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Finite Element Structural Analysis of Automobile Camshaft

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Abstract: ***This Cam is a Mechanical Linkage utilized particularly in changing turning movement into straight movement. Its principle capacity is to control the valve timing in I.C Engines. In the present work we are composed Automobile camshaft by Numerical Calculations there after it is planned by utilizing Modeling software PRO-E and CAE Analysis is done in ANSYS by differing material AL Metal Matrix Composite (ALMMC) to research the deformation, stress and strain developed on camshaft. The examination will give the most ideal approach to think us for the further future work of camshaft.***
Keywords: Design, Analysis, Pro-E, Ansys, IC Engines

I. INTRODUCTION

A camshaft is a pole to which a cam is affixed or of which a cam structures a vital part. The camshaft is the most vital part of an interior burning motor (internal combustion engine). Its primary capacity is to control the valve timing, along these lines permitting intake valve to open at the right time for feeding fuel and air mixture into the engine.

The camshaft is driven by the motor's crankshaft through a progression of riggings called idler apparatuses and timing gears. The riggings permit the pivot of the camshaft to relate or be in time with the turn of the crankshaft and along these lines permit the valve opening, valve shutting, and infusion of fuel to be planned to happen at exact interims in the cylinder's travel. To build the adaptability in timing the valve opening, valve shutting, and infusion of fuel, and to expand control or to decrease cost, a motor may have at least one camshafts. Commonly, in a medium to expansive V-sort motor, each bank will have at least one camshaft for every head. In the bigger motors, the admission valves debilitate valves, and fuel injectors may share a typical camshaft or have free camshafts. Contingent upon the sort and make of the motor, the area of the camshaft or shafts shifts. The camshaft(s) in an in-line motor is generally discovered either in the leader of the motor or in the highest point of the square running down one side of the chamber bank. At the point when the cylinder goes underneath the level of the ports, the ports are "opened" and outside air or fumes gasses can enter or leave, contingent upon the kind of port. The ports are then "shut" when the cylinder goes back over the level of the ports. Valves are mechanically opened and shut to concede or deplete the gasses as required. The valves are situated in the head throwing of the motor.

The time when the valve seats against the head is known as the valve situate. Most medium-sized diesel motors have either allow valves or fumes valves or both admission and fumes valves.

II. PROBLEM DEFINATION AND OBJECTIVE

Camshafts are pivoting segments with basic burdens. Hence the assurance of correct load values turns into the testing one contrasted and other pivoting individuals. This venture gives the rules to understand such circumstance. The goal is to outline cam shaft systematically and examine the stress distribution the cam shaft for static.

III. DESIGN OF CAMSHAFT

Pro-E is a parametric, coordinated 3D CAD/CAM/CAE arrangement made by Parametric Technology Corporation (PTC). It was the first to showcase with parametric, include based, cooperative demonstrating programming software. The application keeps running on Microsoft-Windows stage, and gives demonstrating, get together and drafting, limited component investigation, and NC and tooling usefulness for mechanical designers.

Initially 2D drawings were created using sketcher toolbar; tools in profile tool bar such As line, circle, rectangle, and point, reference lines etc … and sketch references like grid, vertex, and dimensions are used.

The created drawings were then completely constrained using the tool in constraint tool bar like constraint and auto constraint. Then 2D drawings were converted into 3D using sketch based features tools such as extrude, swept blend, blend.

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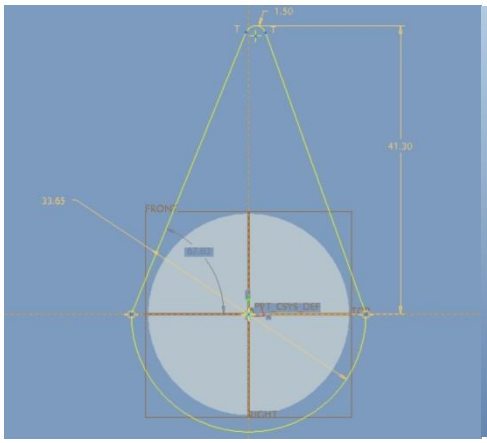
Pro/E Design models are often mixes of different parts, assemblies, drawings, and different items. Pro/E Design makes every one of these substances completely acquainted. That implies if you roll out improvements at a specific level those progressions engender to every one of the levels. For instance on the off chance that you change measurements on a drawing the change will be reflected in the related part. Any adjustment made in any module will consequently make alteration in the other module. So this kind of association from module to module is known as associative.

A. Engine specification

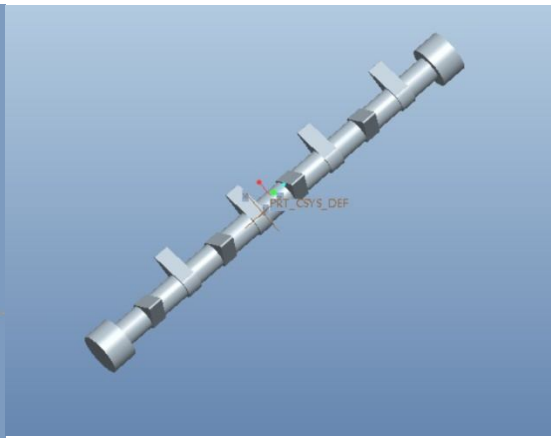
Power = 35 H.P. (for two cylinders)
Speed = 2400 rpm
Maximum Torque = 10.4 kgm
Cylindrical volume = 1.96 lit. (1960cc)
Maximum Pressure = 140 bar at 200 of crank angle from TDC
Bore = 103 mm
Stroke = 120 mm
Compression ratio = 17:1
Inlet valve opens = 10^0 TDC
Inlet valve closes = 46^0 BDC
Exhaust valve opens = 46^0 BDC
Exhaust valve closes = 10^0 TDC
Firing order = 1-2

B. CAMSHAFT DIMENSIONS:

Width of Cam = 19 mm
Camshaft diameter = 28.75 mm
Journal diameter = 51 mm
Height of Cam = 41.3 mm
Base circle diameter = 33.65 mm
Total lift of cam = 7.65 mm



2D sketch of camshaft



Solid Model

IV. ANALYSIS OF CAMSHAFT

ANSYS: The ANSYS Computer software is a huge scale multipurpose limited component strategy (finite element method) program that might be utilized for taking care of a several classes of designing issues. The investigation capacities of ANSYS incorporate the capacity to understand static and dynamic structural analyses , steady state and transient problems, mode frequency and buckling Eigen value problems, static or time varying magnetic analyses and different sorts of field and coupled applications. The program has many extraordinary elements which permit non-freedoms or optional impacts tube incorporated into the arrangement, such as, plasticity, large strain, hyper elasticity, creep; swelling, large deflection contact stress stiffening temperature dependency, material anisotropy and radiation. As ANSYS was created, other unique capacities, for example, surface organizing,

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sub modeling, irregular vibration, piezoelectric, coupled field examination and design improvement was added to the program. These abilities contribute further to make ANSYS a multipurpose analysis device for changed designing order.

The ANSYS program has been in business use since 1970 and it is utilized broadly in the aviation, automotive, development, electronics, vitality, benefit, fabricating, atomic or nuclear, oil and steel ventures. In addition, many counseling firms and several colleges and universities are utilize ANSYS for examination, explore and instructive utilize.

A. Static analysis

Table no 1: material properties

S.no	Properties	ALMMC
1	Young's Modulus (MPA)	2.1×10^5
2	Poisson's Ratio	0.33
3	Density (kg/m3)	7850

B. Calculation for max Gas Force

The calculation is done for $\theta = 46^0$ of crankshaft the exhaust valve begin to open.

And pressure (P′) = 0.606 MPa ……For $\theta = 46^0$

Gas force = Area of valve head * pressure of Gas

$= (\pi/4) * dp^2 * P'$

Considering, dp= 0.435 * d

= 0.435 * 103

= 44.805 mm

Gas force = $(\pi / 4) * (44.805*10^{-3})^2 * (6.0505^{-1}) * 105$

Gas force = 790.913 N

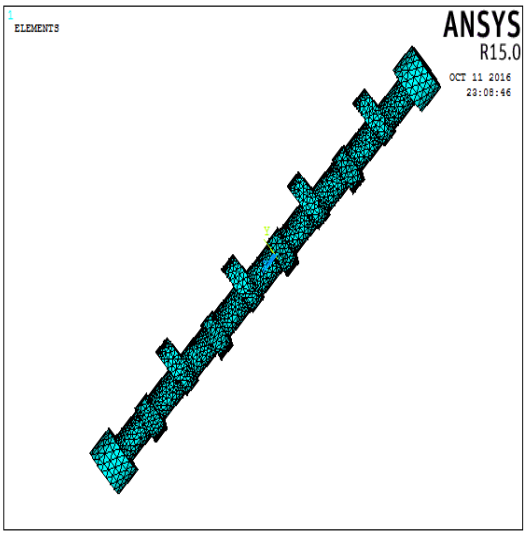
Therefore Gas forces acting on camshaft

= 790.913 * (60.82 / 41.86)

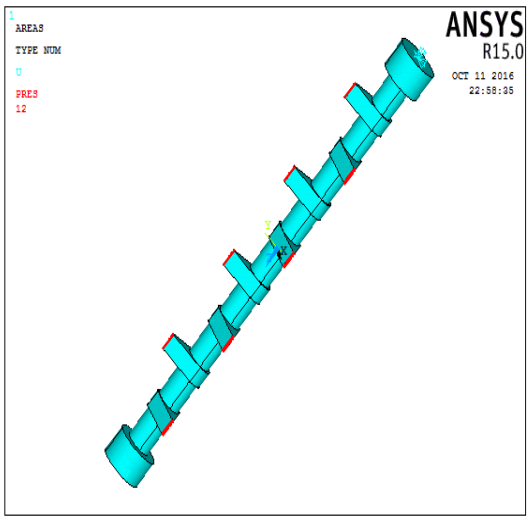
= 15346.18 N

=15.346 KN

C. Results



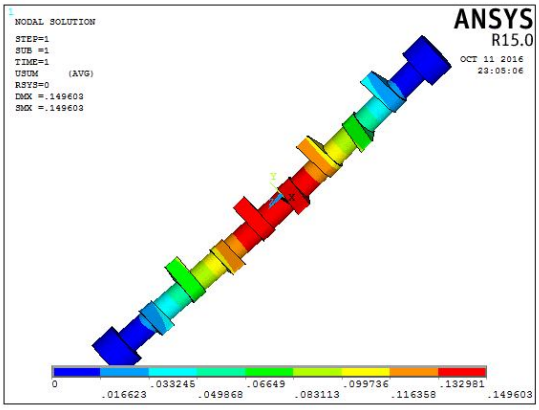
Meshed Model



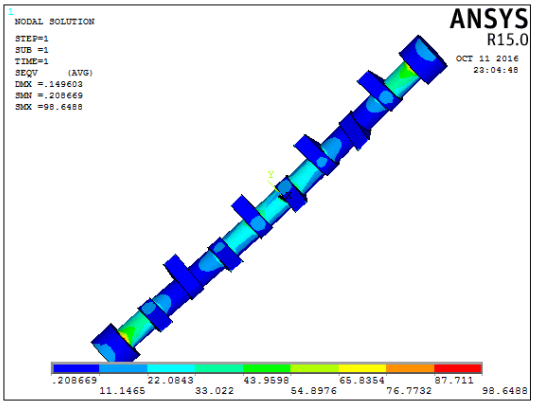
Model with applied load

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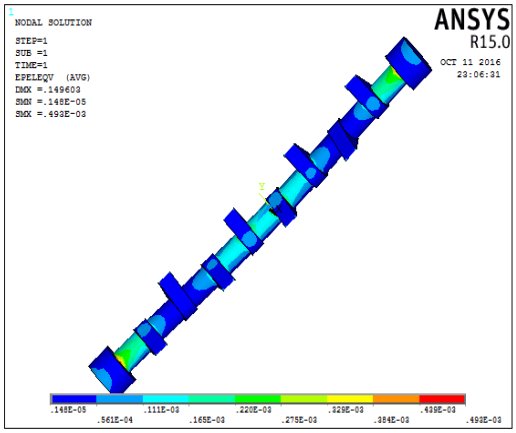
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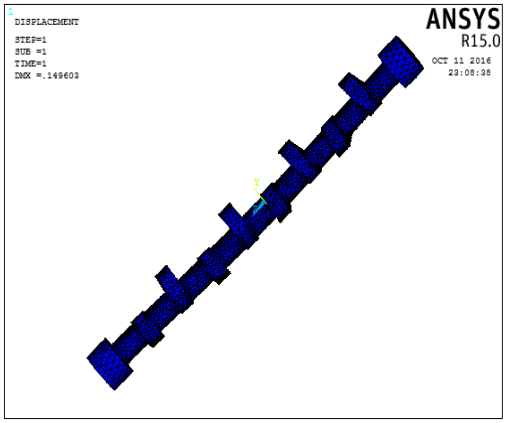
Displacement vector sum



Equivalent (Von Mises) Stress



Equivalent strain



Deformed shape

V. RESULTS AND CONCLUSION

TABLE NO 2: RESULTS

PROPERTIES	ALMMC
Displacement vector sum (mm)	0.1496
Von Mises stress (MPA)	99
Strain	0.000492

CAD model is generated in PRO-E and this model is imported to ANSYS for processing work. An amount of pressure is applied on tip of the cam made of ALMMC individually and outer journal cross sectional area is fixed. Following are the conclusions from the results are obtained:

The maximum displacement vector sum is 0.1496 mm which is shown in fig 4.4 and the maximum deformed area is highlighted by red color in fig.

The Von Mises stress is 99 MPA which is shown in fig 4.6 and highlighted by red color

So that our proposed model of pipe can withstand and satisfy the both taken boundary conditions.

For Designing and Manufacturing of Camshaft Shear Stress plays vital role. So the shear stress of Aluminum Metal Matrix Composite (AMMC) is also very less.

So, the Design of CAMSHAFT is Safe and it will improve the efficiency of component.

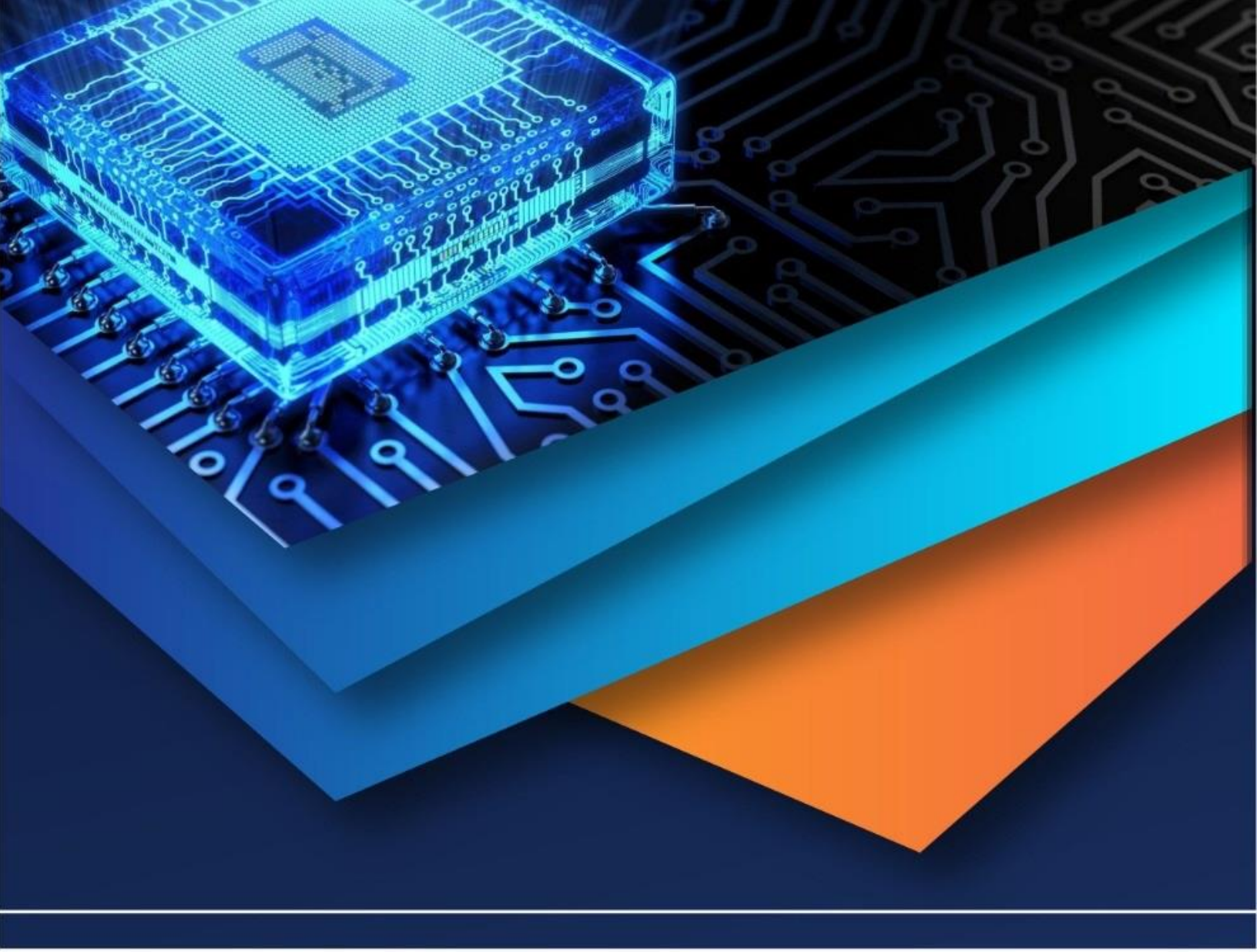
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