ISSN No: 2348-4845
International Journal & Magazine of Engineering,
Technology, Management and Research
A Peer Reviewed Open Access International Journal

CFD And Thermal Analysis of Heat Sink With Perforations With Different Profiles

Shreeshail M Totad
M.Tech Student
Department of Mechanical Engineering
Ellenki College of Engineering and Technology.

K Aparna
Assistant Professor
Department of Mechanical Engineering
Ellenki College of Engineering and Technology.

ABSTRACT
In this thesis, CFD analysis is performed to investigate the heat transfer characteristics of heat sink with different models of perforations. The heat transfer characteristics are compared for different profiles of the perforations considered in this thesis are hexagon, pentagon, elliptical and circular. Thermal analysis is be done by varying the materials used for heat sink Copper and Aluminum alloys. 3D models will be done in Pro/Engineer and analysis is done in Ansys. Theoretical calculations are also done.

INTRODUCTION
Now- a- days the microelectronics and micro-electromechanical systems plays a vital role in development of technological fields. By use of MEMS we can determine the temperature and pressure of micro particles by using sensors. The recent technology involves the demands for greater speed, more power, and less volume and mass have become more and more urgent in most of the forms and n products of the science and technology. The urgency in this operation is due to the changes in the operation of elevated temperatures which is an undesirable consequence. Since the systems tend to operate at higher energy levels, requirements are also emerging for the development of new devices that can remove the greater amounts of thermal energy and can dissipate the higher heat fluxes. The need for greater efficiencies and improved life cycles, which are combined with less thermal stresses, Accelerated creep, and fatigue behaviours, is growing too. Microprocessor microelectronics and gas turbine industries are the two most concerned industries in mechanical stream. The former one is very peculiar with its concentrated efforts on dramatically reducing the size and increasing the speed of its attainments. This resulted in higher functional temperatures, which created a severe operational condition with the significant effect of limiting the life span of the devices. Due to the criticality in the heat removal process in the practical version, it made the interest in micro heat exchangers which is most essential. The current methods of heat transfer characteristics of a block with specified hole or without hole till now we saw the research on this experimentation only. Our motivation is to draw the heat transfer characteristics, velocity and temperature distribution of an aluminium block with tapered circular and hexagonal holes with specified dimensions.

LITERATURE REVIEW
[1]In this model they determine the heat transfer factor by using CFD analysis. It is difficult to determine heat transfer factor experimentally. So they use CFD analysis. In the present work, they combined laminar and turbulent diffusion of energy in the airflows. A physical definition is presented based on the one-dimensional thermal transport equation without advective and transient terms. This study intends to clarify and explain the nature of heat transfer factor between air layers in the block model and to promote its real applications. From this experiment we take the laminar flow characteristics of fluid as air and also we use the CFD software for the solving of block with different shaped holes (like tapper, circular).[2]From this article we observe the fluid flow and conjugate-

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

convective heat transfer characteristics for the three dimensional array of rectangular perforated fins with square windows that are arranged in lateral surface of fins arrangement shown in the figure below. From this journal we designed our block with specified dimensions. For investigation, Navier-Stokes equations are used. Computations are carried out for Reynolds numbers of 2000-5000 based on fin thickness and pr=0.71.Fin efficiency of perforated fins is determined and compared with equivalent solid fin and results show that new perforated fins have higher total heat transfer for considerable weight reduction.[3]From this we predict that three-dimensional incompressible laminar fluid flow and heat transfer of a heated array of rectangular perforated and solid fins attached on a flat surface as shown below are studied numerically. Thermal performance and effectiveness of perforated and solid fins are determined and compared. Higher performances for perforated fins are observed and effectiveness increased by increasing number of perforations. Finally a new correlation is proposed to predict perforated fin effectiveness for the range of computation carried out for the considered fins.

CALCULATIONS

Heat transfer coefficient values of an aluminium block and with a base

$Re=\rho vL/\mu$

$Nu_x = 0.332\ Re^{0.5}\ pr^{0.333}$

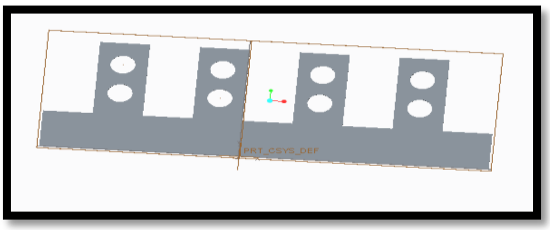
Substituting both Reynolds number and Prandtl number

$Nu = hl/k$

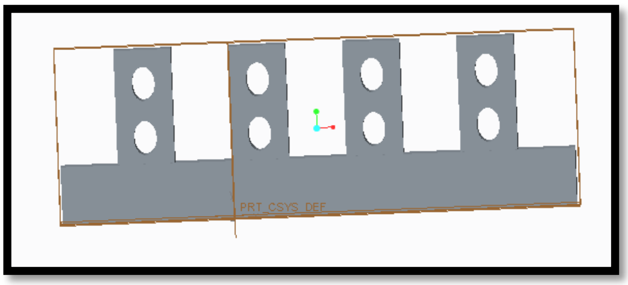
CREO MODELING

CIRCULAR – ORIGINAL MODEL

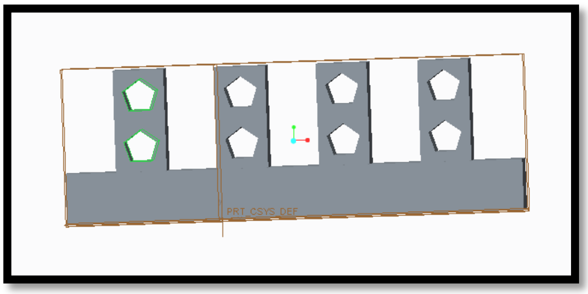
Solid modeling



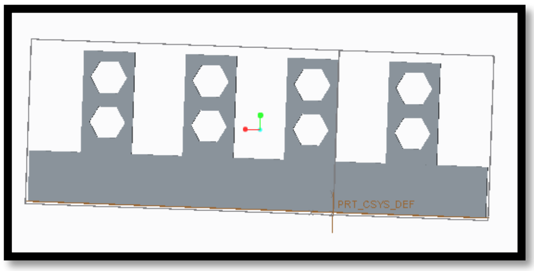
ELLIPTICAL



PENTAGON – ORIGINAL MODEL



HEXAGON – ORIGINAL MODEL

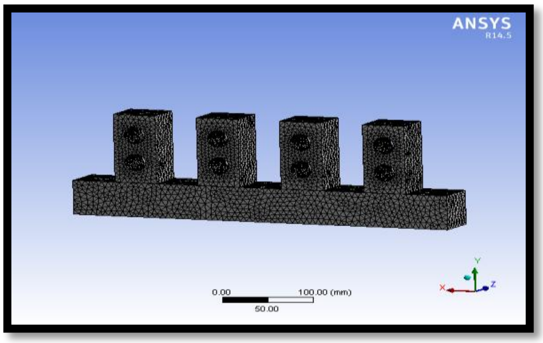


CFD ANALYSIS

CIRCULAR

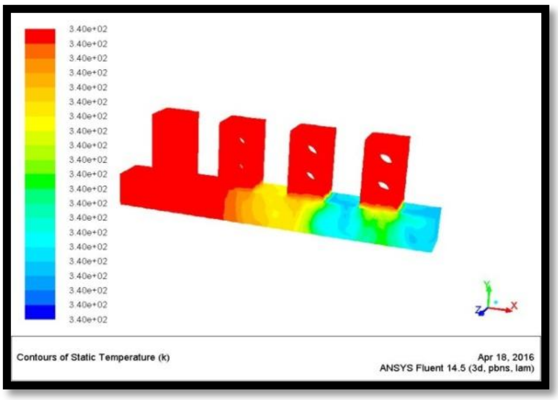
The Boundary conditions for the CFD analysis is taken from the calculations. Velocity = 3m/s and Temperature = 315K

Meshed model

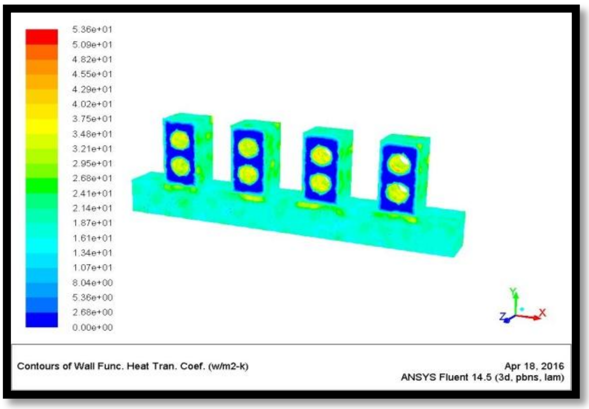


ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Temperature

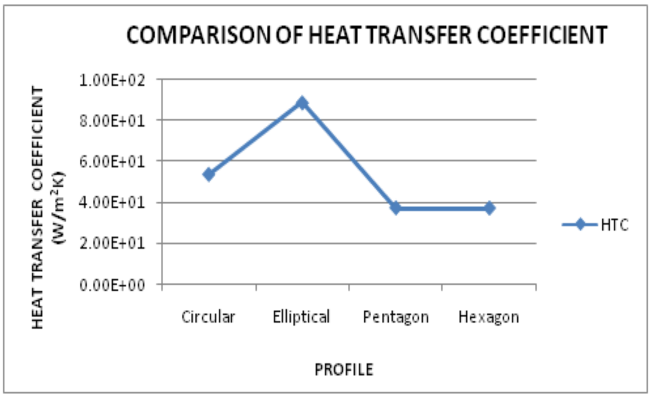


Heat Transfer coefficient



RESULTS TABLE

CIRCULAR		ELLIPTICAL		PENTAGON		HEXAGON	
Temperature (K)	Heat coefficient (W/m² K)	Temperature (K)	Heat coefficient (W/m² K)	Temperature (K)	Heat coefficient (W/m² K)	Temperature (K)	Heat coefficient (W/m² K)
3.40e+02	5.36 e+01	3.40e+02	8.87 e+01	3.40e+02	3.72 e+01	3.40e+02	3.71 e+01

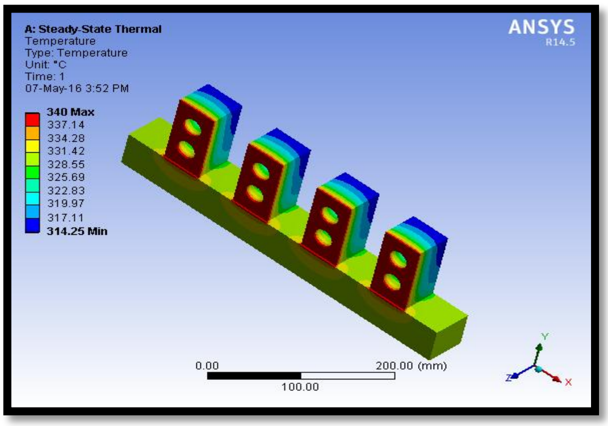


THERMAL ANALYSIS OF FINS

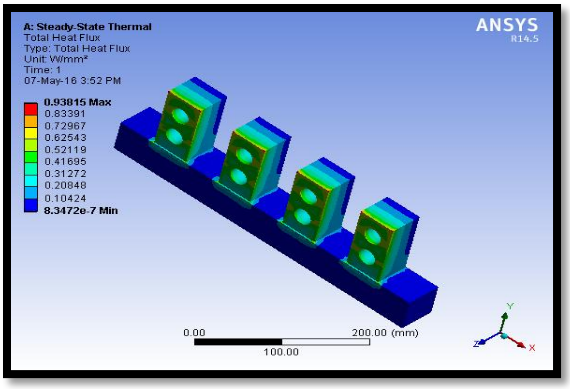
CIRCULAR

MATERIAL – COPPER

Temperature



Heat flux



RESULTS TABLE

CIRCULAR

	Temperature (K)	Heat flux(W/mm²)
Copper	340	0.93815
Aluminum	340	0.70821

ELLIPTICAL

	Temperature (K)	Heat flux(W/mm²)
Copper	340	1.7488
Aluminum	340	1.0086

PENTAGON

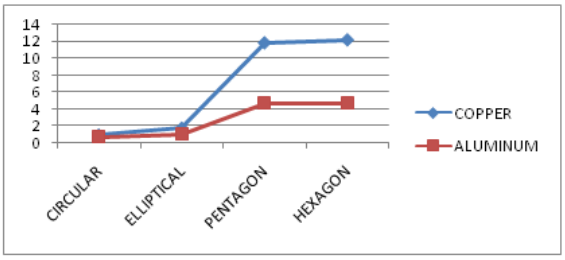
	Temperature (K)	Heat flux(W/mm²)
Copper	340	11.817
Aluminum	340	4.667

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

HEXAGON

	Temperature (K)	Heat flux(W/mm^2)
Copper	340	12.16
Aluminum	340	4.6746

GRAPHS



CONCLUSION

By observing the CFD analysis results, the heat transfer coefficient values for heat sink with Elliptical perforations. When compared, the heat sink with elliptical perforations is more by 40% than that of circular, by 58% that that of pentagon and by 58.17% than that of hexagon perforations. By observing the thermal results, the heat flux (i.e) heat transfer rate values for heat sink with Hexagon perforations. When compared between the results, Copper has higher values than that of Aluminum alloy.

REFERENCES

[1] Xiaoling Yu , Jianmei Feng, Quanke Feng, Qiuwang Wang, "Development of a Plate-Pin Fin Heat Sink and its Performance Comparisons with a Plate Fin Heat Sink", Applied Thermal Engineering 25, 2005, pp.173–182.

[2] Dong-Kwon Kim, Sung Jin Kim , Jin-Kwon Bae, "Comparison of Thermal Performances of Plate-Fin and Pin-Fin Heat Sinks Subject to an Impinging Flow", International Journal of Heat and Mass Transfer 52 , 2009, pp. 3510–3517.

[3] Abdullah H. AlEssa, Ayman M. Maqableh and Shatha Ammourah," Enhancement of Natural Convection Heat Transfer from a Fin by Rectangular Perforations with Aspect Ratio of Two", International Journal of Physical Sciences, volume 4 (10), Oct. 2009, pp. 540-547.

[4] E.A.M. Elshafei, "Natural Convection Heat Transfer from a Heat Sink with Hollow/Perforated Circular Pin Fins", Energy 35, 22 April 2010, pp. 2870-2877.

[5] Monoj Baruah, Anupam Dewan and P. Mahanta,"Performance of Elliptical Pin Fin Heat Exchanger with Three Elliptical Perforations", ISSR Journals, Volume 3 (2), June 2011, pp. 65-70.

[6] Anupam Dewan, Rajesh Kumar Shukla, "Computation of Turbulent Convective Heat Transfer in a Hollow Cirular Pin Fin Heat Exchanger", Proceedings of the 21st National and 10th ISHMT-ASME Heat and Mass Transfer Conference, IIT Madras, India, 27-30 December 2011.

[7] Ji-Jinn Foo, Shung-Yuh Pui, Yin-Ling Lai, Swee-Boon Chin, "Forced Convective Heat Transfer Enhancement with Perforated Pin Fins Subject to an Impinging Flow" , SEGi Review, volume 5, number 1, July 2012, pp. 29-40.

[8] G.Ganesh Kumar, "Comparative Studies on Conjugate Mixed Convection in Perforated Fins", International Journal of Science and Research, 2013, pp. 2319-7064.

[9] R. Sam Sukumar, G.Sriharsha, S.Bala Arun, P.Dilip kumar, Ch.Sanyasi Naidu, "Modelling and Analysis of Heat Sink with Rectangular Fins Having Through Holes", International Journal of Engineering Research and Applications, volume 3, issue 2, March-April 2013, pp.1557-1561.

[10] Amol B. Dhumne, Hemant S. Farkade, "Heat Transfer Analysis of Cylindrical Perforated Fins in Staggered Arrangement", International Journal of Innovative Technology and Exploring Engineering, volume 2, issue 5, April 2013, pp. 2278-3075.