International Journal of Advanced Engineering and Technology
ISSN: 2456-7655; Impact Factor: RJIF 5.54
Received: 07-12-2020; Accepted: 22-12-2020; Published: 08-01-2021
www.newengineeringjournal.com
Volume 5; Issue 1; 2021; Page No. 01-03

Strategy of heat transfer fins of altered constituents and geometries

Shraddha Sonone, Dhiraj Khobragade, Harshal Burde, Akshay Nagelwar, Prajwal Bhoyar
Student (Mechanical Engineering), SGBAU, Yavatmal, Maharashtra, India

Abstract
In this project work, we are going to design the cylindrical fins. Fins are integral part of any heating or cooling system. Our prime objective is to obtain optimum heat transfer rate which will result in producing highly efficient fins. The main objective of this project is to present thermal analysis which is subjected to temperature variation on fins by varying temperature and materials. We know that by increasing the surface area we can increase the heat dissipation rate. This will help to determine better geometry and materials for fins to achieve better heat transfer coefficient. When any fluid flows through rectangular duct with heated object placed inside it, a respective pattern of flow carries heat through convection and radiation. Different profiled objects may give different rate of heat transfer. Hence the objects like pin fin with enhanced surface areas (Perforated) placed inside the duct, the heat transfer rate will be maximum. In this study, a review of different author's research and their papers is carried out to understand the flow through the rectangular duct. Some of other cases are also studied and reviewed. All that methods are summarized and explained. Rate of heat transfer, mass flow rate, inside velocity, pressure and other associated parameters are studied and explained.

Keywords: optimum heat transfer, thermal analysis, geometry, fluid flow, heat transfer rate, pin fin, mass flow rate

Introduction

Heating of a component under different working application is a big problem for today's engineering application, therefore fast heat transfer from heated surfaces, reducing cost and material weight has turned into major challenge for heat transfer. Pin fins are broadly utilized as a part of heat exchanging body which result in enhancing the heat exchange between the surface of the body and ambient fluid by doing thermal analysis on the fins, it is helpful to know the heat dissipation and rate of heat transfer in different types of fins. A fin is a surface that extends from an object to increase the rate of heat transfer to or from the environment by increasing convection. We know that by increasing the surface area of pin configuration we can increase the heat dissipation rate of this process. For the principle of conduction, convection, radiation which determines the amount of heat transfer increasing the temperature difference between the fin configurations. The performance of heat transfer and Laminar or turbulent flow models in predicting the velocity and temperature fields of relevant industrial flows has become importance during the last few years. This requirement for improved predictive performance is also true for turbulent flows which occur frequently in industrial applications such as compact heat exchangers gas turbine cooling systems, cooling channels in combustion chambers, intercoolers and nuclear reactors. Heat transfer in Fins is the exchange of Heat from a Higher to low temperature. Exchange of heat develops till body and the environment reach a similar temperature. As indicated by the second law of thermodynamics, 'Where there is a temperature contrast between objects in nearness, heat exchange between them can never be stopped'; it must be backed off. Heat is the energy in travel between frameworks which happens by ideals of their temperature variations when they communicate.

Literature survey

Basavaraj Olekar, Ganesha T, "Experimental and Numerical Analysis of Cylindrical Pin Fins having Square Thread with and without Perforations by Natural and Forced Convection". In their paper experimentally the rate of heat transfer and flow characteristics are studied. The heat transfer rate of Square Threaded pin fins with and without perforations in inline and staggered pattern are investigated experimentally. Trials were conducted for varying Reynolds number and results were found out respectively for each pin fins. The heat transfer rate of Square Threaded pin fin with perforations shows higher amongst each other. Deepak Kumar Gupta, "CFD Analysis of Heat Transfer on Duct". For their paper, a 3-D model has been developed and SST k-ω turbulent model is to be selected for simulation because it gives better turbulent model. The Results shows a good relation between outlet temperature and Inlet temperature for enhancing the heat transfer. From analysis, triangular duct plate fin array inserts increase the heat transfer rate with expectation of mass flow rate of fluid. Ankit Vyas, Sandeep Gupta, Sunil Gupta, "Determining relation among Shape of Perforation and Convective Heat transfer from Lateral fin arrangement using Simulation by Computational Fluid Dynamics". Heat transfer removal from surfaces has a great importance in many engineering application including high heat generation rate from heat source, excessive rubbing or high speed flow problem from solid surface size, shape and arrangement of fin can be utilized further to enhance the heat transfer phenomenon. In their article shape factor of perforation is studied for optimizing heat transfer and navel method are introduced to find out the optimum shape for which heat transfer can be maximize for given flow condition. Ravi Teja, Pathan F Z, Mandar Vahadne, "Optimization of Heat Transfer through Rectangular Duct". Their study comprehensively simulate the use of laminar and k-ε model for predicting flow and heat transfer with measured flow field data in a stationary duct which sheds light on the detailed physics encountered in the fully developed flow region, and the sharp 180° bend region. Understanding of the unsteady heat transfer in sharp 180° bends is important. The design and simulation are related to concept of fluid mechanics, heat transfer and thermodynamics. Simulation study has been conducted on the response of turbulent flow in a rectangular duct in order to evaluate the heat transfer rate along rectangular.

Types of fins and material used

Types of fins

a. Square Fin

It is square in shape and having square cross section in geometry to judge its heat dissipation capacity. Heat is conducted from the base in to the fin at its root and then while simultaneously conducting along the length of the fin, heat is also convected from the surface of the fin to the ambient fluid with the convective heat transfer coefficient of h in W/m2–Kelvin.

b. Spiral Fin

It is spiral in shape and having spiral cross section in geometry to judge its heat dissipation capacity. Spiral fin provides higher air-side heat transfer performance and friction characteristics than those of the other kind of fins and mainly used heating, cooling and dehumidifying.

c. Circular Fin

It is circular in shape and having circular cross section in geometry to judge its heat dissipation capacity. Circular fin is also called a radial fin or circumferential fin. In circular fin coefficient for surface convection to the ambient air and qr is the heat flux for conduction in the radial direction.

Materials used in fins

a. **Aluminum:** Aluminum material is used in square fin and thermal conductivity of aluminum is 205 w/m.k, the main properties of aluminum is light in weight for fin and its strength at low temperature. Pure aluminum is soft, ductile, and corrosion resistant and has a high electrical conductivity. By using this material in fin of square type geometry the heat transfer rate in both natural and forced convection results in optimum rate of heat dissipation capacity.
b. **Copper:** Copper material is used in spiral fin and thermal conductivity of copper is 385 w/m.k, the main properties of copper is it has high melting point and it is malleable, ductile, and a good conductor of electricity and heat. By using this material in spiral type geometry the heat transfer rate in both natural and forced results a very good performance in heat dissipation capacity as compare to square and composite type of fin.
c. **Composite:** Composite material is used in circular fin and thermal conductivity of composite is 295 w/m.k, the composite material is of aluminum and copper. The properties of copper in fin is it has high melting point and it is malleable, ductile, and a good conductor of electricity and heat while aluminum is light in weight for fin and its strength at low temperature. Pure aluminum is soft, ductile, and corrosion resistant and has a high electrical conductivity.

Conclusion

It was designed an important graphical user interface to analyze and design fins for exchange of heat. Three case studies were performed, the temperature profile of different fins as a function of length for different materials, and the effect of thickness on the proper length of the fin and the heat transfer rate for copper and aluminum. The best working material was copper with the highest thermal conductivity (395W/moC). Low thickness involves low temperature in the extreme of the fin resulting in a low heat transfer in that zone. The higher the thickness, the higher the proper length. Between copper and aluminum, the best material for the same thickness is aluminum because it has the shortest proper length. Though, it is necessary to see the amount of heat removed. Aluminum removes less heat than copper. The composite fin gives result in between two.

Acknowledgement

The authors are willingly thankful to all the professors and mentors who help for the preparation of this paper and would also like to thank all the reviewers, our main authors for their comments to improve the quality and presentation of paper.

References

1. Balendra Singh, Satish Singh. “A Research Paper on Heat Transfer in Notch Fin and UN Notch Fin” International Journal for Research in Applied Science & Engineering Technology (IJRASET). ISSN. 2016; 4(9):2321-9653.
2. Basavaraj Olekar, Ganesha T. “Experimental and Numerical Analysis of Cylindrical Pin Fins having Square Thread with and without Perforations by Natural and Forced Convection.”, IJISET - International Journal of Innovative Science, Engineering & Technology, ISSN (Online). 2016; 3(7):2348-7968.
3. Azarkish H, Sarvari SMH, Behzadmehr A. “optimization design of a longitudinal fin array with convection and radiation heat transfer using a genetic algorithm”. International Journal of thermal Sciences. Elsevier, 2010; 49:589-602.
4. Ganesha Murali J, Subrahmanya S Katte. “Experimental Investigation of heat transfer enhancement in radiating pin fin”, Jordan Journal of Mechanical and Industrial Engineering, ISSN: 1995-6665. 2008; 2(3):163-167.
5. Javid Siddiqui, Gadekar AV. “A review paper on CFD Simulation of square threaded & helical twisted pin fin array in a rectangular channel to enhance heat transfer”, International Journal of Science and Research, ISSN 2319-7064, 2013, 365-372.
6. SM Wange, Metkar RM. “Computational Analysis of Inverted Notched Fin Arrays Dissipating Heat by Natural Convection”, International Journal of Engineering and Innovative Technology (IJEIT), 2013, 2(1).
7. Shivdas S Kharche, Hemant S Farkade. “Heat Transfer Analysis through Fin Array by Using Natural Convection”, International Journal of Emerging Technology and Advanced Engineering, 2012, 2(4).
8. Ganesha BB, Naveen Prakash GV. "Forced Convection Heat Transfer through the Rectangular Fins of Different Geometry of Perforations". International Journal of Recent Technology and Engineering (IJRTE) ISSN. 2019; 8(2):2277-3878.

9. Mageswaran C, Karthikeyan R, Muthukumaran R. "Heat Transfer Enhancement of Perforated Square Pin-Fin Array in a Rectangular Duct". International Journal for Research in Applied Science & Engineering Technology (IJRASET), ISSN: 2321-9653.