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Analysis of Gerotor in a Lubricating Oil Pump

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ABSTRACT

The aim of the article is to present analysis of gerotor used in the lubricating oil pump. Lubricating oil pumps are the heart of the engine and efficiency of the engine is highly depends on quality of oil pump pulsating in it. The main function of lubricating oil pump is to supply the oil under pressure to those components which requires positive lubrication. The parts like sliding pistons, rotating bearings, camshafts etc. requires constant lubrication. Gerotors are used in the gerotor lubricating oil pump which consist of two rotors namely inner rotor and outer rotor. Highly versatile, simple in construction and excellent in performance makes gerotor oil pump dominant in all type of lubricating oil pumps. In gerotor oil pump outer rotor consist of one more tooth than inner rotor and axis of inner rotor is offset from axis of outer rotor. Increasing and decreasing areas creates suction and compression of oil which leads to movement of oil from inlet to outlet.

In this research, design of gerotor with standard measurement is carried out with the help of CATIA software. Analysis is done by taking different materials and determined von-Mises Stress, Strain and Total Deformation.

Keywords: Gerotors, Lubricating oil pump, Optimized standard design, von-Mises stress and strain analysis.

I.INTRODUCTION

Many highly stressed, rapidly moving components in a modem internal-combustion engine need constant lubrication if seizure or excessive wear are to be avoided. The function of an oil pump is to supply oil under pressure to those parts of the engine which require the positive lubrication. The reliability of an engine depends largely on efficient lubrication, and at the heart of the lubrication system is the oil pump. If the oil pump fails, serious mechanical breakdown will quickly follow. The job of the oil pump is to force oil up out of the sump into the lubrication system at a pressure sufficient to reach all the bearings and contact points. The oil pump must therefore be, above all, reliable and long-lasting, and for this reason they are comparatively simple devices employing few moving parts and requiring little or no maintenance. Oil pumps may be mounted on the inside or outside of the engine; when the pump is mounted inside the crankcase maintenance is only practical during major engine overhaul. The need for the priming can be avoided by mounting the pump at low-down, either submerged or around the level of the oil in the sump.

For simplicity lubricating oil pumps are driven by power obtained from engine crankshaft with the help of mechanical gear train or driven by electric motor. Oiling system should be developed in such a way that it should properly lubricate engine when it's running. Proper lubrication not only reduces the friction between contacting surface but it also helps to remove the heat from pistons, bearings and shafts. The lubricating oil pump forces oil through the passages in the engine to properly distribute oil to different engine components.

Fig.1 Gerotors with multiple no. of teeth

II. DESIGN OF GEROTOR

Gerotor was designed using CATIA V5R19 software with standard dimensions.

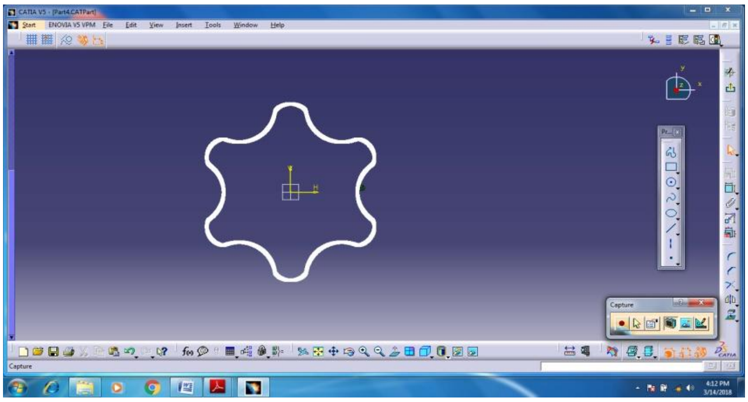

Fig.2 2D model of inner rotor

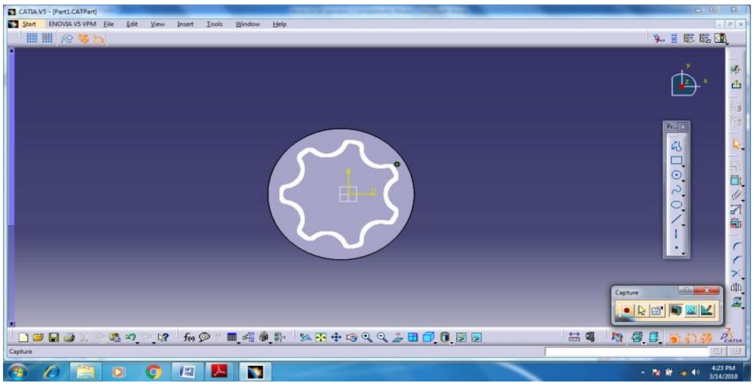

Fig.3 2D model of outer rotor

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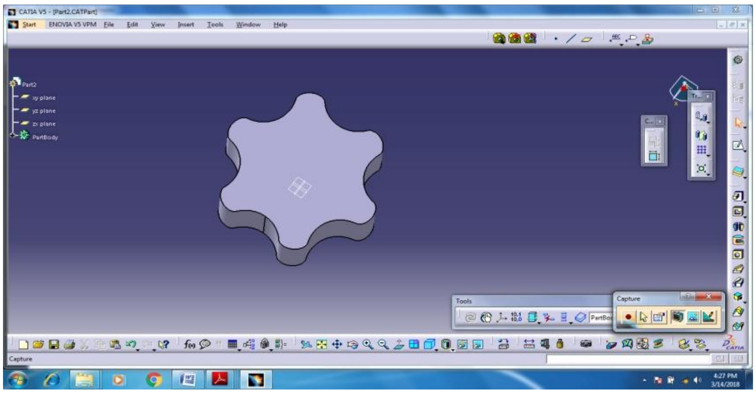

Fig.4 3D model of inner rotor

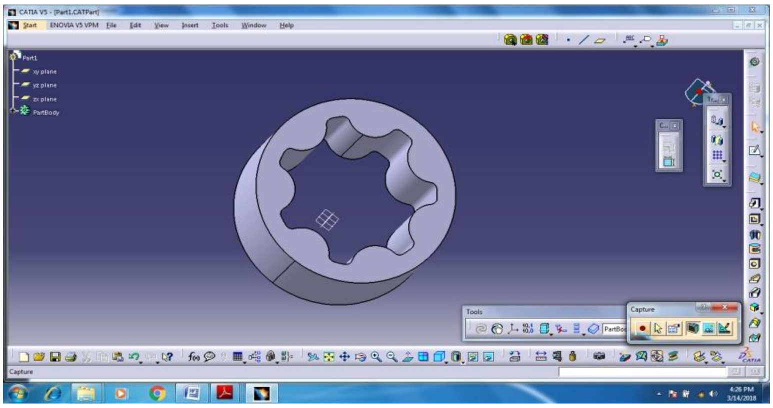

Fig.5 3D model of outer rotor

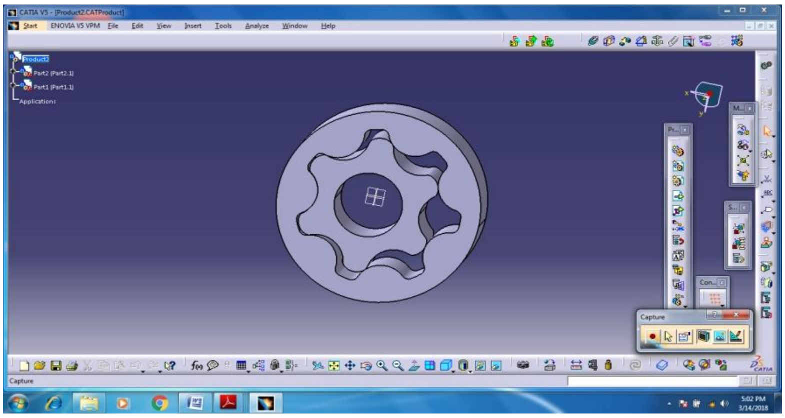

Fig.6 3D model of rotor assembly

III.. STRUCTURAL ANALYSIS OF GEROTORS

3.1 Structural Analysis of Steel

The diagram shows structural analysis of steel.

Table-1 Ansys Results for Steel

	Total Deformation	von-Mises Stress	von-Mises Strain
Maximum	0.0001391 m	2.7216e8 pa	0.0014431
Minimum	4.2604e-5 m	31060 pa	2.8361e-7

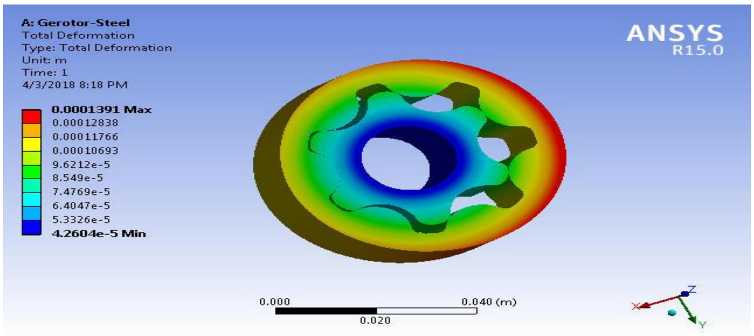

Fig.7 Total deformation of Steel

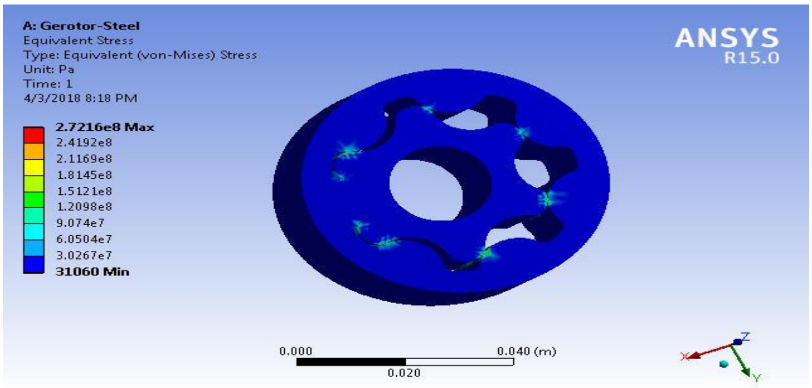

Fig.8 Equivalent stress values on Steel

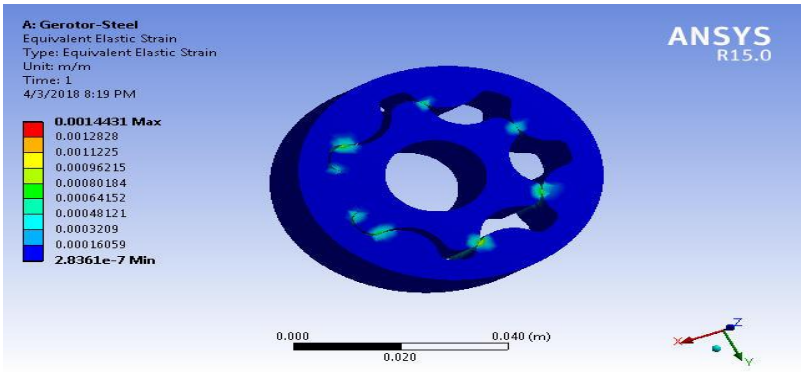

Fig.9 Equivalent strain values on Steel

3.2 Structural Analysis of Cast Iron

The diagram shows structural analysis of Cast iron.

Table-2 Ansys Results for Cast Iron

	Total Deformation	von-Mises Stress	von-Mises Strain
Maximum	0.00017181 m	1.9458e8 pa	0.0017837
Minimum	5.262e-5 m	22550 pa	3.4488e-7

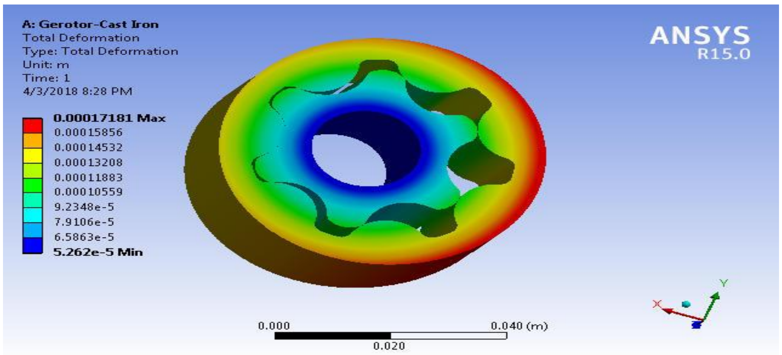

Fig.10 Total deformation of Cast Iron

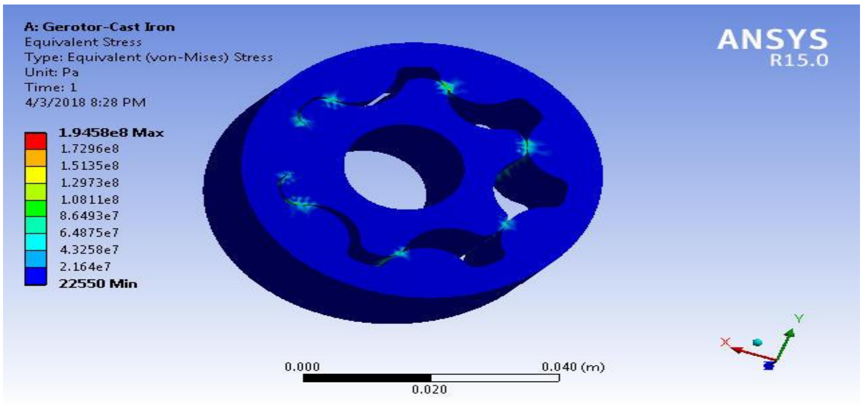

Fig.11 Equivalent stress values on Cast Iron

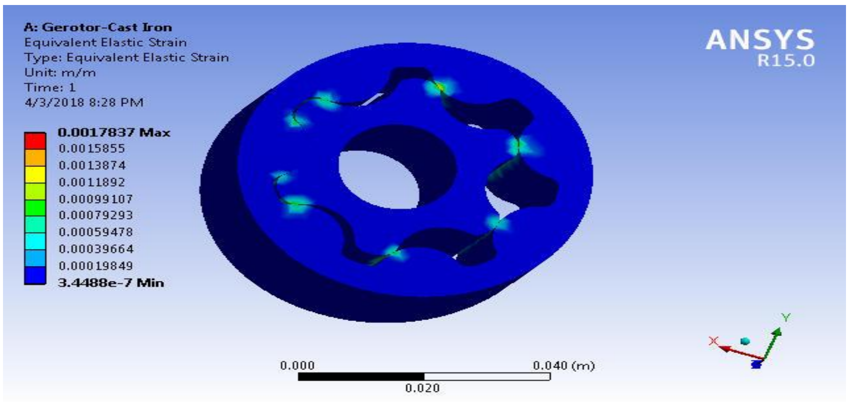

Fig.12 Equivalent strain values on Steel

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3.3 Structural Analysis of Aluminium

The diagrams show structural analysis of Aluminium.

Table-3 Ansys Results for Aluminium

	Total Deformation	von-Mises Stress	von-Mises Strain
Maximum	0.00037706m	2.6629e8 pa	0.0039212
Minimum	0.00011549 m	29670 pa	7.8823 e-7

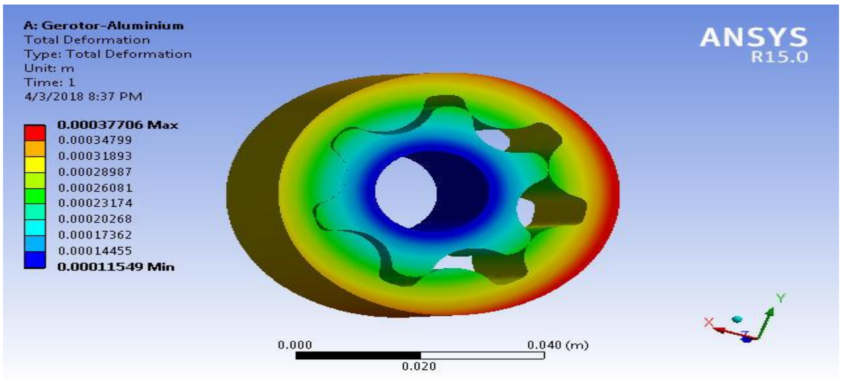

Fig.13 Total deformation of Aluminium

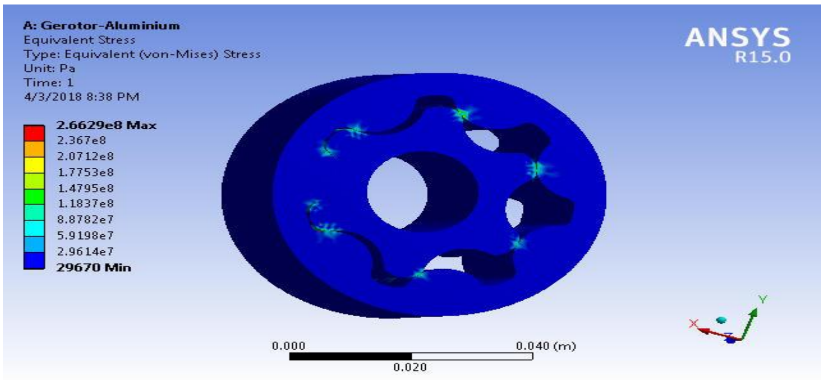

Fig.14 Equivalent stress values on Aluminium

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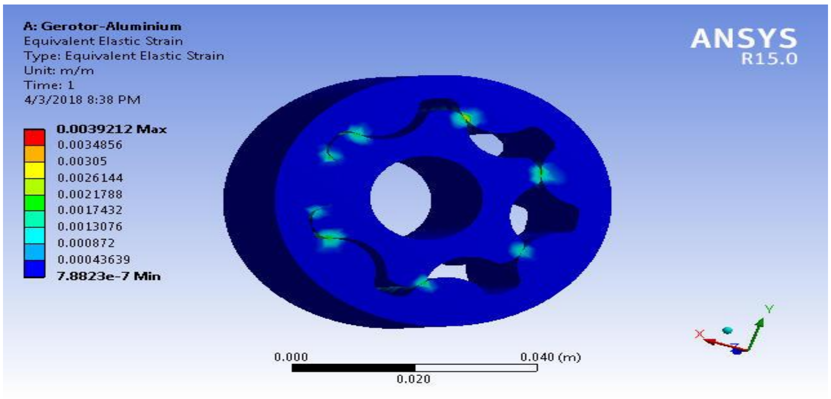

Fig.15 Equivalent strain values on Aluminium

3.4 Structural Analysis of sintered bronze

The diagram shows structural analysis of Sintered Bronze.

Table-4 Ansys Results for Sintered Bronze

	Total Deformation	von-Mises Stress	von-Mises Strain
Maximum	0.00022256 m	2.1773e8 pa	0.0023089
Minimum	8.8166e-5 m	24848 pa	4.5378e-7

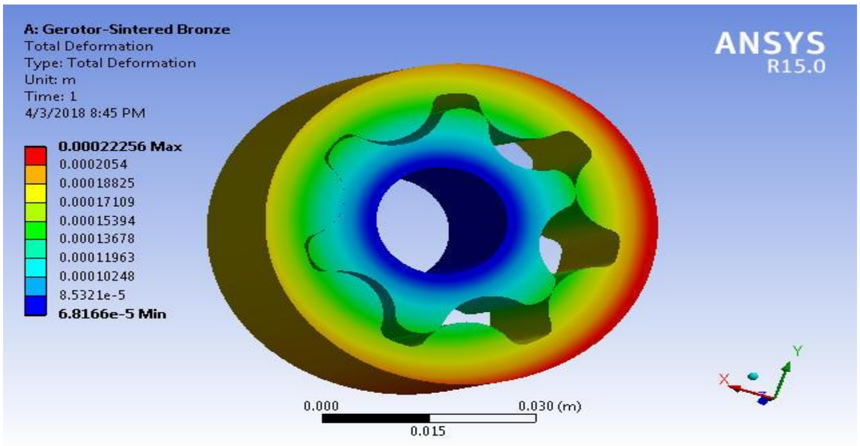

Fig.16 Total deformation of Sintered Bronze

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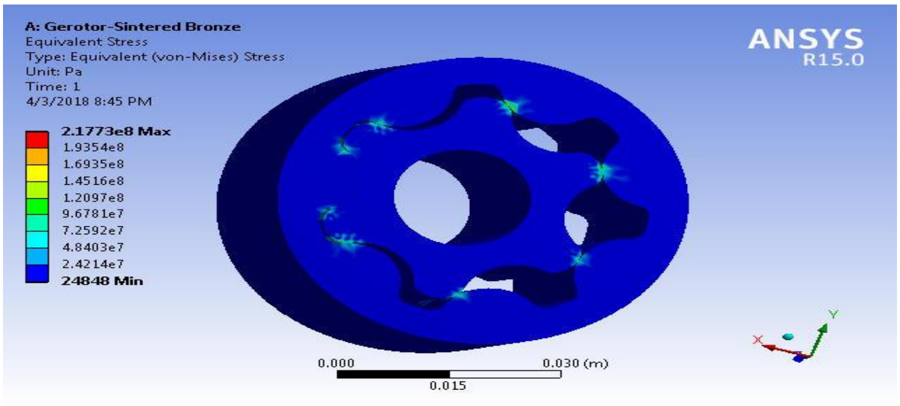

Fig.17 Equivalent stress values on Sintered bronze

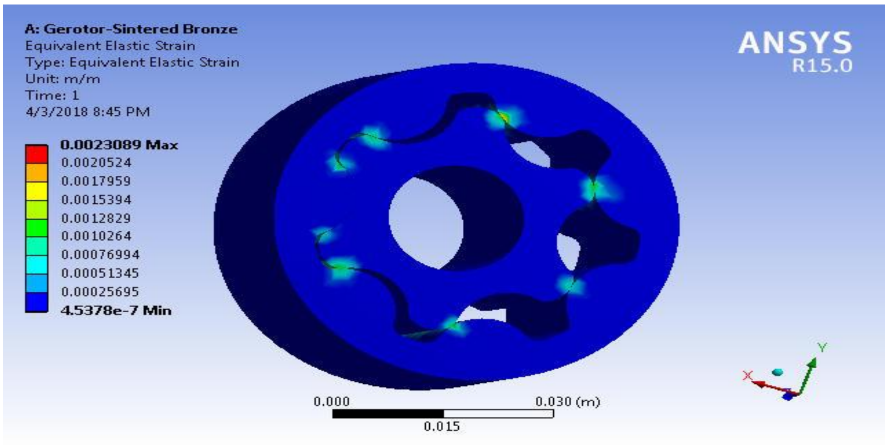

Fig.18 Equivalent strain values on Sintered bronze

IV. STRUCTURAL GRAPHS

In structural graphs of gerotor comparison of von-Mises stresses, von-Mises Strain and total deformation for Steel, Cast iron, Aluminium and Sintered bronze is done.

Graph-1 von-Mises stresses

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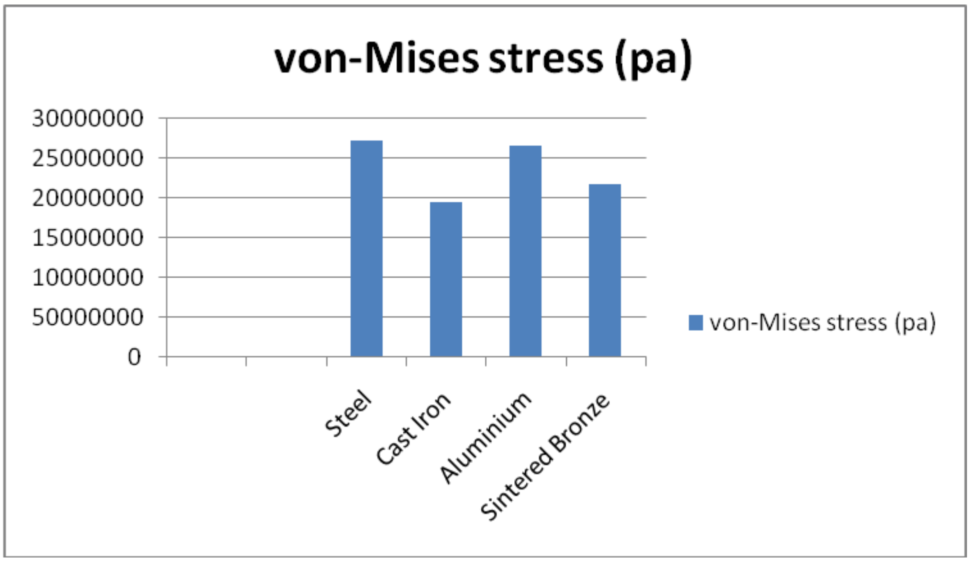
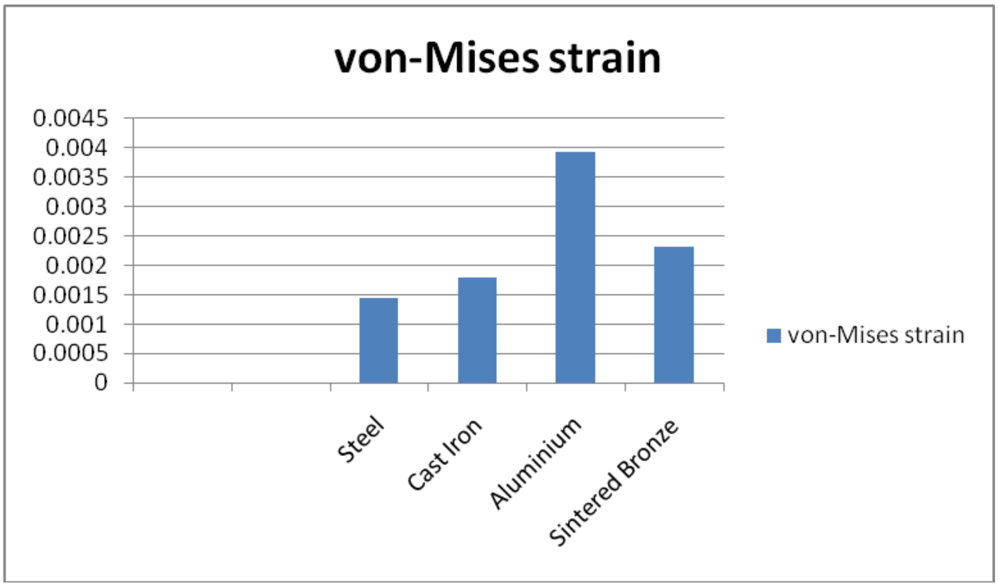
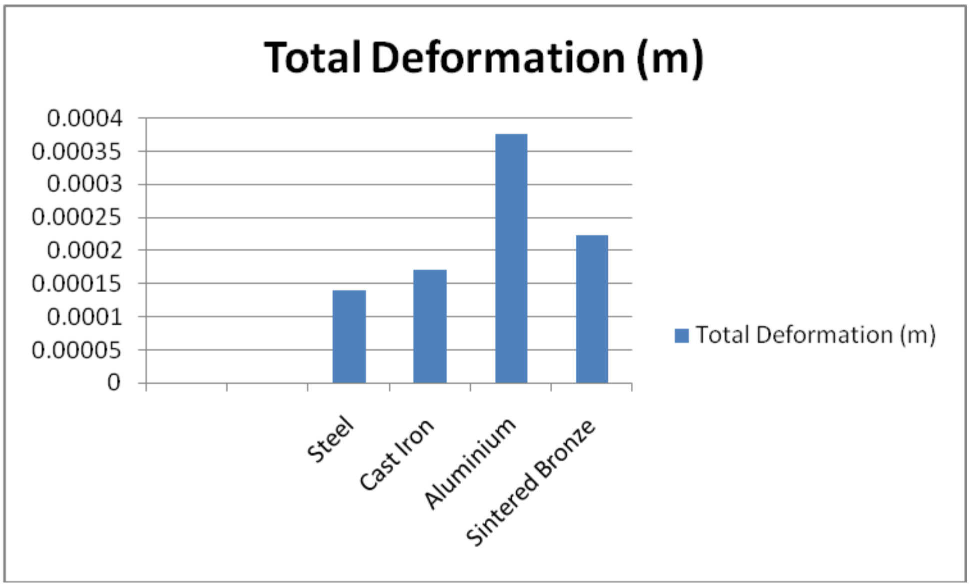


Graph-2 von-Mises strain



Graph-3 Total deformation



V. CONCLUSION

In gerotor lubricating oil pump generally sintered iron are used for developments of inner and outer rotor. In above discussion comparison of the materials Steel, Cast Iron, Aluminium and Sintered bronze are done. From results it is observed that von-Mises strains and total deformation are very less in Steel but von-mises stresses are high as compared to other materials, which unable to sustain fluctuating loads and hence can't be used for replacement of Sintered irons.

Stress, strain and total deformation in Cast Iron is low as compared to Aluminium and Sintered bronze. So in designing gerotors of lubricating oil pump, Cast iron can be used to replace sintered irons to reduce manufacturing cost of lubricating oil pumps.

VI.ACKNOWLEDGEMENT

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