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Design And Analysis of a Rocker Arm

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ABSTRACT

Rocker arms are part of the valve-actuating mechanism. A rocker arm is designed to pivot on a pivot pin or shaft that is secured to a bracket. The bracket is mounted on the cylinder head. One end of a rocker arm is in contact with the top of the valve stem, and the other end is actuated by the camshaft. In installations where the camshaft is located below the cylinder head, the rocker arms are actuated by pushrods. The lifters have rollers which are forced by the valve springs to follow the profiles of the cams. Failure of rocker arm is a measure concern as it is one of the important components of push rod IC engines.Present work finds the various stresses under extreme load condition. For this we are modeling the arm using design software and the stressed regions are found out usingAnsys software. Here in this thesis we are observing that by changing different materials how the stresses are varying in the rocker arm under extreme load condition. And after comparing results we are proposing best suitable material for the rocker arm under extreme load conditions.

Key words:*Ansys, camshaft, pro-e and rocker arm*

I. INTRODUCTION

1.1 Introduction and working of Rocker arm

Rocker arm is an important part of the valve train in fuel injection system providing not only the means of actuating the valves through a fulcrum utilizing the lifter and the push rod but also provide a means of multiplying the lift ratio. Cam shaft design has advanced in leaps and bounds over last three decades but overhead valve engines with centrally located camshafts still use lifters and push rod and rocker arms as a means of opening and closing the intake and exhaust valves in fuel injection pumps. 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 40-500 C and the maximum pressure is exerted by the gas. Therefore in this investigation it has been thought proper to analyze 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.

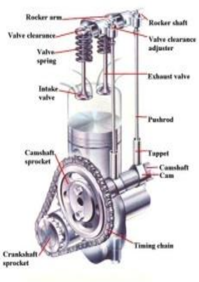

Fig.1 Rocker armFig.2 Position of Rocker arm

II. MODELLING BY USING PRO-E

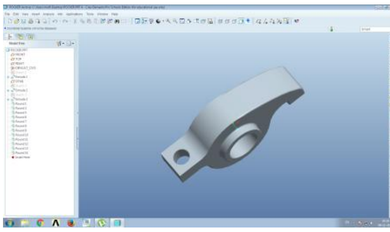 

Fig.3 Solid model Fig .4 Wire frame model

III. ANALYSIS BY ANSYS

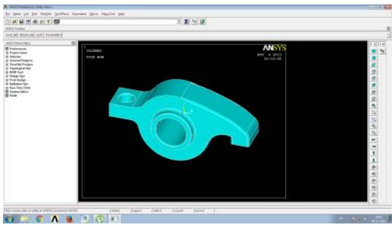 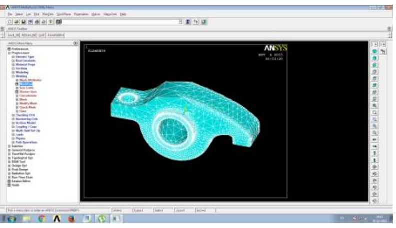

Fig.5 Imported model Fig.6 Meshed model

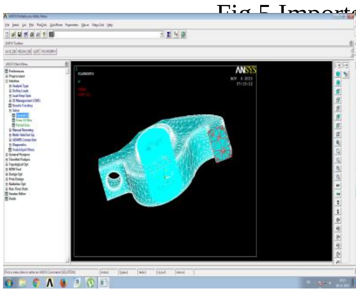 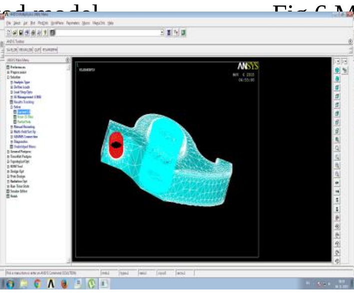 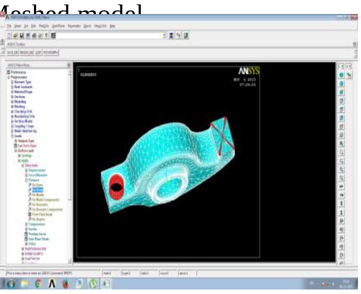

Fig.7 Load distribution at end Fig.8 Load distribution at pin Fig.9 Load distribution at pin and end

IV. RESULTS AND DISCUSSION

4.1 Structural analysis

4.1.1 Load distribution at end

a) Alloy steel -1

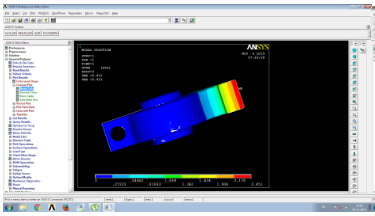 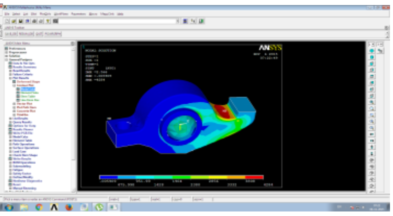

Fig.10 Total deformation Fig.11 Stress intensity

b) Alloy steel -2

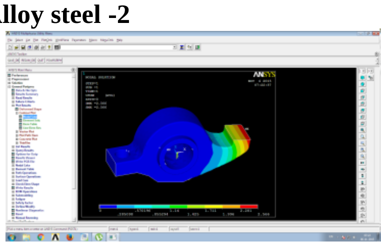 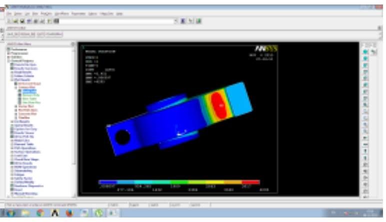

Fig.12 Total deformation Fig.13 Stress intensity

c) Composite material

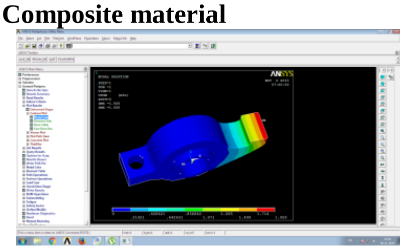 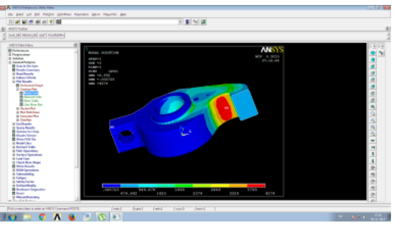

Fig.14 Total deformation Fig.15 Stress intensity

d) Steel

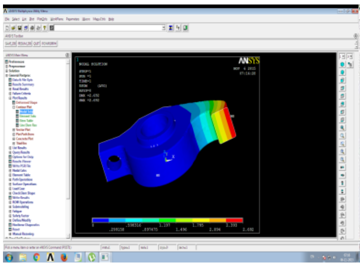

Fig.16 Total deformation

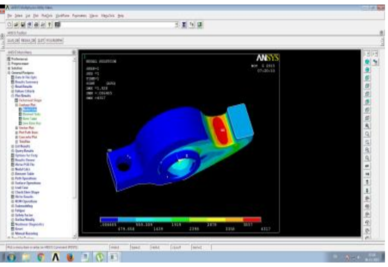

Fig.17 Stress intensity

4.1.2 Load distribution at pin

a) Alloy steel -1

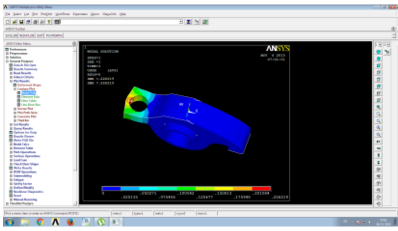

Fig.18 Total deformation

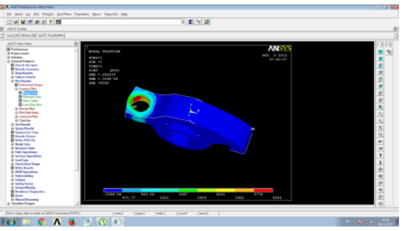

Fig.19 Stress intensity

b) Alloy steel -2

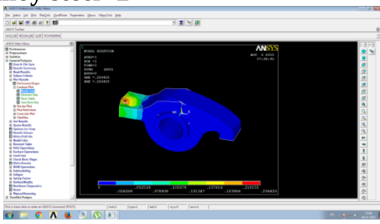

Fig.20 Total deformation

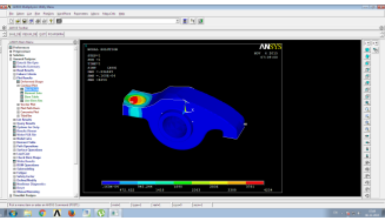

Fig.21 Stress intensity

c) Composite material

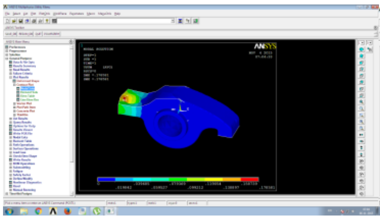

Fig.22 Total deformation

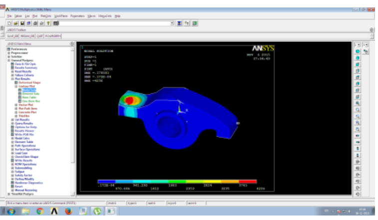

Fig.23 Stress intensity

d) Steel

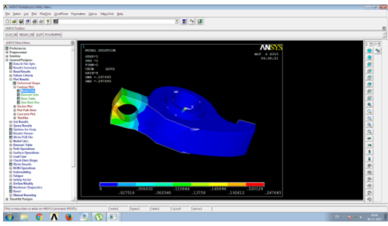

Fig.24 Total deformation

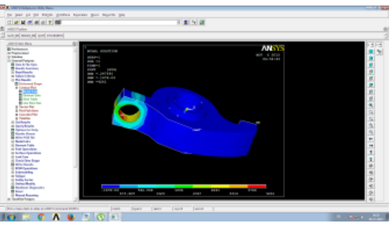

Fig.25 Stress intensity

4.1.3 Load distribution atboth pin and end

a) Alloy steel -1

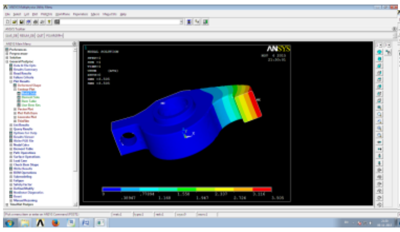

Fig.26 Total deformation

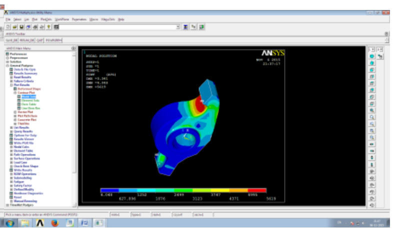

Fig.27 Stress intensity

b) Alloy steel -2

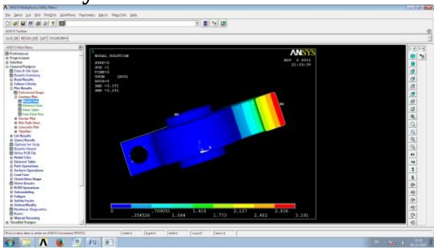
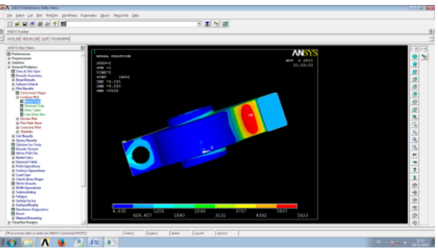

Fig.28 Total deformation Fig.29 Stress intensity

c) Composite material

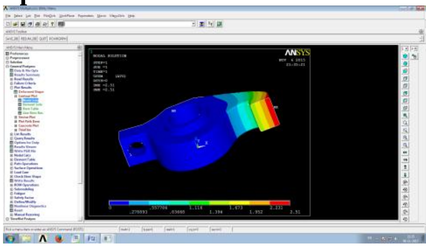
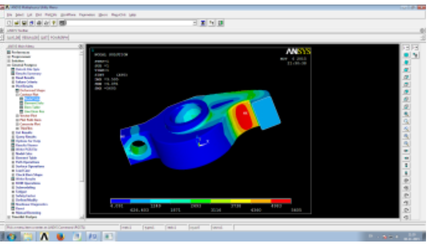

Fig.30 Total deformation Fig.31 Stress intensity

d) Steel

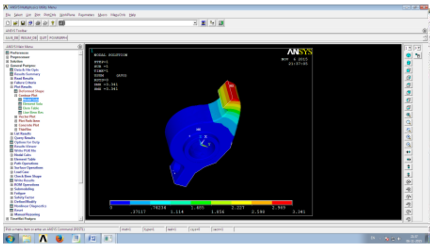
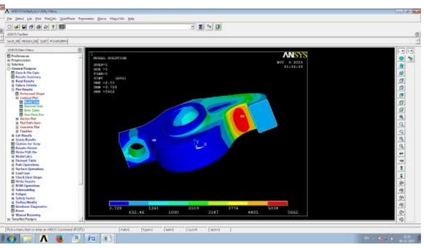

Fig.32 Total deformation Fig.33 Stress intensity

4.2 Results and comparisons

4.2.1 Load at pin

SNO	MATERIAL	TOTAL DEFORMATION	STRESS INTENSITY
1	Alloy steel-1	.2262	4246
2	Alloy steel -2	.2364	4254
3	Composite	.1785	4236
4	Steel	.2476	4261

Table no.1 Load deformation at pin

4.2.2 Load at end

SNO	MATERIAL	TOTAL DEFORMATION	STRESS INTENSITY
1	Alloy steel-1	2.451	4284
2	Alloy steel-2	2.566	4294
3	Composite	1.928	4274
4	Steel	2.692	4317

Table no.2 Load deformation at end

4.2.3 Load at both pin and end

SNO	MATERIAL	TOTAL DEFORMATION	STRESS INTENSITY
1	Alloy steel-1	3.505	5619
2	Alloy steel -2	3.191	5633
3	Composite	2.51	5605
4	Steel	3.341	5662

Table no.3 Load deformation at pin and end

V. CONCLUSION

The modeling of the rocker arm is done by using pro-e and the analysis is performed by Ansys. The project consists of structural analysis of rocker arm which is done to find the strength of the model. To find the strength of the model in structural analysis we are taken 4 different materials and taken 3 load points on the model. We did analysis on the model by applying loads at pin and end side by varying different 4 materials.By the results we observed that the stress values of steel and alloy steel materials are nearer to each other and also for the total deformation the values of the steel and alloy steel got nearly same values. But only composite material got the better values in stress intensity and total deformation when compared to other materials.So by the investigation we conclude that by using composite material the stress values are reduced by that the life time of the rocker arm increases.

Future scope

1. By changing the model design and reducing the thickness we may get better values.
2. And also by using advanced smart materials we can increase the performance of the model.

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