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Development of an Intelligent System for the Design of a Two Wheeler IC Engine Connecting Rod

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***ABSTRACT**: The main objective of this paper is to present the development of an intelligent system for the design of connecting rod of internal combustion engine by using SolidWorks and visual basic and analyze the output of the system with finite element methods. This intelligent system is developed to design the connecting rod based on the loading conditions. An intelligent system is developed with help of macro file and parametric modeling technique in SolidWorks software. CAD modeling is done using SolidWorks package and is automated. The developed system proved itself as a better application by reuse of the design knowledge. Design work is done on the connecting rod using considering materials like Aluminum Alloy 6061, Grey Cast Iron, Titanium 6al 4v, ASTM A 216 GR WCB (cast steel). Analysis work was carried out with ANSYS 15.0 software to determine Von misses Stress and Strain, deformation. ASTM A 216 (cast steel) has less deformation compare to other materials considered in this work.*

***KEYWORDS:** Intelligent Design System, SolidWorks API, Parametric Modeling, Visual Basic, Connecting Rod, Macro, Finite Element Analysis (FEA).*

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I. INTRODUCTION

Connecting rod is a widely used machine part in a variety of Internal Combustion (IC) engines. Developing the CAD part model for connecting rod includes the modeling with dimensions and it can be modeled with help of parametric modeling technique. The CAD became as the inevitable design practice in the recent years. CAD is an acronym for Computer Aided Design it relates to software solutions for designing an object. It provides a computer-implemented method for designing a CAD model object. The method comprises displaying at least one three dimensional parametric shape user interacting with the screen. Modeling is a time-consuming process because of lack of skilled Computer Aided Design modeling professionals [1]. Parametric modeling technique rises about this issue as it recreates the same task in very less time compared to a 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 intelligent system for Design of a Connecting Rod.

II. REVIEW OF LITERATURE

Jayakiran et al. [1] describe 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] describe 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 motorcycle. Calculations. The best combination of parameters like von misses stress and strain, deformation for two-wheeler connecting rod were 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 best 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 the 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. The 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 the 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 intelligent system may design the connecting rod based on the loading conditions and forces acting on the connecting rod. Intelligent system will be developed with the help of macros and parametric modeling technique in SolidWorks software. The connecting rod design program is written with the help of Visual Basics. Initially, design can be developed by using SolidWorks package. After the design of connecting rod, the analysis can be performed on finite element analysis software like ANSYS. Later, structural analysis is performed to determine von misses stress, shear stress, elastic strain, total deformation under the given loading conditions.

DESIGN CALCULATIONS OF CONNECTING ROD

Table.1.Engine Specifications

Particulars	*Specifications*
Type	Air cooled, Four-stroke, Single cylinder
Bore	50 mm
Stroke	49.5 mm
Displacement	97.2 cc
Fuel	Petrol
Compression ratio	9:1

DESIGN VARIABLES

Table.2. Design Variables

Maximum Power	7.5 PS @ 8000 RPM
Maximum Torque	7.95 NM @ 5000 RPM
Material	Aluminum Alloy 6061 / Grey Cast Iron / Titanium 6 AL 4V / ASTM A216 GRWCB (Cast Steel)

IV. METHODOLOGY FOR MODELING, AUTOMATION AND IMPLEMENTATION

4.1. SECOND PHASE DEVELOPING TOOLS FOR SOLID WORK 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.

4.2. GENERATING THE MAN-MACHINE INTERLINKS

A button can be created for the connecting rod in the SolidWorks software. Own GUI can be created and linked with this button with New Macro Button function of SolidWorks.

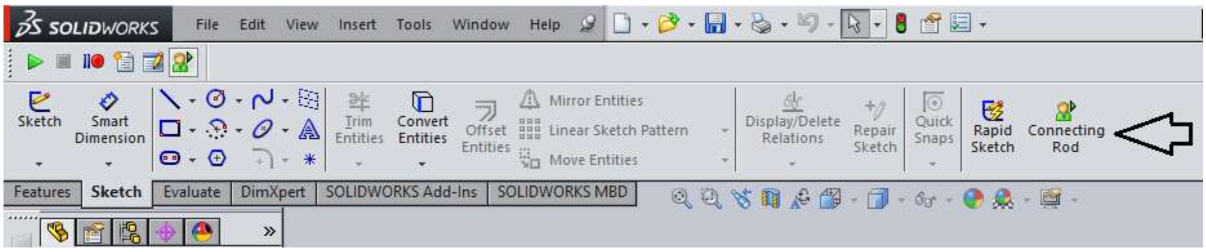

Fig.1. Man-Machine Interface

Upon execution of the developed computer program, the following models of the connecting rod are generated by the SolidWorks with the help of Macro codes.

Material: Aluminum Alloy 6061

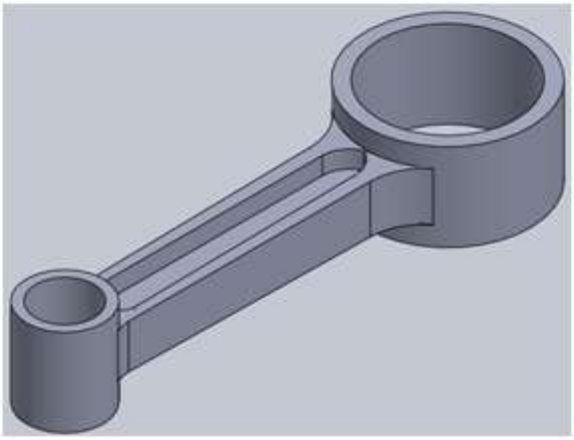

Fig.2.Aluminum Alloy 6061Connecting Rod

Material: Grey Cast Iron

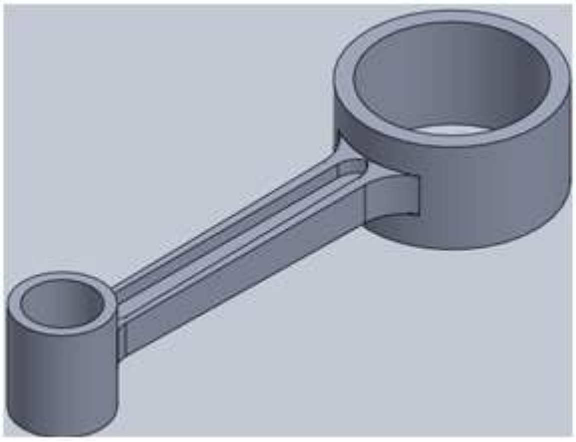

Fig.3. Grey Cast Iron

Material: Titanium 6 AL 4V

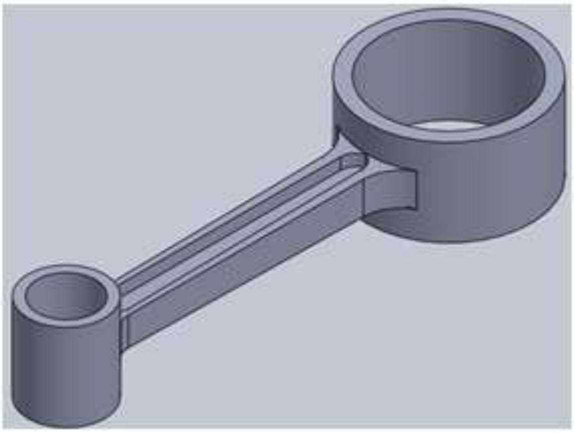

Fig.4. Titanium 6 AL 4V

Material: ASTM A 216 GR WCB

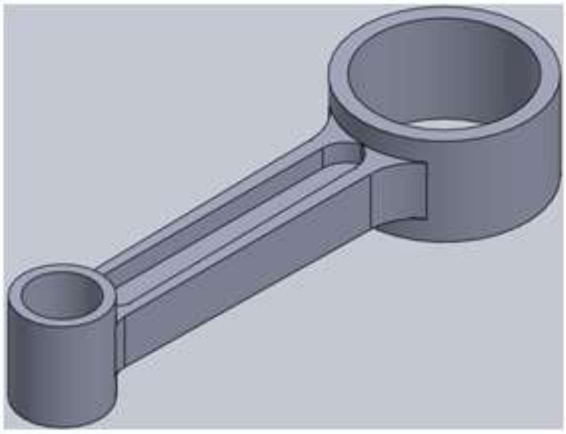

Fig.5. ASTM A 216 GR WCB

V. FEA FOR THE GENERATED MODELS

The Finite Element Analysis for the generated connecting rods is conducted using ANSYS FEA software.

5.1. MATERIAL PROPERTIES

Table.3. Material Properties

Properties	Aluminum alloy 6061	Grey Cast Iron	Titanium 6AL 4V	ASTM A216 GR WCB
Compressive Y.S	290 MPa	820 MPa	225 MPa	250 MPa
Poisson's Ratio	0.33	0.26	0.33	0.29
Density	2.7 g/cm^3	7.2 g/cm^3	4.5 g/cm^3	7.8 g/cm^3
Tensile strength	120 MPa	280 MPa	250 MPa	485 MPa
Young's modulus	80 GPa	140 GPa	120 GPa	210 GPa

5.2. ANALYSIS ON ALUMINUM ALLOY 6061 CONNECTING ROD

5.2.1 Equivalent Stress

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

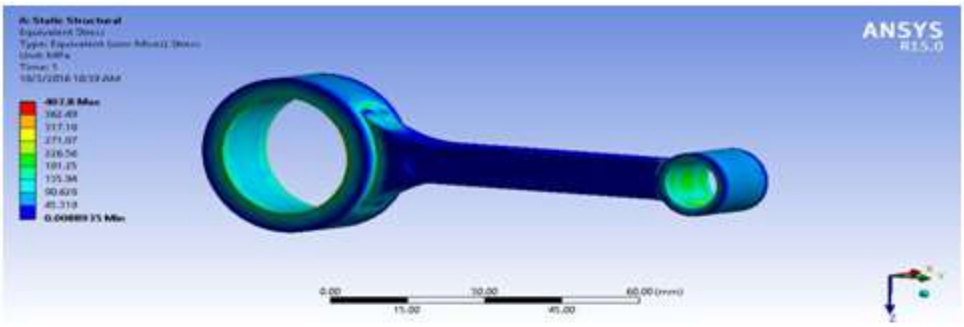

Fig.6. Equivalent Stress in Aluminum Alloy 6061 connecting rod

5.2.2 Equivalent Elastic Strain

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

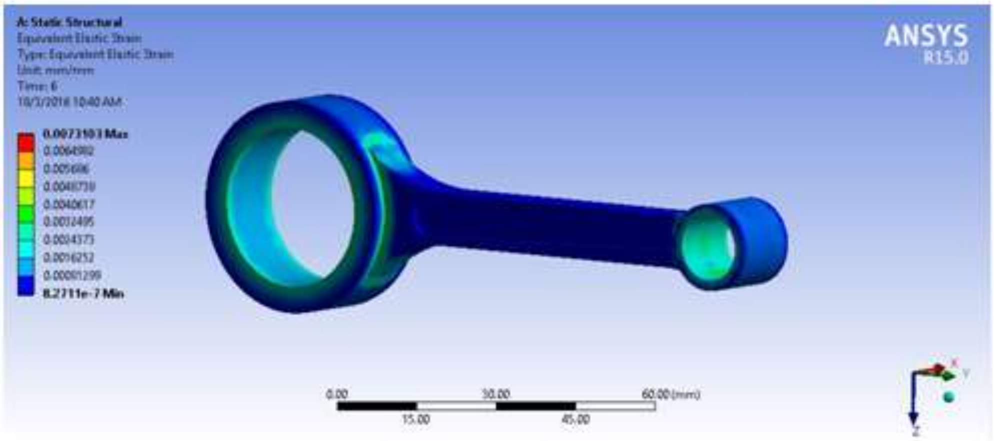

Fig.7. Equivalent Strain in Aluminum Alloy 6061 connecting rod

5.2.3. *Total Deformation*

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

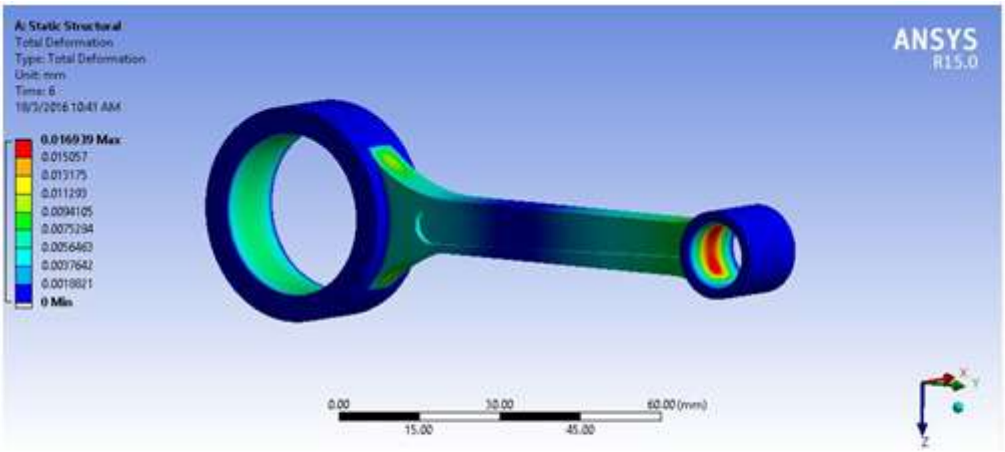

Fig.8. Total Meshing in Aluminum Alloy 6061 connecting rod

5.3. ANALYSIS ON GREY CAST IRON CONNECTING ROD

5.3.1 Equivalent Stress

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

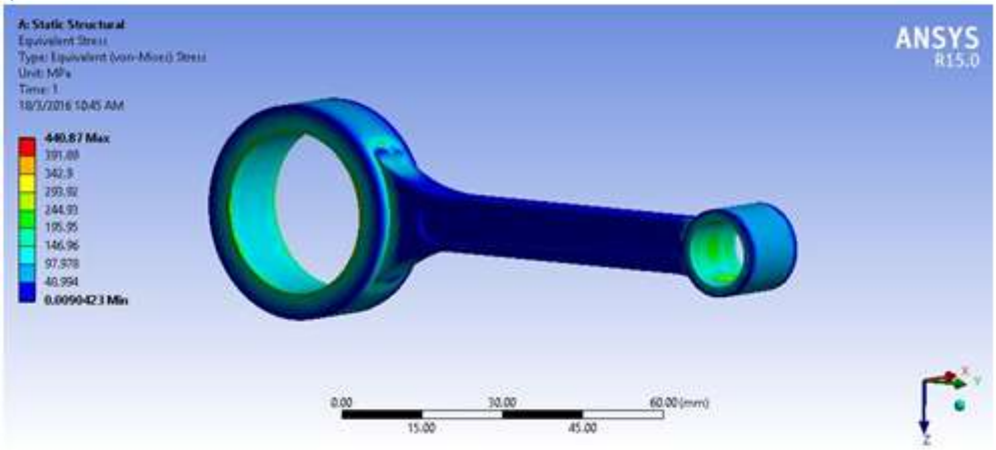

Fig.9. Equivalent Stress in Grey Cast Iron connecting rod

5.3.2. Equivalent Elastic Strain

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

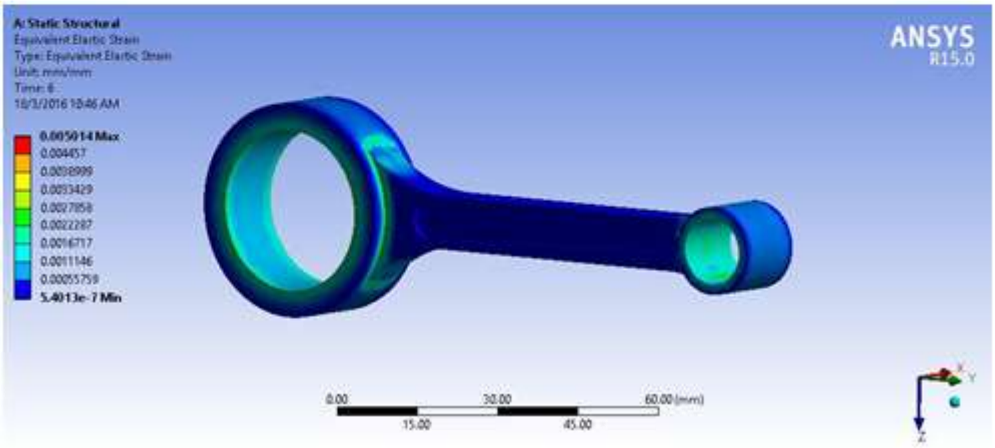

Fig.10. Equivalent Strain in Grey Cast Iron connecting rod

5.3.3. Total deformation

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

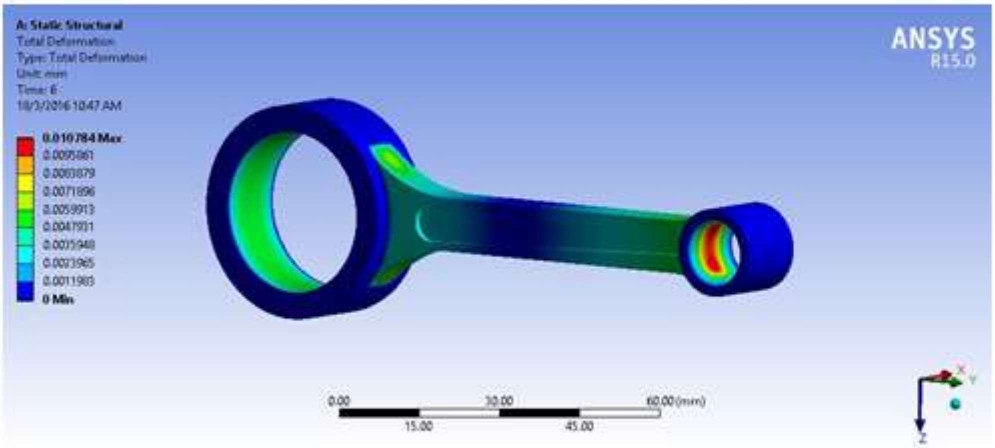

Fig.11.Total Deformation in Grey Cast Iron connecting rod

5.4. ANALYSIS ON TITANIUM 6 AL 4V CONNECTING ROD

5.4.1. Equivalent stress

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

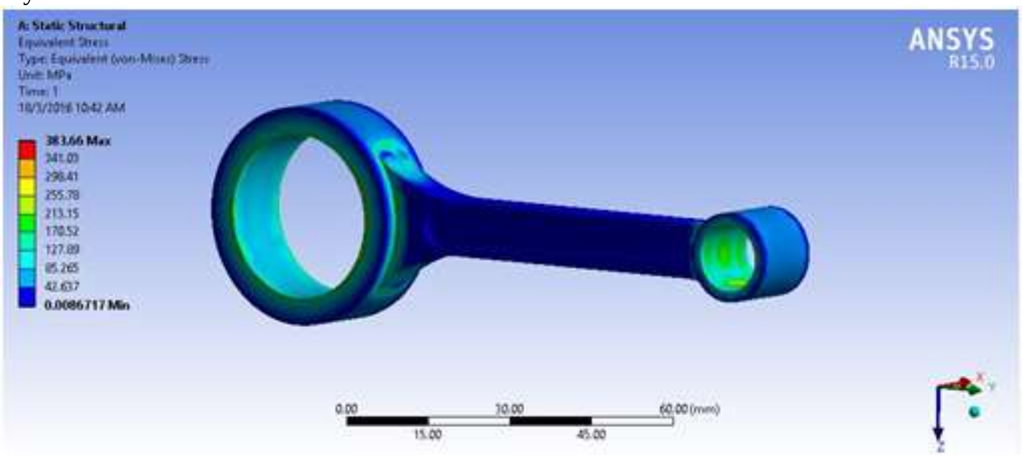

Fig.12. Equivalent stress in Titanium 6 AL 4V connecting rod

5.4.2. Equivalent Elastic Strain

On analysis, it is observed that the maximum equivalent elastic strain at small end is 0.0051476 and at the big end is 5.9752 e^{-7} respectively.

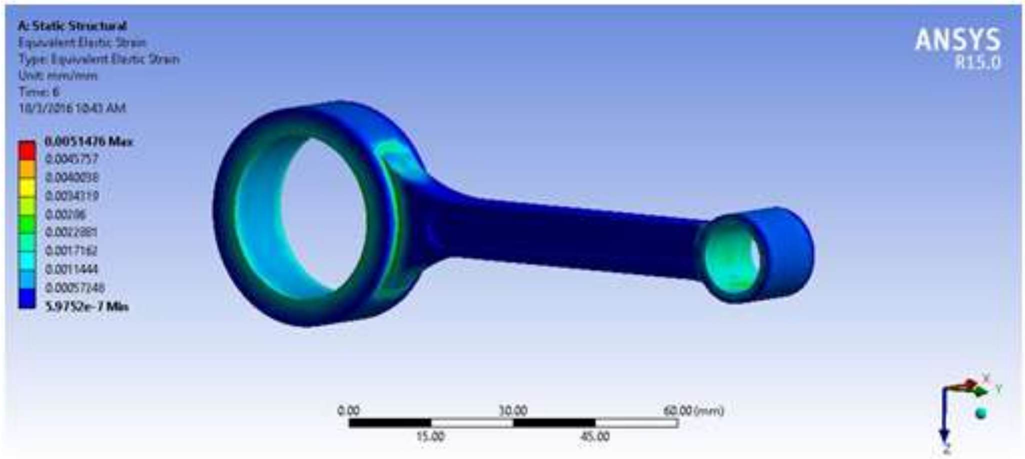

Fig.13. Equivalent elastic strain in Titanium 6 AL 4V connecting rod

5.4.3. Total deformation

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

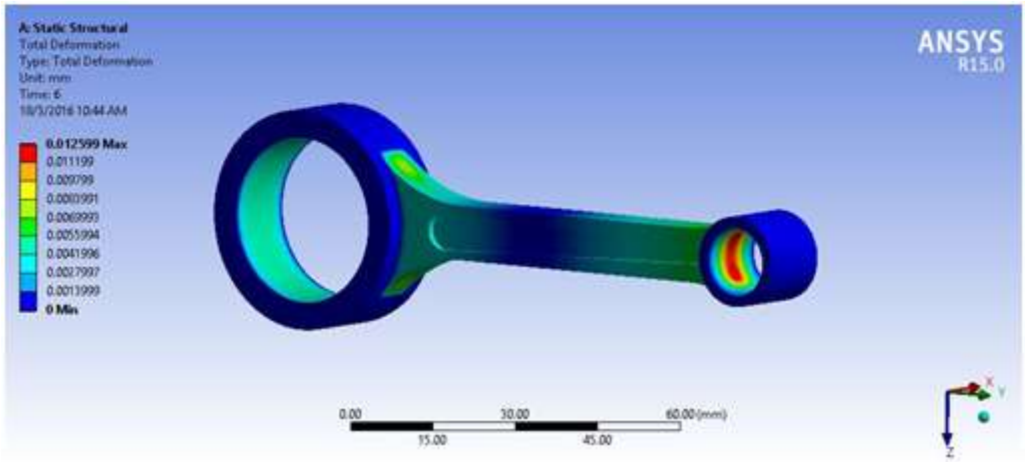

Fig.14. Total deformation in Titanium 6 AL 4V connecting rod

5.5. ANALYSIS ON ASTM A 216 GR WCB CONNECTING ROD

5.5.1. Equivalent stress

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

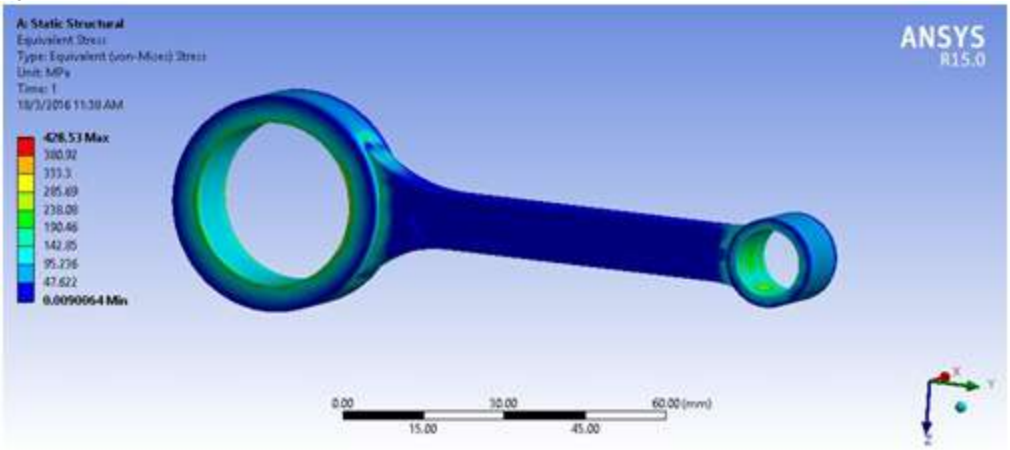

Fig.15. Equivalent stress in ASTM A 216 GR WCB connecting rod

5.5.2. Equivalent elastic strain

On analysis, it is observed that the maximum equivalent elastic strain at small end is 0.0026088 and at the big end is 2.867 e^{-7} respectively.

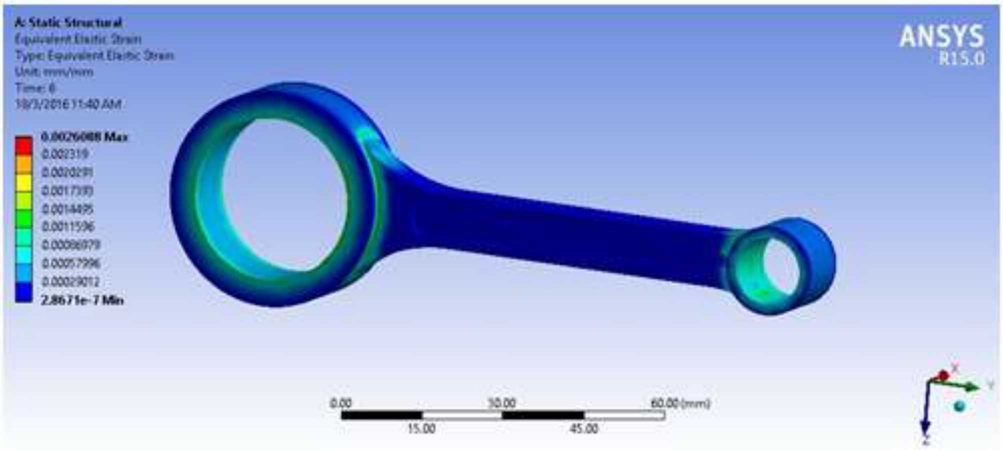

Fig.16. Equivalent strain in ASTM A 216 GR WCB connecting rod

5.5.3. Total deformation

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

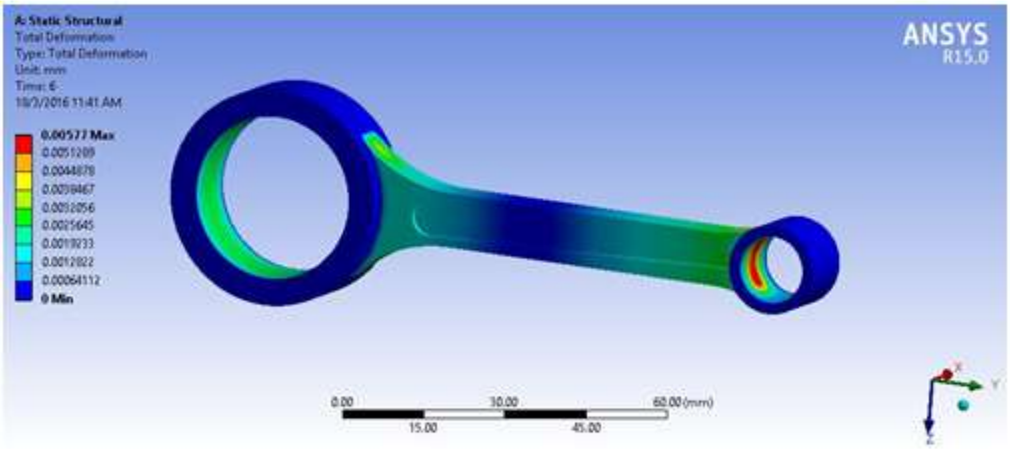

Fig.17. Total deformation in ASTM A 216 GR WCB connecting rod

VI. COMPARISON OF THE ANALYSIS RESULTS

Table.4. Comparison of analysis results

Particulars	Aluminum alloy 6061	Grey cast iron	Titanium 6AL 4V	ASTM A 216 GR WCB
Displacement	0.0073 mm	0.0050 mm	0.0051 mm	0.0026 mm
Stress	407.8 MPa	440.53 MPa	383 MPa	428.8 MPa
Deformation	0.01693 mm	0.010784 mm	012599 mm	0.00577 mm

VII. CONCLUSION

This is the first attempt to implement an intelligent design system for connecting rod of the IC engine. This method is useful for reducing the modeling time and work. Based on the structural analysis it can be concluded that ASTM A 216 material is deforming less in comparison with other stated materials of connecting rod. Moreover, it can be concluded that this intelligent 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.

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