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A Review Paper on Design Analysis of Internal Combustion Components

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ABSTRACT

This paper deals with the past literature survey which shows that in internal combustion engine components like piston, connecting rod and crankshaft are worked together more efficiently and more accurately. Here the materials are highly compared to their previous materials which are used in these components. This study deals with the various loads which are acting on these different-different components on their main loading sections. The objectives of this paper are to study costs and materials optimization with the help of stress analysis by FEA technique. The designation material of these components is steel alloy.

Keywords: ***Piston, Connecting rod, Crankshaft and FEA technique.***

I INTRODUCTION

An internal combustion engine is a heat engine where the combustion of a fuel occurs with an oxidizer or air in a combustion chamber of internal combustion engine that is an integral part of the working fluid flow circuit. In an internal combustion engine, the expansion of the high-temperature and high-pressure gases produced by the combustion applies direct forces to some components of the engine. The forces are applied typically to pistons, turbine blades, and rotor or on a nozzle. This force moves the components over a distance, transforming chemical energy into the useful mechanical energy. The piston is a cylindrical part which seals one ends of the cylinder from the high pressure of the compressed air and combustion products and slides continuously within it while the engine is in the operation. The top wall of the piston is termed as its crown and is typically flat or concave structure. Connecting rods is connected to the offset section of the crankshaft in one end and to the piston in the other end through the gudgeon pin or connecting pin and thus transfers the force and translates the reciprocating motion of the pistons into the circular motion of the crankshaft. In an Internal Combustion engine a Crankshaft is the one of most significant moving component which converts the reciprocating motion of the piston into a rotary motion of crankshaft with a four link mechanism. Crankshaft experiences a many load cycles throughout its Service life. Fatigue and durability performance of this component have to be considered in the design processes. These

improvements are results in the light and small engines with the improvement in fuel efficiencies and high power outputs. The loads which are acting on the crankpin are generally complex in nature.

II FEM TECHNIQUE FOR OPTIMIZATION

In optimization of different internal combustion components, material and cost are to be taken according to their respective densities and market price. The best material according to the required need is taken as suitable. FEM is numerical methods for solving the problems of stress and thermal analysis which give optimize result to suitable materials. Typical problems areas of interest include structural analysis, heat transfer and fluid flow analysis. The analytical solution of these problems are generally requires the solutions for boundary value problems for partial differential equations. The finite element method is formulation of the problems which results in a system of methods yields approximate values of the unknowns at discrete numbers of points over the domain. To solve the problems, it subdivides a large problem into smaller parts, simpler or smaller parts which is called finite elements. FEM are uses variational methods for the calculation of variations to approximate a solution by minimizing its associated error function.

III LITERATURE SURVEY

Amit Kumar, Bhingole P.P. and Dinesh Kumar [1], in their paper have described that connecting rod withstand high gas pressure. The materials used for connecting rods are mild carbon steels (having 0.35 to 0.45 percent carbon), alloy steels (chromium-molybdenum steels) and different alloys like aluminum alloys, titanium alloys and polymeric materials. These alloys are used for various types of applications depending upon the ultimate tensile strength required for their application. In their study the connecting rod is modulate and simulated for the dynamic analysis by using CATIA software for modeling and design of connecting rod and ANSYS for dynamic analysis.

SanthoshReddy.A, Mr. Shivraj J and Dr.Maruthi B H [2]in their woks has discussed about automobile industries in which they are trying to achieve the fuel economy standards which are set by the various countries throughout the world. To achieve these fuel economy and emission standards, automobile companies are looking for designing and innovation of light weight vehicles. Now a day's automobile companies are considering every possible option to reduce the overall weight of the vehicles to achieve the fuel economy standards set by the various countries government. They have always discussed in his thesis towards the options to reduce the weight of the connecting rod which will be contributes to the reduction of overall weight of the vehicles.

Lokesh Singh, Suneer Singh Rawat, TaufeequeHasan andUpendra Kumar [3]in their research have explained about important of mechanical stress which has to improve the quality and efficiency of the piston. In spite of all the improvements and advancements in the technologies there exists many numbers of damaged pistons. Mechanical

fatigue plays a prominent role in the designing of any pistons. Large numbers of complex fatigue tests are to be done by the piston manufacturers but this involves too much high time and cost. FEM analysis is carried out for stresses, temperature and deformation characteristics of the components. After the results from these analyses practical guidance can be provided for engine designing in order to improve performance and efficiency.

Sheikh Naim Sheikh Yusuf, Nikhil D. Raut, Nitin D. Bhusale and Abhijeet A. Sarnaik[4]in their paper have described about the stress distribution of two different-different aluminum alloys piston by using CAE Tools. The specifications are used for the study of these pistons belongs to four stroke single cylinder engine of Pulsar 150cc motorcycle. This paper tells about the procedure for analytical designing of two different aluminums alloy pistons. The results were predicts the maximum stress and critical regions on the different-different aluminums alloy pistons using CAE Tools. It is most important to locate the critical areas of concentrated stresses for desired modifications.

SurekhaS. Shelke, Dr. C. L. Dhamejani and A. S. Gadhave[5]have worked on the crankshaft which is made up by different modern processes like sand cast, wrought forged, and powder metallurgy. The materials used for crankshafts are medium carbon steels (having 0.35 to 0.45 percent carbon) and alloy steels (chromium-molybdenum steels).These alloys are used for various applications depending upon the ultimate tensile strength required for the anyone application. The crank arm which is connected to the crankpin and the shaft parts. The crankpin is manufacture in beam with a various distributed load along its length that varies with crank position. Focusing on this concern, in this study the Crankshaft is modulated and simulated by using CATIA software and ANSYS is used for analysis.

Surekha S. Shelke, Dr. C. L. Dhamejani and A. S. Gadhave[6]haveresearched on 3-D model of a crankshaft which was designed by using CATIA-V5 software. Using ANSYS tool and apply the boundary conditions, the results are obtained Von-misses stress and shear stress induced in the crankshaft is 204 MPa and 98.4 MPa. The theoretical results obtained are von-misses stress and shear stress is 207.91 MPa and 103.97 MPawhere the validation of crankshaft is compared with theoretical and FEA results in the limits.

JaiminBrahmbhatt and Prof. Abhishekchoubey[7]havedescribed in their paper about comparison of theoretical and FEA analysis of von-misses and shear stress. They have obtained a better results and they have said that Dynamic FEA is a good tool to reduce costly experimental workwhich can be optimized as per given condition.

KunalSaurabh, AbhishekPandey, Anand T, Abhijeet R and Amit K [8] have concluded from their works on stress and thermal analysis of combined effect on piston, pin and connecting rods which give the better condition of FEM analysis. The stress on individual piston components is obtained with 81.22 MPa with minor error of 4.4%. This process helps in further analysis on combined effect of piston, pin and connecting rods. And, also thermal analysis

of individual component of piston is obtained with maximum temperature is 250^0C. This is better heat generation inside combustion chamber. It is found that exerted pressure on piston play vital role to move load from combustion chamber i.e. cylinder inside to crankshaft via connecting rod.

IV CONCLUSION

Conclusion of this paper is to deal with the weight and cost optimization of internal combustion engine with their respective previous studied material. This review study deals that the more efficient and useful material which is to be analyzed according to their market price and respective densities of them by FEA technique. In FEA technique desired analysis is stress analysis on each section of the internal combustion engine components has to be done.

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