

Heat Transfer through Fins of Different Materials and Geometries: A Review

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ABSTRACT: In this paper the analysis of fluid flows through duct with heated object placed inside it and flow carries heat through convection. The rate of heat transfer depends on the flow velocity, surface area of exposure, other parameters and characteristics of materials. Different profiled objects may give different rate of heat transfer. Hence the objects like pin fin with enhanced surface areas placed inside the duct, the heat transfer rate will be better understood depending upon type of convection applied. In this study, a review of different author's research work and their papers is carried out to understand the flow through the duct with different geometries and materials. Some of other cases are also studied and reviewed. To perform flow analysis different methods and tools have been used by researchers. Rate of heat transfer, mass flow rate, inside velocity, pressure and other associated parameters are studied and explained.

KEYWORDS: Fluid Flow, Heat Transfer Rate, Pin Fin, Mass flow rate.

I. INTRODUCTION

Heat generation in a component under different working applications is a problem for real time studies, therefore optimum heat transfer from heated surfaces, reducing cost and material weight has turned to be a major challenge for heat transfer. Pin fins are broadly utilized for heat exchanging body which result in enhancing the heat exchange between the surfaces of the body and convecting fluid by doing thermal analysis on the fins, it is helpful to know the heat dissipation. A fin is a object that extend from an surface to increase the rate of heat transfer to or from the environment by increasing convection. It is well known fact that by increasing the surface area of pin configuration we can increase the heat dissipation rate of this process. The principle of conduction, convection and radiation which determines the amount of heat transfer increasing the temperature difference between the fin configurations. The performance of heat transfer in Laminar or turbulent flow models for predicting the velocity and temperature fields of relevant fluid flows has become importance during the last few years. It essential for obtain the optimum heat transfer in many engineering applications such as compact heat exchangers gas turbine cooling systems, cooling channels in combustion chambers, intercoolers and nuclear reactors etc. Heat transfer in Fins is the exchange of Heat from a Higher to low temperature and further it continues till the body and the environment reach to an equivalent temperature. Therefore it is essential that to find different profiles is required to perform by considering the actual experimental analysis.

II. REVIEW OF LITERATURE

Basavaraj Olekar, Ganesha T, stated the experimental investigation of the rate of heat transfer and flow characteristics. Also, 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 heat transfer rate. Deepak Kumar Gupta carried out analysis on 3-D model along with SST k- ω turbulent model for simulation because it gives better turbulent model. The validation 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 mass flow rate of fluid. AnkitVyas, Sandeep Gupta, Sunil Gupta worked on heat transfer removal from surfaces including high heat generation rate from heat source, excessive rubbing or high speed flow problem from solid surface size and shape. 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, MandarVahadne, in 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. P.Satheesh, K.ArunPandi, done the experimental work on engine cylinder is one of the major automobile components, which is subjected to high temperature variations and thermal stresses. In order to cool the cylinder, fins are provided on the surface of the cylinder to increase the rate of heat transfer. The paper is also stressed to analyse the thermal properties by varying geometry, material and thickness of cylinder fins. Transient thermal analysis determines temperatures and other thermal quantities that vary over time. Ganesh B B, G V Naveen Prakash, carried out investigation study on aluminium rectangular fins with triangular, rectangular and circular perforated fins are made under forced convection mode with different voltages, air velocities and fin spacing of 8 mm. Results are compared with solid fins with perforated fins of same spacing. results shows significant increase in heat transfer rate for perforated fins compared with solid fins under some conditions also there is a weight reduction up to 23.6% compared to solid fins.

III. DESIGN OF FINS AND ANALYSIS REVIEW

Sr. No.	Name of Investigator	Different Parameters Tested	Output
1	BasavarajOlekar	Square Threaded pin fins with and without perforations	The heat transfer rate in Square Threaded pin fin with perforations in staggered arrangement higher among each other arrangements in natural and forced convection.
2	Deepak Kumar Gupta	triangular duct plate fin array, a rectangular duct	a triangular duct plate fin array in a rectangular duct or pipe increase the thermal performance of the duct or pipe.
3	AnkitVyas	shape factor of perforation	Heat transfer rate is high for Rectangular shape of perforation
4	Ravi Teja	turbulent flow in a rectangular duct	heat transfer rate at stagnation point is found to be maximum
5	S. Srinivasan	analysis of air and steam cooling a rectangular channel with parallel ribs.	The heat transfer distributions of steam and air flow in the rib roughness channel are similar to each other.
6	P.Satheesh, K.ArunPandi	Thermal properties by varying geometry, material and thickness of cylinder fins	Heat transfer testing conducted by using fin-pin apparatus in two materials such as brass and aluminum. Among two materials the brass gives a better heat transfer rate.
7	R.J. GOLDSTEIN	Reynolds number 3000	The fin surface has higher array-averaged



		to 18,000 based on fin diameter and mean approach-flow velocity	Sherwood number than the end wall and the ratio between them changes with fin shape and Reynolds number.
8	Ganesha B B	aluminum rectangular fins with triangular, rectangular and circular perforated fins	For base pitch of 8 mm and 6 mm perforations, solid fins gives better heat transfer co-efficient. Also, circular perforated fins give high heat transfer co-efficient and triangular fins give very low Nusselt number at all voltages and velocities.

IV. CONCLUSION

This paper presents the study of an overview for heat transfer analysis of fins with different profile and materials. Heat Transfer rate is directly proportional to the surface fin area, flow velocity and room temperature. Heat Dissipation accurse along the flow through duct. CFD tools are one of the reliable methods for analysis of flow though duct where the Mass flow rate, Fin temperature, Inlet velocity etc, are the input parameters. Transient state thermal conditions are needed to simulate exact problem. It was also concluded that the more stress should be given to precise experimental investigations and then for analysis the multidimensional modeling to be done to obtain good validation of heat transfer characteristics.

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