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CFD ANALYSIS AND HEAT TRANSFER RATE PERFORMANCE IMPROVEMENT OF AN AUTOMOBILE RADIATOR

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ABSTRACT:
Air conditioner condensers are a heat exchanger device; ACcondenser units are grouped according to how it rejects the heat to the medium(surround air). The primary component of a condenser is typically the condensercoil, through which the refrigerant flows. Since, the AC condenser coil containsrefrigerant that absorbs heat from the surrounding air, the refrigeranttemperature must be higher than the air.In this project designed an air-cooled Condenser fins for an air conditioner.Presently the material used for coils is Copper and the material used for Fins isCopper or aluminium G Al Cu 4IMG 204 whose thermal conductivity is 110-150W/m K. the condenser fines design using computer aided software Catia. Weare optimizing the design parameters by changing the thickness of the fin for thesame length without failing the load conditions. To validate the temperaturesand other thermal quantities like flux and gradient, thermal analysis is done onthe condenser fines by applying copper for coil and Fin materials G Al Cu4IMG 204, Aluminium Alloy Al99 and Magnesium alloy. Heat flux, directionalheat flux, convection, Thermal analysis is done in ANSYS. And also we arevarying inside cooling fluid Hydrocarbon (HC) and Hydro Chloro-Flouro carbon(HCFC). The best material and best fluid for the condenser of our design can bechecked by comparing the results. Optimization is done by changing thethickness of the Catia is a parametric 3D modelling software and ANSYS is analysis software.

1. INTRODUCTION

Our assignment is to plan a car radiator to work in conjunction with cutting edge cooling liquids. The new radiator configuration will be utilized as a part of new General half and half Motors vehicles. These mixture vehicles have various cooling frameworks for the interior ignition motor, electric motor, and batteries. The notoriety of these mixture vehicles is diminishing the petroleum derivative supply, expanding the significance of another radiator outline that can supplant these different cooling frameworks.

1.1 Radiators

A radiator is a kind of warmth exchanger. It is intended to exchange warm from the hot coolant that moves through it to the air passed up the fan.

Most present day autos utilize aluminum radiators. These radiators are made by brazing slight aluminum blades to smoothed aluminum tubes. The coolant streams from the channel to the outlet through many tubes mounted in a parallel course of action. The blades lead the warmth from the tubes and exchange it to the air moving through the radiator.

These are fundamentally utilized for cooling reason in autos, cylinder motor flying machine, railroad trains, cruisers, stationary power creating plant. The radiator exchanges the warmth from the liquid inside to the air outside, accordingly cooling the liquid, which thus cools the motor. Inner ignition motors are regularly cooled by circling a fluid inside the motor square where it is warmed, at that point through a radiator where it loses warmth to the environment, and afterward came back to the motor. Motor coolant is typically water and oil based. It is regular to utilize a water pump to drive the motor coolant to flow all through the motor and furthermore the hub fan is utilized to compel the air through the radiator.

1.2 Automobile Radiators

The radiator is one of the cooling parts that anticipate motor overheating. Things being what they are ensure your auto radiator is appropriately kept up at all times. Is your motor transmitting more warmth than it should? At that point there may be a major issue with your radiator, which as the greater parts of us know is the cooling framework's principle segment. So if this current part's wastefulness is beginning to drive you up the divider with its untrustworthiness, at that point it's a great opportunity to begin searching for the ideal auto radiator substitution.

Chapter-2

LITERATURE REVIEW

Oliet et al. (2007) examined diverse components which impact radiator execution. It incorporates air, blade thickness, coolant stream and air bay temperature. It is get that warmth exchange and execution of radiator unequivocally influenced via air and coolant mass stream rate. As air and coolant stream builds cooling limit additionally increments. At the point when the air delta temperature expands then the warmth exchange and their cooling amount diminishes. Littler balance dispersing and more noteworthy louver balance edge have higher warmth exchange. Blade thickness might be expanded till it hinders the wind stream and warmth exchange rate diminished.

Sulaiman et al. (2009) utilize the computational Fluid Dynamics (CFD) demonstrating reenactment of wind stream circulation from the car radiator fan to the radiator. The undertaking embraced the model the geometries of the fan and its surroundings is the initial step. The outcomes demonstrate that the outlet air speed is 10 m/s. The mistake of normal outlet air speed is 12.5 % because of contrast in the tip state of the edges. This investigation has demonstrated that the CFD recreation is a helpful instrument in upgrading the plan of the fan sharp edge. In this paper this examination has demonstrated a basic answer for plan a marginally streamlined state of the fan center.

Chacko et al. (2005) utilized the idea that the effectiveness of the vehicle cooling framework emphatically depends reporting in real time stream towards the radiator center. An unmistakable comprehension of the stream design inside the radiator cover is required for streamlining the radiator cover shape to expand the stream toward the radiator center, subsequently enhancing the warm effectiveness of the radiator. CFD investigation of the standard plan that was approved against test information demonstrated that imperative range of re-coursing stream to be inside the radiator cover. This distribution decreased the stream towards the radiator center, prompting a notoriety of hot air takes near the radiator surface and ensuing disfavour of radiator warm productivity. The CFD make capable advancement prompted radiator cover arrangement that disposed of these distribution ranges and expanded the stream

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towards the radiator center by 34%. It is foreseen that this expansion in radiator center stream would vital to expand the radiator warm effectiveness.

Chapter-3

DESIGN OF RADIATOR

CATIA offers a solution to shape design, styling, surfacing workflow and visualization to create, modify, and validate complex innovative shapes from industrial design to Class-A surfacing with the ICEM surfacing technologies. CATIA supports multiple stages of product design whether started from scratch or from 2D sketches. CATIA is able to read and produce STEP format files for reverse engineering and surface reuse

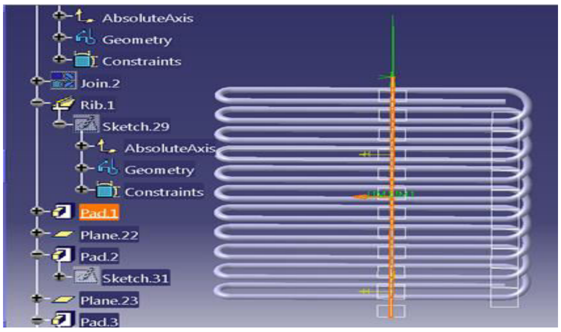


Fig1.4: Sketcher of Radiator

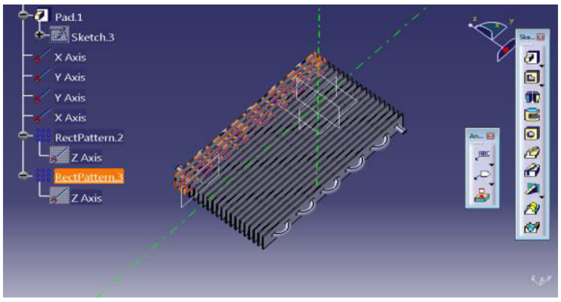


Figure: 1.5 Model of Radiator

Chapter-4

ANALYSIS OF RADIATOR

ANSYS is general-purpose finite element analysis software, which enables engineers to perform the following tasks:

1. Build computer models or transfer CAD model of structures, products, components or systems
2. Apply operating loads or other design performance conditions.
3. Study the physical responses such as stress levels, temperatures distributions or the impact of electromagnetic fields.
4. Optimize a design early in the development process to reduce production costs.

5. A typical ANSYS analysis has three distinct steps.

6. Pre Processor (Build the Model).

ANALYSIS OF RESULTS:

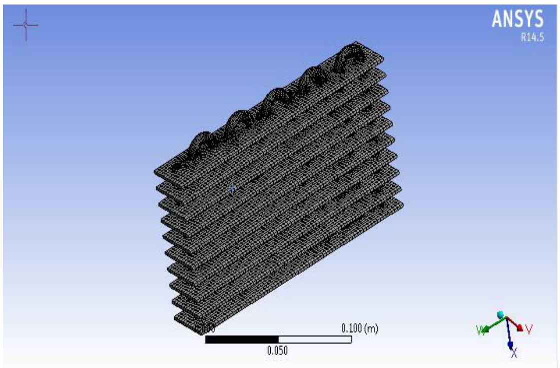
In this chapter, the results obtained for the analysis of enivarmental chamber system for the original profile and dynamic structural analysis are discussed. And also explained the graphs plotted by comparing those results.

- **Material Data**

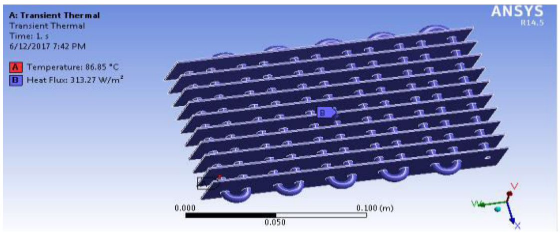
Aluminium Alloy Al99

Density	2700 kg m^-3
Coefficient of Thermal Expansion	22 C^-1
Specific Heat	900 J kg^-1 C^-1
Thermal Conductivity	14.99 W m^-1 C^-1

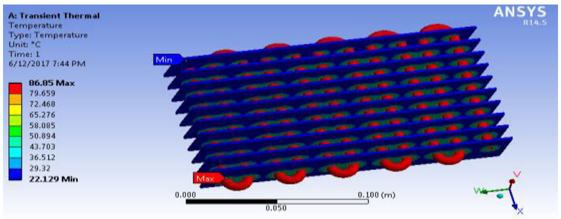
- **Mesh:**



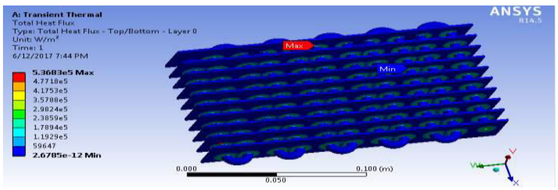
Loads:



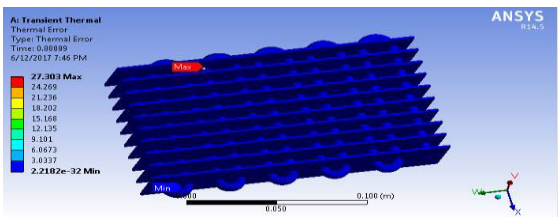
Temperature:



Total heat flux:



Thermal Error:

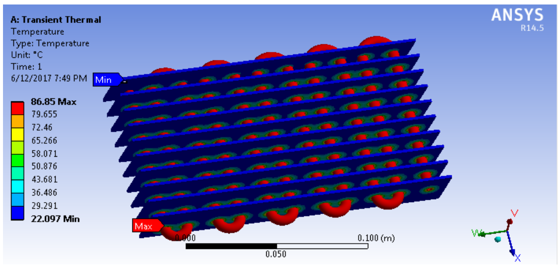


Object Name	*Temperature*	*Total Heat Flux*	*Thermal Error*	*Directional Heat Flux*
Minimum	22.129 °C	2.6785e-012 W/m²	2.2182e-032	-4.1154e+005 W/m²
Maximum	86.85 °C	5.3683e+005 W/m²	6.2269	4.5278e+005 W/m²

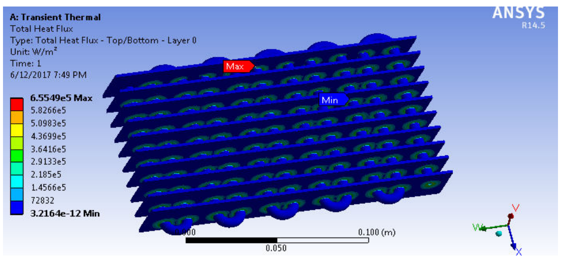
Al2O3:

Density	3690.7 kg m^-3
Thermal Conductivity	18 W m^-1 C^-1
Specific Heat	880 J kg^-1 C^-1

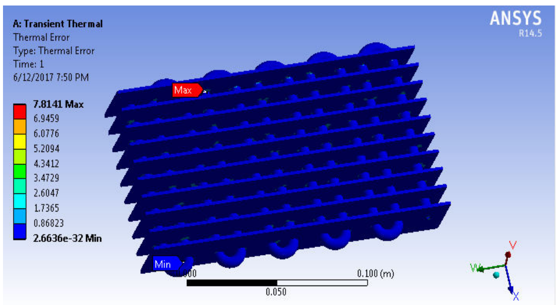
Temperature:



Total heat flux:



Thermal Error:



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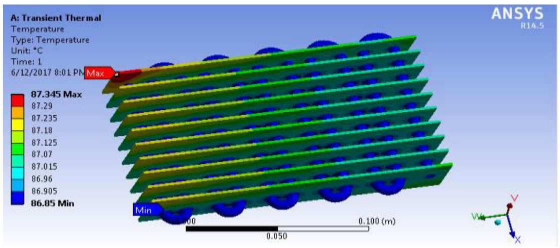
Object Name	*Temperature*	*Total Heat Flux*	*Thermal Error*	*Directional Heat Flux*
Minimum	22.097 °C	3.2164e-012 W/m²	2.6636e-032	-5.0486e+005 W/m²
Maximum	86.85 °C	6.5549e+005 W/m²	7.8141	5.5541e+005 W/m²

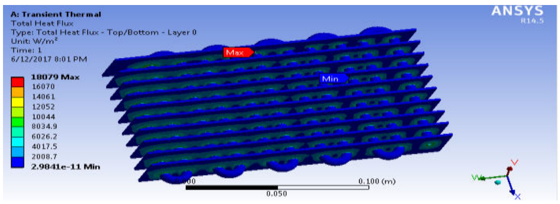
AA-6061:

Density	2700 kg m^-3
Thermal Conductivity	167 W m^-1 C^-1
Specific Heat	0.896 J kg^-1 C^-1

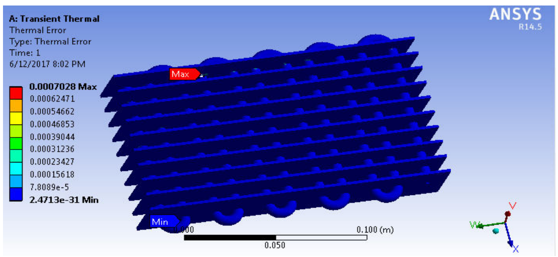
Temperature:



Total heat flux:



Thermal Error:



Object Name	Temperature	Total Heat Flux	Thermal Error	Directional Heat Flux
Minimum	40. °C	2.9213e-011 W/m²	7.1813e-032	-9.9316e+006 W/m²
Maximum	219.95 °C	1.1514e+007 W/m²	198.61	8.3827e+006 W/m²

Computational Fluid Dynamics (CFD):

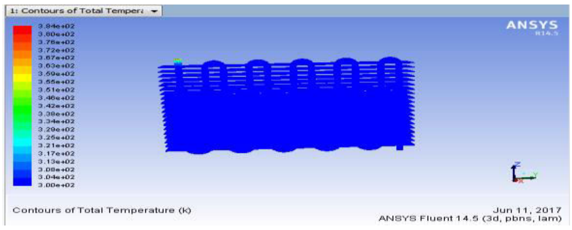


Figure: 4.1 Total Temperature Distributions

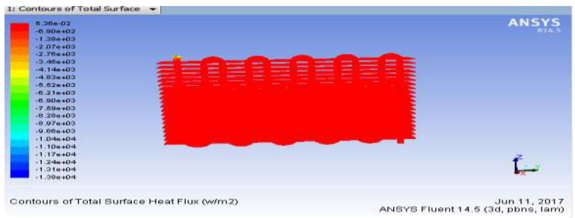


Figure: 4.2 Surface Heat Flux

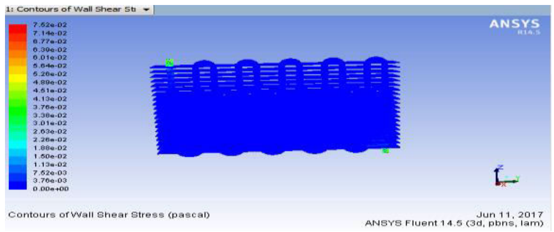


Figure: 4.3 Wall Shear Stress Distributions

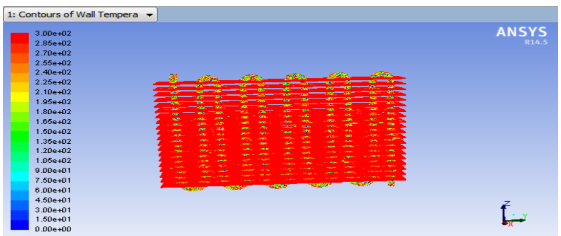


Figure: 4.4 Wall Temperatures

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Minimum Absolute Pressure 1

Maximum Absolute Pressure 5e+10

Minimum Temperature 1

Maximum Temperature 5000

CONCLUSION:

Radiator plan and its working execution are finished by using Catia V5 and ANSYS. In ANSYS we did CFD and warm examination to discover the execution disappointments. Our errand was to plan a superior warm productivity esteem idea for a car radiator.

1. Al2O3 material is better appropriate for radiator in light of the fact that this material gives more warmth exchange proficiency contrasted and different materials.

2. The general warmth exchange coefficient rate increases when volumetric stream rate of the fluid (water-fluid) is improved altogether.

3. AA-6061 material is additionally better appropriate for radiator since its general warm blunder is less when compared with other materials and likewise it gives a superior temperature withstanding values.

4. The warm examination and CFD investigative outcomes were contrasted with guarantee a sheltered and solid plan.

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