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A Review of Modeling and Structural Analysis of Connecting Rod by using CATIA and ANSYS

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ABSTRACT-

The connecting rod is an integral part of the internal combustion engine. It acts as a link between the piston and the crankshaft. It is a staple attached to a pin in which more weight is concentrated towards the large end. From the point of view, the location of the connecting rod CG point is located more towards the large end. The material used to manufacture the conductive block is steel, but it can also be made of aluminum due to its lightness and high shock absorption capacity at the expense of toughness, titanium for a combination of strength and lightness at the expense of affordability for high performance engines, or of cast iron. Connecting rods can be produced either by casting, powder metallurgy or forging. Forged rods are free of blow holes over casting rods. The stress concentration was observed using typical analysis.

Keywords- Connecting Rod, Catia Ansys.

1. INTRODUCTION

Automobile engine connecting rod is an important component, with large volume production. The reciprocating piston connects to the rotating crankshaft, and the piston thrust due to gas pressure is transmitted to the crankshaft. Every vehicle using an internal combustion engine requires at least one connecting rod per cylinder. The connecting rod is an integral part of the internal combustion engine; it acts as a link between the piston and the crankshaft. The connecting rod has three main areas. Piston pin end, center stem and crank end. The piston pin end is the small end, the center leg of the cross section I and the crank end is the large end. The connecting rod is a support attached to a pin in which more weight is concentrated towards the large end. Hence the location of the connecting rod CG point is located more towards the large end. This connecting rod is mostly made of steel for production engines, but it can be made of aluminum (for lightness and high shock absorption capacity at the expense of durability) or titanium (for a combination of strength and lightness at the expense of affordability) for high performance engines or of cast iron.

Figure 1 A simple connecting rod

It can be produced either by casting, powder metallurgy, or forging. However, connecting rods can be produced by casting, but due to the presence of blow holes in them which interfere with durability and fatigue. The fact that forgings produce rods that are free of holes and better gives them an advantage over casting rods. Metal powder blanks have the advantage of reducing material waste and being close to the net shape. However, the cost of vacuum is high due to the high cost of materials and advanced manufacturing techniques.

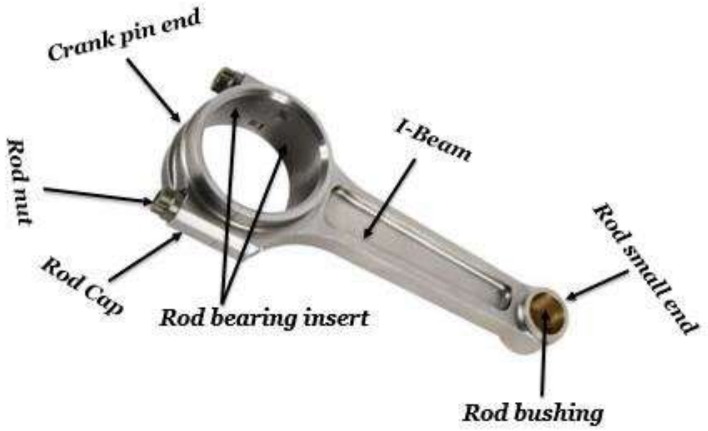

Figure 2 A connecting rod with nomenclature

Cars must be lightweight so that they consume less fuel and at the same time they must provide comfort and safety for the occupants, which unfortunately lead to an increase in the weight of the car. This trend in vehicle construction led to the invention and implementation of completely new materials that are lightweight and meet design requirements. The improvement of the steel bar is further aimed at working with different materials to have sufficient light weight and strength.

Optimization begins with determining the correct load conditions and strength. Overestimating the loads will simply increase the safety factors. The idea behind optimization is to keep the same strength required. The component is already part of the assembly, so by doing reverse engineering the same part is created but with enough overhead.

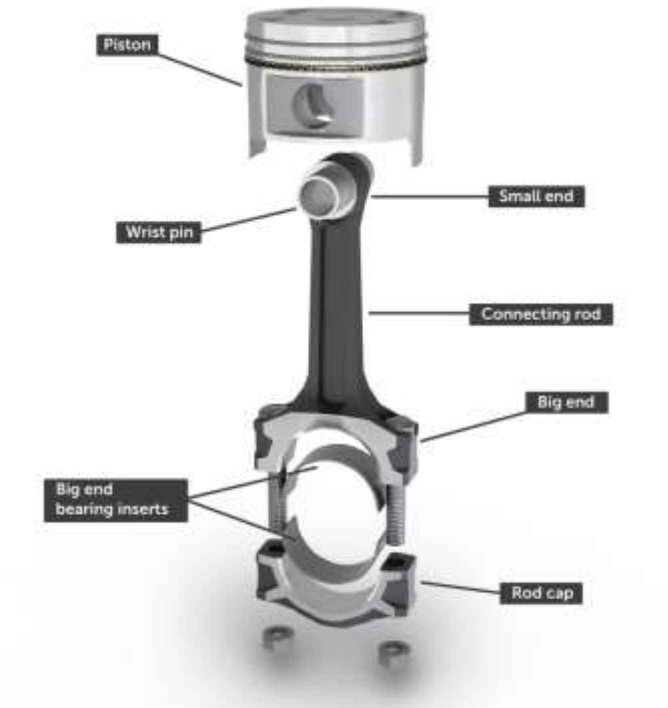

Figure 3 A connecting rod with nomenclature and piston

The weight and weight of the connecting rod affect the performance of the vehicle. Hence it affects the credibility of the vehicle's manufacture. The change in design and materials results in a significant difference in weight and also in engine performance. Structural factors considered for weight reduction during optimization include diastasis load factor, stresses under loads, bending stiffness, and axial stiffness. Thus, the component can give higher strength, efficient design and lighter weight that would be a huge success in the automotive industry.

The connecting rod is a key link inside the combustion engine. The piston connects to the crankshaft and is responsible for transferring power from the piston to the crankshaft and sending it to the transmission. There are different types of materials and production methods used to create connecting rods. The most common types of connecting rods are steel and aluminum. The most common types of manufacturing processes are casting, forging, and powder metallurgy. Connecting rods are widely used in a variety of engines such as in-line engines, V-engines, cylindrical engines, radial engines, and piston engines. The connecting rod consists of a pin end, a stem section and a crank end. The serrated end and crank end holes are machined on the upper and lower ends to allow for precise mounting of the bearings. The function of the connecting rod is to transmit the piston's thrust to the crankshaft. The figure shows the role of the connecting rod in converting reciprocating motion into rotating motion. A four-stroke engine is the most common type. The four strokes are intake, compression, power, and exhaust. Each stroke requires approximately 180 degrees of crankshaft rotation, so a full revolution will take 720 degrees. Each stroke plays a very important role in the combustion process. In the intake cycle, while the piston is moving down, one of the valves opens. This creates a vacuum, and the air-fuel mixture is sucked into the chamber. During the second blow pressure occurs.

2. LITERATURE REVIEW

Rotational motion is generated from the rotation of the crankshaft piston using a connecting rod. The combustion gases of the engine and the movement of the inertial components exert stresses which cause compressive and tensile stresses in the connecting rod respectively [1]. Connecting rods fail due to overloading, bearing failure, irregular bolt adjustments and faulty assembly or fatigue [3]. It is important that the connecting rods are able to withstand the complex high tensile loads they operate on. As a result, various design, material selection, working and fatigue testing techniques for the connecting rod have been studied and presented [2]. The mechanical properties (such as hardness, tensile strength, toughness and stress resistance) of the materials used in the manufacture of the connecting rod on composites depend on the design of the connecting rod [3]. The failure of the rod connection is due to the large force required to bear the load. This can be overcome by extending the life cycle by increasing the strength. Conducting rod finite element analysis has been performed and presented by many researchers. In, the theory and FEA were made for the connecting rod of the motor IC. The obtained analysis result shows the reasons for the failures in the slices of both ends due to the induced stress. In FEA the constant fatigue and deformation and weight optimization of the connecting rod using ANSYS workbench are implemented and presented. From the proposed design changes obtained from the weight optimization result, the failure result is further updated to achieve better result. In a Bansal research paper, a dynamic stress analysis was performed on a single-cylinder four-stroke diesel engine connecting an aluminum rod with FEA [4].

FEA is a commonly used computational tool for testing and modifying engineering structures within certain design limits. It involves diving into the small units known as "elements" of static and dynamic analysis of a simple to complex model under various design constraints. Further research can also be done to improve the design for optimal performance and life span with respect to design failures [5]. Several literatures have worked on improving weight. Gaikwad in his paper modifies the roller conveyor by performing a weight optimization procedure after performing a static analysis on the roller conveyor. Further analysis of the structure optimization is also performed to identify a new optimized structure with new deformation and stress values respectively. Analysis was performed using an ANSYS static structural mechanical analyzer with a tensile strength of 100 N acting on its larger end.

3. FINITE ELEMENT ANALYSIS OF CONNECTING ROD

3.1 Finite Element Analysis

Finite element analysis is a numerical approach that is described by partial differential equations to investigate and solve problems to arrive at their approximate exact solution. Solving engineering problems involving complex structures is a good characteristic of Catia. ANSYS is a Catia software package that generates equations that solve and control the behavior of elements. Geometry is first defined depending on the nature of the analysis to be performed.

A 3D model can be rendered in ANSYS either by saving it as an Initial Graphics Interchange Specification (IGES) format and then importing it into an ANSYS workbench, or by building the entire structure into an ANSYS workbench. In this paper, the analysis is done by importing geometry from CATIA in IGES format into the program.

3.2 Load distribution on connecting rod

For static structural analysis, a load is applied at the piston end and a fixed support is provided at the crank end. The analysis is performed under axial loads. Here the axial load applied is 15,000 N (compression). Comparisons were made for the purpose of optimization.

4. SHAPE OPTIMIZATION

Failure of all or part of the system will lead to risks of death and financial loss. Just as in the human context, when the human body does a lot of work, it becomes tired and sick, and eventually a nervous breakdown may occur. Also, in an engineering structure, failure may occur when the structure is subjected to a great deal of stress. The amount of stress in the geometric model that occurs when exposed to an external force or load is called a stress, which indicates that the applied load is a function of the amount of stress. The designer uses Von-Mises stress analysis to ascertain the failure of his design structure. Failure is inevitable when the strength of the material used is less than the maximum pressure value. The safety factor calculation includes the yield strength; therefore, it becomes necessary to declare this parameter before simulation in material properties.

5. CONCLUSION

The main objective of the analysis is to reduce the mass and cost with the connecting rod loading range. The weight optimization of the connecting rod with target weight reduction of 20, 30, 40, 50 and 60% is performed under the mentioned constraints to determine which block should be removed to reduce the cost. Moreover, the deformation, stress, tension and safety factor were compared under the same loading conditions before and after a 60% target weight reduction.

References

[1]. KirankumarJagtap, AbhijeetDeshpande "Numerical and Experimental Analysis of Connecting Rod", International Journal of Emerging Engineering Research and Technology (IJEERT), Volume 2, Issue 4, PP 242-249, July 2014.

[2]. Jeetendra Kumar Tiwari, Sharad Kumar Chandrakar, "Fatigue Analysis of Connecting Rod Using FEA to Explore Weight and Cost Reduction Opportunities for a Production of Forged Steel Connecting Rod", International Journal of Advanced Mechanical Engineering, Volume 4, Issue 7, pp. 783-802, 2014

[3]. Sirajuddin Elyas Khany, Syed Hamza Shareef, "Design, Fabrication and Analysis of a Connecting Rod with Aluminum Alloys and Carbon Fiber", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 10, pp-16674-16687, October 2014.

[4]. S.Vijaya Kumar, S.K. Thenadayaal, V.P. Vasanth, V. Vasantha Kumar "Design and Analysis of Two Wheeler Connecting Rod", International Journal of Innovative Research in Science, Engineering and Technology, Volume 4, Special Issue 6, May 2015.

[5]. V. B. Bhandari, "Design of Machine Elements" third edition, Tata McGraw Hill Education pvt.ltd., New Delhi, 2010.