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Design and Thermal Analysis on Cylinder Fin by Varying Its Geometry and Material

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ABSTRACT:

The main aim of the project is to analyze the thermal properties such as Heat flux, Thermal gradient by varying geometry, material and thickness of cylinder fins. Parametric models of cylinder fins have been developed to predict the transient thermal behavior.

The models are created by varying the geometry, rectangular, circular and curved shaped fins and also by varying thickness of the fins.

In this project we have taken rectangular, circular and curved fins of 3mm thickness, initially and reduce the thickness into 2.5mm and done analysis on the point " How the heat transfer changes by the reducing the thickness of the fin.

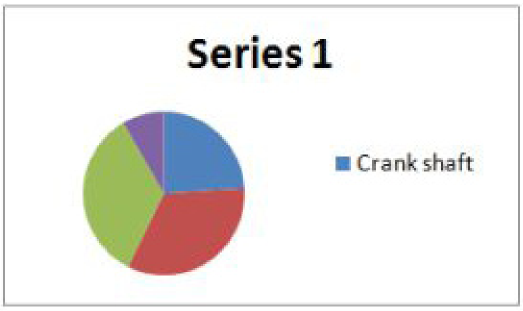
The 3D modeling software used is Pro/Engineer. The analysis is done using ANSYS. Presently Material used for manufacturing cylinder fin body is Aluminum Alloy 204 which has thermal conductivity of 110-150W/mk .

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 pushes the piston downwards with great force. Piston movement rotates the crank shaft, due to this vehicle moves.

NECESSITY OF COOLING :

All the heat produced by the combustion of fuel in the engine cylinders is not converted into useful power at the crankshaft. Typical distribution for the fuel energy is given below:



Most internal combustion engines are fluid cooled using either air (a gaseous fluid) or a liquid coolant run through a heat exchanger (radiator) cooled by air. Marine engines and some stationary engines have ready access to a large volume of water at a suitable temperature. The water may be used directly to cool the engine, but often has sediment, which can clog coolant passages, or chemicals, such as salt, that can chemically damage the engine. Thus, engine coolant may be run through a heat exchanger that is cooled by the body of water .

METHODS OF COOLING: :

1.AirCooling .
2.Water cooling.

AIR-COOLING:

Air cooling system is one of the cooling systems employed in cooling of I.c engines. Air is used as working medium in air cooling systems. In air cooling systems, fins or extended surfaces are used to dissipate the heat .when the air comes and contacts surface of the fin, heat transfer takes place form fin to air. The heat which is generated in the cylinder is dissipated in to the atmosphere by conduction mode through the fins or extended surfaces are used in this system, which are incorporated around cylinder. When the air comes into contact with the fins, the heat which is present in the fins gets dissipated into atmosphere by conduction. Normally if we take bigger unit fans are generally provided to circulate air around the fins.

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Water cooling system:

Water cooling system is the one which is generally adopted in the medium and heavy vehicles. The main medium used in this is water which is mainly employed for recirculation through the water jacket of the combustion chamber, cylinders. The water is circulated continuously with the help of a centrifugal water pump. After passing through the engine parts, water is sent into the radiator where its gets cooled with help of air produced by the fan which is installed inside the radiator .The drained cooled water is again ready for circulation.

AIM OF THE PROJECT:

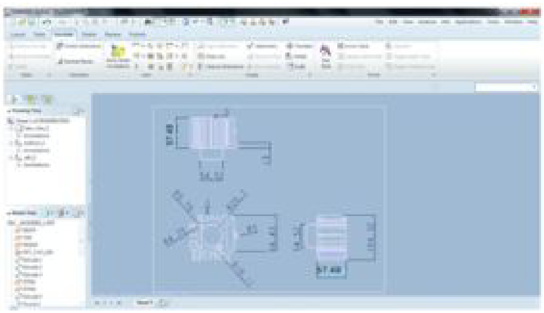
In this project we mainly stood on how to effectively design the fins of the cylinder and studied on the analysis of the behavior of the fins by changing the thickness of the fins, and geometry of the fin. Analysis is also done by varying the materials of fins. In this work we used material for cylinder fin body is Alum alloy 204 Our destination is to find the material which gives better heat discarding without damaging the performance of the engine; this is carried by changing the material and also thickness of the fin Geometry of fins – Rectangular, Circular and Curved Thickness of fins – 3mm and 2.5mm.

STEPS followed IN THE PROJECT:

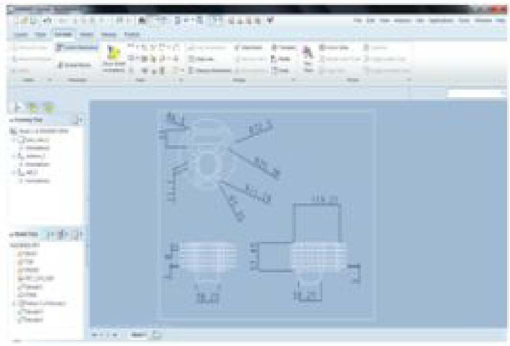
1.Modeling.

2.Transient Thermal Analysis.

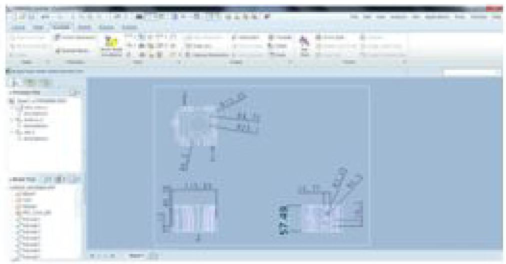
For modeling of the fin body, we have used Pro-Engineer which is parametric 3D modeling software. For analysis we have used ANSYS, which is FEA software.



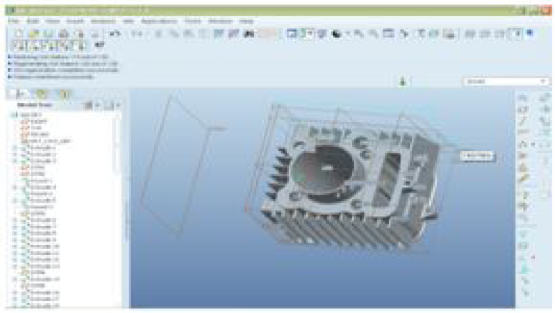
RECTANGULAR FIN



CIRCULAR FIN



CURVED FIN



PRO E MODEL OF CYLINDER FIN

Boundary conditions:

Define Loads -Apply Thermal-Temperature- on Area-Select inside area=555K

Convections – on Areas (select Remaining areas-Film Co-efficient – 25 W/mmK

Bulk Temperature – 313 K

3mm thickness

ALUMINUM ALLOY 204

MODEL IMPORTED FROM PRO/ENGINEER

MATERIAL PROPERTIES

Thermal Conductivity – 120 w/m k

Density – 2.8 g/c c

RESULTS

Nodal Temperature

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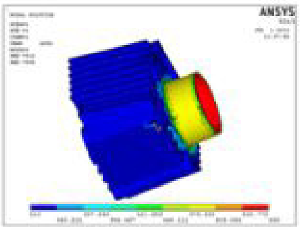
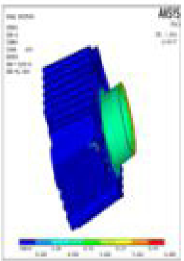
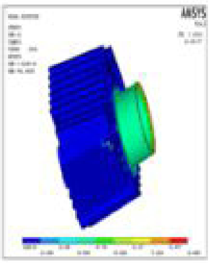






Thermal gradient &Thermal Flux

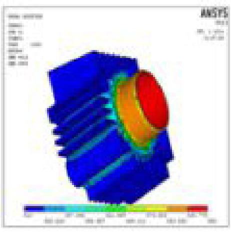
BERYLLIUM

MATERIAL PROPERTIES

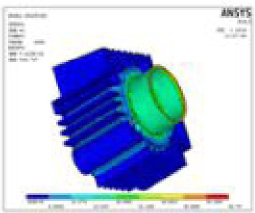
Thermal Conductivity – 216 w/m k
Density – 1.87 g/c c

RESULTS

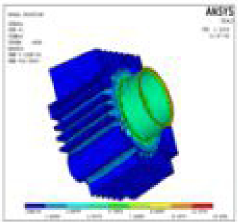
NODAL TEMPERATURE



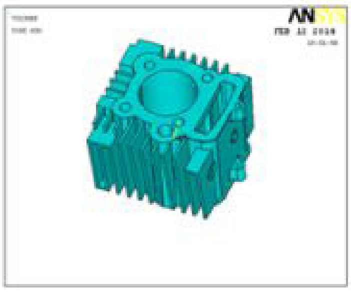
Thermal Gradient Sum



Thermal flux



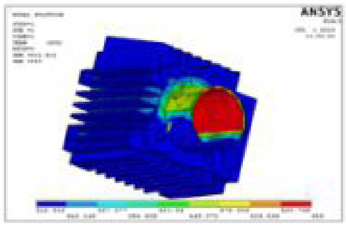
2.5mm THICKNESS
ALUMINUM ALLOY 204
MODEL IMPORTED FROM PRO/ENGINEER



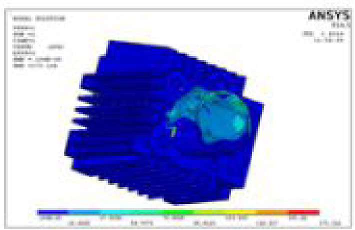
MATERIAL PROPERTIES

RESULTS

NODAL TEMPERATURE



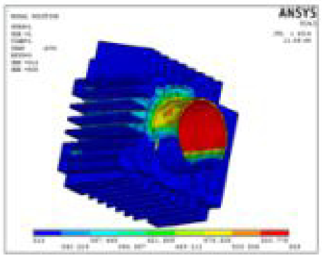
.THERMAL GRADIENT SUM



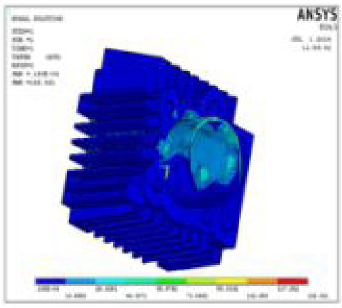
BERYLLIUM

RESULTS

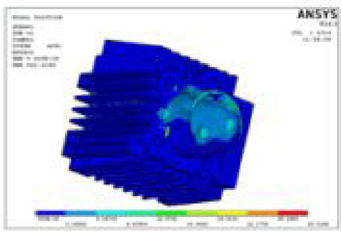
NODAL TEMPERATURE



THERMAL GRADIENT



THERMAL FLUX SUM



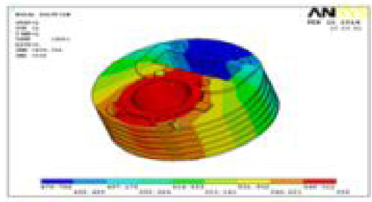
The maximum heat transfer rate is 25.5166 W/mm2 and minimum heat transfer rate is 3.16852 W/mm2.

CIRCULAR 3mm THICKNESS ALUMINUM ALLOY 204 PRO/E MODEL

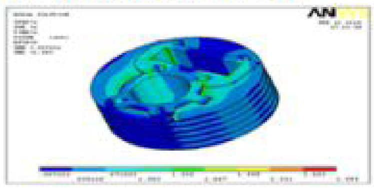
MESHED MODEL

RESULTS

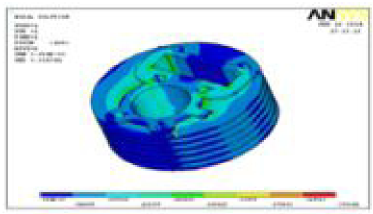
NODAL TEMPERATURE



THERMAL GRADIENT SUM



THERMAL FLUX SUM



.THERMAL FLUX SUM

The maximum heat transfer rate is 20.4146 W/mm2 and minimum heat transfer rate is 2.26829 W/mm2.

In the same manner we have done analysis on magnesium, beryllium, Al204, A7075 and got the following results

Results:

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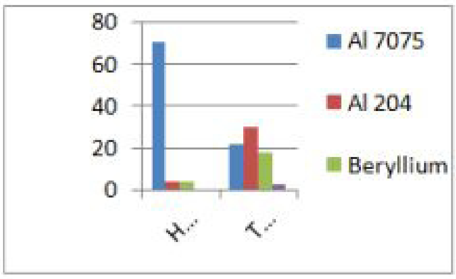
FIN THICKNESS	TYPE	MATERIALS	RESULTS		
			NODAL TEMPERATURE	THERMAL GRADIENT	HEAT FLUX
2.5mm	Rectangular	Al 7075	333	91.7453	3.76193
		Al 204	333	80.034	3.604
		beryllium	333	92.7891	3.84244
		magnesium	333	873671	1.433137
	Curved	Al 7075	333	32.16393	1.467841
		Al 204	333	33.354	1.40233
		beryllium	333	37.62442	1.454023
		magnesium	333	32.663	1.023381
	Circular	Al 7075	333	122.998	23.0087
		Al 204	333	119.122	20.4146
		beryllium	333	132.021	28.3166
		magnesium	333	130.767	22.3819
3mm	Rectangular	Al 7075	333	65.39	0.413
		Al 204	333	82.537	0.424496
		beryllium	333	83.96731	0.42278
		magnesium	333	.763	0.439337
	Curved	Al 7075	333	1.12	0.366
		Al 204	333	2.99	0.339343
		beryllium	333	1.04111	0.377373
		magnesium	333	1.1772	0.377
	Circular	Al 7075	333	70.7334	12.234
		Al 204	333	91.6603	10.9993
		beryllium	333	39.747	12.9054
		magnesium	333	73.234	11.9634

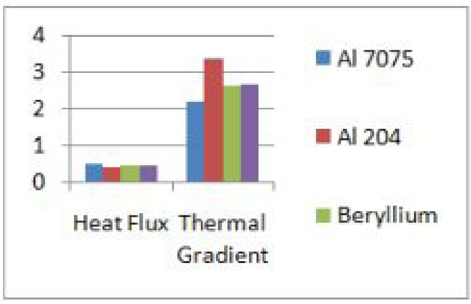
GRAPHICAL REPRESENTATION

Thickness of 2.5 mm

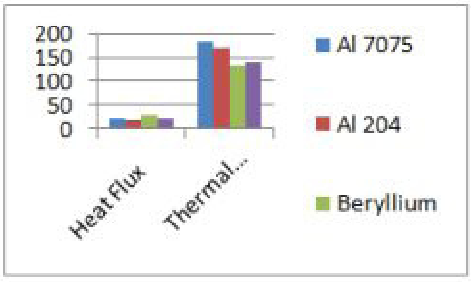
Curved



Circular



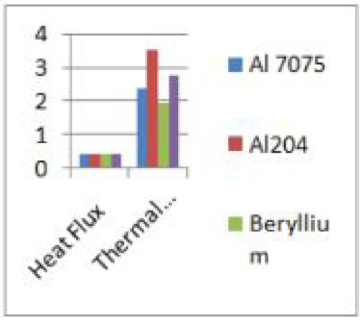
Rectangular



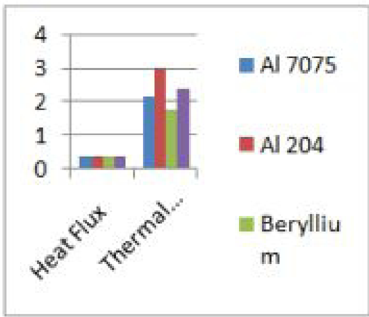
By observing the graphs, the heat flux is more for Beryllium and Aluminum alloy 7075.

Thickness of 3 mm

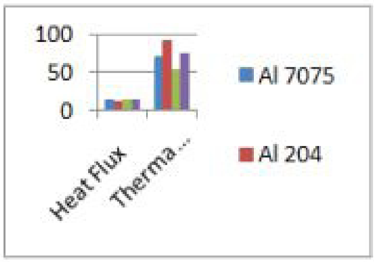
Curved



Circular



Rectangular



By observing the graphs, the heat flux is more for Beryllium .

CONCLUSION:

In this project we modeled, a cylinder fin body for a 150cc motorcycle making use of using Pro-e software. In this, we done analysis on the effect of reducing the thickness is changed by reducing the thickness of the fins. The thickness of the original model is 3 mm it has been reduced to 2.5 mm. By modifying shape of fins, the overall weight is reduced.

Present used material for fin body is Aluminum Alloy 204. In this project we also considered other materials which have more thermal conductivities than Aluminum Alloy 204. The materials are Aluminum alloy 7075, Magnesium Alloy and Beryllium. Thermal analysis is done on these materials. The material for the original model is changed by taking the consideration of their densities and thermal conductivity.By observing the thermal analysis results, we observed thermal flux is more for Beryllium and also by reducing the thickness of the fin to 2.5mm, heat transfer rate is increased. So by considering the above results, 2.5mm thickness rectangular fin made of beryllium metal is good.

FUTURE SCOPE:

The shape of the fin can be modified to improve the heat transfer rate and can be analyzed. So more experiments has to be done on curved fins.The use of Aluminum alloy 6061 as per the manufacturing aspect is to be considered. By changing the thickness of the fin, the total manufacturing cost is extra to prepare the new component.

REFERENCES:

1.Thermal Analysis of I C Engine cylinder fins array using CFD by Mr. Mehul S. Patel, Mr. N.M.Vora.

2.Heat Transfer Simulation by CFD from Fins of an Air Cooled Motorcycle Engine under Varying Climatic Conditions by Pulkit Agarwal, Mayur Shrikhande and P. Srinivasan.

3.Experimental Study of Effect of Angle of Inclination of Fins on Natural Convection Heat Transfer through Permeable Fins by U. V. Awasarmol and Dr. A. T. Pise.

4.The effect of fin spacing and material on the performance of a heat sink with circular pin fins by A Dewan, P Patro, I Khan,and P Mahanta.

5.Thermal Engineering by I. Shvets, M. Kondak.

6.Thermal Engineering by Rudramoorthy.

7.Thermal Engineering by R.K. Rajput.

8.Thermal Engineering by Sarkar.

9.Online Materials.