JES
Journal of Engineering Sciences
Vol 11, Issue 4, APRIL /2020
ISSN NO:0377-9254

CFD APPORACH FOR DIFFERENT FLUIDS VARIANTS IN COMPACT HEAT EXCANGER AT DIFFERENT PARAMETRIC CONDITIONS

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Abstract:

Compact heat exchangers, because of their compactness, low weight and high effectiveness are widely used in aerospace and cryogenic applications. Here in this CFD approach is done for Compact heat exchanger with varying different fluids like MFC Coolant, Coolant ECSTAR, TFC anti-freeze. The approach is carried for with same parametric conditions for all the fluids to find the better fluid approach in getting temperature difference with CFD. The design is done in CATIA and the analysis is done in ANSYS.

Keywords: CATIA, ANSYS and CFD.

Introduction:

A heat exchanger is a device to transfer heat from a hot fluid to cold fluid across an impermeable wall. Fundamental of heat exchanger principle is heat flow from hot fluid to cold fluid. This heat flow is a direct function of the temperature difference between the two fluids, the area where heat is transferred, and the conductive/convective properties of the fluid and the flow state.

Compact heat exchangers Applications

Compact heat exchangers are very flexible in the various fields of possible applications. They are available with standard connections in various diameters and in different lengths. Compact heat exchangers can be designed in horizontal and vertical orientation and can be used for a wide variety of applications including, among other

- Compressed Gas / Water coolers
- Water / water coolers
- Oil / water coolers
- Preheaters, CiP-Preheaters
- Condensers and evaporators for chemical and technical processes of all kinds
- Machine coolers

- Oil coolers for hydraulic systems
- Oil and water coolers for power machines
- Refrigeration and air-conditioning units

METHODOLOGY:

CFD Approach:

The characteristics of low-Reynolds flow and high-Reynolds flow are compared with contour plots of velocity with vectors.

In the case of the case with inlet velocity of 0.3 m/s, the top velocity at the second tube is 0.88 m/s, nearly 3 times the inlet velocity. For the 6.2 m/s inlet flow case, the top velocity reaches 15 m/s, more than twice the inlet velocity.

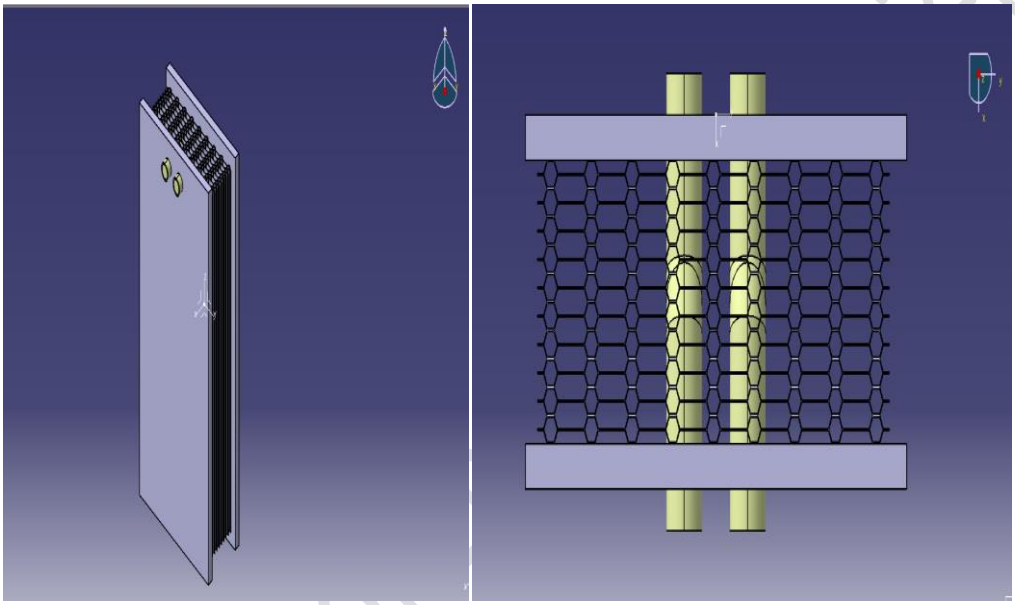
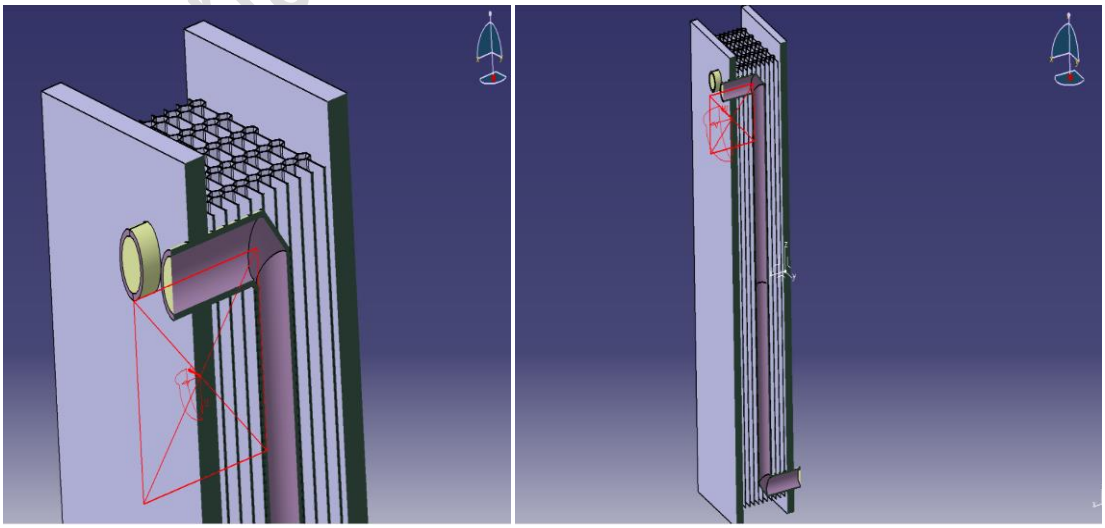


Figure 6.20 1) Geometrical View of compact heat exchanger 2) heat exchanger with concentrated fin structures



3) Sectional view of compact heat exchanger 4) complete view of compact heat exchanger

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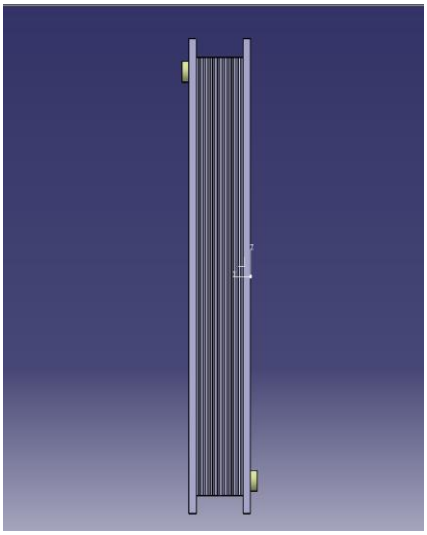
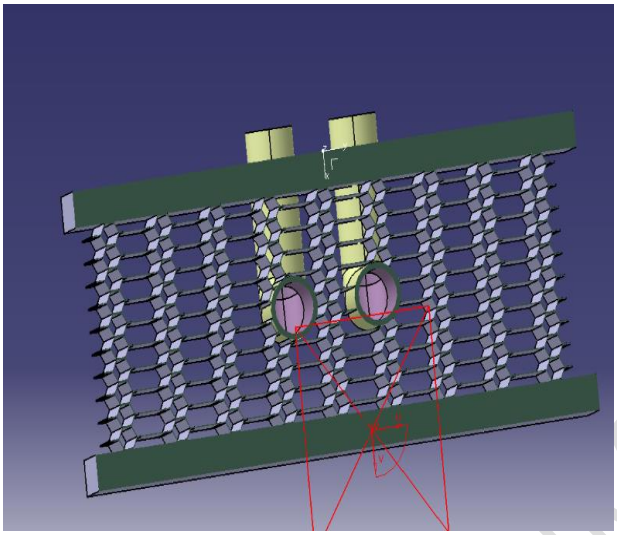


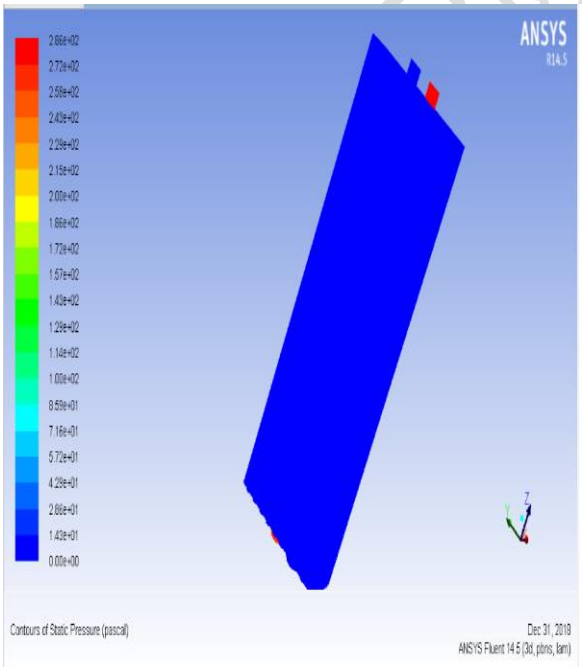


5) Flow distribution arrangement of fins 6) tube to fin arrangement for flow along section

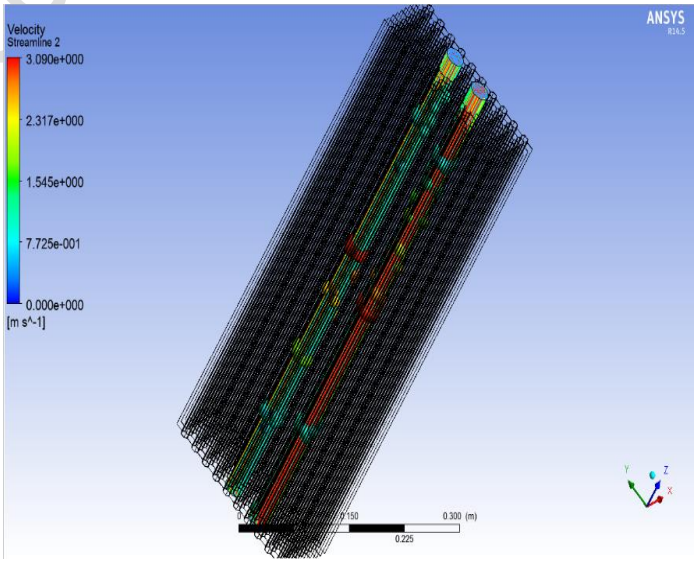
The design is done such that the flow enhancement parameters of the fluids are to be taken in particular ratios of the desired parameters. The concentrations of these fin structures along the tube are even so that during the maintained velocity and pressure will be constant all along the system to obtain regular flow with span of time intervals taken for each fluid concentrations.

Results:

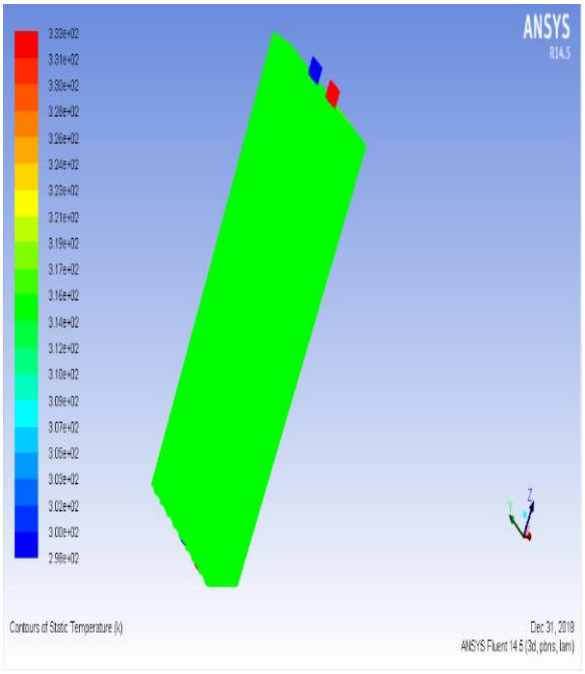
Analytical approach for water with MFC Coolant:



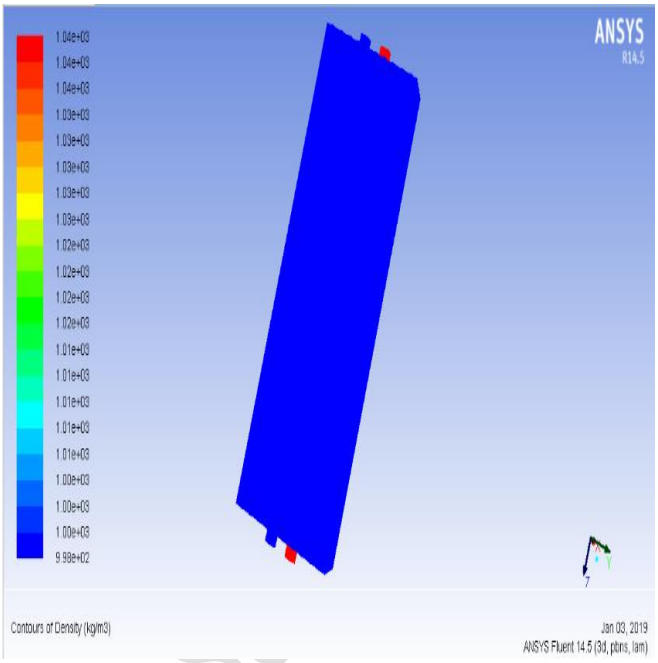
counters of static pressure at 60^0c



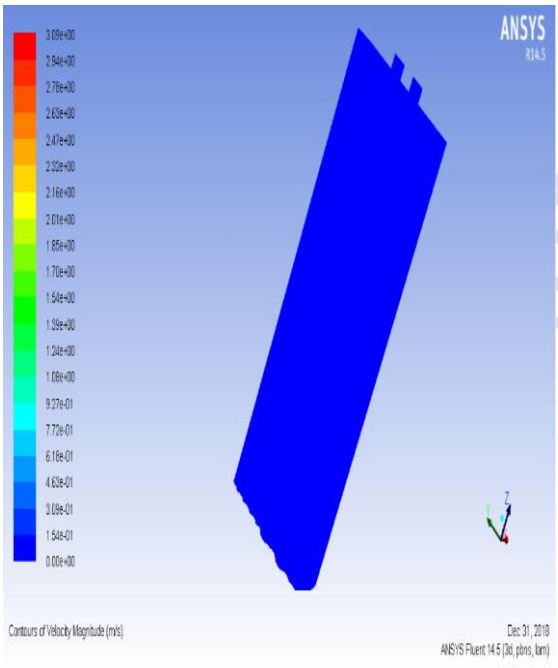
counters of velocity streamline at 60^0c



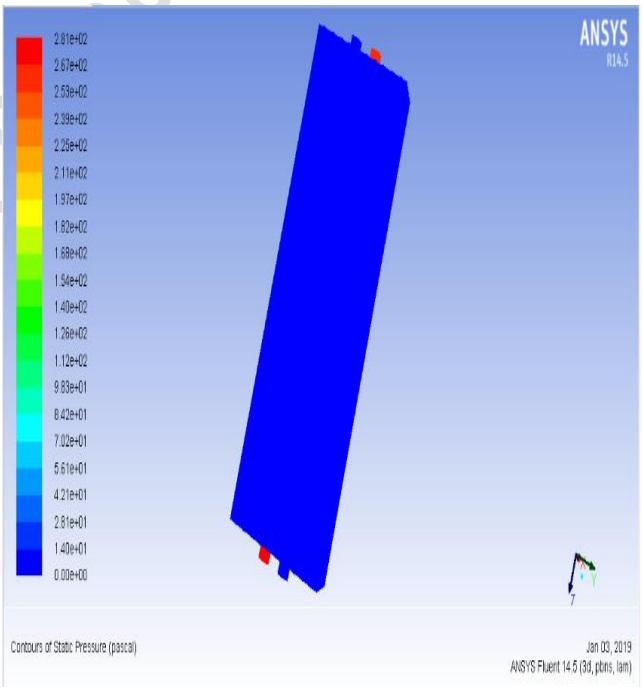
counters of static temperature at 60^0c



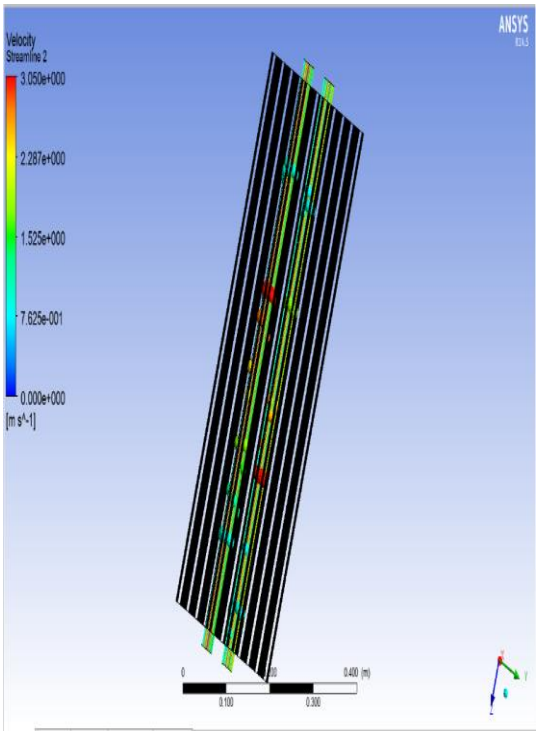
counters of density at 60^0c



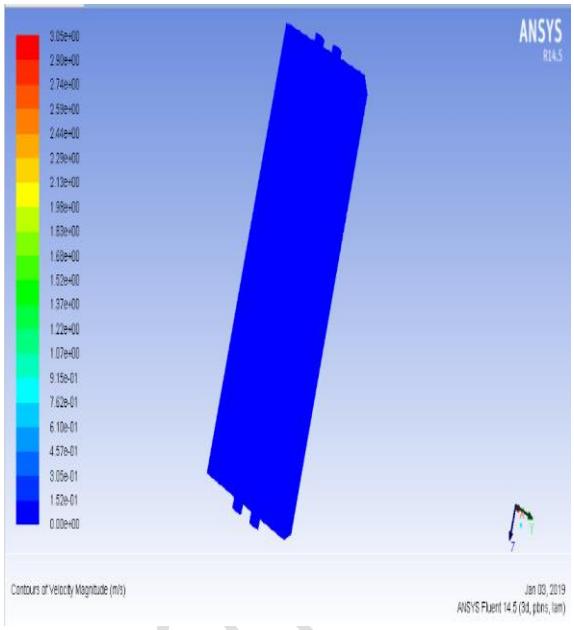
counters of velocity magnitude at 60^0c



counters of static pressure at 80^0c

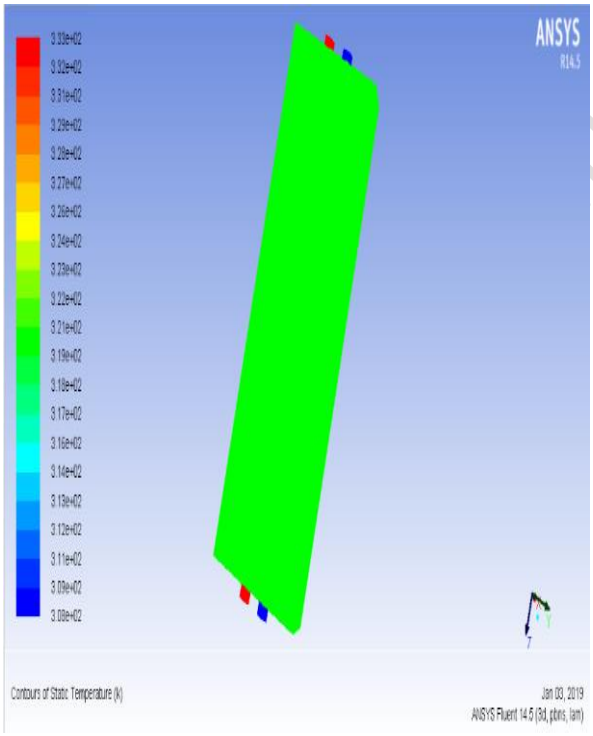


counters of velocity streamline at 80^{0}c

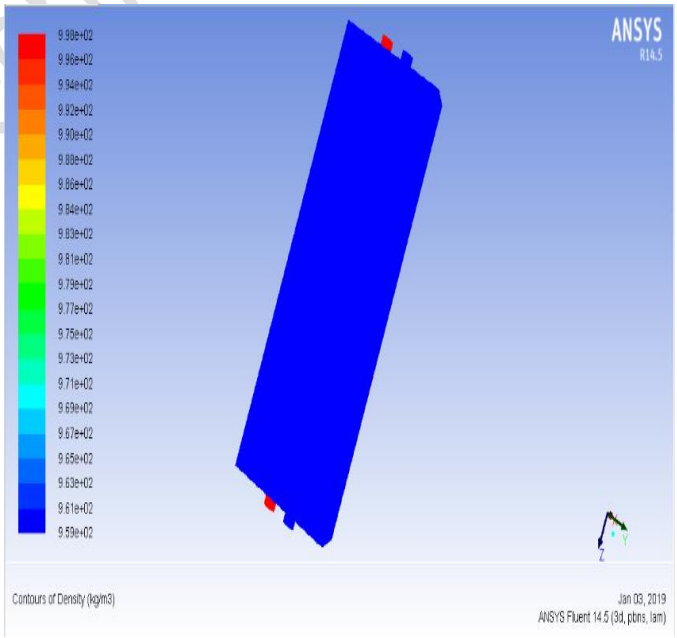


counters of velocity magnitude at 80^{0}c

Analytical approach for water with Coolant ECSTAR:



counters of static temperature at 80^{0}c



counters of density at 60^{0}c

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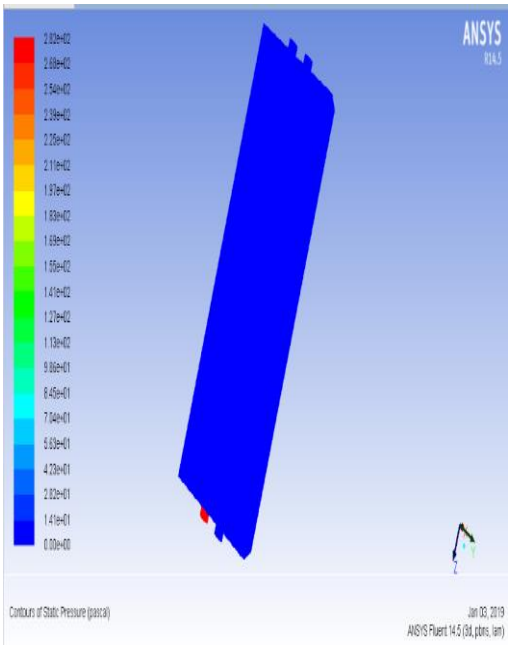
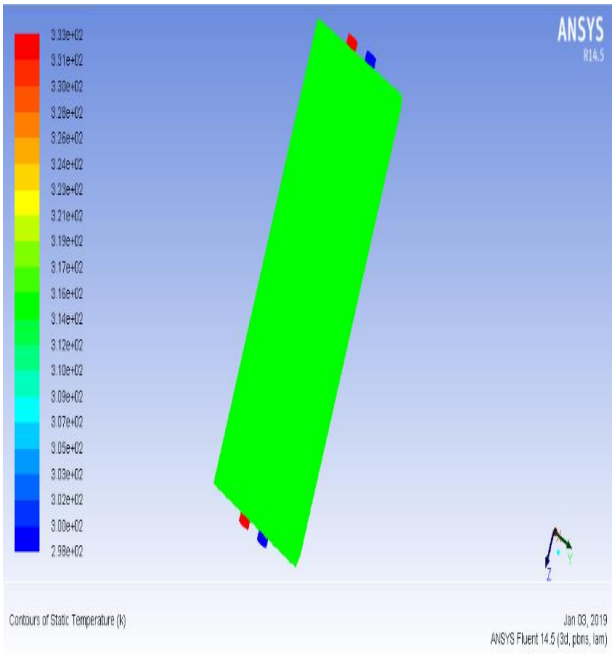
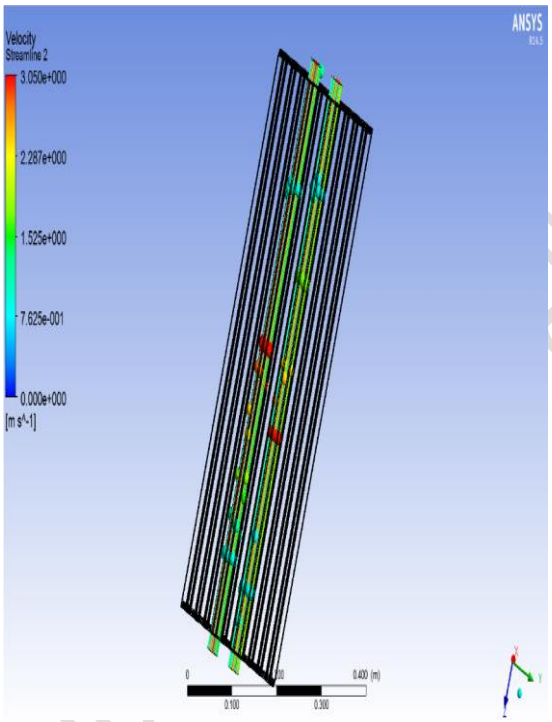


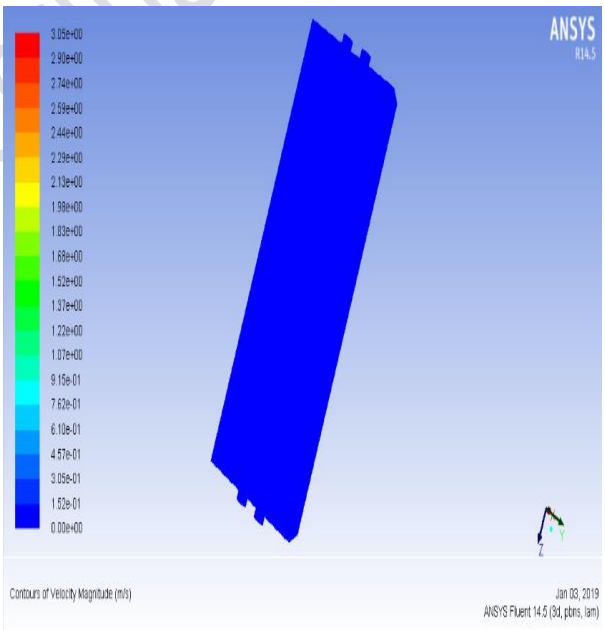
counters of static pressure at 60^0c



counters of static temperature line at 60^0c



counters of velocity stream line at 60^0c



counters of velocity magnitude line at 60^0c

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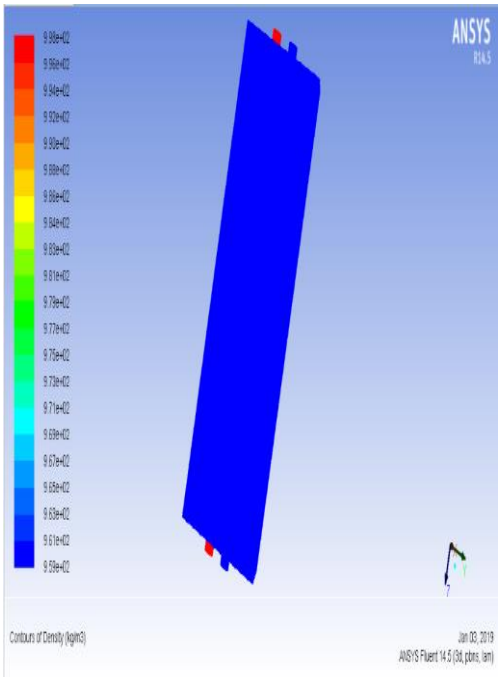
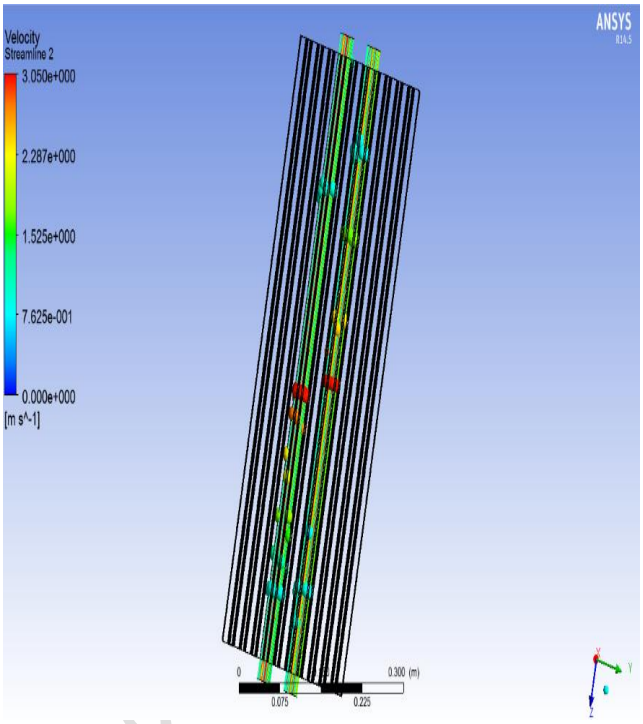
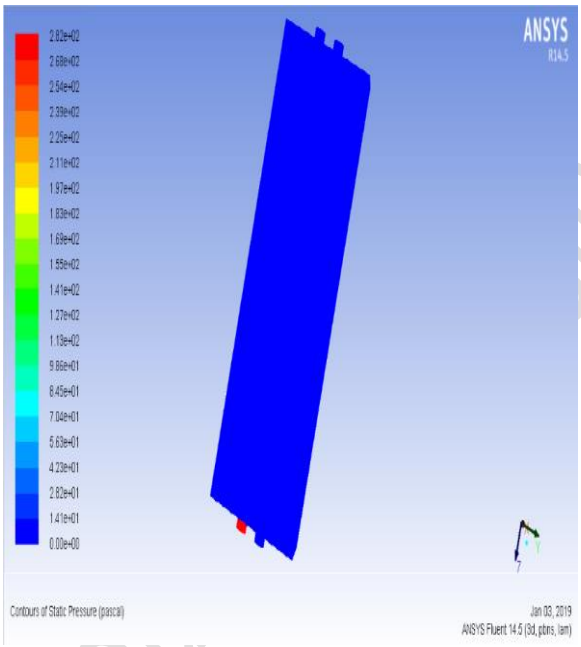


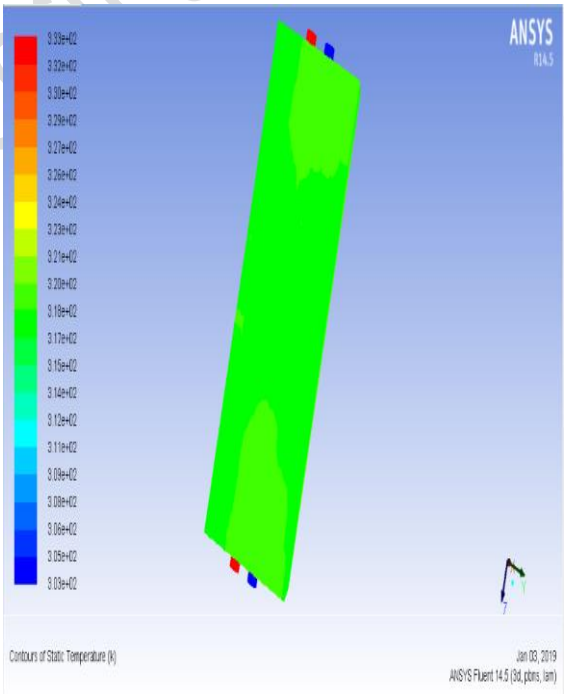
counters of density line at 80^0c



counters of velocity stream line at 80^0c



counters of static pressure at 80^0c



counters of static temperature line at 80^0c

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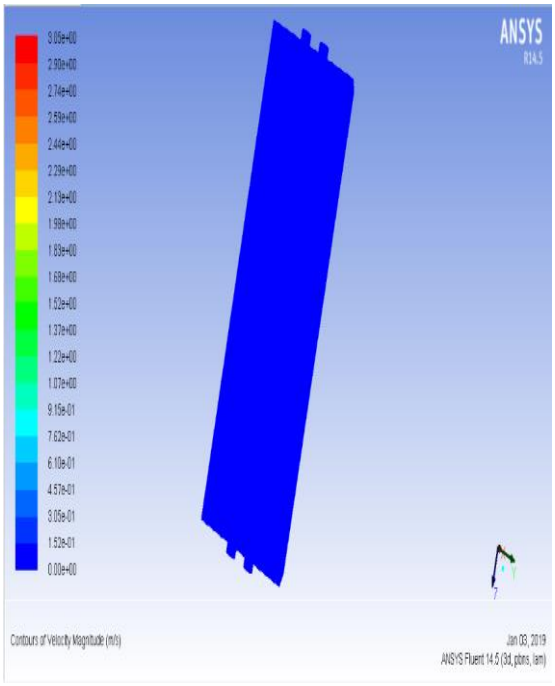
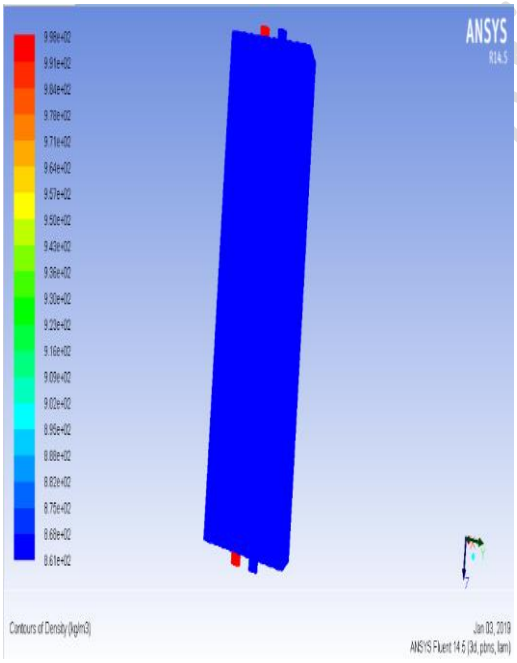
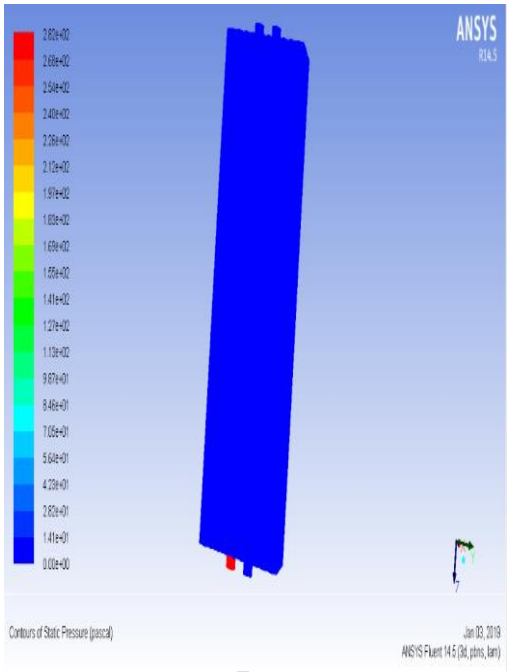


counters of velocity magnitude line at 80^0c

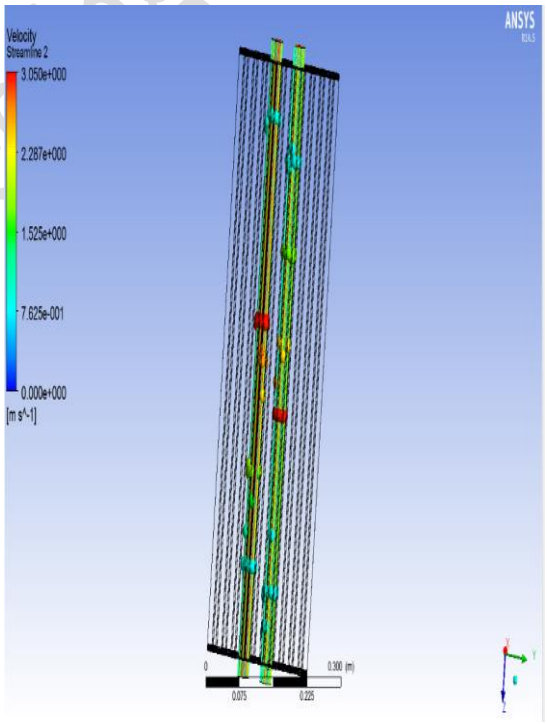
Analytical approach for water with TFC Anti-freeze coolant:



counters of density line at 60^0c



counters of static pressure at 60^0c



counters of velocity streamline at 60^0c

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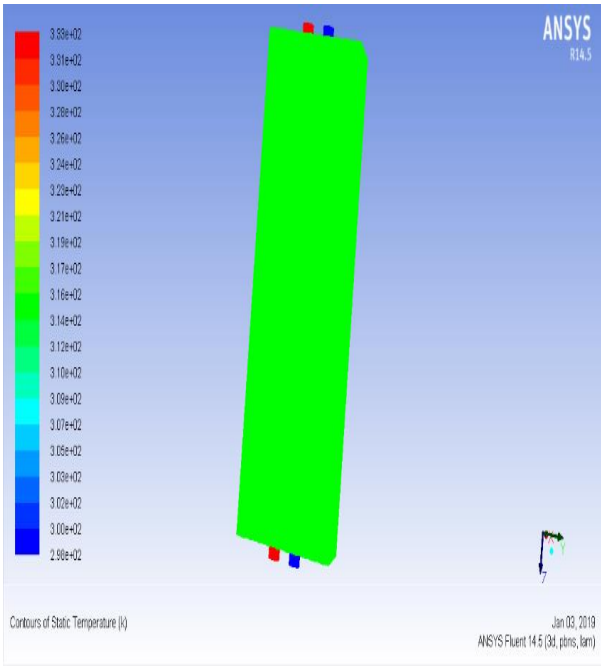
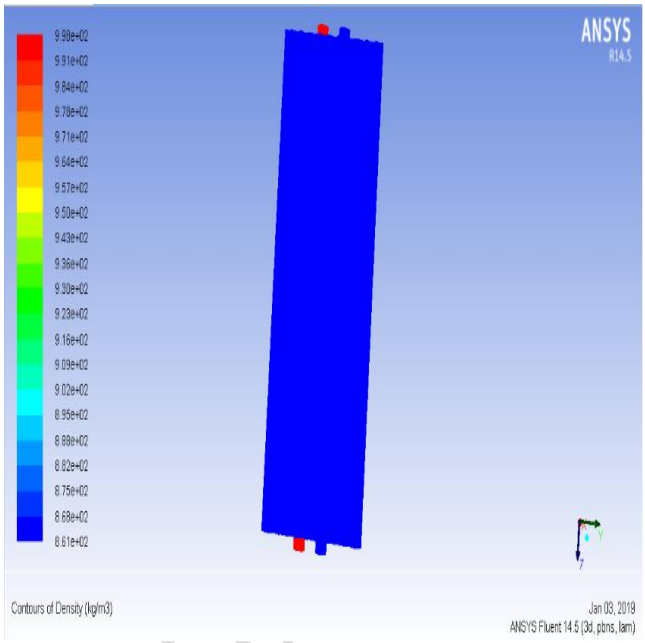
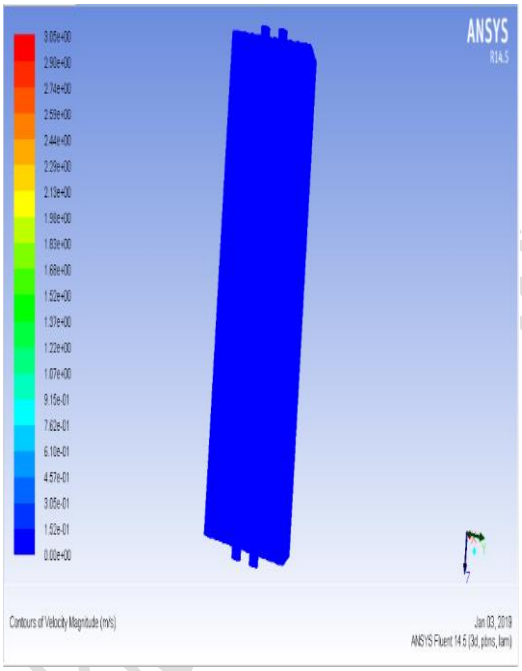


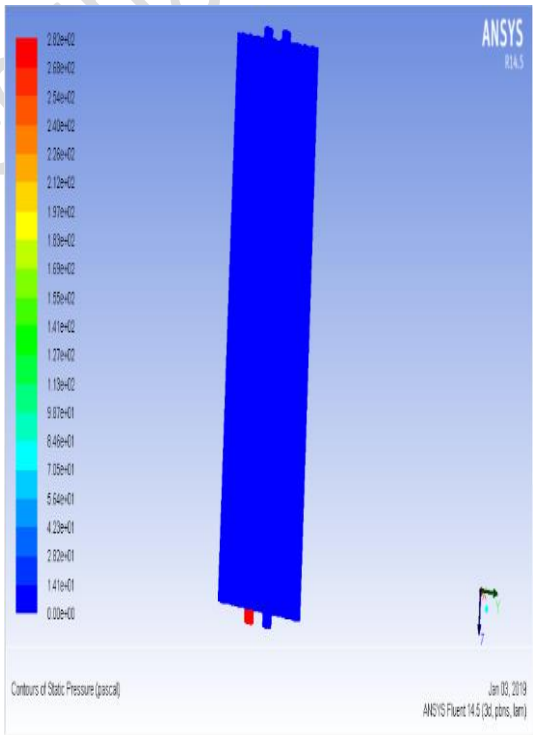
counters of static temperature at 60^0c



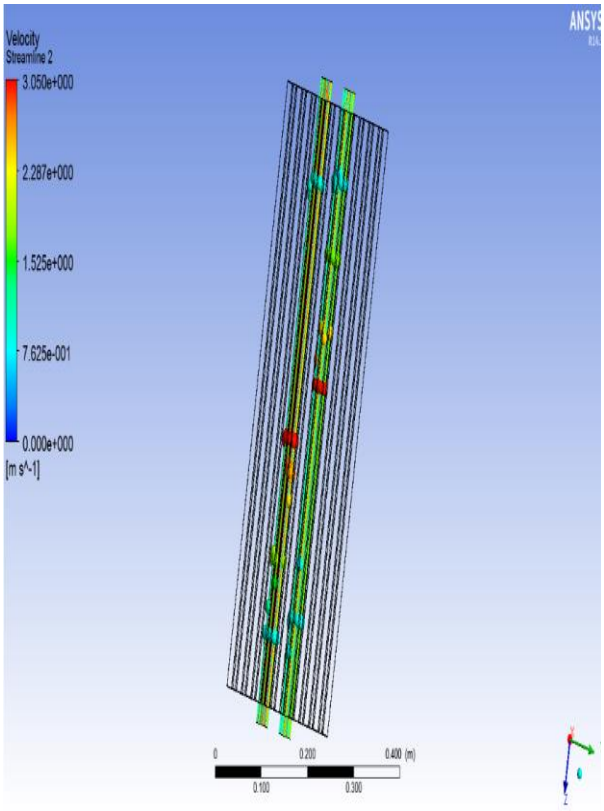
counters of density 80^0c



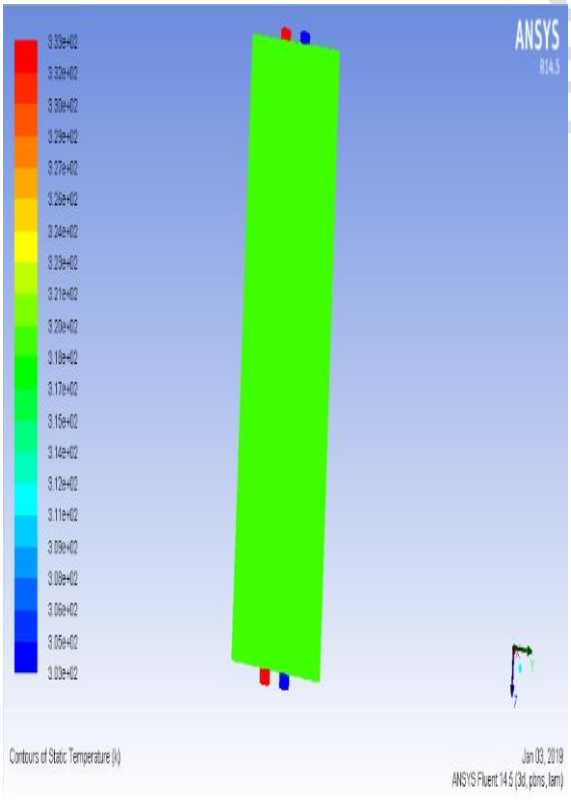
counters of velocity magnitude 60^0c



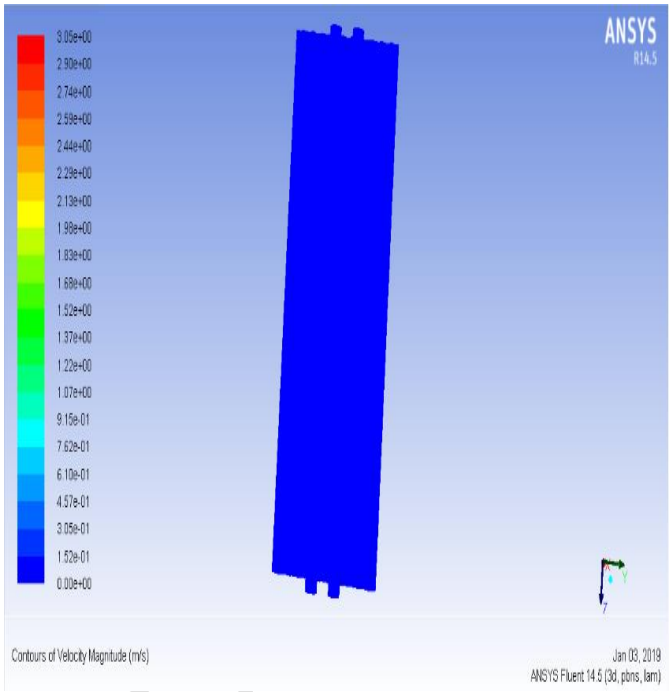
counters of static pressure 80^0c



counters of velocity stream line at 80^{0}c



counters of static temperature at 80^{0}c



Counters of velocity magnitude at 80^{0}c

Conclusions:

The use of the CFD model offers particular benefits especially when minor modification are applied to the fin surface for which the correlation equations are not defined, for instance fin thickness modification. Here in these cases of CFD approach it is found that the TFC anti-freeze is having higher heat transfer rate than the other two fluids by which we can say that the TFC would be the better one in choosing the flow conditions temperature setup run in the case of CFD approach too.

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