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THERMAL ANLYSIS OF PISTON FOR COMPRESSION IGNITION ENGINE

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Abstract

Piston is one of the most important part in IC engine. It is very important to maintain condition of piston in proper manner to maintain the proper functioning of the engine. Piston mainly fails due to thermal conditions, because of this it is very important to search out proper thermal distribution among various piston materials. Present research work is carried out to find out the thermal distribution on different piston materials of Aluminium alloys. This analysis is carried out with the help of finite element method and ANSYS software.

Keywords: IC engine, Piston, ANSYS, Piston Materials, WB-Modeller, aluminium alloy.

I. INTRODUCTION

An internal combustion engine is defined as an engine in which the chemical energy of the fuel is released inside the engine and used directly for mechanical work, as opposed to an external combustion engine in which a separate combustor is used to burn the fuel. The piston is a vital component of a cylindrical engine. It reciprocates inside the cylinder bore. The piston acts as a movable end of the combustion chamber. The cylinder head is the stationary end of the combustion chamber. The aim of the present research work is to understand the thermal behaviour of piston with different type of materials.

In today's automotive industry, Internal Combustion engine have importance of piston in automotive system with its terminology is clearly described by the history. The detailed explanation is given on the history of the piston with keen concentration on type of piston materials and the selection of suitable piston materials.

The present task is undertaken as:

1. To design an IC Engine piston according to the procedures and specifications given in machine design and data book on CREO.
2. To perform the structural analysis using ANSYS.

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Material Properties:
Following are the material properties of Aluminium alloy which is taken under consideration :

1. Young's modulus: 2.3×105MPa
2. Poisons ratio: 0.24
3. Density: 2937 kg/m3
4. Thermal conductivity: 197 W/m0C
5. Specific heat: 894 J/kg0C

II. DESIGN OF PISTON

The desired piston design considerations are as follows:
It should have minimum weight so that it can withstand the inertia forces. It should have enormous strength to withstand the combustion pressure. It should reciprocate at desired speed without much noise. It should have sufficient support for the piston pin. It should have sufficient strength to withstand the mechanical distortion.

S No.	Dimensions	Preferable Size (in mm)
1	Cylinder Bore, D	80
2	Height of the piston, H	75
3	Wall thickness of leading part	3
4	Thickness of sealing part	3
5	Distance of the first channel	7
6	Hole diameter of piston pin	23
7	Radial thickness of piston ring	7

Meshing of Model
For this model default size is used.
Number of Nodes 24809.
Number of Elements 24809.

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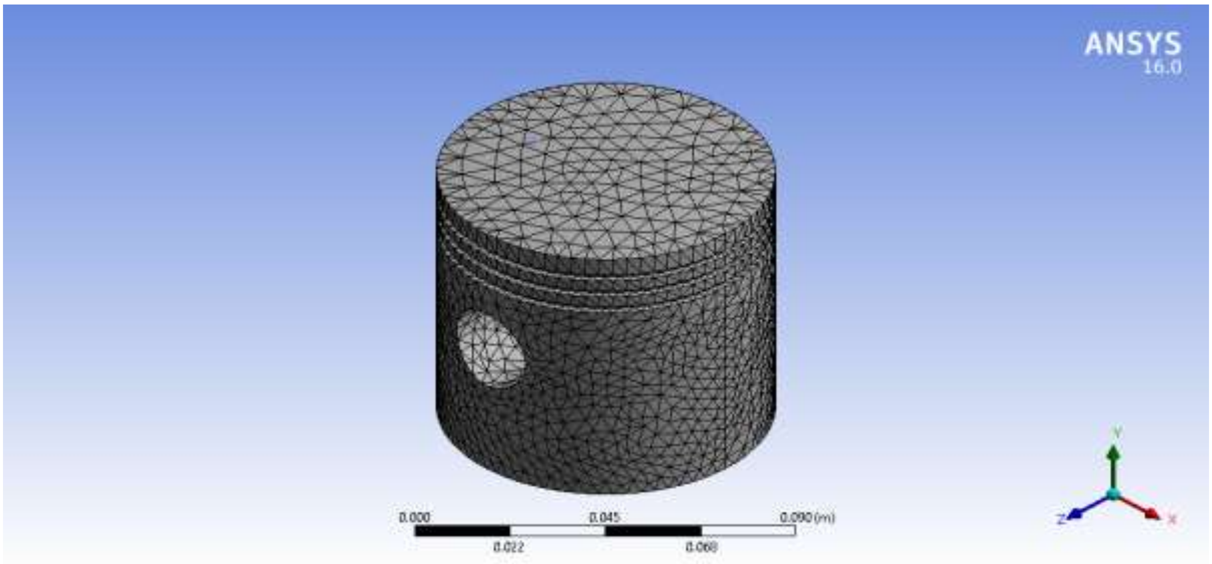

Fig .1 – Meshed model

III. RESULTS

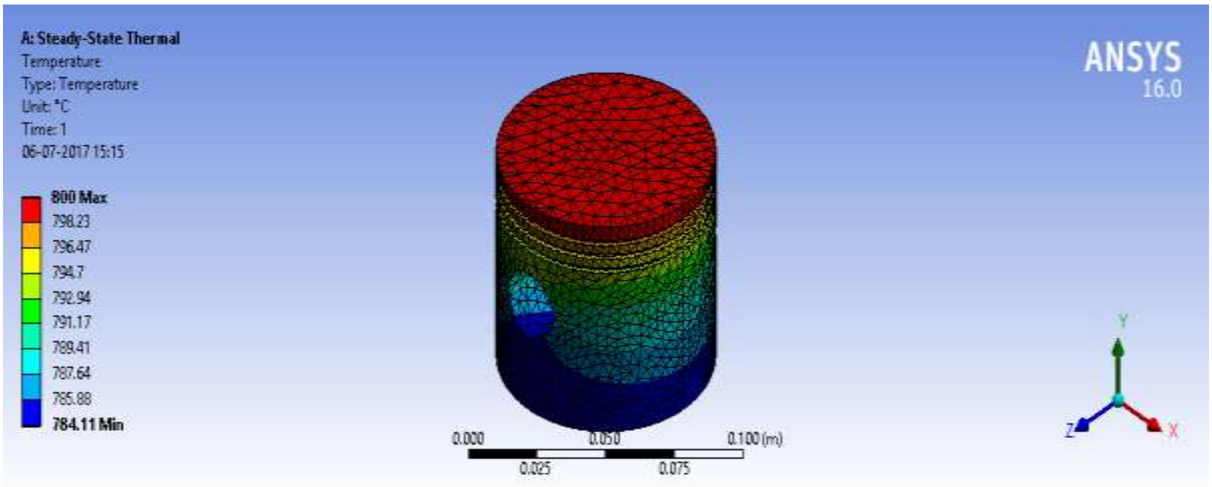

Fig .2 – Temperature Distribution model

Fig 2 shows the distribution of Temperature induced within the piston body. The maximum values of Temperature observed at top surface of the piston crown.

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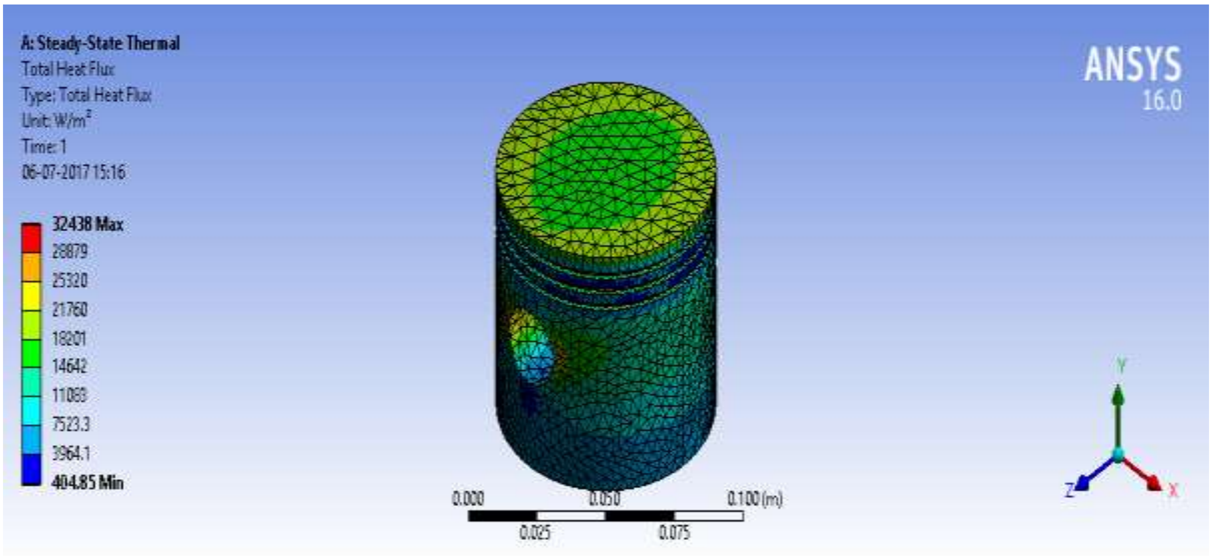

Fig .3 – Total Heat Flux model

Fig 3 show the maximum total heat flux in the piston geometry due to the application of gas temperature is 32438 W/m2, which is observed at the edge portion of the piston crown.

IV. CONCLUSIONS

Following conclusions are drawn from results are as follows:
From the thermal analysis of the Aluminium alloy piston material is observed that total heat flux is varied from 404.85 W/m^2 to 32438W/m^2 but it attains its maximum value for negligible time period and average value for the heat flux is approximate 14000 W/m^2.
In steady state thermal analysis average value of the temperature is approximate 700^0 C.

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