DESIGN AND ANALYSIS OF CRANKSHAFT FOR MULTICYLINDER ENGINE

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ABSTRACT:

In this research work concern to analyze for every internal combustion engine crankshaft plays the most important role in power transmission, here the impact load will be applied on the crank shaft which leads to bend or crack the crank shaft. This paper involves in design and analysis of multi cylinder diesel engine crank shaft. Design of the crank shaft was done with the help of CATIA V5 R15 design software and the analysis was done with ANYSYS software. The stress analysis of a 4 cylinder crankshaft is discussed using finite element method. In this paper maximum stress area and critical areas are found by the stress analysis of crankshaft. The analysis was done for different materials. All the obtained values were plotted. From the obtained values the materials with more stiffness and other suitable properties will be found and reported as the most suitable materials for crankshaft manufacturing.

Key words: Crank shaft, Multi Cylinder, Stress area, Critical area.

I.INTRODUCTION:

Crankshaft is one among the foremost vital moving elements in combustion engine. Crankshaft is the large component with a complex geometry in the engine, which converts the reciprocating displacement of the piston into a rotary motion. To convert the reciprocating motion into rotation, the crankshaft has “crank throws” or “ crankpins”, additional bearing surfaces whose axis is offset from that of the crank, to which the “big ends” of the connect rods from each cylinder attach. It typically connects to flywheel, to reduce the pulsation characteristic of the four stroke cycle, and sometimes a torsional.

Crank Shaft Manufacturing Processes:

Crank shaft is manufactured by different methods based on the use and the capacity needed. Generally crank shafts are made either by forging or casing method.

1.1 Forging:

Many high performance crank shafts are formed by the forging process, in which a billet of suitable size is heated to appropriate forging temperature, typically in the range of 1950-2250 degree Fahrenheit, and then successfully pressed in to the desired shape by squeezing the billet between pairs of dies under very high pressure. But complex shapes and extreme deformations often require more than one set of dies to accomplish the shaping. [5] discussed about a disclosure which is made regarding a driving alert system which is designed in the form of a neck cushion which has the capability to sense the posture of the drivers neck position so as to identify whether the driver is alert and if he is dozing of. The system is made intelligent to obtain data from the movement so as to produce triggers to alert the user and to keep him/her awake to avoid accidents. The system is also linked to a mobile computing device so as to provide a report of the analysis done. The drivers location can also be tracked using the same.

1.2 **Machining:**

Billet crank shafts square measure absolutely machined from a spherical bar ("billet") of the chosen material. The method to be brittle. So it may be reinforced by some post processes heat treatment and surface treatment processes.

II.OBJECTIVES

The objectives of this project is to identify the method to increase the hardness of the crankshaft and to select a suitable materials for the crankshaft which can be produce lower values of stress and deformations for which structural analysis is carried out. In this study the weight, manufacturing cost and fatigue performance of the component were the main objectives. Optimization attempt was to reduce the weight and manufacturing cost, while improving the fatigue performance and maintain the bending stiffness with permissible limits. To create the model crankshaft by using CATIA V5 software. To mesh the model crankshaft by meshing step in ANSYS WORKBENCH. Static analysis by using ANSYS WORKBENCH.

III.CRANKSHAFT MATERIAL

Crankshaft materials should be really shaped, machined and heat treated and have adequate strength, toughness, hardness, and high fatigue strength.

MATERIAL 1:

Chemical composition

S.NO	ELEMENT	PERCENTAGE
1	Carbon C	0.38-0.43
2	Manganese Mn	0.75-1.00 max
3	Phosphorus P	0.035 max
4	Sulphur S	0.040 max
5	Silicon Si	0.20-0.35
6	Chromium Cr	0.80-1.10

3.1 FORGED STEEL

Properties:

Young's modulus (E) = 221000Mpa

Poisson's ratio (v) = 0.3

Density = 7833 kg/m^3

MATERIAL 2:

Chemical composition:

S.NO	ELEMENTS	PERCENTAGE
1	Carbon C	3-4
2	Silicon Si	2.2-2.8
3	Manganese Mn	0.1-0.5
4	Magnesium Mg	0.03-0.05
5	Phosphorus P	0.005-0.04
6	Sulphur S	0.005-0.004

3.2 NODULAR CAST IRON (OR) DUCTILE CAST IRON

Properties:

Young's modulus (E) = 165GPa

Poisson's ratio (v) = 0.275

Density (p) = 7100kg/m^3

MATERIAL 3:

Chemical composition:

NICKEL CHROMIUM MOLYBDENUM STEEL

S.NO	ELEMENTS	PERCENTAGE
1	Carbon C	0.30
2	Nickel Ni	2.5
3	Chromium Cr	0.65
4	Molybdenum Mo	0.55

Properties:

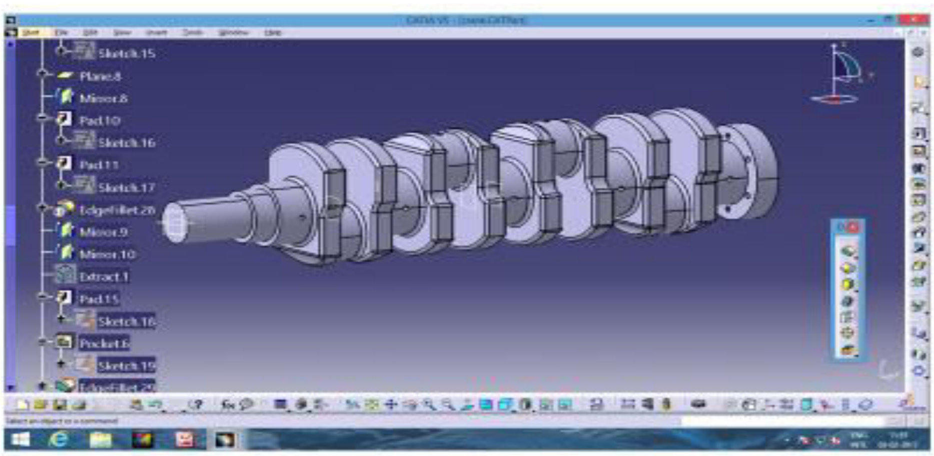
Young's modulus (E) = 210Gpa

Poisson's ratio (v) = 0.30

Density(p) = 7910 kg/m^3

IV.DESIGN

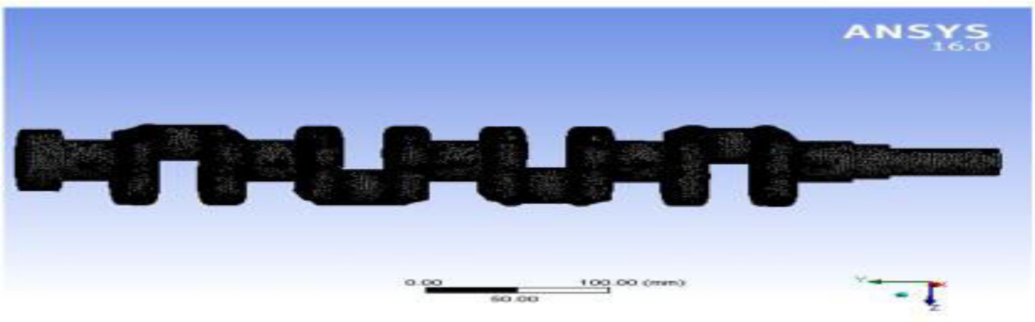
4.1 CATIA MODEL FOR CRANK SHAFT:



CATIA DESIGN

The figure 1 shows the CATIA V5 design for crank shaft in multi cylinder engine which is used analyze the stress level for the required material that given manually for meshing in anysis workbench.This model is converted to Initial Graphic Exchange (IGE). Finite element analysis (FEA) is performed to obtain the variation of stresses at critical locations of the crank shaft using the ANSYS software and applying the boundary conditions. [9] discussed about a disclosure which is made regarding a gear blocking gear cover for the four wheeler vehicle where the protective cover has been with touch sensors and biometric sensors. Here in case of theft even if the car is started without a key the gear system is locked using biometric locks which can read the palm of the user to unlock the gear system thus protecting the vehicle against any form of theft. This device can be attached to any type of four wheeler vehicle.

4.2 MESHING FOR CRANK SHAFT:

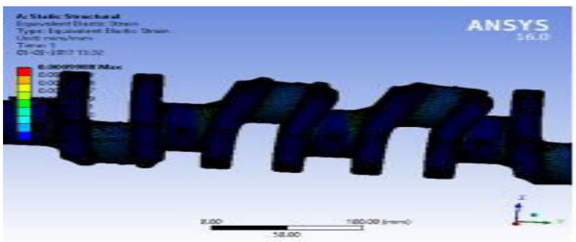


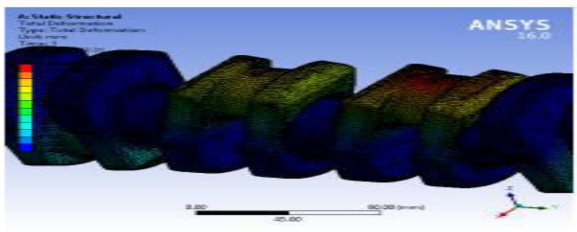
MESHED PICTURE OF DESIGN

Figure 2 shows the meshed picture of design in crank shaft for multi cylinder engine to analyze the stress level of crank shaft. By using ANSYS workbench analyze of crankshaft for multi cylinder engine is designed and meshed for the better results in stress level.

4.3 STATIC STRUCTURE OF CRANKSHAFT:

Equivalent Elastic Strain **Total Deformation**





From the above figure 3 and 4 has been analyzed for the Equivalent Elastic Strain and Total Deformation for the Crank Shaft for Multi Cylinder Engine. It has been analyzed by using the analysis software Ansys Workbench 16.0.

FIGURE 1:

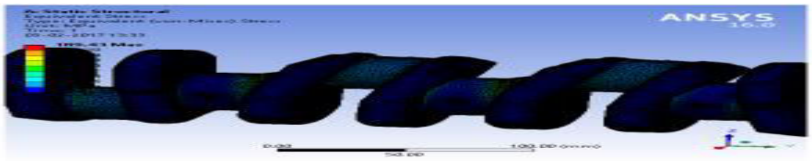


Figure 1shows the static structural Equivalent Stress design for the crankshaft for multi cylinder engine.

V.RESULT AND CONCLUSION

The static analysis is performed for the multi cylinder diesel engine crankshaft for forged steel, nodular cast iron and a steel alloy. In the results the stress and deformation values for all materials are different. From the above materials forge steel shows the low stress and deformation values for all the applied force values. By comparing the results we can conclude that the forged steel is best material used for crankshaft which does not cause the breakage of the crankshaft and its better performance.

VI.REFERENCES

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