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RESEARCH ARTICLE

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WEIGHT OPTIMIZATION AND THERMAL ANALYSIS FOR DIFFERENT GEOMETRY OF CYLINDER FINS

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ABSTRACT

The heat transfer rate from air cooled engine depends upon the geometry, size and Material of construction of the fin. In this paper, the heat transfer rate has been studied by varying the thickness and material of construction of the default fin. The thickness has been varied from 3mm to 2.5mm, the default being 3mm. Three type of geometry has been used viz, rectangular, circular and curved. Also the material of construction used are Al alloy 2014, Al alloy 6061, Al alloy A204 and Al alloy C443. The model has been recreated in CREO PARAMETRIC 2 and the analysis has been done in ANSYS 16 using workbench module, transient thermal analysis. The temperature difference of all the geometry has been compared and the one which gives best result of heat transfer has been selected.

I. INTRODUCTION

In air cooled internal combustion engine, fins are used to dissipate the heat from the engine body to atmosphere. As it is evident that the temperature inside the cylinder goes to a very high degree which needs to be dissipated or else it will tend to wear and tear of engine components. Fins play a major role in this heat dissipation. Fins also help in maintaining the thermal efficiency of the engine. Mostly, the two wheeler bikes have an air cooled engine in which fins are used for cooling purpose.

Figure 1 Automobile Fin

Natural Cooling: In air cooled engine, the engine remains exposed to surrounding atmosphere. The air passes through the fins and ultimately the cooling effect is induced in the engine. The fins work on the phenomena of convection. The heat transfer rate through fins depends on the geometry, size and thickness of the fin. If proper cooling is not provided to the engine, then the efficiency of engine may decrease as high temperature may lead to preheating of engine.

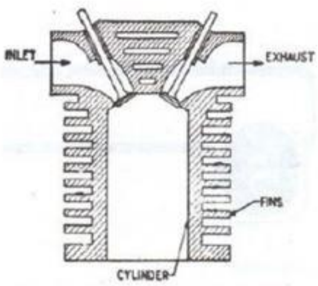

Figure 2 Natural Air Cooling

II. PROBLEM DEFINITION

Due to high temperature engine overheating. This overheating damages the internal component of the cylinder and decreases the thermal efficiency of the vehicle. Through this paper check the heat flux rate for different geometry with varying thickness 3mm to 2.5mm.

Modelling of Cylinder fins: Model recreated in CREO Parametric software. The dimension of the cylinder along with fin was taken from commercially available bike data sheet. Fins with different geometries (circular and rectangular) were modelled using Pro-E.

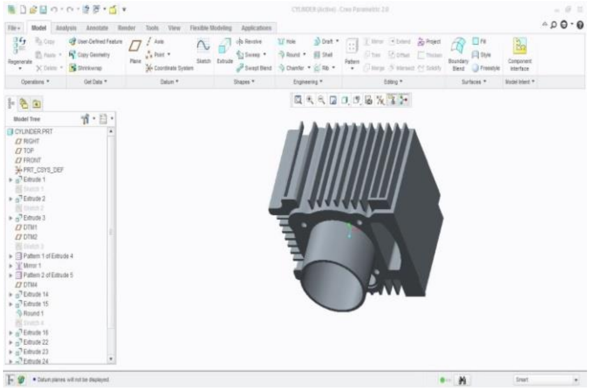

Figure 3 Rectangular Fins

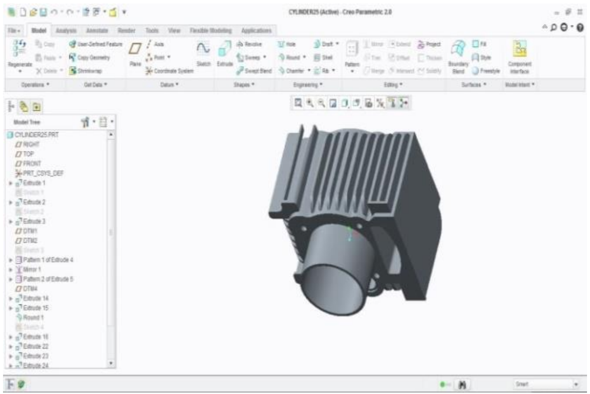

Figure 4 Curved Fins

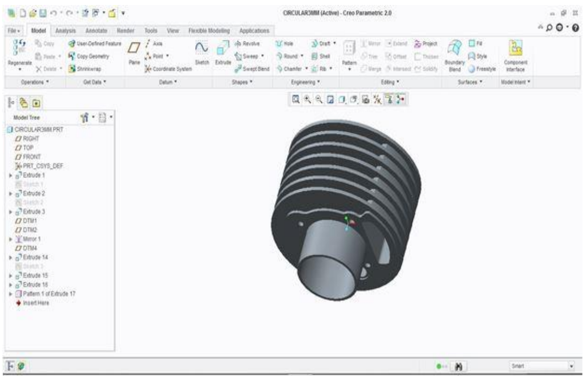

Figure 5 Circular Fins

Table 1Material Properties

Material	Density (g/cc)	Specific Heat (j/g c)	Conductivity (W/m c)
Aluminium 6061	2.7	0.896	180
Aluminium A204	2.8	0.963	120
Aluminium 2014	2.8	0.88	192
Aluminum C443	2.69	0.936	142

III. FE ANALYSIS ON THERMAL ANALYSIS

Apply boundary condition for different geometry is Rectangular Fins, Circular Fins and Curved Fins.

Internal temperature=285c

Thermal Conductivity=25W/m^2 c

Surrounding temperature=25c

(i) Rectangular Fins thickness 3mm

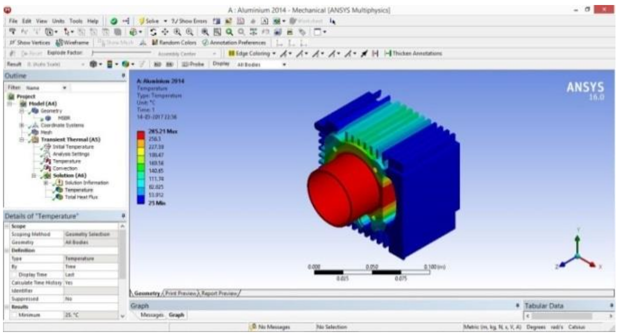

Figure 6(a) Material 2014

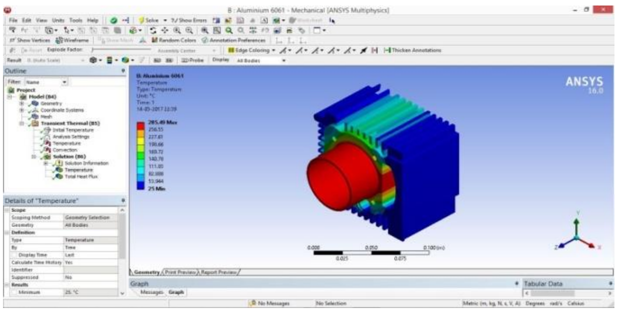

Figure 6(b) Material 6061

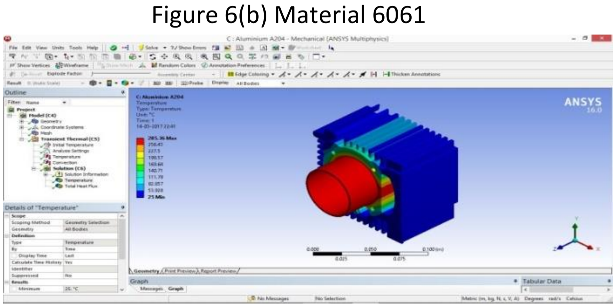

Figure 6(c) Material A204

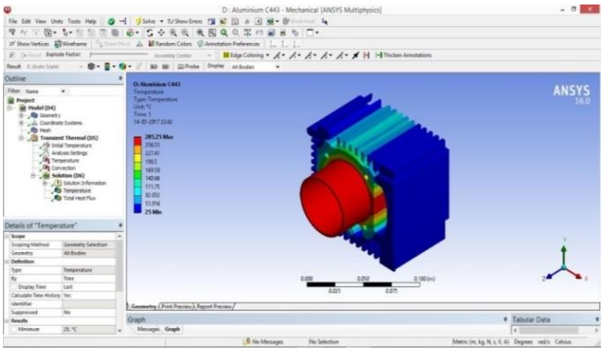

Figure 6(d) Material C443

(ii) Circular Fins thickness 3mm

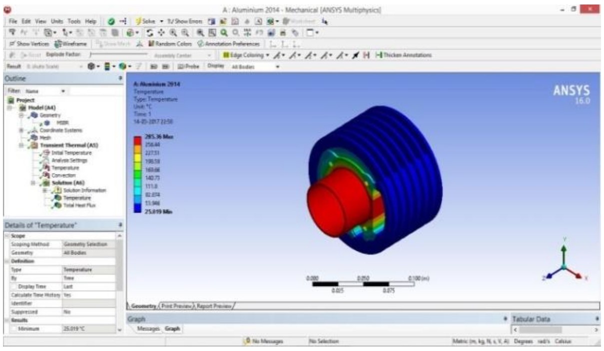

Figure 7(a) Material 2014

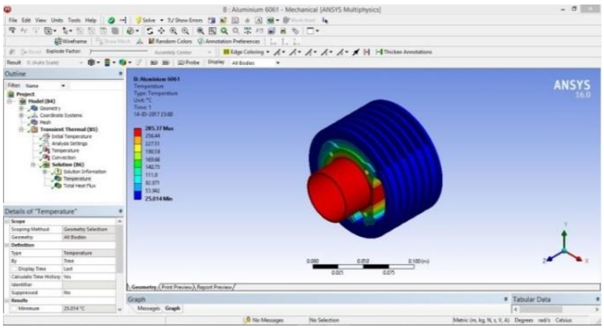

Figure 7(b) Material 6061

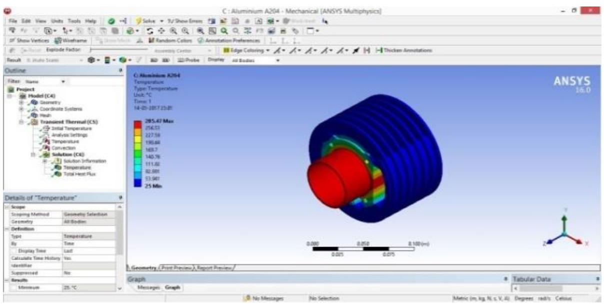

Figure 7(c) Material A204

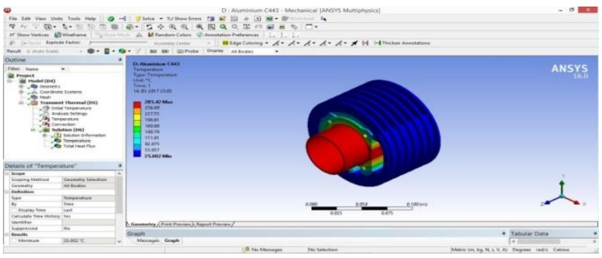

Figure 7(d) Material C443

(iii) Curved Fins thickness 3mm

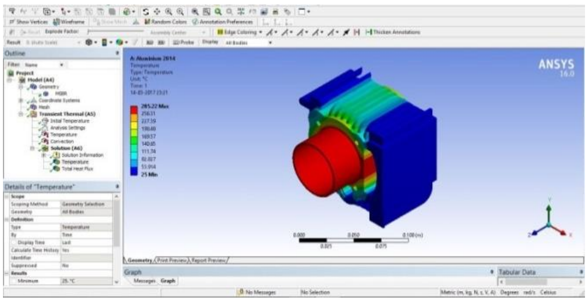

Figure 8(a) Material 2014

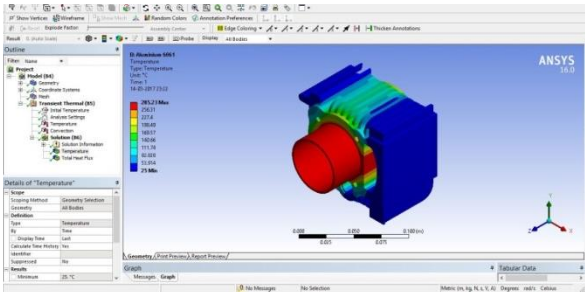

Figure 8(b) Material 6061

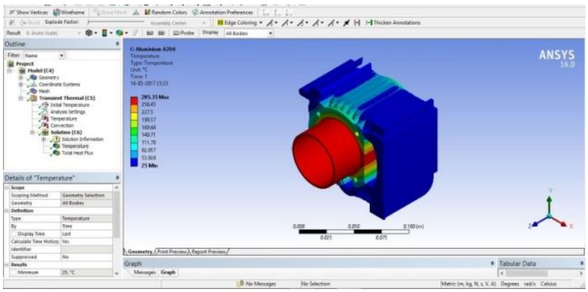

Figure 8(c) Material A204

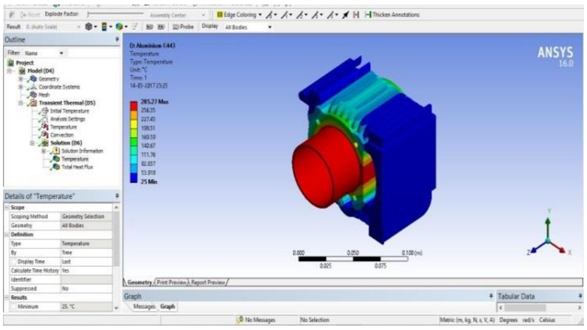

Figure 8(d) Material C443

(iv) Rectangular Fins thickness 2.5mm

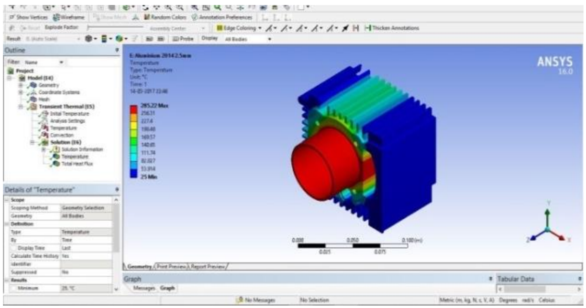

Figure 9(a) Material 2014

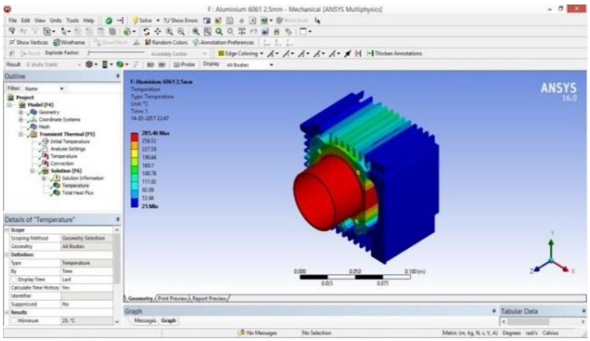

Figure 9(b) Material 6061

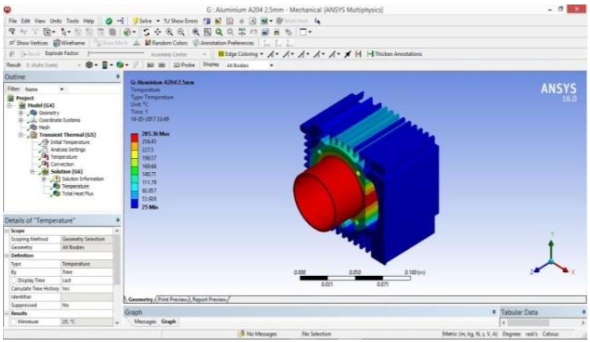

Figure 9(c) Material A204

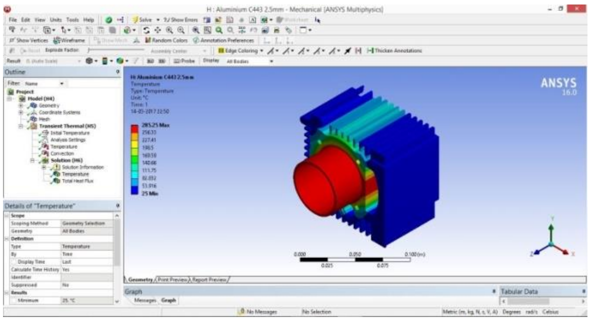

Figure 9(d) Material C443

(v) Circular Fins thickness 2.5mm

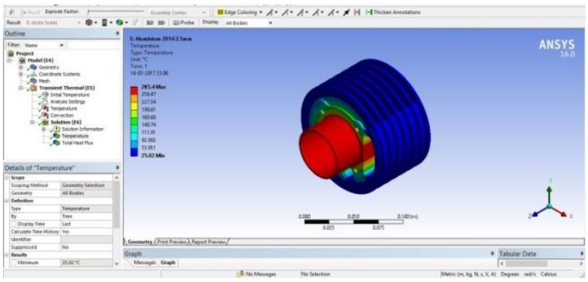

Figure 10(a) Material 2014

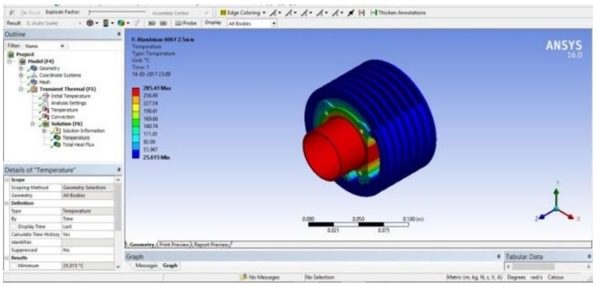

Figure 10(b) Material 6061

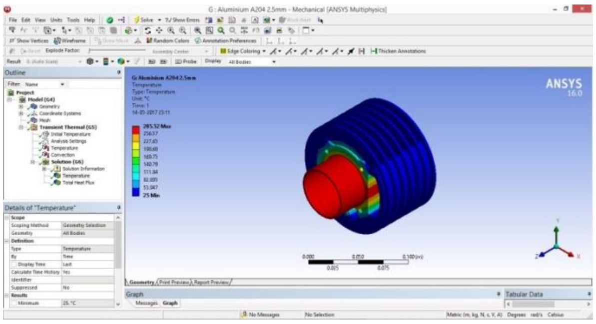

Figure 10(c) Material A204

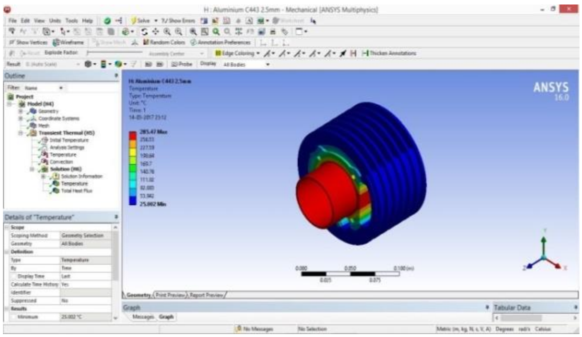

Figure 10(d) Material C443

(vi) Curved Fins thickness 2.5mm

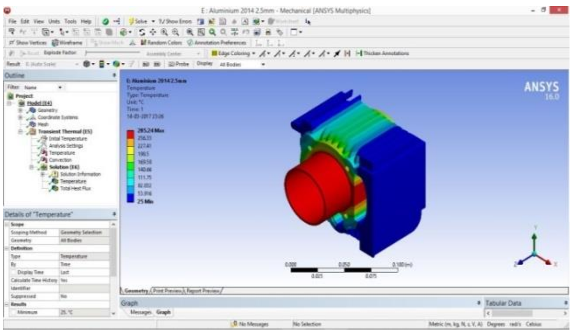

Figure 11(a) Material 2014

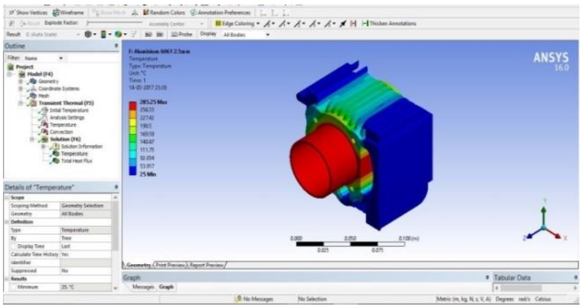

Figure 11(b) Material 6061

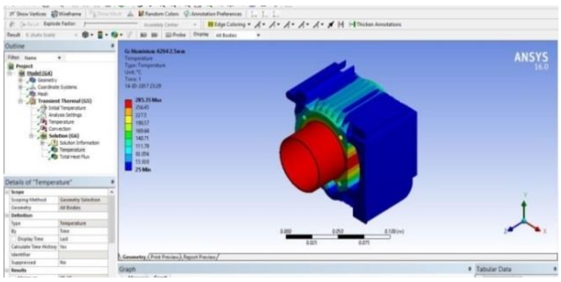

Figure 11(c) Material A204

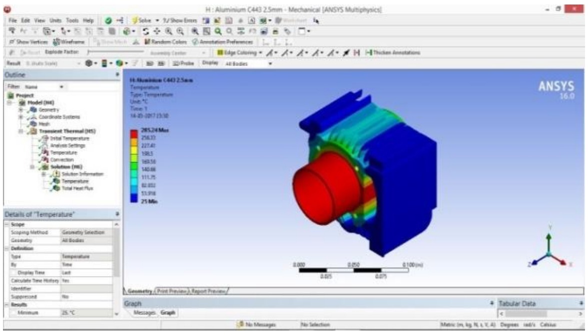

Figure 11(d) Material C443

IV. DISCUSSION OF RESULTS

In Figure 12, show the compression between the all different materials results of the temperature difference “heat dissipation rate per unit area” of the cylinder fin body for different geometry.

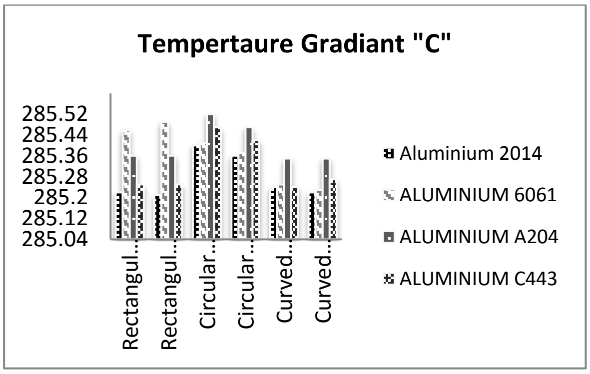

Figure 12 Comparison of all different geometry

Mass of Cylinder- Fins Body : In this figure 13 and figure 14 mass of cylinder fin body of various thicknesses from 3mm to 2.5mm has been obtained. Also the mass has been calculated for the various different geometry viz, rectangular, circular and curved. The below table indicate the value of the heat flux for various default material Aluminium Alloy 204 and other Aluminium Alloy material of different geometry and size.

Fins shapes	**Aluminium 2014**	**Aluminium 6061**	**Aluminium Alloy A204**	**Aluminium Alloy C443**
Rectangular	.9961kg	.9605kg	.9961kg	.957kg
Circular section	.9603kg	.9260kg	.9603kg	.9226kg
Curved	.9822kg	.9471kg	.9822kg	.9436kg

Figure 13 Fins thickness 3mm

Fins shapes	Aluminium 2014	Aluminium 6061	Aluminium Alloy A_2O_4	Aluminium Alloy C443
Rectangular	.9599kg	.9256kg	.9599kg	.9222kg
Circular section	.9133kg	.8807kg	.9133kg	.8775kg
Curved	.9481kg	.9142kg	.9481kg	.9108kg

Figure 14 Fins thickness 2.5mm

V. CONCLUSIONS

In this project a cylinder fin body of a100cc hero Honda bike has been redesigned in a 3d Pro-e Creo parametric software. The default fins thickness 3mm and it of rectangular shape. The default material is aluminium alloy A204. In his project fin shape has been changed to circular and curved and the thickness has been varied from 3mm to 2.5mm. A transient thermal Analysis has been on the fin body by changing its material, thickness and shape. The material used is aluminium 2014, aluminium 6061 and aluminium alloy C443

Hence we conclude that the circular fin of thickness 2.5mm example aluminium A204 can give a better heat transfer rate rather than the present (default fin). Also we have found that the weight of circular fin of aluminium A204 is quite less as compared to the other geometry of same material as well as other material.

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