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CFD ANALYSIS OF CACTUS AND INVERTED TRAPEZOIDAL SHAPE FIN PROFILE FOR FOUR STROKE IC ENGINE

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ABSTRACT

CFD analysis plays an important role in understanding the working of the model and getting the best result economically. Nowadays CFD analysis is a powerful tool for engineers. CFD is used in various tasks to get the idea of how it would actually work practically before building any prototype of that model. In this paper CFD analysis of fin profile is done for four stroke IC engine. Here four fin profiles have been considered for analysis. Main objective of this paper is to select best fin profile which has highest heat transfer rate among the other three fin profiles. For better results two new fin profile have been designed. The calculations and CFD analysis for inverted trapezoidal and Cactus-Shape fin profile have been shown. For model validation, direct results for triangular and rectangular profile have been shown by comparing the CFD values with experimental values. In Ansys steady state thermal analysis, observations have been made for cactus shaped fin profile which has highest heat transfer rate of 148.800 W per fin among all expansion strokes and on the other hand, the inverted trapezoidal profile has highest heat flux of 299.247×10³ W/m² among all expansion strokes. The steady state thermal analysis of the fin is carried out by using aluminium material which is lighter, economical and has a higher thermal conductivity. For better heat transfer rate cactus shape fin profile can be selected.

Keywords *Cactus Shaped Profile, CFD analysis, Fin profile, Inverted Trapezoidal Profile.*

1. INTRODUCTION

In four stroke IC engine, the surface of the cylinder gets heated due to various strokes such as compression, expansion and exhaust. So, to dissipate the heat from surface of the cylinder, an extended surface is connected to the cylinder which is known as fin. According to Fourier's law of heat conduction, the heat transfer rate will be directly proportional to the heat conduction area. So, while attaching the extended surface which is also known as fins, the area of the cylinder to dissipate heat will be increase. So, the heat transfer rate will also increase and more heat will be dissipate from the inner side of the cylinder to the atmosphere through fins. For this reason, we use extended surface (fins) on the outer part of the cylinder. There are many types of fin profile available. But in this paper two new fin profiles have been designed which has better heat transfer rate and heat flux as compared to others.

In [1], the new design and heat transfer properties of the fins have been analyzed to increase the heat transfer rate and fin efficiency by simulating the different geometry fins. In [2], for the different profile with the aluminium material, a numerical analysis is investigated. To enhance rate of heat transfer by transferring heat from different types of fins with notches with varying materials has done by [3]. The fins with groves or notches reduces the cost of the material. Optimizations of engine fins and heat transfer analysis for different geometries has done by [4]. In [4], study have been made for optimizing heat transfer rate with different material. They have analyzed the heat transfer rate by varying the shape and surface roughness of the fins.

In this paper, for analysis, Ansys steady state thermal 2021 R1 has been used for calculating heat transfer rate. Since only the experimental values of heat transfer rate for rectangular and triangular fin profile are available from [2], for model validation, CFD analysis is performed for rectangular and trapezoidal fin profile. Once the model validation is done for rectangular and triangular fin profile by comparing CFD values with experimental values, the same model can be used for cactus and inverted trapezoidal shape which will give acceptable result.

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