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CFD Analysis of Engine Cylinder FIN

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Abstract: the engine cylinder is one of the major i c engine components, which is subjected to high temperature variations and thermal stresses. To cool the cylinder, fins are provided on the surface of the cylinder to increase the rate of heat transfer. By doing thermal analysis on the engine cylinder fins, it is helpful to know the heat dissipation inside the cylinder. The principle implemented in the project is to increase the heat dissipation rate by using the invisible working fluid of air. We know that, by increasing the surface area we can increase the heat dissipation rate, so designing such a large complex engine is very difficult. The main purpose of using these cooling fins is to cool the engine cylinder by air.
Keyword : thermal analysis ,fins geometry, material, velocity variation and cfd.

I. INTRODUCTION

IC engine is a heat transfer fluid to occur in the engines themselves, usually the burning of fuel and air the oxygen content of the air. Internal combustion engines use thermal conversion of the energy of fuel. In IC all engine fuel energy into motive force. And after converting the heating power supply excess heat must be removed from the loop. Thermal will move to the atmosphere means that a fluid with water and air. The engine of the heat will move to the atmosphere of the fluid temperature is low. As a result of the combustion process. Engine temperature does not meet the entire power supply. If excess heats are never deleted, engine parts due to excessive temperature. Heat from the areas of high temperature areas of low temperature as shown in the following figure the area below. When engine oil is oxidized (burning) heat generation. Additional heat generated by friction between moving parts. Only about 30% of the energy released is converted into useful work. The rest of the form (70 per cent) must be removed from the engine to prevent parts melted. The main purpose is to project the analysis thermal properties of different geometry as the square and round holes of the shark fin, materials and speed changes cylinder fin.Transient thermal analysis to determine if the temperature and other thermal quantity changes over time.Different temperature distribution with the passage of time, the interest in many applications (such as in cooling). Accurate Thermal simulation to allow the key design parameters must be to improve their standard of living.

II. PROBLEMM FORMATION

This work is concerned with carrying out three-dimensional simulations on splender engine fin geometry with different shape change such as square perforated and circular perforated fin having material Al alloys 7075 and cast iron. When we drive two wheeler vehicle at certain speed it subject to high temperature and pressure and having low heat dissipation rate. The purpose of this analysis heat transfer/ heat dissipation rate analysis at velocity 20km/hr, 40km/hr and 60km/hr for Al alloys 7075 and cast iron material. We also analysis the pressure and temperature drop surrounding the engine.

A. Existing Model Specification

Engine model- Hero Honda splendor, Engine type- air cooled 4 stroke single cylinder engine Displacement - 97.2cc, Bore×stroke- 50mm×49.5mm
Height between top and bottom end face- 69mm
Compression ratio - 9.1: 1, Diameter of sleeve- 54.4 mm
Modified existing model specification
Fluid flow- air
Property of material- cast iron
Thermal Conductivity – 0.05 w/mm k, Specific Heat – 500 J/kg ºC, Density – 7.1 g/cc
Property of material Al alloys 7075 Thermal Conductivity – 0.130 w/mm k, Specific Heat – 0.963 J/g ºC, Density – 2.8 g/cc,
No of hole -10 (Fin shape perforated fin like square perforated and circular perforated). Circular perforated diameter - 1.1256 mm,

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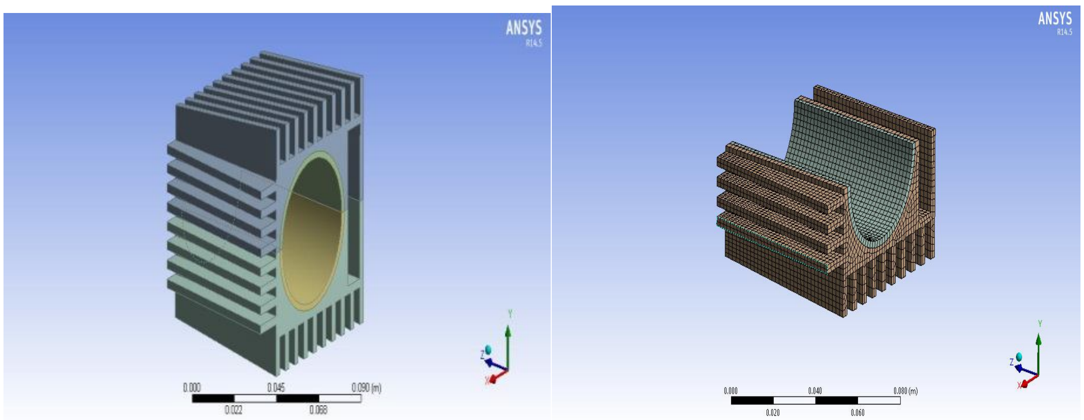
Square perforated diameter - 1 mm$\times 1mm$.

III. METHODOLOGY

The work has been done by the help of CFD by using ANSYS Fluent 14.5. At first the geometry were made for each case according to the dimensions and then meshing was done.

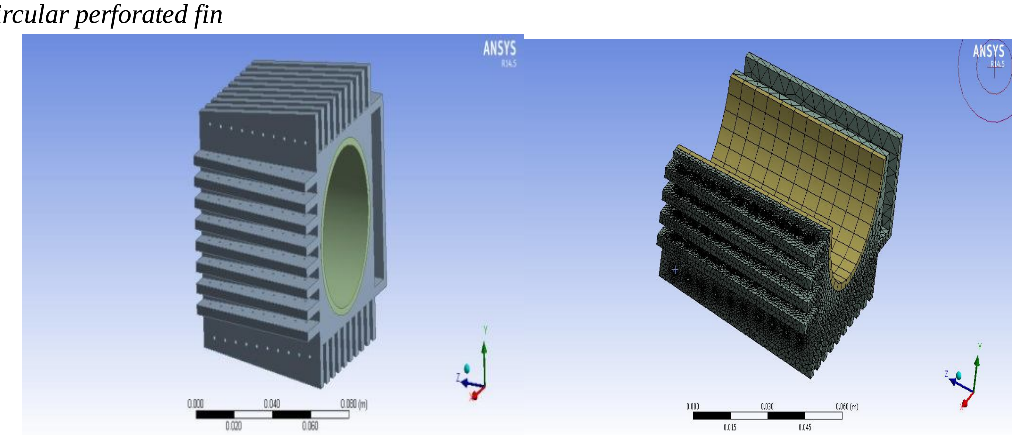
The geometry of different fin after meshing is shown in following figure in next page starting from meshed geometry of existing engine fin then modified engine fin geometry as the square and round holes of the shark fin, materials and speed changes cylinder fin perforated having material cast iron and Al alloys 7075

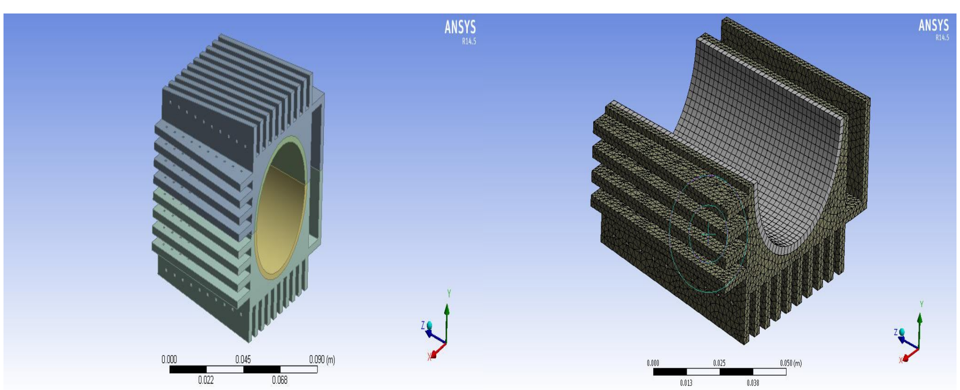
A. Existing Mesh Model



B. Modified Existing Model

1) square and circular perforated fin





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Fluid flow- air

Material property- Al alloys 7075 and cast iron

INLET:

Velocity v_1 =20km/hr, velocity v_2= 40km/hr, velocity v_3=60km/hr

Initial temperature=303.15k,Cylinder temperature-503.15k

Initial pressure - 101325 Pa

Turbulence intensity - 1%,Hydraulic diameter-24mm

OUTLET:

Gauge pressure = -85Pa

Turbulence intensity - 1%, Hydraulic diameter-11.5mm

2) Turbulence Model In this work the turbulence model selected for analysis is k-ε model. This model uses two kinds of transport equations for the analysis. First determines turbulent kinetic energy (k) while second determines the rate of dissipation of the turbulent kinetic energy (ε).

3) Solver Type Pressure based solver has been used in the analysis

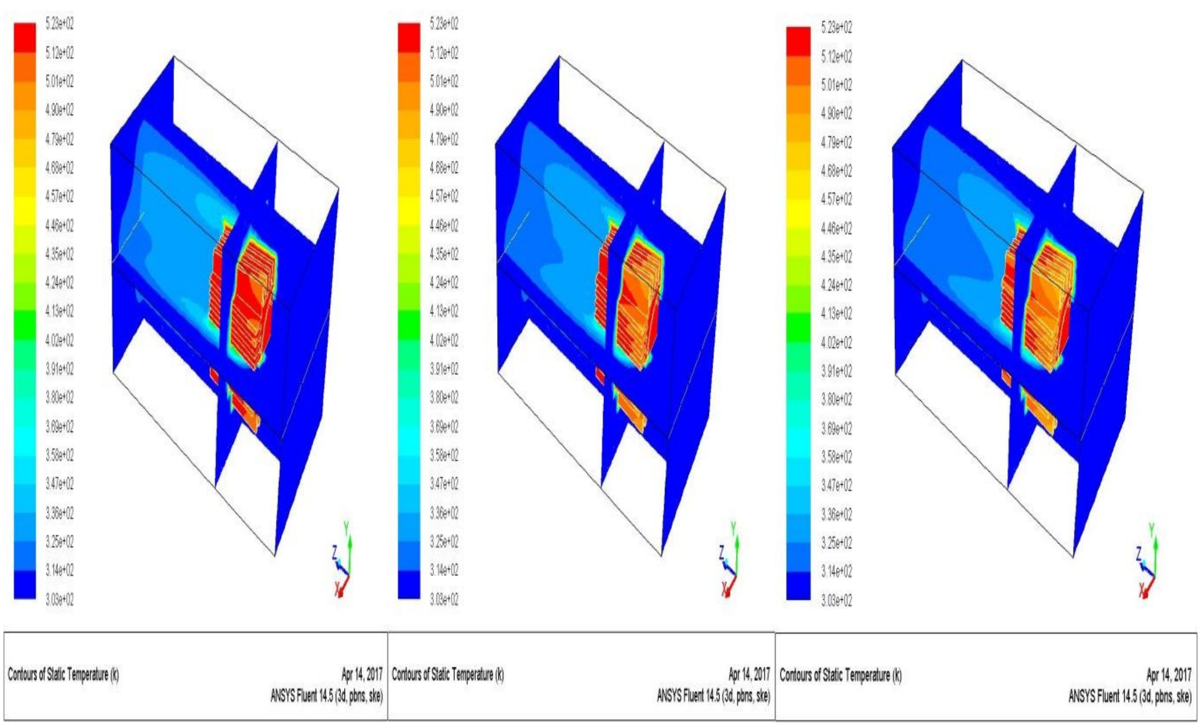
4) Solution Method The solution method used to solve the problem is SIMPLE. While Standard pressure option has been used along with the second order in momentum option.

IV. RESULTS AND DISCUSSION

To measure the thermal performance of engine fin, heat transfer rate heat transfer coefficient (h) & Nusselt number (Nu) are the parameters which need to be analyzed. While pressure drop on engine fin tells us about the rate of heat transfer, friction factor (f) is the measure of the pressure drop. In the present work on engine fin design like square and circular perforated fin with different material as cast iron and Al alloy 7075 and we measure heat transfer rate at different velocity as 20km/hr, 40km/hr and 60km/hr. as shown in below.

A. Existing model result

Spender fin existing for al alloys 7075



Spender fin existing for cast iron

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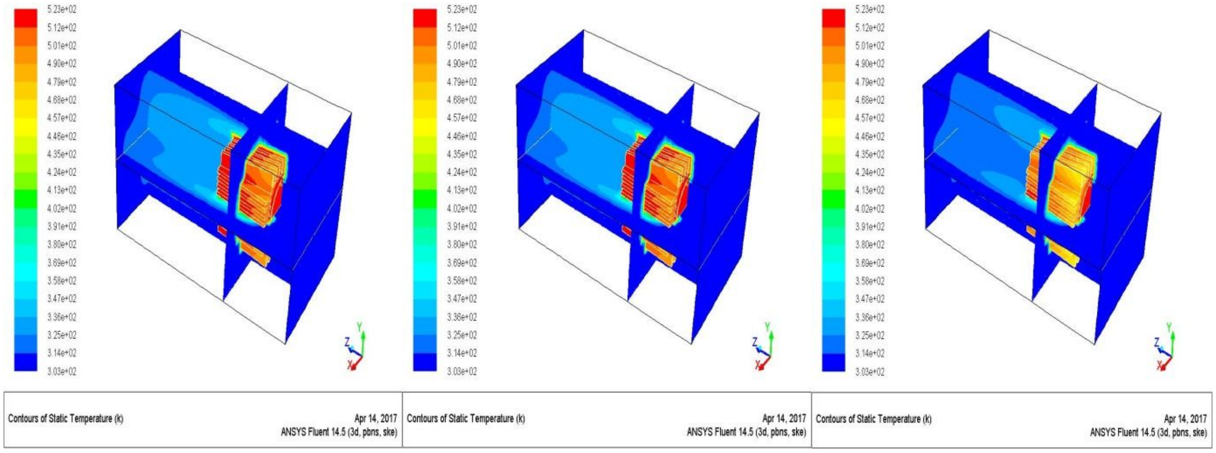
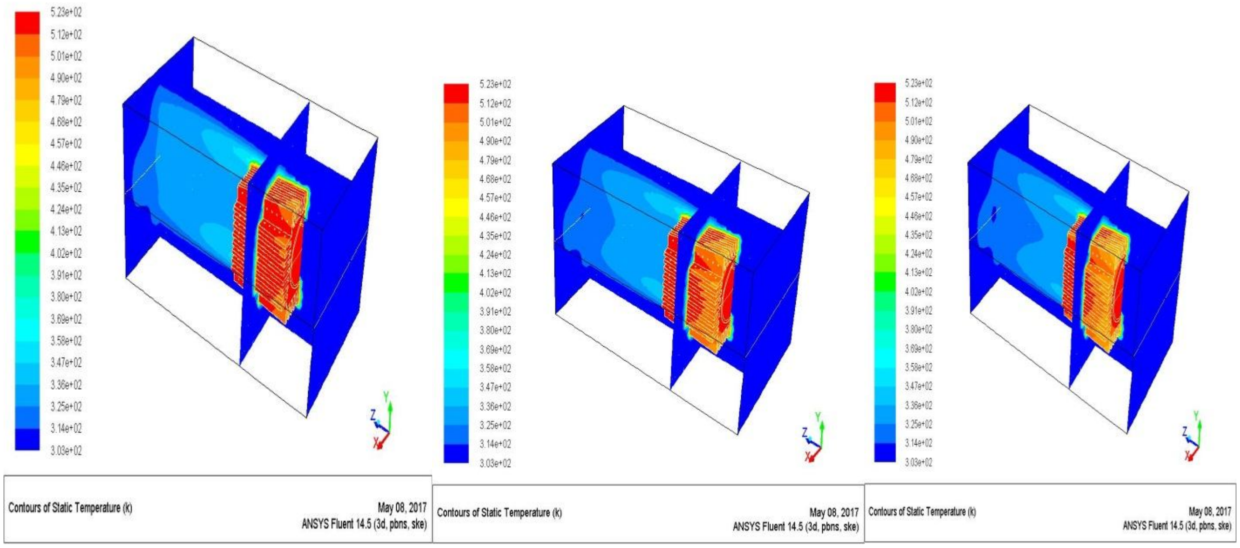
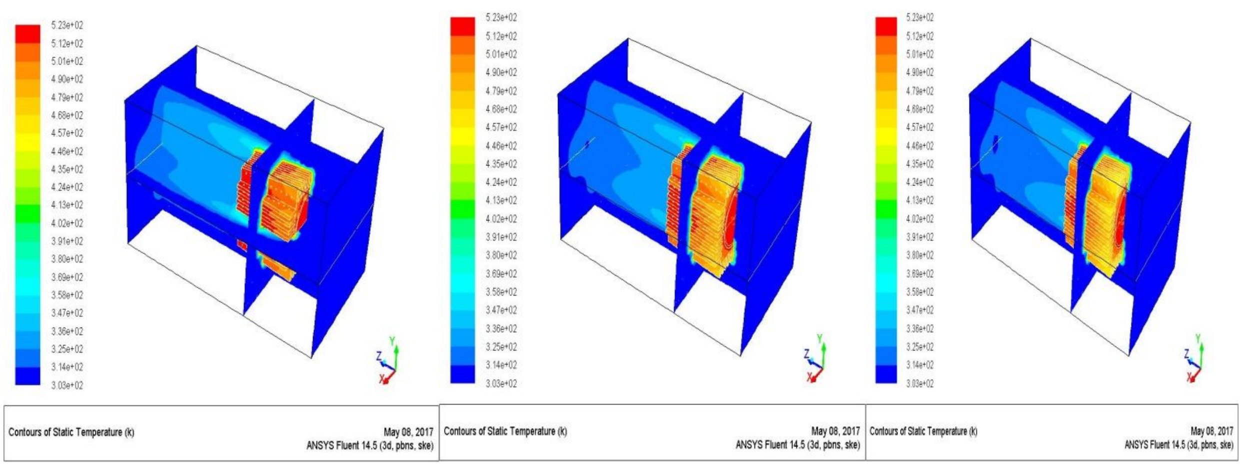


Spender fin circular perforated-al alloys 7075

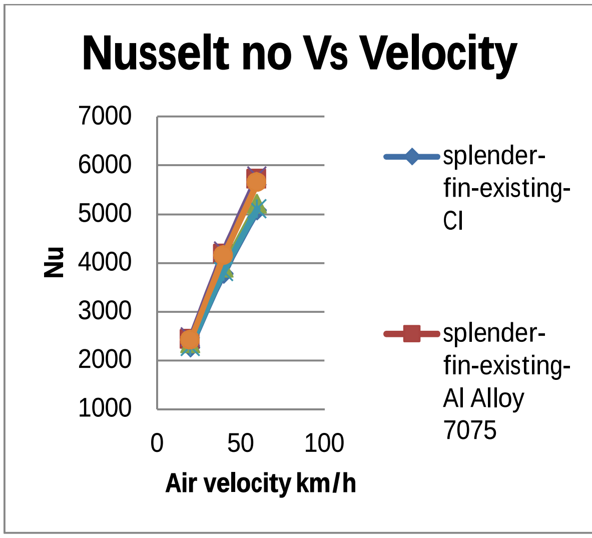


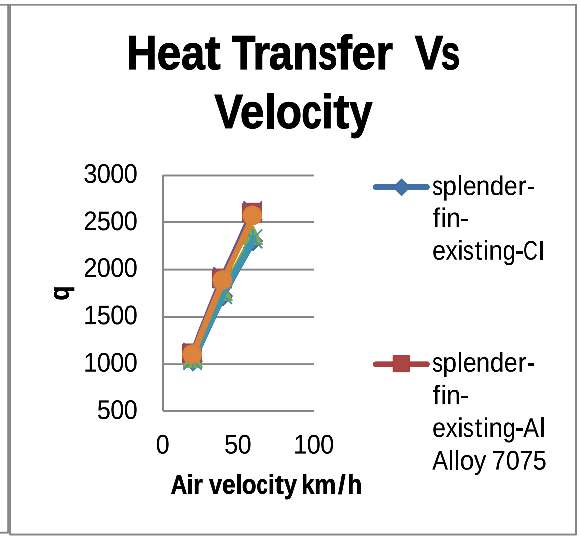
Spender fin square perforated cast iron



Similarly the temperature and pressure contours for different cases have been observed in the work.
Based on the study performed in the software the findings have been listed and the graphs have

been plotted to get a conclusion based on the study done. Graphs have been plotted with respect to Nusselt number of the different flow rates. Here for square perforated fin using material Al alloys 7075 having velocity 20km/hr, 40km/hr and 60km/hr corresponding the Nusselt no 2342, 3895and 5208 respectively and for circular perforated fin using material cast iron having velocity 20km/hr, 40km/hr and 60km/hr corresponding the Nusselt no 2285, 3823 and 5112 respectively. Following graph plot between them as follows





A. Tabulation Splender Existing Cylinder

1) For cast iron material

Velocity km/hr	Temperature of air in k	Pressure drop in Pa	Air heat transfer (q)in W	Convection co efficient h	Nu no.
20	303.15	22.802126	1030.304	396.411	2268.7
40	303.15	90.627502	1718.926	661.36	3785.1
60	303.15	203.00793	2304.102	886.507	5073.6

2) For AL alloys 7075 material

S No.	Velocity km/hr	Temperature of air in k	Pressure drop in Pa	Air heat transfer (q)in W	Convection co efficient h	Nu no
1	20	303.15	22.802126	1102.613	424.232	2427.9
2	40	303.15	90.627502	1895.809	729.415	4174.5
3	60	303.15	203.00793	2591.558	997.106	5706.6

B. Splender Square Perforated Fin

1) Cast iron square cross section 1mm×1mm

S no	Velocity km/hr	Temperature of air in k	Pressure drop in Pa	Air heat transfer (q)in W	Convection co efficient h	Nu no
1	20	303.15	22.668991	1063.525	409.193	2341.9
2	40	303.15	90.5877	1768.748	680.528	3894.8
3	60	303.15	202.33867	2365.303	910.054	5208.4

Al alloys 7075 cross section 1mm×1mm

S no	Velocity km/hr	Temperature of air in k	Pressure drop in Pa	Air heat transfer (q)in W	Convection co efficient h	Nu no
1	20	303.15	22.668991	1124.282	432.569	2475.7
2	40	303.15	90.5877	1925.644	740.894	4240.2
3	60	303.15	202.33867	2624.955	1009.96	5780.1

C. Splender Circuler Perforated Fin

1) For cast iron material

S no	Velocity km/hr	Temperature of air in k	Pressure drop in Pa	Air heat transfer (q)in W	Convection co efficient h	Nu no
1	20	303.15	21.627192	1037.799	399.295	2285.2
2	40	303.15	86.005447	1736.024	667.938	3822.7
3	60	303.15	192.62653	2321.509	893.204	5111.9

Al alloys 7075 cross section 1mm×1mm

S no	Velocity km/hr	Temperature of air in k	Pressure drop in Pa	Air heat transfer (q)in W	Convection co efficient h	Nu no
1	20	303.15	21.627192	1095.039	421.318	2285.2
2	40	303.15	86.005447	1880.918	723.686	3822.7
3	60	303.15	192.62653	2565.014	986.893	5111.9

V. CONCLUSION

In this line of argument, a cylinder fins SPLENDER institutions 97.2cc motorcycle model using Parametric Software ANSYS 14.5 fluent the original model is accomplished by changing the geometry of the heat sink, cross-section of the fins modifications as square and round hole, 10-hole in the middle of the length of the fins. The materials used for the current fin body is cast iron, but the materials used for the cast iron and AL alloy 7075. The original model of material changes through the consideration of their density and thermal conductivity. Low-density aluminum alloy 7075 compared to other cast material weight fin institutions rarely used 7075 aluminum alloy. The results of the analysis by observing the hot, heat transfer rate the square holes fin AL alloy 7075 speed 60 km/h is 2624.955 watts. This shows the effective results as compared to other existing model.

REFRENCES

[1] Masao YOSHIDA, Soichi ISHIHARA, Kohei NAKASHIMA: “Air-Cooling Effects of Fins on a Motorcycle Engine”
[2] Pratima S. Patil, S.N. Belsare, Dr. S. L. Borse. “ Analysis of internal combustion engine heat transfer rate to improve engine efficiency, specific power & combustion performance prediction” International journal of Mechanical engineering & Technology. ISSN 0976-6340,Vol. 3 Issue 2, May-Aug(2012),pp.447-452
[3] G.Raju, Dr. Bhramara Panitapu, S. C. V. Ramana Murty Naidu. “Optimal Design of an I C engine cylinder fin array using a binary coded genetic algorithm”. International journal of Modern Engineering Research. ISSN 2249-6645,Vol. 2 Issue.6, Nov-Dec.(2012),pp.4516-4520
[4] Magarajan U. , Thundil karrupa Raj R. , Elango T. “ Numerical study on heat transfer I C Engine cooling by extended fins using CFD” Research journal of Recent sciences, ISSN 2277-2502,Vol. 1(6), June(2012), pp.32-37
[5] Mr. N. Phani Raja Rao, Mr. T. Vishnu Vardhan. “Thermal Analysis Of Engine Cylinder Fins By Varying Its Geometry And Material.” International journal of Engineering Research & Technology.ISSN:2278-0181,Vol. 2 Issue 8, August(2013)
[6] Mishra A.K., Nawal S. and Thundil Karuppa Raj R. “Heat Transfer Augmentation of Air Cooled Internal Combustion Engine Using Fins through Numerical Techniques.” Research journal of engineering Science. ISSN 2278-9472,Vol 1(2),August(2012),pp.32-40
[7] G. Babu, M. Lava kumar. “Heat Transfer Analysis and Optimization of Engine Cylinder Fins of Varying Geometry and Material.” IOSR Journal of Mechanical & Civil Engineering. e-ISSN 2278-1684, p-ISSN 2320-334X, Vol.7 Issue 4, July-Aug.(2013),pp.24-29
[8] Heat Transfer Augmentation of Air Cooled 4 stroke SI Engine through Fins- A Review Pape. International Journal of Recent Development in Engineering and Technology. ISSN 2347 – 6435, Volume 2, Issue 1, January (2014)
[9] N.Nagarani and K. Mayilsamy, Experimental heat transfer analysis on annular circular and elliptical fins.” International Journal of Engineering Science and Technology 2(7): 2839-2845.
[10] A. Mohammadi, M. Yaghoubi. “Estimation of instantaneous local heat transfer coefficient in spark ignition engine.” International journal of Thermal Science 49 (2010) 1309-1317
[11] C.S.WANG and G.F.BERRY. “Heat transfer in I C Engine.” American engineering & technology”.
[12] V. GANESAN, (2008). I C Engines, McGraw-Hill Education (India) PVT Limited.
[13] John B Heywood “Internal Combustions Engine Fundamentals” McGraw Hill Inc
[14] R. K. Rajput (2007). Heat & Mass Transfer (M.E.), S. Chand Limited. “ Process heat transfer.” By Donald & Kern (McGraw-Hill international editions)
[15] J P Hollman(2010).Heat transfer,(The McGraw-Hill international editions)
[16] Domkundarwar(2010).Heat and Mass Transfer, Dhanpat Rai publication company.
[17] Donald &Kern(2010). Process heat transfer (McGraw-Hill international editions)
[18] Anderson(2012) Computational fluid dynamic: the basics with application Jivuvan.(2013
[19] A Computational fluid dynamic- A Practical approach (B/H Publicatio)