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A DIFFERENTIAL GEARBOX ANALYSIS THROUGH FINITE ELEMENT METHODS

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Abstract

Differential is a part of inner axle housing assembly, which includes the differential rear axles, wheels and bearings. The differential consists of a system of gears arranged in such a way that connects the propeller shaft with the rear axles. The following components consists the differential. Crown wheel and pinion, Sun gears, Differential casing. In the present work all the parts of differential are designed under static condition and modeled. Modeling and assembly is done in Pro/Engineer. The detailed drawings of all parts are to be furnished. The main aim of the project is to focus on the mechanical design and contact analysis on assembly of gears in gear box when they transmit power at speed 2400 rpm. Analysis is also conducted by varying the materials for gears, Cast Iron, and Aluminum Alloy.

The analysis is conducted to verify the best material for the gears in the gear box at higher speeds by analyzing stress, displacement and also by considering weight reduction. The. Modeling is done in the Pro/Engineer. Analysis is done in Cosmos software.

Index Terms—gear box,pro engineer,cosmos software,sun gears,aluminium,cast iron

I. INTRODUCTION

Differential is used when a vehicle takes a turn, the outer wheel on a longer radius than the inner wheel. The outer wheel turns faster than the inner wheel that is when there is a relative movement between the two rear wheels. If the two rear wheels are rigidly fixed to a rear axle the inner wheel will slip which cause rapid tire wear, steering difficulties and poor load holding.The Electromagnetic Single – Wheel Active Suspension System

Supporting the Vehicle Engine is Shown below.

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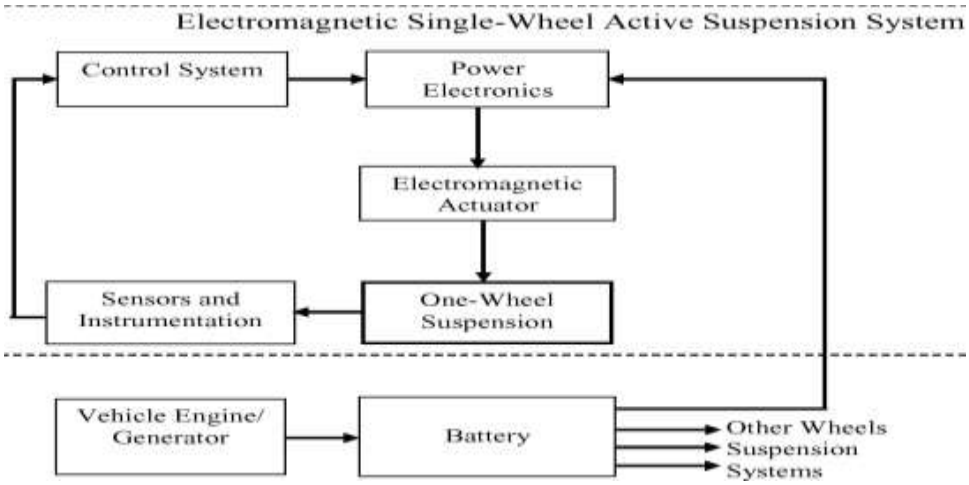
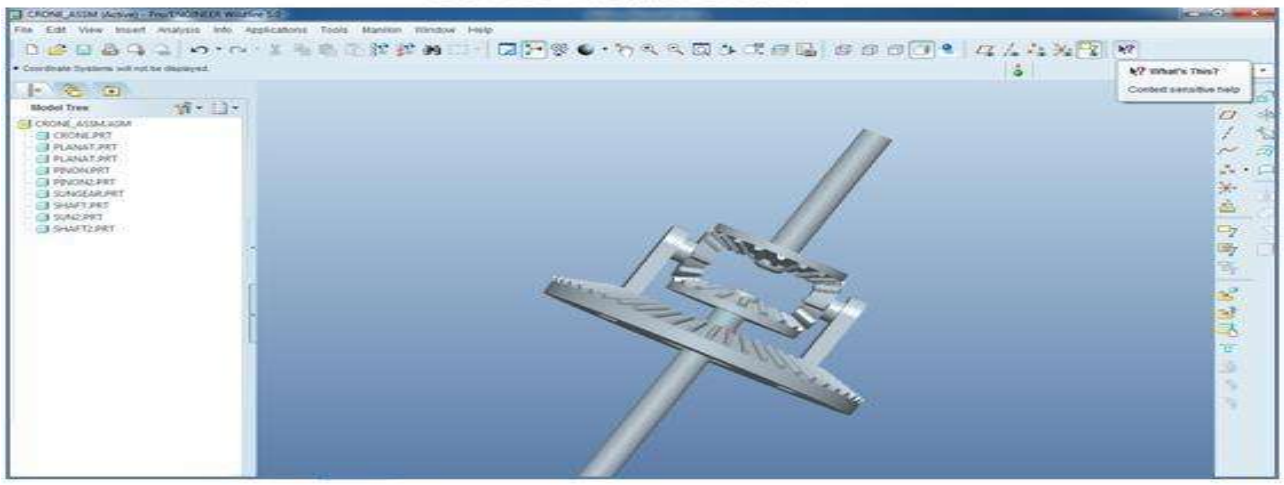


INTRODUCTIONOF PROE/ENGINERRING

Pro/ENGINEER is the industry's standard 3D mechanical design suit. It is the world's leading **CAD/CAM /CAE** software, gives a broad range of integrated solutions to cover all aspects of product design and manufacturing. Much of its success can be attributed to its technology which spurs its customer's to more quickly and consistently innovate a new robust, parametric, feature based model, because the Pro/E technology is unmatched in this field, in all processes, in all countries, in all kind of companies along the supply chains. Pro/Engineer is also the perfect solution for the manufacturing enterprise, with associative applications, robust responsiveness and web connectivity that make it the ideal flexible engineering solution to accelerate innovations. Pro/Engineer provides easy to use solution tailored to the needs of small, medium sized enterprises as well as large industrial corporations in all industries, consumer goods, fabrications and assembly, electrical and electronics goods, automotive, aerospace etc.

Model Designed In PRO/E

CADD Model of a Differential Gearbox Assembly by using Pro-E Wildfire 5.0v



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Mesh Information Details

Total Nodes	39721
Total Elements	21842
Maximum Aspect Ratio	250.8
% of elements with Aspect Ratio < 3	63.3
% of elements with Aspect Ratio > 10	1.11
% of distorted elements(Jacobian)	0

II. BACKGROUND INFORMATION

Name:	**al**_alloy7475-t761	**Name:**	**Malleable Cast Iron**
Model type:	**Linear Elastic Isotropic**	**Model type:**	**Linear Elastic Isotropic**
Default failure criterion:	**Max von Mises Stress**	**Default failure criterion:**	**Max von Mises Stress**
Yield strength:	**1.65e+008 N/m^2**	**Yield strength:**	**2.75742e+08 N/m^2**
Tensile strength:	**3e+007 N/m^2**	**Tensile strength:**	**4.13613e+08 N/m^2**
Elastic modulus:	**7e+010 N/m^2**	**Elastic modulus:**	**1.9e+011 N/m^2**
Poisson's ratio:	**0.33**	**Poisson's ratio:**	**0.27**
Mass density:	**2600 kg/m^3**	**Mass density:**	**7300 kg/m^3**
Shear modulus:	**3.189e+008 N/m^2**	**Shear modulus:**	**8.6e+010 N/m^2**

Introduction to COSMOS:- Cosmos works is useful software for design analysis in mechanical engineering. That's an introduction for you who would like to learn more about COSMOS Works. COSMOS Works is a design analysis automation application fully integrated with Solid Works. This software uses the Finite Element Method (FEM) to simulate the working conditions of your designs and predict their behavior. FEM requires the solution of large systems of equations. Powered by fast solvers, COSMOS Works makes it possible for designers to quickly check the integrity of their designs and search for the optimum solution.

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Cosmos Results:-

The vonmisses stress results obtained from cosmos software are shown below.

III. MAIN RESULT

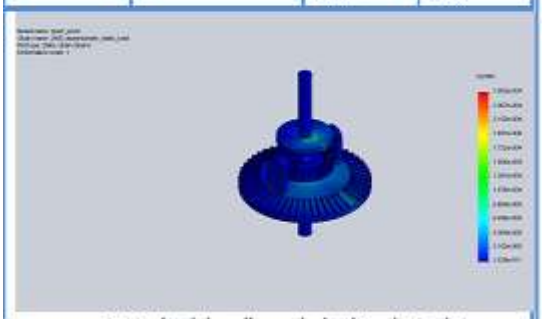
Name	Type	Min	Max
Stress1	VON: von Mises Stress	8.11597e-007 N/mm^2 (MPa) Node: 33574	19.8068 N/mm^2 (MPa) Node: 20475

2part_assm-2400_aluminiumally_static_load-Stress-Stress1

Name	Type	Min	Max
Stress1	VON: von Mises Stress	2.37779e-007 N/mm^2 (MPa) Node: 38267	3.57544 N/mm^2 (MPa) Node: 20365

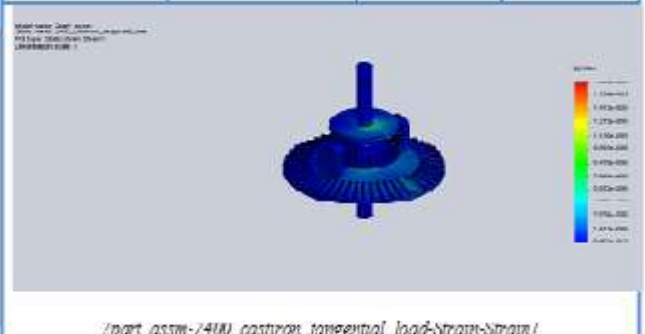
2part_assm-2400_castiron_tangential_load-Stress-Stress1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.52786e-011 Element: 20107	0.000258239 Element: 1069



2part_assm-2400_aluminiumally_static_load-Strain-Strain1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	9.901.77e-011 Element: 21285	1.99336e-007 Element: 9903



2part_assm-2400_castiron_tangential_load-Strain-Strain1

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IV. RESULTS

TANGENTIAL	Aluminum Alloy	Cast Iron
LOAD (N)	2922.51	3243.08
DISPLACEMENT (mm)	0.0241696	0.0100566
STRESS (N/mm^2)	3.19018	3.57544
STRAIN	4.1593e^{-5}	1.69558 e^{-5}
STATIC		
LOAD (N)	18143.3	37933.7
DISPLACEMENT (mm)	0.150063	0.11763
STRESS (N/mm^2)	19.8068	41.8212
STRAIN	0.000258239	0.000198329

V. CONCLUSION

In the present work designed a differential gear box for Ashok Leyland 2516M. Loads are calculated when the gears are transmitting different speeds 2400rpm, and different materials Aluminum Alloy and Cast Iron.
Structural and Frequency analyses are done on the differential gear box to verify the best material by taking in to account stresses, displacements, weight etc.
By observing the structural analysis results using Aluminum alloy the stress values are within the permissible stress value. So using Aluminum Alloy is safe for differential gear. When comparing the stress values of the two materials for speed 2400rpm, the values are less for Aluminum alloy than Cast Iron.
By observing the frequency analysis, the vibrations are less for Aluminum Alloy than other two materials since its natural frequency is less.
And also weight of the Aluminum alloy reduces almost 3 times when compared with Cast Iron since its density is very less. Thereby mechanical efficiency will be increased.
By observing analysis results, Aluminum Alloy is best material for Differential.

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