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Experimental Analysis to Determine Effect of Aspect Ratio on Heat Transfer from Square Taper Fin Array in Natural Convection

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ABSTRACT:

Heat transfer from the heat sink plays major role on the performance on various components in different industries like Automobile industries, Air conditioning industries, Heat treatment, Electronic Industries. In this heat transfer process material type, shape, length plays a major role.

In this thesis Thermal and CFD analysis will be conducted on the square fin arrays by natural convection heat transfer process. In this thesis, materials considered are aluminium alloy he 15 and 30. Parameters varied in this work are space between fins, length, and thickness. Experimental work will be conducted in the still air. 3D modeling software CATIA V5 will be used for 3D models of square fin arrays. Thermal and CFD analysis will be done in ANSYS.

Keywords: - ***Heat transfer, square array***

I. INTRODUCTION

The removal of excessive heat from system components is essential to avoid the damaging effects of burning or overheating. Therefore, the enhancement of heat transfer is an import subject of thermal engineering. The heat transfer from surfaces may in general be enhanced by increasing the heat transfer coefficient between a surface and its surroundings, by increasing the heat transfer area of the surface, or by both. In most cases, the area of heat transfer increased by utilizing extended surfaces in the form of fins attached to walls and surfaces Extended surfaces (fins) frequently used in heat exchanging devices for the purpose of increasing the heat transfer between a primary surface and the surrounding fluid.

Fins are surfaces that extend from an object to increase the rate of heat transfer to or from the environment by increasing convection. The amount of conduction, convection, or radiation of an object determines the amount of heat it transfers. Increasing the temperature gradient between the object and the environment, increasing the convection heat transfer coefficient, or increasing the surface area of the object increases the heat transfer. Sometimes it is not feasible or economical to change the first two options. Thus, adding a fin to an object increases the surface area and can sometimes be an economical solution to heat transfer problems.

THE FUNCTION OF FINS:

Increase heat transfer rate for a fixed surface temperature,

or

Lower surface temperature for a fixed heat transfer rate Newton's law of cooling

Examples of fins:

- Thin rods on the condenser in back of refrigerator.
- Honeycomb surface of a car radiator.
- Corrugated surface of a motorcycle engine.
- Coolers of PC boards.

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FINS ORINIGINAL MODEL

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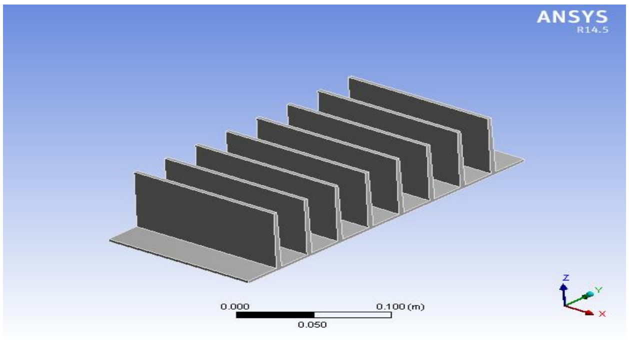

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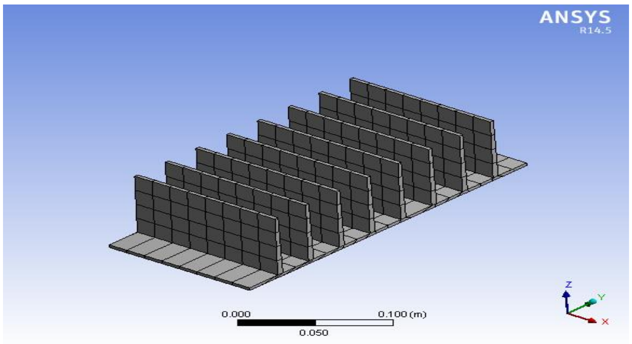

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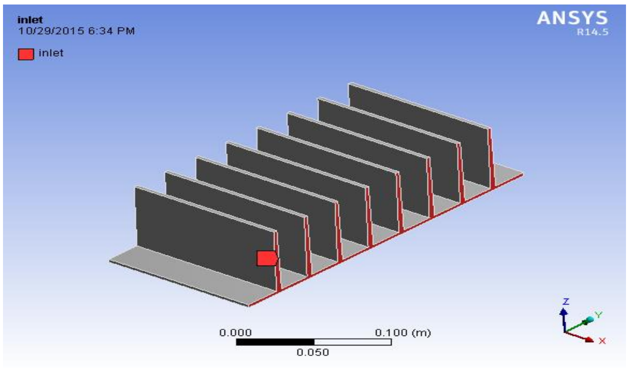

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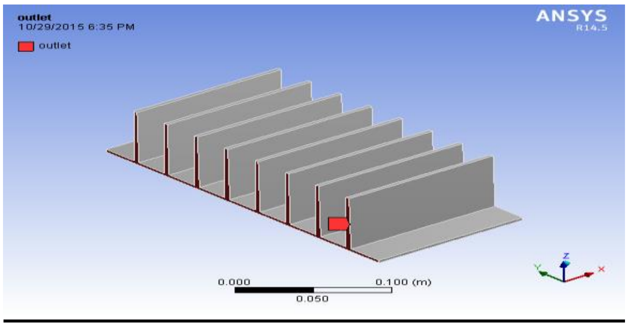

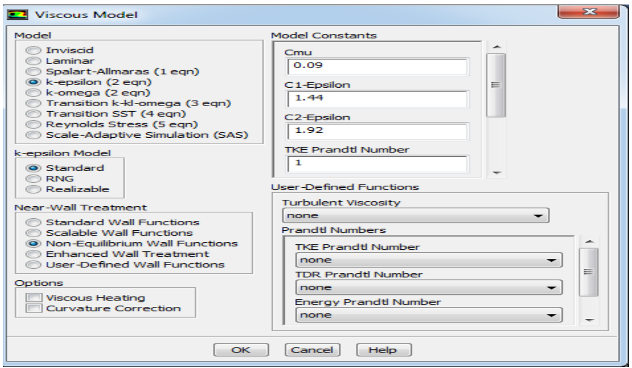

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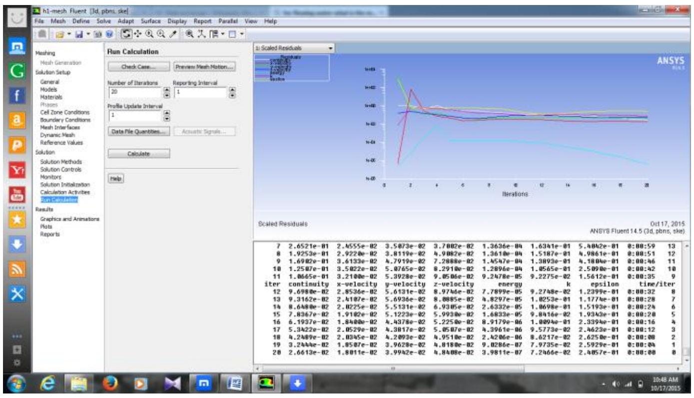

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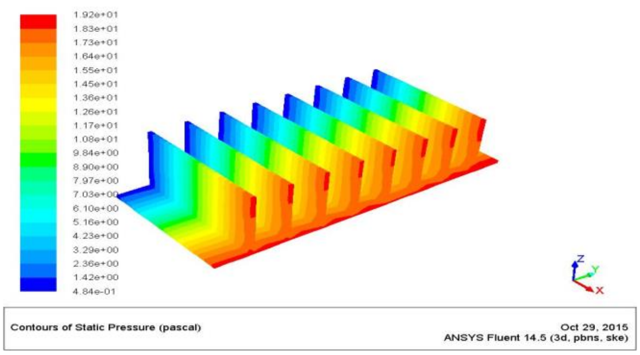
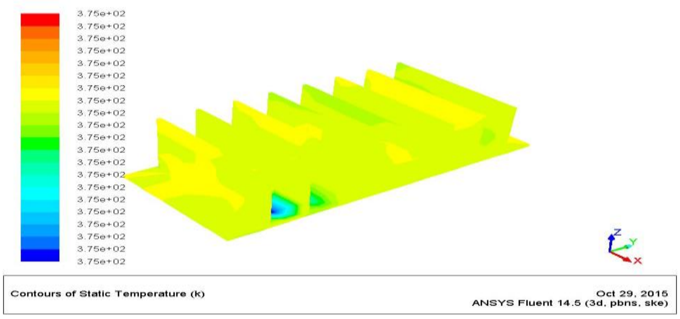
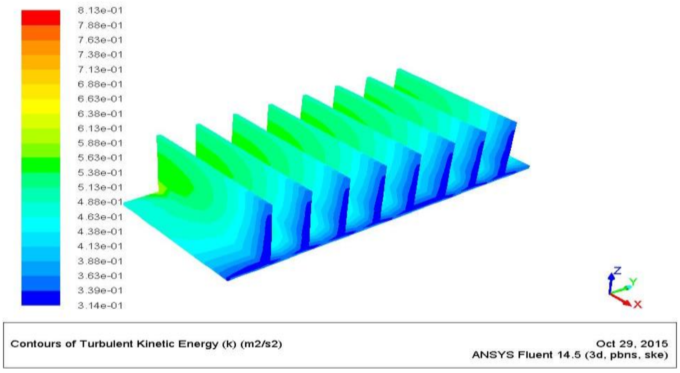
Static Pressure



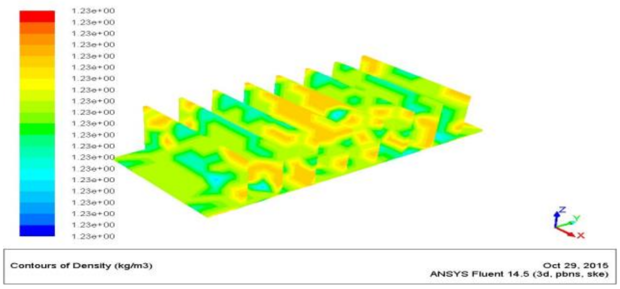
Static Temperature



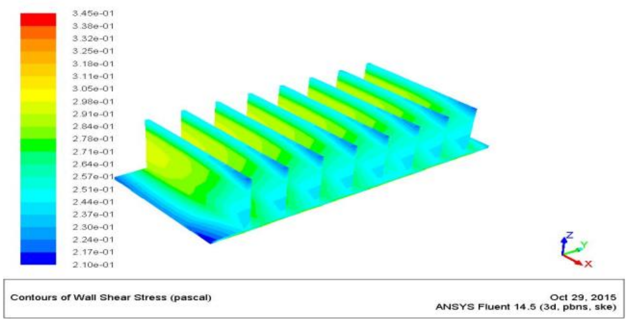
Turbulence



Density

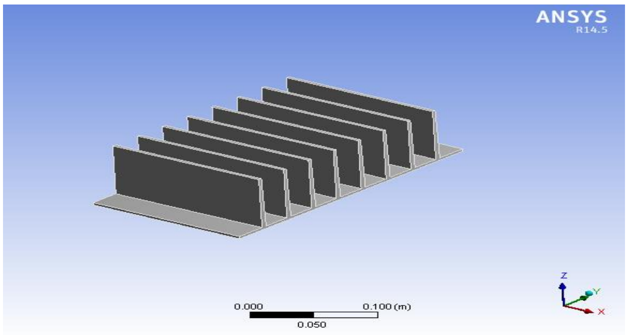


Wall fluxes



FINS LENGTH MODIFY MODEL

Import modal



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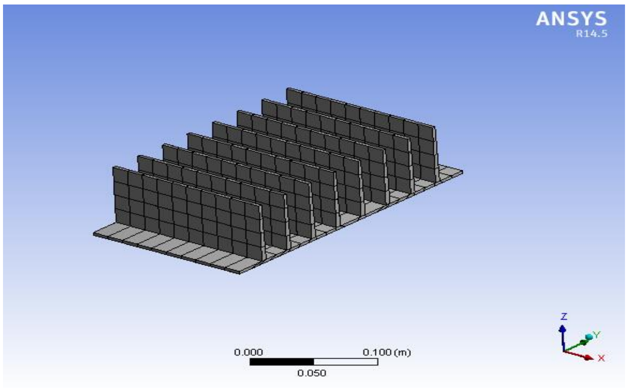
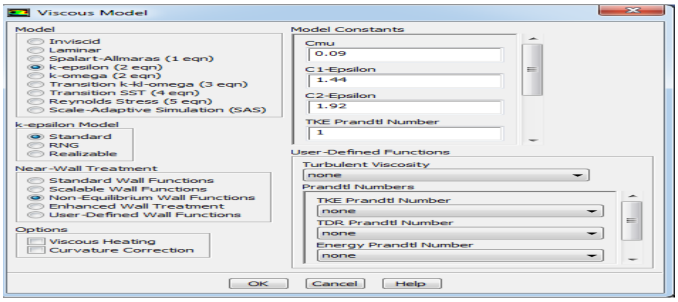
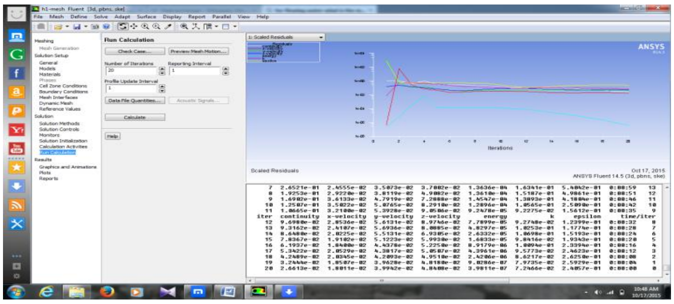


SPECIFYING BOUNDARIES FOR INLET AND OUTLET



Solution Iterations Graph



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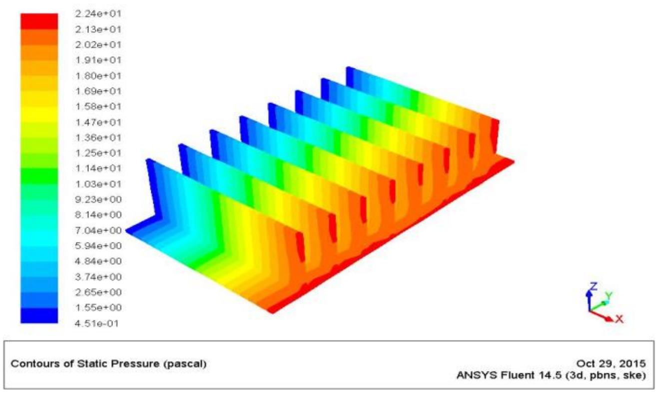
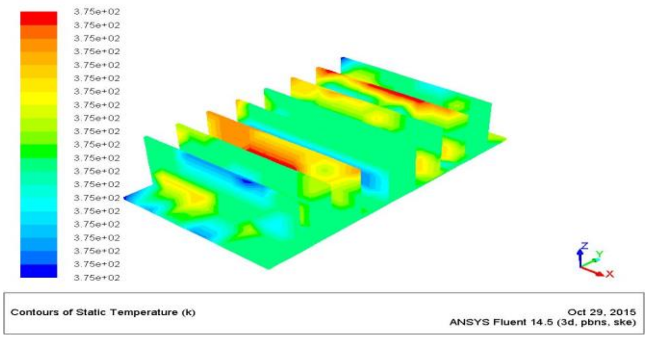
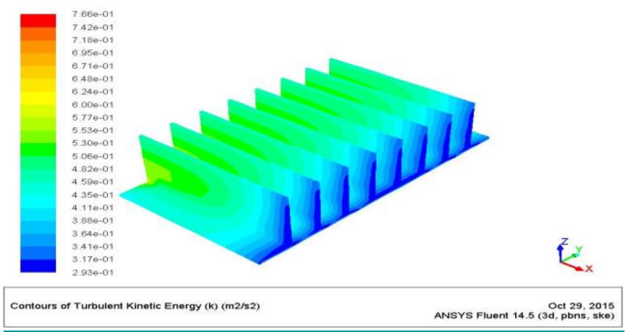


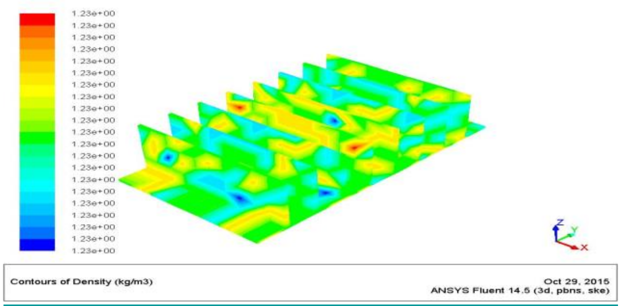
Static Temperature



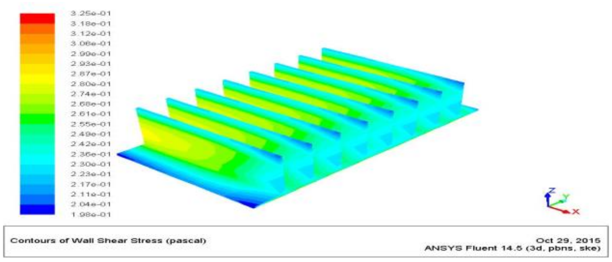
Turbulence



Density



Wall fluxes



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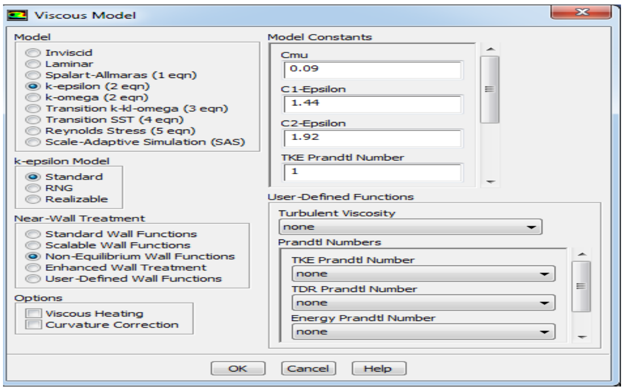
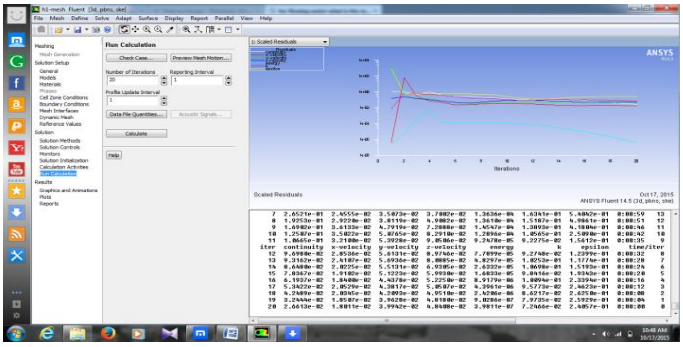
FINS SPACE MODIFY MODEL

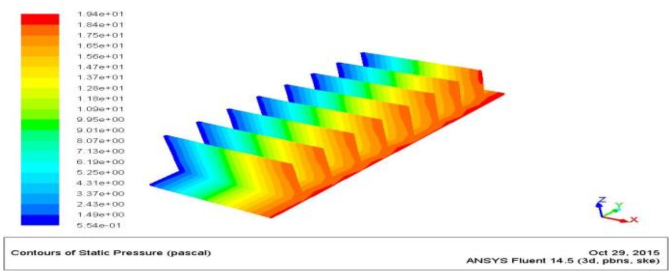
SPECIFYING BOUNDARIES FOR INLET AND OUTLET



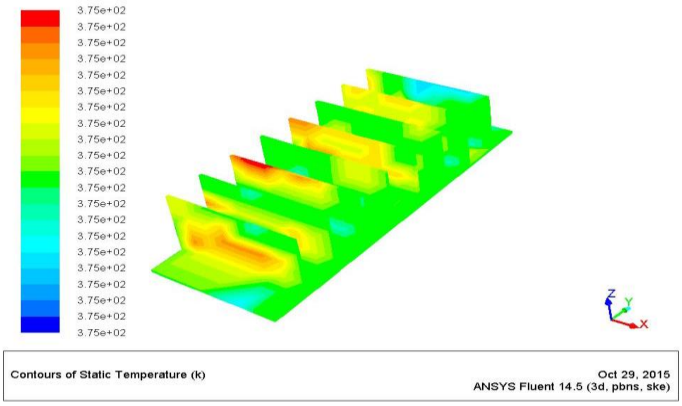
Solution Iterations Graph



Static Pressure



Static Temperature



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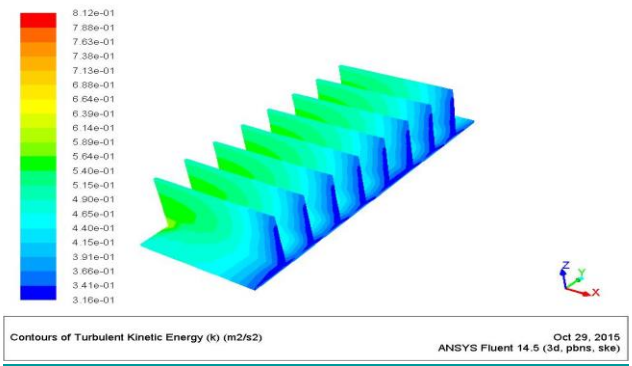

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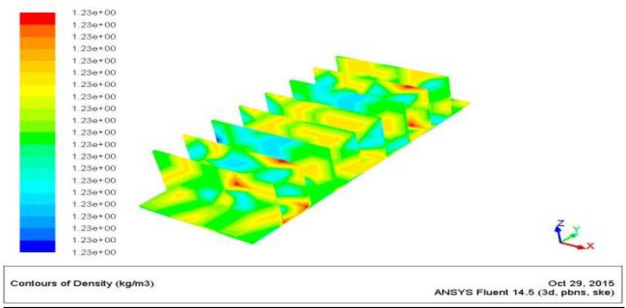

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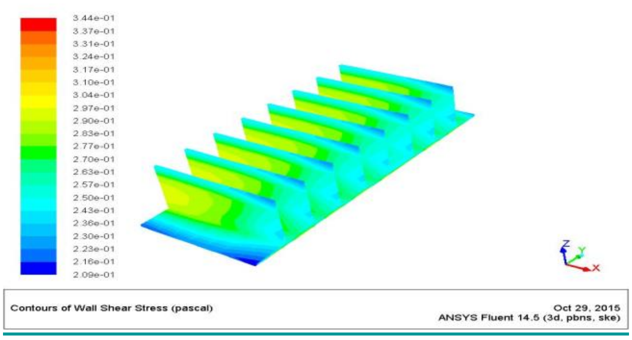
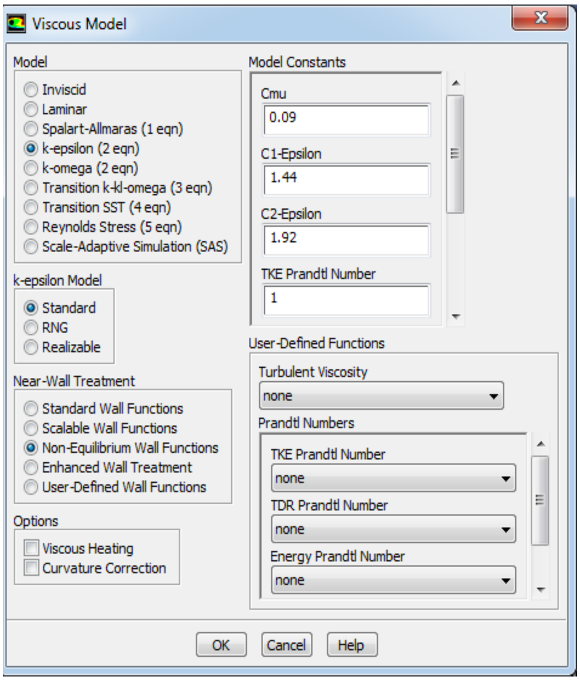
Wall fluxes

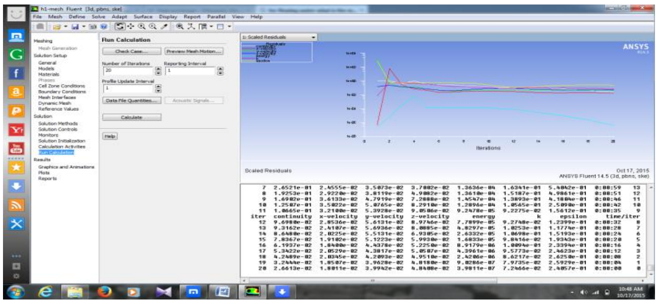


FINS THICKNESS MODIFY MODEL

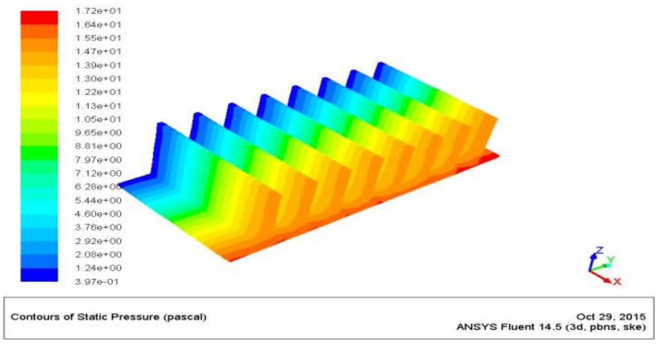
SPECIFYING BOUNDARIES FOR INLET AND OUTLET



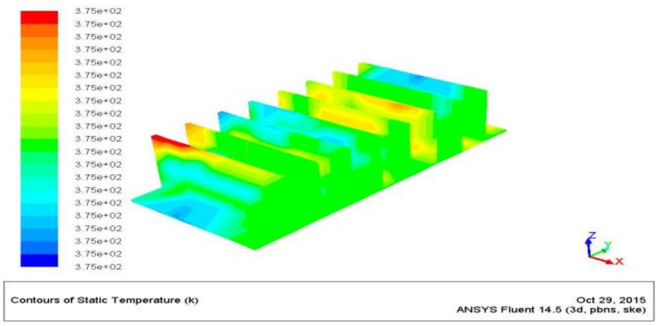
Solution Iterations Graph



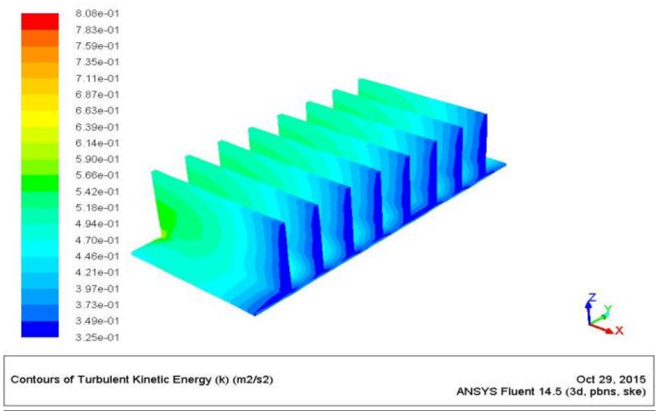
Static Pressure



Static Temperature



Turbulence



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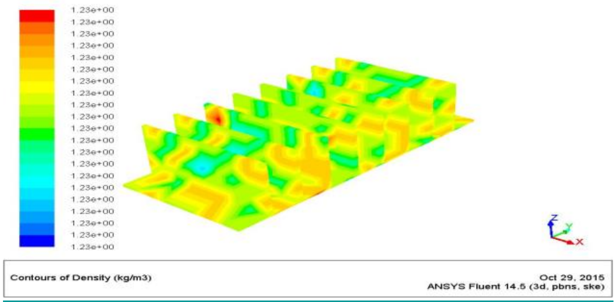
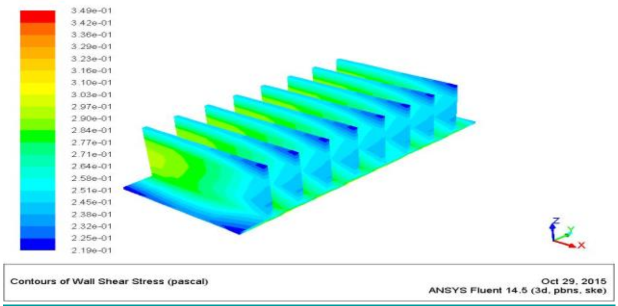
Density



Wall fluxes



RESULTS TABLE

Type of model	Static pressure		temperature	Turbulent kinetic energy		Density	Wall fluxes	
	Min	Max	Overall	Min	Max	Overall	Min	Max
Original model	4.84e-01	1.92e+01	3.75e+02	3.14e-01	8.13e-01	1.23e+00	2.10e-01	3.45e-01
Length modified model	4.51e-01	2.24e+01	3.75e+02	2.93e-01	7.66e-01	1.23e+00	1.98e-01	3.23e-01
Space modified model	5.54e-01	1.94e+01	3.75e+02	3.16e-01	8.12e-01	1.23e+00	2.09e-01	3.44e-01
Thickness modified model	3.97e-01	1.72e+01	3.75e+02	3.25e-01	8.08e-01	1.23e+00	2.19e-01	3.46e-01

CONCLUSION

Acording to the above results we can say that heat transfer rate or total heat transfer may vary based on thermal fuexe and turbulance generated we can also get same heat transfer in a model with less surface area by creating more space for turbulant flow, more over it is also iportant that the thick ness of the fin should be adiquate

When we compare the maximim presures developed in the models the maximum presure is recrded in length modified model as they creat a more turbulence then the other models these high length fins are capable of creating hi turbulent flows

Maximun turbulent kinetic energy is recorded in space modified because here there is more scope for the wind to flow smothly and creat enough turbulance even though the pressurs are slightly low when comparred with the model two

Coming to wall fluxes which are very important to desipate the heat from the body, the highest fluxes are developed in the thickest fin ,from this it is evident that to get maximum heat transfer thickness also maters

Finally we conclude that forth model wich have less aspect ratio and more spacing between fins is the best model becacue even tough model one and model four have almost same but the material requirment for the model four is much less than model one

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