ISSN : 2455-9679
Impact Factor : 2.865

IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"THERMAL ANALYSIS OF AIR FLOW IN CPU CABINET HEAT FINS BY USING ANSYS 19.2"

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ABSTRACT

The present work investigates the numerical simulation of thermal analysis of mixed convection air flow in a CPU Cabinet. The simulation is focused on the non-uniformly heated mother board temperature distribution. In this modern world speed determines everything especially desktop PC, CPU have been popular. The computer revolution is growing rapidly in almost every field. CPU is the electronic components, which produces a lot of heat that reduces the performance. In this study the forced convection cooling of heat sinks mounted on CPU are investigated. The design is based total chassis power dissipation. This represents significant power dissipation for the chassis components (Main processor chip, other chipsets North bridge heat sink and South bridge heat sink) the main processing chip has fin attachments (heat sink) over it for heat dissipation. There are many designs of heat sink to improve the efficiency, few heat sink designs are selected and analyzed, which would be give the maximum heat dissipation. The air flow and thermal behavior of the heat sink assembly are simulated with 2019 ANSYS Transient Thermal analysis.

Key Words: *CPU, Heat sink, Heat dissipation, Cooling, ANSYS*

I. INTRODUCTION

Thermal administration has turned into a basic component in the present electronic structure, as increasingly minimized plans have prompted more noteworthy trouble in expelling heat from the framework. So as to keep the segments inside their safe working territory, the working temperature of the segments must not surpass the maker indicated most extreme temperature. A decrease in working temperature expands the segment future and along these lines builds the unwavering quality of the framework.

The activity of many designing frameworks results in the age of warmth. This undesirable result can cause genuine overheating issues and now and again prompts disappointment of the framework. The warmth delivered inside a framework must be disseminated to its surroundings so as to keep up the framework at its suggested working temperatures and working viably and dependably. So as to accomplish the ideal rate of warmth dissemination, with minimal measure of material, the ideal mix of geometry and direction of the finned surface is required, which are commonly known as warmth sinks.

Thermal sinks are utilized to move heat far from the gadget so as to keep up a lower gadget temperature. By and large, expanding the warmth sink surface territory decreases the thermal sink warm obstruction, making it progressively viable in exchanging heat from a segment to the surrounding air. The warmth dispersal from the finned frameworks to the outer surrounding climate can be acquired by utilizing the instruments of the convection and radiation warmth

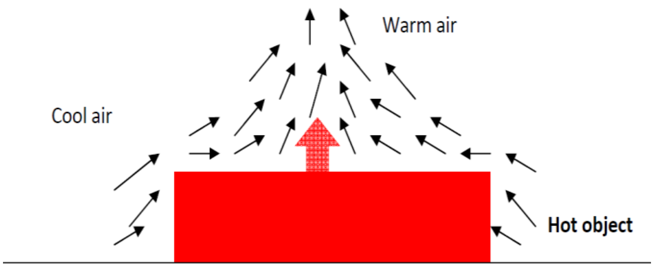
ISSN : 2455-9679
Impact Factor : 2.865

exchange. The impact of radiation commitment in absolute warmth exchange rate is very low because of low emissivity estimations of utilized blade materials, for example, Aluminum and Duralumin amalgams.

II. SIGNIFICANCE OF HEAT SINK

A heat sink is a passive heat exchanger with having a large surface area in contact with the surrounding environment (cooling) medium like air. The components or electronic parts or devices which are inadequate to moderate their temperature, necessitates heat sinks for cooling. Heat generated by every element or module of electronic circuit must be dissipated for improving its reliability and preventing the premature failure of the component. Therefore, it is essential to maintain thermal stability in limits within every electronic and electrical component of any circuit or electronics parts of any system. There are various factors such as sink material, surface treatment, protrusion design and air velocity, which significantly affects the performance of the heat sink. However, if heat sinks are not provided for electronic circuits, then it may lead of tragic failure of components such as voltage regulators,

transistors, LEDs, power transistors and ICs. Even though soldering an electronic circuit, it is recommended to employ heat sink to avoid over heating of the elements. Moreover, Heat sinks not only provide heat dissipation, but also utilized for thermal energy management done by effectively dissipating heat when the heat is augmented. In case of low temperatures, heat sinks are intended to provide heat by releasing thermal energy for proper operation of the circuit.



This work is concerned with the comparative convective heat transfer analysis of a Vertical and horizontal heats sink with different number of fins and Fin spacing. In which heat convective transfer has been examined and with the help of thermo physical characteristic performance is predicted with the help of Finite Element Method tool ANSYS- Fluent, where simulation is being done. The goal is to carry out evaluating heat transfer within the heat sink using different Density based module such as incompressible and Boussinesq model. The FEM results are validated with well published results in the literature and furthermore with experimentation.

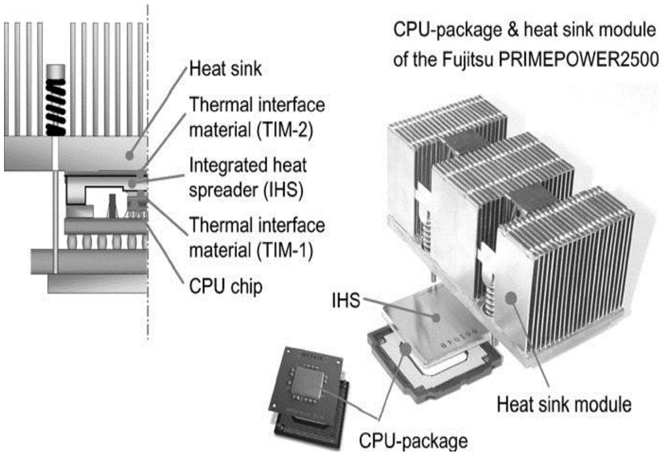


Fig.1. 2 CPU package & heat sink

III. PROBLEM IDENTIFICATION

In most cases, and with how computers are designed today, the entire system shuts down when a CPU reaches a specific temperature to keep it from going up in smokes. This assures that your computer is kept from possible and further damage.

Regardless, regular high temperature readings when using your computer for long periods of time could risk and **damage the CPU**. This also **risks damaging the motherboard** down the line. This is a reason why you need to make sure your CPU temperatures are kept at low levels. A **CPU temperature should play around 75-80 degrees celsius** when gaming. When the computer is *doing small processes* or *in an idle state*, it should be around **45 degrees celsius to a little over 60 degrees celsius** at most.

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In heat sink various problem is encountered which significantly affect the performance of the heat sink are enlisted below. High heat-sink surface, It's at the surface of the heat sink where the thermal transfer takes place. Therefore, Heat sinks should be designed to have a large surface; this goal can be reached by using a large amount of fine fins, or by increasing the size of the heat sink itself.

1. Good aerodynamics. Heat sinks must be designed in a way that air can easily and quickly float through the cooler, and reach all cooling fins. Especially Heat sinks having a very large amount of fine fins, with small distances between the fins may not allow good air flow. A compromise between high surface (many fins with small gaps between them) and good aerodynamics must be found. This also depends on the fan the heat sink is used with: A powerful fan can force air even through a heat sink with lots of fine fins with only small gaps for air flow - whereas on a passive heat sink, there should be fewer cooling fins with more space between them. Therefore, simply adding a fan to a large heat sink designed for Fanless usage doesn't necessarily result in a good cooler.

2. Good thermal transfer within the heat sink. Large cooling fins are pointless if the heat can't reach them, so the heat sink must be designed to allow good thermal transfer from the heat source to the fins. Thicker fins have better thermal conductivity; so again, a compromise between high surface (many thin fins) and good thermal transfer (thicker fins) must be found. Of course, the material used has a major influence on thermal transfer within the heat sink. Sometimes, heat pipes are used to lead the heat from the heat source to the parts of the fins that are further away from the heat source.

3. Perfect flatness of the contact area. The part of the heat sink that is in contact with the heat source must be perfectly flat. A flat contact area allows you to use a thinner layer of thermal compound, which will reduce the thermal resistance between heat sink and heat source.

4. Good mounting method. For good thermal transfer, the pressure between heat sink and heat source must be high. Heat sink clips must be designed to provide a strong pressure, while still being reasonably easy to install. Heat sink mountings with screws/springs are often better than regular clips. Thermo conductive glue or sticky tape should only be used in situations where mounting with clips or screws isn't possible.

Heat sink material: - The thermal conductivity of the heat sink's material has a major impact on cooling performance. Thermal conductivity is measured in W/mK; higher values mean better conductivity. As a rule of thumb, materials with a high electrical conductivity also have a high thermal conductivity

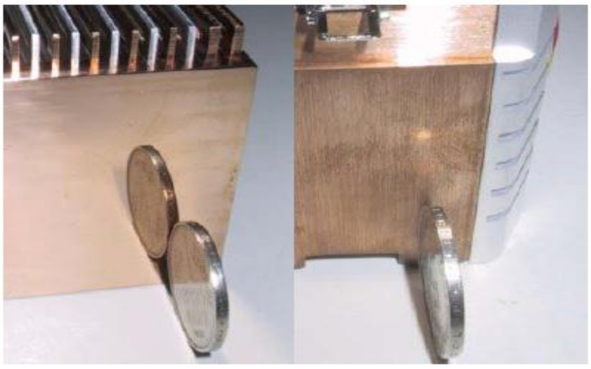

Fig 2.1 Good and bad example for contact area

IV. MODELING & SIMULATIONS

4.1 Dell CPU Cooling fins

4.1.1 Circular fins heat sink Aluminium

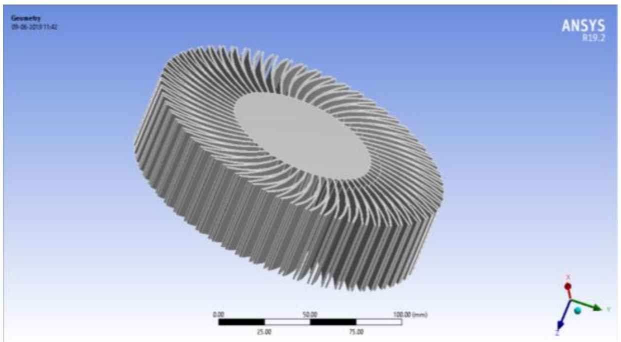

Fig. 4.1 Circular flared heat sink import ANSYS

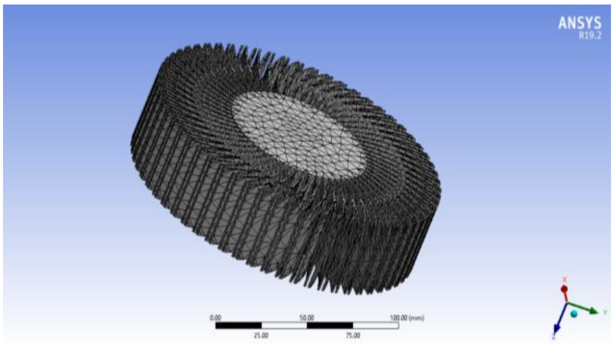

Fig. 4.2 Circular flared heat sink meshing ANSYS

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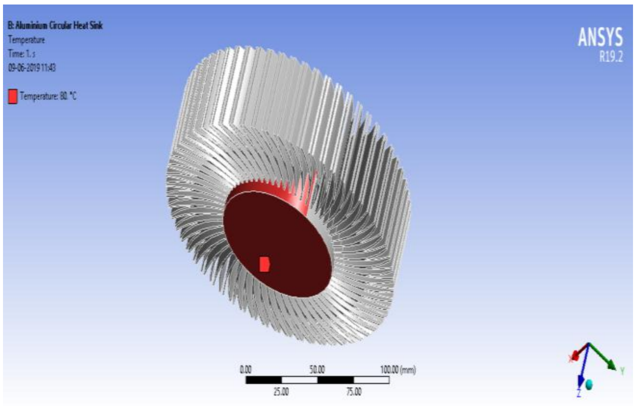

Fig. 4.3 Circular flared heat sink temperature

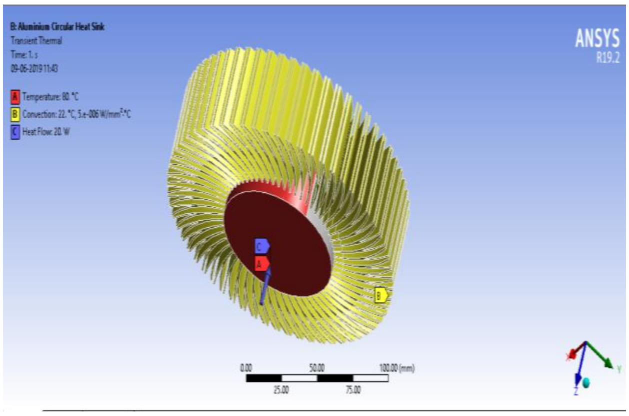

Fig. 4.4 Circular flared heat sink thermal boundary

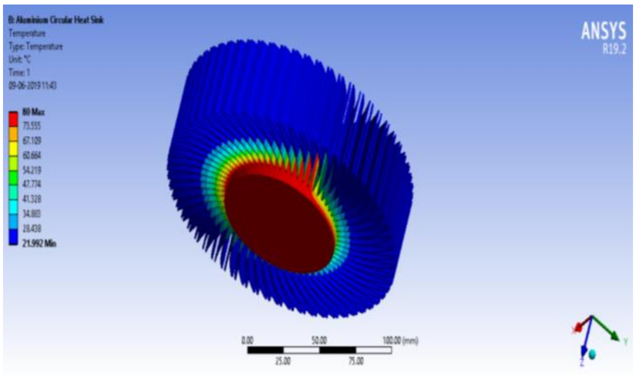

Fig. 4.5 Circular flared heat sink temperature

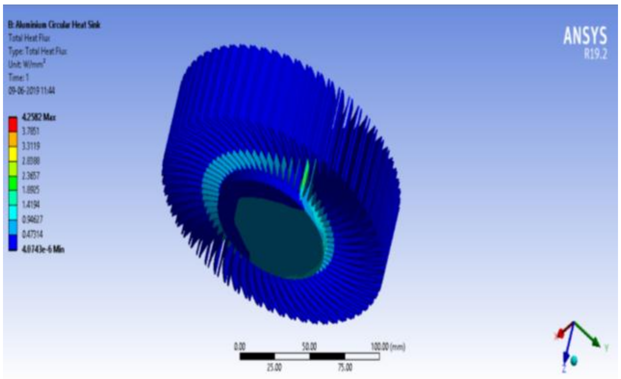

Fig. 4.6 Circular flared heat sink heat flux result

4.1.2 Taper fins heat sink Aluminium

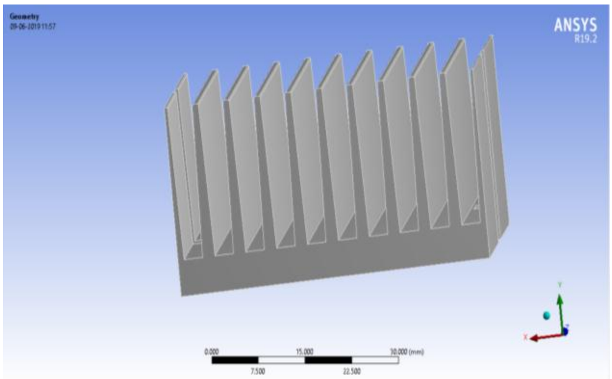

Fig. 4.7 Taper fins heat sink import ANSYS

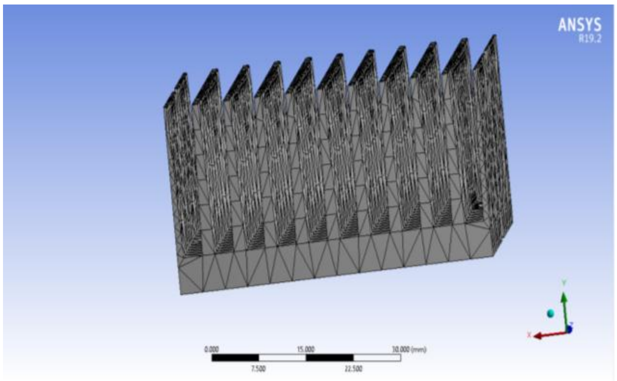

Fig. 4.8 Taper fins heat sink meshing ANSYS

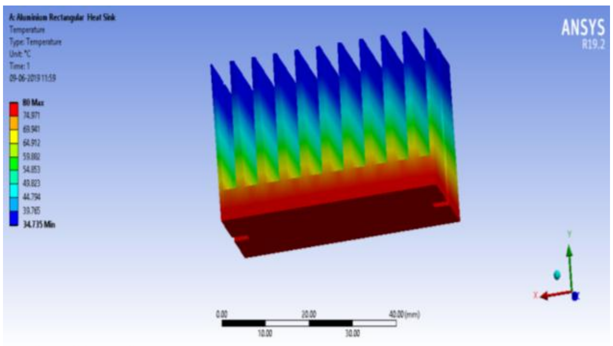

Fig. 4.9 Taper fins heat sink temperature result

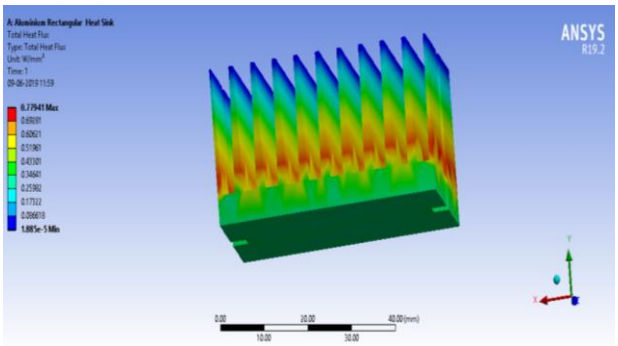

Fig. 4.10 Taper fins heat sink heat flux result

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3.1.3 Rectangular fins heat sink Aluminium

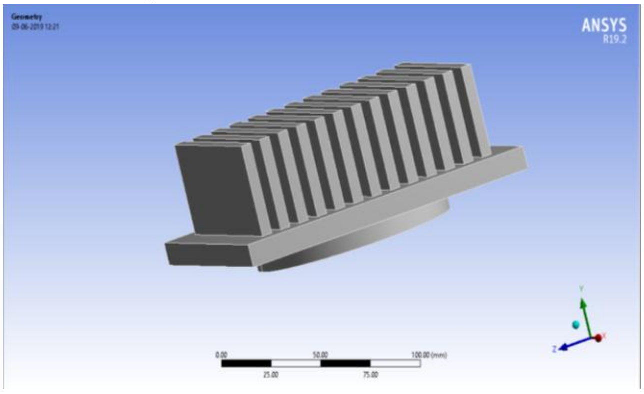

Fig.4.11 Rectangular fins heat sink import ANSYS

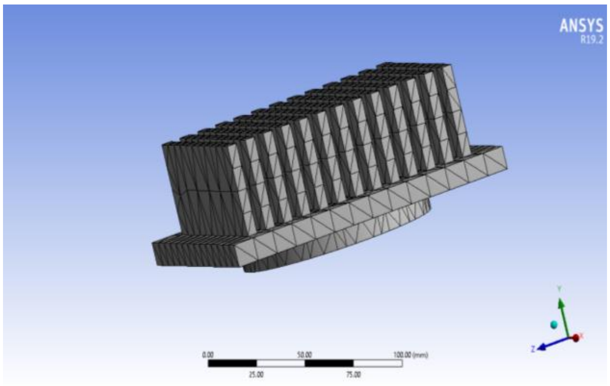

Fig. 4.12 Rectangular fins heat sink meshing ANSYS

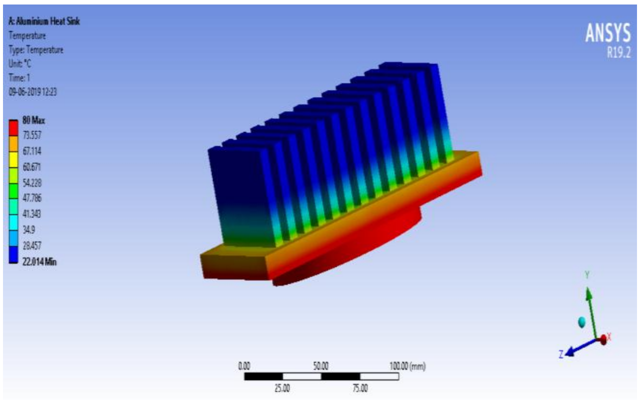

Fig. 4.13 Rectangular fins heat sink temperature reult

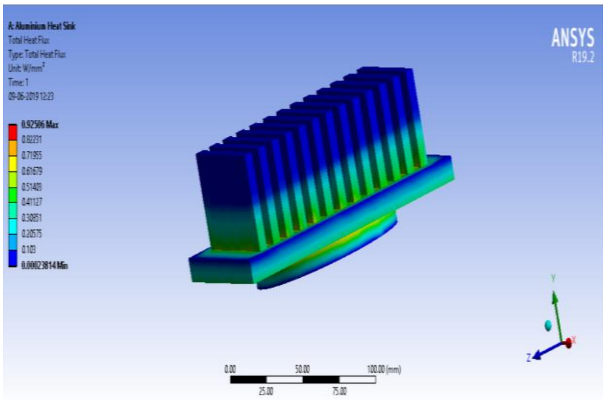

Fig. 4.14 Rectangular fins heat sink heat flux result

4.1.4 Pin fins heat sink Aluminium

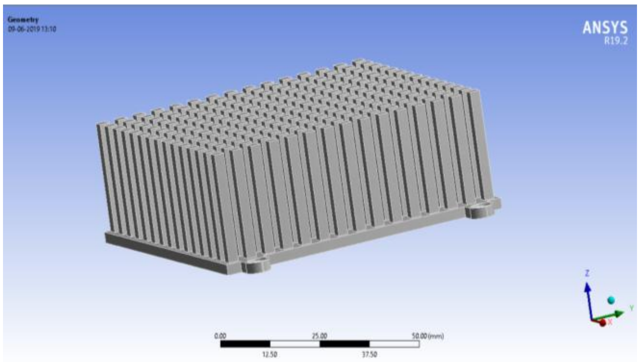

Fig. 4.15 Pin heat sink import ANSYS

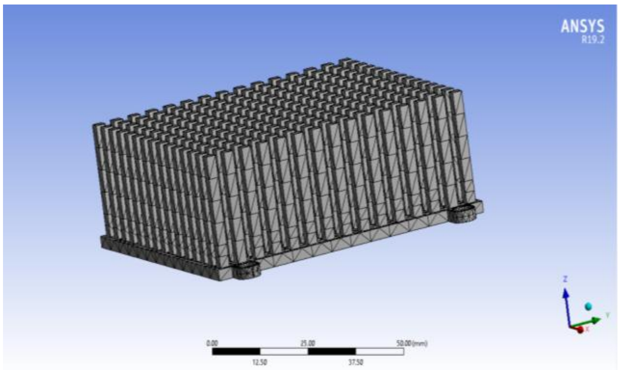

Fig. 4.16 Pin heat sink meshing ANSYS

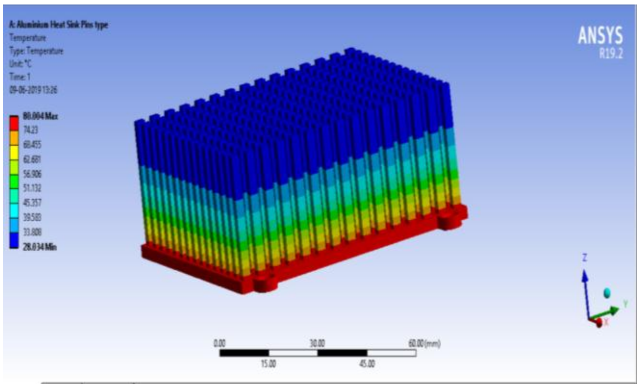

Fig. 4.17 Pin heat sink temperature result

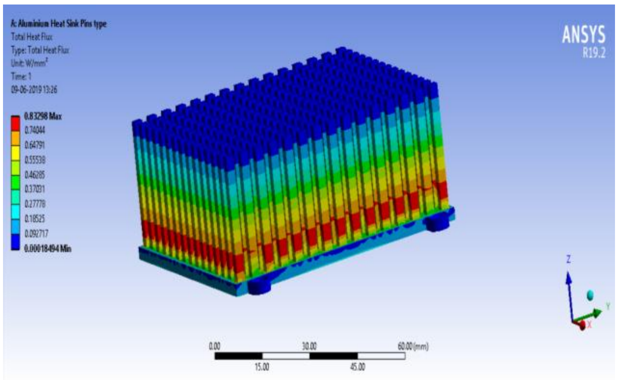

Fig. 4.18 Pin heat sink heat flux result

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V. RESULT & DISCUSSION

We get most extreme temperature esteem for all material like **Circular heat sink**, **Taper Fins heat sink**, Rectangular **heat sink** and **Pin fins heat sink** separately are 73.5 C, 74.97 C , 73.55 C and 74.23 C . Here we can obviously saw that **Circular heat sink aluminium** materials have less estimation of temperature contrast with different geometries. So it is used for future design.

We get most extreme heat flux an incentive for all material like **Circular heat sink**, **Taper Fins heat sink** , **Rectangular heat sink** and **Pin fins heat sink** individually are 4.25 w/mm^2, 0.77 w/mm^2, 0.925 w/mm^2 and 0.832 w/mm^2. Here we can unmistakably saw that **Circular heat sink aluminium** materials have more heat flux value with different geometries. So it is ok for future plan.

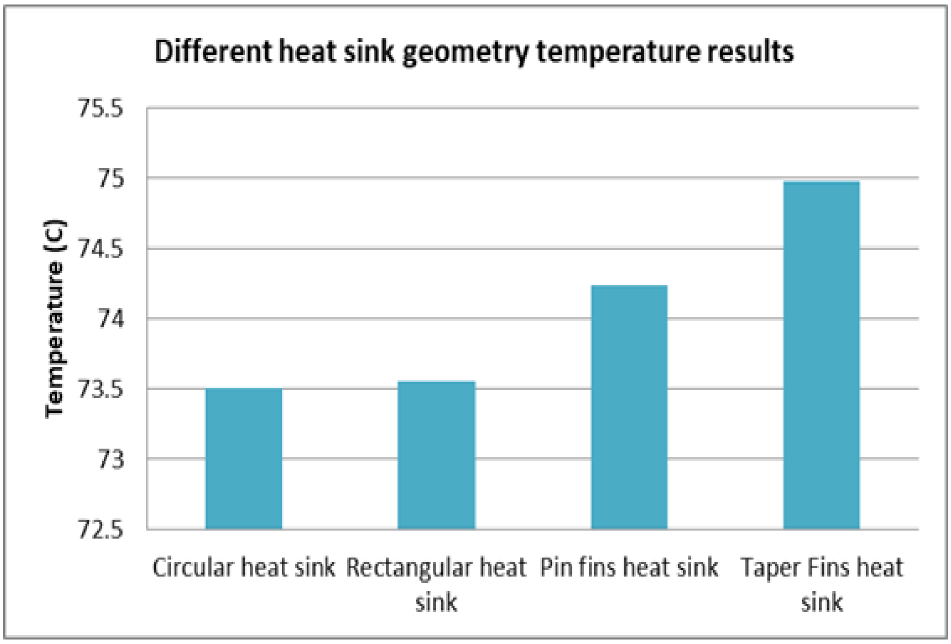

Fig. 5.1 Different heat sink geometry temperature results

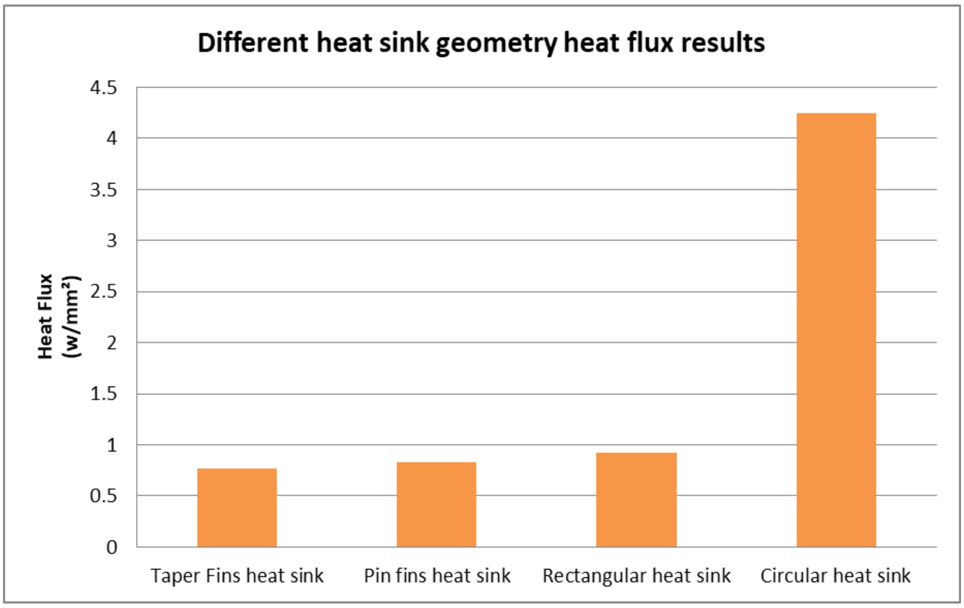

Fig. 5.2 Different heat sink geometry heat flux results

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VI. CONCLUSION

For Optimization and analysis of a heat sink following conclusion has been drawn which significantly affects the performance of heat sink

- On increasing fin spacing convective heat transfer first increases up to optimum spacing and then starts decreasing. This is due to higher heat transfer coefficient but lesser surface area.
- As temperature difference increases convective heat transfer coefficient increases noteworthy.
- Widely spaced heat have high heat transfer coefficient at corresponding higher temperature difference.
- Vertical configuration heat sink has better performance on comparison with horizontal one.
- Nusselt number(Nu) linearly increases has temperature difference increases.
- Increasing fin spacing Nusselt number(Nu) increases
- Convective heat transfer coefficient is a strong function of Nusselt number.
- At a specified temperature difference and fin height, the convective heat transfer rate increases with increasing fin spacing till it reaches optimum spacing and then with further increasing fin spacing heat transfer rate decreases.
- On increasing fin height by employing longer fins, but with a fixed volumetric flow rate performance may actually decrease with fin height.

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