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Performance Optimization of a Fin Geometry Used In an IC Engine

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ABSTRACT:

In this design the single cylinder air cooled engine to be analysis with different profile fins such as triangular, rectangular, elliptical, trapezoidal profile and compare to the existing profile of engine. Comparative thermal tests will be carried out using Aluminum two stroke S.I engine made with triangular film, with rectangular elliptical, trapezoidal profile without varying the material properties of engine block. A cylinder with a single film mounted on it to be tested. The numerical simulation of the same setup was done with ansys. The main aim of this project is to study various researches done in the past to improve heat transfer rate of cooling fins by changing cylinder block fin profile. In this project we done the modeling in catiav5 and analysis is done in ansys 14.5

INTRODUCTION

We know that in case of Internal Combustion engines, combustion of air and fuel takes place inside the engine cylinder and hot gases are generated. The temperature of gases will be around 2300-2500°C. This is a very high temperature and may result into burning of oil film between the moving parts and may result it seizing or welding of same. So, this temperature must be reduced to about 150-200°C at which the engine will work most efficiently. Too much cooling is also not desirable since it reduces the thermal efficiency. So, the object of cooling system is to keep the engine running at its most efficient operating temperature. It is to be noted that the engine is quite inefficient when it is cold and hence the cooling system is designed in such a way that it prevents cooling when the engine is warming up and till it attains to maximum efficient operating temperature, then it starts cooling. To avoid overheating, and the consequent ill effects, the heat transferred to an engine component (after a certain level) must be removed as quickly as possible and be conveyed to the atmosphere. It will be proper to say the cooling system as a temperature regulation system. It should be remembered that abstraction of heat from the working medium by way of cooling the engine components is a direct thermodynamic loss.

The Function of Fins

Increase heat transfer rate for a fixed surface temperature, or Lower surface temperature for a fixed heat transfer rate Newton's law of cooling.

$$\dot{Q}_s = aS_s (T_s - T_\infty)$$

Extending" $S_s$increases Q_s&for a fixed T_s

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$$T_s = T_\infty + \frac{\dot{Q}_s}{aS_s}$$

Examples of fins:

• Thin rods on the condenser in back of refrigerator.
• Honeycomb surface of a car radiator.
• Corrugated surface of a motorcycle engine.
• Coolers of PC boards.

LITERATURE REVIEW

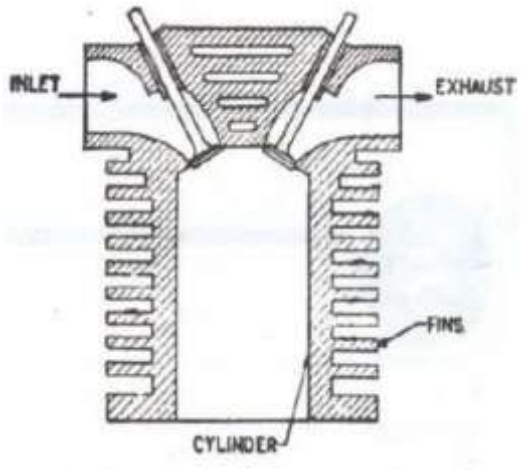
In the research of J. Ajay Paul and Sagar Chavan Vijay Parametric Study of Extended Fins in the Optimization of Internal Combustion Engine they found that for high speed vehicles Engines thicker fins provide better efficiency. When fin thickness increases, the gap between the fins reduces that resulted in swirls being created which helped in increasing the heat transfer. Large number of fins with less thickness can be preferred in high speed vehicles than thick fins with less numbers as it helps inducing greater turbulence.

Author plotted the experimental results, it shows the variation of the heat Transfer with respect to velocity. This was used to predict the behavior or wind flow and analysis. At zero velocity it is seen that the heat transfer from the 4mm and 6mm fins are the same. When the velocity is increased it can be seen that the heat transfer is increased with due to forced convection and also due to the swirl generated between two fins which induces turbulences and hence higher heat transfer. For a larger fin thickness, the corresponding fin spacing is comparatively small. As a consequence, the generated swirled flow may mingle with the main flow and result in a higher heat transfer performance.

METHODOLOGY

A transient numerical analysis can be carried out with wall cylinder temperature of 423 K initially and the heat release from the cylinder can be analyzed for various wind velocity. The heat release from the cylinder which is calculated numerically can be validated with the experimental results. In the present paper an effort is made to study the effect of fin parameters on fin array performance which includes variation in pitch and fin. In addition, the current paper considers the effect of air flow velocity on different fin pitch. With the help of the available numerical results, the design of the internal combustion engine cooling fins can be altered for better efficiency.

NATURAL AIR COOLING:



In normal cause, larger parts of an engine remain exposed to the atmospheric air. When the vehicles run, the air at certain relative velocity impinges upon the engine, and sweeps away its heat. The heat carried-away by the air is due to natural convection, therefore this method is known as natural air-cooling

FINS: A fin is a surface that extends from an object to increase the rate of heat transfer to or

from the environment by increasing convection. The amount of conduction, convection, radiation of an object determines the amount of heat it transfers. Increasing the temperature difference between the object and the environment, increasing the convection heat transfer coefficient, or increasing the surface area of the object increases the heat transfer. Sometimes it is not economical or it is not feasible to change the first two options.

METHODS OF COOLING

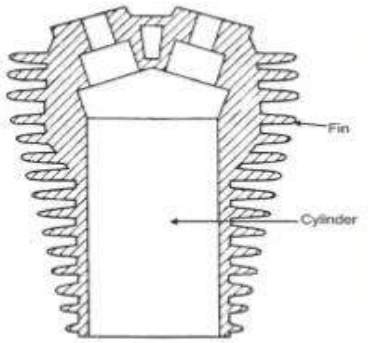
In order to cool the engine a cooling medium is required .This can be either air or a liquid. Accordingly there are two types of system in general use for cooling the IC engines.

They are

- Air cooling or direct cooling,
- Water cooling or indirect cooling

AIR COOLING SYSTEM

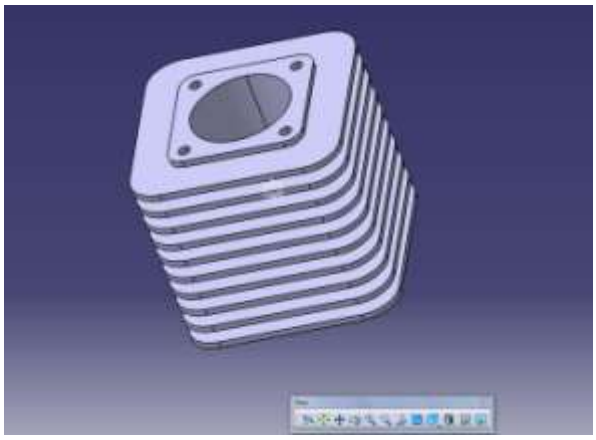
In this type of cooling system which is conducted to the parts of the engine, is radiated and conducted away by the stream of air, which is obtained from the atmosphere. In order to have efficient cooling by means of air, providing cooling fins around the cylinder and cylinder head increase the contact area as shown in below

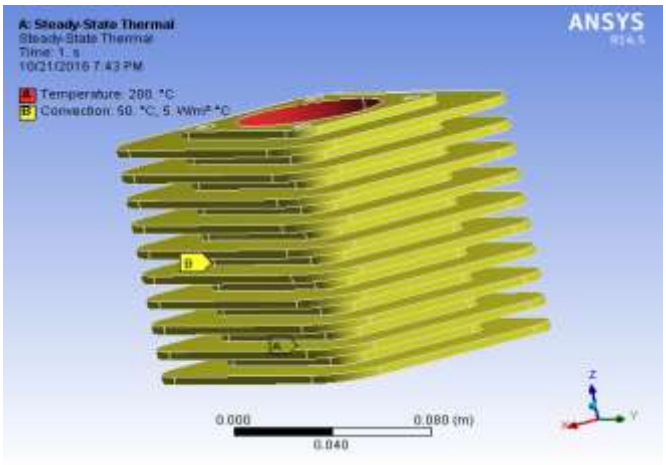


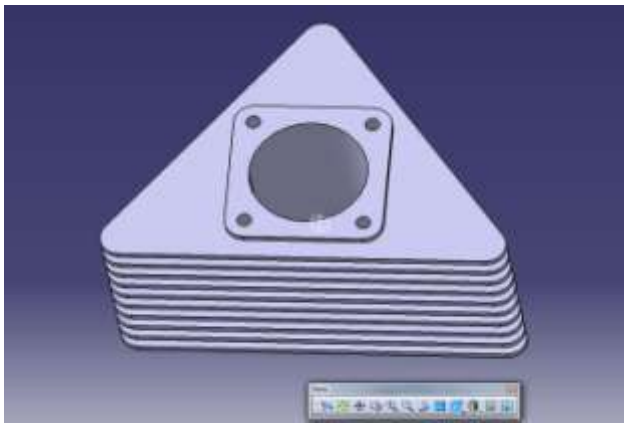
Types of Water Cooling System

1) Thermo Siphon System
2) Pump Circulation System
(a) Radiator,
(b) Thermostat valve,
(c) Water pump,
(d) Fan,
(e) Water Jackets, and
(f) Antifreeze mixtures

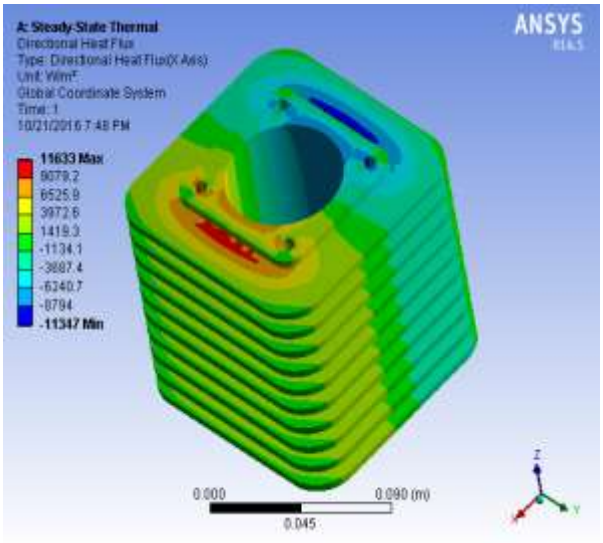
DESIGN OF THE MODELS



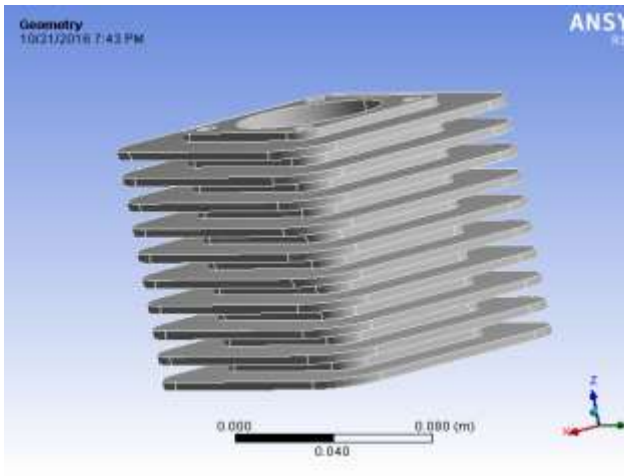




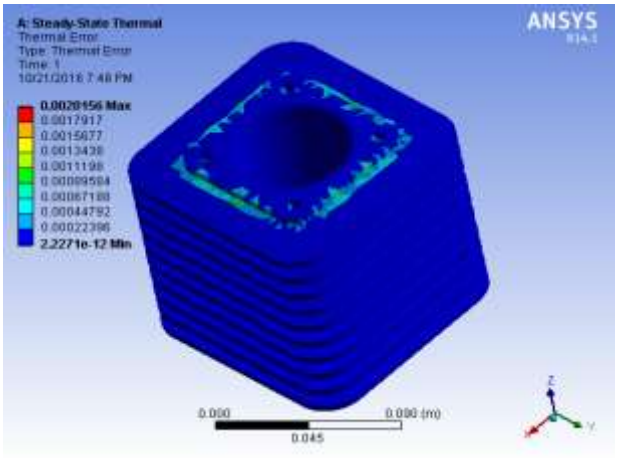
DIRECTIONAL HEAT FLUX



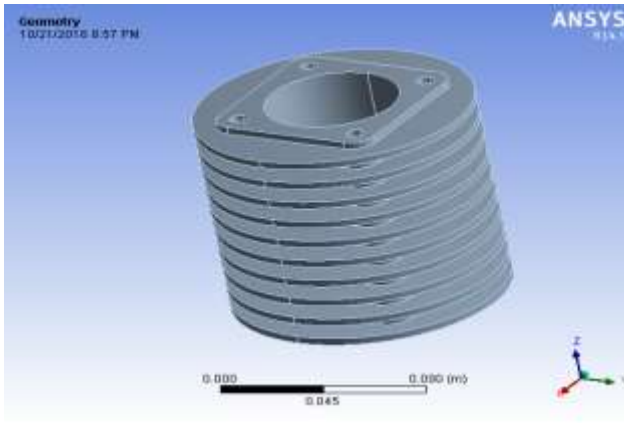
Model (A4)
Geometry



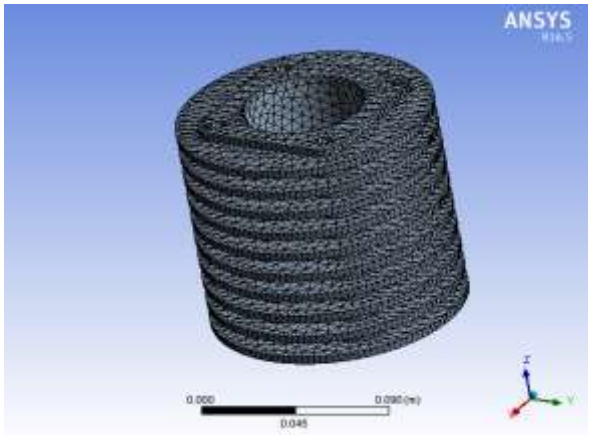
THERMAL ERRROR



IMPORTED FILE



MESHED FILE



THERMAL ANALYSIS OF ELLIPITICAL FIN FOR CYLINDRICAL BLOCK USING AL 5052

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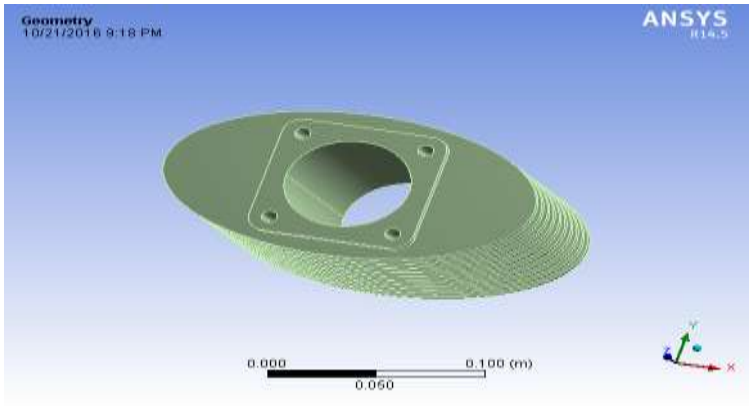
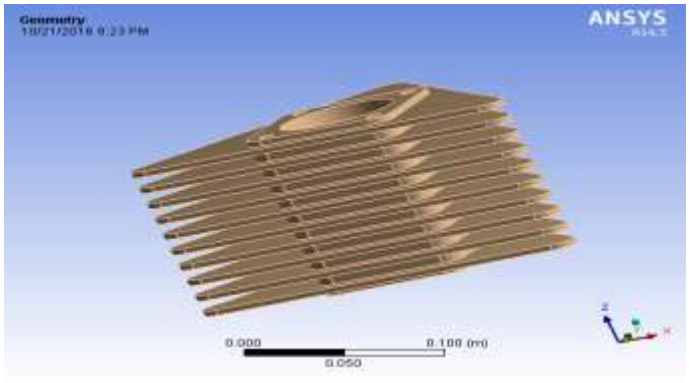


THERMAL ANALYSIS OF TRIANGULAR FIN FOR CYLINDRICAL BLOCK USING AL 5052

IMPORTED FILE



TABLES

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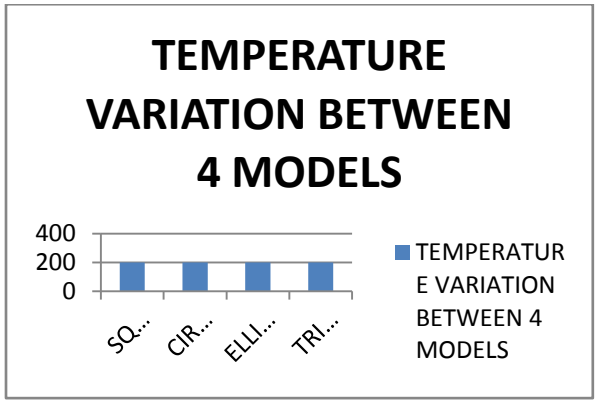
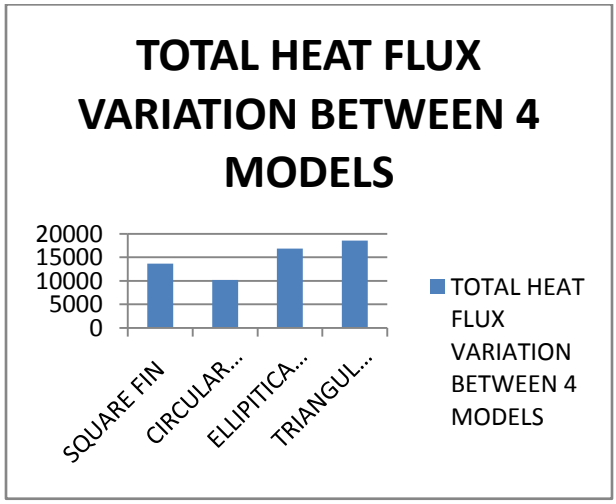
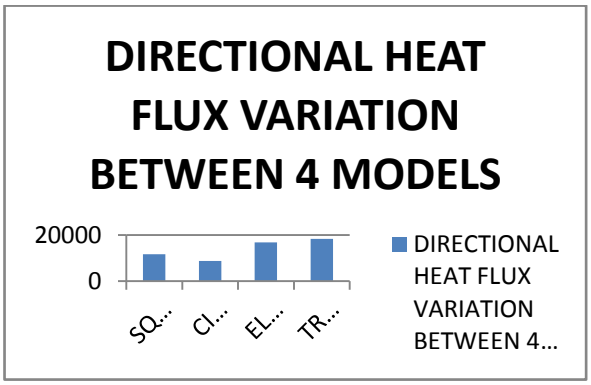
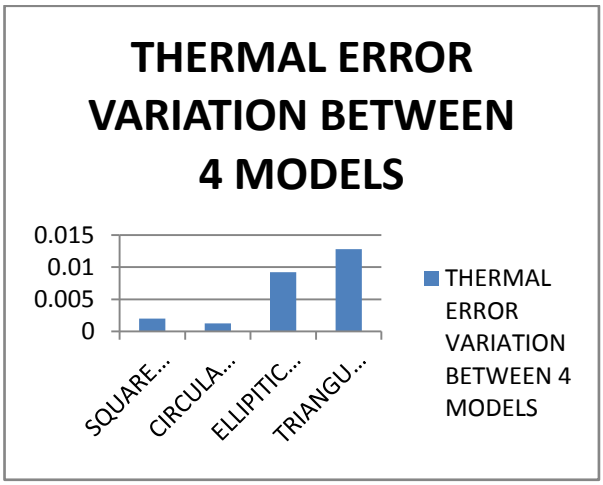
		SQUARE FIN	CIRCULAR FIN	ELLIPITICAL FIN	TRIANGULAR FIN
TEMPERATURE	MIN	197.59	297.93	196.23	194.24
	MAX	200	200	200	200
TOTAL HEAT FLUX	MIN	148.14	93.634	141.77	398.18
	MAX	13643	10197	16865	18542
DIRECTIONAL HEAT FLUX	MIN	-11347	-9136.2	-16366	-17644
	MAX	11633	8789.4	16848	18356
THERMAL ERROR	MIN	2.2271E-12	7.7734E-11	5.5449E-11	3.9002E-10
	MAX	0.0020156	0.0012344	0.0092055	0.012803

GRAPHS









CONCLUSION

In this thesis we are going to design the single cylinder air cooled engine with different profile fins such as triangular, rectangular, elliptical, circular profile and compare of the results is done. Thermal analysis is carried out using Aluminum 5052 for two stroke S.I engine made with triangular film, with rectangular elliptical, circular of engine block. The main aim of this project is to study various researches done in the past to improve heat transfer rate of cooling fins by changing cylinder block fin profile. In this project we done the modeling in catiav5 and analysis is done in ansys 14.5. All the results are tabulated in a tabular form and compared in the

graphical representation. As from the results while we compare the temperature results, the data obtained is same for all the profiles. While if we see the results of total heat flux, the cylindrical fin is giving the best efficiency and the cooling is more for the cylindrical fin profile. As now if we observe the results of directional heat flux, even here the same has been repeated as the circular profile has the best results in the cooling system, as finally if we see the error percentage of thermal error obtained for the object, here the same repeated as the circular profile fin has got the best results than other profiles. So from all the results obtained, here we can conclude that the circular profiled fin with Al 5052 material gives the better efficiency and better life with better cooling efficiency for the single cylindrical two stroke S.I engine.

REFERENCES:

[1] Ashok Tukaram Pise, Umesh Vandeorao Awasarmol., "Investigation of Enhancement of Natural Convection Heat Transfer From Engine Cylinder WithPermeable Fins",(IJMET)No.1,July-Aug 2010, pp.238-237.

[2] J.Ajay Paul,Sagar Chavan Vijay, U.Magarajan & R.Thundil Karuppa Raj., "Experimental And Parametric Study of Extended Fins in The Optimization of Internal Combustion Engine Cooling Using CFD",(IJARME) ISSN: 2231 –5950, Volume-2, Issue-1, 2012.

[3] Arvind S.Sorathiya, Ashishkumar N. Parmar, Pravin P. Rathod., "Review Paper on Effect of Cylinder Block Fin Geometry on Heat Transfer Rate of Air-Cooled 4S SI Engine",(IJRDET)(ISSN 2347 -6435 (Online) Volume 2, Issue 1, January 2014).

[4] Magarajan U., Thundil karuppa Raj R. and Elango T., "Numerical Study on Heat Transfer of Internal Combustion Engine Cooling by Extended Fins Using CFD",(ISCARJRS) Vol. 1(6), 32-37, June (2012).

[5] S.S.Chandrakant, et al. (2013). "Numerical and Experimental Analysis of Heat Transfer through Various Types of Fin Profiles by Forced Convection." International Journal of Engineering Research & Technology (IJERT) 2(7).

[6] A.R. Kumar, et al. (2013). "Heat Transfer Analysis in the Cylinder Head of a Four-Stroke Si Engine." International Journal of Engineering Research & Technology (IJERT) 2(5).

[7] R.P. Patil and P. H. M. Dange (2013). "Experimental and Computational Fluid Dynamics Heat Transfer Analysis on Elliptical Fin by Forced Convection." International Journal of Engineering Research & Technology (IJERT) 2(8).

[8] N.P.R. Rao and T. V. Vardhan (2013). "Thermal Analysis of Engine Cylinder Fins By Varying Its Geometry and Material." International Journal of Engineering 2(8).

[9] S. Wange and R. Metkar (2013). "Computational Analysis of Inverted Notched Fin Arrays Dissipating Heat by Natural Convection." International Journal of Engineering and Innovative Technology (IJEIT) 2(11).