CFD Analysis of Enhancement of the Forced Convection Heat Transfer over the Pin Fin with Trapezoidal Fin Micro channel

B. Siva Srinivas, B. Rama Krishna, D.Apparao

Abstract— **Steady state forced convection heat transfer from vertical trapezoidal fin array and oblique trapezoidal fin array Simulation was done for both in which amount of heat transfer rate is calculated and compared. Test results indicate that vertical trapezoidal fin orientation array yield the lowest heat transfer rate. However the oblique trapezoidal fin array gave the best performance of heat transfer rate. The proposed work is concerned with the analysis of the improved heat transfer by forced convection on trapezoidal fin array and analysis of the structure of flows in a CFD. The value of heat transfer coefficient obtained for the surface of Nusselt number of the pressure drop of the study, the heat resistance and the pressure drop of the heat to the vertical trapezoidal fin array information at different velocities in different heights is to examine the effect of a heat sink design .thermal resistance, pressure drop, and structure of the Nusselt number are compared with oblique trapezoidal fin array. Parameters such as the geometry of the heat sink, the height and the number of fins and the fin base height is regarded, in particular, the shape of the heat sink. The thermal model with various fin heat sink design of the geometry has been selected and the characteristics of the heat sink thermal fluid flow stream were studied. The pin fin plate and trapezoidal heat sinks of the fin geometry were used with base plate to improve heat dissipation. Some features formed in an infinite variety of geometries resulting in different heat transfer characteristics. The objective of the present work is to find the heat transfer rate and distribution of the airflow on surfaces with different parameters which are considered (height, speed) and all results will be compared with each other and the results have shown considerable increase in amount of heat transfer and Nusselt number in oblique trapezoidal fin array when compared to straight fin array for the same velocity of flow and both the properties have also been increased with increase in velocity.**

Index Terms— **Computational Fluid Dynamics, Pin-end heat sink, trapezoidal fin.**

I. INTRODUCTION

The most common method for the transfer of heat from the environment is to use a heat sink member. Estimate the junction temperature of a component, is the value of the desired heat sink thermal resistance. The thermal resistance of the heat sink can be determined by analysis or experiment. In electronic systems, a heat sink is a passive element. In the computer, the heat sinks for cooling the electronic components. Heat Sinks for high-performance semi-conductors, power transistor, and optoelectronic devices like light emitting diodes (LED), where in the heat capacity of the entire device base insufficient to regulate the temperature. Heat sink is cooling system as it requires new technologies that improve the thermal performance without cost penalties. Heat dissipation characteristics are incorporated. The results of breakthroughs thermal re-research and manufacturing are sought as new product offerings. Pin fin heat sink is of interest and should be investigated. An isometric model is developed to investigate the heat transfer rate and the combined heat sink for any item as electronic device. A series of numerical calculations have been carried out in common and the results are shown in order to represent the effects of the temperature distribution, overall coefficient of heat transfer, and thermal resistance surface Nusselt number in the heat sinks. Nowadays trend in electronics industry to produce small and compact size goods that can be accommodated in given space, which is constraint in many cases. The heat generated due to active components in such electronic devices is enormous, may be the order of 100 W/m^2. It is therefore necessary to remove the heat generated, which otherwise detriment to the life of such devices and their reliability. Heat sinks are used to remove the heat generated in electronic components. Heat sink is nothing but an array of fins or extruded surfaces remove the heat from the localized point through heat conduction and convective heat transfer process. Heat sink is attached to electronic chip to help prevent the chip from overheating.

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II. MODELING AND ANALYSIS

Modeling software Creo Parametric 1.0 creates geometry and the geometry is imported to the established Ansys 15.0, where the mesh is made and exports Fluent mesh. The Boundary conditions, material properties, and surrounding property are defined by the fluent file. Fixed a problem with the software to achieve the convergence limit is the number specified by the user to be implemented to achieve the iterations considered two cases to show vary with height of pin fin. And find out results from Ansys software R 15.0. Like Thermal Resistivity, Nusselt Number, with respect to air Velocity.

The procedure to solve the problem is:

1) Create geometry.
2) Mesh the domain
3) Define the material
4) Obtaining the solution

2 cases taken to show vary with height of pin fin. And find out results from Ansys software R 15.0. Like Heat dissipation, Nusselt Number with respect to air Velocity.

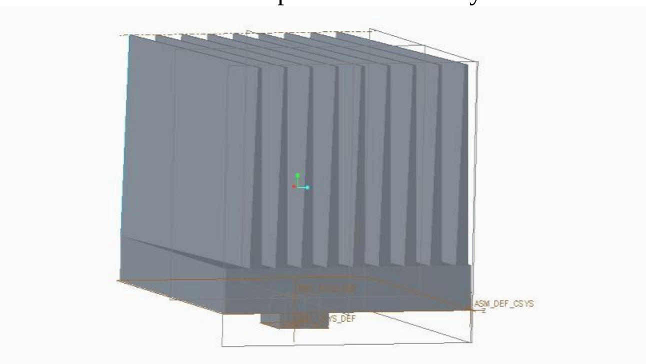

Figure 1 .vertical trapezoidal fin

Table.1.Fin Parameters for vertical Trapezoidal fin.

Fin No	Fin Height	Fin Length	Fin Thickness	Fin To Fin Distance
1	**67**	**110**	**15**	**12**

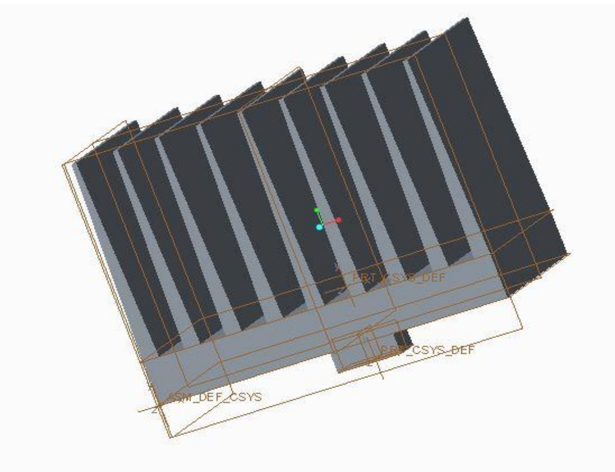

Figure 2 .Oblique trapezoidal fin

Table2. Fin Parameters for Oblique Trapezoidal fin.

Fin No	Fin height	Fin length	Fin Thickness	Fin to fin distance	Fin angle
2	**67**	**110**	**15**	**12**	**10^0**

Steps in CFD Calculation

CFD numerical algorithms can solve the problem code in the fluid. To facilitate access to their own power to solve all the commercial CFD software, including the input parameters of the problem, the complexity of the user interface and check the results. Therefore, all the code is composed of three main factors: the CFD calculations, there are three main steps

1) Pre- treatment

2) Resolution

3) The post-processing.

Solving the CFD Problem

The component that analysis and work the problem is called the CFD solver. It produces the required results in a non interactive/ batch process. A CFD problem is solved as follows.

1) The partial differential equations are integrated over all control volumes in the region of interest. This is equivalent to applying a fundamental law of conservation for each control volume.

2) These integral equations are converted into a system of algebraic equations by generating a set of approximations for the terms in the integral equations.

III. SIMULATION AND ANALYSIS

Table 3 Straight profile heat transfer rate

HEAT TRANSFER RATE		
Air Velocity	**Straight Profile Simulation Result 1**	**Oblique Profile Simulation result 2**
5	20.0004	94.4337
10	89.241	28.565919
15	119.996	29.9445

Straight profile heat transfer rate

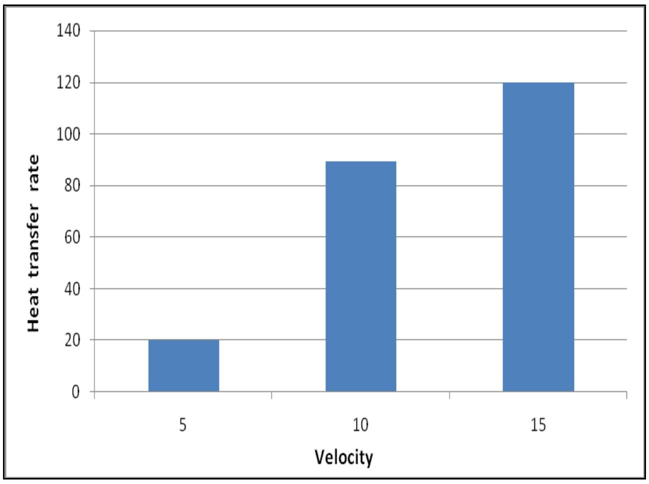

Figure 3: Heat dissipation and air velocity

Table 4 Nusselt numbers

NUSSELT NUMBER		
Air Velocity	**Straight Profile Simulation Result 1**	**Oblique Profile Simulation result 2**
5	5110	6220
10	8250	8560
15	9500	10850

Oblique profile heat transfer rate

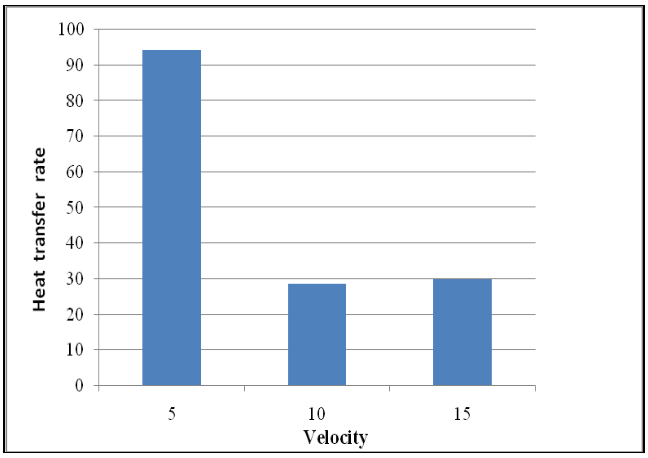

Figure 4: Heat transfer rate and air velocity

Comparison between straight and oblique profiles

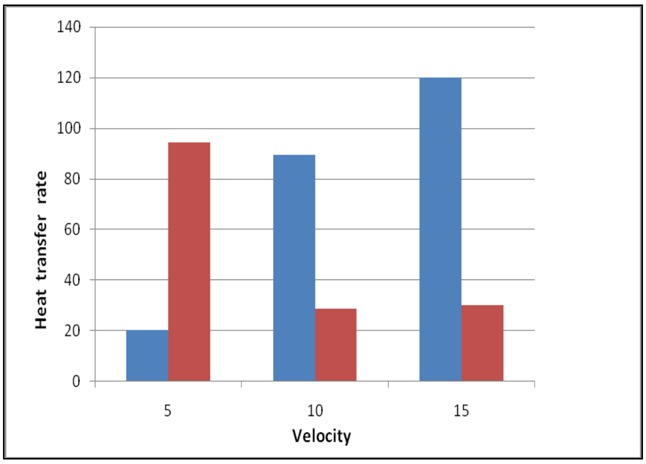

Figure 5**: **Heat dissipation and air velocity

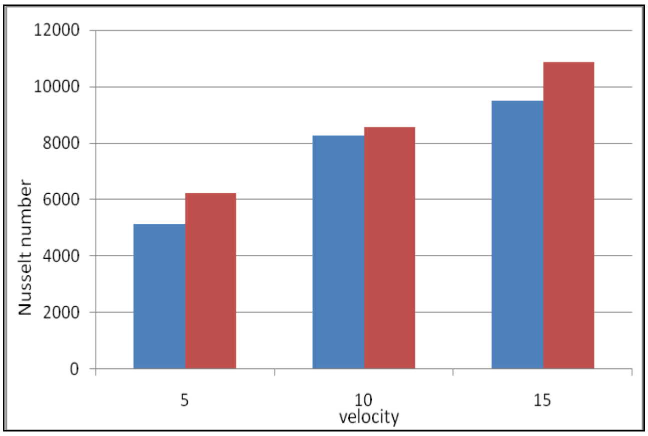

Fig 6: Nusselt number and air velocity

IV. CONCLUSION

From the above result analysis the heat transfer rate and distribution of the airflow on surfaces with different parameters which are considered and all results will be compared with each other and the results have shown considerable increase in amount of heat transfer and Nusselt number in oblique trapezoidal fin array when compared to straight fin array for the same velocity of flow and both the properties have also been increased with increase in velocity.

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