International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Performance Analysis of Connecting Rod for different Materials Using FEM

Prof.Akshay Nighot[1], Nikhil Kulkarni[2],

Yogeshani Khedekar[3], Sahebrao Chakre[4] , Sandeep Kumar Singh[5]

[1,23,4,5]Mechanical engineering, SPPU, Pune, Maharashtra, (India)

ABSTRACT

The connecting rod is the mediating member between the piston and the Crankshaft. Its main function is toconvert the reciprocating motion of the piston into rotary motion of the crank. The connecting rod is modelled using CATIAsoftware for both existing solid and modified truss designs. Boundary conditions are applied to the models after finishingthe pre – processing work in ANSYS 16.2 software. The best combination of parameters like Von misses stress and strain,Deformation, Factor of safety, fatigue and life cycle calculation, bi-ability indication for two wheeler piston were done inANSYS 16.2 software. This project also tends to optimize the design by calculating weight and stiffness for variousmaterialistic designs by using the output values of mass and volume of the connecting rod which will also be obtained fromthe software. This paper will conclude whether the modified design is safe along above selected materials. And will bepresenting the best design for future reference.

Keywords: Connecting Rod, Design-Change, Truss Design, Optimization, Von Misses Stress.

I INTRODUCTION

A connecting rod is a shaft which connects a piston to a crank or crankshaft in a reciprocating engine. Together with the crank, it forms a simple mechanism that converts reciprocating motion into rotating motion. A connecting rod is an engine component that transfers motion from the piston to the crankshaft and functions as a lever arm. Connecting rods are commonly made from cast aluminium alloy and are designed to withstand dynamic stresses from combustion and piston movement. The small end of the connecting rod connects to the piston with a piston pin. The piston pin or wrist pin provides a pivot point between the piston and connecting rod. Spring clips, or piston pin locks, are used to hold the piston pin in place .The big end of the connecting rod connects to the crankpin journal to provide a pivot point on the crankshaft. Connecting rods are produces as one piece or two-piece components. A rod cap is the removable section of a two-piece connecting rod that provides a bearing surface for the crankpin journal. The rod cap is attached to the connecting rod with two cap screws for installation and removal from the crankshaft.

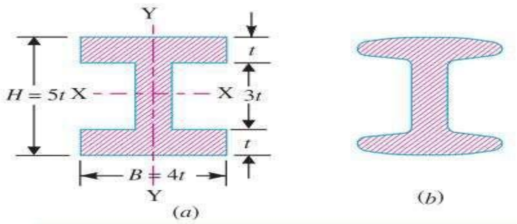
II METHODOLOGY

1- To design the connecting rod for a diesel engine so as to determine the section thickness of connecting rod.
2- To geometrically model the connecting rod as per the dimensions generated from the process of design procedure.
3- To analysis the whipping load which is bending stress due to inertia forces acting on each material of connecting rod.
4- To analysis the stress using FEA approach on each material selected for study.

III DESIGN OF CONNECTING ROD

Case Study=Design a connecting rod for an I.C. engine running at 1800 r.p.m. and developing a maximum pressure of 3.15 N/mm^2 . The diameter of the piston is 100 mm ; mass of the reciprocating parts per cylinder 2.25 kg; length of connecting rod 380 mm; stroke of piston 190 mm and compression ratio 6: 1. Take a factor of safety of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2 and the corresponding bearing pressures as 10 N/mm^2 and 15 N/mm^2 . The density of material of the rod may be taken as 8000 kg/m^3 and the allowable stress in the bolts as 60 N/mm^2 and in cap as 80 N/mm^2

Solution :



B = 4t H = 5t

A = 2 (4 t × t) + (3t × t) = $11t^2$(Figure a)

$I_{xx}=1/12(4t(5t)^3-3t*(3t)^3)=419/12t^4$

$I_{yy}=2*1/12*t(4t)^3+1/12*3t*t^3=131/12*t^4$

$I_{xx}/I_{yy}=3.2$

$F_C=24740N$

$W_B=148440N$

$K_{xx}=1.78t$

R=190/2=95mm

L=380mm

According to Rankine’s formula

$148440=6_c.A/1+a(L/K_{xx})$

t=7mm

B=4t=28mm

H=5t=35mm

IJARSE
ISSN: 2319-8354

IV CAD MODEL OF CONNECTING ROD

Fig:CAD Model of connecting rod

V PROPERTIES OF MATERIAL:

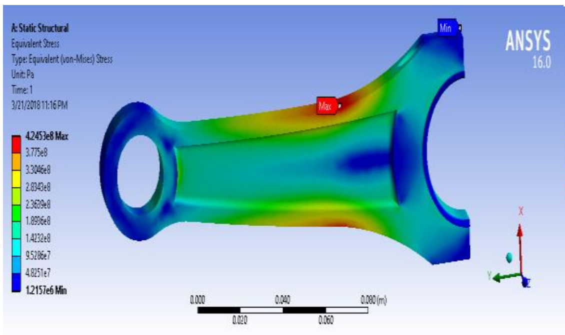
Table-Properties of material

Properties	Aluminium Alloy	Titanium Alloy	Beryllium Alloy
Tensile strength(MPa)	317	862	1280
Yield strength(MPa)	170	970	965
Poisson's ratio	0.334	0.31	0.33
Modulus of rigidity(GPa)	69	40	50
Young's modulus(GPa)	120	110	125

VI ANALYSIS ON ANSYS WORKBENCH 16.2

Analysis software. It is used to check design feasibility of the design almost in all aspect. Ansysasa software is made to be user-friendly and simplified as much as possible with lots of interface options to keep the user as much as possible from the hectic side of programming and debugging process.

6.1 Analysis of Connecting Rod of Aluminium 360-



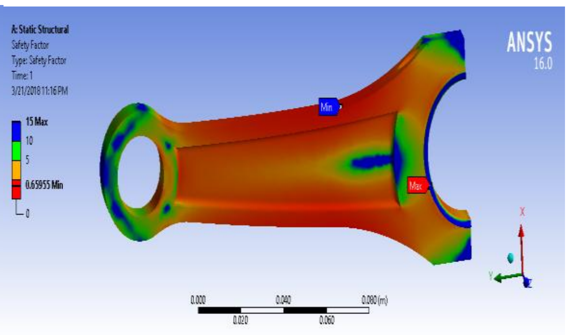


Fig-Equivalent Stress Analysis **Fig-Equivalent Safety factor Analysis**

IJARSE
ISSN: 2319-8354

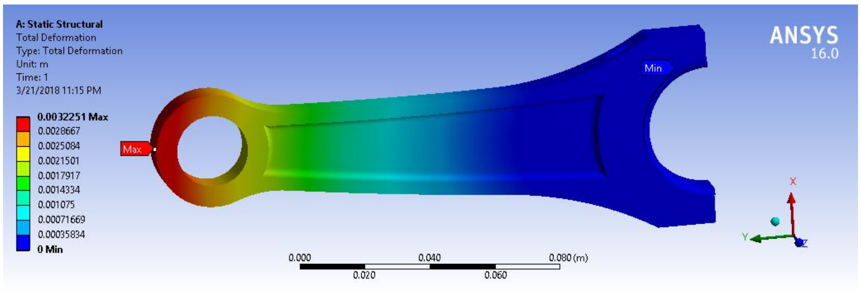


Fig-Equivalent Deformation Analysis

Table-4.2 Result and Analysis

	Minimum	Maximum
Stress	1.334×10^{6}	2.9557×10^{8}
Strain	1.9632×10^{-5}	0.0044616
Deformation	0.0	0.00033186

6.2 Analysis of Connecting Rod of Beryllium

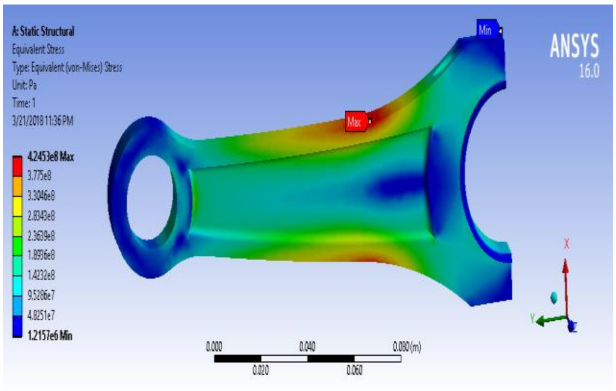


Fig-Equivalent Stress Analysis

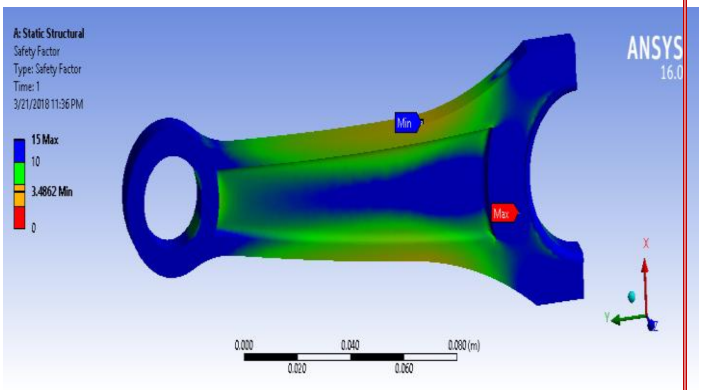


Fig-Equivalent Safety factor Analysis

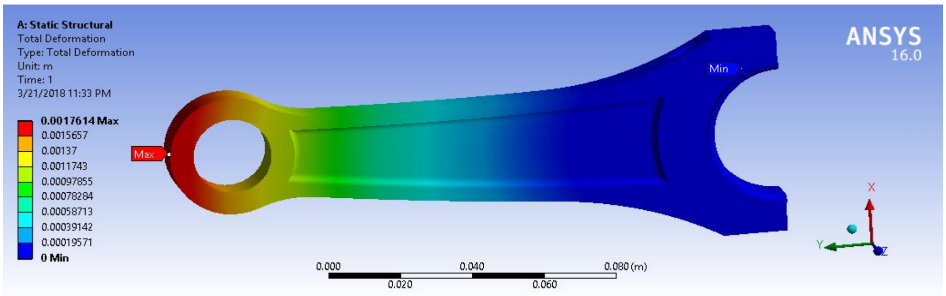


Fig-Equivalent Deformation Analysis

Table-Result and Analysis

	Minimum	Maximum
Stress	1.334×10^{6}	2.95578×10^{8}
Strain	1.1151×10^{-5}	0.0025342
Deformation	0.0	0.00018849

6.2 Analysisof Connecting Rod of Ti-13V-11Cr-3Al.

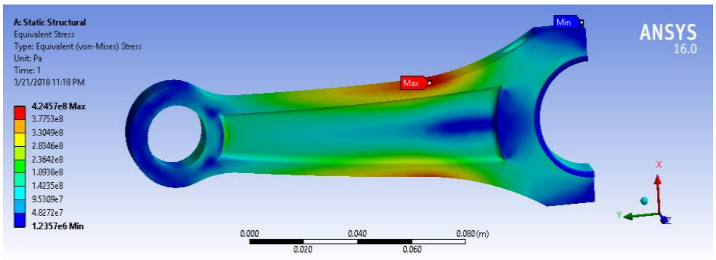


Fig-Equivalent Stress Analysis

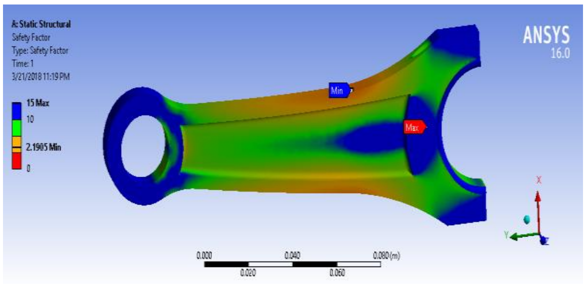


Fig-Equivalent safety factor Analysis

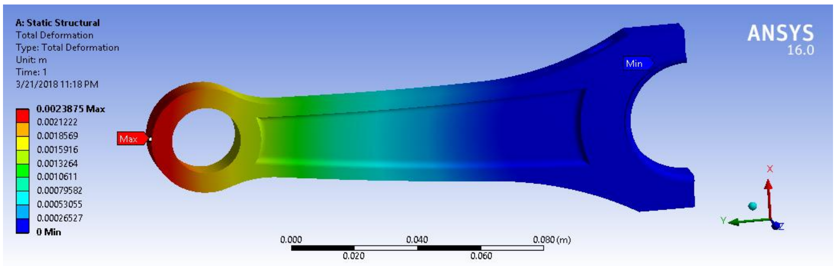


Fig-Equivalent Deformation Analysis

Table-Result and Analysis

	Minimum	Maximum
Stress	1.4385×10^{6}	2.9774×10^{8}
Strain	1.2413×10^{-5}	0.002651
Deformation	0.0	0.00019652

VII CONCLUSION

A. Forged steel connecting rod is having more weight than Aluminium, magnesium and beryllium alloys connecting rod.

B. Aluminium alloy connecting rod is having more weight and displacement than magnesium and beryllium alloys. So, aluminium connecting rod shows more shaky behaviour.

C. Maximum von mis sesstress, Maximum von misses strain and Maximum displacement are minimum in connecting rod of Beryllium alloy.

D. Comparing the different data it is observed that stress, strain and displacement is minimum in beryllium alloy connecting rod. So, beryllium alloy can be used for production of connecting rod for longer life.

REFERENCES

[1] Kuldeep B, ArunL. R, Mohammed Faheem "*Analysis and Optimization Of Connecting Rodusing Alfasic Composites", ISSN: 2319*-875, International Journal of Innovative Research in Science, Engineering and Technology,Vol.2,Issue6,June2013

[2] Prof.N.P. Doshi, 1 Prof. N.K. Ingole "*Analysis of Connecting Rod Using analytical And finite Element Method "* International Journal Of Modern Engineering Research" (IJMER) www.ijmer.comVol.3,Issue.1,Jan-Feb.2013,ISSN:2249-6645.

[3]FOLGAR *Analysis of Connecting Rod Using Analytical and Finite Element* " International Journal of Modern Engineering Research(IJMER),JanFeb.2013,*Vol.3,Issue.1,pp-65-68*

[4]RABB"*FINITE ELEMENT ANALYSIS OF CONNECTIN GROD USING ANSYS*"ProceedingsofThirdIRFInternationalConferenceon8thFebruary2015,Cochin, India,*ISBN:978-93-84209-88-9*

[5]PAI, "*Dynamic analysis of laods and stresses in connectin*g", Proc. I Mech E*Vol.220* Part C: J.Mechanical Engineering

[6] SONSINO and ESPER, *Stress Analysis of I.C.Engine Connecting Rodby FEM*, International Journal of Engineering and Innovative Technology(IJEIT) *Volume1,Issue3,March2012*

[7] BALASUBRAMANIAM. Vijaya Bhaskar Reddy, *Modelingand Analysisof Two Wheeler Connecting Rodby Using Ansys*, IOSR Journal of MechanicalandCivilEngineering(IOSR-JMCE)*Volume6,Issue5(May.-Jun.2013),PP8387.*

[8] SARIHAN and SONG, *Design Evaluation and Optimization of Connecting Rod Parameters Using FEM* International Journal of Engineering and Management Research,*Vol.-2*,*Issue-6*,*December2012.*

[9] ISHIDA "*Structural Analysis of Bush Bearing For Small End Connecting Grod Using "Promechanica*" ISSN*0975–668X|NOV12TOOCT13|VOLUME*–02.2344-02

[10]Webster.w.d,coffellR,and AlfaroD. "*Modelling and analysis of two wheeler connecting rod whileusing Ansys software* " IOSR Journal mechanical and civil engineering.

Books

1. R.S.Khurmi, J.K.Gupta "Textbook of Machine Design".
2. V.B. Bhandari, R.S.Aggarwal "Books of Machine Design".