iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** XI **Month of publication:** November 2017

DOI: http://doi.org/10.22214/ijraset.2017.11066

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

An Expert System for the Design of Two Wheeler IC Engine Connecting Rod

R. Rama Chandra[1]
[1]Professor, Department of Mechanical Engineering, SKD Engineering College, Gooty, Andhra Pradesh, India

Abstract: The objective of the paper is to present the process of the development of an expert system for generating the two wheeler IC Engine connecting rod by using SolidWorks and analyzing the CAD model with finite element methods. The system is developed to generate the automatic CAD model of the two wheeler IC engine connecting rod in SolidWorks and analysing its capabilities using ANSYS 15.0 based on the loading conditions. The expert system is developed with help of macro file of the SolidWorks software. The presented system proved itself as better application by reuse of the design knowledge. The considered connecting rod materials are Aluminium Alloy 6061, Grey Cast Iron, Titanium 6al 4v, ASTM A 216 GR WCB.
Keywords: Expert System, SolidWorks API, Parametric Modeling, Connecting Rod, Macro, Finite Element Analysis.

I. INTRODUCTION

Connecting rod is a widely used and unavoidable machine part in modern Internal Combustion (IC) engines. The CAD became as the inevitable design practice in the recent years. Developing the CAD part model of a connecting rod is tedious job because of complexity in drawing the curvature of the body and to recreate the same with minor changes. Modeling is a time consuming process because of lack of skilled Computer Aided Design modeling professionals [1]. Parametric modeling technique rise about this issue as it recreates the same task in very less time compare to manual approach. As the parametric modeling technique is dimension driven it facilitates automatic re-process of already existing the design process. This technique is quick, efficient and interactive in comparison with all conventional 3D modeling techniques. The parametric modeling technique is required to development of an expert system for the design of a Connecting Rod.

II. REVIEW OF LITERATURE

Jayakiran et al. [1] describes a typical knowledge based engineering system for rapid design and modeling of bearings based on operating conditions by integrating commercially available CAD package solid works with Microsoft Access. An interface engine and properties interface was developed for bearing design for assisting the engineering designers. Raviraj et al. [2] describes Finite Element Analysis of connecting rod. In the present work connecting rod is replaced by materials ASTM A216 GR WCB and Aluminum 360 for Hero Splendor motor bike. Calculations. The best combination of parameters like von misses stress and strain, deformation for two wheeler connecting rod where done in ANSYS workbench 15.0. Finally these results are compared with each other. Dipalee et al .[3] presented the design evaluation through finite element analysis for fatigue life of Hero Honda Motorcycle connecting rod. By using FEA and experimentation method find the structural system of the existing connecting rod and on the basics of FEA and experimentation result recommend the alternative design for connecting rod. 3D model of connecting rod is created in CATIA software and is analyzed in HYPERMESH software. The structural strength of connecting rod is verified on universal testing machine (UTM). Sayeedahmed et al. [4] presented a work to replace the existing connecting rod made of forged steel which is broken for LML freedom with aluminum connecting rod. Analysis is done on the connecting rod using materials aluminum 6061, aluminum 7075, aluminum 2014 carbon fiber 280gm bidirectional and analysis is also done for the assembly of piston, connecting rod and crankshaft [4]. Similarly, Abhinav et al. [5], Ram Bansal [6], Kuldeep et al. [7], Vaibhav et al. [8], Priyank [9] attempted to design and optimize the connecting rod with different materials using CAD and CAE software.

III. SPECIFICATION OF THE PROBLEM

This expert system can design the connecting rod based on the loading conditions on it. The system is equipped to generate the connecting rod with the help of Macro codes in order to automate the CAD modeling process. This automation is further enhanced with parametric modeling technique. The CAD modeling process is written in a program with the help of Visual Basics (VB). Initially, the CAD model can be generated by using SolidWorks package, later the same is modeling process has been converted into macro code for automating the CAD modeling process. The CAD model has been analysed using ANSYS 15.0 for its robustness. Then, the structural analysis is performed to determine von misses stress, shear stress, elastic strain, total deformation under the given loading conditions. Table 1. provides the considered IC engine specifications. Table 2. contains the design variables of the connecting rod.

TABLE 1
IC ENGINE SPECIFICATIONS

S.No	Particulars	Specifications
1	Type	Air cooled, Four stroke, Single cylinder
2	Bore	50 mm
3	Stroke	49.5 mm
4	Displacement	97.2 cc
5	Fuel	Petrol
6	Compression ratio	9:1

TABLE 2
DESIGN VARIABLES

S.No	Particulars	Specifications
1	Maximum Power	7.5 PS @ 8000 RPM
2	Maximum Torque	7.95 NM @ 5000 RPM
3	Material	Aluminum Alloy 6061 / Grey Cast Iron / Titanium 6 AL 4V / ASTM A216 GRWCB (Cast Steel)

IV. METHODOLOGY FOR MODELING, AUTOMATION AND IMPLEMENTATION

A. Second Phase Developing Tools for SolidWorks Software

If any programming language supporting Component Object Model (COM) and object linking Embedding (OLE) can be used as development tools of SolidWorks software (Example: Visual Basic (VB)). SolidWorks is a CAD software allows to model the three dimensional objects using parametric modeling technique.

A computer program is written in VB for design calculations of the connecting rod with all material properties, assumptions, rules and considerations to find the size of the connecting rod. Macro code is developed for the generation of the connecting rod.

B. Generating the Man-Machine Interlinks

A button is created for the connecting rod in the SolidWorks software. Own GUI is created and linked with this button with New Macro Button function of SolidWorks. Fig. 1 shows sample screen shot of the SolidWorks having Connecting Rod button embedded with the macro code.

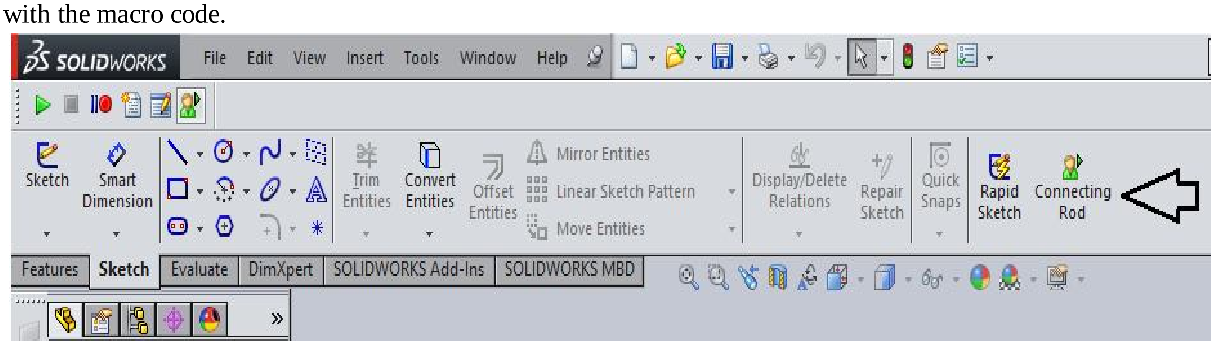

Fig. 1 Sample screen shot of the SolidWorks having Connecting Rod button.

Upon execution of the developed computer program, the following CAD models of the connecting rod are generated based on the considered IC engine specification and design variables by the SolidWorks with the help of Macro code. Fig. 2 to fig. 5 shows the system generated CAD models of the connecting rod of different considered materials.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

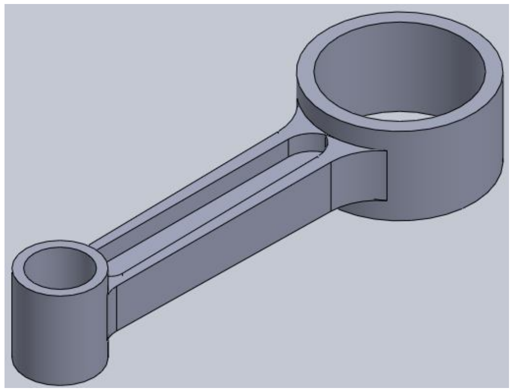

Fig.2.Aluminum Alloy 6061Connecting Rod

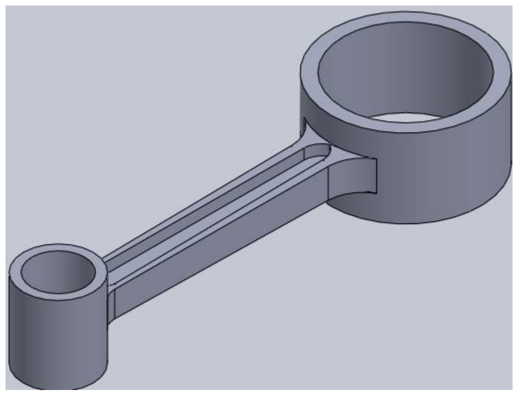

Fig.3.Grey Cast Iron Connecting Rod

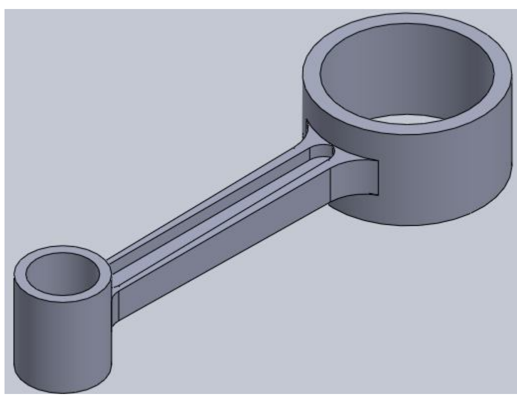

Fig. 4. Titanium 6 AL 4V connecting rod.

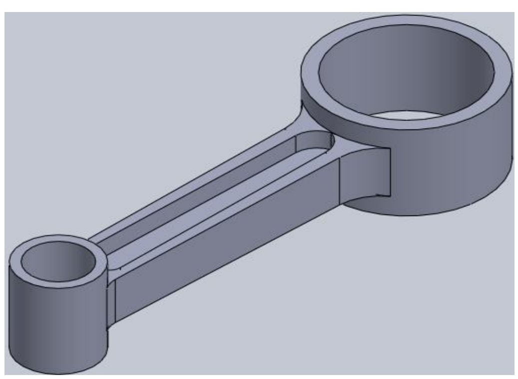

Fig. 5. ASTM A216 GR WCB connecting rod.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

After generating the CAD models of the connecting rods as shown above, finite element analysis process was carried out to analyse the output of the presented expert system. The FEA for the generated connecting rods is conducted using ANSYS FEA software by considering the material properties of the considered materials as shown in table 3.

TABLE 3
CONNECTING ROD MATERIALS PROPERTIES

S.No	Properties	Aluminum alloy 6061	Grey Cast Iron	Titanium 6AL 4V	ASTM A216 GR WCB
1	Compressive Y.S	290 MPa	820 MPa	225 MPa	250 MPa
2	Poisson's Ratio	0.33	0.26	0.33	0.29
3	Density	2.7 g/cm^3	7.2 g/cm^3	4.5 g/cm^3	7.8 g/cm^3
4	Tensile strength	120 MPa	280 MPa	250 MPa	485 MPa
5	Young's modulus	80 GPa	140 GPa	120 GPa	210 GPa

A. Analysis on Aluminium Alloy 6061 connecting rod

On analysis it is observed that the maximum stress at small end of the connecting rod is 407.8 Pa and at the big end of the connecting rod is 0.00889 Pa respectively.

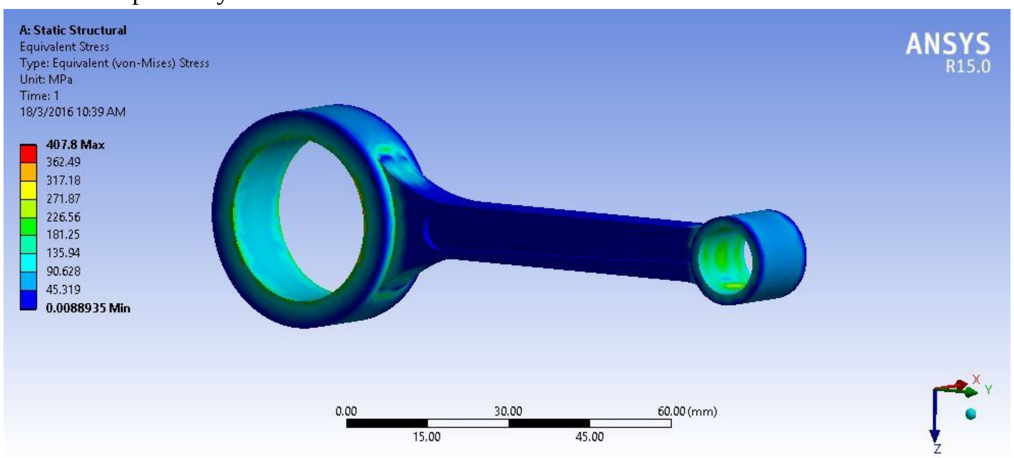

Fig.6. Equivalent Stress in Aluminum Alloy 6061 connecting rod

On analysis it is observed that the maximum equivalent elastic strain at small end of the connecting rod is 0.007310 and at the big end of the connecting rod is 8.2711 e^{-7} respectively.

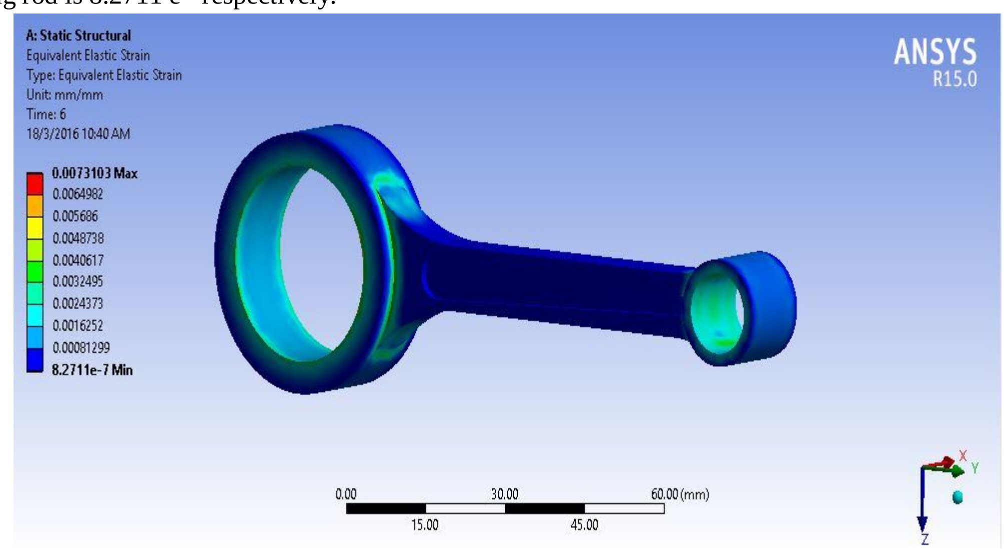

Fig.7. Equivalent Strain in Aluminum Alloy 6061 connecting rod

On analysis it is observed that the maximum deformation occurs at the small end of the connecting rod of an amount of 0.01693mm.

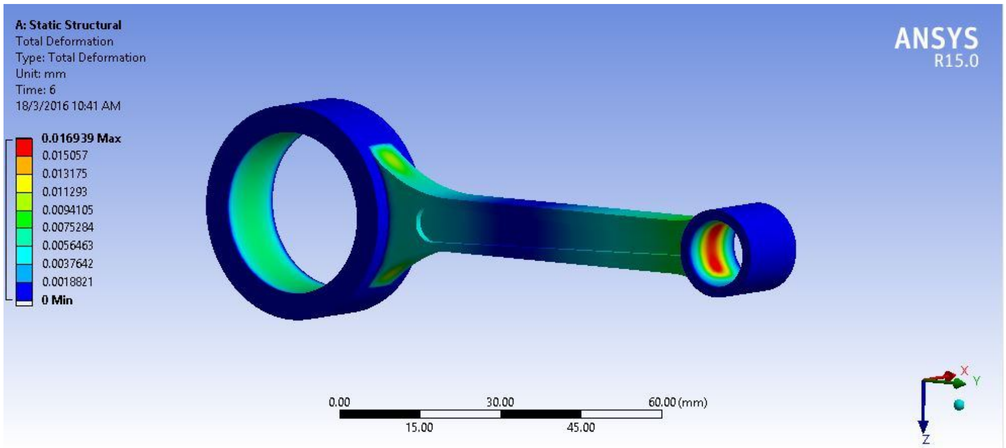

Fig.8. Total Meshing in Aluminum Alloy 6061 connecting rod

B. Analysis on Grey Cast Iron connecting rod

On analysis it is observed that the maximum stress at small end of the connecting rod is 440.87 Pa and at the big end of the connecting rod is 0.009042Pa respectively.

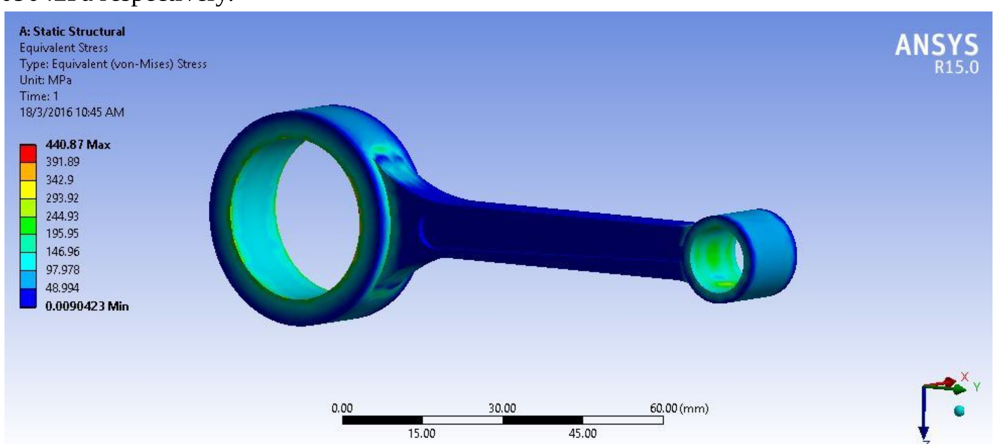

Fig.9. Equivalent Stress in Grey Cast Iron connecting rod

On analysis it is observed that the maximum equivalent elastic strain at small end of the connecting rod is 0.005014 and at the big end of the connecting rod is 5.4013 e^{-7} respectively.

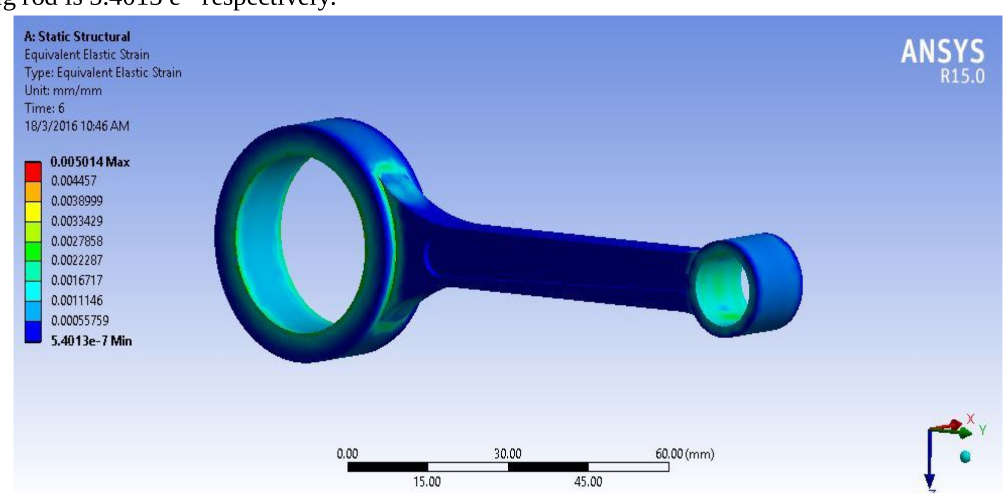

Fig.10. Equivalent Strain in Grey Cast Iron connecting rod

On analysis it is observed that the maximum deformation occurs at the small end of the connecting rod of an amount of 0.010784mm.

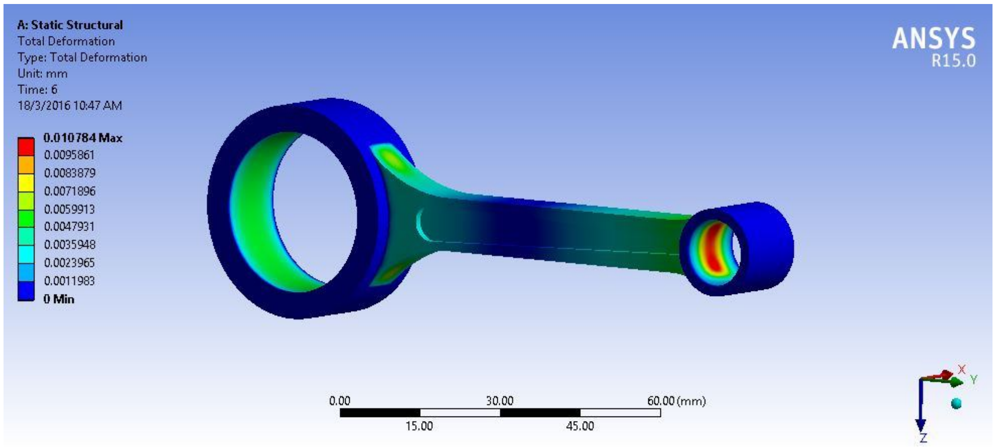

Fig.11.Total Deformation in Grey Cast Iron connecting rod

C. Analysis on Titanium 6 AL 4V connecting rod

On analysis it is observed that the maximum stress at small end of the connecting rod is 383.66Pa and at the big end of the connecting rod is 0.008671Pa respectively.

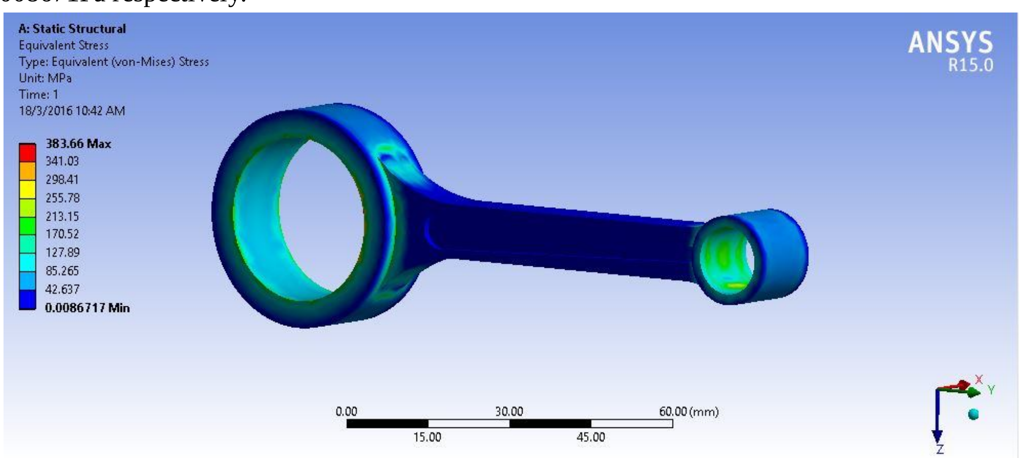

Fig.11. Equivalent stress in Titanium 6 AL 4V connecting rod

On analysis it is observed that the maximum equivalent elastic strain at small end of the connecting rod is 0.0051476 and at the big end is of the connecting rod 5.9752 e-7 respectively.

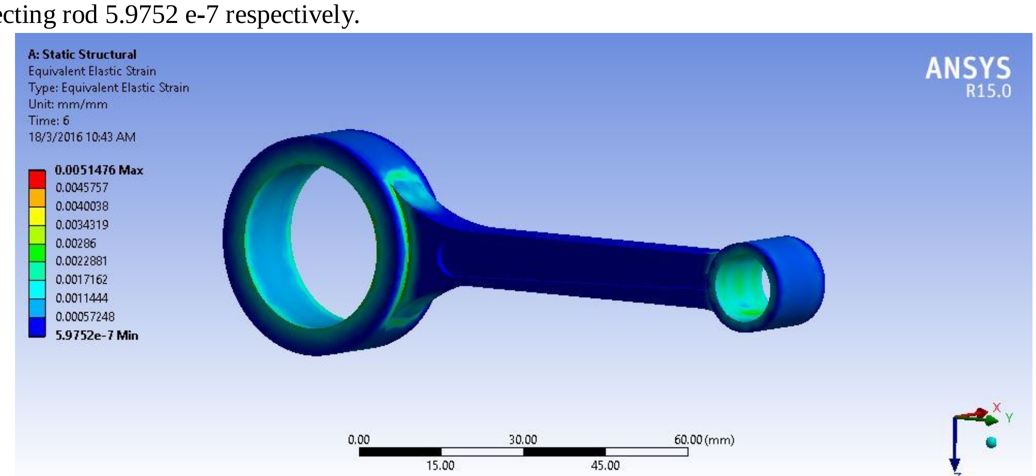

Fig.12. Equivalent elastic strain in Titanium 6 AL 4V connecting rod

On analysis it is observed that the maximum deformation occurs at the small end of an amount of 0.012599mm.

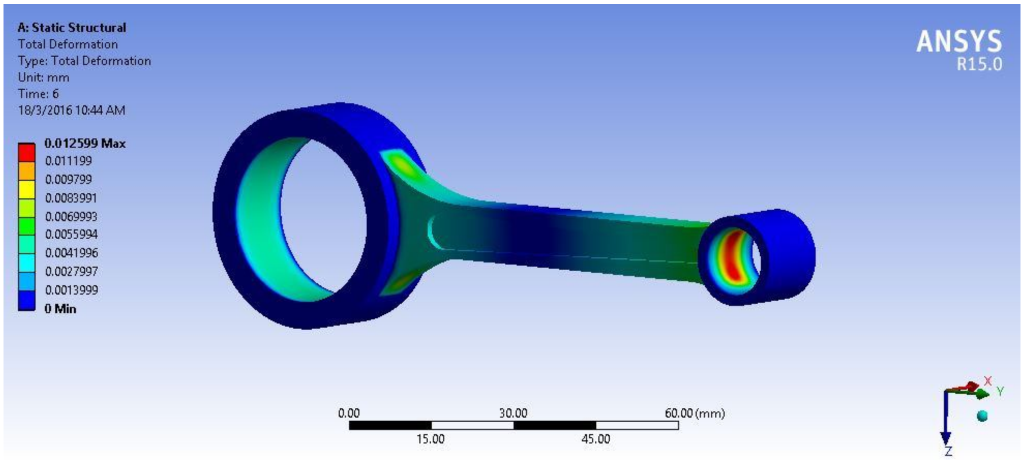

Fig.13. Total deformation in Titanium 6 AL 4V connecting rod

D. Analysis on ASTM A 216 GR WCB connecting rod

On analysis it is observed that the maximum stress at small end of the connecting rod is 428.53Pa and at the big end of the connecting rod is 0.009064Pa respectively.

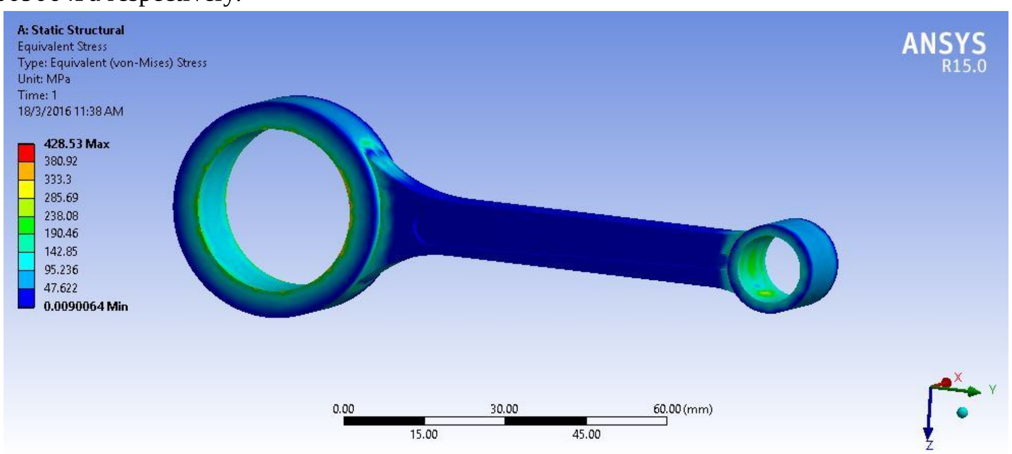

Fig.14. Equivalent stress in ASTM A 216 GR WCB connecting rod

On analysis it is observed that the maximum equivalent elastic strain at small end of the connecting rod is 0.0026088 and at the big end of the connecting rod is 2.867 e-7 respectively.

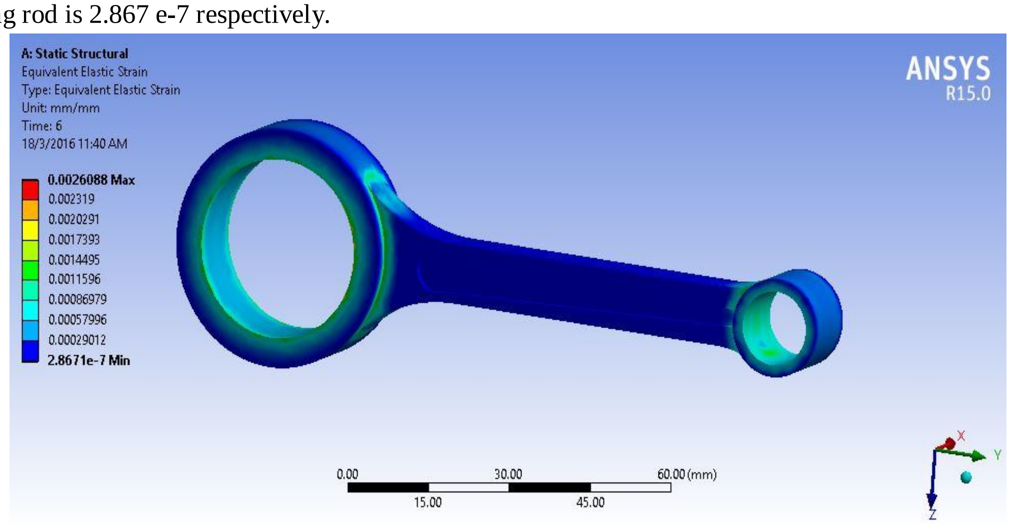

Fig.15. Equivalent strain in ASTM A 216 GR WCB connecting rod

On analysis it is observed that the maximum deformation occurs at the small end of an amount of 0.00577mm.

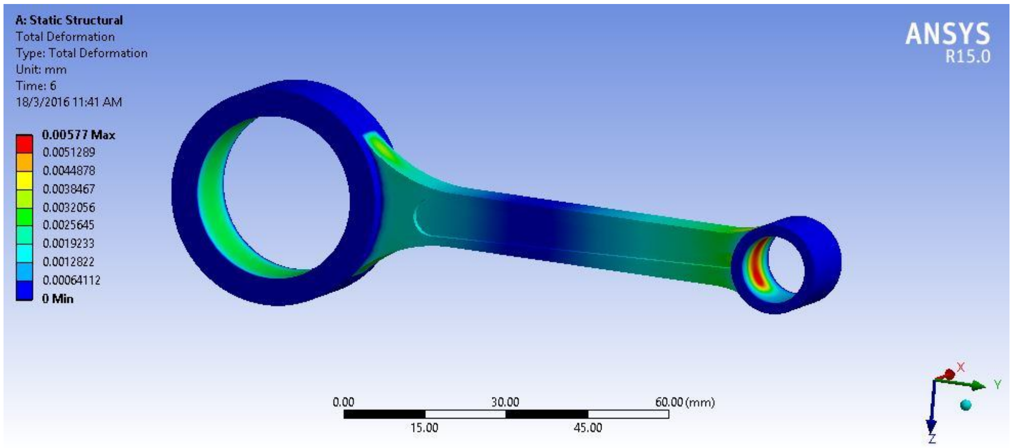

Fig.15. Total deformation in ASTM A 216 GR WCB connecting rod

The FEA results of the considered connecting rod materials are compared in the table 4.

TABLE 4

CONNECTING ROD MATERIALS PROPERTIES

S.No	Properties	Aluminum alloy 6061	Grey Cast Iron	Titanium 6AL 4V	ASTM A216 GR WCB
1	Displacement	0.0073 mm	0.0050 mm	0.0051 mm	0.0026 mm
2	Stress	407.8 MPa	440.53 MPa	383 MPa	428.8 MPa
3	Deformation	0.01693 mm	0.010784 mm	012599 mm	0.00577 mm

V. CONCLUSIONS

The paper presents an expert system for generating the CAD model of the two wheeler IC engine connecting rod. Additionally, the paper also presents the FEA on the generated CAD models. This method is useful for reduce the modeling time and work. Based on the structural analysis it can be concluded that ASTMA 216 material is deforming less in comparison with other stated materials of connecting rod. Moreover, it can be concluded that this expert system is able to generate the CAD model of the connecting rod with loading conditions as input data.

REFERENCES

[1] E. Jayakiran Reddy, C.N.V Sridhar, V.Pandu Rangadu, “Research And Development Of Knowledge Based Intelligent Design System For Bearing Library”, Advances in Intelligent Systems and Computing, Vol. 2, pp. 311-319, 2016.

[2] Raviraj Yashwanth Taware, Abhay Arun Utpat, “Analysis of Connecting Rod in Two Wheeler under static loading by FEA” International Journal of Engineering Trends and Technology, Vol. 20, pp. 27-31, 2015.

[3] Dipalee S. Bedse, Mangesh. A. Ahire “Design Evaluation through FEA for Fatigue Life of Connecting Rod used in Two Wheelers”, International Journal of Advanced Technology in Engineering and Science, Vol. 3, pp. 126-133, 2015.

[4] Sayeedahmed G. M., Sirajuddinelyas Khany, Syed Hamza Shareef, “Design Fabrication and Analysis of a Connecting Rod with Aluminum Alloys and Carbon Fiber”, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, pp. 16674-16687, 2014.

[5] Abhinav Gautam, Priya Ajit, “Static Stress Analysis of Connecting Rod using Finite Element Approach”, IOSR Journal of Mechanical and Civil Engineering, Vol. 10, pp. 47-51, 2013.

[6] Ram Bansal “Dynamic Simulation of a Connecting Rod made of Aluminium Alloy using Finite Element Analysis Approach” IOSR Journal of Mechanical and Civil Engineering, Vol. 5, pp. 01-05, 2013.

[7] Kuldeep B, Arun L.R, Mohammed Faheem “Analysis and optimization of connecting rod using ALFASiC composites”, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, pp.2480-2487, 2013.

[8] Vaibhav v. Mukkawar, Abhijit P. Kadam, Abhijitn. Ingole, Mangeshd. Chopade, "Design, Analysis and Optimization of Connecting Rod using Ansys", International Journal of Advances in Mechanical and Civil Engineering, Vol. 2, pp. 38-41, 2015.

[9] Priyank D. Toliya, Ravi C. Trivedi, Nikhil J. Chotai, “Design and Finite Element Analysis of Aluminium-6351 Connecting Rod”, Vol.2, pp. 565-572, 2013.