International Journal of Pure and Applied Mathematics
Volume 118 No. 5 2018, 1011-1017
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
url: http://www.ijpam.eu
Special Issue

DESIGN AND ANALYSIS OF DIFFERENT TYPES OF FIN CONFIGURATIONS USING ANSYS

[1] L.Prabhu, [2]M.Ganesh Kumar [3] Prasanth M, [4] Parthasarathy M
[1,] Associate Professor [2] Assistant Professor, [3, 4] UG Students,
Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation

ABSTRACT

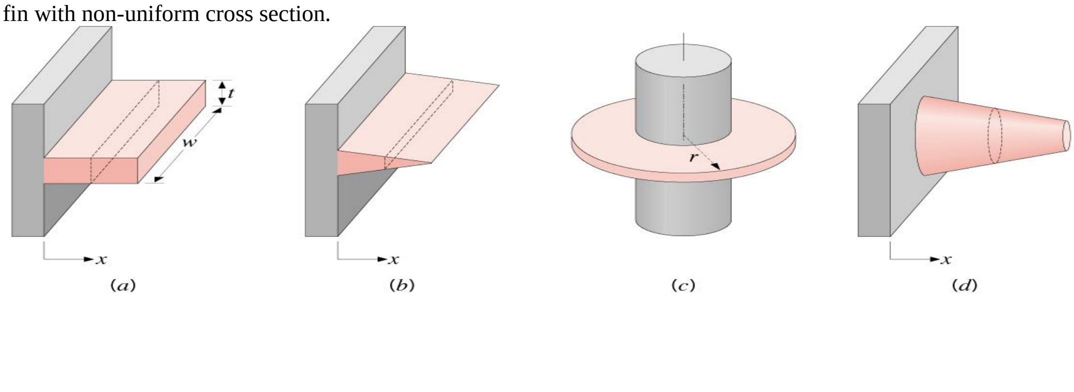
Convective heat transfer between a surface and the surrounding has been a major issue and a topic of study for a long time. In this project, the heat transfer performance of fin is analyzed by ANSYS workbench for the design of fin with various design configuration such as cylindrical configuration, square configuration and rectangular configuration. The heat transfer performance of fin with same base temperature having various geometry is compared. In this thermal analysis, Aluminum was used as the base metal for the fin material and for various configurations. Fin of various configuration are design with the help of CATIA V5R16 software Analysis of fin performance done through the software ANSY 15.0. On comparison, rectangular configuration provides the greatest heat transfer than that of other configurations having the same volume. The effectiveness of rectangular fin is greater as compare to other configuration of fin.

Keywords: Fins, Design, Analysis and Heat transfer enhancement. ANSYS Work Bench

1. INTRODUCTION

The Fin is a major component used in many systems for increasing the rate of heat transfer. In order to cool the system, fins are provided on the surface of the system to increase the rate of heat transfer. By doing thermal analysis on the fins, it is helpful to know the heat dissipation and rate of heat transfer in different types of fin. We know that, by increasing the surface area of pin configuration we can increase the heat dissipation rate of this process, so designing such a large complex systems is very difficult. Therefore fins are provided on the surface of the system to increase heat transfer. 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.

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



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 Fins

A fin is a surface that extends from an object to increase the rate of heat transfer to or from the environment 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 is a temperature difference, Flows faster when this difference is higher, Always flows from high to low temperature, Is greater with greater surface area.

1.3 Modes of Heat Transfer

Heat, by definition, is the energy in transit due to temperature difference. Whenever the process of pin configuration exists a temperature difference in a medium state or between media, heat flow must. Different types of pin configuration of heat transfer processes are called modes. When a temperature gradient of pin configuration exists in a stationary medium, which may be a solid or a fluid to the concern, heat flows under the law of conduction and convection heat transfer. On the other hand if the temperature gradient as been to exists between the pin surface and a moving fluid to the process we use the term Convection. The third mode of heat transfer is termed Radiation its depends on the pin and it needs no medium to transfer pin since it is driven by electromagnetic waves emitted from all pin surfaces of finite temperature, so there is a net heat transfer by conduction and radiation between two surfaces at different temperatures

2. Calculation

2.1 Circular Fin Configuration

Surface Area:

d=0.023m

$A = 2\pi r\square + 2\pi r^2$

h=0.1m

$= 2\pi\left(\frac{0.023}{2}\right)(0.1) + 2\pi\left(\frac{0.023}{2}\right)^2$

A= 8.06×10^{-3} m^2

Diameter (d) = 0.023 m

Length (l) = 0.1 m

Area of the circular fin:

$A = \frac{\pi}{4}d^2$

A = 4.15×10^{-4} m^2

Volume of the circular fin:

Volume (v) = Area×Length

= $4.15\times 10^{-4}\times0.1$

Volume (v) = 4.15×10^{-3}

FIN CONFIGURATION	VOLUME
CIRCULAR	4.15×10^{-5} m^3
SQUARE	4×10^{-5} m^3
RECTANGUAR	4×10^{-5} m^3

2.2. Square Fin Configuration

Surface Area: $A = a^2 + 2a\sqrt{\frac{a^2}{4} + \square^2}$

A = 4.42×10^{-3} m^2

Side (a) = 0.02m

Height (h) = 0.1m

Area of square fin

Area = a×a

Area = 4×10^{-4} m^2

Volume of square fin

Volume = A× □

Volume = 4×10^{-5} m^3

2.3. Rectangular Fin Configuration

Surface Area:

A = 2 (bl+lh+lb)

A = 10.8×10^{-3} m^2

Area of rectangular fin:

Area = $l \times b$

= 0.04×0.01

Area = 4×10^{-4} m^2

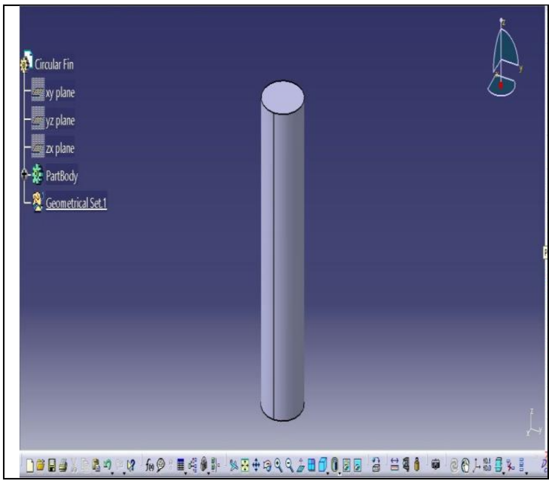
Volume of rectangular fin:

Volume = Area × Height

= $(4\times10^{-4)}\times0.1$

Volume = 4×10^{-5} m^3

3. Design of Circular, Square & Rectangular Fin Configuration



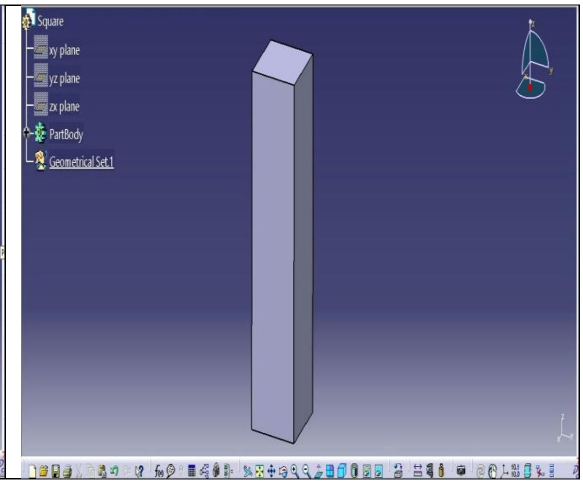


Fig 3.1 Circular Fin Configuration **Fig 3.2 Square Fin Configuration**

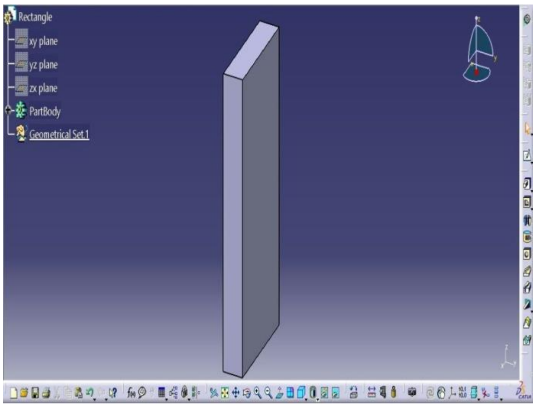
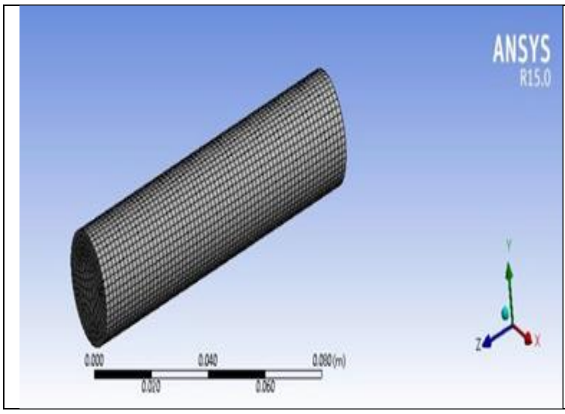


Fig 3.3 Rectangular Fin Configuration

ANALYSIS IN ANSYS WORKBENCH

All the 3D models of the different fin configurations (circular, rectangular, square) are imported to ANSYS WORKBENCH 15.0 for meshing and steady state thermal analysis.



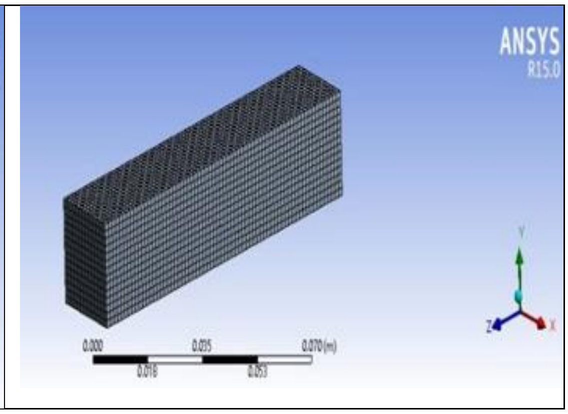


Fig 3.4 Meshed Model of Circular Fin **Fig 3.5 Meshed Model of Square Fin**

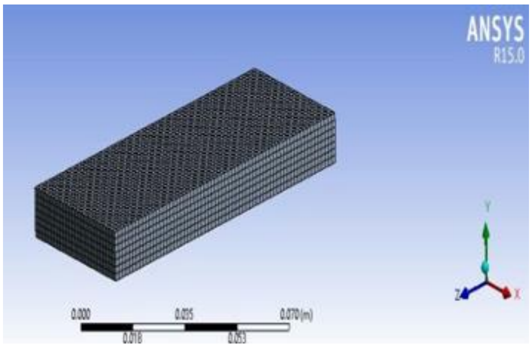
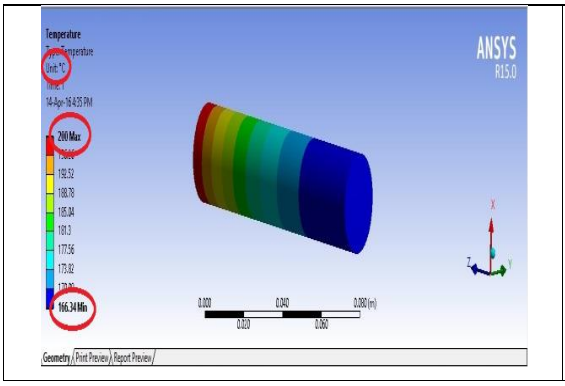


Fig 3.6 Meshed Model of Rectangular Fin



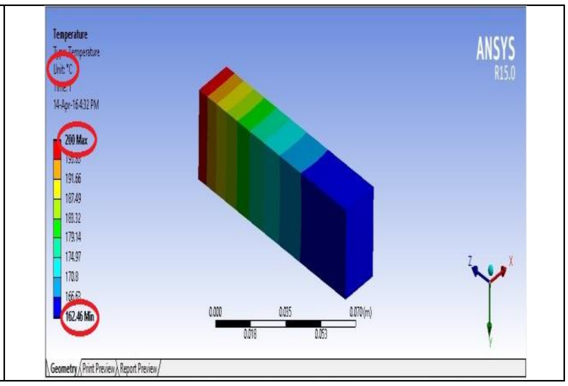


Fig 3.7 Steady State Thermal Analysis of Circular **Fig 3.8 Steady State Thermal Analysis of Square**

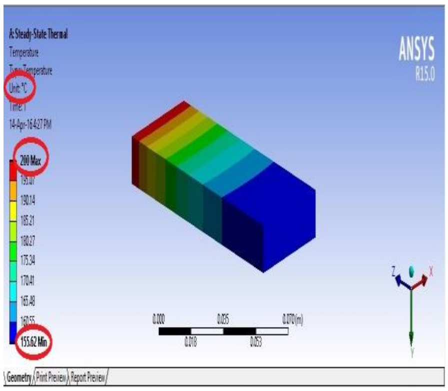
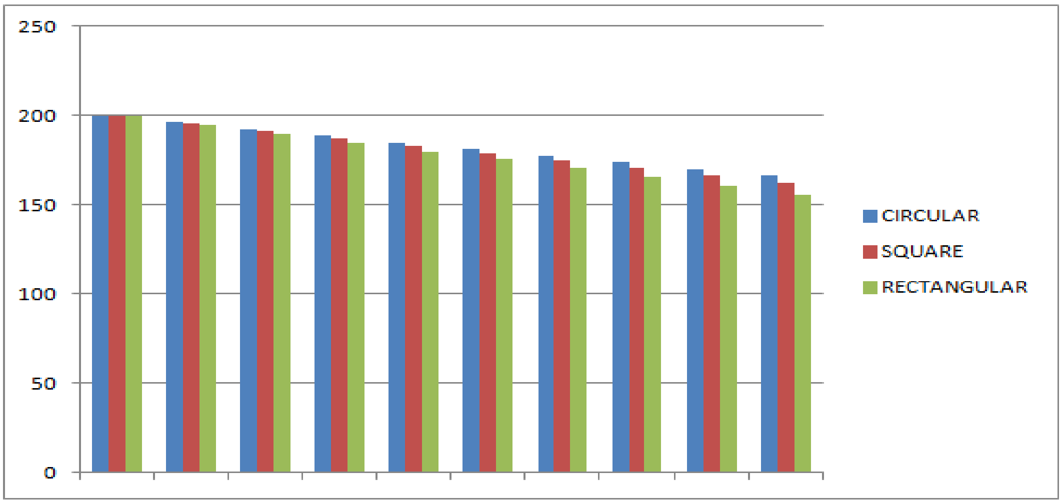


Fig 3.9 Steady State Thermal Analysis of Rectangular

ANSYS Mechanical is a Workbench application that can perform a variety of engineering simulations, including stress, thermal, vibration, thermo-electric, and magneto static simulations. A typical simulation consists of setting up the model and the loads applied to it, solving for the model's responses to the loads, then examining the details of the response with a variety of tools. The Mechanical application has "objects" arranged in a tree structure that guide you through the different steps of a simulation. By expanding the objects, you expose the details associated with the object, and you can use the corresponding tools and specification tables to perform that part of the simulation.



FIN CONFIGURATION	MAXIMUM TEMPRATURE	MINIMUM TEMPRATURE
CIRCULAR	200□	166.34□
SQUARE	200□	162.46□

RECTANGULAR	200	155.62

CONCLUSION

The use of fin (extended surface), provide efficient heat transfer. Heat transfer through fin of rectangular configuration is higher than that of other fin configurations. Temperature at the end of fin with rectangular configuration is minimum, as compare to fin with other types of configurations. The effectiveness of fin with rectangular configuration is greater than other configurations. Choosing the optimum size fin of rectangular configuration will reduce the cost for heat transfer process and also increase the rate of heat transfer.

REFERENCE

[1]. Abdullah, H. Alessa and Mohammed, Q. Al-Odat, "Enhancement of Natural Convection Heat Transfer from a Fin by Triangular Perforations of Bases Parallel and Toward its Base", The Arabian Journal for Science and Engineering, vol. 34, pp. 531-544, 2009.

[2]. B. Ramdas, Pradip and K. Kumar, Dinesh, "A Study on the Heat Transfer Enhancement for Air Flow through a Duct with Various Rib Inserts", International Journal of Latest Trends in Engineering and Technology, vol. 2, issue 4, pp. 479-485, 2013.

[3]. Golnoosh Mostafavi, "Natural Convective Heat Transfer from Interrupted Rectangular Fins", MASc, Simon Fraser University, Canada, 2012.

[4]. Sable M.J., Jagtap S.J., Patil P.S., Baviskar P.R. and Barve S.B., "Enhancement of Natural Convection Heat Transfer on Vertical Heated Plate by Multiple V-fin array", IJRRAS, vol. 5, issue 2, pp. 123-128, 2010.

[5]. Vishal S., "Auto-CAD", Dhanpat Rai Pubblicating Company, New Delhi, pp. 10-11, 2004.

[6]. Rajput R. K., "Heat and Mass Transfer", S. Chand & Company Ltd.,