THERMAL ANALYSIS OF AUTOMOBILE RADIATOR USING CAE TOOLS

[1]MR. KULKARNI PANKAJ PADMAKAR &[2]MR.GOVIND KURUMBHATTE
[1]ME, Dept. of Mechanical,MatoshriPratishthan School of Engineering, khupsarwadiVishnupuriNanded
[2]Assistant Professor, Dept. of Mechanical,MatoshriPratishthan School of Engineering, khupsarwadiVishnupuriNanded.

Abstract

Radiators are used to transfer thermal energy from one medium to any other for the cause of cooling. Radiators are used for cooling internal combustion engines, especially in cars however also in piston-engine aircraft, railway locomotives, motorcycles, stationary generating plant. The radiator transfers the heat from the fluid inside to the air out of doors, thereby cooling the fluid, which in flip cools the engine. Research is being carried out for several many years now, in improving the performance of the heat exchangers, having excessive degree of floor compactness and higher warmth transfer talents in car industry. In this thesis, the compact warmth exchangers have fins, louvers and tubes. Present examine makes use of the analysis tool to carry out a numerical have a look at on a compact warmth exchanger at special mass glide costs. The domain is recognized from literature and validation of present numerical method is installed first. Later the numerical evaluation is extended by modifying chosen geometrical and float parameters like louver pitch, air go with the flow charge, water drift fee, fin and louver thickness, via varying one parameter at a time and the outcomes are in comparison. The fabric used for fins of radiator is Aluminum material. Modeling is completed in CATIA and analysis is accomplished in ANSYS. Recommendations must be made on the premiere values and settings will be based totally on the variables tested, for the selected compact warmth exchanger.

Keywords: -Nodal Temperature,Temperature Gradient, Thermal Flux, Heat Flow

1. INTRODUCTION

Radiators are warmness exchangers used to transfer thermal energy from one medium to any other for the motive of cooling and heating. The majority of radiators are constructed to characteristic in motors, homes, and electronics. The radiator is constantly a supply of heat to its environment, although this will be for both the reason of heating this surroundings, or for cooling the fluid or coolant supplied to it, as for engine cooling. Despite the name, radiators typically transfer the bulk in their heat via convection, now not with the aid of thermal radiation, though the time period "convector" is used greater narrowly; see radiation and convection, underneath. The radiator transfers the warmth from the fluid inner to the air outside, thereby cooling the fluid, which in turn cools the engine. A normal radiator utilized in car. Radiators are also often used to chill automated transmission fluids, air conditioner refrigerant, intake air, and from time to time to chill motor oil or power guidance fluid. Radiators are commonly mounted in a position where they get hold of airflow from the forward movement of the automobile, consisting of at the back of a the front grill. The experimental paintings diagnosed from the open literature to validate the prevailing computational method is so as to be mentioned in element in this bankruptcy. The authors examined air-aspect warmness switch and stress drop characteristics of go with the flow over louvered fins in compact heat exchangers experimentally. The take a look at samples consist of varieties of fin configurations. A series of exams had been carried out to take a look at the geometrical parameters of louver pitch, louver association (symmetrical and asymmetrical) and wide variety of louver regions. Their calculated results indicate that a symmetrical association of louvered fins offers a nine.Three% growth in warmness switch overall performance and a 18.2% lower in pressure drop than the asymmetrical association of louvered fin. Also, for a regular rate of heat transfer and pressure drop, a 17.6% lower of fin weight is found for the symmetrical arrangement of fins and this is following with the aid of good sized decrease in general weight and fee of the heat exchanger. The outcomes from this investigation indicate that the configuration of the louvered fins has the dominant have an effect on on the warmth transfer and stress drop and in Chapter 2 we're lead a discussion on running mechanism of the radiator, Chapter three we are lead a dialogue design results the usage of extraordinary gear like Computer Aided Three-dimensional Interactive Application, Chapter four we're lead a dialogue on analysis end result FE Analysis Using ANSYS.

2. WORKING MECHANISM

Almost all cars in the market today have a type of heat exchanger referred to as a radiator. The radiator is part of the cooling gadget of the engine as shown in Figure below. As you may see in the figure, the radiator is simply one of the many additives of the complicated cooling machine. Coolant direction and Components of an Automobile Engine Cooling System Most modern cars use aluminum radiators. These radiators are made with the aid of brazing thin aluminum fins to flattened aluminum tubes. The coolant flows from the inlet to the hole thru many tubes established in a parallel arrangement. The fins conduct the warmth from the tubes and switch it to the air flowing through the radiator. The tubes now and again have a sort of fin inserted into them known as a tabulator, which will increase the turbulence of the fluid flowing thru the tubes. If the fluid flowed very smoothly thru the tubes, most effective the fluid sincerely touching the tubes could be cooled immediately. The amount of heat transferred to the tubes from the fluid walking through them depends on the distinction in temperature among the tube and the fluid touching it. So if the fluid that is in contact with the tube cools down quickly, much less warmth can be transferred. By creating turbulence within the tube, all of the fluid mixes collectively, retaining the temperature of the fluid touching the tubes up so that more heat may be extracted, and all the fluid inside the tube is used efficiently. Radiators usually have a tank on every aspect, and within the tank is a transmission cooler. In the photograph above, you can see the inlet and outlet wherein the oil from the transmission enters the cooler. The transmission cooler is sort of a radiator within a radiator, except as opposed to replacing heat with the air, the oil exchanges warmth with the coolant inside the radiator. The louver arrangement in a fin used in an automobile radiator. Although lot of work has been executed so far in the computational evaluation for the compact warmth exchangers, validation of an experimentally examined area and conducting analysis of modified designs to optimize the design and improve performance on the identical area become now not suggested up to now. This forms the incentive of the present work. Thus, the goal of the existing work is to pick out an experimental paintings from literature, perform computational analysis for the area studied experimentally to validate the present numerical work. The 2d objective is to carry out geometrical and waft parameter look at at the area identified via various louver pitch, air flow fee, water float rate, fin and louver thickness, one parameter at a time. Comparison of those numerical outcomes will assist in figuring out the superior combination of geometrical and float parameters for the domain selected**.**

3. DESIGN RESULTS

The Automobile Radiator is designed inside the Catia V5 software by using both the component modeling and Assembly modeling. This modeling is being done by following steps:Part Modeling of Automobile RadiatorSketch: It offers the profile, like outer diameter and internal diameter through meant method of line, rectriangle command.

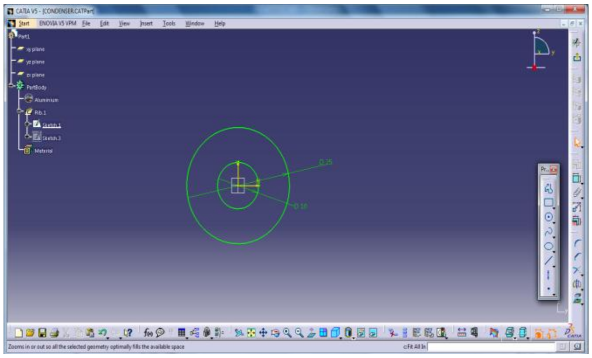

Fig:-1 Using Sketch Command for outer profile

Pad: It offers the desired thickness to the factor .After the cartoon, click at the near workbench icon after which the pad command seems, on clicking on it, the conversation box opens; the specified price can be entered.

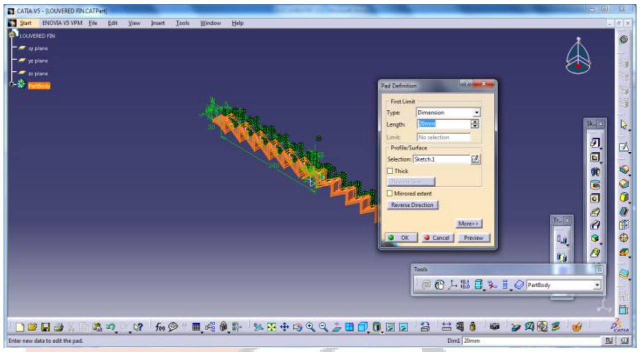

Fig:-2 Using Pad Command for thickness

Sketch: It offers the profile of the tools enamel, like a internal tooth or outer enamel gear by meant means of circle, arc, trim, reference line instructions.

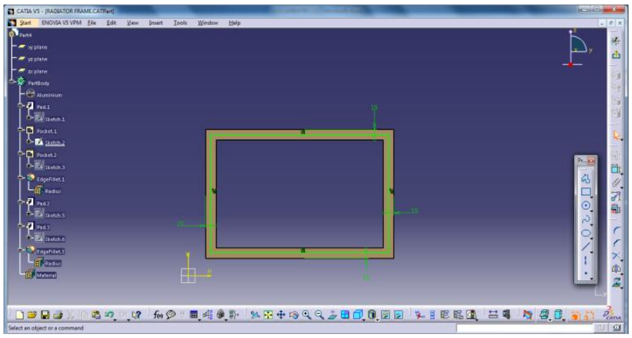

Fig:-3 Window for hook/ circles profile

Pocket: It gives the specified pocket / groove / hollow to the tools aspect .After the cartoon, click at the close workbench icon and then the pocket command seems, on clicking on it, the conversation container opens; the required value can be entered.

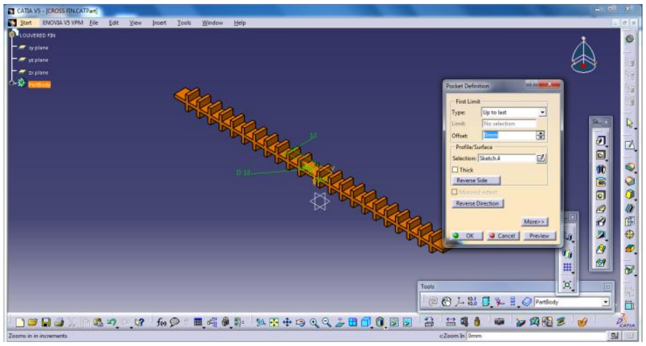

Fig:-4 Using Pocket Command for removing material/ thickness

Circular Pattern: This command is used to copy the profile shape on the total selected workbench. This is the command want to enter the variety of profiles are to be repeated on the workbench in the given conversation field.

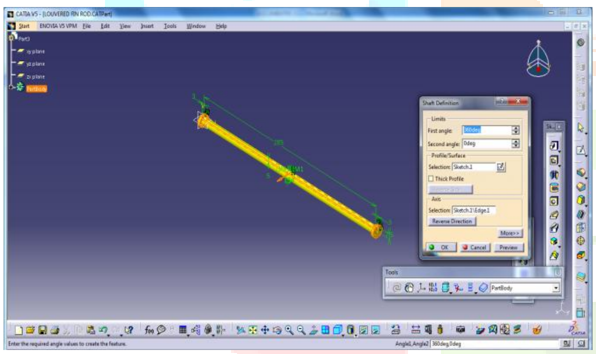

Fig:-5 Using Circular Pattern Command for gear tooth formation

Edge Fillet: This command is used to apply the smooth surface structure on the selected edges of the workbench.

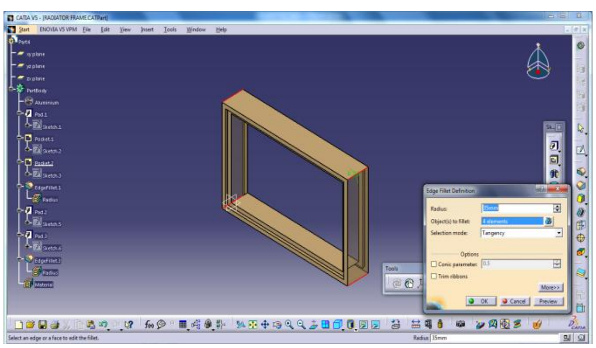

Fig:-6 Using edge fillet Command

Measure Length: Here we get all the values of the material by which the properties were applied; like length, height, width, etc.

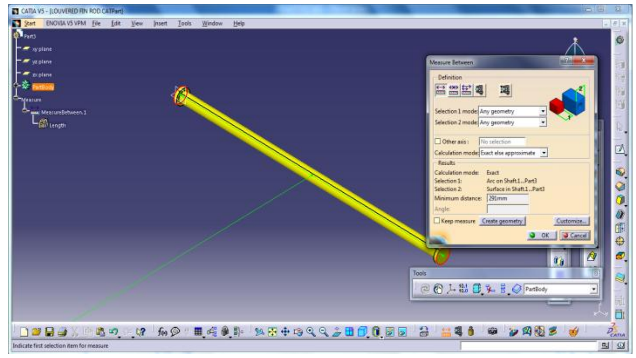

Fig:-7 Using Measure Length

Measure Radius: Here we get all the values of the material by which the properties were applied; like Circle, Dia, radius, curves, etc.

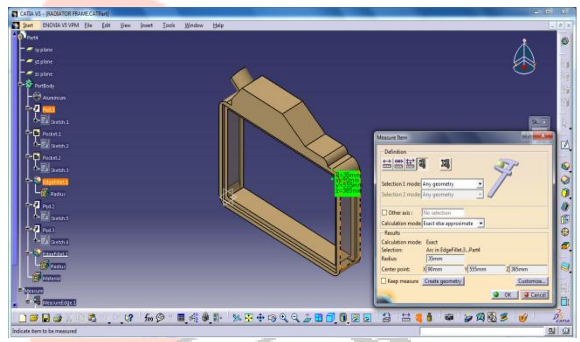

Fig:-8 Using Measure Radius

Applying Material properties: Selection of Component and type of material

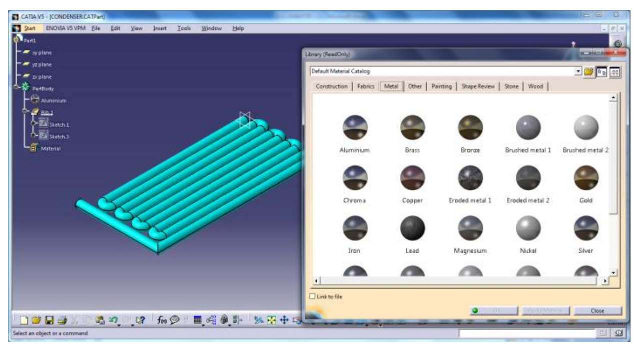

Fig:-9 Applying Material properties

Measure Inertia: Here we get all the values of the material by which the properties were applied; like Mass, Area, Moment of Inertia, Young's Modulus, etc.

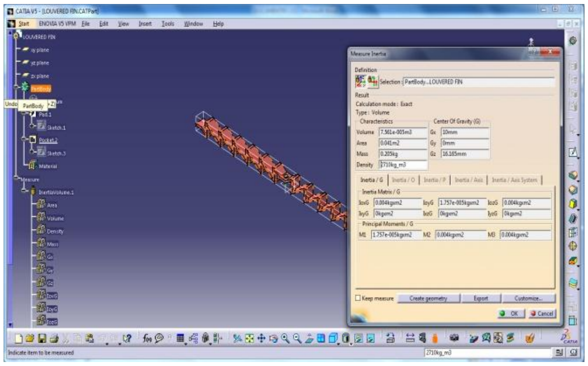

Fig:-10 Using Measure Inertia

Multi View: This is the command in which all the views of the component / model can be displayed on the screen at a same time, they can be edited under the workbench.

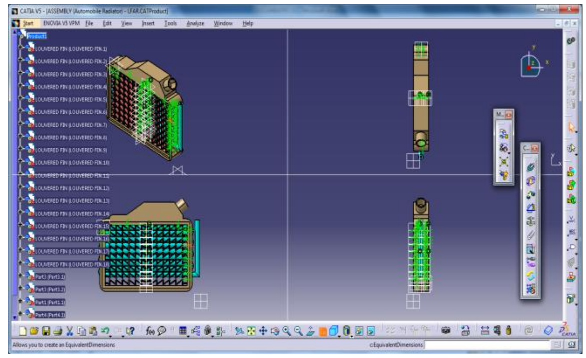

Fig:-11 Using Multi View Command

Bill of Material

S.No	Component Name	Material	Qty	Density (Kg/m^3)	Mass	Area (m^2)
01	Radiator Frame	Aluminum	01	2710	17.008	0.477
02	Louvered Fin	Aluminum	---	2710	0.205	0.041
03	Cross Fin	Aluminum	---	2710	0.248	0.046
04	Louvered Fin Rod	Aluminum	01	2710	0. 064	0.01
05	Condenser	Aluminum	01	2710	5.818	0.573

4. DISCUSSION ON ANALYSYS RESULT

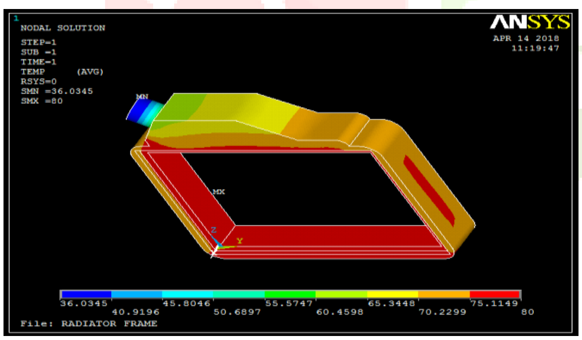

Fig:-12 Nodal Temperature of RADIATOR FRAME

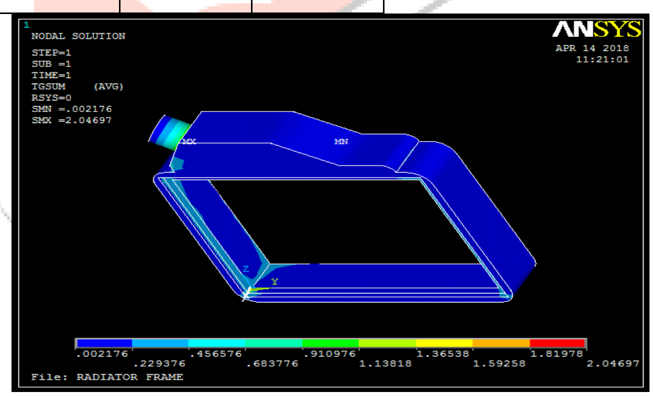

Fig:-14 Thermal Gradient of RADIATOR FRAME

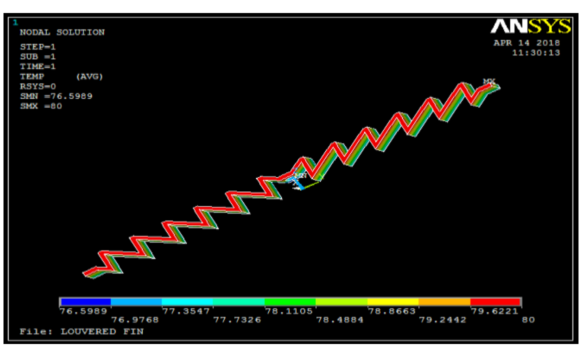

Fig:-13 Nodal Temperature of LOUVERED FIN

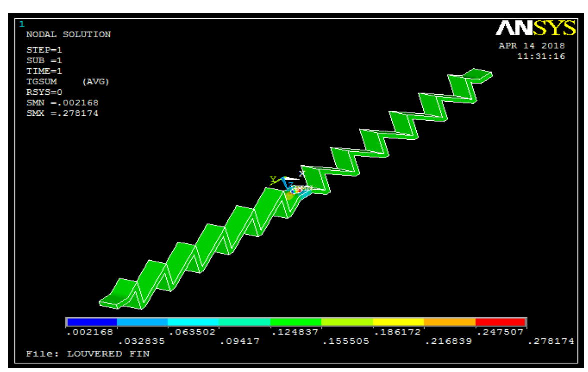

Fig:-15 Thermal Gradient of LOUVERED FIN

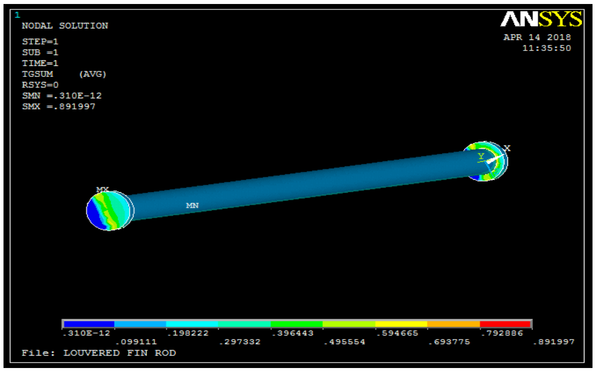

Fig:-16 Thermal Gradient of LOUVERED FIN ROD

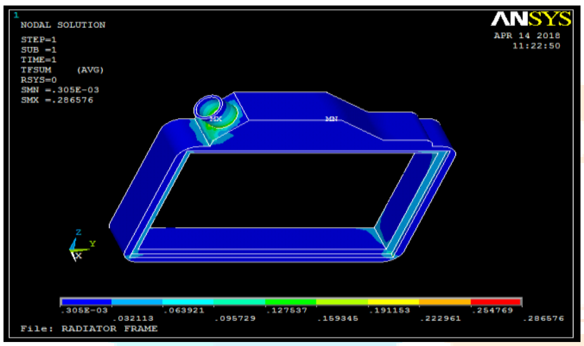

Fig:-17 Thermal Flux of RADIATOR FRAME

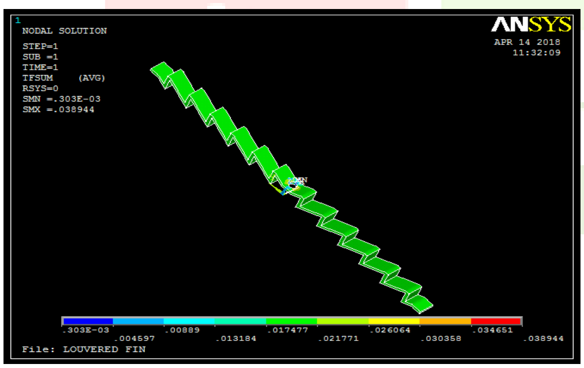

Fig:-18 Thermal Flux of LOUVERED FIN

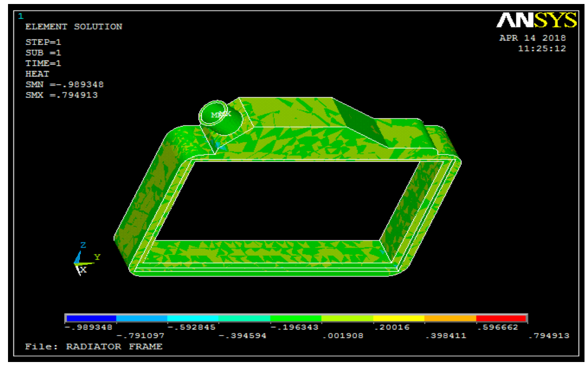

Fig:-19 Heat Flow of RADIATOR FRAME

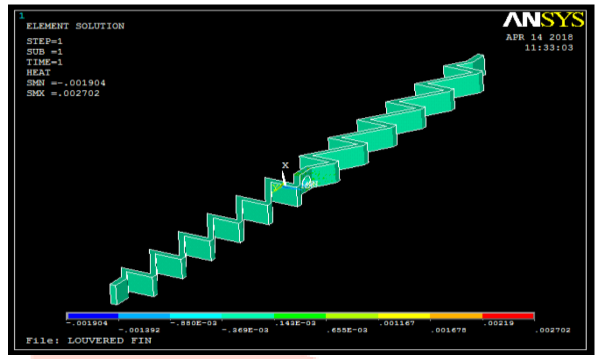

Fig:-20 Heat Flow of LOUVERED FIN

5. CONCLUSION

In this project a radiator is designed, it has been modified by specifying louver fins. 3D model is designed in Catia.

6. TABLE FOR RESULTS

S.No	Radiator Frame	Louvered Fin	Louvered Fin Rod
Nodal Temperature	36.03	76.59	76.52
Temperature Gradient	2.04	0.278	0.89
Thermal Flux	0.28	0.038	0.12
Heat Flow	0.79	0.002	0.02

The analysis device Ansys is used to perform thermal analysis on additives of radiator at distinctive areas. By gazing the analysis consequences, the nodal temperature is improved with the aid of 76.5; temperature gradient is multiplied through 0.278 for the changed version of the radiator with louvered fins.

7. COMPARISION RESULTS

S.No	Louvered Fin	Cross Fin
Nodal Temperature	76.59	77.83
Temperature Gradient	0.278	0.216
Thermal Flux	0.038	0.030
Heat Flow	0.002	0.006

Heat transfer evaluation is executed to analyze the heat switch price to decide the thermal flux. The material taken is Aluminum alloy 6061 for thermal analysis. By gazing the thermal analysis consequences, and thermal flux charge is zero.0389; the Heat flow charge is zero.0027 at the floor medium for the modified version of radiator.

8. FUTURE SCOPE

So it can be concluded that enhancing the radiator version with louver fins yields higher effects. It may be summarized that with the aid of offering louvers for the radiator and growing the louver pitch helped in lowering the pumping electricity necessities with boom in warmness transfer fee. This will help in increasing the energy output according to unit mass of the radiator. Hence it's miles advocated to growth the louver spacing for the geometry under attention. Scope for Future, in the gift Analysis, constant temperature boundary conditions are taken into consideration along the partitions. The version provides an idealized scenario. A greater correct model can be to bear in mind the finite thickness of the plates of the louvered fin exchanger and the interrupted louvered fin and clear up the conjugate warmth transfer problem. The answer of the conjugate warmness transfer hassle can be anticipated to yield predictions which are extra actual. The computations can similarly be executed evaluating one-of-a-kind styles of fin shapes. The gift work may be in addition prolonged for special geometries of the inserts like fins getting used between the radiator frames of the compact warmness exchanger. The evaluation may be carried out assuming the flow regime to be turbulence model and force convection. And adjustments of geometry make in simplest rectangular fin can be similar kind of geometry can trade in specific geometry form.

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