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# Contact Analysis of a Cam and Follower in Two Wheeler

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## ABSTRACT

*A cam and follower system is system/mechanism that uses a cam and follower to create a specific motion. The cam is in most cases merely a flat piece of metal that has had an unusual shape or profile machined onto it. This cam is attached to a shaft which enable it to be turned by applying a turning action to the shaft.*

*As the cam rotates it is the profile or shape of the cam that causes the follower to move in a particular way. The movement of the follower is then transmitted to another mechanism or another part of the mechanism. The use of cam and follower systems are vital in engines, where they are used to open and close the inlet valve and the exhaust valve to the cylinder head.*

*In this project, a cam and follower assembly is designed and modeled in 3D modeling software Pro/Engineer. Present used material is Forged Steel. We are replacing with Aluminum alloy A360. Structural and Modal analysis are done on the assembly to verify the strength. The analysis is done on the assembly by applying the forces and also by changing the materials of the cam and follower.*

***Key words: cam ,cam and follower, Shaft.***

## 1. INTRODUCTION

A cam may be defined as a machine element having a curved outline or a curved groove, which, by its oscillation or rotation motion, gives a predetermined specified motion to another element called the follower.

As the cam rotates it is the profile or shape of the cam that causes the follower to move in a particular way. The movement of the follower is then transmitted to another mechanism or another part of the mechanism. The use of cam and follower systems is vital in engines, where they are used to open and close the inlet valve and the exhaust valve to the cylinder head.

The transformation of one of the simple motions, such as rotation, into any other motions is often conveniently accomplished by means of a **cam mechanism**A cam mechanism usually consists of two moving elements, the cam and the follower, mounted on a fixed frame. Cam devices are versatile, and almost any arbitrarily-specified motion can be obtained. In some instances, they offer the simplest and most compact way to transform motions.

## 2. OBJECTIVE

In this project, a cam and follower assembly is designed and modeled in 3D modeling software CATIA. Present used material is Forged Steel. We are replacing with Aluminum alloy A360.

Structural analysis is done by using materials Forged Steel and Aluminum Alloy A360. By observing the analysis results. Aluminum alloy is safe under given load condition,By comparing the results for both materials.

We have also done modal analysis to determine the natural frequencies. By observing the deformation and frequencies Of Aluminum A 360 and Forged Steel.

## 3. METHODOLOGY

Themethodologyinvolved in carryingoutthis workisdiscussed below:

**Selectionofthematerial:**Aluminiummaterialwithhighthermalconductivity and lowdensityisinvestigated.

**Modeling**

- **Geometry**:2Dand3Ddesignofthecam and follower generated accordingto thedimensions with CATIA V5 R20.
- **Domain**:Aphysicaldomainofdesireddimensionisgeneratedsubjectedto theatmospheric conditionsusingANSYS.
- **FV-analysis:**3Dmodelismeshedandboundaryconditionsandloadingare applied with ANSYSCFX15.

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**FVanalysis:**FVmodelissubjectedtotherequiredanalysisusingANSYS.

**Interpretationsofresults:**TheFVresultsareanalysis withtheexperimental data.

**Presentationof data:**theplots, graphsarepresentedin MS-excel.

**Prototype model:** The tool for the final design is realized and the actual componentis fabricated byadoptingarelated manufacturingtechnology.

## 3.1. GEOMETRY:

A3Dmodelofcam nd followerhasbeencreatedusing CATIAV5R20as shown infig. And their respectivedimensions are show in 2D figure.

Fig 3.1 3D cam and follower.

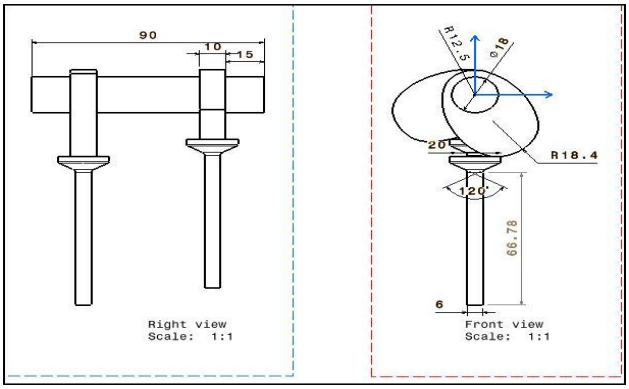



Fig 3.2 2D cam and follower.

## 3.2. Selection of material:

Materialselectionplaysvitalrolein themodeling process.Itisoneofthemost important steps the designer must make before creating the model. To select an appropriate material, the designershould look at their characteristics and behavioral featurerequiredforthecomponent.Theoverall performance, efficiency,servicelifeof thestructuralcomponentdependsonthematerialused.Following factorsshouldbe considered whileselectingthe material are,

- Geometry of the component.
- Operatingenvironment.
- Required Servicelife.
- Performancerequired.
- Modesof failure.
- Loadingconditions.
- Cost.

## 3.3. Boundary conditions

According to the need of the model boundaryconditions are used. Theturbulence model applied forpresent analysiswas SST model.

### 3.4 Material properties

**3.4.1Forged steel:**

i.Density:7850kg/$m^3$

ii.Young's modules:180GPA

iii.Poisson ratio:0.265

**3.4.2 Aluminum A360 alloy:**

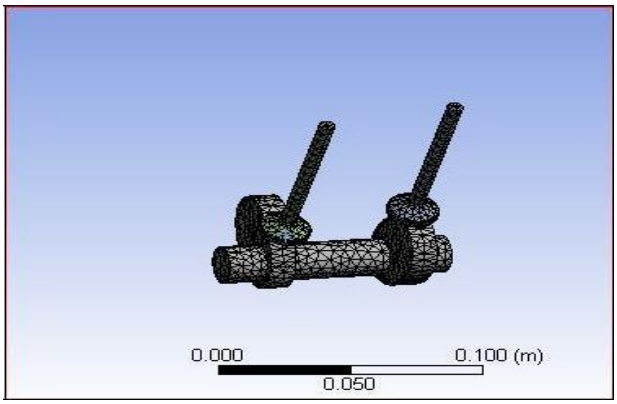
i.Density:2630kg/$m^3$

ii.Young's modules:317Mpa

iii. Poisson ratio:0.33

Pressure:15.454 pa.

### 3.5 . Tetra mesh




Themeshofthemodelisshowninfig.Itdepictsthatthedomainwasmeshed with tetra cells. Initially a relativelycoarser meshis generated. This meshcontains triangular facesat the boundaries. Careis taken to use structured tetracells as much possible.

Itismeanttoreducenumericaldiffusionasmuchas possiblebystructuring themeshina wellmanner,particularlynear thewall region.Lateron,afine mesh is generated panel is increased from 0.75mm to 1.00mm

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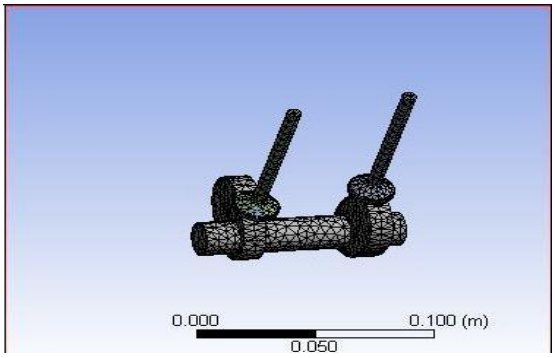


3.5.1 Meshing of the model

## 4 Results

Thecontoursforthetemperaturedistribution,velocity distribution,andheat transferco-efficientdistributionondouble pipehelicalcoilarestudiedfirst.Thenthe effectofthese distributionsonhelicalcoil,heattransfer enhancementisevaluatedby studying theheattransferco-efficientandtemperaturevariationoninnercoilandoute r coil. Theresultis analyzed fordifferent massflowrates.

### 4.1. Static analysis:

A static analysis calculates the effects of steady loading conditions on a structure, while ignoring inertia and damping effects, such as those caused by time-varying loads. A static analysis can, however, include steady inertia loads (such as gravity and rotational velocity), and time-varying loads that can be approximated as static equivalent loads (such as the static equivalent wind and seismic loads commonly defined in many building codes).

| Modes | Total deformation(mm) | Frequency (Hz) |
|---|---|---|
| **Mode1** | 433.22 | 1.1269e^-004 |
| **Mode2** | 404.88 | 1.4337e^-004 |
| **Mode3** | 340.41 | 2.5615e^-004 |

Table 4.1 Results of static analysis

### 4.2. Model analysis

Modal analysis is to determine the vibration characteristics (natural frequencies and mode shapes) of a structure or a machine component while it is being designed. It also can be a starting point for another, more detailed, dynamic analysis, such as a transient dynamic analysis, a harmonic response analysis, or a spectrum analysis.

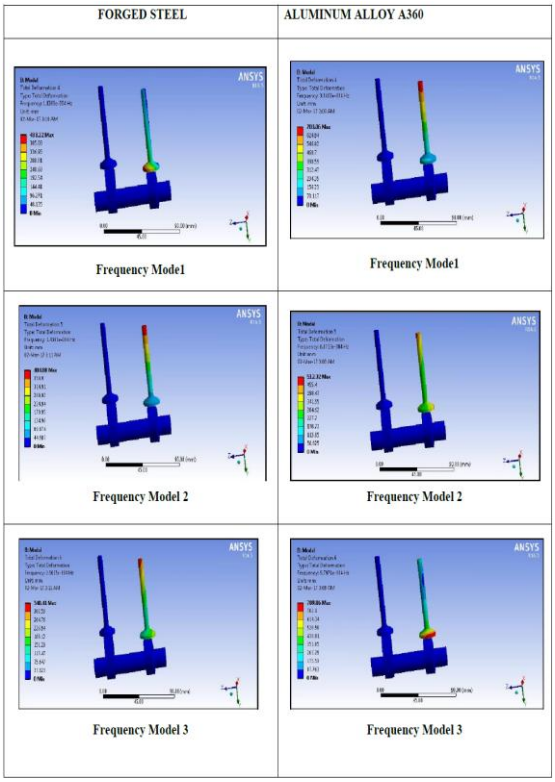


Fig 4.1 Model analysis of forged steel and alluminium alloy 360

| Material | Stress (MPa) | Strain | Total deformation |
|---|---|---|---|
| **Forged steel** | 17.58 | 2.1902 | 2.1920 |
| **A360** | 17.4 | 0.6069 | 1.128 |

Table 4.2 Results of model analysis

**CONCLUSION:**

In this project, a cam and follower assembly is designed and modeled in 3D modeling software CATIA. Present used material is Forged Steel. We are replacing with Aluminum alloy A360. The density of the aluminum alloy A360 is less than that of Forged Steel, so the weight of the component reduces.

Structural analysis is done by using materials Forged Steel and Aluminum Alloy A360. By observing the analysis results, the stress values are less than their respective permissible stress values for both materials. So using Aluminum alloy is safe under given load condition. By comparing the results for both materials, the stress value is less when Aluminum alloy A360 is used than Forged Steel.

We have also done modal analysis to determine the natural frequencies. By observing the results, the deformation and frequencies are increasing for Aluminum A360 when compared with of Forged Steel. Vibrations will be increasing when frequencies increases.

So we can conclude that using Aluminum alloy A360 is better considering less stresses and weight.

**REFERENCES**

[1] A.S.Dhavale, V.R.Muttagi "Study of Modeling and Fracture Analysis of Camshaft" International Journal of Engineering Research and Applications, Vol. 2, Issue 6, November-December 2012, pp.835-842.

[2] Mahesh R. Mali, Prabhakar D. Maskar, Shravan H. Gawande, Jay S. Bagi , " Design Optimization of Cam & Follower Mechanism of an Internal Combustion Engine for Improving the Engine Efficiency", Modern Mechanical Engineering, 2012, 2, pp.114-119

[3] Bayrakceken H, Ucun I. &Tasgetiren S. "Fracture analysis of a camshaft made from nodular cast iron". [ 1240-1245] 3 NOV 2005.

[4] Paradon V. "An Impact Model for Industrial CamFollower System: Simulation And Experiment". [ 01-11] 11th OCT, 2007 [5] G.K. Matthew., D. Tesar.(1976), Cam system design: The dynamic synthesis and analysis of the one degree of freedom model, Mechanism and achine Theory, Volume 11, Issue 4, Pages 247-257.

[6] M.O.M Osman., B.M Bahgat., Mohsen Osman., (1987),Dynamic analysis of a cam mechanism with bearing clearances, Mechanism and Machine Theory, Volume 22, Issue 4, Pages 303-314.

[7] Robert L Norton.( 1988), Effect of manufacturing method on dynamic performance of ams— An experimental study. part I—eccentric cams,Mechanism and Machine Theory, Volume 23, Issue 3,Pages 191-199