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INVESTIGATION OF EFFECT OF ORIENTATION ON MODIFIED ANNULAR RECTANGULAR FINS

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1. INTRODUCTION

The engine cylinder is major component of automobiles which is subjected to high temperature variations and thermal stresses. In order to cool the cylinder fins are provided to increase the rate of heat transfer. If fins are not dissipating heat properly there are lots of problems like overheating, also burning of oil layer may occur. If fins are dissipating heat in excess, more loss of heat will take place and engine becomes less efficient according to second law of thermodynamics. It is become critical job for a designer to design the fins precisely matching exact requirements by thermal loading. Many researchers have found their interest to enhance the heat transfer from engine cylinders. Basically heat transfer engine fins are analyses clearly as an annular fin over a cylinder. So annular fins of different profiles compared with new trial profile for heat dissipation and heat transfer enhancement analyzed in many of context. Engine life and effectiveness can be improved with effective cooling. Engine heat is transferred by conduction through combustion chamber walls and finned material. Air medium takes that heat away by convection process from surface of fins. This work is focusing on material saving and improving heat dissipations by introducing new profiles for annular fins.

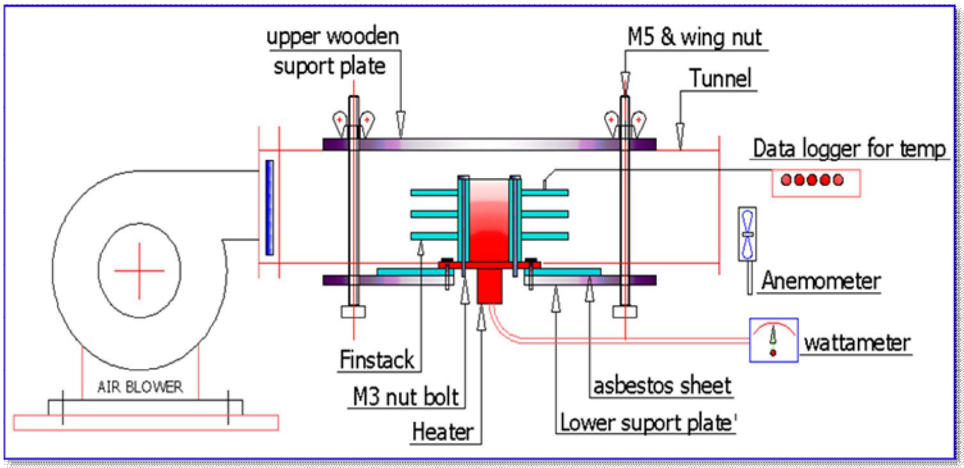
2. LITURATURE

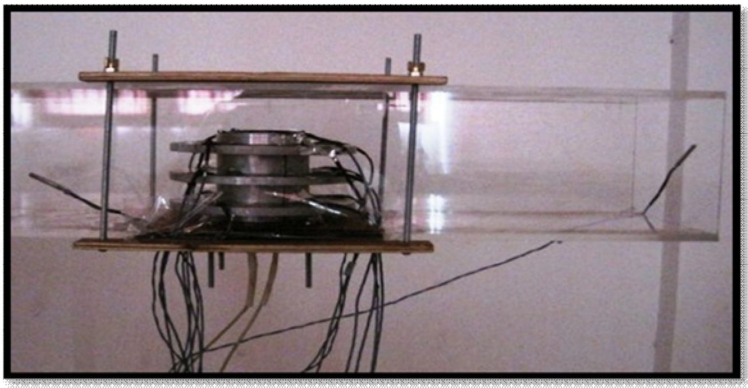
Yamammoto et.al.[1]
performed an experimental analysis for annular fins for various slit. Slits used variable width & slit position & orientation. Author uses Aluminum alloy for fins and uses insulation between consecutive fins ultimately found modified geometry gives better cooling for natural convective heat transfer. Author plotted heat dissipation vs number of slit and also temperature vs. distance from root.

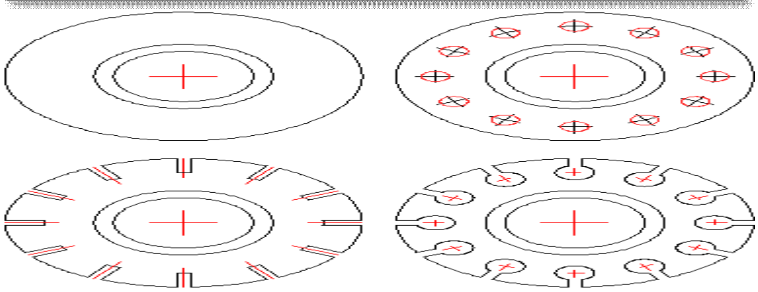
Yamammoto et.al.[2]
performed an experimental analysis for annular fins for various perforations. Residual heat released in natural convection heat transfer is investigated. Variables used are angle between consecutive perforations, diameter of port, pitch circle diameter. Geometry with perforation surly gives better cooling than regular geometry for annular fins.

ASSUMPTIONS

- Heat supplied by heater is uniform.
- Fin material is homogeneous
- Average convective heat transfer coefficient on surface of the fin is constant.
- There is no contact resistance at fin base joint.
- No heat source within fin itself.
- Temperature of the medium in surrounding assumed to be constant for each performed individual experiment.
- Heat transfer from all fins is assumed to be same.
- There is constant supply of air from blower discharge.
- Surface to surface heat transfer by radiation is neglected.







Variables used for experimentation

Reynold's number	40723	61084.5	81446.1
Heat flux(W/m^2)	909.09	1363.63	1818.18
Spacing	11 mm	16.66 mm	28 mm
Orientation	10^o Ccw	15^o Ccw	20^o Ccw

Stack of 4 fins are being tested for different geometries in tunnel and blower assembly for 909.09W/m^2. Spacing between two consecutive fins used for this assembly was 11 mm.

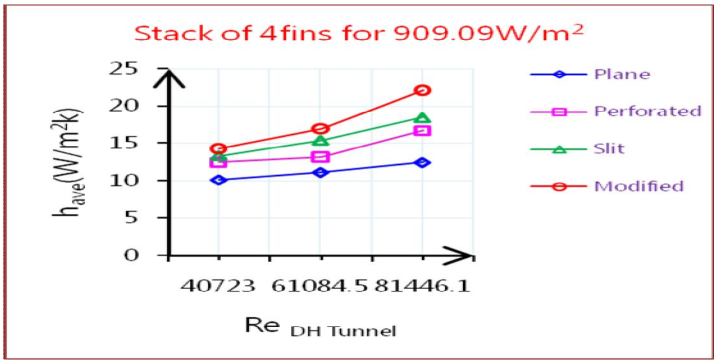


Fig.5.3.1: Graph of h_{ave} verses Reynolds number for D_H of tunnel for stack of 4 fins at 909.09W/m^2

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Above plot shows variation of Reynolds number for a medium air flowing through tunnel and average heat transfer co-efficient over annular fins surfaces. Graph clearly indicates value of average heat transfer co-efficient for all geometries are increasing as velocity of air increases. For slit and modified fins surfaces it is showing little increase in average heat transfer co-efficient than plane and perforated fins. Separate two graphs plotted for 1363.63W/m^2 and 1818.18W/m^2 below, each graph is showing the variation of average heat transfer co-efficient of the various geometries for same heat flux supply but at different Reynolds number range.

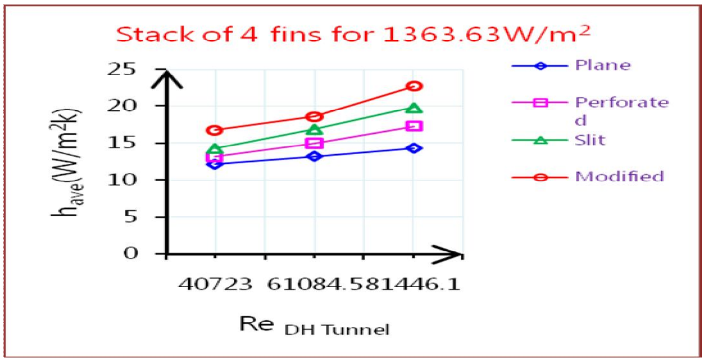


Fig.5.3.2: Graph of h_{ave} verses Reynolds number for D_H of tunnel for stack of 4 fins at 1363.63W/m^2

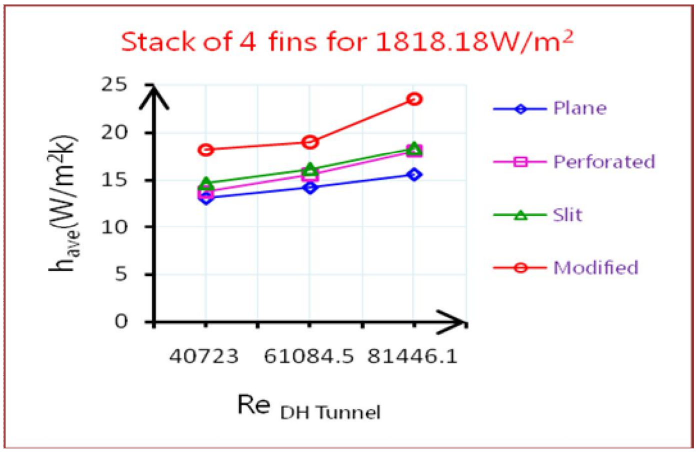
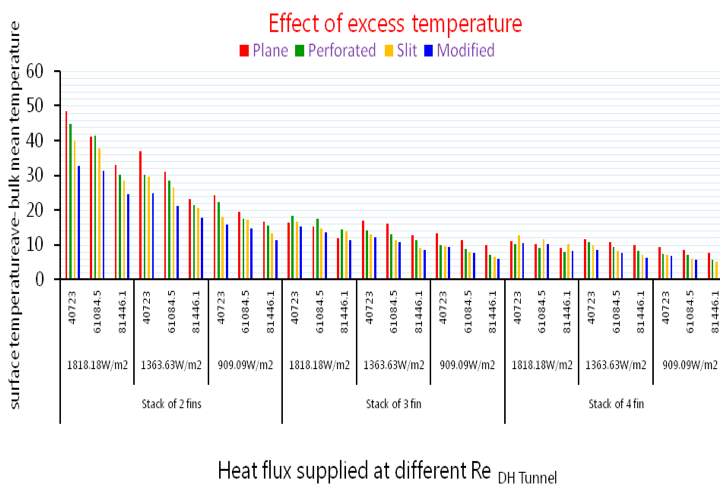
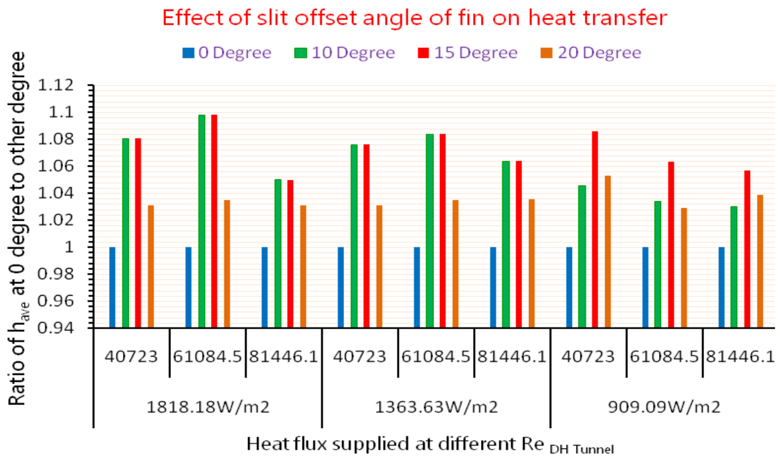


Fig.5.3.3: Graph of h_{ave} verses Reynolds number for D_H of tunnel for stack of 4 fins at 1818.18W/m^2



Effect of rotation on excess temperature and enhancement of heat

Study was proposed for stack of 3 fins for three different slit offset angles. Vertically First and last fin is being rotated from its position and second fin is being kept as it is. Fig.5.6.1 graph is drawn for ratio of h_{ave} at 0 degree to h_{ave} at other three 10 degrees, 15degree, and 20 degree. Its comparative study of Average heat transfer co-efficient at different slit angle offsets. It is constant for simple stack without rotation. Ratio increases from 10 degree and found to be a maximum for 15 degree. It is fond that for 20 degree average heat transfer co-efficient again decreases.



3. CONCLUSIONS

1) System is found to be cooled for more number of fins. As the graph of excess temperature clearly gives that more are the fins, more is the cooling.
2) Stack found to be coolest for modified fins as excess temperature is very less for given supply of heat fluxes, and it also reduces material required for fins.
3) Ratio of average heat transfer co-efficient for different angle of slit offset are being tested and best angle is 15 degree that is staggered arrangement is best for offset rotation.
4) Optimum number of fin found to be four numbers of fins for this particular experimental arrangement.