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Design And Analysis Of Connecting Rod-A Review

M.Tech. Scholar Alsabah Rayeen, Professor Ganesh Kesheorey
Department of Mechanical Engineering,
VITS, Indore,India

Abstract- The connecting rod is an essential component found within internal combustion engines, serving as the link between the piston and the crankshaft. Its primary function is to transmit power from the piston to the crankshaft, making it a critical factor in terms of structural stability and performance. Manufacturers have focused on reducing the weight of the connecting rod by optimizing its form and minimizing the use of materials, although this approach is not always feasible. The production of lightweight connecting rods is therefore a key objective. Additionally, the connecting rod plays a vital role in high-volume production outputs. Each internal combustion engine, depending on the number of cylinders, requires at least one connecting rod. Consequently, optimizing the design of the connecting rod is a rational pursuit. This optimization process aims to reduce the weight of engine components, resulting in decreased inertia loads, lower overall motor weight, improved motor efficiency, and energy savings.

Keywords- structural stability, high-volume production etc.

I. INTRODUCTION

Connecting rod was an element found within a combustion engine. By way of the connecting rod, the piston is attached to the crankshaft and transfers forces there. Depending on the number of cylinders in the engine, any automobile with an internal combustion engine requires at least one rod[1]. In other words, a connecting rod is a stiff part that connects the piston and crankshaft of a reciprocating engine. Together with the crank, it creates the fundamental mechanism that converts reciprocal motion into rotational motion[2].

Figure 1: Connecting rod [2]

1. Material of Connecting Rod

Rods are often bound using steel or aluminum. Most factories use one of three primary manufacturing processes: casting, forging, or powdered metallurgy. Production of connecting rods is typically industrial scale. Connecting rods are made with a wide range of materials and processes by producers all over the world[6]. As may be observed in Fig.1.1, the dependable rods in modern automotive internal combustion engines are often made of steel for manufacturing motors. However, it can also be made out of titanium or cast iron, or the aluminum alloys T6-2024 and T651-7005 used in high-performance motors(for applications such as motor scooters) [2].

2. Stress Acting on Connecting Rod

Connecting rod (CR) operation results in cyclic loading that is transmitted to the crankshaft. Compressive stress (the pressure of the surrounding gas) is applied (mostly because of inertia force). The bending rod is frequently stressed because of itsswiveling motion. As a mobile component of an engine, it needs to be both lightweight and durable. That also has to be sufficient strength in the parts and the structure.By keeping the connecting rod well oiled, power can be transmitted from the pump and piston to the crankshaft. Therefore, "the pressure distribution of the lubricant" determines the tension given to the rod. The stiffness of the end drilling on the connecting rods may have an effect.

The top-side bearing box and crankshaft maintain a stable inertial moment due to lubricating friction. The CR and the cap have a seamless union thanks to the CR bolts. Because of friction, the CRs become oval, and the bolts are bent on the outside. If the bolt force is insufficient, the connecting rod bolted joint will open on the cord pin side [5]. Therefore, with maximum gas strain, the CR shank drives the crank log into the hydrodynamic boundary layer. The bolts are curved into the inner side of the ovalized connecting rod. the Extreme bending stress causes the termination of the connecting rod. In "straight split connecting rods," the filets on the shaft transfer to the big and small end experience the highest stress. The "blind hole thread" at the top of an angle split rod is instantly exposed to the highest stress.

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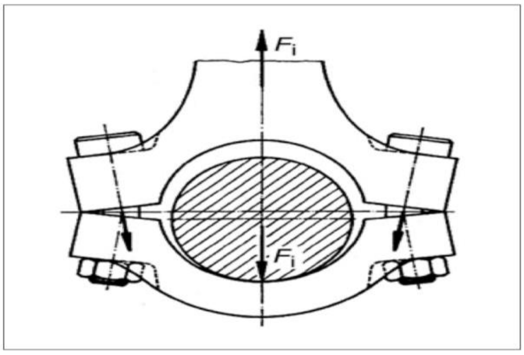

Figure 2: Horizontal close-in, bolt bending and gap .

2.Opening caused by inertia force

1. Mass of the Connecting Rod

In order to reduce fuel consumption and frictional agitation, it is recommended that moving masses be kept as low as practical. A lighter connecting rod will result in a smaller piston, lighter balancer, lighter bearings, and a smaller shaft. Deck height can be decreased by cutting down on the length of the rod connections. However, it has to account for shifts in the lateral forces acting on the piston's skirt. In order to maintain a quiet activity and low vibration levels, the spinning and oscillating masses may line up as perfectly as feasible.

There is a rotating crankshaft component and a mass that swings on the piston's side[5]. Tolerance ranges on raw components might be less than 1% thanks to the sintering process. The completed rods are used to determine the weights of the rotating and oscillating parts, and the rods are subsequently divided into different weight categories. In this case, the connecting rod is measured horizontally using two weights placed at the small end and the crank's end. The value at the end crank represents the moving mass, whereas the value at the little end bore represents the oscillating ma.

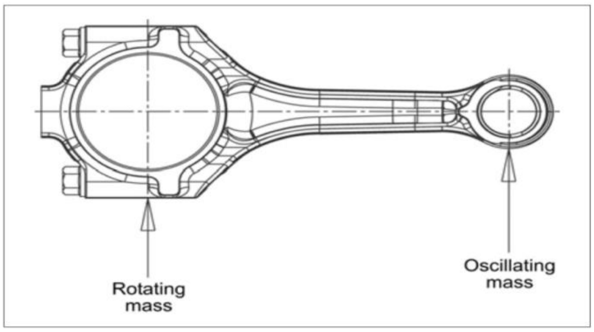

Figure 3: Distribution of moving masses of a connecting rod

II. LITERATURE REVIEW

Sathish et al. (2020) "It was ultimately determined that AA2014, AA6061, and AA7075 are two distinct materials. Shear stress and overall deformation were collected from the ANSYS program, and the software also performed a FEA assessment for the three materials and for missing stress. The AA2014 is the most lightweight and rigid of the three materials". Muhammad et al. (2020) optimized diesel engine uses and rod connection topology were identified. Weight reduction and cost savings may be achieved without compromising durability or strength by optimizing the weight of the link rods with targets of 20%, 30%, 40%, 50%, and 60% under a 100N static stress.

The static deformation, tension, elastic strain, and protection component of Von Misses structure are compared both before and after optimization. The results suggest that ANSYS Tools may be used by industrial companies to reduce resource waste while boosting output quality and productivity. Muhammad et al. (2020) The stress and optimization of a connecting rod, with a focus on key characteristics such as deformation, stress, fatigue and stress, factor protection, and life values. The performance of a connecting rod in a car engine is determined by its construction and its weight. As a result, developing a connecting rod that is strong, inexpensive, and lightweight necessitates study and improvements.

Linga et al. (2020) This connecting rod for two wheels serves as an improvised empirical tool. CATIA V5 is used to create a physical prototype of the intended product. The FEA method was applied to examine the rod connection mechanism employed in the structure. The FEA application ANSYS WORKBENCH 14.5 is used to assess stresses under a variety of loading scenarios. Forged steel and Al-360, two similar materials, have identical functional properties. Results acquired from testing the prototype component in 3D printing under conditions of varying tension, shear stress, and fatigue life are compared. Saheb, Shaik Himamet al. (2020)I investigated how much lightweight and less expensive some compression ignition motors might be if they used connecting rods that were tuned for weight reduction. Due to the whipping stress experienced by the connecting rod, several pressures and forces might be explored to ensure that the rod does not fail in operation. The evaluation is useful for making design tweaks by taking into consideration all these strengths.

Bulut, Mehmet et al. (2020) The critical stress areas were located using a numerical rod joining analysis. Connection rod stress and deformation values were calculated based on a theoretical static implementation of the load at varying motor speeds. Inputs to the static simulation model included numbers for engine power and torque as well as geometric measurements of the rod connection and its material qualities. At different motor speeds, stress and deformation tests confirmed that the connecting rod would not break under the external load. Pani, Amiya Ranjan et al. (2020)found that the buckling resistance of the alloy's aluminum rod was much less than the steel rod forged, and that the merchant-rankine solution was inadequate in the case of a hydro lock failure on the connecting pin. This also won't be utilized in conjunction with diesel-powered semis. Important information on the buckling failure of rod configuration in large diesel engines is provided by the results of this study.

III.CONCLUSION

The connecting rod comprises a crucial component of the I.C engine. A connecting rod, which is itself dependent on the numerous cylindrical tubes within an internal combustion engine, was a necessary component of any vehicle that uses such an engine. As a result of inertia under high compressive loads, it goes through the heavy cyclic tonnage of 108-109 cycles. The risk of a connecting rod breaking in an engine increases as it is subjected to alternating compressive and tensile pressure cycles. The crankshaft and connecting rod work together to turn the piston. Tension and compression forces on the connecting rod are the basis for the engine's combustion gases and the inertia component forces. The connecting rod is responsible for transmitting energy throughout an internal combustion engine. The design and weight considerably affect its performance and are, thus, crucial factors in determining its efficiency. They depend critically on the environment to survive. In reality, many aspects of the connecting rod have been studied, including its manufacture, materials, performance modeling, etc.

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