Convective Heat Transfer Comparison between Solid and Perforated Pin Fins

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Abstract— *Heat transfer equipment is used to analyze the Convective Heat transfer between solid and perforated pin fins, Heat dissipation is an important factor to consider for any device or equipment which requires heat dissipation. The heat transfer in both solid fins and perforated fins is measured and the purpose of this project is to discuss the difference between solid pin fins and perforated pin fins with 1 perforation and 2 perforation arranged in a array of inline pattern and ascending or staggered pattern and then analyze each arrangement and perforations employed in pin fins to conclude the effective design of fins and effective pattern used which better heat transfer.*

Keywords— Natural convection, forced convection, perforated fins, heat transfer rate.

I. INTRODUCTION

Heat dissipation plays a vital role in most of the equipments and devices, so there is a need for heat transfer to take place most effectively. Temperature will be reduced from higher to lower region in course of time; temperature difference in a body is reduced gradually. Heat transfer takes place in nature in all substances like solid, liquid and gases. For effective convective heat transfer in various equipments and devices we use fins such that more effective heat transfer takes place, since we need more effective heat transfer there is a huge requirement for the optimization of fins and scope of designing optimal fins for various industrial and commercial purposes is huge.

Convection Heat transfer increases when fins are used suitably, since the surface contact area for heat transfer

Increases, recently perforated fin design is considered for the sake of improving the heat transfer and many investigations have been done recently and tupes of fins are used and different shapes of perforations are tried to know the effect of heat transfer and improve it for the better design for greater rate of heat transfer.

II. EXPERIMENTAL SETUP

Fig. 1: Experimental setup

Heat transfer equipment consist of tunnel box for the passage of air, control panel with respective connections, heater with dimmerstat, blower, thermocouple, anemometer and base plate with suitable pin fins and another set of base plates with perforated fins. Thermocouple generates thermal signal which shows the raise in temperature in the fins, generated thermal signal will be sent to the control panel for display of the temperature from the respective thermocouple, heater is controlled using a dimmerstat to get desired base plate temperature and at that constant base plate temperature respective temperature readings in pin fins are noted for further calculation and analysis.

Natural and Forced convection heat transfer in solid pin fins and perforated pin fins is studied in this experimental project. Increase in Surface contact area increases the heat transfer and hence we use fins to increase the rate of convective heat transfer where air is used as the cold fluid and we have studied the effect of heat transfer when different number of perforations is used.

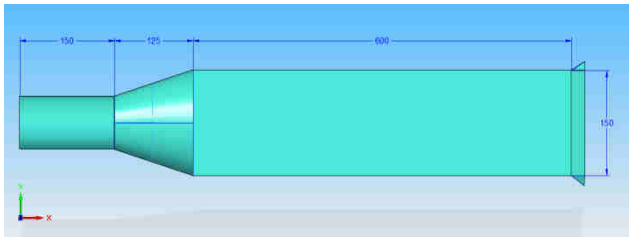

Fig. 2: Tunnel Box

Solid pin fins are arranged in inline pattern with a horizontal spacing of 62.5 mm and vertical spacing of 32.5 mm from one pin fin center to another pin fin center respectively. Nine solid fins are used and diameter of each fin is 12.5 mm.The fins are mounted on base plate 125 mm width and 6mm thickness.

Solid pin fins are arranged in ascending pattern with a horizontal spacing of 62.5 mm and vertical spacing of 25 mm from one pin fin center to another pin fin center respectively. Nine solid fins are used and diameter of each fin is 12.5 mm.

The surface are of base plate is 0.067 m^2 and total surface area of all 9 solid fins is 0.03558 m^2.

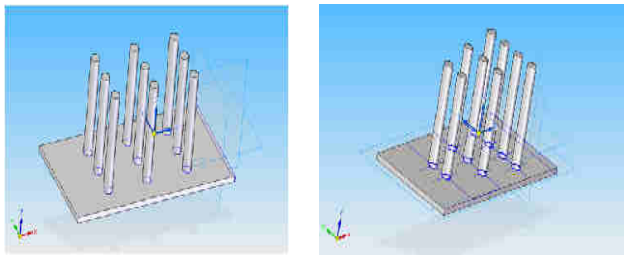

Fig. 3: Solid Pin Fins–Inline and Ascending Arrangement

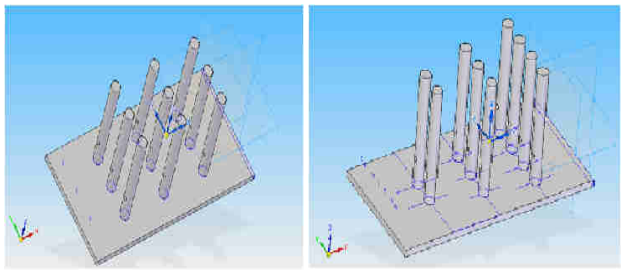

Fig. 4: Pin Fins with 1 Perforation– Inline and Ascending Arrangement

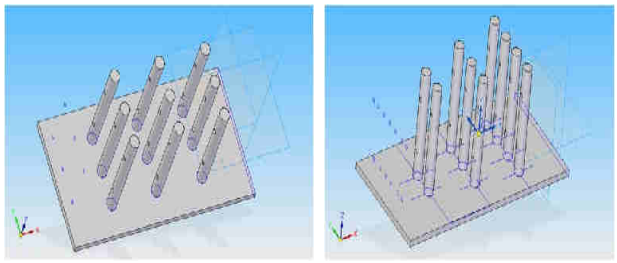

Fig. 5:Pin Fins with 2 Perforations – Inline and Ascending Arrangement

III. RESULT AND DISCUSSION

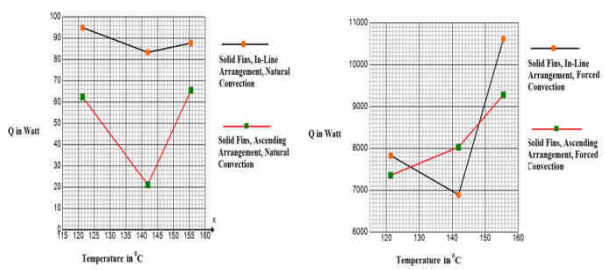

Fig.6: Sold fins

Fig 6 shows the solid fins in inline arrangement has higher heat transfer rate compared to ascending arrangement in natural convection. Also solid fins in inline arrangement has high rate of heat transfer compared to ascending arrangement in forced convection

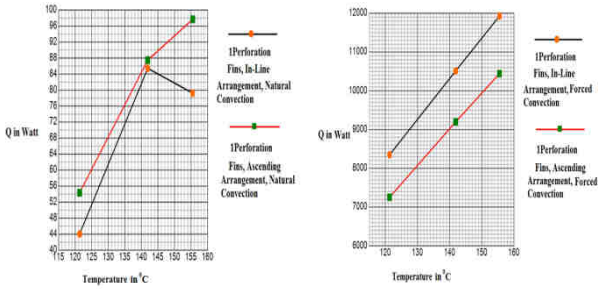

Fig. 7: Fins with 1 Perforation

In fig7 fins with 1 perforation in ascending arrangement has higher rate of heat transfer compared to fins in In-Line arrangement in natural convection.But fins with 1 perforation in inline arrangement has high rate of heat transfer compared to fins in ascending arrangement in forced convection

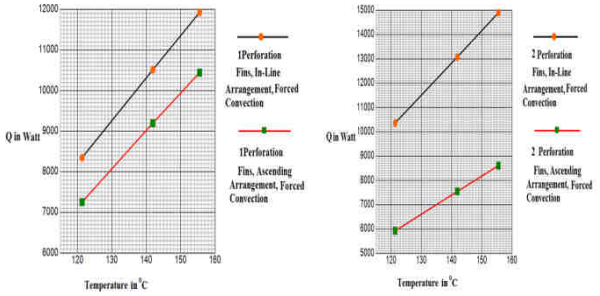

Fig.8: Fins with 2 Perforations

Fins with 2 perforations in In-Line arrangement has high rate of heat transfer compared to fins in ascending arrangement in natural convection. Also fins with 2 perforations in inline arrangement has high rate of heat transfer compared to fins in ascending arrangement in forced convection.

IV. CONCLUSION

- In Natural convection, solid pin fins in inline arrangement transfers higher rate of heat compared to ascending arrangement.
- In Fins with 1 perforation the rate of heat transfer is more in ascending arrangement but fins with 2 perforations in In-Line arrangement has high rate of heat transfer in natural convection.
- In Forced convection in solid fins, and fins with 1 and 2 perforation the rate of heat transfer is high in inline arrangement compared to ascending arrangement

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