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Comparative Study of Connecting Rod Materials using Numeric Technique

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Abstract-The connecting rod is the transitional part between the piston and the Crankshaft. Its essential capacity is to transmit the push and pull from the piston stick to the crank, hence changing over the responding movement of the piston into rotating movement of the crank. Right now existing associating bar is fabricated by utilizing structural steel the connecting rod is compared with four different materials 20CrMo steel alloy, AA7010, AA7068, AA6010 aluminum alloys. In this illustration is drafted from the computations. A parametric model of Connecting rod is designed utilizing UNIGRAPHICS NX 11 programming and to that model, investigation is completed by utilizing ANSYS 16.2 Workbench Software. Limited component investigation of associating rod is finished by thinking about the materials, viz., Aluminum Alloys. The best combination of parameters like Von-Misses Stress and Strain, deformations, Factor of safety and weight decrease for bike cylinder were done in ANSYS programming. In this paper different materials are compared and AA7068 possess less weight and deformations. Aluminum Alloys are lesser in weight, corrosion resistance, non-toxic, flexible in design and stiffer than other material like Steel.

Keywords— Connecting Rod, Analysis of Connecting Rod, Four Stroke Engine Connecting Rod, Aluminum Alloy Connecting Rod, Design and Analysis of Connecting Rod, RPM.

I. INTRODUCTION

The connecting rod is the link between the piston and the crank shaft. Its main function is to transmit the to and fro motion from the piston pin to the crank pin because it is rigid, and thus convert the reciprocating motion of the piston into rotary movement of the crank. 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 [1]. In a reciprocating piston engine, the connecting rod connects the piston to the crank or crankshaft. 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 lightness and the ability to absorb high impact 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 forapplications such as motor scooters [2]. The small end attaches to the piston pin, gudgeon pin (the usual British term) or wrist pin, which is currently most often press fit into the con rod but can swivel in the piston, a "floating wrist pin" design. The connecting rod is under tremendous stress from the reciprocating load represented by the piston, actually stretching and being compressed with every rotation, and the load increases to the third power with increasing engine speed[1]. Failure of a connecting rod, usually called "throwing a rod" is one of the most common causes of catastrophic engine failure in cars, frequently putting the broken rod through the side of the crankcase and thereby rendering the engine irreparable; it can result from fatigue near a physical defect in the rod, lubrication failure in a bearing due to faulty maintenance or from failure of the rod bolts from a defect, improper tightening, or re-use of already used (stressed) bolts where not recommended[5]. Despite their frequent occurrence on televised competitive automobile events, such failures are quite rare on production cars during normal daily driving.

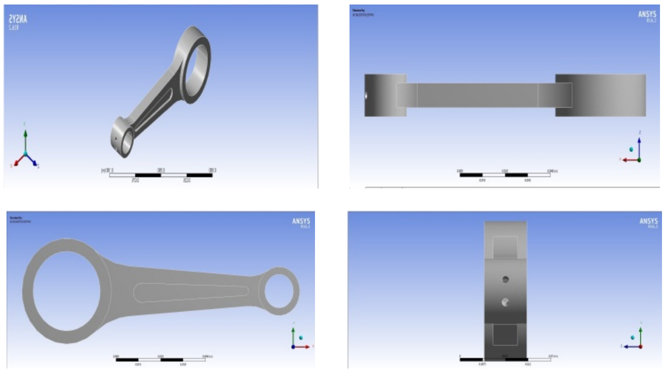


Fig 1.1: Schematic Diagram of Connecting Rod

II. SPECIFICATION OF THE PROBLEM

The objective of the present work is to design and analyze the connecting rod made ofAluminum Alloy. Steel materials are used to design the connecting rod. In this project the material

(Structural Steel) of connecting rod iscompared with Aluminum Alloys. Connecting rod was designed in UNIGRAPHICS NX 11. Model is imported in ANSYS 16.2 workbenchfor analysis. After computational analysis a comparison ismade between existing Steel and AluminumAlloys connecting rods in terms of weight, factor ofsafety, stiffens, deformation and stress.

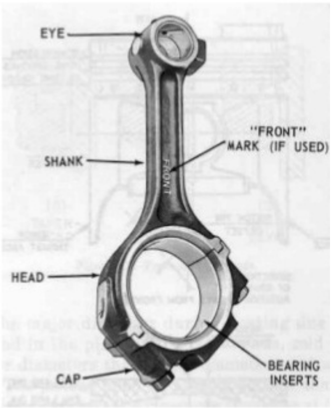


Fig 2.1: 3-DimensionalView of Connecting Rod Showing its Components

The connecting rod is under tremendous stresses or pressure due to the reciprocating load of the piston which increase with every rotation and engine speed. Various forces acted on the connecting rod are as follows:

- Dormancy power following up on the cylinder because of gas weight
- Meandering stress due to the inertia acting onthe connecting rod
- The strength acts due to rubbing betweenpiston pin and eccentric pin bearings

2.1 DESIGN OF CONNECTING ROD

Its primary function is to transmit the push and pull from the piston pin to the crank pin, thus converting the reciprocating motion of the piston into rotary motion of the crank. This Dissertation describes designing and analysis of connecting rod. Currently existing connecting rod is manufactured by using Carbon Steel. The following dimensions are required to be determined to design a connecting rod:

- Dimensions of cross-section of the connecting rod,
- Dimensions of the crankpin at the big end and the piston pin at the small end.

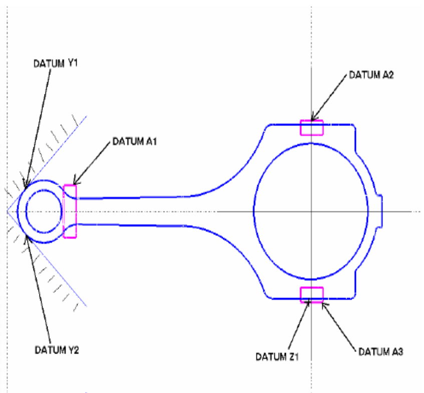


Fig 2.3: A typical connecting rod to be designed

2.2 MATERIALS USED FOR CONNECTING ROD

Connecting rods are fabricated mainly by two methods drop forging operation and molding operations. The steel forging processes fabricate a light weight but more costly connecting rods. Malleable or spheroidal-graphite iron casting or sinter forgings processes are being used to produce small to medium sized IC engines. Steel connecting-rod uses a bronze or brass small end bush with a detachable large-end shell bearing is of white metal. The problem face in using steel is that they are extremely heavy and as a result consume more power result in more stresses. The aluminum alloy connecting rods are advantageous on steel connecting rods as they are lighter in weight and both small-end and big-end bearings can be directly bored into the parent metal of rod and need not to be disjoined. Babbitt lining bearings are used for gas engine of small & light duty purpose and bearing with copper-lead lining is used in compression ignition engines.

2.3 FALIURE OF CONNECTING ROD

Failure of a connecting rod, usually called throwing arod, is one of the most common causes of catastrophic engine failure in cars, frequently putting the broken rod through the side of the crankcase and thereby rendering the engine irreparable; which results from fatigue near a physical defect in the rod and/or lubrication failure. Connecting Rod fails for any of the above reasons. The rod is expanded and compressed at every stage. The rod breaks due to this pressure and other responsible factors. The deformed rod can completely block the engine, ruining the engine condition known as "throwing of rod".

2.3.1 Overloading the Rods :-Usually, the rods are strong enough to accommodate extreme performance modifications. They also can handle some of the racing types. However, they have the limits to which they can comfortably handle. With an increase in power levels and RPMs, the rods will get the point where they cannot support the job further and this can lead to the connecting rod failure which in return can get the engine destroyed within a second. Overloading associates with extreme racing where, the motor makes higher horsepower than needed. However, cases of rod failure about overloading are not common.

2.3.2 Less Lubrication and Heat :-When there is a reduced gap between the rod's bearing and the crankshaft surface, it minimizes the amount of film oil space. As a result, there is an increase in friction which in return generates more heat. The heat makes the bearing to expand resulting into reduction of oil delivery. As the temperature increases to the peak, it results in annealing of the bearing towards journal race. And this tightens and freezes the bearings against crankshaft journal. The overheating, blueblack marks formed on the journals and the bearing results to rod’s failure.

2.3.3 Elongated Rod Bore :-In case the rod’s bore elongates more with high RPM, there it can distort clearances that exist between the bearings and the shaft. It can also happen in case the bolts do not get properly torqued. If the bolt torque doesn’t get proper fixing, it fails to keep the rod in place.The bolts can also be very weak at high RPMs. Such property will pull the cap away off the connecting rod. When the rod is not in its correct positioning, it results to rod’s failure which in return will destroy vehicle`s engine.

2.3.4 Bolt Stretch :-When we experience tight bearing, it can result in excessive bolt stretch. The final result is tearing and weakening of available threads in rod cap. When the rod bolts get exposed to such stresses, they weaken, and their tensile power gets reduced.

2.3.5 Fatigue:-Fatigue is the main cause of broken connecting rods mainly in older engines. The constant compression during the power stroke and stretching during the exhaust stroke, over thousands of times in a minute, eventually wears the metal out and it gets brittle and eventually stops the relative motion between the mating surfaces of connecting rod.

2.3.5 Pin Failure :-Piston pin or gudgeon pin connects the connecting rod to the piston. A lot of wear is acting on piston pin. Due to walkover of this pin the connecting rod disconnects to the any/both sides of connections. For some engines this results in catastrophic engine failure-the connecting rod goes through the engine block or the crankshaft is bent, but in some engines it causes a heavy loss of power.

2.3.6 Hydro Lock:-Hydro lock is a distortion of the connecting rod caused when water gets into the piston chamber. This usually occurs after the automobile has been pushed through deep water, such as a flooded street.

III. LITERATURE SURVEY

Various research papers are studied to find the new method and new area of study that increases the efficiency, performance and life of connecting rod.Various designswere studied to reach the appropriate conclusion.

[2] BOGA SUDHA et al “Design and Thermal Analysis of IC Engine’s Connecting Rod for Different Heat Conditions” 2018- In this paper hediscussconnecting rod is the intermediate between the piston and the crankshaft. It transfers the rotary motion of crank to reciprocating motion of piston in cylinder. In this Dissertation, the comparison is takes place for the best material between Carbon Steel & Aluminum Alloy. The connecting rod is modeled in 3D modeling software knows as Solid Works. Then, these designs are carried for thermal analysis. This thermal analysis is done in a software calls ANSYS. By thermal analysis we can get the heat flux values & by that we can select the best material for connecting rod.

[3] SushilKushwaha et al in “Review on design and analysis of IC engine connecting rod”2018- Discuss the Connecting Rod is one of the main parts of internal combustion engine. The main function of connecting rod is to transmit the power. Connecting Rod is designed for the purpose to transmit the power from the engine to the shaft and to convert reciprocating motion into rotary motion. Therefore, the strength together with fatigue and high temperature resistance of the material become important parameters for completing the designing process of the connecting rod. The main objective of this work is to modify the existing design. Modification is being done by changing in material composition. Material uses in this study are Aluminum, Aluminum alloy, Aluminum alloy with titanium coating. Different materials and their alloys are being tested and compared to generate the final result to design connecting rod with upgraded material and enhance mechanical properties.

[4] Naman Gupta et all in “Modern Optimized Design Analysis of Connecting Rod of an Engine Connecting rod”-2018. He discuss the connecting rod connects reciprocating piston to rotating crankshaft, transmitting the thrust of the piston to the crankshaft. It has two ends. The small end is connected to the piston by a gudgeon pin while other end is connected crankshaft using crank pin. The reciprocating motion generated during the transmission of brake power at piston head causes various stress to acts on the connecting rod. It is generally use to transmit the force through mechanism. So, it is important to reduce the weight with the consideration of the permissible limit for manufacturing of better connecting rod. This further analysis move towards von misses stress so that we get the better component with reduced weight, cost effective and provide better result than other components. This paper illustrates a general study on three designs of connecting rod along with modern structure.

[5] BiradarAkshaydattaVinayakrao et al “Analysis and Optimization of Connecting Rod used inHeavy Commercial Vehicles”-2017.DiscussConnecting rods are subjected to forces generated by mass and fuel combustion. Connecting rod is modeled using CATIA software and FE analysis is carried outusing ANSYS Software. Load distribution plays important role in fatigue life of the structure. This paper describes thedesign and finite element analysis of alternating material for connecting rod of heavy vehicle. The design and finiteelement analysis is performed by using computer aided design (CAD) software. The objective is to design and analysis thestructural stress distribution of connecting rod at the real time condition during process. In the present work, an attempt as been made to investigate the suitable material which is lighter than steel and has fatigue strength, Yield strength anddensity properties. The optimization is carried out to reduce the stress concentration and weight of the connecting rod forSteel 4340, 42CrMo4, Al 7075-T7 which keeps upspring mass low thereby increasing the stability of the vehicle. Withusing computer, aided design (CAD), CATIA V5 software the structural model of connecting rod is developed. Thesuitable material for the connecting rod is 42CrMo4, Al 7075-T7 and all the values obtained from the analysis are lessthan their allowable values. Hence, the connecting rod design is safe based on the strength and rigidity criteria. Byidentifying the true design features, the extended service life and long term, stability is assured.

[6] AmaravathiRajugopalVarma et al "Design and Analysis of 150CC IC Engine Connecting Rod"-2017 In this project he designed a connecting rod for a four stroke single cylinder engine for two different materials Carbon Steel and Aluminum alloy. Both the designs are modeled in 3D modeling software CREO. Structural analysis is done on the connecting rod to verify the strength of the connecting rod original and modified model by using two materials Aluminum alloy by applying the pressure developed in the engine. Modal analysis is done to determine the natural frequencies when loads are applied. The analysis is done to verify the better material for connecting rod to reduce the cost. Modeling is done in CREO and analysis is done in ANSYS.

[7] K. Sudershan Kumar et al. "Modeling and Analysis of Two Wheeler Connecting Rod," In this paper connecting rod material is replaced by Aluminum coated with Boron carbide. A model is design by using PRO-E software and analysis is done on ANSYS software.

[8]Prof. Vivek C. Pathadeworked on the stress analysis of connecting rod by Finite Element Method using Pro/E Wildfire 4.0 and ANSYS Workbench 11.0 software. Experimental method of Photo elastic is used for comparison and verification of the results obtained in FEA.From the FEA and Photo elastic Analysis he found that the stresses induced in the small end of the connecting rod are higher than the stresses induced at the big end. It is also found from the photo elastic that the stress concentration effect exist at both small end and big end and it is negligible in the middle portion of the connecting rod. Therefore, the connecting rod fails may be at fillet section of both ends.

[9] G. M. Sayeed Ahmed worked on "Design Fabrication and Analysis of a Connecting Rod with Aluminum Alloys and Carbon Fiber" he replaced a forged steel connecting rod with Aluminum alloy and Carbon fiber. The Connecting Rod is modeled on Pro/E. Connecting rod of materials aluminum6061, aluminum 7075, aluminum 2014 and carbon fiber 280 GSM are used and analysis is done.

IV. MATERIAL USED

Steel is normally used for construction of automobile connecting rods because of its strength, durability, and lower cost. However, steel with its high mass density exerts excessive stresses on the crankshaft of a high speed engine. This in turn requires a heavier crankshaft for carrying the loads and, therefore, the maximum RPM of the engine is limited. Additionally, higher inertia loads, such as those caused by steel connecting rods and heavier crankshafts reduces the acceleration or declaration rates of engine speed. Therefore, light alloy metals such as aluminum and titanium are currently being used in high speed engine connecting rods to circumvent the above-mentioned problems. Titanium has better mechanical properties than aluminum, at theexpense of higher density and cost. This higher density and cost have made aluminum connecting rods more popular and attractive. However, they suffer from relatively low strength and fatigue life.

The automobile engine connecting rod is a high volume production, critical component. It connects reciprocating piston to rotating crankshaft, transmitting the thrust of the piston to the crankshaft. Every vehicle that uses an internal combustion engine requires at least one connecting rod depending upon the number of cylinders in the engine. Connecting rods for automotive applications are typically manufactured by forging from either wrought steel or powdered metal. They could also be cast. However, castings could have blow-holes which are detrimental from durability and fatigue points of view. The fact that forgings produce blow-hole-free and better rods gives them an advantage over cast rods. Between the forging processes, powder forged or drop forged, each process has its own pros and cons. Powder metal manufactured blanks have the advantage of being near net shape, reducing material waste. However, the cost of the blank is high due to the high material cost and sophisticated manufacturing techniques.

With aluminum alloys, the material is inexpensive and the rough part manufacturing process is cost effective. The first aspect was to investigate and compare fatigue strength of 20CrMo steel alloy, AA7010, AA7068 and AA6010 aluminum alloysconnecting rods with that of the structural steel connecting rods. The second aspect was to optimize the weight and manufacturing cost of the structural steel connecting rod.Due to its large volume production, it is logical that theoptimization of the connecting rod for its weight or volume will result in large-scale savings of material & cost. Further achieving the objective reducing inertia loads, thus reducing engine weight and improving engine performance and fuel economy.

V. NUMERICAL ANALYSIS

Connecting rods are mostly used in variety of engines such as, in-line engines, V-engines, opposed cylinder engines, radial engines and oppose-piston engines. A connecting rod consists of a pin-end, a shank, and a pin-end and crank-end pin holes at the upper and lower ends.Both endsare machined to permit accurate fitting of bearings. These holes must be parallel. The upper end of the connecting rod is attached to the piston by the piston pin. If the piston pin is locked in the piston pin bosses in the piston and the connecting rod, the upper hole of the connecting rod will have to use a solid bearing of bronze or someother material. As the lower end of the connecting rod rotate with the crankshaft, the upper end is forced to turn back and forth on the piston pin. Although this crusade is rebuff, the bearing bushing is essential because of the high pressure and temperatures. The lower hole in the connecting rod is used to permit it to be fixed around the crankshaft. The bottom part is made of the same material as the rod and is attached by two bolts. The surface that tolerate on the crankshaft is generally a bearing material. The two parts of the bearing are maintaining in the rod and cap by dowel pins, forecasts, or short brass screws. Split bearings may be of the accuracy or semi accuracy type.

The connecting rod in I.C. engines are subjected to high cyclic loads comprised of dynamic tensile and compressive load. Its primary function is to transmit the push and pull from the piston pin to the crank pin and thus convert the reciprocating motion of the piston into the rotary motion of the crank. It consists of a long shank, small end and a big end. The cross section of the shank may be rectangular, circular, tubular, I-section or H-section. Commonly the circular section is used for low speed engine while I-section is preferred for high speed engine. Stress analysis of connecting rod is done by finite element method using ANSYS 16.2 workbench software and it is analyzed that the stress induced in the piston end of the connecting rod are greater than the stresses induced at the crank end. So, the piston end has more fractures as compare to crank end.

VI. CALCULATIONS

[6.1] Specifications:-

Bore × Stroke =58×56 mm

Compression Ratio =9.5:1

Maximum Power =14.85 hp @9000 rpm

Maximum Torque =12.11hp @6500 rpm

Density of Petrol 737.22 kg/m^3

Temperatureof Petrol@ Room =288.855 K

Mass of Petrol =Density × Volume = 0.011 kg

Molecular Weight of Petrol =0.114228 kg /mole

Gas Equation:P.V = m×R×T

P =15.521 MPa

[6.2]Standard Proportions of I-Section:-

Width of the section, B = 4t

Depth of the section, H =5t

Area of the section =11t^2

Depth of the section near the big end = 1.1H to 1.25 H

Depth of the section near the small end = 0.75H to 0.9 H

Moment of inertia about X-Axis I_{xx} = 34.91 t^4

Moment of inertia about y-Axis I_{yy} = 10.91 t^4

Therefore, $\frac{I_{xx}}{I_{yy}} = 3.2$

Radius of gyration of the section about X-Axis = 1.78t

Length of crank pin = 1.25d_c to 1.5d_c

Length of piston pin = 1.5d_p to 2d_p

[6.3] Dimensions of I-section of Connecting Rod:-

The maximum force acting on the piston due to gas pressure,

Since the connecting rod is designed by taking the force on connecting rod (F_c) equal to the maximum force on the piston (F_L) due to gas pressure, therefore

$F_c = \frac{\pi \times D^2 \times p}{4}$ = **41007.714 N**

Designed Force= Maximum Force × Factor of Safety

F_c = 102519.28 N

Since, factor of safety considered is **2.5**.

Radius of gyration of the section about X-Axis, $K_{xx} = \sqrt{\frac{I_{xx}}{A}} = \sqrt{\frac{34.91t^4}{11t^2}}$ = 1.78t

Radius of crank $=\frac{56}{2}$ = 28 mm

FromRankine's formula,

$$W_B = \left[\frac{\sigma_c . A}{1 + a\left[\left(\frac{L}{k_{xx}}\right)^2\right]}\right]$$

Where,

σ_c= 250 MPa, E = 2× 10^5MPa

$a = \frac{\sigma_c}{\pi^2 E}$ =1/7895.68

⇨ **t = 6.1 mm**

Width of the section, B = 4t = 24.4 mm

Height of the section = 5t =30.5 mm

For small end of rod, $F_p = I_p d_p p_b$

Where, I_p =Length of piston pin, d_p =Diameter of piston pin, P_b =Permissible bearing pressure, p_b is taken as 10 to 14 N/mm^2,

$\frac{I_p}{d_p}$ =1.5; d_p=44.19 mm

For big end of rod, $F_p = l_c d_c p_b$

Where, I_c =Length of crank pin, d_c =Diameter of crank pin, P_b =Permissible bearing pressure, p_b is taken as 5 to 10 N/mm^2

$\frac{I_c}{d_c}$ = 1.25; d_c= 57.25 mm

[6.4] Maximum Tensile Force :-

Mass of the connecting rod, m = volume× length× density

= 0.305 kg

Maximum force in the crank pin, F_{max} =ρAω^{2}r = **80793 N**

Resultant normal force on the connecting rod, $F_n = \frac{1}{2} F_{max}$ L

= **3837.67 N**

Maximum Bending moment, $M_{max} = \frac{2F_n.L}{9\sqrt{3}}$= **46.77 N-m**

Section Modulus, $Z_{xx} = \frac{I_{xx}}{Y_{max}} = 3.16\times10^{-6} m^3$

Maximum bending stress due to inertia bending forces = $\frac{M_{max}}{Z_{xx}}$ = **14.75×10^6 N/m^2**

This is safe

Same procedure is followed for the four different materials summary is reported in the table no. 1

Materials	Density ρ(kg/m^3)	Young modules (GPa)	Mass (kg)	Compressive Stress σ_c(MPa)	Thickness (mm)
Structural steel	7850	200	0.305	250	6.1
20CrMo	7860	210	0.1186	685	3.8
AA6061	2700	68.9	0.0982	276	5.9
AA7010	3000	70	0.0651	410-540	4.56
AA7068	2850	73.1	0.0471	683	3.98

Table 1: Analytical data for I-section materials

VII. SIMULATION RESULTS & SUMMARY

[7.1]Mashing and forces applied:-By applying boundary condition we can apply the force over connecting rod in two way. In first condition we can fix the big end of the connecting rod and apply the force on small end. We can apply the compressive load of 3837.7 N.

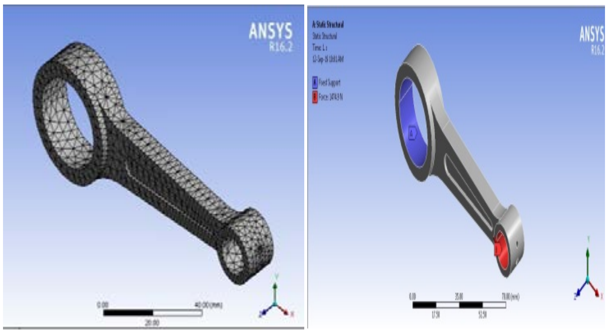


Figure 7.1: Mashing and forces applied on a connecting rod

[7.2] Total Deformation:For structural steel the Total deformation value are calculated here we get deformation which varies form 0 mm to 0.0023299 mm.

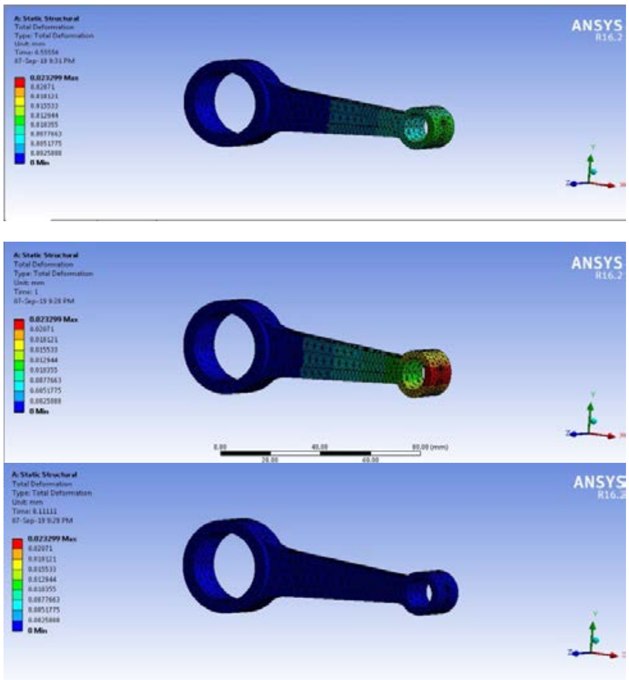


Figure 7.2Total Deformation at different time slot.

[7.3] Equivalent Stress analysis:-For structural steel the Equivalent Von-Mises Stress value are calculated here we get stresses which varies from 0.00030727 MPa to 132.46 MPa.

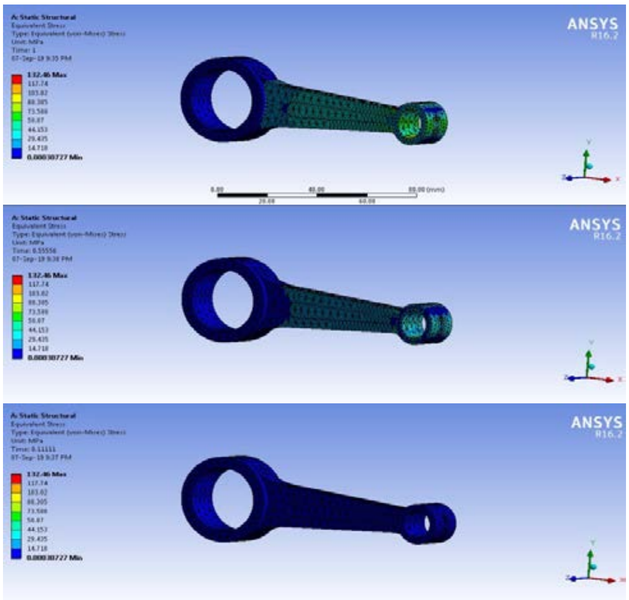


Figure 7.3Equivalent Stress analysis at different time slot.

[7.4] Equivalent Elastic Strainanalysis: -For structural steel the Equivalent Elastic Strain value are calculated here we get strain which varies from 2.4732 × 10^{-9} to 0.00066695mm/mm.

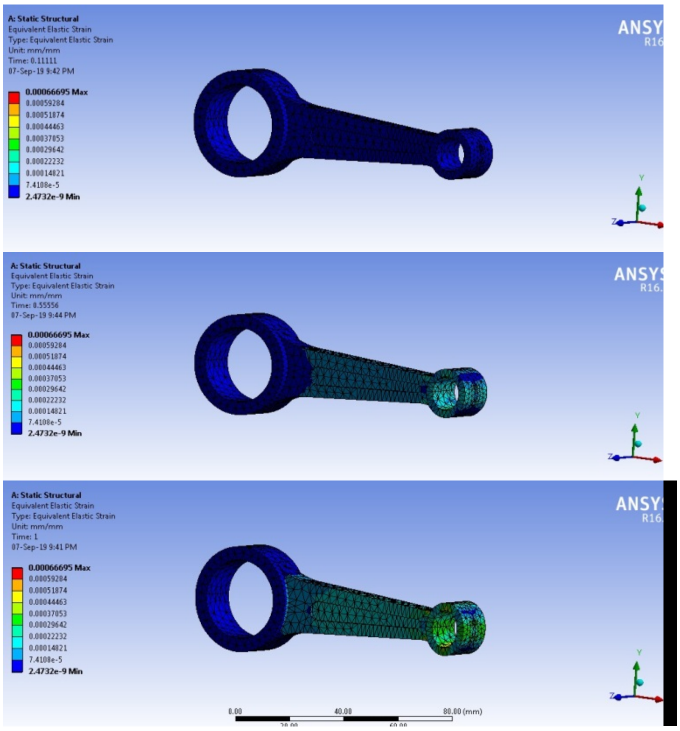


Figure 7.4Equivalent Elastic Strain analysis at different time slot

[7.5]Factor of Safety:For structural steel the Factor of Safety value are calculated here we get FOS which varies from 2.5197 to 15

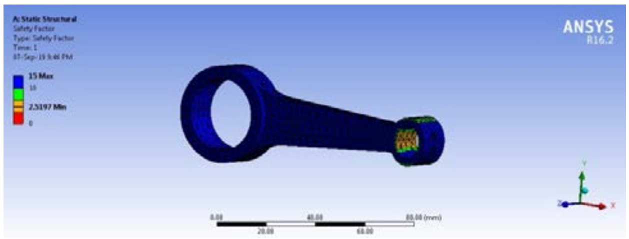
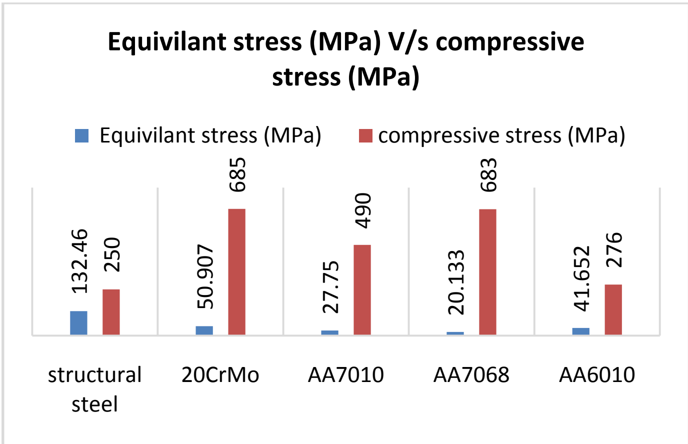


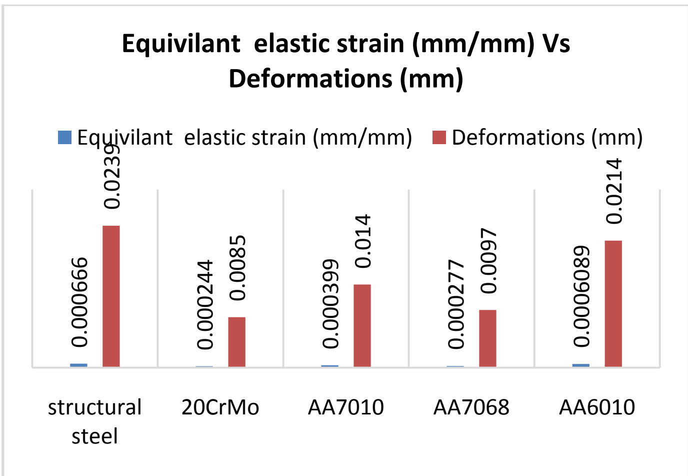
Figure 7.5 Factor of Safety Analysis

[7.7] FEA Results &Discussion:-

Materials	Deformation (mm)	Equivalent Elastic strain (mm/mm)	Equivalent stress (MPa)
Structural steel	0.02399	0.000666	132.45
20CrMo	0.0085	0.0002444	50.907
AA6061	0.02146	0.00060899	41.652
AA7010	0.01403	0.0003999	27.75
AA7068	.009777	0.000277	20.133

Table 2: Comparative static analysis of the four different materials





Graph 1: Comparison between material and there property

Finite Element Analysis of the connecting rod has been done using FEA tool in ANSYS Workbench 16.2 and results are obtained. The deformation is 0.0239 mm for Steel, 0.0085 mm for 20CrMo, 0.009777 mm for AA7068, 0.01403 mm for AA7071, and 0.02146 mm for AA6061. The Maximum Equivalent Stress found to be, 132.46 MPa for the Steel, 50.907 MPa for 20CrMo, 20.133 MPa for AA7068, 27.75 MPa for AA7010, 41.652 MPa for AA6010.The material models presented here is safe and under the permissible limit of stresses and material AA7068 has least maximum stress i.e. 20.133 MPa as compared to the other three materials.

In general, study on the design along with the consideration of all aspect of industrial material used in connecting rod the main objective of this work is to optimize weight and make the component lighter without applicable change in size and manufacturing cost of connecting rod.

The mass of the connecting rod of steel is 0.305 kg with thickness of 6.1 mm, for 20CrMo material it is to be 0.1186kg with thickness 3.8 mm, for AA7010 material it is to be 0.0651 kg with thickness 4.56 mm, for AA7068 material it is 0.047 kg, for AA6010 material it is to be 0.0982 kg with thickness 5.9 mm and from the following result we can conclude that material AA7068 has the minimum mass of 0.0471 kg with thickness 3.98mm.

VIII. CONCLUSIONS

From the static structural analysis it is observed that Equivalent von-Mises stresses, Equivalent Elastic Strain for Aluminum Alloy and Structural Steel was compared and it is observed that the stresses are high Aluminum Alloy so it has high strength compared with Structural Steel for a given loading conditions. AA7068 Aluminum alloy which required less material and less dimensions to sustain required pressure generated inside the cylinder compared to structural steel,20CrMo steel alloy, AA7010, and AA6010 aluminum alloys material connecting rod. From four materials the optimized connecting rod is AA7068 Aluminum alloy and it is good in nature than other material used in this work.

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