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REVIEW ON DESIGN AND ANALYSIS OF IC ENGINE CONNECTING ROD

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ABSTRACT

The connecting rod of a piston engine, often known as a con rod, links the piston to the crankshaft. The connecting rod and the crank turn the piston's reciprocating action into crankshaft rotation. The connecting rod must transmit the piston's compressive and tensile stresses to the connecting rod, which must also spin at both ends. Mechanical connections used in old water mills turned water wheel spinning into a reciprocating motion, predecessor to today's connecting rod. The most typical uses for connecting rods in cars are internal combustion engines and steam engines. In order to reduce weight and improve fuel economy, the usage of composite materials would be beneficial. A CAD programme called CATIA was used to create the connecting rod, and a FEA tool called ANSYS was utilised to analyse it in order to better understand its exact behaviour under various material properties.

Keywords:Connecting rod, Aluminium alloy connecting rod, Analysis of connecting rod.

1. Introduction:

In an internal combustion engine, the connecting rod is the connection that connects the piston to the crankshaft, and it is made of steel. A connecting rod has three primary zones, each of which is described below. “The big end of the piston pin, the cylinder shank, and the end of the piston pin The two smaller ends of the central shank are the I-cross section central shank and the crank end” Greater weight is forced toward the crank end in a pin-jointed strut like a connecting rod. As a consequence, the CG point of the connecting rod is closer to the big end. Steel is the most frequent material for connecting rods in production engines, although high-performance engines may also use aluminium, titanium, or cast iron, and lower-performance engines can also utilise cast iron. They may be made via casting, powder metallurgy, or forging. Blow holes in casting-produced connecting rods, on the other hand, are generally harmful to durability and fatigue. Cast rods have an advantage over forgings in that forgings produce better rods with fewer blow holes. Powder metal blanks offer an advantage over other types of manufacture because of their near-net shape and little waste. As a consequence, because to the high cost of materials, producing a blank is costly.

Cars should be light in order to save gasoline while yet providing passengers with comfort and safety, which unfortunately results in a heavier vehicle. As a result of this breakthrough in vehicle design, new lightweight materials are being created and put to use. Because smaller connecting rods don't need a big crankshaft balance weight, they help minimise engine lead caused by inertia forces. Use of composite materials provides for enhanced engine power and fuel efficiency because to its high strength-to-weight ratio and advances.

The automotive industry is always looking for goods that are both cost-effective and high-quality. As a result, we may look at other design approaches to see if we can't better fulfil the demands of the industry. The design process must spend less time on

trial and error analysis in order to remain competitive in today's fast-paced business. As a consequence, a computational method was employed early in the design process. The finite element method is utilised for modal and structural analysis of the connecting rod. To establish a system's dynamic attributes, modal analysis uses the system's natural frequencies, damping factors, and modes. Stress distribution under loading situations is provided via structural analysis. Mesh selection is critical to ensuring that other factors are studied with the best mesh size. It is frequently required to raise the mesh quality since it has an impact on the stability and convergence of many mesh processing applications.

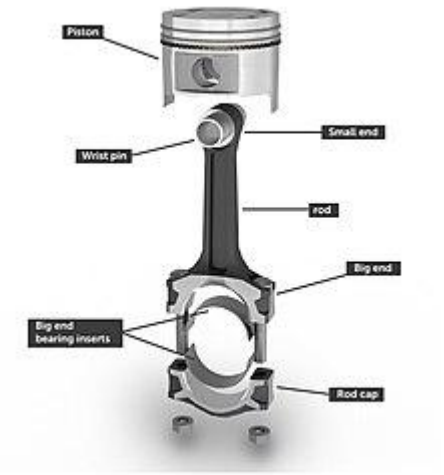

Figure 1: Automobile Connecting Rod

2.LiteratureReview

Suraj Pal et al. [1] "Design Evaluation and Optimization of Connecting Rod Parameters Using FEM" A single cylinder four-stroke petrol engine is the focus of this paper's finite element analysis, which may be used to examine the structural systems of connecting rods. In order to construct a valid Finite Element Model, Pro/E Wildfire 4.0 Cad is utilized. To determine the von Misses stress, shear stress, elastic strain, and total deformation in the present design connecting rod under the required loading conditions, a static analysis is carried out using the Finite Element Analysis Software ANSYS. The static stresses on the connecting rod are studied in the first step of the study, and then further work is done to guarantee the design is safe.

G. Naga Malleshwara Rao et al. [2] "Design Optimization and Analysis of a Connecting Rod using ANSYS" By examining various materials such "genetic steel, aluminium, titanium, and cast iron" we want to find ways to reduce the weight of an I.C engine's connecting rods. As a result, we had to do a comprehensive load investigation.

K. Sudershan Kumar et al. [3] "Modelling and Analysis of Two Wheeler Connecting Rod" Using rod designing and simulating together is the topic of this paper. For the SuzukiGS150R motorbike, a Boron carbide-enhanced aluminium connecting rod is used instead of the original. It is used to produce a two-dimensional image. A connecting rod parametric model is created using PRO-E 4.0 software. The analysis is done using ANSYS software.

B. Anusha, et al. [4] "Modelling and Analysis of Two-wheeler Connecting Rod by Using Ansys" The connecting rod of a single-cylinder, four-stroke petrol engine is statically analysed in this article. PRO/E, a programme for creating solid models, was used to produce this one (creo-parametric). To compute the von-misses stresses, shear stresses, and strains given the provided loading parameters, a finite element analysis is used.

B. Anusha, Dr. C. Vijaya Bhaskar Reddy et al. [5] "Comparison of Materials for Two- Wheeler Connecting Rod Using Ansys" The ANSYS analysis tool received the planned connecting rod as an input. Analytical software such as ANSYS may be used to calculate von-misses stresses, strain, shear stress, and total deformation for the given loading circumstances using

static analysis. This inquiry makes use of materials from two different sources. Using software that compares the properties of two distinct materials, the connecting rod is created.

Mr. H. B. Ramani et al. [6] "Analysis of Connecting Rod under Different Loading Condition Using Ansys Software" After a thorough load study, Ansys-13's finite element method was used to model the connecting rod. As a result, the connecting rod was modelled, meshed, and loaded into Ansys software to determine the overall force it exerts. The maximum stress levels in the various components of the connecting rod were discovered through analysis. Both the pin end linkage and bearing cup linkage pressures were the greatest. The pin end and the connection between the pin end and the rod end were found to have the highest tensile stress. It's possible to use this knowledge to alter the design of the connecting rod, say experts.

G.M. Sayeed Ahmed et al. [7]a forged steel connecting rod that shattered during their duty was replaced with aluminium alloys and carbon fibre. The weight of connecting rods was reduced, and they all operated as intended, according to the authors. Carbon fibres are very durable, despite their strength and light weight. Throughout the testing phase, the rods were exposed to both ideal and variable loads. The rods were tested to the limit and performed well. The aluminium crankshaft was also examined, and the results were favorable, resulting in less stress on the connecting rods.

Vikas Gupta [8] An existing tractor engine connecting rod design was reworked as part of his inquiry. Static and fatigue loading were both used in this investigation. In order to verify several stress and fatigue metrics, the same boundary and loading conditions were used. Static and fatigue research identifies and improves key areas. An improved design and manufacturing process have resulted in a connecting rod that is lighter and more durable. The material stayed the same, but Von mises emphasis had a big shift. At the critical point, 9.4% less stress was recorded under static load circumstances. There was just a 5% reduction in body weight, which is nothing to be proud of. Consequently, It is possible to infer that not only materials, but also design parameters, may be optimized.

Ambrish Tiwari et al. [9] The numerical tools were heavily employed throughout the development period. As a consequence, understanding the processes involved and the numerical approach is critical in order to fully use technological advantages such as faster project timeframes and cheaper prototype costs. Using the FEA methodologies presented in this research, the weight and cost of forged steel connecting rods may be lowered. The modified Goodman diagram was also used to conduct fatigue research utilizing stress life theory.

Bin Zheng et al. [10] for small commercial vehicles' connecting rods, a study found that 40Cr was the optimal material. The maximum compression condition and the connecting rod's safety factor both increased by 59%, according to the research.

Prof. Vivek C. Pathade [11] I used Pro/E Wildfire 4.0 and Ansys Workbench 11.0 software to conduct a stress assessment on a connecting rod. The Photo elastic experimental technique is used to compare and verify FEA results. He discovered that the tensions in the little end of the connecting rod are higher than the stresses in the bigger end. A stress concentration effect may be seen at the connecting rod's small and big ends, but it is negligible in the middle, as shown by the photo elastic analysis. It's possible that one or both of the connecting rod's fillets will fail.

Bagri & Telang [12] the shank fillet radius will be optimized to reduce the maximum equivalent von misses stress. When the connecting rod's stress distribution was examined, it was observed that its shank fillet's radius had a considerable influence on the stress distribution. In comparison to the baseline model, a different shank fillet radius was used for modal analysis, and it resulted in less distortion.

3. Conclusion

The connecting rod determines the performance and power capabilities of an IC engine. A connecting rod's failure rate may be lowered by improving the design, the material quality, or both of these factors. The performance of a connecting rod may be increased by altering the composition of the material. The qualities of several materials may be obtained by alloying them together. As a consequence, this study conducts a literature review in order to give a method for future research.

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