Experimental Investigation of Heat Transfer by varying Inner Diameter of Circular Hollow Pin Fin

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Abstract— Heat transfer enhancement over surface results from the pin fin forming circular recesses. Heat Transfer enhancement using hollow pin fin. The aim of the present study is to improve the heat transfer characteristics and to investigate the performance of fin efficiency by using fins of different size hollow circular pin fin. Here the system follows natural convection as the mode of heat transfer and it is the principle used in it. This experiment accomplished by using brass circular pin fin, which connects to the thermocouple. From the heater the pin fin gets heated and the surrounding air convicted out it from the surface of the pin fin. This procedure followed for the fin of different inner diameter of size of hollow diameter. This paper studies the temperature variation along the fin length for the various inner diameters of hollow pin fin, under the natural convection.

Key words: Heat Transfer, Pin Fin, Various Inner Diameters of Hollow Pin, Temperatures, Pin Length

I. INTRODUCTION

The heat conducted through solids, walls or boundaries has to be continuously dissipated to the surroundings or environment to maintain the system in steady state conduction. In many engineering applications large quantities of heat have to be dissipated from small areas. Heat transfer by convection between a surface and the fluid surroundings it can be increased by attaching to the surface thin strips of metals called fins. The fins increase the effective area of the surface thereby increasing the heat transfer by convection. The fins are also referred as "extended surfaces". Fins are manufactured in different geometries, depending up on the practical applications Most of the engineering problems require high performance heat transfer components with progressively less weights, volumes, accommodating shapes and costs.

The heat transferred through the fins provides the problem of determination of heat flow through a fin requires the knowledge of temperature distribution through it. This can be obtained by regarding the fin as a metallic plate connected at its base to a heated wall and transferring heat to a fluid by convection. The heat flow through the fin is by conduction. Thus the temperature distribution in a fin will depend upon the properties of both the fin material and the surrounding fluid.

In this section, we will analyze circular pin fin with hollow pin fin having various inner diameter, with respect to temperature distribution. The experiment is conduct to investigate the effect of the different size of inner diameter of hollow circular pin fin.

In the present work brass pin fin was used as a test surface. Variation of inner diameter from zero (i.e. solid fin) to 2mm, 6mm and 10mm is investigated.

II. MATERIAL

A brass fin of circular cross section in fitted across a long rectangular duct. One end of the fin projects outside the duct and is heated by a heater. Temperature at five points along the length of the fin was measured with the help of five thermocouples.

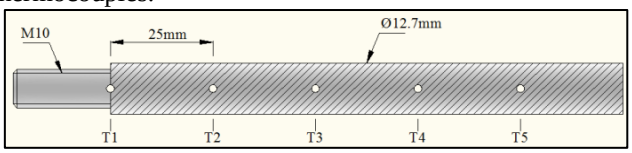

Fig. 1: Solid Pin Fin

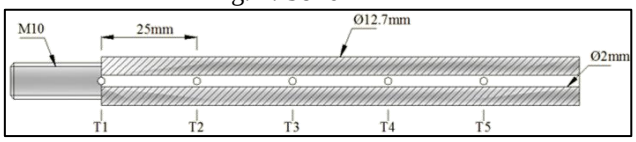

Fig. 2: Hollow Pin Fin with Inner Diameter = 2mm

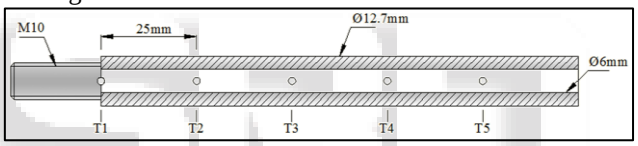

Fig. 3: Hollow Pin Fin with Inner Diameter = 6mm

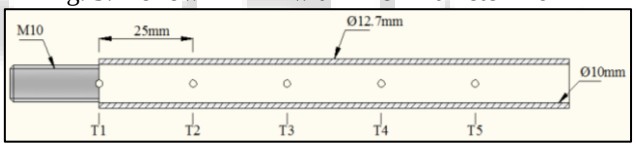

Fig. 4: Hollow Pin Fin with Inner Diameter = 10mm

III. OBJECTIVES

There are two main objectives in this work,

- To investigate Temperature distribution of pin fin with different inner diameter hollow circular pin fin.
- To investigate the heat flow rate and compared it with the hollow circular pin fin to optimize the size of hollowness in circular pin fin.

IV. EXPERIMENTAL SETUP

A brass fin of circular cross section is fitted across a long rectangular duct. One end of the fin products outside the duct & is heated by the heater. Temperature at five points along the length of the fin is measured by Chromel Allumel Thermocouples connected along the length of the fin.

To study the temperature distribution along the length of a pin fin in natural conviction. Start heating the fin by switching ON the heater element & adjust the voltage on dimmerstat to say 120 V (Increase slowly from 0 onwards). When steady state is reached, record the final readings T1 - T5 & also record the ambient temperature reading T6.

Fig. 5: Experimental Setup

V. RESULT

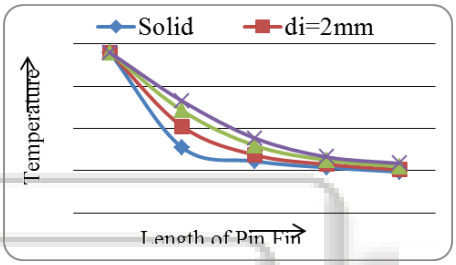

Fig. 1: Result

Result shows that the solid pin fin gives the higher temperature values as compared to hollow pin fin, which is as expected due to hollowness of pin, the total surface area for heat transfer will be increased and thus rate of heat transfer, also the temperatures shows reduced values for hollow pin fin.

VI. CONCLUSIONS

1) Heat transfer will increases with hollow pin fin as compared to solid pin fin.
2) Heat transfer rate increases with increased in inner diameter which causes increased in convective heat transfer area.
3) Also due to hollowness, the total thermal conductive resistance decreases as compared to solid pin which causes increased heat transfer rate.
4) Thus it is concluded that, pin fin with hollow structure gives faster heat transfer as compared to solid pin fin.

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