Comparision Of Materials For Two-Wheeler Connecting Rod Using Ansys

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***ABSTRACT--* Connecting rod is a major link inside of a internal combustion engine. Its primary function is to transmit the push and pull from the piston pin to the crank pin thus converting the reciprocating motion of piston in to rotary motion of the crank. In the present investigation a 4-stroke petrol engine of a specified model, market available connecting rod is selected for the investigation. For present investigation the designed connecting rod is modeled using solid modeling software i.e. PRO/E.The modeled connecting rod imported to the analysis software i.e. ANSYS. Static analysis is done to determine von-misses stresses, strain, shear stress and total deformation for the given loading conditions using analysis software i.e. ANSYS. In this analysis two materials are selected and analyzed. The software results of two materials are compared and utilized for designing the connecting rod**

***Keywords*--connecting rod, Pro/E(creo-parametric), ANSYS Workbench, Finite Element analysis**

I. INTRODUCTION

Connecting rod is a major link inside of a combustion engine. It connects the piston 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 in the creation of connecting rods. The most common types of connecting rods are steel and aluminium. The most common type of manufacturing processes are casting, forging and powdered metallurgy. Connecting rod is among large volume production component in the internal combustion engine. It connects the piston to the crankshaft and is responsible for transferring power from the piston to the crankshaft and sending it in to transmission. They are different types of materials and production methods used in the creation of connecting rods. The major stresses induced in the connecting rod are a combination of axial and bending stresses in operation. The axial stresses are produced due to cylinder gas pressure (compressive only) and the inertia force arising in account of reciprocating action (both tensile as well as compressive), where as bending stresses are caused due to the centrifugal effects. It consists of a long shank, a small end and a big end. The cross-section of the shank may be rectangular, circular, tubular, I-section or H-section. Generally circular section is used for low speed engines while I-section is preferred for high speed engines. The most common type of manufacturing processes is casting, forging, and powdered metallurgy. Connecting rod is subjected to a complex state of loading. It undergoes high cyclic loads of the order of 10^8 to 10^9 cycles, which range from high compressive loads due to combustion, to high tensile loads due to inertia. Therefore, durability of this component is critical importance. Due to these factors, the connecting rod has been the topic of research for different aspects such as production technology, materials, performance, simulation, fatigue etc.

II.MODELING

Connecting rod of Hero Honda splendor, market available is selected for the present investigation. The dimensions of the selected connecting rod are found using vernier calipers, screw gauge and are tabulated and presented in the table1.According to the dimensions the model of the connecting rod is developed using PRO/E (creo-parametric). The modeled connecting rod is as shown in figure 1. In this analysis two materials are used.

A) Material names:

Cast-Iron
Structural Steel

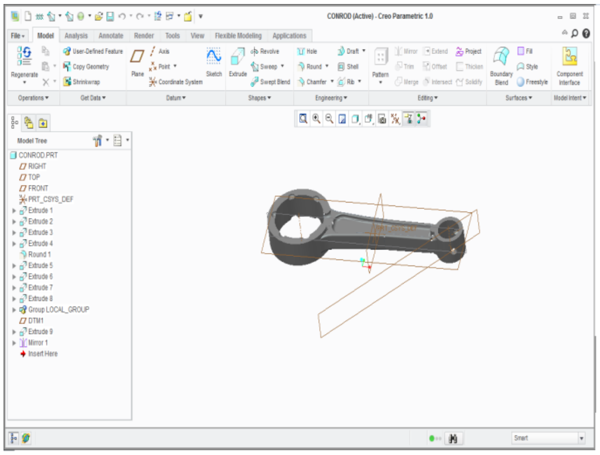

Fig1: Model of connecting rod

S.no	Parameters	Values
1.	Length of connecting rod	94.27mm
2.	Outer Diameter of Big end	39.02mm
3.	Inner Diameter of Big end	30.19mm
4.	Outer Diameter of Small end	17.75mm
5.	Inner Diameter of small end	13.02mm

Table 1: Dimensions of connecting rod

PROPERTIES OF MATERIALS USED

The properties of cast-iron as shown in the table 2

Material Selected	**Cast Iron**
Young's Modulus(E)	1.78e+005Mpa
Poisson's Ratio	0.3
Density	7.197e-006Kg/mm^3
Tensile Ultimate Strength	100 to 200 Mpa
Compressive Strength	400 to 1000 Mpa
Shear Strength	120 Mpa

Table 2: Properties of Cast Iron

The properties of structural steel materials as shown in table3

Material Selected	Structural Steel
Young's Modulus(E)	2.0e+005Mpa
Poisson's Ratio	0.3
Density	7.85e-006Kg/mm^3
Tensile Ultimate Strength	460 Mpa
Tensile Yield Strength	250 Mpa
Compressive Yield Strength	250 Mpa

Table 3: Properties of structural steel

III MESHING

The next stage of the modeling is to create meshing of the created model .The mesh model of connecting rod is as shown in fig 2.

Type of Element : Tetrahedron
Number of Nodes : 16076
Number of Elements : 8373

Fig 2: Mesh model of connecting rod

IV . LOAD DIAGRAM OF CONNECTING ROD

A PRO/E model of connecting rod is used for analysis in ANSYS Workbench. Analysis is done with the pressure of 3.15Mpa load applied at the piston end of the connecting rod and fixed at the crank end of the connecting rod. It is shown in Fig3.

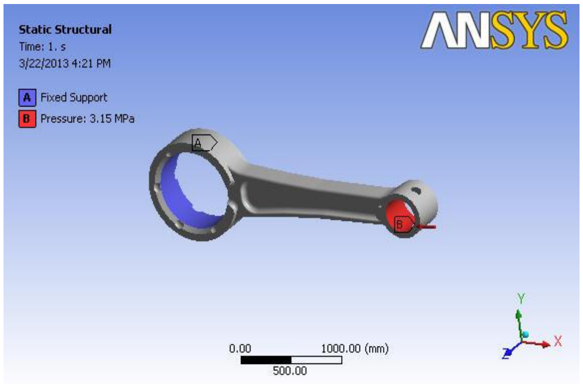

Fig 3: Loads and boundary conditions of connecting rod.

V RESULTS AND DICUSSION

For the finite element analysis 3.15Mpa of pressure is used. The analysis is carried out using PRO/E (creo-parametric) and ANSYS work bench software. The pressure is applied at the small end of connecting rod keeping big end fixed. The maximum and minimum von-misses stress, strain, and shear stress, are noted from the ANSYS Work bench.

i) Material used for connecting rod is Cast-iron:

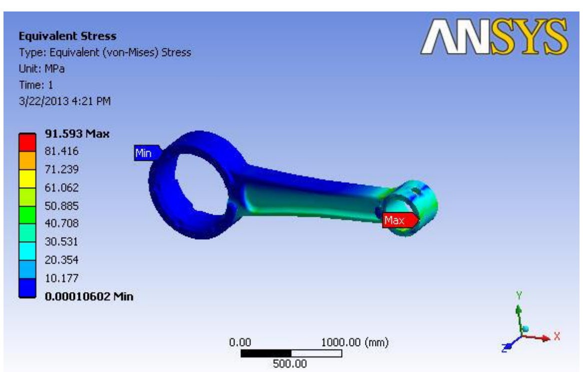

Fig 4: von-misses stress of connecting rod

From the fig 4 the maximum stress occurs at the piston end of the connecting rod is 91.593 Mpa and minimum stress occurs at the crank end of the connecting rod is 1.06e-4 Mpa.

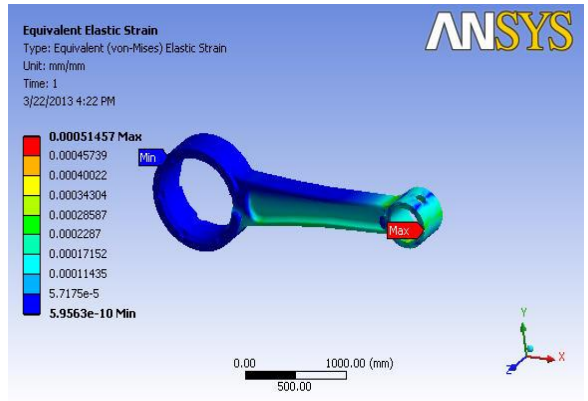

Fig 5: Elastic strain of connecting rod

From the fig 5 the maximum Equivalent elastic strain occurs at the piston end of the connecting rod is 0.000514mm and minimum stress occurs at the crank end of the connecting rod is 5.95e-10mm.

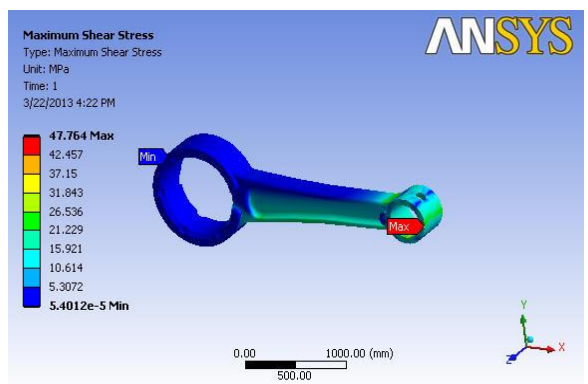

Fig 6: Shear stress of connecting rod

From the fig 6 the maximum shear stress occurs at the piston end of the connecting rod is 47.764 Mpa and minimum stress occurs at the crank end of the connecting is 5.40e-5 Mpa

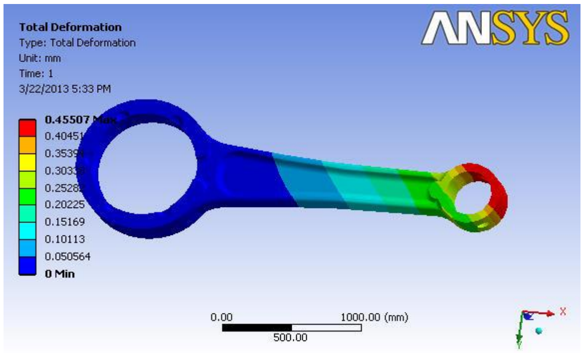

Fig 7: Total Deformation of connecting rod

From the fig 7 the maximum total deformation occurs at the piston end of the connecting rod is 0.45507 mm and minimum total deformation occurs at the crank end of the connecting rod is 0.

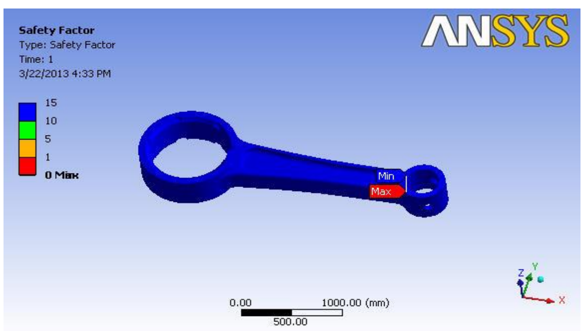

Fig 8 : Factor of Safety of connecting rod

i) Material used for connecting rod is Structural steel:

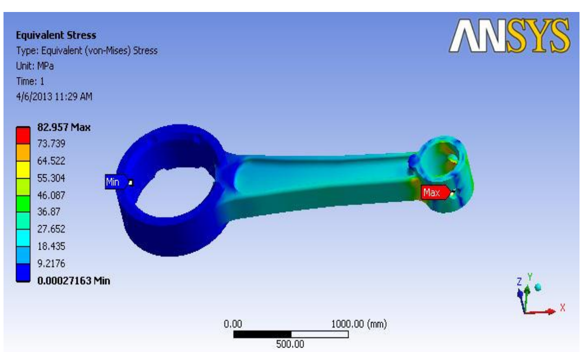

Fig 9 : von-misses stress of connecting rod

From the fig 9 the maximum stress occurs at the piston end of the connecting rod is 82.593 Mpa and minimum stress occurs at the crank end of the connecting rod is 2.71e-4 Mpa.

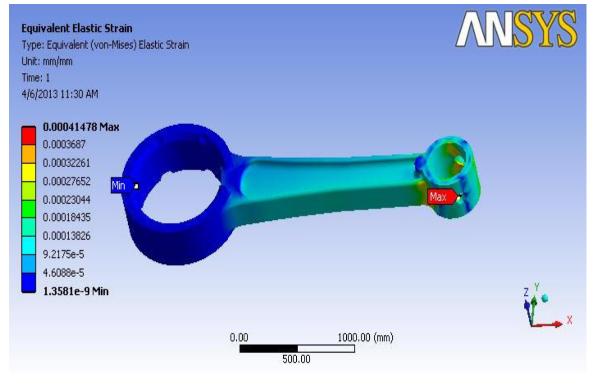

Fig 10 : Elastic strain of connecting rod

From the fig 10 the maximum Equivalent elastic strain occurs at the piston end of the connecting rod is 0.000414mm and minimum stress occurs at the crank end of the connecting rod is 1.358e-9mm.

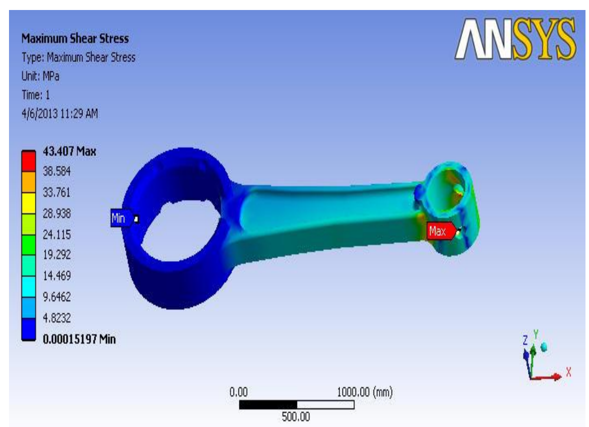

Fig 11: Shear stress of connecting rod

From the fig 11 the maximum shear stress occurs at the piston end of the connecting rod is 43.407 Mpa and minimum stress occurs at the crank end of the connecting is 0.000151 Mpa.

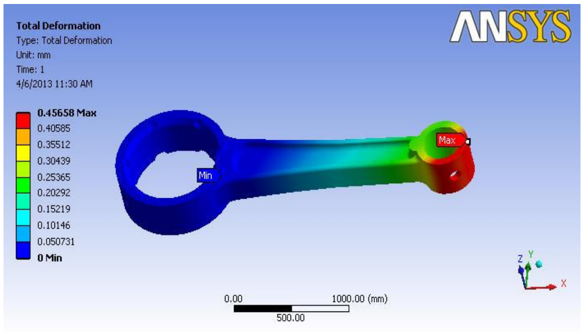

Fig 12 : Total deformation of connecting rod

From the fig 12 the maximum total deformation occurs at the piston end of the connecting rod is 0.45678 mm and minimum total deformation occurs at the crank end of the connecting is 0.

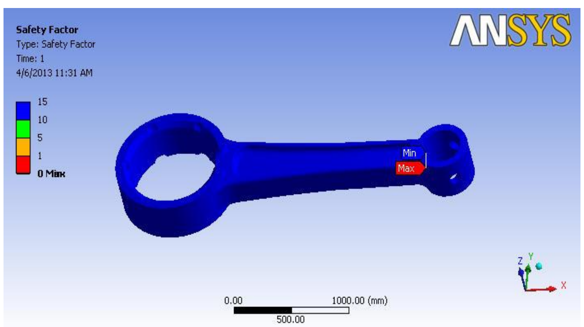

FIG 13 : Factor of safety

COMPARISION RESULTS

Table 4: Comparison Results

S.no	Type	Cast Iron	Structural Steel
1.	Von misses stress	91.59Mpa	82.593Mpa
2.	Shear stress	47.764Mpa	43.407Mpa
3.	Elastic strain	0.000514mm	0.000414mm
4.	Total deformation	0.455mm	0.456mm

V CONCLUSION

Finite Element analysis of the connecting rod of a Hero Honda Splendor has been done using FEA tool ANSYS Workbench and are tabulated in table 4.

1.Static analysis of two materials is carried out by ANSYS and the maximum von misses stress for cast iron is 91.593Mpa and the maximum stress for structural steel is 82.593Mpa

2. Maximum stress occurs at the piston end of the connecting rod

3. Connecting rod design is safe for both materials based on the ultimate strength

4. Comparing the different results obtained from the analysis, it is concluded that the stress induced in the structural steel is less than the cast iron for the present investigation. Here structural steel can be used for production of connecting rod for long durability as cast iron is brittle material.

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