Analysis of rectangular interrupted fins models by using natural convection heat transfer-A review

[1]Sachin Wankhade, [2]Sanjay Chikalthankar, [3]Vishal Shelke, [4]Priya Madlapure
[134]Department of Mechanical Engineering, Dr D Y Patil Institute of Engineering & Technology Ambi, Pune
[2]Department of Mechanical Engineering, Government collage of Engineering, Aurangabad

Abstract: The excessive heat removal from system is the components is in essential to avoid the damaging effects of the overheating or burning. There for, enhancement of the heat transfer is an import of the subject in thermal engineering. Heat transfer from the surface may be general in enhanced by the increasing heat transfer coefficient between a surrounding and its surfaces, by increasing heat transfer surface of the area or by both. The heat transfer enhancement is the process increasing the effectiveness of the fin. Fins are extended surfaces designed to the increases heat transfer rate for fixed surface temperature, or lower surface temperature for a fixed heat transfer. the parameters of heat transfer of fin are affected by varying its shape and heat transfer in natural convection. The effect on heat transfer from inclined interrupted fin channels which has improve natural convection by the heat transfer.

Keywords-- Rectangular interrupted fins ; Natural Convection; heat transfer ; Extended Surface.

I. INTRODUCTION

Heat transfer from the surface may be general in enhanced by the increasing heat transfer coefficient between a surrounding and its surfaces, by increasing heat transfer surface of the area or by both. In the most cases area of heat transfer increases by increasing utilizing the extended surfaces in form of the attached fins to the surfaces and walls. Extended surfaces of the fins frequently used in heat exchanging devices for purpose of the increases heat transfer between the surrounding fluid and primary surface of the fin.

Fins are of the different geometries depending, upon practical applications. They may be of uniform cross-sectional area or variable cross section. To construct, design and investigation of heat transfer by using different modified fin and also fins should be cost effective and lighter systems. The geometric shapes we chose are rectangular, interrupted, staggered and perforated fins but all are of same surface area. Fins are the extended surface protruding from a surface or a body and they are meant for increases the heat transfer rate between surface and its surrounding fluid by the increasing area heat transfer. Many researchers have been mentioned through their literature, is a heat transfer rate is increased by increasing by heat transfer area or heat transfer coefficient rate. In case of natural convention there is only scope of increasing heat transfer area by providing finned surface. the ratio of enhancement heat transfer depends on geometric parameter of fin arrays and fins orientations fins orientations.

In the most common configurations of fins using arrays of heat sinks involves vertical or horizontal surface plate to the which fin number of arrays attached.

II. LITERATURE REVIEW

P. Moorthy. A.N Oumer [1] studied and reaserched the rectangular fins is the best in terms of high heat transfer rate in plane fin has the least heat transfer rate in performance but high efficiency is achieved. Fins are used widely engineering application including that power plant, transport, heating system The heat exchangers various type of fin used in include that plateway and rectangular fins. Wavy fins angle is the 162.1 mm and height are 1.5mm for suitable heat transfer. The performance increases in plain, wavy and rectangular orderly. Performance wavi fins 30 % and rectangular fin 69 %. Rectangular fins are higher performance of the fins. Rectangular fins produces highest heat transfer performance due to the interruption done by temperature boundary layer and staggered surface to the flow also the flow orientation. It is found that the rectangular fin has highest heat transfer performance as compared to plain fin and wavy. Wavy fins are higher than the plane fins.

Lenordomicheli, K.S. Reddy [2] studied and reaserched the scope is the presented paper is comparing thermal performance of a plate in micro fins arrays under the natural convection heat transfer condition in air, the investigation pin in micro fin can be improve the thermal performance as compared to plate micro fins arrays the under in natural convection is air condition. Then the pin fin is better heat dissipation. In the present investigation of the heat transfer coefficient on pin fin is natural convection in air has been find to be the higher than that of fin plate. The same power using heat transfer coefficient 3% to 6% higher than fin plate. This paper has been intended compared then the performance of plate micro fins and pin micro fin.

B. Jithendra Kumar [3] reaseached and studied fabrication and thermal analysis of pin fin the present work, an attempt is made to find the fin efficiency heat, Heat transfer rate, temperature distribution and heat transfer coefficient, for a solid and composite pin fin. From the results in the concluded that the efficiency, Heat transfer rate are higher for composite pin fin than that of solid pin fin. The efficiency for composite fin is improved by 22.05% and heat transfer rateimproved by 66.21%. when compared to solid pin fin.

Arun Eldhose1, Dr. Benny Paul2, Jelvin Tom Sebastian [4] has studied and researched - Fins are the surfaces that extend from an object. It helps in increases the heat transfer rate and thereby increase the life and efficiency of the devices. Heat transfer is take place by Conduction, Convection, and Radiation. Fins are mainly used in the field of automobiles, electronic devices, etc. The shape and the materials used have great effect in the thermal performance of the fin. Different shaped fins are used for different applications and Aluminum is the most common material that used for making the fin.

Nico Setiawan Effendi. Severianus S.G. Putra, Kyoung Joon Kim [5] has studied and reaserched that the investigate prediction method for natural convection hallow around the hybrid fin of the heat sinks (HHFHS). This HHFHS is in the staggered array of hallow pin fins concatenated with radially fin plate placed. 3D computational thermal models have been generated by using a commercial CFD Software packaged and using to develop correlations predict Nusselt numbers is around the HHFHSs. Nearly hundred cases under various parametric condition to be calculated by obtaining abroad range of thermal data. Correlation for Nusselt number has been obtained by considering the dependence on Rayleigh number, internal and external diameters and height of fin.

Abdullah, H. Alessa and Mohammed, Q. Al-Odat [6] “Had studied that by using equilateral triangular perforation on rectangular fin can increase the natural convection of the heat transfer rate. Geometrical dimensions effect of the perforated fin was studied in detail. Then the heat is released rate from the perforated fins is also compared to that the equivalent solid one without fins. Then the concluded that for a certain values of triangular dimension then the perforated fin can be results in increases the heat transfer rate. The amount of increase is in proportional to the fin thickness and its thermal conductivity K of the material. The extrusion of fins not only increases the heat dissipation rates but at same time it also to decreases the expenditure of the material by decreasing the material, Mass and weight of the object.”

Aparnasingh gaur [7] “They studied, the effect of the various parameters like geometry, Aspect ratio and various dimensions of the perforation and plate on the heat transferred by the rectangular fins with

square perforation is investigated with the help of software. In the effect of perforation and Aspect ratio on the heat transfer characteristics in determined. The Nusselt number is perforated fins arrays as well as Solid fin is to be arrays increases in Aspect ratio. Then the friction factor slightly increases in the size of perforation. Utilization of perforated fins increases heat dissipation .

V.karthikeyan [8] researched on Heat transfer through fin arrays with rectangular extensions higher than that of fin with other type of fins compared to it. Temperature at the end of fin arrays with rectangular extensions is Minimum as compare to fin with extensions, without extension and with Perforated. Fin arrays with rectangular extensions provide near about 13 % to 21% more than enhancement of heat transfer as compare to the other type of fins. Then this result may vary for forced convection Heat transfer.

M. J. Sable [9] has studied and researched as compared to be conventional vertical shaped fins this V type of fin partition plates works not only as extended surface but also as to flow tabulator. In order to be enhanced the heat transfer by V shaped partition fins with edges faced upstream were attached to the two identical vertical plates. The mica gladded Nichrome flat heating element was sandwiched in between these two base plates. It is supplied with stabilized A.C.supply. The electrical heat input was controlled through dimmer stat and measured using a wattmeter. The V-type partition plates with two different heights were tried. The heat transfer is the vertical downstream region of the partition plate is markedly enhanced when the plate is height exceeds certain critical value because of the inflows of the low temperature flow fluid into the separation of region

1-1 Power Electronics Cooling

The high power density electronics requirements design of the efficient cooling strategies is essential for a reliable for performance. Many of a failure mechanism in electronic devices to such as intermetallic growth, Metal migration growth, Migration, and void formation are closely related to thermal effects. In literature survey it is found, the rate of failure rate about double with in every 10°C increase above the operating temperature (~80°C) of the high power electronic system [11]. Another way the damage due to excess of heat is focus, it increases many times the movement of free electrons within semiconductors, causing an increase in signal noise [12]. So it is important to note Thermal management products which show a growth from approximately variation $7.5 billion in 2010 to $8 billion in 2011, and it is expected that it grow in 2016 to $10.9 billion, for a compound annual growth rate which increase of 6.4%. count for between 4% and 6% of the market, respectively.

a) rectangular b) radial c) pin fins

Figure. 1: Various types of fins

Vertical rectangular fins by using the natural convection heat transfer rate from is as shown in Figure 1-2, also from the pin fins is well studied subjected in the literature review. It has been investigated analytically numerically also experimentally. Then the following paragraphs provide to an overview on the mention literature of the subject. In the provide studied are grouped into analytical, numerical also experimental works.

Figure. 2: Heatsink with continuous rectangular fins.

The main focus in this study is natural convection heat transfer from an interruption, vertical and rectangular fins. However more general overview on these literature in area of natural heat transfer from fins provided in this section.

Three dimensionless numbers are important in natural convection heat transfer: the Nusselt (Nu) number, the Prandtl (Pr) number and Rayleigh number (Ra). These three non-dimensional numbers are used extensively in the heat transfer literature for analytical purposes only. These Number explain as the Nusselt number is ratio of convection heat transfer to fluid conduction in heat transfer under the same condition.

$$Nu_l = \frac{hl}{k}$$

Where l is length of fins, h is the convective heat transfer coefficient of the fins, and k is fluid thermal conductivity of the fins, respectively. Then the Prandtl number is ratio of the momentum diffusivity or kinematic viscosity to thermal diffusivity.

$$pr = \frac{\nu}{\alpha}$$

Where, ν is kinematic viscosity and α is thermal diffusivity of the fluid.

The last number is Rayleigh number Ra, where which is dimensionless number of associated with buoyancy driven flow. Where Ra is defined as, the product of Grashof number Gr which describes the relationship between buoyancy and viscosity within a fluid, and it is the Prandtl, in these cases of the uniform surface heat flux and uniform surface of temperature.

$$Nu_L = \left\{ 0.825 + \frac{0.387 Ra_L^{\frac{1}{6}}}{\left[1 + \left(\frac{0.492}{pr} \right)^{\frac{9}{16}} \right]^{\frac{8}{27}}} \right\}^2$$

$$Ra_L = \frac{g\beta\Delta TL^3}{\alpha\upsilon},$$

$$Gr_L = \frac{g\beta\Delta TL^3}{\upsilon^2}$$

where g is the gravitational acceleration and β is thermal expansion in coefficient to respectively. ΔT is the temperature different between the fins and ambient temperature.

III. Objectives

The previous section on literature review indicated that the mostly focus on the partient research in the area of natural convection heat transfer from fin, has been mostly on continuous fins. The pin fin is 2D and no in depth study has been performed to the investigation the natural convection heat transfer from interrupted fins for external heat transfer in natural convection. In the 3-D modelling of rectangular interrupted fins. In the mostly interrupted fins studied for internal natural convection as well as forced convection.

Interrupted fins 3D to be the more general form of the fins and it can include both continuous and pin fin at a limit of the fins interruption approaches zero In this closer look continuous fins and pin fins are two extreme cases of the targeted interrupted rectangular fins is adding interruptions leads to a heat transfer surface area reduction, which decreases the total heat transfer. There for these two competing effects clearly indicate that on optimum fins interruption exists that the provide the maximum heat transfer rate from naturally cooled heat sinks as shown in fig 2-1.

The goal of this study is to investigate the effect of adding interruption to the fins in 3D and determined by optimum value for different geometrical parameters of the fins arrays. The focus in mainly the fin length and fin interruption length. also have in order to study the natural convective heat transfer from interrupted fins, New concept, Effective length, is introduced and new relationship for the Nusselt number is developed based on the non-dimensional geometrical parameters by making analysis on interrupted 3D models.

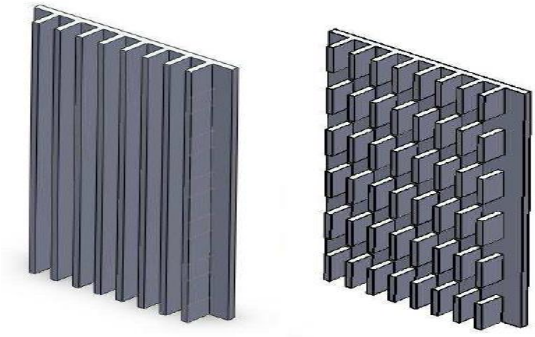
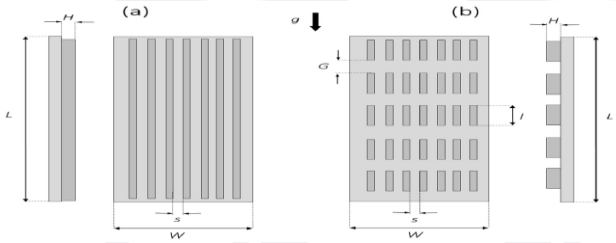


Figure. 3: Continuous and Interrupted rectangular fins

IV. METHODOLOGY AND MODELING

In a schematic diagram of the considered fin in geometry with there salient geometric parametric parameters is shown in fig. 2.2. When heat sinks is heated by the buoyancy force causes the surrounding fluid to start moving there for as a result in thermal boundary layers start to developed at bottom edges of the fins. This method is the boundary layers mostly merge if the fins or channels are sufficiently long continuous, creating a fully developed channel flow. Interrupted fins, therefore disrupt the thermal boundary layer growth also maintaining the thermally developed by flow regime and which can lead to a high natural heat transfer coefficient.



a) Continuous rectangular heat sink fin; b) Interrupted rectangular heat sink fin.

Fig.4. Schematic of the considered heat sink geometry.

The investigate in effect of fin interrupted by 3D and to determine an optimum fin length to the interruption ratio. We can started by the using the existing analytical models in [12]to calculate the fins spacing is optimum. This idea is to be decouple the effect of fin spacing from the fin interruption. Such as the fin spacing will be kept constant at its optimum value proposed by Rohsenowe Bar-Cohen model [13] analysis in throughout. We can also independently investigate the effect of fin spacing experimentally.

V.EXPERIMENTAL SETUP

In the experimental study is to investigate of the effect in fin interruption length as well as fins spacing in the natural convection heat transfer is considered rectangular vertical fins. In enable this investigation, two new custom-made test bed were designed. A number of heatsinks and single wall samples, with various geometrical parameters were prepared. In total, two series of the test were undertaken. The first series of tests was designed to investigate the effect of interruptions in 3-D and their comparison to the non-interrupted (continuous) 3-D channels (as shown in fig. 4-2). The second series of tests were undertaken to the validate in numerical data used for calculating the Nusselt number for in vertical fins.

In this experimental setup a new test bed has been designed for measuring natural convection heat transfers from fins to heat sinks. as shown in Fig. 4-1. set-up included by enclosure made enclosure made of poly(methyl)methacrylate (PMMA)which has insulated by the layer of foam with thickness of 10mm. These test bed also included also included 20 cm long Chromalox strip heaters (120 V, 150 W), which is attached to the 37 of fins in backside base plate and data acquisition system (DAQ).

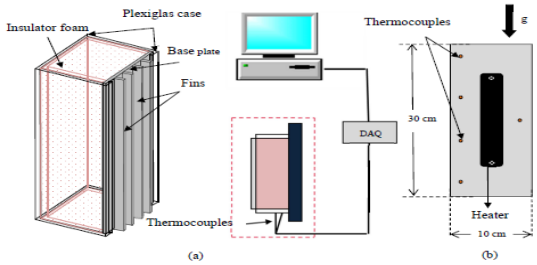


Figure.5: Experimental setup

VI.CONCLUSION

The present study provides a survey about Analysis of rectangular interrupted fins models by using by the natural convection of heat transfer, from long rectangular interrupted fins where both the continuous and interrupted must be keeping into account simultaneously. It is concluded from these review of interruption an important contribution of the analysing the natural convective heat transfer from the vertical fin. also with in similarity solution for boundary layer equations for the cases of uniform surfaces heat flux. The effect of an analytical study on the two parallel plates by using natural convective heat transfer. The three-dimensional bodies based on the squared roots of the wetted area correlation of the Nusselt number. The effect on the heat transfer from inclined interrupted fin channels which has improve natural convection heat transfer which are applicable of the variety of electronics, Power electronic as well in telecom application.

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