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REVIEW OF NATURAL CONVECTION HEAT TRANSFER FROM DIFFERENT CONFIGURATION OF HORIZONTAL RECTANGULAR FIN ARRAYS

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ABSTRACT

Fin arrays on horizontal and vertical surfaces are used in variety of engineering applications to dissipate heat to the surroundings. Studies of heat transfer and fluid flow associated with such arrays are therefore of considerable engineering significance. The main controlling variables generally available to the designer are the orientation and the geometry of the fin arrays. In case of short horizontal arrays, it is observed that the air entering symmetrically from both the ends gets heated as it moves towards the Centre of the fin channel, as well as it rises due to decrease in density. So, the central portion of the fin becomes ineffective because hot air-stream passes over that part and therefore it does not bring about large heat transfer. The purpose of the present study is to investigate thoroughly the possibility of performance improvement of such arrays by providing a notch at the Centre and suggest for selection of optimum notch dimensions, and spacing by analyzing variety of fin Configuration.

INTRODUCTION

Fins are used to enhance convective heat transfer in a wide range of engineering applications, and offer a practical means for achieving a large heat transfer surface area without the use of an excessive amount of primary surface area. Fins are commonly applied for heat management in electrical appliances such as computer power supplies or substation transformers. Other applications include Internal Combustion engine cooling, such as fins in a car radiator. Natural convection heat transfer is often to increase by provision of rectangular fins on horizontal or vertical surfaces in many electronic applications, motors and transformers. Thus heat transfer from fin arrays has been studied experimentally. The current trend in electronic industry is microminiaturization of electronic packages. The thermal design problem is recognized as one of the factors limiting achievement of higher packaging densities. Because of reduction in surface area available for heat dissipation, optimization of fin surface area and geometry becomes very important in natural convection heat transfer.

LITERATURE REVIEW

Recent work that has been carried out for evaluation of heat transfer coefficient of air flowing from Horizontal Rectangular fin array with a Rectangular Notch and Triangular Notch with different Configurations.

N.K. Sane et al. [1] performed experimentation on Natural Convection Heat Transfer from Horizontal Rectangular Inverted Notched Fin Arrays. The values of 'h' are 50–55% higher for investigation on normal and inverted notched fin arrays (INFAs) giving better performance. For smaller spacing, increment in 'h' is small due to the flow constriction effect.

N.G. Narve et al. [2] worked out experimental investigation to observe heat transfer characteristics of natural convection heat flow through vertical symmetrical triangular fin arrays and its results were compared with equivalent rectangular fin arrays. They observed that parameters like spacing and Grash of number plays vital role in improving the heat transfer characteristics of fin arrays. Symmetrical triangular fin arrays on vertical surface has provided increased average and base Nusselt number over the equivalent rectangular fin arrays. Overall heat transfer characteristics of symmetrical triangular fin arrays are better than rectangular fins.

P.R. Kulkarni [3] carried out experimentation on Natural Convection Heat Transfer from Horizontal Rectangular fin arrays with a Triangular Notch at the Center. They conclude that the Notched fin configuration performs 40-42% better heat transfer coefficient than normal fin array.

S.R. Dixit et al. [4] their study had carried investigated total heat flux as well as the heat transfer coefficient increase as the notch depth increases. The performance of inverted notched fin arrays is 30 to 50% superior than corresponding un-notched arrays, in terms of average heat transfer coefficient.

S.R. Pawar et al. [5] carried out experimental investigation in this, material from fin array stagnant portion is removed in the shape of triangular notch from the central bottom portion of fin and added on top side to modify its geometry for analysis. The fin weight remains same. Three types of fin arrays have been analysed that are fin array with 0%, 20% and 40% notch. The results are compared that heat transfer coefficient, Nusselt no. and effect of notch. With increase in heat input, heat transfer coefficient (h) also increases for all types of fin arrays whether it is notched or without notch fin array. Nusselt number increases with increases with increase in heat input as well as increases in notch area.

S.D. Wankhede et al. [6] discusses about inverted notched Fin configurations and notched configurations yield 50–55% higher values of heat transfer and coefficient of heat transfer compared with the un-notched fin for natural convection. For force convection, the notched configurations yield 60–65% higher values predicted for heat transfer and coefficient of heat transfer compared with the un-notched fin.

G.P. Lohar et al. [7] worked out on horizontal rectangular fin array under natural and forced convection it is observed that, the values of average heat transfer coefficient ha increases as the distance between the fin increases but this trend does not remain same and later heat transfer coefficient decreases after the fin spacing of 16 mm .The average heat transfer coefficient is maximum when the spacing between the fin is 14 mm to 16 mm. Later the average heat transfer coefficient decreases as the fin spacing increases. But in case of the forced convection the maximum heat transfer coefficient is obtained between the fin spacing of 12 mm to 14 mm and near about 36 % heat transfer is increased in case of the forced convection.

A.A. Walunj et al. [8] discussed about geometric parameters of fin array i.e. fin height, fin spacing, fin length, fin thickness, number of fins affects convective heat transfer rate. Rectangular fins with vertical base vertically orientation has maximum heat transfer rate. Optimum fin spacing which maximizes heat transfer is a function of fin height and fin length. Fin thickness has not significant effect over heat dissipation.

OBJECTIVES

i. To determine the heat transfer characteristics experimentally for horizontal rectangular fin arrays, horizontal rectangular fin arrays with a semi circular profiled notch at the center and horizontal rectangular fin arrays with a semi circular profiled notch at the center with area compensated type configurations.

ii. To analyze the effect of different parameters like height, spacing of fins on heat transfer coefficient in case of horizontal rectangular fin arrays, horizontal rectangular fin arrays with a semi circular profiled notch at the center and horizontal rectangular fin arrays with a semi circular profiled notch at the center with area compensated type.

iii. To investigate thoroughly the possibility of performance improvement of such arrays by providing a profiled semi circular notch at the centre and suggest for selection of optimum dimensions and spacing by analyzing variety of fin configurations.

PROPOSED WORK

Following work will be carried out during the experimentation:

- **THEORETICAL WORK:**

i. To review the literature to find out the existing work done in this area and identify research issues.

ii. According to that different design parameters are selected to develop the experimental setup.

- Experimental Work:

i. To develop the experimental setup as per design.

ii. To conduct the experiment according to the different specified conditions of operation and noting down the set of readings for each specified operating condition.

iii. Calculation of the heat transfer characteristics like; heat transfer coefficient of air, Grashof No., Nusult No. for each of the configuration.

- **VALIDATION:**

  After performing the experiment, calculation of the heat transfer coefficient of air by using correlation method will be done. Finally the comparison of the results of experimental investigation with the results obtained by using correlation method will be done.

PROPOSED EXPERIMENTAL SET-UP

Proposed experimental set-up designed for determination of heat transfer coefficient of air flowing from and Horizontal Rectangular Fin Array is as shown in Fig.1. Similarly; experimentation is done for horizontal rectangular fin arrays with a semi circular profiled notch at the center and horizontal rectangular fin arrays with a semi circular profiled notch at the center with area compensated type configuration as shown in Fig. 2.

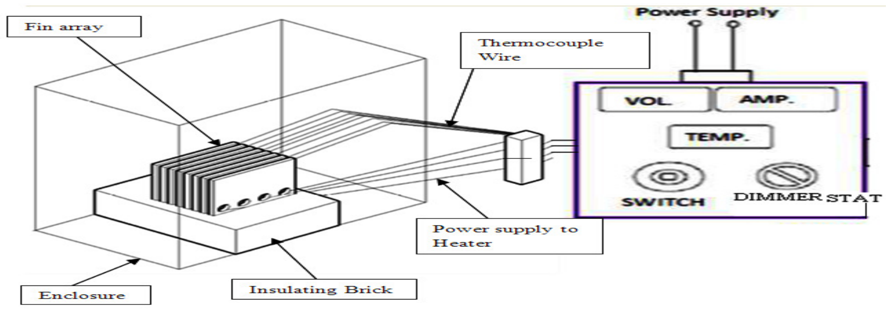
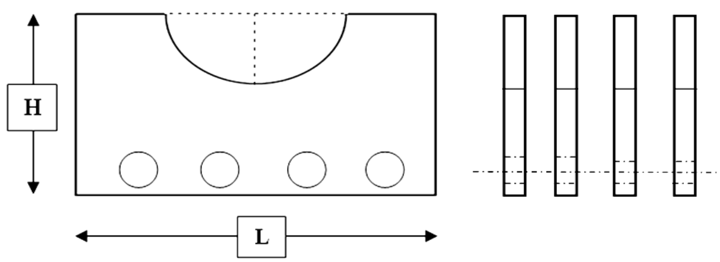
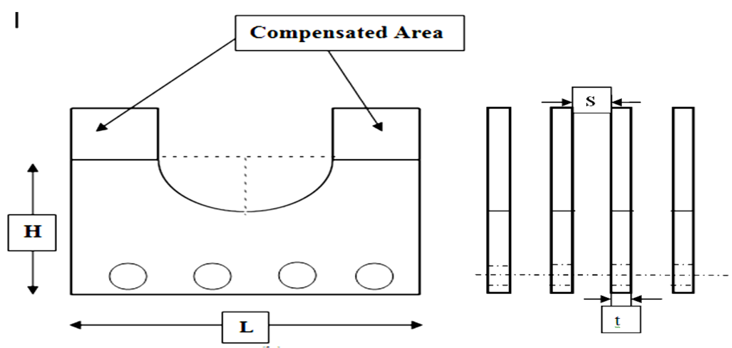


Figure 1. Proposed experimental set-up for Horizontal Rectangular Fin Arrays



a) Horizontal Rectangular Fin Arrays with a Semi Circular Profiled Notch at the Center



b) Horizontal Rectangular Fin Arrays with a Semi Circular Profiled Notch at the Center with area compensated type.

Figure 2. Proposed fin configuration

CONCLUSION

i. It is observed that total heat flux as well as the heat transfer coefficient increase as the notch depth increases in case of Triangular and Rectangular notched fin array.

ii. When this area is removed and added at place where it is more useful for heat transfer, the heat transfer increases and so does the convective heat transfer coefficient.

iii. The performance of rectangular notched fin arrays is 30 to 50% superior than corresponding unnotched arrays, in terms of average heat transfer coefficient.

iv. In proposed work the fins are modify with different configuration as shown in Fig.2

v. It will be interesting to investigate thoroughly the possibility of performance improvement of such arrays by providing a profiled semi circular notch at the centre and suggest for selection of optimum dimensions and spacing by analyzing variety of fin configurations.

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