

Analysis of Two Stage Reduction Gearbox

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ABSTRACT

An All-Terrain Vehicle is an Off-Road vehicle that has the ability to drive on any terrain without any difficulty. BAJA vehicles are the most famous Off Road vehicles in India. However, due to the extreme loads caused by the gravel track and the constraints to reduce the weight, one major component is susceptible to failure Reduction Gearbox. The Power Train assembly is so complicated that it occupies a lot of space in the vehicle hence increasing the overall weight. The objective of this project is to design a gearbox that is compact, lightweight and has extended life. Major fields covered are Material selection, Machine Engineering Design of Gears, Shafts, Gearbox Casing, bearing selection, Vibrations caused due to the Engine. These analytical designs have been validated through the help of CAD and FEA software like Solid Works and ANSYS. Various Analysis like Structural, repeated loads and have been performed to study the behavior of components and oil flow during operations. The design is also finalized with the fits required for assembly and the final product is expected to be efficient, lightweight, compact and long lasting than the other Gearboxes being used today.

Keywords : Reduction Gearbox, All-Terrain Vehicle, Finite Element Analysis (FEA) & Vibrations

I. INTRODUCTION

A reduction gearbox is a device by which an input speed can be lowered for a requirement of slower output speed, with same or more output torque. Reduction gear assembly consists of a set of rotating gears connected to an output shaft. The high-speed incoming motion from the wheel work is transmitted to the set of rotating gears, where in the motion or torque is changed. The number of gears used in the reduction gear assembly depends on the output speed requirement of the application. The Volvo Group introduced a concept of Automatic Transmissions. It is discussed that Manual Gear boxes are complicated in design and is difficult for the users to drive the vehicle. The power and braking requirements were calculated. On the basis of these requirements and

results, a detailed market study was carried out and suitable materials parts and components were selected. John M. Hawkins simplified the design of a gearbox and made it more compact for usages in low power vehicles like Mopeds and Forklifts. Willis, Christopher Ryan (VTechWorks-79677) have developed a CVT design that can be tuned to a range of Reduction ratios. It has been observed that the origin of noises is from the improper meshing of gears in the assembly.

By studying the gearbox theoretically the various parameters related to the gearbox such as types in the gearbox, single stage, multistage gearboxes etc. can be understood. To Design, Analyze the problems being faced in an ATV and overcome all those flaws. Major flaws include weight, size, and cost. Occasional breakdowns and constant maintenance have been

observed. Design plan includes research and material selection for the Casing, Gears, and shafts. Gear oil selection is also based on market survey and behaviour of fluids at a given temperature range. Once the material is selected, the calculations for minimum dimensions will be calculated. Standard dimensions similar to the minimum dimensions are selected and modeled in CAD software. Various profiles have been created on the components to ensure structural integrity and less weight.

II. MODELING OF THE COMPONENTS

After the detailed study of the gearbox, the calculation of the gearbox will be done by considering various parameters. The reduction ratio is decided according to the comfortable engine provided by considering the FMAEBAJA INDIA event. After the reduction ratio was finalized the diameters of the gears, opinions shaft can be fixed and then the selecting the bearing type as well as sizes for the proper functioning of the gearbox. According to the reduction decided we calculated the teeth for the gears and opinions, also calculated the dimensions for shafts and keys. Finally, after all the above calculations, it is decided with the calculations for the casing of the gearbox. Once the calculations of the gearbox finalized, start the designing of the gearbox virtually on the software such as Solid Works by considering the calculated parameters of the gearbox.

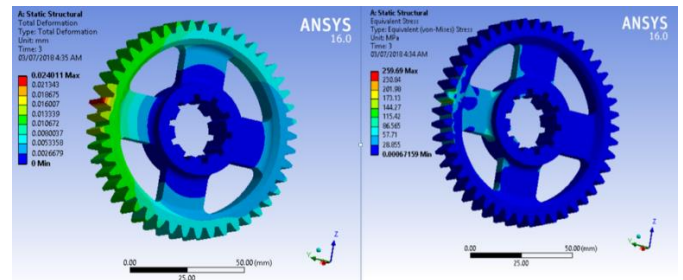
III. RESULTS AND DISCUSSIONS

The results and discussions include static structural analysis on Gears and shafts, vibration and loading the casing, flow analysis using flow simulation.

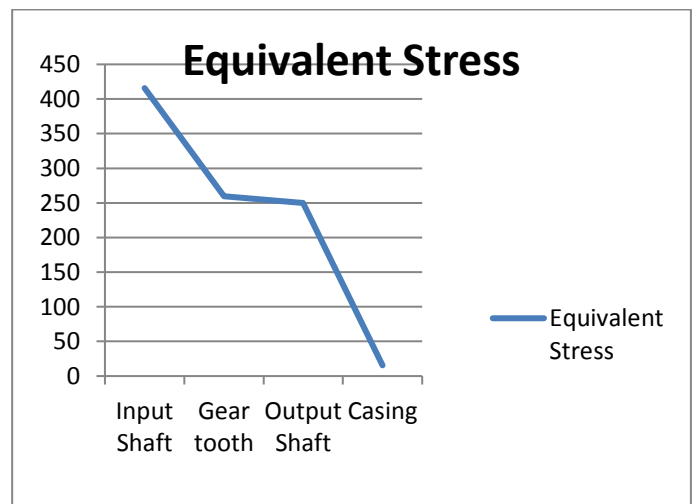
Forces Acting on the Gears

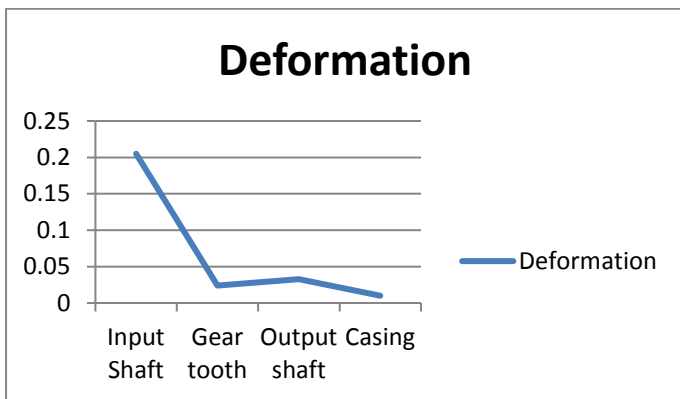
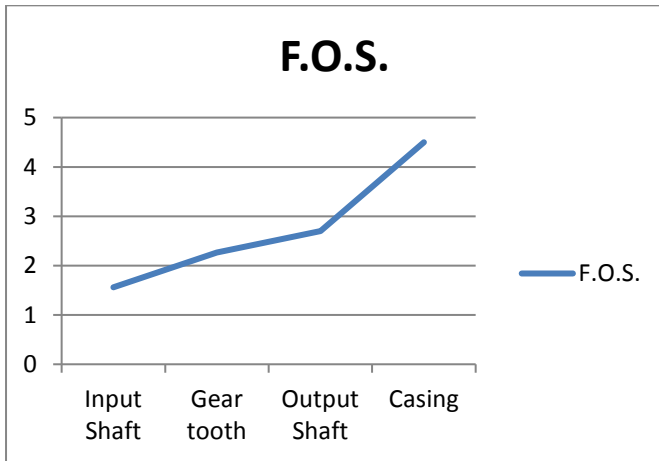
The gears inside are subjected to high torque during the operation. Due to the High Torque produced, the gear is subjected to twisting moment from the center of the axis. Negligible resistance offered by the gear against the torque. However, since there is high

torque variation from the CVT the center of the gear is welded to the shaft, there is moment of Inertia of the Gear may resist the torque for a small amount attached to Roller bearings that have negligible friction, it is essential to perform torque analysis on the gears assuming the shaft is fixed rigidly.



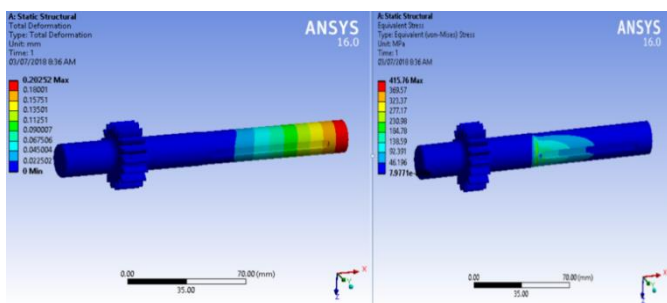
Finite Element Analysis			
Component	Equivalent Stress (MPa)	F.O.S	Deformation (mm)
Input Shaft	415.76	1.56	0.205
Gear tooth	259.69	2.267	0.024
Output shaft	250	2.7	0.0328
Casing	15.50	4.5	0.01





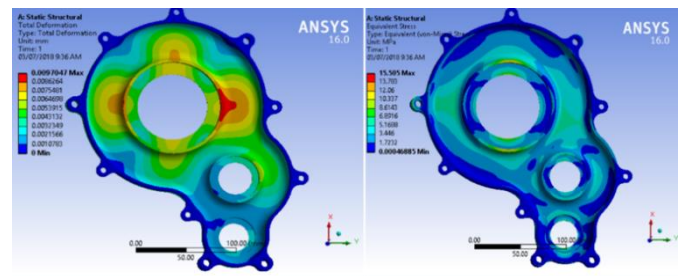
Forces Acting on the Shafts:

The gear is welded to the shaft and then the whole assembly Rotates with the shafts. The shafts are made to roll freely on the bearings with the help of the torque transmitted by the gears. There are three major types of forces act on to press fit of bearings and the weight excreted by the Gears. Since the preload force excreted by the bearings cannot be calculated, the main loads focused on are Torsional Stress. Hence, the summations of both the torques generated by the gears are applied.



Vibration and Loading Effect on the Casing:

The Vibrations produced by the engine is approximately 50 Hz. The vibrations from the engine are transmitted through the CVT and to the input shaft of the gearbox. Practically, there will be many other vibrations because of the rotating CVT. For the safety considerations, it is assumed that the CVT can transmit all the Vibration that is produced by the engine. Additionally, the weight of the inside components and the Gear oil is also added to the addition of vibration to the analysis to make sure that the casing absorbs all the vibrations without disturbing the shafts and bearings due to which eccentricity or misalignment takes place. The material of the casing is 7075 T6 Endurance limit of 121 MPa



IV. CONCLUSION

Today's Gearboxes in All Terrain Vehicles occupy more space, heavy and have limited life based on the operation. Operating these Gearboxes for continuously will produce heat that may affect the structural integrity. The Reduction Gearbox designed to be coupled with a CVT that can vary the transmission ratios. The transmission ratio of CVT reduces as the Engine RPM increases. Based on the analytical calculations and FEA conclude that all the components are not bound to failure within the given working parameters. The Gearbox is lightweight, compact and has increased life over the conventional Manual Gearboxes.

V. ACKNOWLEDGEMENT

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VI. REFERENCES

- [1]. Hohn, B-R., and K. Michaelis. "Influence of oil temperature on gear failures. "Tribology International 37, no. 2 (2004): 103-109.
- [2]. Chetan Wadile, Rohan Dubal, Roshan Kolhe, Versha Rangaswamy, Aqleem Siddiqui &Nitin Gurav (2013), Selection, Modification and Analysis of Power Transmission and Braking System of an ATV, International Journal on Mechanical Engineering and Robotics (IJMER) Vol.1(1)1, pp.97-102.
- [3]. Aditya Patankar, Rohit Kulkarni, Sanket Kothawade and Sameer Ingle (2016), 'Design And Development of A Transmission System For An All Terrain Vehicle', International Journal of Mechanical Engineering and Technology (IJMET) Vol.7(3), pp.351-359. etc.

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