OPTIMIZATION OF CYLINDER HEAD FINS

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INTRODUCTION

This project is shows that what is CAD-CAE and its application. Mechanical engineers mainly concern with core industrial processes like design manufacturing of steel, forging, casting and many such others. How CAD-CAE provides assistance and how it can be beneficial to the industry is always been a question mark. For this project the cylinder head is reverse engineer for modelling and then generate fin dimensions and create CAD model of it. Perform steady state thermal analysis on it, for knowing temperature and thermal stress distribution also for validation of result. And suggest optimize fin.

REVERSE ENGINEERING:-

Engineering is the process of designing, manufacturing, assembling, the product and system. We can define two types of engineering, forward engineering and reverse engineering. Forward engineering is the general traditional process of conversion of logical idea in to physical product or system. Sometimes it is found that physical part (existing product)/ product without engineering data. The process of duplicating such a existing product without drawings, documentation, or a computer model is known as reverse engineering. Reverse engineering is also defined as the process of obtaining a geometric CAD model from 3-D points acquired by scanning/ digitizing existing parts/products. RE often defined by researchers with respect to their specific task (Motavalli & Shamsaasef 1996). Abella et al. (1994) described RE as, “the basic concept of producing a part based on an original or physical model without the use of an engineering drawing”. Yau et al.(1993) define RE, as the “process of retrieving new geometry from a manufactured part by digitizing and modifying an existing CAD model”[1]

FIN:-

Extended surfaces (fins) are frequently used in heat exchange device for the purpose of increasing heat transfer rate between primary and secondary fluids.

Fins are used to enhance convective heat transfer in wide range of engineering application.[2]

Types of fin [2]

There are various types of fin

Rectangular fin	Circular fin
Triangular fin	annular fin
Tapered fin	

PROBLEM FORMULATION

In present cylinder head, it observes that there is problem of heat dissipation. To overcome such difficulties we need to change the shape and material of cylinder head. In this project I suggest the different types of shape of fins which increase the heat transfer rate. Firstly I will analyze the various fins and then by comparing their result, best fins structure will be suggest.

The various geometry which I am going to study are as follows:

- Rectangular Shapes fin
- Taper shape fin
- Triangular shape fin

Fin formulae [2]

l- Length of fin

b- Width of fin

y- Thickness of fin

P-Perimeter of fin

Ac/s-Area of cross-section

to- Temp. At base of fin

ta- Ambient temperature

K- Thermal conductivity

h- Heat transfer coefficient

Heat flow/dissipation fron fin

$Q_{fin} = K\, A_{c/s}\, m\, (t_o - t_a)$ [3]

Where

$$m = \sqrt{\frac{hP}{kAcs}}$$ [3]

Efficiency of fin [2]

$$\eta_{fin} = \frac{\tanh(ml)}{(ml)}$$

$Q_{cond} = K\, A_{c/s}\, DT/DS$

$Q_{conv} = h\, A_s\, (T_s - T_f)$,

$Q_{rad} = F\, \sigma A_s\, (T1^4 - T2^4)$

Specification

K- Thermal conductivity 180 W/m^2 K

h- Heat transfer coefficient

Ts- Base Temperature 470º C =743 K

Tf- End/face temperature 35º C =308 K

A- Area in M

Density- 2.7 g/cc

Qcond = K Ac/s DT/DS

Qconv = h As (Ts-Tf)

Qrad = F σAs ($T1^4$ - $T2^4$)

$\eta_{fin} = \frac{\tanh(ml)}{(ml)}$ $m = \sqrt{\frac{hP}{kAcs}}$

Rectangular Fin

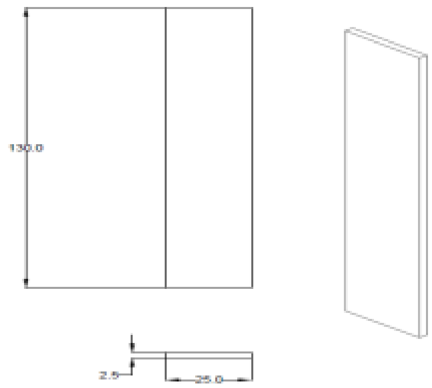

Figure 1:- Rectangular Fin

Qcond = 2.03 W

Qconv = 45.34 W

Qrad = 89.13 W

η_{fin} = 73.75 %

Tapered Fin

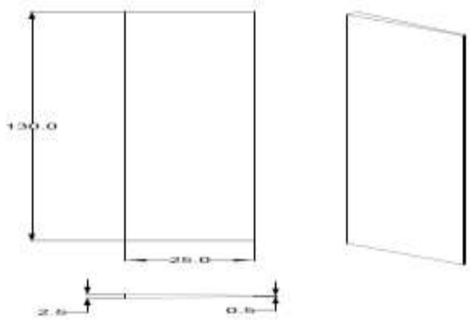

Figure 2:- Tapered Fin

Qcond = 1.38 W

Qconv = 44.7 W

Qrad = 59.13 W

ηfin = 53%

Triangular Fin

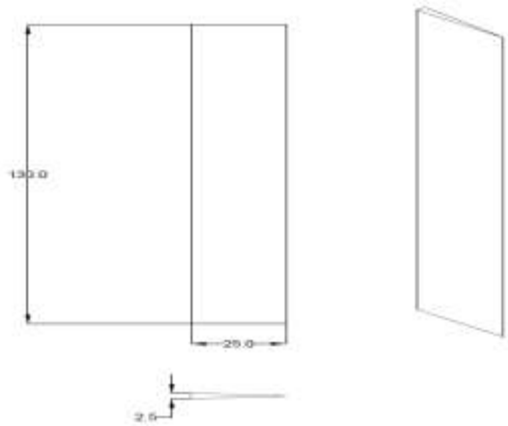

Figure 3:- Triangular Fin

Qcond = 1.22 W

Qconv = 46.13 W

Qrad = 61.23 W

ηfin = 85%

MODELING AND ANALYSIS

MESING OF VARIOUS FINS:-

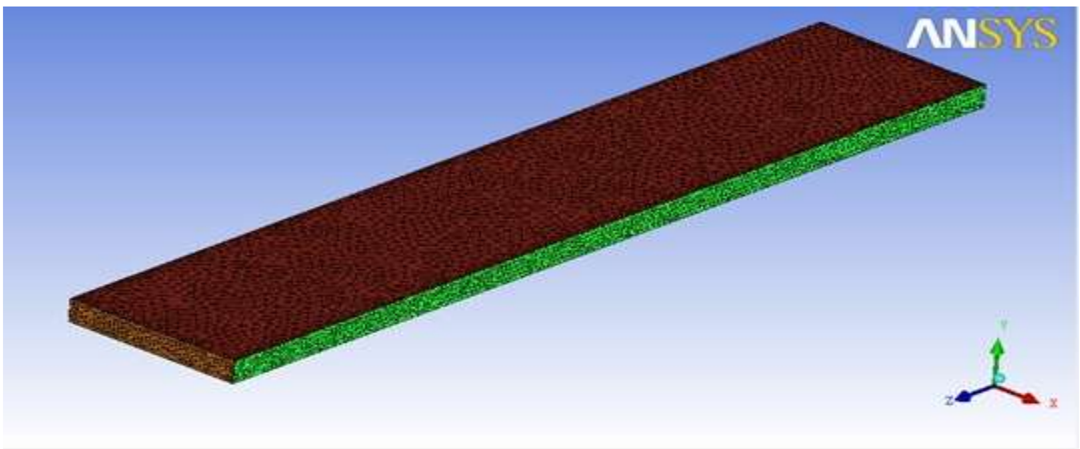

Figure 4:-Rectangular fin after meshing

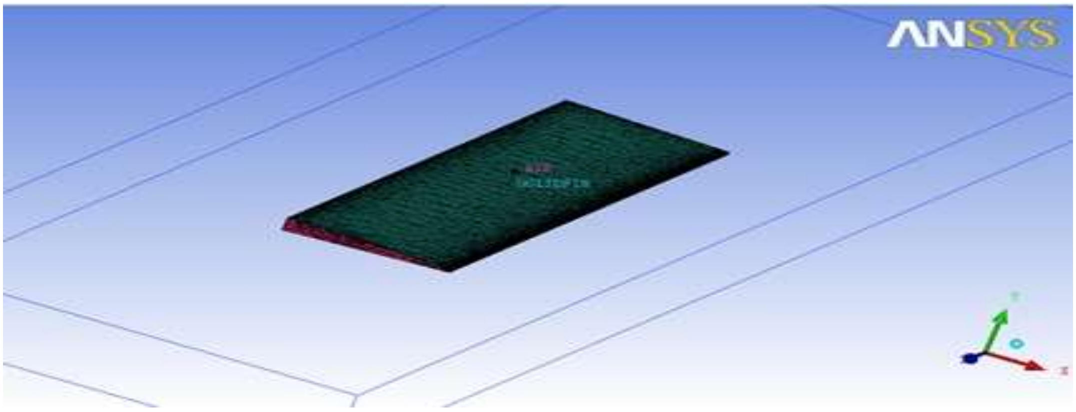

Figure 5:-Taper Fin After Meshing

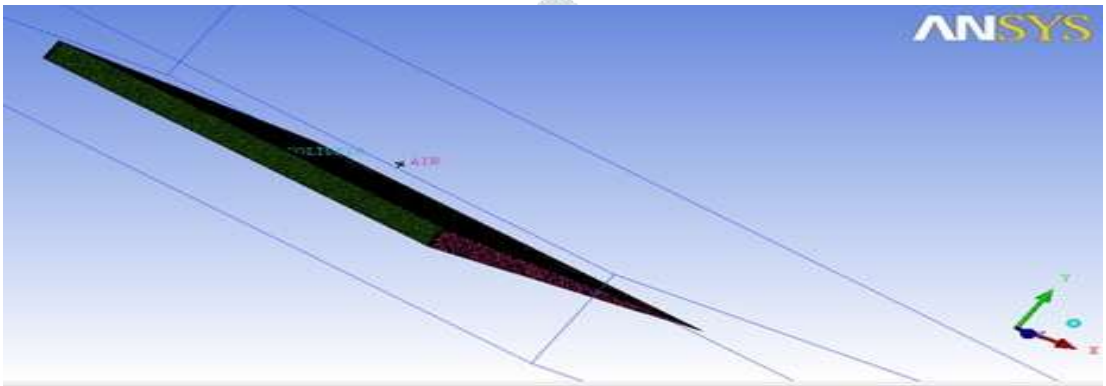

Figure 6:-Triangular Fin after Meshing

HEAT DISTRIBUTION

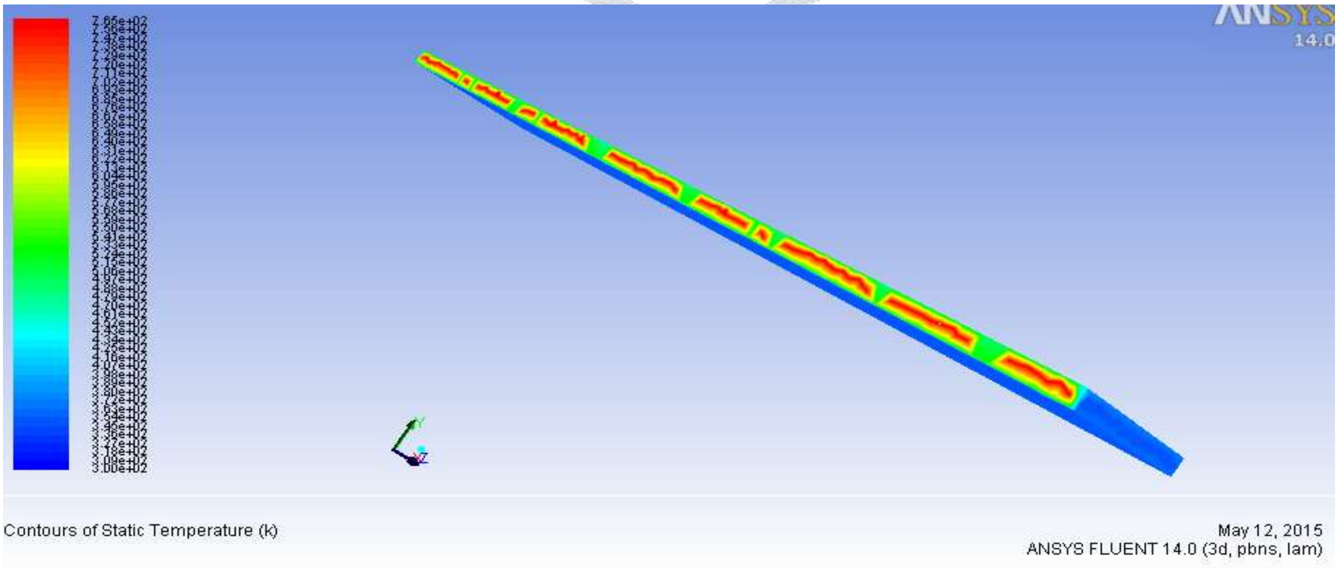

Figure 7:- Heat distribution on straight fins

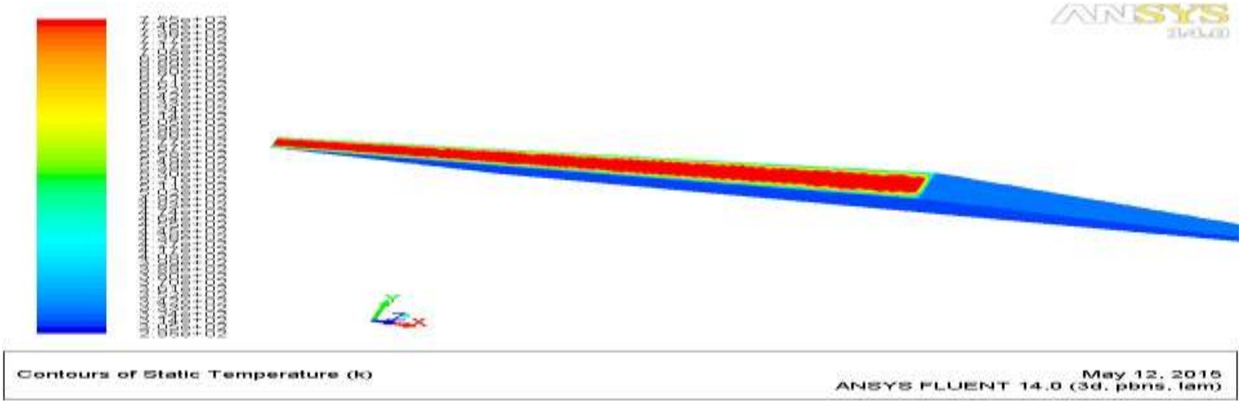

Figure 8:-Heat distribution on tapered fins

Figure 9:- Heat distribution on triangular fins

RESULT:-

	CALCULATION			ANALYSIS	
	T1 K	T0 K	ηfin	T1 K	T0 K
Rectangular fin	743	308	73.75	765	300
Taper fin	743	308	53	755	295
Triangular fin	743	308	85	780	297

Table 1: Result and comparison

As calculated Initial (Measuring) temperature and ANSYS analysis gives nearly same temperature, so our Experimentation validate.

CONCLUSION

It is being found that in calculation efficiency of triangular fin is more than rectangular and tapered shape fin also Qconv for triangular fin is more than that of rectangular and tapered fin. So it can be suggested that triangulate fin is more efficient for.

References

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