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"3D Modeling & Analysis of Connecting Rod & Comparison With The Composite Material"

Puvar Hirenkumar R.[1], Patel Harsh V.[2], Modi Anash I.[3], Patel Jainish M.[4], Rana Nileshkumar V.[5]

[1]*Student, Mechanical Engineering Department, Mahavir Swami College of Engineering & Technology, Surat*
[2]*Student, Mechanical Engineering Department, Mahavir Swami College of Engineering & Technology, Surat*
[3]*Student, Mechanical Engineering Department, Mahavir Swami College of Engineering & Technology, Surat*
[4]*Student, Mechanical Engineering Department, Mahavir Swami College of Engineering & Technology, Surat*
[5]*Assistant Professor, Mechanical Engineering Department, Mahavir Swami College of Engineering & Technology, Surat*

***Abstract* — Connecting rod is an important part of I.C. Engine which form link between piston and crankshaft to convert the linear reciprocating motion of piston to the rotary motion of the crankshaft. Till now, vast research is going on the field of metallurgy and large number of newly developed (Composite) materials are available to select materials for particular application. In the study of connecting rod, first we created the model of connecting rod through the Parametric Modeling software and done the analysis through the FEA tool and then replaced the existing material with the composite material to figure it out which one was better.**

***Keywords* – Connecting Rod, Parametric Modeling Tool, FEA Tool, Composite Material**

I. INTRODUCTION

Connecting rod is used to connect the piston to the crank or crankshaft in a reciprocating engine. Its primary function is to transfer the motion from piston to the crankshaft. Connecting rods also convert rotating motion into reciprocating motion. As we all know that the connecting rod is rigid, it may transmit either push or pull and that's why the rod may rotate the crank through both halves of revolution that is piston pushing and piston pulling. In some two stroke engines the connecting rod is only required to push. In today's time the connecting rods are best known their use in I.C. Engine, such as in automobiles. In this study there were some cons figured out such as the material 20CrMo which was the existing material used in production of connecting rod of Bajaj Pulsur 150 cc was heavier than other material [1]. The composite material Al6061 + B_4C is going to be replaced the existing material in this study [2]. In this study the model was designed through the Parametric Modeling software and then the analysis was done through the Finite Element Analysis Tool

II. EXPERIMENTAL CALCULATION

2.1 Engine Specifications:

Bajaj Pulsur 150 is a 150 cc, 4-stroke air-cooled engine is used for the study on connecting rod. The maximum pressure calculation which was applied on the smaller end of the connecting rod described below [3].

- Engine type:- Air cooled 4-stroke, single cylinder Bajaj Pulsur 150cc
- Bore = 58 mm
- Stroke = 56.4 mm
- Displacement = 149 cc
- Maximum Power = 14.86 bhp @ 9000 rpm
- Maximum Torque = 12.5 Nm @ 6500 rpm
- Compression Ratio = 9.35 : 1
- Density of Petrol C_8H_{18} = 737.22 $kg/m^3 = 737.22 \times 10^{-9}\ kg/mm^3$
- Temperature T = 60°F $= 288.855\ k$
- Mass = Density × Volume = $737.22 \times 10^{-9} \times 149 \times 10^3 = 0.1098\ kg$
- Molecular Weight of Petrol = 0.114228 $kg/mole$
- From gas equation $pV = mR_{specific}T$
  - $R_{specific} = 8.314/0.114228 = 72.48$
  - $p = (0.1098 \times 72.78 \times 288.855)/149 = 15.49\ Mpa \approx 16\ Mpa$

2.2 Material Properties:

Table 1: Materials Properties

Materials /Properties	Density (gm/cc^3)	Poisson Ratio	Young Modulus (Mpa)	Compressive Yield Strength (Mpa)
20CrMo	7.83	0.30	210	685
Al6061 + B_4C	2.64	0.31	97.10	666.88

III. MODELING & STATIC ANALYSIS

3.1 Modeling:

Creo is designing software supporting product design for discrete manufactures and is developed by PTC. Creo runs on Microsoft Windows and provides apps for 3D CAD parametric features such as solid modeling, 3D direct modeling, 2D orthographic view, finite element analysis & simulation, viewing and visualization.

Table 2: Design Specification for Connecting Rod

Description	Dimensions in mm
Big End Diameter	48
Small End Diameter	23
Big End & Small End Pitch	96
Big End Thickness	16
Small End Thickness	16
Crank Pin Diameter	30

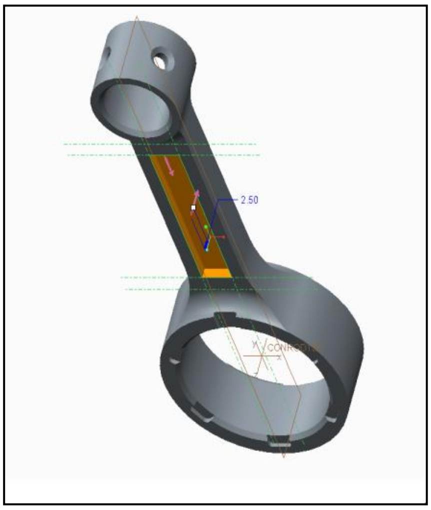

Fig 1: Extrude Command

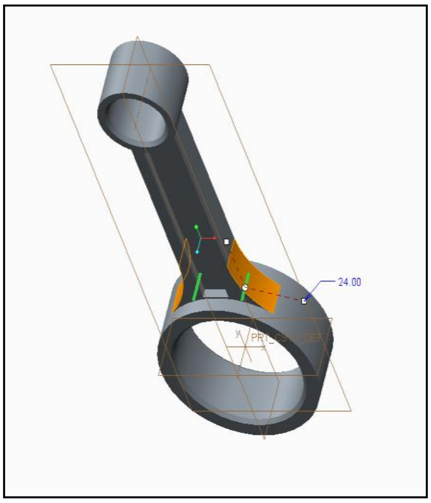

Fig 2: Fillet Command

3.2 Static Analysis:

The static analysis of connecting rod was carried out on Ansys Workbench 15.0. A finite element analysis is used to find out the response of a system based on the type of loading and a set of supports.
Any analysis can be described in the context of four main steps:

1. Preliminary Solution
2. Preprocessing

3. Solution
4. Post Processing

The steps of the basic procedures are generally reflected in the outline view as shown in the fig below.

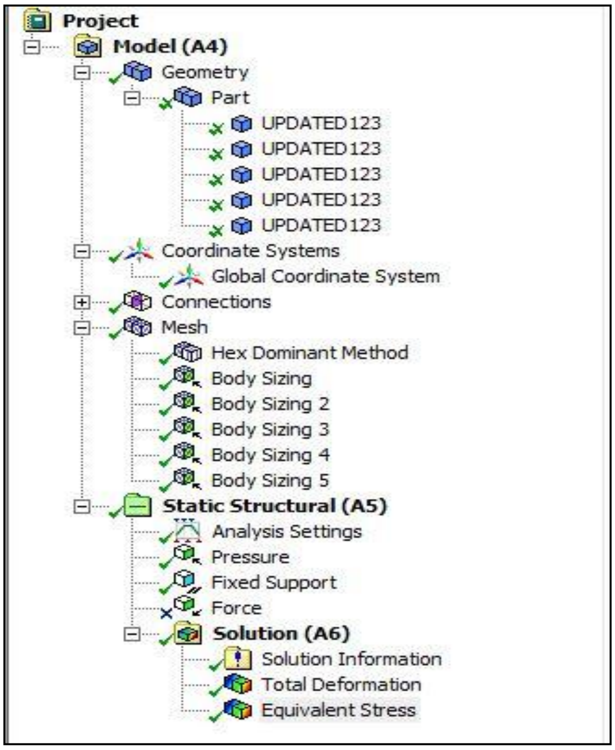

Fig 3: Outline Tree

To get accurate results and do some changes in geometry, the Design Modeler was extremely useful. For that the whole geometry sliced into 5 parts with the help of slice command as shown in fig below. The meshing is the most important part of the whole analysis procedure. Due to FEA does the calculations at only finite number of points & then interpolate the results for the entire domain. For that with the help of meshing FEA method reduces dof from infinite to finite. Here in this analysis hexahedral mesh was provided at the critical areas and at other areas the mesh was provided through the sizing method as shown in figures below.

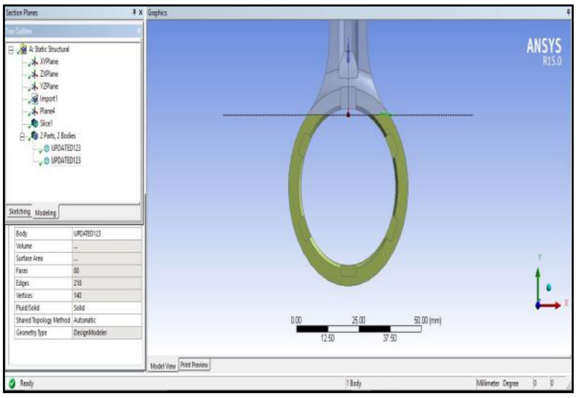

Fig 4: Use of Slice Command to Make Parts

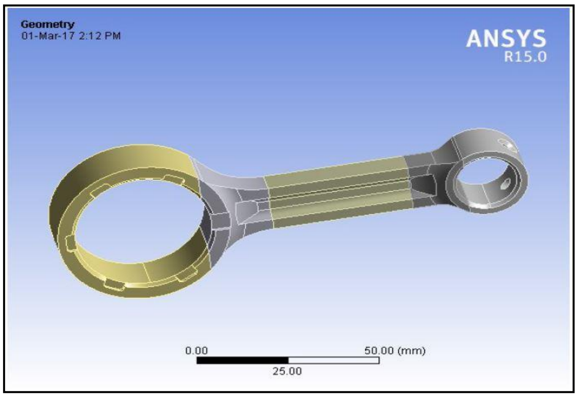

Fig 5: Sliced Model

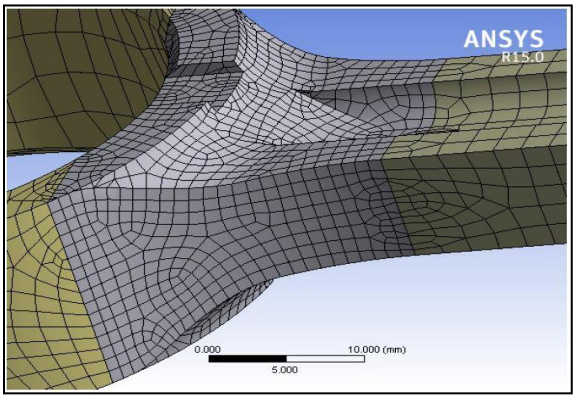

Fig 6: Big End Mesh

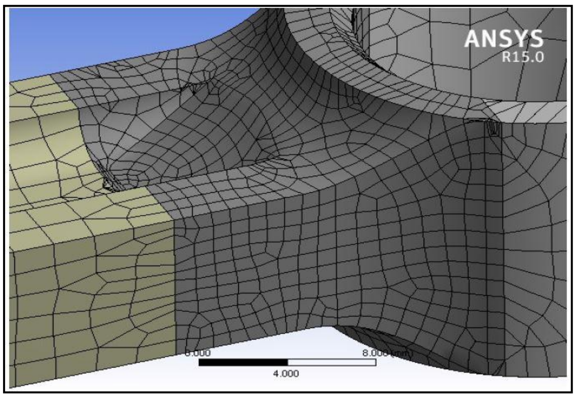

Fig 7. Small End Mesh

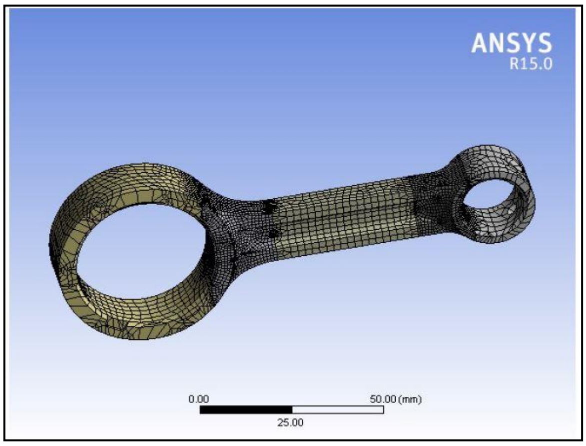

Fig 8: Meshed Model

Analysis was done with the pressure of 16 Mpa which was calculated in the experimental calculation applied at the small end that is at the piston end of the connecting rod by fixing the big end that is the crank end as shown in fig below

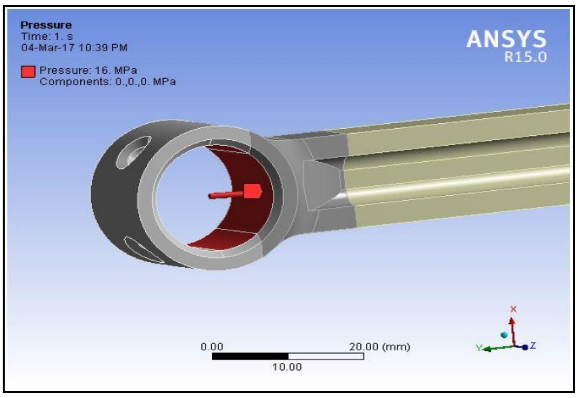

Fig 9: Pressure of 16 Mpa applied at Small End

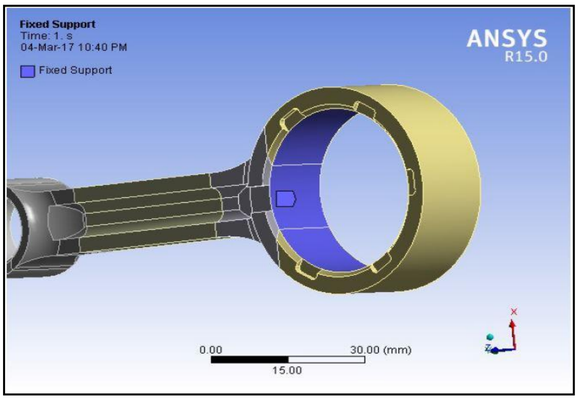

Fig 10: Fixed Support Provided at Big End

3.3 Analysis Result for Material 20CrMo:

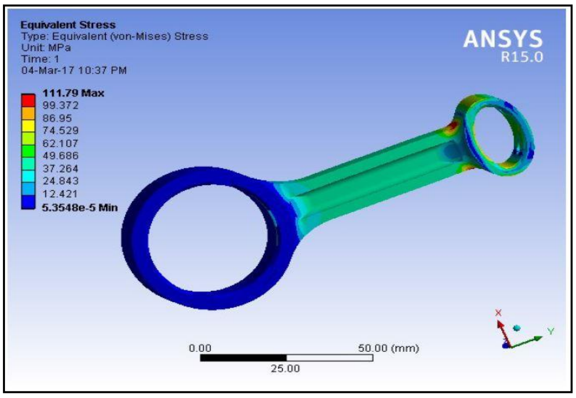

Fig 11: Equivalent Stress

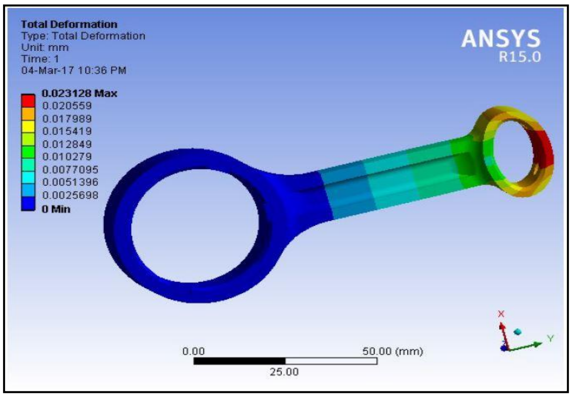

Fig 12: Total Deformation

3.4 Analysis Result for Material Al6061 + B_4C:

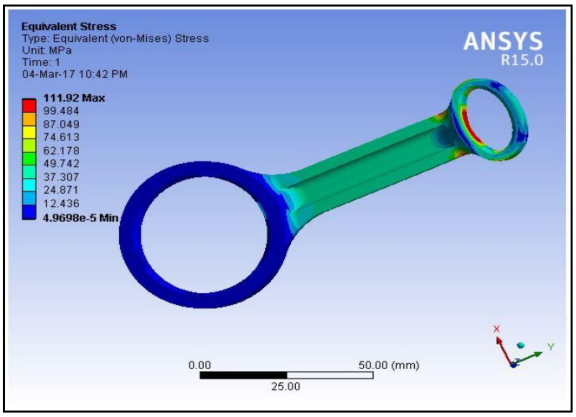

Fig 13: Equivalent Stress

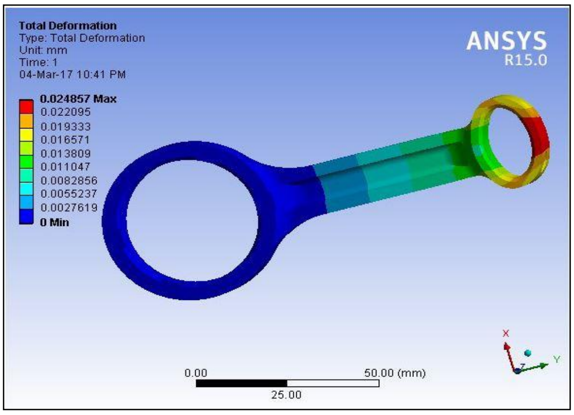

Fig 14: Total Deformation

IV. RESULT INTERPRETATION FOR STATIC ANALYSIS

Table 3: Result Interpretation for Static Analysis

Materials /Properties	Density (gm/cc^3)	Deformation (mm)	Stress (Mpa)		Mass (gram)
			Maximum	Minimum	
20CrMo	7.86	2.3128e-002	111.79	5.3545e-005	160.2261
Al6061 + B_4C	2.67	2.4857e-002	111.92	4.9698e-005	54.43

V. CONCLUSIONS

- By using the finite element analysis tool Ansys Workbench 15.0 it's concluded that the design is safe in static condition.
- In this study the mass of the connecting rod is reduced by changing the existing material with the composite material as mentioned in the result interpretation by using analytic methods.
- The weight of the rod is important because its affect the reciprocating forces inside the engine. Lighter is usually better because less weight means faster throttle response & acceleration.

REFERENCES

[1] Abhinav Gautam, K Priya Ajit, (2013),"Static Stress Analysis of Connecting Rod Using Finite Element Approach" IOSR Journal of Mechanical and Civil Engineering, Volume 10, pp.47-51.

[2] G. Shaikshavali, Dr. E. Venugopal goud, M. Murli mohan. (2016) "Mechanical Properties of Al6061 Based Metal Matrix Composites Reinforced with Ceramic Particulates and Effect of Age Hardening on its Tensile Characteristics.

[3] Amit Kumar, Bhingole P.P., Dinesh Kumar, (2014),"Dynamic Analysis of Bajaj Pulsur 150cc connecting rod using Ansys 14.0" Asian Journal of Engineering & Applied Technology,pp.19-24, Volume 3.

[4] P. Tulasi Radha, T.Prakash Lazarus, I.Satyanarayana (2014),"Modeling Structural and Thermal Analysis of Conrod using Composite Material" International Journal of Advanced Research in Science and Technology, Volume 3, pp.111-118.

[5] Shubham Tiwari, Ajay Kumar Kaviti. (2015)," Parameters influencing connecting rod: A Review" International Journal of Scientific & Engineering Research, Volume 6, Issue 8, pp. 8-16.

[6] Christy V Vazhappilly, P.Sathiamurthi. (2013), "Stress analysis of connecting rod for weight reduction A Review" International Journal of Scientific & Engineering Research, Volume 3, Issue 2.

[7] Raviraj Yashwant Taware, Abhay Arun Utpat. (2015) "Analysis of connecting rod used into two- wheeler under static loading by FEA" International Journal of Engineering Trends and Technology, Volume 20, pp. 27-34.

[8] Mr. Shahrukh Shamim (2014) "Design and comparatative analysis of connecting rod using finite element method" International Journal of Engineering Research &technology, Volume 3, Issue 9.

[9] HirenPrajapati, RudreshMakwana, Punit Patel.(2014) "Investigation and Solution of Repetitive Failure of Connecting Rod" International Conference on Multidisciplinary Research & Practice, Volume I Issue 6.

[10] Mr.F.A.Pathan, Prof.M.K.Wasekar.(2015) "Static Analysis of Connecting Rod for Weight optimization" International Research Journal of Engineering and Technology (IRJET), Volume 2 Issue 3.

[11] Rajnish Kumar, Jagadish, Amitava Ray, "Selection of Material for Optimal Design using Multi-Criteria Decision Making" Procedia Material Science 6 (2014) 590-596.

[12] Hitesh Kumar, Vijay Kumar Sharma, "Stress Analysis and Optimization of I.C. Engine Connecting Rod by Finite Element Analysis", International Journal of Engineering Research & Technology, vol. 4, 2015, pp. 590-595