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DESIGN AND ANALYSIS OF ALL TERRAIN VEHICLE

Engineering

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ABSTRACT

This study aims to design and analysis of all-terrain vehicle (ATV) in accordance with the SAE BAJA rule book. A detailed designing of components is carried out like roll cage, suspension etc. The main focus of our study was on safety of driver and stability of vehicle. Roll cage of our vehicle is designed in such a way that, in case of rolling of vehicle, it will provide the double strength to the vehicle without causing any harm to the driver with also considering the aesthetic of the cage. Finite element analysis is carried out on the vehicle by using software like SolidWorks, ANSYS etc. The objectives of the project are, calculation of stresses acting on the chassis of the vehicle under different loading conditions and deciding the cost efficiency of such product in terms of large scale manufacturing i.e. final product. The product can prove to be very efficient product in its all aspect such as cost, durability, maintenance, easy usage, better transportation medium in rough terrains et

KEYWORDS

Durability, Analysis, Roll Cage, Finite Element Analysis, Ansys.

INTRODUCTION

In today's world everyone require a cost efficient solution. We have seen many ATVs designs made from steel and from many other material. ATVs are best suited for making quick turns. They operate well in tight woods, and are great for situation that call for quickly hopping on and off the vehicle of hauling small cargo load. ATVs are typically cheaper than UTVs and they are getting high tech with the addition of power steering, independent suspension.

The objective of the study is to design a safest vehicle for driver. The roll cage is designed in accordance with the SAE BAJA rule book. 3D assembly of the whole vehicle is modelled in a SolidWorks software. The driver's Ingress/egress time should be sufficient as per the rule book. Based on the obtained results the design is modified accordingly. The length of the vehicle was kept small so as to reduce the weight of vehicle and maintain a desired center of gravity, while the width of the vehicle was kept suitable to maintain stability of the vehicle.

DESIGN ANALYSIS REFERENCES

Optimization of chassis of an All-Terrain Vehicle by Junaid Farooq, studied chassis of ATV. The paper deals with design of chassis frame for an all-Terrain Vehicle and it's Optimization. Various loading tests like Front Impact, Rear Impact, Side Impact and Roll Over test etc. have been conducted on the chassis and the designed has been optimized by reducing the weight of the chassis. Rahul Dev Gupta and other in their paper "Design and development for roll cage of All Terrain vehicle" studied aims to give an introduction t the material selection procedure and various tests that need to be done before finalizing the design. Simulation Aspects of a full car ATV model semi active suspension written by Kasi Kamalakkannan studied, modeling and simulation and testing procedure of All Terrain Vehicle fitted with SAS, which is used in BAJA SAEINDIA standards. Various factors such as impact force determination, loading points, the mesh size dependence of generated stress, deformation and factor of safety are studied.

DESIGN AND GENERAL LAYOUT

The design of the vehicle is made such that, It would be simple in design to make it easy to fabricate. It should be appropriate as per the design requirements. It should take the weight of the engine and driver also. It should give the driver a comfortable posture while riding the ATV so as to give out better drivability quotient. The chassis should be fabricated in such a way that there would be space good enough to carry out routine maintenance work. The design and fabrication work should cost and time efficient.

VEHICLE SPECIFICATIONS

Maximum length of chassis: 1866.67 mm
Maximum width of chassis: 815.39 mm
Maximum height of chassis: 1176.27 mm

DESIGN CONSIDERATION

We selected to use SOLIDWORKS to design three dimensional model of the chassis. The design software allowed to visualize the design in 3-D space and reduce the error in fabrication. The main criterion in chassis design is to achieve perfect balance between a spacious and ergonomics drive area with easy ingress and egress, and compact dimensions to achieve the required weight and torsional rigidity criteria.

After a series of design changes; with consequent finite elemental analysis using SOLIDWORKS simulation, the final chassis was decided upon.

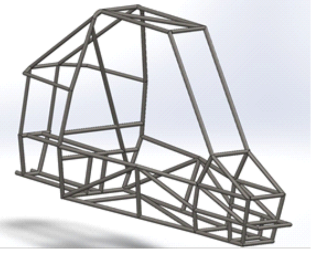

Figure 1: SolidWorks Design

Although there is added cost associated with out sourcing tube bending, this cost is offset by a reduction in fabrication man hours through decreasing the amount of welded joints and eliminating man hours and material needed to fabricate for fit-up.

The need for the LFS and SIM members to pass through the mounts also reduced the number of fixtures needed for maintaining dimensional accuracy.

TABLE – 1 ROLL CAGE DESIGN

Roll Cage Material	AISI 1020
Yield Tensile Strength(N/m^2)	3.51e+08
Ultimate Tensile Strength(N/m^2)	4.21e+08
Modulus Of Elasticity	2e11
Poisson's Ratio	0.29
Density(kg/m^3)	7900

The frame needs to withstand any collision that it might be subjected to as part of the testing process of competition. To ensure driver safety, required frame strength, five impact scenarios were analyzed to ensure the frame design will not fail.

IMPACT ANALYSIS

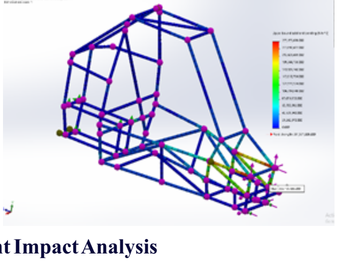

Figure 2: Front Impact Analysis

TABLE – 2 Theoretical Calculation

Parameter	Value
Stress	255.15×10^6
Deformation	0.772
Factor of Safety	1.378
Loads	20000

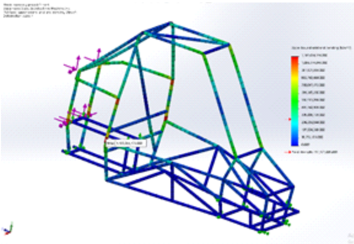

Figure 3: Rear Impact Analysis

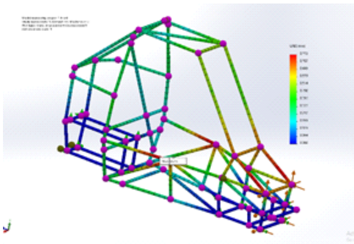

Figure 4: Deformation Analysis

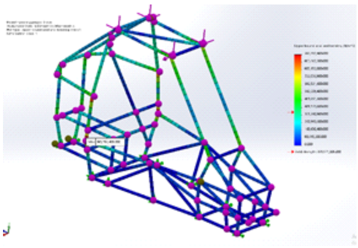

Figure 5: Topple Effect

CONCLUSIONS

The material used are assumed to be reliable and less costly than the available market ATV. All the values of stresses and displacement were found to be safe and within limits by practical and theoretical calculation, so we can say that our design is safer and by iterations we can also conclude that ergonomically better.

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