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Modelling and Analysis of Four Wheeler Rocker ARM

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ABTSRACT

A rocker arm in the context of an internal combustion engine of automotive, marine, motorcycle and reciprocating aviation types is an oscillating lever that conveys radial movement from the cam lobe into linear movement at the poppet valve to open it.

In this project we model a rocker arm using a 3D modeling software PRO E using theoretical calculations of a four wheeler and the CAD model is optimized using ANSYS workbench with different Materials such as Aluminum alloy AL360, Steel and Metal Matrix Composites (MMC) AlSiC. The obtained results such as Stresses Total Deformations are provided by ANSYS Workbench are compared and optimized for different materials and best material is optimized according to its low cost and reducing the weight of rocker arm.

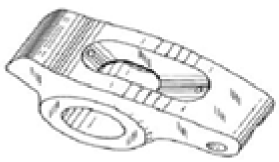
Key words: ***pro-e, ansys, al360, steel.Mmc (alsic)***

INTRODUCTION

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. Rocker arms were first invented in the 19th century and have changed little in function since then. Improvements have been made, however, in both efficiencies of operation and construction materials

A rocker arm is a valve train component in internal combustion engines. As the 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. Rocker arms were first invented in the 19th century and have changed little in function since then. Improvements have been made, however, in both efficiency of operation and construction materials. Many modern rocker arms are made from stamped steel, though some applications can make use of heavier duty materials.

In many internal combustion engines, rotational motion is induced in the crank shaft as the pistons cause it to rotate. This rotation is translated to the camshaft via a belt or chain. In turn, lobes on the camshaft are used to push open the valves via rocker arms. This can be achieved either through direct contact between a camshaft lobe and rocker arm or indirectly though contact with a lifter driven pushrod. Overhead cam engines have lobes on the camshaft which contact each rocker arm directly, while overhead valve engines utilize lifters and pushrods. In overhead cam engines, the camshaft can be located in the head, while overhead valve engines have the camshaft in the block. Both varieties are seen in the US, but regulations have contributed to the decline of overhead valve applications elsewhere in the world.



Rocker arm

DESIGN AND ANALYSIS OF ROCKER ARM

Syed Mujahid Husain and Siraj Sheikh

In this paper we discussed about Rocker arm of Tata Sumo victa that was designed and analyzed to find the

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critical regions. CAD models of Rocker Arm was created using Pro/E and ANSYSsoftware was used for analysis of rocker arm.

Stress Analysis of Hand Crank and Rocker ARM

N. Lenin Rakesh, A. Thirugnanam

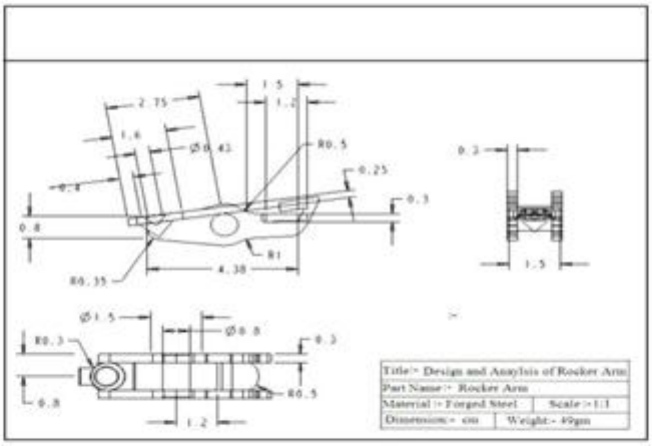
The main objective of this project is to find out the stress analysis of rocker arm and the hand crank by using finite element analysis software ANSYS. The structure of the hand crank and rocker arm model was performed using pro-E 4.0 version. Then finite element analysis are performed using ANSYS.

Stress Analysis of Glass Composite Rocker Arm by Finite Element Method

Antaryami Mishra

An attempt has been made in this investigation to find out various stresses under extreme load condition for a polymer matrix composite rocker arm. Glass fibre reinforced (10% volume fraction) composite rocker arm of fuel injection pump has been considered for analysis owing to its light weight, higher strength and good frictional characteristics.

Rocker Arm Specification



DESIGN PROCESS:

The process of designing is characterized by six identifiable steps or phase

1. Recognition of need
2. Definition of problem
3. Synthesis
4. Analysis and optimization
5. Evaluation
6. Presentation

APPLICATION OF COMPUTERS FOR DESIGN:

The various design-related tasks which are performed by a modern computer-aided design system can be grouped into four functional areas:

1. Geometric modeling
2. Engineering analysis
3. Design review and evaluation
4. Automated drafting

Geometric Modeling:

In computer-aided design, geometric modeling is concerned with the computer- compatible mathematical description of the geometry of an object. The mathematical description allows the image of the object to be displayed and manipulated on a graphics terminal through signals from the CPU of the CAD system. The software that provides geometric modeling capabilities must be designed for efficient use both by the computer and the human designer.

There are several different methods of representing the object in geometric modeling. The basic form uses wire frames to represent the object. Wire frame geometric modeling is classified into three types, depending on the capabilities of the interactive computer graphics system.

The three types are:

1. 2D- Two Dimensional representation is used for a flat object.
2. 2½D- This goes somewhat beyond the 2D capability by permitting a three-dimensional object to be represented as long as it has no side wall details.
3. 3D- This allows for full three dimensional modeling of a more complex geometry.

The most advanced method of geometric modeling is solid modeling in three dimensions. Another feature of some CAD systems is color graphics capability. By means of color, it is possible to display more information on the graphics screen. Colored images help to clarify components in an assembly, or highlight dimensions, or a host of other purposes.

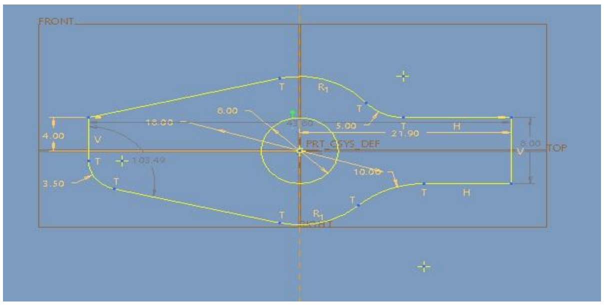
ENGINEERING ANALYSIS:

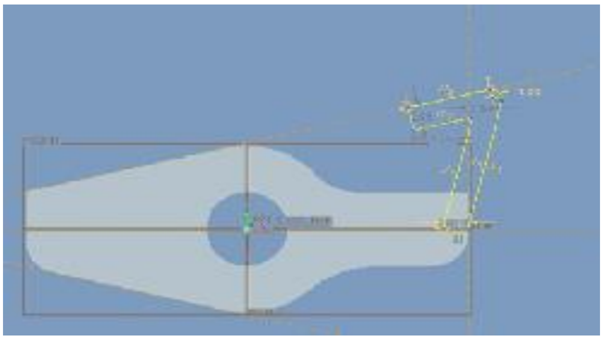
CAD/CAM systems often include or can be interfaced to engineering analysis software which can be called to operate on the current design model. Examples of this type are

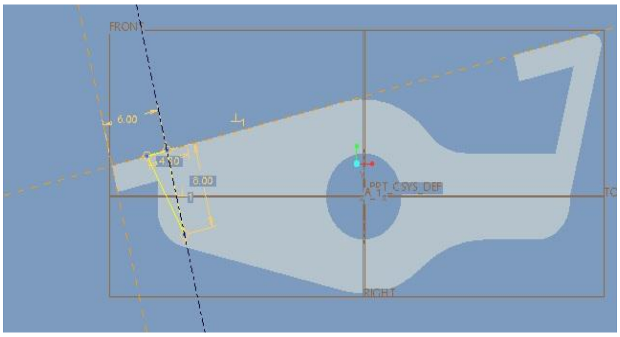
- Analysis of mass properties
- Finite element analysis

The analysis may involve stress –strain calculations, heat-transfer computations, or the use of differential equations to describe the dynamic behavior of the system being designed.

ROCKER ARM IN PRO-E







Materials used

In this paper we optimized steel with aluminum alloy and mmc material (alsic)

FINITE ELEMENT ANALYSIS

Finite element analysis (FEA) has become commonplace in recent years, and is now the basis of a multibillion dollar per year industry. Numerical solutions to even very complicated stress problems can now be obtained routinely using FEA, and the method is so important that even introductory treatments of Mechanics of Materials { such as these modules { should outline its principal features. In spite of the great power of FEA, the disadvantages of computer solutions must be kept in mind when using this and similar methods: they do not necessarily reveal how the stresses are influenced by important problem variables such as materials properties and geometrical features, and errors in input data can produce wildly incorrect results that may be overlooked by the analyst.

Perhaps the most important function of theoretical modeling is that of sharpening the designer's intuition; users of finite element codes should plan their strategy toward this end, supplementing the computer simulation with as much closed-form and experimental analysis as possible.

Finite element codes are less complicated than many of the word processing and spreadsheet packages found on modern microcomputers. Nevertheless, they are complex enough that most users do to program their own code. A number of prewritten commercial codes are available, representing a broad price range and compatible with machines from microcomputers to supercomputers1. However, users with specialized needs should not necessarily shy away from code development, and may the code sources available in such texts as that by Zienkiewicz2 to be a useful starting point. Most finite element software is written in FORTRAN,but some newer codes such as felt are in C or other more modern programming languages.

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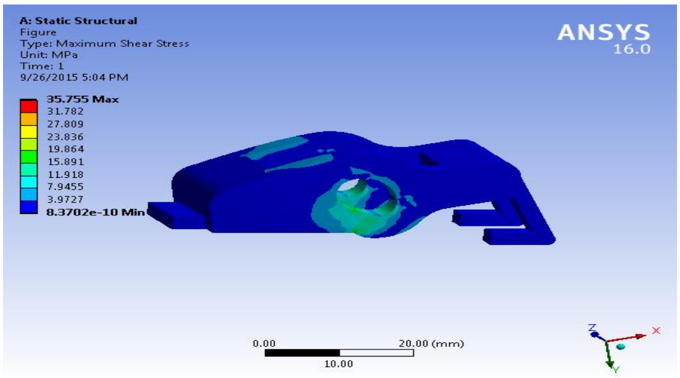
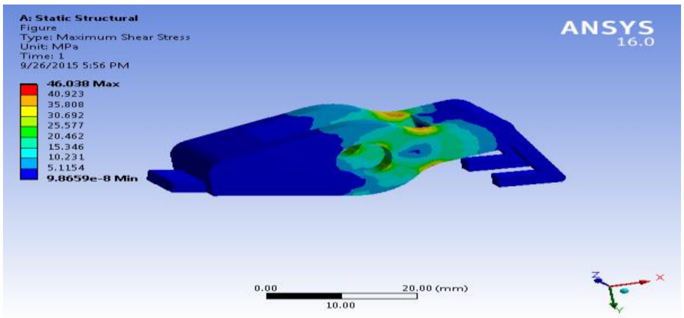
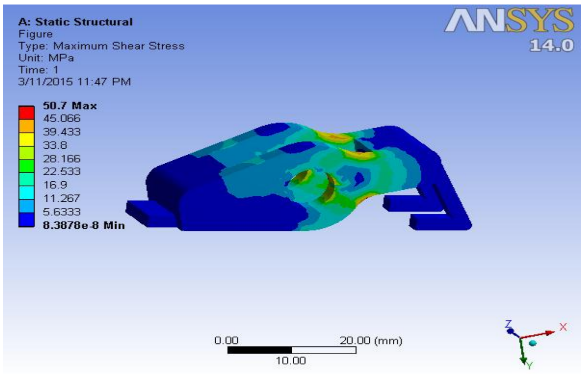


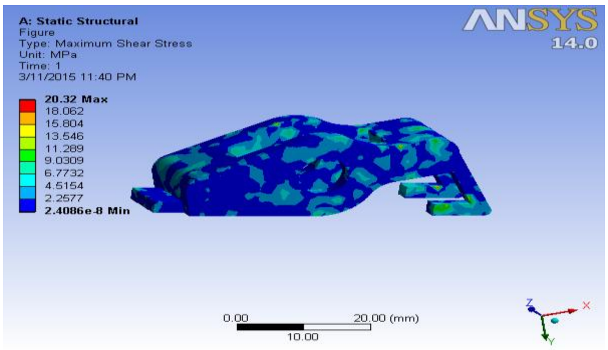
Maximum shear stress mmc (alsic) at hole35.755mpa



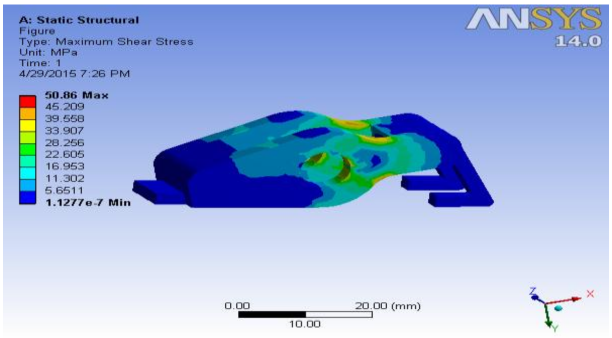
Maximum shear stress mmc (alsic) at neck 46.03mpa



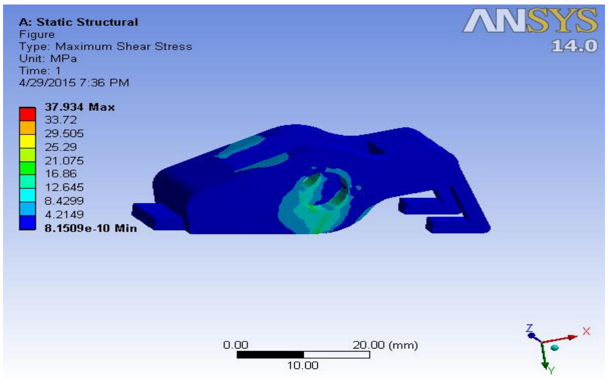
Maximum Shear Stress in Steel at neck 50.7mpa



Maximum Shear Stress in Steel at Hole 20.32mpa



Maximum Shear Stress in aluminum alloy at neck50.8mpa



Maximum Shear Stress in aluminum alloy at Hole 37.934mpa

Results and discussion

It is observed from the results that maximum shear stresses are developed at Sharpcorners and hole of the rocker arm. A comparison of maximum shear stress, total deformation and equivalent stress values for steel and aluminum alloy, Metal Matrix Composite (MMC) SiC are compared , the maximum shear stress and vonmises stress values nearly equal and those are allowable stresses, but the density of AlSic is less than the existing material, Hence by using AlSiC we can decrease the weight of the four wheeler Rocker arm..

Material	steel		Aluminum alloy		Mmc (Alsic)	
	At hole	At neck	At hole	At neck	At hole	At neck
Force	688.62 N	688.62 N	688.62 N	688.62 N	688.62 N	688.62 N
Deformation	0.00150 mm	0.02119 mm	0.006266 mm	0.05994 mm	0.1959 mm	1.4933 mm
Von mises stress	78.963 MPa	101.17 MPa	72.82 MPa	101.6 MPa	**67.758 MPa**	**91.36 MPa**
Shear stress	20.32 MPa	50.7 MPa	37.934 MPa	50.86 MPa	**37.755 MPa**	**46.03MPa**

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CONCULSION

In our project we have modeled a four wheeler rocker arm using a 3D modeling software (PRO E). Static Structural analyses of a Rocker arm is done using FEA Tool ANSYS WORKBENCH with different materials, Present used materials are steel. We are replacing the material with Aluminum alloy AL360 grade, and MMC(AlSiC) materials to reduce the weight of the rocker arm.By observing the stress values obtained in structural analysis, they are less than the yield stress value of Aluminum alloy and MMC, AlSiC, And also by comparing with stainless steel materials, the stress value is 93Mpa which can be allowable for AlSiC than the other material. So we can conclude that by changing the material to AlSiC the weight of the Rocker arm is decreased and the efficiency of the vehicle can be increased.

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