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Experimental Investigation and FEA Analysis of an Engine Block Fins by Varying Cooling Fluids

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Abstract:

Cooling system plays important roles to control the temperature of car's engine. One of the important elements in the car cooling system is cooling fluid. The usage of wrong cooling fluid can give negatives impact to the car's engine and shorten engine life. An efficient cooling system can prevent engine from overheating and assists the vehicle running at its optimal performance. This project is conducted to study the effectiveness of various types cooling agent in the vehicle cooling system which will influence the operation time of the engine block mainly cylinder in the light vehicle cooling systems. In this project experimental investigations are made to measure the temperature of the prototypes of the engine block manufactured using two aluminum materials 6463 and 6063 by changing the fin angle. The fin angles taken are 900, 930 and 960 measured from the base. The temperatures are measured by heating and cooling the engine block fins with different cooling fluids Water, R134A and Castor Oil.CFD analysis is done to determine the heat transfer coefficients of cooling fluids Water, R134A and Castor Oil for all the models. Thermal analysis is done on the engine block using two aluminum materials 6463 and 6063 by applying the temperature and heat transfer coefficients. Thermal analysis results define the heat transfer rates.

Keywords:

Cooling Systems, FEA analysis, Engine block Fins, Thermal analysis.

Introduction:

Although gasoline engines have improved a lot, they are still not very efficient at turning chemical energy into mechanical power. Most of the energy in the gasoline (perhaps 70%) is converted into heat, and it is the job of the cooling system to take care of that heat. In fact, the cooling system on a car driving down the freeway dissipates enough heat to heat two average-sized houses! The primary job of the cooling system is to keep the engine from overheating by transferring this heat to the air, but the cooling system also has several other important jobs.The engine in your car runs best at a fairly high temperature. When the engine is cold, components wear out faster, and the engine is less efficient and emits more pollution. So another important job of the cooling system is to allow the engine to heat up as quickly as possible, and then to keep the engine at a constant temperature.

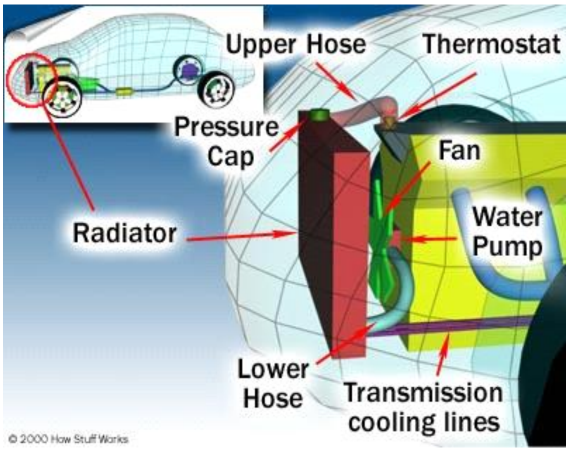

Fig :Engine cooling system

The engine block and cylinder head have many passageways cast or machined in them to allow for fluid flow. These passageways direct the coolant to the most critical areas of the engine.

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Fig: Engine block

Temperatures in the combustion chamber of the engine can reach 4,500 F (2,500 C), so cooling the area around the cylinders is critical. Areas around the exhaust valves are especially crucial, and almost all of the space inside the cylinder head around the valves that is not needed for structure is filled with coolant. If the engine goes without cooling for very long, it can seize. When this happens, the metal has actually gotten hot enough for the piston to weld itself to the cylinder. This usually means the complete destruction of the engine.

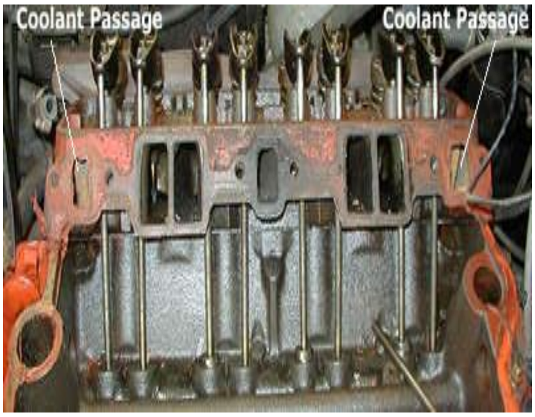

Fig :Input and output of coolant

Related work:

In the paper by **Navid Bozorgan, Komalangan Krishnakuma, Nariman Bozorgan**[1], application of CuO-water nanofluid with size of the nanoparticles of 20 nm and volume concentrations up 2% is nu- merically investigated in a radiator of Chevrolet Suburban diesel engine under turbulent flow conditions. The heat transfer relations between airflow and nanofluid coolant have been obtained to evaluate local convective and overall heat transfer coefficients and also pumping power for nanofluid flowing in the radiator with a given heat exchange ca- pacity. In the present study, the effects of the automotive speed and Reynolds number of the nanofluid in the different volume concentrations on the radiator performance are also investigated. The results show that for CuO-water nanofluid at 2% volume concentration circulating through the flat tubes with Renf = 6000 while the automotive speed is 70 km/hr, the overall heat transfer coefficient and pumping power are approximately 10% and 23.8% more than that of base fluid for given conditions, respectively.

JP Yadav and Bharat Raj Singh[2],in their studies also presented parametric study on automotive radiator. In the performance evaluation, a radiator is installed into a test setup. The various parameters including mass flow rate of coolant, inlet coolant temperature; etc. are varied. Following remarks are observed during study :Influence of coolant mass flowcooling capacity of the radiator has direct relation with the coolant flow rate. With an increase in the value of cooling flow rate, there is corresponding increase in the value of the effectiveness and cooling capacity. Influence of coolant inlet temperaturewith the increase in the inlet temperature of the coolant the cooling capacity of the radiator increases.

Mazen Al-Amayreh[3] in his study, tested the thermal conductivities of ethylene glycol + water, diethylene glycol + water and triethylene glycol + water mixtures, measured at temperatures ranging from 25°C to 40°C and concentrations ranging from 25 wt. % glycol to 75 wt.% glycol. Increasing the concentration of glycol leads to decrease of thermal conductivity. Increasing the temperature of mixture resulted in slight increase in thermal conductivity.

P. K. Trivedi, N. B. Vasava[4], illustrated the effect of Tube pitch for best configured radiator for optimum performance. Heat transfer increases as the surface area of the radiator assembly is increased.

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This leads to change the geometry by modifying the arrangement of tubes in automobile radiator to increase the surface area for better heat transfer. The modification in arrangement of tubes in radiator is carried out by studying the effect of pitch of tube by CFD analysis using CFX. Results Shows that as the pitch of tube is either decreased or increased than optimum pitch of tubes, the heat transfer rate decreases.

Pitambar Gadhve and Shambhu Kumar[5] described use of dimple surface to improve forced convection heat transfer. Heat transfer enhancement is based on principle of scrubbing action of cooling fluid inside the dimple. Surface dimples promote turbulent mixing in flow and enhance heat transfer. An experimental set up has been designed and fabricated to study effect of dimpled surface on heat transfer in rectangular duct. Results compared with flat surface tube and found heat transfer enhancement over the later one.

CFD ANALYSIS ON ENGINE BLOCK FINS

FIN WITH 90^0 ANGLE

FLUIDS - WATER, CASTOR OIL & R134A

WATER FLUID PROPERTIES

Density=998.2kg/m^3
Thermal conductivity=0.6w/m-k
Specific heat=4182j/kg-k
Viscosity=0.001003kg/m-s

CASTOR OIL FLUID PROPERTIES

Density= 956.1kg/m^3
Thermal conductivity=0.09w/m-k
Specific heat=4.72kj/kg-k
Viscosity=0.8893kg/m-s

R134A FLUID PROPERTIES

Density= 4.25kg/m^3
Thermal conductivity=0.06w/m-k
Specific heat=1.500kj/kg-k
Viscosity=0.000183kg/m-s

COOLING FUID - WATER

→→Ansys → workbench→ select analysis system → fluid flow fluent → double click

→→Select geometry → right click → import geometry → select browse →open part → ok

→→ Select mesh on work bench → right click →edit → select mesh on left side part tree → right click → generate mesh →

GEOMETRY

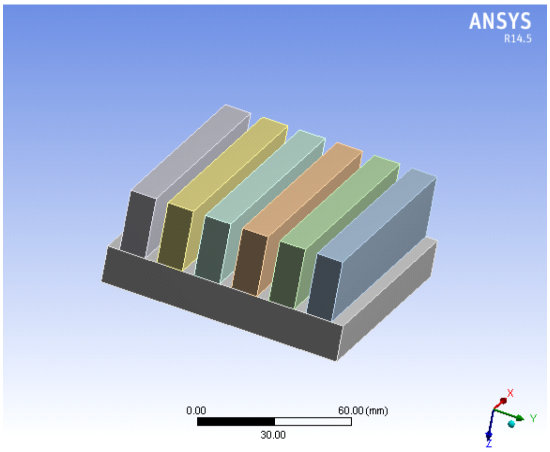

Fig: Imported model

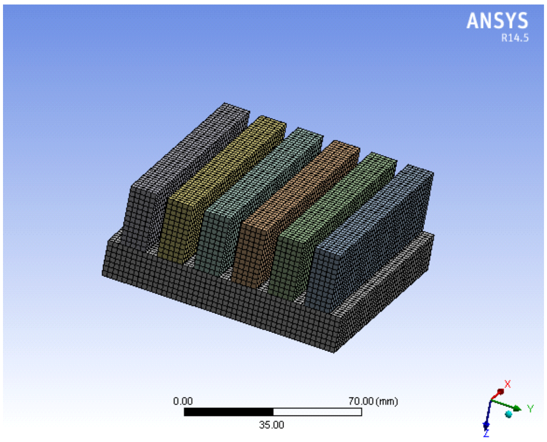

Fig:Meshed model

Select faces → right click → create named section → enter name → air inlet

Select faces → right click → create named section → enter name → air outlet

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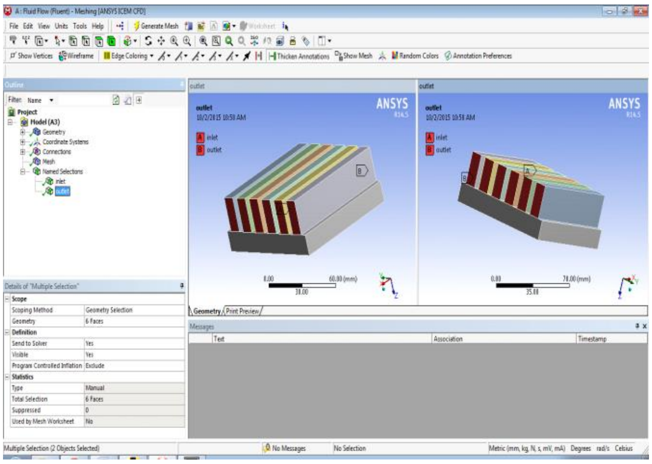

Fig : Inlet and outlet of Specify fluid material

Update project>setup>edit>model>select>energy equation (on)>ok

Materials> Materials > new >create or edit >specify fluid material or specify properties > ok

Select fluid

WATER FLUID PROPERTIES

Density=998.2 Kg/m^3
Thermal conductivity=0.6W/m-K
Specific heat=4182J/Kg-K
Viscosity=0.001003Kg/m-s
Boundary conditions>inlet>enter required inlet values
Velocity=20m/s
Pressure=101325Pa
Temperature=313K
Solution > Solution Initialization > Hybrid Initialization >done
Run calculations > no of iterations = 10> calculate > calculation complete>ok
Results>edit>select contours>ok>select location (inlet, outlet, wall.etc)>select wall flux>select wall flux heat transfer coefficient >apply

FIN WITH 90^0 ANGLE

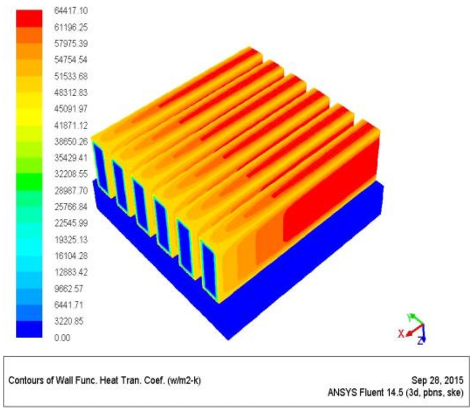

Fig: Heat transfer coefficient of fluid-water at fin angle at 90^0

The heat transfer co efficient maximum(64417.10 W/m^2-k) at fins on the outlet surface, minimum(3220.85 W/m^2-k) at fins inlet surface.

R134A FLUID PROPERTIES

Density= 4.25Kg/m^3
Thermal conductivity=0.06W/m-K
Specific heat=1.500KJ/Kg-K
Viscosity=0.000183Kg/m-s.

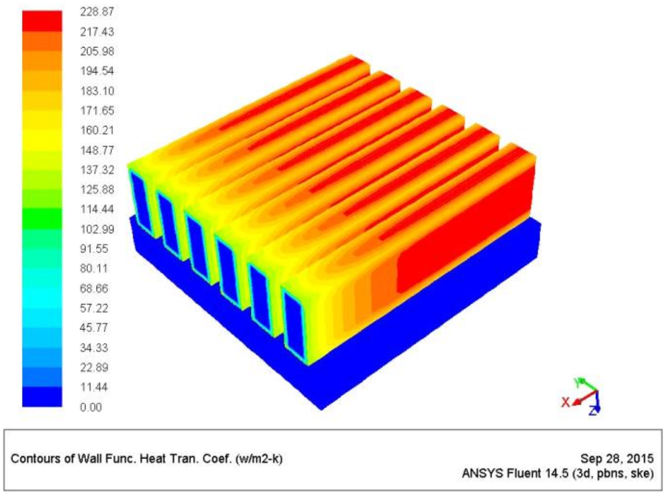

Fig: Heat transfer coefficient of fluid-R134A at fin angle at 90^0

The heat transfer co efficient maximum(228.87 W/m^2-k) at fins on the outlet surface, minimum(11.44 W/m^2-k) at fins inlet surface.

CASTOR OIL FLUID PROPERTIES

Density= 956.1Kg/m^3

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Thermal conductivity=0.09W/m-K
Specific heat=4.72Kj/Kg-K
Viscosity=0.8893Kg/m-s

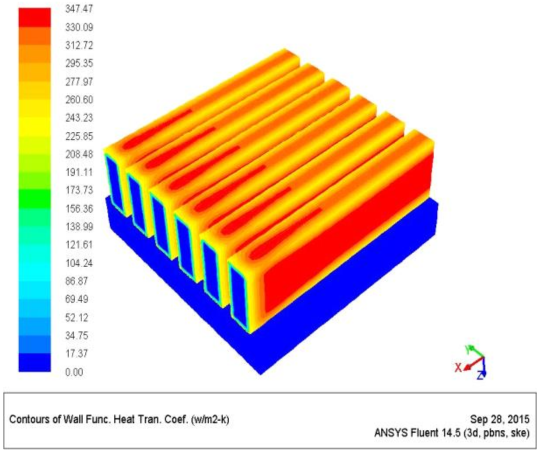

Fig : Heat transfer coefficient of fluid-castor oil at fin angle at 90^0

The heat transfer co efficient maximum(347.47 W/m^2-k) at fins on the outlet surface, minimum(17.37 W/m^2-k) at fins inlet surface.

FIN WITH 96^0 ANGLE

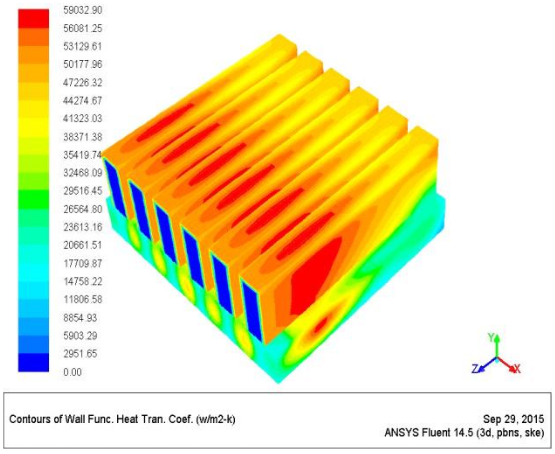

Fig: Heat transfer coefficient of fluid-water at fin angle at 96^0

The heat transfer co efficient maximum(50032.90 W/m^2-k) at fins on the outlet surface, minimum(2951.65 W/m^2-k) at fins inlet surface.

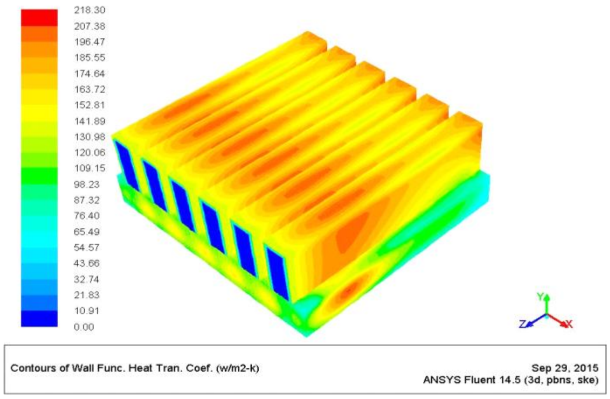

Fig : Heat transfer coefficient of fluid-R134A at fin angle at 96^0

The heat transfer co efficient maximum(218.30W/m^2-k) at fins on the outlet surface, minimum(10.91 W/m^2-k) at fins inlet surface.

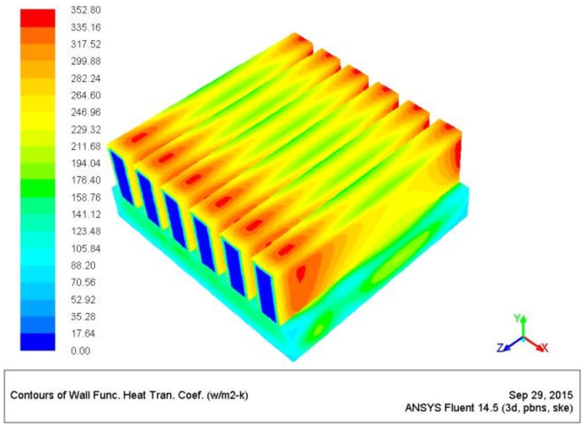

Fig : Heat transfer coefficient of fluid-castor oil at fin angle at 96^0

According to the counter plot, the heat transfer co efficient maximum (352.80 W/m^2-k) at fins on the outlet surface, minimum (17.64 W/m^2-k) at fins inlet surface.

FIN WITH 93^0 ANGLE

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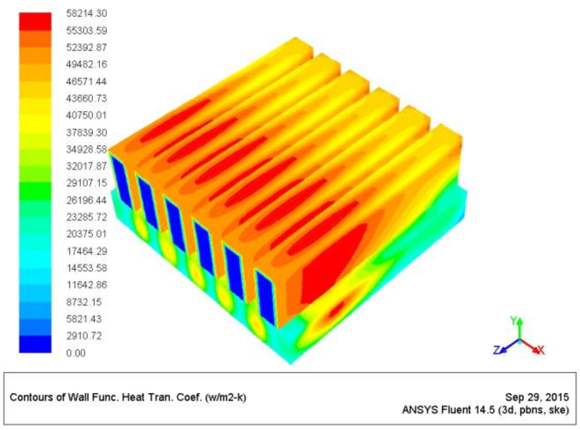

Fig: Heat transfer coefficient of fluid-water at fin angle at 93^0

The heat transfer co efficient maximum(58214.30 W/m^2-k) at fins on the outlet surface, minimum(2910.72 W/m^2-k) at fins inlet surface.

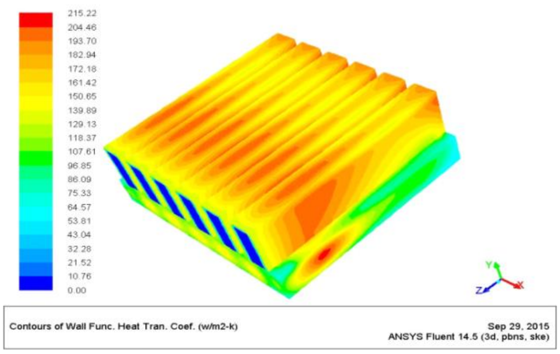

Fig: Heat transfer coefficient of fluid-R134A at fin angle at 93^0

The heat transfer co efficient maximum(215.22 W/m^2-k) at fins on the outlet surface, minimum(10.76 W/m^2-k) at fins inlet surface.

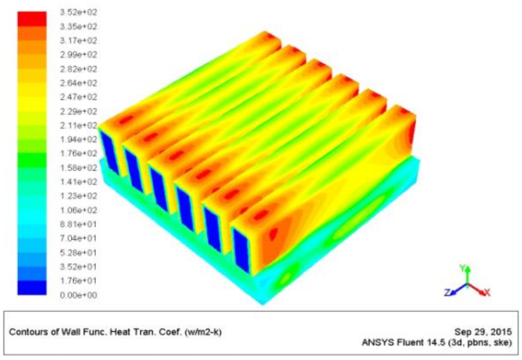

Fig : Heat transfer coefficient of fluid-castor oil at fin angle at 93^0

The heat transfer co efficient maximum(3.52e$^+$00 W/m^2-k) at fins on the outlet surface, minimum(1.76e$^+$00 W/m^2-k) at fins inlet surface.

EXPERIMENTAL INVESTIGATION

The prototypes of the engine block are manufactured using two aluminum materials 6463 and 6063 by changing the fin angle. The fin angles taken are 90^0, 93^0 and 96^0 measured from the base.

Fig: Prototypes of the engine block fin with 90^0

Fig: Prototypes of the engine block fin with 93^0

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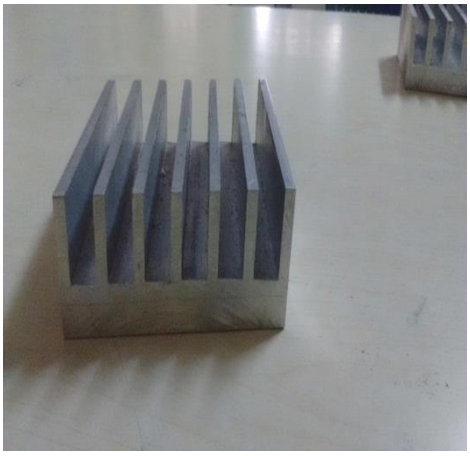

Fig: Prototypes of the engine block fin with 96^0

Temperatures are measured on the pieces using a thermocouple by varying the cooling fluids Water, Castor oil and R134A.

The following are the results obtained from the investigation.

FIN MATERIAL	COOLING FLUID	TEMPERATURE (^{0}C)		TIME (min)	
		INITIAL	FINAL	HEATING	COOLING
ALUMINUM ALLOY 6463	WATER	40	33	2.41	5.5
	R134A	40	37	2.1	9.38
	CASTOR OIL	40	35	2.5	7.4
ALUMINUM ALLOY 6063	WATER	40	31	2.41	5
	R134A	40	36	2.1	8.4
	CASTOR OIL	40	34	2.5	6.8

Table 4.1: Results from the investigation

THERMAL ANALYSIS

THERMAL ANALYSIS OF ENGINE BLOCK FINS

I. FIN WITH 90^0 ANGLE
MATERIAL – ALUMINUM 6063
COOLING FLUID - WATER

Open work bench 14.5>select **steady state thermal** in analysis systems>select geometry>right click on the geometry>import geometry>select **IGES** file>open

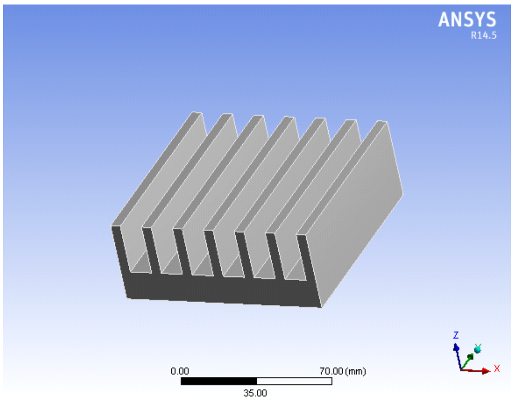

Fig :Imported model of 90^0 fin

MATERIAL PROPERTIES - ALUMINUM6063
Thermal conductivity=218GPa
Specific heat=900J/Kg-K
Density= 2.70g/cc
Model >right click>edit>select generate mesh

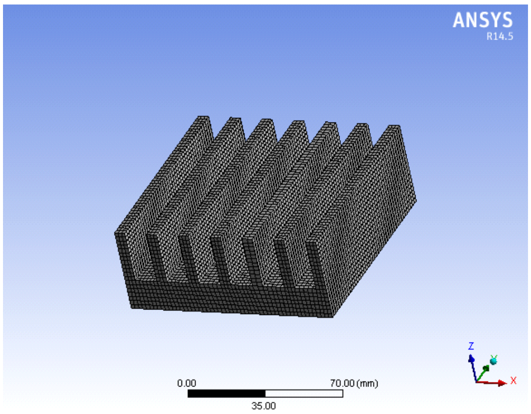

Fig : Meshed model of 90^0 fin

Boundary conditions

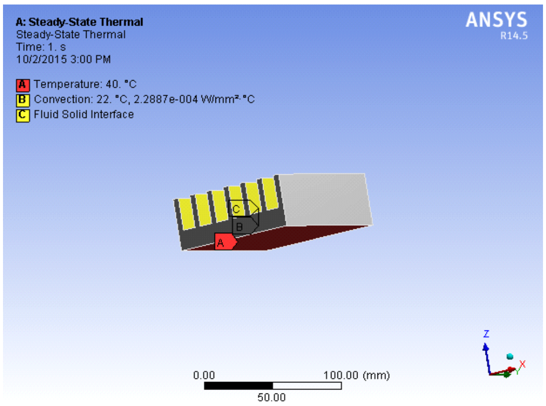

Fig:Boundary conditions of 90^0 fin

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Select steady state thermal >right click>solve
Solution>right click on solution>insert>select temperature

Water heat transfer co-efficient =64417.05W/m^2-K

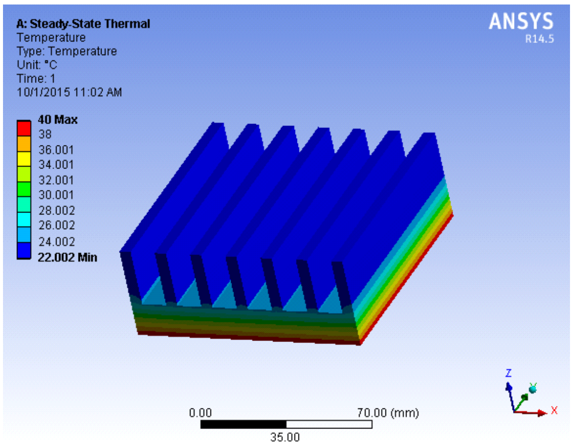


Fig :Temperature of 90^0 fin with cooling fluid – WATER

The heat transfer maximum(40^{0}C) at fins on the outlet surface, minimum(22.002^{0}C) at fins inlet surface.

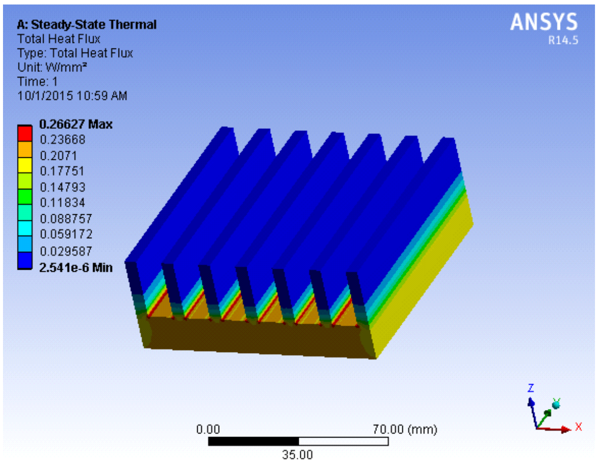


Fig : Heat flux of 90^0 fin with cooling fluid – WATER

The heat flux maximum(0.26627 W/mm) at fins on the outlet surface, minimum(2.541 W/mm) at fins inlet surface.

COOLING FLUID – R134A
R134A heat transfer co-efficient =228.8721W/m^2-K

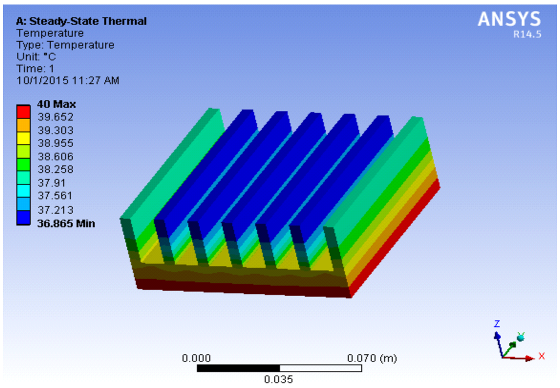


Fig: Temperature of 90^0 fin with cooling fluid – R134A

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(36.865 ^{0}C) at fins inlet surface.

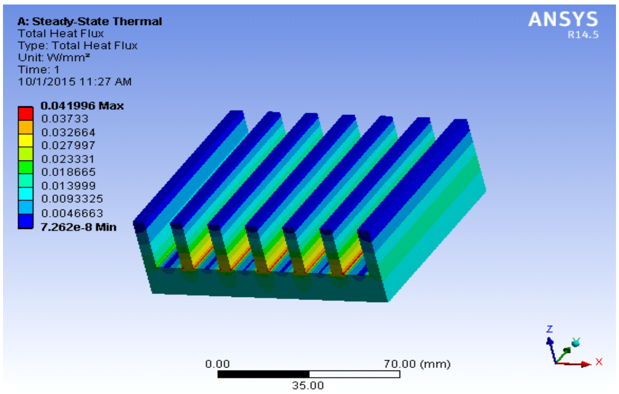
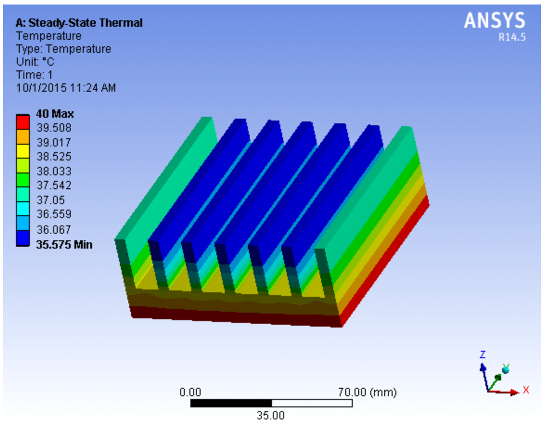


Fig: Heat flux of 90^0 fin with cooling fluid –R134A

The heat flux maximum(0.03733 W/mm) at fins on the outlet surface, minimum(7.262e-8 W/mm) at fins inlet surface.

COOLING FLUID – CASTOR OIL
Castor oil=228.8721W/m^2-K



ISSN No: 2348-4845
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Fig : Temperature of 90^0 fin with cooling fluid – CASTOR OIL

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(35.575 ^{0}C) at fins inlet surface.

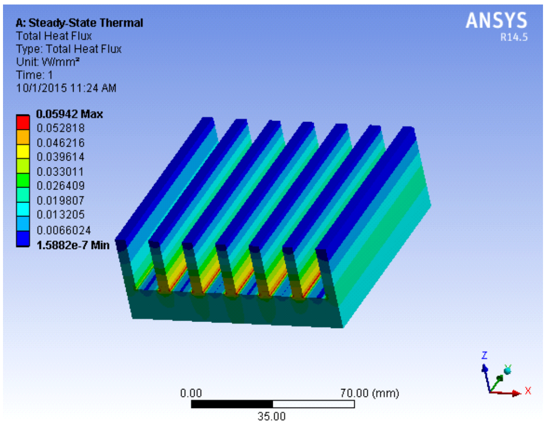

Fig : Heat flux of 90^0 fin with cooling fluid – CASTOR OIL

The heat flux maximum(0.05942 W/mm) at fins on the outlet surface, minimum(1.5882e-7 W/mm) at fins inlet surface.

II. MATERIAL – ALUMINUM 6463

COOLING FLUID – WATER

MATERIAL PROPERTIES ALUMINUM6463

Thermal conductivity=200GPa

Specific heat=890 J/Kg-K

Density= 2.69g/cc

Water heat transfer co-efficient =64417.05W/m^2-K

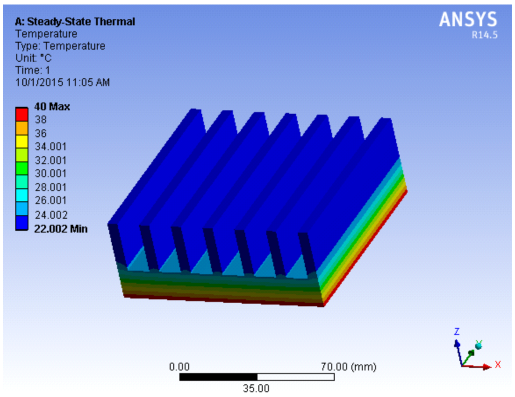

Fig: Temperature of 90^0 fin with cooling fluid – WATER

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(22.002 ^{0}C) at fins inlet surface.

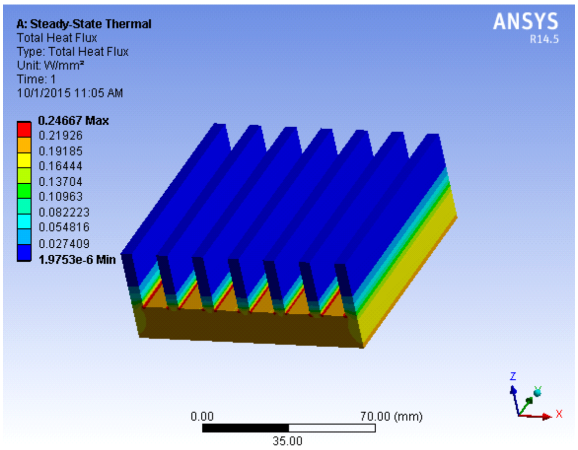

Fig : Heat flux of 90^0 fin with cooling fluid – WATER

The heat flux maximum(0.24667 W/mm) at fins on the outlet surface, minimum(1.9753e-6 W/mm) at fins inlet surface.

COOLING FLUID – R134A

R134A heat transfer co-efficient =228.8721W/m^2-K

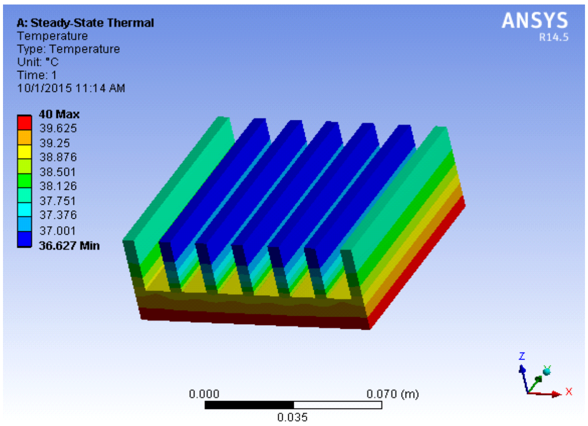

Fig: Temperature of 90^0 fin with cooling fluid – R134A

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(36.627 ^{0}C) at fins inlet surface.

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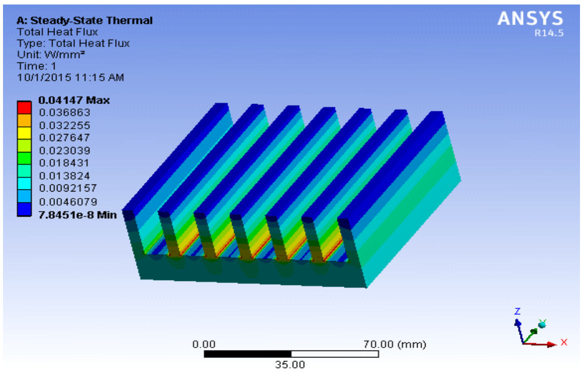

Fig: Heat flux of 90^0 fin with cooling fluid –R134A

The heat flux maximum(0.04147 W/mm) at fins on the outlet surface, minimum(7.8451e-8 W/mm) at fins inlet surface.

COOLING FLUID – CASTOR OIL

Castor oil heat transfer co-efficient =228.8721W/m^2-K

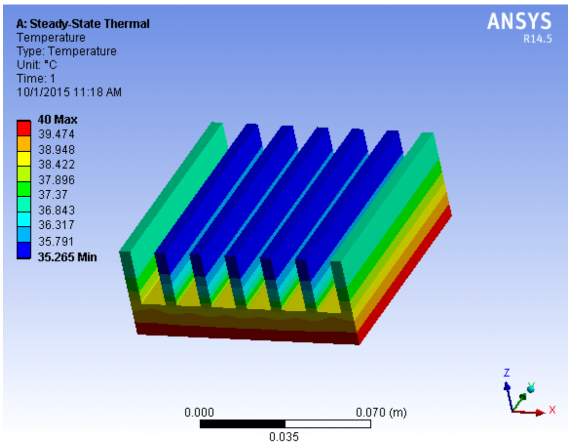

Fig: Temperature of 90^0 fin with cooling fluid – CASTOR OIL

The heat transfer co efficient maximum(40 ^{0}C) at fins on the outlet surface, minimum(35.265 ^{0}C) at fins inlet surface.

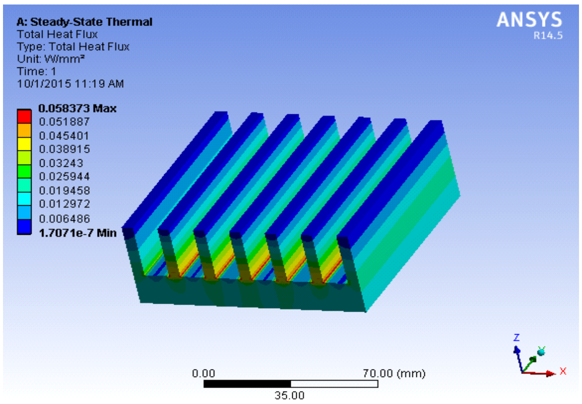

Fig: Heat flux of 90^0 fin with cooling fluid – CASTOR OIL

The heat flux maximum(0.058373 W/mm) at fins on the outlet surface, minimum(1.7071e-7 W/mm) at fins inlet surface.

III. FIN WITH 96^0 ANGLE

MATERIAL – ALUMINUM 6063

COOLING FLUID – WATER

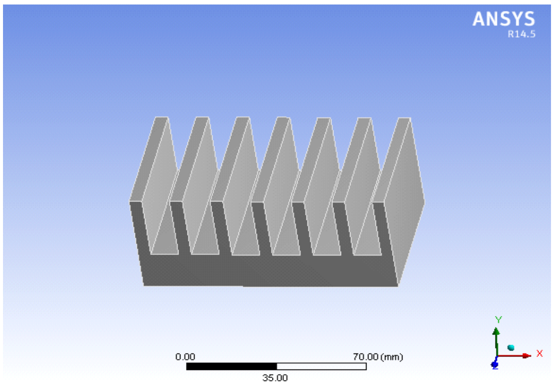

Fig :Imported model of 90^0 fin

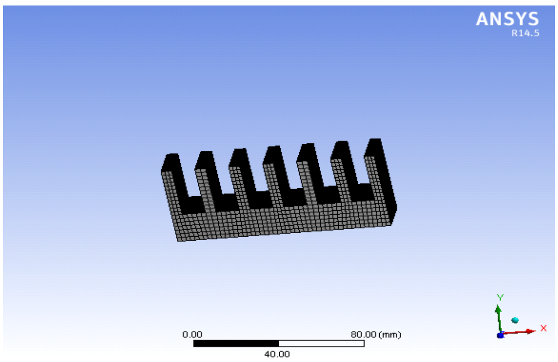

Fig :Meshed model of 90^0 fin

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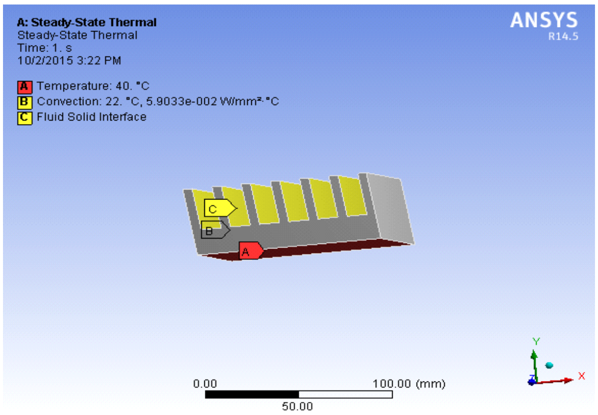

Fig :Boundary conditions of 90^0 fin

Water heat transfer co-efficient =64417.05w/m^2-k

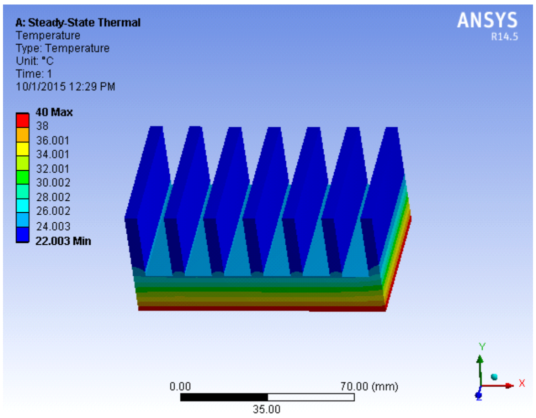

Fig: Temperature of 96^0fin with cooling fluid – WATER

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(22.003 ^{0}C) at fins inlet surface.

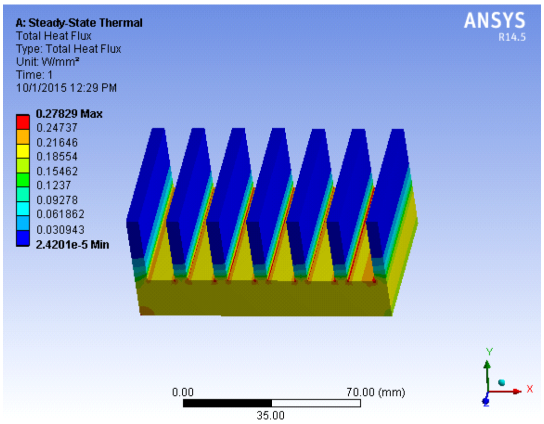

Fig: Heat flux of 96^0fin with cooling fluid – WATER

The heat flux maximum(0.27829 W/mm) at fins on the outlet surface, minimum(2.4201e-5 W/mm) at fins inlet surface.

COOLING FLUID – R134A

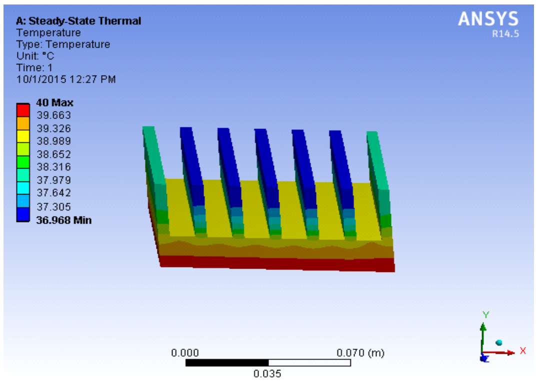

Fig : Temperature of 96^0 fin with cooling fluid – R134A

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(36.968 ^{0}C) at fins inlet surface.

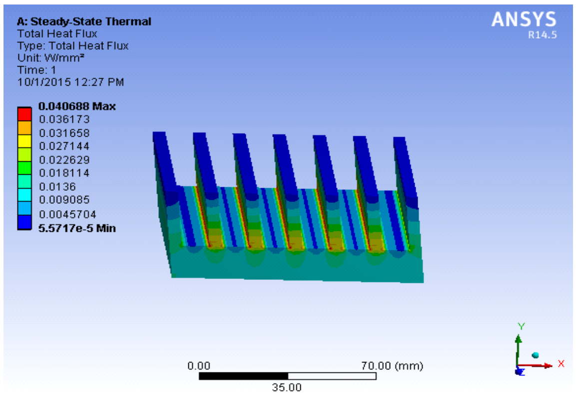

Fig : Heat flux of 96^0 fin with cooling fluid –R134A

The heat flux maximum(0.040688 W/mm) at fins on the outlet surface, minimum(5.5717e-5 W/mm) at fins inlet surface.

COOLING FLUID – CASTOR OIL

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
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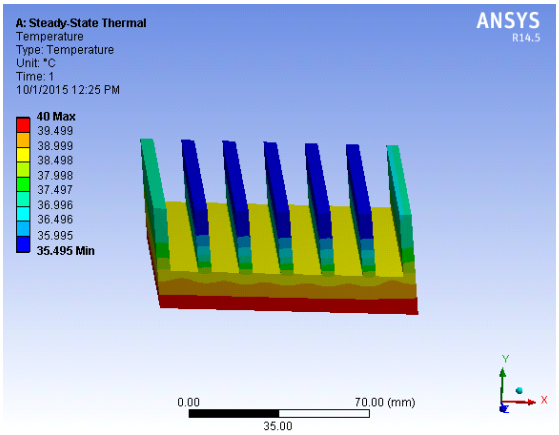

Fig: Temperature of 96^{0}fin with cooling fluid – CASTOR OIL

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(35.495 ^{0}C) at fins inlet surface.

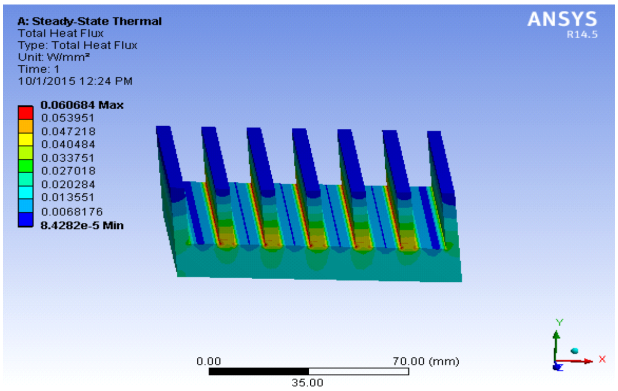

Fig: Heat flux of 96^{0}fin with cooling fluid – CASTOR OIL

The heat flux maximum(40 W/mm) at fins on the outlet surface, minimum(8.4282E-5W/mm) at fins inlet surface.

IV. FIN WITH 96^0 ANGLE
MATERIAL – ALUMINUM 6463
COOLING FLUID - WATER

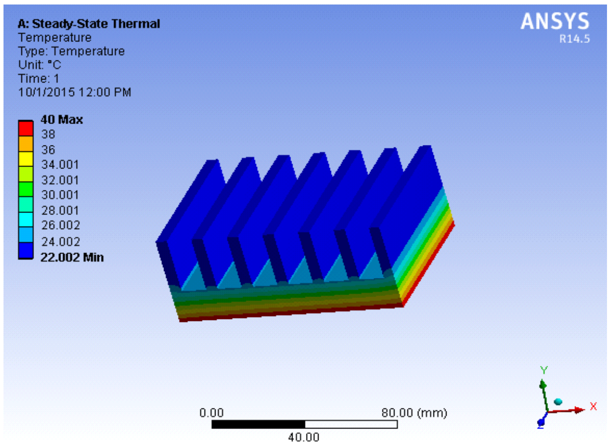

Fig: Temperature of 96^{0}fin with cooling fluid – WATER

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(22.002 ^{0}C) at fins inlet surface.

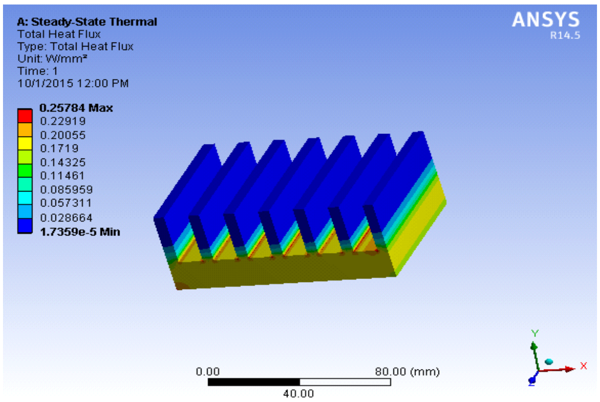

Fig 5.26: Heat flux of 96^{0}fin with cooling fluid – WATER

The heat flux maximum(0.25784 W/mm) at fins on the outlet surface, minimum(1.7359e-5W/mm) at fins inlet surface.

COOLING FLUID – R134A

ISSN No: 2348-4845
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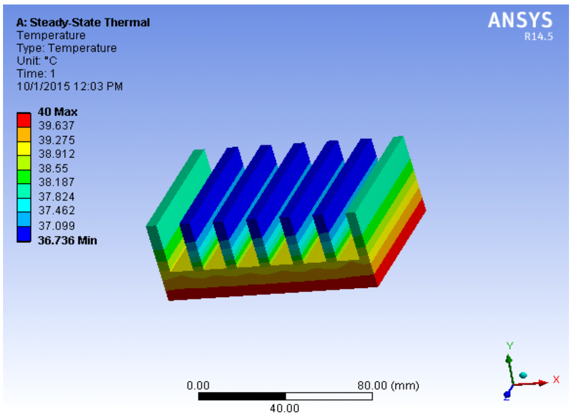

Fig: Temperature of 96^{0}fin with cooling fluid – R134A

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(36.736 ^{0}C) at fins inlet surface.

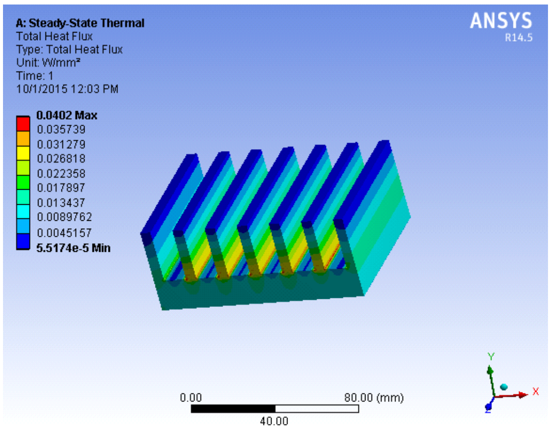

Fig: Heat flux of 96^{0}fin with cooling fluid – R134A

The heat flux maximum (0.0402 W/mm) at fins on the outlet surface, minimum(5.5174e-5W/mm) at fins inlet surface.

COOLING FLUID – CASTOR OIL

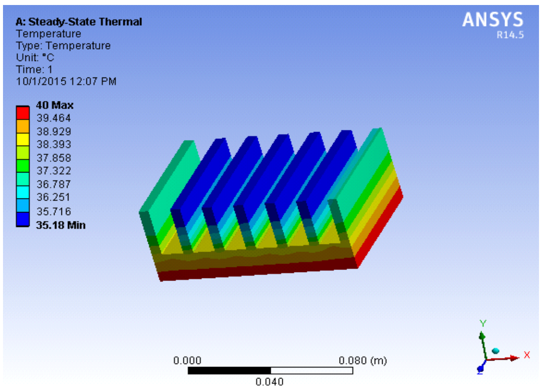

Fig: Temperature of 96^{0}fin with cooling fluid – CASTOR OIL

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(35.18 ^{0}C) at fins inlet surface.

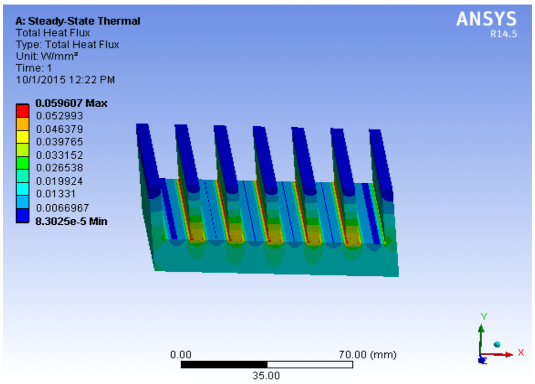

Fig: Heat flux of 96^{0}fin with cooling fluid – CASTOR OIL

The heat flux maximum(0.25784 W/mm) at fins on the outlet surface, minimum(8.3025e-5W/mm) at fins inlet surface

V. FIN WITH 93^0 ANGLE
MATERIAL – ALUMINUM 6063
COOLING FLUID – WATER

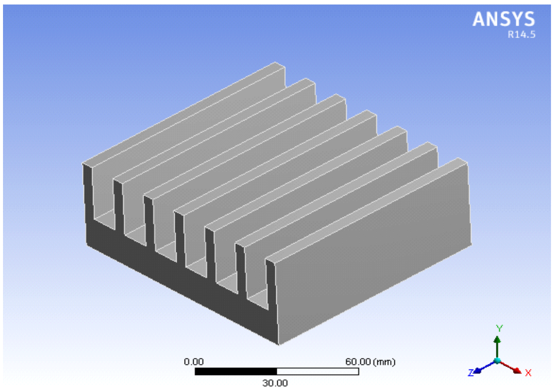

Fig :Imported model of 93^0 fin

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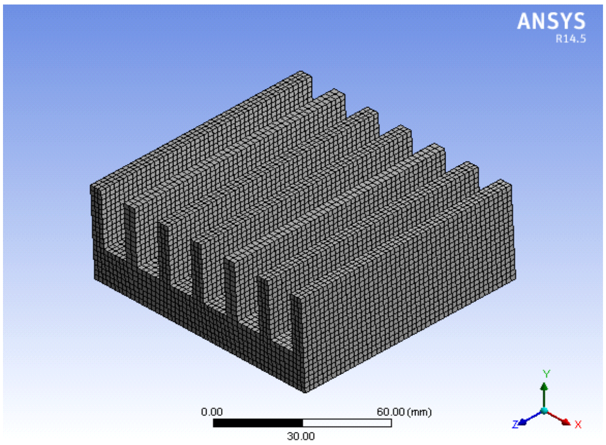

Fig : Meshed model of 93⁰ fin

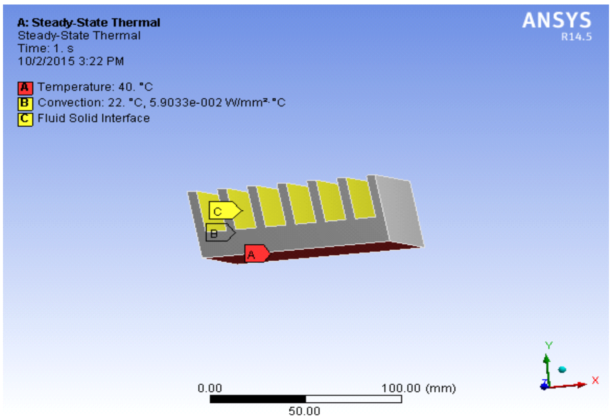

Fig:Boundary conditions of 93⁰ fin

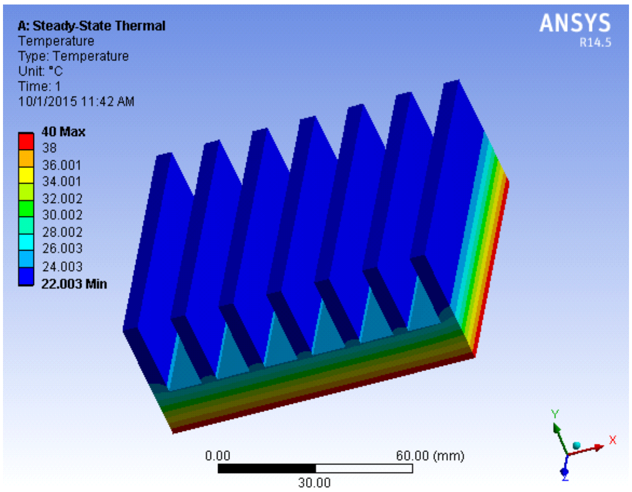

Fig: Temperature of 93⁰fin with cooling fluid – WATER

The heat transfer maximum(40 ⁰C) at fins on the outlet surface, minimum(22.003 ⁰C) at fins inlet surface.

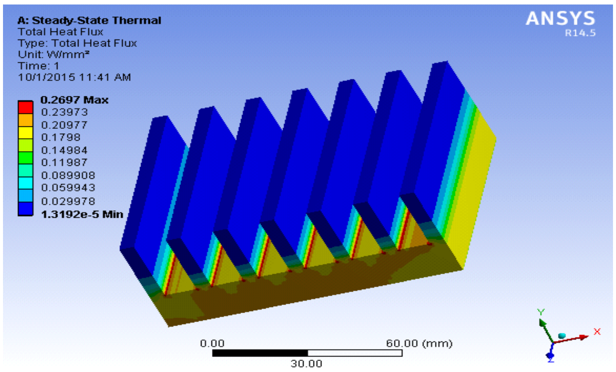

Fig : Heat flux of 93⁰ fin with cooling fluid – WATER

The heat flux maximum(0.2697 W/mm) at fins on the outlet surface, minimum(1.3792e-5W/mm) at fins inlet surface

COOLING FLUID – R134A

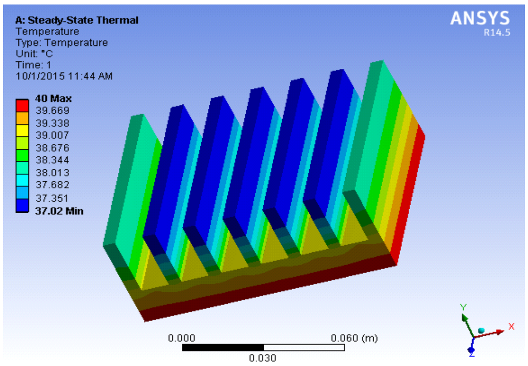

Fig: Temperature of 93⁰fin with cooling fluid – R134A

The heat transfer maximum(40 ⁰C) at fins on the outlet surface, minimum(37.02 ⁰C) at fins inlet surface.

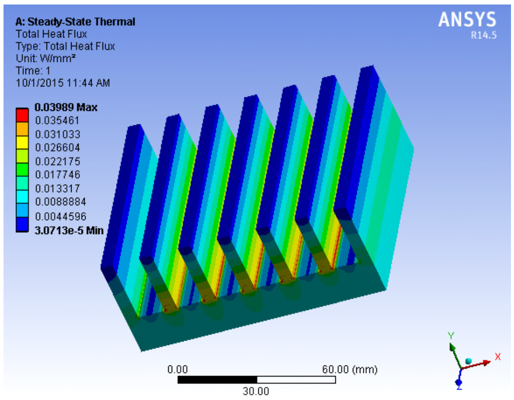

Fig : Heat flux of 93⁰ fin with cooling fluid – R134A

ISSN No: 2348-4845
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The heat flux maximum(0.03989 W/mm) at fins on the outlet surface, minimum(3.0713e-5W/mm) at fins inlet surface

COOLING FLUID – CASTOR OIL

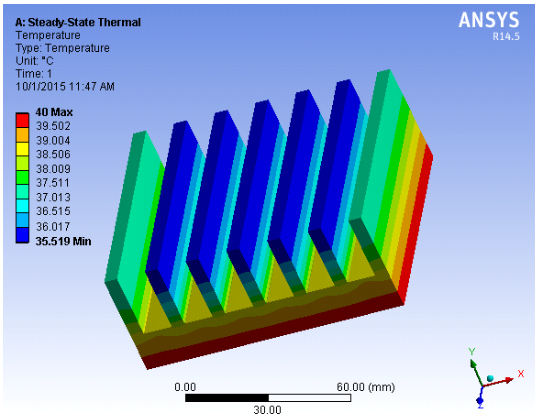

Fig: Temperature of 93^{0}fin with cooling fluid – CASTOR OIL

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(35.519 ^{0}C) at fins inlet surface.

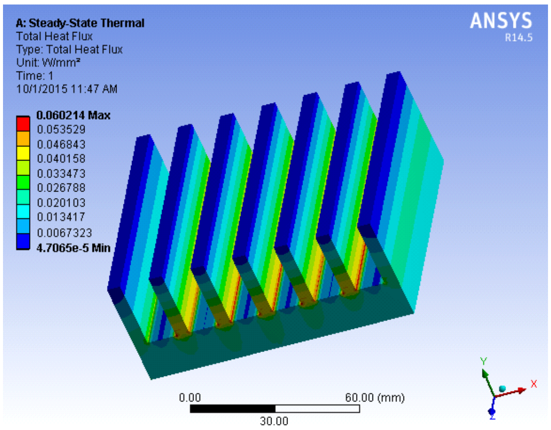

Fig: Heat flux of 93^{0}fin with cooling fluid – CASTOR OIL

The heat flux maximum(0.060214 W/mm) at fins on the outlet surface, minimum(4.7065e-5W/mm) at fins inlet surface

VI. FIN WITH 93^0 ANGLE

MATERIAL – ALUMINUM 6463

COOLING FLUID – WATER

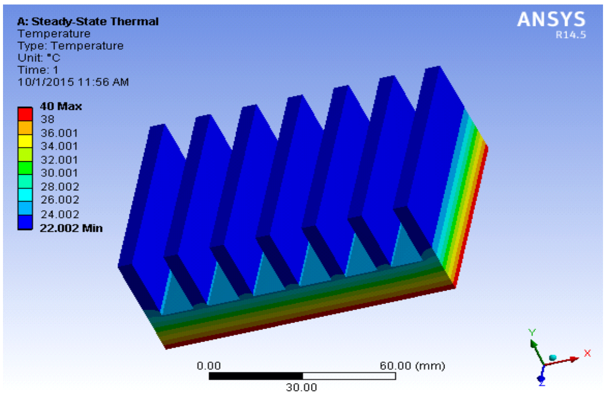

Fig: Temperature of 93^{0}fin with cooling fluid – WATER

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(22.002 ^{0}C) at fins inlet surface.

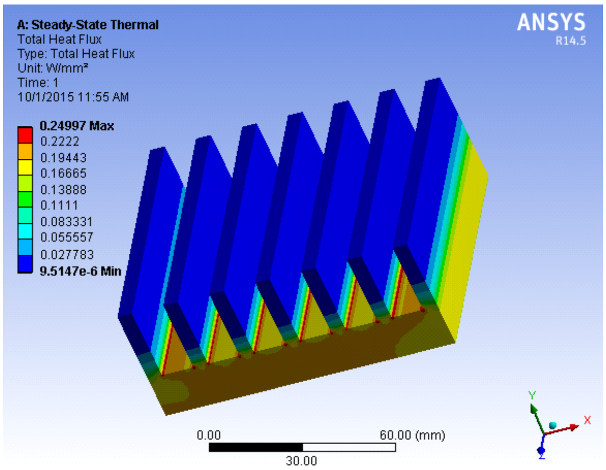

Fig: Heat flux of 93^{0}fin with cooling fluid – WATER

The heat flux maximum(0.24997 W/mm) at fins on the outlet surface, minimum(9.5147e-5W/mm) at fins inlet surface

COOLING FLUID – R134A

ISSN No: 2348-4845
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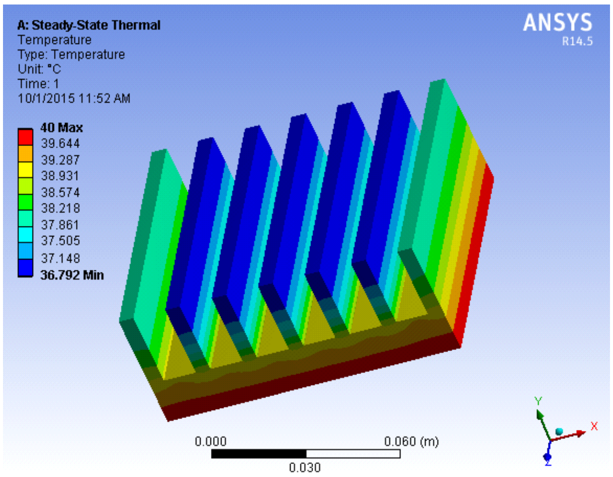

Fig : Temperature of 93^0 fin with cooling fluid – R134A

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(36.762 ^{0}C) at fins inlet surface.

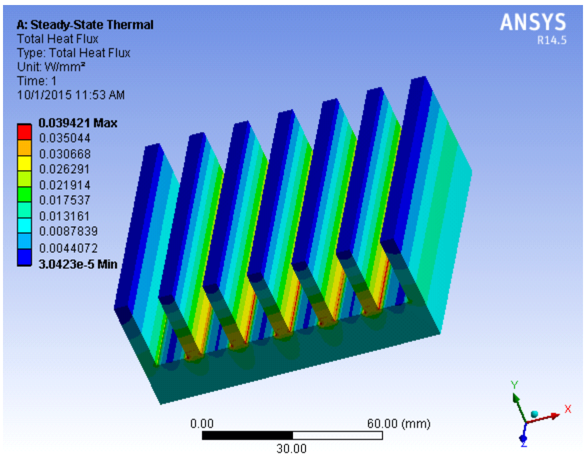

Fig : Heat flux of 93^0 fin with cooling fluid – R134A

The heat flux maximum(0.039421 W/mm) at fins on the outlet surface, minimum(3.0423e-5W/mm) at fins inlet surface

COOLING FLUID – CASTOR OIL

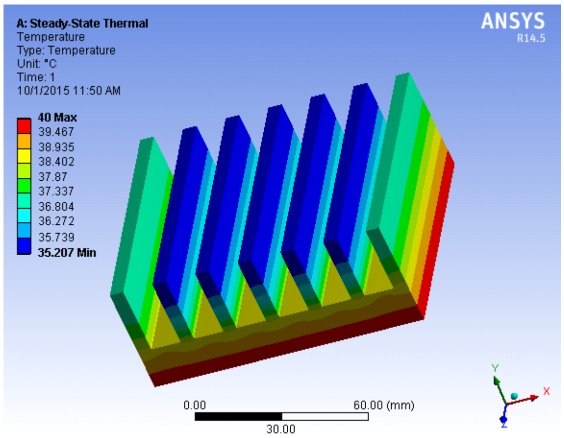

Fig: Temperature of 93^{0}fin with cooling fluid – CASTOR OIL

The heat transfer maximum(40 ^{0}C) at fins on the outlet surface, minimum(35.207^{0}C) at fins inlet surface.

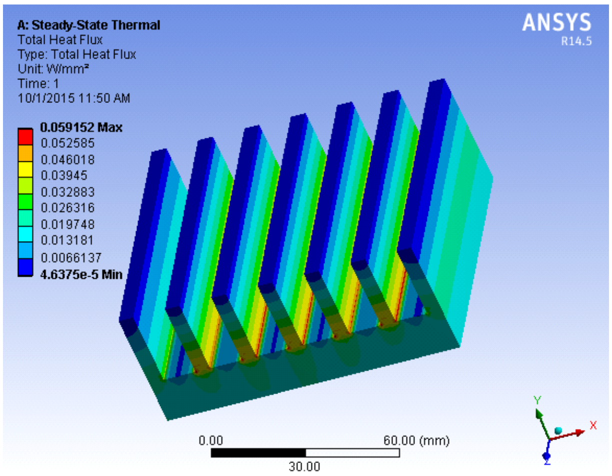

Fig: Heat flux of 93^{0}fin with cooling fluid – CASTOR OIL

The heat flux maximum(0.059152 W/mm) at fins on the outlet surface, minimum(4.6375e-5W/mm) at fins inlet surface

RESULTS AND DISCUSSION

ISSN No: 2348-4845
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Fin angle	Fluid	Heat transfer coefficient(W/m^2-K)
90^0	Water	64417.05
	R134a	228.8721
	Castor oil	347.47
96^0	Water	59032.88
	R134a	218.30
	Castor oil	352.580
93^0	Water	58214.25
	R134a	215.22
	Castor oil	352.2082

Table : Results of cfd analysis of fluids

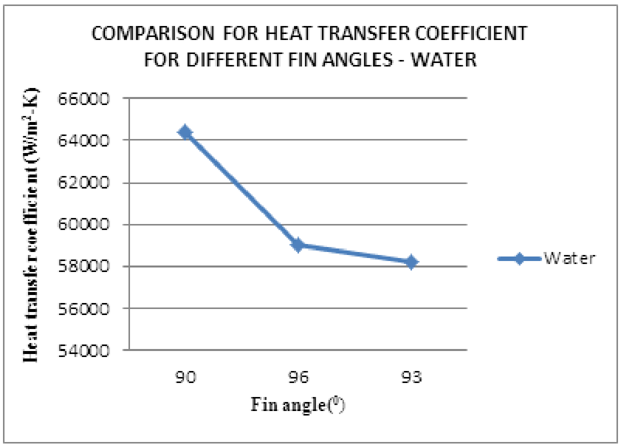
RESULTS OF THERMAL ANALYSIS

FIN ANGLE	FLUID	MATERIAL	RESULTS	
			TEMPERATURE(°C)	HEAT FLUX(W/mm^2)
90^0	WATER	Al 6063	40	0.26627
		Al 6463	40	0.24667
	R134A	Al 6063	40	0.041996
		Al 6463	40	0.04147
	CASTOR OIL	Al 6063	40	0.05942
		Al 6463	40	0.058373
96^0	WATER	Al 6063	40	0.27829
		Al 6463	40	0.25784
	R134A	Al 6063	40	0.040688
		Al 6463	40	0.0402
	CASTOR OIL	Al 6063	40	0.060684
		Al 6463	40	0.059607
93^0	WATER	Al 6063	40	0.2697
		Al 6463	40	0.24997
	R134A	Al 6063	40	0.03989
		Al 6463	40	0.039421
	CASTOR OIL	Al 6063	40	0.060214
		Al 6463	40	0.059152

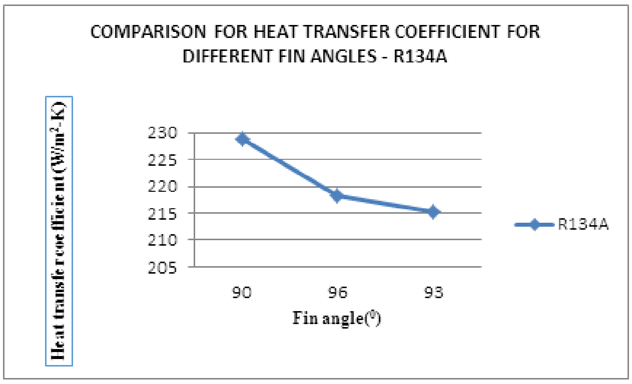
Table: Results of thermal analysis of fluids and materials

CFD GRAPHS FOR ENGINE BLOCK FINS

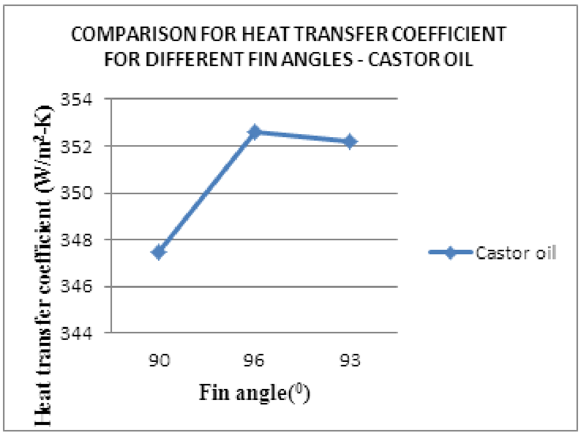
The heat transfer co efficient maximum 93^0 fins angle and minimum 90^0 fins angle



The heat transfer co efficient maximum 90^0 fins angle and minimum 93^0 fins angle

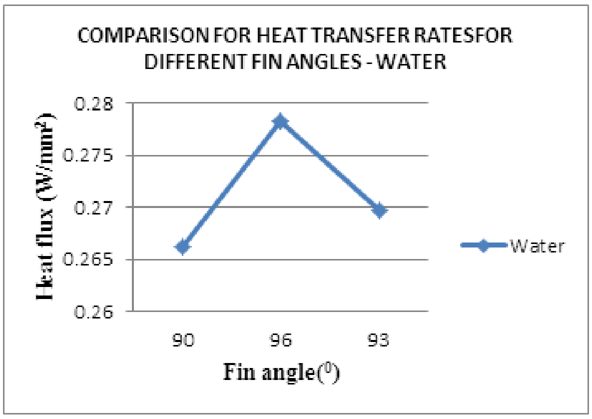


The heat transfer co efficient maximum 93^0 fins angle and minimum 90^0 fins angle



THERMAL ANALYSIS GRAPHS FOR ENGINE BLOCK FIN MATERIAL – ALUMINUM 6063

The heat transfer co efficient maximum 93^0 fins angle and minimum 90^0 fins angle



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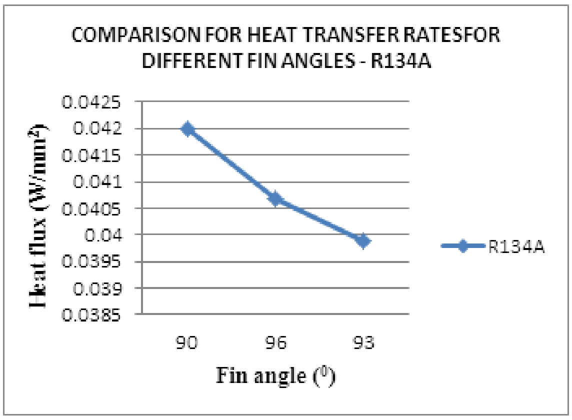
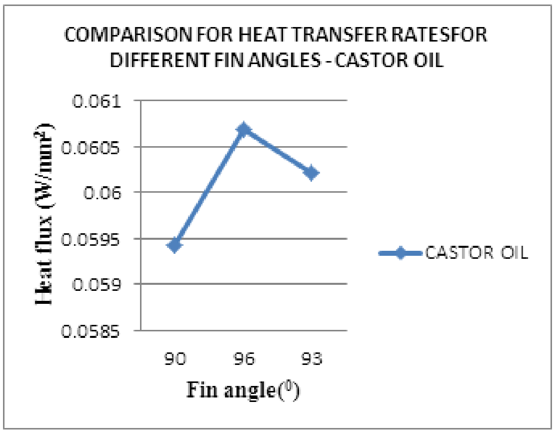
The heat transfer co efficient maximum 90^0 fins angle and minimum 93^0 fins angle

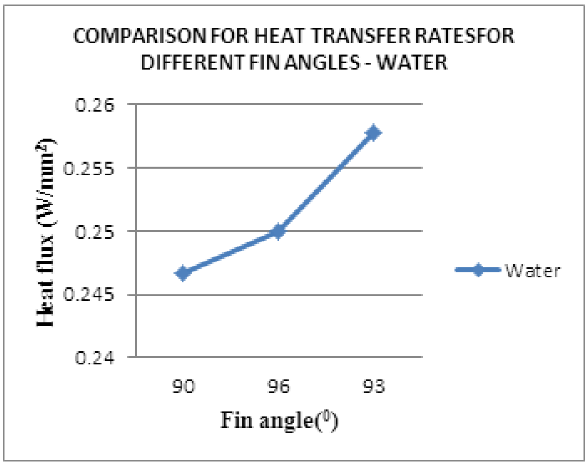


The heat transfer co efficient maximum 93^0 fins angle and minimum 90^0 fins angle

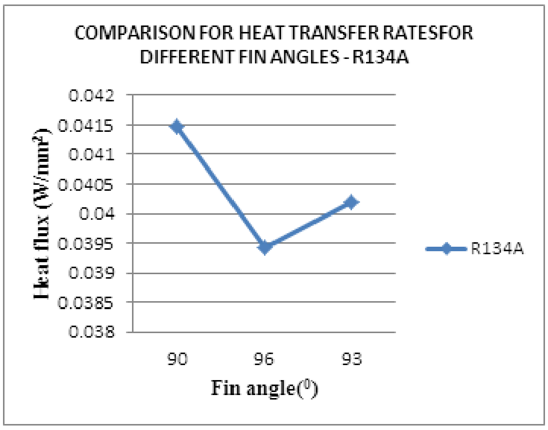


MATERIAL - ALUMINUM 6463

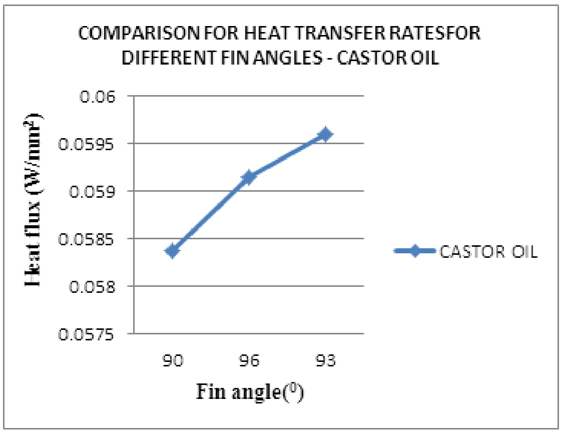
The heat transfer co efficient maximum 93^0 fins angle and minimum 90^0 fins angle



The heat transfer co efficient maximum 90^0 fins angle and minimum 93^0 fins angle

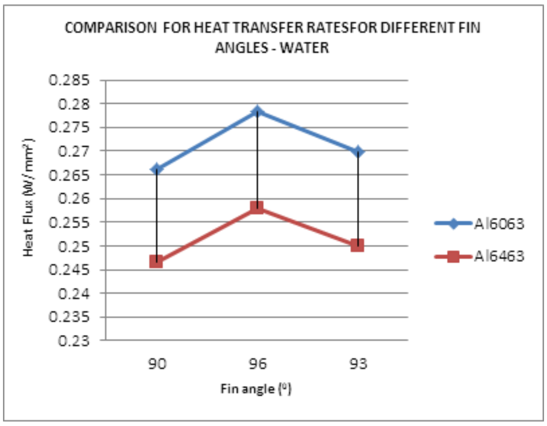


The heat transfer co efficient maximum 93^0 fins angle and minimum 90^0 fins angle



COMPARISON GRAPHS

The heat transfer co efficient maximum 93^0 fins angle and minimum 90^0 fins angle



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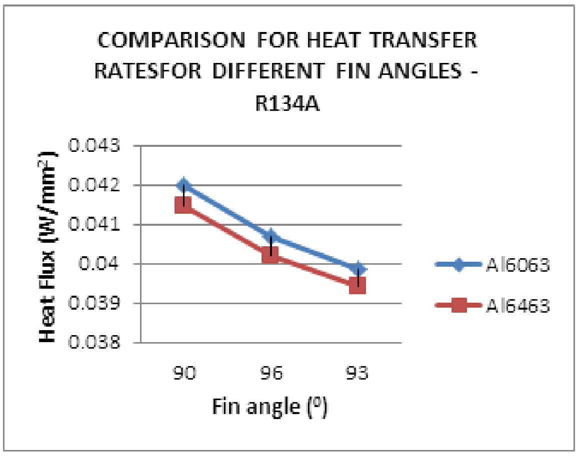
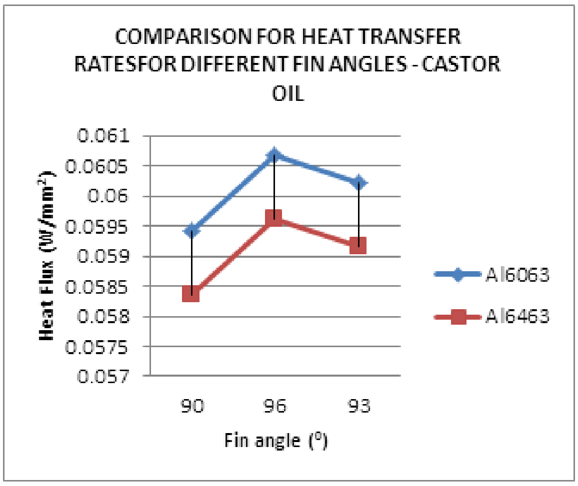
The heat transfer co efficient maximum 90^0 fins angle and minimum 93^0 fins angle



Heat transfer co efficient maximum 93^0 fins angle and minimum 90^0 fins angle



CONCLUSION

In this project experimental investigations are made to measure the temperature of the prototypes of the engine block manufactured using two aluminum materials 6463 and 6063 by changing the fin angle. The fin angles taken are 90^0, 93^0 and 96^0 measured from the base. The temperatures are measured by heating and cooling the engine block with different cooling fluids Water, R134A and Castor Oil. By observing the experimental results, using water as the cooling fluid is better than Castor oil and R134A since the temperatures measured after cooling is less and time taken to cool is also less. By taking fin angle as 90^0 is better.

CFD analysis is done to determine the heat transfer coefficients of cooling fluids Water, R134A and Castor Oil for all the models. Thermal analysis is done on the engine block using two aluminum materials 6463 and 6063 by applying the temperature and heat transfer coefficients. Thermal analysis results define the heat transfer rates. By observing the thermal analysis results, the heat transfer rates are more when cooling fluid water is used when compared with that of Castor oil and R134A since heat flux is more. By changing the material of the fin, there is not much difference in the heat transfer rates and the better fin angle is 96^0 when water and Castor oil are used and 90^0 when R134A is used.

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