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NATURAL CONVECTION HEAT TRANSFER OF NARROW PLATES

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Abstract— Natural convection is a mechanism, or type of heat transport, in which the fluid motion is not generated by any external source (like a pump, fan, suction device, etc.) but only by density Differences in the fluid occurring due to temperature gradients. In natural convection, fluid surrounding a heat source receives heat, becomes less dense and rises. The surrounding, cooler fluid then moves to replace it. This cooler fluid is then heated and the process continues, forming convection current; this process transfers heat energy from the bottom of the convection cell to top. The driving force for natural convection is buoyancy, a result of differences in fluid density. Steady state natural convection from heat sink with narrow plate-fins having parallel arrangement mounted on inclined base was experimentally investigated. Aluminium heat sink with two different cases. case 1 is horizontal plane convection case2 vertical plane convection with suitable for these thermal boundary conditions.

Keywords: Temperature, Stress, Strain, Thermal barrier etc…

I. Introduction

Natural convection is a mechanism, or type of heat transport, in which the fluid motion is not generated by any external source(like a pump, fan, suction device, etc.) but only by density Differences in the fluid occurring due to temperature gradients. In natural convection, fluid surrounding a heat source receives heat, becomes less dense and rises. The surrounding, cooler fluid then moves to replace it. This cooler fluid is then heated and the process continues, forming convection current; this process transfers heat energy from the bottom of the convection cell to top. The driving force for natural convection is buoyancy, a result of differences in fluid density. Because of this, the presence of a proper acceleration such as arises from resistance to gravity, or an equivalent force (arising from acceleration, centrifugal force or Coriolis effect), is essential for natural convection.

For example, natural convection Essentially does not operate in free-fall (inertial) environments, such as that of the orbiting International Space Station, where other heat transfer mechanisms are required to prevent electronic components from overheating. Convective heat transfer, often referred to simply as0T 0Tconvection, is the transfer of heat from one place to another by the0T 0T32movement of fluids32T.

1.1 two types of convective heat:

Free or natural convection: when fluid motion is caused by buoyancy forces that result from the density variations due to variations of thermal temperature in the fluid. in the absence of an external source, when the fluid is in contact with a hot surface, its molecules separate and scatter, causing the fluid to be less dense. As a consequence, the fluid is displaced while the cooler fluid gets denser and the fluid sinks. Thus, the hotter volume transfers heat towards the cooler volume of that fluid.P [2]P Familiar examples are the upward flow of air due to a fire or hot object and the circulation of water in a pot that is heated from below. Forced convection: when a fluid is forced to flow over the surface by an external source such as fans, by stirring, and pumps, creating an artificially induced convection current.

II. Literature Review

W.Elenbass [1] investigated experimentally, the heat transfer performance of rectangular fins on a vertical base in free convection heat transfer. The effects of geometrical parameters and base-toambient temperature difference on the heat transfer performance of fin arrays were observed and the optimum fin separation values were determined.

E.M Sparro [2] investigated the heat transfer performance of rectangular fins on a vertical base in free convection heat transfer. The effects of geometric parameters and base-to-ambient temperature difference on the heat transfer performance of fin arrays were observed and the optimum fin separation values were determined.30 fin configurations were tested.

J.R Bodoia [3] investigated steady state natural convection from heat sink of rectangular fins on a vertical base. The effects of geometric parameters and base-to-ambient temperature difference on the heat transfer performance of fin arrays were observed and the optimum fin separation values were determined. 30 fin configurations were tested. A.De Lieto Vollaro [4] tested heat sink for wide range of angle of inclination with upward and downward orientations.

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By modifying Grashoff number with cosine of inclination angle, they suggested the modified correlation, which is best suited for inclination angle interval of $-60° \leq \theta \leq +80°$. It was also observed that the flow separation inside the fin channels of the heat sink is an important .

III. Problem Description & Methodology

The objective of this project is to make a 3D model of the narrow plates and study the thermal and static behavior of the narrow plates by performing the finite element analysis. 3D modeling software (CATIA) was used for designing different geometries (with out coating of ceramics and with coating of ceramics) and analysis software (ANSYS) was used for thermal analysis. The methodology followed in the project is as follows:

• Create a 3D model of the steam narrow plates using parametric software catiav5r20.

• Perform thermal analysis and linear layer thermal analysis on the narrow plates for thermal loads, to find out the temperature distribution and heat flux

IV. Introduction to CAD

Throughout the history of our industrial society, many inventions have been patented and whole new technologies have evolved. Perhaps the single development that has impacted manufacturing more quickly and significantly than any previous technology is the digital computer.

1. Introduction to catia

CATIA is a totally automation programming which relates with the mechanical field. It is graphical UI which is definitely not hard to learn moreover the item is feature based and parametric solid illustrating. We can draw 2D and 3D models of an area and in like way the social affair of the parts ought to be conceivable in it.

The shape or geometry of the model or assembling is poor upon the qualities which are suggested as objectives. Modules, for instance, sketcher module used to design 2D illustrations, part layout module is used to diagram the 3D models of geometry, and Assembly work arrangement is used to accumulate the different parts which are pulled in the part plot module. Kinematics is used to give the entertainment or development to the part bodies which are arranged and amassed to some degree and get together layout modules.

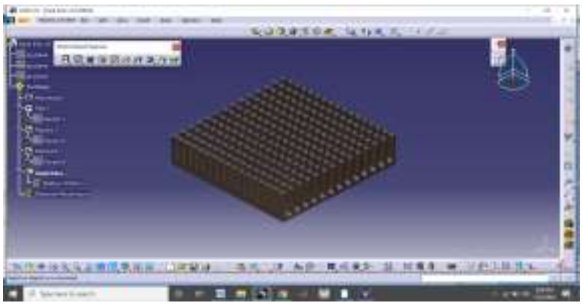

fig1: narrow plates model in catiav5r20

B. Introduction to Finite Element Method

Finite Element Method (FEM) is also called as Finite Element Analysis (FEA). Finite Element Method is a basic analysis technique for resolving and substituting complicated problems by simpler ones, obtaining approximate solutions Finite element method being a flexible tool is used in various industries to solve several practical engineering problems. In finite element method it is feasible to generate the relative results. ANSYS is an Engineering Simulation Software (computer aided Engineering). Its tools cover Thermal, Static, Dynamic, and Fatigue finite element analysis along with other tools all designed to help with the development of the product. The company was founded in 1970 by Dr. John A. Swanson as Swanson Analysis Systems, Inc. SASI. Its primary purpose was to develop and market finite element analysis software for structural physics that could simulate static (stationary), dynamic (moving) and heat transfer (thermal) problems.

V. project analysis

Ansys workbench

steady state thermal analysis

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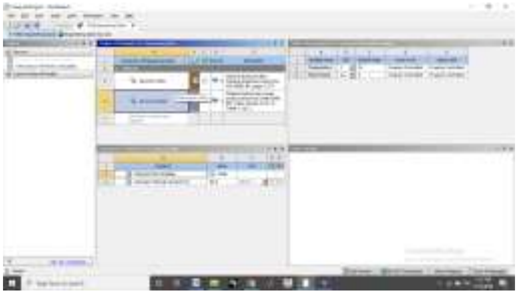
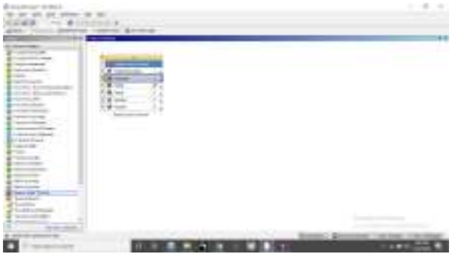
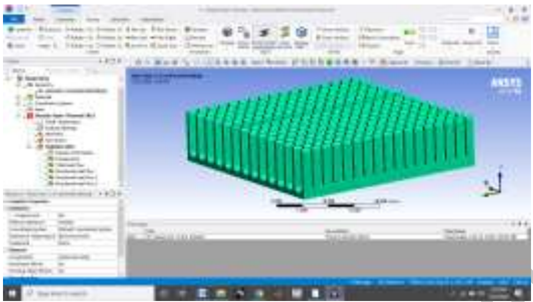


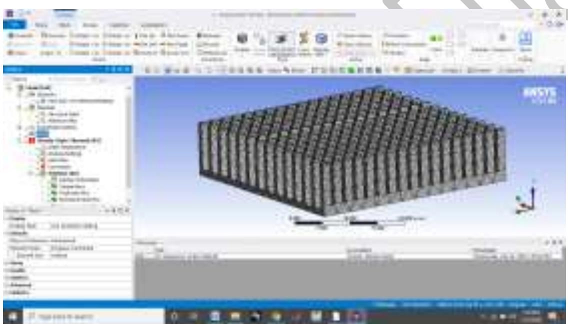
engineering data



geometry

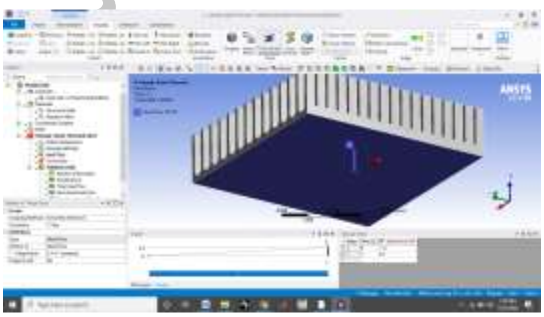


catia model in Ansys

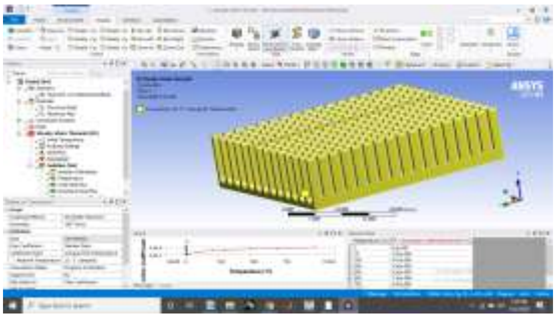


mesh model in Ansys

boundry conditions



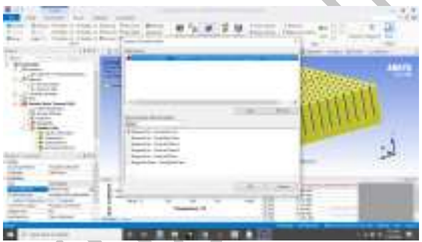
heat flow



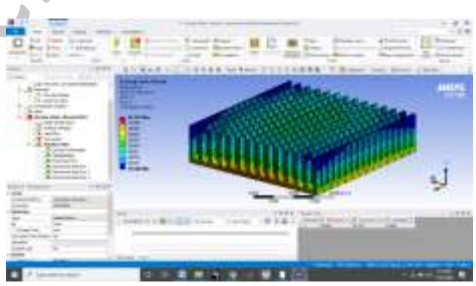
convection

case 1

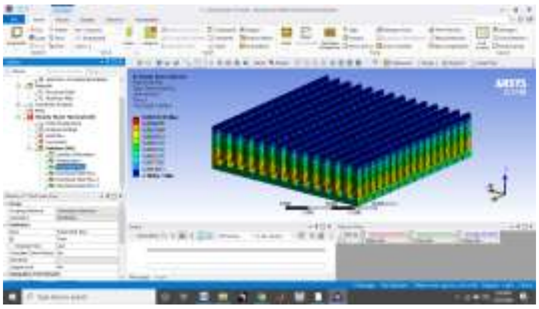
convection in horizontal planes



convection tabler data horizontal plane



temperature distribution



total heat flux

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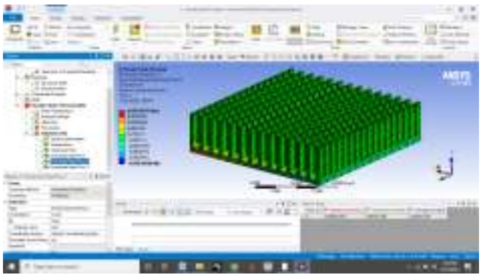
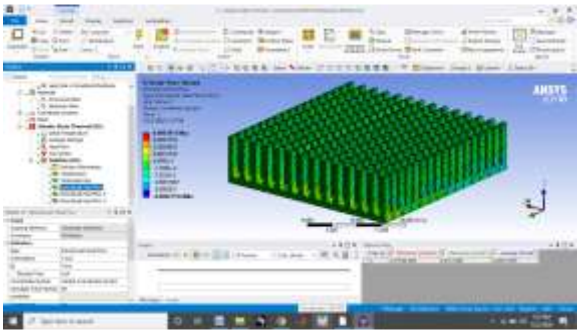
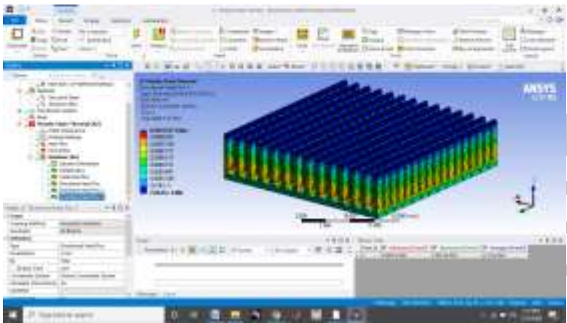


heat flux in x direction



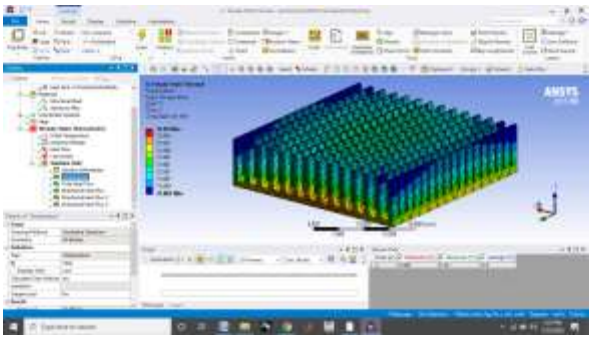
heat flux in y direction



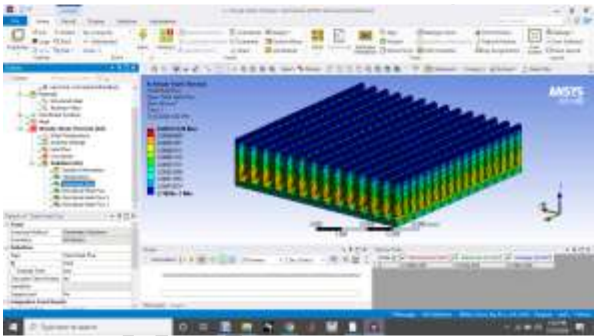
heat flux in z direction

case 2 convetion in vertical planes

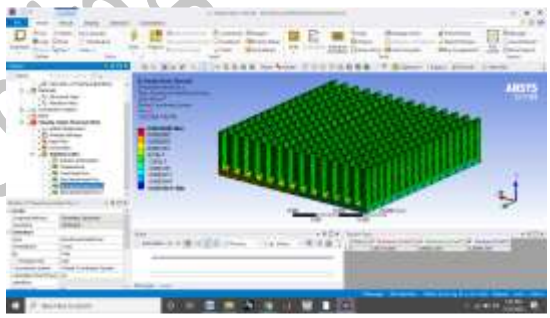
convection in vertical planes



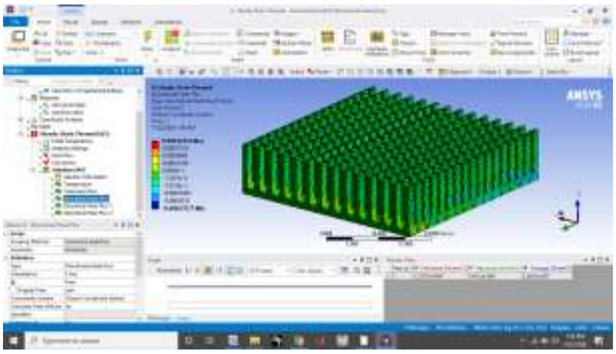
temparature distribution



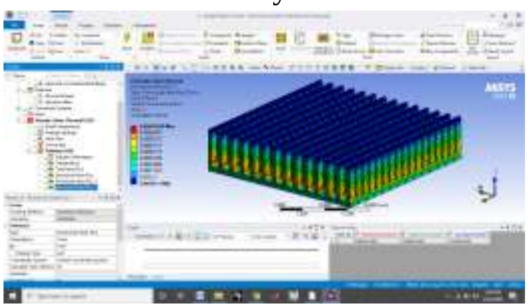
total heat flux



heat flux in x direction



heat flux in y direction



heat flux in z direction

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Results

Case No	Temperature(°C)	Total heat flux(W/mm^2)	Heat flux in x direction (W/mm^2)	Heat flux in y direction (W/mm^2)	Heat flux in z direction (W/mm^2)
1	29.703	7.2745e-004	3.6979e-004	3.411e-004	7.0573e-004
2	31.92	7.2728e-004	3.6982e-004	3.4112e-004	7.0558e-004

CONCLUSION:

In this project we did the design of adjacent narrow plates by using the 3d cad modeling tool i.e catia v5 r20 after completion of the design we did the thermal analysis by using the ea tool i.e. ansys19.3. in this project we worked with two cases. one is horizontal convection and other one is vertical convection by ibserbing the results of both cases we obserb the horizontal case have batter results then the vertical convection

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