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Design And Manufacturing Of Semi Trailing Arm Suspension System

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Abstract : ATV is a principally an off- road vehicle with capability to repel harsh road conditions. Stability, control, performance, and comfort these are the introductory conditions for an ATV. Suspension system is one of the important systems which is responsible for fulfilment of introductory conditions. This paper is grounded on design and development of semi-trailing arm suspension for ATV. The report describes the methodology followed to design a system and analysis of suspension factors witnessing major forces during dynamic conditions. The main ideal is to design and develop a suspension system which improves overall performance and handling parcels of ATV. The main idea behind the paper is to design, assay as well as pretend the semi running suspension system figure installed in the reverse of an All-Terrain Vehicle (ATV). The Suspension system which is the most important constraint for running has experienced a substantial quantum of development in the history. Therefore, the content is concentrated on designing the forenamed suspension system incorporating dynamics of the vehicle with furnishing optimum performance of the vehicle while maximizing motorist comfort. Parameters like camber, wheel trip, roll centre were estimated to attain the asked performance. The system was designed from scrape using computations in CATIA, followed by arms in solidworks. The factors were analysed in Ansys software and the complete figure was dissembled in Lotus Suspension Analysis software**.**

Keywords - *Half shaft geometry, independent suspension, SAE BAJA, Semi-trailing arm, Structural analysis, Suspension geometry. ATV, Catia, Ansys, Lotus Suspension Analysis*

I. INTRODUCTION

Semi-trailing arm suspension is multilink independent suspension system which provides better lift control and stability to vehicle. The design of suspension system should be suitable to sustain at worst condition. The main target is to design the suspension system which can give further comfort, light weight, better running, better shock absorbing capacity, vehicle stability, less complex system. By taking all these considerations we design suspension system which gives us better performance and also the cost effective. This report is grounded on step-by step design methodology. ATV is design and manufactured for competition purpose which demands a vehicle which is suitable to survive worst road conditions. Suspension system plays major part in control and stability of vehicle. Semi-trailing arm as hinder suspension has numerous advantages over other suspension types. Objects of suspension system 1. To minimize shocks and climate being due to road irregularities and give comfort to motorist. 2. To give cornering stability to vehicle. 3. To maintain ground concurrence. 4. To give stability during dynamic conditions. 5. To repel pitch, roll and yaw movement of vehicle. Advantages of semi-Trailing Arm Suspension 1. As semi-trailing arm suspension is a 3- link independent suspension it provides better lift quality and running. 2. In semi-trailing arm suspension during the suspension movement the camber angle changes, as a result the tires remain vertical to the ground during body roll. 3. Lower cost, lower complexity and further conciseness. 4. It provides more side cargo running capacity. 5. More anti-squat properties.

II. LITERATURE REVIEW

This chapter literature review of dissertation work includes study of design and analysis of trailing arm. Following is a list of researchers who has worked in this area of trailing arm and optimization Kali Charan Rath, Debasish Shee, "Some Aspects of CAE for Modelling and Analysis of Trailing Arm of Auto-Rickshaw",

International Journal of Emerging Trends in Engineering and Development Issue 3, Vol.6 (November 2013) ISSN 2249-6149 In this paper, author has performed structural and modal analysis on trailing arm of auto rickshaw. Torque, torsional stiffness, bending stiffness has been calculated. Analysis by assigning suitable material, properties is done in Ansys. Output of analysis results was stress and deformation which were found well within the safe limit. Mr. Milind M. Gore, Dr. B. P. Ronge, Prof. N. D. Misal, "A Review Paper on Design and Analysis Of System Of Three Wheeler", International Journal of Application or Innovation in Engineering &Management, Volume 4, Issue 5, May 2015 ISSN 2319 – 4847.

The authors have studied vibrational analysis on three wheeled vehicles (TWV). Aniket Thosar, "Design, Analysis and Fabrication of Rear Suspension System for an All Terrain Vehicle", 2229-5518. All-Terrain Vehicle (ATV) is defined by ANSI as a vehicle that travels on low pressure tires, which is used to handle any kind of terrain it faces. The paper focuses on design of rear suspension system for an ATV.

The paper covers simulation, modelling and analysis of suspension geometry. Suspension is designed such that it provides better handling and better comfort for an ATV. S. Pathmasharma, J.K. Suresh, P. Viswanathan, R. Subramanian, "Analysis of Passenger Car Suspension System Using Adams", International Journal of Science, Engineering and Technology Research, Volume 2, Issue 5, May 2013, ISSN: 2278 – 7798.

This paper discusses about the analysis of the existing of the suspension system and improved design is suggested for achieving maximum comfort. Passenger vehicle suspension system data from the existing vehicle are collected and a model is created using UG. Automatic dynamics Of Mechanical System (ADAMS) has become an important feature of roadside hardware design and analysis in recent year. Using ADAMS analysis of existing model is carried out to determine the forces acting on components of suspension system.

III. PROBLEM DEFINITION

The exploration paper shows the design and analysis of the semi running arm suspension of an ATV vehicle which then's specifically designed to be antique- fitted on being E-ATV vehicle running on double wishbone suspension in the rear. This study was substantially arised due to ground concurrence issue running out after taking hugh potholes under its stride and suspension system bottoming out due to hinder end weight of the vehicle. By introducing semi trailing arm suspension system to the rear of the vehicle, we introduce further suspension trip to the entire system and wheel geste in the rear during bounce and rejounce. Therefore perfecting riding dynamics, stability, and further concurrence on perpendicular impact. It also reduces redundant weight from the system which was due to double wishbone suspension hence perfecting overall performance due to weight reduction and bettered power to weight ratio. Objective-To Design and fabricate semi trailing arm suspension for E-ATV which will replace being double wishbone suspension with the use of solidworks, lotus, ansys in 3D modelling stages and latterly using multiple manufacturing tools to fabricate the system to delicacy.

IV. METHODOLOGY

First step in suspension design is to decide wheel base and wheel track. As per the rule mentioned in BAJA SAE rulebook maximum dimension is within limit of 64in width by 108in length. So, wheel base kept minimum to minimize turning radius and track width also kept moderate according to wheel base to maintain stability during maneuver. Also we did load transfer iteration for different wheel base and wheel track and CG height combination and for balanced load transfer we come up with following values: Wheelbase =56in and Wheel track=52 in It will results in minimum load transfer and also leads to better stability. Semi-trailing arm suspension geometry After deciding vehicle dimensions next important part is suspension geometry. Suspension geometry is one which is directly affect on performance of system. Therefore, it is very important to design geometry with all considerations achieve system objectives. For semi trailing arm geometry, we take some considerations like ground clearance, wheel dimensions, and upright dimensions. According to this we draw geometry in Catia software. The angle for semi-trailing arm is adjusted according to roll Centre height. For rear we are using Fox float Evol R. Half shaft geometry When the driving wheels of a vehicle have independent suspension, which means that each wheel can move up and down independently of the other, then you will find that the transmission will be hard mounted to the frame, and "half-shaft" axles will connect between the transmission and the driving wheel. This axle has CV (constant velocity) joints on both ends. CV joints allows some degree of freedom to the axle so as per independent motion of suspension axle can be adjust without loss in power/torque. According to the suspension geometry half shaft geometry is designed to check the working range of CV joints. CV joints has 2 inch of lateral plunging moment also it can vary its own length by ±1 inch. From the geometry length and the inclination angle of half shaft is decided. Inclination of angle from CV joints can be works till 35°, after that there

may be problem with insufficient plunging moment results in loss in integrity of the CV joints. Maintenance of these CV joints are plays important role for better life. CV joint boots are used to cover protect the joint, which is nothing but rubber sleeves around the CV joints. The boots keep grease in debris out. In geometry we get the travel of the half shaft along with wheel travel. The plunging moment of the half shaft is 1.5inch and angle of inclination is 24°. Design of semi-trailing arm Design of semi-trailing arm and upright is done as per length and other required dimensions obtained from geometry. Modelling of semi-trailing arm and upright is done in solidworks. Material selection Material selection is important for design of any component. By comparing different materials, we select AISI 4130 material for semi-trailing arm and Al7075 t-6 for upright and hub. These materials have significantly higher ultimate tensile strength and yield strength as compared to other materials. Damper Fox float evol-r Advantages: In fox float Evol-r load optimizing air technology is used instead of spring it allows us to change the stiffness and to change ride height according to our design. Due to this, we can easily achieve CG height. It is made from Al6061-T6 material which makes it light weighted.it gives us variable stiffness which we can achieve by simply adjusting the pressure in the main chamber and evol chamber. Some main advantages of fox are following: 1. Lightweight. 2. Better damping capability than spring. 3. Better shock-absorbing capacity. 4. Adjustable stiffness Wheelbase-56in Wheel track-52in Ride height-12in CG height-20.12in Wheel travel rear bump-4 in Wheel travel rear droop-2 in Roll center height rear-8 in Wheel travel Rear6in Suspension travel-5.3in Motion ratio Rear-0.8 Spring rate (N-mm) Rear-19.86 Natural frequency (Hz) Rear-2.64Ride rate (N-mm) Rear: 18.4

V. RESULT AND CONCLUSION

When undertaking design of any vehicle; There are several factors to be considered that are common to all engineering vehicles. A vehicle must have proper scope with clearly defined goal. With such an approach, engineers can come up with the best possible product for the society. The chosen design is the safest and the most reliable car for any long terrain. All the parameters like safety, cost, reliability, performance, durability, standard dimensions and material were also taken in consideration on the same time. Catia V5, Ansys, solid works were used to get more clear and accurate output of designed parameters to meet high accuracy and to reduce any type of any unlike situation

REFERENCES

[1] Kali Charan Rath, Debasish Shee, “Some Aspects of CAE for Modelling and Analysis of Trailing Arm of Auto-Rickshaw”, International Journal of Emerging Trends in Engineering and Development Issue 3, Vol.6 (November 2013) ISSN 2249- 6149.

[2] Mr. Milind M. Gore, Dr. B. P. Ronge, Prof. N. D. Misal, “A Review Paper on Design and Analysis of System of Three-Wheeler”, International Journal of Application or Innovation in Engineering & Management, Volume 4, Issue 5, May 2015 ISSN 2319 – 4847.

[3] Aniket Thosar, “Design, Analysis and Fabrication of Rear Suspension System for an All-Terrain Vehicle”, International Journal of Scientific & Engineering Research, Volume 5, Issue 11, November- 2014, 258 ISSN 2229-5518.

[4] S. Pathmasharma, J. K. Suresh, P. Viswanathan, R. Subramanian, “Analysis of Passenger Car Suspension System Using Adams”, International Journal of Science, Engineering and Technology Research, Volume 2, Issue 5, May 2013, ISSN: 2278 – 7798.

[5] Thomas D. Gillespie, “Fundamentals of vehicle dynamics”, SAE International, 1992. [6] William F. Milliken Jr., “Race car vehicle dynamics”, SAE International, 1995.

[6] “2019 Baja SAE Series Rules.” SAE International. 2019.

[7] Nitish Malik " FineTuning of the Suspension System of Baja ATV" International Journal of Engineering Research and Applications, 7.8 (2017).