RESEARCH ARTICLE OPEN ACCESS

Air cooling effect of fins on a Honda shine bike

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ABSTRACT
The main of aim of this work is to study various researches done in past to improve heat transfer rate of cooling fins by changing cylinder block fin geometry. Low rate of heat transfer through cooling fins is the main problem in this type of cooling. So efficiency of the engine is increase by increase the heat transfer. Examples of direct air cooling in modern automobiles are rare. The most common example is the commercials Automobile bike like a Honda Shine, Bajaj bike, Honda splendor etc.
It is conclude about shape try to this fins is more effectively heat transfer in Honda shine bike compare to existing fins. After FEA Analysis it checking on fin whether efficiency of heat transfer increases or not. This work validation with Experimental and Mathematical.
Keywords *- Fins, Heat transfer rate, Air contact area, FEA, PRO-ENGINEERING, ANSYS*

I. INTRODUCTION

Air-cooling and Water cooling are the main type of the 4S-SI engine cooling system. Water cooling system efficiency is more than air cooling system, but due to some advantages like reduced weight, lesser space requirement and cheaper over water cooling system, most of the Indian Motor-cycles are air-

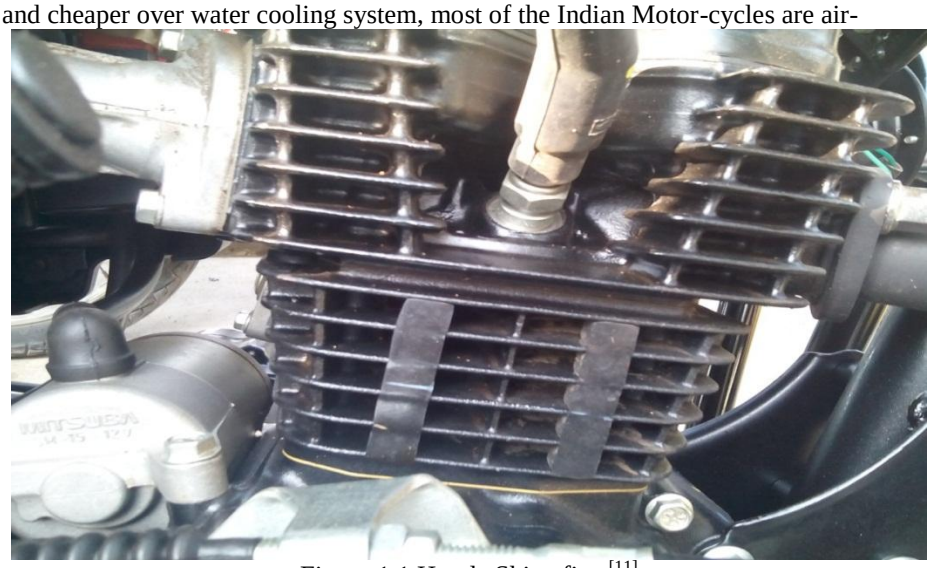

Figure:1.1 Honda Shine fins [11]

cooled. In the case of the engine head, such knowledge is temperature and the distribution of heat these parameters by fins. This element experiences high forces due to combustion chamber pressure and thermal load, which come from combustion process, and from the huge temperature gradient between intake and exhaust gas flows.

Engine heat transfers phenomena have been extensively analyzed for many geometry of fins. Numerous mathematical, experimental and ANSYS(software) are used for analysis to heat transfer have been analysis, which are widely accepted.

1.1 OBJECTIVES OF THE WORK

- In this present work FEA analysis of Honda Shine bike fins and it valid with experimentally result.
- After that FEA analysis and mathematically evaluation of modified existing fins dimensions
- To find optimum design of fin with help of trail & error method for increase the contact area to effective heat transfer rate.

II. DIMENSIONS AND PROPERTIES OF EXISTING FIN

- Element type- solid87
- Analysis Type- Thermal
- Material =Aluminum alloy (Cu 4%,si 9% , Mn 2%, Mg 0.09%)
- Thermal Conductivity= 190 watt/m ºC
- Density= 2770Kg/m^3
- Specific Heat= 900J/Kg K
- Length of fin=73mm
- One side height =19.2mm
- Second side height=8.3mm
- Thickness of fin=2.5mm

2.1 FEA ANALYSIS USING ANSYS WORKBENCH SOFTWARE

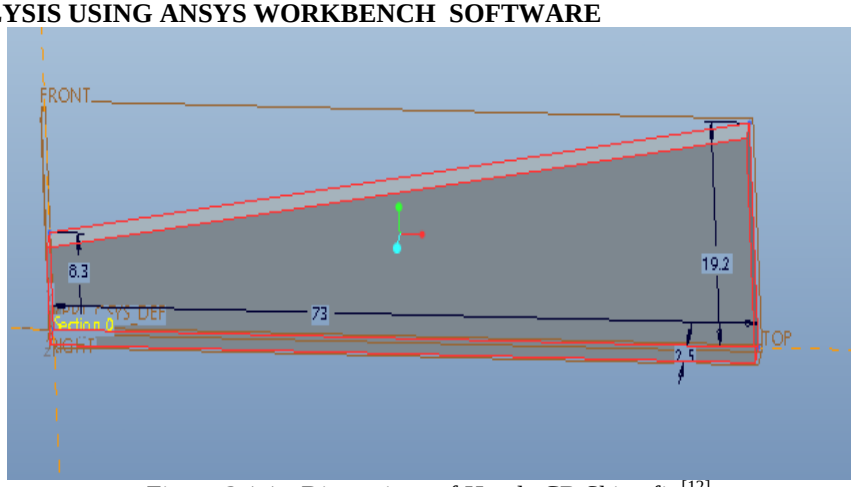

Figure-2.1.1:- Dimensions of Honda CB Shine fin[12]

By using messing tool the fin is dived in the 13127 node. Model of messing is shown in figure for more than 10000 elements it takes more time and for fewer elements the accuracy could now good so I divide in 2448 element for better result.

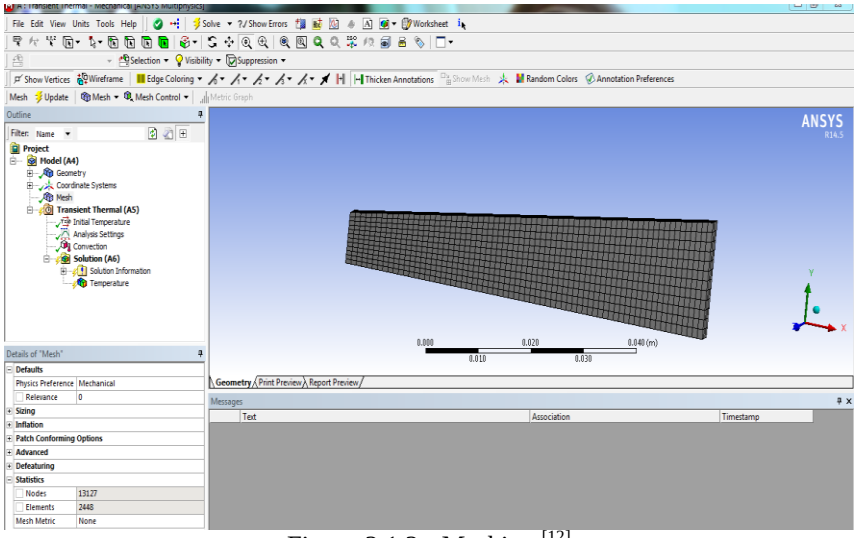

Figure-2.1.2:- Meshing [12]

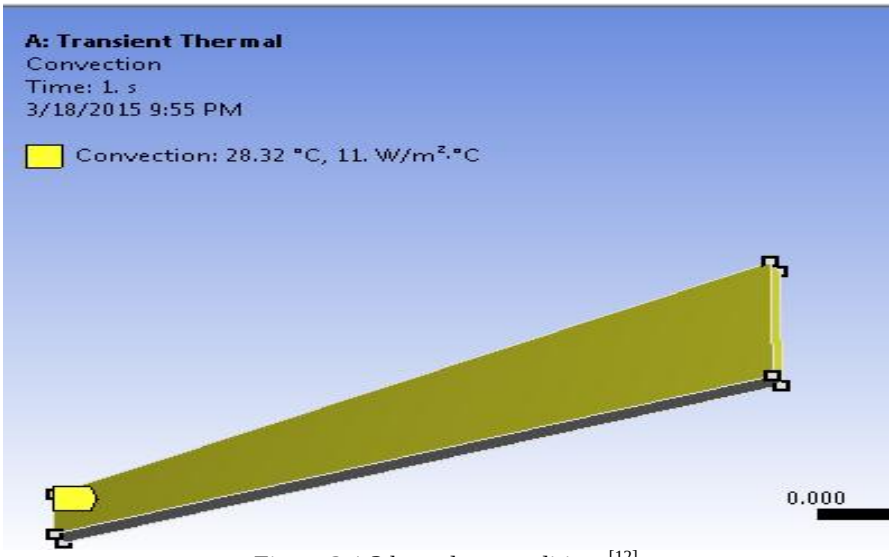

Figure 2.1.3 boundary conditions[12]

In figure Conduction and convection will occurred in fins during heat transfer. Heat transfer process starts when engine stops. 5 sides of fins are in contact of air and one side is contact of cylinder. So in 5 sides there will heat convection will done and in bottom side heat conduction process done.
Shown in figure Fin come to ambient temperature after 1500 sec.

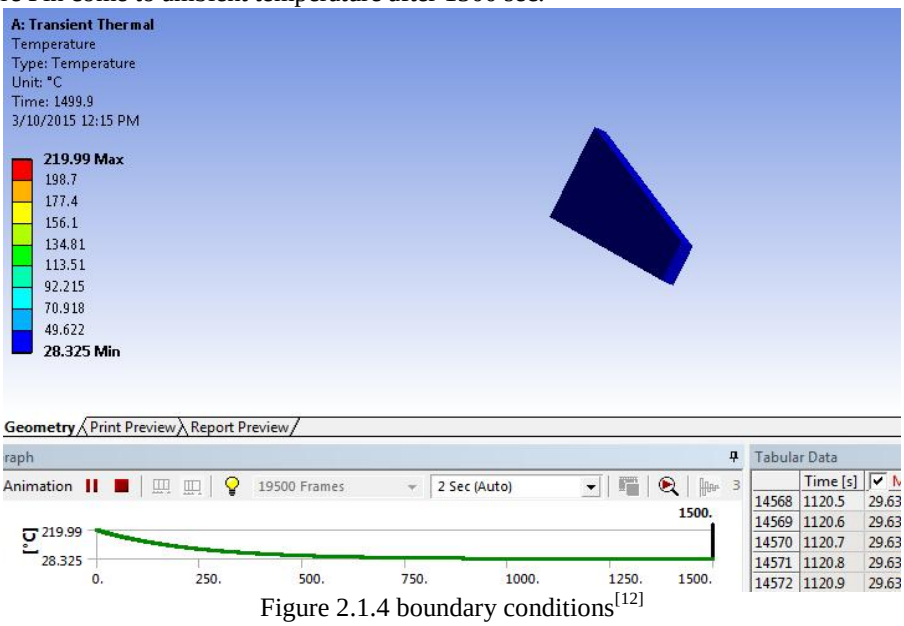

Figure 2.1.4 boundary conditions[12]

2.2 FEA RESULT

Table 2.1 results of FEA analysis of existing fin[12]

Time (after stop engine)	FEA result readings
Initial temp.	220°C
5 sec	216.731 ºC
50 sec	182.99 ºC
100 sec	153.3 ºC
200 sec	109.89 ºC
300 sec	81.51 ºC
400sec	62.975 ºC
700 sec	37.764 ºC
1120 sec	29.743 ºC
1500 sec	28.325 ºC

2.3 EXPERIMENTAL WORK

Measure temperature by K type thermo-couple

Figure-2.3.1:-Measure temp of Honda CB shine[11]

2.4 EXPERIMENTAL RESULT

Table 2.2 Experimental reading CB Honda shine[11]

Time (after stop engine)	Temperature
Initial temp.	220°C
5 sec	218°C
50 sec	183°C
100 sec	155°C
200 sec	110°C
300 sec	84°C
400sec	64°C
700 sec	39°C
1120 sec	32°C
1500 sec	28.36°C

2.4.1 Experiment of Ergo-Tec Honda shine bike

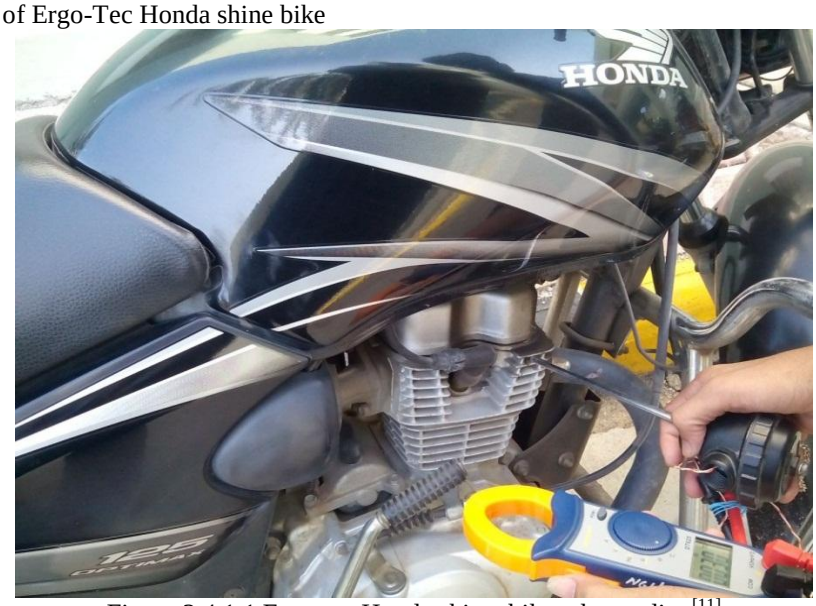

Figure 2.4.1.1 Ergo-tec Honda shine bike take reading[11]

2.5 COMPARISONS OF RESULT

2.5.1 FEA AND EXPERIMENTAL RESULT HONDA CB SHINE

Table 2.3 Comparison Honda CB SHINE and FEA reading[11]

Time(after stop engine)	FEA(ANSYS)result readings	Experimental Honda CB Shine model
Initial temp.	220°C	220°C
5 sec	216.731 ºC	218°C
50 sec	182.99 ºC	183°C
100 sec	153.3 ºC	155°C
200 sec	109.89 ºC	110°C
300 sec	81.51 ºC	84°C
400sec	62.975 ºC	64°C
700 sec	37.764 ºC	39°C
1120 sec	29.743 ºC	32°C
1500 sec	28.325 ºC	28.36°C

Show in table experiment result and software result approximate nearly so software validate with experimentally

2.5.2 EXPERIMENT RESULT OF TWO HONDA SHINE MODEL

Table 2.4 Comparison Honda CB SHINE and Honda Ergo-Tec model experimental reading[12]

Time(after stop engine)	CB shine model	Ergo-tec shine model
Initial temp.	220°C	220°C
5 sec	218°C	218°C
50 sec	183°C	185°C
100 sec	155°C	157°C
200 sec	110°C	114°C
300 sec	84°C	85°C
400sec	64°C	66°C
700 sec	39°C	40°C
1120 sec	32°C	32°C
1500 sec	28.36°C	30°C
1600 sec		28.35°C

III. FEA OF MODIFIED FIN

I have done FEA analysis of different modified fin dimensions without change the volume of the existing fins using ANSYS software

3.1 FEA ANALYSIS OF ONE MODIFIED FINS

MODEL CREATED USIND PRO-E SOFTWARE

After measuring the dimensions of fin.I have generate the model of that fin in FEA software, length of fin as 72 mm and height is one side 9 mm and another side is 26 mm. the thickness of fin is 2mm.

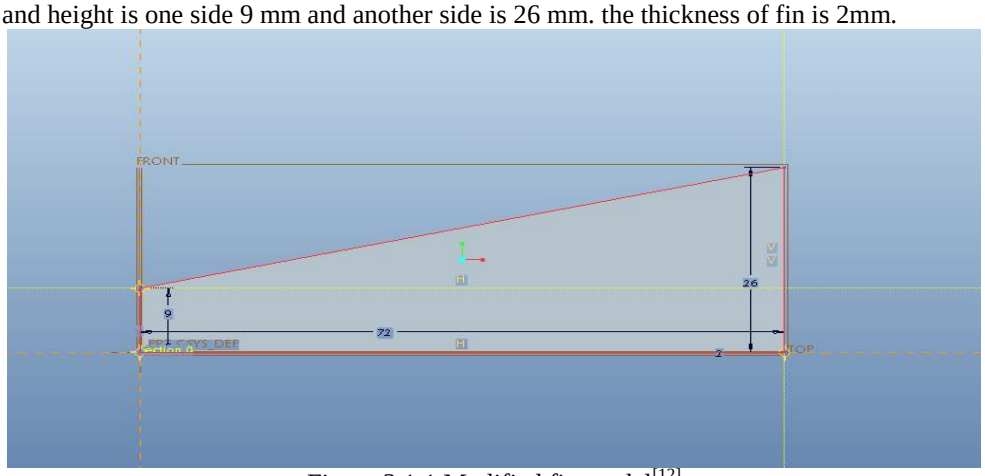

Figure 3.1.1 Modified fin model[12]

Maximum temperature 220 ºC it will be decrease at bulk temperature 28.32 ºC in approximate 25 min By using messing tool the fin is dived in the 13127 node. Model of messing is shown in figure 3.4.2.1 for more than 10000 elements it takes more time and for fewer elements the accuracy could now good so I divide in 2448 element for better result.

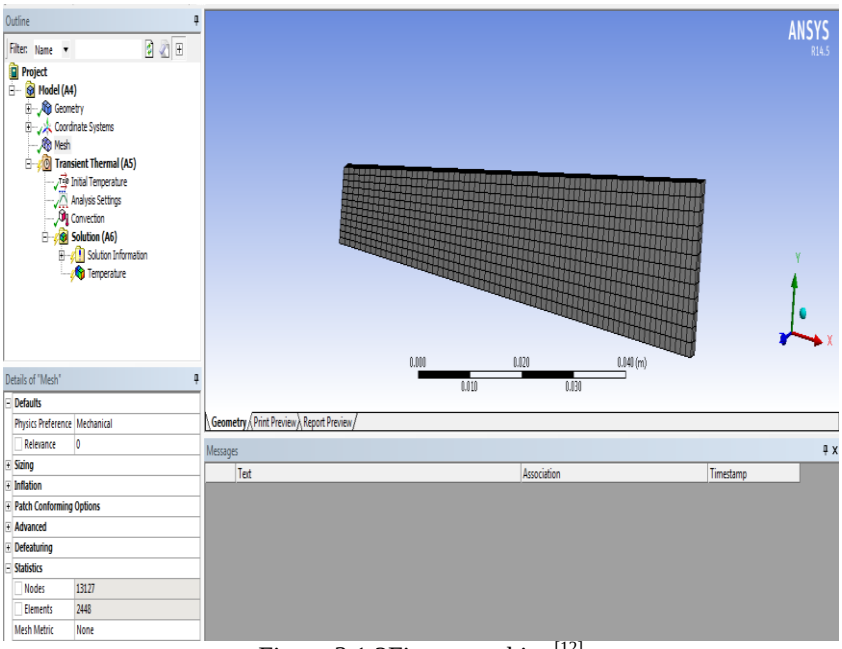

Figure 3.1.2Figure meshing[12]

Result after 1120 sec

After 1120 sec maximum temperature is 28.402° C and minimum temperature is 28.361°C

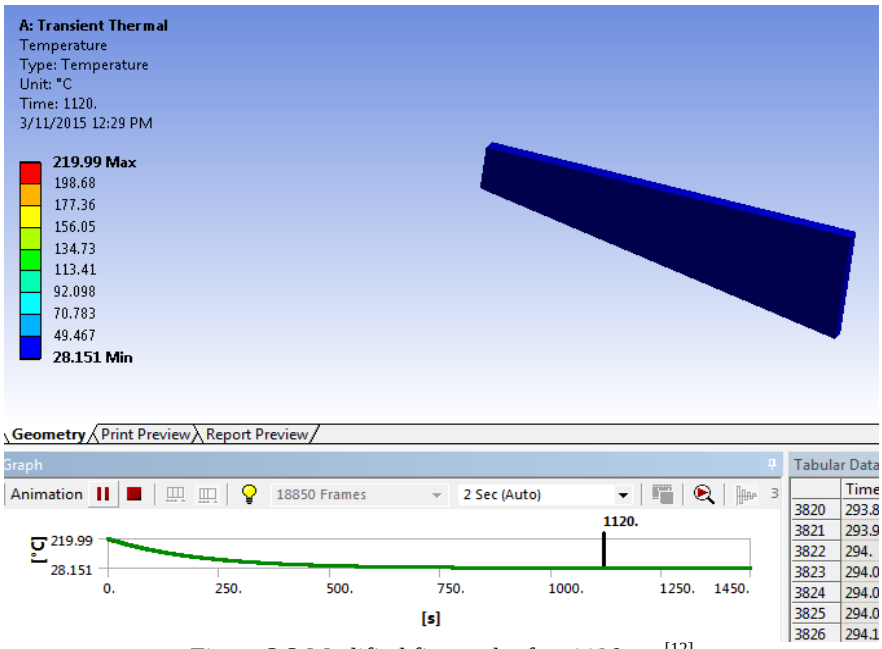

Figure 3.3 Modified fin result after 1120 sec[12]

3.2 FEA RESULT OF MODIFIED FINS

I take this type different dimensions fins and do its FEA analysis shows reading in below table.

-All fins Ambient temp is 28.32 ºC, t = thickness, h1 = one side height, h2 = second side height, L = length

Table 3.1 FEA result of different modified fins[12]

TIME (SEC)	L=73mm t=2mm h1=8.3mm h2=26mm	L=71mm t=2.3mm h1=8.3mm h2=23mm	L=73mm t=2.5mm h1=8.3mm h2=19.2mm Existing fin	L=72mm t=2mm h1=9mm h2=26mm	L=73mm t=2.5mm h1=8mm h2=20mm	L=72mm t=2mm h1=8mm h2=25mm
5	215.321 ºC	215.623 ºC	216.731 ºC	215.283 ºC	215.872 ºC	215.083 ºC
50	178.583 ºC	182.123 ºC	182.99 ºC	177.86 ºC	184.25 ºC	177.87 ºC
100	148.131 ºC	151.83 ºC	153.3 ºC	145.12 ºC	155.36 ºC	145.14 ºC
200	105.032 ºC	107.99 ºC	109.89 ºC	99.535 ºC	112.61 ºC	99.554 ºC
300	93.621 ºC	79.66 ºC	81.51 ºC	89.710 ºC	84.213 ºC	71.712 ºC
400	57.223 ºC	61.366 ºC	62.975 ºC	54.682 ºC	65.346 ºC	54.702 ºC
700	35.906 ºC	36.99 ºC	37.764 ºC	33.981 ºC	38.952 ºC	34.082 ºC
1120	28.721 ºC	29.434 ºC	29.743 ºC	28.361 ºC	30.96 ºC	28.763 ºC
110	28.343 ºC	28.364 ºC	29.703 ºC		29.972 ºC	24.342 ºC
1200		28.332 ºC	29.642 ºC		29.418 ºC	
1250			28.853 ºC		29.023 ºC	
1300			28.761 ºC		28.940 ºC	
1400			28.431 ºC		28.341 ºC	
1500			28.325 ºC			

Table shows that Compare FEA analysis of the different modified dimensions fin in FEA software length of fin as 72 mm and height is one side 9 mm and another side is 26 mm. the thickness of fin is 2mm dimensions fin is more effectiveness for heat transfer rate .

3.3 EVOLUATION OF MODIFIED FIN[8]

Efficiency(n)= $\frac{\tanh(ml)}{ml}$

Where, m= $\sqrt{\frac{ph}{Ak}}$

L= one side height of fin,P= periphery 2(b+y) ,b= length of fin,K= Thermal Conductivity 190 watt/m ºC ,A= cross section area (b×y)

Here,

b= 72mm ,y= 2mm ,L= 26mm ,h= film coefficient 11w/m^2K

So area A= (b×y) = 144mm^2 = 0.000144m^2 And P= 2(b+y) = 148mm = 0.148m

m= $\sqrt{\frac{0.148\times11}{0.000144\times190}}$ =7.71

Now,

ml= 7.71×26×10^{-3}= 0.20, tanh(ml)=tanh(0.20)= 0.1979 .

so,Efficiency(n)= $\frac{\tanh(ml)}{ml}$ =$\frac{0.1979}{0.20}$ =0.989

Effectiveness of fin

=$\frac{total\ area}{cross\ section\ area}\times n=\frac{2(9\times72)+2\times0.5(72\times17)+(9\times2)+(26\times2)+(73\times2)}{72\times2}$×0.989 =18.791

Same calculation for all modified fins dimensions

Table 3.2 Modified fins dimensions and effectiveness[8]

Dimensions of modified fin	L=73mm t=2mm h1=8.3mm h2=26mm	L=72mm t=2mm h1=8mm h2=25mm	L=71mm t=2.3mm h1=8.3mm h2=23mm	L=73mm t=2.5mm h1=8.3mm h2=19.2mm Existing fin	L=72mm t=2mm h1=9mm h2=26mm	L=73mm t=2.5mm h1=8mm h2=20mm
Effectiveness	17.44	17.77	15.87	13.44	18.79	13.87

3.4 VALIDATION OF MODIFIED FINS (FEA AND MATHAMATICALY)

Ambient temp 28.32 ºC

Table 3.3 Validation of FEA with Mathematically [8]

Modified Fin dimensions	L=73mm t=2mm h1=8.3mm h2=26mm	L=71mm t=2.3mm h1=8.3mm h2=23mm	L=73mm t=2.5mm h1=8.3mm h2=19.2mm	L=72mm t=2mm h1=9mm h2=26mm	L=73mm t=2.5mm h1=8mm h2=20mm	L=71mm t=2.3mm h1=8mm h2=20mm
FINAL FEA(temp) reading)	28.34ºC	28.33ºC	28.33ºC	28.34ºC	28.36ºC	28.40ºC
Come to ambient temp (TIME sec)	1200	1250	1500	1120	1400	1300
Mathematical Evaluation (Effectiveness)	17.44	15.87	13.44	18.79	13.87	14.26

IV. FEA of different different geometry shape

4.1 Rectangular fin (required 1500 sec)

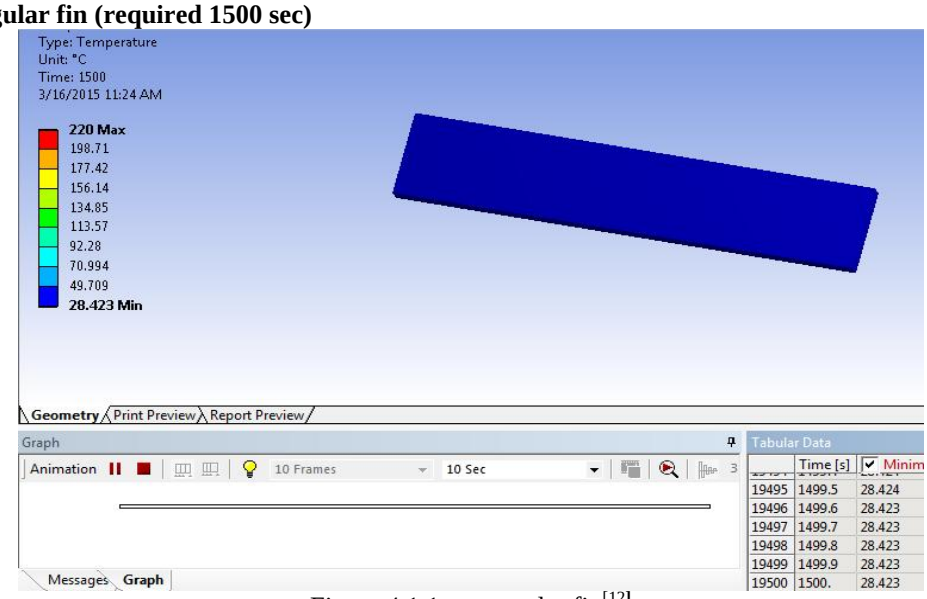

Figure 4.1.1 rectangular fin[12]

4.2 Triangular fin (required 1050 sec)

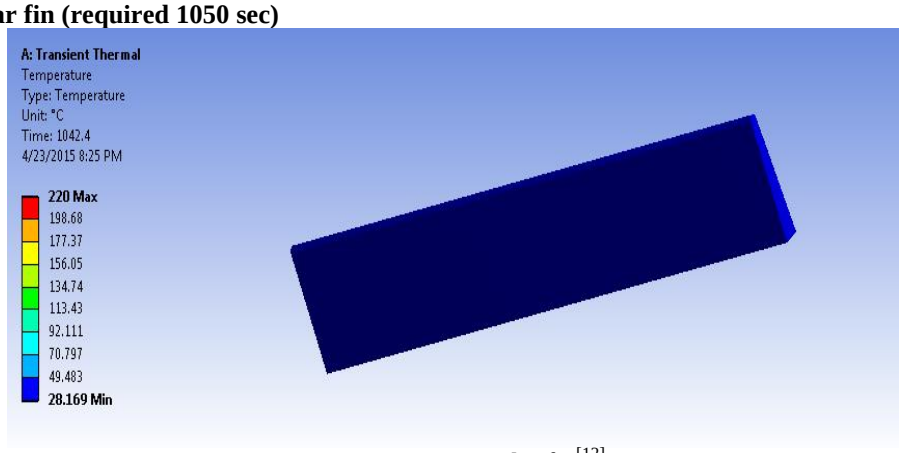

Figure 4.2.1 triangular fin[12]

4.3 Round triangular fin (required 1100 sec)

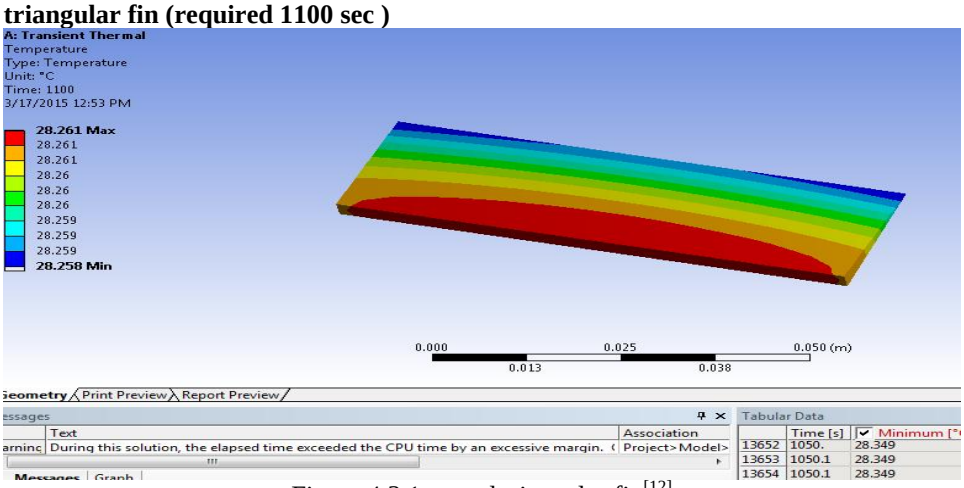

Figure 4.3.1 round triangular fin[12]

4.4 Trapezoidal fin (required 1120 sec)

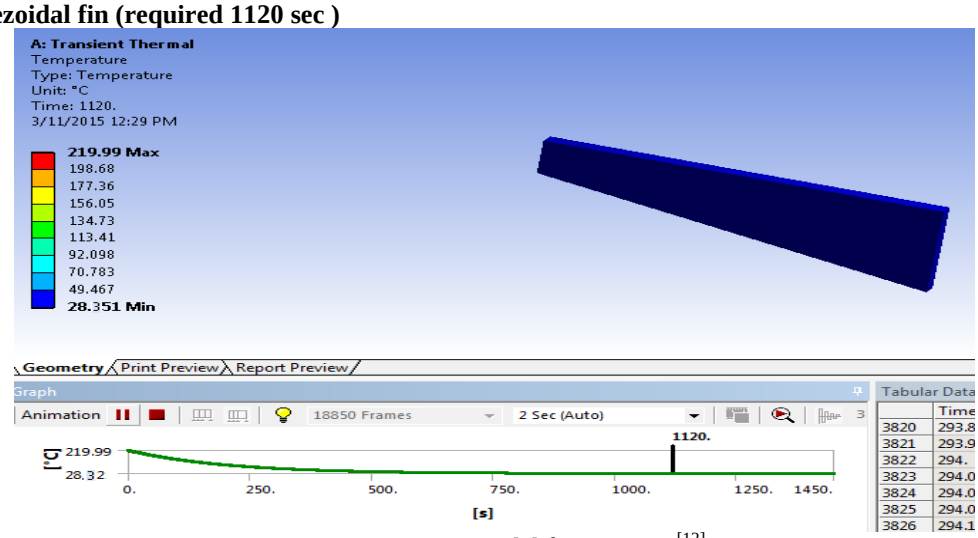

Figure 4.4.1 trapezoidal fin 1120 sec[12]

Shown in above figure triangular fin is more cooling effect compare to other geometry shape but its manufacturing is complicated.So trapezoidal fin is effective shape for IC engine bike fins.

V. CONCLUSION

- Trapezoidal fin is effective shape for IC engine bike fins
- Existing fins come to ambient temperature approximate 1500sec
- L=72mm, t=2mm, h1=9mm , h2=26mm Modified fins come to ambient temperature approximate after 1120 sec. It means this dimensions fins is generate more cooling effect compare to existing fin

VI. ACKNOWLEDGEMENTS

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Last, but not the least, I want to thank my institute, Noble Group of Institutions, Junagadh, for giving me this opportunity to work in the great environment.

VII. FUTURE SCOPE

With modification in material of the Honda CB-Shine fin, we could have more efficient fin performance. Heat transfer rate can be maximized using geometric optimization

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