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Design And Thermal Analysis On The Engine Cylinder Fins

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ABSTRACT

Engine Cylinder is one of the chief automobile componentswhich is exposed to extreme heat temperature variations and thermal stresses. Fins are equipped on the cylinder to surge the heat transfer rate so that the cylinder is cooled up. Theheat dissipation rate can be increased by increasingits surface area, which leads to a difficulty in designing such a large complex engine. The mainaim of applying these fins is to cool down the enginewith the help of air. distance or gap between the thickness cylinder fins. The 3D model is made using Catia v5. Thermal analysis is done on the cylinder fins to regulate temperature variation circulation over time using ANSYS. Currently cast-iron is used in manufacturing the body of cylinder fin. In this work analysis is done on gray cast iron and Aluminum alloy also. The Thermal analysis is made for all the two materials for different geometries and the analytical and results are compared.

Key words: IC engines, Catia v5, FEM, ANSYS.

INTRODUCTION

HEAT TRANSFER

The phenomena of heat transmission from high temperature to low temperature is called as Heat Transfer. According to thermodynamic system, difference in temperature amidst the surroundings of system, the result will be a transmission of heat at boundary. The heat transfer occurs inside the system because of variation in temperature at different points within the system. The temperature difference is considered as 'potential' which origins the heat flow and also heat is known as flux. Modes of heat transmission are conduction, radiation and convection. There is a need of medium for conduction and convection, but for radiation medium is not required.

Conduction

The transference of heat in two solid objects is known as conduction. Depending upon the difference incold and hotobjects tem-

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perature. Anexample of conduction is when two bodies at dissimilar temperature kept in contact with oneanother and one more instance could be when theone end of metal (copper) is heated, due to which heat transmits toanother end of the metal which is also getting heated.

Convection

The heat transmission between the solid andliquidsurface is called as convection heat transfer. Considering a vessel of water to be heated, in this instancewater gets heated due to transfer of heat from the vessel is known as convection heat transfer.

FINS (Extended Surfaces)

The theory explains thatthe surfaces of Fins extended from an object in order to increase the measure of heat transfer from or to the atmosphere by raisingthe convection.

Determination of heat transmission quantity through convection, radiation andconductionof body.

Heat transfer increases when there is an increase in temperature inclinebetween theenvironment and object, raising the coefficient of convection heat transfer

It is not necessarily economical or feasible sometimes to modify the first two options. Therefore, when a fin is added to an object, surface area increasesand could be an economical benefit to heat transfer issues.

Fin Efficiency

The ratio of the actual rate of heat transfer through the fin to the maximum possible rate of heat transfer through the fin, is defined by fin temperature or efficiency.

$$\eta_f = \frac{\tan h(mL_c)}{mL_c}$$

$$mL_c = \sqrt{\frac{2h_f}{kt}L_f}$$

Where,

- h_f is the convection coefficient of the fin
  - Air: 10 to 100 W/m²K
  - Water: 500 to 10,000 W/m²K
- K is the thermal conductivity coefficient of the fin
- L_f is the fin height (m)
- t is the fin thickness (m)

Application of fins in convection

In several applications fins are used, to increase the heat transmission from surfaces. Characteristically, thermal conductivity is very high in fin. The exposure of fin is to a fluid which is flowing, that cools down or heats up, with the raise in thermal conductivity re-

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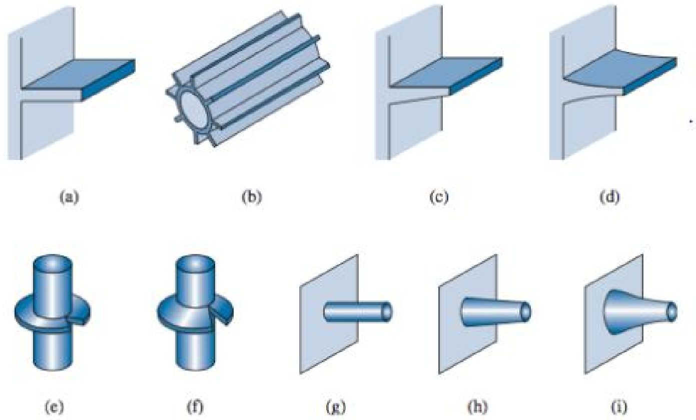

sulting the conduction from the surface of wall through the fin.

TYPES OF FINS

There are different types of fins such as longitudinal fins, radial fins, pin fins etc

Fig 1.5
Types of Fins

1.1 ASSUMPTIONS OF FIN ANALYSYS

- Thickness of fin is small when compared length and width. Heat transfer is one dimensional. The material is isotropic and thermal conductivity remains constant.
- Entire fin surface has uniform heat transfer coefficient (h) and negligible radiation heat exchange.
- No heat generation within fin joint itself.
- Steady state heat dissipation.
- Ambient temperature is T_∞ and base temperature is T_b.

LITERATURE SURVEY

Fins effects on an Air-CoolingMotorcycle Engine has been elucidated by “Masao YOSHIDA, Kohei NAKASHIMA,Soichi ISHIHARA, they had developed the experimental cylinder for an engine which is air-cooled, to inspect the effects of the number of fins, wind velocities and fin pitch on cylinder chilling. The main results attained are to increase the cylinder cooling and the cylinder should have a bigger number of fins. On a lower speediness the air movement separated on the fin surface at the downwind side and the temperature on the fin surface improved there. Local fin surface’shigher temperaturemakes cylinder to bear a greater distortion, resulting, scuff

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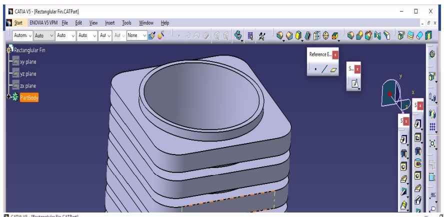
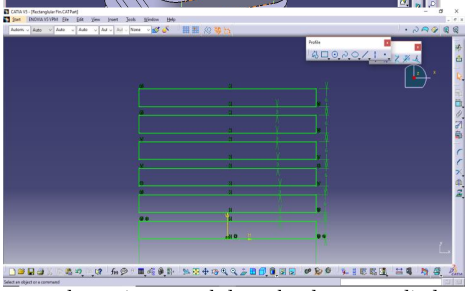
and may increase the lubricating oil consumption.

"S.N. Belsare, Pratima S. Patil, Dr. S. L. Borse, Study of internal combustion heat transfer rate of engine to improve its specific power,efficiency & performance prediction ofcombustion" This paper focuses on existence of substantial difference heat flux on several places in the engine cylinder. In each part,maximum heat flux occurs when the cylinder pressure is maximum. Other places of the cylinderhas lower Heat flux compared to the intake valves. Cylinder head has more Heat flux





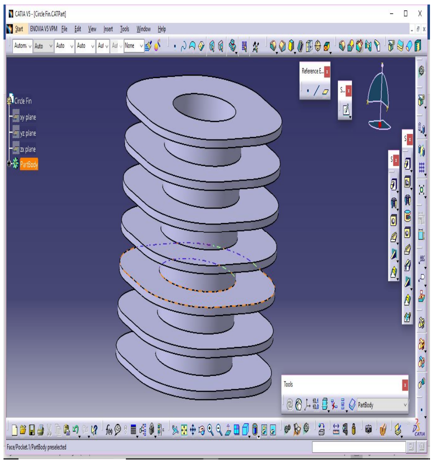
than piston and has the lowest cylinder linervalue.

3.1 MODELING OF CYLINDER FIN

Cylinder along with fin was modelled in CATIA software. The proportions of the fin were randomly considered. Fins with different geometries were modelled using CATIA software.

Final modelling of Rectangular cylinder fin

Drawing a Circular fin



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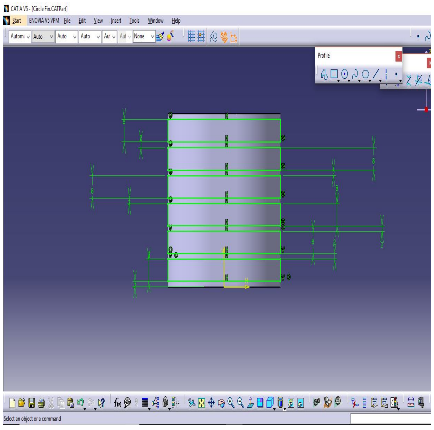

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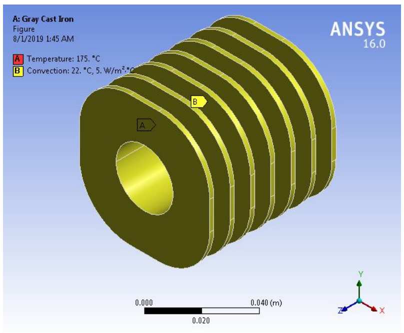
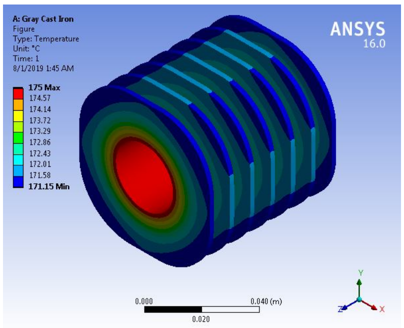
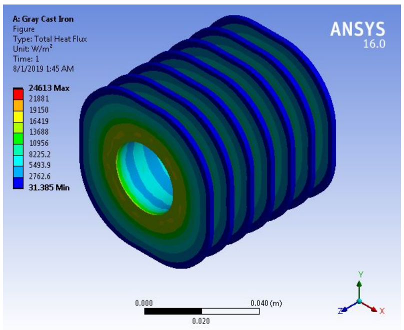
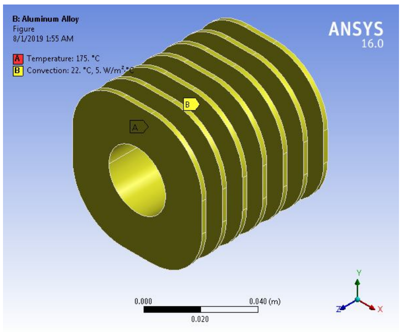
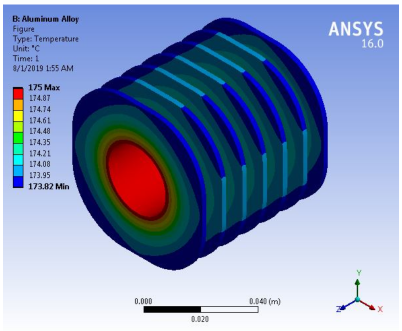
Thermal analysis of circular fin with Gary cast iron and Aluminium alloy

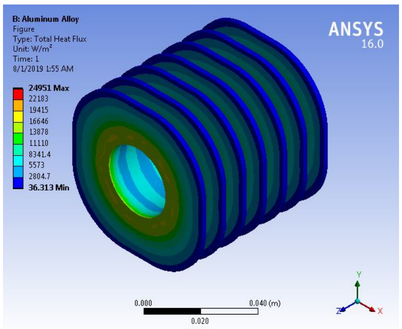












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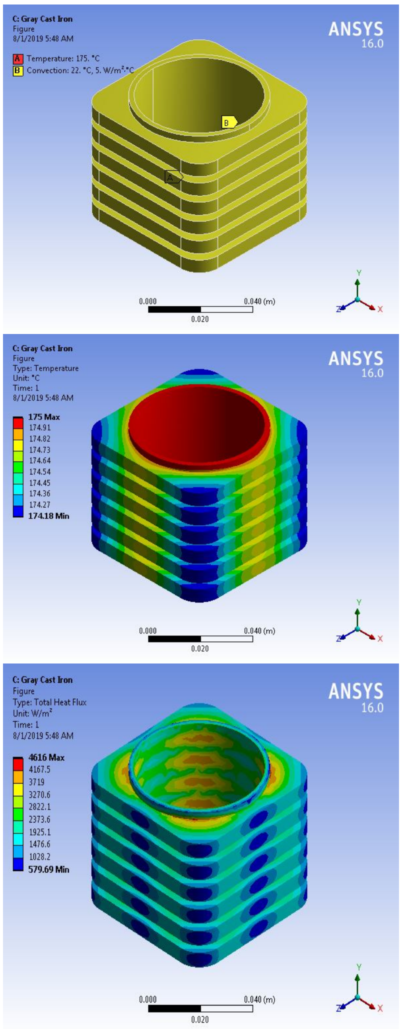
Thermal analysis of rectangle fin with gray cast iron an aluminium alloy



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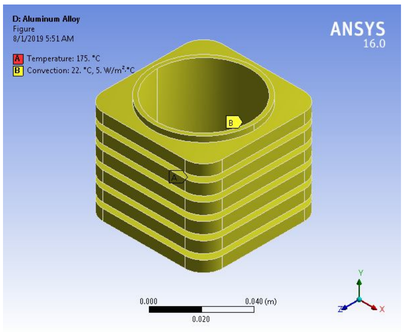
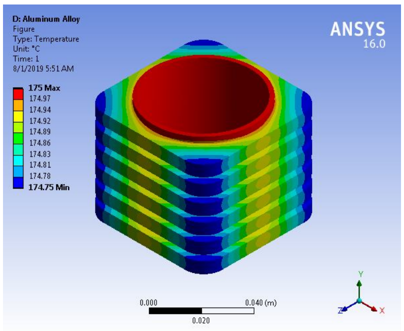
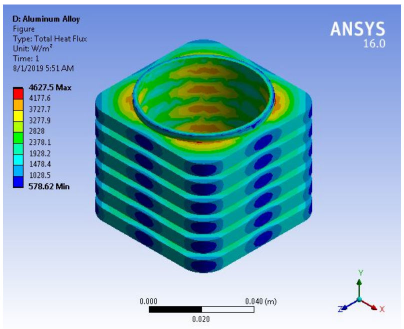
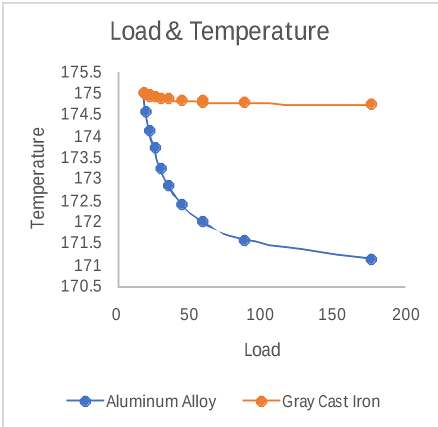


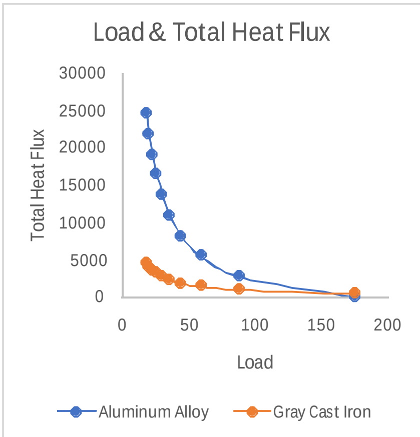




GRAPHS

CIRCULAR FIN





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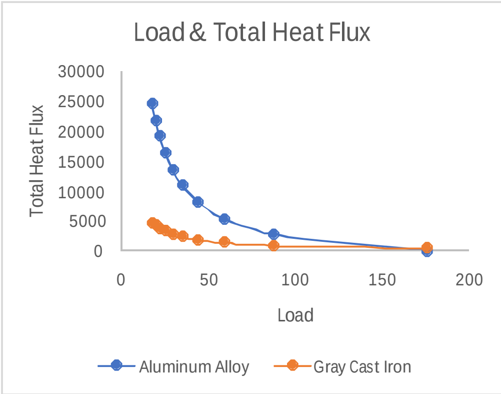
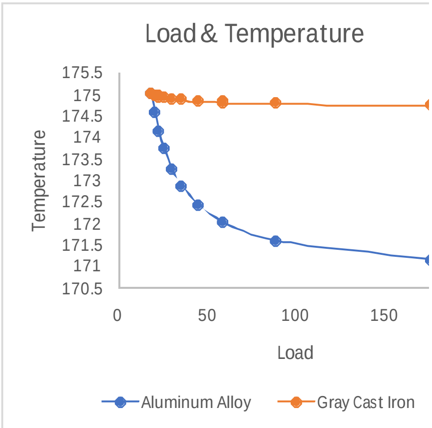


RECTANGULAR FIN



CONCLUSION

	Grey Cast Iron		**Aluminum Alloy**	
	Circular	**Rectangular**	**Circular**	**Rectangular**
Temperature	173.075	174.59	174.875	174.875
Total Heat Flux	12322.19	2597.845	2603.06	2603.06

As per the analysis the maximum temperature induced in Aluminum Alloy is more in circular and rectangular fin but the minimum temperature induced is less in Grey Cast Iron for the circular fin. The heat flux is less in aluminum alloy and whereas grey cast is more.

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Hence Aluminum Alloy is the best

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