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A Review on Dynamic Analysis of the Suspension System used in a All Terrain Vehicle

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ABSTRACT

The purpose behind the design of this suspension system is to control camber and toe (based on iterations) with maximum damping and minimum wheelbase and track width change. Suspension system plays an important role in handling of the vehicle. This paper deals with the design and analysis of the parts used in the suspension system of an ATV in front and in rear. This study summarizes in brief the design parameters, targets and considerations followed for the fabrication and assembly of the system. The suspension system plays an important role in stability of the vehicle in static and dynamic conditions.

***Key Words:** Isolation of masses, Double Wishbone, Multi-point, Force Interaction, Spring tuning, Material selection and analysis.*

1. INTRODUCTION

Suspension is defined as isolation of two masses hence while designing suspension, a balanced design should be provided in order to carry out functions like road holding, load carrying and passenger comfort. It consists of arms, damper, spring, joints, tire, knuckle and hub. it is necessary to design a suspension system that can handle the roughest of terrain and endure extreme force conditions without affecting the vehicle's stability and at the same time also provide a smooth ride to the driver. Suspension system is an important part of vehicle which provides comfort, control and safety to the passengers. It allows vehicle to travel over rough surfaces with minimum up-and-down body movement. so it has been decided to go for the double wishbone in front and h-arm in rear with a dual rate spring system, so that it can sustain the design load and give excellent comfort and control over the off-road, providing safety to the driver.

2. LITRETURE REVIEW:

Mr. Prashanthasamy R.M.T and et al., (2016) [1] concluded that stresses and deformation is maximum in the existing design with AISI 1040 of 218 MPa and 2.062 mm respectively. The stresses and deformation for the existing design with aluminum alloy is almost maximum compare to AISI 1040. In the existing design of wishbone suspension arm is completely hallow and it is welded joint, due to which there is a chances of fracture at the welded joints.

M. Sridharan et al., (2016) [2] in his paper deals with the reduction of unsprung mass of vehicle by topology optimization of lower control arm. For analysis existing lower control arm of Mac-Pherson suspension system is selected. On the basis of stress developed, topology optimization is carried out by removing excess material from CAD model. Lower control arm is redesigned and is analysed for stress distribution and deformation. It is observed that total reduction of weight in existing model is found to be 13.46 %.

John C. Dixon (2009) [3] explained that the need for suspension arises because of the roll and pitch associated with vehicle manoeuvring, and from the roughness of roads.

Jörnsen Reimpell et al., (2002) [4] said that the suspension of modern vehicles need to satisfy a number of requirements whose aims partly conflict because of different operating conditions(loaded/unloaded, acceleration/braking, level/uneven road, straight running/ cornering).

William F. Milliken, Douglas L. Milliken (1995) [5] said that suspension linkages are expected to position the knuckle very accurately in all directions while allowing it to move up and down against the spring shock.

Morishita, M et al., (1989) [6] In his paper discussed as a power-saving electromagnetic suspension system has been developed in which electromagnets with permanent magnets are used to suspend the vehicle. The electromagnets are controlled to maintain air gap length so that the attractive force by the permanent magnet always balances the total weight of the vehicle and its loads, based on modern control theory. This technology realizes a significantly power-saving system in which the electromagnetic coil current required to keep a vehicle levitating was extremely small, ideally zero. The 8-kg weight test vehicle with 4-kg load could be levitated continuously over 8 h, without recharging the on-board 1300-mAh batteries. This technology realized a

completely contact-free material transportation system when combined with a contact-free driving system using linear motors. The attractive force characteristics of a permanent magnet with control electromagnets and the newly developed electromagnet control system that can eliminate collecting devices from the electromagnetic suspension system are described.

Mizuno, T. and Y. Takemori (2000) [7] A new vibration isolation system is proposed which uses zero-power magnetic suspension. Since a zero-power system behaves as if it has a negative stiffness, combining it with a normal spring can generate infinite stiffness against disturbances on the isolation table. It enables the system to have good performance both in reducing vibration transmitted from ground and in suppressing direct vibration. The basic characteristics of the proposed system are studied both analytically and experimentally.

Vinayak Kulkarni et al.(2000) [8] according to him "Finite Element Analysis and Topology Optimization of Lower Arm of Double Wishbone Suspension using RADIOSS and Optistruct" May 2014, this paper deals with calculating the forces acting on lower wishbone arm while vehicle subjected to critical loading conditions. Suspension geometry and suitable materials for the suspension arm has been identified. Lower arm suspension has been modeled using Pro Engineer. Von mises stress –strain is carried out in order to find out maximum induced stress and strain. 2

3. PROBLEM DEFINATION

The conventional buggies had a mono suspension at the rear wheels that will make both the wheels up or down as per the terrain conditions. This makes one of the wheels to leave the ground contact unnecessarily. When the buggy bounces on the rough terrain one transmission wheel should be on ground so as to gain control over vehicle. A solid design methodology that uses the time, resources, talent and research available to produce a competitive vehicle has not been established. This is attributed to the infancy of the program; many hours have been spent acquiring resources and research for the betterment of the organization.

4. METHODOLOGY

Chart1: Design methodology

The tire dimensions decided was 23*7*10 for the better traction, ease of assembly of component, low unsprung mass and the rim is offset by 1.5 inches and uniform bolt dimensions for interchangeability. The arms were decided to keep as long as possible for the stability of the vehicle and minimize the variations in geometry. The length of the upper arms was decided through geometry modeling, shorter upper arm meant negative camber in bump travel and optimum roll-camber coefficient.

The design of suspension begins with considering some important factors. The requirement for a good suspension system is to select good dampers, types of suspension system considering which is best suited for the current chassis design and steering system.

5. CONCLUSION

The paper describes about designing and analyzing suspension of all terrain vehicle (ATV) and their integration in the whole vehicle. The ATV has been designed and analyzed based on the facts of vehicle dynamics. The primary objective of this paper was to identify the design parameters of a vehicle with proper study of vehicle dynamics. This paper also helps us to study and analyze the procedure of vehicle suspension designing and to identify the performance affecting parameters. It also helps to understand overcome the theoretical difficulties of vehicle design.

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