View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by International Journal of Science Engineering and Advance Technology (IJSEAT)

IJSEAT International Journal of Science Engineering and Advance Technology

Computational Fluid Dynamics Analysis Of Louver Fins With Different Configurations

V Prasanna kumar #1, M Babji #2, P.Satish Reddy #3, P Bhaskara Rao #4
PG Scholar, Asst. Prof., Assoc.Prof.,Asst. Prof.
ME Department, Prasiddha College of Engg and Technology, Anathavaram
[1]prasannakumar1048@gmail.com,[2]babjimech303@gmail.com,[3]satish2436@gmail.com,[4]smilybobbys@gmail.com

Abstract

Investigates in warmth move have been completed over the past a very long while, prompting the advancement of the right now utilized warmth move improvement strategies. Louver blades are broadly utilized in warmth exchanger for car applications, for example, radiator, intercooler, condenser, warmer center and so forth.

This study presents numerical analysis of effect of various louver fin configurations on heat transfer rate. The three dimensional governing equations for fluid flow and heat transfer are solved using ANSYS Fluent 19.2., fin geometries are developed by using CATIA v5. Multiple fin geometry's are included in this study for better understanding of the fin behavior.

Keywords: Louver fin, heat exchangers, CFD, Ansys Fluent.

I. Introduction

The radiator is a gadget blueprinted to disperse the warmth which the coolant has wrapped up from the motor. It is made to get a handle on a huge amount of water in cylinders or ways which supply a huge zone in contact with the environment. It commonly comprises of a radiator heart, with its water-transport cylinders and huge cooling region, which are related to a getting tank (end top) at the top and to an arrangement tank at the base. Side stream radiators have their "end tops" as an afterthought, which permits a lower spread line.

An improved louvered blade heat exchanger having plural balances orchestrated in generously parallel, firmly divided connection and a majority of warmth move cylinders going through adjusted openings in the balances is revealed. Each blade incorporates a majority of first and second louvers which meet an ostensible plane of the balance at separate first and second points to such an extent that the primary louvers are in veering association with the second louvers on one side of the balance and in uniting association with the second louvers on a contrary side of the balance, consequently giving a bi-directional louver arrangement. Each balance further incorporates a majority of collars characterizing the separate blade openings. Each neckline has a significantly round and hollow segment and two particular base segments on one side of the blade which characterizes two unmistakable breaks on a contrary side of the balance. Each generously barrel shaped neckline is adjusted to connect with the one of the recessed segments of a nearby blade neckline to encourage arrangement of the balances during gathering. The louvered balance of the present innovation is especially appropriate to suit littler breadth (e.g., on the request for 5/16 inch) heat exchanger tubes.

Louvered balance conservative warmth exchangers are utilized in an assortment of utilizations, incorporating into warmth dismissal frameworks in cars, private air-conditionings, oil coolers, and radiators. One of the most significant destinations of past examinations on smaller warmth exchangers has been the improvement of elite warmth exchangers which don't forfeit gentility and little volume.

With its huge warmth move zone per unit volume, the conservativeness of the louvered balances is organized for recuperating vitality from a warmth source. Achaichia and Cowell were the first to tentatively check that it is generally imperative to structure louvered blades with a louver coordinated stream as opposed to a pipe coordinated stream. Their investigation showed an expansion in warmth move coefficients when the stream was on the move from being channel coordinated to being louver-coordinated. They utilized the warmth move attributes of the louvered blades to decide the stream proficiency. For the constrained convection stream over the cooler louvered flush out your coolant occasionally.

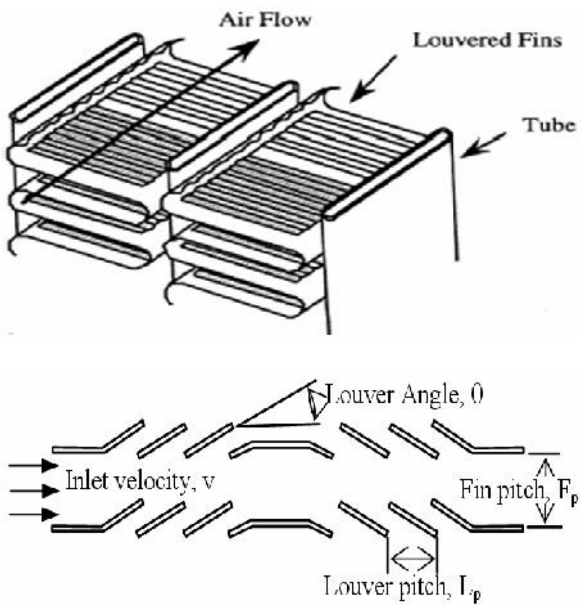

Fig-1 Louver Fins Arrangement

II. *Dimensions of the Louver*

θ=28°…… …….louver angle
L_i=17.18mm…….louver length
F_p=1.8mm……….fin pitch
F_d=22mm………...fin depth
T_p=24mm ……….tube pitch

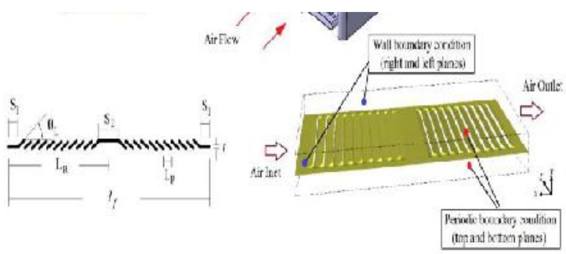

Fig.02 Layout of Radiator with Louvered Fins

Louver Angle Θ	28 degrees	Louver Pitch L_p	1.42mm
Louver Length L_l	17.18mm	Fin Thickness	0.16mm
Fin Pitch F_p	1.8mm	Fin Length F_l	19mm
Fin Depth F_d	22mm	Hydraulic Dia D_h	3.041mm
Tube Pitch T_p	24mm	Tube Depth T_d	22mm

Table 01. Geometric Parameters of Louver Fin Radiator

Fig-2 Dimensions of louver fin

III. *Modeling of louver*

Total 11 models are made using Catia v5 R20. All the models differ in the arrangement of louver fins and their dimensions. All these models are converted into .igs format and exported to Ansys.

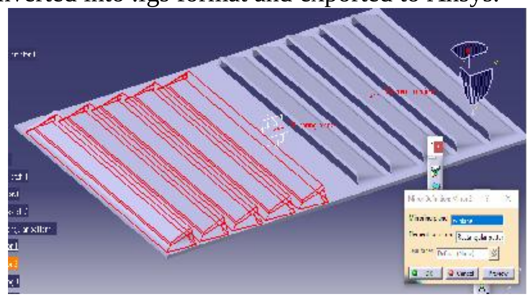

Fig-3: Model 1

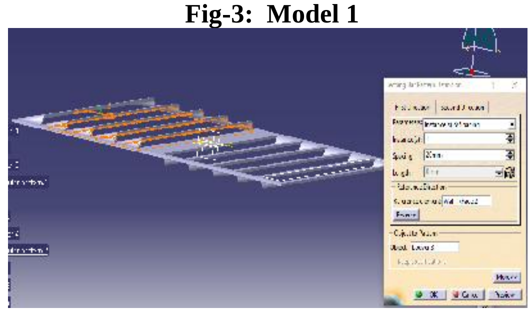

Fig-4: Model 2

Chemical Composition
Aluminium alloy 6061

Chemical Element	% Present
Manganese (Mn)	0.0 - 0.15
Iron (Fe)	0.0 - 0.70
Magnesium (Mg)	0.80 - 1.20
Silicon (Si)	0.40 - 0.80
Copper (Cu)	0.15 - 0.40
Zinc (Zn)	0.0 - 0.25
Titanium (Ti)	0.0 - 0.15
Chromium (Cr)	0.04 - 0.35
Other (Each)	0.0 - 0.05
Others (Total)	0.0 - 0.15
Aluminium (Al)	Balance

Fig-5 Aluminium alloy 6061

Properties of Aluminium Alloy 6061

Properties

Physical Property	Value
Density	2.70 g/cm³
Melting Point	650 °C
Thermal Expansion	23.4 x10^-6 /K
Modulus of Elasticity	70 GPa
Thermal Conductivity	166 W/m.K
Electrical Resistivity	0.040 x10^-6 Ω .m

IV.CFD Analysis for Model 1:

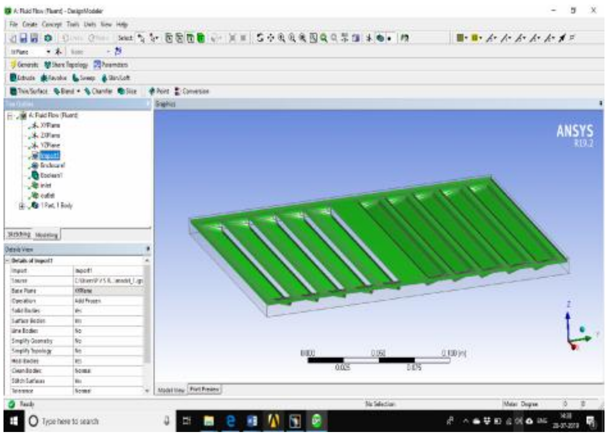

Fig-6 Louver imported Model

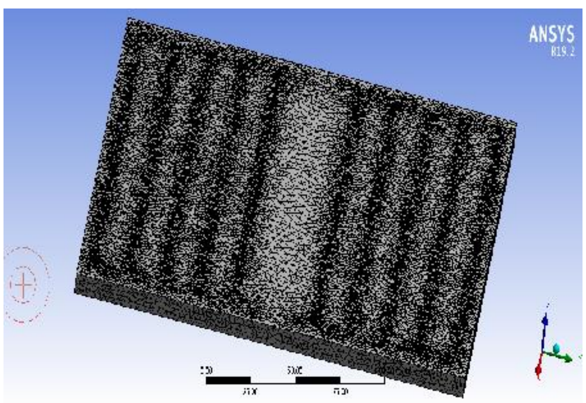

Fig-7 Messed Model

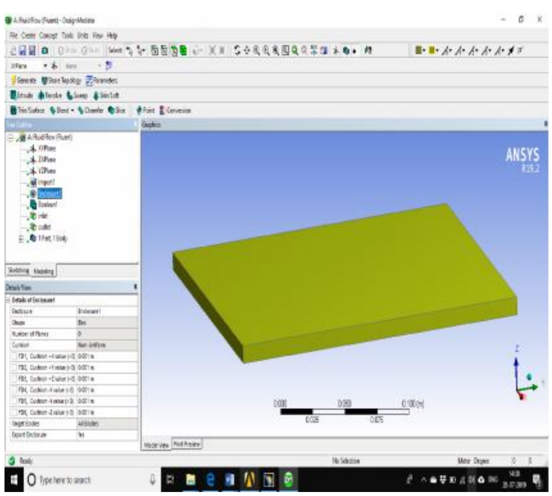

Fig-8 Model after applying enclosure

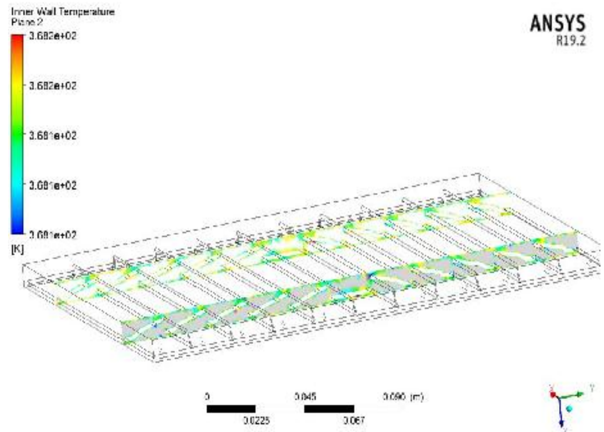

Fig-9 CFD Analysis of Model 1(inner wall temperature)

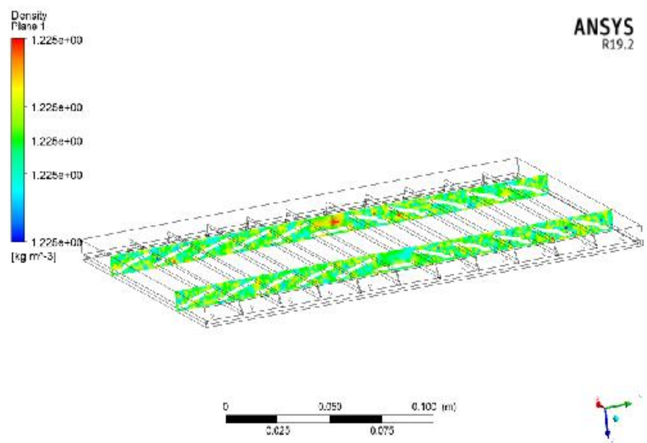

Fig-10 Model 1 (local density)

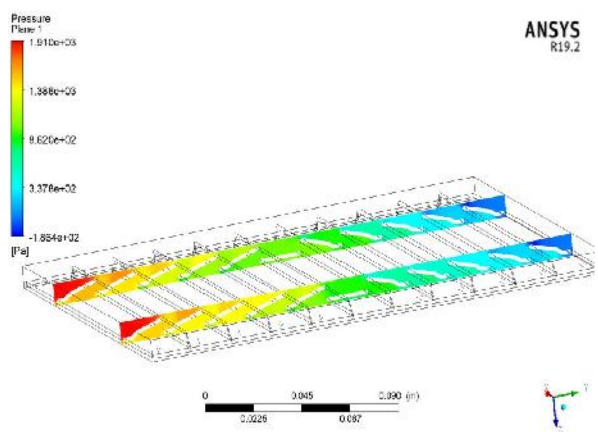

Fig-11 Model 1 (pressure)

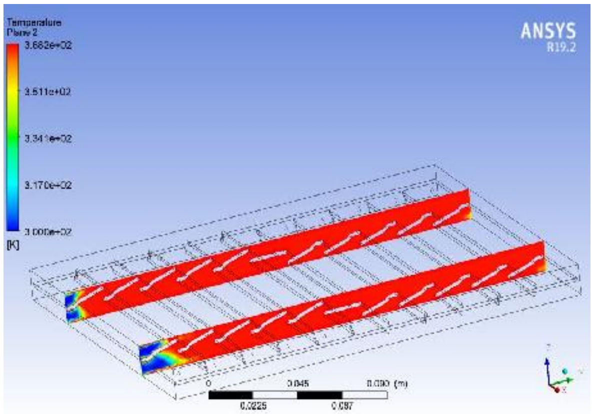

Fig-12 Model 1 (over all temperature)

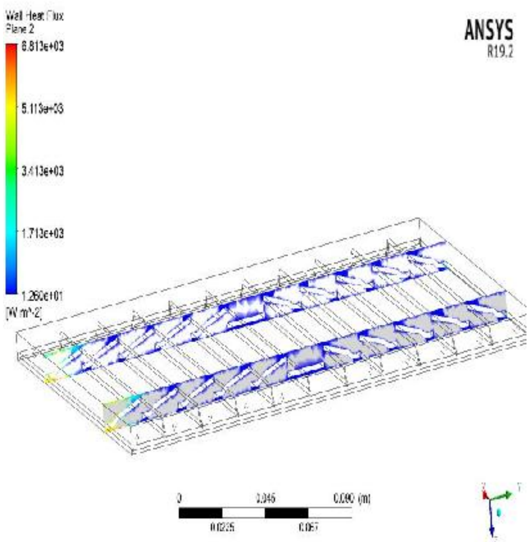

Fig-13 Model 1 (total wall flux)

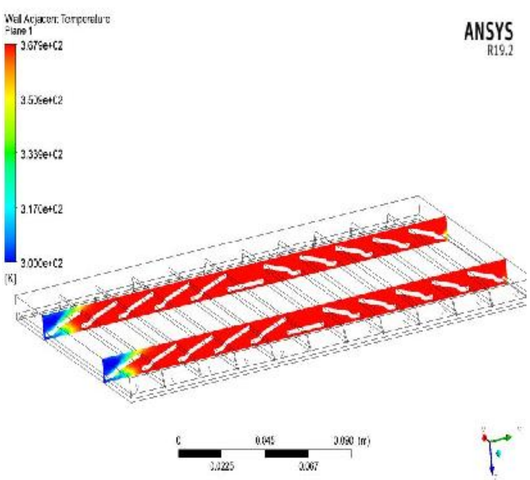

Fig-14 Model 1 (wall temperature)

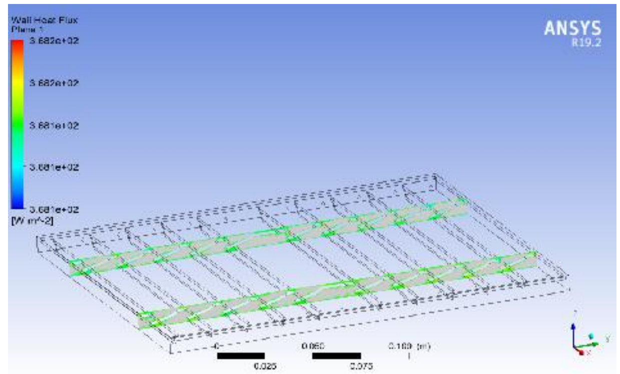

Fig-15: Heat flux for Model 4

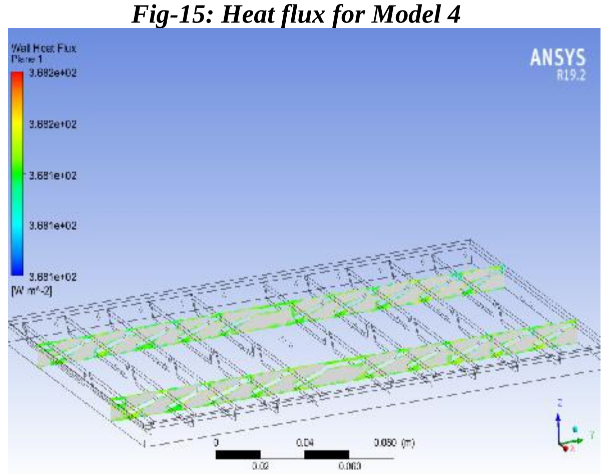

Fig-16: Heat flux for Model 5

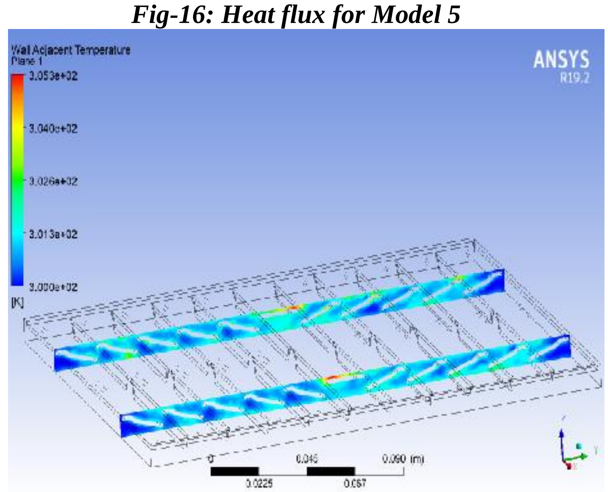

Fig-17: Heat flux for Model 6

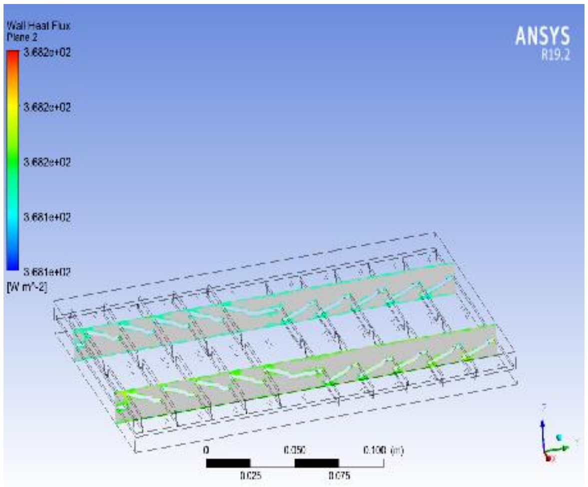

Fig-18: Heat flux for Model 7

IV. Results

Table displaying Ansys simulation results of different models:

model	inner wall temperature (K)		density (kg m^-3)	pressure (Pa)		temperature (K)		wall heat flux (W m^-2)		wall adjacen temperature (K)	
	min	max		min	max	min	max	min	max	min	max
model 1	368.1	368.2	1.225	-1.86E+02	1910	300	368.1	1.26E+01	6.81E+03	300	367.9
model 2	368.1	368.2	1.225	-2.61E+03	1.13E+02	300	368.2	2.24E+01	4.91E+03	3.00E+02	3.68E+02
model 3	3.68E+02	3.68E+02	1.225	-2.14E+02	5.77E+02	3.00E+02	3.68E+02	2.05E+01	5.88E+03	3.00E+02	3.68E+02
model 4	3.03E+02	3.16E+02	1.225	-2.92E+02	5.04E+02	3.00E+02	3.13E+02	3.68E+02	3.68E+02	3.00E+02	3.04E+02
model 5	3.03E+02	3.17E+02	1.225	-4.71E+03	-9.70E-01	3.00E+02	3.17E+02	3.68E+02	3.68E+02	3.00E+02	3.04E+02
model 6	3.03E+02	3.17E+02	1.225	-1.12E+03	1.16E+03	3.00E+02	3.17E+02	3.68E+02	3.68E+02	3.00E+02	3.05E+02
model 7	3.02E+02	3.15E+02	1.225	-2.18E+03	2.20E+03	3.00E+02	3.15E+02	3.68E+02	3.68E+02	3.00E+02	3.03E+02
model 8	3.68E+02	3.68E+02	1.225	-5.95E+02	1.21E+02	3.00E+02	3.68E+02	2.11E+01	5.12E+03	3.00E+02	3.68E+02
model 9	3.68E+02	3.68E+02	1.225	-7.07E+01	8.61E+02	3.00E+02	3.68E+02	2.07E+01	5.64E+03	3.00E+02	3.68E+02
model 10	3.68E+02	3.68E+02	1.225	-5.06E+03	-7.62E-01	3.00E+02	3.68E+02	3.35E+01	3.63E+03	3.00E+02	3.68E+02
model 11	3.68E+02	3.68E+02	1.225	-1.31E+02	1.95E+03	3.00E+02	3.68E+02	1.22E+01	8.63E+03	3.00E+02	3.68E+02

Fig-19 Analysis simulation results

Graphs comparing Ansys simulation results of different models

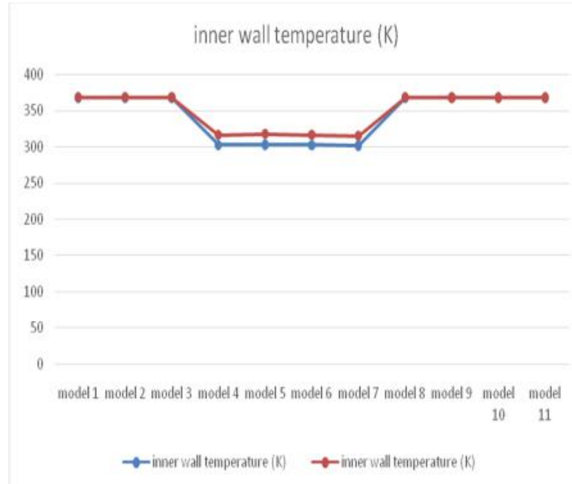

Fig-20: graph of inner wall temperature

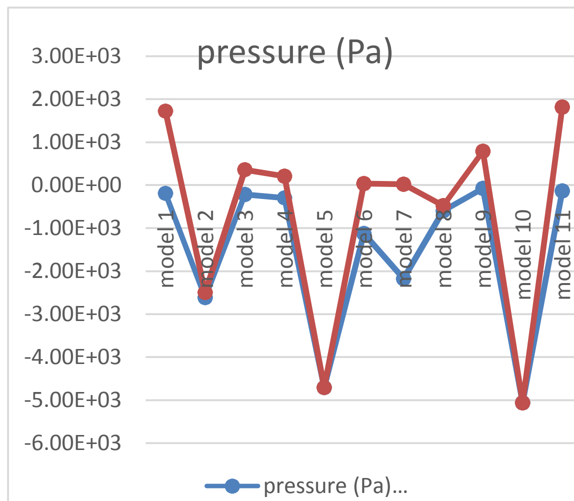

Fig-21 Graph of pressure

Modal Analysis

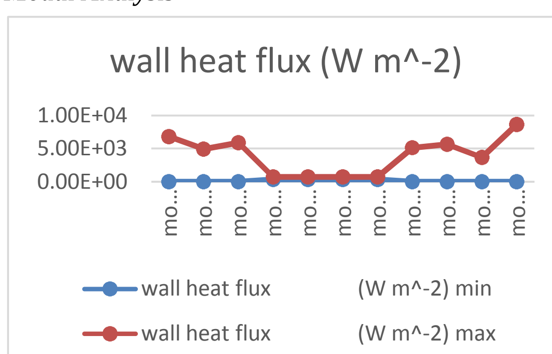

Fig-22 graph for heat flux

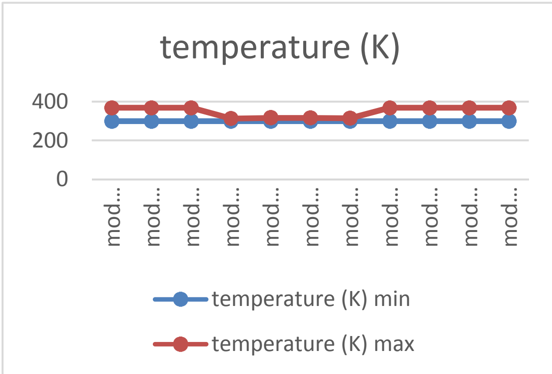

Fig-23 graph for overall temperature

V. Conclusions

VI.

This study presents numerical analysis of effect of various louver fin configurations on heat transfer rate. The three dimensional governing equations for fluid flow and heat transfer are solved using ANSYS Fluent 19.2, fin geometries are developed using Catia v5. Multiple models are included in this study for better understanding of the fin behavior. Total 11 models are designed using Catia and are analyzed using Ansys fluent module. The observations made during the study are discussed below:

1. The thermal behavior of fins is almost similar except for model 4, 5, 6, 7.
2. The variation in the behavior of fin is due to change in turbulence in flow.
3. The heat flux in these models is steady and uniform when compared to other models.
4. Fluxes are highly fluctuating in all models except in 4,5,6,7.
5. It is evident that by controlling the air flow rate we can govern the heat transfer.
6. Here the performance of the fin is evaluated using lowest temperature recorded and low range of fluxes.

VII. Future Scope

Present study deals with Louver fin performance with Aluminum alloy 6061. At present condensers doesn't have Louver fins. In this study we added Louver fins to the Radiator. In this thesis it gave the good results for the condensers with louver fins. Experimentation and theoretical analysis is much suggested.

***VIII.* References**

[1] Experimental and CFD study of a single phase cone-shaped helical coiled heat exchanger: an empirical correlation. By Daniel Flórez-Orrego, ECOS June 26-29, 2012.

[2] Numerical And Experimental Studies of a Double pipe Helical Heat Exchanger by Timothy John Rennie, Dept. of Bio-resource Engg. McGill University, Montreal August 2004.

[3] Experimental and CFD estimation of heat transfer in helically coiled heat exchangers by J.S. Jayakumar, S.M. Mahajani, J.C. Mandal, P.K. Vijayan, and RohidasBhoi, 2008, Chemical Engg Research and Design 221-232.

[4] Heat Transfer Optimization of Shell-and-Tube Heat Exchanger through CFD Studies by Usman Ur Rehman, 2011, Chalmers University of Technology.

[5] Structural and Thermal Analysis of Heat Exchanger with Tubes of Elliptical Shape by Nawras H. Mostafa Qusay R. Al-Hagag, IASJ, 2012,Vol-8 Issue-3.

[6] Numerical analysis of forced convection heat transfer through helical channels Dr. K. E. Reby Roy, IJEST, July-2012 vol-4.