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CFD and Thermal Analysis of FIN Tube Evaporator

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ABSTRACT:

An evaporator is used in an air-conditioning system or refrigeration system to allow a compressed cooling chemical, such as Freon or R-22, to evaporate from liquid to gas while absorbing heat in the process. It can also be used to remove water or other liquids from mixtures. The process of evaporation is widely used to concentrate foods and chemicals as well as salvage solvents. In the concentration process, the goal of evaporation is to vaporize most of the water from a solution which contains the desired product.

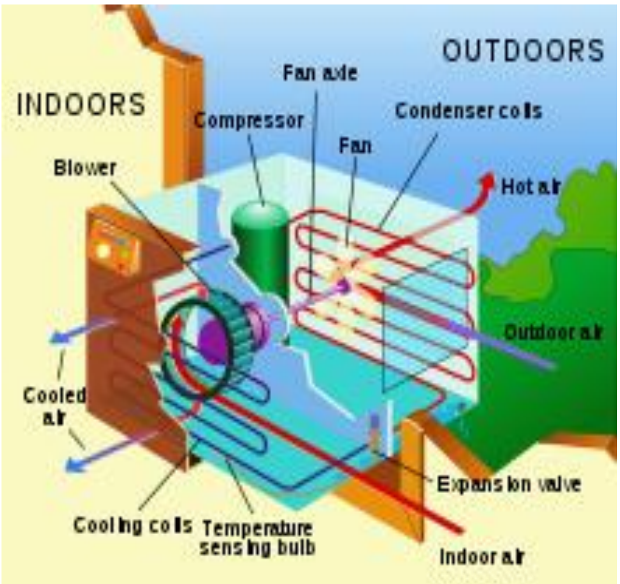
In this thesis, different shapes of fins in fin tube evaporator are modeled in 3D modeling software Pro/Engineer. The fins considered are continuous rectangular fin, interrupted rectangular fin, continuous circular fin, interrupted circular fin and tapered fin. The mass flow rate and heat transfer rate are analyzed by CFD analysis done in Ansys. CFD analysis is done by varying fluids R600A, R32 and R410A on all the models.

The inputs of CFD analysis are velocity and pressure and the results determined are Pressure, Velocity, Mass Flow Rate, Heat Transfer Rate and Heat Transfer Coefficient.

Thermal analysis is done by considering Aluminum alloy for fins and Copper for tubes.

INTRODUCTION

An air conditioner (often referred to as AC) is a home appliance, system, or mechanism designed to dehumidify and extract heat from an area. The cooling is done using a simple refrigeration cycle. In construction, a complete system of heating, ventilation and air conditioning is referred to as "HVAC". Its purpose, in a building or an automobile, is to provide comfort during either hot or cold weather.



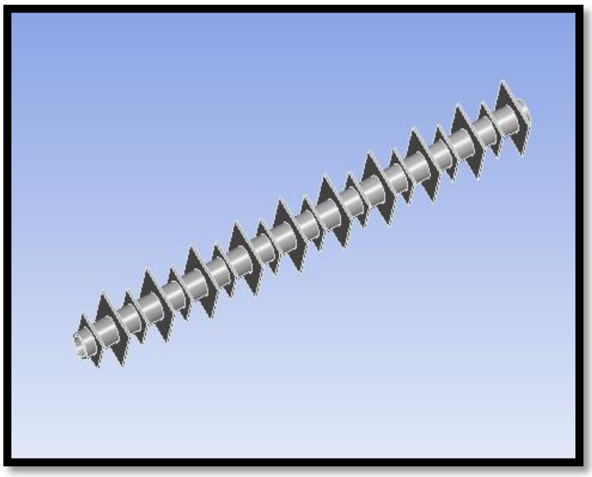
A typical home air conditioning unit

CFD ANALYSIS OF FIN TUBE EVAPORATOR BY VARYING DIFFERENT PARAMETERS

RECTANGULAR FIN WITH TUBE

FLUID- R32

IMPORTED MODEL



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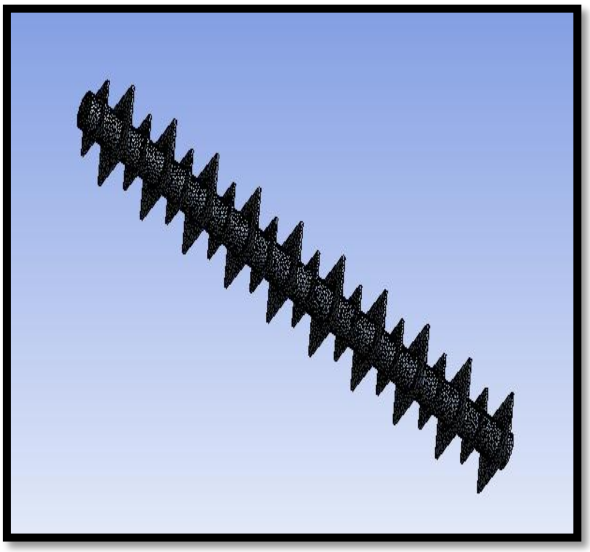
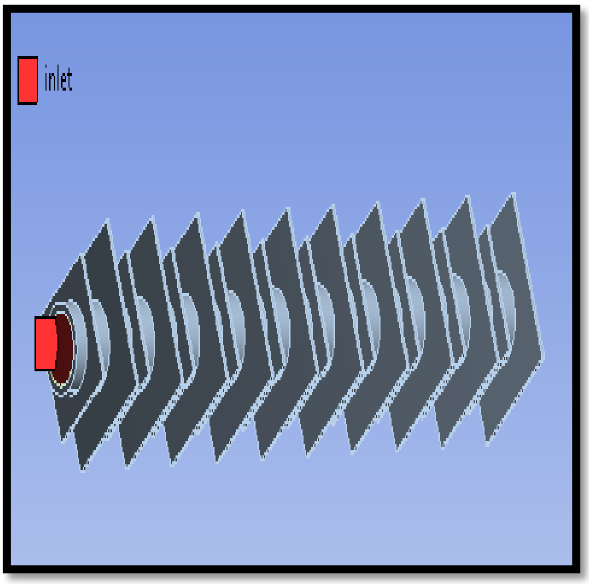
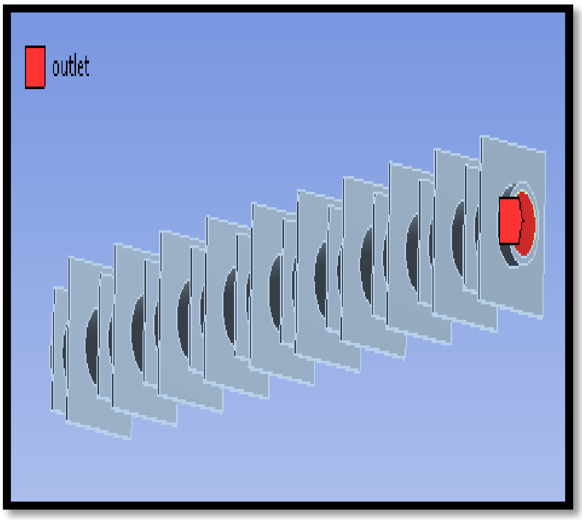
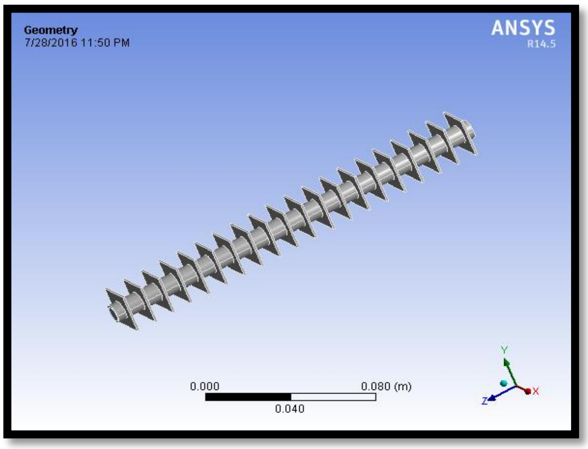
MESHED MODEL







EVAPORATOR CONTINUOUS RECTANGULAR FIN WITH TUBE IMPORTED MODEL



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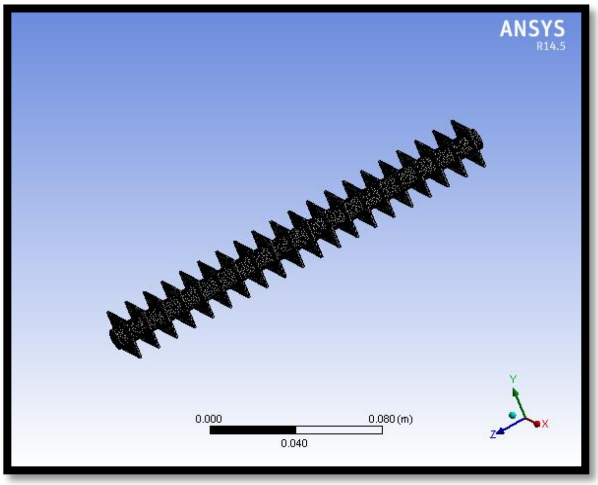
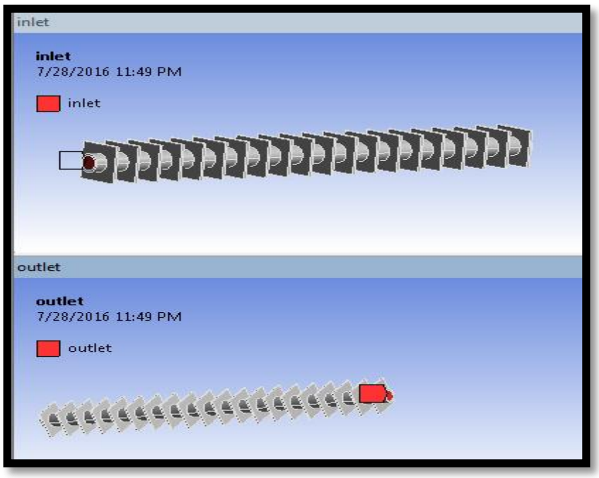


INLET& OUTLETS



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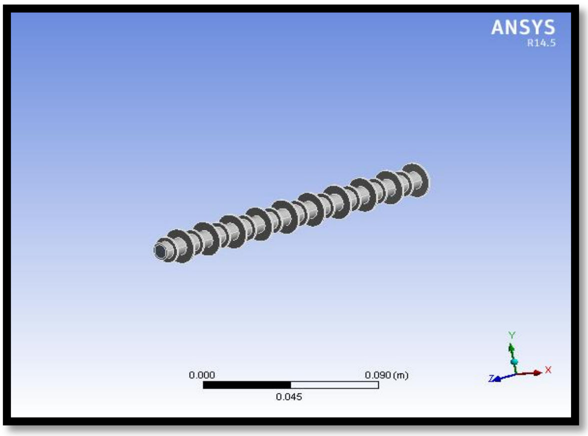
FLUID- R32
EVAPORATOR- INTERRUPTED CIRCULAR FIN WITH TUBE
IMPORTED MODEL



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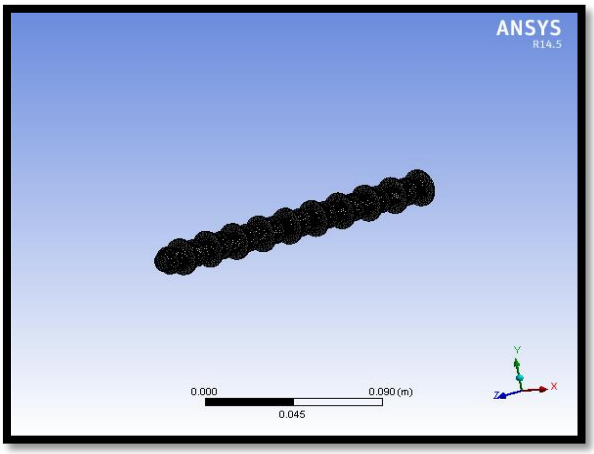

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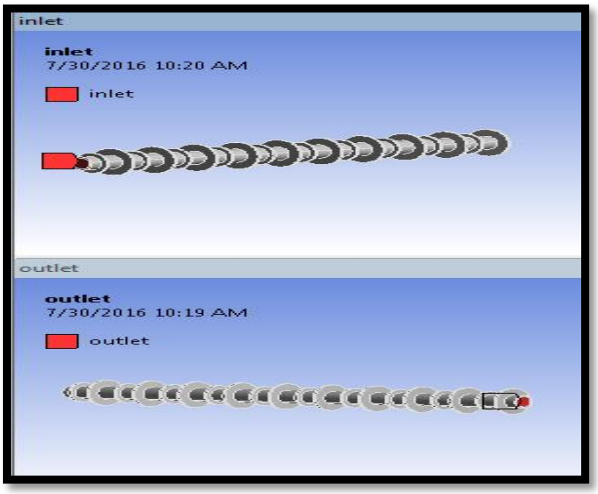
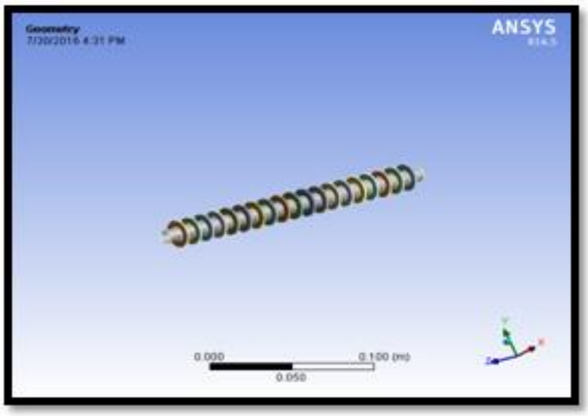


THERMAL ANALYSIS OF FIN TUBE EVOPORATOR
CONTINUOUS CIRCULAR FIN WITH TUBE
FLUID –R32
IMPORTED MODEL



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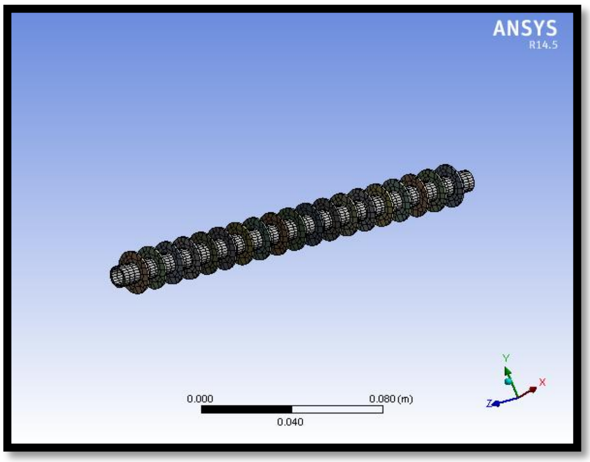
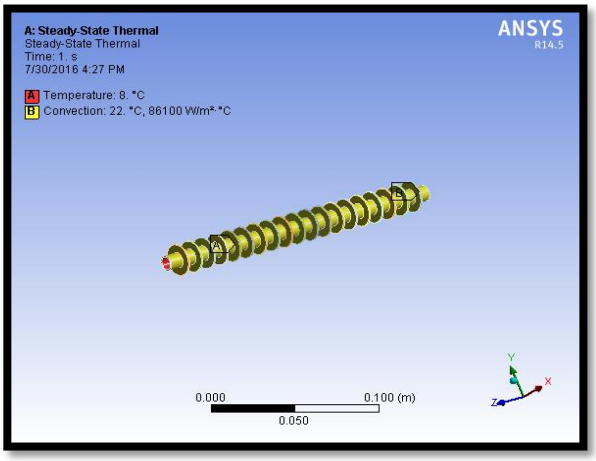


BOUNDARY CONDITION



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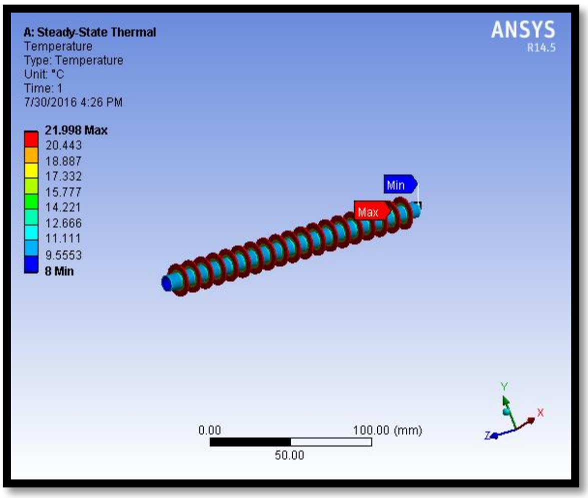
TEMPERATURE



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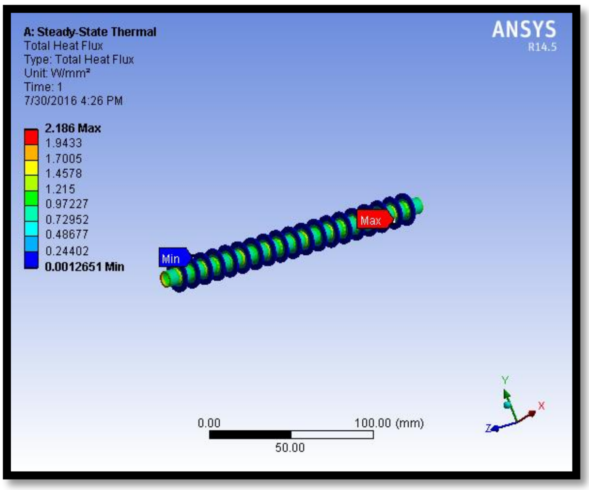
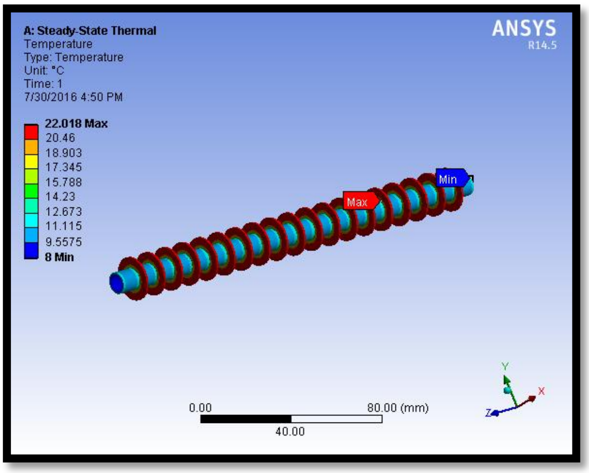


FLUID –R600A

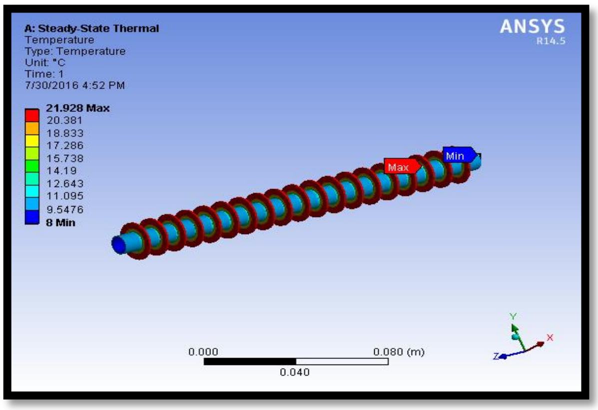
TEMPERATURE



HEAT FLUX

FLUID –R410A

TEMPERATURE



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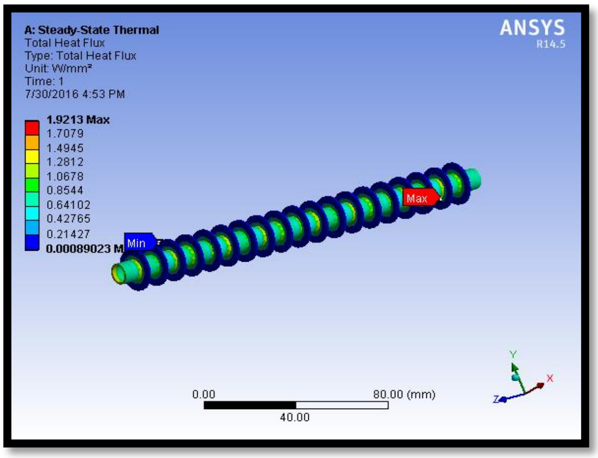
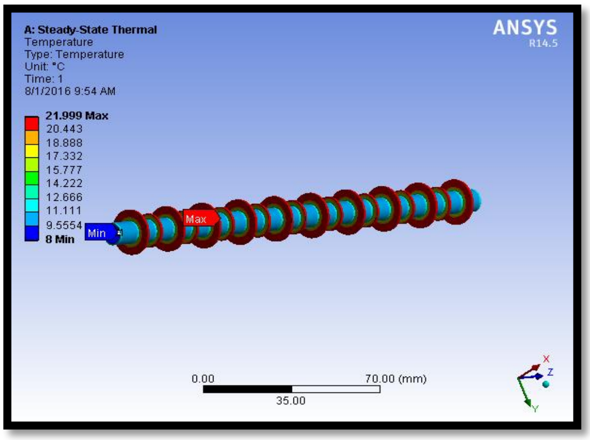


INTERRUPTED CIRCULAR FIN WITH TUBES

FLUID –R32

TEMPERATURE



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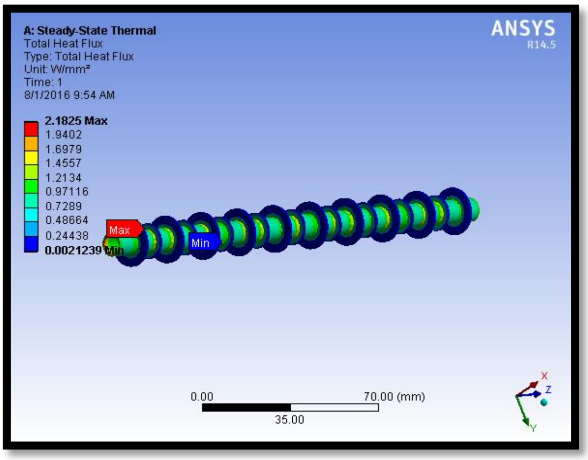
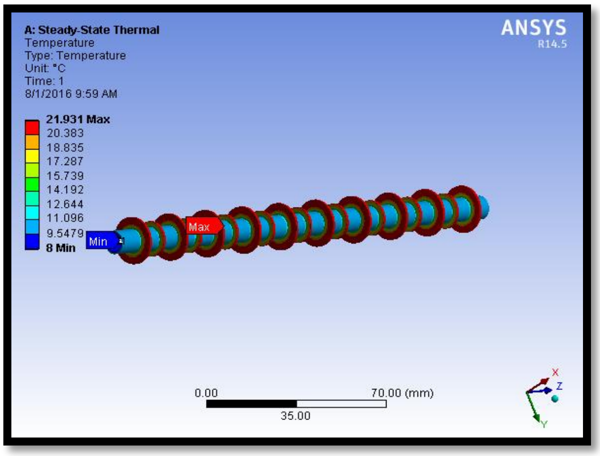
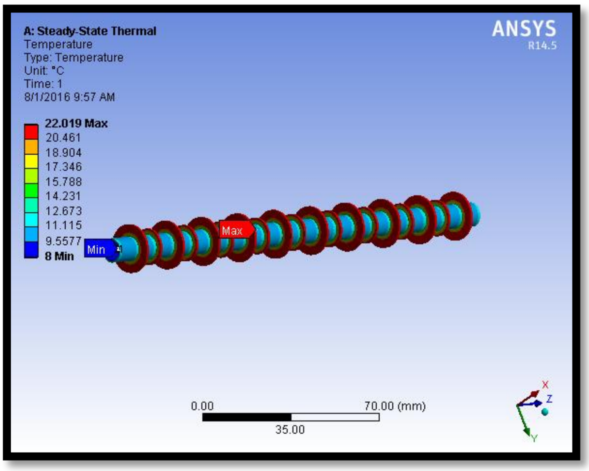


FLUID –R410A
TEMPERATURE



FLUID –R600A
TEMPERATURE



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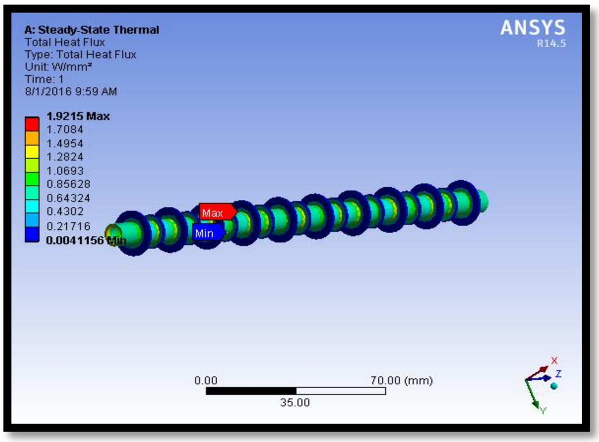

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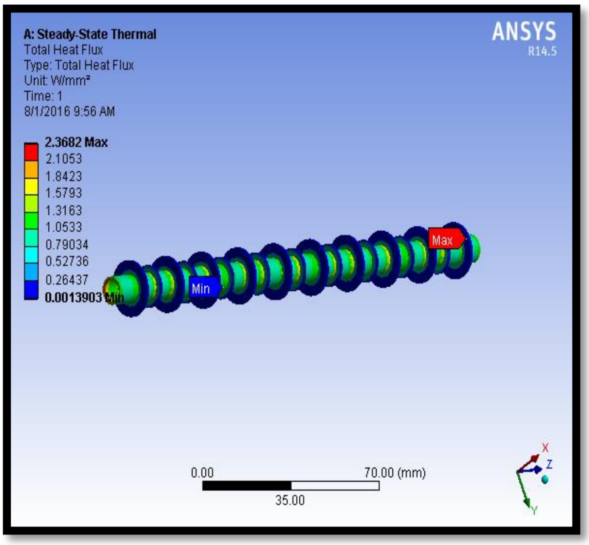
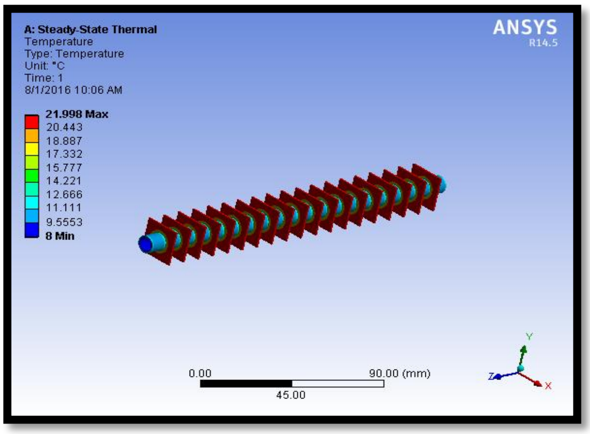


CONTINUOUS RECTANGULAR FIN WITH TUBE
FLUID –R32
TEMPERATURE



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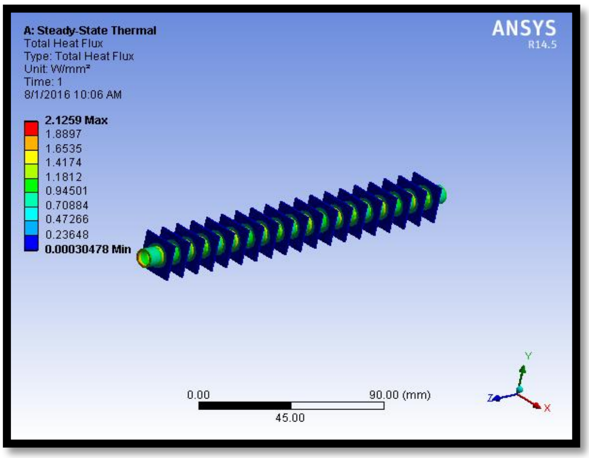
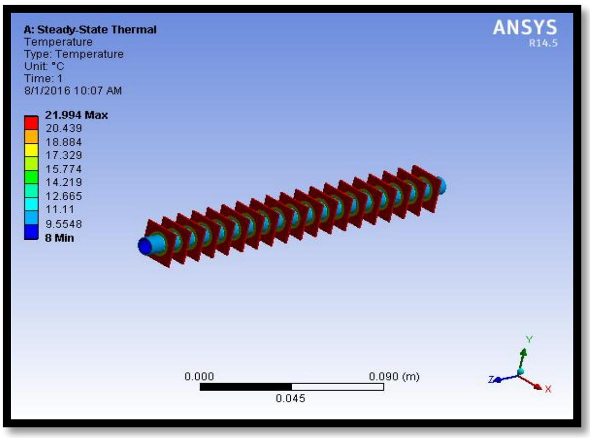


FLUID –R410A

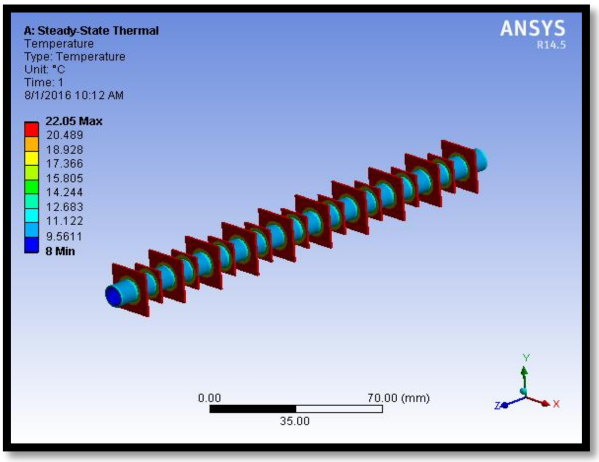
TEMPERATURE



INTERRUPTED RECTANGULAR FIN WITH TUBE

FLUID –R32

TEMPERATURE



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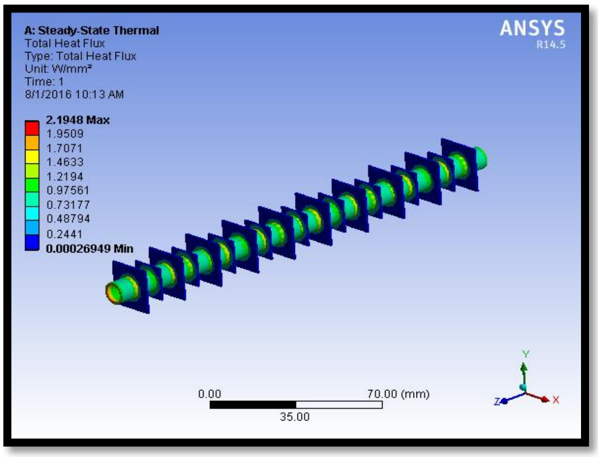
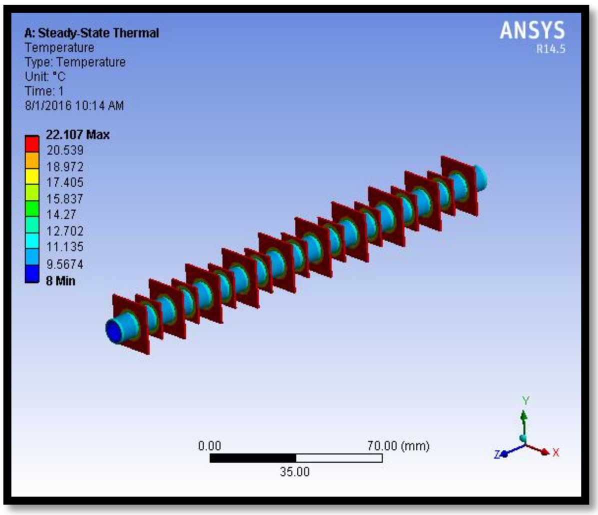


FLUID –R600A

TEMPERATURE



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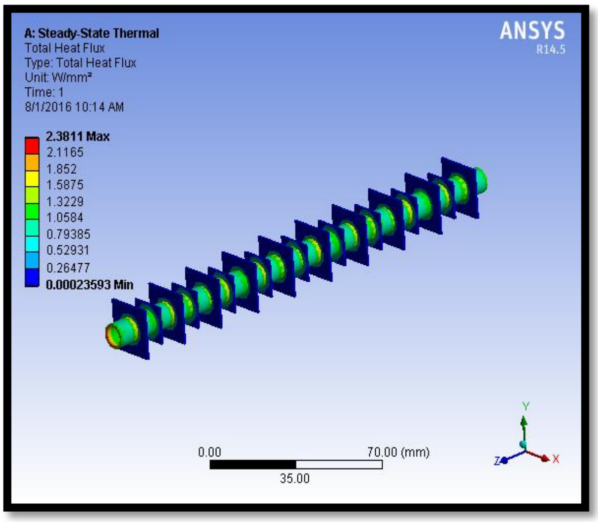
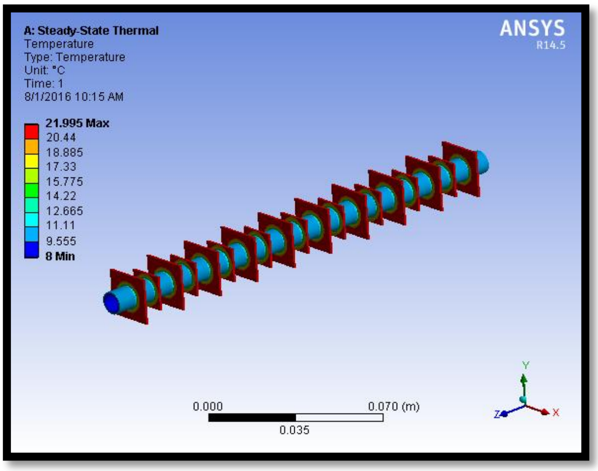


FLUID –R410A
TEMPERATURE



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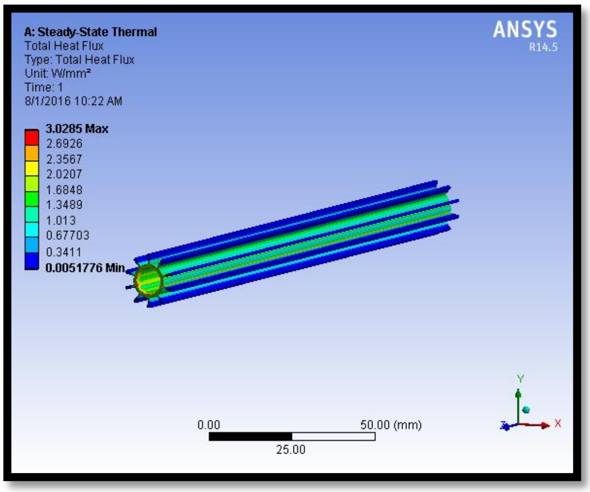

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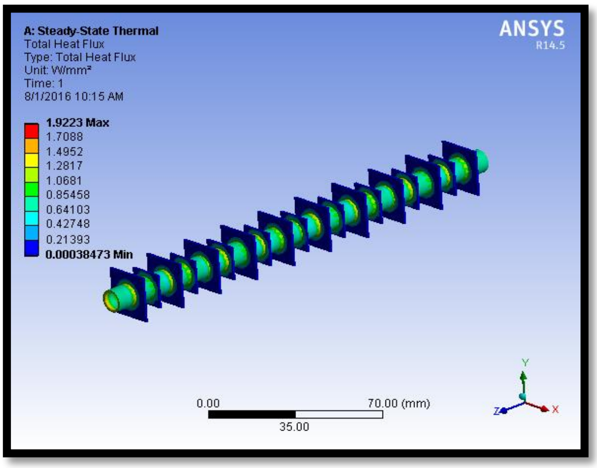
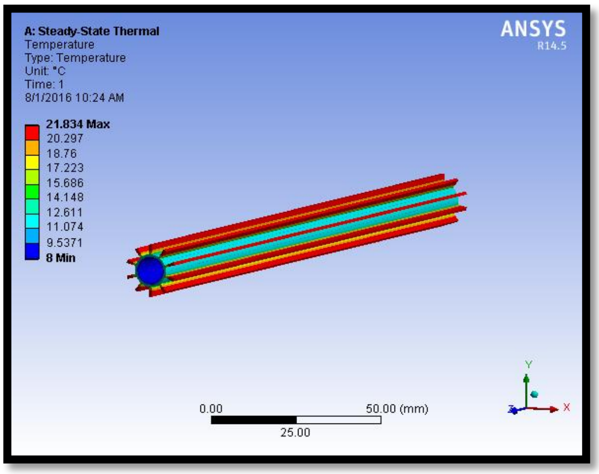
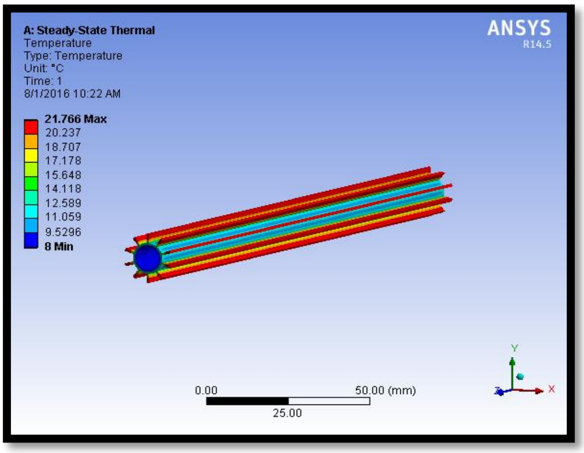


FLUID –R600A
TEMPERATURE



TAPERED FIN WITH TUBE
FLUID –R32
TEMPERATURE



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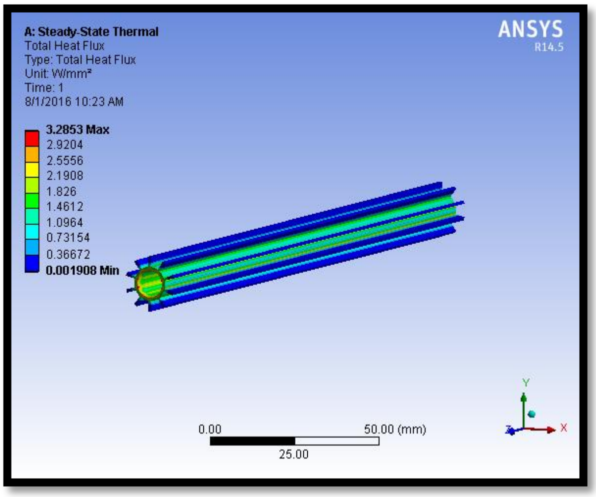

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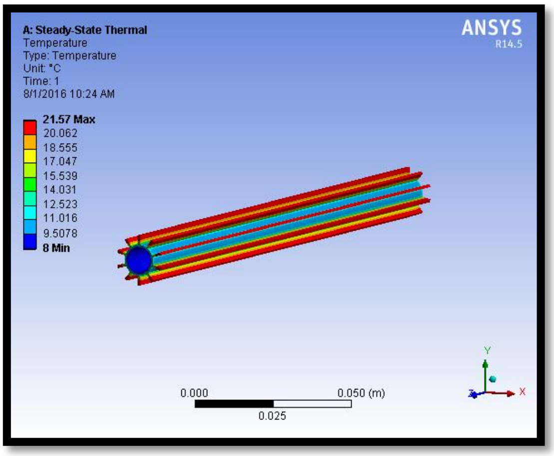
FLUID –R410A

TEMPERATURE



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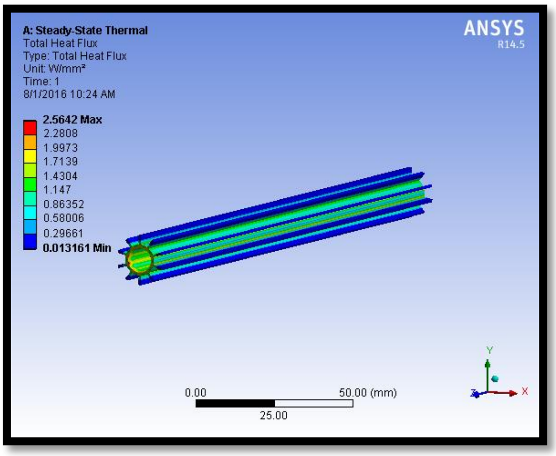

TABLES

CFD ANALYSIS RESULTS TABLE

CONTINOUS CIRCULAR FIN WITH TUBE

Fluids	Pressure(Pa)	Velocity (m/s)	Heat transfer coefficient (W/m²-k)	Mass flow rate (Kg/s)	Heat transfer rate(W)
R32	1.34E+05	3.16E+01	7.50E+04	1.2874E-05	0.3507
R600A	6.27E+04	1.43E+01	8.61E+04	3.18288E-05	1.2881318
R410A	1.21E+05	2.80E+01	5.68E+04	4.3988E-05	1.27624

INTRRUPTED CIRCULAR FIN WITH TUBE

Fluids	Pressure(Pa)	Velocity(m/s)	Heat transfer coefficient (W/m²-k)	Mass flow rate (Kg/s)	Heat transfer rate(W)
R32	1.32E+05	3.16E+01	7.50E+04	1.54972E-05	0.57023413
R600A	6.18E+04	1.42E+01	8.65E+04	4.124641E-05	1.6296179
R410A	1.20E+05	2.78E+01	5.71E+04	0.000161170	4.4433562

CONTINOUS RECTANGULAR FIN WITH TUBE

Fluids	Pressure(Pa)	Velocity (m/s)	Heat transfer coefficient (W/m²-k)	Mass flow rate (Kg/s)	Heat transfer rate(W)
R32	1.195E+05	3.00E+01	7.14E+04	0.00116300	37.738019
R600A	6.02E+04	1.38E+01	8.05E+04	0.00132584	53.967663
R410A	1.17E+05	2.71E+01	5.35E+04	0.00126147	34.064296

INTRRUPTED RECTANGULAR FIN WITH TUBE

Fluids	Pressure(Pa)	Velocity (m/s)	Heat transfer coefficient (W/m²-k)	Mass flow rate (Kg/s)	Heat transfer rate(W)
R32	1.41E+05	3.04E+01	7.58E+04	0.0004985	15.894343
R600A	6.37E+04	1.40E+01	8.71E+04	7.18832E-05	2.6134137
R410A	1.16E+05	2.75E+01	5.75E+04	0.0008912	24.105978

TAPERED FIN WITH TUBE

Fluids	Pressure(Pa)	Velocity(m/s)	Heat transfer coefficient (w/m²-k)	Mass flow rate (kg/s)	Heat transfer rate(W)
R32	1.11E+05	3.04E+01	7.56E+04	7.1525E-05	2.3590117
R600A	5.41E+04	1.40E+01	8.68E+04	0.0003129	12.812933
R410A	1.24E+05	2.75E+01	5.73E+04	0.0001885891	5.2145905

CONCLUSION

In this thesis, different shapes of fins in fin tube evaporator are modeled in 3D modeling software Pro/Engineer. The fins considered are continuous rectangular fin, interrupted rectangular fin, continuous circular fin, interrupted circular fin and tapered fin.

CFD analysis is done by varying fluids R600A, R32 and R410A on all the models. By observing CFD analysis results, the pressure drop is more for interrupted rectangular fin, heat transfer coefficient is more for interrupted rectangular fin and mass flow rate and heat transfer rate are more for continuous rectangular fin. By comparing the results between refrigerants, pressure drop is more when R32 is used, heat transfer coefficient and heat transfer rate are more when R600A is used.

Thermal analysis is done by considering Aluminum alloy for fins and Copper for tubes. By observing the heat flux values, the values are more for tapered fin due to less area than rectangular and circular fins. So heat transfer rate is more for tapered fin. When R600A is used, heat flux is more.

So it can be concluded that using refrigerant R600A for rectangular continuous fin is better.

REFERENCES

1. CFD analysis of tube-fin 'no-frost' evaporators by Jader R. Barbosa, Jr.; Christian J. L. Hermes; CláudioMelo

2. Numerical Modeling and Experimentation on Evaporator Coils for Refrigeration in Dry and Frosting Operational Conditions by ZineAidoun, Mohamed Ouzzane and AdlaneBendaoud

3. FEA of fin tube evaporator by Kiran B. Parikh, Diptesh R. Patel, Sapna A. Solanki, International Journal of Advanced Engineering Research and Studies, E-ISSN2249–8974

4. Analysis of Fin-and-Tube Evaporators in No-Frost Domestic Refrigerators by Carles OLIET, Carlos D. PEREZ-SEGARRA, Joaquim RIGOLA, Assensi, International Refrigeration and Air Conditioning Conference

5. Heat Transfer Analysis of Room-Temperature Finned-Tube Evaporator for Cryogenic Nitrogen by Shun Ching Lee and Tzu-Min Chen, J. Heat Transfer 133(9), 091502 (Aug 01, 2011) (9 pages) doi:10.1115/1.4003924

6. Performance of a finned-tube evaporator optimized for different refrigerants and its effect on system efficiency by Piotr A. Domanski, David Yashar, Minsung Kim, International Journal of Refrigeration 28 (2005) 820–827

7. An Optimized Design of Finned-Tube Evaporators Using the Learnable Evolution Model by Piotr A. Domanskia, David Yashara, Kenneth A. Kaufmanb&Ryszard S. Michalskibc, DOI:10.1080/10789669.2004.10391099

8. Thermoeconomic optimization for a finned-tube evaporator configuration of a roof-top bus air-conditioning system by M. Khamis Mansour, Md Nor Musa and Mat Nawi Wan Hassan, International Journal of Energy Research, Vol 32, Issue 4

9. Parametric Study of Plain Fin and Tube Evaporator Using CO_2 as A Refrigerant by Ashish D. Kadam, Dr. Atul S. Padalkar, Avadhoot V. Wale, International Journal of Engineering Research and Development, e-ISSN: 2278-067X, p-ISSN: 2278-800X, Volume 3, Issue 2 (August 2012), PP. 59-69

10. Evaluation of a Refrigerant R410A as Substitute for R22 in Window Air-conditioner by S. S. Jadhav, K. V. Mali, 5th International Conference on Sustainable Energy and Environment (SEE 2014): Science, Technology and Innovation for ASEAN Green Growth 19-21 November 2014

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