Proposed Work and Methodology of Research Work

Fins are usually analyzed by assuming uniform heat transfer coefficient model on its surface. However, studies by various investigators revealed that it is not constant but varies along the fin length. The temperature gradient occurs in the heat sink base due to the heat dissipation resistance in the fin arrays. It is mainly because of non-uniform resistance experienced by the fluid flow in the inter fin region, resulting hot spots and non-uniform heat flux at the heat sink level.

In order to dissipate the heat of very high heat flux densities, the required heat sink must often be larger than device. Consequently, the heat sink performance is reduced. The inter fin resistance may be reduced by adding the notches or by adding the perforation to the fins. Adding a cross-fin at center helps to increase the heat dissipation area but it forms the stagnant layer at the bottom of the fin array. The fluid flow rate at the bottom of the cross-fin array can be eased by adding perforation to the fins, resulting enhancement of heat dissipation rate from fin arrays.

Hence, selected topic “Thermal Performance Analysis by Natural Convection of Perforated Rectangular Fins with Cross Fins at Centre” has remained untouched by researchers.

In the present research work, actual experiments and analysis of the natural convection heat transfer characteristics of perforated rectangular plate fin arrays with cross fin at center will be carried, by varying size of perforation. Results will be validated by CFD (Software preferably by ANSYS CFX).

The term perforation means holes of different geometries over the lateral surface of the fin. The solid fin arrays will have external dimensions same as that of perforated fins. In the experimentation, fin arrays will be fixed on the rectangular base with fixed spacing, base will be insulated to avoid the heat losses, and whole assembly will be enclosed to get the natural convection condition. Experiments will be carried for different heater inputs. The steady state reading will be noted. Calculation of ha, Nu, Ra from obtained readings will be done. Based on results various performance characteristics will be plotted. From obtained plots, comparison of heat transfer of perforated fin arrays with its equivalent solid fin arrays will be carried out.

Other part will be of simulation using software, it consists of three main steps.

i) CFD Pre-Processing  
ii) The use of Solver  
iii) Post processing  

In the Pre-processing geometry will be created by using the suitable tools. Then geometry will be taken to for discretion (meshing). During the CFD simulation setup, we need to define boundary conditions where you can apply specific physics. For example, we may need to define where the fluid enters the geometry or where it leaves. After applying the proper boundary conditions, solvers are started to get solutions. When residuals go below the set level, it is said be that solution is converged. The results will be examined in the post processing.

Hence, proposed work consists of

i) Fabricating and assembling of the experimental set up, fabricating the various types of fin arrays required for experimental investigation.
ii) Conducting the experiment and noting down the steady state readings on various arrays i.e.
rectangular arrays of with cross fin without perforation and rectangular arrays with cross fin
and perforation.

iii) Plotting performance characteristics of various fin arrays from obtained results.

iv) Comparisons between without perforated and perforated rectangular plate fin arrays as well
    as with and without cross-fin at center will be carried.

v) CFD simulation with help of suitable software

vi) Comparision of obtained results by CFD and experiment, hence the validation of results.

vii) Experimental investigation will be carried on the solid base plate without fin array to find fin
effectiveness.

viii) Heat transfer coefficient of perforated fin arrays of various size of perforation will be
    find out and compared with the solid rectangular cross fin arrays set of same dimensions
    (L x b x H).

ix) Also flow visualization test will be carried out to know the flow pattern.

x) Making over all conclusions.