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RESEARCH ARTICLE

DESIGN MODIFICATION AND HEAT FLUX ANALYSIS OF AIR COOLED FIN

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ABSTRACT

Transient and Steady state heat transfer simulation is carried out on the engine. A two wheeler bike engine is chosen (e.g. Unicorn bike engine) and geometry is designed in Design Modeller in Ansys 16.0. Material used for is Al 6063 which has a thermal conductivity of 200 W/m K. A modification in design of engine is made by creating holes on fin, various diameters 2mm, 6mm & 10mm holes on fin have been considered. In addition, a perforated fin was compared with an imperforate fin to observe the differences.It is observed from the results that before a time period of 400 seconds Transient minimum heat flux of all fins has not reached to steady state. However, Fin with a hole of 2mm & 10mm dia has reached the steady state limits before a time period of 100 seconds when compared with other fins.

INTRODUCTION

In Engine When fuel is burned heat is produced. Additional heat is also generated by friction between the moving parts. Only approximately 30% of the energy released is converted into useful work. The remaining (70%) must be removed from the engine to prevent the parts from melting. For this purpose Engine have cooling mechanism in engine to remove this heat from the engine some heavy vehicles uses water-cooling system and almost all two wheelers uses Air cooled engines, because Air-cooled engines are only option due to some advantages like lighter weight and lesser space requirement. The heat generated during combustion in IC engine should be maintained at higher level to increase thermal efficiency, but to prevent the thermal damage some heat should remove from the engine. In air-cooled engine, extended surfaces called fins are provided at the periphery of engine cylinder to increase heat transfer rate. That is why the analysis of fin is important to increase the heat transfer rate. Computational Fluid Dynamic (CFD) analysis and Wind tunnel experiments have shown improvements in fin efficiency by changing fin geometry, fin pitch, number of fins, fin material and climate condition.

Types of Cooling System

Air Cooled System Air cooled system is generally used in small engines says up to 15-20 kW and in aero plane engines. In this system fins or extended surfaces are provided on the cylinder walls, cylinder head, etc. The amount of heat dissipated to air depends upon

- Amount of air flowing through the fins.
- Fin surface area.
- Thermal conductivity of metal used for fins

Water Cooled System In water cooling system of cooling engines, the cylinder wall and heads are provided with jackets where water or a coolant is filled.

LITERATURE REVIEW

DG.Kumbhar*et.al*. [1] Heat transfer augmentation from a horizontal rectangular fin by triangular perforations whose bases parallel and towards the fin base under natural convection has been studied using ANSYS. G.Yakar and R Karabacak [2] used heater whose fins had holes with an angle of 0° and an s/d = 0.345 were studied. A T Pise and U V Awasarmol [3] conducted the experiment to compare the rate of heat transfer with solid and permeable fins. N.Nagarani and K. Mayilsamy [4] Experimental heat transfer analysis on annular circular and elliptical fins.

Matkar *et.al*. [5] Calculated the heat transfer rate and the temperature behavior for the same object with the different material (like copper and aluminium). P.Agarwal *et.al* [6]

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simulated the heat transfer in motor-cycle engine fins using CFD analysis. SH Barhatte *et.al*. [7] Natural convection heat transfer from vertical rectangular fin arrays with and without notch at the center has been investigated experimentally and theoretically. AK Mishra *et.al*. [8] They carried out transient numerical analysis with wall cylinder temperature of 423 K initially and the heat release from the cylinder is analyzed for zero wind velocity. A.Paul *et.al*. [9] Parametric Study of Extended Fins in the Optimization of Internal Combustion Engine they found for high speed vehicles thicker fins provide better efficiency.

G Raju *et.al*. [10] They investigated maximization of heat transfer through fin arrays of an internal combustion engine cylinder, under one dimensional, steady state condition with conduction and free convection modes. Chandrakant SS *et.al*.[11] They conducted experiments for rectangular and triangular fin profiles for air velocities ranging from 0 to 11 m/s. RS Sukumar *et.al*. [12].Presented CFD analysis of heat sinks which contain continuous rectangular fins, interrupted rectangular fins and above models with through holes for electronic cooling is investigated. Sami *et al* [13]. They presented the application of a mathematical model for simulation of the swirling flow in a tube induced by elliptic-cut and classical twist tape inserts.

N.P.R.Rao and T. V. Vardhan [14] worked on a cylinder fin body. Modeled and transient thermal analysis is done by using Pro/Engineer and ANSYS. These fins are used for air cooling systems for two wheelers. Aluminum alloy 6061 and Magnesium Alloy are used and compared with Aluminum Alloy A204.

G. Babu, and M. Lavakumar [15] Designed rectangular fin body made of Aluminium alloy 204 replacing with Aluminium alloy 6061 and Magnesium Alloy, changed the shape with circular and curve shaped. conclude that using material Aluminium alloy 6061 improves heat transfer. SS Arvind *et.al*, [16].There is a scope of improvement in heat transfer of air cooled engine cylinder fin if mounted fin's shape varied from conventional one. A. A Mohsin and S.M Kherde [17].There is a scope of improvement in heat transfer of air cooled engine cylinder fin if mounted fin's shape varied from conventional one. R Kamboj *et.al*. [18] When the winglet type of VGs (TWPH & CTWPH) are fitted in a rectangular channel, the effect on the heat transfer (Nu) or Colburn factor (j), friction factor (f) and thermal performance factor (h) have been investigated numerically by using ANSYS-14.

S Chaitanya *et.al*. [19]. Presented work on a cylinder fin body. Modelled and transient thermal analysis is done by using Pro/Engineer and ANSYS. Aluminium alloy 6061 is compared with Aluminium Alloy A204.

G Deepak and S.R Wankhade [20] They designed a cylinder fin body used in a 100cc Hero Honda Motorcycle and modeled in parametric 3D modeling software Pro/Engineer. AL Shabbani [21] found the accurate values of temperature with respect to the varying time. Applied principle of separable variables to heat conduction subjected in cylindrical fins subjected to lateral surface to provide a simplified formulation that can be used to identify the temperature and heat transfer rate.

PROPOSED METHODOLOGY

It is noticed from the above literature that the research work was already carried out widely on cylinder fins with various geometry and materials.

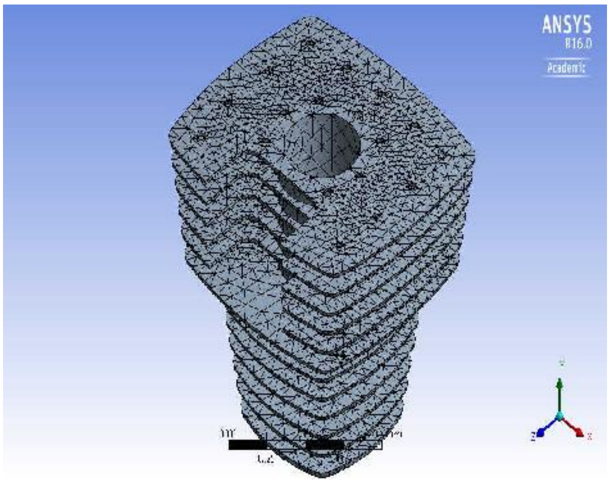


Fig-1 engine cylinder meshed

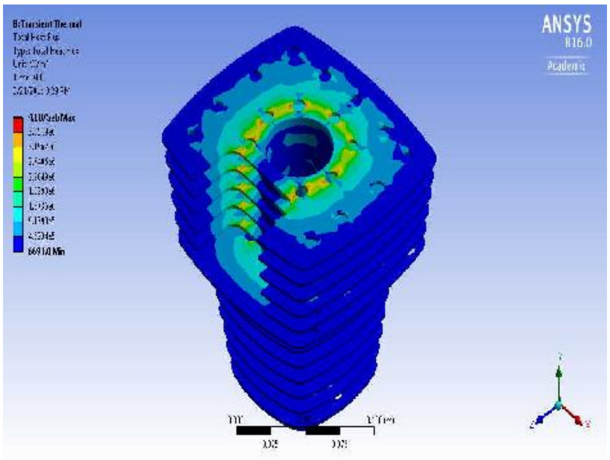


Fig-2 transient analysis of engine fin

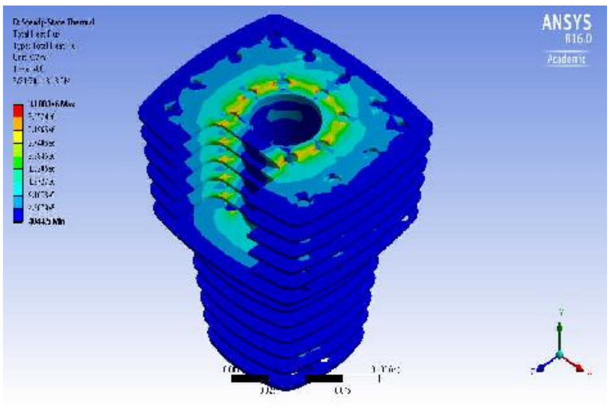


Fig-3 steady state analysis of engine fin

Simulation/experimental results

Hence our effort will be to design an engine (e.g. Unicorn bike) in Design Modeler in Ansys 16.0 and increase the surface area by creation of holes which in turn increases the heat transfer. A comparative analysis will be carried out to study the variation of heat flux on creation of various diameters 2mm, 6mm, & 10mm holes on fin.

After simulation of Engine Fin in transient and steady state Thermal Analysis in Ansys 16.0. It was observed that the final temperature of fin varies with the diameter of the hole created. Transient & Steady State thermal Analysis of the fin is made and results are tabulated:-

Table 1 Transient min heat flux of all fins (w/m^2)

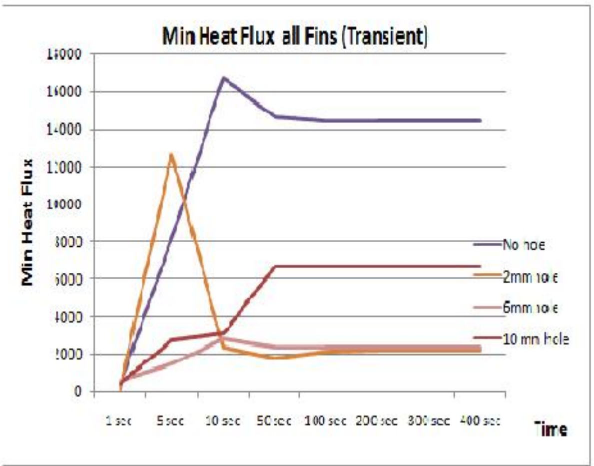
Hole / Time	No hole	2mm hole	6mm hole	10mm hole
1 sec	322.83	98.4	530.64	442.66
5 sec	8131.2	1261.5	1436.8	2732.9
10 sec	16690	2314.0	2761.5	3158.3
50 sec	14606	1774.0	2333.4	6700.0
100 sec	14351	2120.0	2330.2	6692.5
200 sec	14398	2151.9	2330.3	6691.9
300 sec	14399	2152.1	2330.3	6694.2
400 sec	14400	2152.1	2330.3	6694.8

Table 2 Steady State Min Heat Flux Of All FINS (W/m^2)

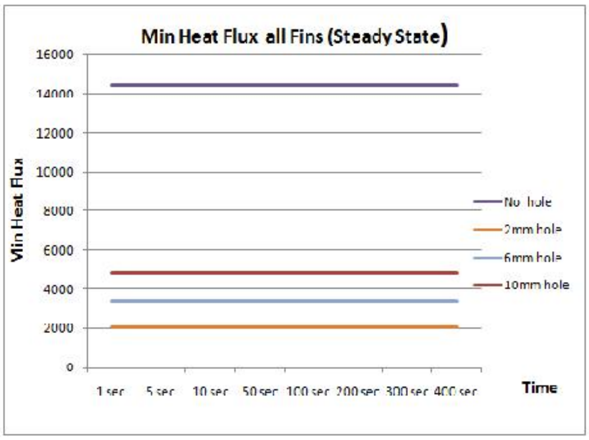
Hole / Time	No hole	2mm hole	6mm hole	10mm hole
1 sec	14399.51	2053.4	3419.1	4844.5
5 sec	14399.51	2053.4	3419.1	4844.5
10 sec	14399.51	2053.4	3419.1	4844.5
50 sec	14399.51	2053.4	3419.1	4844.5
100 sec	14399.51	2053.4	3419.1	4844.5
200 sec	14399.51	2053.4	3419.1	4844.5
300 sec	14399.51	2053.4	3419.1	4844.5
400 sec	14399.51	2053.4	3419.1	4844.5

Table 3 Time Taken By Fin To Reach Steady State From Transient State (Minheat Flux)(W/m^2)

Sl No	Fin with hole size	Transient state Min Heat Flux (K)	Steady state Min Heat Flux (K)	Time Taken to reach Steady State Min Heat Flux (Sec)
1	No holes	14400	14399.51	393.5
2	2mm	2152.1	2053.4	82
3	6 mm	2330.3	3419.1	> 400
4	10mm	6694.8	4844.5	19



Graph 1 Min Heat Flux V/S Time For All Fins (Transient)



Graph 2 Min heat flux v/s time for all fins (steady)

CONCLUSION

On the basis of the study carried out in the rectangular engine fin by Transient and Steady State Thermal Analysis in ANSYS Workbench 16.0, the following conclusions have been drawn.

1. Heat Flux of the fin varies on creation of holes.
2. Heat lost by the body can be increased by increasing the surface area i.e. increasing the diameter of the hole created on the fin.
3. Turbulence of flow of air is increased between the fins on creation of hole.
4. It is observed from the results that before a time period of 400 seconds Transient min heat flux of all fins has not reached to steady state, however fin with a hole of 2mm & 10mm dia has reached the steady state limits before a time period of 100 seconds when compared with other fins.

References

1. D.G.Kumbhar *et al*, "Finite Element Analysis and Experimental Study of Convective Heat Transfer Augmentation from Horizontal Rectangular Fin by Triangular Perforations". *Proc. Of the International Conference on Advances in Mechanical Engineering*, Vol- 3(5), pp 376-380 (2009).
2. GulayYakar&RasimKarabacak "Effects of holes placed on perforated finned heat exchangers at different angles on the Nusselt and Reynolds numbers". *Scientific Research and Essay*, Vol-5, pp 224-234, (2010).
3. A. T. Pise& U. V. Awasarmol."Investigation of Enhancement of Natural Convection Heat Transfer from Engine Cylinder with Permeable Fins."*International Journal of Mechanical Engineering & Technology*, Vol-1(1), pp 238-247, (2010).
4. N. Nagarani& K. Mayilsamy, "Experimental heat transfer analysis on annular circular and elliptical fins." *International Journal of Engineering Science and Technology*, Vol-2(7), pp 2839-2845,(2010).

5. M. Matkar& P. M. Ravanan “Thermal Analysis of Copper Fin by FEA”. *International Conference on Operations and Quantitative Management*. Nasik, India. (2011).
6. P. Agarwal, *et al*. “Heat Transfer Simulation by CFD from Fins of an Air Cooled Motorcycle Engine under Varying Climatic Conditions”. *Proceedings of the World Congress on Engineering,* Vol-3, pp 6-8, (2011).
7. Barhatte, *et al*. "Experimental and Computational Analysis and Optimization for Heat Transfer through Fins with Different Types of Notch." *Journal of Engineering Research and Studies E-ISSN 976: 7916*. (2011).
8. A. Mishra, *et al*. "Heat Transfer Augmentation of Air Cooled Internal Combustion Engine Using Fins through Numerical Techniques." *Research Journal of Engineering Sciences ISSN 2278:9472*. (2012).
9. J. Ajay Paul[1], SagarChavan[2], Vijay Magarajan[3]& R.ThundilKaruppaRaj[4], “Experimental and Parametric Study of Extended Fins In the Optimization of Internal Combustion Engine Cooling Using CFD”, *International Journal of Applied Research in Mechanical Engineering,* Vol-2 (1), (2012).
10. G.Raju[1], Bhramara Panitapu[2], & S. C. V. RamanaMurty Naidu[3]. “Optimal Design of an I C engine cylinder fin array using a binary coded genetic algorithm”. *International journal of Modern Engineering Research,* Vol-2(6), pp 4516-4520 (2012).
11. S.S.Chandrakant, *et al*. "Numerical and Experimental Analysis of Heat Transfer through Various Types of Fin Profiles by Forced Convection." *International Journal of Engineering Research & Technology,* Vol-2(7), (2013).
12. R. Sam Sukumar[1], G.Sriharsha[2], S. Bala Arun[3], P.Dilip kumar[4], &Ch. Sanyasi Naidu[5], “Modelling And Analysis Of Heat Sink With Rectangular Fins Having Through Holes”. *International Journal of Engineering Research and Applications* Vol-3(2), pp.1557-1561, **(**2013).
13. Sami *et al* “CFD Simulation of heat transfer and friction factor augmentation in a circular tube fitted with elliptic-cut twisted tape inserts” *Hindawi Publishing Corporation, Mathematical problem in Engineering* Vol-13(163839), pp 1-7,(2013).
14. Phani Raja Rao& T Vishu Vardhan “Thermal Analysis of Engine Cylinder Fins By Varying Its Geometry And Material”. *International Journal of Engineering Research & Technology,* Vol-2(8), pp 404-412, (2013).
15. G. Babu, & M. Lavakumar “Heat Transfer Analysis and Optimization of Engine Cylinder Fins of Varying Geometry and Material”. *IOSR Journal of Mechanical and Civil Engineering,* Vol-7(4), pp 24-29, (2013)
16. Arvind S.Sorathiya[1], Ashishkumar N. Parmar[2], &Pravin P. Rathod[3] “Review Paper on Effect of Cylinder Block Fin Geometry on Heat Transfer Rate of Air-Cooled 4S SI Engine”. *International Journal of Recent Development in Engineering and Technology,* Vol-2(1), pp 33-38, (2014).
17. Mohsin A. Ali[1]& S.M Kherde[2] “Design Modification And Analysis Of Two Wheeler Cooling Fins-A Review” *International Journal of Engineering and Applied Sciences*, Vol-5, pp 30-33, (2014).
18. Russi Kamboj[1], Sunil Dhingra[2, &]Gurjeet Singh[3] “CFD Simulation of Heat Transfer Enhancement by Plain and Curved Winglet Type Vertex Generators with Punched Holes”. *International Journal of Engineering Research and General Science* Vol-2(4),pp 648-659, (2014).
19. P. Sai Chaitanya[1], B. Suneela Rani[2], & K. Vijaya Kumar[3] “Thermal Analysis of Engine Cylinder Fin by Varying Its Geometry and Material”. *IOSR Journal of Mechanical and Civil Engineering,* Vol-11(6), pp 37-44, (2014).
20. Deepak Gupta &Wankhade S.R. “Design and Analysis of Cooling Fins” *ISSN Print 2331-5747*, Vol-3(2), pp 1-4, (2015).
21. Ali hamazahKadim Al Shabani, University of Al Qadisiya. “CFD Simulation of Unsteady State Thermal Anlalysis for Circular Fins”. *Industrial Engineering Letters ISSN,* Vol-5(12), (2015).

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