

# Thermal Performance Analysis of IC Engine Fins

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**ABSTRACT:** The Engine fin design is highly limited by the designing of the system. But still certain parameters and geometry could be modified for better heat transfer rate from engine block. . In this research focuses on increasing the life time of engine by increasing heat transfer rate from engine block to fin. In such a way newly designed of Fin (Extended Surface) that would provide better Heat transfer rateHeat transfer rate by modification of fin structure and fin geometry. The geometry are created as Tapered shaped fins and holes createdon the fins to improve the uniform heat transfer rate, the simulating of fin under varying climatic condition. The 3D modelling software used for creating fin geometry. We are analysing the cylinder fins using the material Aluminium alloy 6061.

**KEYWORDS:** Fins Geometry, Tapered Fins, Contact Area, Heat Transfer rate.

## 1. INTRODUCTION

Cylinder is the one of the major components in Engine, 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 rate. Fins are Basically Mechanical structures which are used to cool various structures via the process of convection and conduction. Extended fins are well known for enhancing the heat transfer in IC engines. The construction of air cooling system is very simpler. Therefore it is important for an air-cooled engine to utilize the fins effectively to obtain uniform temperature in the Engine cylinder.

**1.1 FINS:**In study of heat transfer, a fin is a surface that it is extends from an object to increase the rate of heat transfer. Fin act as the important part that help to reduce the distribution of overheat by the engine block. In Many thermal applications heat has to be removed from a small area to the surrounding (or) Environment to maintain it in a steady state condition.

### 1.2 AIR COOLING SYSTEM:

Air cooled system is generally used in small engines. In this system fins or extended surfaces are provided on the cylinder walls, cylinder head, etc. Heat generated due to combustion in the engine cylinder will be conducted to the fins and when the air flows over the fins, heat will be dissipated to air. The cooling system is a key to efficient engine operation.

The amount of heat dissipated to air depends upon

- Amount of air flowing through the fins.
- Fin surface area.
- Thermal conductivity of metal used for fins.

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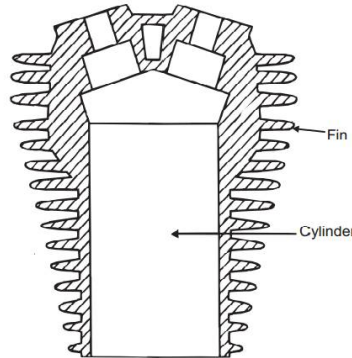


Fig 1: Cylinder With fin

## 1.2.1 There are some ways to increase the rate of heat transfer

Consider a cylindrical fin around a cylinder wall, while in dynamic motion Of the engine is considered.

- The front part of the engine gets the more air flow than the rear side of the engine. The flow of air must be equalized at the both rear and front part of the engine.
- Consider the dynamic motion of an engine at a velocity of 60km/hr. (or) 16.6 m/s. The velocity of the bike is more over equal to the velocity of air passing into the engine opposite to the bike direction. So the velocity of the air has to be decreased, so there is an increase in the flow rate of air and also increase in the surface contact time of air.
- We can increasing the heat transfer rate without increasing the surface area of fin if we increasing the contact time between air and in
- When the velocity has to be decreased to the maximum, the compression ratio of the fin will get decreased, so due to the high pressure created the air trends to move in a low pressure region.

## II. MODELLING

**2.1 Radial Fin:** Radial Fin Elements are extended area, star-shaped elements developed for the better heat transfer. The filtration efficiency of radial fins covers a wide range of variety of media in the 0.3-200 micron selectivity with a 100-1000° F temperature range with supporting screens. The Sectional Diagram of radial fins are given below as shown in the fig.2

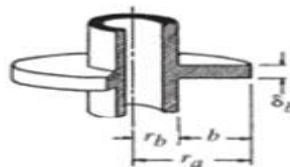


Fig 2: Radial Fins

## 2.2 Material used

Material generally used for the manufacturing of cylinder and piston are Aluminium (6061 Alloy).

### Properties of Aluminium (6061 Alloy)

- Density=2700 kg/m<sup>3</sup>
- Thermal Diffusivity=84.18\*10<sup>-6</sup> m<sup>2</sup>/s
- Specific Heat, c= 1300 J/kgk
- Thermal Conductivity, k = 170 w/mk.

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- Density =2.7g/cc

## 2.3 Dimension And Magnitude of new designed Fin

The Dimension and Magnitude of our newly designed fin are given below in tabulation as shown:

Design Parameter	Calculated Value
Length of the fin	25mm
Height Distance between two fins in relation	14mm
Height Distance between two fins not in relation	7mm
Thickness of the fin	2mm
Diameter of the hole at front and back of each bottom face	8mm
Tapering Angle	141.34 degree

## 2.4 New designed Fin

- Its end of the fin is Tapered for allow required amount of air inside the fin. (Tapered Angle 141.34 degree)
- The holes are made of 5 mm in the surface of the fin for uniform heat transfer rate.
- Surface holes are used to decrease the velocity and create the turbulence inside the engine fin.
- Due to the slow velocity, fluid tries to another side of the engine and the circular motion around the engine block.

### 2.4.1 Purpose of New Designed Fin

- The contact area of the engine fin is increased.
- The velocity of the air is decreased inside the fin
- Most importantly the flow direction of the air will get changed and the maximum air flow is attained.

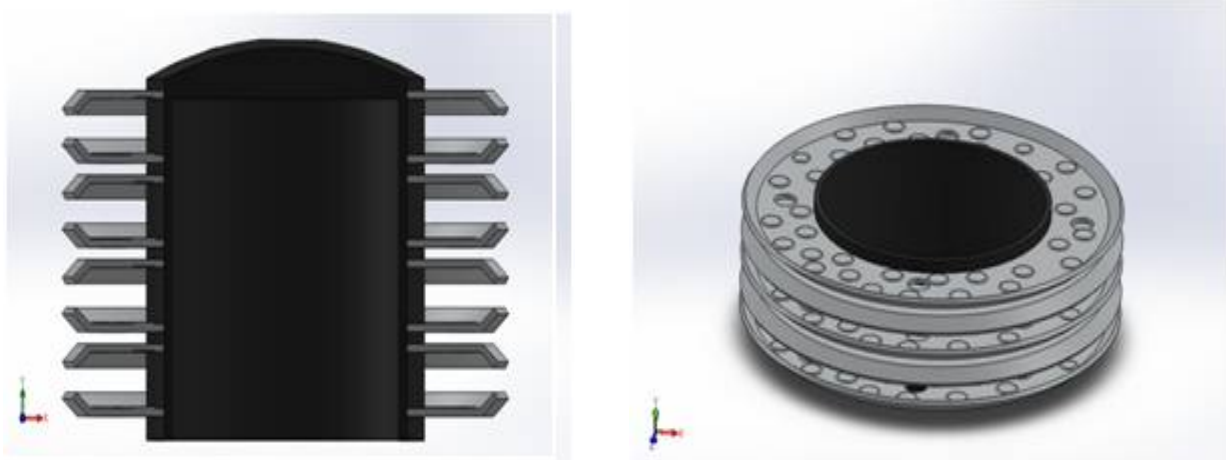


Fig 3: Front And Top View Of newly Designed Fin.

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## 2.5 Engine Specification for Designed Fin

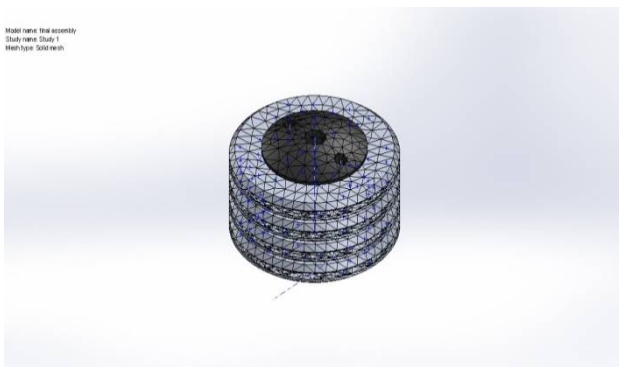
Bike Model	Hero Honda
Number of Cylinders	1 Cylinder
Bore	98 mm
Stroke	85mm
Piston Displacement	641 cc
Compression Ratio	9.22
Fuel used	Petrol
Engine Position	Vertical
Deck Height	10.341 mm

## III. RESULTS AND DISCUSSION

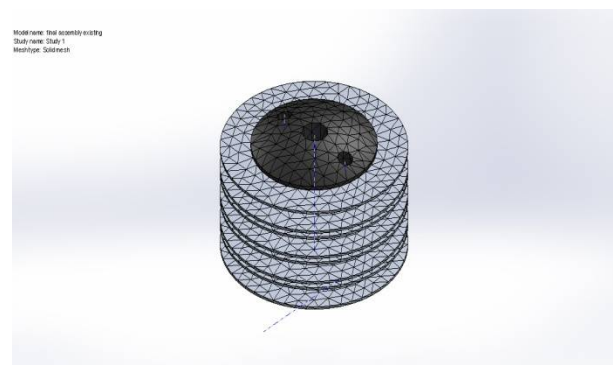
### 3.1 THERMAL ANALYSIS

#### Input loads

- Maximum Temperature = 1023.15 K
- Minimum Temperature = 631.092 K
- Convective Coefficient = 173 W/m<sup>2</sup>k
- Bulk Temperature = 305 K



Meshing of newly developed model



meshing of existing model

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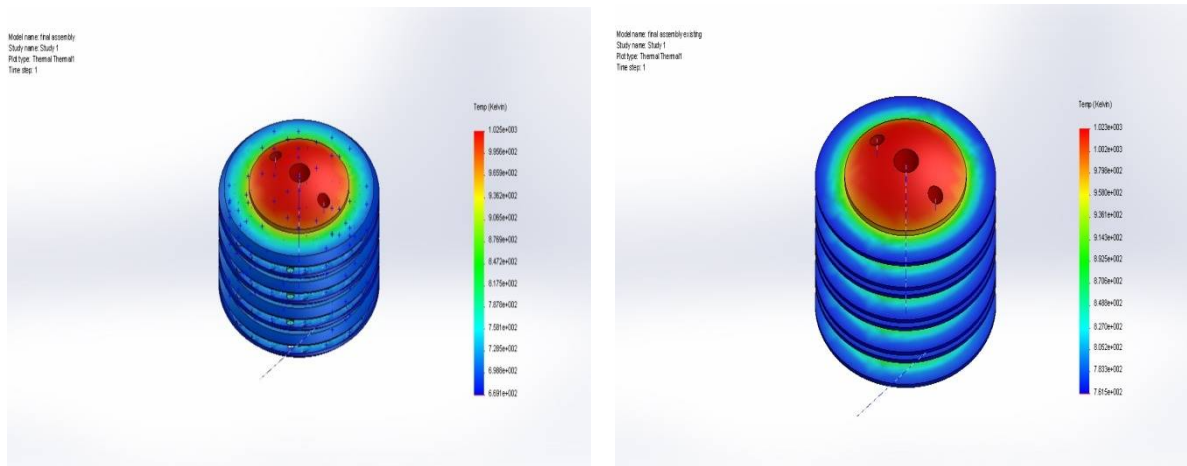


Fig: 4 Comparison between Existing Fin and Newly Developed fin

Ambient Temperature: 305K

Name	Existing Fin		Newly Designed Fin	
	Minimum	Maximum	Minimum	Maximum
Temperature Of the fin at the end of thermal simulation.	761.504 K	1023.44 K	631.092 K	1025.26 K
Pressure [Pa]	94042.25	107434.95	2.62e-008	101870.22
Density [kg/m <sup>3</sup> ]	1.07	1.20	7.10	7.10
Surface Heat Flux [W/m <sup>2</sup> ]	-3333.428	349.092	-2.750e+011	3.757e+013
Temperature Of the Fin At the End of flow analysis.	350.67	394.44	304.97	305.01

## IV. CONCLUSION

Engine life time can be increased with increases the heat transfer rate from engine block to atmosphere, so external surface is required to increase heat transfer rate from the engine block. But in segmental designed fin having some problems to transfer the heat. In this research consider all existing problem and rectified all this type of problem by modified design. In this research have designed a cylinder fin which is used in a Hero Honda Motorcycle and modelled in parametric 3D modelling software Solid works. From the analytical solution, thermal analysis and flow simulation we get that the heat transfer to the atmosphere is more while comparing the existing fin. Hence the change in geometry of fin increases the rate of heat transfer from 1025K to 631K. So the difference of heat transfer temperature different 130K.

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