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FINITE ELEMENT ANALYSIS OF CRANKCASE

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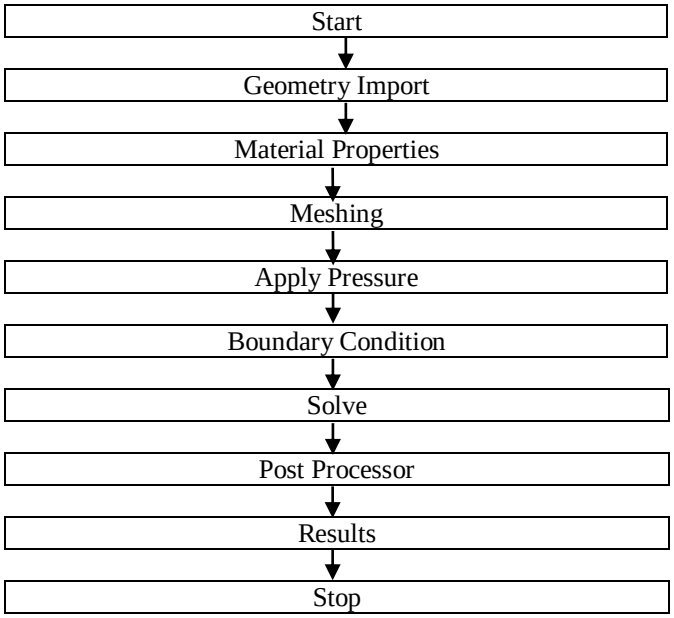
***Abstract*— In an internal combustion engine of the reciprocating type the crankcase is housing for crankshaft. Crankcase is main building block of engine. The enclosure form the large cavity in the engine and it is locate below cylinder or cylinders head which in multi cylinder engine is usually integrated into one or more cylinder block. In this paper analysis investigation has been conducted on the crankcase of four cylinder engine. In this paper static analysis and modal analysis is done through ANSYS software. A static analysis is use to find total deformation, stress, strain of crankcase caused by pressure. In modal analysis natural frequency find out. In analysis for component material is important so for crankcase gray cast iron is used. This paper shows that crankcase is well safe state and under the yield strength range at particular pressure.**

Keywords — *Crankcase, Static analysis, Modal analysis, ANSYS.*

I. INTRODUCTION

In an internal combustion engine of the reciprocating type the crankcase is housing for the crankshaft. Crankcase is the main building block of engine. The enclosure form the large cavity in the engine and it is locate below cylinder or cylinders head which in multi cylinder engine is usually integrated into one or more cylinder block. In the engine crankcase is bigger part other than any part which is present in engine. It gives the protection to crankshaft as well as engine from the dust. It is also provide the rigid structure with which to join the engine. CAD model of crankcase is getting from the NX software. Analysis is a finite element analysis (FEA) which is computer based technique which is used for find the behavior of the component as well as its stress, strain, deformation and natural frequency. In this paper analysis is done in FEA software ANSYS. The result is correlated with mechanical properties of the component and conclusion drawn accordingly. Through reference paper we get information of static and modal analysis. This paper helps to get result about the safe zone of the crankcase.

II. ANALYSIS PROCESS



Process Methodology

We start the analysis process first we get the 3D model of crankcase from the NX software which is called geometry importing process. So we get that imported file in the Parasolid format and then this file open in the ANSYS software.

A. Material Properties

Cast Iron: It is basically of iron and carbon in which carbon is varies from 2.0 to 6.67 %
Gray Cast Iron: It is type of cast iron, it contains free carbon i.e. graphite in the form of flakes and the fracture is gray in colour. Gary cast iron has excellent machinability, good compressive strength, good bearing properties and good corrosion resistance. It also has some grades like FG 200, FG 220, FG 260, FG 300, FG 350. In this paper for crankcase analysis we use FG 200 grade material.

TABLE I. Mechanical properties of FG 200

Sr.No	Properties	FG 200
1.	Tensile ultimate strength	200 Mpa
2.	Tensile yield strength	130 Mpa
3.	Young's modulus	114 Gpa
4.	Poisson's ratio	0.26
5.	Density	7.2 g/cm³

B. Meshing

Meshing is one of the important part of the analysis and analysis process is start from the meshing. The accuracy

of the model is depending on the element size, mesh pattern. Meshing is important because it divide component in number of small parts and help to provide load, pressure on each part of component in equally distributed manner. Low mesh size give fast operation speed but decrease the accuracy of analysis result so Fine mesh size give the high accuracy of analysis result so in this paper Fine mesh size and default element size is used.

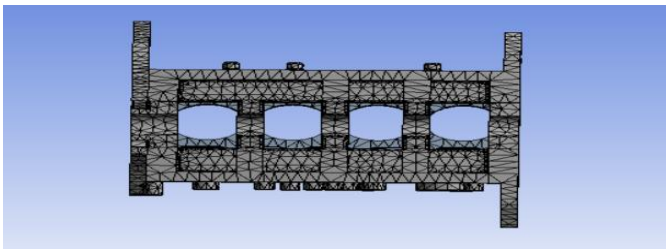


Fig 1: Meshing

C. Pressure

In this crankcase analysis for the static structural analysis load is important but here crankcase applied load is in the form of pressure. Pressure is created in the crankcase because of moment of the crankshaft in the upward and downward direction. Pressure is formed at crankshaft and crankcase attached area. 120 bar pressure is created in this crankcase.

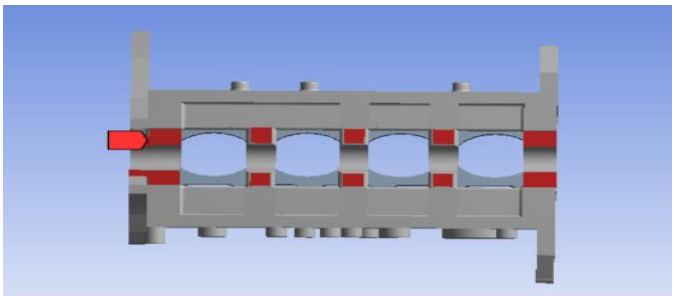


Fig 2: Loading condition

D. Boundary condition

In this crankcase analysis boundary condition is fixed support. Fixed support is given at base of crankcase. Fixed support is given for restricting the movement of the crankcase in the corresponding direction.

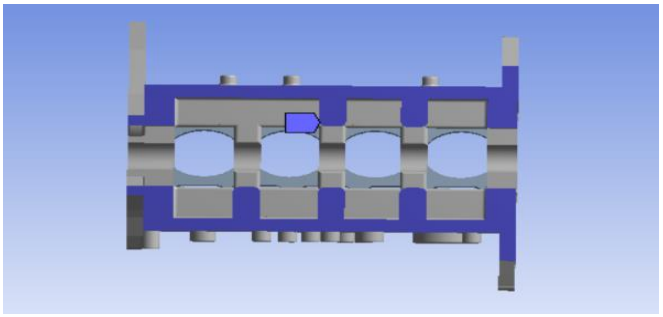


Fig 3: Fixed support

E. Result

After solve the all analysis process we get the result. We find out this result in the form of Static analysis and Modal analysis.

a) Static Analysis: Static analysis gives the information of the structural behaviour of the crankcase. It is also give the information about the stress, strain and total deformation of the component.

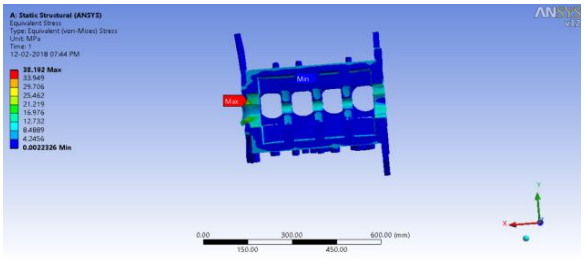


Fig 4: Equivalent Stress

Maximum stress and Minimum Stress for this crankcase is 38.192 Mpa and 0.0022326 Mpa respectively.

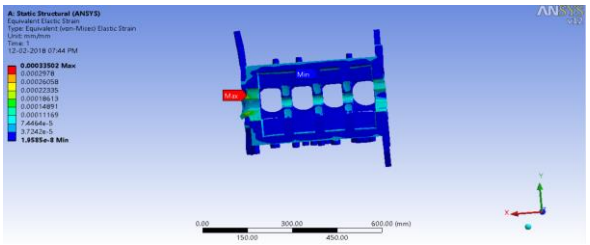


Fig 5: Equivalent strain

Maximum strain and Minimum strain for this crankcase is 0.00033502 and 1.9585e-8 respectively.

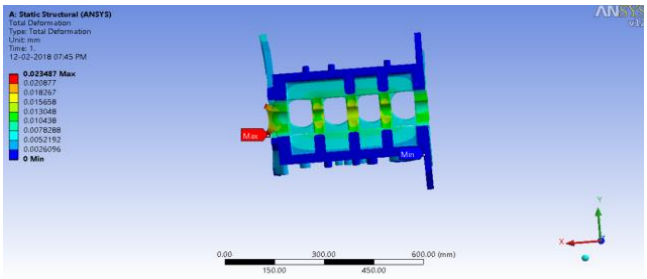


Fig 6: Total deformation

Total Deformation for this crankcase is 0.023487 mm.

b) Modal Analysis: Modal analysis is used for the find out natural frequency of the component. Everybody has its own natural frequency so it can be find out with help of modal analysis.

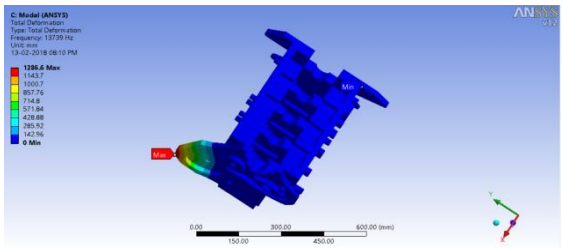


Fig 7: Mode 1 frequency

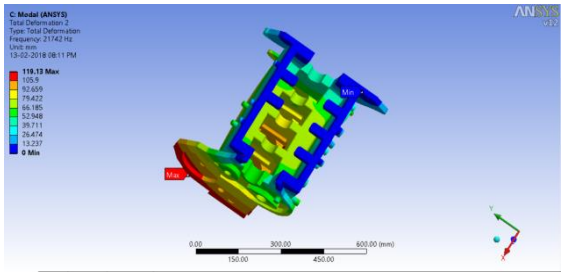


Fig 8: Mode 2 frequency

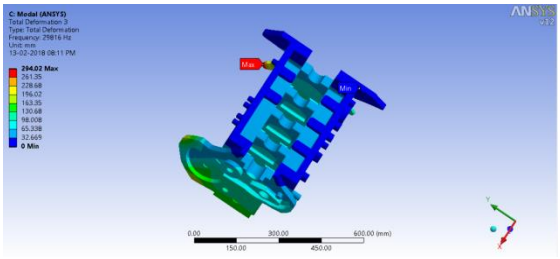


Fig 9: Mode 3 frequency

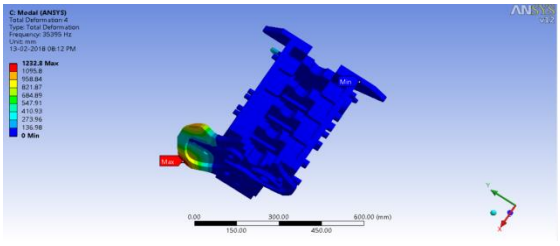


Fig 10 : Mode 4 frequency

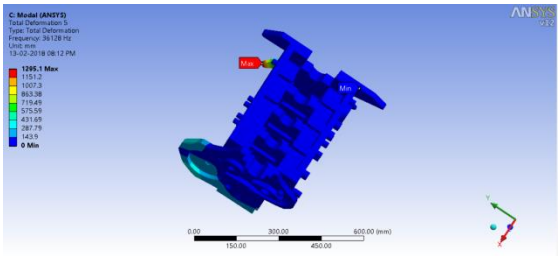


Fig 11: Mode 5 frequency

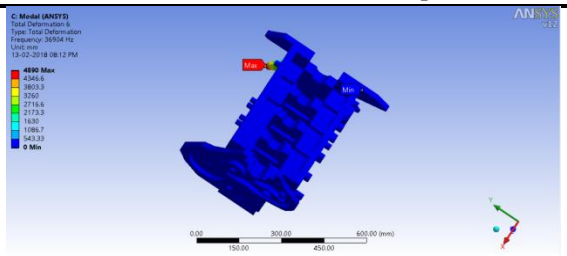


Fig 12: Mode 6 frequency

In this modal analysis we find out natural frequency of crankcase in six modes which is in below table.

TABLE II. Frequency

Mode	Frequency(Hz)
1.	13739
2.	21742
3.	29816
4.	35395
5.	36128
6.	36904

III. CONCLUSION

In this study it was observed that after doing the analysis we get clear result of crankcase analysis. We use FG 200 material for this crankcase analysis which grade have yield strength is 130 Mpa and after analysis we get maximum stress for this crankcase is 38.192 Mpa at 120 Bar pressure so this stress value show that it is lower than yield strength value so this crankcase is in safe state. Modal analysis shows that natural frequency of the crankcase.

After doing analysis we achieve the results and it show that crankcase is in safe zone. So this result also we will use for optimization of crankcase like weight reduction, through this optimization we will save cost as well as save the material of crankcase.

ACKNOWLEDGMENT

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