Analysis & Testing of Connecting Rod Using Aluminium Metal Matrix Composites

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Abstract- *Connecting Rod is used to transmit tractive force from piston to the crank and vice-versa. This entire process is done by cylinder, piston, crankshaft and connecting rod. It has two ends-small end and big end. The small end is connected to piston and big end is hold by crank shaft through crank pin. In this paper we have made a model of connecting rod in CATIA V5-6 and imported it into ANSYS 2019. The material used for connecting rod is Aluminium Matrix (composite material).*

Keywords- Connecting Rod, Aluminium Matrix, Modelling, Analysis

I. INTRODUCTION

In a reciprocating engine, the connecting rod forms the link between the piston and the crank or crankshaft [3]. It helps in the conversion of the reciprocating motion of piston to rotary motion of crankshaft. As there are many conventional material which are used for the connecting rod, we have used composite material for the connecting rod. We chose Aluminium Silicon Carbide i.e. (Aluminium Matrix Composite) as the material for making the connecting rod as composite materials are good in mechanical properties and the weight of the components also reduces [9].

II. PROBLEM STATEMENT

The problem statement is to design and analyze Connecting Rod Using Aluminium Matrix Composite Material (AMC's) in order to optimize weight and cost and determination of stress parameters and which is further compared with the existing steel model of connecting rod.

III. ANALYSIS

A model is made with the help CATIA V5-6 according to the following dimensions.

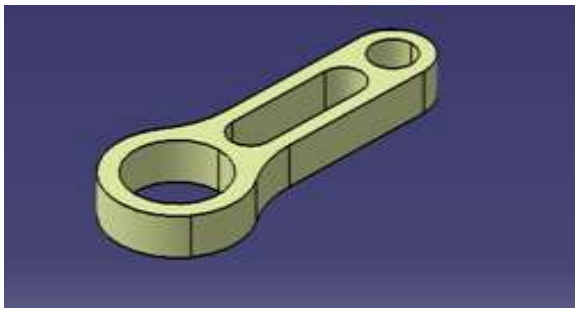

Fig 1:- CAD Model

Sr. No.	Parameters
1.	Thickness of the connecting rod = 6.5mm
2.	Width of the section = 18mm
3.	Height of the section = 144mm
4.	Height at the big end = 18mm
5.	Height at the small end = 18mm
6.	Inner diameter of the small end = 18mm
7.	Inner diameter of the big end = 39mm
8.	Outer diameter of the big end = 54mm

Analysis:-

Analysis of the model was done with the help of ANSYS. The material used for the connecting rod is aluminium matrix. Properties of the mentioned material is shown in table below.

Physical Properties	Values
Poisson's Ratio	2880 kg/m^3
Young's Modulus	115000 Mpa
Bulk Modulus	95833 Mpa
Shear Modulus	44231 Mpa
Ultimate Tensile Strength	659 Mpa
Tensile Yield Strength	464 Mpa
Fatigue Strength	210 Mpa

In analysis the big end is fixed and tensile force is applied on small end.

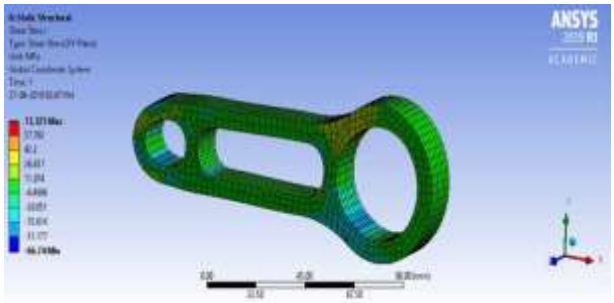

Fig 4:-Shear Stress (XY plane)

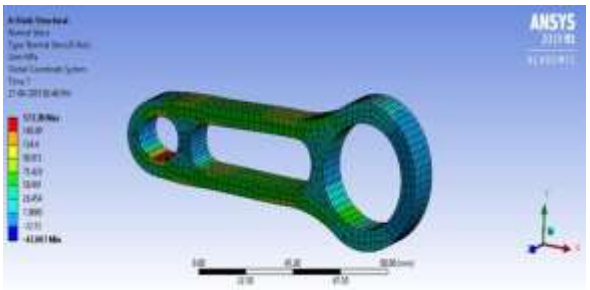

Fig 5:- Normal Stress

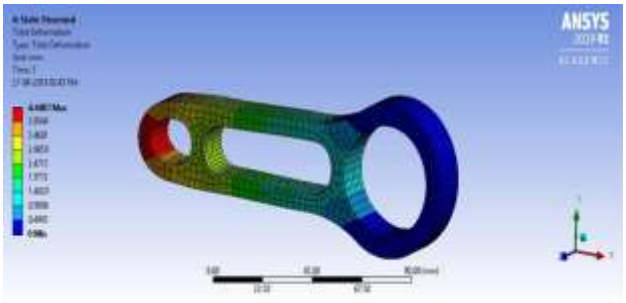

Fig 6 :- Total Deformation

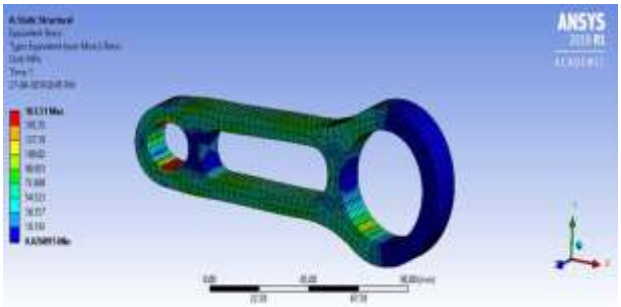

Fig 7:- Von Misses Stress

IV. MANUFACTURING OF CONNECTING ROD

In the manufacturing process various methods are been used for manufacturing so in order to manufacture the connecting rod the least expensive method is the stir casting which we have used for its manufacturing in this process first the wooden block is placed with accurate dimension in the mould then the mud is applied to the wooden block along with the various chemicals mixed in the mud thereafter the wooden block is removed and the hollow mould is obtained consisting of the mud then the molten metal is then poured in it using the sitirrer it is mixed and also the molten metal should occupy the mould after that the molten metal is cooled and the desired product is obtained from the mould there after the finishing process is been carried out in CNC and thus the finished product is ready for testing [10].

Fig 9:- Manufactured Component

V. EXPERIMENTAL PROCEDURE

As tensile testing is to be done on Universal Testing Machine (UTM), a suitable fixtures was manufactured for the required testing.The component was fixed in the UTM machine as shown in the figure and the big end was fixed in the intermediate jaw of the UTM machine and the small end was mounted in the upper jaw of the machine. The testing was carried out successfully. We got the results, the connecting rod broke in the tesile test at the load of 16.20 kN.

Fig 11:- Experimental Setup

The big end is fixed and tensile force is applied on small end.

VI. RESULTS

The results of the analysis done are as shown in the table below. For reference purpose graphs are also plotted from the values that we got from the analysis.

Sr No.	Parameters	Maximum MPa	Minimum MPa
1	Shear Stress	73.325	- 66.74
2	Normal Stress	173.38	- 47.007
3	Total Deformation	0 (mm)	4.4487 (mm)
4	Von Mises stress	163.51	0.026895

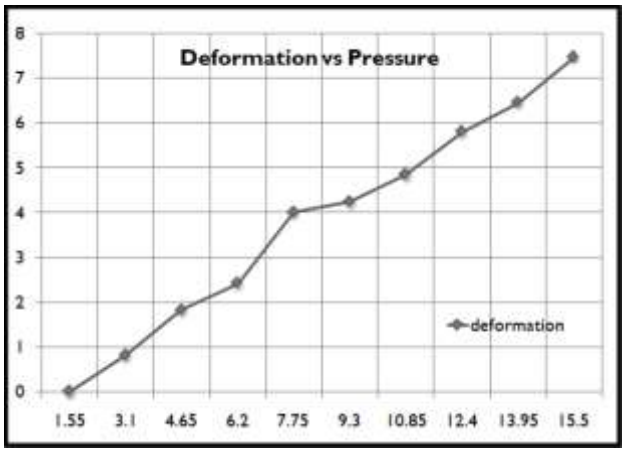

Fig 12:- Deformation Vs Pressure

Experimental Results:-

The image shown below is the graph that was acquired by the testing done on UTM machine.

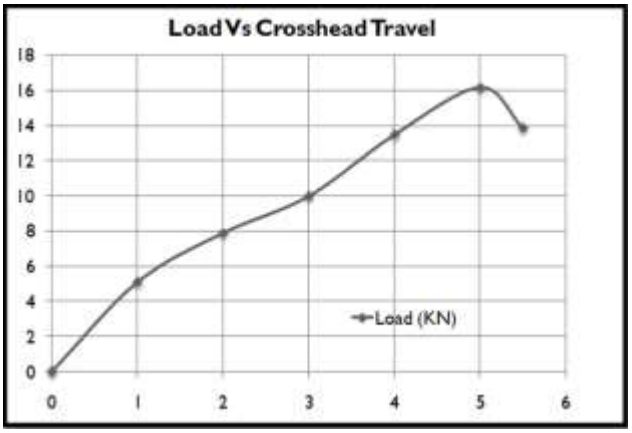

Fig 13:- Load Vs Crosshead Travel

Material / Parameter	Forged Steel	Aluminium Silicon Carbide
Weight of Connecting rod (kg)	0.164	0.126
Deformation (mm)	5.20	4.90
Failure (Tensile Load in kN)	50	16.20
Stress (MPa)	620 N/mm^2	138.46 N/mm^2

VII. CONCLUSION

We successfully did the analysis and pratical testing of the connecting rod which is made of aluminium matrix composite. We got the values for the same as shown above table. As the connecting rod was of H-Section and the forges steel rod was of I-Section the values were more for the forged steel rod. If we design the connecting rod of I-section and material as aluminium matrix we can get a better result, as composite material are good in strength. The weight was only reduced when compared with the forged steel.

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