Suspension Assembly of BAJA ATV

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Abstract— *In the modern day and age where automobiles are an essential part of our day to day life, the requirements of each are different. Some demand for a high-performance machine whereas others require a comfortable ride. The modern engineering helps in achieving all the aspects of a safe, reliable and fast vehicle. With the change in time, the need for an all-terrain vehicle has gradually increased. The research paper includes the optimisation of wheel assembly for better stability, comfort ride along with better handling. The analysis and simulation are done to obtain a better wheel assembly which can provide the best in class arrangements for the customer. The research mainly focused on the wheel hub, wishbones and knuckle. The designs provide the sturdiness and durability which is the primary requirement for an all-terrain vehicle. The key focus is given to material selection which provides durability and comfort. The material is inexpensive which presents an edge for the market competition as well as is value for money for the customer point of view. The Static load on wheel hub is calculated and analysed for elucidating the characteristics. The material EN-24 provides better machinability and welding applications making it more suitable for mass production.*

Keywords— **suspension, knuckle, material.**

I. INTRODUCTION

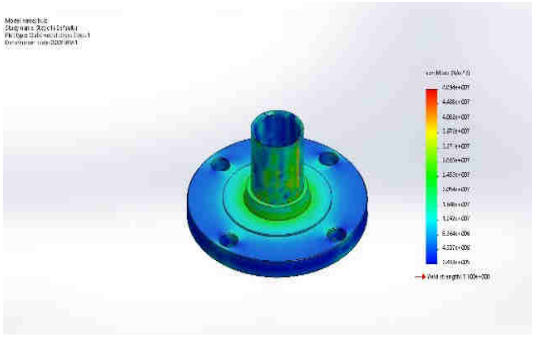
Off-road vehicles especially single seater buggy's can have a lot of versatility in them and can be optimized as per requirements. The bound and travel of the wheels can make the ride of the ATV comfortable or agile as per requirement or both. We have used materials like EN24 and SS302 for making the required design according to the set specifications. The specifications derived by wheel travel, track width, steering effort and wheelbase. Previously other researchers have focused on weight optimization and camber, caster adjustment methods, and we focus on sturdiness and optimization as per required need. The calculations and analysis are done to attain the wheel assembly which provides safety, sturdiness as well as comfort. Our research consists of the optimisation of understeer geometry for better handling and security according to conditions. The design can withstand the consistent angular velocity and dynamic angular acceleration varied because of the all-terrain conditions.

II. DESIGN

A simple wheel assembly comprises of the following parts:

Hub

The Hub interacts directly to the Rim of the Wheel, and the PCD of the Hub should match that of the rim to fit perfectly, the hub made in such a way that it can withstand the high amount of impact and yet absorb vibrations. Material for the Hub was selected as EN24.the hub faces many static and dynamic loads varied because of the conditions. The chosen material provides the suitable Elongation with ease in machining and weld ability.



Structural Analysis of Hub

Knuckle

Knuckle is the Hinge point of the A-arms, and the mounting of the disc and callipers, done on it. Knuckle is the most important part of the wheel assembly as it governs the travel and the mounting of the A-arms. It consists of attachments which join the entire wheel assembly. Hence, it plays the most important role in the assembly and faces various static and dynamic loads. The material requires elongation, the higher capability to meet yield stress. The material is capable of withstanding shock loads and has enough tensile stress. It also retains good impact properties even at a high temperature, making it suitable for the vehicle.

Bearing

Bearing connects the hub and knuckle while providing the rotatory movement of the wheel. The bearing provides the stability for movement and provides the uniaxial motion.

Disc-Brake

We have added disc brakes on all four of our wheels as it provides better braking traction and stopping distance. The disc brake consists of the pads which with the help of callipers provides friction and contributes to retard or to

halt the vehicle.The energy of motion converted into heat.The disc brakes made of cast iron but by sintering the disc, quality is improved so that it helps to provide better durability.As sintering is just below the melting temperature, it helps to improve the quality and to lead to efficiency of the disc.

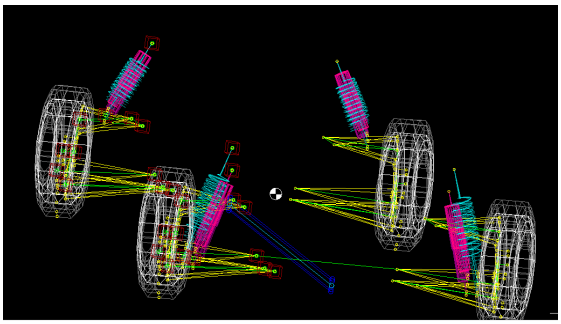
Structural Analysis of Disc

Calliper

Calliper mounting on the knuckle plays an important role as the forces on the calliper are maximum during panic braking.

Wheel Positions

Lotus Shark Software was used to calculate the primary mounting points of the A-Arms on the knuckle; the present values fed in the Lotus shark software.



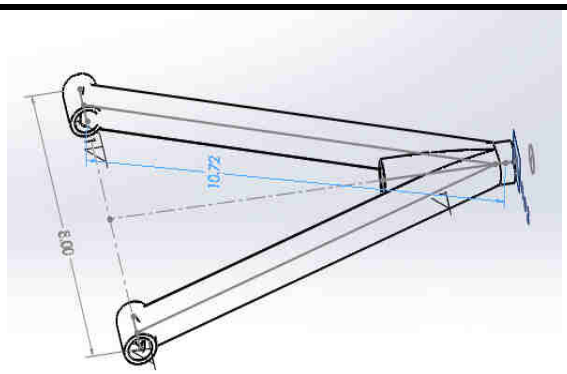
Front and Rear mountings

Wheel Base Parameters

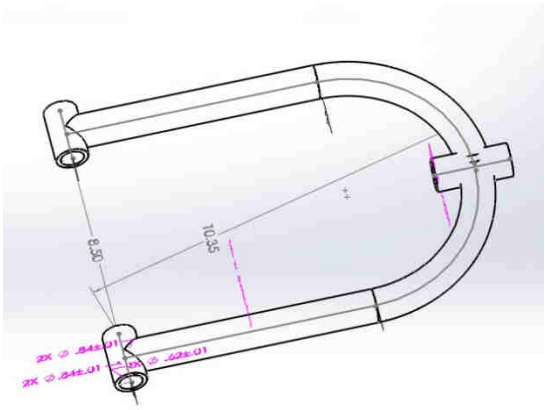
	EN19	EN24	AL7075
Yield Stress	700 N/mm^2	680 N/mm^2	740 n/mm^2
Elongation	9%	13%	17%
Machinability	Good	Medium	Medium
Weld ability	Good	Good	None

Front A-Arm

As per the Software for maximum rebound required by us, the Upper A-Arm should be 10” from the End of End and 7” apart A- the shape of the Wishbones was incorporated as this is most feasible for our knuckle designs, manufacturability, and wheel travel.



Front Lower Wishbone



Front Upper Wishbone

According to the Lotus Shark software, the front Knuckle was designed, and the top Mounting is attained to be 15mm more than the bottom’s centre as it has to support the unequal length of the A-Arm.

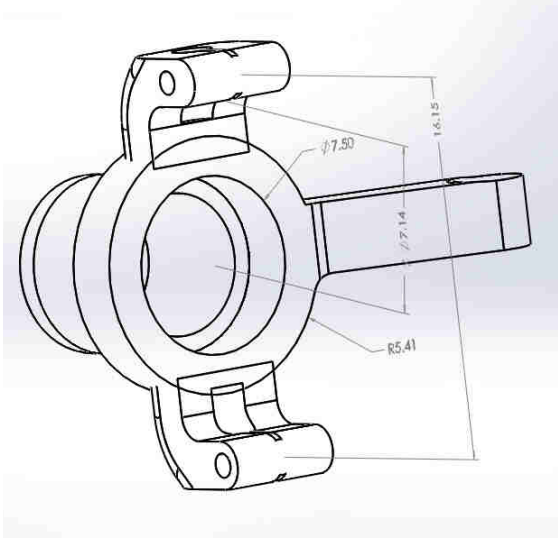
Knuckle Design and dimensions

Various Materials are available for manufacturing, but major considerations are manufacturability, strength and market availability.

Material Selection

Specification	Front	Rear
Wheel Travel	6”	3.5”
Track width	54”	58”
Wheel Base	58”	

EN24 was selected for the majority of the manufacturing of the knuckle and hub, as it has good elongation point and is easy to machine and weld thus proving ideal for our work process, it highly wears resistant and can absorb high amplitude of vibrations thus giving us large field of the area to work.



Length of Spring	279.4mm
Total Length	419.4mm
Wire Diameter (d)	8mm
Mean Coil Diameter	62mm
Pitch	15mm
No of Active Turns	15
Total No of Turns	17

Knuckle Design

Suspensions

The suspension is the combination of spring as well as the damper. The primary objective of suspension in an ATV is to absorb the road shocks so that it increases the comfort of the driver while driving the vehicle and it is also important for the suspension to make the road wheel in contact with the road surface. The material selected for spring is chrome vanadium steel, along with it hydraulic dampers for damping actions. When the vehicle experiences bump, the spring changes its shape thereby storing the elastic energy. On releasing, the spring rebounds and comes back into shape by dissipating the stored energy. In our ATV, we used independent suspension that is double wishbone so that during ground irregularities the contact between the ground and wheel is not lost as we want the four wheels to act independently of each other, and hence we get better adhesion with the ground. The shock absorber is placed inside the coil spring and is attached to the wishbones. Independent suspension helps to reduce the acceleration braking and cornering force which helps the vehicle to remain in contact with the ground on hard cornering or braking. We used helper spring along with our main leaf spring as a support for our suspension. Nowadays helper spring is very common in commercial vehicles in addition to the main leaf spring. The advantages of helper springs are that it allows the wide range of loading. When the loading is light the helper spring does not come into working but the load increases they divide the load with the main leaf spring. Commonly helper springs are used in rear suspension only. When the amount increases to such an extent so that the main leaf spring gets deflected to its maximum, the helper spring comes into operation.

Front Suspension

In Front suspension, we used the double wishbone of unequal length as this allows better control of suspension parameters and hence allowing the wheel track to be constant, thereby avoiding the tyre wear. The front alignment is adjustable to allow the change in tire size. Caster and Camber made by adjusting the helm joint in the Upper A-arm. We designed our damper in such an away so that the mounting point can be on the lower wishbone. The front suspension travel is 4.3". The front suspension parameters are:

Front Suspension Calculation

Rear Suspension

In the rear, we designed an independent suspension so that if one of the wheels comes against an obstacle the other one will remain unaffected and the contact with the ground would not be affected. We connected a system of two springs in parallel so as to increase the stiffness of rear spring. The one being the main spring and other the helper spring so as to share the load in case of heavy loading situations. We kept the mounting point on the upper wishbone and its end. The rear suspension travel is 4.8."

Length of Spring	203.2mm
Total Length	482.6mm
Wire Diameter (d)	8mm
Mean Coil Diameter	75mm
Pitch	26mm
No of Active Turns	9
Total No of Turns	11

Rear Suspension Calculation

III. CONCLUSION

The research work concludes the safe, comfortable and balanced wheel assembly arrangements for BAJA ATV. The wheel composed of designed knuckle helped to attain the desired performance. The calculations helped to achieve better under steer all-terrain vehicle which is able to handle tough conditions. The suspension composed of the hydraulic dampers and springs provides the sturdiness along with the flexibility to absorb shocks and bumps. The material EN-24 withstand enough for all-terrain conditions leading to conclusion for inexpensive, weld

ability material. The Static load on wheel hub is calculated and analysed for elucidating the characteristics. The calculations and analysis are good enough to attain the wheel assembly which provides safety, sturdiness as well as comfort. Our research consists of the optimisation of understeer geometry for better handling and security according to conditions.

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