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A Review on Design Optimisation of Connecting Rod

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Abstract- Connecting rod is a component inside of an internal combustion engine. The piston is connected to the crank by connecting rod and it is the principal part to transmit power from the piston to the crankshaft. In terms of structural stability and performance, it is considered a critical factor. The main effort in reducing weight has been to optimize the form and remove materials, which is not often possible. In order to manufacture lightweight connecting rod. Furthermore, the connecting rod is a vital component of high volume production output. The reciprocal piston is connected to the rotating shaft and the piston thrust is sent to the shaft. Each motor that uses an inner combustion engine contains, based on the engine number of cylinders, at least one connecting rod. It is only rational to optimize the connecting rod design. The goal may also be met to lower the engine part weight and thereby reduce inertia loads, reduce motor weight, and improve motor efficiency and save power.

Keywords-Connecting rod, design, optimisation.

I. INTRODUCTION

1. Parts or Construction of Connecting rod

Connecting rod is a component inside of an internal combustion engine. The piston is connected to the crankshaft by connecting rod and transmit forces from the piston to the crankshaft. Any car using an internal combustion engine needs at least one rod, based on the number of motor cylinder[1]. In other terms, a connecting rod is a rigid component that joins a piston in a reciprocal engine to a crankshaft. It forms a basic mechanism along with the crank that transforms the reciprocal motion into rotary movement [2].

Figure 1

Connecting rod [2].

2. Stress Acting on Connecting Rod

During the operation connecting rod (CR), cyclic loading have been acting and transmit to crankshaft.It is loaded under compressive stress (under the prevalent gas pressure) (primarily due to inertia force). Owing to its swiveling movement, the bending rod is often strained. It should be as light as possible and strong enough as a moving engine part. There must also be adequate part and structural strength. "Through lubricating the connecting rod, control is transferred from the pump and the piston through the connecting rod to the crankshaft". Therefore, the stress applied to the rod depends on "the pressure distribution of the lubricant. In turn, the rigidity of the connecting rod" end drills may impact this. The lubrication friction between the crankshaft and the bearing box on the top-side holds the inertia force in balance. CR bolts provide for the joint continuity between the CR and the cap. The CR ovalize under the influence of friction and the bolts are externally curved. The connecting rod bolted joint will open to the pin side of the cord [5] if the bolt force is inadequate. CR shank, therefore, presses the crank log into the hydrodynamic boundary layer under maximum gas strain. Connecting rod is ovalized and the bolts curve into the inner side of the rod. The linking rod end is caused by significant bending tension. In comparison to the bolt threads, filets on the shaft transfer to the big and small end are the most strained places in "straight split connecting rods." The downside of angle split rods is that the top section of the "blind hole thread" is placed immediately in the most stressful direction.

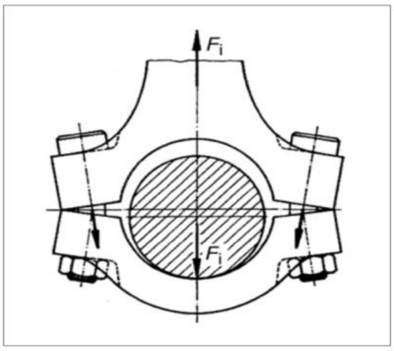

Figure 2 Horizontal close-in, bolt bending and gap opening caused by inertia force.

II.LITERATURE REVIEW

Sathish et al. (2020) "two separate materials such as AA2014, AA6061 and AA7075 have been analyzed. FEA review for selected three materials and for missed stress has been carried out by ANSYS tools; shear stress and overall deformation have been obtained from the software of ANSYS. The AA2014 has fewer weight and higher rigidity compared to the three materials".

Muhammad et al. (2020)determined topology for connecting a rod appropriate for diesel engine applications and structural optimization… The link rod weight optimisation takes place with a 20% weight reduction goal, 30%, 40%, 50%, and 60% under a 100N static loading to decide the weight to be removed to reduce weight and costs while affecting its strength and longevity. Comparison of structural static deformation, tension, elastic strain and protection component of Von Misses before and following optimization. Based on the outcome it can be inferred that manufacturing firms can use ANSYS Tools to mitigate waste of materials, while ensuring product consistency and efficiency at the same time.

Muhammad et al. (2020) The study of stress and the optimization of a connecting rod with strong emphasis on essential parameters including deformity, stress, fatigue and stress, factor protection, and life values, among other things. A connection rod's output in an automotive motor is dependent on its design and weight. Therefore, research and optimization are important for producing a durable, cheaper and lightweight connecting rod.

Linga et al. (2020) An empirical tool constructed is the presented connecting rod for two wheels. A physical model is built in CATIA V5 according to the design. FEA has been used to analyze the structural rod connection mechanism. Various stresses are measured using FEA program ANSYS WORKBENCH 14.5 for specific loading conditions. Similar materials perform in the same way (forged steel and Al-360). The findings obtained are compared on the basis of different performances with considerable tension, shear stress, fatigue life based on the results achieved and we prepared the prototype part in 3d printing.

Saheb, Shaik Himamet al. (2020)researched and compare the weight and price of the connecting rod optimized reduction of certain compression ignition motors. Because the connecting rod is subject to whiping stress in order to design the rod, we can investigate multiple pressures and different forces such that connecting rods do not malfunction. In taking all these strengths into account, the review is helpful to improve design.

Bulut, Mehmet et al. (2020) a numerical rod connecting analysis for the determination of essential stress regions was identified. The load of various motor speeds was supposed to be statically implemented in the study of the connection rod and its resulting stress and deformation values were evaluated. Engine power and torque values were used in static simulation model as the load border conditions, whereas the geometric measurements of the rod connector and its material properties were other parameters used as input values. Stress and deformation tests were assessed at the various motor speeds and showed that the connecting rod did not malfunction and fractured under the external pressure.

Pani, Amiya Ranjan et al. (2020) concluded that in the event of a hydro lock failure on the connecting pin, the merchant-rankine solution is inadequate to buckling load measurement and the aluminum alloy rod buckling resistance even weaker than the steel rod forged. It will also not be used with diesel heavy duty engines. The findings of this project provide important details for the buckling failure of rod configuration in heavy diesel engines.

Abraar et al. (2020)find inducted stresses due to high capacity, examined the connector rod of the 1500 hp diesel motor in a truck. On top of the piston in a film-based system the net force operating on the gas pressure and inertia. For this study, the reaction forces produced at each eye of the main connecting rod were forecast and provided. In the static study it was noticed that the induced stress was within the allowed limit of the rated speed connecting rod. The static study for maximum speed and maximum torque conditions has also been performed.

Natrayan et al. (2019)based on the working of the tractor in general tie rod that does not perform overload application.Firstly, old rod designs and materials were tested and mutated designs were examined in crucial loading situations, with different stresses and deformation features, using ANSYS software.

Mahfouth et al. (2019) Performed finite element analyzes and design optimization analysis with solid works on a connecting rod. The sensitivity analysis was carried out and a convergence with a standardized element duration of 1.5 mm was achieved. The maximum tension existed mainly between the pin, crank and shank regions in the transition field. The optimization thesis was carried out to examine potential to reduce weight by changing some connecting rod measurements to restrict acceptable stresses and the protection factor. The percentage decrease was achieved by optimization with a minimum protection factor of 2.2 and an overall stress of 127 MPa by Von Mises. In the static structural review the overall stress is less than the material yield power.

Muhammad et al. (2019) [17] submitted form optimization with a reduction goal weight rate of 20 to 60% with a static load period of 10 N. A new optimized system with new deformities and stress values is often analyzed for the structural optimisation respectively. The research is performed with a static structural, mechanical solver ANSYS with a tensile strength of 100N on the bigger end.

Kumar et al. (2019) examined the optimization of weight and the cost reduction of the Diesel connection rod. To get the concept of the connecting rod, different stresses are to be addressed while the connecting rod is designed. This included a systematic study of the load. Stress distribution and deflections are key variables that are focused.

III.CONCLUSION

Connecting rod connects between piston and crankshaft and transmits force from piston to crankshaft which cyclic in nature. As the compressive forces are significantly higher than the tensile strength, the cross-section of the joining rod is constructed as a 'strut' and the formula of Rankine is used. "The connecting rod buckles about x-axis as a neutral axis in the motion plane of the connected rod under applied load or y-axis is the neutral axis. The design of connecting rod is regarded as both ends are hinged for buckling about x-axis and both ends are fixed for buckling around y-axis. In each case, it should be strong in buckling".

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