MODELING AND ANALYSIS OF CONNECTING ROD, PISTON AND GUDGEON PIN

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ABSTRACT: The present aim of the project is to study the effect of the materials being used for the Connecting rod, Piston and Gudgeon pin assembly for an engine. The material selected for the piston, connecting rod and gudgeon pin is ALLUMINIUM ALLOY. The engine speed was desired to be increased. The effect of the materials used for the assembly and its behavior was required to be studied. The parts connecting rod, Piston and gudgeon pin are designed using theoretical calculations. The designed parts are modeled and assembled in 3D modeling software CATIA . The meshing is done in Hyper mesh. The Finite Element Analysis is done in Ansys. The FE Analysis involves structural analysis of the assembly. The parts of the assembly should be rigid. And, when they are connected together, they should perform as a mechanism. This requires calculation of the forces acting on the components and the dynamic stresses. As the assembly will be working under high temperatures, thermal analysis also has to be done. From the results, it is observed that a change in the piston material will allow the engine to operate at the new high speed.

LITERATURE SURVEY

Digvijay, Mohd.Ahmad, Ajay Mishra, Karunakar Mishra,AlokPanday, ShyamBihary Lal Connecting rod is an intermediate link between piston & crank. it's responsible to transmit the push & pull motion from the piston pin & crank pin. they also converting reciprocating motion of the piston to rotary motion of the crank. The main objective of this work is to weight reduction opportunities in the connecting rod of an I. C. engine by examining various materials such as steel alloy, cost Iron, Structural steel. The objective of the present work is to design & analyses of connecting rod made of structural steel. Insulated Pistons made of Composites", National Conference on Machines and Mechanisms (NACOMM- Ravinder Reddy P., Ramamurthy G,"Computer Aided Analysis of Thermally Air Gap 95), pp. 177-180, Jan 20-21, 1995, CMERI, Durgapur Ravinder Reddy Pinninti [1] has investigated to determine both temperature and thermal stress distributions in a plasmasprayed magnesia- stabilized Ekrem Buyukkaya [7], Muhammet Cerit [6] et al (2007) has investigated a conventional (uncoated) diesel piston, made of aluminum silicon alloy and steel. He has performed thermal analyses on pistons, coated with MgO– ZrO2 material by means of using a commercial code, namely ANSYS. Finally, the results of four different pistons are compared with each other. The effects of coatings on the thermal behaviors of the pistons are investigated. Bala Showry A.V.S et al, Analysis of the stress distribution in the various parts of the piston to know the stresses due to the gas pressure and thermal variations using with Ansys. The definite-element analysis software, a three-dimensional definiteelement analysis has been carried out to the gasoline engine piston. Considering the thermal boundary condition, the stress and the

deformation distribution conditions of the piston under the coupling effect of the thermal load and explosion pressure have been calculated, thus providing reference for design improvement. Results show that, the main cause of the piston safety, the piston deformation and the great stress is the temperature, so it is feasible to further decrease the piston temperature with structure optimization. U.I Siodin et al,study for wear interaction between piston and piston ringgroove in radial piston ringThis paper involves simulation of a 2-stroke 6S35ME marine diesel engine piston to determine its temperature field, thermal, mechanical and coupled thermal mechanical stress. The distribution and magnitudes of the afore-mentioned strength parameters are useful in design, failure analysis and optimization of the engine piston. The piston model was developed in solid-works and imported into ANSYS for pre-processing, loading and post processing. Material model chosen was 10-node tetrahedral thermal solid 87. The simulation parameters used in this paper were piston material, combustion pressure, inertial effects and temperature. Yanxia Wang et al. 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. In this paper pressure analysis, thermal analysis and thermomechanical 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. 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 “THERMAL ANALYSIS OF A PISTON OF RECIPROCATING

AIR COMPRESSOR”, by Bhaumik Patel, Asst. Prof. Mechanical Engineering,

L.D.R.P Institute of Technology and Research, Gandhinagar, in International Journal of Advanced Engineering Research and Studies, Volume-1, Issue-3, ISSN 2249– 8974, Page No- 73-75. “In this

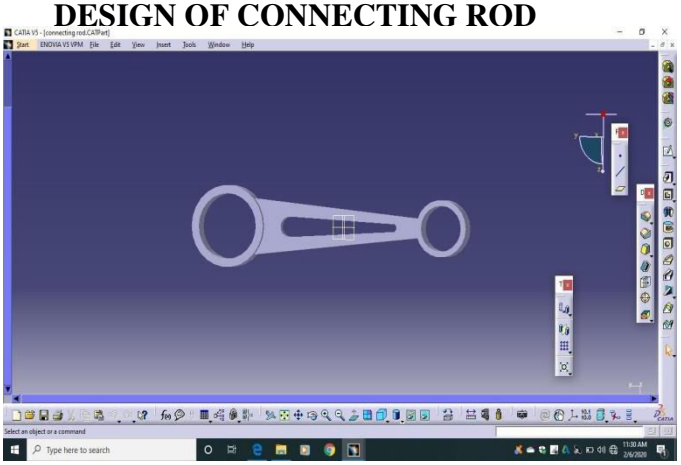
study, the wok is carried out to measure the distribution of the temperature on the top surface

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." Points to be note from this: - Boundary condition for thermal analysis - Temperature distribution in piston.

MODELING OF CONNECTING ROD, PISTON AND GUDGEON PIN IN CATIA

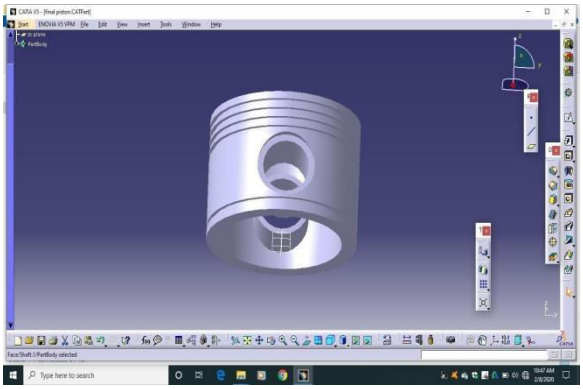
A connecting rod, also called a con rod, is the part of a piston engine which connects the piston to the crankshaft. Together with the crank, the connecting rod converts the GUDGEON PIN of the piston into the rotation of the crankshaft. The connecting rod is required to transmit the compressive and tensile forces from the piston, and rotate at both ends.

DESIGN OF CONNECTING ROD



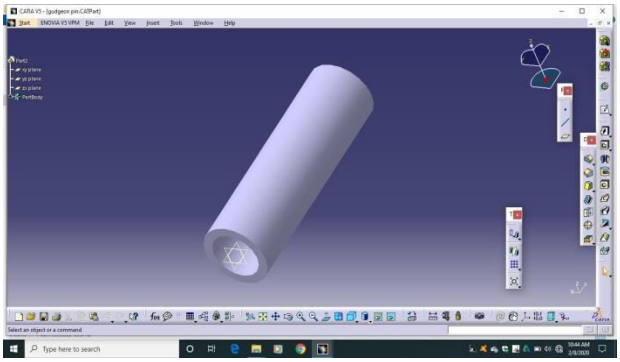
connecting rod

DESIGN OF PISTON



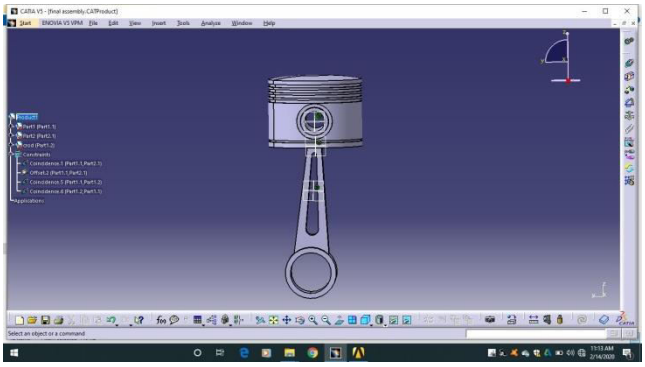
Piston

DESIGN OF GUDGEON PIN



Gudgeon pin

ASSEMBLED DESIGN



Assembled design

STATIC ANALYSIS

Static analysis involves no dynamic execution of the software under test and can detect possible defects in an early stage, before running the program. Static analysis is done after coding and before executing unit tests.

Static analysis can be done by a machine to automatically "walk through" the source code and detect non complying rules. The classic example is a compiler which finds lexical, syntactic and even some semantic mistakes.

Static analysis can also be performed by a person who would review the code to ensure proper coding standards and conventions are used to construct the program. this is often called code review and is done by a peer developer, someone other than the developer who wrote the code.

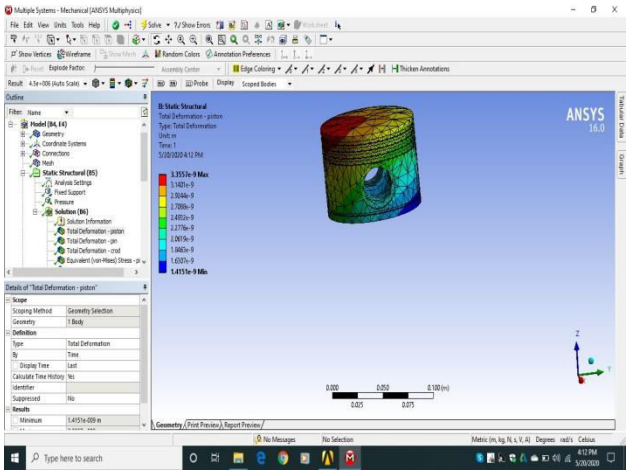
Static analysis is also used to force developers to not use risky or buggy parts of the programming language by setting rules that must not be used.

When developers performs code analysis, they usually look for

- Lines of code
- Comment frequency
- Proper nesting

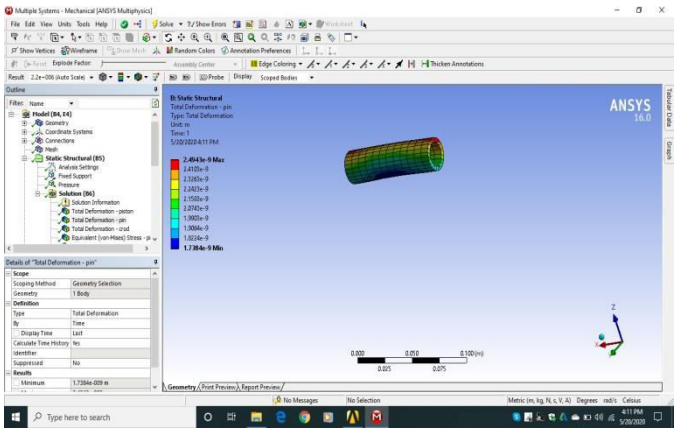
RESULT

TOTAL DEFORMATION OF PISTON



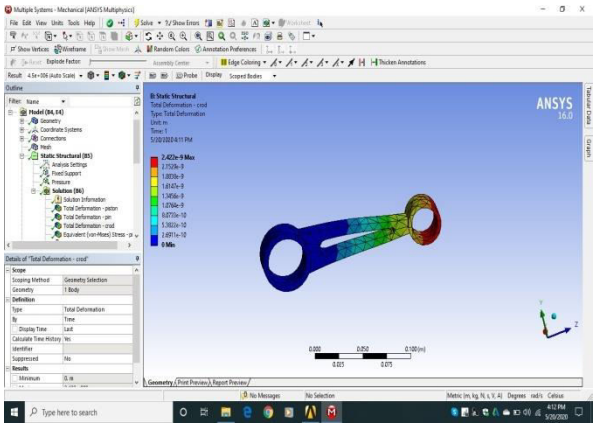
Total Deformation of piston

TOTAL DEFORMATION OF PIN

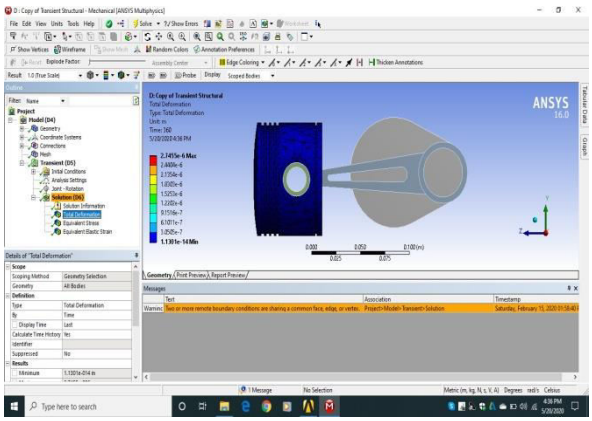


Total Deformation of pin

TOTAL DEFORMATION OF CONNECTING ROD



TOTAL DEFORMATION



The Maximum and Minimum values of Total Deformation

CONCLUSION

In this project, the main parts of the engine piston, connecting rod and Gudgeon pin are designed using the theoretical Calculations for the given engine specifications. The designed parts are modeled and assembled in CATIA modeling software.The materials used are Aluminium Alloy for Connecting rodand Aluminium Alloy for the piston and Aluminium Alloy for Gudgeon pin. To use the same piston assembly for higher speed engines, the material of the piston has to be changed. The stress concentration is then minimised by making suitable changes in connectimng rod, piston design and mounting. The work consists of design of gudgeon pin and then the Finite Element Method is established using CATIA software and ANSYS software to analysis the stresses on gudgeon pin and minimizing it.By using this and the effect of the material use for the assemlly and its behaviour is studied the engine speed is increased.

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Hierapolis relief takes it back another three centuries, which confirms that water- powered stone saw mills were indeed in use when Ausonius wrote his Mose .

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