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Design and Analysis of Rocker Arm by Numerical Analysis

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Abstract - *Rocker arm is a pivoted lever used in an internal combustion engine to transfer cam or pushrod motion to a valve stem. Increase strength and durability of rocker arm is still subject of research and investigation. There are many stresses acting on rocker arm of IC engine. Present work finds the various stresses in rocker arm. For this we are modeling the arm using design software like CATIA and the stressed regions are found out using ANSYS software. Using different materials for construction of rocker arms is one of the best methods to increase its durability and strength. This also helps to reduce stresses values in rocker arm. Here we are observing that how the stresses are varying by changing different materials of the rocker arm. After comparing values of stresses we are proposing best suitable material for the rocker arm.*

Key Words: ANSYS, CATIA, Design and Analysis, Rocker Arm, Stresses, Strain.

1. INTRODUCTION

A rocker arm is a valve train component in internal combustion engines. As a rocker arm is acted on by a camshaft lobe, it pushes open either an intake or exhaust valve. This allows fuel and air to be drawn into the combustion chamber during the intake stroke or exhaust gases to be expelled during the exhaust stroke.

Failure analysis is a broad discipline that includes metallurgy and mechanical engineering. There are numerous failure mechanisms that might occur, some appear more often than others, which includes various types of corrosion or wear itself, corrosion in combination with wear, and compression to name a few. Failure of engineering products and structures can occur by cyclic application of stresses (or strains), the magnitude of which would be insufficient to cause failure when applied singularly. Structural and mechanical components subjected to fluctuating service stress (or more appropriately, strain) are susceptible to failure by fatigue. Fatigue is considered as one of the most cause of structural and machinery component failures which are frequently found in engineering services. Fatigue failure is localized structural damage that occurs when a material is subjected to variable cyclic stresses. These stresses are much lower than the ultimate tensile stress limit when under the application of a single static stress.

Advancement in materials used in construction of rocker arm for reducing the noise, weight and higher strength for efficient operation is going on throughout the globe since long. The usual materials used for such purpose are Steel, Aluminum, and Forged steel to Stainless steel, alloys and composites. The success to investigate the possibility creating a light weight rocker arm that could provide a friction reducing fulcrum using needle bearings and a roller tip for reduced friction between the rocker and the valve stem but still be less expensive than steel lies in the development of composite rocker arms. Lighter mass at the valve is also allowed for increased speed while strength of the material caters to durability. The rocker arm usually operates at 40^0-500^0 C and the maximum pressure is exerted by the gas. Therefore in this investigation it has been thought proper to analysis a composite rocker arm of high density polyethylene (HDPE) reinforced with short S-glass fibers of 10% volume fraction. Finite element analysis may be carried out to determine the stresses and make a comparison between steel and composite to predict the failure modes.

The objective of this paper is to measure stress, strain and stress concentration on rocker arm. Also increase strength and durability by finding best material for rocker arm.

By considering all above facts, this paper tries to cover literature which deals with Design and Analysis of Rocker Arm.

2. MODELING OF ROCKER ARM

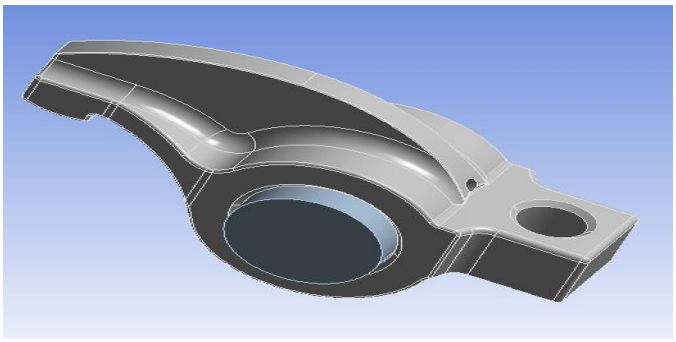


Fig-1: Cad model of rocker arm

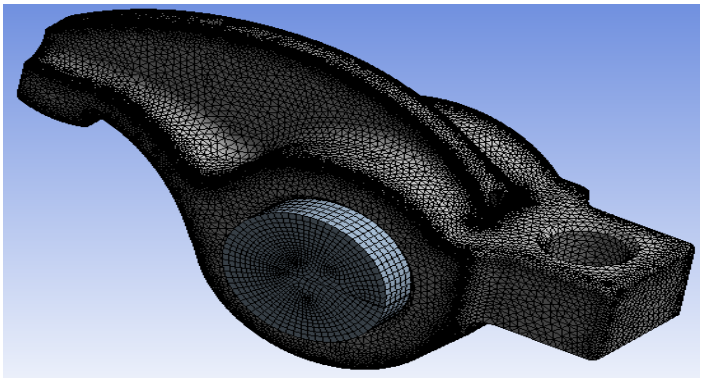


Fig-2: Finite element model of rocker arm

3. ANALYSIS BY ANSYS

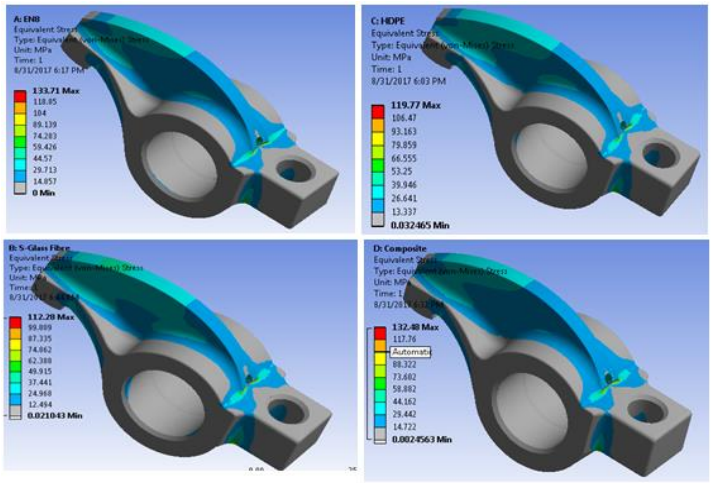


Fig-3: Overall equivalent stress plot (von-misses stress) (Mpa)

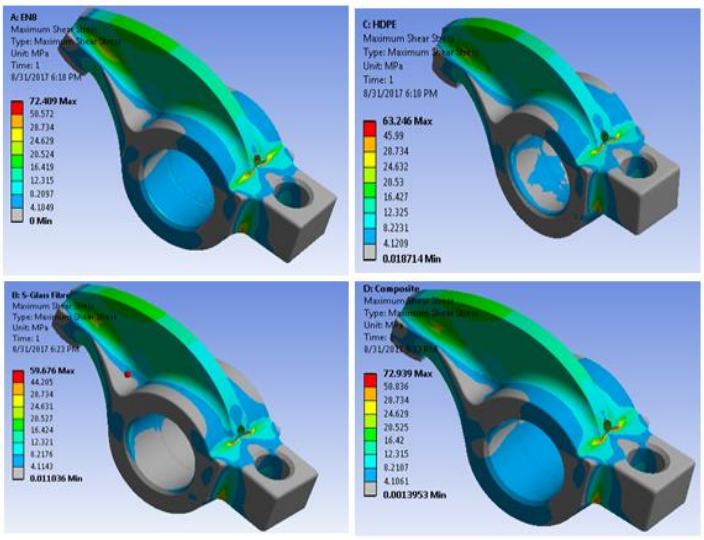
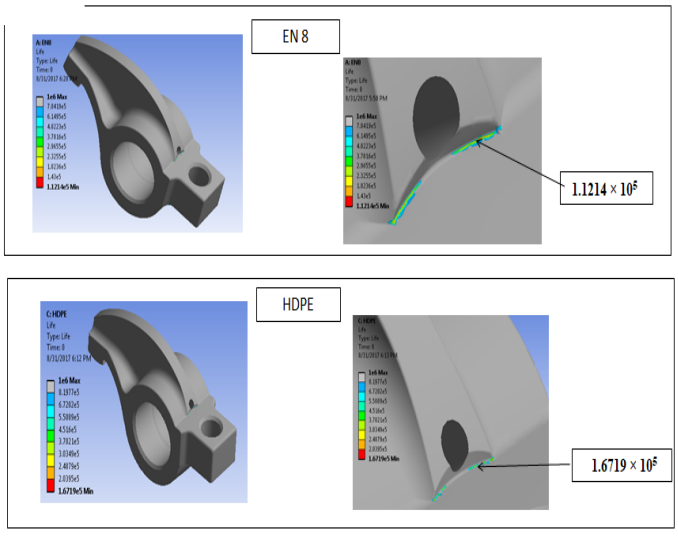


Fig-4: Max. shear stress plot (Mpa)



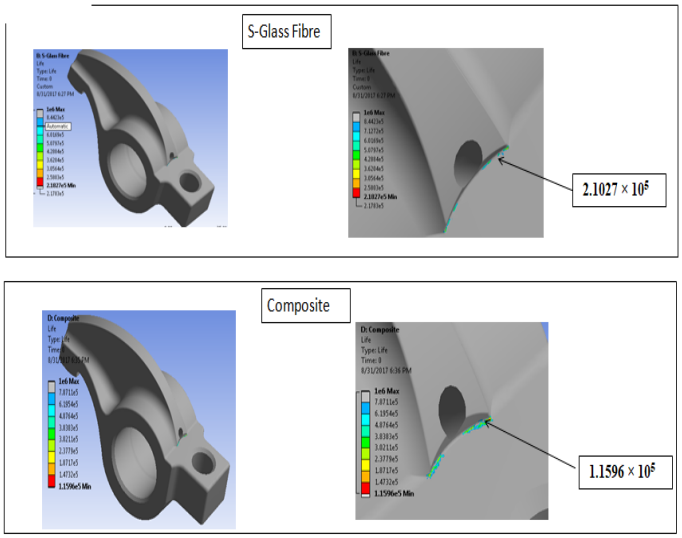


Fig-5: Fatigue life- cycles

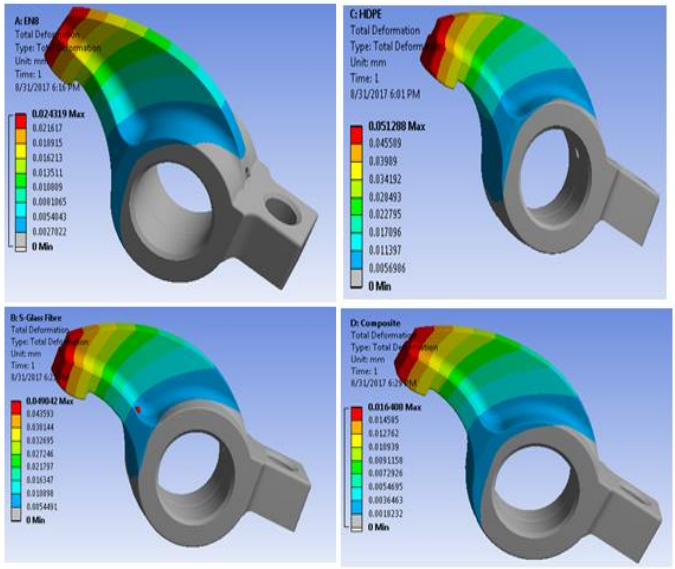


Fig-6: Deformation plot (mm)

4. NUMERIAL ANALYSIS RESULT

All values for numerical analysis of rocker arm for all four materials is shown in table below,

Table-1: Numerical analysis result of all materials

Material	EN8	S-Glass Fibre(S-2)	HDPE (ASTM, D-638)	Composite
Shear stress- τ (N/mm^2)	72.409	59.676	63.246	72.939
Von-misses				

stress- σv (N/mm^2)	133.71	112.28	119.77	132.48
Max. Deformation- δmax (mm)	0.024319	0.019012	0.051288	0.016400
No. of cycles	1.1214×10^5	2.1027×10^5	1.6719×10^5	1.1596×10^5

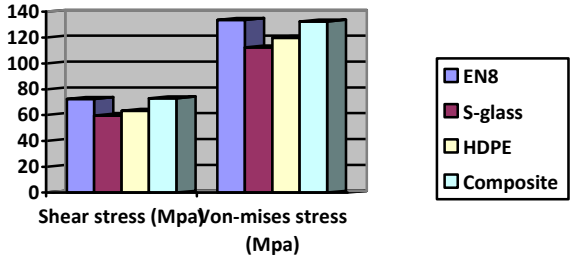


Chart-1: Comparing stresses value (numerical analysis)

5. CONCLUSION

In this paper numerical analysis of rocker arm are carried out. In this analysis design of rocker arm is done on Catia software & the actual deceleration of stresses is analyzed with help of the software Ansys. Here S-Glass fiber is surviving the given loading for 2.1 Lac cycles which is nearly two times than EN8. Also The S-Glass Fiber shows better life expectancy against commonly used EN8 material along with cost benefit.

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