CONCEPTUALIZATION AND ANALYSIS OF DIFFERENTIAL GEARBOX

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report "**CONCEPTUALIZATION AND ANALYSIS OF DIFFERENTIAL GEARBOX**" is the bonafide work of"**FRANKLINE AMBRO G(710419114020),RAJA ANNAMALAI S (710419114052) ,SABARINATHAN M(710419114055),SUTHAKAR V (710419114067)**"who carried out the project work under my supervision.

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ABSTRACT

Differential plays an important role in maintaining speeds and torque distribution between the wheels of the automobile. There are number of types of differentials based on the need are available in automobile industry such as Open differential , Limited slip differential (LSD), Locked differential, Torque vectoring differential (VTD).

In the present project work, limited slip differential is considered and the objective of the project is to find out tangential, axial and radial forces involved in meshing of the differential gears theoretically. Finite Element Analysis (FEA) is carried out on Final, Crown, Side and Ring gears made of 20MnCr5 material and running at a speed of 4000rpm and torque of 122N-m.

As a part of FEA, 3D modelling of gears was done in Solidworks 2017 and analysis was carried on ANSYS workbench 14.5. Using ANSYS, von-Misses stresses, deformation and factor of safety are computed for Final, Crown, Side and Ring gears. From the analysis, it is found that the forces and stresses obtained are below the allowable stress of the material considered in designing gears of the differential. Maximum von-Misses stress is for Ring gear and Minimum for Side gears.

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CHAPTER V

RESULTS & DISCUSSION

In chapter III, design calculations for finding out tangential, radial, axial forces and factor of safety are calculated for differential gears of centrally suspended cage-less limited slip differential from the input torque given to the final drive gear. The results are tabulated in table 5.1

Table 5.1 Theoretically calculated forces

Sl.No	Gear name	Tangential Forces (N)	Radial Forces (N)	Axial/Thrust Forces (N)	Factor of safety
1	Final drive gear	1310.89	396.99	264.66	>10
2	Crown gears	2126.127	547.1929	547.1929	6.9
3	Side gears	2126.127	547.1929	547.1929	6.9
4	Ring gear	1310.89	264.66	396.99	>10

Beam and Wear strength of differential gears, safety factors against bending failure and pitting failure are calculated from Tangential forces acting on the differential gears and are tabulated in table 5.2

Table 5.2 Beam and Wear strength of differential gears

Sl. No	Gear name	Beam strength (N)	Wear strength (N)	FS_b	FS_w	Effective load (N)
1	Final drive gear	20,178.32	35,954.53	3.46	6.1714	5825.962
2	Crown gears	11,204.9296	10,800	1.6048	1.5468	4855.786
3	Side gears	11,204.9296	10,800	1.6048	1.5468	4855.786
4	Ring gear	20,178.32	35,954.53	3.46	6.1714	5825.962

The beam strengths obtained above are greater than actual working Tangentialload acting on the differential gears.

The Beam and Wear strength of tooth of the differential gears is more than the effective load between the meshing teeth of differential gears. Hence, the design is safe.

Safety factors against bending and pitting failures are more than 1 and less than 7 to avoid unnecessary weight of Components which increases weight of the differential resulting in increase of the total weight of vehicle.

By conducting static structural analysis on the following differential gears, solutions obtained are maximum and minimum von-Mises stresses and factor of safety. The results obtained are tabulated in table 5.3

Table 5.3 von-Mises stresses

Sl.No	Gear name	Minimum stress (Pa)	Maximum stress (Pa)	Allowable stress (Pa)	Factor of safety
1	Final drive gear	55.588	2.2066e7	5.5e8	>10
2	Crown gears	1766.3	1.5801e8	5.5e8	5.3794
3	Side gears	0.0062892	1.2546e8	5.5e8	6.7753
4	Ring gear	76.257	3.2477e7	5.5e8	>10