Analysis of Inner Rotor in a Georotor

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***Abstract*—** For any gas turbine engines, various systems are involved for the safe and reliable operation, in that oil system plays a vital role for the engine lubrication .Oil pump is the most significant equipment as a part of engine oil system.
The main function of oil pump in the engine is to supply lubricating oil to various rotating and sliding parts of an engine in order to prevent the wear & tear, excessive heat generated during the engine operation
The oil pump works on the principle of geo rotor (similar to internal gear arrangement) which is a positive displacement pump. The oil pump develops required pressure greater than the bearing chamber pressure and flow for maintaining the bearing temperature in the engine. The oil pump geo rotor is driven by the engine power through the gear box and quill shaft connected to oil pump driven shaft.
In this research we designed the geo rotor with standard measurements by using pro/e software. Also analysis should be done by taking different materials of Vonmises Stress, Strain& Total Deformation

Keywords*—*Geo Rotor; Design;Vonmises Stress & Strain; Analysis

I. INTRODUCTION

The geo rotor is a positive displacement pumping unit compared with external and internal gear pumps; it keeps an advantage of less components, simple structure, low noise and low ripple of flow rate. Therefore it is widely used in applications of lubricating systems of on-road or off-road engines.

It mainly consists of inner rotor, outer rotor. The inner rotor lies inside the outer rotor and it positions itself at a fixed eccentricity from the outer rotor inside the housing.

Input torque is to drive the inner rotor and outer rotor rotates with it since they contact each other at less several points on their geometric profile.Geo rotors may be mounted directly on an existing shaft.gerotors can handle any flowing substances from air to hot melt glue. A single geo rotor set accommodates multiple flow streams operating at different pressures.

II. DESIGN OF GEOROTOR

Georotor was designed using Pro-E software with the specified dimensions

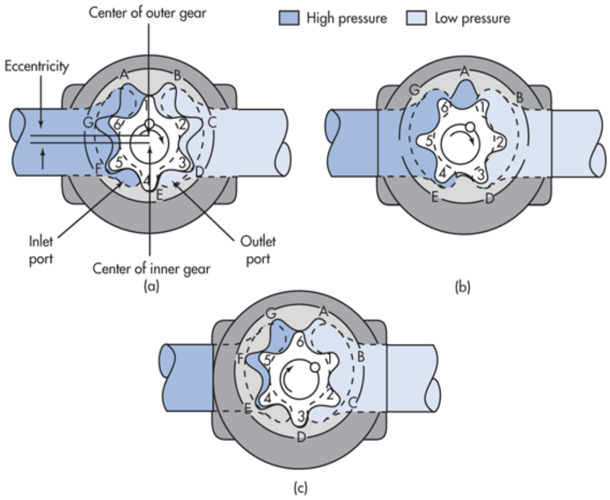


Fig-1

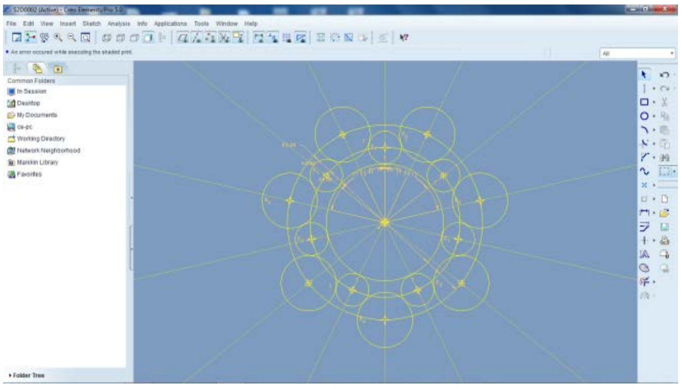


Fig-2

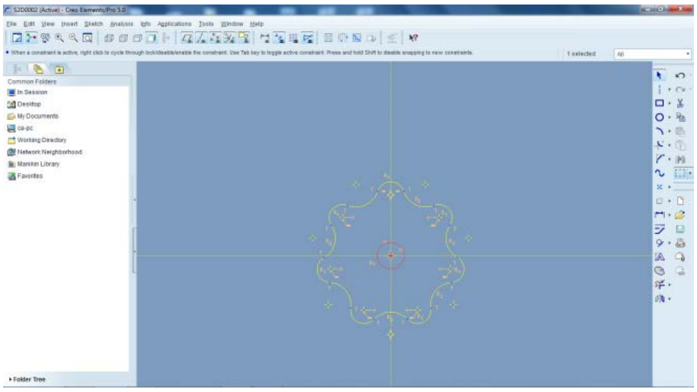


Fig-3

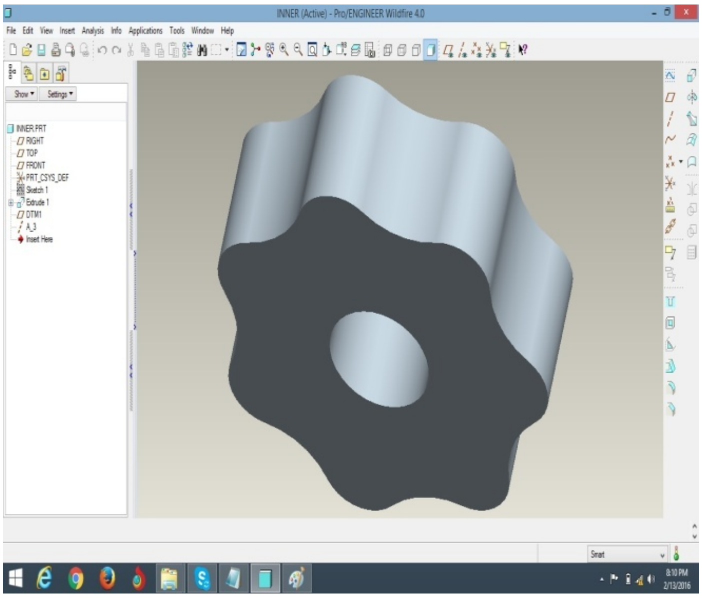


Fig-4

TOTAL DEFORMATION OF STEEL

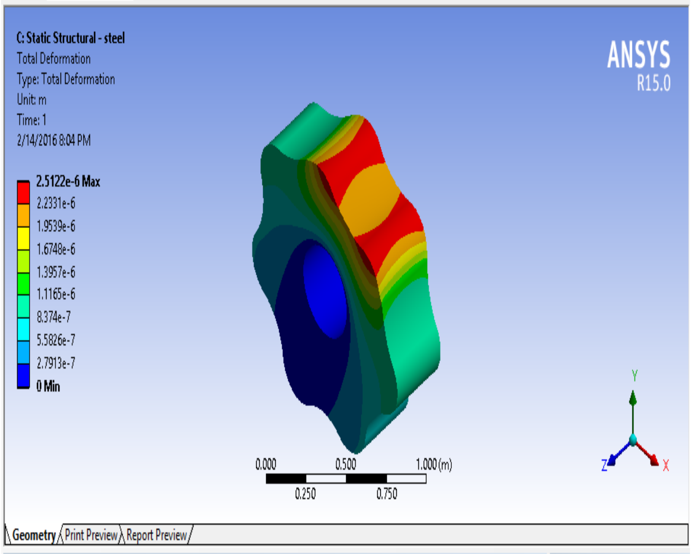


Fig-5.1

EQUIVALENT STRESS VALUES ON STEEL

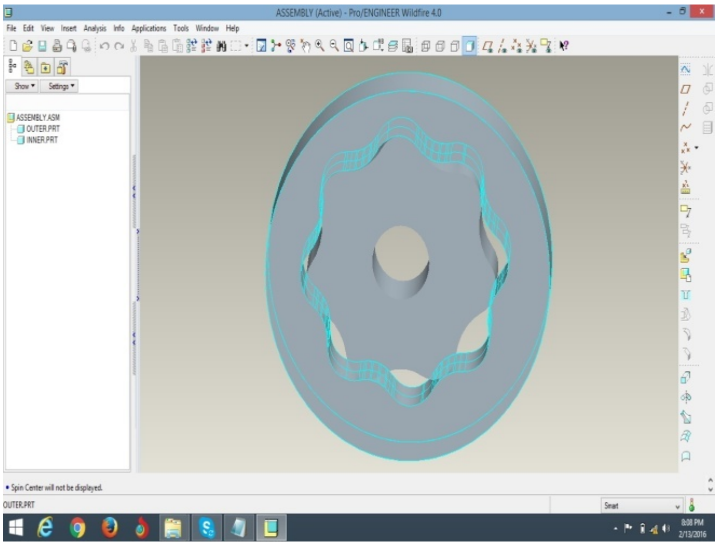


Fig-5

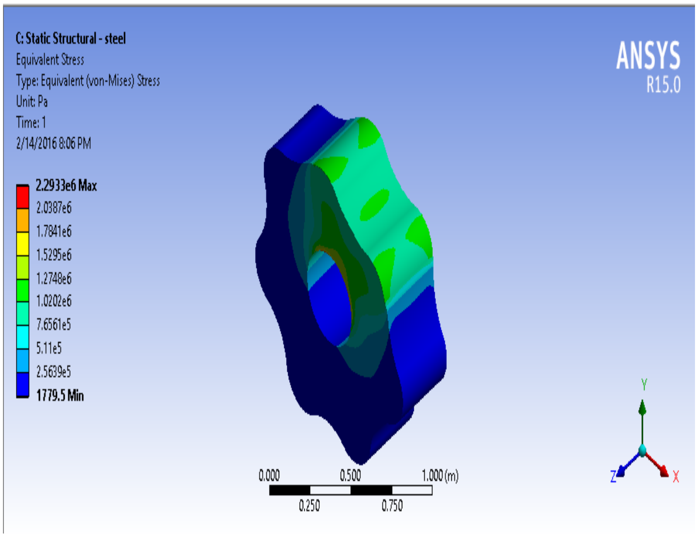


Fig-5.2

III STRUCTURAL ANALYSIS OF GEOROTOR

STRUCTURAL ANALYSIS OF STEEL

The diagrams shows the structural analysis of steel

	TOTAL DEFORMATION	VONMISES STRESS	VONMISES STRAIN
MAXIMUM	2.5122e-6 m	2.2933e6 pa	1.1467e-5
MINIMUM	0	1779.5 pa	1.3185e-8

Table-1

EQUIVALENT STRAIN VALUES ON STEEL

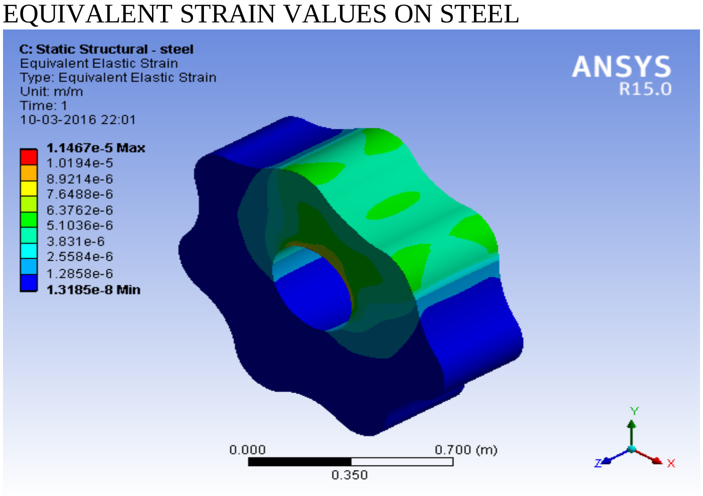


Fig-5.3

THERMO STRUCTURAL ANALYSIS OF STEELS

The diagrams shows the thermo structural analysis of steel

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	0.0001677 m	1.7751e8 pa	MAXIMUM
MINIMUM	0	3.3761e5 pa	MINIMUM

Table-2

TOTAL DEFORMATION OF STEEL

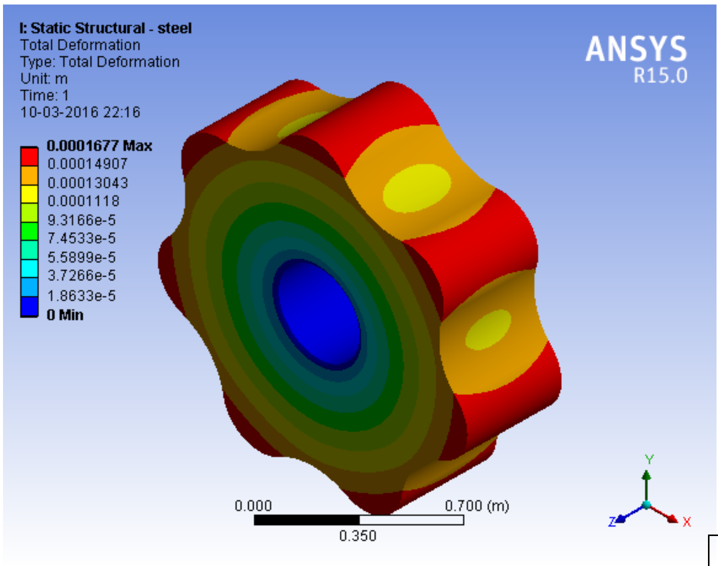


Fig-5.4

EQUIVALENT STRESS VALUES ON STEEL

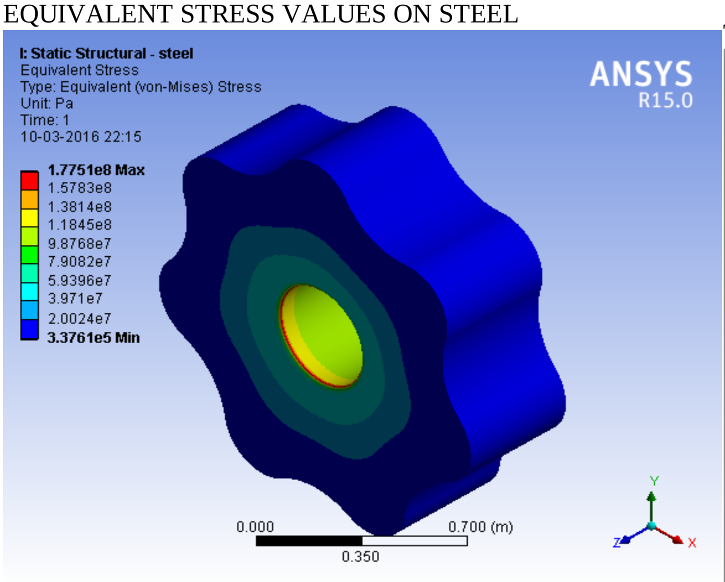


Fig-5.5

EQUIVALENT STRAIN VALUES OF STEEL

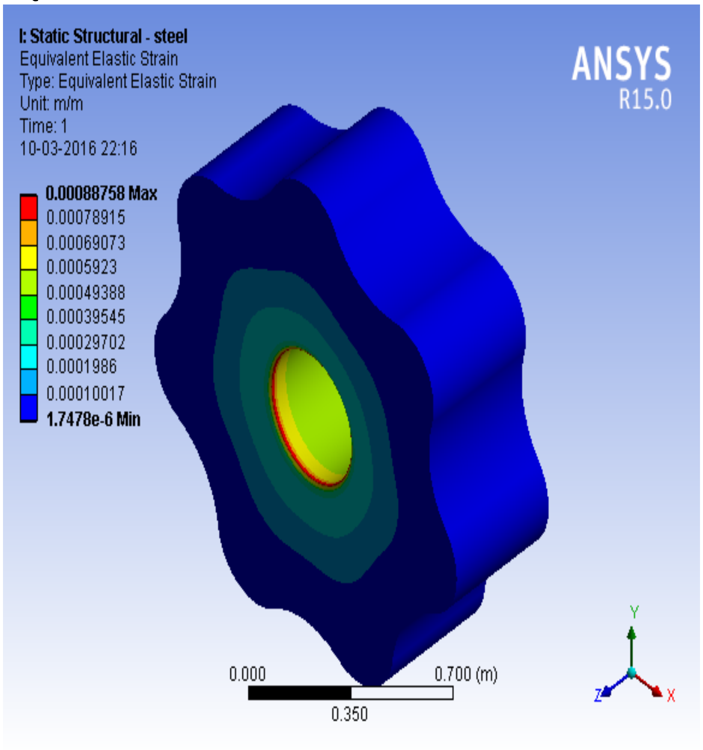


Fig-5.6

STRUCTURAL ANALYSIS OF ALUMINIUM

The diagrams shows the structural analysis of aluminum

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	7.0748e-6 m	2.3893e6 pa	MAXIMUM
MINIMUM	0	2001.9 pa	MINIMUM

Table-3

TOTAL DEFORMATION OF ALUMINIUM

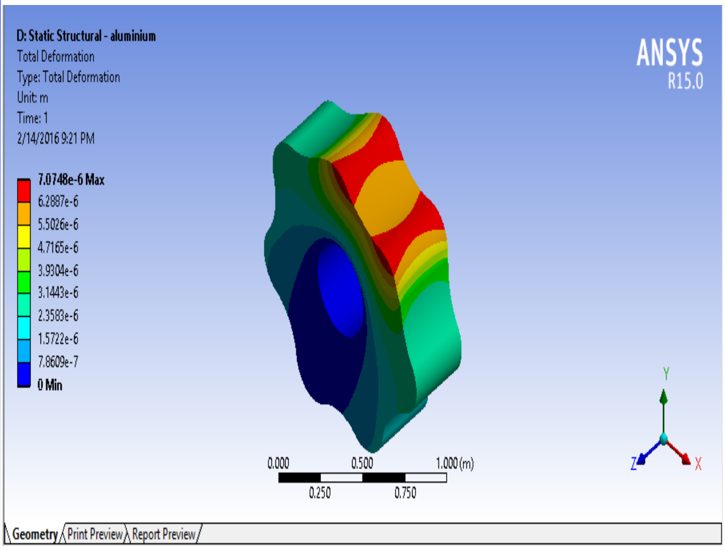


Fig-5.7

EQUIVALENT STRESS VALUES OF ALUMINIUM

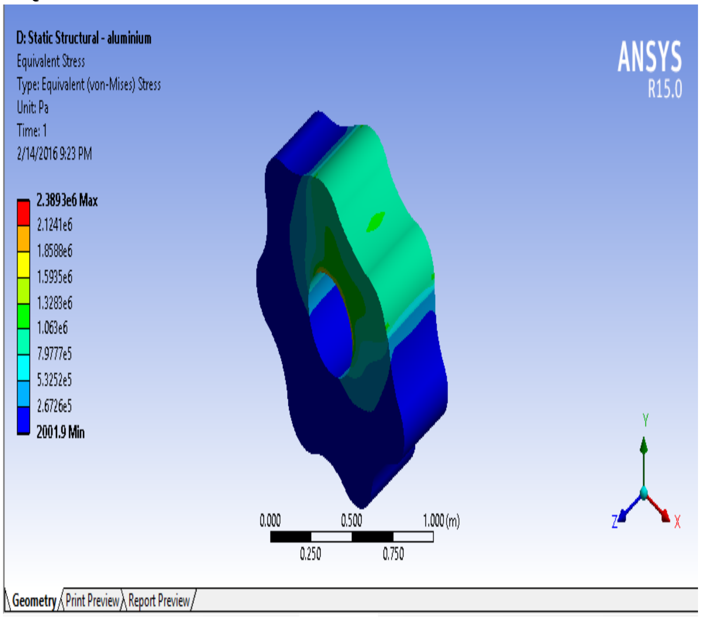


Fig-5.8

TOTAL DEFORMATION OF ALUMINIUM

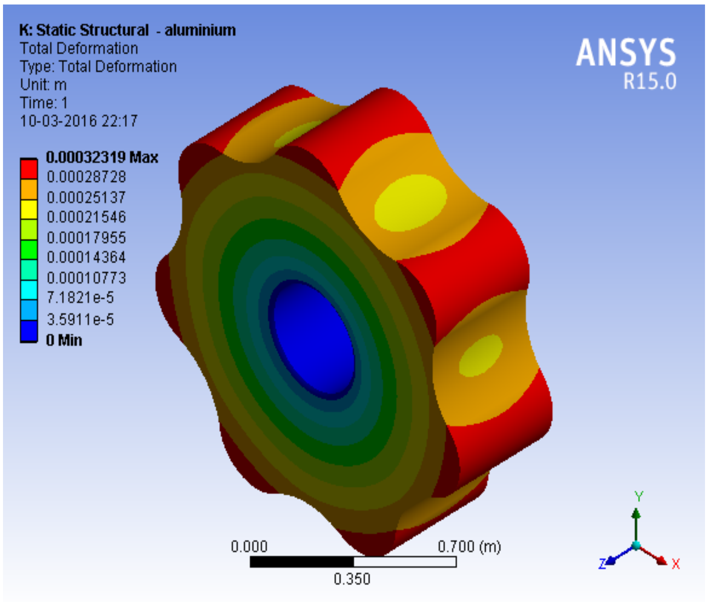


Fig-5.10

EQUIVALENT STRAIN VALUES ON ALUMINIUM

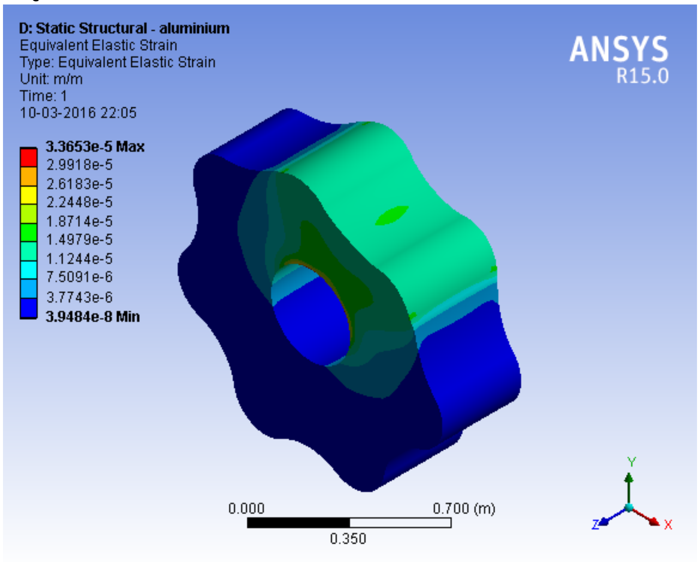


Fig-5.9

EQUIVALENT STRESS VALUES OF ALUMINIUM

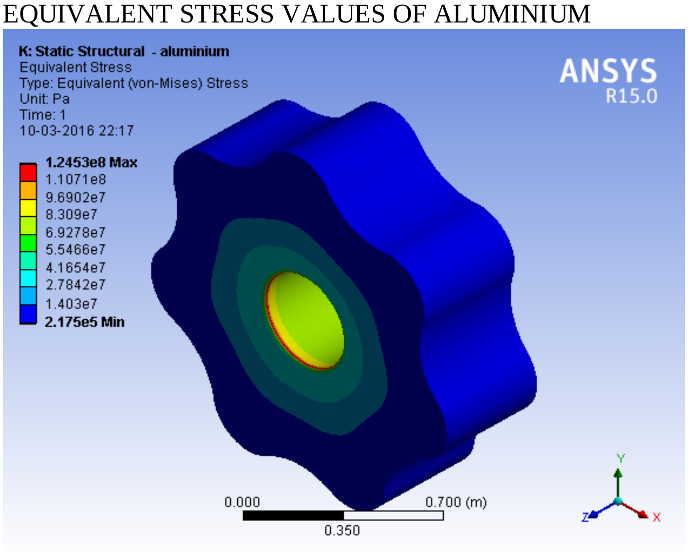


Fig-5.11

EQUIVALENT STRAIN VALUES OF ALUMINIUM

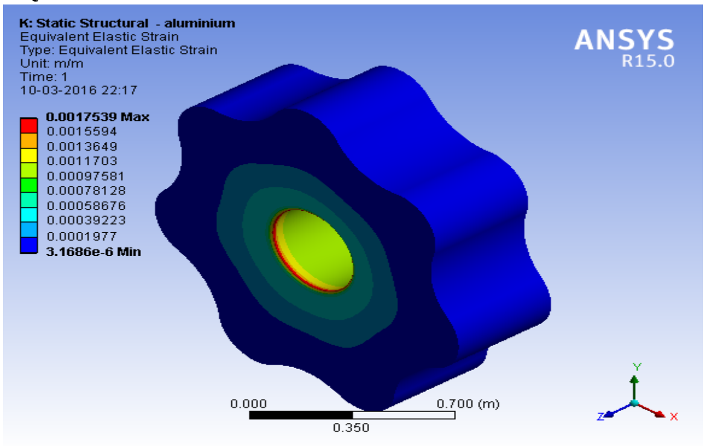


Fig-5.12

THERMO STRUCTURAL ANALYSIS OF ALUMINIUM

The diagrams show the thermo structural analysis of aluminum.

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	0.00032319 m	1.2453e8 pa	MAXIMUM
MINIMUM	0	2.175e5 pa	MINIMUM

Table-4

STRUCTURAL ANALYSIS OF CAST IRON

The diagrams show the structural analysis of cast iron.

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	4.5691e-6 m	2.2355e6 pa	MAXIMUM
MINIMUM	0	1607.9 pa	MINIMUM

Table-5

TOTAL DEFORMATION OF CAST IRON

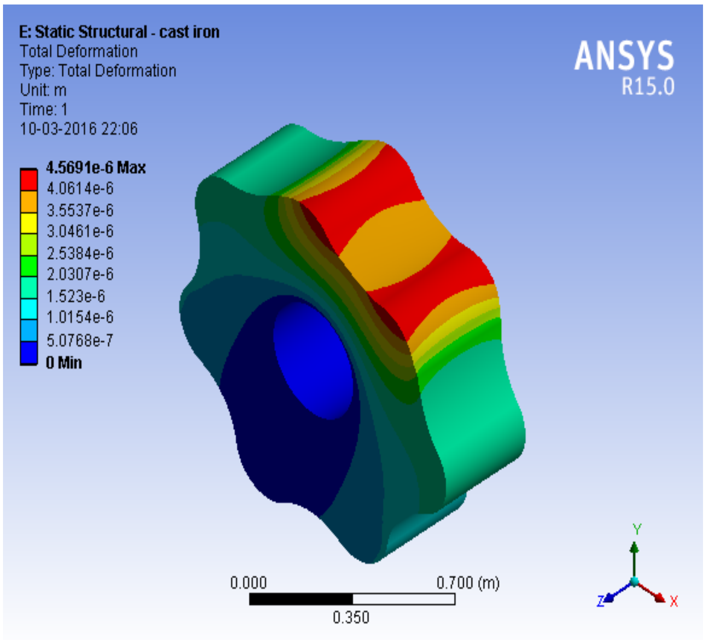


Fig-5.13

EQUIVALENT STRESS VALUES OF CAST IRON

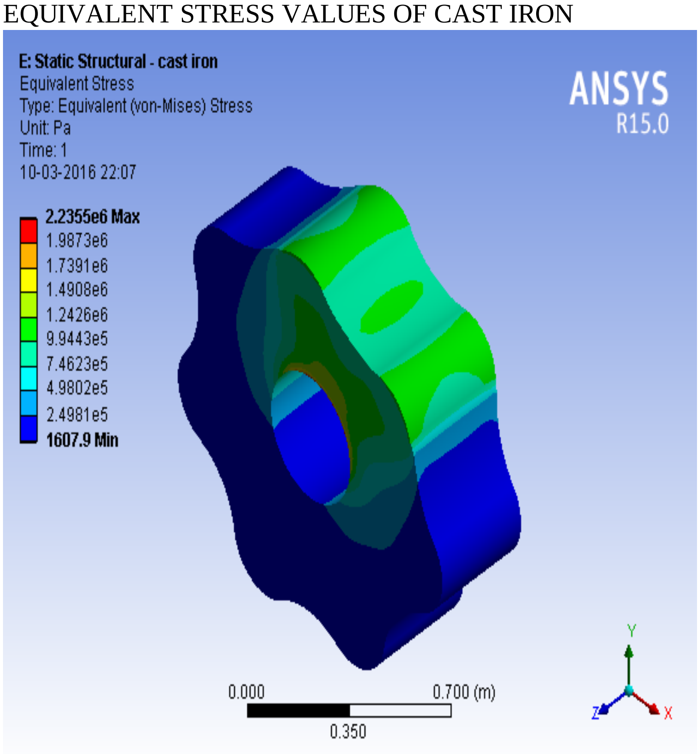


Fig-5.14

EQUIVALENT STRAIN VALUES ON CAST IRON

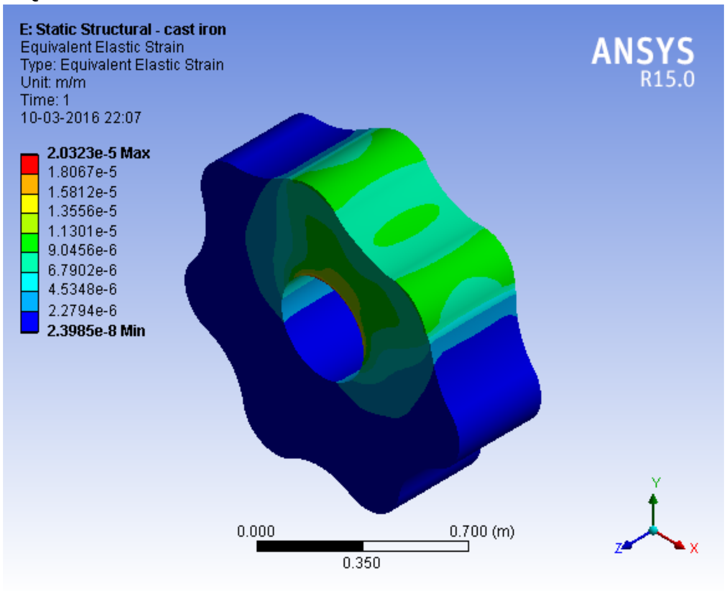


Fig-5.15

THERMO STRUCTURAL ANALYSIS OF CAST IRON

The diagrams show the thermo structural analysis of cast iron

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	0.00015338	8.8447e7	MAXIMUM
MINIMUM	0	1.6508e5	MINIMUM

Table-6

TOTAL DEFORMATION OF CAST IRON

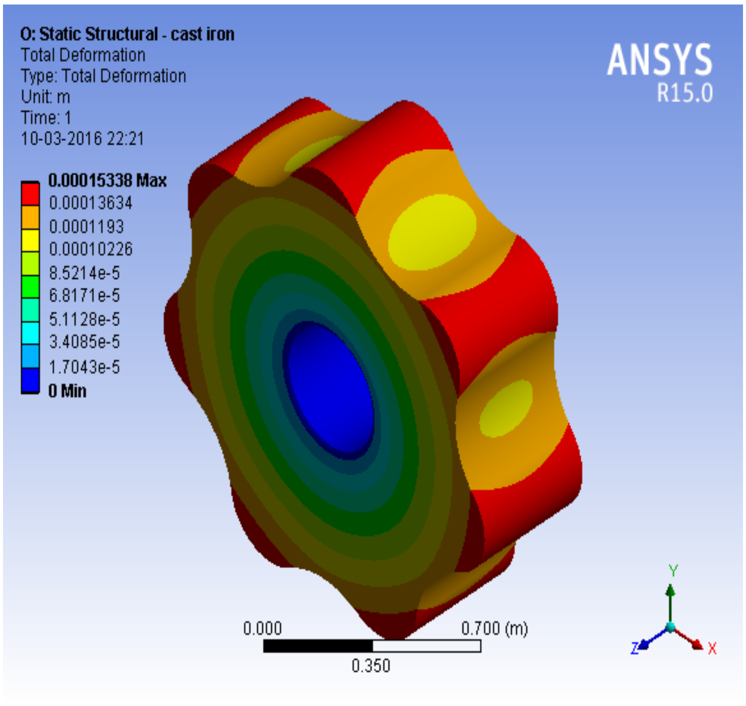


Fig-5.16

EQUIVALENT STRESS VALUES OF CAST IRON

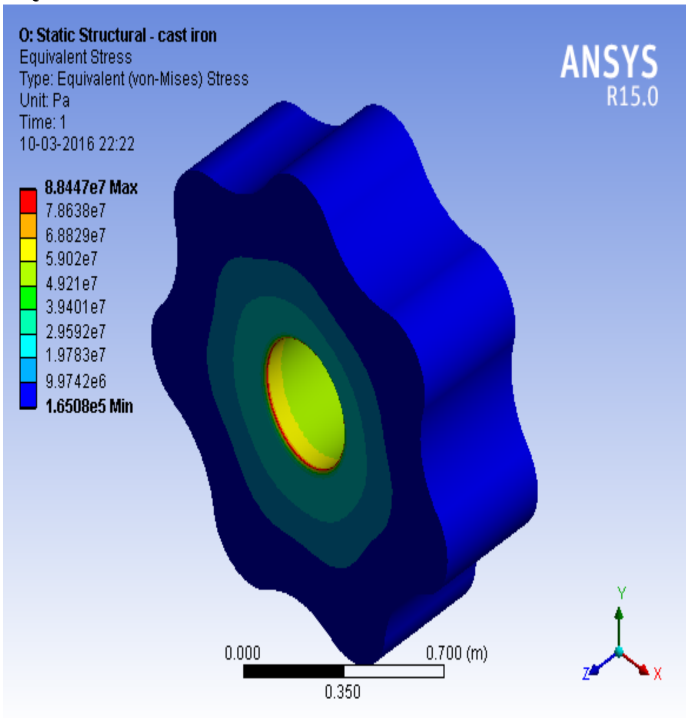


Fig-5.17

EQUIVALENT STRAIN VALUES OF CAST IRON

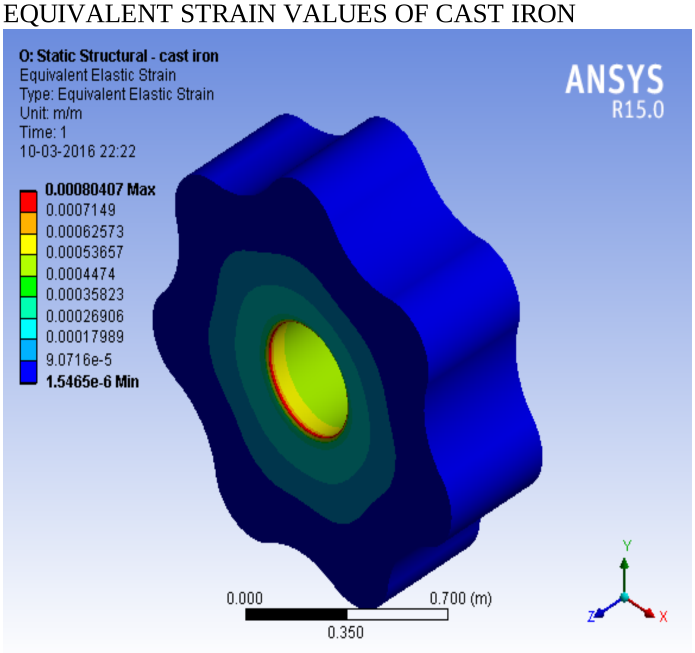


Fig-5.18

STRUCTURAL ANALYSIS OF TITANIUM

The diagrams shows the structural analysis Titanium

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	5.2323e-6 m	2.4993e6 pa	MAXIMUM
MINIMUM	0	2295.6 pa	MINIMUM

Table-7

TOTAL DEFORMATION OF TITANIUM

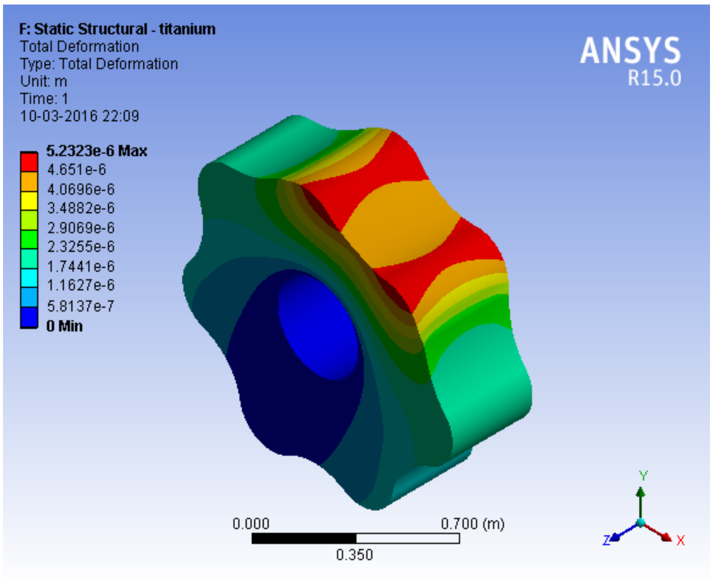


Fig-5.19

EQUIVALENT STRESS VALUES OF TITANIUM

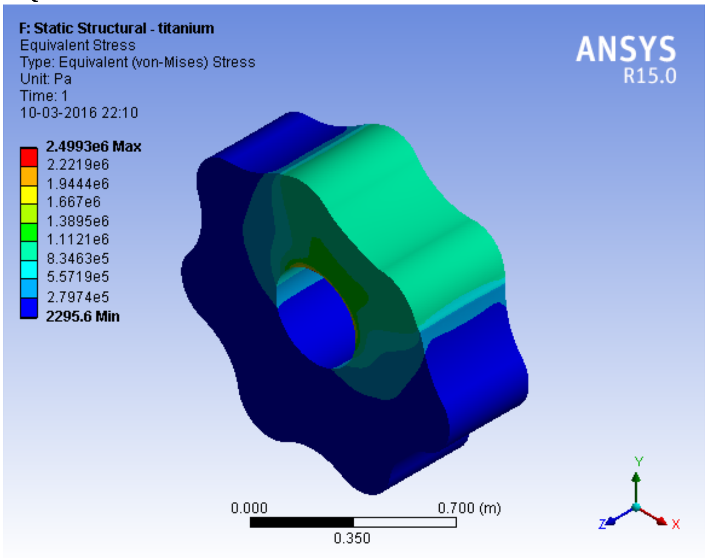


Fig-5.20

EQUIVALENT STRAIN VALUES OF TITANIUM

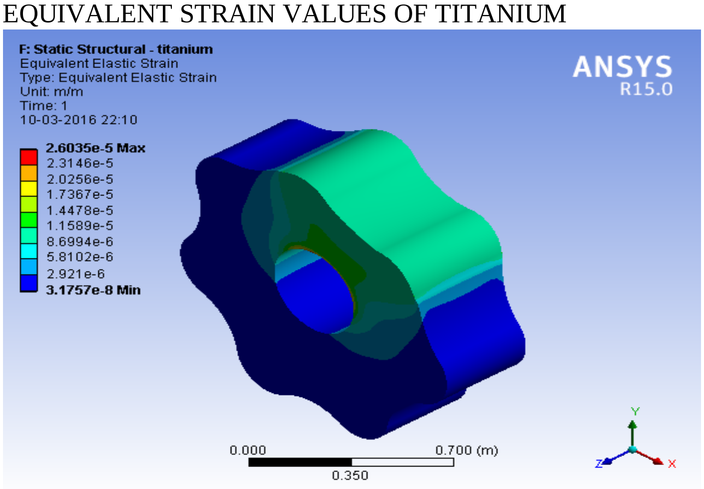


Fig-5.21

THERMO SRTUCTURAL ANALYSIS OF TITANIUM

The diagrams shows the thermo structural analysis of Titanium

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	0.00013295 m	7.4372e7	MAXIMUM
MINIMUM	0	1.09e5	MINIMUM

Table-8

TOTAL DEFORMATION OF TITANIUM

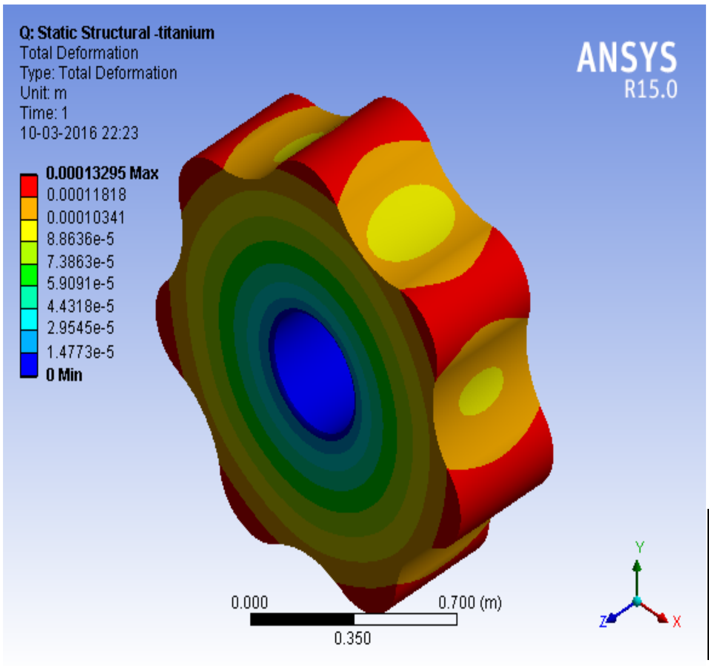


Fig-5.22

EQUIVALENT STRESS VALUES ON TITANIUM

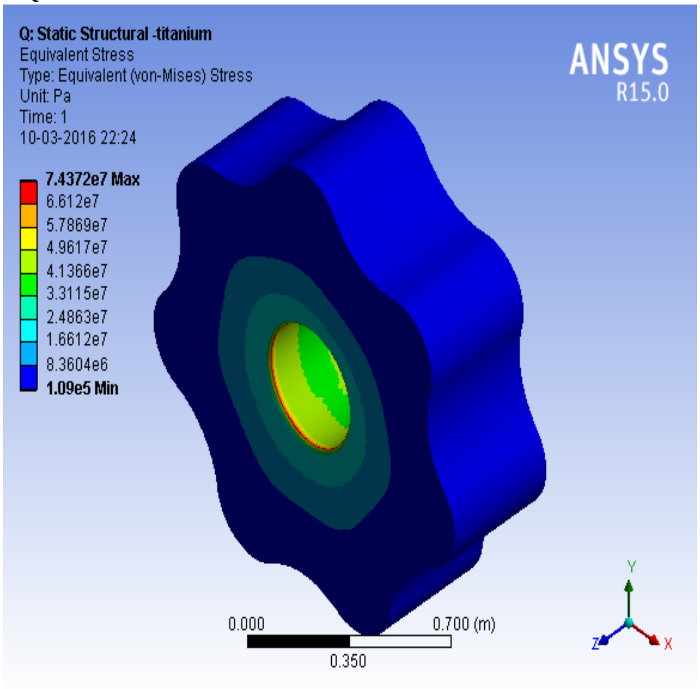


Fig-5.23

EQUIVALENT STRAIN VALUES ON TITANIUM

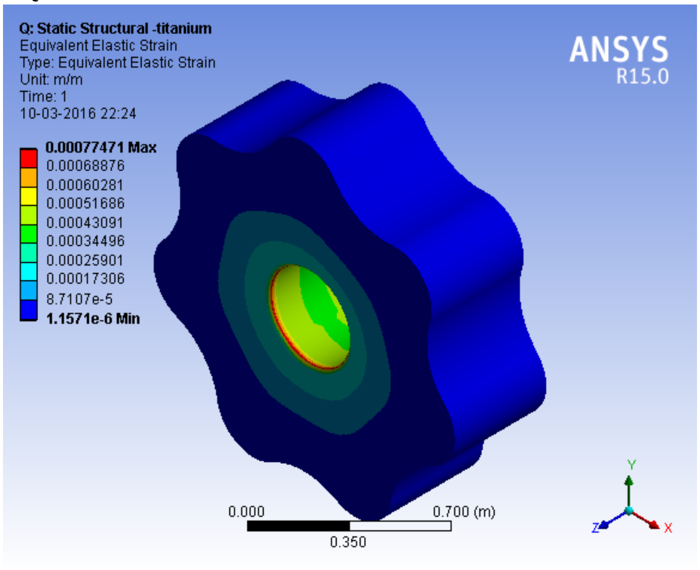


Fig-5.24

STRUCTURAL ANALYSIS OF MAGNESIUM

The diagrams shows the thermo structural analysis of Magnesium

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	1.1162e-5 m	2.4609e6 pa	MAXIMUM
MINIMUM	0	2174.4 pa	MINIMUM

Table-8

TOTAL DEFORMATION OF MAGNESIUM

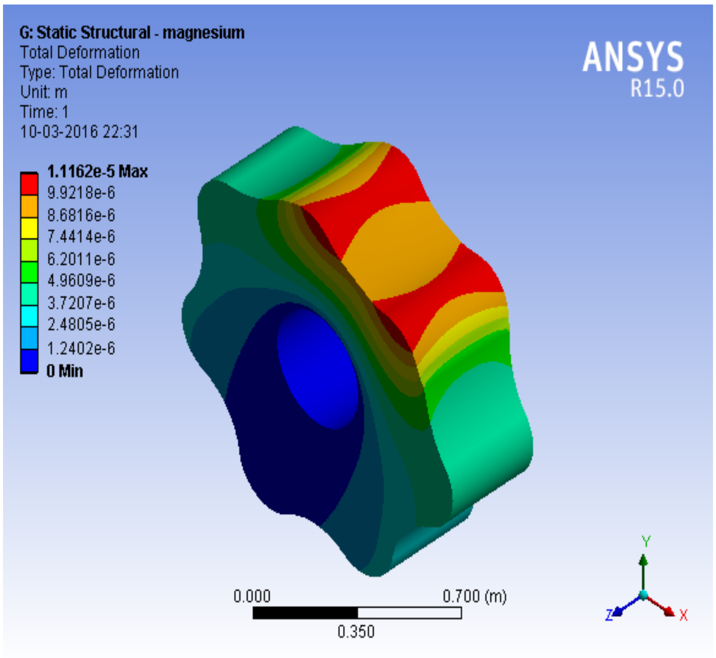


Fig-5.25

EQUIVALENT STRESS VALUES OF MAGNESIUM

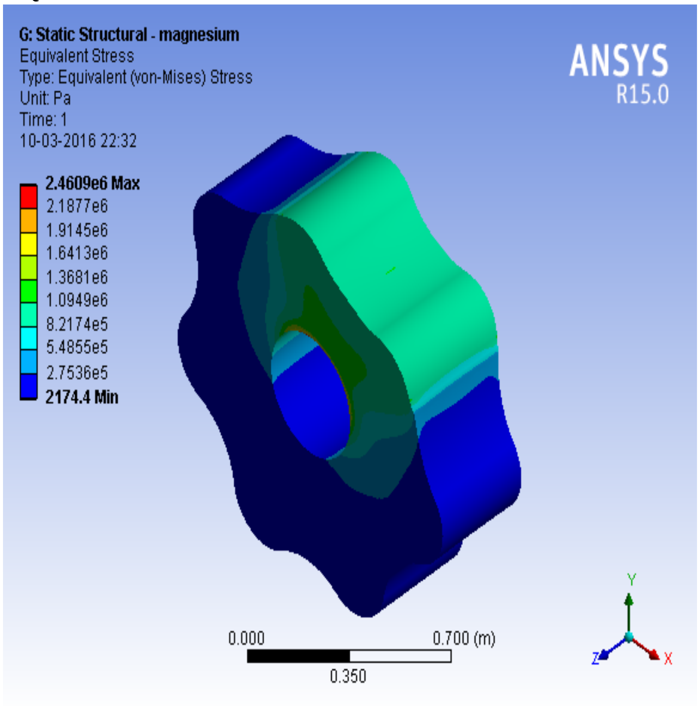


Fig-5.26

EQUIVALENT STRAIN VALUES OF MAGNESIUM

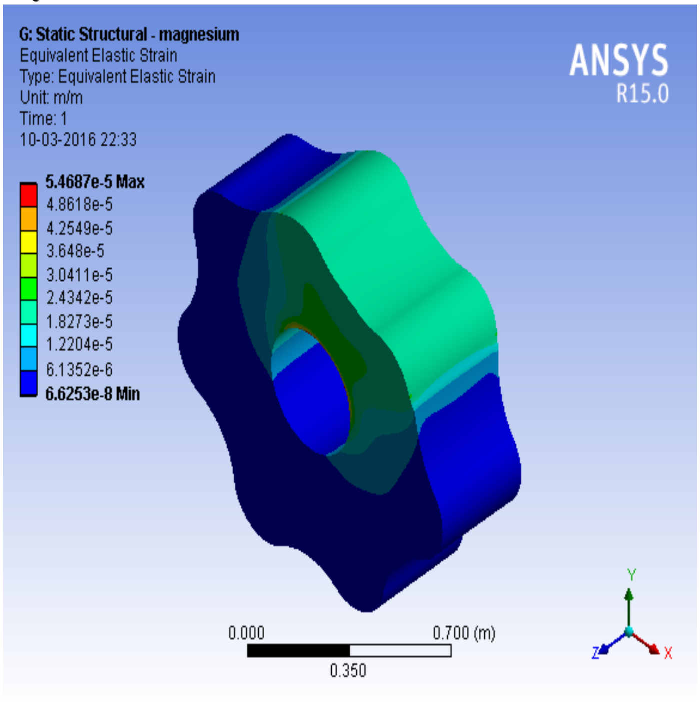


Fig-5.27

THERMO STRUCTURAL ANALYSIS OF MAGNESIUM

The diagrams shows the thermo structural analysis of Magnesium

TOTAL DEFORMATION	EQUIVALENT STRESS	EQUIVALENT STRAIN	TOTAL DEFORMATION
MAXIMUM	0.00036683 m	9.2174e7 pa	MAXIMUM
MINIMUM	0	1.4759e5 pa	MINIMUM

Table-9

TOTAL DEFORMATION OF MAGNESIUM

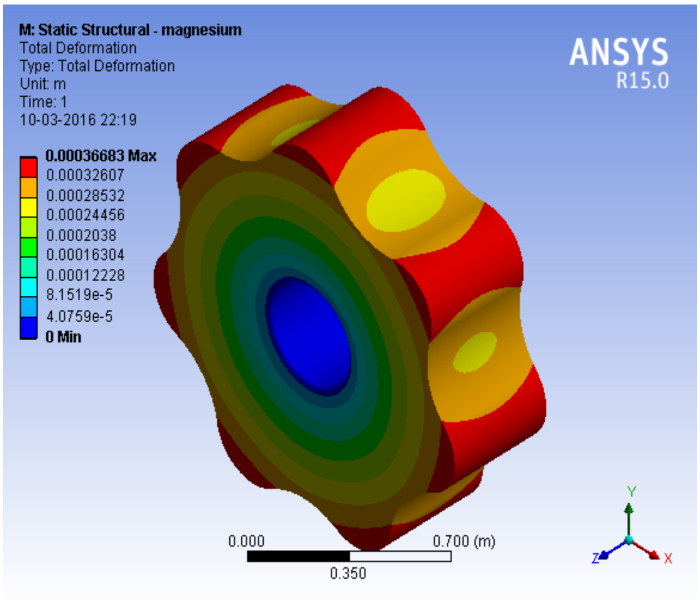


Fig-5.28

EQUIVALENT STRESS VALUES OF MAGNESIUM

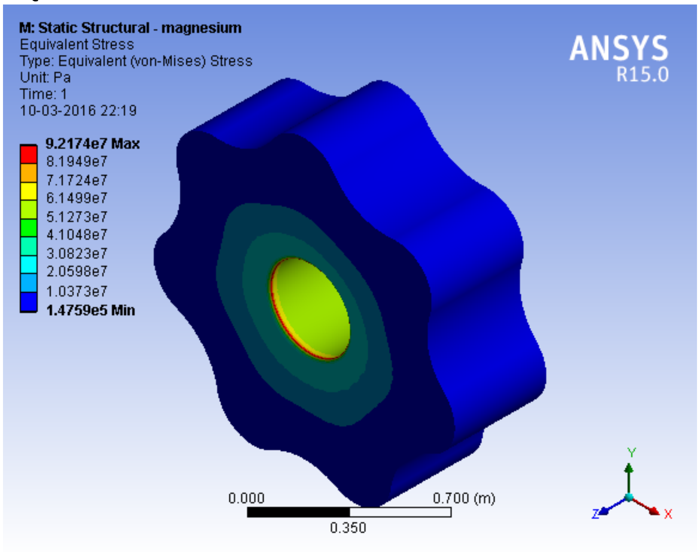


Fig-5.29

EQUIVALENT STRAIN VALUES OF MAGNESIUM

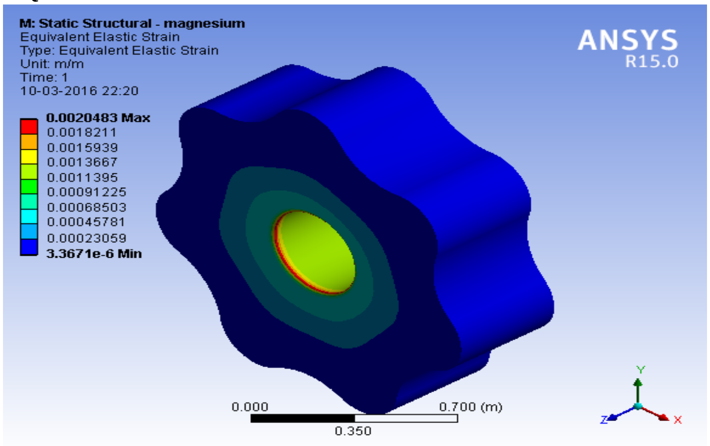
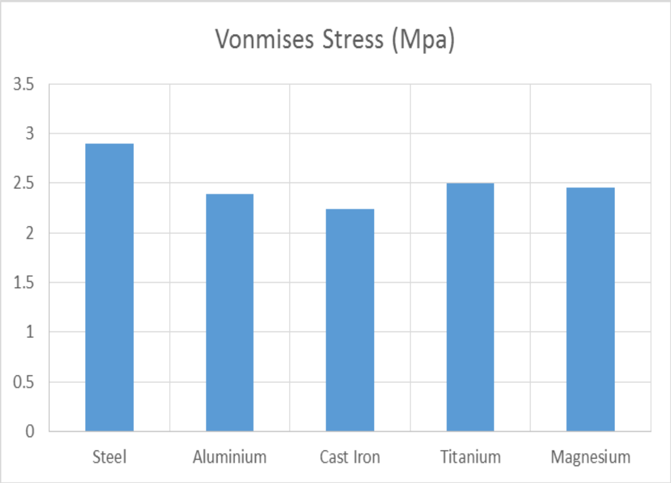


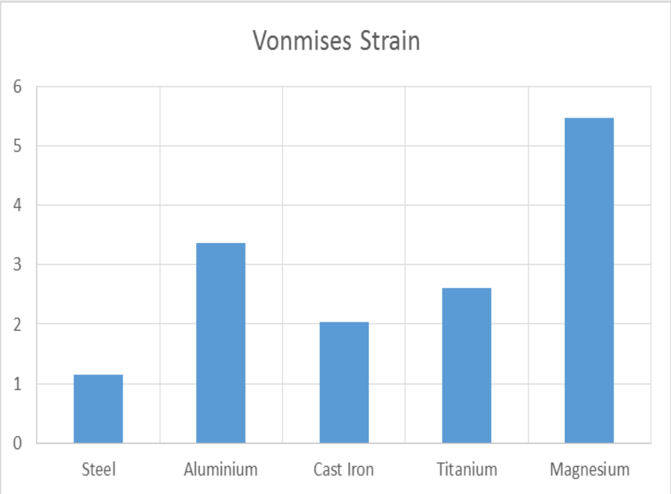
Fig-5.30

STUCTURAL GRAPHS

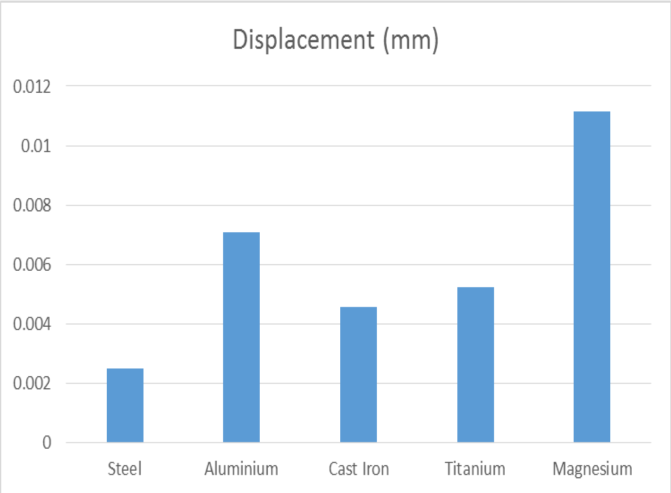
In structural graphs of georotor we are comparing the vonmises stresses, vonmises strain, and total deformation& shear stress values for different materials



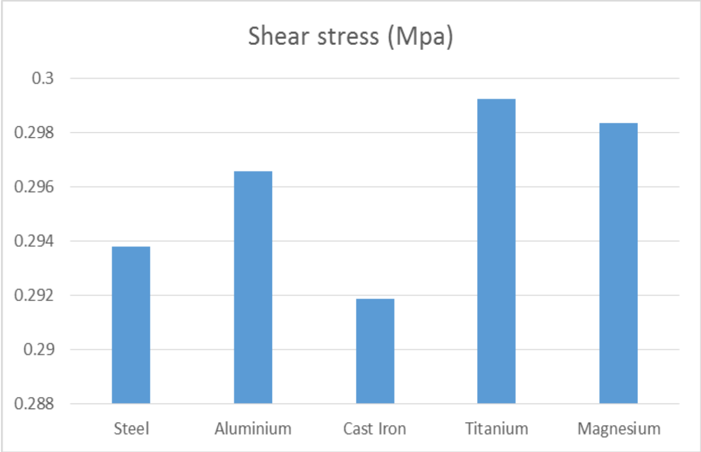
Graph-1



Graph-2



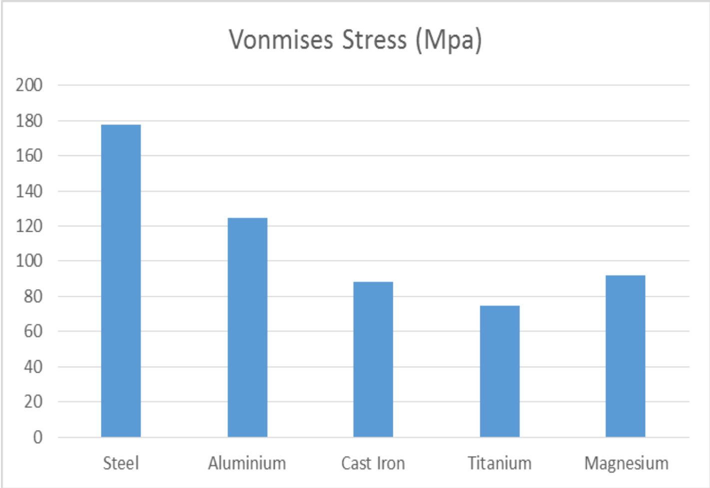
Graph-3



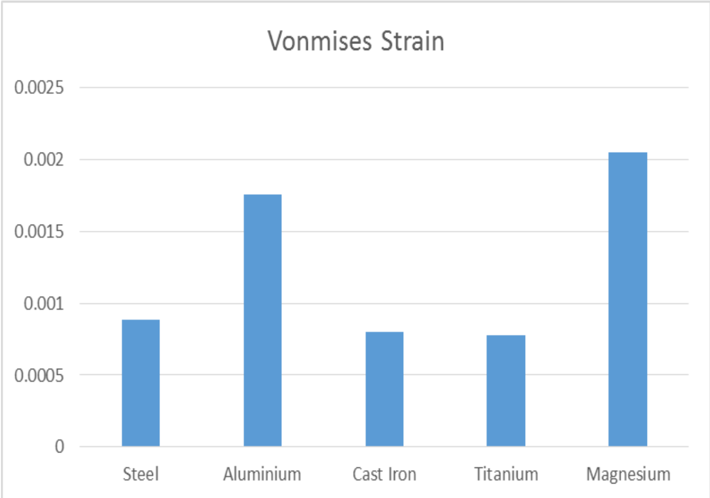
Graph-4

THERMO STRUCTURAL GRAPHS

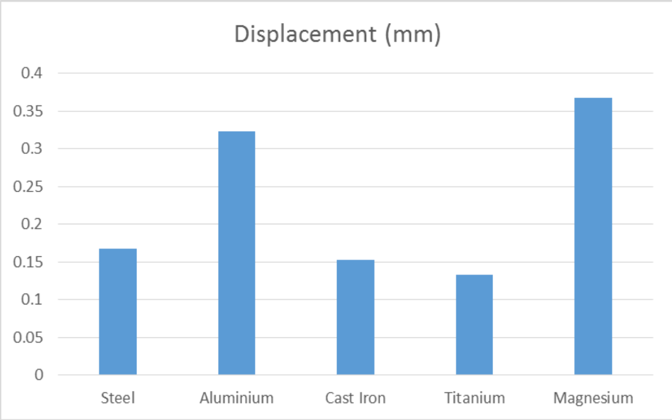
In thermo structural graphs we are comparing the graphs of vonmises stress, vonmises strain, total deformation& shear stress values for different materials.



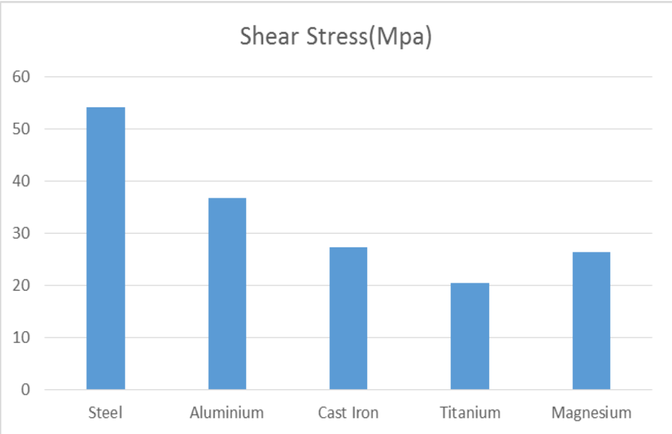
Graph-5



Graph-6

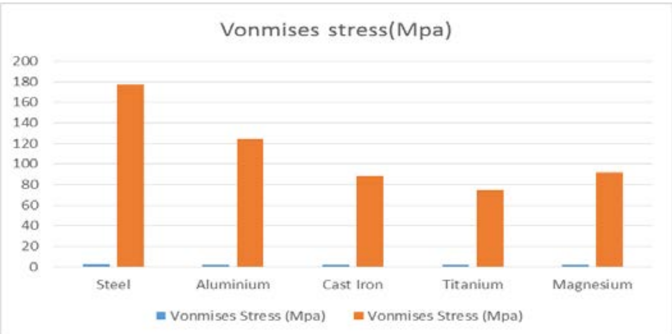


Graph-7

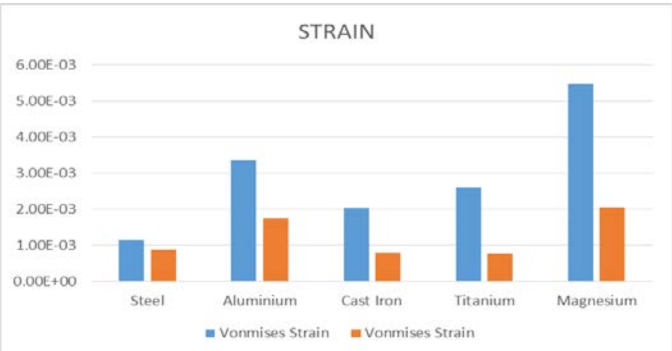


Graph-8

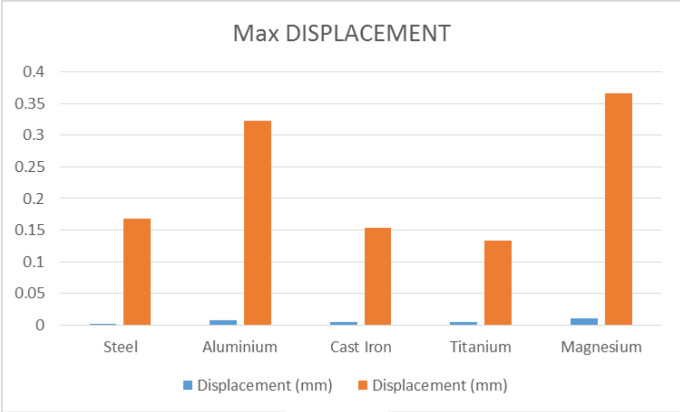
In below three graphs we are comparing both structural analysis and thermo structural analysis by taking the vonmises stress vonmises strain total deformation values for different materials



Graph-9



Graph-10



Graph-11

CONCLUSION

Generally we use steel in design of georotor and we compared with other materials such as aluminum, cast iron, titanium and magnesium. Therefore by above results we observed that VONMISES STRESS & STRAIN, TOTAL DEFORMATION is less for cast iron than other materials. So we used to suggest cast iron in design of georotor inner rotor.

Even though from our results we observed titanium which gives better results after analysis but due to its high cost and other parameters we can't use titanium for designing of inner rotor of georotor.

So we suggest cast iron which shows near results of stress, strain and deformation results which is almost similar to titanium.

FUTURE WORK

Harmonic analysis and fluid analysis should be done for inner rotor of georotor to find how the inner rotor behaves and how it deforms by using harmonic analysis in workbench even we should find how the bending stresses in the inner rotor of georotor varies.

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