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# Modeling And Analysis Of Differential Geear Box In Vechicles

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***Abstract***

*The differential can be expressed as a gear train used to control the speed and torque to the rear wheels. While proceeding, the fundamental necessity of the vehicle is to control the speed of rear wheels with the goal that the vehicle turns easily on road surface. The differential basically comprises of three shafts and gear train plan. The main shaft is propeller shaft which gives the need torque and speed to differential for turn. The other two shafts are hub shafts mounted for each rear wheels. These shafts are joined to propeller shaft by crown gear and pinion game plan in this way making a slope pair of gears. The two fundamental pieces of differential transmission system, one is crown gear which gives suitable speed to turn the vehicle and another is pinion which gives permissible speed and torque to turning the vehicle. Hence, the analysis of such crown gear and pinion makes need for strength. The principle objective of this paper is to perform mechanical plan of differential gear box and analysis of gears in gear box. We have taken dark cast iron and aluminum compound materials for leading the analysis.*

## Introduction

At the point when the vehicle is proceeding onward a road and when it takes a turn both the outside and inside wheel need to travel distinctive distance so here the differential gearbox comes into job. The transmission system utilized in the vehicle contain a segment which is utilized to move power from propeller shaft to both the wheels is called as differential. It is a gathering of gear in an epicyclic train which grant the rotation of two shaft at two diverse speed, utilized at the rear side of the vehicle to turn the wheel quicker than the other. The differential is utilized twoly, one is that it gets an information and makes two yields while other is that It gets two data sources consolidated it and gives one yield. The differential is situated in the middle of the two-rear wheel of the vehicle to turn one wheel quicker than the other. At the point when the vehicle goes ahead, the inward wheel covers less distance than the external wheel, so it implies the speed of internal wheel must be not exactly the external wheel. Be that as it may, when the vehicle goes straight both the wheel turn at a similar speed. To give both the condition differential gearbox is utilized.

At the point when the vehicles one wheel is in mud, snow, potholes or stucked to the snag the two issue is that the wheel which is stucked rotates double the typical speed while the other wheel is fixed. This is because of the wheel which is stucked has sufficient foothold power acting to the road surface. To stay away from this issue the improvement in the gearbox is to be done and the answer for have differential locking system which give commitment or separation. The plan of the differential impact on the disappointment of the differential. As it makes with the gathering of the slant gear it is useful for taking heap of the vehicle. Along these lines, the improve the general differential and to stay away from disappointment because of loading.

## Literature Review

Ronak P Panchal and Pratik B Umrigar talked about the qualities of a bevel gear in a unique conditions including fitting solidness and different burdens produce are examined. By utilizing a mathematical



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methodology the creator has built up a hypothetical model of bevel gear and decided the impact of cross section gear tooth stresses by taking material unfeeling combination steel (15Ni4Cr1).

Luciana SgarbiRossinoa et al. made an examination to decide the reasons for surface contact exhaustion disappointment of a callous pinion. The assessment of the segment uncovered the presence of a solidified layer considerably thicker than that by and large indicated for pinions formulated for this application. This relationship with the gigantic presence of weak threadlike carbon-rich cementite stage ($Fe_3C$) in earlier austenite grain limits of the pinion teeth supported surface break nucleation and proliferation during cyclic loading prompting spallation of the contact surface with the partner gear which debilitated the system's activity.

**Method**

To decide the structural analysis on the differential gearbox. To start with, we need to make a model of differential gearbox in displaying software. We have the assembly of differential gearbox in SOLIDWORKS.

Develop a three-dimensional portrayal of the bevel gears in SOLIDWORKS. The assembly comprises of 2 side gears, 2 ring gears, and sun gear. Subsequent to doing the assembly in strong works. Save the record in. IGES design proceeding with the further work in ANSYS Mechanical.

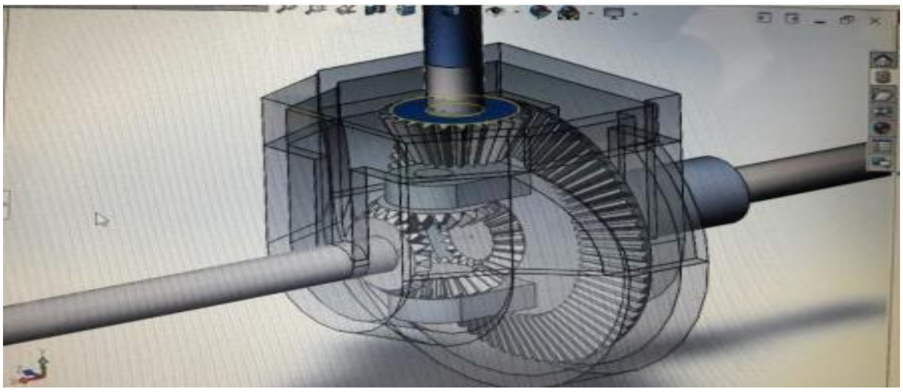

**Figure 1. Differential Gear Assembly**

**Design of differential Gear Box**

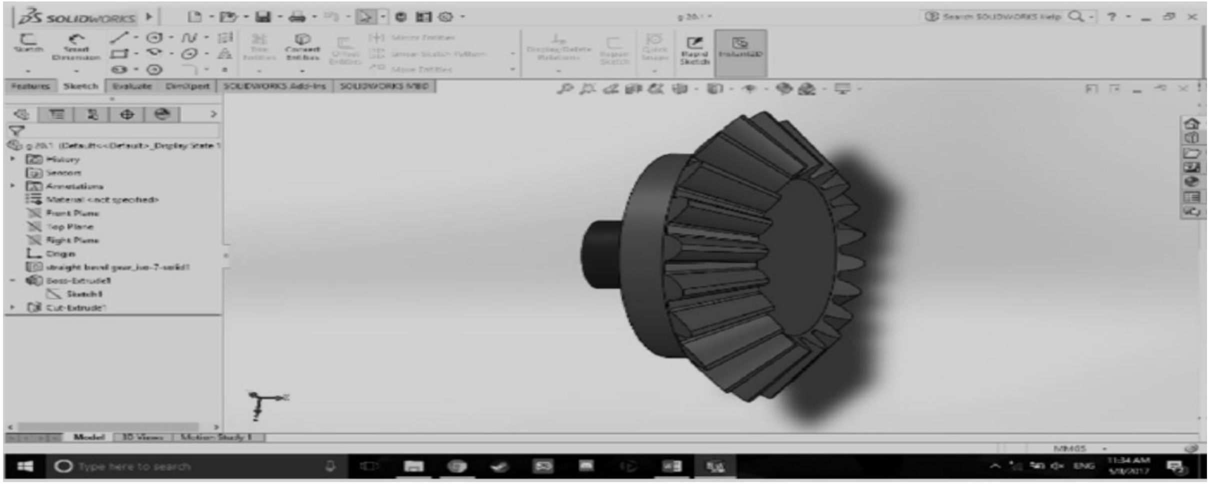

**Figure 2. This figure represents the modeling of first side gear in solidworks. It is created by drawing the bevel gear profile from prerequisites and removing the faces of bevel gear tooth for 45 deg mating of other gears for assemblyand adding an extruded stub axles rods to it.**



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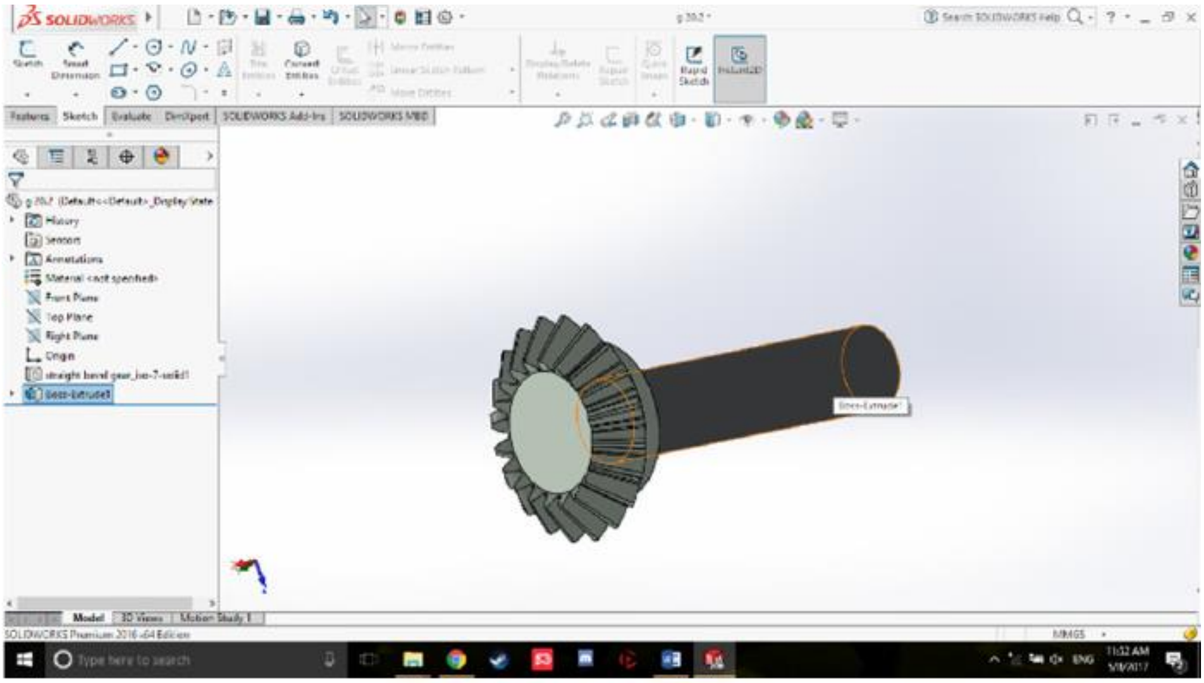

**Figure 3. It is the second bevel side gear. This figure represents the modelling of second side gear in Solid works. It is created by drawing the bevel gear profile from prerequisites and removing the faces of bevel gear tooth for 45 deg mating of other gears for assembly and adding an extrude stub axles to it.**

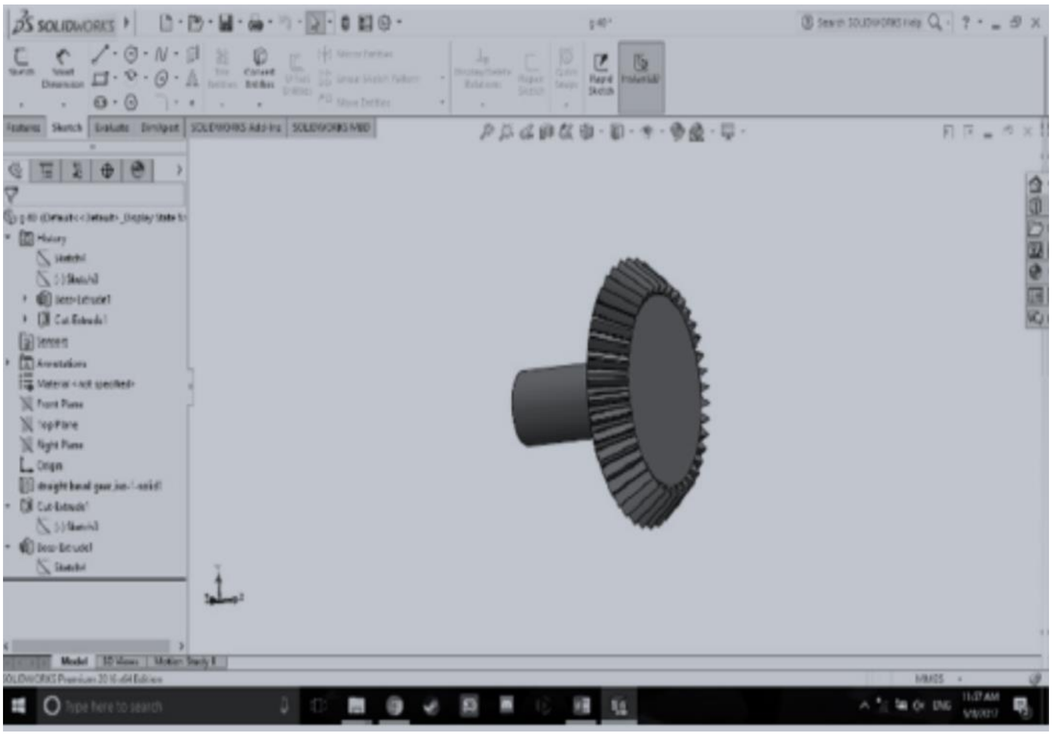

**Figure 4 This figure represents the modelling of ring gear in solidworks. It is created by drawing the bevel gear profile from prerequisites and removing the faces of bevel gear tooth for 45 deg mating of other gears for assemblyand adding an xtrude stub axles to it. The ring rotates while the vehicle is taking a turn. It rotates in it's own axis.**



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**Analysis**

In this paper we usedtwo different materials like aluminium alloy and grey cast iron for the analysis of this product.

**Table 1. Grey cast iron material Properties**

| | |
|---|---|
| Density | 7200 kg m^-3 |
| Coefficient of Thermal Expansion | 1.1e-005 C^-1 |
| Specific Heat | 447 J kg^-1 C^-1 |
| Thermal Conductivity | 52 W m^-1 C^-1 |
| Resistivity | 9.6e-008-ohm m |
| Young's Modulus Pa | 1.1e+011 |
| Poisson's Ratio | 0.28 |
| Tensile Ultimate Strength | 2.4e+008 |
| Compressive Ultimate Strength | 8.2e+008 |

**Table 2. Aluminium Alloy Material Properties**

| | |
|---|---|
| Density | 2770 kg m^-3 |
| Coefficient of Thermal Expansion | 2.3e-005 C^-1 |
| Specific Heat | 875 J kg^-1 C^-1 |
| Young's Modulus Pa | 7.1e+010 |
| Poisson's Ratio | 0.33 |
| Resistivity | 3.63e-008-ohm m |
| Thermal Conductivity | 114 W m^-1 C^-1 |
| Tensile Yield Strength | 2.8e+008 |
| Tensile Ultimate Strength | 3.1e+008 |

**Frictional Contacts**

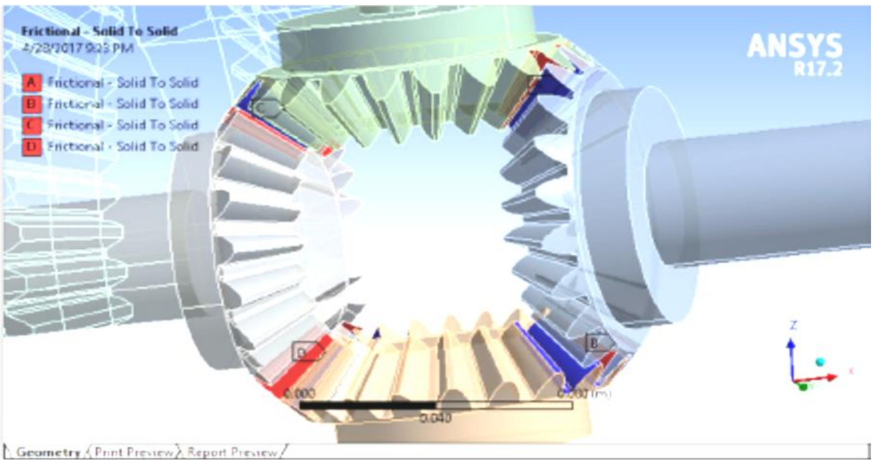


**Figure 5. It shows the frictional coefficient between the mating gears as 0.2. for the frictional or rubbing contact between to test for the thermal conditions**



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**Meshing of Differential Gear Box**

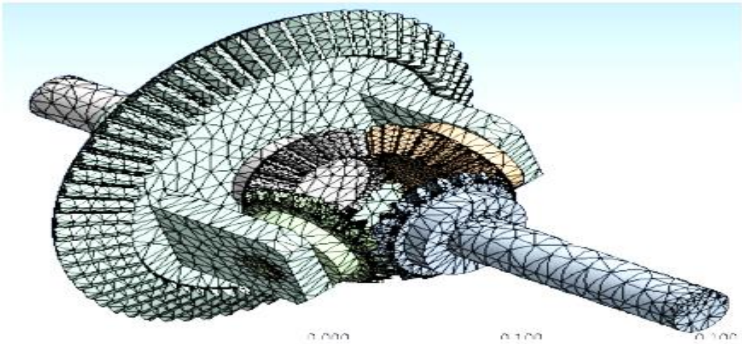

**Figure 6. Meshing of grey cast iron in ansys**

The fine meshing on the grey cast ironof element size of 0.6 and fine meshing of span angle center. By, meshing we can do the analysis properly and perfectly to know the load values on the differential gear box.

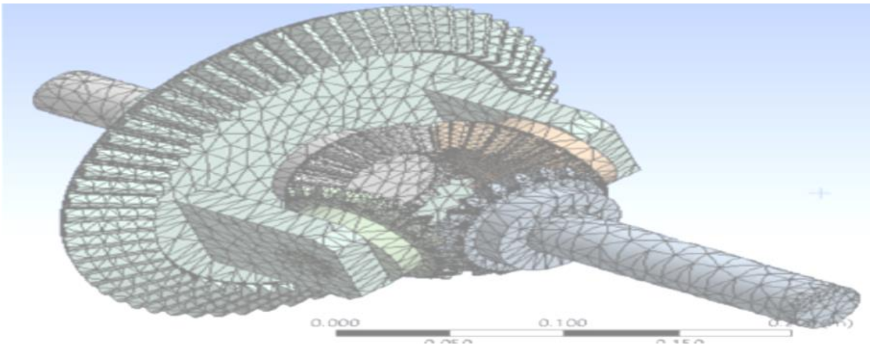


**Figure 7. Meshing of Aluminium Alloy in ansys**

The fine meshing on the Aluminium Alloyof element size of 0.6 and fine meshing of span angle center. By, meshing we can do the analysis properly and perfectly to know the load values on the differential gear box.

**Result and Discussion**

**Grey Cast Iron Total Deformation**

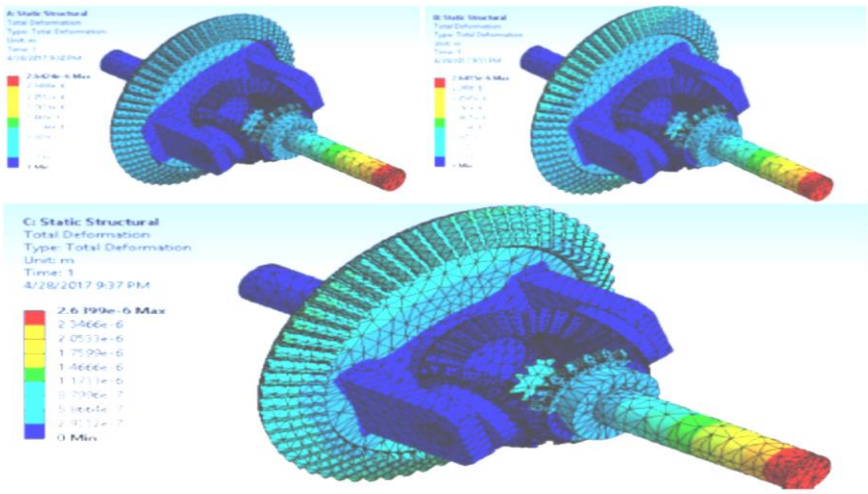


**Figure 8. Total Deformation stress values of the differential gear box at different torques at 190, 235, 320 (N-m) on Grey Cast Iron**



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**Von-Mises Stress of Differential Gear Box**

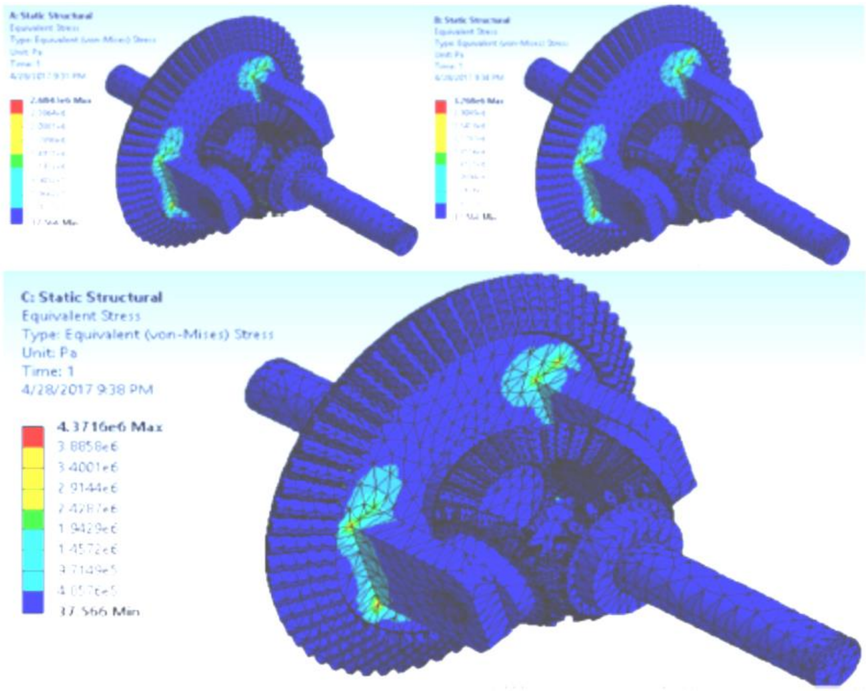


**Figure 9. Von-Mises stress values of the differential gear box at different torques at 190, 235, 320 (N-m) on Grey Cast Iron**

**Total Deformation of Aluminium Alloy**

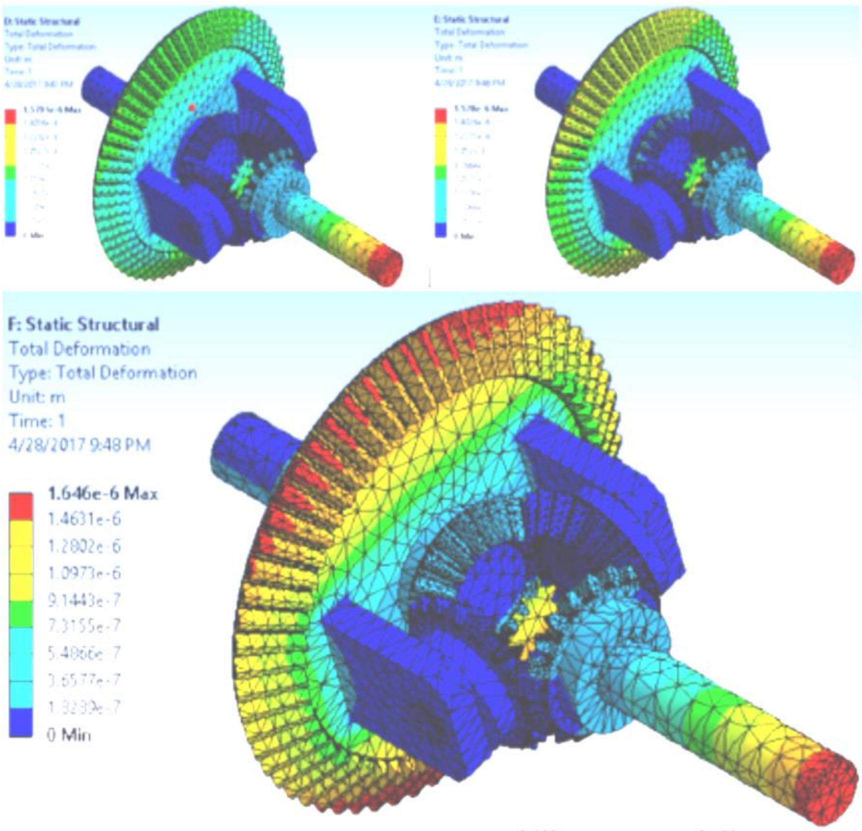




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**Figure 10. Total Deformation stress values of the differential gear box at different torques at 190, 235, 320 (N-m) on Aluminium Alloy**

**Table 3 Total Deformation and Von-Mises Stresses of Grey Cast Iron**

| S.no | Torque (N-m) | Total Deformation (mm) | Von-Mises Stresses (MPa) |
|---|---|---|---|
| 1 | 190 | 2.6424*e^-3 | 20.6847 |
| 2 | 235 | 2.6415*e^-3 | 32.681 |
| 3 | 320 | 2.6399*e^-3 | 43.716 |

**Table 4 Total Deformation and Von-Mises Stresses of Aluminium Alloy**

| S.no | Torque (N-m) | Total Deformation (mm) | Von-Mises Stresses (MPa) |
|---|---|---|---|
| 1 | 190 | 1.5791*e^-3 | 25.029 |
| 2 | 235 | 1.578*e^-3 | 30.773 |
| 3 | 320 | 1.646*e^-3 | 44.18 |

**Graph for Grey cast Iron**

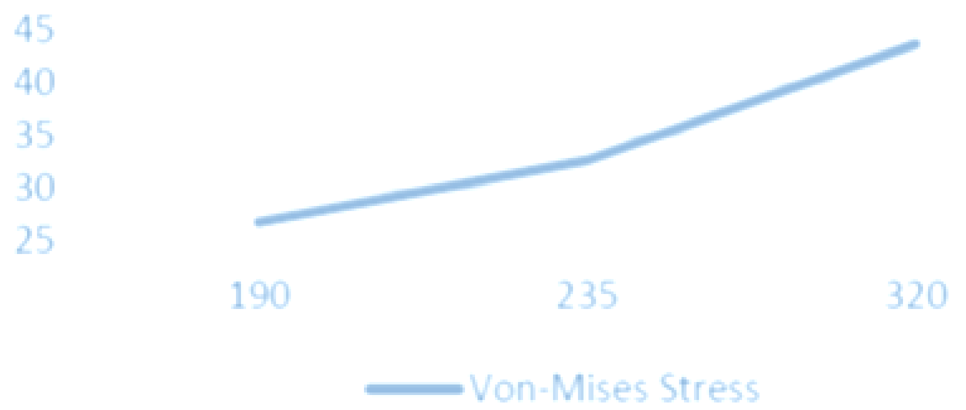


**Figure 11. Von-Mises Stress of Grey cast Iron**



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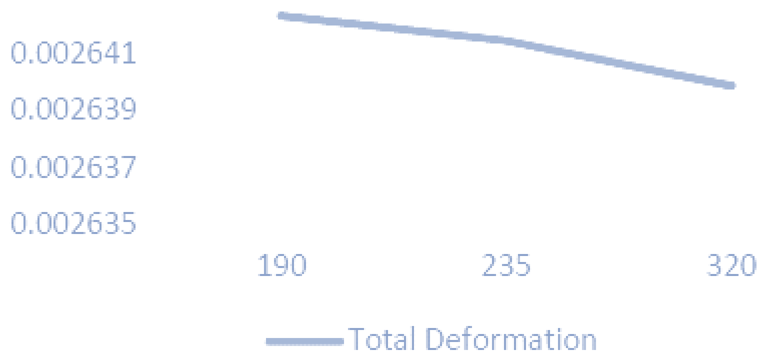


**Figure 12. Total Deformation of Grey cast Iron**

**Graph for Aluminium Alloy**

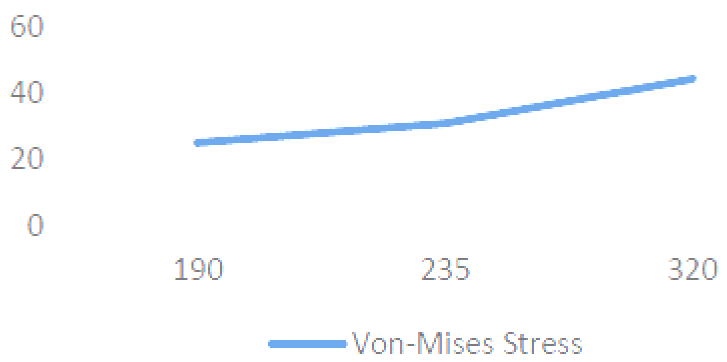


**Figure 13. Von-Mises Stress of Aluminium Alloy**

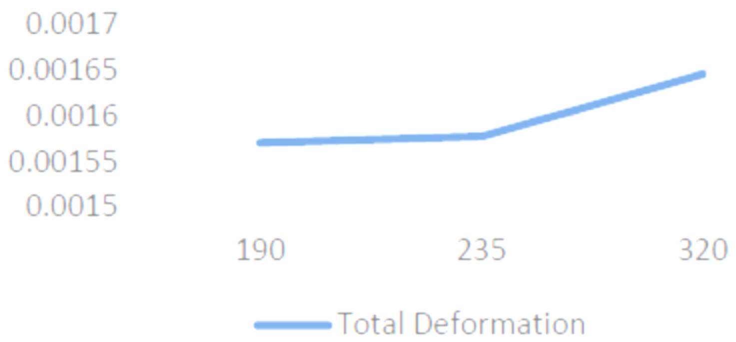


**Figure 14. Total Deformation of Aluminium Alloy**

**Conclusion**

In automobiles and other wheeled vehicles, the differential permits every one of the driving wheels to turn at various speeds, while most vehicles providing equivalent torque to every one of them. A vehicle's wheels pivot at different speeds, essentially when turning corners. The material utilized for the body of the differential gearbox ought to be aluminum compound as it diminishes the weight and the gear ought



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to be comprised of steel because of its solidarity. In the improvement of adjusted differential gearbox various systems can be utilized.

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