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DESIGN AND ANALYSIS OF AL 7075 CONNECTING ROD

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Abstract

The use of connecting rod is the link between the piston and the crank shaft. The function of the connecting rod is to transmit the thrust force from the piston pin to crank pin, by converting the reciprocating motion of the piston to rotary motion of the crank shaft. Generally, production of connecting rods are using carbon steel and in later aluminium alloys are used for manufacture of the connecting rods. In this work existing connecting rod material is replaced by AL 7075. The modelling and analysis of connecting rod is also described. FEA analysis was carried out by considering three materials AL 7075. In this paper a solid 3D model of connecting rod was developed using PRO-E latest software and an analysis was carried out by using ANSYS R 15 Software and useful factors like von mises stress, von mises strain and displacement were carried out.

***Key Words*:**Ansys 10.0, FE Analysis, Connecting Rod, Pro-E 4.0, Von Mises Stress And Strain.

1 INTRODUCTION

Every Internal Combustion (I.C.) engine consists of mainly cylinder, piston, connecting rod, crank and crank shaft. The Connecting Rod is one of the important parts of an engine. Its work is to transmit the thrust of piston from piston pin generated by the burnt gass pressure to the other part of engine called Crank via crank pin. It has two ends one is called small or piston end and other one is big or crank end. The big end makes a joint with crank or crank shaft by crank pin and small end make a joint with piston by piston pin. It gives the rotating motion to the crank shaft by converting the reciprocating motion of piston into rotating motion. The connecting rod should be such that which can be withstand the maximum load without any failure during high cycle fatigue in operation. The fracture toughness also should be such that it does not go below a certain minimum limit. A further need is that the connecting rod should not buckle during operation. These requirements are used to select an appropriate cross section and material for manufacture [3]. The connecting rod generally has a long shank, a small end and a big end. According to the requirements, the cross-section of the shank may be rectangular, circular, tubular, I-section or H-section. It has been observing that circular section is used for low speed engines and I-section is used for high speed engines [6]. In a long research span it has been noted that during reciprocating motion of the piston a wear of cylinder wall occurs, which is caused by sideways force of piston acting on cylinder wall and results in an oval cross-section rather than being circular. Due to which piston rings lose their closeness to the cylinder wall and are failed to seal the cylinder. Geometrically, it can be seen that longer connecting rods will reduce the amount of this sideways force, and therefore may increase the engine life [5]. A connecting rod is one of the most mechanically stressed components in internal combustion engines. There are different types of stresses induced in connecting rod. One of which is axial stress induced by cylinder gas pressure (compressive only) and second one is bending stress caused by centrifugal action and third one is inertial force generated by reciprocation of piston [11]. The connecting rod has a tremendous field of research. In addition to this, vehicle construction led the invention and implementation of quite new materials which are light and meet design requirements. And the optimization of connecting rod had already started as early year 1983 by Webster and his team. There are many materials which can be used in connecting rod for optimization. In modern automotive internal combustion engines, the connecting rods are most usually made of steel for production engines, but can be made of aluminum (for reducing the weight and the ability of absorbing high impact at the expense of durability) or titanium (for a high performance engines) or of cast iron for applications such as motor scooters. In this study three materials Al360, Beryllium alloy 25 and Magnesium alloy have considered for analysis. Tukaram S. Sarkate et al [3], (2013) carried out an analysis to find out an optimum material for connecting rod. The results obtain by FEA for both Aluminum 7068 alloy and AISI 4340 alloy steel are satisfactory for all possible loading conditions. Kuldeep B. et al [4], (2013) described in the study that Weight can be reduced by changing the material of the current Al360 connecting rod to hybrid alfasic composite. Leela Krishna Vegi, Venu Gopal Vegi [5], (2013), demonstrated that the factor of safety (from Soderbergs), stiffness of forged steel is more than the existing carbon steel found and The weight of the forged steel material is less than the existing carbon steel and reported that by using fatigue analysis life time of the connecting rod can be determined. B. Anusha et al [6] (2013), clarified in the paper and concluded that the stress induced in the structural steel is less than the cast iron for the present investigation. Pushpendra kumar Sharma et al [9] (2012), performed the static FEA of the connecting rod using the software and took the advantages of using crackable forged steel (C70) in place of current forging steel for reducing weight of connecting rod. And the software gives a view of stress distribution in the whole connecting rod which gives the information that which parts are to be hardened or given attention during manufacturing stage. Ram bansal [8] et al, in the paper a dynamic analysis was performed on a connecting rod made of aluminium alloy using FEA. The analysis was performed under dynamic to determine the in service loading of the connecting rod and FEA was conducted to find the stress at critical points.

2 PROBLEM FORMULATION

The objective of the present study is to design and analysis of two wheeler connecting rod and to find the best alternative material of connecting rod. In the present study AL 7075 have taken in place of currently using materials like aluminium 360 for CAE analysis for choosing and evaluating the material using for manufacture the connecting rod of single cylinder 4 stroke combustion engines. In this work, an analysis is done for AL 7075. AL 7075 feature high fatigue strength and resistance to wear, corrosion, galling, and stress relaxation.

3 PROPERTIES OF MATERIALS

MATERIAL	DENSITY (Kg/m3)	YOUNG'S MODULUS(Gpa)	POISON RATIO
AL 7075	2850	75	0.39

4 ANALYSIS OF CONNECTING ROD

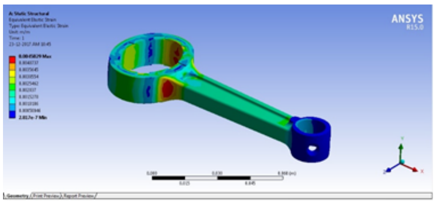

Figure 1: Elastic strain in connecting rod using AL 7075

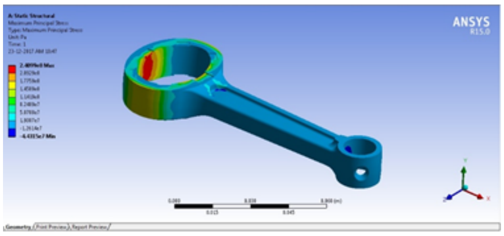

Figure 2: Maximum principal stress in connecting rod using AL 7075

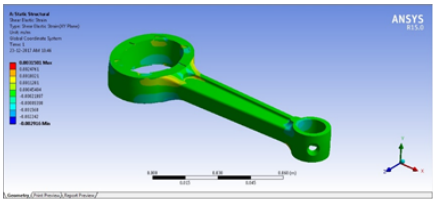

Figure 2: Maximum principal stress in connecting rod using AL 7075

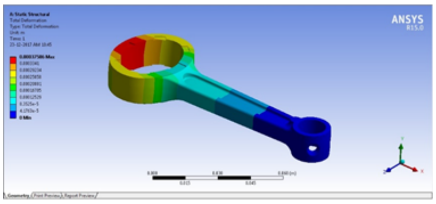

Figure 4: Total deformation in connecting rod using AL 7075

5 RESULT AND DISCUSSION

It is evident from the Fig.1 that the elastic strain occurs at the piston end of the connecting rod is 0.003E8 Mpa. It is also evident from the Fig.2 that the maximum principal stress occurs at the piston end of the connecting rod is 2.4E-8. It is noticeable from the Fig.3 that the maximum principal strain occurs at the piston end of the connecting rod is 0.0045E-2. It is cleared from the Fig.4 that the total deformation occurs at the crank end of the connecting rod is 0.0003E-9 for AL 7075.

6 CONCLUSIONS

By checking the above results it has been noticed that AL 7075 is the best suitable material for connecting rod of two wheeler vehicle. In the present study, the prime concern is to find the best suitable material for connecting rod. It is noteworthy that the economic aspect has not been incorporated in the present study. In the view of above discussion, following conclusion can be made.

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