Design and Thermal analysis of fin with different geometries of engines

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***Abstract*— In Thermodynamic, Heat engine could be a system which converts thermal or heat energy into mechanical work. Similarly, we have various systems operating on high temperature and very high thermal stresses and it is essential to cool them to desired temperature. Two techniques are used for cooling purpose, either water cooling or air cooling method. According to the requirements and working conditions any of this method is utilised. Considering this factor that either of the method has its own drawbacks at many condition we tried to consider replacement of water cooled system with modified air cooling system(fins) with the example of heat engine.**

An air cool engine block has extended outer surface on its block(Fins) which releases heat into the atmosphere by forced convection. This work deals with modification in the design of fins with the use of different materials. And the purpose of using fins is to utilise atmospheric air and to obtain desired outputs which are good enough to replace water cool system.

A model of I.C. engine cylinder and modified fin structure over it is created Solidworks and thermal Analysis is performed in ANSYS.

***Keywords*— *Fins, Heat engine, Heat transfer, thermal analysis* .**

I. INTRODUCTION

With the advancement in research and inventios, many applications in thermodynamics are coming up with the different conditions and requirements of cooling.for eg. In I.c.engine there are water cooled and air cooled type engines.. Nowadays mostly Air cooled are replaced by water cooled engines those are comparetively more efficient in dissipating heat co, though in 2- wheeler and some other applications only Air cooling system is used. In Air cooled engines extended surface i.e. fins are facilitated covering outside of cylinder head which results in increase in area on which air can act. Fins are extended surface for heat transfer and are employed to increase heat transfer. In IC engines, heat produced during combustion should be maintained as thermal efficiency at highest level. When surfaces extension is done on fins it increases heat dissipation capacity of engine. Various types of extensions can be provided on fins, like Rectangular extension, Circular extension, Triangular extension and trapezium extension.

Golnoosh Mostafavi [1] investigated the natural convection heat transfer of heat sink with vertically placed rectangular interrupted fin. J.Ajay Paul [2] Performed a study of extended fins in IC engine model and found that thicker fins provide better efficiency for high speed vehicles. N. Nagarani[3] They analyzed the rate of heat transfer and efficiency of fins for various environmental conditions. Shivanand karve [4] he examine the heat transfer by considering of engine parameters and applicable conditions and results are obtained by numerical method. Sable, M.J. et. al.[5] Studied for natural convection of vertical heated based plate with v- type arranged fins in ambient atmosphere.

To decrease the cost, weight and complexity in designing we used air cooled system over liquid cooled system. We modified various various conditions such as heat transfer coefficient and surrounding air velocity for finding optimum solution in air cooled systems. We compared heat transfer conditions of actual air cooled engines with other research work models. We understood effect of change in parameters on fins with help of thermal analysis by modifying the structure of fins to find the optimum result.

II. DESIGN OF FINS

Fins are surfaces which is extended on engine cylinder for increasing heat transfer rate. As Engines heats up during operation and over heating causes engine seizure. Hence for prevantion, fins are provided on engine cylinder. Basically fins increases heat transfer rate by creating more region available for natural convection.

Fin Material we used are Copper Alloy, Magnesium Alloy, Stainless Steel and Alluminium Alloy.
This material properties are as follows,

Material	Melting point (F)	Density (kg/m^3)x10^3	Thermal conductivity (w/mK)	Thermal expansion (in/inFx10^-6)
Copper alloy	1084	8.96	385	1.7
Magnesium alloy	1105	1.8	156	2.6
Stainless steel	1454	8.1	36.7	2.07
Aluminium alloy	1240	2.770	167	2.3

III. THERMAL ANALYSIS OF FINS

Thermal analysis is performed in Ansys by which we got experimental values. Here we calculate Heat distribution and Heat flux of engine fins. Its results are given below,

Material 1 :- Copper Alloy

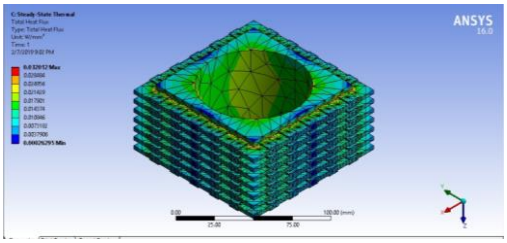

fig 2.1 Heat Flux

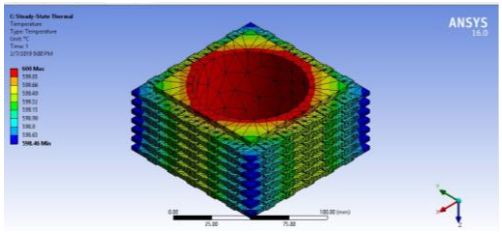

fig 1.2 Temperature Distribution

Result

TEMPERATURE DISTRIBUTION (degree Celcius)	HEAT FLUX (W/m^2)
598.46	32012

Material 2 :- Magnesium Alloy

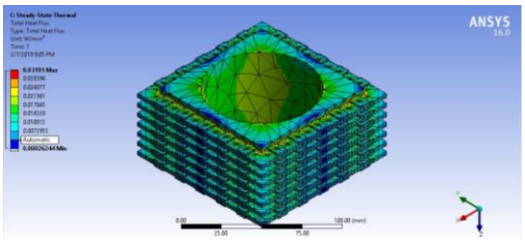

fig 2.1 Temperature Distribution

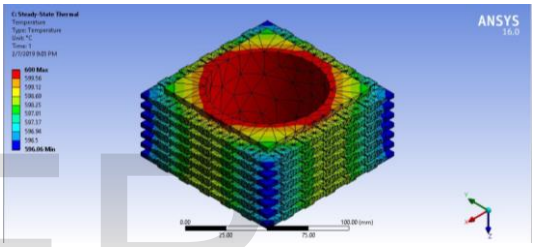

fig 2.2 Heat Flux

Result

TEMPERATURE DISTRIBUTION (degree Celcius)	HEAT FLUX (W/m^2)
596.06	31910

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Material 3 :- Stainless Steel

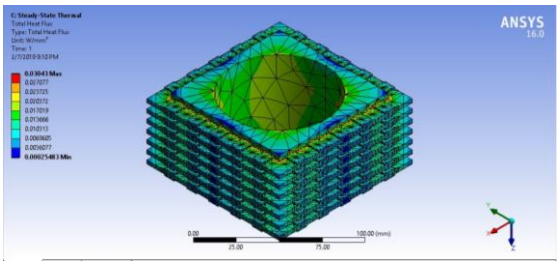

fig 3.1 Temperature Distribution

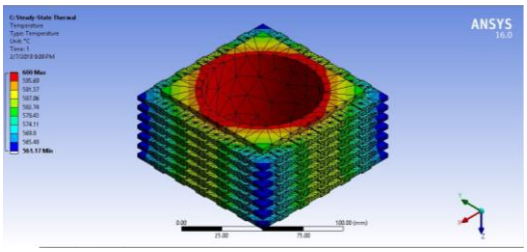

fig 3.2 Heat Flux

Result

TEMPERATURE DISTRIBUTION (degree Celcius)	HEAT FLUX (W/m^2)
561.17	30430

Material 4 :- Aluminium Alloy

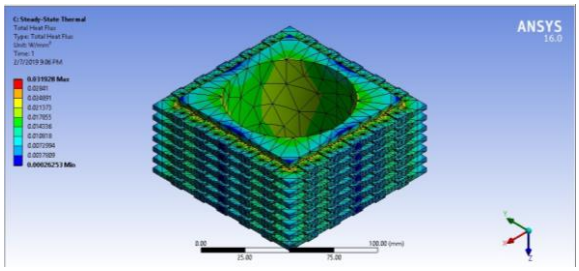

fig 4.1 Temperature Distribution

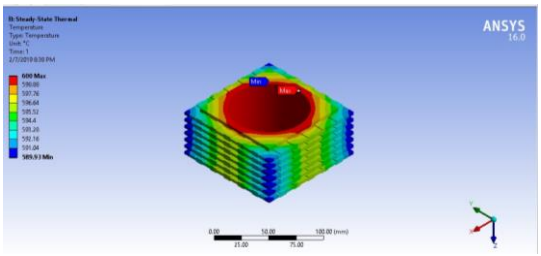

fig 4.2 Heat Flux

Result

TEMPERATURE DISTRIBUTION (degree Celcius)	HEAT FLUX (W/m^2)
589.31	31928

IV. Results and Conclusions

A parametric experimental model of IC Engine, cylinder block with material designs of fins placed over it was taken into consideration. For performing thermal Analysis. Comparison of thermal analysis of regular fins without modification and result of thermal analysis of fins with modified design adding extra surface on both sides of fins The variation in change in area is subjected to required conditions and desired outputs.

The existing fin design gives 25107 w/m^2 and modified fin design gives 31928 w/m^2 which means increase in surface area by modification of fin design increase heat flux upto 27%.

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