Thermal Analysis of Engine Cylinder Block Creating Dimple on Triangular Fin

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***Abstract*- Performance of Engine depends on different parameters such as type of materials used for making engine, numbers of fins, fin thickness, and fins Shape which escort thermal effect on them. To transfer the heat from any system either by conduction or convection medium. Both modes of heat transfer have been enhanced by providing an additional equipment's in the outer periphery of the heat transfer system. Heat transfer analysis of engine has been done by using computational fluid dynamics. This study focus on the heat transfer rate in fins of light weight automobile engine with use dimples. In this study triangular dimples made on fins which improve the heat transfer of engine The main objectives of the heat transfer analysis is to enhance the heat transfer rate from system to surrounding.**

Index Terms- Cylinder Block, Triangular Dimple, Heat Flux, Ansys 14.5, Heat Transfer.

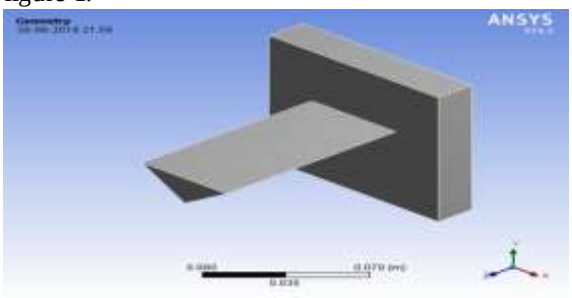
INTRODUCTION

It has been observed that in case of IC engines, combustion of air and fuel takes place inside the engine cylinder and hot gases are being generated. The temperature of gases will be too high. At this temperature it may result into burning of oil film between the moving parts of the engine and may result it seizing or welding of same. So, this temperature must be reduced so that the engine will work much more efficiently. Too much cooling may not be desirable as it reduces the thermal efficiency of engine. So, the work of cooling system is to keep the engine running at its most efficient operating temperature. The note should be taken that the engine is quite inefficient when it is cold and hence the cooling system is to be designed in such a way that it prevents cooling when the engine is warming up and till it attains maximum efficient operating temperature and then it starts cooling. Engines mounted on two wheelers are mostly cooled by natural air. As the heat dissipation is a function of frontal cross-sectional area of the engine, therefore there is a need to enlarge this area. An engine with enlarged area will become heavy and in turn will also minimize the power by weight ratio. Hence, as an alternative arrangement, fins are constructed to enhance the frontal cross-section area of the engine.

Heat transfer by fins

"Pin fin geometry highly affects the different heat exchangers efficiency although these devices are used in various industries. Drop shaped pin fins can show more heat transfer with lower pressure drop from system and it was used for heat exchange purpose from past decades. In the heat transfer, a fin is a surface that extends from an object to increase the rate of heat transfer to or from the environment by increasing convection. The amount of conduction, convection, or radiation of an object determines the amount of heat it transfers.

Increasing the temperature difference between the object and the environment, increasing the convection heat transfer coefficient, or increasing the surface area of the object increases the heat transfer. Sometimes it is not economical or it is not feasible to change the first two options. Adding a fin to an object, however, increases the surface area and can sometimes be an economical solution to heat transfer problems. The model of engine cylinder is shown in figure 1.



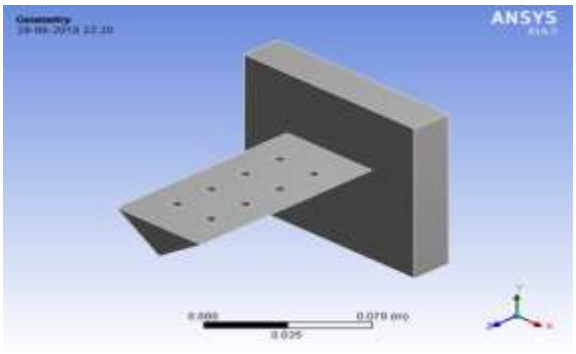


Fig 1. Model View of Engine cylinder block outer

LITERATURE REVIEW

J.Ajay Paul, SagarChavanVijay [2010]
Parametric Study of Extended Fins in the Optimization of Internal Combustion Engine they found for high speed vehicles thicker fins provide better efficiency. When fin thickness was increased, the reduced gap between the fins resulted in swirls being created which helped in increasing the heat transfer. Study of Extended Fins in the Optimization of Internal Combustion Engine.
Kumbhar D.G et.al. [2011]
Heat transfer augmentation from a horizontal rectangular fin perforation whose bases parallel and towards the fin base under natural convection has been studied using ANSYS. Heat transfer augmentation from a horizontal rectangular fin.
N. Nagarani et.al. [2013]
Elliptical fin efficiency is more than circular fin. If space restriction is there along one particular direction while the perpendicular direction is relatively unrestricted elliptical fins could be a good choice. Heat transfer rate and efficiency analysis for circular and elliptical annular fins for different environmental conditions.
K. Mayilsamy [2014]
Normally heat transfer co- efficient depends upon the space, time, flow conditions and fluid properties. If there are changes in environmental conditions, there is a change in heat transfer co-efficient and efficiency also. Experimental Analysis of heat transfer on annular circular and elliptical fins.
H.M. Dange [2016]
The experiment is carried for different air flow rate with varying heat input. The CFD temperature distribution for all cases verifies experimental results. At air flow rate of 3.7 m/s, the heat transfer rate decreases as heat input increases. CFD and experimental analysis of elliptical fins for heat transfer parameters.
Ashok Kumar et. al.[2017]
The results indicate that the presence of fins with dimple shows improved results on the basis of heat transfer. Reduce the Heat of the Engine by Making Dimple in the Fins of the two Wheeler Engine.

METHODOLOGY

Geometry Description
The meshing model of the engine block cylinder having triangular fin with and without dimple is shown in the Figure 2. For simulating the engine block cylinder having triangular fin with and without dimple ANSYS 14.5 finite element control volume approach has been used. The geometry of engine block cylinder having triangular fin with and without dimple are as follows:

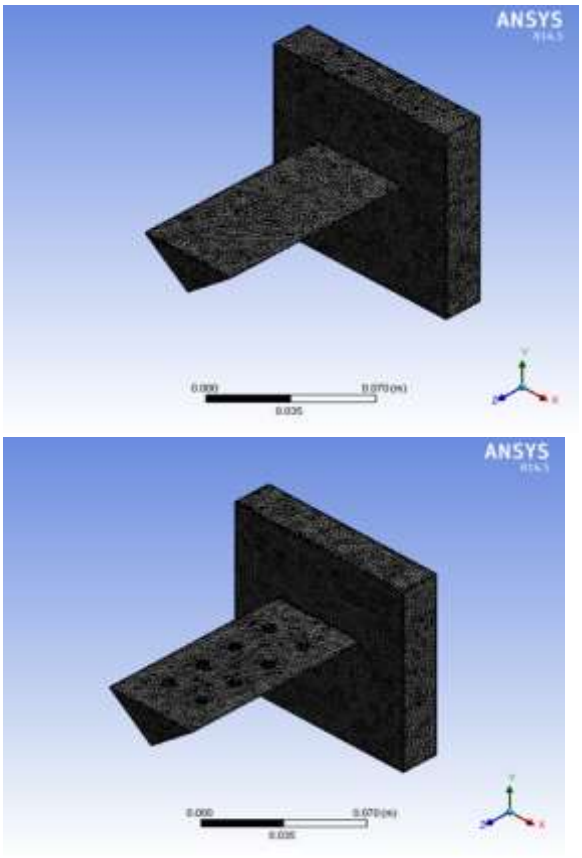


Figure 2 Meshing of Triangular fin with and without dimples.

Table 1. Dimensions and Material of triangular fin with and without dimple.

Material	Aluminium Alloy
Base Plate Size	Height =100mm Length =100mm Thickness =20mm
Triangular fin dimension	Base =50mm Height =20mm Length =100mm
Dimple dimension	Number of hole =8 Diameter =5mm

RESULT AND DISCUSSION

After applying the boundary conditions, the solution is initialized and then iteration is applied so that the values of all parameters can be seen in a curve or line graph. After the iteration gets completed final result could be seen. CFD study is conducted to study the effect in heat dissipation in cylindrical block having triangular fins with and without dimples. Afterward, the effect of hole in heat dissipation is analysed. The obtained results are presented.

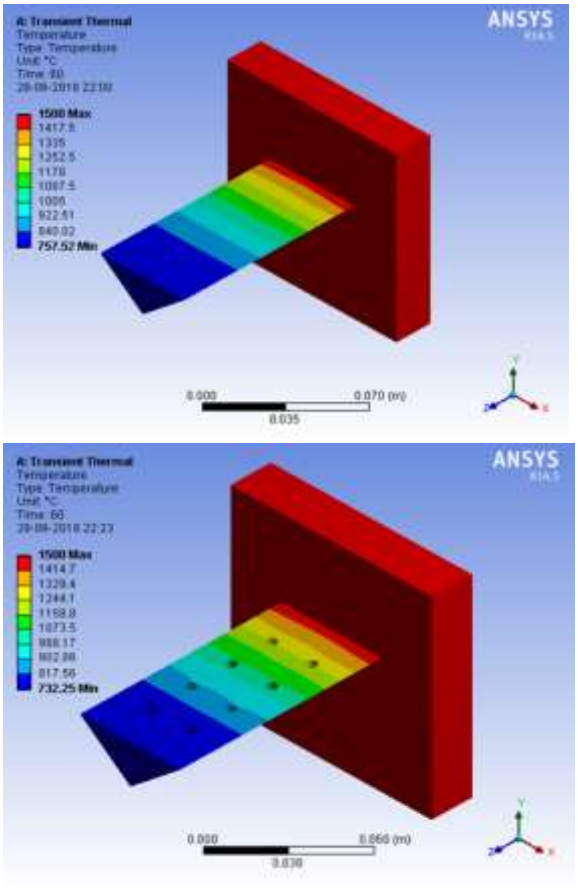


Figure 3Temperature contour of Triangular fin with and without dimple

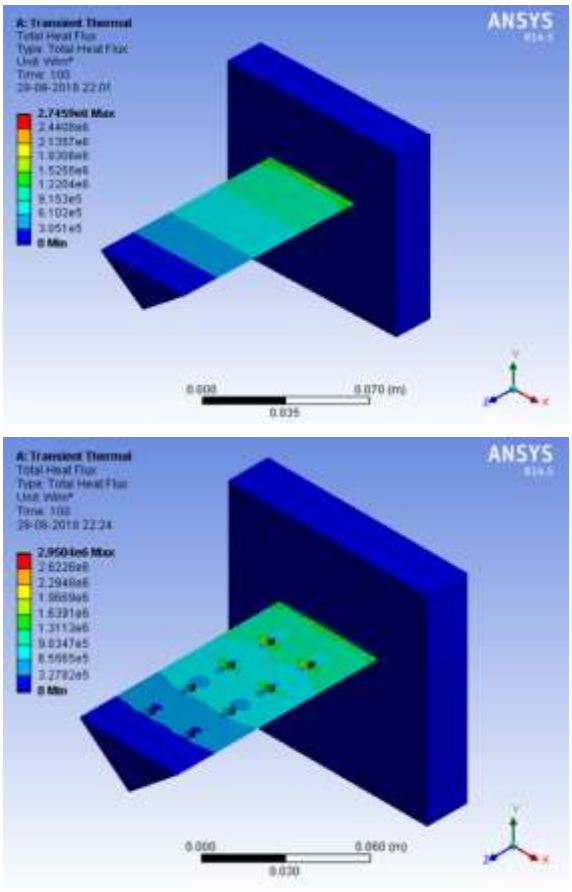


Figure 4 Total heat flux contour of Triangular fin with and without dimples

CONCLUSION

Transient thermal analyses were performed for actual and proposed design of engine cylinder in order to optimize geometrical parameters and enhanced heat transfer from the IC engine. In the present work transient thermal analysis is performed on actual design and also on two different geometrical designs at ambient temperature 30oC.

The following points have been recognized in the form of conclusive statements which are as follows.

- The result of transient thermal analysis of design of engine cylinder at ambient temperature 30oC indicates the temperature at the end of fin for triangular fin without dimple is 1085.8oC while in previous study with rectangular fin without dimple was 1072.1 oC at 100 second.
- The result of transient thermal analysis of design of engine cylinder at ambient temperature 30oC indicates the temperature at the end of fin for

triangular fin with dimple is 1061.2oC while in previous study with rectangular fin with dimple was1091.4oC at 100 second.

- The variation in temperature without dimple is 1.277% and with dimple is 2.767 as compared to previous model.

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