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ANALYSIS AND OPTIMIZATION OF AN ALL TERRAIN VEHICLE (ATV)

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Abstract: *The aim of this study is to do a analysis of and ALL TERRAIN VEHICLE and make calculations of analysis. The focus has been laid on the simplicity of design and its high performance. The design and development comprise of material selection, chassis and frame design, design of various components of power train, suspension and wheel assembly, braking system and steering system. During the entire design process, an innovative idea was always the primary goal.*
For performing a analysis, there is a need for a 3d model, for which we use SOLIDWORKS 2018. Its user friendly UI and feature packed software lets us design and make changes in the 3d model on the go. It also allows adding material specifications which is of utmost importance for analysis. Our vehicle dimensions are according to the BAJA SAE INDIA rule book. The main focus of the paper leans towards the durability of the vehicle for different materials uneven circumstances. Again this allows us to choose the material wisely, ex .Economically and most important the materials should reach the required standards of the ATV.

Keywords - *Solidworks, analysis, Design, SAE INDIA, Optimization.*

1. INTRODUCTION

Computer-aided engineering (**CAE**) is the broad usage of computer software to aid in engineering analysis tasks. It includes finite element analysis (FEA), computational fluid dynamics (CFD), multibody dynamics (MBD), durability and optimization. Computer aided engineering primarily uses Computer Aided Design (CAD) software, which are sometimes called CAE tools. CAE tools are being used, for example, to analysis the robustness and performance of components and assemblies. The term encompasses simulation, validation, and optimization of products and manufacturing tools. In the future, CAE systems will be major providers of information to help support design teams in decision making. Computer-aided engineering is used in many fields such as automotive, aviation, space, and shipbuilding industries.

CAE areas covered include:

- Stress Analysis on components and assemblies using Finite Element Analysis (FEA);
- Thermal and fluid flow analysis Computational Fluid Dynamics (CFD);
- Multibody Dynamics (MBD) and Kinematics;
- Analysis tools for process simulation for operations such as casting, moulding, and die press forming.
- Optimization of the product or process.

The Software used for CAE Analysis are ANSYS, MATLAB, HYPERMESH etc. The Ansys structural analysis software enables you to solve complex structural engineering problems and make better, faster design

decisions. With the finite element analysis (FEA) solvers available in the suite, you can customize and automate solutions for your structural mechanics problems and parameterize them to analyze multiple design scenarios. You can also connect easily to other physics analysis tools for even greater fidelity. Ansys structural analysis software is used across industries to help engineers optimize their product designs and reduce the costs of physical testing.

2. LITERATURE REVIEW

P. Vivekanandan, A. Vishnu, S. Pradeep, R.Sambasivam– In this paper he has discussed about how he dealt with the challenges faced in the design of the chassis. There was a special learning curve mentioned by him that the further the mass is kept away from the neutral axis the more rigid the frame will be. Their whole study attempted to analyze the stress on the chassis using the finite element analysis

William B. Riley and Albert R. George– In this paper he has discussed about a variety of issues related to frame and chassis design. A simple mathematical model was developed for comparing the structural stiffness to gain insight into proper design targets for the vehicle structure. The model was constructed on the ANSYS and some experimental methods were presented which best captured the load parts, suspension contributors

Upendra S. Gupta, Sumit Chandak, Devashish Dixit - In this paper, it provides in-detail description of the design considerations, static & dynamic analysis and mathematical data involved in the design of a ATV Vehicle. The focus has been laid on the simplicity of design, high performance, easy maintenance and safety at very reasonable prices. The design and development comprise of material selection, chassis and frame design, cross section determination, determining strength requirements of roll cage, stress analysis and simulations to test the ATV against failure

M. Senthil Kumar, C.D. Naiju, S. J. Chethan Kumar, Joseph Kurian–In this paper, the study is focused on analyzing the existing chassis design and the noise, vibration and harshness (NVH) characteristics are studied. Modeling of chassis structure is carried out using 3D modeling software SOLIDWORKS and finite element model is created by meshing using ANSYS software.

Denish S. Mevawala, Mahesh P. Sharma, Devendra A. Patel, Darshan A. Kapadia – In this paper the focus is mainly on the roll cage. The roll cage adds to the aesthetics of a vehicle. So determining strength requirements of roll cage, stress analysis is carried out using FEA software ANSYS workbench. This paper deals with design of roll cage for an ATV and Various loading tests like Front Impact, Side Impact and rear impact have been conducted. The modeling and stress analysis is done by ANSYS software. We have focused on every point of roll cage to improve the performance of vehicle without failure of roll cage.

Dr.V. K. Saini, Sunil Kumar, Vishal Choubey - Their study compared the material AISI 1018 and AISI 4130 and proved how AISI 4130 is the optimum choice for the structural members of the roll cage. Choosing this material helped us achieving good strength and also maintaining low weight as well.

Akshay Pawar, Suraj Sambre -All the calculations for designing steering system were referred from this particular paper. Objective of achieving better directional stability, minimum turning radius, less steering effort and minimal bump steer was made possible by referring this paper.

3. PROBLEM DEFINATION

As per the name an **ALL-TERRAIN VEHICLE (ATV)** is designed to run and maneuver on different terrains or in other words we can say that an ATV is designed especially for off-roading purpose. In off roading condition, we came across various load which are finally transmitted to the frame of the vehicle. As the off-roading considered, the component and frame of an ATV came across various forces, which should be sustain by the component. ATV have a wide range of applications nowadays like in Military, Forest departments, Farming, etc. The project is to design an ATV by calculating all the required parameters, designing CAD model of each component and make necessary analysis on ANSYS software. In order to make a safe and light weight vehicle we do optimization. Optimization would be on the basis of safety of the driver i.e. strength of the component, weight of the vehicle should be reduce to improve the performance, and also cut off the cost.

4. PROPOSED METHODOLOGY

As we discuss above , we mainly focus on the optimization of the component of the atv. The optimization can be done by two method –

1. Design optimization
2. Material optimization

We do analysis on the several components of atv on the ansys software to check whether the material or design is safe or not .
We also check the stress generated , deformation etc on the component as per which we optimized the components.

The parts and type of Analysis are shown in the table below-

Table No. 1- Part and Type of Analyasis

PARTS	**ANALYSIS**
Roll cage	Impact Test, Roll over, Collision
Suspension	Bumping force analysis
Knuckle	Fatigue analysis
Hub	Fatigue & Torsional analysis
Driveshaft	Torsional analysis
Brake Disc	Thermal & Fatigue analysis
Gears	Static analysis

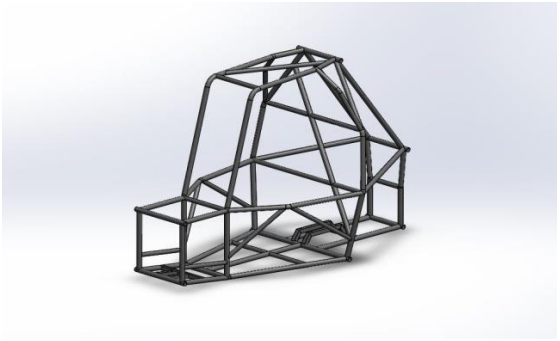

Fig.1- Roll cage

Fig.2- Hub

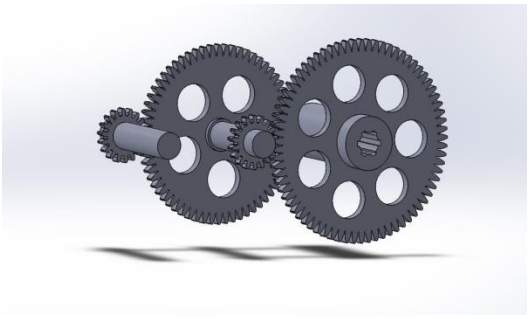

Fig.3- Gear Assembly

Fig.4- Disc Brake

5. CONCLUSION

Considering the safety factor, all the analysis of the component can be done in the ANSYS. The purpose of this project is not only to design and manufacture components of the ATV, but also to get an in-depth study in the process taken to arrive at the final design. The Optimization of ATV is done on the basis of strength of the components, weight reduction, cost etc.

REFERENCE

Journal Papers:

[1] Nitin S Gokhale, Sanjay S Deshpande, Sanjeev V Bedekar, Anand N Thite**,** "Practicalfinite element analysis", *J*anuary 2008

[2] Richard G Budynas, Keinth Nisbett J, 2011, Shigley's Mechanical engineering design book (Mc - Graw Hill), Ninth edition

Books:

[3]Gillespie, Thomas D., *Fundamentals of Vehicle Dynamics* (Society of Automotive Engineers, Inc., Pennsylvania, 1992)