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DESIGN AND ANALYSIS OF AN OFF-SET FIN IN A RADIATOR

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Abstract -*Heat exchangers are used in various machineries to transfer heat from a hot body to a cold body. They are used in automobiles, solar powered equipment's and general equipment's where transfer of heat is mandatory for better efficiency of the machine. The efficiency of the radiator mainly depends on the flow rate of the cooling liquid, velocity of air & the surface area of fin. In this project the efficiency of the radiators are compared for the various surface of the fin by changing the geometry of the fin.*

Keywords- *Radiator, flow rate, surface of fin.*

I. INTRODUCTION

Radiators are heat exchangers used to transfer thermal energy from one medium to another for the purpose of cooling and heating. The majority of radiators are constructed to function in automobiles, buildings, and electronics. The radiator is always a source of heat to its environment, although this may be for either the purpose of heating this environment, or for cooling the fluid or coolant supplied to it, as for engine cooling. Despite the name, most radiators transfer the bulk of their heat via convection instead of thermal radiation. Spacecraft radiators necessarily must use radiation only to reject heat

1.1 Parts of a radiator

The main parts of the radiator to be considered for the analysis purpose are
1. Outer fins
2. Water tubes
3. Coolant inlet and outlet

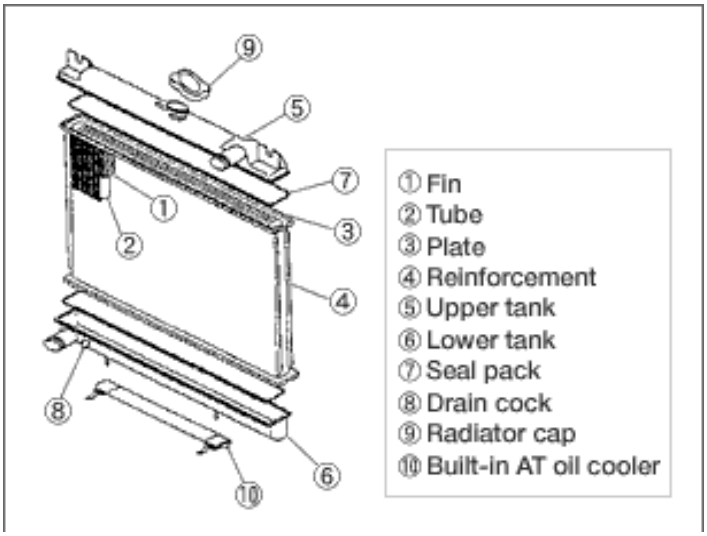

Fig 1. Parts of radiator

1.2 TYPES OF RADIATOR BASED ON MATERIALS USED

- Copper-brass
- Plastic
- Aluminum

1.3 Outerfins

In the study of heat transfer, 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.There are many type of outer fins used in the industry, the main types that are used are

- Plain fin
- Offset fin

II. DESIGN and ANALYSIS

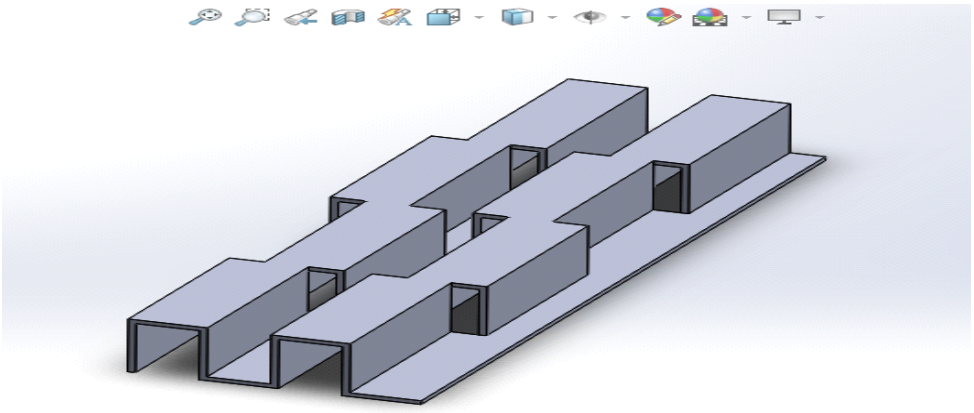

Fig .2 Offset outer fin isometric view.

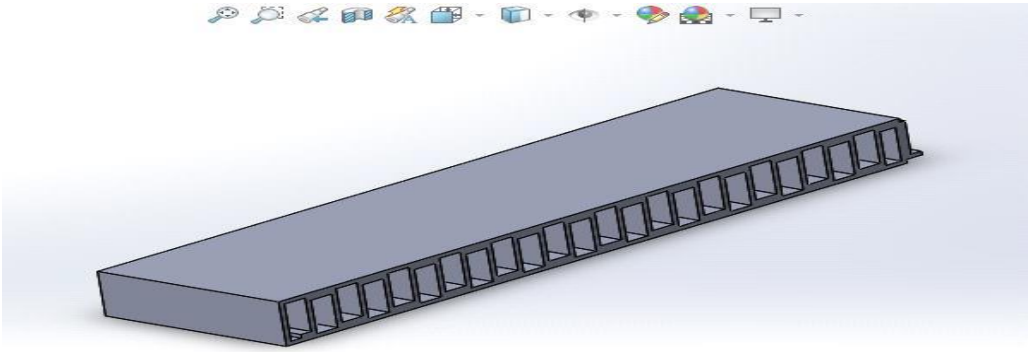

Fig.3 Water tubes isometric view.

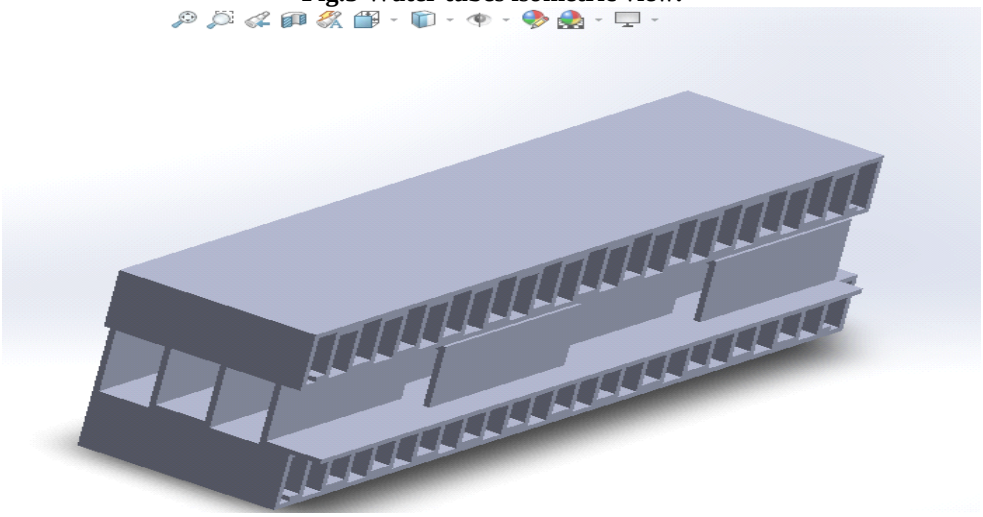

Fig. 4 Offset fin final assembly isometric view.

III. ANALYSIS

In this paper the efficiency of the radiators are analyzed for the various surface of the fin by changing the geometry of the fin by using ANSYS. ANSYS smart shape optimization tools give fast, specific insight into finding the ideal solutions for problems such as reducing pressure drop, optimizing drag, lift or heat transfer.

3.1 BOUNDRY CONDITION

a) AIR

- Inlet velocity - 10m/s
- Inlet temperature - 300k
- Outlet condition - constant pressure outlet

b) WATER

- Inlet mass flow rate - 0.008 kg/s
- Inlet temperature 423k
- Outlet condition - constant pressure outlet

c) MATERIAL

The material used for the outer-fin and tube is aluminium solid.

- Heat transfer coefficient of 100w/m^2k is used.

IV. THEORITICAL CALCULATIONS

AREA CALCULATION

$$A=(7*0.5)+(4.5*0.5)+(6.5*0.5)+(4.5*0.5)+(6.5*0.5)+(4.5*0.5)+(6.5*0.5)$$
$$+(4.5*0.5)+(6.5*0.5)+(2.25*0.5)+(6*0.5)+(2.25*0.5)+(6*0.5)$$

$$AREA(A)= 33.75mm^2$$

PERIMETER CALCULATION

$$P=7+5+6.5+4.5+6.5+4.5+6+2.5+0.5+2.5+6+4+6.5+5+6.55+4.5+6.5+6.5+0.5+6.5+$$
$$0.5+5+2.5+6.5+0.5+6+2.25+.25+6+0.5+6.5+2.5$$

$$PERIMETER(P)= 134.05mm$$

Taking the condition of the fin as short- fin and end insulated. So the heat transfer is

Q= (hPKA)0.5 (Tb-Ta) tanh(mL)
Where,
m= hP/KA
Taking the heat transfer coefficient _h' as 100W/m^2k
And thermal conductivity _K' as 202W/mk
We get the total heat transfer
Heat transfer _Q' = 2.4W

V. ANALYSIS RESULTS

The figure shows the FEA model of the analysis taken for consideration

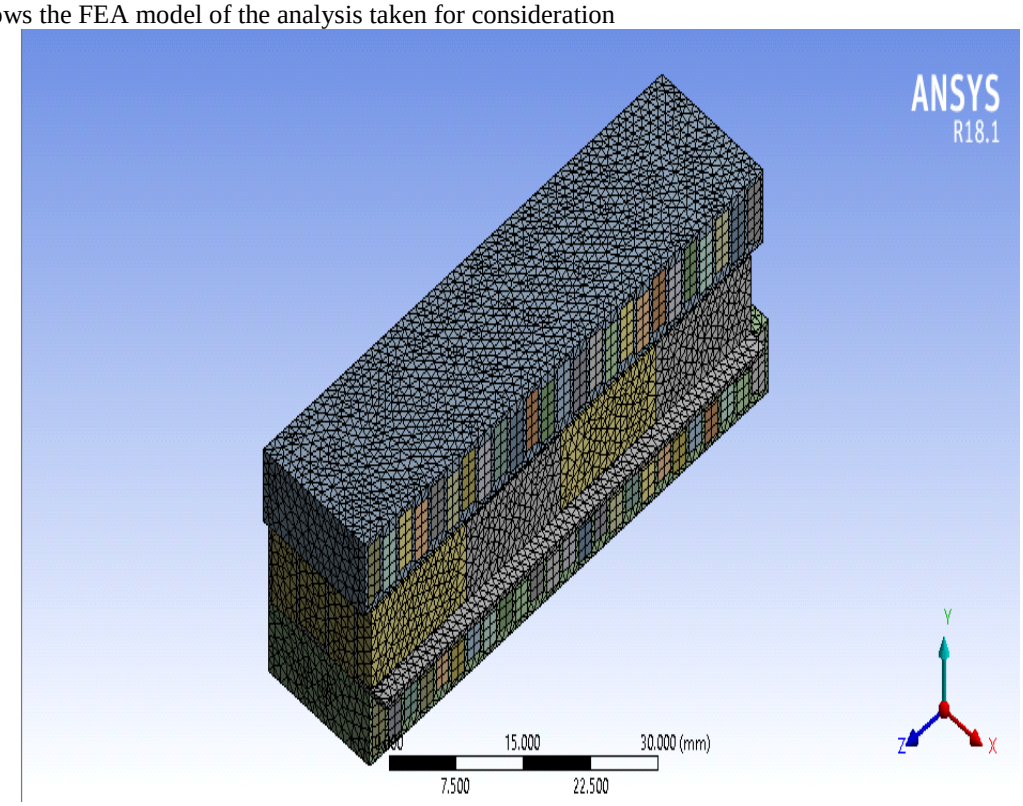

Fig.5 Mesh file of the off-set fin.

The figure shows the direction and temperature contour of water flow. It can be inferred that the temperature of the inlet water has been significantly reduced. Hence the simulation was successful.

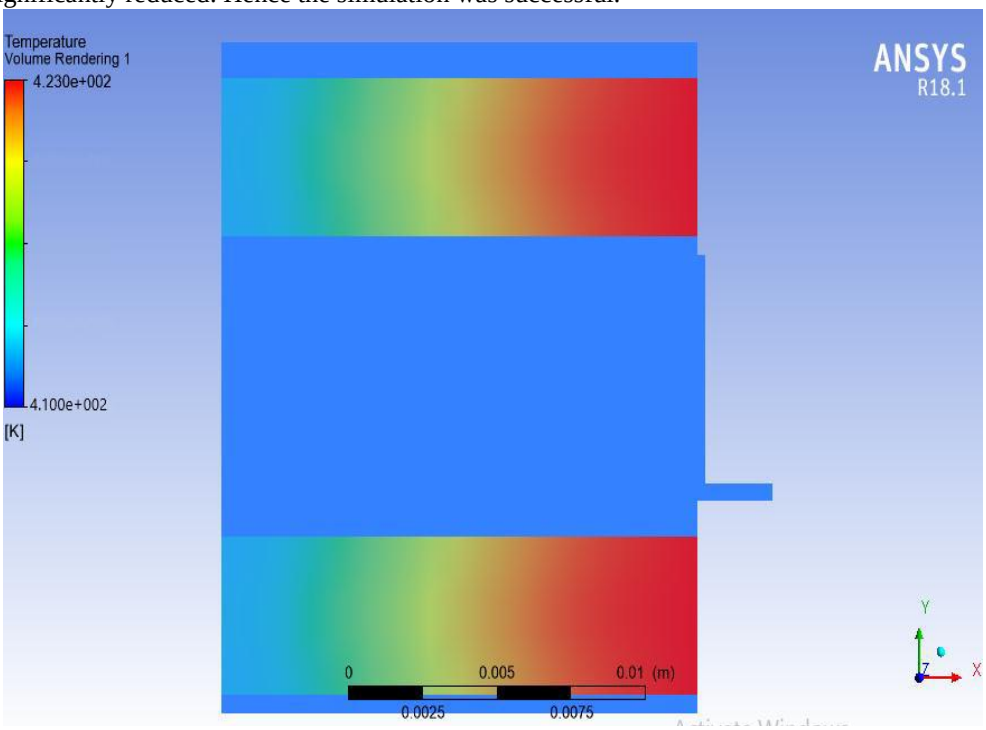

Fig.6. Temperature contour for water flow.

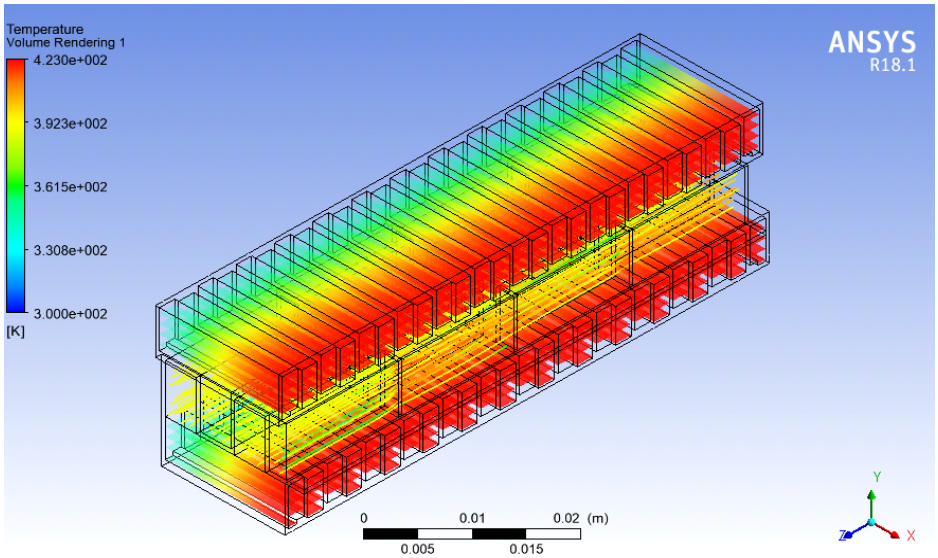

Fig.6 Isometric view of simulation

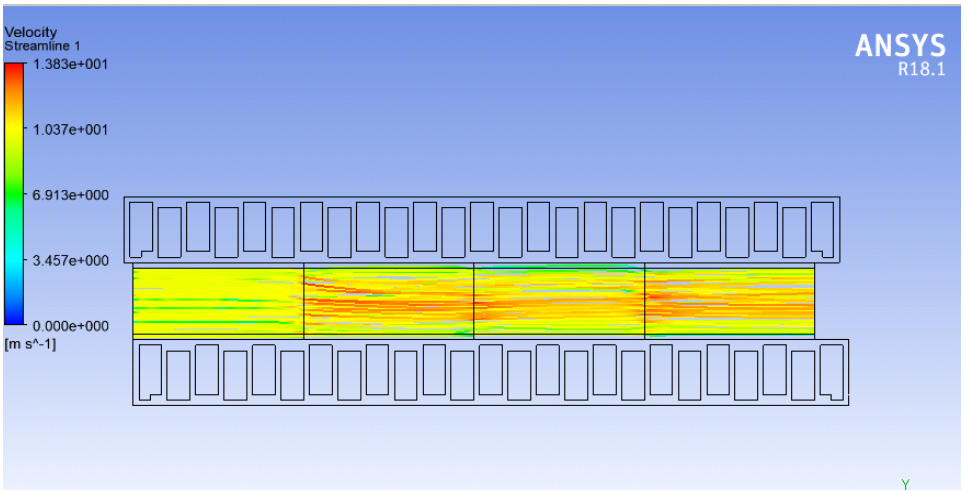

Fig 7.Velocity stream line of air along with the change in temperature.

VI. CONCLUSION

Hence from the project we can conclude that the part of the radiator is analyzed and reduced the temperature of water from the engine by the process of conduction and convection, at same time transferring the heat to the ambient air, and also increasing its velocity.

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