ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Design and Thermal Analysis on 220cc Engine Cylinder Fins By Varying Materials

C Santhosh Kumar Reddy
M. Tech (Thermal Engineering),
Department of Mechanical Engineering,
Malla Reddy College of Engineering.

Mr. B.Rahul
Assistant Professor,
Department of Mechanical Engineering,
Malla Reddy College of Engineering.

ABSTRACT:

The 220cc engine cylinder is one of the major automobile components, which is subjected to high temperature variations and thermal stresses. In order to cool the cylinder, fins are provided on the cylinder to increase the rate of heat transfer. By doing thermal analysis on the 220cc engine cylinder fins, it is helpful to know the heat dissipation inside the cylinder. The principle implemented in this project is to increase the heat dissipation rate by using the invisible working fluid, nothing but air. Fins are basically mechanical structures which are used to cool various structures via the process of convection.

An air-cooled engine releases heat to the atmosphere through the mode of forced convection. To facilitate this, fins are provided on the outer surface of the cylinder.

The main object of this project is to analyze thermal properties such as Temperature distribution and Total heat flux by varying materials of cylinder fins.

In this project we have taken rectangular fin with 3mm thickness. The heat transfer surface of the engine is modeled in 3D modeling software Solid works. Thermal analysis is done on the fins to determine variation temperature distribution over time. The analysis is done using ANSYS. Analysis is conducted by varying material. Presently Material used for manufacturing fin body is Cast Iron. In this thesis, it is replaced by aluminum alloy. By observing the analysis results, total heat flux is more for aluminum alloy 6082. So using aluminum alloy is better.

1. INTRODUCTION:

A).Cooling System for I.C. Engines

Internal combustion engines at best can transform about 25 to 35 percentage of the chemical energy in the fuel in to mechanical energy. About 35 percentage of the heat generated is lost in to the surroundings of combustion space, remainder being dissipated through exhaust' and radiation from the engine. The temperature of the burning gases in the engine cylinder is about 2000 to 2500° C. The engine components like cylinder head, cylinder wall piston and the valve absorb this heat. Such high temperatures are objectionable for various reasons state below.

Necessity for Engine Cooling

1. Engine valves warp (twist) due to overheating.
2. Damage to the materials of cylinder body and piston.
3. Lubricating oil decomposes to form gummy and carbon particles.
4. Thermal stresses are set up in the engine parts and causes distortion (twist or change shape) and cracking of components.
5. Pre – ignition occurs (i.e. ignition occurs before it is required to igniter due to the overheating of spark plug.
6. Reduces the strength of the materials used for piston and piston rings.
7. Overheating also reduces the efficiency of the engine.

To avoid the above difficulties, some form of cooling is provided to keep the temperature of engine at the desired level. It should be noted that if the engine

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

becomes every cool the efficiency reduces, because starting the engine from cold requires more fuel.

B). General Equation of Fin:

Let us consider a fin of length L, width W and thickness t attached to a base, which is maintained at T_o. The fin is exposed to the surroundings at temperature T_α and having a connective heat transfer coefficient of 'h'. the temperature at the base of fin is $T_O and$ as we proced along the length of the fin temperature gradually decreases and $\Delta T\ between$ the surface and surroundings is not constant. Hence we can't directly use the Newton's law of cooling formula. The heat transfer is thus evaluated from first principles by applying the conservation of energy to a different element of thickness *dx* as shown in fig. Considered at a distance x from the base the rate of heat conducted into this element at x is the sum of rate of heat conducted from element at (x + dx) and rate of convection from the element.

$$Q_{conduction\ ,x} = Q_{conduction\ ,x+dx} + Q_{convection}$$

$$Q_x = Q_x + \frac{d}{dx}(Q_x)dx + Q_{conv}$$

$$Q_x = Q_x + \frac{d}{dx}(\text{-k } A_c \frac{dT}{dx})dx\text{+h. d } A_s(T - T_\alpha)$$

Where T is the temperature of the surface maintained at distance x and $(dA)_s$ represents the elemental surface area exposed to the environment.

$$dA_s = perimeter \times dx = Pd$$

$$kA(x)\frac{\partial^2 T}{\partial x^2} + h.P(x)(T-T_\alpha)=0$$

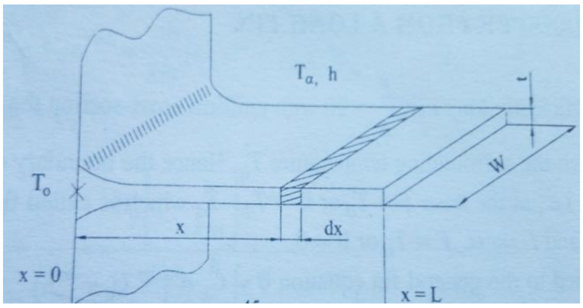


Fig Heat transfer through a rectangular fin

$$\frac{\partial^2 T}{\partial x^2} - \frac{hP(x)}{kA(x)}(T - T_\alpha),\ \text{Let } \theta = T - T_\alpha$$

$$\frac{\partial^2 \theta}{\partial x^2} - \frac{hP(x)}{kA(x)}\ \theta=0$$

If the area of fin and perimeter are constants all along the length of the fin we can write the above equation

$$\frac{\partial^2 \theta}{\partial x^2} - \frac{hP}{kA}\theta = 0$$

$$\text{Let } m^2 = \frac{hP}{kA} \qquad \frac{\partial^2 \theta}{\partial x^2} - m^2\theta = 0 \quad \text{-------------------(1)}$$

This is the general equation for a fin.

$'\theta'$ represents the excess temperature at any location all along the length of the fin. The solution of the above 2nd order linear homogeneous differential equation is $\theta = C_1 e^{mx} + C_2 e^{-mx}$

Where C_1, C_2 are arbitrary constants whose values are to be determined from the specified boundary conditions.

2. PROBLEM DEFINATION

In the present paper investigation on thermal issues on automobile fins were carried out. Investigation yields the temperature behavior and heat flux of the fins due to high temperature in the combustion chamber. Also the material is changed so that better heat transfer rate can be obtained. we have taken rectangular fin with 3mm thickness. The heat transfer surface of the engine is modeled in 3D modeling software SOLID WORKS. Thermal analysis is done on the fins to determine variation temperature distribution over time. The analysis is done using ANSYS. Analysis is conducted by varying material of fins and a comparison is thus established between them.

3. MODELING AND ANALYSIS OF CYLINDER FIN

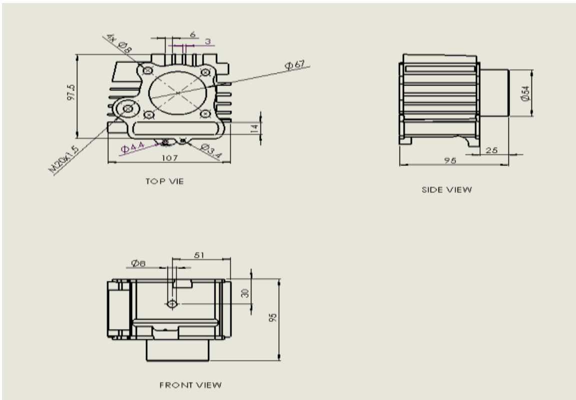


Fig . Dimensions of cylinder fins

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

A).MODELING IN SOLID WORKS:

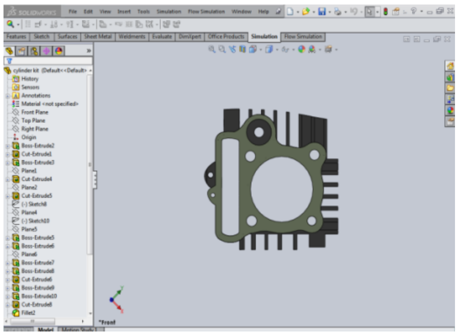


Fig Front view of cylinder fin body

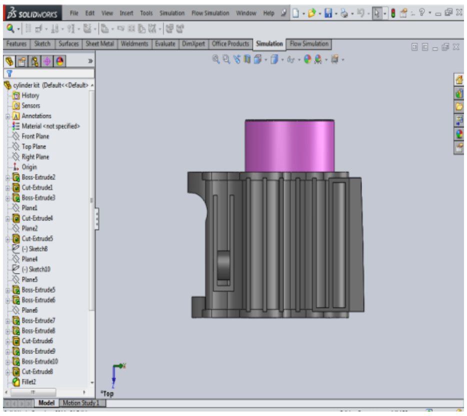


Fig Top view of cylinder fin body

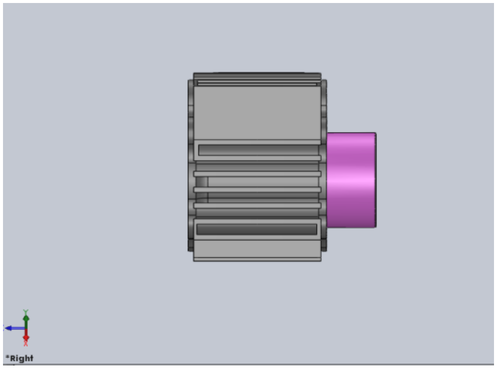


Fig Right side view of cylinder fin body

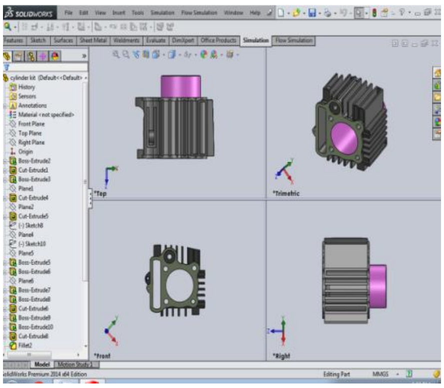


Fig Trimetric view of cylinder fin body

B). THERMAL ANALYSIS OF CYLINDER FINS

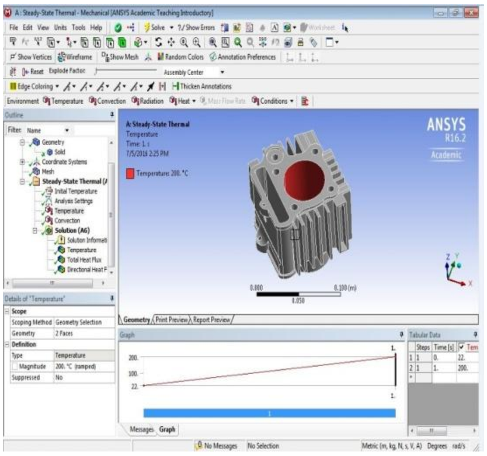


Fig .Input Temp

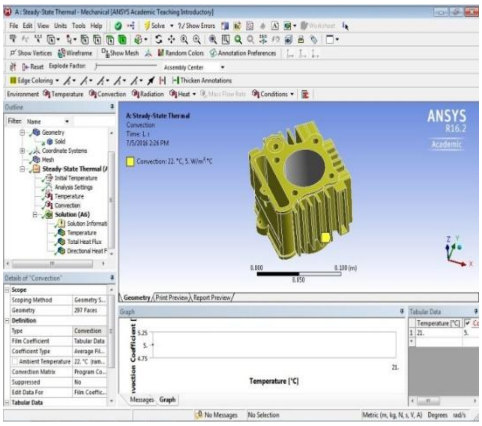


Fig .Steady state thermal convection

I). CAST IRON:

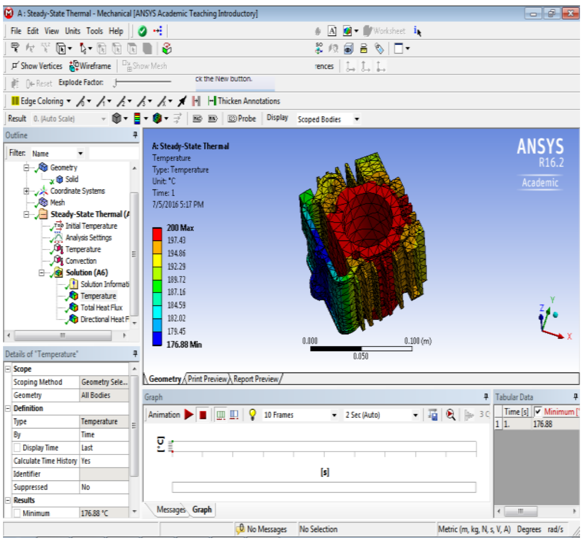


Fig 5.3.Temp Distribution

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

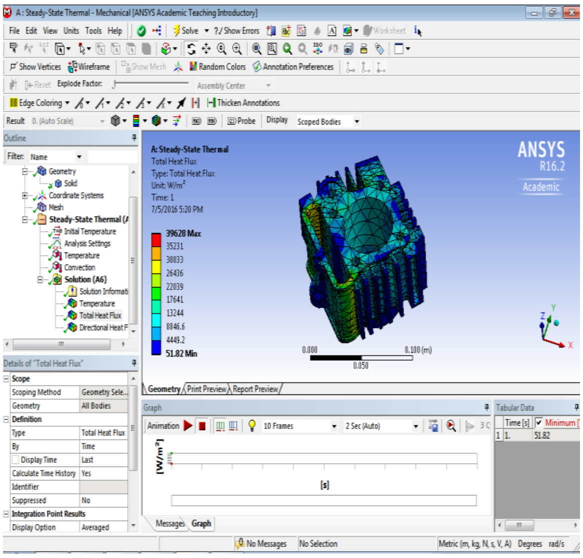


Fig 5.4.Total heat flux

II).ALLUMINIUM ALLOY:

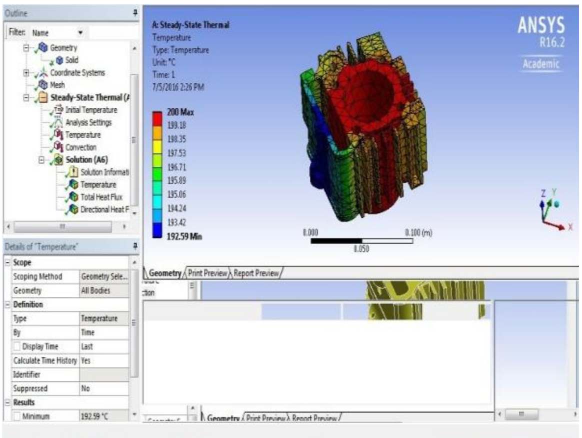


Fig Tempe Distribution

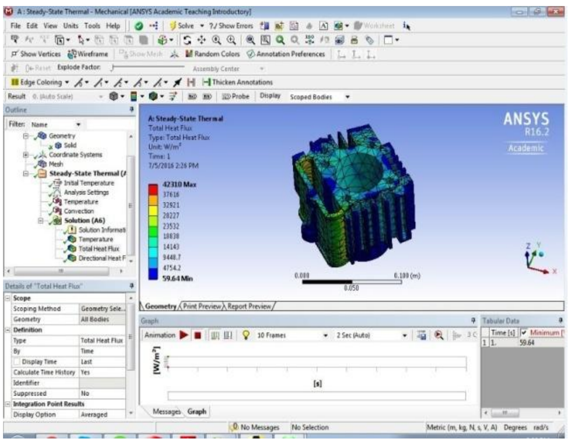


Fig Total heat flux

III). MEGNISIUM ALLOY:

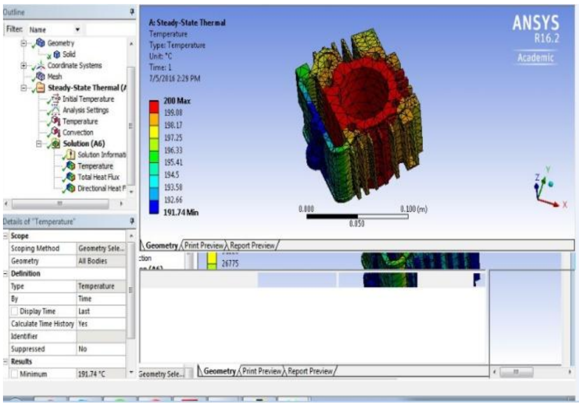
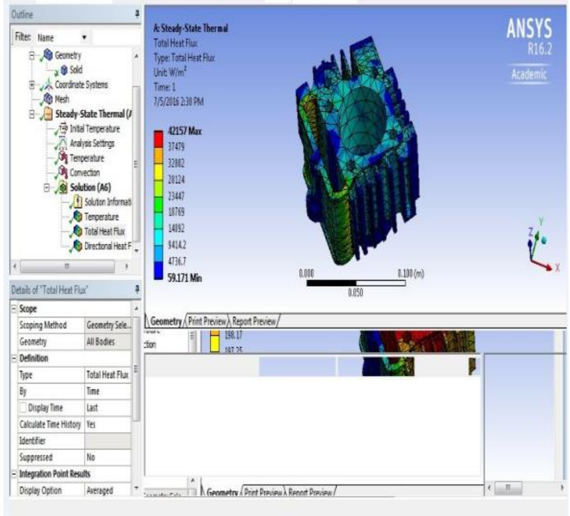


Fig. Temperature Distribution



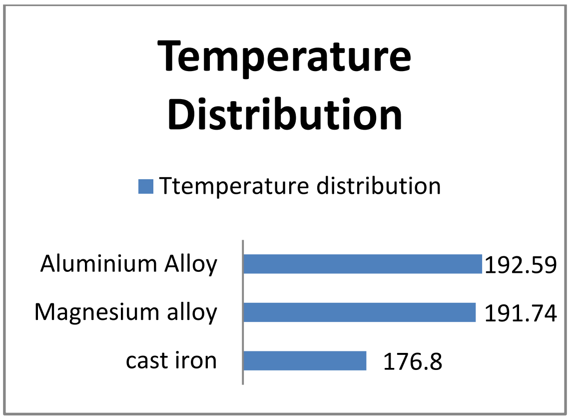
Total heat flux

4. RESULT

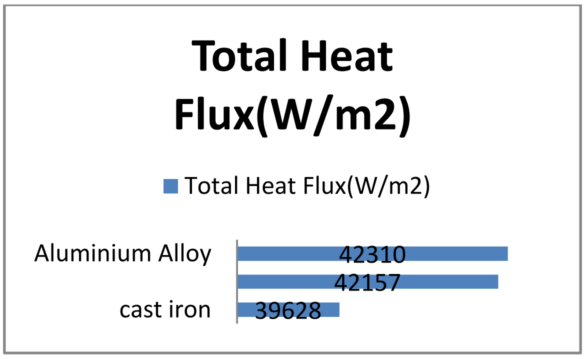
MATERIAL	TEMPERATURE DISTRIBUTION(°C)	TOTAL HEAT FLUX(W/m2)
CAST IRON	176.8	39628
MEGNISIUM ALLOY	191.74	42157
ALLUMINIUM ALLOY	192.59	42310

Above simulation results shows good qualitative agreement in Aluminum alloy cylinder fins compared to cast iron and magnesium alloy. By observing the analysis results, total heat flux is more for aluminum alloy than remaining two materials for cylinder fins. So using aluminum alloy is better.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal



Graph: Temperature Distribution Vs Material Applied



Graph: Total heat flux Vs Material Applied

By observing the analysis results, total heat flux is more for aluminum alloy than remaining two materials for both condenser and evaporator. So using aluminum alloy is better.

5. CONCLUSION

The following conclusions can be drawn from the present work:-

1.The 220cc engine cylinder is one of the major automobile components, which is subjected to high temperature variations and thermal stresses. In order to cool the cylinder, fins are provided on the cylinder to increase the rate of heat transfer.

2. By doing thermal analysis on the 220cc engine cylinder fins, it is helpful to know the heat dissipation inside the cylinder. The principle implemented in this project is to increase the heat dissipation rate by using the invisible working fluid, nothing but air.

3. We know that, by increasing the surface area we can increase the heat dissipation rate, so designing such a large complex 220cc engine is very difficult. The main purpose of using these cooling fins is to cool the 220cc engine cylinder by any air A parametric model of piston bore fins has been developed to predict the thermal behavior.

4. The parametric model is created in 3D modeling software Solid works. Thermal analysis is done on the fins to determine variation temperature distribution over time. The analysis is done using ANSYS. Analysis is conducted by varying material. Presently Material used for manufacturing fin body is Cast Iron. In this thesis, it is replaced by aluminum alloy.

5. By observing the analysis results, total heat flux is more for aluminum alloy than remaining two materials for both condenser and evaporator. So using aluminum alloy is better.

6. REFERENCE

[1] Kumbhar D.G, Dr. N.K. Sane, Chavan S. T**.** "Finite Element Analysis and Experimental Study of Convective Heat Transfer Augmentation from Horizontal Rectangular Fin by Triangular Perforations", Proc. of the International Conference on Advances in Mechanical Engineering

[2] Abdullah, H. Alessa and Mohammed, Q. Al-Odat**,** "Enhancement of Natural Convection Heat Transfer from a Fin by Triangular Perforations of Bases Parallel and Toward its Base", The Arabian Journal for Science and Engineering,

[3] Thornhill, D., May, A.,"An Experimental Investigation into the Cooling of Finned Metal Cylinders, in a Free Air Stream", SAE Paper 1999-01-3307, (1999).

[4] Shivdas S. Kharche, Hemant S. Farkade ["Heat Transfer Analysis through Fin Array by Using Natural

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Convection", International Journal of Emerging Technology and Advanced Engineering.

[5] Mr. N. Phani Raja Rao, Mr. T. Vishnu Vardhan. "Thermal Analysis Of Engine Cylinder Fins By Varying Its Geometry And Material." International journal of Engineering Research & Technology.ISSN:2278-0181,Vol. 2 Issue 8, August(2013)

[6]P.K. Sharma, K. Rama Krishna "Heat transfer"

[7] R.K. Rajput ,"Thermal Engineering".