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ANALYSIS OF IC ENGINE AIR COOLING OF VARYING GEOMETRY AND MATERIAL

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ABSTRACT

The fins are generally extended surfaces of projections of materials on the system. The fins are generally used to increase the heat transfer rate from the system to the surroundings by increasing the heat transfer area. The heat transfer rate depends upon the velocity of the vehicle and fin geometry and temperature of cylinder many experimental methods are available in literature to analyze the effect of these factors on the heat transfer rate. The aim of the project is increase heat transfer rate from extended fins modifying geometry of circular fins with curvature shape and Aluminium alloy 6061.The parametric model is created in 3D modeling software SOLIDWORKS 2012. Heat transfer simulation will be conducted using ANSYS Workbench 14.0 software.

KEYWORDS: Fins,Heat Transfer Rate,Circular Fins, Curvature shape, Aluminium alloy 6061.

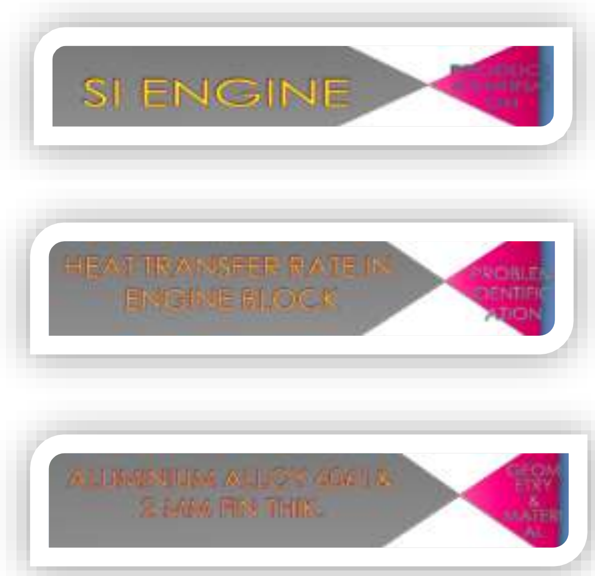
INTRODUCTION

The internal combustion engine is an engine in which the combustion of a fuel (normally a fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber. In an internal combustion engine, the expansion of the high-temperature and -pressure gases produced by combustion applies direct force to some component of the engine, such as pistons, turbine blades, or a nozzle. This force moves the component over a distance, generating useful mechanical energy. Air cooled engines are phased out and are replaced by water cooled engines which are more efficient, but almost all two wheelers uses Air cooled engines, because Air-cooled engines are only option due to some advantages like lighter weight and lesser space requirement. The heat generated during combustion in IC engine should be maintained at higher level to increase thermal efficiency, but to prevent the thermal damage some heat should remove from the engine.

Extended surfaces (Fins) are one of the heat exchanging devices that are employed to increase the heat transfer on engine cylinder. It is necessary to analyze the heat transfer rate of the fins. Experiments has been made to increase fin efficiency by Changing fin material and fin geometry.

METHODOLOGY

The following method's were conducted for this project.They were:



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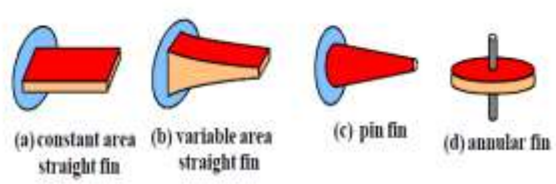
PROBLEM IDENTIFICATION

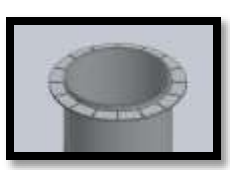
Internal Combustion engines, combustion of air and fuel takes place inside the engine cylinder and hot gases are generated. The temperature of gases will be around 2300-2500 ^{0}C. This is a very high temperature and may result into burning of oil film between the moving parts and may result into seizing or welding of the same. So, this temperature must be reduced to about 150-200 ^{0}C at which the engine will work most efficiently.

Internal combustion engines at best can transform about 25 to 35 % of the chemical energy in the fuel in to mechanical energy. About 35 % of the heat generated is lost in to the surroundings of combustion space, remainder being dissipated through exhaust and radiation from the engine.

SELECTION OF GEOMETRY AND MATERIAL

Geometry selection





(e) Annula

In this thesis, we selected annular fin with curvature shape by the use of literature survey. The present thickness of fin is 3mm. In this thesis, thickness is reduced to 2mm and radius of curvature is 0.5mm.

Material selection

Present used material for cylinder fin body is Cast Iron. In this thesis it is replaced with Aluminum Alloy 6061.Thermal analysis is done on the cylinder body by varying the material to determine the heat transfer rate.

MATERIAL PROPERITIES

Table 1.Material properities of Cast Iron

Elastic Modulus	66178.1N/mm^2
Poisson's Ratio	0.27
Thermal Expansions Co-efficient	1.2x10^{-5}/K
Thermal Conductivity	45w/mk
Specifis Heat	510J/kg k

Table 2.Material properities of Aluminium Alloy 6061

Elastic Modulus	69000 N/mm^2
Poisson's Ratio	0.33
Thermal Expansions Co-efficient	2.4x10^{-5}/K
Thermal Conductivity	170 w/mk
Specifis Heat	1300 J/kg k

Aluminium Alloy 6061 is good thermal conductivity than Cast Iron.Also it is good corrosion resistance and weight less.

3D MODELLING

Existing Cylinder Block 3D Model

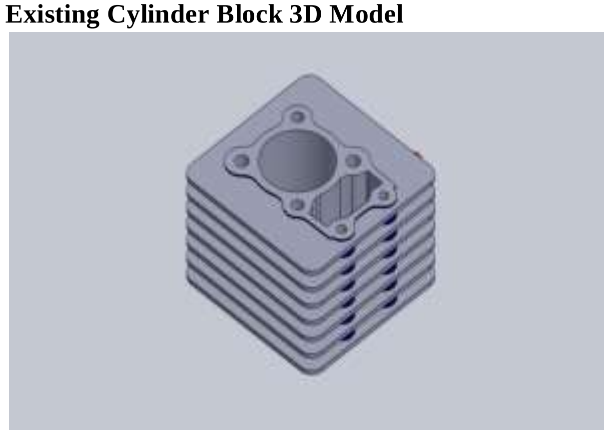


Fig:1. Rectangular with curves at corner and

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SPECIFICATION	EXISTING MODEL	NEW MODEL
Engine Model	Bajaj CT 100	Bajaj CT 100
Engine Type	Four-Stroke, Air Cooled	Four-Stroke, Air Cooled
Bore X Stroke	76 X 96 mm	76 X 96 mm
Fuel System	Carburetor	Carburetor
Displacement Volumes	100 c.c	100 c.c
Cylinder Block Material	Cast Iron	Aluminium Alloy 6061
Fin Shape	Rectangular with curves at corner	Circular Fins with Curvature Shape
Fin Thickness	3 mm	2 mm
Pitch	10 mm	10 mm

Fin thickness 3 mm

Modification of Cylinder Block

ANALYSIS BY ANSYS

The Analysis is carried out by ANSYS WORKBENCH 14.0 optimize which material will maximum heat transfer rate to the surrounding by the following steps.

1.Model Creation

2.Mesh Generation

3.Applying boundary conditions

4.Initialization

5.Solution

ANALYSIS DIAGRAM

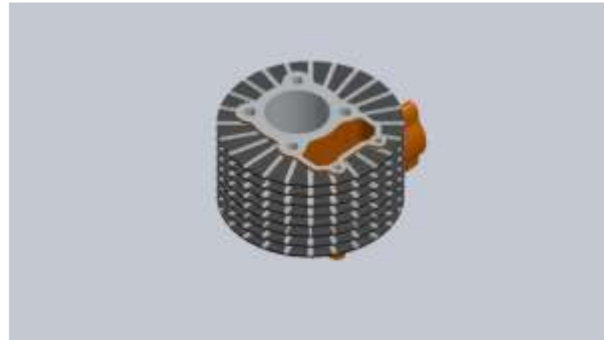

Fig:2. Circular Fins with Curvature Shape and Fin thickness 2 mm

SPECIFICATION OF ENGINE

Table 3.Existing and New model

1.Model Creation

The Model is created by SolidWorks and it is imported in ANSYS Workbench 14.0.

2.Mesh Generation

After importing the model to the ANSYS, fine meshing is done.

3.Applying boundary conditions

After fine meshing is done the boundary conditions are applyied to the component

4.Initialization

The solver functioning areas its initialization values in constant working temperature at max 200 °C and with stagnant air.

5.Solution

After give the temperature value and boundary condition we can get the result by the solution

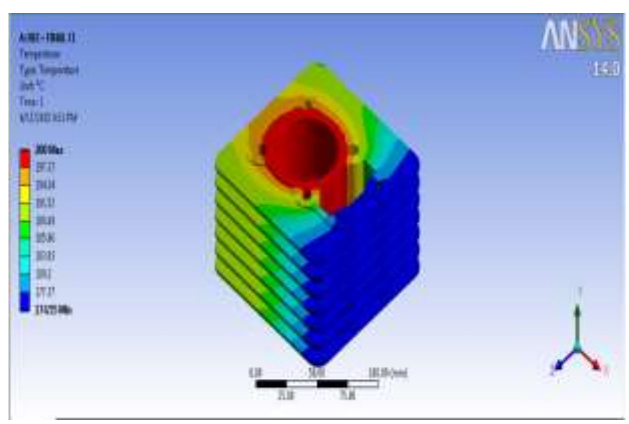

Fig:3.Rectangular with curves at corner and Cast Iron Material

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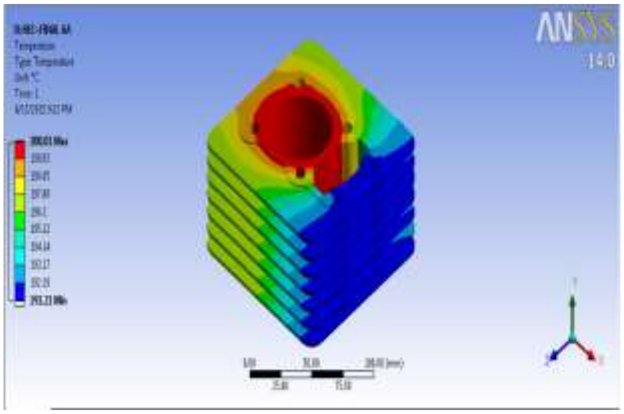

Fig:4.Rectangular with curves at corner and Aluminium Alloy 6061 Material

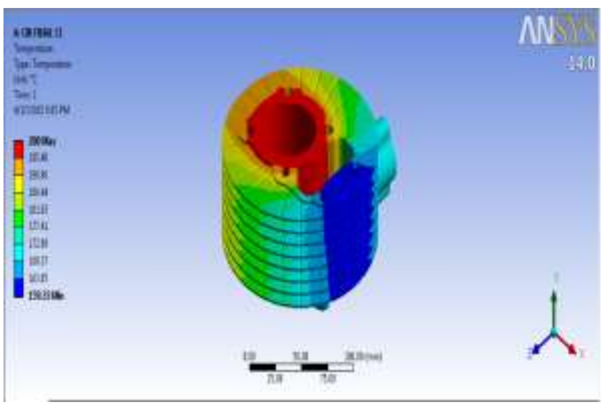

Fig:5.Circular with Curvature shape and Cast Iron Material

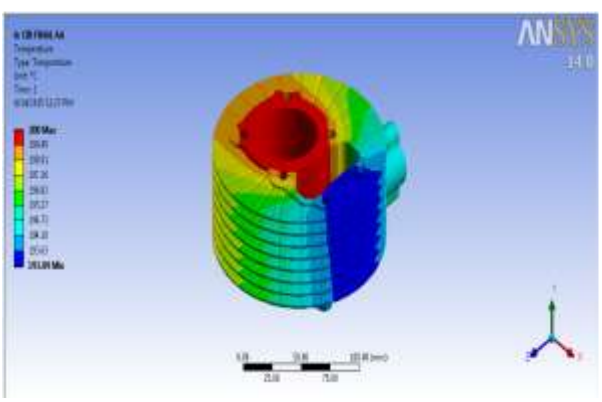

Fig:6.Circular with Curvature shape and Aluminium Alloy 6061 Material

RESULT AND DISCUSSION

Rectangular Fins

Aluminium Alloy 6061 material is high heat transfer rate in Rectangular with Curves at Corner than Cast Iron Material in 3 mm thickness of fins

Table 4.Temperature Difference in two materials with Rectangular with curves at corner

	Temperature(^{0}C)	
	Cast Iron	Alluminium Alloy 6061
Rectangular with curves at corner,3 mm fin thickness	174.55	191.21

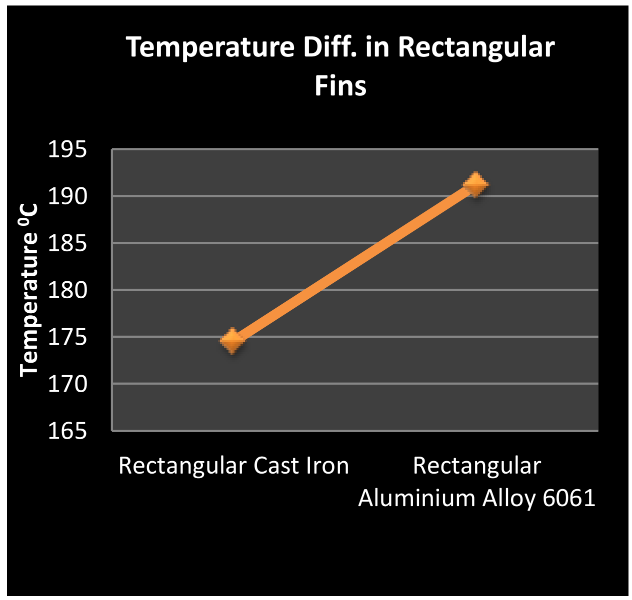

Fig:7.Temperature Difference in Rectangular with curves at corner Fins

Circular Fins

Aluminium Alloy 6061 material is high heat transfer rate in Circular with Curvature shape Corner than Cast Iron Material in 3 mm thickness of fins

Table 5.Temperature Difference in two materials with Circular with Curvature shape

	Temperature(^{0}C)	
	Cast Iron	Alluminium Alloy 6061
Circular with Curvature shape ,2 mm fin thickness	159.33	193.09

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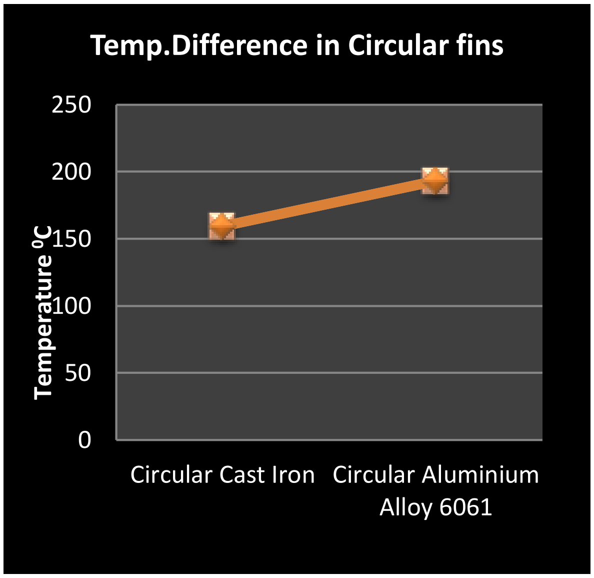

Fig:8.Temperature Difference in Circular with Curvature shapeFins

Comparision of Two Material and Two Model

Comparing Two Material and Two Model,Aluminium Alloy 6061 Material and Circular with Curvature 2 mm thickness fins gives high heat transfer rate than Rectangular with curves at corner 3 mm thickness fins with Cast Iron Material

Table 6.Comparision of Two Materials

<table>
<tr><td rowspan="2"></td><td colspan="2">Temperature(^{0}C)</td></tr>
<tr><td>Rectangular Aluminium Alloy 6061</td><td>Circular Aluminium Alloy 6061</td></tr>
<tr><td>Rectangular with curves at corner,3 mm fin thickness</td><td rowspan="2">191.21</td><td rowspan="2">193.09</td></tr>
<tr><td>Circular with Curvature shape ,2 mm fin thickness</td></tr>
</table>

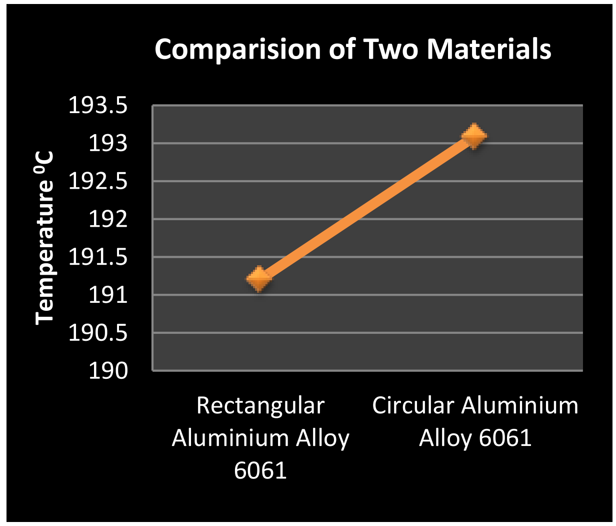

Fig:9.Comparision of Two Materials

WEIGHT OF THE CYLINDER BLOCK

	Weight of the Cylinder Block(Kgs)	
	Cast Iron	Aluminium Alloy 6061
Rectangular with curves at corner,3 mm fin thickness	2.4	1.3
Circular with Curvature shape ,2 mm fin thickness	3.1	**1.2**

CONCLUSION

The following conclusions can be drawn from the present work:

In this thesis, a cylinder fin body for Bajaj CT 100cc motorcycle is modelled using parametric software SolidWorks 2012. The thickness of the original model is 3mm, in this thesis it is reduced to 2mm.

The fin shape is Rectangular with curves at corner,in this thesis Circular with curvature fin and radius of curvature is 0.5 mm.

Present used material for fin body is Cast Iron. In this thesis, thermal analysis is done for all the two materials Cast Iron and Aluminum alloy 6061. The material for the original model is changed by taking the consideration of their thermal conductivity and design of fins.

By observing the thermal analysis results, Aluminum

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alloy its weight is less, so using Aluminum alloy 6061 is better heat transfer material . And also by reducing the thickness of the fin, the heat transfer rate is increased.

REFERENCES

[1] Fernando Illan and M. Alarcon (2002). "Optimization of Annular Cylindrical and Spherical Fins in an Internal Combustion Engine under Realistic Conditions." Journal of Thermal Science and Engineering Applications 2.

[2] A. Bassam and K. A. Hijleh (2003). "Enhanced Forced Convection Heat Transfer from a Cylinder Using Permeable Fins." ASME Journal of Heat Transfer 125.

[3] D.G.Kumbhar, et al. (2009). 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.

[4] A. T. Pise and U. V. Awasarmol (2010). "Investigation of Enhancement of Natural Convection Heat Transfer from Engine Cylinder with Permeable Fins." International Journal of Mechanical Engineering & Technology (IJMET) 1(1): 238-247.

[5] P. Agarwal, et al. (2011). Heat Transfer Simulation by CFD from Fins of an Air Cooled Motorcycle Engine under Varying Climatic Conditions. Proceedings of the World Congress on Engineering.

[6] G.Raju, et al. (2012). "Optimal Design of an I.C. Engine Cylinder Fin Arrays Using a Binary Coded Genetic Algorithms." International Journal of Modern Engineering Research (IJMER) 2(6): 4516-4520.

[7] A. Mishra, et al. (2012). "Heat Transfer Augmentation of Air Cooled Internal Combustion Engine Using Fins through Numerical Techniques." Research Journal of Engineering Sciences ISSN 2278:9472.

[8] J.A. Paul, et al. (2012). "Experimental and Parametric Study of Extended Fins in the Optimization of Internal Combustion Engine Cooling Using CFD." International Journal of Applied Research in Mechanical Engineering (IJARME) 2(1).

[9] U. Magarajan, et al. (2012). "Numerical Study on Heat Transfer of Internal Combustion Engine Cooling by Extended Fins Using CFD." International Science Congress Association 1(6): 32-37.

[10] G. Babu and M. Lavakumar (2013). "Heat Transfer Analysis and Optimization of Engine Cylinder Fins of Varying Geometry and Material." IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) 7(4): 24-29.

[11] 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).

[12] 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).

[13] Manankumar B. Joshi (2014) "Heat Transfer Augmentation of Air Cooled 4 stroke SI Engine through Fins- A Review Paper" IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 2, Issue 1, Feb-Mar, 2014.

AUTHOR BIBLIOGRAPHY

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