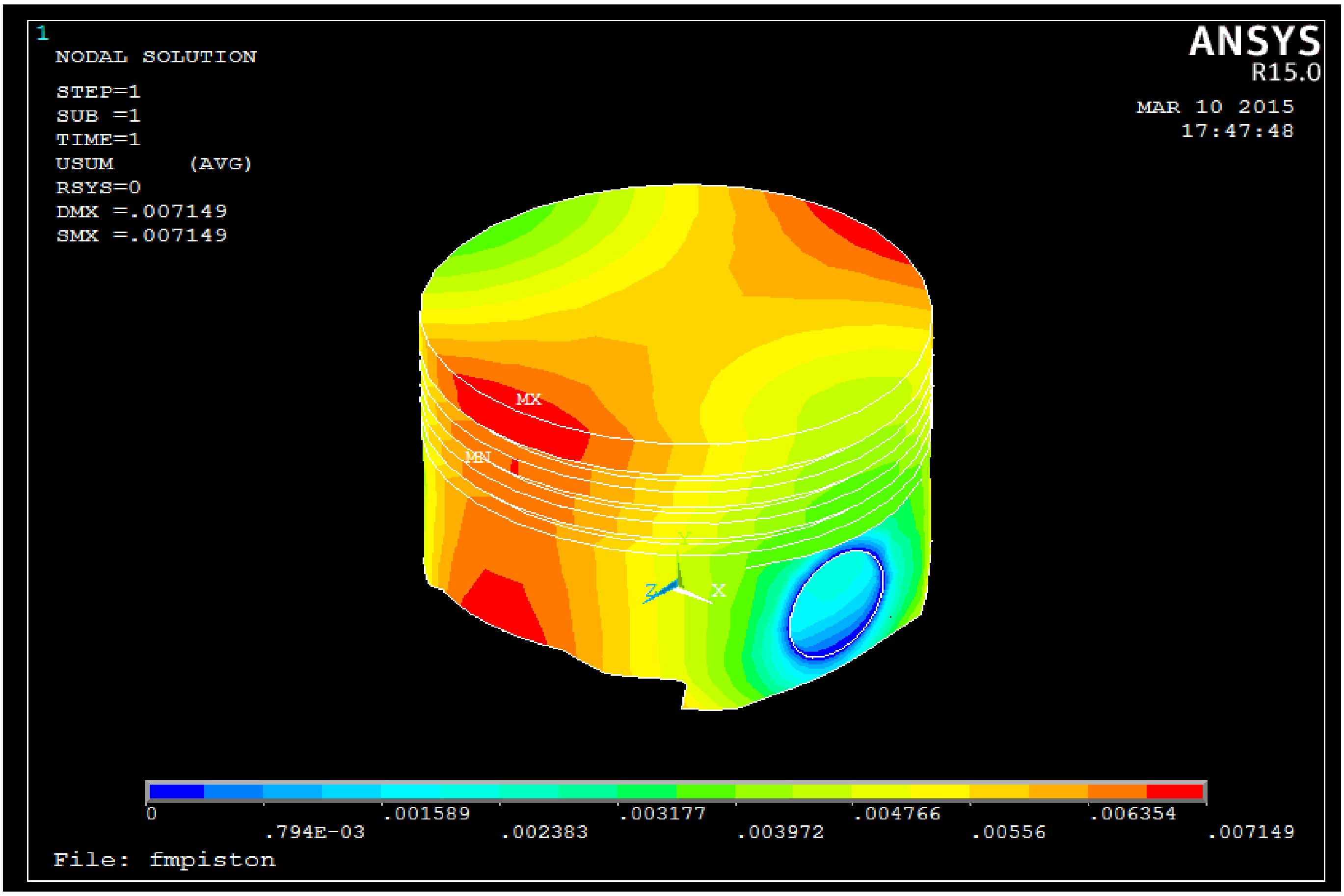

Figure 5.20: Total deformation on Al-SiC pistonAPDL

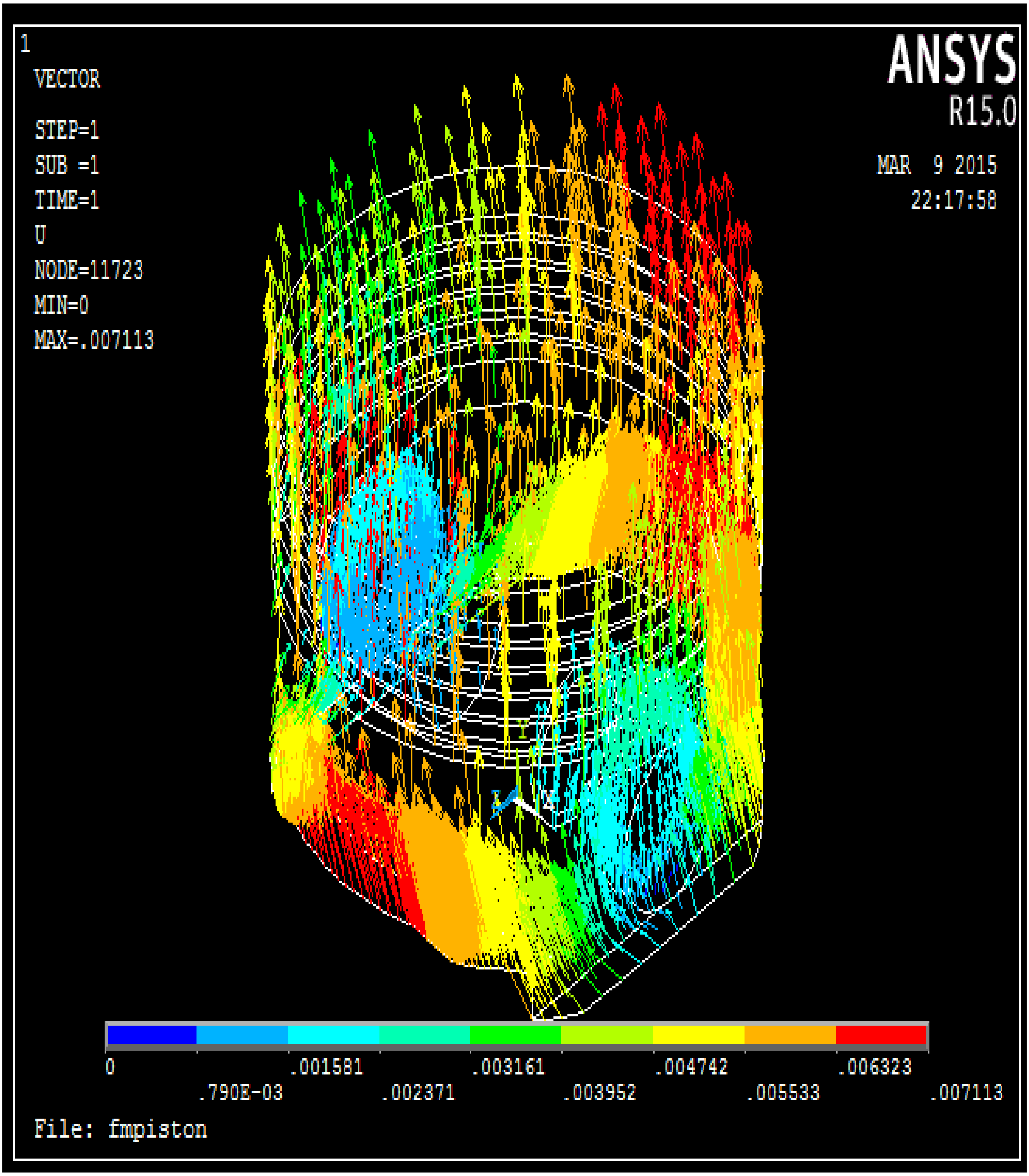

Figure : 5.21 Total vector displacement on Al-SiC piston

5.3 RESULT OF STRUCTURAL ANALYSIS:

TABLE:5.3 Result of structural analysis of Al-SiC Piston

Object Name	Total Deformation (mm)	Equivalent Stress (MPa)	Equivalent Elastic Strain (mm/mm)	Normal Stress (MPa)	Normal Elastic (mm/mm)
Minimum	0. mm	8.4304e-002	9.3447e-007	-280.39	-1.3357e-003
Maximum	0.18261 mm	1482.4	1.6019e-002	196.07	3.2438e-003

It is observed that the analysis results clearly show that the piston with aluminium MMC material has better results than the former materials. It also indicated that have minimum displacement than conventional materials. When compared to the conventional material the new material found to have less weight and more strength The analysis is carried out by using aluminium metal matrix composite material properties in Ansys workbench 14.0 and Mechanical Apdl 15.0

CHAPTER:6

RESULTS AND DISCUSSION-II

6.0 ANALYSIS OF Mg-SiC PISTON

To analysis of Mg-SiC piston de-formations resulting from thermal load was done using calculated temperature distribution in the cross-sections of the piston. The piston is modelled and analysed for structural and thermal behaviours for the original material to the composite material.

6.1 THERMAL ANALYSIS:

Thermal analyses by finite element methodIn the numerical performed a truck engine piston, made ofMg-SiC, is taken as the basis in the simulation. 3-Dfinite element thermal analyses are carried out on both conventional and ceramic-coated engine piston. The finite element mesh of the piston model used ANSYS code. In the thermal analyses, eight nodes thermal elements are used. In the model, surface to surface contact elements are defined between piston ring and ring grove. Piston thermal boundary conditions consist of the ring land and skirt thermal boundary condition, underside thermal boundary condition, piston pin thermal boundary condition, combustion side thermal boundary condition.

Thermal circuit method is used to model the heat transfer in the ring land and skirt region with the following assumptions:

• Effect of piston motion on the heat transfer is neglected,

• Rings and skirt are fully engulfed in oil and there are no cavitations,

• Rings do not twist,

• Conductive heat transfer in the oil film is neglected

TABLE: 6.1 Properities of magnesium- silicon carbide

Young's Modulus	81500 Mpa
Poisson's Ratio	0.275
Density	1.8852e-006 kg mm^-3
Thermal Expansion	8.5e-006 1/°C
Thermal Conductivity	0.1524 W mm^-1 C^-1
Specific Heat	814. J/kg·°C
Bulk Modulus	60370 MPa
Shear Modulus	31961 MPa

6.1.1 ANSYS SIMULATION:

TABLE:6.1.3 Ansys stimulation

Model (A4) > Geometry > Parts	
Object Name	piston
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Mg-sic
Thermal Strain Effects	Yes
Properties	
Volume	5.4314e+005 mm^3
Mass	1.0239 kg
Centroid X	2.1118e-002 mm
Centroid Y	54.506 mm
Moment of Inertia Ip1	1401.9 $kg \cdot mm^2$
Moment of Inertia Ip2	1970. $kg \cdot mm^2$
Statistics	
Nodes	598994
Elements	391081

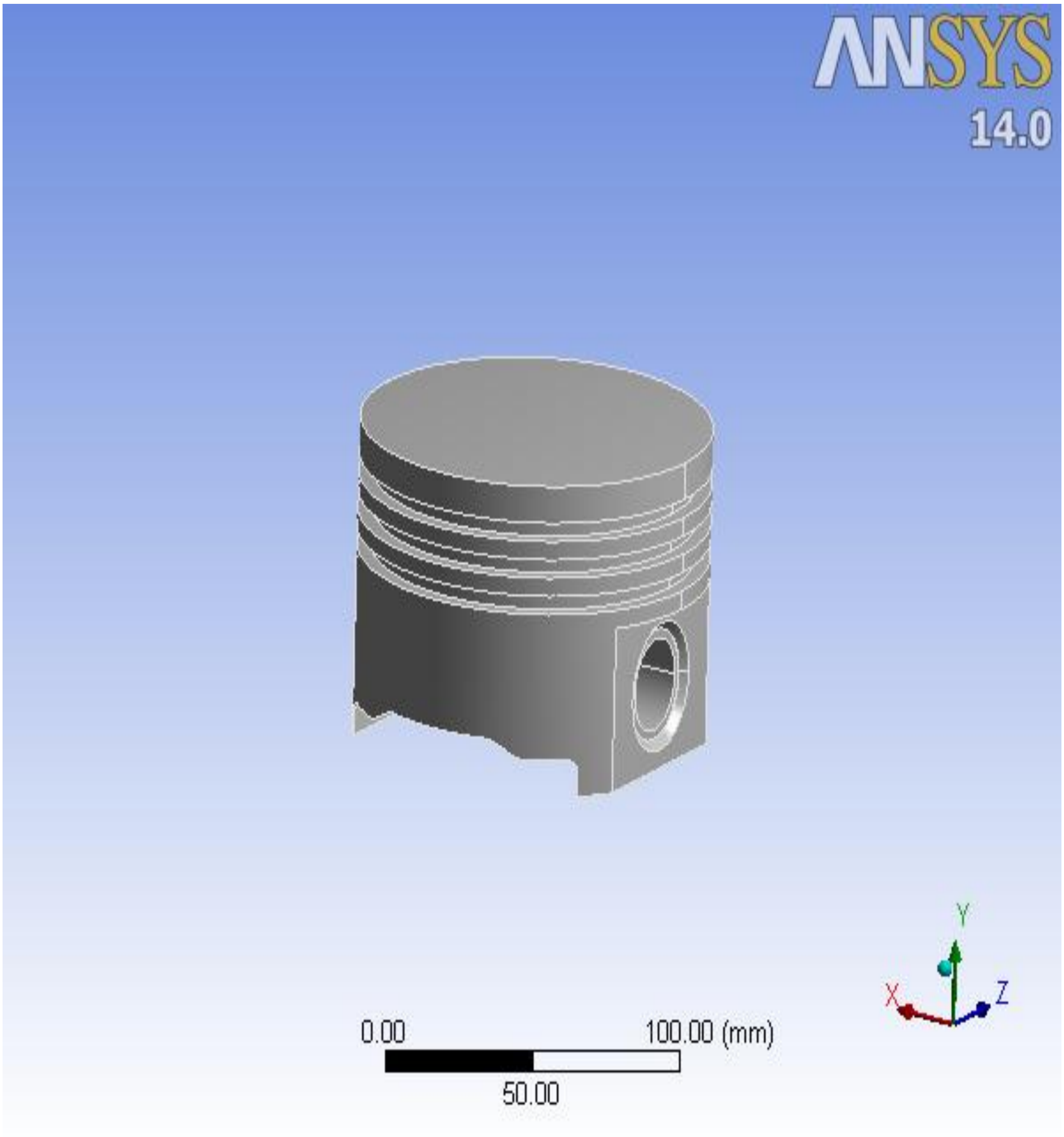

Fig:6.2 Geometry view of piston in ansys workbench

6.1.2 MESHING USING ANSYS

In preparing the model for analysis, Ansys subdivides the model into many small tetrahedral pieces called elements that share common points called nodes The SOLID 187 tetrahedral element is used for meshing of piston. SOLID187 element is a higher order 3-D, 10-node element. The element is defined by10 nodes having three degrees of freedom at each node translations in the nodal x, y, and z directions. The mesh count for the finite element model contains 75140 numbers of nodesand 58560 numbers of elements.

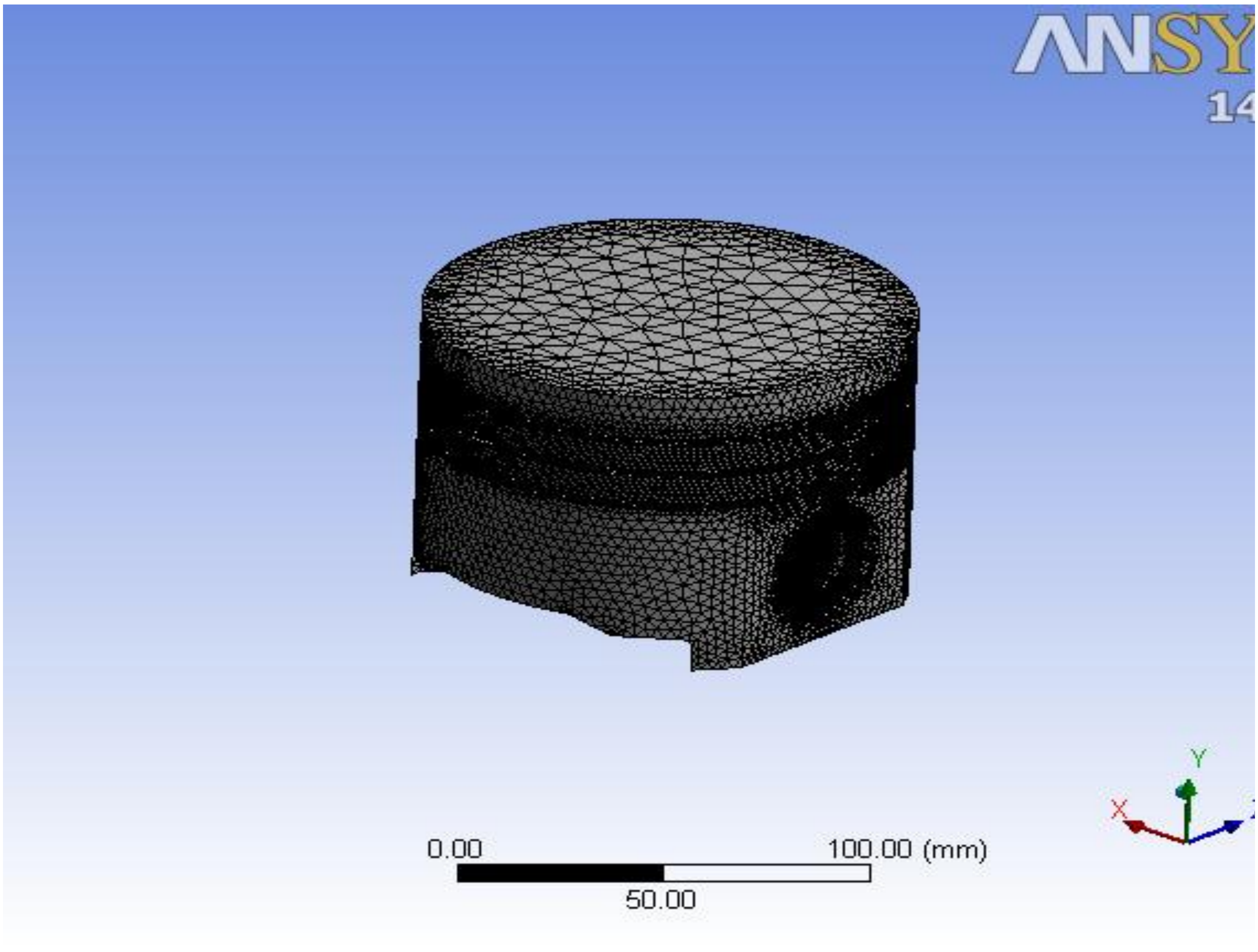

Figure:6.3 Mesh Model of Piston

- Red dots represent the element's nodes.
- Elements can have straight or curved edges.
- Each node has three unknowns, namely, the translations in the three global directions.
- The process of subdividing the part into small pieces (elements) is called meshing. In general, smaller elements give more accurate results but require more computer resources and time.
- Ansys suggests a global element size and tolerance for meshing. The size is only an average value, actual element sizes may vary from one location to another depending on geometry.
- It is recommended to use the default settings of meshing for the initial run. For a more accurate solution, use a smaller element size.

After meshing the model the boundary conditions are applied properly then the final results are obtained. The following figure shows the final results of thermal analysis for Mg-SiC.

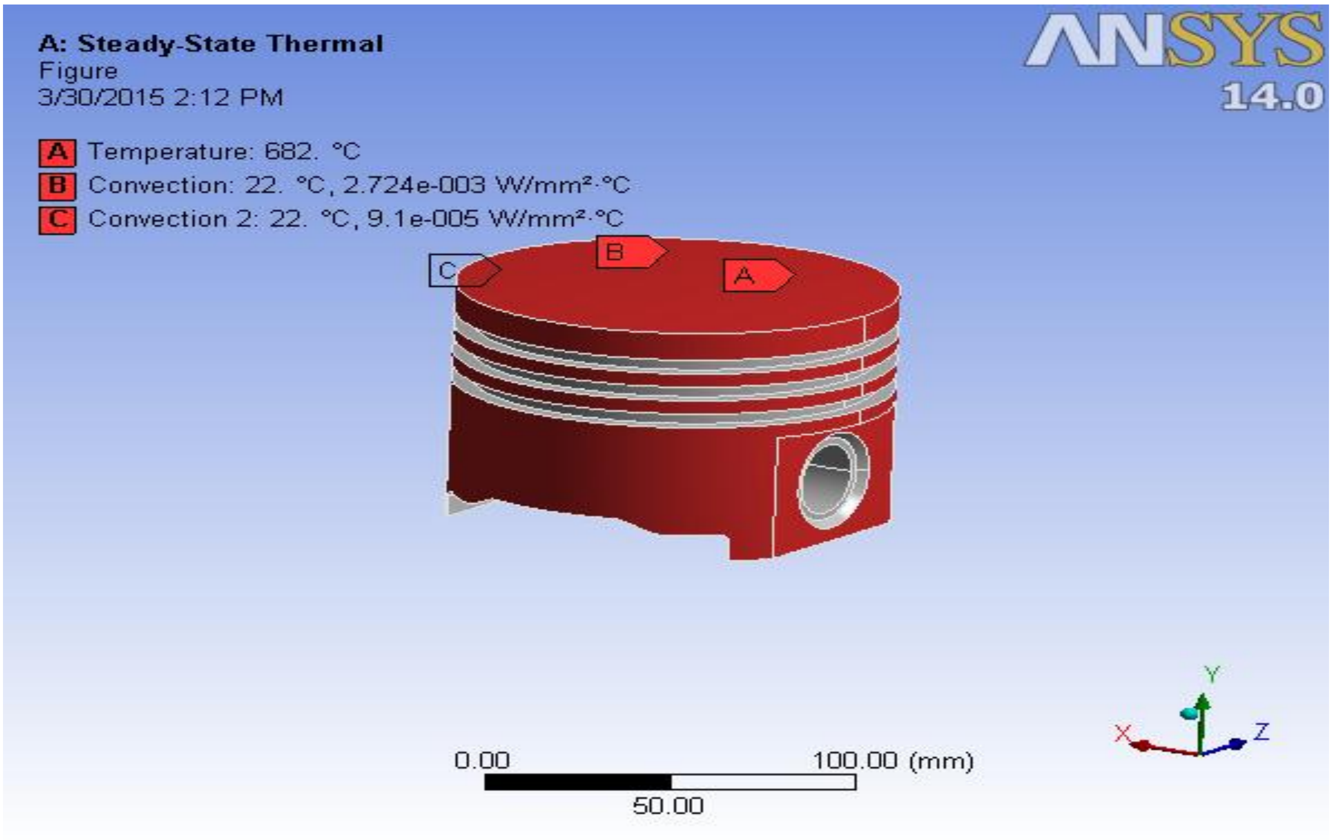

Fig :6.4 Temperature Distribution of convection Mg-SiC Piston

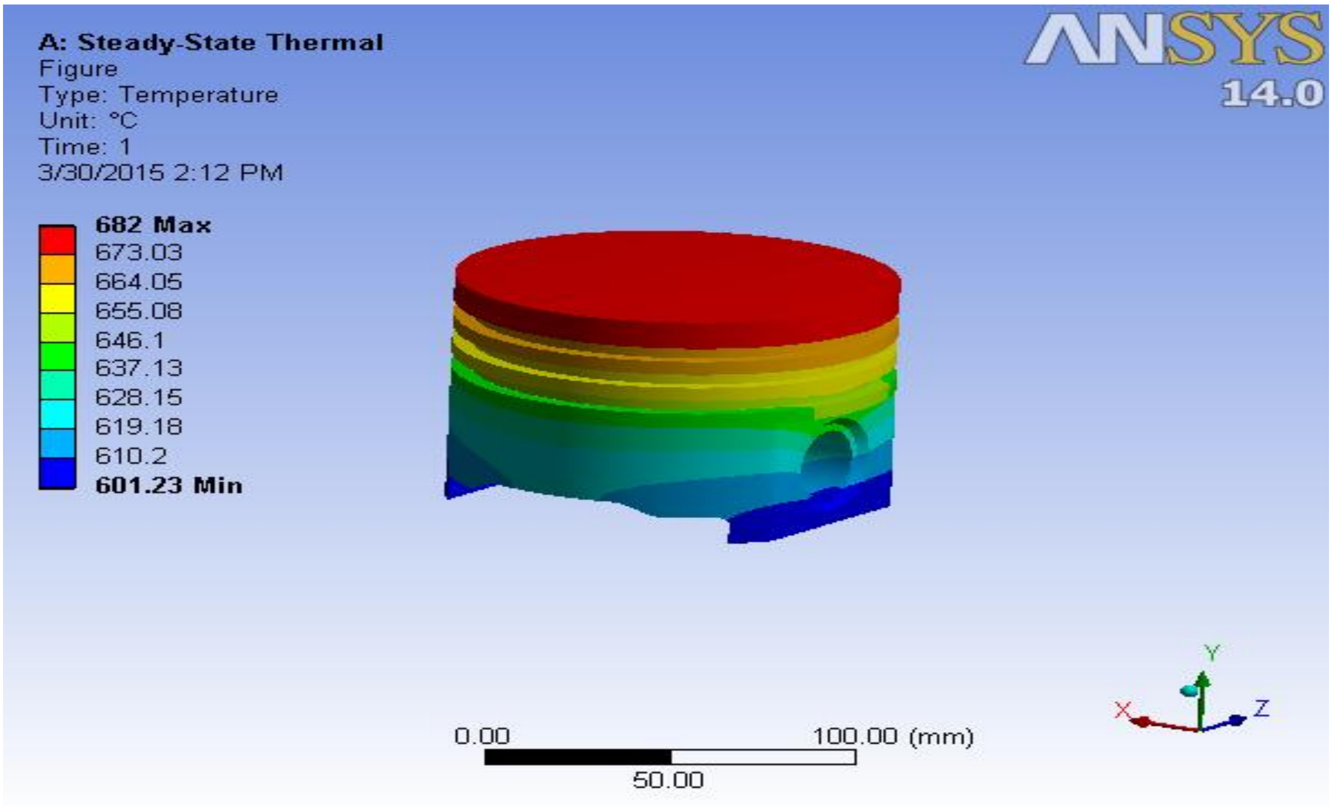

Figure:6.5 Temperature Distribution Mg-SiC Piston

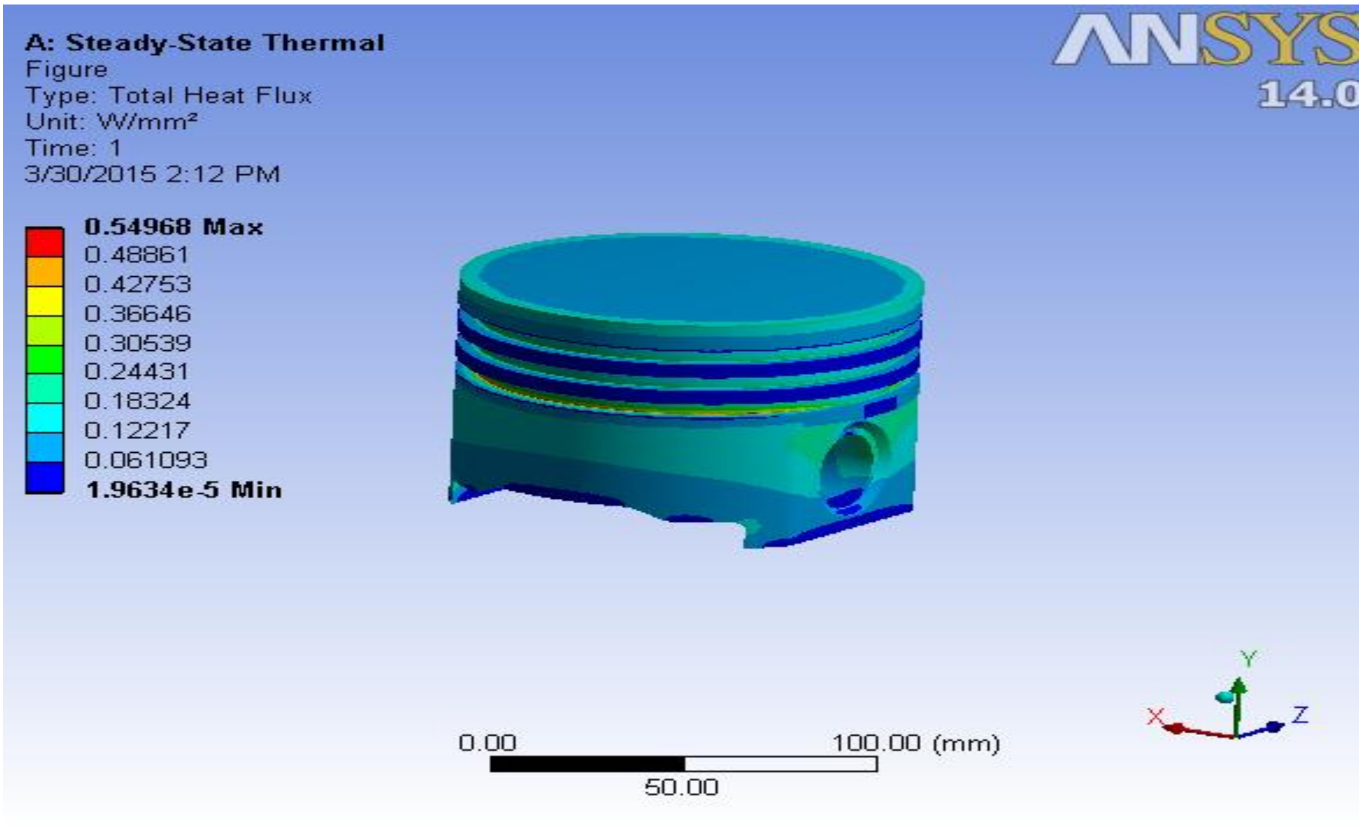

Figure:6.6 Total Heat flux in Mg-SiC Piston

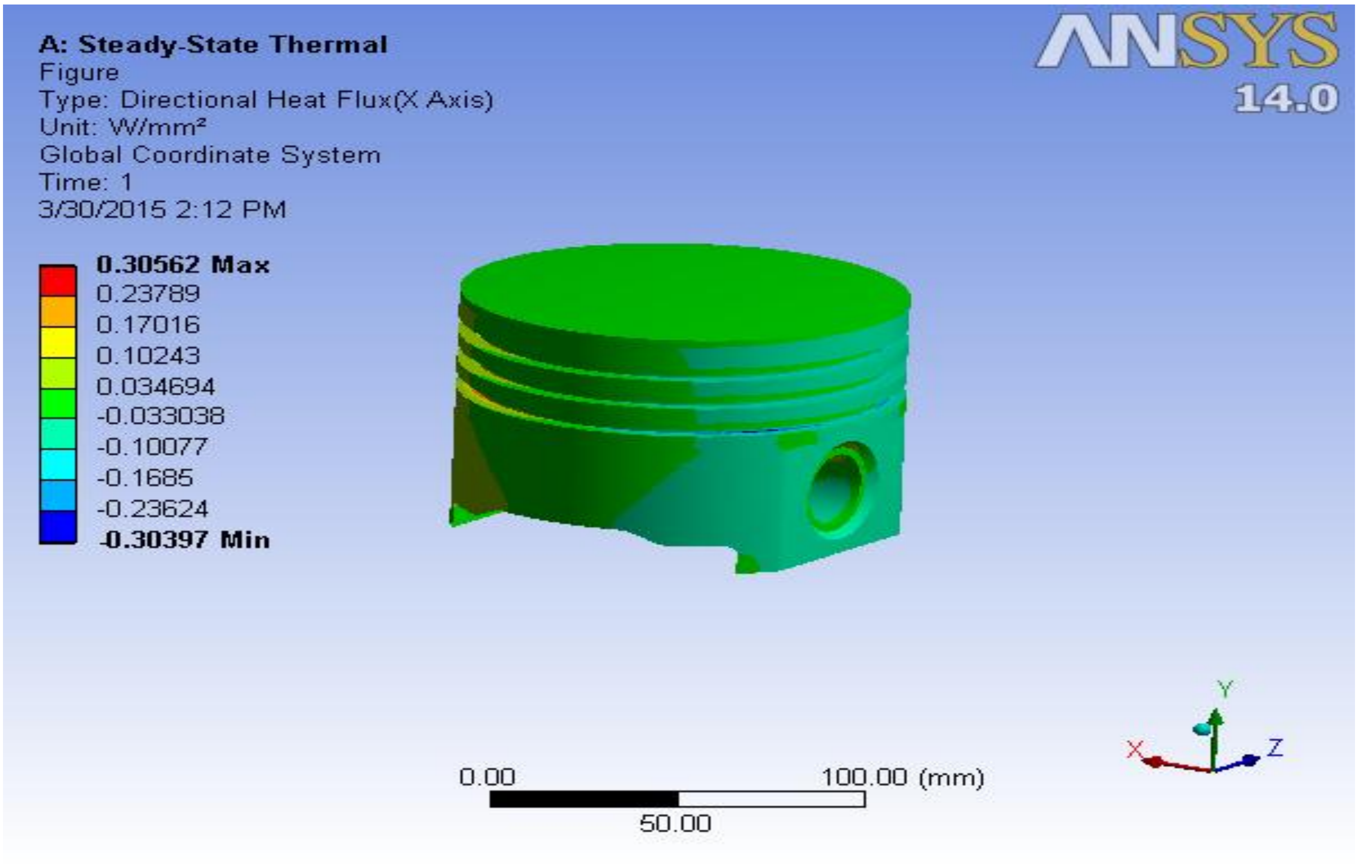

Figure:6.7 Directional Heat flux (X-axis) in Mg-SiC Piston

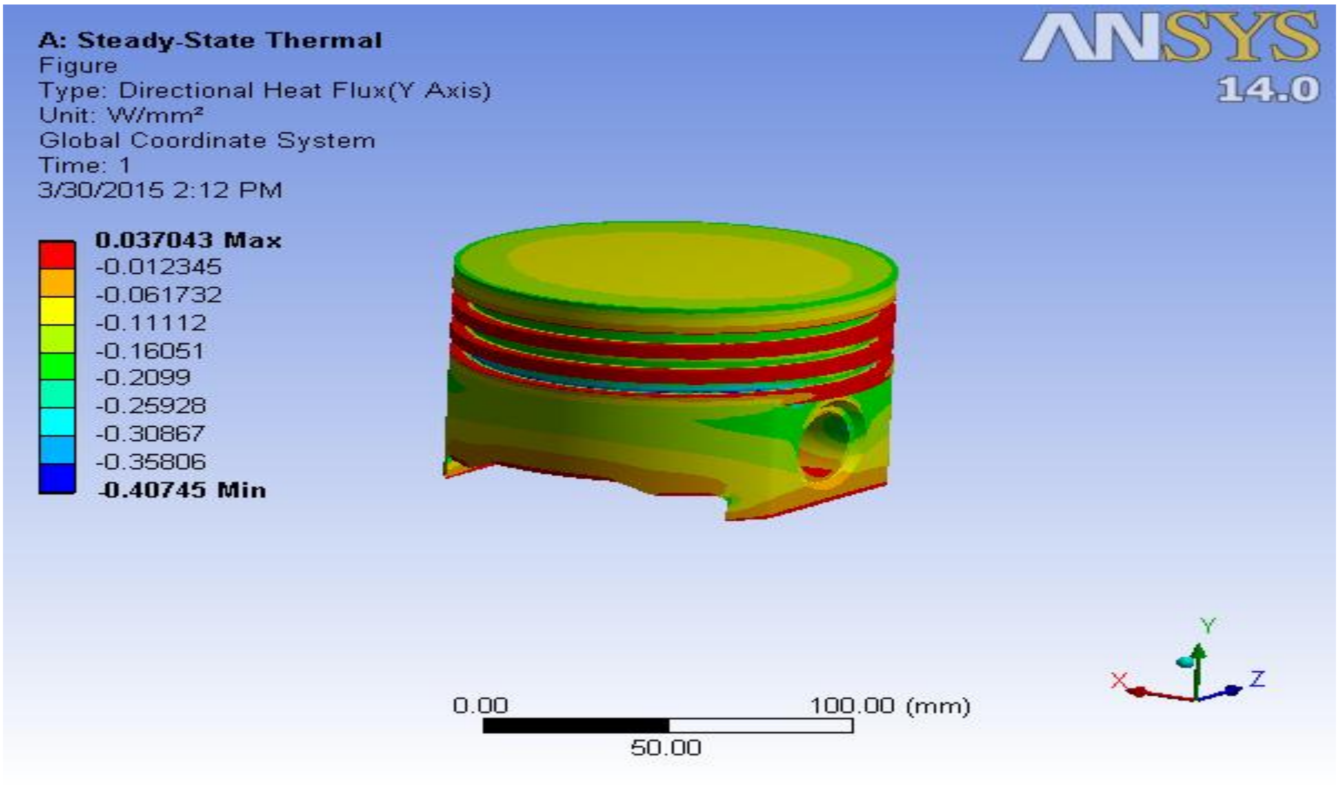

Figure:6.8 Directional Heat flux (Y-axis) in Mg-SiC Piston

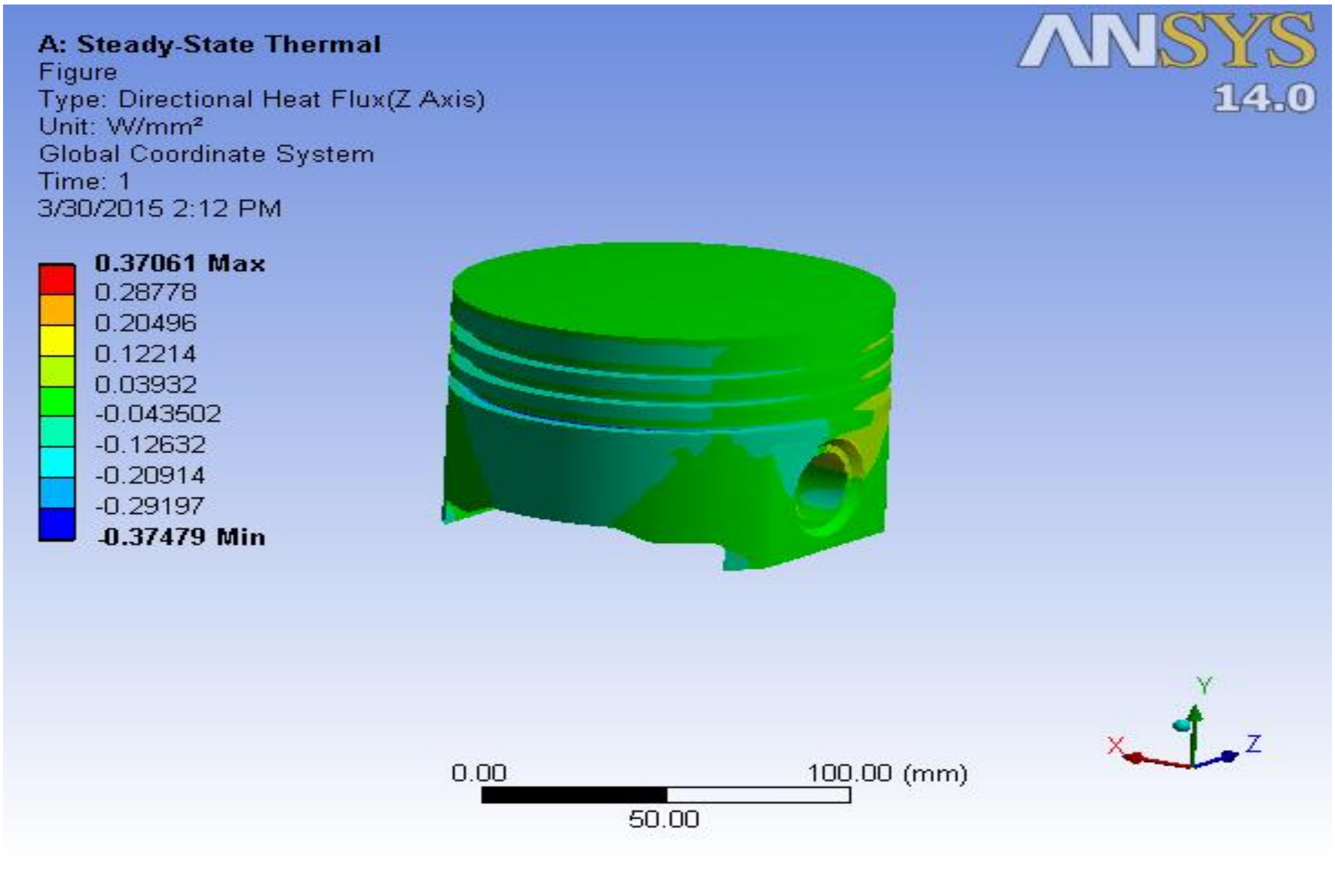

Figure:6.9 Directional Heat flux (Zaxis) in Mg-SiC Piston

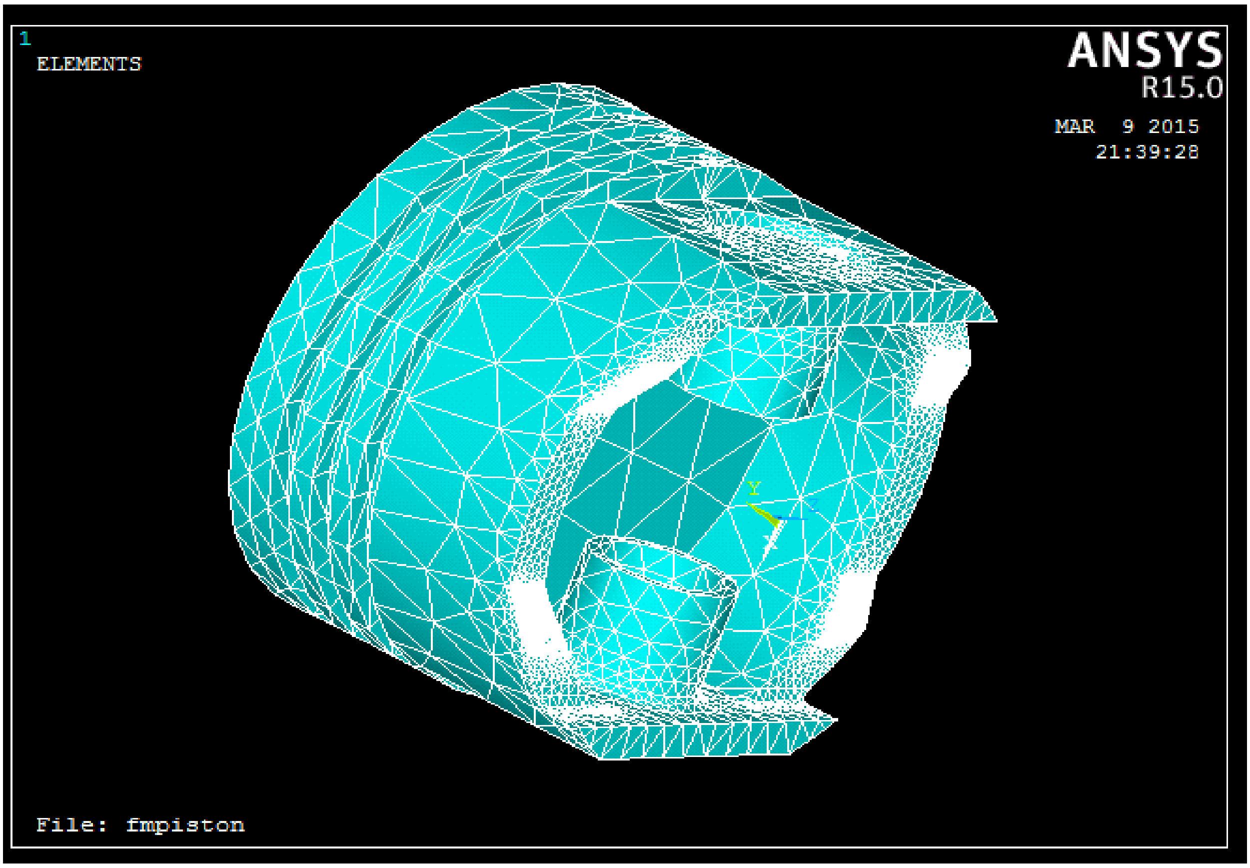

Figure:6.10 Mesh model on Mg-SiCPiston APDL

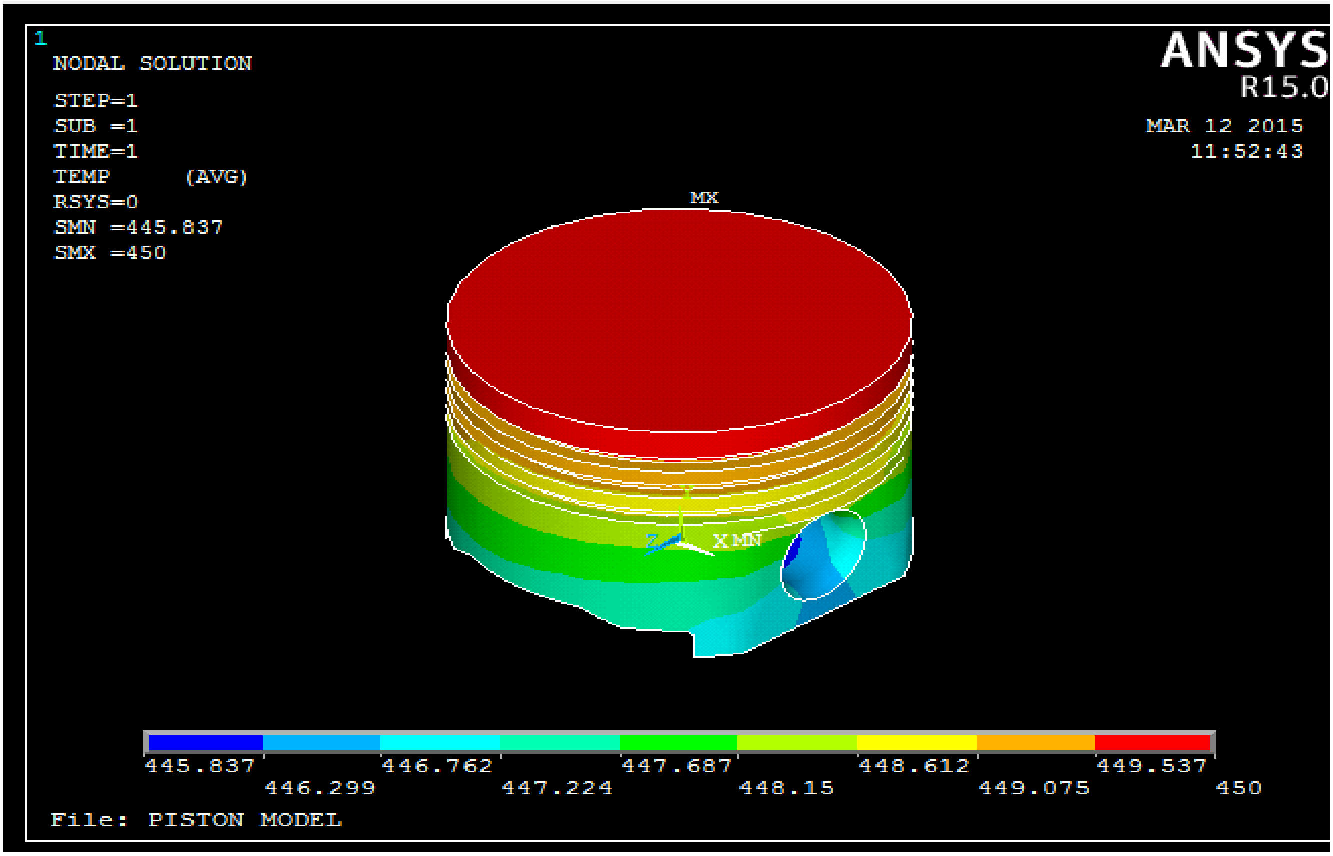

Figure:6.11 Total deformation on Mg-SiCPiston

TABLE:6.2 THERMAL LOADS INPUT		
Type	Temperature	Convection
Magnitude	682. °C (ramped)	
Suppressed	No	
Film Coefficient	2.724e-003 W/mm²·°C (ramped)	9.1e-005 W/mm²·°C (ramped)
Ambient Temperature	22. °C (ramped)	

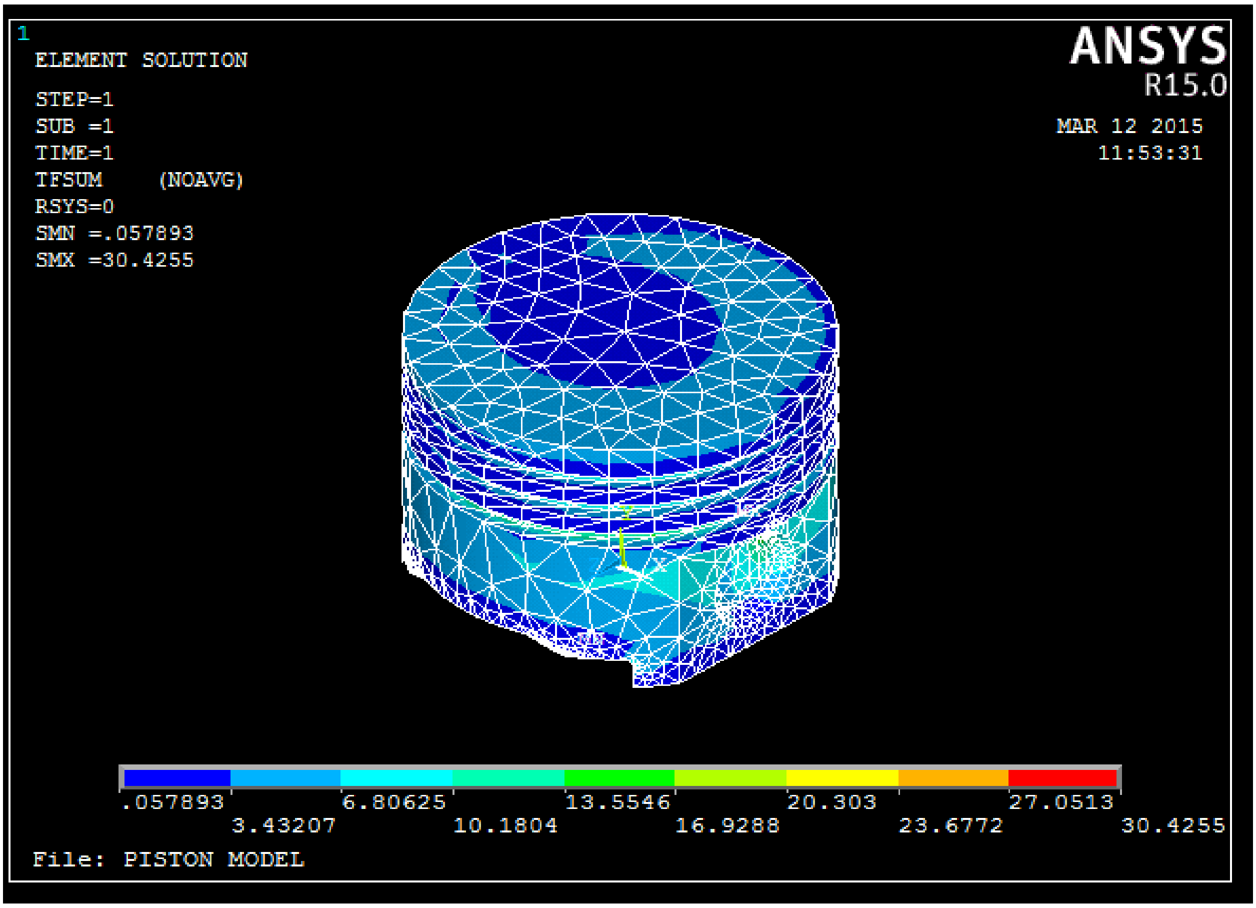

Figure:6.12 Total heat flux on Mg-SiC Piston

6.1.4 RESULTS OF THERMAL ANALYSIS:

TABLE:6.3 Result of thermal analysis of Mg-SiC Piston

Object Name	Temperature	Total Heat Flux (W/mm^2)	Directional Heat Flux X (W/mm^2)	Directional Heat Flux Y W/mm^2	Directional Heat Flux Z W/mm^2
Minimum	601.23 °C	1.9634e-005	-0.30397	-0.40745	-0.37479
Maximum	682. °C	0.54968	0.30562	3.7043e-002	0.37061

From the diagram, we can find the piston temperature is gradient descent along the piston axis direction from up to down, but the temperature change of piston skirt is lesser. The diagram indicates that thermal deformation of the piston is bigger from bottom to top and heat distortion of the bottom is minimum .The heat inside the cylinder block and the piston crown is reduced and this helps to achieve good wear resistance. Total heat transfer is increases and temperature distribution is uniform. Thermal deformation is very less. When compare the conventional aluminium piston it has maximum temperature 955K withstand. The result was thoroughly analysed by using Ansys workbench14.0 and mechanical Apdl 15.0

6.2 STRUCTURAL ANAYSIS OF Mg-SiC PISTON:

6.2.1 Specify Element Type & Material Properties:

Next, the material properties are defined. In an elastic analysis of an isotropic solid these consist of the Young's modulus and the Poisson's ratio of the material.

6.2.2 Mesh the Object:

Then, the structure is broken (or meshed) into small elements. This involves defining the types of elements into which the structure will be broken, as well as specifying how the structure will be subdivided into elements (how it will be meshed). This subdivision into elements can either be input by the user or, with some finite element programs (or add-ons) can be chosen automatically by the computer based on the geometry of the structure (this is called auto meshing).

6.2.3 Apply Boundary Conditions & External Loads:

Next, the boundary conditions (e.g. location of supports) and the external loads are specified.

6.2.4 Generate Solution:

Then the solution is generated based on the previously input parameters.

6.2.5 Post -Processing:

Based on the initial conditions and applied loads, data is returned after a solution is processed. This data can be viewed in a variety of graphs and displays.

6.2.6 Refine the Mesh:

Finite element methods are approximate methods and, in general, the accuracy of the approximation increases with the number of elements used. The number of elements needed for an accurate model depends on the problem and the specific results to be extracted from it.

Thus, in order to judge the accuracy of results from a single finite element run, you need to increase the number of elements in the object and see if or how the results change.

6.2.7 Interpreting Result:

This step is perhaps the most critical step in the entire analysis because it requires that the modeller use his or her fundamental knowledge of mechanics to interpret and understand the output of the model. This is critical for applying correct results to solve real engineering problems and in identifying when modelling mistakes have been made (which can easily occur)

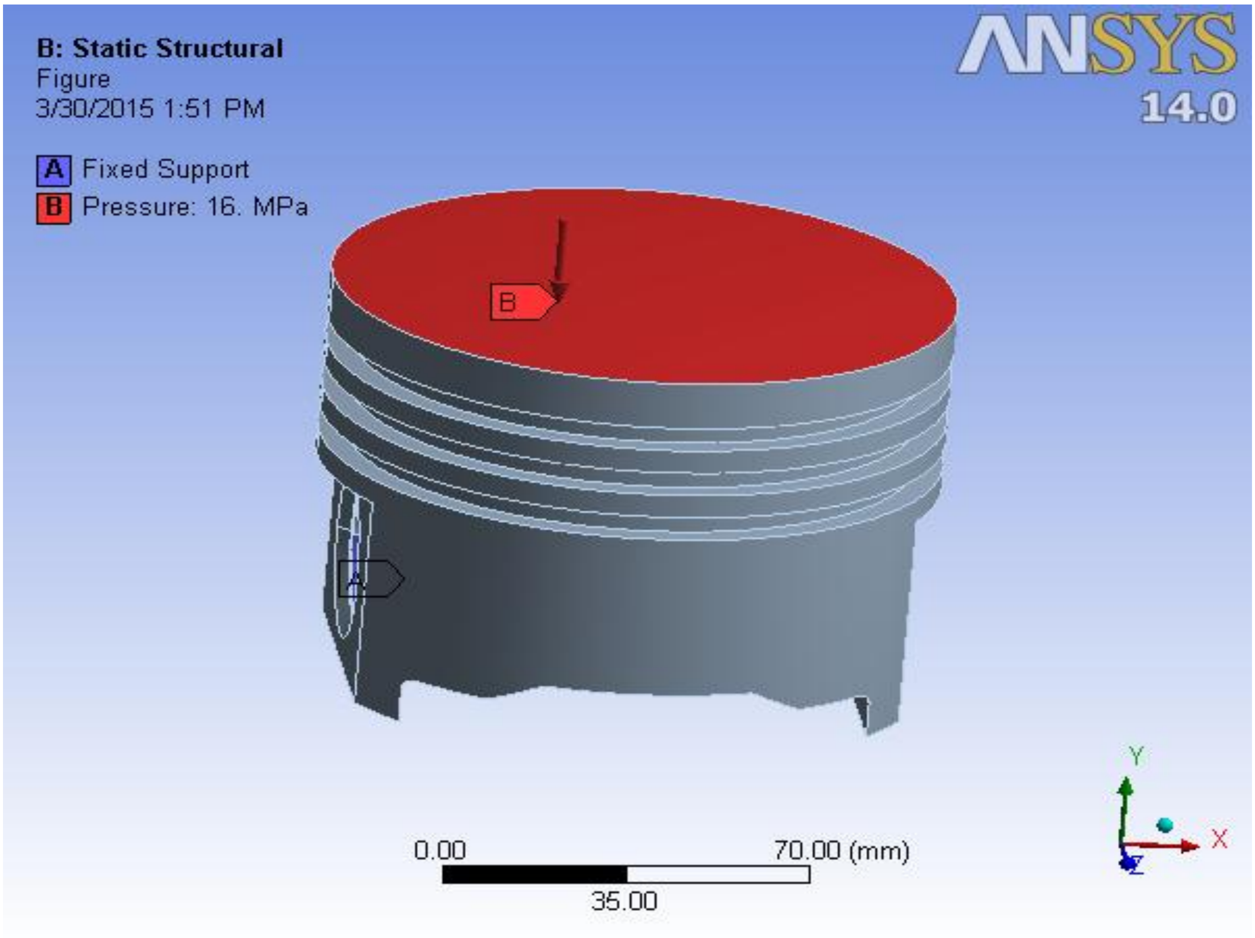

Fig :6.13 pressure acting on Mg-SiC Piston

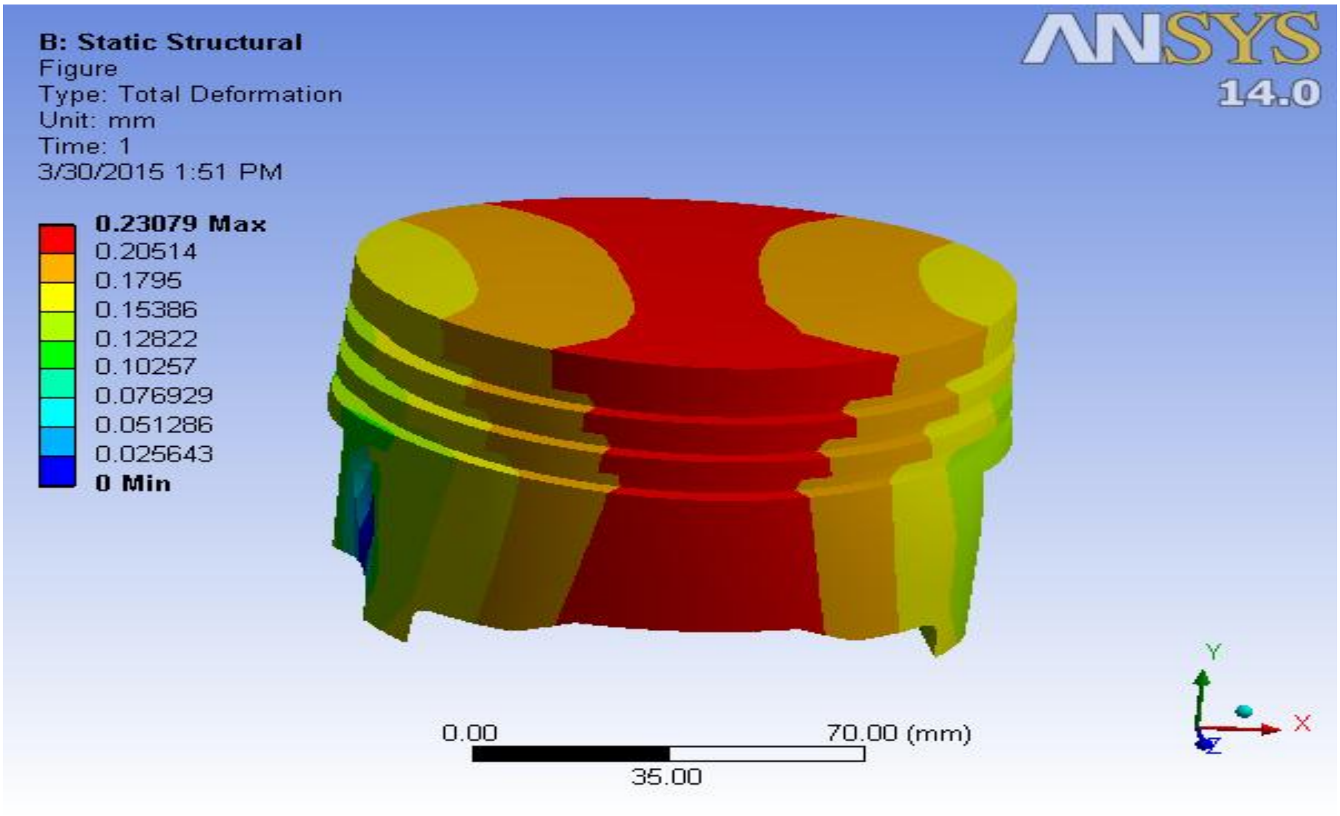

Figure : 6.14 Total deformation on Mg-SiC piston

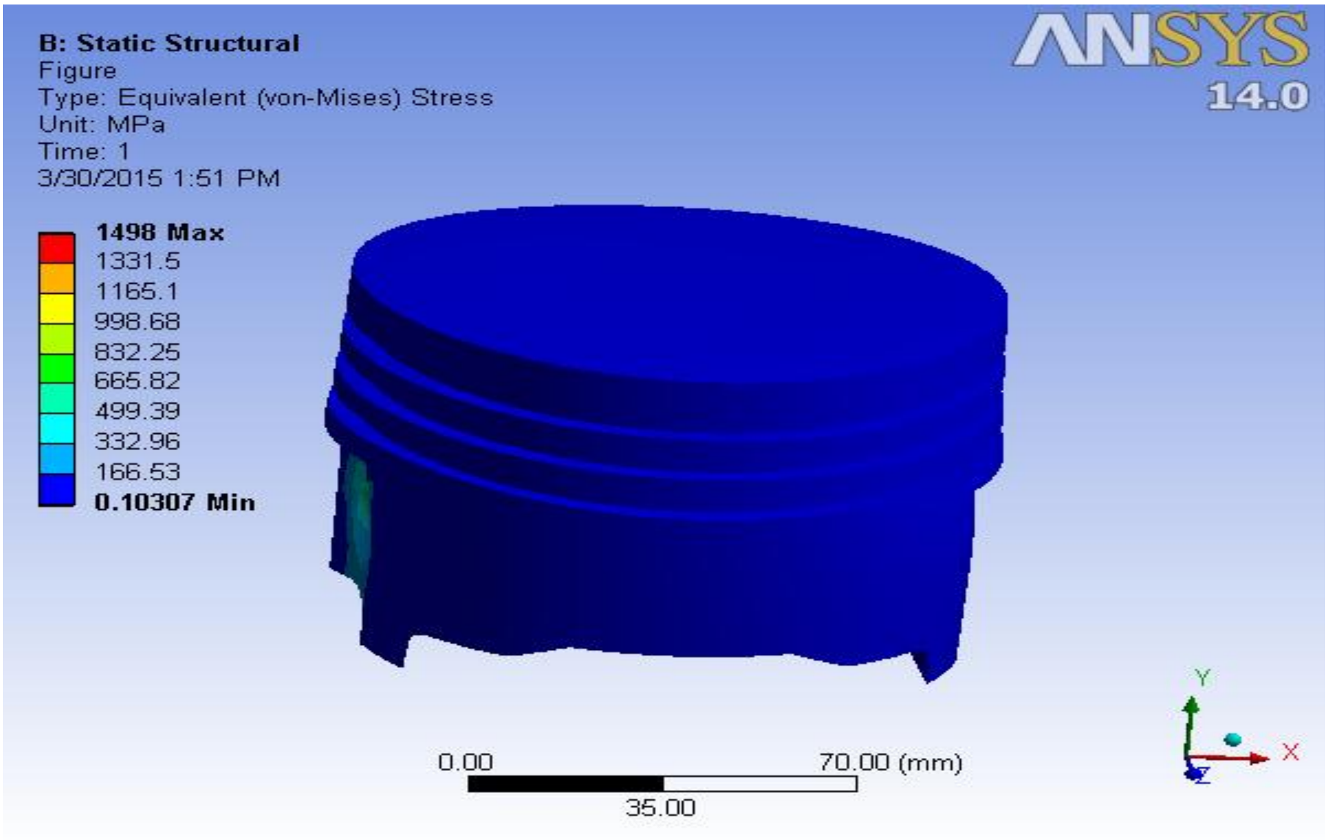

Fig:6.15 Equivalent stress of Mg-SiC piston

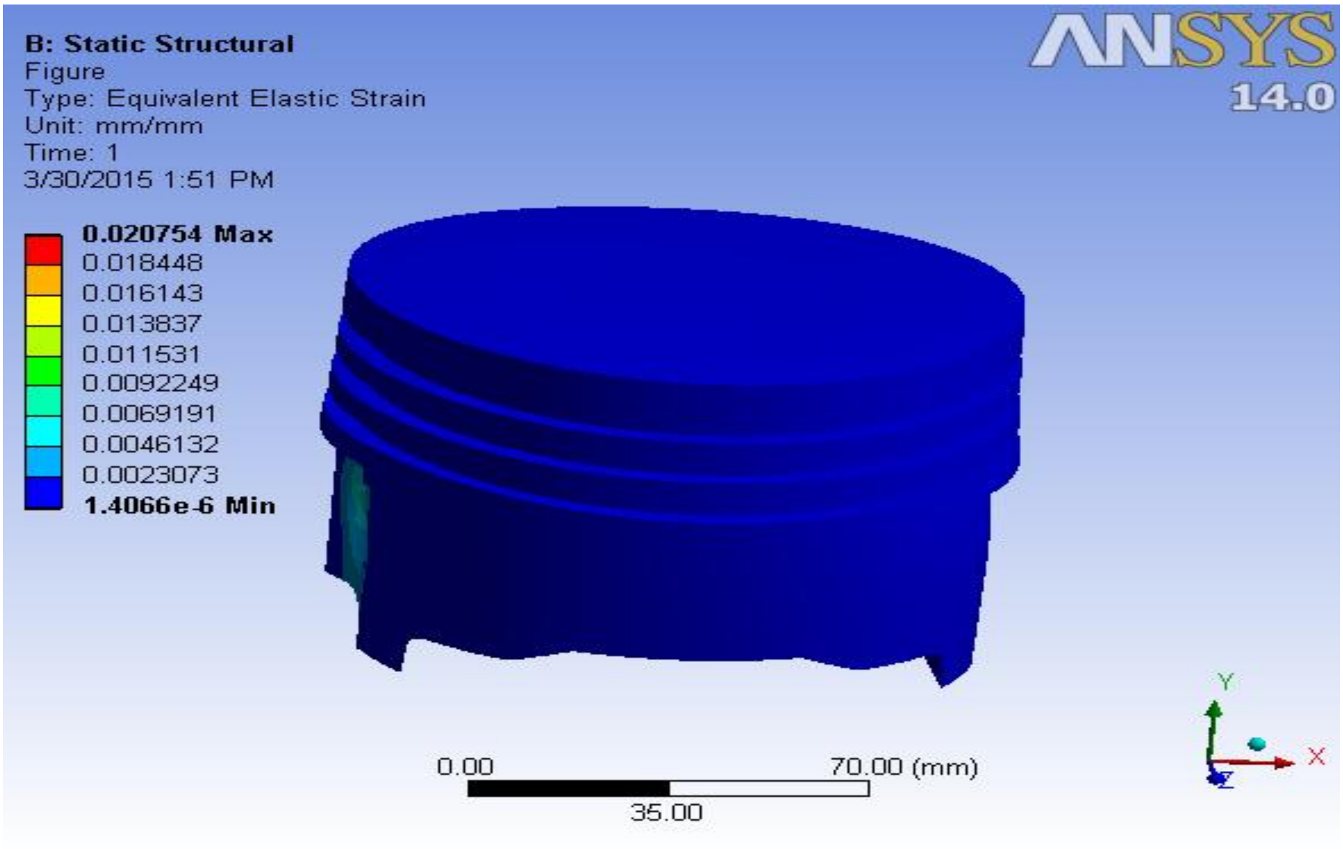

Fig:6.16 Equivalent Elastic Strain of Mg-SiC Piston

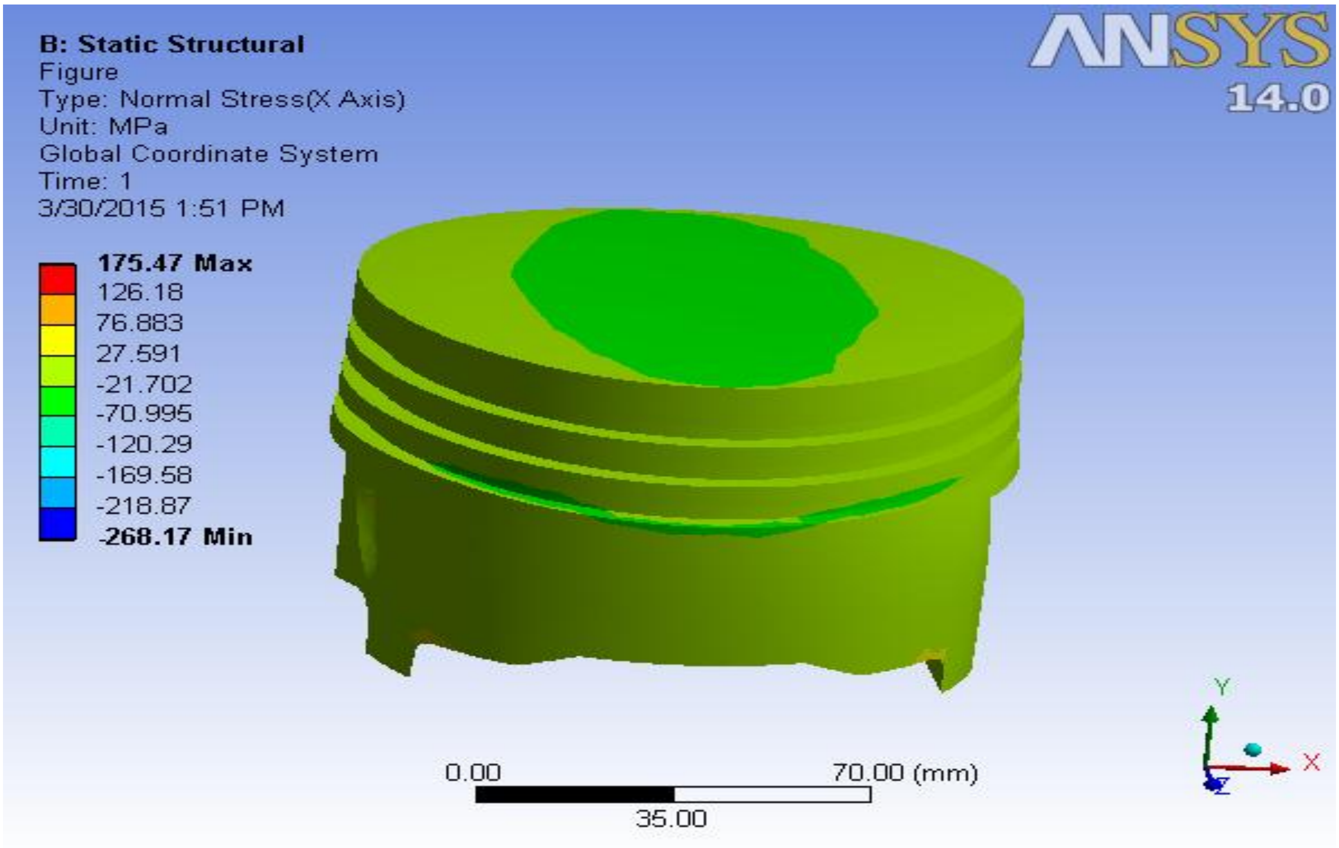

Fig:6.17 Normal stress acting along X-axis on Mg-SiC Piston

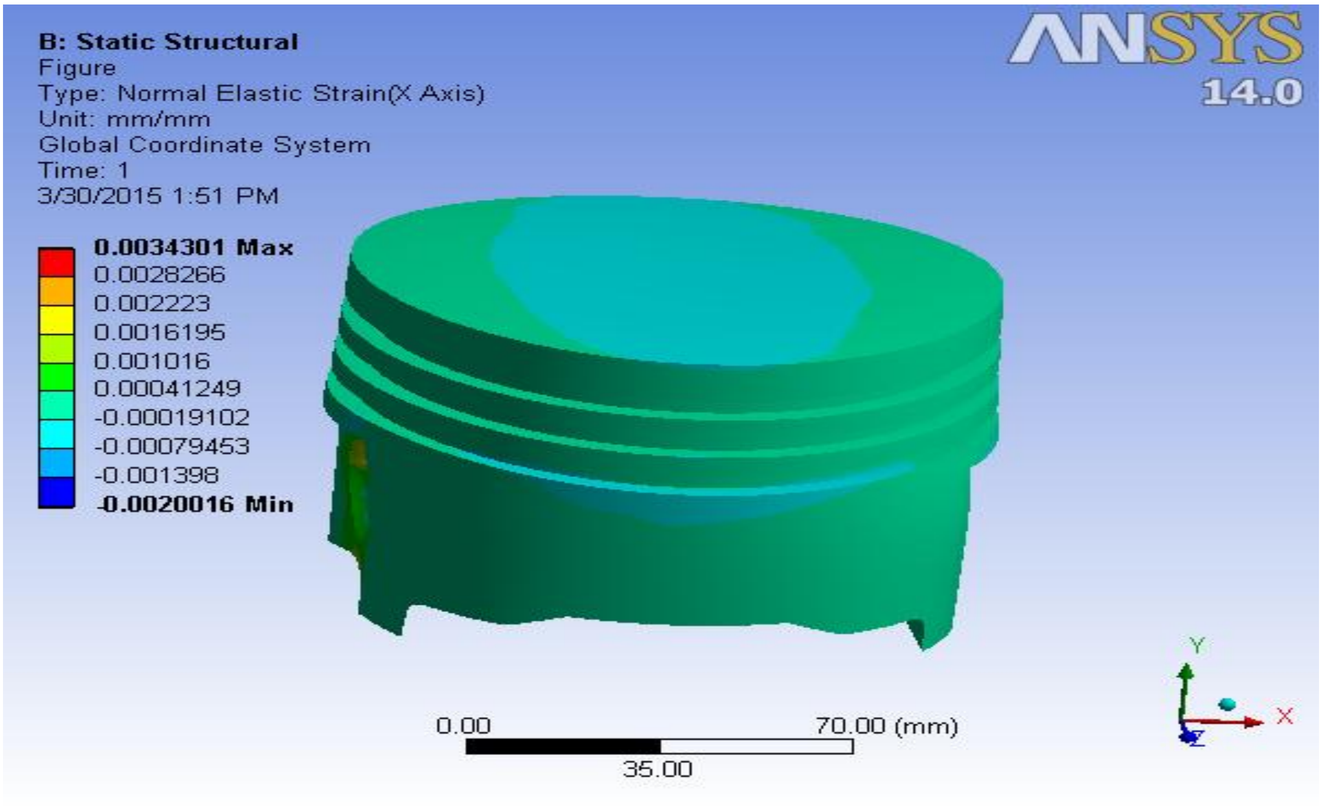

Fig: 6.18 Normal elastic strain acting along X-axis on Mg-SiC Piston

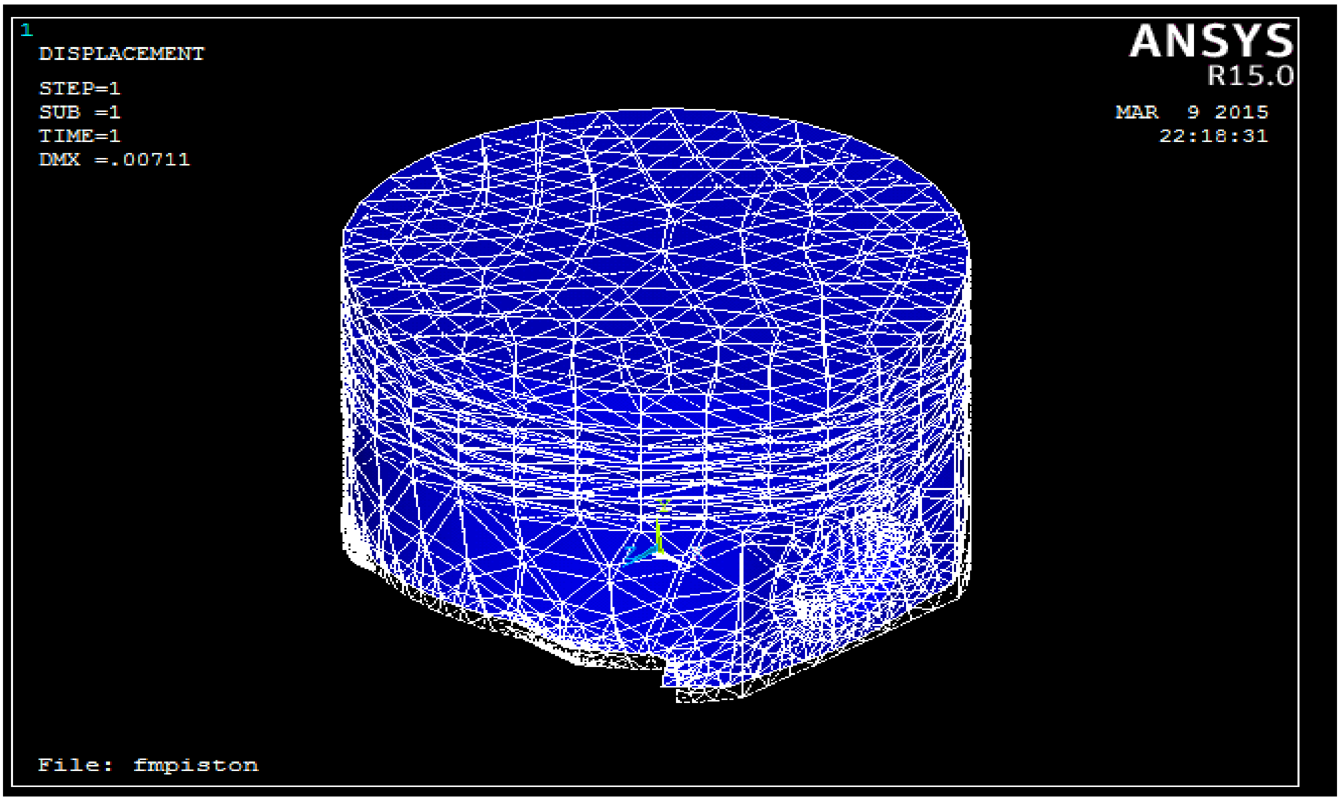

Figure:6.19 Total displacement model on Mg-Sic piston

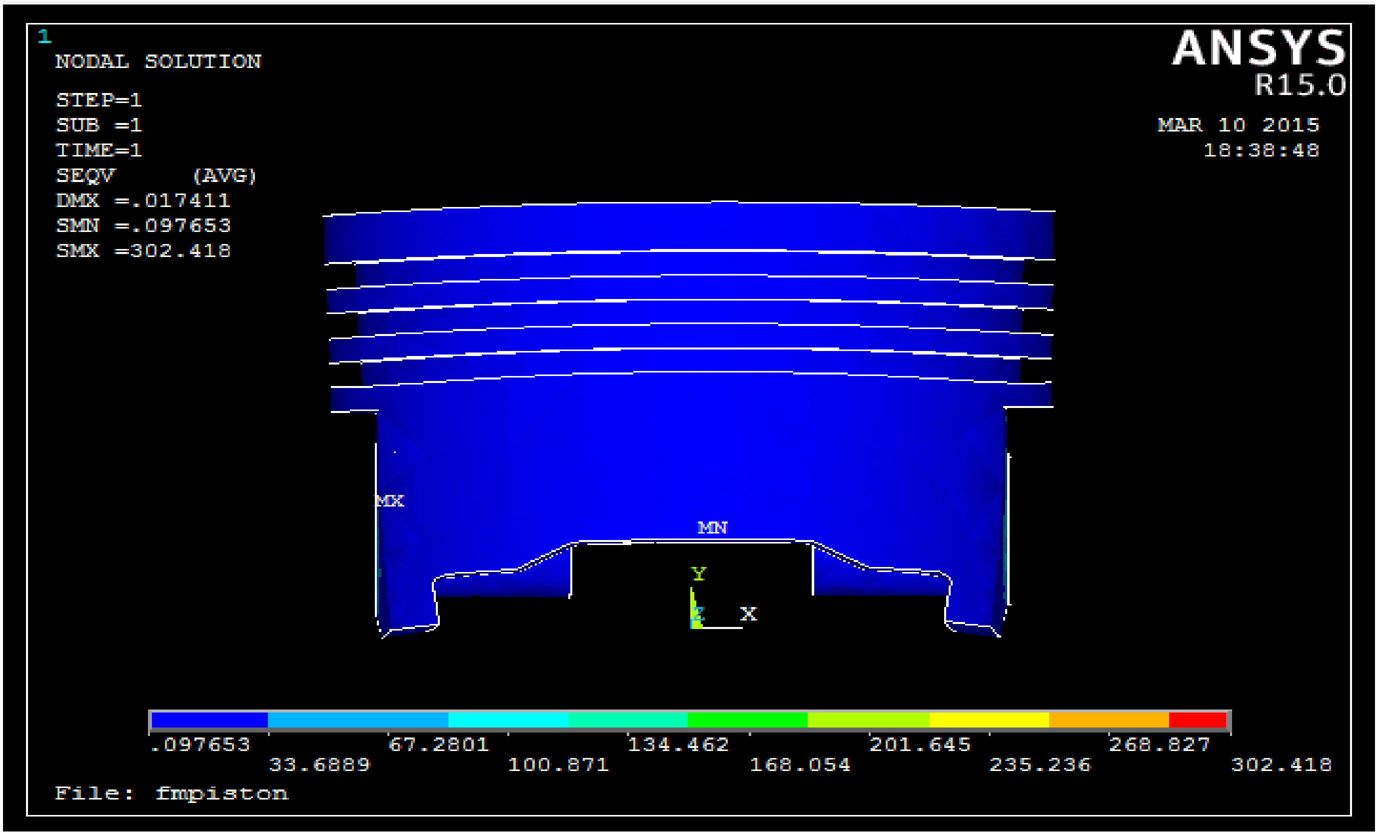

Figure : 6.20 Von mises stress plot on Mg-Sic piston

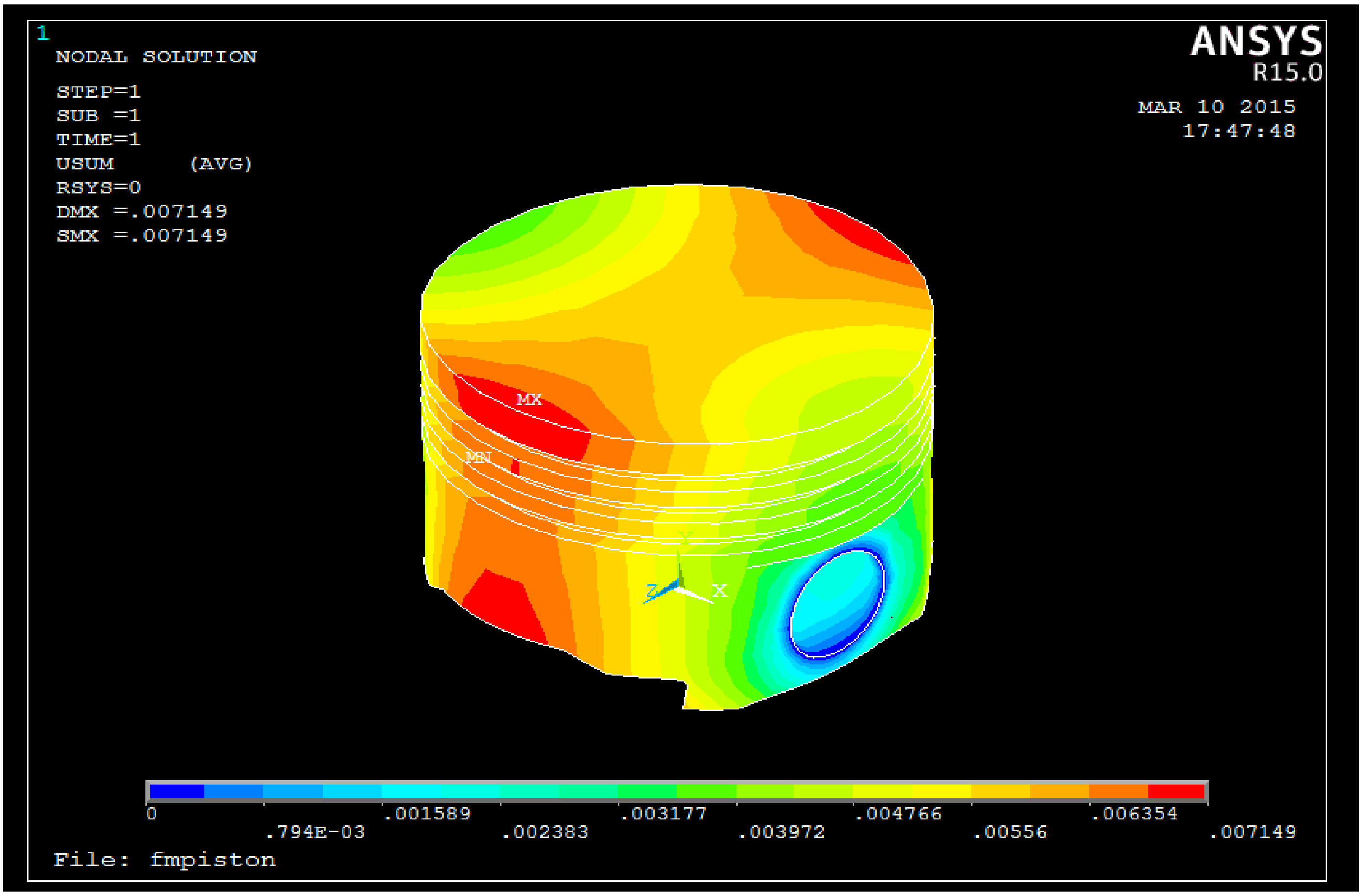

Figure : 6.21 Total deformation on Mg-SiC piston

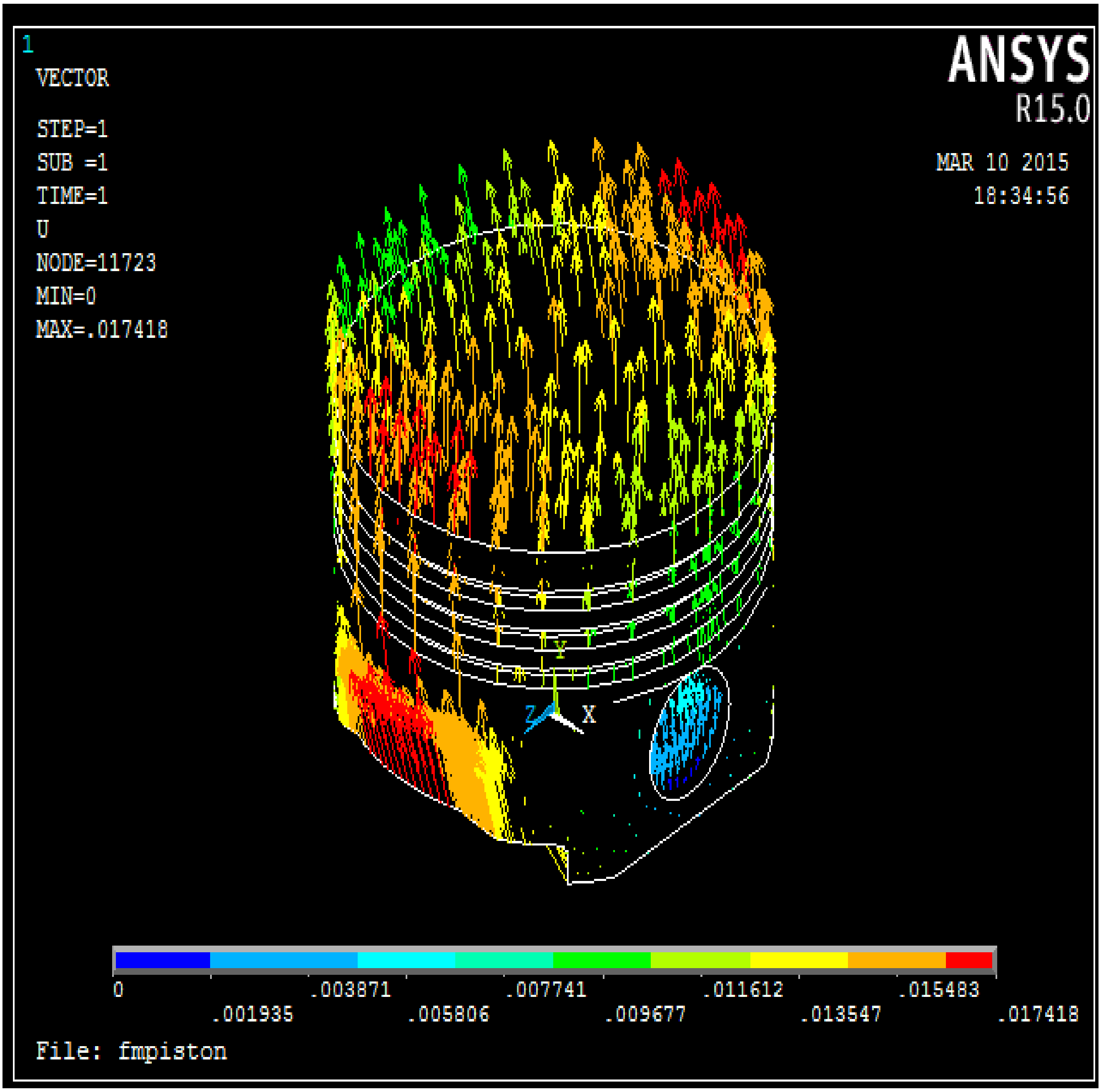

Figure : 6.22 Total Vector displacement on Mg-SiC piston

6.3 RESULT OF STRUCTURAL ANALYSIS:

TABLE 6.5: Resut of structural analysis of Mg-SiC Piston

Object Name	Total Deformation (mm)	Equivalent Stress (MPa)	Equivalent Elastic Strain (mm/mm)	Normal Stress (MPa)	Normal Elastic (mm/mm)
Minimum	0. mm	0.10307	1.4066e-006	-268.17	-2.0016e-003
Maximum	0.23079	1498	2.0754e-002	175.47	3.4301e-003

It is observed that the analysis results clearly shows that the piston with Mg-SiC material has better results than the former materials Al-SiC. It also indicated that have minimum displacement than conventional materials. When compared to the conventional material the new material found to have less weight and more strength.The result was analysed successfully by using Ansys workbench14.0 and Ansys MechanicalApdl15.0.

CHAPTER-7

CONCLUSION

The influence between the matrix and reinforcement is a very important structural factor influencing the properties of the metal matrix composites. The achievement of the desired composite structure and a bond between the components requires controlling of the phenomena and reactions taking place in these materials. During the working condition piston exposed to the high gas pressure because of combustion. So the methodology for analyze the piston is to consider the gas pressure as applied uniformly over the piston crown. The pressure force generated by the burning of fuel is calculated using gas equation and it is assumed that side thrust force and inertia force is negligible but in reality this may have some influence on stress and deformation of piston. Also the temperature effect is neglected and that temperature is uniform.

The structural analysis shows that the deformation is low compared to the conventional piston. On the basis of the analyzed results it can be observed, that introduction of different composition of magnesium and silicon carbide materials as well as applying coating process for the piston to reduce the heat and deformation. Two stroke petrol engine pistons is used to taking 3d model and thermal analysis and result are compared to exiting material. Mg-sic composite material are weight are reduced and heat flux are increased to Al-sic. From this project we get the clear knowledge about the composite materials and its feature.

CHAPTER-8
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