International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Design and Analysis of Suspension in Baja ATV

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Abstract: An ATV Stands For Any/All terrain vehicle is the vehicle which is designed to move through all terrains. There are various purposes such as military, rescue purpose during natural disasters , to reach some remote areas and also for inspections of forest. Suspension system of this vehicle should be strong To provide good ride and handling performance enough so that it will provide better ride quality and maximum comfort to the one who rides it i.e the driver. Independent suspension systems are required for this purpose hence we have selected double wishbone suspension system and it is designed in LSSA (Lotus Shark Suspension Analysis).After designing the hard points are received and then they are located by using this points A-arms are designed by using SOLIDWORKS and CATIA software and after that we selected the material to fabricate according to the limitations of bajaforum, but before fabrication we did analysis on the various stresses acting upon it by ANSYS. We also designed front and rear uprights and analysed it by using ANSYS. This project aims at selecting, analysing and fabricating a suspension system of national level event of BAJA ATV which will be able to sustain bumps and will easily move through various terrains it will encounter during the ride.
Keywords: Suspension system, Lotus shark, suspension analysis, terrain vehicle, Double wishbone, A-Arms, Knuckle

I. INTRODUCTION

Suspension system is one among the key element of the vehicle that is employed to possess a most traction effort in between road and tyres and to produce most possible comfort to the driver. The contact between the road and tyres are maintain owing to the load applied by the vehicle that acts through the tyres and mechanical system. We have to design by keeping two aspects in our mind.

A. Uneven surface of roa
B. Variations in Loads

Road irregularities includes the large hills and little uneven surfaces which can be termed as high frequency (hills) and low frequency (uneven surfaces).Variations in loads are due to numerous aspects like load during cornering, load during braking, load during acceleration . thus to sustain within these cases we should have reliable suspension system that ought to be soft for giving comfort to the driver and hard for carrying uneven loads whereas move in the hills and mountains. Suspension system reduces reaction force generated because of obstructions on the trail of the vehicle. This reaction force's magnitude is directly proportional to the unsprung mass of the vehicle. With higher sprung to un sprung weight quantitative relation we will accomplish additional reduction of reaction force effecting each vehicle and the the} occupants and may also enhance vehicle control ability. thus suspension system is principally divided into a pair of categories: Dependent Suspension System: Here during this suspension the movement of one wheel depends upon another wheel. independent Suspension System: Here during this suspension the movement of one wheel doesn't depends upon another wheel. Here every wheel is independent of every alternative.

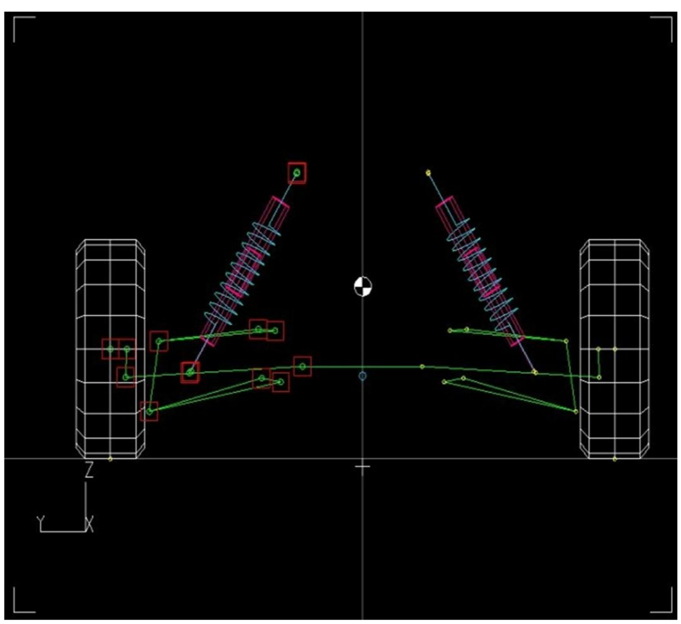
So we have set to decide on Double wishbone System as per our use of the vehicle. Double wishbone suspension system contains 2 A-arms (upper wishbone and lower wishbone) sometimes of various length together with a spring and a damper. This type of suspension system provides negative camber at the time of ride and it's an excessive load bearing capability. It conjointly provides higher stability and roll height.

II. DESIGN METHODOLGY

The design is completed in LOTUS SHARK suspension designing software system .

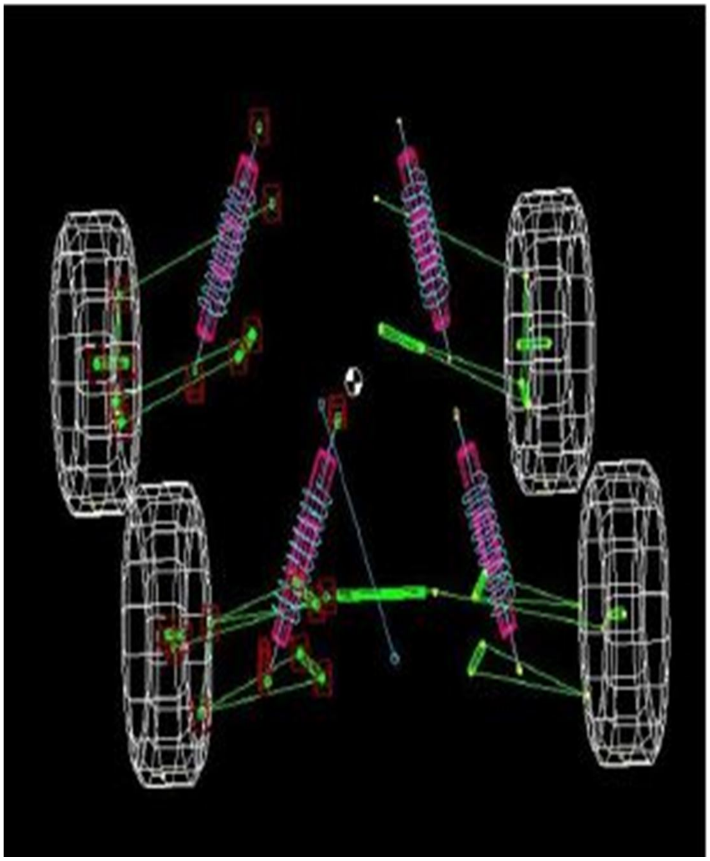
The calculations are made concerning the analysis papers. The design is formed keeping the anti-dive properties to the minimum to stay the ATV stable altogether conditions. Before designing the suspension of vehicle we have concentrate upon a number of the essential parameters of the vehicle needed for it. therefore the basic parameters are:

Unsprung mass	150 kg
Sprung mass	220 kg
Suspension travel	12 “
Roll gradient	0.201 deg
Roll centre (faw)	260.67mm
Roll centre (raw)	278.8 mm
Camber Change	3 to -6 deg
CG	18”
Toe in/ out	Toe In
Castor, KPI & Scrub radius	1.8,8.14 & 1.8”



Wheelbase:60 inch.
Track Width:Front-54 inch,
Rear-50 inch
Tire size:23×7×10 (Carlisle)
Sprung Mass:220 kg
Unsprung Mass:150kg
So by using these parameters we started the process of designing the suspension system of the ATV. We have selected the LSSA (LotusShark Suspension Analysis) software to design it.

A. Lotus Shark Suspension Analysis



LOTUS Shark suspension analysis tool is employed for initial calculation of the vehicle. 3D moving models are often create and change in LOTUS Shark Suspension Analysis (LSSA). Using LSSA hard points are drawn and graphical and numerical values are found out. This modelling approach permits user to form their own suspension models and work on them simply. The changes in any parameters can be find out camber angle, toe angle are often displayed diagrammatically against motions like roll motion, bump motion, steering motion. many parameters are thought of to induce the hard points of the suspension system like damping magnitude relation, sprung and un-sprung weight, spring rate, camber angle, caster angle, roll centre, wheelbase, track dimension, toe angle, ground clearance.
So before coming up with in LSA we've got design considerations:

1) Kingpin and caster angle are kept in such a way that they'll compensate every others camber gain well, by providing there individual function
2) A positive king pin angle is kept to assist in steering the vehicle. Roll center below CG to avoid unwanted force.
3) Front ride frequency is more than rear portion.
4) Roll axis inclined towards front portion to present understeer characteristic to the vehicle.
5) Front double wishbone unequal para Camber angle.

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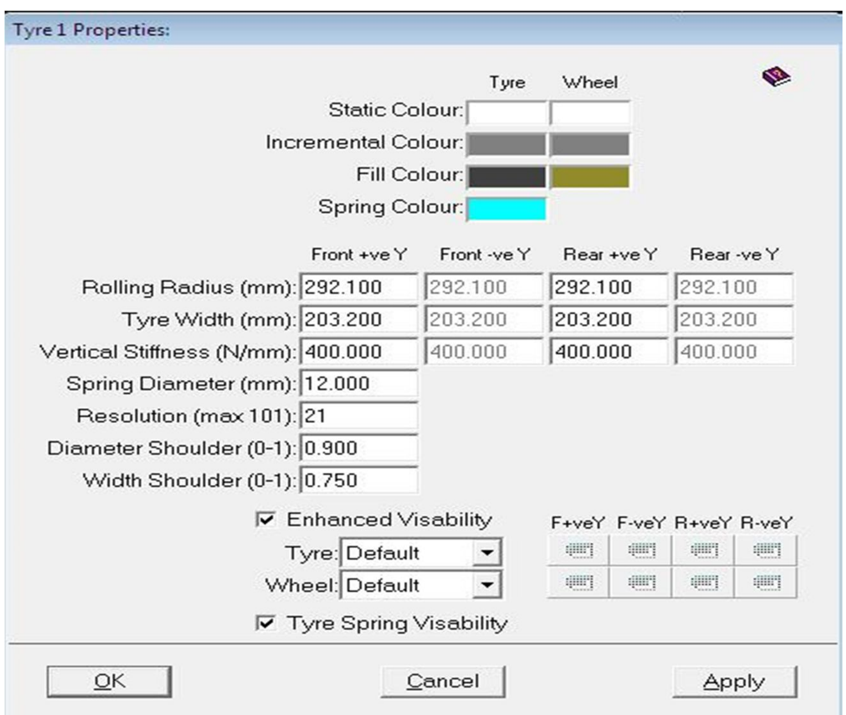
We have taken Damper to lower wishbone for the front suspension and damper to upper wishbone in rear suspension system. We have design by using these parameters and additionally by checking various properties likeroll motion roll centre, bump motion, steering motion. These properties are controlled by controlling the camber, caster, toe, kingpin angle etc. So after designing we get the results a Numerical value

Table1: Numerical results

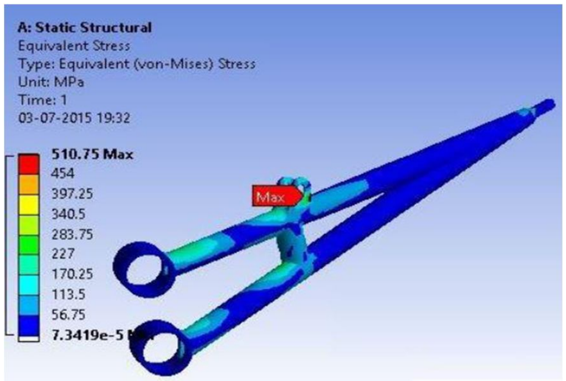
Motion Ratio	0.5	Spring stiffness	14.715N/mm
Suspension Travel	12	Toe In	0°
Camber angle	-2.68°	Ride rates	2960 N/mm
Castor angle	1.8°	Roll centre	260.67mm

B. Design Of Wishbones

Design of the suspension was administered in computer aided designing (CAD) using CATIA deigning software and SOLID-WORKS for designing purpose. Design of wishbones is that the necessary step to construct a suspension system. Initially, for designing we've located coordinates from LSSA

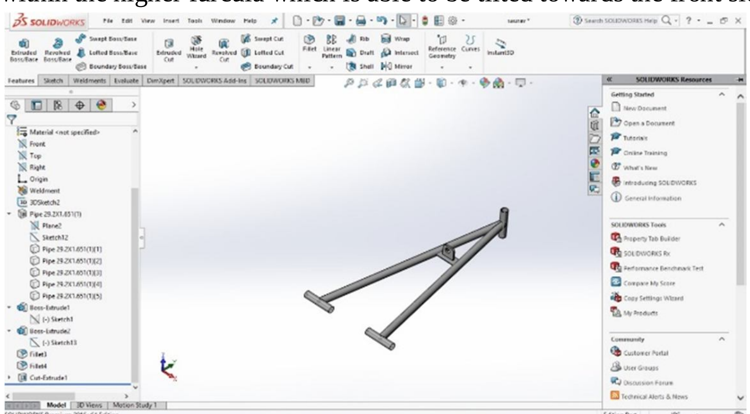


1) *Front Wishbones:* Double wishbone suspension system of unequal length and parallel was implemented for Front suspension additionally referred to as short long arms (SLA). We tend to finalise the form of wishbone to be an arms because it-will distribute stresses over the members effectively and in a very proper method. Upper wishbone is shorter than lower wishbone. The advantage of getting completely different lengths is that once the vehicle takes a flip a negative camber is induced that will increase the stability Negative camber is important to maintain ground contact. This arrangement is titled as SLA (Short Long Arm) as mentioned earlier. We've got each the lower still as upper arm as A-arms. As we've got caster angle 1.8° that makes our front suspension unequal and parallel. We'll mount the spring within the lower wishbone which is able to be inclined towards the rear aspect.



2) *Rear Suspension system:* It consists of equal A-arms and parallel arm design. independent equal A-arms are widely accepted as camber changes is simply eliminated and controlled. One end is connected to the chassis and alternative end is connected to the knuckle. A-arm provides great deal of travel and principally equal the front suspension. At rear side the camber angle and caster and conjointly the toe angle can the zero.

As we are having damper to upper wishbone in rear side therefore the upper wishbone are of A -shape and therefore the rear lower wishbone can of A-shape. As we've caster and camber angle 0° that makes our front suspension equal and parallel. we'll mount the spring within the higher furcula which is able to be tilted towards the front side.



C. Upright Design

Upright is design by Catia And Solid works software by using the right tire dimensions. it's designed in such a way that it may hold the upper and lower pivot points of the a-arms and therefore the output shaft long with the hub and brake callipers without any[13] difficulties .After the designing it's valid using the CATIA FEA package. After thisit's tested by collecting all the remaining elements of the suspension system.

III. ANALYSIS

After designing is over in CATIA it is imported to ANSYS simulation software (Computer aided Engineering). Analysis of suspension is completed by using ANSYS software. Many types of thermal analysis, structural analysis may

bemade attainable using ANSYS software. Here we tend to are conducting structural analysis to define the boundary conditions and to work out the stresses and deflection developed by applying various masses. For analyzing the total system some basic calculations are used to calculate the values of varied loads working on it.an exact quantity of force planning} given so as to visualize the varied deformations that are going to be

held throughout simulation. Therefore to see this we tend to are using the FEA software ANSYS to look at these deformations

A. Analysis of Wishbone

For analysis of the wishbones, a 3G newton quantity of force is given to check the strength of the design of the wishbones. By this we tend to calculated the maximum potential deformation and maximum stress developed within the arms within the impact load conditions.

B. Upright Analysis

The front and rear upright are analysed by FEA analysis software ANSYS. The upright can offer support to the bearings of the hub that ultimately allows[17] the wheels to rotate. The FEA analysis is completed by applying 2000N which provides some quantity of red zones on the upright.

So to harden the upright we fabricated it by using aluminium alloy to provide strength of that it will sustain the forces performing on it. The front upright is of material aluminium alloy 7560 and rear upright is made-up by using aluminum alloy 6061-T6.Both the uprights are having completely different| completely different} material because of their different design.

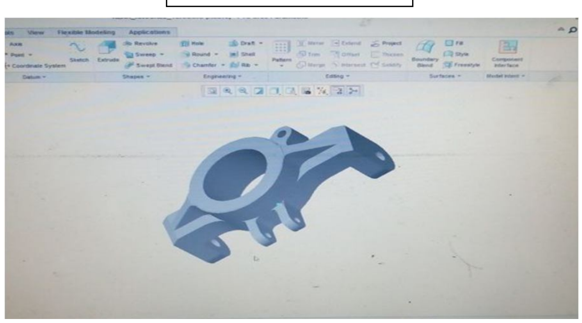
IV. RESULTS

After Manufacturing the ATV various results are obtained. Those tests includes both static and dynamic results. The following results are obtained from static conditions:

Inclination of suspension w.r.t KPI Front = 29º
Inclination of suspension w.r.t KPI Rear = 32º
Front Upper left A-Arms dimensions = 10.6 inch
Front Upper right A-Arms dimensions = 9.7 inch
Front Lower left A-Arms dimensions =11.5 inch
Front Lower right A-arms dimensions =11 inch
Rear Upper left A-Arms dimensions =14 inch
Rear Uper right A-Arms dimensions =15 inch
Rear Lower left A-Arms dimensions =18 inch
Rear Lowe right A-Arms dimensions=19 inch
Front Upright Dimensions=7.5 inch
Rear Upright Dimensions =9.2 inch

Dynamic results are received by testing the vehicle in varied terrains like mud, hills etc. we are able to further modify the suspension system of the vehicle by using trailing and semi-trailing arm at rear side in the spring are going to be mounted on knuckle and firewall. The wishbone arms will be mounted on the knuckle and the base of the chassis

FRONT KNUCKLE



REAR KNUCKLE

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V. CONCLUSION

The paper describes regarding the design related with analysing of suspension of an Any terrain Vehicle (ATV) and their combination within the whole vehicle. The ATV has been designed and analysed based on the facts of vehicle dynamics. the first objective of this paper was to spot the design parameters of a vehicle with a correct study of vehicle dynamics. This paper conjointly helps us to review and analyse the procedure of vehicle suspension designing and to spot the performance affecting parameters. It additionally helps to know and overcome the theoretical difficulties of vehicle design

REFERENCES

[1] International Journal of Current Engineering and Technology (IJCET) Vol.7, No.1 (Feb 2017) E-ISSN 2277 – 4106, P-ISSN 2347 – 5161 Ashish Sangave* and ChaitanyaAurangabadkar: "Design and Analysis of an ATV Suspension System"

[2] International Journal of Scientific & Engineering Research, Volume 7, Issue 3, March-2016164ISSN 2229-5518Shijil P, AlbinVargheese, AswinDevasia, Christin Joseph, Josin Jacob: "Design And Analysis OfSuspension System For An All-Terrain Vehicle".

[3] Ijsrd - International Journal For Scientific Research & Development Vol. 2, Issue 03, 2014|Issn (Online): 2321-0613.K.N.Patel, B.N.Gelot, A.H.Gupta: "A Review Study- Design And Analysis Of Suspension System"

[4] .Journal Of Mechanical Engineering And Sciences (Jmes) Issn (Print): 2289-4659; E-Issn: 2231-8380; Volume 9, Pp. 1640-1654, December 2015 M.S.M. Aras, M.K.M. Zambri, F.A. Azis, M.Z.A. Rashid, M.N. Kamarudin: "System Identification Modelling Based On Modification Of All Terrain Vehicle (Atv) Using Wireless Control System"

[5] International Journal Of Emerging Technology And Advanced Engineering Volume 5, Special Issue 1, April 2015.Kanishktyagi, Abhayrana, Abhishekvij:" An Experimental Study Of Various Aspects Of An All Terrain Vehicle"

[6] IJIRT - DESIGN AND ANALYSIS OF SUSPENSION SYSTEM OF AN OFF ROAD VEHICLE (ALL TERRAIN VEHICLE)Manishkumar Manjhi1, Shaktiprasanna Khadanga2, Bibhutibhusan Sahoo3, SusarthakRath4,Karankumar Guru 5 and P. Murarji61,3,4,5,6Student, Mechanical Engineering Department, Gandhi Institute Of Engineering And Technology, Gunupur, Odisha, India2Asst. Professor , Mechanical Engineering Department, Gandhi Institute Of Eng neering And Technology, Gunupur, Odisha, India