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A Review Paper on Technical Advancement of IC Engine Connecting Rod

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Abstract—*The highly competitive global automobile sector always demands the cost and fuel-efficient engines without compromising the vehicle safety standards. It has now become the modern trend in the automotive engineering industry to emphasize on the optimization of the engine components. The automobile engine consists of connecting rod, crankshaft, piston, cylinder block, valves, etc. Connecting rod, being a very crucial component must have certain characteristics like very high rigidity and fatigue strength to tackle the huge dynamic stresses and at the same time, it should have the lowest weight possible. Till now so many techniques are evolved for improving its robustness and efficiency of the connecting due to continuous researches and experimentations. Its prime function is to transfer the power produced by the gases from the piston to the crankshaft which eventually drives the wheels of the automobile. Hence, it becomes necessary to optimize the connecting rod. In the past various researches have been done on weight optimization, fatigue analysis, and buckling analysis of the connecting rod. The detailed review targets the fatigue analysis for the identification of critical parts of the connecting rod as well as the exploration of alternate materials which satisfies the design constraints for weight optimization.*

Keywords: *Connecting Rod, fatigue strength, weight optimization, dynamic stresses.*

1. INTRODUCTION

The connecting rod is a basic component of an IC engine that establishes the relation between the piston and the crankshaft. The expanded gases exert the pressure to the piston which eventually drives the crankshaft with the aid of connecting rod. So basically it is the immediate component that helps in the conversion of straight travel of the piston into the rotatory travel of the crankshaft. Since the temperature of them expanded gases reaches very high, there is also a provision of oil drills in the connecting rod to cool it.In order to sustain such high pressures and stresses; it must have sufficient mechanical strength. Various kinds of material is available in the market like cast iron , aluminium, titanium, and their different alloys, but finding their best combination and composition is the real task**.**

Figure 1: Connecting rod fitted in piston

2. LITERATURE SURVEY

D. Gopinath, Ch.V.Sushma[1] developed a geometric model of Forged Steel connecting rod using CATIA, and using HYPER MESH software, Finite Element modal was developed to analyze the design performance. The various stresses were found for the existing load conditions using ANSYS 11.0 software. For weight reduction, Topological optimization technique was used which helped in a mass reduction of the connecting rod by 483 grams, and the stress distribution in the middle of the shank region found to be very low compared to the designed values.

S.V. Uma Maheswar, T.V. Hanumanta Rao, K. Satyanarayana, B.Nagaraju[2] performed kinematic and dynamic analysis of a connecting rod using MATLAB at different compression ratios related to the diesel engine. In the analysis they have taken three different materials namely Forged Steel, Aluminium Alloy and Titanium Alloy. For these materials Von-misses stresses and equivalent deformations

were calculated using ANSYS software. From the data, it is concluded that the fatigue life of Titanium Alloy is $5.4282e^7$ cycles for the design values they have taken which was nearly ten times the fatigue life of of Aluminium Alloy and hundred times than that of Forged Steel. Also the Titanium Alloy produced the best results under high loading conditions.

Vytla Jayaprakash, Dr.Alok Kumar Rohit[3] has designed the connecting rod taking two different materials namely Aluminium alloy 7475 and 6061 for the 150 cc engine motorbike and performed static, modal, harmonic as well as transient analysis. They made the conclusion that Aluminium alloy 7475 is suitable material.

Ganesha Ram, Dr.P.K.S Nain, Mr.Promod Kumar[4] performed the static analysis of the alloy steel connecting rod and explored the weight reduction possibilities using the FEA analysis. They identified the maximum stress generation regions as crank end, shank and between pin end.

Naman Gupta, Manas Purohit and Kartik Choubey[5] had done the static analysis on connecting rod by taking three different materials namely AISI4340, Aluminium 7068 and Aluminium boron carbide .Also they had designed three different section i.e. full connecting rod , vertical cut section and horizontal cut section .Then they compared the von-mises stresses using the software HYPERMESH and they then concluded that the weight is reduced up to 74% of solid connecting rod of AISI4340 to the vertical cut connecting rod of Al7068.Further reductions could be possible scarifying the factor of safety.

Dr. B.K Roy [6] performed Analysis of Design and Optimization of Various Parameters of Connecting Rod using CAE Softwares. Various designs of connecting rod were thoroughly analyzed and then an optimal design was selected for Finite Element Analysis. In his analysis he put the fixed support at the end of the crank and simultaneously calculated static load was applied. He also discussed about the non-linear function as they also considers the plastic deformation. He also mentioned the complete set of FEM procedures. Stress behaviour, Strain, Deformation of connecting rod, Life, Damage, Biaxiality Phenomenon etc. were studied and analyzed to get the good design parameters with taking into account the safe permissible stresses and factors.

Kaliappan S, Revanth Raam AP, Charan B[7] had done the modal analysis on two different materials which were Aluminium Alloy 7068 and Magnesium Alloy AZ91for the study of dynamic properties of systems in the frequency domain. In the analysis they found the natural frequency of Al-Alloy was marginally higher than that of Mg-Alloy,so Magnesium alloy can be a replacement but only for the light load engines. Also, Magnesium Alloy offers low density and easy manufacturing.

M.Srinivas Rao, A. Girish Kumar and Dr. Vijayaganapathy [8], had modeled AL 7075 material with the aid of PRO-E designing software and later analyzed in ANSYS R 15 software to evaluate the crucial parameters like von misses stresses as well as displacements. The choice of the material was based on the fatigue strength; wear strength as well as galling characteristics. The results obtained proved the choice of the material suitable but the cost factor was neglected in the research

3. CONCLUSIONS

From the above literature survey following conclusions could be drawn

- For modeling purpose, CATIA and PRO-E are the favorite choices of the researchers.
- Most of the researchers have done an analysis of ANSYS software.
- Determination of critical sections of the connecting rod is the common area of focus.
- Aluminium alloy is the favorite material for the connecting rod as it is light weight and also fulfills the load sharing abilities.
- A very few researches have been done on dynamic loading despite the connecting rod is always in cyclic motion.
- In the static analysis, researchers have taken very large factor of safety like 6 in order to consider the fatigue effect on connecting rod.

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