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Review on Numerical Analysis of Rectangular Fin profile using Different Fin Materials

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ABSTRACT - *In presented work we have done the analysis of the simplest type of fin i.e. of the rectangular profile with three different materials namely brass, copper and nickel using number of fins ranging from one to five. Our objective is to see whether increasing the number of fins will actually effective or not and also to check whether changing the fin material have that impact or not*

Keywords: Fins, rectangular profile, Material optimization, CATIA, ANSYS.

1. INTRODUCTION

A fin for the circular, Square and rectangular surface that extends from a pin configuration to increase the rate of heat transfer from the environment by increasing convection. For this principle of Conduction, convection, radiation of a fin configuration determines the amount of heat and its transfers. Increasing the temperature difference between the fin configuration and the Depends on the environment, slightly increasing the convection heat transfer coefficient, or slightly increasing the surface area of the pin configuration of the object increases the heat transfer. Sometimes it is not economical or it is not feasible to change the first two options.

Adding a fin configuration, however, increases the surface area of circular, square and Rectangular can sometimes be economical solution to heat transfer problems.

1.1 Major Types:

Straight fin with uniform cross sections, Straight fin with non-uniform cross sections, Annular fin, Pin fin with non-uniform cross section.

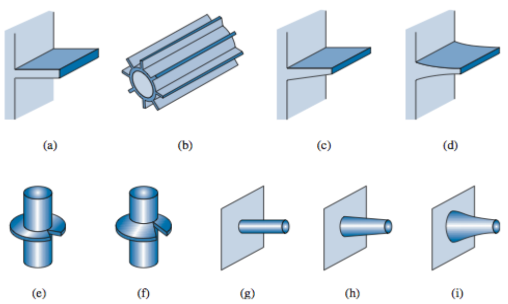

Fig1: Types of heat transfer

(a) Longitudinal fin – Rectangular profile

(b) Longitudinal fin – Rectangular profile

(c) Longitudinal fin - Trapezoidal profile

(d) Longitudinal fin - Concave parabolic

(e) Radial fin – Rectangular profile (f) Radial fin – Triangular profile

(g) Pin fin – Cylindrical

(h) Pin fin – Tapered profile

(i) Pin fin – Concave parabolic

The fins are also referred as 'extended surfaces 'Fins are factory-made in several geometries, depending upon the practical applications. The ribs connected on the length of a tube are known as longitudinal fins. The concentric macular discs around a tube are termed circumferential fins. Pin fins or spines are rods protruding from a surface. The fins could also be of uniform or variable cross-sectional. They have many different practical applications, via cooling of electronic components, cooling of motor cycle engines, compressors, electric motors transformers, refrigerators, high-efficiency boiler super heater tubes etc. Solid gas turbines blades typically act as fins, conducting heat down their length to a cool disc.

1.1 Fin Materials Properties: Aluminum Fins: Provide the best overall value, Stainless Steel Fins: Fight high external corrosion, Copper Fins: Provide the best heat transfer

1.2 Introduction of fin

A fin may be a surface that extends from associate object to extend the speed of warmth transfer to or from the setting by increasing convection. For the principle of conduction, convection, radiation of an pin configuration determines the amount of heat it transfers Increasing the temperature difference between the fin configuration and the depends on the environment, slightly increasing the convection heat transfer coefficient, or slightly increasing the surface area of the pin configuration of the object increases the heat transfer. Sometimes it is not economical or it is not feasible to change the first two options. Adding a fin configuration to the object, however, slightly increases the surface area and can sometimes be economical solution to heat transfer problems.

Circumferential fins around the cylinder, square and rectangular shape of a motor cycle engine and fins attached to condenser tubes of a refrigerator are a few familiar examples only occurs when there's a temperature distinction, Flows quicker once this distinction is higher, continually flows from high to temperature, larger is bigger with greater expanse.

2. LITERATURE REVIEW

If new technique is being developed, the underlying principles can also be studied well in advance so that more efficient technique can be developed. So, extensive literature survey on compact plate fin heat exchangers is carried out for plain and perforated fin surfaces, reviewed the published literature on numerical evaluation of heat transfer and flow on different type of fin surfaces.

B. Ramdas Pradip et. al. [1] studied many industries are utilizing thermal systems wherein overheating can damage the system components and which may lead to failure of the system. To overcome this problem, thermal systems with heat exchanger effective emitters such as ribs, fins, baffles etc. are desirable. The need to increase the thermal performance of the systems, there by affecting energy, material and cost savings has led to development and use of many techniques known as “Heat transfer Augmentation”. This technique is additionally termed as “Heat transfer Enhancement”. Augmentation techniques increase the convective heat transfer by reducing the thermal resistance in a heat exchanger. Many heat augmentation techniques has been reviewed, these are (a) surface roughness, (b) plate baffles and wave baffles, (c) perforated baffles, (d) inclined baffles, (e) porous baffles, (f) channel, Crossed Ribs and Grooves. Most of these techniques are based on the baffle arrangement. The Heat transfer enhancement techniques lead to increase in heat transfer coefficient but at the cost of increase in pressure drop.

Pardeep Singh, Harvinder lal, Baljit Singh Ubhi et al (2014).[2] In this paper, the heat transfer performance and effectiveness of fin is analyzed by design of fin with various extensions such as rectangular extension, trapezium extension, triangular extensions and circular segmental extensions. The heat transfer performance of fin with same geometry with various extensions and without extensions is compared. The ranging 5% to 12% increase in heat transfer can be achieved with these various extensions on fin as compare to same geometry of fin without these extensions.

Kumbhar D.G, Dr. N.K. Sane, Chavan S. T., et al (2009) [3] in this paper, the effect of triangular perforations on rectangular fin is investigates the comparison of perforated fin with solid fin for temperature distribution along the fin and heat transfer rate. The analysis is done using software ANSYS and also by experimentation. The investigation observed that heat transfer rate increases with perforations as compared to fins of similar dimensions without perforations.

Umesh Vandeorao Awasarmol et. al (2010).[4] Researcher the first engine blocks were taken for experimentation work. Modifying the solid rectangular fins as permeable fins by drilling three holes per fins inline in one half of the length of the fin of a cylinder block. The investigation observed heat transfer rates, heat transfer coefficients and percentage saving of material for solid and permeable fins are compared.

The experiment shows that heat transfer rate improves with the use of permeable fins. The base temperatures profiles of solid fins are more elevated as compared to permeable fins and the tip temperatures of solid fins are more elevated as compared to permeable fins. It means that for the same heat flux the cylinder with permeable fins runs cool which shows that heat transfer rate is more in permeable fins as compared to solid fins. Also there is a net increase in heat transfer rate with permeable fins as compared to that of the cylinder block with solid fins.

N. Nagarani et al. [2012] [5] The study of this paper presents numerical and experimental comparative study of elliptical and circular fins which are made up of same kind of metal with same surface area and fed with constant heat inputs under free convection. The numerical result show a lot of distribution of isotherms and elevated rate of temperature distribution on the axis of elliptical fin than those of circular fin.

In this research work, the heat transfer of elliptical and circular fins which are made up of same kind of metal with same surface area has been analyzed experimentally by feeding constant heat inputs below free convection. In elliptical fin, the surface temperature goes on decreasing gradually and continuously. The experimental results show that the performances of elliptical fins are better in respect of isotherms, temperature distribution, formed tube potency and effectiveness when put next to those of circular fins.

Rossano Comunelo [6] had studied the influence of neighbourhood of fins under the natural convection field using vertical plates. The vertical plate that was thought of had a length of zero.15 m. Their study enclosed the numerical simulations in conjunction with experimental studies.

Waqar Ahmed Khan [7]. The pin-fins, fins with circular cross-section, were applied heat removal mechanism in the electronic packaging by The authors had developed analytical methods for estimating the heat transfer rate from heat sinks with pin-fins organized in inline similarly as staggered pattern.

Gaurav A Chaudhari [8]. They was investigated by the improvement of fin effectiveness underneath the natural convection variable the perforations on the fins by the plate fins, rectangular cross-sectional area, were considered by the authors in this experimental study. They had investigated for 100 present, 20% and 30% fin perforations for varying operating conditions. From their results, they had concluded that fin configuration with 30% perforation provided higher heat transfer rate.

Padma Lochan Nayak [9]. An circulate composite fin for dissipating heat within the radial direction was studied by experimentation by the authors had additionally investigated the impact of surface coatings on the fin surfaces over the fin effectiveness. The zinc surfaces coatings were compared with the fin configuration of without any surface coatings.

Mangesh D Shende [10] had analyzed such a radial heat sink for heat removal mechanism in LEDs under the natural convection field. Their experimental study was conducted by varying three parameters – fin length, fin height and number of fins – for a specified heat flux condition. Based on their results, they had noted that as the fin length, fin height and the number of fins were increased, the thermal resistance and the heat transfer coefficient decreased.

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