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Heat Transfer Analysis in Annular Fin with Tapered Profile used in IC Engine

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ABSTRACT

Internal combustion engine has required for more amount of heat transfer rate. Fins are the extended surface used to increase the heat transfer rate. The heat transfer rate depends on the thermal conductivity of the material and surface exposed to atmosphere. In this project, the heat transfer rate of IC engine will be improving with the help of change the fin area and profile. The rate of conduction heat transfer is getting improved by changing the fin profile from annular fin of rectangular to tapered profile. To investigate the performance of fins by experimental as well as theoretical. The heat transfer rate is also improved by forced convection. Thermal analysis of fin by using ANSYS WORKBENCH.

1. INTRODUCTION

Fins are the extended surfaces which are used to increase the heat transfer rate. It is used in refrigerators, compressors, engines etc. The heat transfer rate is increased by increased by increasing the surface area. The heat transfer is also improved by forced convection. The heat transfer is calculated by the conduction, convection and radiation. The heat transfer rate depends on the thermal conductivity of the material and surface exposed to atmosphere. The convective heat transfer is calculated by

$$Q = h*A_s*(T_s - T_\infty)$$

where,
Q- convective heat transfer rate (W/mK),
h – heat transfer coefficient in W/m 2 K
A s - surface area in mm,
T s - surface temperature in °C,
T ∞ - ambient temperature °C.

The optimum fin spacing for maximum heat transfer varies between 5 to 6mm roughly for Rayleigh number. The overall fin efficiency depends on the operating condition of the fin surface. The heat transfer rate increases with increase in length of the fin at a particular point after it decreases. By varying the pitch length the heat transfer rate varies.

1.1 Types of Fins

It is classified into
1. Straight fin
2. Annular fin
3. Pin fin

2. DIMENSIONS AND ANALYSIS OF FINS

The dimensions used for our project is listed below. All Dimensions are in mm.

Table 2.1 Dimensions of Rectangular profile

Cylinder inner diameter	50
Cylinder outer diameter	60
Length of Fin	45
Pitch length	13
Thickness of fin	5
Length of Cylinder	95
Overall cylinder diameter	105

Table 2.2 Dimensions of Tapered profile

Cylinder inner diameter	50
Cylinder outer diameter	60
Length of Fin	45
Pitch length	10
Thickness of fin	8
Length of Cylinder	95
Overall cylinder diameter	105

2.1 RESULTS OBTAINED IN RECTANGULAR PROFILE

The results shows that the temperature reduces from 300°C to 260.69°C when air flowing over the fin and the temperature gradient is 4.37°C

Fig - 2.1 Temperature for rectangular profile

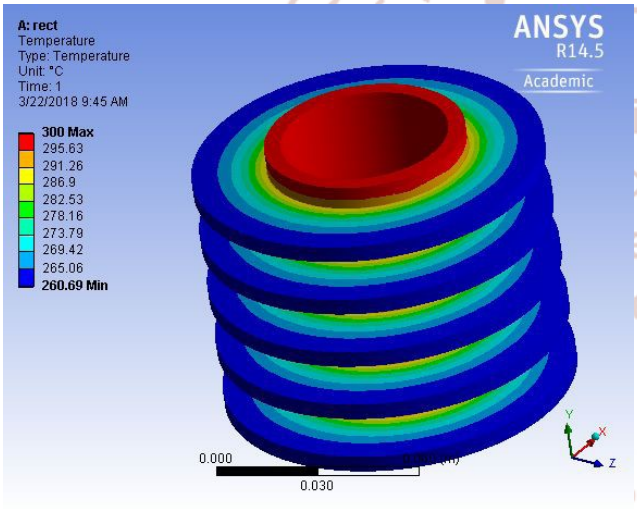
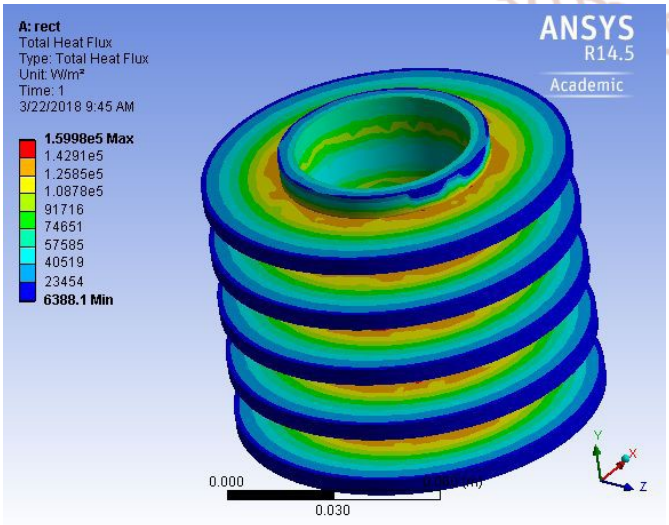


Fig - 2.2 Heat flux for rectangular profile



It is observed that the heat transfer coefficient varies from 1.5998*10 5 to 6388.1W/m 2. The difference in heat transfer is 0.1708 W/m 2.

2.2 RESULTS OBTAINED FOR TAPERED PROFILE

It is obtained that the temperature reduces from 300°C to 268.77°C when air flowing over the fin and the temperature gradient is 3.47°C

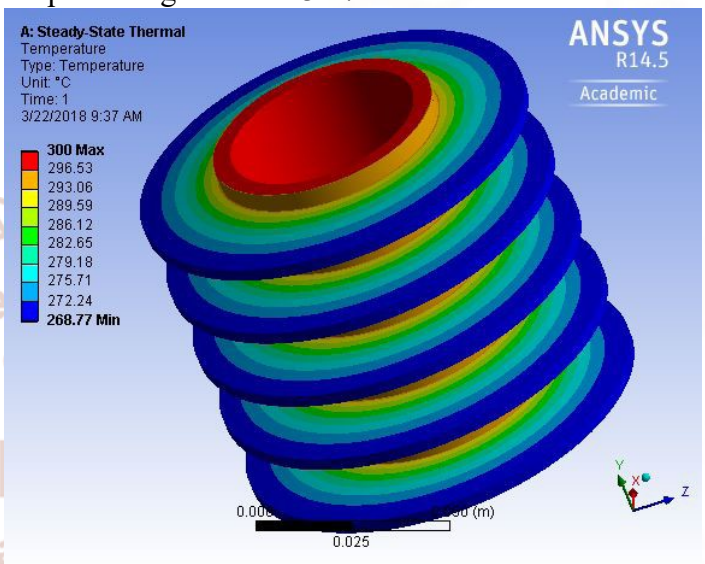


Fig - 2.3 Temperature for tapered profile

It is observed that the heat transfer coefficient varies from 1.1966*10 5 to 7539.6W/m 2. The difference in heat transfer is 0.1246 W/m 2.

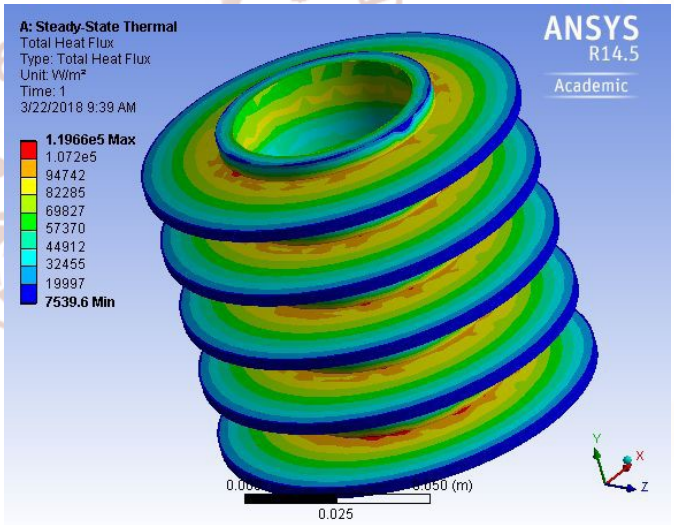


Fig - 2.4 Heat flux for tapered profile

Efficiency of the fin is defined as the ratio of actual heat transfer to the maximum heat transfer. Effectiveness is defined as the ratio of heat transfer with fin to the heat transfer without fin.

CONCLUSION

From the results, we compared the heat transfer between the rectangular profile and tapered profile. The solid model was created in SOLIDWORKS and the thermal analysis was done in ANSYS WORKBENCH. Area of rectangular profile is less than tapered profile. The heat transfer increases with increase in surface area and pitch length is also a factor to increase heat transfer. From the analysis results it is conclude that the heat transfer for the rectangular profile is more compared to the tapered profile.

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