

# Comparative Stress Analysis of Connecting rod using ANSYS for Different Materials

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**Abstract**—Now a days the IC Engines are widely used. Connecting rod is used to connect the piston to the crankshaft. As it plays very important role its analysis should be carried out. In this presented work connecting rod of two-wheeler is modeled using CATIA v5 R21 software. After modeling of connecting rod it is made available for analysis in ANSYS. In the ANSYS Workbench static analysis of connecting rod is performed. Analysis is performed for different materials like Cast iron, Copper alloy, Silicon anisotropic, Structural steel and Titanium alloy to find Von mises stress coming on the connecting rod. From above analysis it is shown that Titanium alloy is most suitable material for the two wheeler connecting rod.

**Index Terms**— Connecting rod, Two-wheeler, CATIA v5 R21, ANSYS Workbench

## I. INTRODUCTION

Now a days engines requires the more power and higher speed which requires the better strength of connecting rod as it connects the piston and crankshaft. Connecting rod is the important component of internal combustion engine. It connects the piston to the crankshaft. The connecting rod converts the linear motion of piston to the rotary motion of crankshaft. It is made up of three parts like big end at crankshaft, small end at piston and a long shank. On the piston side due to combustion of fuel the pressure is acting on the small end of connecting rod. This pressure develops the stress in the small end of connecting rod. In this presented work the analysis of connecting rod for different materials like Cast iron, Copper alloy, Silicon anisotropic, Structural steel and Titanium alloy is carried out to find the Von mises stress developed on the connecting rod. This analysis gives the suitable material for the connecting rod.

Ankit Gupta et al. [1] studied the different materials for connecting rod and made analysis of connecting rod to find the Von mises stress, Von mises strain and Displacement while loading. This study shows that the Beryllium alloy is the most suitable material over the Aluminum and Magnesium alloy. K. Sudershn Kumar et al. [2] made the analysis of connecting rod using ANSYS Software to find different parameters like Von mises stress, Von mises strain,

Displacement and working factor of safety. The comparative results are drawn over the Aluminum, Carbon steel and Aluminum boron carbide material for connecting rod. Puneet Agarwal et al. [3] made the analysis of two wheeler connecting rod using different materials like Forge steel, Titanium alloy and Aluminum alloy also finds the Von mises stress and Von mises strain using ANSYS software. Further by selecting the Aluminum material with increased silicon percentage, analysis is carried out. This comparative study of two material sets shows that the Aluminum with increased silicon percentage gives reduction in stress. Mr. Ruchir Shrivastava [4] made modeling of two wheeler connecting rod using Cre O software also made the analysis using ANSYS software. The comparison of two materials like C70S6 Steel and Structural Steel is carried out which shows nearly similar results for Von mises stress, principal stress and shear stress.

Durgesh Yadav et al. [5] studied the two wheeler connecting rod and also made analysis using ANSYS software. The comparative analysis of Cast iron, Carbon steel and Al 360 shows the most suitable material for two wheeler connecting rod is Al 3650 on the basis of von mises stress, maximum principal stress, shear stress, equivalent elastic strain and total deformation. Fanil Desai et al. [6] studied the stress analysis review of connecting rod. This review paper states that the FEA is the most suitable tool for the analysis of connecting rod for different materials. N. A. Wankhade et al. [7] made review on design and analysis of connecting rod for different materials. This review study states the comparison of bending moment and bending stress for the different materials like Steel, Al 7075, Al 6061 and High strength carbon fiber. Santhosh Reddy. A et al. [8] studied the load analysis and Multi body dynamic analysis for the connecting rod which contains the analysis of C70 material for connecting rod. Linear and Bilinear analysis is carried out with Modal analysis for safe life of connecting rod. P. Viswabharathy et al. [9] made the modeling and analysis of two wheeler connecting rod and shows that the cast iron is the cheap material for the manufacturing of connecting rod. B. Krishna Kanth et al. [10] studied the design and analysis of connecting rod. This paper also shows the results between material like structural steel, C70 steel and Belgium for the manufacturing of connecting rod. By using ANSYS software the Von mises stress, total deformation, directional deformation and shear stress is calculated. Also, Various researchers have reported the perform analysis of components like hydrodynamic bearing, microchannels using softwares like ANSYS, Comsol Multiphysics, etc. [11-14].

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II. METHODOLOGY

A. Modeling:

For modeling CATIA is mostly preferred software. 3D model of any complex model is easily visualized by the CATIA. Therefore the connecting rod of two wheeler is modeled using CATIA v5 R21 software. This model of connecting rod is prepared by using Part design module in the CATIA v5 R21. The model of two wheeler connecting rod is shown in fig. 1.

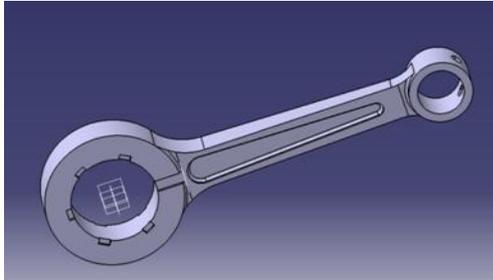


Fig. 1 Model of Two wheeler connecting rod

B. Meshing:

Meshing is very important step in the analysis process. Meshing divides the product or model in number of parts for further analysis. If meshing is accurate then results are also feasible. Therefore the fine meshing is carried for better results. The meshing of two wheeler connecting rod is as shown in fig. 2.



Fig. 2 Meshing of Two wheeler connecting rod

C. Analysis:

The connecting rod of two wheeler is very important part of internal combustion engines. It connects the piston to the crankshaft. There are different forces acting on the connecting rod like combustion pressure is acting on the small end of connecting rod. Due to such pressure there may be fracture of connecting rod. To avoid the fracture, the material should be strong enough to withstand with excess stress and pressure. So, the static analysis is carried out to find the Von mises stress and to find the which material is best suitable for the two wheeler connecting rod. In this analysis the compressive pressure is applied on the small end of connecting rod which is generated by the combustion gas. According to this pressure the analysis of different materials like Cast iron, Copper alloy, Silicon anisotropic, Structural steel and Titanium alloy is carried for the calculation of Von mises stresses.

Boundary conditions:

Pressure: 16 MPa

The table of materials showing density is given below,

Table. 1 Density of Materials

Material	Density(kg/m <sup>3</sup> )
Cast iron	7874
Copper alloy	8960
Silicon anisotropic	2328
Structural steel	7800
Titanium alloy	2700

III. RESULT AND DISCUSSION

Static analysis of two wheeler connecting rod is carried out for different materials are presented in given section.

a) Cast iron :

In this, the Cast iron material is selected for the analysis of two wheeler connecting rod. For this material the Von mises stress is 1.4917e<sup>8</sup>. The Von mises stress is calculated in the ANSYS software is shown in fig. 3.

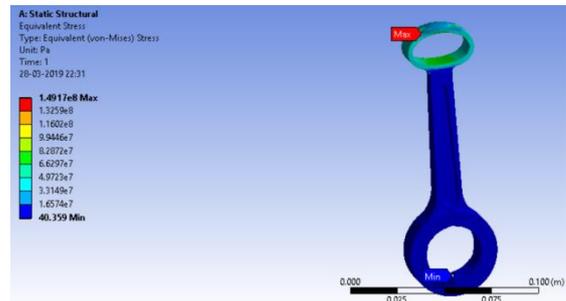


Fig. 3 Von mises stress of Cast iron

b) Copper alloy:

In this, the Copper alloy material is selected for the analysis of two wheeler connecting rod. For this material the Von mises stress is 1.4704e<sup>8</sup>. The Von mises stress is calculated in the ANSYS software is shown in fig. 4.

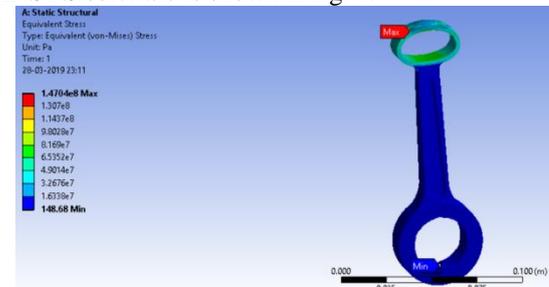


Fig. 4 Von mises stress of Copper alloy

c) Silicon anisotropic:

In this, the Silicon anisotropic material is selected for the analysis of two wheeler connecting rod. For this material the Von mises stress is 1.5401e<sup>8</sup>. The Von mises stress is calculated in the ANSYS software is shown in fig. 5.

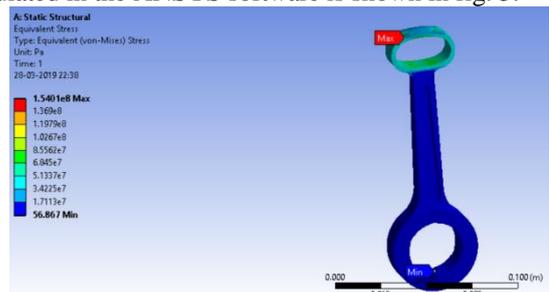


Fig. 5 Von mises stress of Silicon anisotropic

d) Structural steel:

In this, the Structural steel material is selected for the analysis of two wheeler connecting rod. For this material the Von mises stress is  $1.4847e^8$ . The Von mises stress is calculated in the ANSYS software is shown in fig. 6.

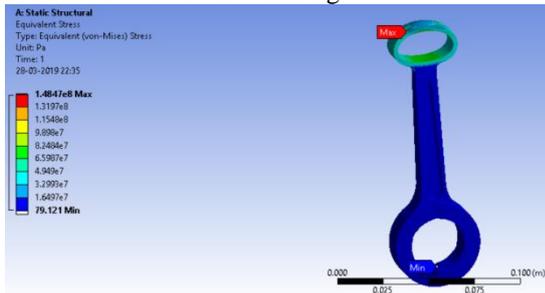


Fig. 6 Von mises stress of Structural steel

e) Titanium alloy:

In this, the Titanium alloy material is selected for the analysis of two wheeler connecting rod. For this material the Von mises stress is  $1.4631e^8$ . The Von mises stress is calculated in the ANSYS software is shown in fig. 7.

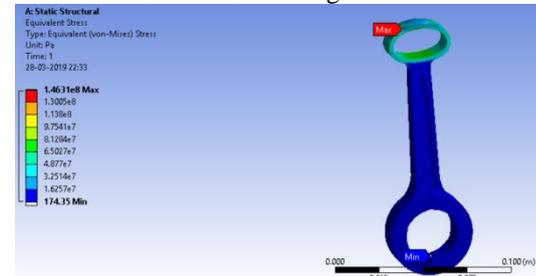


Fig. 7 Von mises stress of titanium alloy

The results of Von mises stresses calculated for the analysis of two wheeler connecting rod using ANSYS Software is tabulated below,

Material	Von mises Stress (Pa)
Cast iron	$1.4917e^8$
Copper alloy	$1.4704 e^8$
Silicon anisotropic	$1.5401 e^8$
Structural steel	$1.4847 e^8$
Titanium alloy	$1.4631 e^8$

IV. CONCLUSION

In the presented work the static analysis of two wheeler connecting rod is carried out for different materials like Cast iron, Copper alloy, Silicon anisotropic, Structural steel and Titanium alloy . From above analysis it is seen that the Titanium alloy produces less stress which is of  $1.4631e^8$  Pa which is lower than above mentioned materials. Therefore the Titanium alloy is the best suitable material for the Two Wheeler Connecting Rod.

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