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Design And Analysis of Gudgeon pin

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Abstract :*Gudgeon pin connects the piston and the small end of the connecting rod of engines. The wear of the Gudgeon pin and connecting rod concern for the company.In this Way frictional stress and Von-mises stresses are produced on Pin and they are determined by finite element analysis tool ANSYS .Fatigue life of pin is determined using fatiuge analysis tool.*

Keywords *– Analysis Design, Fatigue analysis, Gudgeon pin, Stress analysis,*

I. INTRODUCTION

Piston pin or gudgeon pin connects the piston and the small end of the connecting rod of engines.The premature wear of the Gudgeon pins intiated this FEA investigation.The purpose was to develop design variation that would remove this failure mode.Gudgeon pin is hollow and wear resisting surface.Simple in appearance,no moving parts.Gudgeon pin should be high strength and light in weight.This paper deals with finite element analysis is performed on piston assembly consisting of piston,Gudgeon pin and connecting rod.The assembly of the piston is analyzed with maximum combustion pressure and the frictional streeses and maximum Von-mises stresses coming on the gudgeon pin are determined.In that fatigue analysis is performed on piston assembly.

1.1Piston and connecting rod Gudgeon pin joints

The gudgeon pin connects the piston and connecting rod.Its supported in holes which is bored in piston at right angles to axis of the piston about mid height position, and centre portion of the gudgeon pin passes through the connecting rod small end eye. The piston pin should be centered in the piston.

The method of locating and securing the gudgeon pin in position can be achieved in two ways

1.1.1semi-floating

1.1.2fully-floating

II. Problem Statement

The function of the piston is to absorb the energy released after the combustion and to produce useful mechanical energy. When the combustion of fuel takes place in heavy diesel engine cylinder, high temperature and pressure develops. Because of high speed and at high loads, the piston is subjected to high thermal and structural stresses. The investigations indicate that the greatest stress appears on the upper end of the piston and stress concentration is one of the main reasons for fatigue failure. Due to stress concentration and high thermal load the upper end of the piston, crack generally appears. This crack may even split the piston.

Objective

3.1 To investigate the maximum stress using stress analysis

3.2 To investigate Stiffness of the piston crown to reduce the deformation

3.3 To investigate Fatigue life of piston pin

III. Literature Review

Yanxia Wang et al. [1] Due to the fatigue failure and the fracture injury occurs under the alternative mechanical loads, the optimal design of the piston pin and the piston pin boss is presented depending on the FEA static analysis. The optimization is carried out using the Genetic Algorithm (GA), and the piston noncircular pin hole is used to further reduce the stress concentration on the upper end of the piston pin seat.

Vaishali R. Nimbarte et al. [2] In this paper pressure analysis, thermal analysis and thermo-mechanical analysis is done. The parameter used for the analysis is operating gas pressure, temperature and material properties of piston. In I.C. Engine piston is most complex and important part therefore for smooth running of vehicle piston should be in proper working condition. Piston fails mainly due to mechanical stresses and thermal stresses. Analysis of piston is done with boundary conditions, which includes pressure on piston head during working condition and uneven temperature distribution from piston head to skirt. The analysis predicts that due to temperature whether the top surface of the piston may be damaged or broken during the operating conditions, because damaged or broken parts are so expensive to replace and generally are not easily available.

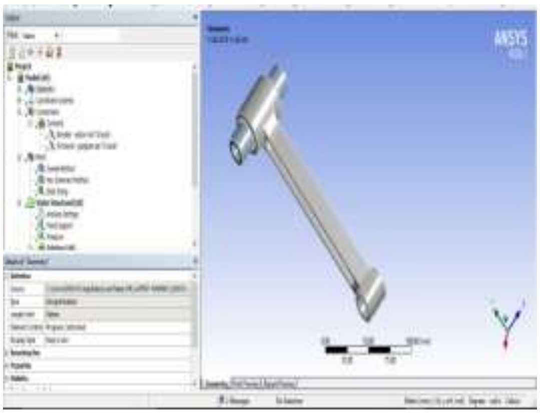
Dilip Kumar Sonar et al. [3] Engine pistons are one of the most complex components among all automotive or other industry field components. The engine can be called the heart of a car and the piston may be considered the most important part of an engine. Notwithstanding all these studies, there are a huge number of damaged pistons. Damage mechanisms have different origins and are mainly wear, temperature, and fatigue related. Among the fatigue damages, thermal fatigue and mechanical fatigue, either at room or at high temperature, play a prominent role. Aluminium alloy have been selected for structural and thermal analysis of piston. An analysis of thermal stress and damages due to application of pressure is presented and analysed in this work. Results are shown and a comparison is made to find the most suited design.

R. C. Singh et al. [4] Piston in the internal combustion (IC) engine is robust, dynamically loaded tribo pair that reciprocates continuously at varying temperature. Study has been made by various researchers on piston design, dynamics, fatigue and wear at the interface with other element in contact along with their effects on IC engines. It was found that the friction coefficient increases with increasing surface roughness of liner surface and thermal performance of the piston increases with increased coating thickness. The free material liberated due to deep scoring between the piston and liner snowballs, leads to seizure failure.

Bhaumik Patel et al.[5] In this study, the wok is carried out to measure the distribution of the temperature on the top surface of the piston. Which predicts that due to temperature weather the top surface of the piston may be going to damaged or broken during the operating conditions because damaged or broken parts are so expensive to replace and generally are not easily available. So it is possible to recover the damage or broken parts due to thermal analysis before taking into operations. It can be seen from that the prescribed operating temperature inside the cylinder penetrates the piston crown through nearly 75 % of its thickness before piston ring dissipates some of heat.

S. Srikanth Reddy et al. [6] In this work, the main emphasis is placed on the study of thermal behaviour of functionally graded coatings obtained by means of using a commercial code, ANSYS on aluminium and zirconium coated aluminium piston surfaces. The analysis is carried out to reduce the stress concentration on the upper end of the piston i.e. (piston head/crown and piston skirt and sleeve). With using computer aided design NX/Catia software the structural model of a piston will be developed. Furthermore, the finite element analysis is done using Computer Aided Simulation software ANSYS.

Finite Element Analysis



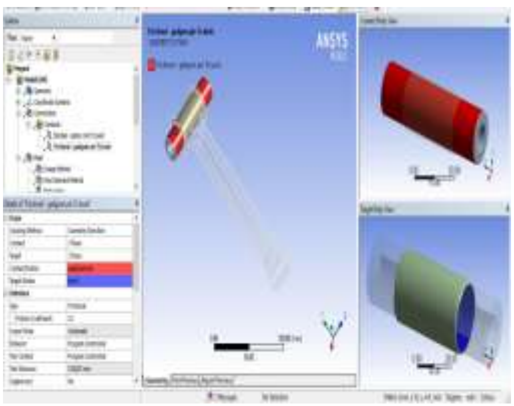


fig1. Import the CAD model in Ansys Workbench using Import command **fig2.** Set the contact between parts of analysis and Mesh the CAD model with proper meshing techniques

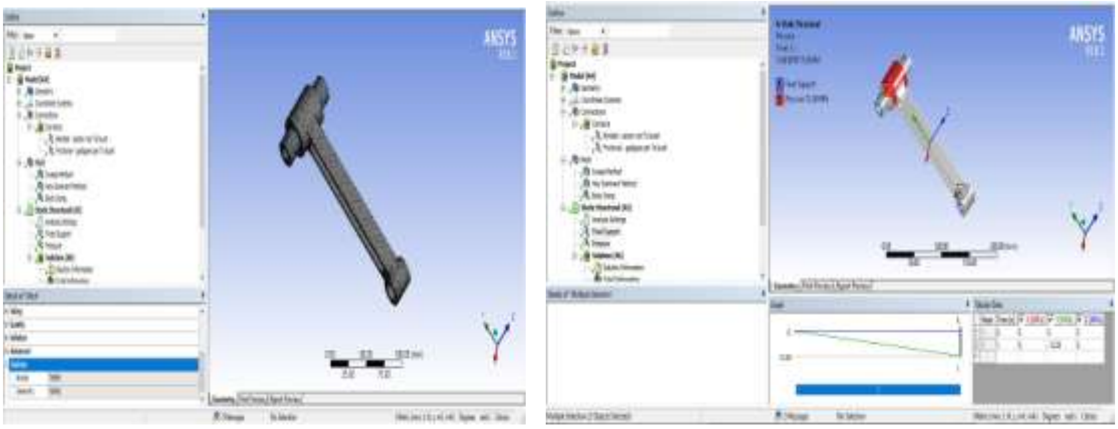
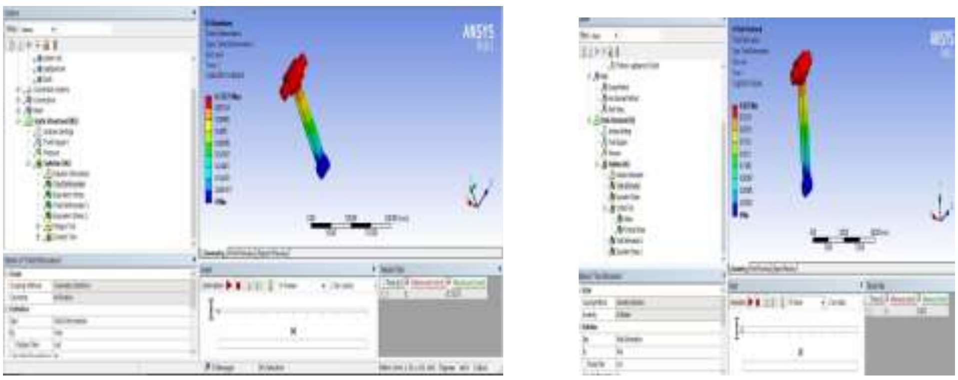


fig3. Apply the boundary conditions at the desired locations- fixed support and loading

fig 4 Frictional stress in both material

fig 5 - Von Mises stress in both material



fi g 5 Deformation in both material

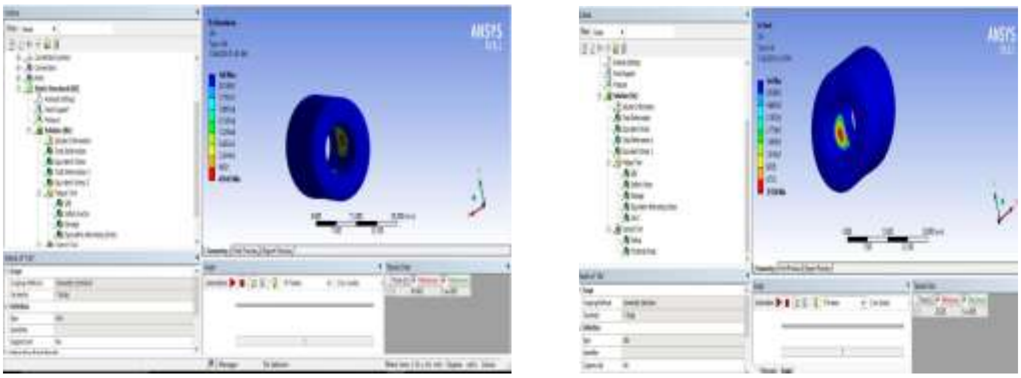


fig 6 Fatiuge life in both material

IV. Result

Parameters	Aluminum(FEM)	Steel(FEM)
Frictional stress	26.43	16.89
Von Mises stress	171.44	178.36
Deformation	0.7325	0.2611
Fatiuge life	1e8	1e6

Table 1 Comparison between aluminum and steel

V. Conclusion

As we considered both the material compared with each other. The aluminum having better strength as compared to steel..

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