Thermal Analysis of Cylinder Liner to Improve Efficiency of Diesel Engine By Using FEA

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Abstract- *The Cylinder liner is one of the key components of diesel engine. Many times it is difficult to analyze the actual working conditions and problems created which may lead to development of stresses and thus may cause failure, also it's difficult to find the stresses developed in each section of component thus the, material required to added or subtracted not easily analyzed. Therefore, the element analysis of Cylinder liner in the heat load and mechanical load is significant, the finite element analysis shows the deformation and the stress distribution of the Cylinder liner. It is meaningful for improving Cylinder liner material and reliability.*

Keywords- ANSYS,Cylinder liner, diesel engine, FEA

I. INTRODUCTION

Cylinder liner is a component of the IC engine which is cylindrical in shape and is installed within the engine block. The purpose of the liner is to provide surface for the piston to reciprocate and perform its objective of compression. These liners are removable and can be replaced when they worn out. Generally, liners are made from materials like cast iron and aluminum alloys.

In a four stroke cycle engine, the shape of the liner is flanged at the top end in order to provide location where they can be securely placed in the block. Below this flange, there is a joint ring, usually made up of copper or heat resistant rubber in several cases. The lower end of the liner has rubber rings fitted to seal the bottom from the water space and also prevents oil from the crankcase to enter the water jackets.

A cylinder liner is designed by treating it as either thick cylinder or thin cylinder depending upon the bore to thickness ratio. A cylinder liner should be checked for thermal stress caused by high temperature difference between the outer and inner surfaces of the liner. In a cylinder liner, longitudinal stress is produced in addition to hoop stress, though marginal which causes extension of the cylinder. The side thrust caused by obliquity of the connecting rod on the cylinder liner induces bending stresses.

II. LITREATURE REVIEW

Materials for dry cylinder liner

The liner material should be strong, hard and corrosion resistant and produce a good bearing surface. The liner materials in order of preference are: A good grade grey cast iron with homogenous and close grained structure, i.e., Perlitic and similar cast irons. Nickel cast iron and Nickel chromium cast iron Nickel-chromium cast steel with molybdenum in somecases

A. Ductile iron is not a single material, but a family of cast irons distinguished by its micro structural features. Engine Builder columnist Norm Brands explains the difference this way: Fig No2.15- Dry cylinder liner without and with collar "To the naked eye, both types appear to be extremely smooth. Under a microscope, however, there is a clear difference between gray iron and ductile iron. Gray iron has a more textured appearance, with a surface made of larger, coarser-shaped granules or graphite flakes. Ductile iron has a smoother appearance, made of smaller, more rounded graphite nodules."

Although the main focus of this study is the effect of liner temperature upon frictional losses and fuel consumption from an IC engine, it is also interesting to investigate briefly the rate at which the thermal losses are reduced as the liner wall temperature rises. This simple method eliminates the need for a lengthy, cumbersome Computational Fluid Dynamics (CFD) and thermodynamic analyses (e.g. see [51,52]), even though such an analysis would provide more detailed and accurate predictions

The heat transfer coefficient depends on the engine geometry, such as the exposed cylinder area and bore, and the piston speed. Due to the complex gas flow in the cylinder, it varies with location in the cylinder and in time with changing piston position. The value of the heat transfer coefficient is found from a Nusselt number - Reynolds number type correlation, A number of empirical equations exist for hg in the cylinder at any instant; perhaps the most commonly used being that by Woschni.[8] There are three types of heat transfer coefficients used in engines heat transfer. The peak values of the instantaneous and local coefficients can be many times higher than the averaged values.

III. RESULT AND CONCULSION

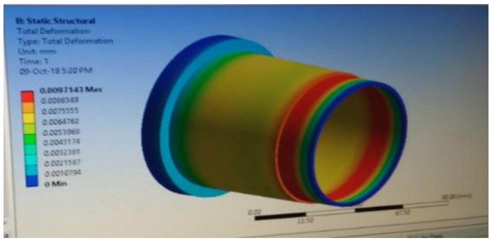

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Fig 1: model discription

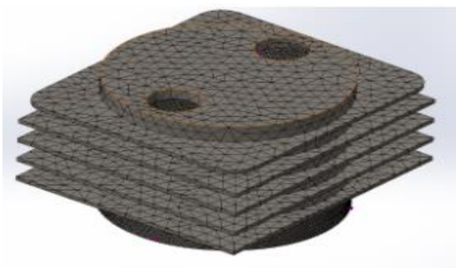

Fig 2:- meshing of cylinder fin

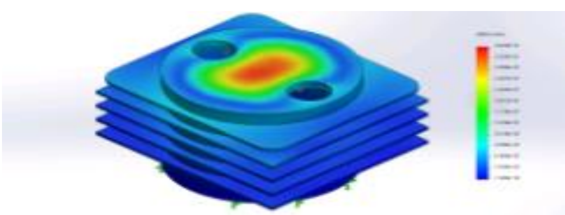

Fig 3:- analysis of cylinder fin

The design constains of cylinder liner fin simulation are :

1.An air cooled motorcycle engine release the heat to the atmosphere through the mode of forced convection, fins are provided on the outer surface of the cylinder block of the engine. The fins allows the cooling wind over its surface and transfer heat from fins surface to the air.

2.In order to have efficient cooling by means of air, providing fins around the cylindered. cylinder head increases the contact area. A blower is used to provide air. Advantages of Air Cooled Engines

3. To solve this, fins are provided on the outer of the cylinder. The heat transfer rate is defined depending on the velocity of vehicle, fin geometry and the ambient temperature. However, CFD analysis will be use to simulate the heat transfer of the engine block. ANSYS software is selected to run the simulation.

3.1 Material properties:-

1. AISIS 4340 Steel annealed
   Yield strength-4.7e+08N/m^2
   Tensile strength:7.45+08N/m^2
   Poisson ratio:0.285
   Mass density:7850kg/m^3
2. Gray cast iron
   Tensile strength:1.51658e+08N/m^2
   Elastic modulus : 6.61721e+10N/m^2
   Poisson ration:0.27
   Mass density :7200kg/m^3

3.2. Advantages and limitations of FEA

Planning the analysis is arguably the most important part of any analysis, as it helps ensure the success of the simulation. Oddly enough, it is usually the one analyst‟s leave out. The purpose of an FE analysis is to model the behavior of a structure under a system of loads. In order to do so, all influencing factors must be considered and determined, whether their effects are considerable or negligible on the final result. The degree of accuracy to which any system can be modeled is very much dependent on the level of planning that has been carried out.FEA is an approximate way of simulating the system behavior. But the results can be quite close to actual testing values. FEA can never replace actual physical testing all the times. This is due to the fact, the information required for FEA simulations, like material properties emanates from physical testing.

FEA results by themselves can never be taken as complete solution. Usually at least one prototype testing is necessary before the design guided/validated through FEA can be certified. But when effectively used FEA can predict the results/behavior quiet close to reality and can reduce the design lead times as well as the number of prototypes to be tested. Also there are some situations like gears in contact, which cannot be simulated exactly using FEA techniques. Under such situations some work around such as simulating the worst condition that can happen can be followed.

IV. CONCLUSION

- Based on the about analysis showed that the maximum stress of the cylinder liner in all operation condition occurs.

- Cylinder liner fin is important to the cooling in engine
- To optimized the design and meet the allowed the stress of the premise we need to design reasonable structured and appropriated heat treatment to minimized the stress concentration.
- So the service life of cylinder liner can be extend.
- The results shows, by using circular fin with material Aluminum Alloy 6061 is better since heat transfer rate of the fin is more. By using circular fins the weight of the fin body reduces compared to existing rectangular engine cylinder fin.

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