International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

Comparative Analysis and 3D Printing of Rocker Arm of 4 Cylinder Engine with Minimum Weight

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Abstract - *Rocker arm is important component in valve actuating mechanism of an IC engine. From several years' research is going to be held in the automotive industries considering various parameters of optimization like cost, weight, stresses, material compositions, etc. A failure of the rocker arm in valve actuating mechanism is measure concern. [2] Therefore we are analyzed stresses generated and created modeling of rocker arm using CATIA V5 software and Finite Element Analysis was done using Ansys Software. In this project, we are using three different materials which are structural steel, Carbon Steel and HMCF (High modulus carbon fiber). So by comparing FEA results for all above materials we can study stress level and deformation in rocker arm at extreme load conditions and going to propose best suitable material among above materials.[3][4][5]*

Key Words: FEA, Rocker Arm, Ansys, Catia

1. INTRODUCTION

Rocker arm [1] is the part of the actuating component and is used to design to pintle on the hinge pin or Shaft i.e. secured to a bracket. The bracket is fixed on the cylinder head. First end of the rocker arm is in contact with the top of the valve stem, and the another end has actuated by the camshaft. In installation where the camshafts are positioned below the cylinder heads, rocker arms were actuated by pushrods. A lifter has rollers which are imposed by the valve spring to follow the profile of the cams. Here we are studying and analyzing that by changing different materials.

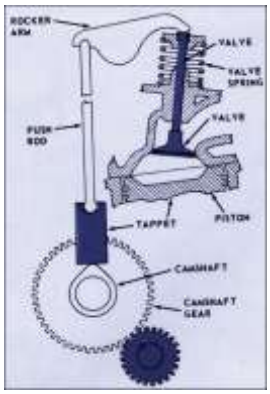


Fig - 1: a rocker arm

1.1 working of rocker arm

The Rocker arms are back and forth levers that convey radial movements from cam lobes into straight line movement at the poppet valves to open it. First end raised and lowered by the rotating lobes of camshafts,[3][4] while another end act as on valves stem. When a camshafts lobe raised the outside of the arms, the inside causes to move into a position of contact with downward on the valve stem, openings the valve. When the outside of a arms permits to return due to the camshaft rotation, then inside rises, allowing the valve springs to close the valves.[5]

1.2 Literature Survey

Chin-sung Chung, ho-kyung kim [10] paper on safety evaluation of the rocker arm of a diesel engine shows about evaluating the fatigue endurances for rocker arm of a IC engine, stresses computations were performed using strain gauge placed near the neck, which was one of the critical region in the rocker arm, meanwhile unstable the engine speed.

z.w. yu, x.l. xu, [7] Discussed about Failure analysis of diesel engine rocker arms. From this paper a failure analysis of IC engine rocker arms used in Vehicles, which are failed in services. Fractures are takes place at the hole of the rocker arm shaft in 2 cases. Beach mark and fatigue step can be detecting on the fracture surfaces.

Syed Mujahid Husain and Siraj Sheikh [1] study shows about Rocker arm of Tata Sumo that was designed and examines to find the critical stresses and region. Computer Aided Design model of Rocker Arm were created using Pro/E and ANSYS software used for analysis of rocker arm. The CAD model was given as input to ANSYS Workbench and Equivalent Stresses and Maximum Shear Stresses was calculated. The results were obtained by ANSYS Workbench, and compared to the results which were calculated by manually.

2. Methodology

Modeling of Rocker Arm in CAD Software for material structural steel

FEA Analysis of Rocker Arm for material structural steel

Modeling of Rocker Arm in CAD Software of material HMCF UD

FEA Analysis of Rocker Arm for material HMCF UD

Modeling of Rocker Arm in CAD Software of material Carbon steel EN6

FEA Analysis of Rocker Arm for material Carbon steel EN6

Taking better material out of above mentioned material. And modify the model in CAD Software

3D printing of a model before modify.

FEA Analysis of modified mode

3D printing of a model after modify.

3. CAD Modeling of Rocker Arm by CATIA software

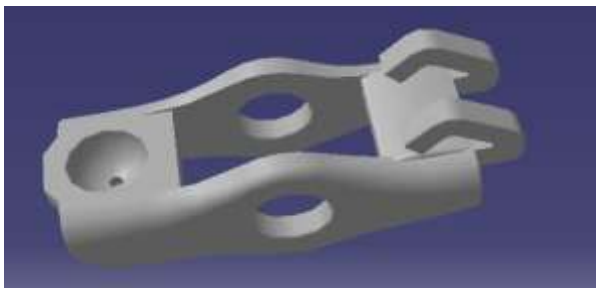


Fig - 2: Model of Rocker Arm using CATIA

4. FEA Analysis Using Ansys Software

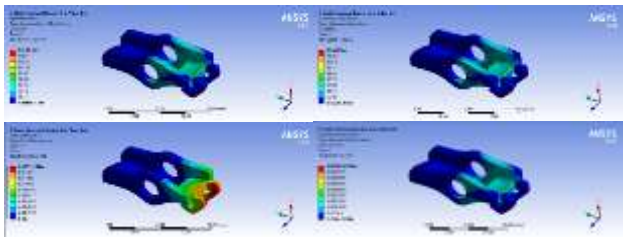


Fig - 3: Analysis at Valve end for structural steel

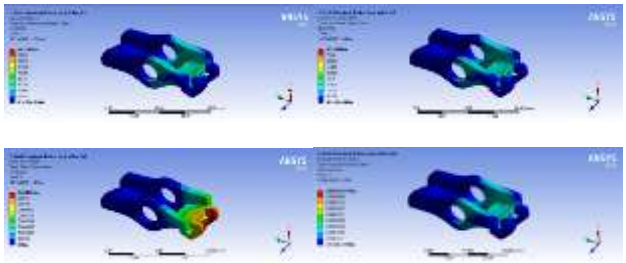
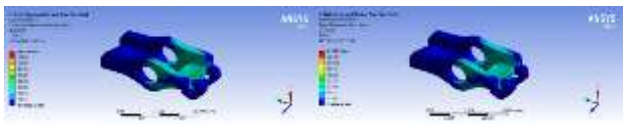


Fig - 4: Analysis at Valve end for Carbon Steel



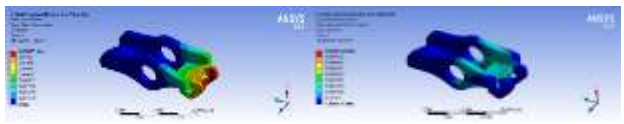


Fig - 5: Analysis at Valve end for HMCF UD

5. Comparative Analysis

Table -1: Comparative Analysis

Result	Material		
	Structural Steel	HMCF UD	Carbon Steel EN6
Total Deformation(mm)	0.015	0.015	0.014
Equivalent Stress(MPa)	145.09	145.09	143.38
Equivalent Strain (mm/mm)	0.00083	0.00083	0.00078
Max. Shear Stress(MPa)	83.59	83.59	82.59

6. CONCLUSION

The Von-Misses stress values for Structural Steel, HMCF UD and Carbon Steel EN 6 rocker arms are 145.09 MPa, 145.09 MPa and 143.38 MPa. The total deformation for structural steel and HMCF UD rocker arm is 0.015 mm while for Carbon Steel EN 6 rocker arm is 0.014 mm. Weight of rocker arm for material HMCF UD before modification is 4.9244e-003 kg and after modification 4.894e-003 kg. From above acquired results it can be noticed that light weight and considerably high strength HMCF UD can be used as rocker arm with good strength.

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