OPTIMISETION OF CYLINDER HEAD FINS: A REVIEW

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ABSTRACT

The present project is based on the concept of CAD-CAM and its industrial application. CAD- CAM is very wide field which began with automotive industries and then it spread up in almost all the industries like medical application; mechanical engineering; civil engineering; marine services and such others. Mechanical engineers mainly concern with core industrial processes like manufacturing of steel, forging, casting and many such others. How CAD-CAM provides assistance and how it can be beneficial to the industry is always been a question mark. For this project the cylinder head is reverse engineer for modeling and perform transient thermal analysis on it, for knowing temperature and thermal stress distribution by using CAD-CAE. And optimize the present fin by redesign for 100 cc engine.

Keywords: - Heat Transfer, FEA Analysis, Fins, Modeling

AIM: -

The aim of the project is to study the present 100 cc engines cylinder head and reverse engineering for modeling then performing thermal analysis of it also redesign present fin by varying shapes and thickness and make comparison for optimization.

OBJECTIVES:-

To attain the above aim the following objectives are deciphered to

- Study the cylinder head (model) without actual manufacturing.
- Select the proper material for cylinder head.
- Model of cylinder head and also different shapes of fins.
- Analyze the heat transfer rate along the cylinder head and on different shaped fins.
- Finally compare the result of heat transfer by fins.

REVERSE ENGINEERING:-

• The process of recreating a design by analyzing a final product.

• The process of duplicate of an existing component or product without the help of drawings, documentation or computer model is known as reverse engineering.

• A systematic methodology for analyzing the design of an existing device or system either as an approach to study the design or as a prerequisite for re-designs

TYPES OF FIN

In Practice all kinds of shapes and size of fin are employed. Some common types are

1 Uniform straight fin

2 Tapered straight fin

3 Splines

4 Annular

5 Pin Fin

REVIEW OF LITERATURE

The literature review gives some background into the engine worked out in various industries.

Rosli abu bakar,devaraj Ramasamy and chiew Chen wee had studied the importance of heat transfer in design of two stroke engines to make sure the engine will perform to expectation during actual working condition. Heat transfer was modeled with conduction as the main source of heat transfer and neglecting convection and radiation. Heat transfer is a very wide field used in analysis of internal combustion engine. Heat transfer in spark ignition engine is needed to determine thermal stress on material component. Thermal stresses must be kept below level that would cause fatigue cracking (less than about 400◦c for cast iron and 300◦c for aluminum alloy). As technical remark the engine seem to dissipate the heat generated quite efficiently as the value are constant in the 60 second time of the analysis. But hear the time can also be increased to give a more detailed view of heat transfer scenario. The thermal load causes very less displacement to the material and value are almost in microns**.** [1]

H.K.D.H Bhadeshia suggested that Thermal analysis comprises a group of techniques in which a physical property of substance is measured as a function of temperature, while the substance is subjected to a controlled temperature program. In differential thermal analysis, the temperature differences that develop between a sample and an inert reference material are measured, when both are subjected to identical heat treatment. The related technique of directional scanning calorimetric relies on difference in energy require to maintain the sample and reference at an identical temperature. Length or volume change that occur on subjecting material heat treatment are detected in dilatometry; x-ray or neutron diffraction can also be used to measure dimensional changes.

Both thermo gravimetric and evolved gas analysis are technique which relies on samples which decompose at elevated temperature. DTA may be defined formally as a technique for recording the differences in temperature between a substances and a references and a references material against either time or temperature as the two specimens are subjected to identical to temperature regimes in an environments heated or cooled at controlled rate.[2]

V.Esfahanian, A.Javaheri and M.G haffarpour Studied Thermal analysis of an S.I. engine using different combustion boundary condition treatment and the heat transfer to an engine. Three different methods for the combustion boundary condition are used. The result of different combustion side boundary condition treatment is compared and their effect on the thermal behavior of the combustion chamber is investigation .it has been shown that using spatial and time

averaged. Combustion side boundary condition is a suitable treatment method within engineering approximation. The main heat source for the piston is the hot gases in the combustion chamber for this boundary condition .this engine are modeled with KIVA-3V computational code. From the combustion chamber thermal analysis point of view the hot gases in the combustion chamber at various stages (resulting from the KIVA-3V code) is required. There for iteration is needed to obtain the correct boundary condition.[3]

Ing. RadekTichánek, Ing. MiroslavŠpaniel, CSc.,Ing. Marcel -Cylinder head is one of the parts of I.C.Engine which is responsible for maintain temperature. One end of it close. It contain the inlet and exhaust valves through which the air fuel mixture entered inside cylinder and exhaust gases escape to the atmosphere from the cylinder.

In the combustion chamber there are peaks of combustion pressure and temperature on the order of 15 MPa and 2500K. The heat fluxes and temperature no uniformities lead to thermal stress, which further escalates mechanical loading from combustion pressure. The maximum temperature of the head material is much lower and the regions around the combustion chamber need to be safely cooled to prevent overheating. Placing the cooling passages closest to the most exposed regions is not always possible because of space demand, which results in limited cooling in these regions. The parts of the engine head assembly are usually made of different materials with various thermal expansion. These facts lead to many compromises In Design, which can be sources of failures in operation. To avoid the risk of failure in operation is one of the targets of engine designers. The design of the engine head must be tested under operational conditions. This procedure is necessary but expensive. An FE modeling of the cylinder head assembly operational conditions isan appropriate complement to the operational testing. [4]

Azrol Bin Arof, This dissertation describes the stress distribution of the upper piston with using finite element analysis. The finite element analysis is performed by using computeraided engineering (CAE) software. The main objectives of this project are to investigate and analyze the stress distribution of upper piston at the real engine condition during combustion process. The dissertation describes the mesh optimization with using finite element analysis technique to predict the higher stress and critical region on the component. The upper piston is implemented in the six stroke engine of 110 cc Modena's motorcycle. Aluminum 356-T7 is selected as an upper piston material. Despite all the stresses experience by the upper piston does not damage the upper piston due to high tensile strength but the upper piston may fail under fatigue loading. Thus, it is important to determine the critical area of concentrated stress for appropriate modification. With using computer aided design (CAD) which is SOLIDWORK, the structural model of an upper piston is developed. Furthermore, the finite element analysis performed with using MSC PATRAN and MSC NASTRAN. The finite element analysis is performed by using linear static stress method. The result of the analysis shows that mesh type of TET 10 give more accurate result compare to TET 4 at its each mesh convergence point. The stress analysis results are significant to improve the component design at the early developing stage. The result can also significantly reduce the cost and time to manufactured the component and the most important to satisfy customer needs. [5]

G. Babu, M. Lavakumar Presented the results of various shapes of fin by varying its geometry and material. Parametric models of cylinder head with fins have been prepared to find out the transient thermal behavior. The models are created with, rectangular, circular and curved shaped fins and also by changing thickness of the fins.The analysis is done using ANSYS. Presently Material used for manufacturing cylinder fin body is Aluminum Alloy 204 which has thermal conductivity of 110-150W/mk. They have analyzing the cylinder fins using Aluminum Alloy 204 material and also change material to Aluminum alloy 6061 and Magnesium alloy which have higher thermal conductivities.[6]

P. Sai Chaitanya, B. Suneela Rani, K. Vijaya Kumar Suggested that The Engine cylinder is one of the major automobile components, which is subjected to high temperature variations and thermal stresses. In order 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. P. Sai Chaitanya, B. Suneela Rani, K. Vijaya Kumar Experimented the on fin by changing dimensions and material then comparison is made to get optimum result. 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 aim of the present paper is to analyze the thermal properties by changing design, material and thickness of cylinder head fins using ansys work bench. Thermal analysis shows temperatures and other thermal quantities those changes with respect to time. The accurate thermal analysis could permit critical design parameters to be identified for improved life. Presently Material used for manufacturing cylinder head fin body is Aluminum Alloy A204 it has thermal conductivity of 110-150W/mk and also using Aluminum alloy 6061 which have higher thermal conductivities.[7]

CONCLUSION

From above discussion it is concluded that Cylinder head fin may optimize for better heat transfer by changing shape or redesign.

In present cylinder head, it is found that problem regarding heat transfer. To overcome such difficulty it need to change design of Present fins. I will design various shapes of fins (including Present one) and conduct Experimentation on that by any one analysis software.

The various types of fin which I am going to study are:

- Rectangular fin. Triangular fin, Tapered fin.

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