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Modelling and Analysis of I.C Engine Multi Crankshaft and Cam Shaft by Using Different Materials and Loads

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ABSTRACT:

A machine element with having curve outline or curved grooved in an ignition combustion engine is called camshaft, which gives the predetermined specified motion to a follower. This plays an important role to run the engine, but cam profiles are developed according to the engine performance. Crankshaft is another important component which transmits the reciprocating motion in to the rotary motion and vice verse in a reciprocating compressor. The motion is transferred from the larger end of the connecting rod to the crankpins, whose axis is offset from that of the crank. Both the crankshaft and camshaft are interlinked, which makes the engine run in smooth way.

In heavy engines more than one cylinder is seen which requires each cam and crank to run, so multi camshaft and crankshaft is designed to run multi cylinder engine. As the multi engine is subjected to higher load at high speed many analyses done to the components to check their failure properties. Many analyses are done according to the components function and mostly thermal analysis is done to all the models because of the heat the released by the engine is affected to them, but static structural analysis is done to All the components. These analyses will give the results which are evaluated and required changes can be done to them to reach the customer requirements.

This paper focus on the design and static structural analysis of the crankshaft and camshaft of multi cylinder engine. The design of a crankshaft is of 4 stroke multi cylinder S.I engine. So that two revolution of crankshaft for each stroke. The peak pressure acting on the engine crankshaft. The crankshaft and camshaft of the located model is designed using CATIA with the accurate dimensions and material standards.

CATIA is one of the best design software in design tools were we can easily design components based on it dimensions and structural analysis in ansys with accurate results. We compare the results of crank shaft and cam shaft at different load conditions and two different materials (i.e. nodular cast iron, forged steel). The results are taken and evaluated with the given load conditions and following deformation results are shown.

1.INTRODUCTION:

Every automotive industry is competitive and responsive for any issues. The components are fabricated with low cost and high quality and greater performance. The optimization techniques or numerical methods to be used to design a component, which requires CAD tools to simulate the operating conditions and find out whether the component meets the expectations and feasibility before starting the production, thereby saving time, money and resources.Crankshaft and camshaft studied and simple computational model is to be prepared by using CATIA. The working principal of crankshaft is to convert the motion and transfers it to the gearbox which runs the vehicle. The camshaft is placed under the rocker arms which are connected to inlet and outlet values. The valve timing depends on the cam profile which in turn depends on the motion of a flywheel connected to the crankshaft. Both crankshaft and camshaft analysed by importing two materials one by one and results are taken to find out the optimum values.

CRANKSHAFT:

An engine produces motion by creating explosions inside the cylinder. The pistons which are subjected to those explosions moves downwards in turn give the motion to the crankshaft. The intermediate link between both the piston and crankshaft is connecting rod that transmits the force.

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In which the crankshaft converts the reciprocating motion to rotary motion. The shaft is connected to the flywheel that transmits the circular motion to other parts of the engines that makes the vehicle to move forward. A notch in the flywheel makes the circular motion smooth. The design and weight of the flywheel is depends upon the crankshaft on which load is subjected. The design calculations are given below, that helps to design in CADTOOLS. D_G= Journal diameter D= crankpin diameter.

Permissible hole in the journal pin

$$D_{BG} = D_S * \sqrt{1 - \frac{4000 * S_R * M_{max}}{\mu * \pi * D_S^2 * L_S * \sigma_{SP}}}$$

Fatigue strength

Related to crankpin diameter:

$$\sigma_{DW} = \pm K * (0.42 * \sigma_B + 39.3) * [0.264 + 1.073 * D^{-0.2} + \frac{785 - \sigma_B}{4900} + \frac{196}{\sigma_B} * \sqrt{\frac{1}{R_X}}$$

Related to the journal diameter:

$$\sigma_{DW} = \pm K * (0.42 * \sigma_B + 39.3) * [0.264 + 1.073 * {D_G}^{-0.2} + \frac{785 - \sigma_B}{4900} + \frac{196}{\sigma_B} * \sqrt{\frac{1}{R_G}}$$

CAM SHAFT:

Camshaft is one of the key parts or components in the engines of automobile and other vehicles. The performance is to control the open and close intervals of the inlet and exhaust poppet valves by its cams. Due to the cyclic impact loading on the contacting surfaces of the cam and the follower, it often gives rise to premature wear of cam profile and affects a routine run of the valve gear such as the rotational speed, valve displacement and the torque.

On the other hand, simultaneously the most serious, under cyclic bending and torsion, fatigue fracture of camshaft initiating at stress concentration easily occurs. Therefore it demands the camshaft has not only excellent wear resistance but also adequate anti-impact toughness working of cam. The following figure shows the camshaft profile which is related with the operating poppet valves.

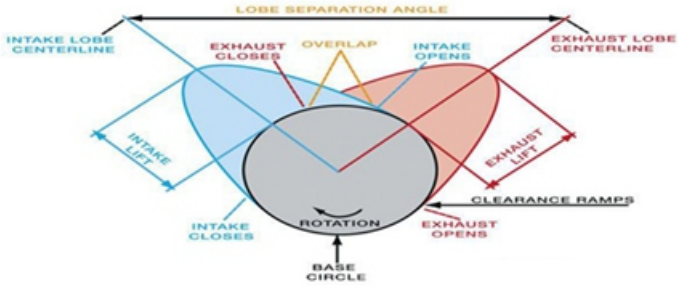

Figure 1: Cam rotation and its operation

2.RELATED WORK

CATIA

CATIA is a 3d modeling software widely used in the design process. CATIA is used by the automotive and aerospace industries for automobile and aircraft product and tooling design. The following snapshots contains the 3D computational model of crankshaft and camshaft .

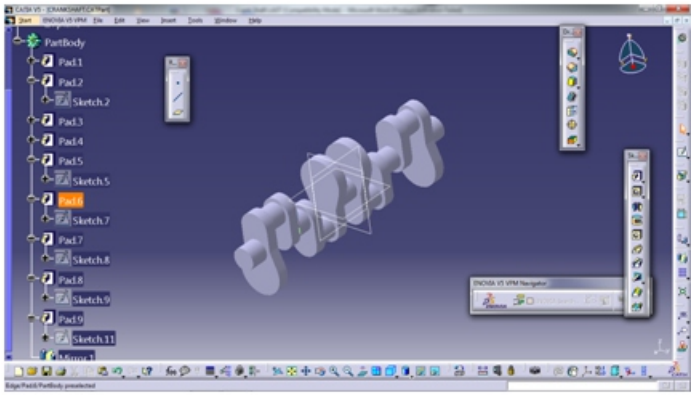

Figure 2: Complete model of multi crank shaft.

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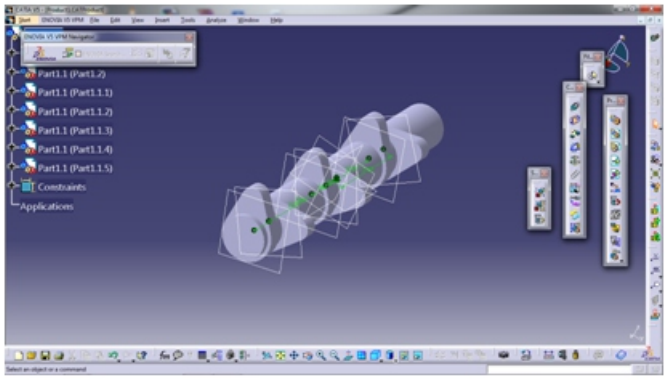


Figure 3: Complete model of multi camshaft

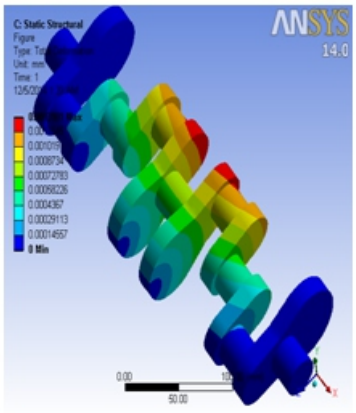
ANSYS:

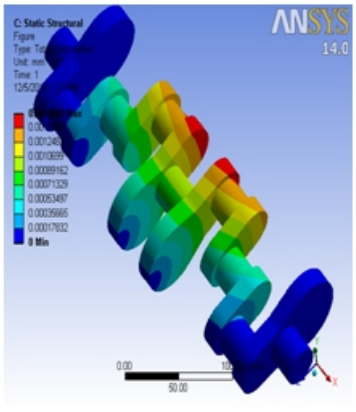
ANSYS is general-purpose finite element analysis (FEA) software package. Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces (of user-designated size) called elements. ANSYS workbench is used for static analysis for different materials and compares the results for future references in research and development centres.

3.STATIC STRUCTURAL (LOAD 2000)

MULTI CRANKSHAFT

Forged Steel Modular Cast Iron





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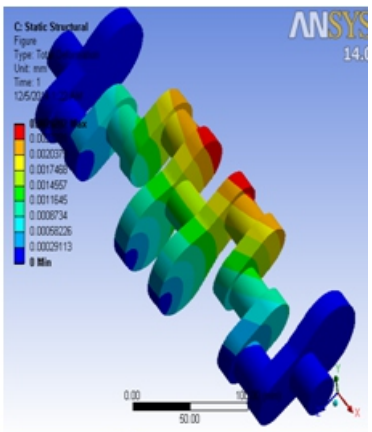
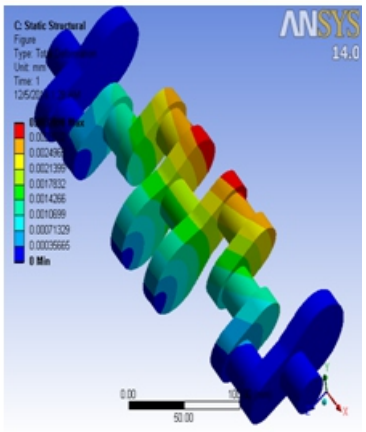
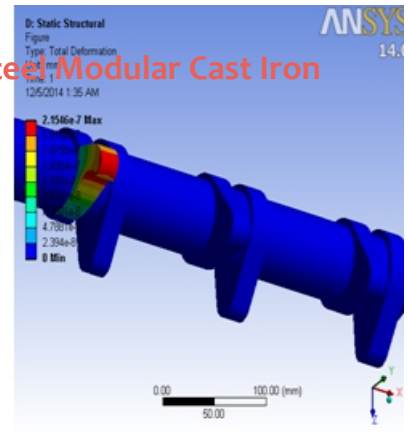


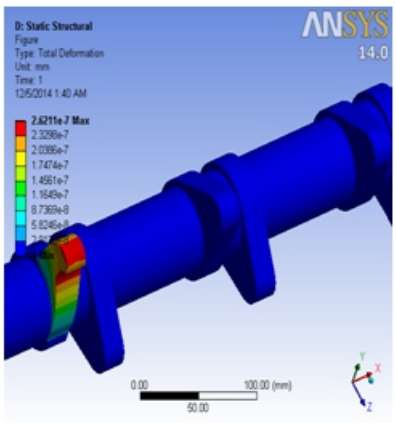


MULTI CAMSHAFT

LOAD 1 N

Forged Steel Modular Cast Iron





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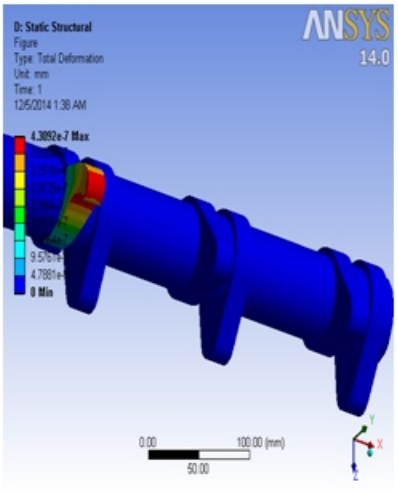
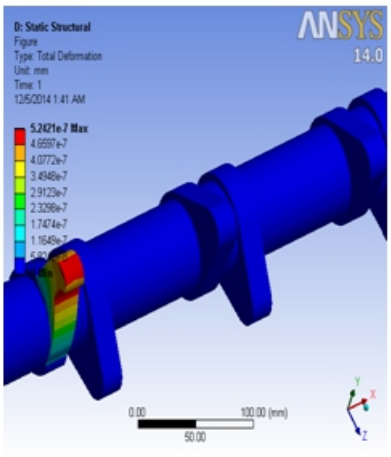
LOAD 2 N





4.CONCLUSION AND FUTURE SCOPE:

According to the analysis the values of NCI is more than Forged Steel when comparison was done. Although the values are high for NCI it is suitable for the Crankshaft design because it can sustain with its strength. The following deformations are shown at different load conditions. The values that are generated by subjecting different loads are kept as a reference and compare them with the different material, that may gives the researchers to achieve the optimum design in the future.

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