Comparison of Performance of Different Profiles of Fins using Thermal Analysis

Prabhmeet Singh, K. K. Jain, R. K. Dave, Pooja Tiwari

Abstract— In this paper different profiles of fins were considered for thermal analysis (Rectangular, Triangular and helical)in an IC engine. The models were constructed of same dimensions and only outer profiles were changed using CATIA were made rectangular, tapered and helical .The boundary conditions were set up using Ansys .The main aim of this work is to study the steady state temperature distribution in Fins and to improve the heat transfer rate .In this paper we have also considered helical profile at various angle for heat transfer and temperature distribution.

Keywords— Ansys, CATIA, Heat Transfer, Fins.

I. INTRODUCTION

Heat transfer in fins can be increased if we increase the surface area of the fins during its manufacturing .Various research work is carried out to improve the heat transfer rate .Some work has to be done in order to increase the heat transfer rate in SI engine .Currently rectangular circular fins are used and certain modifications are needed to use helical profile which will only depend on helix angle.Previous work has been done in various profiles of fins and mainly aluminium is used as the material for the manufacture of the fins due to its light weight and good heat transfer rate.

II. LITERATURE REVIEW

Prajesh Paul, Ram C Sharma et al. [1] has done research work through ansys on various profiles of fins and analyzed through various alloys of aluminium including Aluminium Nitride, Cupronickel and Inconel MA754.All the properties of the alloys were analyzed in this paper.

Pardeep Singh, Harvinder lal et al [2] has done research work on various profiles of fins with extensions and without extensions using software and up to a certain length and they concluded that with extensions heat transfer rate is better as compared to no extensions.

Arvind S Sarothiya, Ashishkumar N Parmar et al[3] has done survey on Indian 2 wheeler market and various design of engines based on air cooling .As the air cooled engine builds heat ,the cooling fins allow the wind and air to move the heat away from the geometry. Based on this various parameters are considered for the changes in design using Ansys have been studied in this paper.

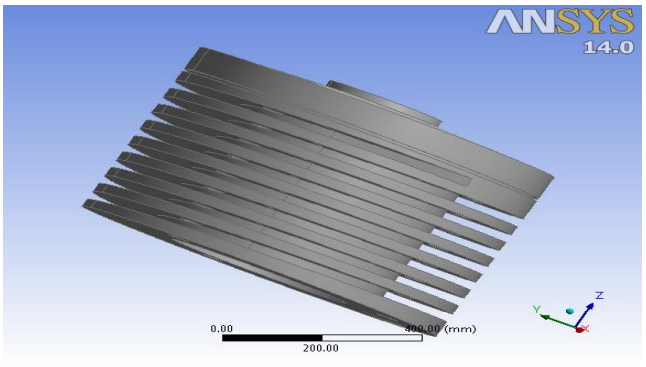
Vipul Shekhada, Dr. Shashi Jain et al [4] has done study on Ansys software in which they have compared the previous data and the current data of air cooled fins and validated upon the previous conditions and showed that the new fins have better heat transfer rate as compared to the existing one.

III.ANALYSIS

The numerical analysis has been carried out for computing the temperature and thermal stress distributions in circular fins using commercially available finite element software ANSYS. The custom system option for thermal analysis was selected. The numerical analysis was based on the following assumptions

i) Steady-state heat flow,
ii) The materials are homogeneous and isotropic,
iii) There is no heat source,
iv) The convection heat transfer coefficient is the same all Over the surface,
v) The temperature of the surrounding fluid is uniform,
vi) The thermal conductivity of the material is constant

In this work we have made a model for cylinder engine using CATIA for various profiles which includes rectangular, tapered and helical. The below figure shows the helical



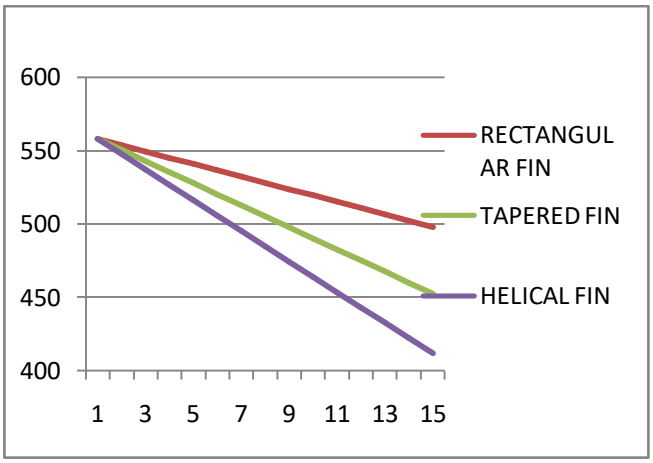
profile in a cylinder engine .Similarly other profiles were only changed in the above model. After the model has been made then we assign the boundary conditions based on the paper. In this we have taken basically 3 parameters steady state, total heat flux and directional heat flux for all the three profiles.

Manuscript Received on March 2015.

Prabhmeet Singh, PG Student, Department of Mechanical Engineering, Shri Ram Institute of Technology, Near ITI Madhotal Jabalpur, MP, India.
Prof. K. K. Jain, HOD (Mechanical), Department of Mechanical Engineering, Shri Ram Institute of Technology, Near ITI Madhotal Jabalpur, MP, India.
Dr. R. K. Dave, Director (PG Courses), Department of Mechanical Engineering, Shri Ram Institute of Technology, Near ITI Madhotal Jabalpur, MP, India.
Asst. Prof. Pooja Tiwari, Head (ME Heat and Power), Department of Mechanical Engineering, Shri Ram Institute of Technology, Near ITI Madhotal Jabalpur, MP, India.

All the above three figure shows the temperature distribution profile for all profiles in which we find that the helical fin gives the best heat transfer rate for the same boundary conditions. Similarly other conditions were also analysed for all the profiles of fins and in that also we found that the helical profile gave the best results.

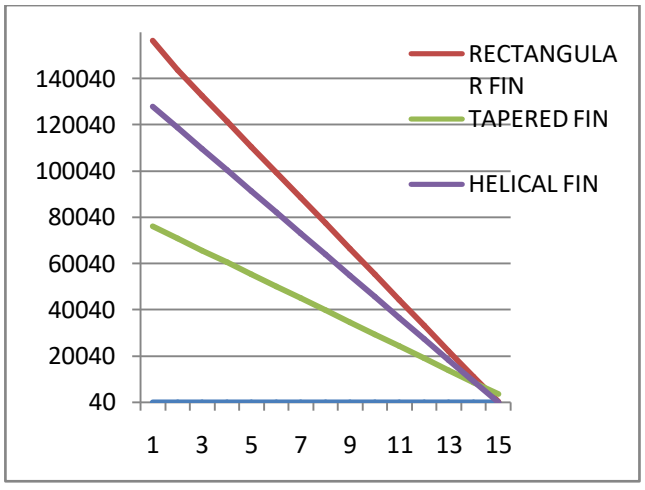
Graph 1 .Temperature Distribution



In the above graph we have put the analysis which has been done in ansys for the given fixed temperature and showing the relation between time and temperature in which again helical fin profile gives the best heat transfer rate . So it is concluded that helical fin profile will be better than rectangular and tapered fin profiles.

Graph NO 2: TOTAL HEAT FLUX

In the given graph we find that the total heat flux obtained in case of helical fins is giving optimum result.



Both the graphs shows that the helical fins are giving better results in all parameters.

IV. RESULTS AND DISCUSSIONS

In this paper we have analysed the certain factors and parameters based on fins in which we have opted the use of thermal software and try to find out the results operating at similar boundary conditions .We have fixed the boundary conditions same for all the profiles in case of rectangular in which we find that under steady state the minimum temperature in case of rectangular fin is greater than tapered fins which is greater than helical fins. In the second graph we have studied the total heat flux for all the three profiles which is also the second parameter we have used under boundary conditions .Again we find that the results obtained in case of helical fins is better than the other two profiles. Similarly directional heat flux which is the third parameter shows better result for helical fins. The problem which could arise in case of helical fins is the helical angle which should give the best results. We find that lower the helical angle more will be the surface area and better results will be obtained and greater helical angle could not give better results.

V. CONCLUSION

We have studied temperature distribution for three profiles rectangular, tapered and helical and in helical comparison has been done on helical angle. The graph has been plotted according to certain fixed boundary conditions and considering all the conditions we found that the helical fins can be used to get optimum results.

REFERENCES

1. Proc. of Int. Conf. on Advances in Mechanical Engineering 2011Comparative Study Of Thermal Stress Distributions In
2. Fins Operating At High Temperature For Different
3. Profiles And Materials Prajesh Paul1, Ram C Sharma2.
4. A. Aziz and T. Fang, “Thermal analysis of an annular fin with
5. Simultaneously imposed bas temperature and base heat flux and
6. Fixed base and tip temperatures”, *Energy Conversion and*
7. *Management*, Vol. 52, pp. 2467-2478, 2011.
8. International Journal of Innovative Research in Science,
9. Engineering and Technology Pardeep Singh, Harvinder lal, Baljit Singh Ubhi.
10. Modelling and Simulation of engine cylinder fins by using FEA(IJRASET),B,ARUNKUMAR,S PRATAP.
11. Heat Transfer Analysis and Optimization of Engine Cylinder Fins of Varying Geometry and Material G. Babu, M.Lavakumar, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).
12. Review Paper on Effect of Cylinder Block Fin Geometry
13. on Heat Transfer Rate of Air-Cooled 4S SI Engine
14. Prof. Arvind S.Sorathiya1, Ashishkumar N. Parmar2, Prof. (Dr.) Pravin P. Rathod.
15. DESIGN MODIFICATION AND ANALYSIS OF TWO WHEELER COOLING FINS-A REVIEW
16. Mohsin A. Ali1, Prof. (Dr.) S.M Kherde, International Journal of Engineering and Applied Sciences.
17. G.Raju, Dr. BhramaraPanitapu, S. C. V. RamanaMurty Naidu. “Optimal Design of an I C engine cylinder fin array using a binary coded genetic algorithm”. International journal of Modern Engineering Research. ISSN 2249-6645,Vol. 2 Issue.6, Nov-Dec.(2012),pp.4516-4520.
18. V. GANESAN, (2008). I C Engines, McGraw-Hill Education (India)
19. PVT Limited.
20. R. K. Rajput, (2007). Heat & Mass Transfer (M.E.), S. Chand.
21. S. Wange and R. Metkar (2013). "Computational Analysis of
22. Inverted Notched Fin Arrays Dissipating Heat by Natural
23. Convection." International Journal of Engineering and Innovative
24. Technology (IJEIT) .
25. N.Nagarani and K. Mayilsamy (2010). "EXPERIMENTAL HEAT
26. TRANSFER ANALYSIS ON ANNULAR CIRCULAR AND
27. ELLIPTICAL FINS." International Journal of Engineering Science
28. and Technology 2(7): 2839-2845.