

# A Review on Heat Transfer Analysis of Solid Cylindrical and Cylindrical with Perforated Fins

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**ABSTRACT:** The present review paper is on heat transfer analysis of cylindrical solid and cylindrical with perforated fins. The different types of heat transfer improvement technique here used by different researcher. The heat transfer technique such as used active or passive heat transfer method adopting for improving the heat transfer. The passive technique included modified surface such as use as dimple, grooves, fins are incorporated for improving the heat transfer rate also heat transfer enhancement is also governed by the Reynolds number range.

This paper explore the review on researcher presented for improvement in heat transfer rate with different types of Fins and also the research study used for the developing the propose study and experimental model for improving the heat transfer rate by fins.

**KEYWORDS:** Fins, Heat Transfer, Reynolds number, Active heat transfer

## I. INTRODUCTION

Extended surfaces (fins) are frequently used in heat exchanging devices for the purpose of increasing the heat transfer between primary surface and the surrounding fluid. Various types of heat exchanger fins, ranging from relatively simple shapes, such as rectangular, square, cylindrical, annular, tapered or pin fins to a combination of different geometries have been used. These fins may protrude from either rectangular or cylindrical base one of the commonly used heat exchanger fins is the pin fin.

Extended surfaces (fins) is used in large number of application to increase the heat transfer from surface, typically the fin material has high thermal conductivity. The fin is exposed to flowing fluid, which cool or heat it, with high thermal conductivity allowing increased heat being conducted from the wall through the fin. Fins are used to enhanced convective heat transfer in wide range of engineering application, and other practical means for achieving a large total heat transfer surface area without the use of an excessive amount of primary surface area. Fins are commonly using I any heat generating devices and it is need to transfer this heat to surrounding for proper working of heat generating devices.

Heat transfer enhancement in any types of heating device is very important.

## HEAT TRANSFER ENHANCEMENT TECHNIQUES

These are broadly classified into...

- **Passive Techniques:**

These techniques generally used surface or geometrical modification to the flow channel by incorporating inserts or additional devices, in case extended surface effective heat transfer area by the side of extended surface is increased.

Passive techniques hold the advantage over the active techniques as they not required direct input or external power.

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Vol. 7, Issue 4, April 2018

- **Active Techniques:**

These techniques are more complex from the used and design point of view, as the method required some external power input to cause the desired flow modification and improvement in the rate of heat transfer.

- **Compound Techniques:**

These techniques is the one where more than one of the above mention techniques is used in combination with the purpose of further improving het transfer rate.

## II. LITERARURE REVIEW

### **Tzer-Ming jeng, Sheng-Chung Tzeng [1]**

Studied the pressure drop and heat transfer of a square pin-fin array in a rectangular channel. The variable parameters are relative longitudinal pitch ( $XL=1.5,2,2.8$ ), The relative pitch ( $XT=1.5,2,2.8$ ) and the arrangement (in-line or staggered). The result shows that the in-line square pin-fin array has smaller pressure drop then the in-line circular pin-fin array at high  $XT$  ( $XT=2.0$  or  $2.8$ ) but an equivalent (or even slightly higher) pressure drop at low  $XT$  ( such as  $XT=1.5$ ) Additionally, the staggered square pin-fin array has the largest pressure drop of the three pin fin array ( inline circular pin-fins, in-line square pin-fins and staggered squared pin-fins) Most in-line square pin-fin arrays have poorer heat transfer than an inline circular pin-fin arrays, but a few, as when  $XL=2.8$  exhibit excellent heat transfer at high Reynolds number for instant, when  $XL=2.8$ ,  $XT=1.5$

### **Bayram Sahin, Alparslan Demir [2]**

Studied the heat transfer enhancement and corresponding pressure drop over a flat surface equipped with square cross-sectional perforated pin fins in a rectangular channel. The experimental results show that the used of square pin fins may lead to heat transfer enhancement. Enhancement efficiencies varied between 1.1 and 1.9 depending on the clearance ratio and inter-fin spacing ratio. Both lower clearance ratio and lower inter-fin spacing ratio and comparatively lower Reynolds numbers are suggested for higher thermal performance. In this study, the overall heat transfer, friction factor and the effect of the various design parameters on the heat transfer and friction factor for the heat exchanger equipped with square cross sectional perforated pin-fins were investigated experimentally

### **R. Karthikeyan,, R. Rathnasamy [3].**

Studied the heat transfer and friction characteristics of convective heat transfer through a rectangular channel with cylindrical and square cross section pin-fins attached over a rectangular duraliam flat surface . the pin fins were arranged in in-line and a staggered manner. Various clearance ratios ( $C/H=0.0, 0.5$  &  $1.0$ ) and inter-fin distance ratio ( $S_y/d$  and  $S_x/d$ ) were used . the experimental result shows that the used of cross-section pin-fins may lead to an advantage on the basis of heat transfer enhancement. For higher thermal performance, lower inter fin distance ratio and clearance ratio and comparatively lower Reynolds number should be proffered for in-line and staggered arrangement the staggered pin-fin array significantly enhanced heat transfer as a result turbulence at the expense of higher pressure drop in wind tunnel. The square pin-fin array performance is slightly higher than the cylindrical array with the penalty of pressure drop.

### **G.J.Vanfossen and B.A. Brigham [4]**

Studied the heat transfer by short pin-fins in staggered arrangements. According to their results, longer pin-fin in staggered arrangement. According to their results longer pin-fin ( $H/d=4$ ) transfer more heat than shorter fin ( $H/d=0.5$  and  $2$ ) and the array- averaged heat transfer with eight rows of pin-fins slightly exceeds that with only four rows. Their result also established that the average heat transfer coefficient on the fin surfaces is around 35% larger than that on the wall end.

**Giovanni Tanda [5]** studied Heat transfer and pressure drop experiments were performed for a rectangular channel equipped with arrays of diamond-shaped elements. Both in-line and staggered fin arrays were considered, for values of the longitudinal and transverse spacing's, relative to the diamond side, from 4 to 8 and from 4 to 8.5, respectively. The height-to-side ratio of the diamonds was 4. Thermal performance comparisons with data for a rectangular channel

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Vol. 7, Issue 4, April 2018

without fins showed that the presence of the diamond-shaped elements enhanced heat transfer by a factor of up to 4.4 for equal mass flow rate and by a factor of up to 1.65 for equal pumping power..

### **D.E.Metzger and C.S.Fan and S.W. Haley [6]**

Investigated the effect of pin-fin shape and array orientation on the heat transfer and the pressure loss in pin-fin arrays. According to their results the use of cylindrical pin fin with an array orientation between staggered and in-line can sometimes promote the heat transfer, while substantially reducing pressure, when oblong pin-fins are used, heat transfer increases at around 20% over the circular pin-fins were measured, but these increases were offset by increases in the pressure loss around 100%. Their estimate indicated that the pin-fin surface coefficient were approximately double the end wall value.

### **O.N.Sara et al.[7]**

Reported another way to improve heat transfer rate is to employ attachments with perforations, a certain degree of porosity, slot which allow the flow to go through the blocks. In case of perforated attachments, the improvement in the flow is brought about by the multiple jet-like flow through the perforation thus the aim of this study is also to determine heat transfer and friction factor characteristics of perforated staggered cylindrical fins. The heat transfer enhancement is achieved at the expense of increased pressure drop.

### **M.R Shaeri, M.Yaghoubi [8]**

Investigated analysis of turbulent convection heat transfer from an array of perforated fins, numerical investigation is made for three dimensional fluid flow and convective heat transfer from an array solid and perforated fin that are mounted on flat plate, sometimes an image may contain text embedded on to it. Detecting and recognizing these characters can be very important, and removing these is important in the context of removing indirect advertisements, and for aesthetic reasons. perforation such as small channels with square cross section are arranged stream wise along the fins length and their number varied from 1 to 3 flow and heat transfer characteristics are presented by Reynolds number from  $2 \times 10^4$  and  $4 \times 10^4$  based on the fin length of previous investigation and good agreement were observed result show that fins with longitudinal pores have unmark able heat transfer enhancement in addition to the consider reduction in weight by comparison with solid fins.

### **Jnana Ranjan Senapati and Sukanta Kumar Dash and Subhranshu Roy [9]**

Numerical convection heat transfer from an annular finned horizontal cylinder with different eccentricity has been studied numerically in the this work. This paper present numerical investigation is able to capture a complete picture of natural convection over a horizontal cylinder with fins of different eccentricity. In present conjugate heat transfer study of annular finned horizontal cylinder annular disc fins can be design for the purpose to increase the heat transfer rate significantly with marginal loss in the heat transfer with respect to to the concentric annular fins.

### **Tamir K. Ibrahim, and Marwah N. Mohammed, and Mohammed kamil Mohammed, and Najafi, and Nor azwadi Che Sidik, and firdaus Basrawi, and Ahamed n, Abdalla & and S.S. Hoseini [10]**

This paper investigates the effect of perforation shape on the heat transfer of perforated fins. This types of heat exchanger used in heat sink with the perforated fins under the forced convection heat transfer to determine the performance for each perforation shape between circular, cylindrical, rectangular triangular, and also with the non perforated fins. The experimental result compare between perforations shape and the heat transfer coefficient to clarify the best perforation shape for the plate heat sink after studied experimentally and numerically using CFD. The difference between experimental & numerical is reported about 8% & 9% for temperature distribution when power supplied are 150 W 100W respectively. The higher temperature difference of the fins are with the circular perforation shape which is 51.29% when compared with at the tip of the fins with the temperature at the heat collector followed by the rectangular perforation shape with 45.57 then followed by the rectangular perforation shape by 42.28% then lastly the non perforated fins by 35.82%. The perforation of the fins shows significant effect on the performance of force convection heat transfer

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## III. PROBLEM IDENTIFICATION

The use of solid cylindrical fins having less heat transfer enhancement than the perforated cylindrical fins. Enhancement efficiencies vary depending on clearance ratio and inter-fin spacing ratio and comparatively lower Reynolds number are suggested for higher thermal performance. Also it is observed that solid fins require maximum material and have a weight higher than perforated fins. In this research work, it is proposed to study the heat transfer enhancement in the cylindrical perforated and solid fins with staggered arrangement.

## IV. AIM AND OBJECTIVE OF EXPERIMENT

Researchers are facing a problem on heat dissipation while designing the equipments like compact heat exchanger, electronic devices, computer components, power module of space vehicle etc. To avoid heat generation, devices are equipped with one of the heat transfer augmentation methods. While using the augmentation method, various factors are considered viz. availability of space, design temperature, friction factor, pressure drop, surrounding condition etc. By keeping in mind all factors, perforated fins are best suited for duct flow to achieve high heat transfer rate. The following are the main objectives of this work.

- To achieve heat transfer enhancement technique with the help of perforated fins.
- To study the heat transfer rate with solid and perforated fins and validate data by comparing it.
- To study the pressure drop and friction factor at different velocities.
- To study the effect of varying Reynolds number on various parameters such as heat transfer rate, friction factor, heat transfer coefficient ratio etc.

## V. PROPOSED EXPERIMENTAL SETUP

The proposed experimental setup is shown in Fig. (a). It consists of a tunnel with a length of about 1 meter. This duct is attached with a controlling unit and the fins. The testing section for taking readings. The anemometer is used for measuring the flow of air in the duct. The base plate with fins is fixed on the heating section for measuring heat transfer enhancement. The experiments are repeated at regular intervals with two different types of fins viz. perforated and solid. The base plate is shown in Fig. (b) and is manufactured with aluminium material and tested with perforated and solid fins.

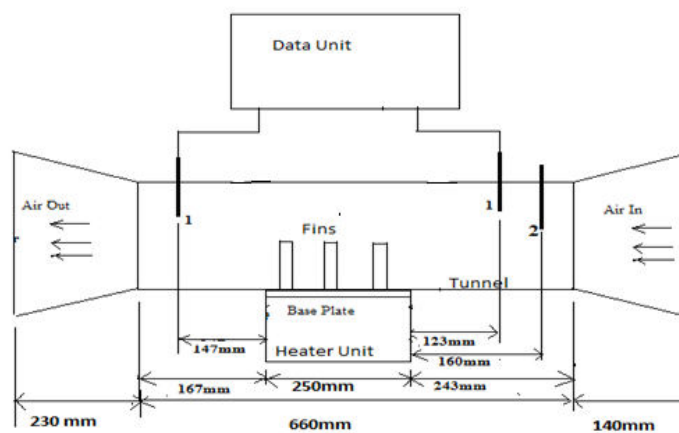


Fig.(2) Experimental Set-up

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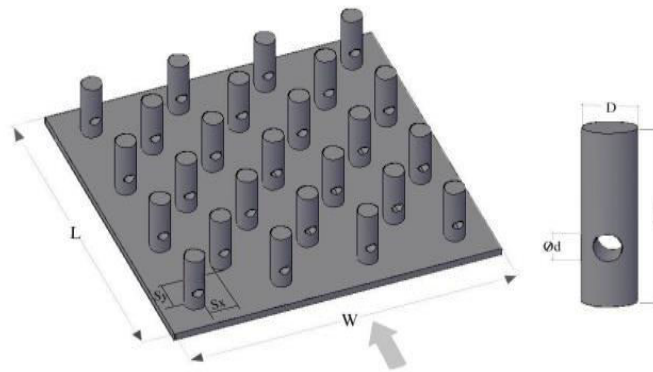


fig.(2) Base Plate with fins in staggered arrangement

## VI. CONCLUSION

From this review, various techniques for enhancing the heat transfer rate with used different techniques is presented. The performances of different thermal devices with references to dimensionless number like Reynolds number, nusselt number were studied and discuss. The presented review explores the theoretical discussion used for improving the thermal performance of different types of extended surfaces (fins).

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