

EFFECT OF PIN FIN GEOMETRY ON PERFORMANCE OF HEAT SINK

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Abstract - The main use of pin fins is to increase the rate of heat transfer to or from the environment by increasing the convection. The amount of heat transfer is determined by the amount of conduction, convection, radiation. If the temperature gradient between the object increases then the heat transfer rate also increases. The main aim of our project is to increase the heat transfer rate. The 3 D model will be drawn with the help of CATIA software. The analysis will be carried out with the help of ANSYS software. All the components will be manufactured and then assembled together. The experimental testing will be carried out and then the result & conclusion will be carried out.

Key Words: Pin fin, Heat transfer rate, CATIA, ANALYSIS, Result.

1. INTRODUCTION

Heat transfer is a subject of widespread interest to the student of engineering curriculum, practicing engineers & technicians engaged in the design, construction, testing and operation of the many diverse forms of heat exchange equipment required in our scientific and industrial technology.

Electrical engineers apply their knowledge of heat transfer for the design of cooling systems for motors, generators & transformers. Chemical engineers are concerned with the evaporation, condensation, heating & cooling of fluids.

An understanding of the laws of the heat transfer flow is important to Civil engineers in the construction of dams, structures and to the architect, in the design of buildings. The Mechanical engineer deals with problems of heat transfer, in the field of internal combustion engines, steam generation, refrigeration and heating & ventilation.

To estimate the cost, the feasibility and size of the equipment necessary to transfer a specified amount of heat in a given time, a detailed heat transfer analysis must be made.

The dimensions of boilers, heaters, refrigerators and heat exchangers depend not only on the amount of heat to be transmitted but rather on the rate at which heat is to be transferred under given condition.

The successful operation of equipment components such as turbine blades and walls of combustion chambers of gas turbine depends on the possibility of cooling certain metal parts by removing heat continuously at a rapid rate from the surface. These varied examples show that in almost every branch of engineering, heat transfer problems are encountered, which cannot be solved by thermodynamic reasoning alone but required an analysis based on science of heat transfer.

MODES OF HEAT TRANSFER

The literature of heat transfer generally recognizes three distinct modes of Heat Transmission. Heat transfer is the energy in transits due to temperature difference.

Whenever there is exist temperature difference in a body, heat flows from regions of high temperature to the region of low temperature. This heat transfer takes place by three different processes called as modes of heat transfer.

These are

- a) Conduction
- b) Convection
- c) Radiation

These three modes are similar in that a temperature differential must exist and the heat exchange is in the direction of decreasing temperature. Each method has, however, different physical picture and different controlling laws.

CONDUCTION: -

“Thermal conduction is a mechanism of heat propagation from a region of higher temperature to a region of low temperature within a medium (solid, liquid or gaseous) or between different medium in direct physical contact.”

Conduction does not involve any movement of the molecule relative to another. The thermal energy may be transferred accomplished by two different mechanisms.

- (a) Lattice vibration
 - (b) Flow of free electron
- Convection

The process of heat transfer between surface & moving fluid when they are at different temperature is called as convection. In this process flow of energy is obtained because of movement of fluid molecules.

When the fluid flows over the surface, a thin region is formed over the surface. Where the fluid molecules flow in different layers parallel to the surface. Layer of the fluid in contact with surface is stationary. Velocity of the other layers of fluid increases with the distance from the surface & finally becomes same as that as free stream velocity. This region above the surface known as film region.

2. OBJECTIVES

- To determine heat transfer characteristics of the array of dimpled rectangular fins.
- To have optimum iteration based on CFD simulation for dimpled rectangular pin fin.
- To validate experimental and CFD results for velocity distribution and temperature.

3. PROBLEM STATEMENT

Most of the heat dissipation processes includes forced convection which is mandatory to control the heat dissipation. So, neglecting the conventional method of increasing heat transfer, there is need for work on the arrangement of fins as well as the material of fins used conventionally in the components. The present study includes parametric and CFD analysis of various geometric parameters of pin fin and also the study of parameters such as velocity distribution and temperature distribution, to enhance the heat transfer inside the flow passage.

4. METHODOLOGY

Step 1: - I started the work of this project with literature survey. I gathered many research papers which are relevant to this topic. After going through these papers, I learnt about pin fin efficiency.

Step 2: - After that the components which are required for my project are decided.

Step 3: - After deciding the components, the 3 D Model and drafting will be done with the help of CATIA software.

Step 4: - The components will be manufactured and then assembled together.

Step 5: - The experimental observations will be taken, calculations will be done and then the result will be concluded.

5. DESIGN

Computer-aided design (CAD) is the use of computer systems (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. CAD software for mechanical design uses either vector-based graphics to depict the objects of traditional drafting, or may also produce raster graphics showing the overall appearance of designed objects. However, it involves more than just shapes. As in the manual drafting of technical and engineering drawings, the output of CAD must convey information, such as materials, processes, dimensions, and tolerances, according to application-specific conventions.

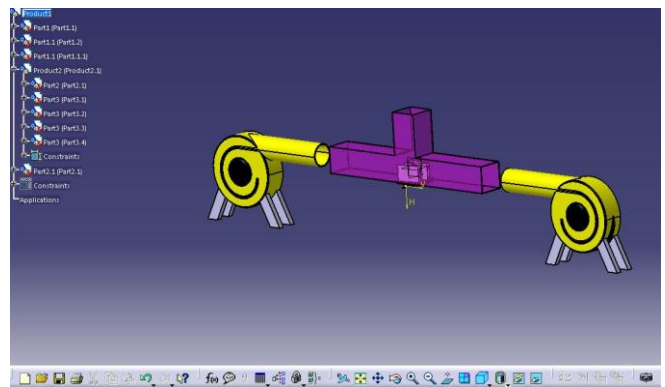


Fig. 1 CATIA model of Experimental Setup

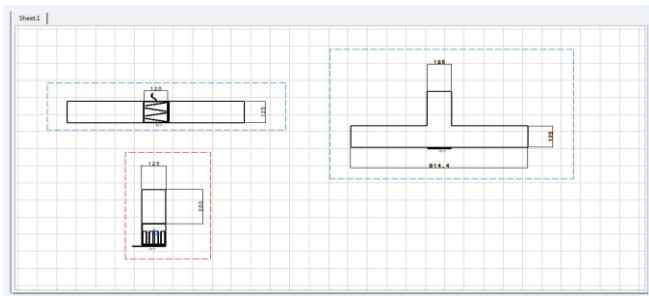


Fig. 2 Drafting of set up

6. FUTURE SCOPE

1) Heat transfer by radiation is also a factor of consideration. This can be studied by surfaces of the fin arrays made of polished & dull by providing a black coating etc.

2) The work was concerned with the combined convection heat transfer from rectangular fin array. It is worthwhile to carry out the work on vertical rectangular fin array under forced and Natural convection condition also

3) It may also be possible to change the specimen material from aluminum to its alloy, cast iron etc. because the heat transfer rate & the thermal conductivity for different material is different.

4) In future the similar experiment may be studied for the various cross-sectional specimen such as Circular, Rectangular, triangular trapezoidal etc. by using different materials of the specimen & using different working fluids.

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