ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

FATIGUE ANALYSIS OF COMPOSITE CONNECTING ROD

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DOI: 10.5281/zenodo.159327

ABSTRACT

In engine connecting rod plays a major role. It acts as a mediator between piston and crankshaft. It is used to convert the reciprocating motion of the piston to rotatory motion of the crank. Also it faces a lot of compressive loads in its life time. Mostly connecting rods are manufactured using carbon steel and in these days aluminium alloys are using for the manufacture of connecting rod. In this work connecting rod is replaced by aluminium and glass laminated composite material called Glare. it also describes the modeling and Fatigue analysis of connecting rod. SOLIDWORKS modeling software is used to generate the 3-D solid model of Connecting rod. ANSYS software is used to analyze the connecting rod. The main aim of the project is to analysis the Fatigue strength of connecting rod by using composite materials

KEYWORDS: Connecting Rod, Aluminium, Laminated glass, GLARE Composite Materials.

INTRODUCTION

A Connecting rod is the link between the reciprocating piston and rotating crank shaft. Small end of the connecting rod is connected to the piston by means of gudgeon pin. The big end of the connecting rod is connected to the crankshaft. In this work connecting rod is replaced by composite material called GLARE (Glass Laminated Aluminium Reinforced Epoxy). And it also describes the modeling and Fatigue analysis of connecting rod. FEA analysis was carried out by considering two materials in ANSYS workbench software. Compared to the former material, the new material found to have less weight and better stiffness. It resulted in reduction of 40% of weight, with 70% reduction in displacement.

Mostly connecting rods are manufactured by carbon steel and aluminium alloys. And these can withstand at high temperature but the rods which we use are heavy in weight. The main intension of this paper is to reduce the weight of the connecting rod by using GLARE (Glass Laminated Aluminium Reinforced Epoxy) composite material. In this paper fatigue analysis will be shown between Aluminum alloy and GLARE material. GLARE is fiber metal laminate composed of several thin layers of metal interlinked with glass fiber, bonded together with a matrix such as epoxy. It was patented by Akzo Nobel in 1987. GLARE laminates are used for aircraft structures. In this fatigue test GLARE is coated on the Aluminium alloy with the thickness of 0.3mm.

MODELLING OF CONNECTING ROD

Connecting rod was modeled in SOLIDWORKS 2015 design software. This is one of the most advanced designing software. The force applied on it was 4500 N.

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Fig:1 Connecting Rod

ANALYSIS OF ALUMINIUM ALLOY

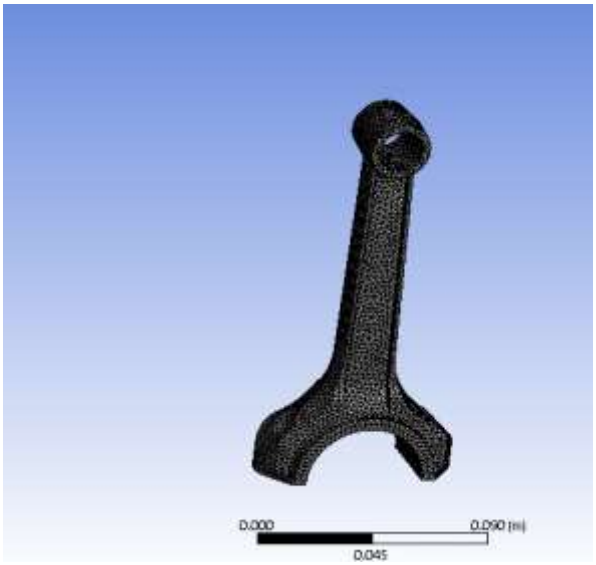

Fig:2 Mesh model of Aluminium alloy connecting rod

In the above figure the model has been meshed and aligned in a manner so that it can visible correctly. The mesh was done in the ANSYS V15 software. In which the model has to done fatigue analysis.

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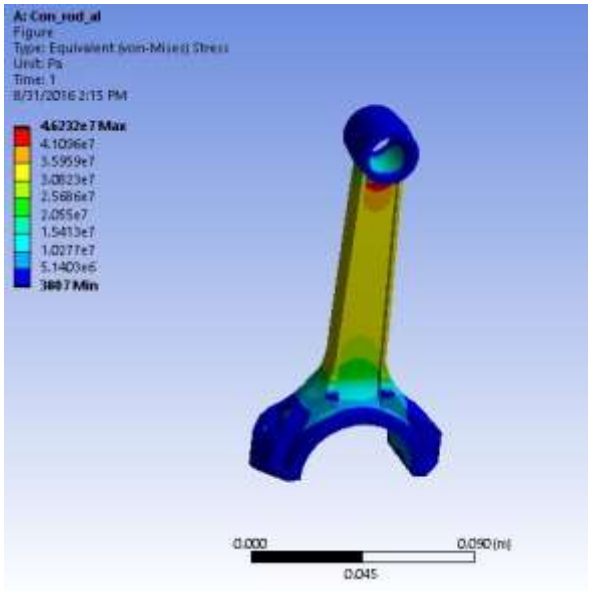

Fig:3 Equivalent (Von-Mises) Stress

After meshing we have to do analysis on the model and for fatigue analysis we Von mises stress, damage, factor of safety, Baxiality Indication.

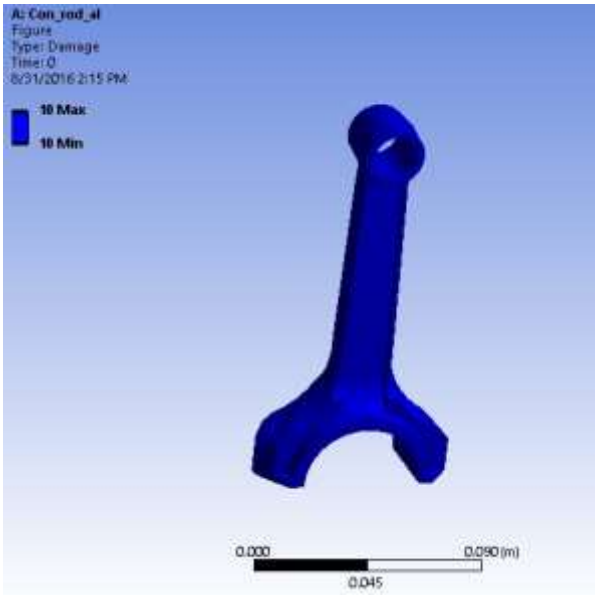

Fig:4 Damage analysis of Aluminium alloy connecting rod

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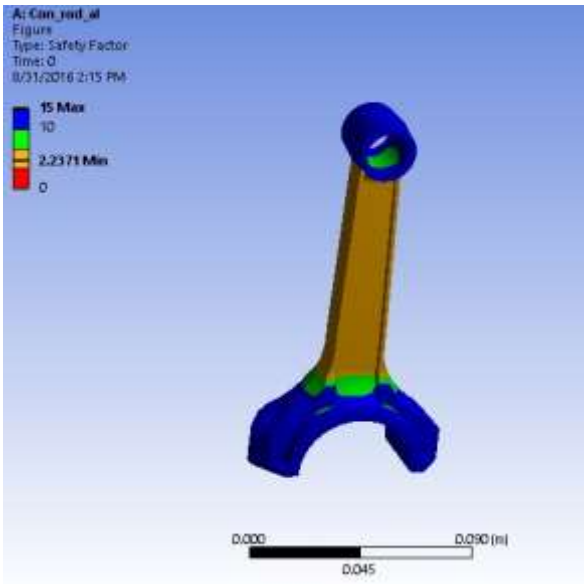

Fig:5 Safety Factor of Aluminium alloy connecting rod

Factor of safety is maximum at cylindrical bolt head is 15 and minimum at crank head is 2.2371.

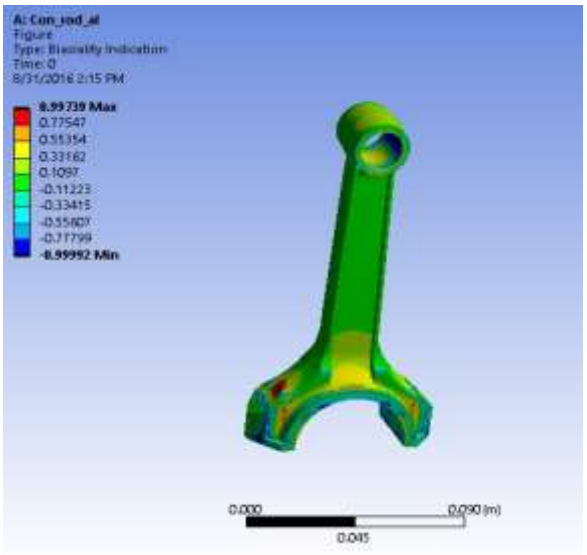

Fig:6 Baxiality Indication of Aluminium alloy connecting rod

Baxiality indication is maximum at crank end is 0.99734 and minimum at piston end is -0.99992

Fig:7 Model GLARE connecting rod

The materials are Aluminium alloy and Epoxy S-Glass UD used to conduct fatigue analysis. In this analysis the glass composite material is coated on Aluminium alloy with the thickness of 0.3mm. Again the model is meshed and all the analysis has to be done on the GLARE connecting rod.

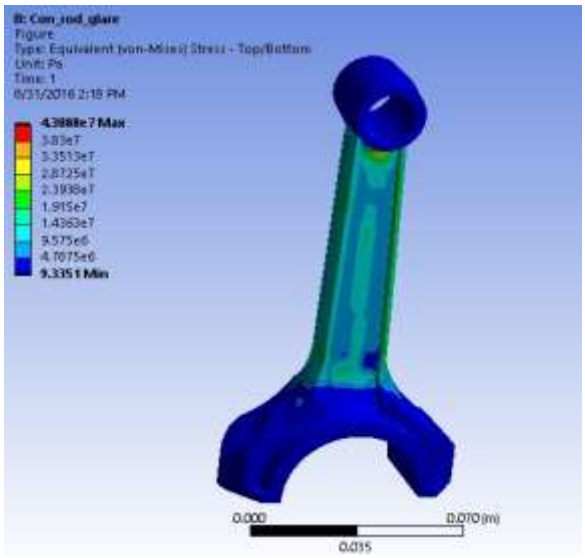

Fig:8 Equivalent (Von-Mises) Stress of GLARE connecting rod

The equivalent stress is maximum at piston end is 43.088Mpa and minimum at crank end is 9.3351e-6Mpa.

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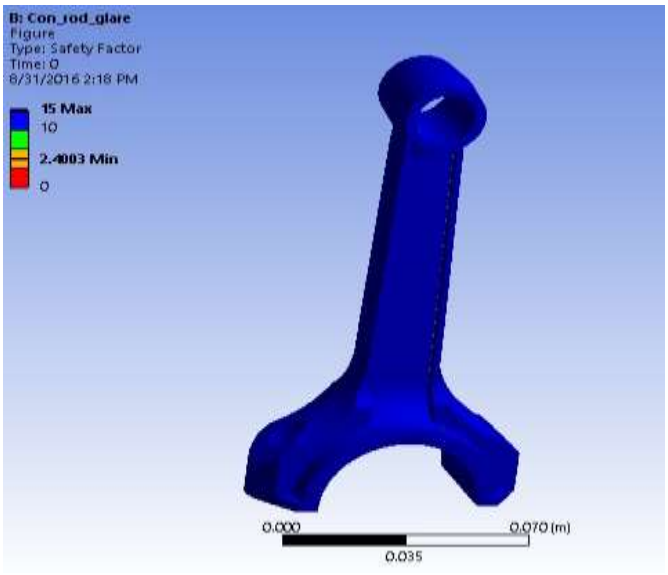

Fig:9 Safety Factor on GLARE connecting rod

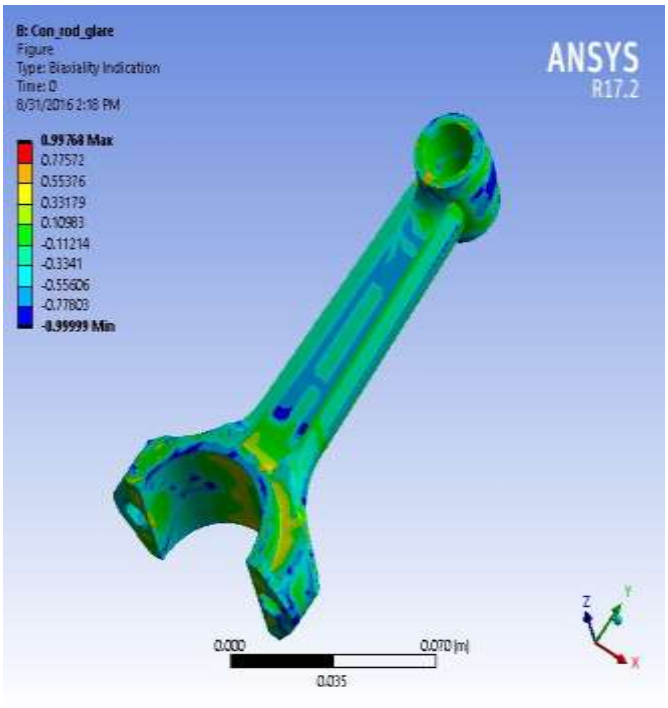

Fig:10 Baxiality Indication on Glare connecting rod

The baxiality indication occurs maximum at 0.99768 and minimum at -0.999999. In the above figure the maximum baxiality induction occurs at crank end but in minimum value which is better than the alluminium connecting rod.

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RESULTS COMPARISION

Tables:

Comparison table for Aluminium alloy and aluminium with Glare material

MATERIALS	LIFE (cycles)	DAMAGE	SAFETY FACTOR Max.	Min.
Aluminium alloy	1.e+008	10	15	2.23
Aluminium alloy & GLARE	1.e+008	10	15	2.403

CONCLUSION

The present material Aluminium alloy connecting rod has the low factor of safety compare with the GLARE coated connecting rod. This shows that it can withstand at high force. If Factor of safety is high then the life time of connecting rod is high and damage of connecting rod will be less.

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